PREHISTORY OF NEVADA'S NORTHERN TIER: ARCHAEOLOGICAL INVESTIGATIONS ALONG THE RUBY PIPELINE

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ABSTRACT

The Ruby Pipeline originates in Opal, Wyoming, travels westward across Utah and Nevada, and terminates in Malin, Oregon. Almost 360 miles of the line is in Nevada, where it crosses through some of the most remote, sparsely populated land in the lower 48 states. Despite the remote nature of this corridor, it has produced a rich archaeological record reflecting a dynamic history of land-use pattern changes over a period of at least 13,000 years.

Archaeological excavations were conducted at 578 prehistoric sites prior to construction of the pipeline. The sites were distributed across four ecological regions, including (from west to east): the High Rock Country, Upper Lahontan Basin, Upper Humboldt Plains, and Thousand Springs Valley. First evidence of human occupation dates to the Paleoindian (14,500–12,800 cal B.P.) and Paleoarchaic (12,800–7800 cal B.P.) periods, when people spent most of their time in the High Rock Country where important economic resources reached their highest densities. Paleoindian findings are limited to a series of Great Basin Concave Base projectile points and small obsidian flaked stone concentrations. Paleoarchaic sites are much more common, and tend to be represented by Great Basin Stemmed projectile points, bifaces, and a limited number of other flaked stone tools. Most of these assemblages reflect small groups of hunters refurbishing their tool kits as they traveled through the area. An important exception to this pattern was found at Five Mile Flat along the west end of pluvial Lake Parman where two significant habitation sites dating to 11,180 cal B.P. were discovered. One of these sites includes a house floor, which is the oldest ever found in the Great Basin.

Despite the warm-dry conditions that characterized much of the middle Holocene, it appears that human populations nearly doubled during the Post-Mazama Period (7800–5700 cal B.P.). Most activity remained concentrated in the High Rock Country, but evidence for occupation begins to trickle out into

the Upper Lahontan Basin and Upper Humboldt Plains regions as well. Most of the artifact assemblages remain rather narrow, often composed of Northern Side-notched and Humboldt Concave Base points, bifaces, and debitage, and reflect use of the region by mobile groups of hunters.

Major changes took place with the arrival of the Early Archaic (5700–3800 cal B.P.) and continued forward into the Middle Archaic Period (3800–1300 cal B.P.). Early Archaic projectile points are largely represented by Humboldt and Gatecliff forms. It appears that population densities increased almost fourfold from the preceding interval, and all four regions experienced significant occupation for the first time. Simultaneous to this population increase and dispersal, a full complement of site types began to emerge, with large-scale residential areas becoming significant for the first time. This trend continued forward into the Middle Archaic Period where the relative frequency of residential sites almost doubled compared with the Early Archaic interval. Plant macrofossil and archaeofaunal assemblages also become more abundant and diversified at this time, probably marking a broadening of the diet breadth.

This general trajectory extends into the Late Archaic (1300–600 cal B.P.) and Terminal Prehistoric periods, as people continued to expand into a wider range of habitats. This was particularly case for the latter interval, as the habitat preferences that made sense for over 12,000 years were upended, with population densities highest in the Upper Humboldt Plains and Thousand Springs Valley. This reorientation corresponds to the arrival of Numic speaking populations, especially the Western Shoshone who appear to have reached northern Nevada much earlier than the Northern Paiute, and is probably linked to a greater emphasis on small-seeded plants that are abundantly present in their territory. Although low ranked compared to many other foods, with the proper technology and work organization, small seeds could support higher population densities than was the case earlier in time. Finally, the discovery of obsidian in multiple Terminal Prehistoric sites from sources located much further away than any other time in the past may signal the earliest use of horses in northern Nevada.

CHAPTER 1

INTRODUCTION

William Hildebrandt

This study is the outcome of archaeological excavations that took place as part of the Ruby Pipeline Project. The Ruby Pipeline originates in Opal, Wyoming, travels westward across Utah and Nevada, and terminates in Malin, Oregon, where it meets the Pacific Gas transmission line (fig. 1). It is a 42″ diameter pipe used to transport natural gas, and required more than 4000 people to construct during a 12 month period in 2010 and 2011. Almost 360 miles of the line crosses the Northern Tier of Nevada, where it traverses some of the most remote, sparsely populated land in the lower 48 states. Despite the low number of people living here today, it contains a vibrant archaeological record reflecting a dynamic history of land-use pattern changes over a period of at least 13,000 years. This volume summarizes the prehistoric archaeological record discovered along the Nevada segment of the project.

Intensive archaeological survey of the pipeline corridor and associated facilities resulted in the recording of 916 prehistoric sites, 578 of which required data recovery due to the significant nature of their surface assemblages. Most of the data recovery fieldwork occurred between August 2010 and February 2011, and was accomplished with the help of many local Native American people who served as monitors and archaeological technicians.

The scope of the archaeological record produced by this study is truly remarkable, as every significant prehistoric site along the corridor was surface collected and excavated using the same set of methods. This effort produced what is essentially a 100% sample of the 360 mile corridor, allowing us to study the character and intensity of human activity across vast spans of space and time with levels of precision rarely seen before.

Four general ecological regions are traversed by the corridor, including the High Rock Country, Upper Lahontan Basin, Upper Humboldt Plains, and Thousand Springs Valley (fig. 2). None of these regions have significant stands of pinyon, major watercourses, or extensive wetland areas. Despite the lack of these habitats, which were so critical to ethnographic groups living in the more southerly, core areas of the Great Basin, the project corridor was used by many people throughout the prehistoric past. These occupations were not constant, however. Instead, they occurred in pulses, their intensity based on local habitat productivity as well as demographic processes that took place in adjacent, more productive areas where long-term habitation was more common.

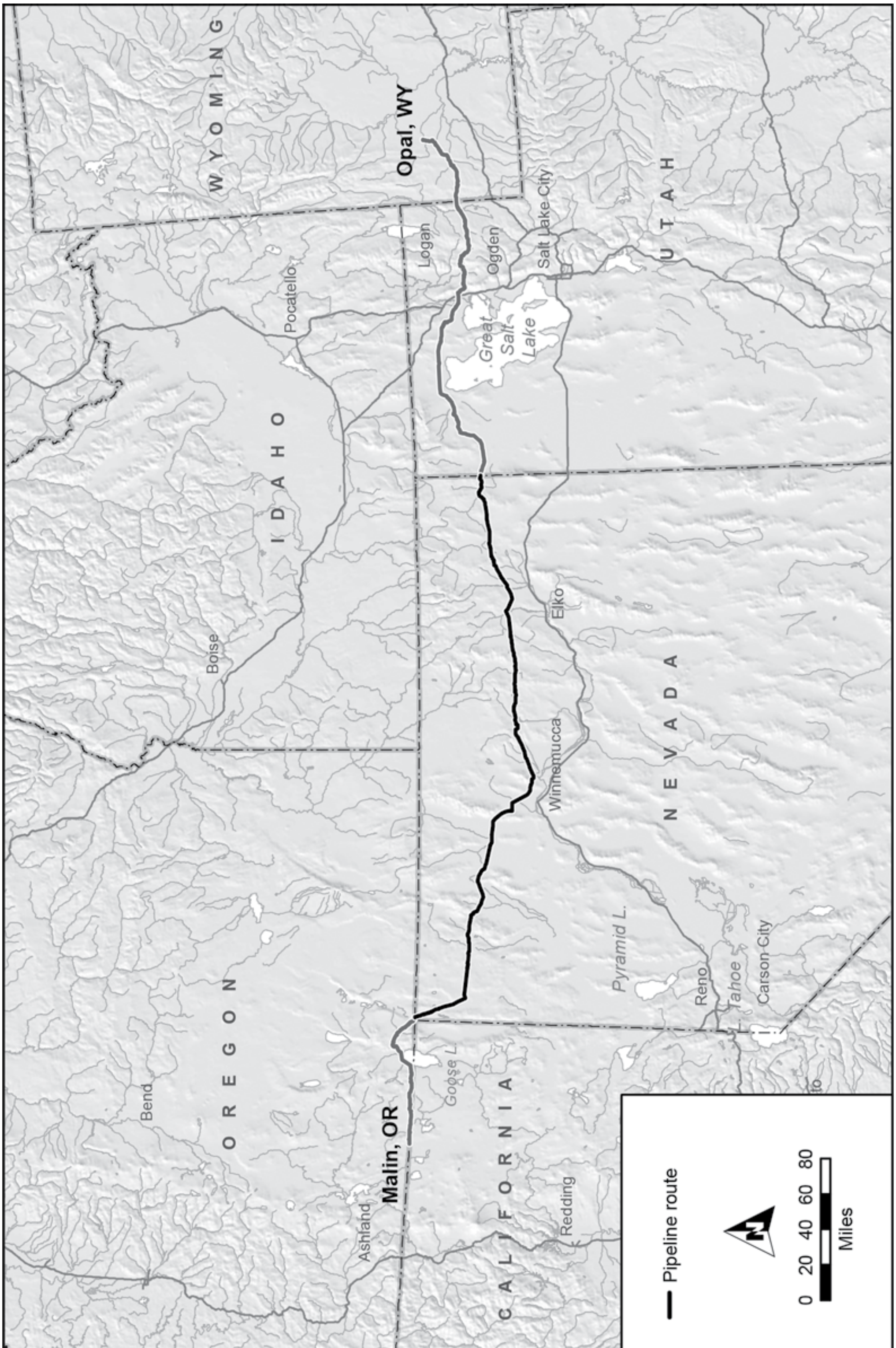

Fig. 1. Ruby Pipeline corridor.

Beginning in the Paleoarchaic Period (12,800–7800 cal B.P.), for example, people made extensive use of many of the obsidian quarries located in the High Rock Country and established settlements at Five Mile Flat, focusing on wetland habitats along the shore of pluvial Lake Parman. Investigations at one of these settlements revealed the oldest house floor ever found in the Great Basin, radiocarbon dated to 11,200 cal B.P.

Populations remained relatively low in the middle Holocene but expanded significantly after about 4500 cal B.P., using the High Rock obsidian quarries like never before and establishing seasonal residential bases in a broader range of habitats. This more intensive use of the landscape first focused on the harvest of root crops, especially epos (yampah) along the western end of the corridor, but ultimately included small-seeded foods found farther to the east. The process of intensification culminated with the arrival of Numic populations at around 500 cal B.P., where the archaeological record indicates that the Western Shoshone arrived in northern Nevada significantly earlier than the Northern Paiute. These findings also explain why the Western Shoshone used pottery and the Northern Paiute did not, and show how the introduction of the horse may have created interaction spheres of unprecedented proportions, evidenced by the presence of obsidian from exotic sources never used before.

Volume Organization

After this Introduction, chapter 2 (Natural Setting of the Northern Tier) provides a detailed account of the four regions outlined above. Each of these regions is distinguished by its unique mix of important landform types, tool-stone quarry zones, climate, plant and animal communities, and resulting economic potential. Because of the great time depth of the archaeological record discovered during the current project, paleoenvironmental reconstructions are also presented in chapter 2, based on the existing literature and packrat midden data obtained during the fieldwork. These reconstructions provide insight into how environmental changes affected the availability of subsistence resources along different segments of the corridor and influenced the land-use patterns we observe in the archaeological record.

Chapter 3 (Cultural Context of the Northern Tier) presents a comprehensive review of northern Great Basin prehistory, highlighting some of the outstanding research issues that can be addressed by this study. It also develops a cultural-historical sequence for the corridor that is used to organize the single component assemblages generated during the project. The ethnographic records of the Northern Paiute and Western Shoshone are then reviewed to develop a better understanding of what day-to-day life was like for these people, thereby enhancing our ability to interpret the archaeological record.

All the field and analytical methods used during the study are summarized in chapter 4 (Field and Analytical Methods). Chapter 5 (Chronological Controls) details the chronological data generated by the project, including radiocarbon dates, time-sensitive artifacts (i.e., projectile points, crescents, pottery, beads), and source-specific obsidian hydration readings. Based on associations between hydration rim measurements and radiocarbon dates, and rim measurements on temporally diagnostic projectile points, hydration rates are developed for each major

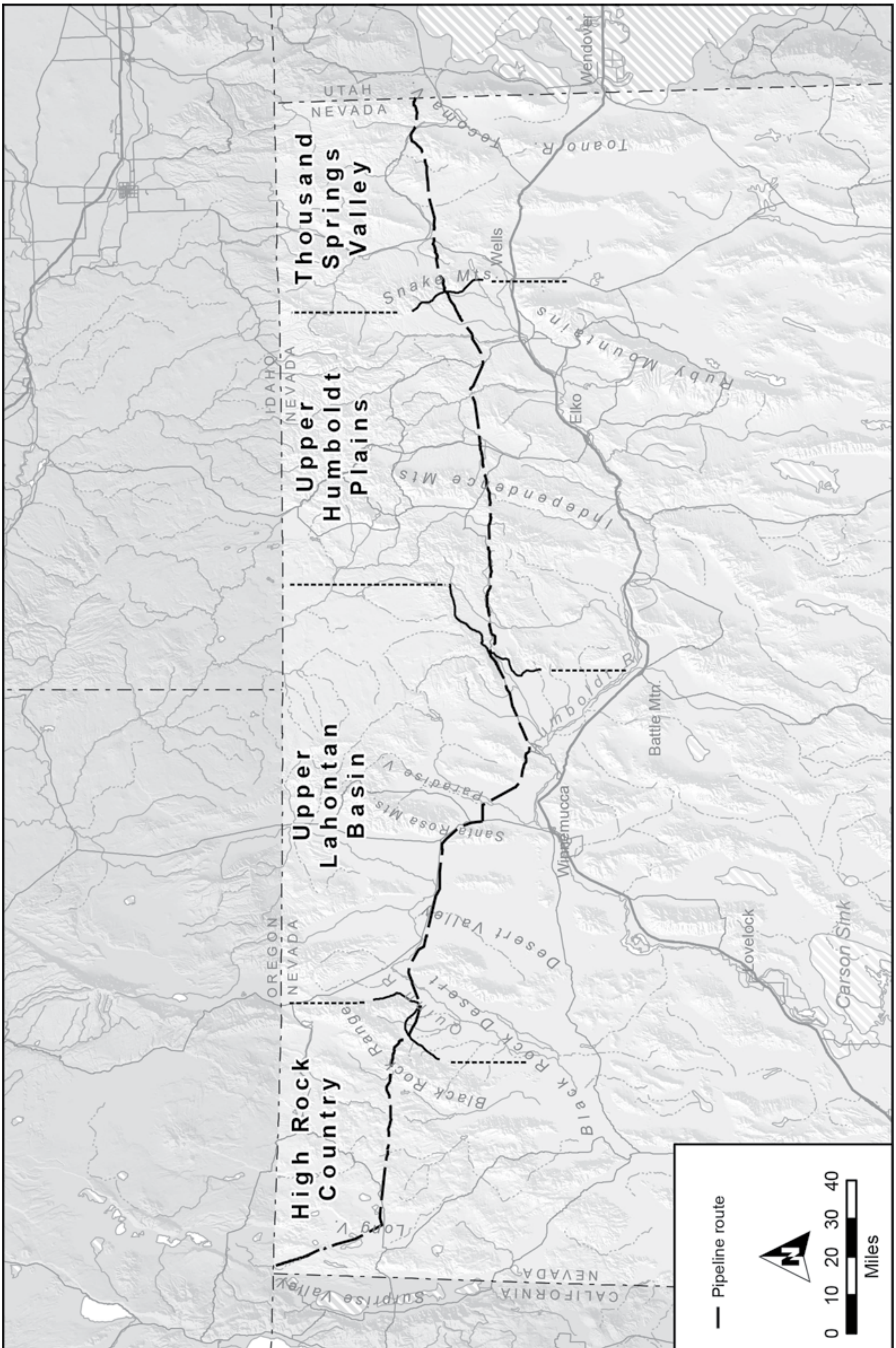

Fig. 2. Nevada segment of the Ruby Pipeline corridor and its relationship to the High Rock Country, Upper Lahontan Basin, Upper Humboldt Plains, and Thousand Springs Valley.

obsidian source. These are crucial, as they are used to date many of the project assemblages.

The archaeological records of the four regions are summarized in chapters 6 through 9. These summaries include chronological overviews, detailing every temporal indicator recovered and how they were used to identify single-component assemblages. Each assemblage is then described, including artifacts, features, and subsistence remains, along with brief interpretive statements about how these findings reflect generalized land-use pattern changes over time.

Most of the basic archaeological reporting requirements are covered by the four regional summaries, where we emphasize description rather than interpretation. The remainder of the report, however, is more interpretive in character and focuses on a series of research themes that can be addressed with the data at hand. We begin with the colonization of northern Nevada (chapter 10), where our robust collection of chronological indicators is used to monitor how the project corridor was initially colonized and ultimately filled in over time. This process of settlement was largely consistent with expectations of Ideal Free Distribution modeling until the end of the sequence, when Numic speakers arrived in the area and radically altered the previous trajectory of settlement. It appears that this disjunction was due to the different subsistence technologies and social organization used by the Numa, which changed the perception, ranking, and use of local environments, creating a pattern of land use never seen before in the region.

Chapter 11 (Flaked Stone Production Patterns) documents how quarrying and subsequent tool production strategies changed over time. Most of these changes were due to reduced access to important tool-stone sources as people filled in the corridor over the millennia, as well as the use of alternative stoneworking techniques late in time, perhaps linked to the introduction of bow-and-arrow technology. Chapter 12 (Trans-Holocene Subsistence-Settlement Change in Northern Nevada) reviews the artifact assemblages, features, and subsistence remains, all of which are used to chronicle the dynamic nature of the trans-Holocene economic systems operating along the Northern Tier. Root crops, especially epos, played an important role in these systems. Chapter 13 (The Archaeological Correlates and Evolution of Geophyte Procurement in the Northwestern Great Basin) addresses this issue, giving particular focus to the western end of the High Rock Country, where root gathering was important deep into antiquity and remains an active enterprise among Native peoples there today.

Chapter 14 (Obsidian Conveyance Patterns) details the distance each time-sensitive obsidian projectile point traveled before it was deposited in the archaeological record. This analysis is also applied to every obsidian debitage assemblage subjected to geochemical sourcing and hydration analysis. The results are consistent with previous studies, showing great conveyance distances early in the Holocene, which are traditionally thought to reflect high levels of residential mobility, and decreasing distances later in time due to increased population densities and smaller territorial ranges. Surprisingly, however, conveyance distances soared during the most recent, Terminal Prehistoric Period, reaching levels much higher than any other interval in the prehistoric past. As mentioned above, we argue that this strange finding probably reflects the introduction of the horse to Native peoples living along the Northern Tier during the late 1600s, which served to expand their interregional exchange networks at that time.

Chapter 15 (Northern Paiute, Western Shoshone, and the Numic Expansion) evaluates cultural-historical differences between the two groups, giving particular emphasis to an explanation of why the Western Shoshone used pottery and the Northern Paiute did not, as well as exploring differences in their migration rates and arrival times in northern Nevada. We end this chapter with a more detailed discussion of the ethnohistoric use of the horse along the Northern Tier and its possible influence on the Late Period archaeological record we encountered.

The final thematic chapter, chapter 16 (Numic Use of Wooden Pronghorn Enclosures), focuses on a series of antelope traps located in Thousand Springs Valley. It provides detailed topographic mapping, photographs, and radiocarbon dating of the ancient juniper structures and reviews the larger archaeological context in which they are found. Chapter 17 (Summary and Conclusions) brings the report to a close with a summary of the major findings of the project, highlighting future research directions that could be followed based on these findings. Finally, detailed analytical data are provided in a series of appendices (see Hildebrandt et al., 2015).

CHAPTER 2

NATURAL SETTING OF THE NORTHERN TIER

As might be expected over such a long study transect, there is regional variation in climate, physiography, hydrology, geology, and geomorphology, as well as plant and animal habitats, all of which affected prehistoric human land use. From west to east, we divide the study corridor into four primary regions—High Rock Country, Upper Lahontan Basin, Upper Humboldt Plains, and Thousand Springs Valley—by reference to a series of previously developed "ecoregions" that "denote areas of general similarity in ecosystems and the type, quality, and quantity of environmental resources" and that consider both "biotic and abiotic phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology" (Bryce et al., 2003). Thirteen such ecoregions are recognized within the study area. Our four project regions were determined by considering both the extent and the boundaries of the dominant ecoregions represented in the study corridor (see fig. 2).

In this chapter, we first review the geomorphic setting of the study corridor using a local landform typology applicable to all regions. We then address the modern climatic regime that, although fairly uniform, is influenced by topography, west-to-east variation in seasonal precipitation and temperature, and long-term quasi-cyclic variations. The resulting floristic regimes and plant communities are described by region. We then review the subsistence base, identifying those specific plant and animal taxa of economic importance to ethnographic and prehistoric peoples. The chapter concludes with a summary of Northern Tier paleoenvironments over the past 15,000 years that is synchronized to the extent possible with the major phases of prehistoric occupation identified in the study area (see chap. 3).

The Geomorphic Setting of the Northern Tier

D. Craig Young

Although formed on ancient basement rocks, the Northern Tier is a relatively young and dynamic landscape. This is especially true along the drainages, playa margins, and broad valleys between the uplifted mountains and plateaus. While the broad array of both ancient and more recent landscape features varies from region to region, more localized landform types are common to all regions found along the study corridor. As such, we first develop a local landform typology that describes the late Pleistocene–Holocene geomorphic structure of erosional, depositional, and stable landforms across the region. The typology works particularly well along the study corridor because, in most cases, the east-west corridor strikes perpendicular to the mountain ranges and drainage basins of the Northern Tier. Combined with additional discussion of the physiographic, geologic, and hydrologic context of the study area, we then use this typology to characterize each of the study corridor's four regions.

Landform Typology

The typology recognizes five primary geomorphic settings: *volcanic plateau*, *midland drainage*, *lowland basin*, *basin margin*, and *uplands* (fig. 3). In turn, each setting is further divided into a series of landforms. Thus, for example, the lowland basin setting is subdivided into the following landforms: inset fans, playa, axial drainage, distal fan, dunes, and medial fan. The regions often correspond closely to the geomorphic settings for long stretches of the study corridor. For example, much of the High Rock Country is composed of volcanic plateau, and the Upper Lahontan Basin is the epitome of a lowland basin setting in northern Nevada. However, each of the four regions encompasses settings and landforms of each type. Figure 4 provides both a planimetric and an elevational profile of the five primary geomorphic settings across the project area.

The settings, along with the landforms within each setting, allow archaeological investigators to evaluate and understand the geomorphic processes that might most affect the distribution, integrity, and preservation of archaeological components at specific sites. Landform characterization may also provide clues to the suite of resources that might have been locally available during the time of site use. Provided below is an overview of each of the five primary geomorphic settings.

Volcanic plateau: The volcanic plateau of northwestern Nevada consists of block-faulted basaltic and rhyolitic rocks laid down during a period of expansive volcanism in the middle to late Tertiary period, 26 to 6 mya (fig. 5). The broad tablelands are creased with faulted rimrocks and escarpments and are incised by dendritic or trellised drainages that follow breaks in the plateau to move toward adjacent lowland basins. In northwestern Nevada, rhyolitic rocks, interbedded with expansive ash-flow tuffs (Harvey et al., 1986; Hughes, 1986; Rytuba, 1989; Young, 2000) are slightly older and typically stratigraphically below the basalt flows. In places, the basalt forms minor cap rocks above the rhyolitic rocks, suggesting that some of the upper stratigraphy of basaltic rocks has been removed by erosion following recent uplift and faulting.

The lowland basin of Massacre Lake and the drainages of Badger and Fish creeks, basically the route of State Highway 8A, mark a relatively distinct boundary between the basalt and rhyolite on the volcanic plateau. Northwest of Massacre Lake, basalt rocks cap faulted blocks that form the west-facing Massacre Rim and east-facing Mosquito Rim. These features provide dramatic relief, rising hundreds of meters above the intervening basin of Long Valley. The rhyolitic plateau, southeast of the Massacre Basin, tends to have gentler relief but is still punctuated by basalt caps, rhyolitic cliffs, and rimrock. Drainages form deep-cut canyons and occasionally spread upstream in dendritic patterns exposing underlying, light-colored ash-flow tuffs and tuffaceous sedimentary

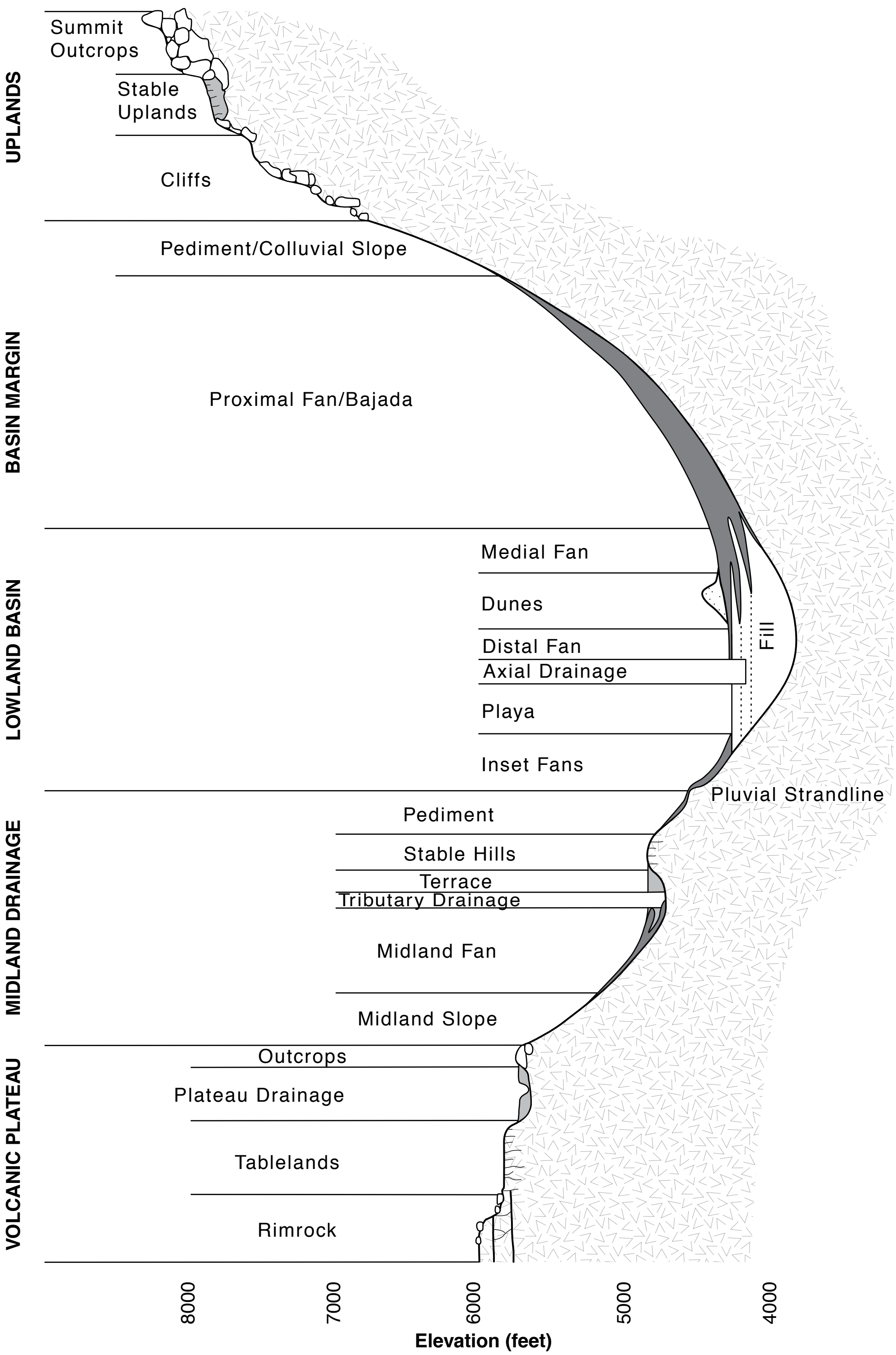

Fig. 3. Schematic model of major landforms of Nevada's Northern Tier.

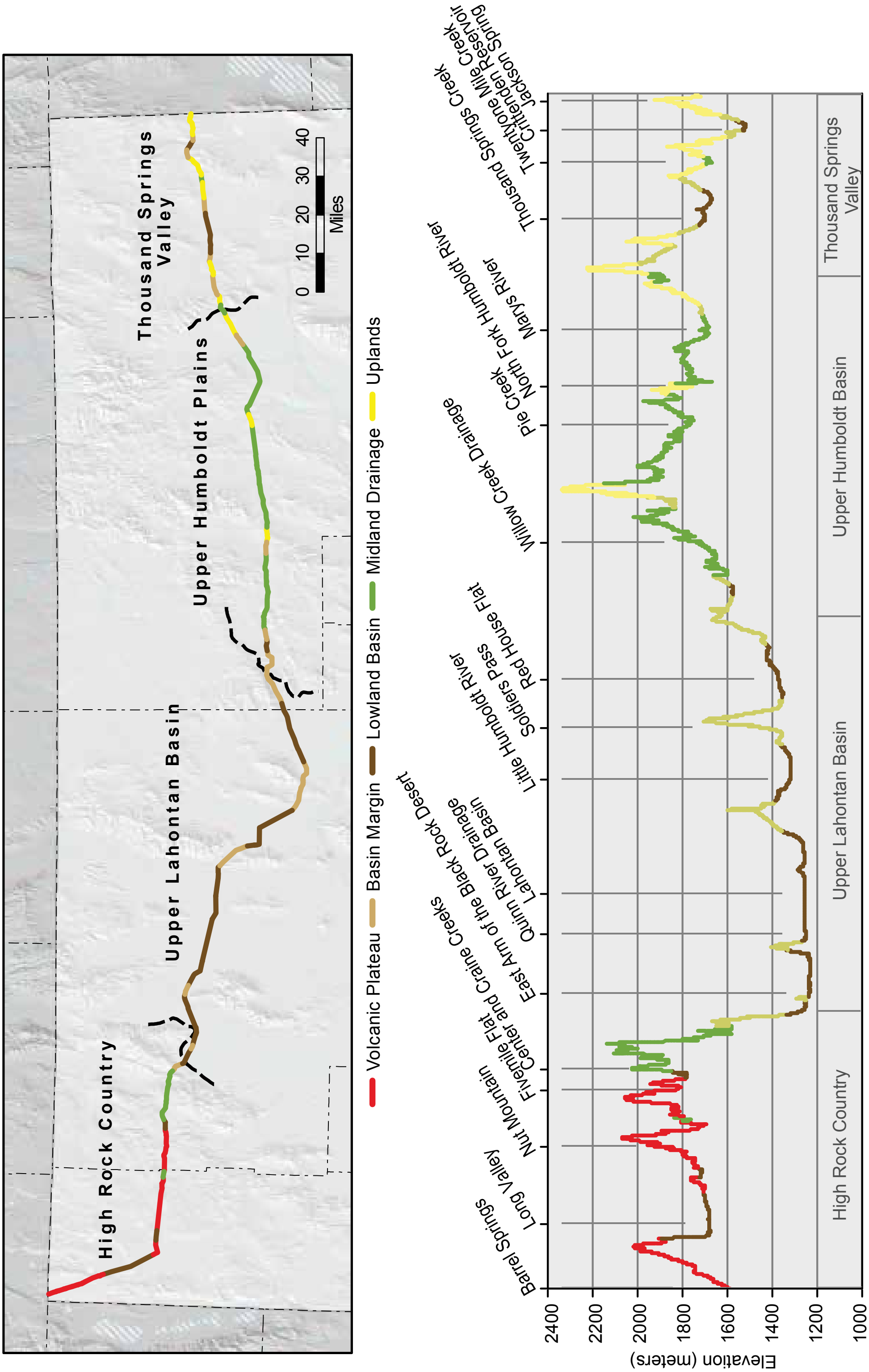

Fig. 4. An elevation profile, landforms, and landmarks by ecological region along the project corridor.

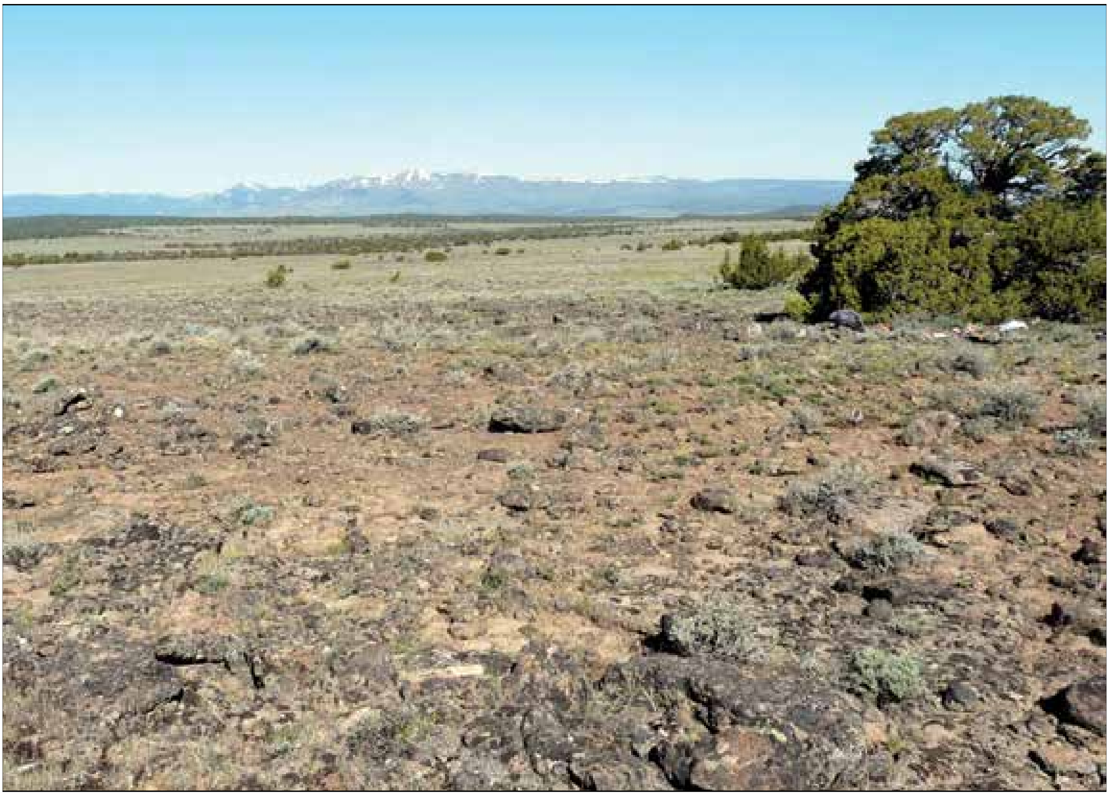

Fig. 5. The volcanic plateau of Barrel Springs, High Rock Country.

rocks. Archaeologically important obsidians, extruded during Miocene eruptions (Harvey et al., 1986), tend to be correlated with the regional distribution of rhyolitic rocks and ash flows. Obsidians of the Massacre Lake/Guano Valley, Coyote Spring, and Nut Mountain localities are Tertiary-age extrusions that have been widely dispersed as lag cobbles and gravels over millennia of uplift and erosion (fig. 6). A few isolated but distinct sources, such as the obsidians of Badger and Craine creeks, are also ancient extrusions, but they are confined to narrow canyons and relatively discrete drainage systems.

The stratigraphic profiles of Quaternary-age and archaeologically significant deposits on the volcanic plateau consist of shallow loess sheets on in situ clay-rich sediment formed by weathering of the local volcanic bedrock. The loess consists of aeolian deposited silt derived from desiccated pluvial lake basins. It can form some deep, dune-like landforms where reworking has been minimal, but the silts are typically shallow remnants that have yet to be reconfigured by slope wash. Sometimes capped by silty loess or exposed by slope wash, lithosols form as the volcanic bedrock decomposes via physical and chemical weathering. The soils began developing in the Pleistocene and form well-developed AB horizons directly on the slowly eroding volcanic rocks.

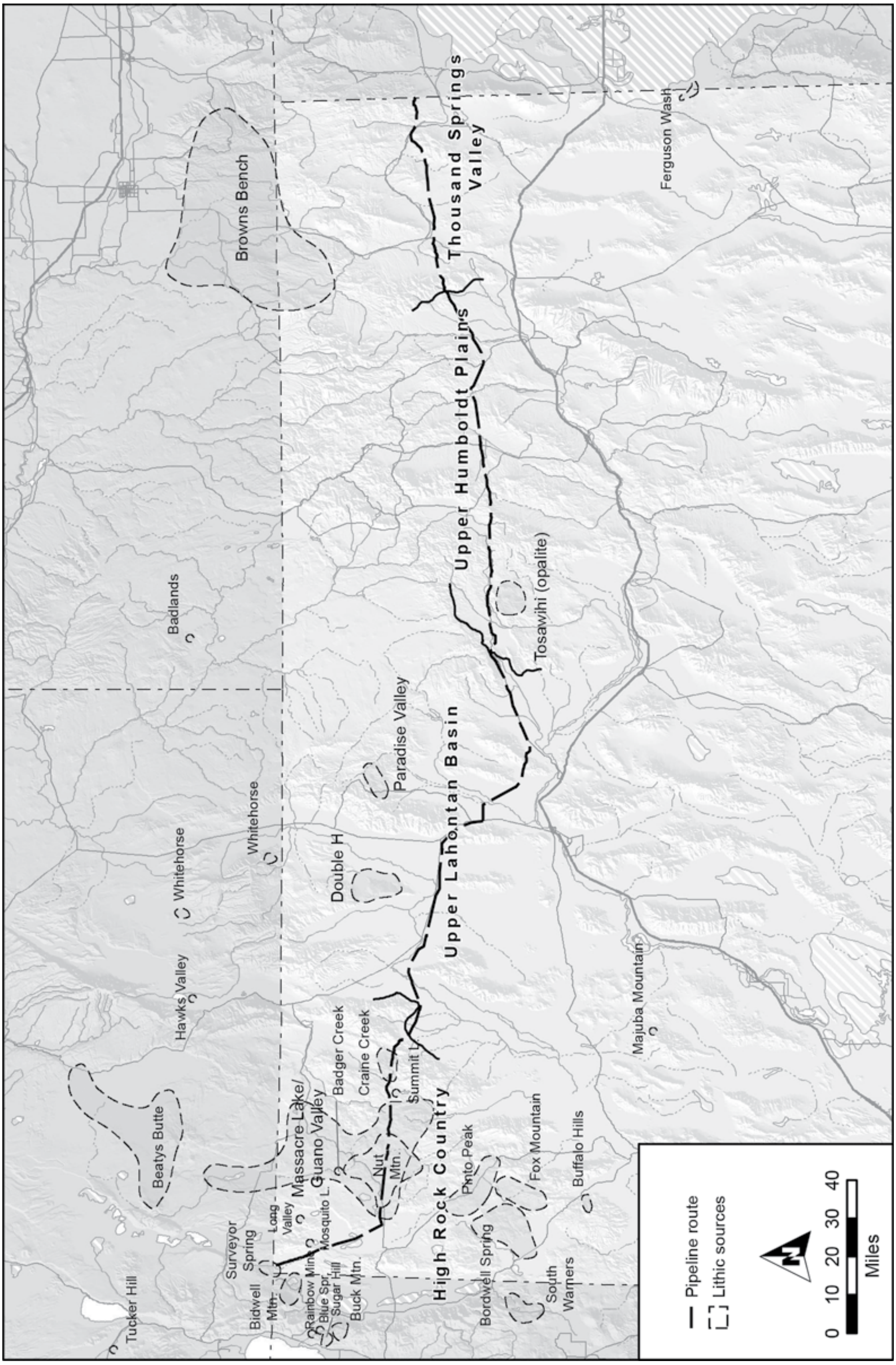

Fig. 6. Major lithic sources within and adjacent to the project corridor.

Clayey B horizons are common signals of local in situ soil formation.

Rimrocks and *outcrops* of the volcanic plateau are generally stable, rocky surfaces commonly exposed across the northwestern Nevada landscape. Loess-capped *tablelands* dominate the volcanic plateau setting. Since the loess deposition of the early Holocene, the tableland landforms have been generally stable. Soil development can be very mature, as evinced by thick, clay-rich lithosols. The loess has been eroding via slope wash since the middle Holocene, but the lithosols have continued to form. As slope wash is organized along creases in the tablelands, *plateau drainages* form. The drainages store fine-grained sediments removed from local slopes in small terraces along drainage courses within canyons, and few of the canyons are steep sided and deep. Where the volcanic tablelands are formed in ash-flow tuffs, plateau drainages can become complex dendritic systems. Unlike midland drainages, which some eventually join, plateau drainages of the volcanic plateau lack alluvial fans along the drainage margins; their margins are limited to narrow terraces. However, the narrow terraces may hold buried archaeological components.

Midland drainages: Although the environment of the Northern Tier is a product of generally arid conditions of the Great Basin, water remains the dominant erosional and depositional force. Seasonal precipitation and episodic, but intense summer storms deliver water to slopes and recharge the local and regional groundwater systems. Midland drainages form where flows become organized into main-stem creeks and streams above the highest strandlines marking lowland basins of regional pluvial lakes (fig. 7). These drainages are typically well-organized, high-order drainages above 5000 feet in elevation. Midland drainage settings can occur in all rock types across the Northern Tier, and most mountain ranges will have drainages that could be described as such. For example, midland drainage settings dominate the Upper Humboldt Plains region. The upper tributaries of the Humboldt River cutting through Tertiary-age sedimentary rocks traverse this region. The streams have regular dendritic tributaries feeding main-stem systems, such as Willow and Rock creeks.

Perennial midland drainages generally have complex terrace systems carved into the sedimentary rocks that form the local valleys. The small alluvial fans and deep terraces store Holocene-age sediments at the margins of the drainages. Here, archaeological components may be deeply buried. The integrity of archaeological components on and in the small fans can vary greatly due to erosional and depositional dynamics. Proximal fans—that is, those at the mountain front—are generally cobble strewn and deeply incised. Remnant lobes extending from the mountain front have strongly developed, Pleistocene-age soils and retain an archaeological record, where present, in surface contexts only. The distal segments of the fans lap onto streamside terraces. The Mazama tephra, deposited as ashfall from a series of climactic eruptions of Mount Mazama (Crater Lake, Oregon) at approximately 7600 cal B.P. (Hallet et al., 1997; Grayson, 2011: 61), is often a prominent bed in Holocene-age fan units and within the stratigraphic profiles of terrace cuts. Immediately after the eruption, the tephra draped much of the northern Nevada landscape; however, the fine-grained volcanic ash did not remain on the landscape for

Fig. 7. Midland drainage landforms in the Black Rock Range, High Rock Country.

long (but see Miller et al., 2004). Slope wash from seasonal storms pushed the tephra into the drainage systems where it piled as deep stratigraphic units. Terraces along Center and Maggie creeks, for example, more than 170 miles apart, contain tephra deposits that grade upward from clean, near-primary ashfall strata to dirty, secondary beds up to several meters thick. In any case, the initial deposition of the tephra provides a critical time marker in the depositional and archaeological sequences in the region. The drainage terraces also preserve soil horizons that may provide clues to the age of the drainage system. Soils may also retain residues useful for documenting local environmental conditions influencing vegetation communities and general resource productivity.

There are six landforms common to midland drainage settings: *Midland slopes* are generally the headward or proximal segments of small alluvial fans emanating from local hills. These erosional slopes transition to *midland fans*, the distal fan segments of recent sediment deposition. The fans terminate at the *tributary drainage*, forming the foundation of the geomorphic setting; that is, all processes lead to the drainage focus. The tributaries can be relatively minor, low-order streams (few upstream tributaries or feeders) coming from adjacent uplands, or they can be large, high-order streams (many

Fig. 8. The lowland basin of Long Valley, High Rock Country.

feeders) with large meanders and complex terraces. The drainages may be bounded by one or more *terraces* and many are deeply incised such that the level terraces stand along prominent modern arroyos. The terraces typically retain deep, Holocene-age depositional units but also preserve the complex changes (erosion, deposition, and stability) unique to the drainage. Above the drainages, *stable hills* give way to locally expansive *pediments* forming generally stable surfaces.

LOWLAND BASINS: The lowland basins of the Northern Tier encompass expansive bottomlands of former pluvial lakes (fig. 8). From east to west the pluvial lake basins include Bonneville, Lahontan, Parman, and Meinzer. Thousand Springs Valley in northern Elko County and the Red House Flat area of eastern Humboldt County are nonpluvial lowland basins along the study corridor; these lack a central defining playa but exhibit alluvial fan segments and minor dune systems common to the lake basins. Because the setting was influenced by pluvial lake desiccation, lowland basins contain the youngest and most active landforms along the project corridor. Although not necessarily synchronous in pluvial lake settings across the northern Great Basin, the latest maximum high stands generally date to about 15,000 cal B.P. (Benson, 2004; Grayson, 2011). With the exception of older outcrops that rise from the bottomlands, basin landforms postdate the latest pluvial high stand of the Late Pleistocene. Sedimentary deposits associated with the expansive pluvial lakes, including beaches, bars, and deltas, have been rearranged throughout the Holocene via the churning waters of fluctuating postpluvial lakes, fan progradation below high stands, and extensive aeolian reworking. These episodic shallow lakes and undulating dunes created a mosaic of resource-rich environments attractive to prehistoric peoples (Young, 2000). In many places, the chronology and structure of the lowland basin archaeological record provide significant information regarding the geomorphic history of a particular basin.

Six primary landforms are identified in the lowland basin settings: *Inset fans* extend basinward from below the high-stand strandlines. These typically small fans have formed since the late Pleistocene high stand and are typically inset into older, more extensive alluvial fans of the basin margin setting. The fans are Holocene depositional environments, but surface ages can be quite variable, and they can lap onto the former lake bed. On particularly active slopes, former strandlines may have been completely erased by large fans intruding into the desiccated basin. Although the proximal portion of these large fans defines the basin margin setting (see next section), the *medial* and *distal fan* segments are generally Holocene-age landforms that extend toward the valley bottoms. The surface ages vary locally, but the fine sediments that comprise these fan segments can bury archaeological deposits.

Sediments reworked from desiccated lake beds and former lake features (e.g., beaches, bars, and deltas) are commonly deposited as complex, lowland basin *dunes*. The silt and sand dunes can rest on fans or sit at playa margins. Where river systems act as efficient conveyors of parent material (i.e., alluvial and fluvial sands), the dune systems can be quite extensive. The Winnemucca dune field, for example, is likely derived from a paleodelta of the Humboldt River (Davis, 1982: 59). These dunes have now overtaken and coalesced with smaller dune systems of the Little Humboldt River in Paradise Valley. Silt dunes form in bottomlands in arcuate or linear patterns along rapidly fluctuating Holocene-age and modern lakes. Lake beds churned by the episodic lakes provide parent material for the lakeside dunes. The arcuate dunes of the northern Great Basin, such as those in Long Valley, appear to be pre-Mazama (pre-7600 cal B.P.) in age (Young, 2000) and have been deflating since their early Holocene formation. In general, the dunes of the lowland basins are Holocene in age and may contain significant stratified deposits with considerable archaeological depth. These dynamic environments, however, can compromise archaeological integrity via reworking, erosion, and deflation, thereby creating deflated archaeological materials from multiple time periods lying within small blowouts and basins. These artifact aggregations can themselves be subsequently buried and appear as an “intact” subsurface record.

The defining landforms of the lowland basin across the Northern Tier are the vast open *playas* or now-dry lake beds of the pluvial lakes. The playas are generally erosional landforms subject to aeolian deflation since the desiccation of the lakes. Local playas can become segmented as smaller, internal lake basins form or as fans intrude onto desiccated surfaces. The small lakes can be surrounded by silt-cored dunes and the fans can become

Fig. 9. Landforms of the Owyhee Bluffs, a basin margin setting.

depositional focal points for sand dunes and loess (silt) sheets. These processes introduce topographic irregularities to the playa margins and add to the varied landscapes of the lowland basin bottomlands. Where lake pulses are not common, the playas can become vegetated. The vegetation, in turn, entraps windblown sediment to form transient coppice dune accumulations that can coalesce to form extensive sheets, or they can just as easily deflate as deposition shifts farther downwind. The archaeological record of playas and their marginal coppice and dune systems is inherently complicated by these dynamics.

As the pluvial lakes dried, feeder streams continued their seasonal flows toward ever more distant termini. Today these form *axial drainages* that traverse the lowland basins, sometimes cutting deep arroyos into the former lake beds. The Humboldt, Little Humboldt, and Quinn rivers are dominant axial drainages of the Northern Tier's lowland basins.

Basin margins: Above the pluvial highstand strandlines are the basin margin settings, composed of expansive alluvial fans and coalesced bajadas (fig. 9). The fans emanate from the mountain fronts that bound the valleys of the Northern Tier. The basin margin fans are typically Pleistocene in age and bury much older fan and bedrock surfaces. Because deposition has shifted basinward during the late Pleistocene and on through the Holocene, most of the basin margin fans form relatively stable surfaces with strong Pleistocene-age soil profiles. Headward drainage cuts typically extend all the way to the mountain front and may be deeply incised. This isolates the fan surfaces from the alluvial depositional and erosional system, though aeolian processes may introduce fine-grained sediment to the fan surface. These aeolian deposits are generally shallow and are soon incorporated into the soil profile.

The most extensive Pleistocene-age basin margin fans along the study corridor are found above the strandlines of the Bonneville and Lahontan basins. The fans were deposited above lake level under well-watered pluvial environmental conditions. During the Holocene, fan progradation has generally extended farther basinward. The fans of the Osgood and Hot Spring mountains and Santa Rosa Range exemplify the basin margin setting along the study corridor.

The landforms of the basin margin consist of rock-strewn *proximal fans* or *bajadas* with a shallow stratigraphy encompassing archaeological components. Fine-grained loess and sand sheets may cap the ancient fan surfaces, but this capping stratum is typically underlain by a gravelly to cobbly, well-weathered and generally stable landform. The stable landform may have a strongly developed soil profile, usually consisting of a shallow A horizon over a strong, clay-rich or oxidized B horizon. Soils form slowly in arid environments in general, so the well-developed soils of the proximal fans provide evidence of long-term landform stability. Upslope, the basin margin may transition into *pediments* or *colluvial slopes*. A pediment may develop as long-term erosion forms a broadly beveled surface with little or very shallow sedimentary deposit. The underlying strata may be tilted at varying angles to the landform surface as erosion cuts across the structural geometry of the local bedrock. Adjacent to uplands cliffs and outcrops, colluvial features such as talus cones and wedges may extend into the Basin Margin. Archaeological deposits are not common in the gravity-fed colluvial settings.

UPLANDS: The study corridor tends to avoid the high-elevation segments of the region's mountain ranges. Nevertheless, upland environments are prevalent on midelevation summits and ridgelines that extend from the area's highpoints (fig. 10). These settings, at the scale of our study, are limited to the mountain ranges of Elko County in northeastern Nevada. The mountain ranges of Elko County are built on some of the oldest rock units in the state. Cambrian to Devonian cherts and quartzites, at least 400 million years old, rise in the Snake Range, while the Independence Range is built on Ordovician cherts and limestones, also more than 400 million years old. Permian limestone and Devonian shales comprise the uplands along the Nevada-Utah border where toolstone-quality cryptocrystalline silicate (CCS) sources outcrop.

The rocky uplands typically have shallow sedimentary profiles, as most of the landforms are erosional or have been stable through the Pleistocene and Holocene. *Cliffs* and *outcrops* are the prominent landforms in the uplands. *Stable upland* surfaces connect the outcropping rock units. These may have shallow, well-developed soils, but surficial sediments will be shallow and strewn with gravel or cobbles. Archaeological components of all ages may be found on the surfaces of upland landforms.

Fig. 10. Upland landforms.

Geomorphic Settings of the Four Project Regions

A general congruence exists between the four project regions and geomorphic setting. For example, the foundation of the High Rock Country is the *volcanic plateau*; the Upper Lahontan Basin corresponds, obviously, to a *lowland basin*. Locally, however, each region contains landforms and settings from all points of the landform typology. Here, we tour the four project regions, highlighting the specific settings along the project corridor.

High Rock Country: Volcanic plateaus and midland drainages, with rimrocks along trellised streams, are typical of the High Rock Country. Between volcanic outcrops and sharp cliff faces, shallow lithosols cap the generally level tablelands. Archaeological sites typically rest on or in the near-surface stratigraphy of these relatively old surfaces. Of course, long-term erosion and local deflation contribute wind-borne dust and alluvial sediment that eventually washes into plateau drainages. The youngest landforms, narrow streamside terraces and small fans, are found on this volcanic landscape.

In northwestern Nevada's High Rock Country, the study corridor traverses the volcanic plateau of the Barrel Springs tablelands, where basalt flows are cut by shallowly incised drainages. Faulted rimrocks of exposed bedrock and stable tablelands capped by shallow but strongly developed lithosols dominate the Barrel Springs landscape between Twelvemile Creek at the Nevada-Oregon border and the northern rim of Long Valley. The basalts of Barrel Springs cap slightly older rhyolitic rocks and, where exposed in cuts and local outcrops, the geologic contact reveals obsidian nodules of the Cowhead Lake and Mosquito Lake sources. These gravel- to cobble-sized nodules are spread as lag in drainages and on locally stable tablelands.

Although the Lahontan Basin dominates the northwestern Nevada landscape, smaller pluvial lakes inundated intervening valleys in the High Rock Country, including Lake Meinzer in Long Valley. The high-stand shoreline of Lake Meinzer reached approximately 5800 feet in elevation (Mifflin and Wheat, 1979: 54; Orme, 2008). The study corridor drops into Long Valley, crossing inset fans below the high-stand strandline, and soon traverses the valley-bottom playa and arcuate dune system formed on the desiccated lake bed. The pluvial history of Lake Meinzer is likely similar to that of well-studied Lake Lahontan. However, pluvial lakes in southern Oregon, such as Lake Chewaucan and Lake Alvord, are somewhat different; there, the chronology of pluvial high stands lags behind that documented in Lake Lahontan, and the Younger Dryas transgression (lake-level rise) has not been documented (Grayson, 2011: 109–112). Lake Meinzer lacks the overall complexity of the multibasin Lake Lahontan, with its many rivers fed by Sierran runoff; thus, the late pluvial history of Meinzer may in fact be more comparable to the northern lakes. At its high stand, Lake Meinzer exceeded the boundaries of Long Valley to coalesce with the Massacre Lake Basin to the east; together the two basins encompass several lowland basin landforms.

The lowland basins of Long Valley and Massacre Lake are connected via a narrow sill north of Painted Rock. It is likely that the smaller Massacre Lake would fill first and then overflow at an elevation of ~5645 ft. There is a prominent strandline in the Massacre Lake Basin that marks this stillstand, outflow level. Lake Meinzer in Long Valley, a much larger basin responding to similar precipitation and groundwater inputs, would be rising more slowly and it may have taken some time for the two lakes to coalesce. As lake regression began, probably soon after 15,000 years ago, the shallow Massacre Lake Basin may have desiccated in a relatively short time. Given the relatively small drainage net surrounding Long Valley, it is likely that the shrinking Lake Meinzer did not last much longer. The first people in the region may have encountered the last remnants of pluvial Lake Meinzer in Long Valley.

Prior to the deposition of the Mazama tephra, small and fluctuating lakes in the basin bottoms encouraged the formation of arcuate silt dunes, and the basins soon took their modern form as segmented lakes and dunes surrounded by encroaching fans. Aeolian silt or loess deposits on the surrounding plateaus, which choke some midland drainage systems farther east, are derived from scouring of the newly dry lake bed. Holocene lakes may have filled the Massacre Lake Basin enough to overflow to Long Valley, especially during the neopluvial episode of the late middle Holocene (the Early and Middle Archaic) between 5000 and 2500 years ago. Based on radiocarbon-dated archaeological components in the Massacre Basin, the lake has remained below the 1722 m strandline since about 2500 cal B.P.

East of the Massacre Lake Basin, the study corridor traverses the heart of High Rock Country. Rhyolitic rocks and ash-flow tuffs form a broad volcanic plateau extending from the Massacre Lake Basin eastward to Fivemile Flat and Summit Lake (Parman Basin). This expanse is cut by a midland drainage setting at Wall Canyon Creek where a deep, Holocene-age terrace system bounds a deeply incised arroyo. Smaller plateau drainages are common across the plateau, as are stable tablelands and rocky outcrops. Nut Mountain is the highpoint between Massacre and Wall Canyon. Here, expansive deposits of obsidian nodules rest as lag on Tertiary-age surfaces and have been incorporated into the deposits of the plateau drainage systems. Other obsidian sources, such as the wide-ranging Coyote Spring, Massacre Lake/Guano Valley, and Nut Mountain source areas, illustrate the dispersed pattern of tool-stone-quality lag deposits.

The lowland basin of Fivemile Flat marks the eastern extent of the volcanic plateau setting along the study corridor. Once inundated by pluvial Lake Parman, Fivemile Flat encompasses vegetated playas and inset fans. Lake Parman reached a maximum elevation of about 5857 ft, at which point it overflowed into the Alvord Basin via Virgin Creek (Mifflin and Wheat, 1979: 31). When at this sill, the lake was approximately four meters deep in Fivemile Flat, either expanding from or joining with the slightly larger lake in the basin of modern Summit Lake. A lake of this size would be highly susceptible to local variations in input, and the shallow basin likely supported extensive wetlands (Layton, 1979). Like pluvial Lake Meinzer, whose drainage system is at about the same latitude, the history of Lake Parman is not well documented. It likely reached its maximum extent at about 15,000 years ago, receiving direct input from its rather limited drainage net. Because Lake Parman (Fivemile Flat) has a natural outlet and was a relatively shallow pluvial lake, its high-stand elevation may have been maintained for relatively long periods. On the other hand, shallow basins desiccate quickly once the sill level cannot be maintained. Early sites on the margins of the Parman Basin (Layton, 1979; Smith, 2006; and herein) suggest that runoff within the local basin was enough to maintain productive wetland environments into the early Holocene.

East of Fivemile Flat and Summit Lake, the structure of the Basin and Range province shifts from regular fault-block tablelands to uplifted mountain ranges and intervening valleys. The Pine Forest and Black Rock Range rise above the volcanic plateau, and the eastern High Rock Country becomes a series of midland drainages coursing through stable hills and small fan systems. Hillsides cut into rhyolitic rocks expose relatively localized obsidian deposits on slopes, and redeposited obsidian nodules are common in the midland drainage alluvium. The midland slopes and short midland fans in the canyons of Idaho Canyon and Craine creeks form the upper tributaries draining the northern extent of the Black Rock Range. Craine, Center, and Cove creeks cut through deep terraces filled with Holocene-age sediment including basal layers consisting of the Mount Mazama tephra. Above the tephra, archaeological components of the middle Holocene (Post-Mazama and Early and Middle Archaic) are often buried.

The High Rock Country transitions to the Upper Lahontan Basin at the foot of the basin margin landforms on the eastern front of the southern Pine Forest Range. Large erosional pediments transition to coalesced fans that extend to the margins of the Leonard Creek embayment of the northern Black Rock Desert.

Upper Lahontan Basin: The lowland basin setting of pluvial Lake Lahontan dominates the northern-tier landscape and is generally congruent with the Upper Lahontan Basin. As the study corridor drops from mountain ranges on the western margin of the Black Rock Desert, it traverses inset fans and playa margin dunes below lake strandlines that reach to approximately 4380 ft in elevation. Understanding the late Pleistocene and Holocene history of Lake Lahontan, including the fluvial and deltaic landforms of the Quinn River (the lake's northern feeder stream), is important for understanding the early colonization of northern Nevada.

Lake Lahontan likely reached its late Pleistocene high stand for a brief period at about 17,600 years ago (Benson et al., 1990; Adams and Wesnousky, 1999; Benson, 2004; Adams et al., 2008; Grayson, 2011). The duration of the high stand is unclear, but by 15,700 cal b.p., the lake was retreating from its maximum. By 14,500 years ago, the lake had dried to such an extent that the Black Rock Desert and Quinn River Basin was isolated, as it has been for much of the Holocene, from Sierran connections via the Pyramid Lake and Honey Lake subbasins. At around 12,600 years ago, however, the lake in the Black Rock subbasin was likely rising again, due to renewed input from the Quinn River in response to increased precipitation of the early Younger Dryas cycle. The extent of the Younger Dryas lake in the Black Rock subbasin at this time remains unclear and, in any case, the shoreline of the Younger Dryas lake remained south of the study corridor. To further complicate these scenarios, Davis (1982) and Benson and Peterman (1996) show that the Humboldt River had a connection to the Black Rock sometime after 15,000 years ago. The Winnemucca dune field, derived from reworked alluvium and delta sediment, is secondary evidence of this fluvial system that would have fed the Quinn River via the Pronto sill (near Jungo, Nevada) and on through Desert Valley.

The study corridor then traverses vegetated and coppiced playa surfaces formed of remnant lake-bed sediments above the highest Younger Dryas levels before intersecting the axial drainage of the Quinn River. The river cuts a floodplain and terrace system in the east arm of the Black Rock Desert, but it is often limited to only seasonal drainage across much of the study area. The corridor then parallels the Quinn River across stream-terraced playas and occasional dunes from the toe of the Jackson Mountains, with its narrow basin-margin fans, through Desert Valley and Silver State Valley. Across the expansive valley floors, saltbush and greasewood vegetation anchors coppice dunes with intervening open playas. Minor axial drainages feed occasional storm runoff to the Quinn River Drainage.

The Santa Rosa Range divides the Quinn River (Black Rock subbasin) from the Humboldt River drainage system. The study corridor rises and falls through a system of broad basin-margin alluvial fans at Paradise Hill, the gap between the two drainages. Reentering the lowland basin of pluvial Lake Lahontan, the study corridor continues across a vegetated playa cut by axial drainages. North of Winnemucca, Nevada, in Paradise Valley, Big Cottonwood Creek and the Little Humboldt River are axial drainages that feed into the Humboldt River. Broad playa surfaces are overlain by local floodplains (and agricultural fields) adjacent to these drainages. This valley was inundated by pluvial lakes only during relatively short-lived maximum high stands. The large dune systems on the valley bottom form the leading edge of the Winnemucca dune field, which is derived from a late Pleistocene delta system when the Humboldt River, altered from its present course, entered Lake Lahontan via the Pronto gap (Davis, 1982; Benson and Peterman, 1996). Originating in Desert Valley to the west, the sands of this long-abandoned delta have entered Paradise Valley, forming prominent parabolic dunes spanning the Little Humboldt River. The drainages in Paradise Valley have also provided sand that forms late Holocene dunes and sand sheets on the local playas and axial floodplains. On the eastern side of Paradise Valley, the corridor rises onto the alluvial fans of the western front of the Hot Springs Range. The fans transition from inset fans below the Lahontan high-stand strandline, to medial fans of the lowland basin, and then upward onto the proximal fans of the mountain range.

The Golconda thrust belt marks a distinct change in the underlying rocks of north-central Nevada, and it is here that the Humboldt River snakes its way through the narrow gap at the southern toe of the Osgood Mountains. The study corridor passes through the Osgood Mountains via Soldiers Pass and Dog Spring, climbing on basin margin proximal fans and erosional slopes of the range's foothills. The surfaces are generally old, as deposition is shifted basinward on the fans and slopes. The fans become extensive, entering Red House Flat and the tributary systems of Kelly and Evans creeks. The proximal fans of the eastern front of the Osgood Mountains transition to lowland basin medial and distal fans that have coalesced in the expansive valley bottom. The lowland basin processes are dominated by alluvial input from the prograding fans and, along the river drainage, meanderings and aeolian reworking of the Humboldt River floodplain (Miller et al., 2004).

On the eastern edge of the Upper Lahontan Basin, the study corridor encompasses the broad coalesced fans extending from the Owyhee Bluffs. The surfaces are generally stable, with well-developed soils only shallowly buried by silt loess. Headward-cutting drainages that have narrowly confined riparian zones flow steeply toward Evans Creek. Landslides are common on the colluvial slopes below the abrupt bluffs that rise above the fans. Near the headwaters of Evans Creek, southeast of Midas, Nevada, the corridor climbs out of the Upper Lahontan Basin and into the Upper Humboldt Plains.

Upper Humboldt Plains: The study corridor rises to the Upper Humboldt Plains, traversing a series of Humboldt River tributaries, each of which is a major regional drainage system. The Basin and Range province is in evidence here as the corridor alternates quickly between mountain ranges and intervening valleys, each valley containing a tributary that, with one exception, leads to the Humboldt River. The exception comprises a portion of Independence Valley where the study corridor lies outside of the hydrographic Great Basin. In general, midland drainage settings characterize the geomorphology of the Upper Humboldt Plains.

Near Midas, the study corridor traverses large, stable alluvial fans in a basin margin setting above Rock Creek in Squaw Valley. Expansive coalesced fans extend to a lowland basin setting where Rock Creek forms an axial drainage with a broad floodplain of complex meanders. The basin margin fans on either side of Rock Creek are stable surfaces with strong soil profiles. It is common for the upper slopes of basin margin landforms to form erosional or stable pediment surfaces cut into Tertiary-age sedimentary rocks. These pediments are ubiquitous in the Upper Humboldt Plains as basin margin landforms and as stable slopes in midland drainage settings.

Willow Creek, a large tributary of Rock Creek, is a prominent east-west trending midland drainage that cuts through western foothills of the Tuscarora Mountains. The corridor closely parallels the Willow Creek drainage from its confluence with Rock Creek to its headwaters in the Tuscarora Mountains. Along the way it shifts between deep floodplain terraces and the stable midland slopes. The Holocene terraces have deep profiles that generally mirror the processes, if not the chronology, evident in the stratigraphy of the middle Humboldt River (Miller et al., 2004). In the early Holocene, based on the strata below the Mazama tephra (7600 cal B.P.), the midland drainages of the Upper Humboldt Plains experienced strong flows that were eventually overtaken by aggrading floodplains marked by strong, organic A horizons or wet meadow environments. The Mazama tephra rests abruptly on the contact with the well-preserved lower profile. In the Humboldt River, Miller et al. (2004: 73) find evidence that as many as 2000 years are missing from the profile between the pre-Mazama floodplain and the reworking of the tephra into the floodplain. The temporal gap may not be present in midland drainages such as Willow Creek, because of the proximity of the source areas (e.g., local slopes) of the airfall tephra. Still, it is clear that the easily eroded tephra that blanketed the landscape after 7600 cal B.P. became a prominent component of alluvial sedimentation for millennia after its initial deposition. The Post-Mazama stratigraphy of midland drainages throughout the region is dominated by aggrading silt beds created as local floodplains developed. Occasionally, these were incised by arroyos, with gravel lenses in the terrace stratigraphy reflecting runoff from the valley margins. The modern arroyos are the most recent iteration of the cut-and-fill cycles common to the midland drainage systems.

When above the terraces of the tributary drainages, the study corridor traverses erosional and stable slopes that confine the local floodplain. The slopes extend from uplifted ranges where local Tertiary-age rhyolitic rocks cap much older (e.g., Ordovician shales) deposits. CCS tool stones, including the white opalite of Tosawihi (Elston and Raven, 1992), outcrop locally and are incorporated into a sometimes expansive lag veneer that rests on local pediments and midland slopes.

The study corridor follows midland drainage settings into the basin of Independence Valley. Skirting the basin's southern periphery, it crosses basin margin proximal fans and pediments of Bronco Canyon and Indian Creek, tributaries of the South Fork of the Owyhee River—a Pacific Ocean drainage system. Unlike Adams Creek, a midland drainage setting to the west, these basin margin drainages feeding local fans lack depositional terraces; their depositional settings are farther north in the bottomlands and distal fans of Independence Valley.

Returning to the hydrographic Great Basin, the study corridor climbs to uplands settings in the southern Independence Mountains. Although locally subject to intensive erosion, the uplands and outcrops of local ridgetops are generally stable landforms with very old surfaces. Crossing the Independence Mountains, the study corridor reaches its highest elevation at approximately 7500 ft.

East of its highpoint in the Independence Mountains, the corridor skirts the northern reaches of Maggie Creek before dropping into the Pie Creek drainage. These midland drainage systems contain Holocene terrace sets and streams confined between stable midland slopes. A stratigraphy anchored on the Mazama tephra is typically present low in the terrace profiles within a stratigraphic sequence similar to the midland drainages throughout the Upper Humboldt Plains. However, the upper tributaries of Pie Creek and Mahala Creek show an active Post-Mazama cut-and-fill sequence (Madsen, 1985), despite tephra being present. Midland slopes east of Pie Creek are beveled into mixed lithologies of Tertiary-age sandstones and Ordovician cherts and shales. These erosional surfaces provide sediment to midland fans that extend to the drainages.

The North Fork of the Humboldt River takes a circuitous route through faulted Tertiary-age rocks, cutting deep canyons in the uplands of the northern Adobe Range. Once the study corridor makes its river crossing in the canyon of the North Fork, it traverses a series of expansive pediments on midland slopes forming the broad valleys of the Marys River and Tabor Creek. The local midland drainage floodplains are not typical of the region's incised terrace systems. These broad streams are closer to the base-level controlled Humboldt River with its constriction at Osino Canyon. Although confined by stable pediments and fans, the tributaries are generally meandering systems on young but shallow floodplains.

Leaving the broad valley of the North Fork and Marys River, the corridor rises into the Snake Mountains and reenters a setting of stable uplands and outcrops culminating at Black Butte. However, Burnt Creek, with its classic midland drainage terrace system and Mazama-bearing stratigraphy, breaks the transition to the region of Thousand Springs Valley.

Thousand Springs Valley: At its eastern end, the study corridor climbs into uplands settings of the Snake Mountains. Here, stable upland slopes and outcrops are formed on Cambrian to Devonian quartzites, the oldest rock types in the region. There are very few archaeological sites on the stable surfaces of the Snake Mountains uplands or the basin margin pediments and fans that extend from the eastern front of the range. The uplifted and incised fans extend to Summer Camp Ridge, where stable uplands settings extend toward Thousand Springs Valley.

The expanse of Thousand Springs Valley is a lowland basin bounded by basin margin alluvial fans. The axial drainage in the valley, Thousand Springs Creek, drains to the Bonneville Basin to the east. The fans of the basin margin are broad pediment surfaces that transition to short, lowland basin medial and distal fans. The pediment surfaces are cut into Tertiary-age sedimentary rocks. Long-term erosion of the beveled surfaces provides fine-grained sediment to the small fans and chokes the axial drainages of Thousand Springs Creek and Toano Draw. Erosional badlands of the basin margin are locally overlain by aeolian dunes and sand sheets reworked from the lowland basin. However, most surfaces of the basin margin are stable or beveled by Holocene erosion. The antelope traps east of Fivemile Draw occupy expansive basin margin landforms, including beheaded pediments formed on sedimentary rimrocks and badlands.

The basin margin landforms rise to meet uplands settings of Ninemile Mountain, where stable upland surfaces and occasional outcrops form prominent ridges. The brief uplands sections of Ninemile Mountain and the southern Delano Mountains (Gamble Hills) are cut by the midland drainage of Twenty-one Mile Creek, a north-flowing tributary of Thousand Springs Creek. The seasonal drainage has a deep Holocene-age terrace incised by a prominent arroyo. The terraces are confined by stable surfaces emanating from the surrounding uplands.

The undulating topography near the Nevada-Utah border brings a variety of settings and landforms into close proximity. The study corridor drops from the uplands of the Gamble Hills, traversing a stable basin margin proximal fan before intersecting Thousand Springs Creek, which has looped its way through the Delano highlands. At this point, Thousand Springs Creek enters the lowland basin below the high stand of pluvial Lake Bonneville. The narrow, lowland basin setting along the corridor in lower Thousand Springs canyon encompasses loess-capped outcrops of lacustrine sediment along the axial drainage. The waters of Lake Bonneville inundated Thousand Springs Creek briefly at about 18,000 years ago—a late Pleistocene time frame generally contemporaneous with, but perhaps slightly earlier than, the high-stand transgressions in the Lahontan basin to the west. However, the lake flooded the narrow embayment along the canyon of Thousand Springs Creek for only a short time. Soon after reaching high stand, it catastrophically downcut its sill at Red Rock Pass in Utah (Grayson, 2011: 102). As the lake downcut the Red Rock Sill, it flooded the Snake River, and the lake level dropped rapidly. The lake drained from the Thousand Springs drainages to regain "high stand" equilibrium at the Provo shoreline in Tecoma Valley.

Climbing away from the narrow Thousand Springs Creek basin, the study corridor traverses the rugged uplands surrounding Jackson Spring. Here, outcrops of Devonian shales and limestones form ridges overlooking steep canyons. The stable cliffs and slopes of the local uplands contain outcrops of tool-stone-quality CCS (grey to red chalcedony) that were occasionally targeted by people as prehistoric-era quarries. Secondary occurrences of the CCS are also common in the colluvium below steep outcrops.

At the Nevada-Utah border, the uplands settings at the eastern terminus of our study corridor look out over the vast Bonneville Basin. The headwaters of generally dry borderland drainages coalesce as they form broad fans at the margin of the pluvial lake basin. High-stand strandlines are visible below the project corridor, where Bonneville encroached on Tecoma Valley in the late Pleistocene. The Holocene transgressions and high stands in the Bonneville Basin occurred far from the study corridor.

Modern Climate

David Rhode

Northern Nevada's climate is marked by warm, dry summers, cold winters, high diurnal temperature variation, and a short grow-

TABLE 1
Climatic Averages for Selected Weather Stations from 1971 to 2000 (National Climatic Data Center Normals)

Station (elevation in ft)	Mean Annual Temperature (°F)	Mean Annual Precipitation (inches)	Mean Summer (Jul-Sep) Precipitation in inches (%)	Mean Spring (Apr-Jun) Precipitation in inches (%)	Mean Fall-Winter (Oct-Mar) Precipitation in inches (%)
Fort Bidwell (4500)	47.5	18.25	1.56 (8.5)	3.69 (20.2)	13.00 (71.2)
Adel (4580)	48.1	9.18	1.24 (13.5)	1.89 (20.6)	5.52 (60.1)
Vya (5660)	44.1	13.75	2.22 (16.1)	3.76 (27.3)	7.77 (56.5)
Sheldon (6510)	42.0	11.91	2.12 (17.8)	3.27 (27.5)	6.52 (54.7)
Leonard Creek (4230)	51.3	9.47	1.26 (13.3)	2.37 (25.0)	5.84 (61.7)
Denio Jct (4190)	49.7	9.82	1.30 (13.2)	3.25 (30.7)	5.27 (56.1)
Orovada (4300)	49.5	10.44	1.54 (14.8)	3.33 (31.9)	5.57 (53.3)
Golconda (4390)	48.9	7.65	1.07 (14.0)	2.34 (30.6)	4.24 (55.4)
Tuscarora (6170)	44.8	11.94	1.70 (14.2)	3.21 (26.8)	7.03 (58.9)
Gibbs Ranch (6000)	42.9	10.77	1.83 (17.0)	3.25 (30.2)	5.69 (52.8)
Wells (5630)	44.8	10.22	1.78 (17.4)	3.20 (31.3)	5.24 (51.3)
Montello (4880)	45.2	8.47	2.13 (25.1)	2.72 (32.1)	3.62 (42.7)
Grouse Creek (5300)	44.6	11.58	2.38 (20.6)	3.55 (30.7)	5.65 (48.8)

ing season. Most of the year's scant precipitation occurs in fall and winter months in the form of snow from Pacific frontal storms, with a significant proportion of the annual water budget also falling as springtime snow and rain (table 1). In these respects, northern Nevada's climate is fairly uniform, with three major exceptions: the influence of elevation, west-to-east variation in seasonal precipitation, and long-term quasi-cyclic variations.

First, elevation strongly affects the amount of precipitation and overall seasonal temperatures. The higher mountains capture significantly greater precipitation than neighboring valleys and basins. For example, the valley floor of the Upper Lahontan Basin, at 4000 ft in elevation, receives 6–8 inches of precipitation annually. The Santa Rosa Range overlooks this broad basin from a vantage up to 5700 ft higher; its peak receives approximately 40 inches of precipitation annually—a fivefold increase from the nearby valley floor. Precipitation profiles along the pipeline route highlight the importance of elevation (fig. 11). The High Rock Country has an average elevation of ~6000 ft and receives about 11 inches of annual water input. The adjacent Upper Lahontan Basin is lower and drier, receiving only 5–10 inches annually. The Upper Humboldt Plains and Thousand Springs Valley area are again higher and moister, climbing to 11–16 inches with the increase in elevation, with a maximum at the Snake Mountain divide between the Humboldt Basin and the Bonneville Basin. Finally, the Thousand Springs Valley descends in both elevation and in annual moisture, dropping between 9 and 12 inches.

Local topographic rises result in local spikes in estimated precipitation. Tempera-

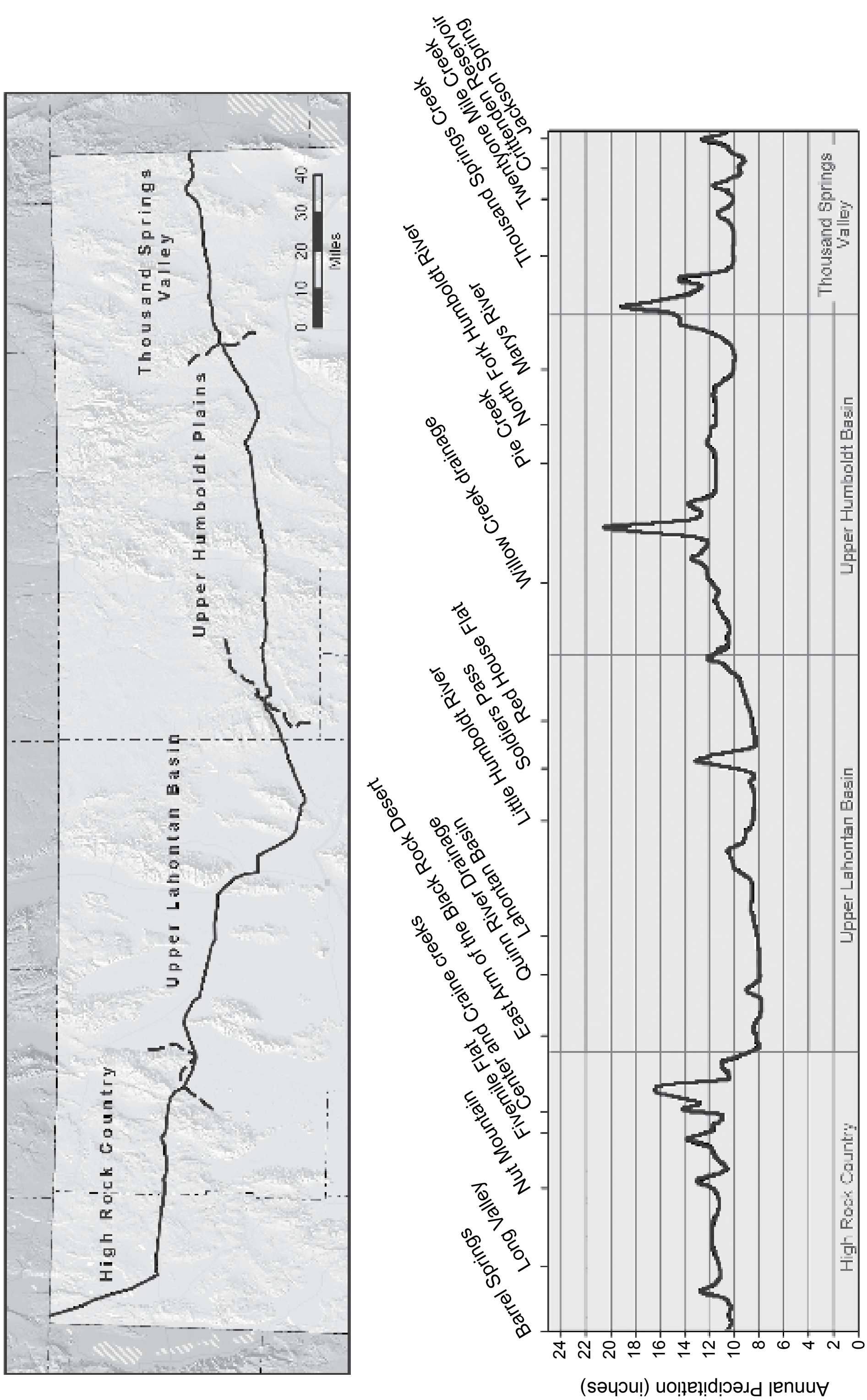

Fig. 11. Precipitation profiles along the project corridor (estimates from PRISM 1971 to 2000 normalized reconstructions).

ture values are inversely related to elevation, generally speaking, with a rough average lapse rate of ~3–4° F per 1000 ft of elevation. However, surface temperature lapse rates in the dry air of the Intermountain West are highly variable and geographically complex (Houghton et al., 1975; Wolfe, 1992; Lundquist and Cayan, 2007; Minder et al., 2010). In the winter, thermal inversions are common in northern Nevada valleys, such that valley floors are often significantly colder than midelevation slopes, due to cold air drainage. Likewise in the summer, surface heating of valleys can be much more intense than in neighboring mountains, creating extreme temperature lapse rates, until thermals mix the atmosphere to a more stable state.

A second major factor that affects the general uniformity of northern Nevada climate arises from west-to-east trends in the proportion of precipitation resulting both from Pacific westerly storms and from tropical summer monsoonal precipitation (Houghton et al., 1975). At the far western end of the study corridor, the influence of Pacific winter storms is significantly stronger than in the east, as air masses pass the Sierra Nevada and move eastward (fig. 12). For example, Adel and Denio Junction, near the western end of the line, receive nearly 50% more fall and winter precipitation than does Montello at the far eastern end, and Fort Bidwell, in Surprise Valley just west of the High Rock Country, receives nearly four times Montello's winter precipitation. This effect falls off quite strikingly, however, beyond the Sierra Nevada. Most of the High Rock Country receives less than half the fall and winter precipitation that Fort Bidwell does (see table 1).

In contrast, summer rainfall fed by moisture moving north from the subtropical Pacific Ocean or Gulf of Mexico is a significant part of the year's precipitation on the eastern end of the corridor (see table 1). The western part of the corridor is farther away from this moisture source and typically receives less than 60% of the amount of summer precipitation (< 1.3 inches) than does, say, Montello or Grouse Creek (>1.7 inches; fig. 12). Over most of the line, however, the overall proportion of summer rainfall contributing to the annual water budget ranges narrowly between 13% and 17%, with Montello and Grouse Creek the exceptions at the far eastern end. On the whole, then, seasonal contribution of precipitation varies only moderately across northern Nevada except at the far eastern and western ends of the route.

One other dimension may differentially affect climates across northern Nevada, and that is its long-term temporal variability. Regional climate varies in response to global-scale decadal and multidecadal oceanic fluctuations such as the El Niño–southern oscillation (ENSO), Pacific decadal oscillation (PDO), and Atlantic multidecadal oscillation (AMO). Recent research based on instrumental records and paleoclimatological proxies yields insights into how these global-scale oscillations may affect the northern Nevada region.

The ENSO, which operates on a two- to seven-year quasi-cyclic pattern, produces a large-scale "seesaw" or dipole pattern of precipitation in western North America: during El Niño events, the Southwest is anomalously wet during the cool season, while the Pacific Northwest is anomalously dry, and the opposite is true during La Niña events (Redmond and Koch, 1991; Dettinger et al., 1998; Cayan et al., 1999). The transition zone in this spatial dipole falls between 40° and 42° north

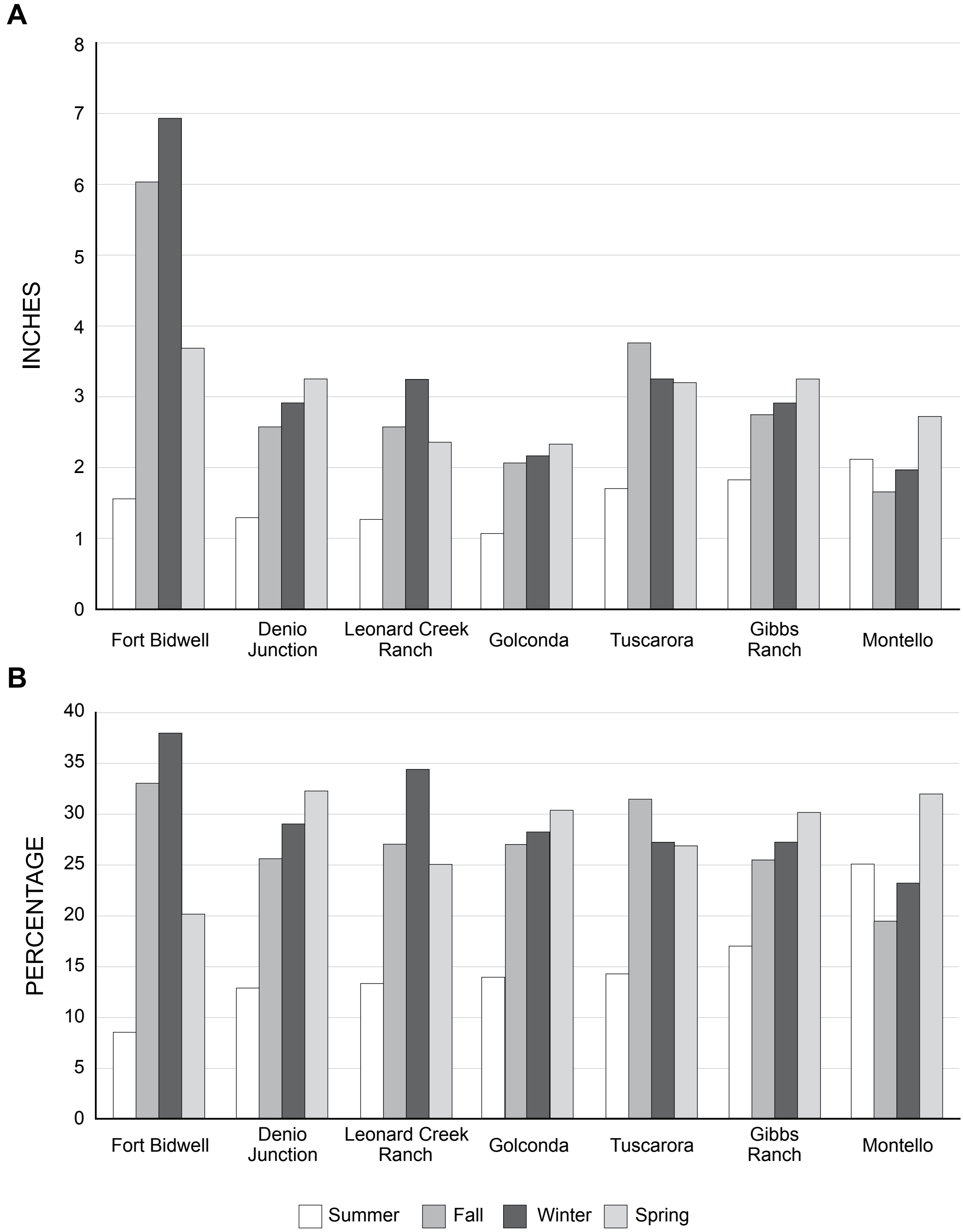

Fig. 12. Annual precipitation for selected weather stations along the project corridor. **A.** Seasonal precipitation amounts. **B.** Seasonal precipitation proportions.

latitude, precisely where the project corridor crosses through Nevada (Wise, 2010; see fig. 1). In this transition zone, precipitation patterns are highly variable and lack correlation with ENSO cycles (Brown and Comrie, 2004). Across this region, there is also little or no correlation between winter precipitation and the June-November Southern Oscillation Index, a leading measure of ENSO strength and polarity; this transition zone "has remained remarkably stationary through time across the Great Basin" (Wise, 2010: 4), with little latitudinal shift through the 20th century. In broad terms, the strength and polarity of ENSO cycles by themselves bear no strong relation to the amount of winter precipitation that northern Nevada receives.

Other large-scale oceanic oscillations do affect patterns of precipitation in this transition zone, in concert with ENSO. The PDO is a mode of variability in sea surface temperatures in the North Pacific Ocean (Mantua et al., 1997; Nigam et al., 1999) related to ENSO but fluctuating over periods of decades rather than years. The PDO's "warm" or "positive" phase is associated with climatic conditions similar to El Niño, while the "cold" or "negative" phase is more like La Niña in its effects. The PDO has been shown to modulate the strength of ENSO patterns and to affect western North American snowpack, flooding, fire frequency, forest growth, fisheries, and ocean resources. The PDO may modulate ENSO effects in northern Nevada as well. In negative PDO phases (cold Pacific waters), northern Nevada tends to experience greater frequency of droughts (McCabe et al., 2008). Positive PDO phases are geographically more complex, however: northeastern Nevada tends to be significantly drier during El Niños and significantly wetter during La Niñas, while northwestern Nevada behaves in the opposite manner, but only weakly so (Wise, 2010). The PDO fluctuation has had a strong, multidecadal periodic expression over the past 200 years, but it has been inconsistent over the past millennium (MacDonald and Case, 2005). It was absent 200–400 years ago and only sporadically expressed from A.D. 1300–1500. The PDO was strongly negative 700–1000 years ago during the Medieval Climatic Anomaly (MCA), and this negative state may have resulted in persistent La Niña–like conditions and widespread megadroughts that affected much of the Great Basin and beyond.

Likewise, the AMO has very strong effects on interior western North American drought frequencies. The AMO exhibits long-term variability of North Atlantic Ocean sea surface temperatures, fluctuating on a quasicyclic 50–70 year scale that has been shown to correlate strongly with drought frequencies and patterns in North America, in correlation with ENSO/PDO patterns (Hidalgo, 2004; McCabe et al., 2004, 2008). The AMO is thought to modulate global atmospheric circulation patterns, affecting precipitation in North America (Hu et al., 2011; Oglesby et al., 2012): a positive AMO (warm North Atlantic surface waters) is strongly correlated with increased drought frequency, while a negative AMO phase is associated with reduced drought frequency, greater precipitation, and persistent pluvials (McCabe et al., 2004, 2008; Cook et al., 2011). Along the project corridor, the same pattern applies, in combination with PDO: warmer north Atlantic and eastern Pacific oceans (positive AMO and PDO) have the strongest connection to persistent drought, while cooler north Atlantic and eastern Pacific oceans (negative AMO and PDO) are strongly connected with moister conditions (McCabe et al., 2004, 2008). The AMO is also thought to have played an important role in the persistence of megadroughts during the MCA (Cook et al., 2007; Feng et al., 2011; Oglesby et al., 2012). Combinations of AMO and PDO regimes can modify precipitation patterns, so that northwestern Nevada patterns are somewhat different from northeastern Nevada (e.g., McCabe et al., 2004: fig. 5; Wise, 2010: fig. 3). Adding further complexity, Wise (2010) found that during a negative AMO, our region tends to have moister winters under La Niña conditions, but slightly drier winters during El Niños; if the AMO is positive, these relationships are reversed but muted. These variable results, depending as they do on distinct oscillations of Atlantic and Pacific waters, are undoubtedly why our region is such a weakly correlated transition zone of the prominent ENSO precipitation dipole in western North America.

Vegetation

David Rhode

Having described the nonbiotic environmental features and conditions prevailing along the study corridor, it remains to review the biotic environment, specifically the plant communities and taxa characteristic of each of the four project regions. As might be expected, there are both similarities and differences between regions, all of which had important implications for prehistoric human occupation.

High Rock Country

As we have previously reviewed, the majority of the High Rock Country consists of dissected volcanic plateaus punctuated by several lowland basins, all generally above 5000 ft in elevation. Sagebrush steppe dominates the plateaus, which are mostly covered with big sagebrush, though low sagebrush occurs in thin soils particularly in the far northwest corner of the state. The sagebrush is mixed with cool-season "palouse" type grasses (wheatgrass, Idaho fescue, and Sandberg bluegrass) along with wild rye, squirreltail, and needlegrass. Typical shrubby associates include antelope bush, desert peach, and Mormon tea. Western juniper woodlands occasionally mix with sagebrush, especially on the westernmost edge of the corridor at Barrel Springs, where winter precipitation is greatest. Springs and seeps (often geothermal) occur frequently but patchily in the region, feeding short riparian corridors in canyons and moist meadows in valley bottoms. These volcanic plateaus and upland areas often contain volcanic lithosols, having well-developed and fertile surface organic layers conducive to development of grasslands and meadows. Certain root vegetables important in traditional subsistence, notably epos (yampah), often occur most abundantly on volcanic lithosols (e.g., Statham, 1982). Other root crops including camas, biscuitroot, bitterroot, and wild onion grow preferentially in thin rocky soils of dry slopes and benches, where their enlarged roots are adapted to survival in extended dry seasons (Meilleur et al., 1999; Gleason, 2002). The sagebrush steppe supports other traditional dietary plants such as balsamroot, ricegrass, and other grasses.

The pluvial basins of Long Valley and Massacre Lake are dominated by desert shrub communities composed of greasewood, shadscale, saltbush, hopsage, seepweed, and salt grass on sodic clay-rich bottomlands, and by sagebrush steppe dominated by bud sage and shadscale on coarser mineral aridosols in the valley's lower margins. These lakebed and marginal sagebrush communities often contain plants of traditional economic importance, notably seepweed; shadscale; various grasses including Indian ricegrass, bluegrass, alkali sacaton, and wild rye; and annual herbs such as blazing star.

In the highest reaches of the study corridor in this region, above 6000 ft, mountain big sagebrush dominates, mixed with a variety of grasses, perennial herbs, montane trees, and shrubs (notably curl-leaf mountain mahogany, snowberry, serviceberry, chokecherry, currants and gooseberries, and snowbrush). A limited number of conifers other than juniper (limber pine, whitebark pine, ponderosa pine, and white fir) are restricted to a few localities in the adjacent higher mountains but do not exist in the immediate study corridor. There are several very limited stands of aspen at higher elevations, which occur with willow thickets along stream courses and in protected "snow pockets"; chokecherry, gooseberry, elderberry, wild rose, and nettle are also present in these locations. Sedge meadows occur at all elevations in broad flats that are subject to a high water table from springs, seeps, or frequent flooding, and may harbor a diverse wetland community of sedges and bulrushes, grasses, perennial herbs, or shrubs common to riparian zones (Rogers and Tiehm, 1979).

Upper Lahontan Basin

East of the High Rock Country, the study corridor drops into the basin of Pleistocene Lake Lahontan in the northeastern arm of the Black Rock Desert, crossing its former lake bed and running along its lower slopes. Because much of the Upper Lahontan Basin is lower in elevation than the High Rock Country and farther from the source of Pacific frontal storms, it is measurably warmer and drier (see table 1). The lowlands have the longest growing season along the route, about 150–160 days. Lake Lahontan's bed is vegetated with an open mosaic of greasewood, seepweed, saltbush, and shadscale desert scrub, depending on the water table and the alkalinity, salinity, or clay content of its weakly developed young soils. Other shrubs common in these open communities include bud sage, hopsage, Nevada Mormon tea, and horsebrush; annual plants occur in abundance but episodically. Moist meadow areas are typically dominated by salt grass and sedges. At slightly higher elevations, above ~4600 ft, sagebrush steppe dominates, with big sagebrush, low sagebrush, and associated dryland grasses forming a patchwork according to soil conditions and aridity (Jensen, 1989). Among the most important plants in the traditional foraging economy are seepweed, Indian ricegrass, tansy mustard, and other small-seed producers; suppliers of green vegetables including prickly pear cactus, princes plume, and others; and dry-adapted root crops such as bitterroot and mariposa lily on rockier soils.

Isolated fault-block mountain ranges, such as the Jackson, Pine Forest, and Santa Rosa ranges, ring the vast Lahontan plain and provide an altitudinal contrast of as much as 5700 ft at the highest peaks. As previously noted, these cooler mountains harvest significantly higher amounts of precipitation than the lowlands, and they support denser sagebrush-grass and mountain brush communities, extensive aspen groves, and (in some localities) subalpine coniferous woodlands. Springs and seeps are rare in the valleys, but they occur frequently in uplands and at their margins.

Upper Humboldt Plains

Near the midpoint of Nevada, and for 105 miles to the east, the study corridor passes through the expansive Upper Humboldt Plains and the Humboldt River watershed. This region is higher in elevation than the Lahontan Basin, varying from 5000 to more than 7000 ft, and in nearby mountains rising to nearly 10,000 ft. As a consequence, annual precipitation is greater (10–15 inches) and the area is moderately colder (see table 1).

The bulk of this region is vegetated by dry sagebrush or sagebrush-grass steppe communities growing on various dryland soils. Deeper, more fertile soils support big sagebrush, while on thin rocky soils, open low sagebrush steppe with sparse associates is the rule (Hironaka et al., 1983; Jensen, 1989). In the sagebrush steppe, typical Great Basin grasses such as Indian ricegrass, needlegrass, and wild rye mix with more northerly cool-season grasses such as Idaho fescue and bluebunch wheatgrass (Jensen et al., 1988). The drier slopes and benches support bitterroot, epos, biscuit-root, wild onion, and other dryland root crops, as well as various small-seed producers like the grasses and mustards.

The study corridor crosses through higher terrain in two places: once in the Independence Mountains near Tuscarora, and again in the Snake Mountains north of Wells. These higher areas, classed as semiarid uplands, are vegetated in big sagebrush steppe mixed with montane brush plants such as mountain mahogany, currant, and other shrubs, as well as economically valuable perennial herbs like balsamroot. Juniper woodlands, composed of Utah juniper and Rocky Mountain juniper, prevail on upper-elevation slopes and flats; pinyon pine is lacking, however. Stands dominated by Rocky Mountain juniper occur along some of the rivers and slopes in the major mountains but are usually a minority component of Utah juniper-dominated woodlands. Sagebrush, Mormon tea, rabbitbrush, antelope bush, gooseberry, and snowberry are common associates.

Extensive aspen forests occur in the higher montane areas of the Santa Rosa, Independence, and Jarbidge mountains. Dense subalpine coniferous forests and meadows occur in the higher reaches of the Independence and Snake mountains, the Jarbidge Mountains farther north, and the Ruby and East Humboldt mountains to the south. These higher mountains feed several permanent tributaries that the study corridor crosses: Rock Creek, Maggie Creek, North Fork Humboldt, Marys River, and Tahoe Creek. Depending on the depth of the water table, among other factors, these streams and spring-fed meadows have a predictable mosaic of riparian plant associations, such as moist meadows and bogs, riparian willow thickets, grassy meadows, greasewood strips, and dense sagebrush belts (Castelli et al., 2000; Chambers et al., 2004). Chokecherry, elderberry, currant, rose, and buffalo berry are fruit trees or shrubs that occur commonly or occasionally along riparian corridors. Some riparian zones are prime habitat for several moisture-loving root crops including camas and tobacco root, and others for a host of wetland marsh resources such as bulrush and cattail.

Thousand Springs Valley

East of the Snake Mountains, the study corridor drops into the watershed of the

Bonneville Basin, with its typically dry stream beds running eastward into Utah. The corridor elevation falls below 6000 ft through most of this basin, generally declining west to east. With the exception of the Snake Mountains, the annual precipitation of the corridor is approximately 10–12 inches, of which fully a quarter may fall in summer thunderstorms (see fig. 11).

Thousand Springs Valley is predominantly sagebrush steppe mixed with cool-season grasses through most of the range, with scattered juniper woodlands in rocky areas at higher elevations. The sagebrush steppe is dominated by big sagebrush on deeper soils and by black sagebrush on thin rocky soils, with some smaller areas in which low sagebrush prevails. Greasewood and shadscale typify desert scrub communities on lower-elevation rocky slopes, along streams, and in the flats below. Mountain brush communities and aspen groves dominate above ~7000 ft in elevation, but the study corridor stays below this elevation. Juniper woodlands, typically containing pure stands of Utah juniper but also often containing Rocky Mountain juniper, are present on midslopes. It is in this region that pinyon pine grows nearest to the corridor, in the Windermere Hills, Pequop Range, Toana Range, and (reportedly) the Leach Range (Charlet, 1996). Springs are frequent in uplands but uncommon on the lower flats and slopes. Plants of traditional economic importance include yampah, bitterroot, mariposa lily, sunflower and balsamroot, various grasses, and other annual and perennial small-seed producers.

Summary

The previous discussion highlights certain ecological continuities in the four regions through which the study corridor passes. Most of the route goes through a sea of sagebrush-grass steppe, typically dominated by big sagebrush but also including low sagebrush on thin rocky substrates, mountain big sagebrush in higher uplands, and black sagebrush on the eastern end of the line. In northern Nevada, the sagebrush-grass steppe features northern cool-season grasses mixed with more typical Great Basin species, and this is especially notable on the northwestern and northeastern ends of the line. In all four regions, sagebrush steppe is replaced by greasewood-saltbush scrub vegetation in soils with high sodic and clay content, typically in the margins of old lake beds in valley bottoms. At higher elevations in all four regions, the sagebrush-grass steppe intergrades with montane brush communities dominated by curl-leaf mountain mahogany, aspen, gooseberry, elderberry, snowberry, and other shrubs. In three of the four regions, juniper woodlands make up a part of the corridor's traverse, with western juniper at the northwestern end and a mix of Utah juniper and Rocky Mountain juniper in the east. Riparian corridors in the various regions are also broadly similar in their vegetation composition, dominated by moist meadows or thickets of willow, chokecherry, wild rose, nettle, wild rye, occasionally birch or alder, and sometimes conifers or other trees more typically found at higher elevations. Subalpine vegetation occurs in the higher mountains of all regions, including coniferous forests, extensive aspen groves, and highland shrublands dominated by mountain sagebrush. In these respects, the vegetation of the four regions is typical of the northern Great Basin (Cronquist et al., 1972; Franklin and Dyrness, 1973).

The broad similarity of the regions being acknowledged, we can also identify some significant differences between them. As noted previously, the climate of the four regions varies depending on elevation and geography, resulting in differences in the abundance of water annually and seasonally. In particular, the High Rock Country and the Upper Humboldt Plains appear to be generally better watered than the Upper Lahontan Basin and the Thousand Springs Valley. A second difference relates to the abundance of certain grasses and other annual herbs and shrubs that produce the small seeds so important to traditional foraging economies. Many of these are plants primarily of lowland desert settings, and thus they appear to be most important in the Upper Lahontan Basin and the Thousand Springs Valley. Third, the abundance of different root crops, which were of major economic importance in the northern Great Basin (Kelly, 1932; Steward, 1938), appears to vary between the four regions. The High Rock Country is notable for the abundance of epos, biscuit-root, bitterroot, and a variety of other geophytes (Kelly, 1932; Couture et al., 1986; Trammell, 2008). The Upper Lahontan Basin may have fewer of these root crops, but bitterroot, mariposa lily, and wild onion may become more important. In the Upper Humboldt Plains, camas, epos, and tobacco root achieve local prominence in moist areas, and bitterroot and biscuit-root may be abundant in drier rocky benches and hillslopes. Bitterroot, mariposa lily, biscuit-root, and wild onion may also be important on the rocky slopes of the Thousand Springs Valley. Finally, pinyon pine grows in the juniper woodlands of nearby mountains only in the eastern part of the study corridor.

Economic Plants and Animals

David Rhode

A wide range of native plant and animal foods made up the traditional subsistence roster in northern Nevada. Root vegetables of various types achieved particular prominence in this region, especially in the western portion of the study area, compared with the rest of the Great Basin. Their dietary significance here was akin to that farther north on the Columbia Plateau. Small seeds may have ranked secondary in dietary importance, unlike other parts of the Great Basin. Among animal foods, small game likely was the largest reliable source of protein. Notably absent over most of the corridor was the pinyon pine, a typical Great Basin staple food south of the Humboldt River.

Vegetable Foods

The following discussion identifies four major classes of vegetable foods: geophytes, small seeds, fruits and greens, and pinyon nuts. As geophytes, and particularly epos, were potentially the most important plant staple in this region, we return to this topic again in chapter 13.

Geophytes: A variety of plants having edible taproots, tubers, bulbs, corms, or rhizomes were vitally important food resources in the northern Great Basin (table 2). The underground storage organs of these so-called *geophytes* (Raunkiaer, 1934; Muller-Dombois and Ellenberg, 1974) are a rich source of stored energy and, therefore, avidly sought after for food by people worldwide. Among the most important dietary staples in the northern Great Basin were epos, biscuit-root, bitterroot, sego lily, wild onion, and balsamroot.

TABLE 2
Important Northern Nevada Plants with Underground or Underwater Storage Organs

Common Name	Scientific Name	Habitat	Reference
Cous biscuit-root	*Lomatium cous*	Dry valleys and hillsides	Couture (1978)
Canby's biscuit-root	*Lomatium canbyi*	NW Nevada, dry rocky places	Couture (1978); Kelly (1932)
Bigseed lomatium	*Lomatium macrocarpum*	Plains and dry hillsides	Kelly (1932); Fowler (1989); Whiting (1950)
Nevada biscuit-root	*Lomatium nevadense*	Dry plains and hillsides	Fowler (1989)
Epos (yampah)	*Perideridia gairdneri* *P. bolanderi*	Volcanic lithosols, dry gravelly hillsides, flats	Couture (1978); Fowler (1989, 1992); Kelly (1932); Trammell et al. (2008)
Bitterroot	*Lewisia rediviva*	Dry rocky flats and slopes	Couture (1978); Fowler (1989, 1992); Kelly (1932)
Sego lily	*Calochortus macrocarpus, C. bruneaunis*	Dry hills and flats	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Steward (1938); Stewart (1941)
Cusick's sunflower	*Helianthus cusickii*	Dry montane slopes	Fowler (1989)
Tobacco root	*Valeriana edulis*	Moist places and meadows	Kelly (1932); Steward (1938)
Yellow Bell, Rice root	*Fritillaria pudica*	Dry sagebrush flats to forests	Chamberlin (1911); Couture (1978); Steward (1938)
Indian paintbrush	*Castilleja confusa*	Dry canyons, slopes	Stewart (1941)
Thistle	*Cirsium acaulescens* spp.	Various	Kelly (1932); Steward (1938)
Spring beauty	*Claytonia lanceolata, C. umbellata*	Infrequent, moist meadows	Chamberlin (1911); Fowler (1989, 1992); Steward (1938)
Spring parsley	*Cymopterus purpurascens, C. corrugatus*	Plains and dry hillslopes	Fowler (1992)
Lassen parsley	*Lomatium ravenii*	Sodic flats and slopes	Fowler (1992)
Desert parsley	*Lomatium leptocarpum*	Moist flats and meadows	Kelly (1932)
Camas	*Camassia quamash*	Moist meadows, streambanks	Chamberlin (1911); Couture (1978); Kelly (1932); Steward (1938)
Balsamroot	*Balsamorhiza sagittata*	Gravelly hillslopes	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932)
Wild onion	*Allium* spp.	Various	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Steward (1938)
Cattail	*Typha latifolia*	Streams, ponds	Couture (1978); Fowler (1992); Kelly (1932); Steward (1938); Stewart (1941)
Bulrush	*Schoenoplectus* spp.	Streams, ponds	Fowler (1992); Steward (1938); Stewart (1941)

Epos is a highly valued root crop with two main species in our region. *Perideridia gairdneri* is the dominant species at Barrel Springs in the westernmost portion of the study corridor, and it thrives in the volcanic lithosols typical in this area (Trammell et al., 2008). *Perideridia bolanderi* is common to dry meadows and hillsides throughout northern and central Nevada, often associated with sagebrush and juniper (Couture et al., 1986). Epos was typically collected in early summer when soil conditions were most favorable to digging and the fragile stem was more easily traced down to the tuberous root cluster (Couture et al., 1986: 157; Trammell et al., 2008). Experiments suggest that burning and tillage significantly enhance plant densities; native procurement practices would have been important in maintaining viable populations (Trammell et al., 2008).

"The roots were rubbed on an open twine tray to divest them of their skins and were … eaten immediately, raw or boiled, or else dried in the sun and stored" (Kelly, 1932: 101). Willard Park reported the Paviotso ate epos tubers raw or roasted them buried in sand beneath a fire (Fowler, 1989). Chamberlin (1911) reported that epos was highly favored by the Gosiute in northern Utah, "commonly prepared by roasting in a pit lined with hot stones" and preserved in bulk for the winter. Kelly (1932: 100) also found pit-roasting a standard method of food preparation for epos. Pit-roasting is usually conducted if roots or other plant tissues (including camas, balsamroot, valerian root, and certain wild onions) have high amounts of the complex polysaccharides fructan and inulin, to break them down into simpler sugars more easily digestible by humans (Thoms, 1989; Wandsnider, 1997). Epos does not contain significant amounts of inulin, so the need for pit-roasting is uncertain.

Epos is rich in carbohydrates and has a moderate amount of protein as well. Couture et al. (1986) reported low return rates for collecting epos (172 kcal/hr; see also Todt and Hannon, 1998), but recent experiments conducted by Trammell et al. (2008) suggest much higher return rates (2000–2600 kcal/hr); the extreme differences might relate to the relative abundance of epos in the different collection areas.

The biscuit-root genus was very important in the traditional diet of peoples in the northern Great Basin and the Columbia Plateau (Hunn and French, 1981; Couture et al., 1986). Economically significant species include cous, Canby's biscuit-root, Nevada biscuit-root, and bigseed lomatium. Cous grows on dry, open flats and slopes often associated with sagebrush, from the Sheldon Antelope Range eastward across northern Nevada through the Independence and Jarbidge mountains and on to the vicinity of Jackpot (Holmgren, 1942; Rogers and Tiehm, 1979; Kartesz, 1987). Canby's biscuit-root, or *chucklusa*, is found in northwestern Nevada on open rocky hills and plains, below about 6000 ft in elevation (Kelly, 1932: 103; Couture, 1978: 43–45; Cronquist et al., 1997). Bigseed lomatium and Nevada biscuit-root are common throughout northern Nevada, associated with sagebrush on dry hills and plains. In early spring, when the flower was blooming, women gathered these tubers with a simple, straight digging stick, then peeled and prepared them in various ways for immediate consumption or for long-term storage (Kelly, 1932; Whitning, 1950; Couture, 1978). Biscuit-root is high in carbohydrates but low in protein content. Couture et al. (1986) provide collection rates using traditional methods ranging from 143 to 1219 kcal/hr, while Francis (2000) estimates a much loftier return rate of 2598 kcal/hr for biscuit-root. Some lomatium species also served as greens, especially desert celery, a rich source of dietary ascorbic acid (Benson et al., 1973; Norton et al., 1984; Meilleur et al., 1999). Others, such as fernleaf biscuitroot and king desert parsley, were important medicines or fish poisons (Chamberlin, 1911; Fowler, 1989; Meilleur et al., 1999).

The bitterroot species grows commonly along much of the corridor, particularly in sagebrush-grass steppe communities. The plant is found on thin, dry, rocky soils on well-drained gravel benches, hillsides, and ridges, generally below ~6500 ft in elevation. An early successional plant, it colonizes disturbed or burned-off areas and may benefit from late summer fires (Blaisdell, 1953). The thick branching taproot is pulled and boiled, after which the bitter skin can be easily removed; in spring when the root is young and in the bud stage, the skin slips off easily without boiling (Couture, 1978: 52). The peeled roots are sun dried for later boiling, roasting, or processing into flour. Nutritionally, bitterroot is rich in vitamin C and moderately rich in carbohydrates. Couture et al. (1986) estimate collection return rates of 1374 kcal/hr, among the highest they measured (Simms [1984] reports similarly high values). Dried bitterroot or bitterroot flour were important exchange items.

The sego lily is a showy flower common to dry sandy or rocky sagebrush plains and hills, where it occurs in sparse patches. The starchy bulb was collected in the spring and was commonly eaten fresh (Couture, 1978). Chamberlin (1911) noted that in Utah large quantities were sometimes dried and stored for winter use, but Kelly (1932: 102) reported that in Surprise Valley, "they were never plentiful enough to be dried." Smith et al. (2001) suggest that in Wyoming, sego lily bulbs were collected and pit-roasted to convert their starches to simpler carbohydrates more suitable for human digestion. They note that return rates of the bulbs was quite low (~207 kcal/hr in pursuit and processing time), but suggest that such a common and drought-resistant food plant might be a predictable, stable resource in a highly variable environment, particularly in spring when other foods were in short supply.

Camas bulbs served as a staple food in much of the Columbia Plateau and northern Intermountain region: the bulbs were subject to intense utilization, processing, storage, and exchange (Statham, 1982; Reeve, 1986; Thoms, 1989). Though less common in our region, they were also highly regarded (Chamberlin, 1911; Kelly, 1932; Steward, 1938; Couture, 1978: 63). After summertime collection, the nutritious bulbs were cooked at length in large earth ovens, which created a sweet food by converting the complex carbohydrate inulin into digestible fructose. The cooked camas was then eaten immediately, and large quantities were also dried and stored for later consumption or exchange with other groups. Return rates for collection of camas have been calculated as very high (5479 kcal/hr), with net return rates of 2042 kcal/hr (including collection, processing, transport, and storage; Thoms, 1989: 235–236). Camas is locally common only in fertile, moist meadows and along creeks in various places from the northwestern edge of Nevada east across the northernmost border to near Owyhee (Kartesz, 1987: 1698). For this reason, procurement and processing of camas in the vicinity of the study corridor must have been limited, but people traveling into the region likely brought processed camas with them from centers of camas collection in southeastern Oregon and south-central Idaho (Couture, 1978; Statham, 1982).

TABLE 3
Important Northern Nevada Herb and Shrub Seed Crop Plants

Common Name	Scientific Name	Habitat	Reference
Goosefoot Family (Amaranthaceae)			
Amaranth	*Amaranthus* spp.	Disturbed places	Chamberlin (1911)
Goosefoot	*Chenopodium album, C. atrovirens, C.* spp.	Various	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Steward (1938); Stewart (1941); Whiting (1950)
Iodinebush (pickleweed)	*Allenrolfea occidentalis*	Playa margins	Chamberlin (1911); Fowler (1992); Stewart (1941)
Povertyweed	*Monolepis nuttallii*	Alkali meadows, disturbed places	Chamberlin (1911)
Saltbush, Orach	*Atriplex argentea, A.* spp.	Dry flats and slopes	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Steward (1938); Stewart (1941); Whiting (1950)
Samphire	*Salicornia rubra*	Playa margins	Chamberlin (1911)
Seepweed	*Suaeda depressa var erecta*	Playa margins	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Stewart (1941); Whiting (1950)
Shadscale	*Atriplex confertifolia*	Dry flats and slopes	Chamberlin (1911); Fowler (1992); Steward (1938)
Sunflower Family (Asteraceae)			
Balsamroot	*Balsamorhiza hookeri, B. sagittata*	Dry flats and slopes	Chamberlin (1911); Couture (1978); Fowler (1992); Whiting (1950)
Big sagebrush	*Artemisia tridentata*	Extensive slopes and plains	Fowler (1992); Steward (1938)
Goldenrod	*Solidago spectabilis*	Moist slopes, streambanks	Chamberlin (1911)
Mule ears	*Wyethia mollis, W. amplexicaulis*	Dry flats and slopes	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Stewart (1941)
Sunflower	*Helianthus annuus, H. bolanderi*	Dry flats and slopes	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Steward (1938); Stewart (1941)
Wormwood	*Artemisia biennis, A. discolor, A. trifida, A. dracunculoides*	Moist meadows, streambanks, flats, and slopes	Chamberlin (1911)
Mustard Family (Brassicaceae)			
Tansy mustard	*Descurainia pinnata, D. sophia, D.* spp.	Dry flats and slopes	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Steward (1938); Whiting (1950)
Pepperweed	*Lepidium* spp.	Dry flats and slopes	Steward (1938)
Sedge Family (Cyperaceae), Cattail Family (Typhaceae), Arrowgrass Family (Juncaginaceae)			
Hardstem bulrush	*Schoenoplectus pungens*	Wetlands	Fowler (1989, 1992); Stewart (1941)
Alkali bulrush	*Schoenoplectus maritimus*	Wetlands	Fowler (1992)
Cattail	*Typha latifolia*	Wetlands	Chamberlin (1911); Fowler (1989, 1992); Steward (1938)

Common Name	Scientific Name	Habitat	Reference
Mint Family (Lamiaceae)			
Dragon head	*Dracocephalum parviflorum*	Open moist slopes and flats	Chamberlin (1911)
Hedgenettle	*Stachys pilosa*	Moist meadows, streambanks	Chamberlin (1911)
Skullcap	*Scutellaria* spp.	Various, dry to moist slopes	Chamberlin (1911)
Other Plant Families			
Dock	*Rumex maritimus*	Wetlands	Fowler (1992); Stewart (1941)
Evening primrose	*Oenothera biennis*	Various, disturbed places	Chamberlin (1911)
Stickseed	*Lappula redowskii*	Dry flats and slopes	Steward (1938)
Stoneseed	*Lithospermum ruderale*	Dry gravelly slopes	Chamberlin (1911)
Blazing star	*Mentzelia albicaulis, M.* spp.	Dry flats and slopes	Couture (1978); Fowler (1989, 1992); Kelly (1932); Stewart (1941)
Tobaccoroot	*Valeriana edulis*	Moist open meadows, streambanks	Chamberlin (1911)
Juniper	*Juniperus* spp.	Upland slopes and flats	Chamberlin (1911); Couture (1978)

Wild onions were eaten in quantity, both the bulbs and the greens. Different species are available in a wide range of habitats, often abundant under greasewood and on sandy sagebrush-covered flats and slopes. According to Kelly (1932), people collected wild onions without needing a digging stick, and they ate them fresh or roasted, but not dried (see also Fowler, 1989). Smith and McNees (2005) report low return rates (230 kcal/hr) for the collection of *Allium textile* bulbs.

Balsamroot is common in dry rocky habitats in foothills, plains, and montane settings. Its large, thick, woody taproot was harvested in the summer and eaten fresh or dried. Pit-cooking of balsamroot increases its available energy by about 250% by reducing inulin into simpler sugars (Peacock, 1998). The plants were also highly important for their young leaves and stems as springtime greens, their edible sunflower-like seeds in summer, and their medicinal properties (Chamberlin, 1911).

Tobaccoroot, adapted to moist habitats, was an important local food, especially along the upper Humboldt River (Steward, 1938). Like camas, it contains abundant inulin that requires long pit-roasting to convert to digestible sugars. Though it tastes sweet after it is cooked, unlike camas, tobaccoroot gives off a pungent smell while it roasts: Kelly (1932) called it "Indian Limburger" and Catherine Fowler (Madsen and Kirkman, 1988) likened it to "dirty gym socks." Tobaccoroot was common along the Humboldt River and its tributaries, and in moist patches across northern Nevada.

Bulrush and cattail are aquatic geophytes. Both bear starchy rhizomes that, along with the attached lower stems, were gathered from the margins of streams and marshes in the spring, summer, and fall. These were peeled and eaten raw, boiled, or roasted; cattail roots could be dried and ground into flour for mush, though bulrush roots were eaten fresh and not stored (Fowler, 1989: 49, 1992).

TABLE 4
Important Northern Nevada Grass Seed Crop Plants

Common Name	Scientific Name	Habitat	Reference
Mexican lovegrass	*Eragrostis mexicanus*	Open disturbed areas	Fowler (1992)
Spike trisetum	*Trisetum spicatum*	Meadows, streambanks	Chamberlin (1911)
Meadow barley	*Hordeum brachyantherum*	Moist meadows, streambanks	Kelly (1932)
Bluegrass	*Poa* spp.	Various widespread uplands	Chamberlin (1911); Fowler (1989, 1992); Kelly (1932)
Squirreltail	*Elymus elymoides*	Dry flats and slopes	Chamberlin (1911); Fowler (1992); Kelly (1932); Steward (1938)
Bluejoint	*Calamagrostis canadensis*	Moist meadows, open woodlands	Chamberlin (1911); Fowler (1992); Steward (1938)
Witchgrass	*Panicum capillare*	Open dry habitats	Fowler (1992)
Manna grass	*Glyceria borealis*, *G.* spp.	wetlands	Chamberlin (1911); Kelly (1932)
Weeping alkaligrass	*Puccinellia distans*, *P.* spp.	Sodic wetlands	Chamberlin (1911)
Great Basin wild rye	*Leymus cinereus*, *L. condensatus*, *L.* spp.	Various, widespread	Chamberlin (1911); Fowler (1992); Kelly (1932); Steward (1938)
Indian ricegrass	*Achnatherum hymenoides*	Dry sandy flats and slopes	Chamberlin (1911); Fowler (1989, 1992); Steward (1938); Stewart (1941)
Mountain brome	*Bromus marginatus*	Mesic montane slopes	Chamberlin (1911)
Tufted hairgrass	*Deschampsia cespitosa*	Mesic meadows and floodplains	Chamberlin (1911)
Sixweeks fescue	*Vulpia octoflora*	Various, sagebrush and juniper woods	Chamberlin (1911)
Fescue	*Festuca* spp.	Montane slopes	Chamberlin (1911)
Needlegrass	*Hesperostipa comata*	Dry flats and slopes	Steward (1938)

These underwater roots and shoots may have been a highly significant food resource in wetland settings along the study corridor (Wheat, 1967; Madsen et al., 1997).

Small seeds: Historically, Great Basin native peoples utilized a wide array of seeds for food (tables 3 and 4). Among the most important were seeds of the grass, goosefoot, sunflower, and mustard families (Chamberlin, 1911; Kelly, 1932; Steward, 1938; Fowler, 1992). Seeds were typically gathered by means of seed-beating or hand-stripping, and then they were winnowed, parched, and ground for use in gruels and cakes (Fowler and Rhode, 2011). The season of collection varies by species, with important crops such as Indian ricegrass ready for collection early to mid summer, many available through summer and fall, and a few species such as seepweed and iodine-bush persisting into late fall and winter. The habitats from which seed crops were collected include marshes, playa margins, saltbush scrub, sagebrush-grass steppe, upland slopes, and open woodlands. In many instances the grain-producing plants are supremely adapted to the colonization of disturbed habitats, so manipulation techniques such as burning of rangelands enhanced their growth and spread. Small seeds were

TABLE 5
Important Northern Nevada Edible Fruit Plants

Common Name	Scientific Name	Habitat	Reference
Chokecherry	*Prunus virginiana*	Mesic uplands, riparian corridors	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Steward (1938); Whiting (1950)
Black haw	*Crataegus douglasii*	Streamside, forest, sagebrush steppe	Kelly (1932)
Serviceberry	*Amelanchier alnifolia*	Dry to mesic uplands	Chamberlin (1911); Fowler (1992); Kelly (1932)
Currant	*Ribes aureum, R. cereum*	Dry slopes, mesic uplands	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Kelly (1932); Steward (1938)
Buffalo berry	*Shepherdia argentea*	Riparian corridors	Chamberlin (1911); Fowler (1989, 1992); Kelly (1932); Steward (1938)
Elderberry	*Sambucus racemosa*	Mesic uplands, riparian corridors	Chamberlin (1911); Fowler (1989, 1992); Kelly (1932); Steward (1938)
Juniper	*Juniperus* spp.	Dry midelevation slopes and flats	Chamberlin (1911); Fowler (1989, 1992); Kelly (1932)
Wild rose	*Rosa woodsii*	Mesic uplands, riparian corridors	Chamberlin (1911); Couture (1978); Fowler (1992); Kelly (1932); Steward (1938)
Prickly-pear cactus	*Opuntia polyacantha*	Dry flats and slopes	Fowler (1992); Steward (1938)
Skunkbush sumac	*Rhus trilobata*	Dry to mesic uplands	Chamberlin (1911); Steward (1938)
Smooth sumac	*Rhus glabra*	Dry to mesic uplands	Chamberlin (1911)

an important staple component of traditional Great Basin subsistence economies, but they are fairly time-consuming to collect and process compared with their caloric return (generally less than 1000 kcal/hr); they are therefore usually considered to be a low-ranked category of resources (e.g., Simms, 1987).

However, small seeds would have been the main category of plant food resources in the Upper Lahontan Basin, where root crops are likely to have been fairly scarce. They may also have been the majority crop in the Thousand Springs Valley, enhanced by spring and summer precipitation. Seed plants would have shared importance with root crops in some of the higher-elevation regions, particularly the High Rock Country and the Upper Humboldt Plains.

Fruits and greens: About a dozen trees, shrubs, and vines yielded edible fruits (table 5). Most grow on upland slopes, along stream courses, or in woodlands, and are gathered in summer and fall. Chamberlin (1911) reported that serviceberries were a very important source of food for the Gosiute of western Utah, serving as stored food for much of the winter. Chokecherries, buffalo berries,

TABLE 6
Important Northern Nevada Food Plants Used for Greens (Stems, Leaves, Pads)

Common Name	Scientific Name	Part	Reference
Cattail	*Typha latifolia*	Shoots, pollen	Couture (1978); Fowler (1989, 1992); Steward (1938); Stewart (1941)
Prickly-pear cactus	*Opuntia polyacantha*	Pads	Fowler (1989); Steward (1938)
Orange agoseris	*Agoseris aurantiaca*	Leaves	Chamberlin (1911)
Hawksbeard	*Crepis glauca, C. occidentalis*	Leaves	Chamberlin (1911); Kelly (1932)
Thistle	*Cirsium eatoni, C. canadensis, C.* spp.	Peeled stems	Chamberlin (1911); Fowler (1992); Kelly (1932); Steward (1938)
Bulrush	*Schoenoplectus acutus, S.* spp.	Shoots, basal stems	Chamberlin (1911); Couture (1978); Fowler (1989, 1992); Steward (1938)
Princes plume	*Stanleya pinnata*	Leaves, boiled	Fowler (1992)
Carveseed	*Glyptopleura marginata*	Leaves	Fowler (1989, 1992); Stewart (1941)
Wild onion	*Allium* spp.	Leaves	Chamberlin (1911); Couture (1978); Fowler (1992); Steward (1938)
Broomrape	*Orobanche fasciculata*	Stems	Chamberlin (1911); Fowler (1989, 1992)
Bigseed biscuitroot	*Lomatium macrocarpum*	Leaves	Chamberlin (1911)
Miners lettuce	*Montia perfoliata*	Leaves	Chamberlin (1911); Fowler (1989)
Spring-parsley	*Cymopterus longipes*	Leaves, boiled	Chamberlin (1911)
White water crowfoot	*Ranunculus aquatilis*	Whole plant, boiled	Chamberlin (1911)

gooseberries or currants, and sometimes elderberries also figured importantly as dried stores for winter use.

Table 6 lists major plants used as fresh green vegetables, particularly important during the early spring as winter stores became depleted. Cactus pads were collected even during the winter as an augmentation to stored foods. Greens do not yield substantial caloric return, but they are crucial as sources of necessary vitamins, minerals, and dietary fiber (Fowler and Rhode, 2011: 255–259).

Pinyon nuts: The pinyon pine, the nuts of which are a traditional dietary staple in much of the Great Basin, rarely occurs along the eastern end of the corridor and is absent to the north. Decent stands occur in the Leach Mountains and Windermere Hills, and in well-developed groves in the Ruby Mountains, East Humboldt Mountains, Toano Range, and Pilot Range. Families living along the Humboldt River or its tributaries traveled south to collect pinyon nuts during the fall (Steward, 1938).

Nuts from other pines likely also served as a food resource, notably limber pine and whitebark pine. Today these subalpine conifers grow only on the tops of the highest mountains in the region: the Pine Forest Range, Santa Rosa Range, Independence Mountains, Jarbidge Mountains, Snake Mountains, and Pilot Range. During the early Holocene, their range was probably greater. Limber pine produces a highly nutritious small seed, with greater amounts of protein and fat than the carbohydrate-rich pinyon pine nut, but it is more time-consuming to collect and process. Depending on how much processing is involved (in particular, whether to shell the nutmeats), the return rates of limber pine can vary considerably, from a high-ranked resource (no shelling) to a very low-ranked one (if shelling is preferred). Limber pine nuts have been found in archaeological contexts at Danger Cave, Utah (Rhode and Madsen, 1998) and in the late prehistoric high-elevation villages in central Nevada and east-central California. Steward (1938) noted that the Lemhi Shoshone in central Idaho collected seeds of the "white pine," presumably limber and/or whitebark pine.

Animal foods

Animal foods also played a crucial subsistence role for the ethnographic and prehistoric peoples of the Northern Tier. The following discussion reviews the most important of these taxa, including small and large mammals, birds, fish, and insects.

Mammals: Of the wide variety of animals figuring into the traditional resource base of northern Nevada native peoples, the smaller game mammals proved the most important economically. Small game includes several species of lagomorphs and a host of rodents. The lagomorphs—rabbits and hares—were of major significance to native lifeways, as they provided a main source of meat, as well as skins for blankets and clothing. Jackrabbits occupy open low sagebrush or saltbush-covered valleys and foothills common throughout northern Nevada. Large numbers could be hunted through communal drives held in fall and early winter, yielding substantial meat and skins. Cottontail rabbits live more commonly in higher sagebrush steppe, brushy slopes, and along riparian corridors. Hunters took cottontails individually using snares and nooses, the bow and arrow, or the throwing stick, rather than via communal drives. Nevertheless, the abundance of cottontail remains often greatly exceeds the numbers of jackrabbit bones in northern Nevada archaeological sites, attesting to their overall economic significance (e.g., Grayson, 1988, 1990; Carpenter, 2004).

Other small to medium-sized game animals, including beavers, porcupines, marmots, ground squirrels, woodrats, gophers, voles, mice, and other rodents, were widely taken with deadfall traps, snares, and other means. Of these, marmots, ground squirrels, and gophers are most widely reported as having been hunted (Kelly, 1932; Steward, 1938; Stewart, 1939; Fowler, 1989, 1992). Many of these genera are widespread across northern Nevada, though certain species have narrower habitat ranges. Beavers were restricted to the Humboldt River, its tributaries, and the uplands of northeastern Nevada.

Large game in northern Nevada includes pronghorn, bighorn sheep, and mule deer; bison and elk occasionally inhabit the region in small numbers. The three main artiodactyls generally occupy different habitats. Pronghorn are found primarily in the valleys and foothills between mountain ranges, preferring open low sagebrush shrublands where they can easily see and flee from predators. In prehistoric times, pronghorn herds likely thrived in northern Nevada along the entire study corridor, and their remains are present, though often in small numbers, in archaeological contexts across northern Nevada. Large prehistoric constructions used as pronghorn drive fences have been reported from within and near the study corridor (see chap. 16; see also Hockett, 2005; Jensen, 2007; Hockett and Murphy, 2009; Hockett et al., 2013).

In contrast to pronghorn, bighorn sheep favor grassland or grassy steppe habitat in rough rocky and steep uplands, such as cliffs, canyons, and open flats with nearby steep terrain affording escape from predators. Populations migrate between a lower-elevation winter range and an alpine or montane summer range, as they follow new vegetative growth into higher elevations through spring and summer and return to lower elevations as snow accumulates in the mountains. In the 19th century, bighorn populations occupied nearly all upland terrain in northern Nevada, but they rapidly succumbed to historic-era ranching, diseases of exotic livestock, and overhunting. Remains of bighorn sheep dominate faunal assemblages in many archaeological sites in the northern Great Basin. Hunting-related blinds and walls are commonplace in talus slopes and along cliffs throughout northern Nevada, undoubtedly related to bighorn procurement.

Mule deer occupy a wide range of habitats but tend to prefer montane brushy slopes, flats, and riparian corridors. Like bighorn, mule deer typically move seasonally between habitats at different elevations, from forest edges at higher elevations in summer to valley floors in winter, following the snow line. Mule deer favor secondary successional habitats, taking advantage of plants that colonize disturbed areas; their diet varies depending on habitat, with shrubs such as sagebrush, antelope bush, serviceberry, snowbrush, and snowberry as staples. Prior to the 20th century, mule deer were generally uncommon in Nevada and their representation in archaeological sites is fairly low. Populations boomed in Nevada beginning in the early 20th century as domestic livestock "led to the removal of grasses and to the spread of plant species favored by deer" (Grayson, 2011: 342).

Compared with these three artiodactyls, bison and elk were much rarer in Nevada. Bison remains found throughout northern Nevada indicate that they occupied several areas in limited numbers during the later Holocene (Grayson, 2006). Bison remains are especially common in eastern Great Basin sites dating between 1600 and 600 B.P., when enhanced summer monsoons promoted native grass growth (and Fremont maize agriculture, as well). Bison remains declined in abundance in the eastern Basin after 600 B.P., but they became more common in southeastern Oregon, possibly as a result of increased moisture and cooling associated with the Little Ice Age (Grayson, 2011).

Elk, or wapiti, commonly reside in the mountains on the Idaho border, but in the past they occasionally inhabited northern Nevada, according to historical and archaeological observations (Grayson, 2011). Elk remains are found in half a dozen archaeological sites in northern Nevada, including Hanging Rock Shelter, Last Supper Cave, and South Fork Shelter, leading Grayson to suggest that "small numbers of wapiti may have been widely scattered throughout northern Nevada and adjacent portions of Oregon during much of the Holocene" (1988: 114).

BIRDS: Birds that played a part in traditional subsistence include water-loving taxa such as grebes, ducks, and geese, and dryland taxa including sage grouse, blue grouse, quail, northern flicker, and others. Other birds, including raptors, owls, and passerines, were also hunted for their meat, feathers, or body parts. Eggs and chicks of many birds were also collected for food. Fowler (1992) lists 40 taxa of waterbirds and 11 lowland or upland birds used by the Cattail-Eater Northern Paiute of Stillwater Marsh.

Fish: Fish were available in numerous streams, wetlands, and lakes scattered through northern Nevada; in some places they contributed significantly to overall subsistence (Steward, 1938: 41; Greenspan, 1985), and in others they were only "of slight importance" (Kelly, 1932: 95). The extensive fishery at Pyramid Lake focused on the endemic cui-ui sucker, lake chub, Lahontan cutthroat trout, and other smaller fry (Fowler, 1989). Cutthroat trout could also be taken at Summit Lake and in the Quinn River system. The Humboldt River and its tributaries boasted a variety of suckers, lake chub, cutthroat trout, whitefish, minnows, redsides, dace, sculpin, and others. These were captured using a variety of methods including harpoons and elaborate dams and weirs (Steward, 1938: 41). Anadromous salmonids (including bull trout, Columbia River redband trout, and Chinook salmon) and other fish of the Columbia River system occurred in headwaters of the Snake River in northeastern Nevada, including the Owyhee and Bruneau rivers (Hubbs and Miller, 1948). Remains of fish often occur in significant quantities archaeologically (e.g., Follett, 1963). At Pie Creek Shelter, for example, a large fish assemblage included at least two different suckers, minnow, cutthroat trout, Lahontan redside, whitefish, and sculpin (Butler, 2004).

Insects: A few types of insects sometimes served as food, including ant eggs, larvae, and certain caterpillars, but the most important were Mormon crickets. These crickets periodically occur in appalling abundance in northern Nevada, principally in sagebrush communities. Mormon cricket meal is a very rich and nourishing source of protein (crude weight 58%) and fat (16.5%); a kilogram of dried Mormon crickets yields 2800 kcal (DeFoliart et al., 1982). Madsen and Kirkman (1988) report on similar collection of grasshoppers that yielded astonishing caloric return rates. In swarm years, Mormon crickets would have been a major food bonanza.

Paleoenvironments of the Northern Tier

David Rhode

In its heyday, Pleistocene Lake Lahontan covered much of northwestern Nevada below ~4380 ft in elevation, including that portion of the study corridor that runs through the Black Rock Desert, Desert Valley, Kings River Valley, Quinn River Valley, Silver State Valley, and Paradise Valley. This vast lake grew via a combination of cold ambient temperatures impeding evaporation and high stream flows from the Humboldt River and streams feeding off the Sierra Nevada. These flows were produced by heavy winter storms directed toward the Lahontan watershed by a polar jet stream deflected south of its modern position (Antevs, 1948; Benson et al., 1990, 2012; Thompson et al., 1993). Lake Lahontan last stood at its highest level at approximately 15,500 cal B.P. (Benson et al., 1995; Adams and Wesnousky, 1998; Benson et al., 2012). Soon after, the lake declined rapidly, receding ~300 ft in depth by 13,900 cal B.P. (Thompson et al., 1986; Adams et al., 2008). The valleys of the Upper Lahontan Basin through which the study corridor passes have remained above the lake's waters ever since.

It is in this postpluvial setting of declining lake levels that our cultural chronology begins. Humans are likely to have lived in

TABLE 7
Proposed Chronological Sequence and Climatic Summary for the Project Area

ENVIRONMENTAL PERIOD		Years cal B.P.	CULTURAL PERIOD	COMMON PROJECTILE POINTS	
LATE HOLOCENE	Overall cooler with episodic droughts	150	Terminal Prehistoric	Desert Side-notched, Cottonwood,	
	Little Ice Age	600			
	Medieval Climatic Anomaly – severe droughts	700 1100	Late Archaic	Small Stemmed Rosegate	
	Enhanced summer precipitation in eastern Nevada	1300			
	Late Holocene dry period	1700	Middle Archaic	Elko, Gatecliff, Humboldt	
	Cool and mesic; expansion of woodlands and forests	2600 3800			
	Modern vegetation distributions largely in place Significantly cooler and moister	4400 4500	Early Archaic	Gatecliff, Humboldt	
MIDDLE HOLOCENE	Pinyon pine expansion in northern Great Basin	5400			
	Drought conditions ameliorated – cycles of severe drought interspersed with wet periods	5700 6300	Post-Mazama	Northern Side-notched, Humboldt, Large Corner-notched	
	Pinyon pine expansion in eastern Nevada complete **Mt. Mazama eruption**	7500			
	Extended dry period until 6300 BP – driest period in Holocene; lake basins dry; extensive dunes form	7800 8500	Paleoarchaic	Great Basin Stemmed	
EARLY HOLOCENE	Transition to MH is gradual; shift from sagebrush-steppe to desert scrub Pinyon migration northward initiated Transition to warmer and drier; greater seasonality	11,700			
YOUNGER DRYAS	Cooler and wetter than Bolling-Allerod; lakes recharged	12,800			
PLEISTOCENE/HOLOCENE TRANSITION	Sagebrush and grass steppe dominant	13,400	Paleoindian	Clovis and Great Basin Concave Base, with some Great Basin Stemmed	
	Bolling-Allerod Interstadial – rapid warming, lake levels decline	13,800 14,500 14,700		Pre-Clovis (no diagnostic artifacts)	

the northwestern Great Basin since at least ~14,400 cal B.P. (Jenkins et al., 2012, 2014), while Lake Lahontan underwent its rapid drawdown. The cultural sequence that ensued after this initial occupation (elaborated upon in chap. 3) provides the framework for our discussion of environmental change through the terminal Pleistocene and Holocene. Of course, cultural phases do not always line up with distinct intervals of significant environmental change, and significant episodes of environmental change often occur within recognized cultural phases; in the following discussion, some cultural phases are subdivided by significant environmental changes (see table 7, opposite page).

Paleoindian (14,500–12,800 cal B.P.)

The Paleoindian Period roughly overlaps the Bølling-Allerød interstadial (~14,700–12,900 cal B.P.), a period of rapid warming of the Northern Hemisphere (Alley and Clark, 1999; Shakun and Carlson, 2010; Clark et al., 2012). Warming temperatures, coupled with changes in oceanic and atmospheric circulation patterns, led to drier conditions in much of the Great Basin (Benson et al., 2012), though summer temperatures were still cooler than today (Wigand and Rhode, 2002). The drying trend resulted in the rapid decline of Lake Lahontan, as noted above, and of the great Lake Bonneville to the east, both of which had dropped steeply by about 15,000 cal B.P. (Benson et al., 2010, 2012).

In contrast, some lakes in the northern Great Basin rose to high levels during this interval. Lake Chewaucan, in southeastern Oregon, expanded beginning ~14,700 years ago to reach a depth of more than 100 ft by 13,800 cal B.P., and then within the next two centuries it declined again to low levels (Friedel, 1994; Licciardi, 2001). Paisley Caves overlooks the Lake Chewaucan Basin, and the people who may have lived there 14,400 years ago would have seen the playa floor covered with a sizeable sheet of lake water, though this was the heart of the Bølling "dry" interval. Benson et al. (1990) suggest that the rise of Lake Chewaucan, at the same time that Lake Lahontan was declining, indicates a northward shifting of the polar jet stream during this period.

As Lake Lahontan retreated, diverse lowland vegetation associations colonized the valley floors and margins in a mixture of montane and sagebrush steppe plants (Nowak et al., 1994). Trees and shrubs grew at elevations significantly lower than they do today (Thompson, 1984: 44–45). Western juniper expanded its range in the Lahontan Basin by 14,000 cal B.P., with whitebark pine present in some piedmont settings (Thompson et al., 1986; Nowak et al., 1994; Wigand and Rhode, 2002). Whitebark pine grows only in high subalpine settings today, so the fact that it occupied locations more than 3500 ft below its modern limits indicates significantly colder temperatures and greater effective moisture, though not quite as cold as during the last glacial maximum. On this basis, Wigand has estimated that mean annual temperature in northwestern Nevada at ~13,850–13,350 cal B.P. was ~11° F cooler than today (Nowak et al., 1994; Wigand and Rhode, 2002).

Low temperatures combined with relatively low precipitation also prevailed during this time period in the western Bonneville Basin, near the east end of the corridor (Rhode and Madsen, 1995; Rhode, 2000: 144–145). Limber pine woodlands mixed with sagebrush steppe grew at elevations as low as 4900 ft, close to the Provo level of Pleistocene Lake Bonneville. These cold but dry-adapted lowland woodland and steppe communities lacked the mesic montane meadow shrubs that had grown at low elevations during Lake Bonneville's high stand. Subalpine fir and spruce grew in upland canyons in nearby mountains. Limber pine woodlands persisted in lowlands until 13,400 cal B.P., with remnant stands lasting until at least 12,900 cal B.P. Xeric-adapted desert shrubs first appeared in the western Bonneville Basin lowlands beginning about 12,900 cal B.P., as the Paleoindian Period was coming to an end.

Although Lake Bonneville stood at low levels below the Provo shoreline, fish bones found in packrat middens and from the basal stratum of Homestead Cave dating older than ~13,100 cal B.P. suggest that a lake sufficiently cold and fresh to support a diverse fish fauna persisted (Rhode and Madsen, 1995; Broughton et al., 2000; Madsen et al., 2001; Hart et al., 2004). Further regression of the lake sometime between 13,100 and 12,300 cal B.P. resulted in a significant fish die-off, though some coldwater fish species continued to live in the lake (and their remains were deposited in Homestead Cave) into the early Holocene (Broughton, 2000).

Unfortunately, for this time period, we currently have little paleoenvironmental information about that long segment of the study corridor between the Lahontan Basin on the west and the Bonneville Basin on the east. Mehringer's (1985) generalized view of pre-Holocene, postglacial vegetation in the northern Great Basin remains reasonable: a broad sagebrush-dominated steppe with abundant grasses and few conifers. Certainly the northern Basin environment was more diverse than that, but obtaining a more refined record will require new studies of alluvial sequences, sediment cores, and packrat middens from the uplands of the High Rock Country, the Upper Humboldt Plains, and the Thousand Springs Valley.

Paleoarchaic (12,800–7800 cal B.P.)

This cultural period incorporates two distinct climatic intervals: the Younger Dryas and the early Holocene climatic period that Antevs (1948) termed the "Anathermal." These are discussed separately.

YOUNGER DRYAS (12,800–11,700 CAL B.P.): A globally recognized reversion to colder Northern Hemisphere temperatures at the close of the last deglaciation process, the Younger Dryas is thought to have been triggered by a shutoff of Atlantic meridional ocean circulation and resulting cooling of the North Atlantic (Alley and Clark, 1999; Shakun and Carlson, 2010; Clark et al., 2012). Its climatic effects in North America and the rest of the world were geographically complex (Meltzer and Holliday, 2010; Shakun and Carlson, 2010). In the Great Basin, the Younger Dryas appears to have been a period of greater effective moisture, resulting from lower overall temperatures, but evidence for enhanced precipitation is uncertain. Madsen (1999: 78) considered the interval to be exceptionally variable on an annual-to-decadal scale compared with today, such that "early Great Basin foragers were being whipsawed from one climatic extreme to another, often within periods of less than a decade." On the other hand, he also regarded the interval as seasonally equable, with significantly cooler summers and winters not much cooler than today. Whether these conditions applied in the Great Basin during the Younger Dryas remains to be more fully confirmed with paleoenvironmental records.

Cooler Younger Dryas–age temperatures have been documented in paleoenvironmental records in the Sierra Nevada and along the Pacific Coast (Hendy et al., 2002; Barron et al., 2003; MacDonald et al., 2008), and these cooler conditions may have resulted in increased effective moisture in the Great Basin as well. Sierra Nevada glaciers had melted by 13,100 cal B.P., however, and do not appear to have had any significant Younger Dryas readvance (Clark and Gillespie, 1997), perhaps for lack of sufficient snowfall. Other nonglacial Sierra Nevada records indicate only slight cooling during the Younger Dryas interval (e.g., Porinchu et al., 2003).

Lake Lahontan rose once more during the Younger Dryas period, reaching elevations of 4025 ft (perhaps 4035 ft) in the western subbasins (Briggs et al., 2005; Adams et al., 2008; Benson et al., 2012). A level of 4035 ft would have placed the lake's shoreline somewhere just south of the corridor in the East Arm of the Black Rock Desert. Briggs et al. (2005) dated one deposit to the early Younger Dryas at ~12,700 cal B.P., but the lake's rise may have begun somewhat earlier (Benson et al., 2012).

Utah juniper grew west of Pyramid Lake and in the Smoke Creek Desert, associated with sagebrush, shadscale, greasebush, wild rose, and rabbitbrush (Nowak et al., 1994; Wigand and Rhode, 2002). Whitebark pine and mountain mahogany had disappeared from lower elevations by this time. At higher elevations, pine forests mixed with sagebrush-grass steppe are reflected in the 9000 ft elevation Patterson Lake pollen record in the Warner Mountains, west of the corridor (Minckley et al., 2007).

Prior to ~11,000 cal B.P., the middle reach of the Humboldt River flowed as a large river, carving huge meanders across its floodplain (House et al., 2001; Miller et al., 2004). We do not know when it began to aggrade its floodplain, but most likely it began at the onset of the Younger Dryas. Other records point to increased streamflow and shallow regional water tables during roughly this same interval: at Sunshine Wells, east-central Nevada, gravel channel fill indicating active stream aggradation date between ~13,500 and 11,300 cal B.P. (Huckleberry et al., 2001).

As the Humboldt River helped raise Lake Lahontan's level in the west, a moderately large lake filled the Lake Franklin basin in Ruby Valley, east of the Ruby Mountains, at ~12,700–12,300 cal B.P. (Thompson, 1992). Vegetation here was dominated by sagebrush grass steppe, with pollen evidence of conifers growing in the region, but not nearby.

At the eastern end of the study corridor, in the western Bonneville Basin, the Younger Dryas is marked by an expansion of Lake Bonneville to cover the Great Salt Lake Desert and form the Gilbert Shoreline (Oviatt et al., 1992). Oviatt et al. (2005) dated this expansion to sometime between ~12,900 and 11,900 cal B.P., noting that the actual time the lake stayed at the Gilbert Shoreline level was likely brief, perhaps on the order of decades, and that its level fluctuated significantly during its brief rise. Deposition of fish bones at Homestead Cave was much reduced during the Younger Dryas interval (Broughton, 2000). Big sagebrush-grass steppe grew extensively in the lowlands, as the mammal record from Homestead Cave (Grayson, 1998, 2000, 2006) and the packrat midden record (Rhode, 2000) reveal. Limber pine woodlands disappeared from low elevations by the early Younger Dryas (Rhode and Madsen, 1995); perhaps the climate was too warm in the summer for their continued lowland growth. The pollen record from Blue Lake, at the margin of the Great Salt Lake Desert south of Wendover, shows high values of pine and sagebrush initially but subsequent declines near the end of the Younger Dryas as saltbush, greasewood, and marshlands colonized the former lake bed and valleys (Louderback and Rhode, 2009). These changes suggest cool conditions in the Younger Dryas, but somewhat warmer than during the previous Bølling-Allerød, a warming trend that gained momentum into the early Holocene.

Early Holocene (11,700–8500 cal b.p.): The early Holocene began the transition to the warmer and drier climate of the middle Holocene. Significantly drier conditions prevailed in the Pacific Northwest, and wetter conditions appear to have prevailed in the American Southwest (Thompson et al., 1993; Miller et al., 2004). Predictably, the project area falls in the middle of this dipole pattern. Strengthened Northern Hemisphere summer solar insolation probably resulted in greater seasonality than at present.

While the beginning date of this period marks the rapid and dramatic shift from the Younger Dryas, the end date is arbitrary, as the early to mid-Holocene transition is gradual, not abrupt, and the timing varies among different records and areas. The end date also does not line up with the proposed end of the Paleoarchaic cultural period adopted in this volume, but that endpoint (the eruption of Mount Mazama) is a geologic (not cultural) marker event that had only transitory climatic and environmental consequences in much of our region (but see Chatters, 2012; Delacorte and Basgall, 2012). The proposed end date does, however, accord with some significant changes in prehistoric peoples' land-use patterns (e.g., abandonment of drying marshes in the Bonneville Basin; Oviatt et al., 2003; Rhode et al., 2005), resource procurement technology (e.g., intensified small-seed processing at Danger Cave; Rhode et al., 2006; Rhode, 2008), and a general decline in estimated human population densities in the Great Basin (Baumhoff and Heizer, 1965; Louderback et al., 2011).

Sometime after ~11,600 cal b.p., Lake Lahontan rapidly declined, falling below 3840 ft within a few hundred years and effectively ending the Lahontan lake cycle. Evidence from several subbasins of the Lahontan system suggests that lakes may have enlarged at times during the early Holocene, but these smaller lakes stayed below the sills of their separate subbasins and did not join together as they had in the Younger Dryas (Davis, 1982; Adams et al., 2008). Lakes to the north (e.g., Malheur Lake) also rose to above-modern high stands several times during the early Holocene (Gehr, 1980; Dugas, 1998). Extensive cattail marshes replaced lakes in some of these basins, as well as in the northwestern Great Basin, until at least ~10,800 years ago (Wigand and Mehringer, 1985; Wigand and Rhode, 2002: 321). Thereafter, greasewood and saltbush communities increasingly colonized playa margins and lower valley floors (Hansen, 1947; Mehringer, 1985). To the east, in the western Snake River Plain, saltbush steppe and greasewood scrub invaded what had been grassland during the Younger Dryas (Henry, 1984).

Early Holocene vegetation near the western end of the corridor was grassy sagebrush steppe with sparse juniper, reflecting relatively moister conditions compared with the present (e.g., Bicycle Pond; Wigand and Rhode, 2002: 321–322). In the Lahontan Basin, Utah juniper died out at low elevations by 10,800 cal B.P. but expanded northward into the uplands of the High Rock Country (Wigand and Rhode, 2002: 323). Higher elevations in the nearby mountains of the northwestern Great Basin were covered in pine forests and steppe grasslands, but with an increasing abundance of sagebrush through the early Holocene (e.g., Patterson Lake; Minckley et al., 2007) or by sagebrush-grass steppe with common juniper (e.g., Fish Lake; Mehringer, 1985).

Climatic reconstructions based on pollen derived by Minckley et al. (2007) contrast sharply with a picture of cool early Holocene temperatures. They suggest that the prevailing climate was significantly warmer and drier during the early Holocene (~9300 cal B.P.) than at present—as much as 7° F warmer with 4–8 inches less precipitation. This holds true at high elevations (~9000 ft); their temperature reconstructions for lower elevations fall within the modern range or are slightly cooler than modern in the winter. These results reflect a time when summer solar insolation was at its Holocene peak (Kutzbach and Webb, 1993) and summer temperatures would expectably be elevated. The reconstructions suggest that seasonal swings in temperature and precipitation were significantly enhanced (Broughton et al., 2008). Grayson (2011) notes that these reconstructions are similar to those for the neighboring Sierra Nevada and Cascades, but differ from parts of the Great Basin to the southeast and east.

By about ~10,800 cal B.P., the Humboldt River had ceased to be a great meandering, aggrading river and instead became a much smaller stream that supported valley bottom stability, minor localized aggradation, and development of extensive marshlands within its floodplain (House et al., 2001; Miller et al., 2004). Generally moist conditions are thought to have persisted along the Humboldt River floodplain up to the deposition of Mazama ash at ~7600 cal B.P.

In Ruby Valley, Lake Franklin remained deeper at the beginning of the Holocene than at present, but gradually declined so that by the time of deposition of the Mazama tephra, the water level was lower than today (Thompson, 1992). Sagebrush steppe vegetation declined in abundance beginning ~9500–9000 cal B.P. and was partially supplanted by saltbush desert and salt marsh grasses in the Ruby Valley lowlands. At nearby Sunshine Wells, perennial stream flow also decreased significantly after 11,300 cal B.P. and generally ceased after 10,200 cal B.P., but water tables remained high, supporting localized riparian communities (and the formation of black mats) until ~9500 cal B.P. (Huckleberry et al., 2001). After this time, riparian/wetland conditions gave over to silty alluvium and aeolian dune deposition for the remainder of the Holocene.

In the Bonneville Basin, desert shrubs prevailed in the lowlands, with sagebrush-grass steppe at higher elevations on valley margins and midslopes of uplands. The pollen record from Blue Lake shows that shallow ponds developed after about 11,700 cal B.P., and extensive peat-forming marshes developed beginning about 11,000 cal B.P. (Louderback and Rhode, 2009). Sagebrush and pine pollen decreased dramatically, and pollen of desert shrubs and grass increased in abundance significantly from 11,000 to 9500 cal B.P.; the desert shrub component continued to be dominant until ~7000 cal B.P. Nearby pollen records confirm the timing and magnitude of regional vegetation shifts by about 9000–8500 cal B.P. (Bright, 1966; Madsen and Currey, 1979; Mehringer, 1985; Beiswenger, 1991).

This record of increased drying and a shift from sagebrush-steppe to desert-shrub communities during the early Holocene is mirrored by the mammal fauna record from Homestead Cave, which shows a dramatic decline in mammals adapted to cooler montane environments that was nearly complete by ~9000 cal B.P. (Grayson, 2000, 2011; cf. Schmitt et al., 2002). This shift has also been observed in Bonneville Estates Rockshelter (Schmitt and Lupo, 2012; Hockett, 2015). A mosaic of sagebrush-grass steppe and mesophilic aspen and montane brush communities with few conifers dominated the uplands. Rocky Mountain juniper dominated midslope woodlands in northern areas (Utah juniper and pinyon pine apparently did not arrive until the end of the early Holocene); limber and whitebark pines retreated to higher elevations and protected canyons.

Climate models have suggested that greater seasonality, particularly higher summer temperatures, might have resulted in stronger summer monsoonal precipitation in continental settings such as the Great Basin (Thompson et al., 1993). However, biotic records in the northern Great Basin, such as the Homestead Cave record, do not appear to support these models (Grayson, 2000, 2011). Possibly the lingering presence of large continental glacier remnants in subarctic North America (Wanner et al., 2011) kept northerly continental areas, including the northern Great Basin, sufficiently cool and dry in the summer to limit the advance of summer convective storms to more southerly regions.

Middle Holocene (8500–3800 cal B.P.)

Post-Mazama and Early Archaic Periods

This long middle Holocene period in the northern Great Basin includes the Post-Mazama and Early Archaic cultural periods and can be divided into two main environmental eras: pre- and post-6300 cal B.P. (Mensing et al., 2004). Before that date, the warm dry conditions that had begun in the early Holocene deepened, culminating in the driest conditions of the Holocene. Dry conditions expanded to a much larger region from the Pacific Northwest south into the Great Basin and American Southwest, including our project area (Thompson et al., 1993). This extended dry period appears to have resulted from suppressed ENSO variability, coupled with the absence of significant monsoonal conditions in the American Southwest (Clement et al., 2000; Barron et al., 2005). After 6300 cal B.P., drought conditions ameliorated, though climate was still quite variable. As middle Holocene climates fluctuated, pinyon pine and Utah juniper migrated into the northeastern Great Basin, and western juniper expanded its range in the west.

Early Middle Holocene (8500–6300 cal B.P.): In the northwestern Great Basin, pollen data from several sites indicate that the climate that typified the period between 9800–6400 cal B.P. was the driest to occur there during the Holocene (Wigand and Rhode, 2002: 325; see also Mehringer, 1986). Lake basins apparently dried and extensive dune systems developed during this period (Mehringer and Wigand, 1986; Dugas, 1998). The high-resolution pollen record from Diamond Pond (Wigand, 1987) indicates that saltbush desert prevailed and the water table stood at ~17 m below modern levels prior to 6200 cal B.P.

A sediment and pollen record from Pyramid Lake spanning much of the past ~7600 years shows evidence for extensive, persistent droughts in the western Great Basin (Benson et al., 2002; Mensing et al., 2004). The early part of the middle Holocene was apparently the driest, with several major centennial-scale droughts. We lack a packrat midden record for the Lahontan basin during this time (Nowak et al., 1994; Wigand and Rhode, 2002), but pollen from Pyramid Lake shows expansion of desert-shrub vegetation (Mensing et al., 2004). The end of this sequence corresponds with the death date of a submerged tree stump in Lake Tahoe, indicating that the lake stood 4 m below its sill for a century or more before ~6300 cal B.P. (Lindström, 1990). During this 1300 year dry interval, one brief but intense wet period between 7000 and 6800 cal B.P. is indicated in the sediment chemistry and the abundance of pine pollen, though not in any evident changes in local vegetation (Mensing et al., 2004).

From ~7700 to 5500 cal B.P., the middle Humboldt River underwent such a decline that a widespread unconformity exists in the alluvial record, with windblown silt taking its place (House et al., 2001; Miller et al., 2004). The lack of an alluvial record suggests that this part of the river all but ceased to flow; Humboldt Lake, which it feeds, did indeed dry up (Byrne et al., 1979). The Ruby Marshes shallowed through the time of deposition of Mazama tephra and continued dry until ~5400 cal B.P. (Thompson, 1992); sagebrush and pine declined and saltbush shrubs increased in abundance. Juniper woodlands and sagebrush steppe increased in abundance at the expense of subalpine forests in the Jarbidge Mountains (Thompson, 1984).

At the far eastern end of the corridor, northwestern Utah also saw significant declines in sagebrush and increases in saltbush shrubs in the lowlands, an indication of greater aridity, prior to ~6300 cal B.P. (Mehringer, 1985; Louderback and Rhode, 2009). Wetlands along the margins of the Great Salt Lake desert diminished in extent or dried up altogether (Kiahtipes, 2009; Louderback and Rhode, 2009). The Great Salt Lake apparently fell to very low levels in the middle Holocene (Currey, 1980), though Murchison (1989) reports two expansions of the lake to above the modern average at ~8200 and ~6700 cal B.P. Packrat midden evidence shows that limber pine and Rocky Mountain juniper persisted in eastern Great Basin uplands, at least in protected settings (Rhode, 2000). Meanwhile, pinyon pine had migrated northward through eastern Nevada to reach the uplands near Wendover by about 7500 cal B.P. (Rhode and Madsen, 1998; Rhode, 2000).

Late Middle Holocene (6300–3800 cal B.P.): In the northwestern Great Basin, increasing sagebrush pollen and evidence of pond vegetation at Diamond Pond indicate wetter conditions after 6200 cal B.P. (Wigand, 1987). Juniper and pine also increased at Bicycle Pond after 6300 cal B.P. (Wigand and Rhode, 2002). At higher elevations, sagebrush declined and pine-fir forests or grassy meadows spread after ~6300 cal B.P. (Mehringer, 1985; Minckley et al., 2007).

A shift toward a wetter climate in the Pyramid Lake area began around 6300 cal B.P., with an increase in sagebrush relative to saltbush and a concomitant increase in pine. This comparatively moist period apparently persisted until ~5200 cal B.P., when another severe period of drought ensued. This drought is correlated with a series of submerged tree stumps rooted at depths up to 1.3 m below Lake Tahoe's sill, dating between ~5600 and 5000 cal B.P. (Lindström, 1990; Benson et al., 2002). After 5000 cal B.P., Lake Tahoe rose above its sill again, spilling into the Truckee River and ultimately feeding Pyramid Lake's rise (Mensing et al., 2004). The Pyramid Lake record documents two other extended periods of middle Holocene drought (~4700–4300 and 3900–3800 cal B.P.). Overall, wetter conditions after 6300 cal B.P. are identified in a number of Sierra Nevada pollen records, while the drought episodes are less well documented (Morrison, 2003; Mensing et al., 2004; but see Adam, 1967).

From 5500 to 3500 cal B.P., middle Humboldt River floodplain aggradation gradually increased, indicating greater flow in the river after its long hiatus (House et al., 2001; Miller et al., 2004). At the Ruby Marshes, lower than modern water levels persisted through the middle Holocene until 5400 cal B.P., continuing the dominance of saltbush scrub. After 5400 cal B.P., pinyon pine and Utah juniper migrated into the mountains surrounding the valley.

A stratified alluvial sequence on Mahala Creek, in the Independence Mountains near the study corridor, reveals six major channel cut-and-fill units spanning ~7800 years (Madsen, 1985). Pollen analysis of the sequence yielded a fairly stable record of sagebrush-steppe vegetation surrounding Mahala Creek through much of the middle and late Holocene, with one major exception. Pinyon pine pollen began to increase quickly in abundance at ~5400 cal B.P., declined somewhat after 4300 cal B.P., and rose again for the remainder of the Holocene. This increase reflects the arrival of pinyon pine into the northern reaches of its range as part of its Holocene migration northward (Thompson and Hattori, 1983; Thompson, 1990). A few other subtle differences in the Mahala Creek pollen record are observable, including higher values of juniper, oak, and dandelion prior to ~5400 cal B.P. and greater values of willow after this date, possibly indicating greater local moisture supporting riparian vegetation.

In the Bonneville Basin, sagebrush increased at the expense of saltbush scrub after ~6300 cal B.P., indicating a return to moister conditions in the latter half of the middle Holocene (Mehringer, 1985; Louderback and Rhode, 2009). The Blue Lake record documents a significant increase in pine pollen, reflecting the spread of pinyon pine into the surrounding uplands, as pinyon pine macrofossils in archaeological sites and packrat middens also show (Rhode and Madsen, 1995, 1998; Rhode, 2008).

Middle Archaic (3800–1300 cal B.P.)

Numerous records point to a significantly cooler and moister period after ~5000–4500 cal B.P., often referred to as the Medithermal (Antevs, 1948), Neoglacial (Porter and Denton, 1967), or Neopluvial (Currey and James, 1982). In the northwestern Great Basin, enhanced effective moisture raised Diamond Pond to its deepest Holocene level at ~4000 cal B.P.; juniper woodland mixed with grasses spread into the area (~500 ft lower than its modern extent) and persisted until ~2000 cal B.P. (Wigand, 1987). Juniper woodland expanded in low elevations at ~4000, 2800, and 2300 cal B.P., consistent with episodes of pine-fir forest expansion east of Lake Tahoe (Wigand and Rhode, 2002: 326). Mehringer (1985) reported a decline in juniper pollen in the high-elevation Fish Lake record, suggesting that colder temperatures may have forced down upper treelines (see also LaMarche, 1973; Scuderi, 1987). Evidence for limited growth of glaciers dating between 3900 and 3200 cal B.P. in the Sierra Nevada and elsewhere in western North America (Konrad and Clark, 1998; Osborn and Bevis, 2001; Koch and Clague, 2006; Bowerman and Clark, 2011) also signals colder high-elevation temperatures.

Woodlands and forests expanded their range in much of the northern and central Great Basin (Thompson and Kautz, 1983; Thompson, 1984, 1992; Madsen, 1985). At Mission Cross Bog, cool wet conditions are documented from 4000 to 3300 cal B.P., broken up by a few intervals of drought (Norman, 2007). Farther north, in the western Snake River Plain, the period from ~3800–2600 cal B.P. was one of the coolest and most mesic of the Holocene (Henry, 1984; but cf. Doerner and Carrara, 2001).

As noted previously, the middle reach of the Humboldt River gradually increased, aggrading its existing floodplain through about 3500 cal B.P., feeding its terminal lakes and wetlands in the Humboldt and Carson sinks (Byrne et al., 1979; Davis, 1985; Wigand and Mehringer, 1985) and supporting the ~4200–4000 cal B.P. occupation of Hidden Cave (Thomas, 1985). From ~3200 to ~2600 cal B.P., the "relatively dynamic river" migrated across its floodplain and formed substantial levees through overbank aggradation, at a time of "persistently wet conditions" (Miller et al., 2004: 79). In Ruby Valley, saltbush shrub vegetation decreased (but remained more expansive than today), sagebrush increased in abundance, and waters deepened in the Ruby Marshes, all suggesting greater effective moisture after ~4900 cal B.P. (Thompson, 1992).

In the Bonneville Basin, the highest Holocene stage of Great Salt Lake is estimated to have occurred sometime between ~3200 and 2000 cal B.P., extending across the Great Salt Lake Desert (Mehringer, 1985; McKenzie and Eberli, 1987; Murchison, 1989; Currey, 1990). This expanded lake may have been fresh enough to support fish (Broughton, 2000; Madsen et al., 2001). Grayson (2000, 2011) reports the recolonization of several different montane and mesophilic mammals to lowland habitats around Homestead Cave during the late Holocene, responding to cooler and moister conditions. Generally moister conditions are also shown at Crescent Springs beginning ~4000–3400 cal B.P. and 2800–2200 cal B.P., with drier conditions in-between (Mehringer, 1985). The Blue Lake record (not inundated by the Holocene high-stand expansion) reveals significantly greater abundance of pine as pinyon pine forests increased in density after ~3700 cal B.P. Sagebrush maintained moderately high proportions from ~4500 to 3400 cal B.P., declined relative to saltbush shrubs from 3400 to 2700 cal B.P., and then rebounded from 2700 to 1500 cal B.P., similar to the Crescent Spring record. In some localities, juniper grew 200–300 ft lower in elevation between 3800 and 3000 cal B.P. than they do at present (Rhode, 2000). Byers and Broughton (2004) argue that enhanced late Holocene moisture increases led to greater abundance of large artiodactyls and, possibly, greater frequency of large artiodactyl hunting (but see Hockett, 2005; McGuire and Hildebrandt, 2005).

After ~2600 cal B.P., the Great Basin appears to have been drier, with persistent drought between 2500 and 2000 B.P. comparable to arid conditions recorded during the middle Holocene (Mensing et al., 2004). In central Nevada upland valleys, this period of extended drought is indicated by hillslope erosion as a result of diminished vegetation cover, active deposition on alluvial fans, upland valley aggradation followed by stream incision, conversion of wet meadows to dry flats, and low plant diversity in packrat middens (Miller et al., 2004; Tausch et al., 2004).

Recurrent multidecadal droughts have punctuated the last two millennia, as shown by the robust tree-ring record of drought severity in North America (Cook et al., 2004). These reconstructions and available sedimentary records (Wigand, 1987; Carter, 1995; Allan, 2003; Smith, 2003; Norman, 2007) reveal a series of decadal and multidecadal droughts, as well as intervening moist intervals. Some of these droughts or wet periods affected only a portion of the northern Great Basin, while others span the entire project area (Mensing et al., 2008). Some localized droughts or wet periods might have been more pervasive, but determining their extent would require better chronological control and cross correlation of the records that document them. The pattern of late Holocene droughts culminated in the centennial-scale, widespread dry periods that characterized part of the Late Archaic of the MCA, ~1100–700 cal B.P. (Stine, 1994; Meko et al., 2001, 2007; Benson et al., 2002).

Late Archaic (1300–600 cal B.P.)

This cultural phase spans a period of distinctive late Holocene climatic patterns linked with the MCA, a period of warmer climates in many parts of the globe (Lamb, 1965; Graham et al., 2007). In the Great Basin, the period is noted for two primary reasons: prolonged droughts in much of western North America (Benson et al., 2007; Oglesby et al., 2012) and increased influx of growing-season moisture in the eastern Great Basin and American Southwest that enhanced production of grasses, including maize. The dry periods appear to be related to the effects of relatively warm surface waters in the Atlantic Ocean (i.e., a positive AMO) combined with relatively cool surface waters in the eastern Pacific Ocean (a negative PDO; McCabe et al., 2004; MacDonald and Case, 2005; Trouet et al., 2009; Oglesby et al., 2012), and possibly the influence of enhanced solar irradiance (Crowley, 2000; Mensing et al., 2004, 2008; Tausch et al., 2004; Wanner et al., 2008).

The record of pervasive, century-scale dry intervals during this period in the Great Basin and western North America is well documented. Telling pieces of evidence for the droughts' environmental impact include the widespread occurrence of now-submerged tree stumps in the Sierra Nevada and western Great Basin (Lindström, 1990; Stine, 1994; Benson, 2004; Yuan et al., 2004); tree-ring records in the Sierra Nevada (Graumlich, 1993; Hughes and Graumlich, 1996); and droughts recorded in the sediment records of lakes, ponds, and wetlands across the Great Basin, including Mono Lake (Stine, 1990), Pyramid Lake (Benson et al., 2002; Mensing et al., 2004), Blue Lake in the Pine Forest Range (Carter, 1995), Mission Cross Bog (Allan, 2003), and the Great Salt Lake (Madsen et al., 2001). The impacts of these extended droughts on cultural dynamics have been the subject of much recent archaeological discussion (e.g., Jones et al., 1999; Benson et al., 2007).

These drought records typically show two major episodes—approximately 1100–900 and 800–650 cal B.P.—with a brief and intense moist period separating them. This wet period appears to have been global in extent and coincided with an interval of reduced solar activity (Wanner et al., 2008). Adams (2003) has suggested that the Carson Sink filled with a moderately deep lake during this brief middrought interval. The lake would have been large enough to submerge the Carson Sink's Stillwater Marsh and Humboldt Sink, directly affecting peoples' land-use and resource-procurement patterns in northern Nevada. If so, high levels of precipitation in the headwaters of both Sierra Nevada streams and the Humboldt River would be necessary to fill a lake of this volume (Benson and Thompson, 1987; Adams, 2003). At present, further evidence and dating are needed to test this hypothesis (Grayson, 2011).

The record of increased summer precipitation in the late Archaic is less well established, though its effect on the success of Fremont farmers and the activities of other native groups may have been equally profound. Enhanced summer precipitation beginning ~1400–1300 cal B.P. is inferred on the basis of increased grass pollen at Diamond Pond (Wigand, 1987) and Blue Lake in the Pine Forest Range (Carter, 1995), both at the western end of the corridor. Similarly, several lines of evidence point to higher summer-fed grass pollen on the eastern end of the line, in the Bonneville Basin (Harper and Alder, 1970; Kelso, 1970; Newman, 1996; Rhode, 2000; Kiahtipes, 2009). Grayson (2006, 2011) highlights the evident connection between increased summer precipitation, increased grass production, and expanded distribution of bison in the northern and eastern Great Basin during this interval.

Terminal Prehistoric (600–150 cal B.P.)

In climatic terms, this cultural period coincides with the Little Ice Age, a cold period recognized in many parts of the world (Grove, 2004), including the Sierra Nevada, where the term was first used to refer to late Holocene glacial advances (Matthes, 1939; Clark and Gillespie, 1997). The cause of the Little Ice Age appears to have been a coincidence of lower summer insolation in the Northern Hemisphere owing to global orbital dynamics, shifts in ocean circulation, a particularly active period of tropical volcanic eruptions leading to hazier skies, and weakened solar inputs (Grove, 2004; Miller et al., 2004; Wanner et al., 2008).

Multiple lines of evidence point to cooler and moister conditions in the Great Basin at this time. Glaciers advanced in the Sierra Nevada (Clark and Gillespie, 1997; Bowerman and Clark, 2011) and in some high wet mountains in the Great Basin (Osborn and Bevis, 2001). Tree-ring sequences from the Sierra Nevada and White Mountains record cooler temperatures and, in some records, enhanced precipitation (Graumlich, 1993; Feng and Epstein, 1994; Hughes and Graumlich, 1996). The tree-ring-based drought reconstructions of Cook et al. (2004) show generally less droughty conditions than the previous MCA, with especially cool temperatures 350–330 years ago. Treelines lowered in high mountains (LaMarche, 1973; Lloyd and Graumlich, 1997) as well as at lower elevations for pinyon pine and juniper (Wigand and Rhode, 2002). The deepening of waters and development of peatlands in the Ruby Marshes, and increases of sagebrush steppe vegetation in Ruby Valley after ~500 cal B.P., suggest some of the wettest conditions here since the early Holocene (Thompson, 1992).

Farther east in the Bonneville Basin, cooler and more mesic conditions are reflected in the late prehistoric rise of the Great Salt Lake to cover much of the Great Salt Lake Desert to the west (Currey, 1990).

The Little Ice Age was distinctly cooler and more mesic overall than the preceding MCA, though obviously the climate did vary on multidecadal scales. The tree-ring-based drought reconstructions show episodes of persistent drought centered around 570, 530, 430 and 350 cal B.P., and mesic periods centered around 670, 450, and 400 cal B.P. (Cook et al., 2008). At Diamond Pond, in the northwestern Great Basin, the period started out in a drought but became more mesic between 300 and 150 cal B.P., enhancing the spread of juniper and grass vegetation (Wigand, 1987). At Blue Lake in the Pine Forest Range, two notable droughts combined with forest fires occurred at ~500–440 cal B.P. and ~300 cal B.P. (Carter, 1995). Pine and grass abundance resurged after each fire. This high-resolution record indicates the variable vegetation history and possible cooling without significant increases in effective moisture in the past few hundred years. A similar high-resolution pollen record developed at Mission Cross Bog (Allan, 2003) shows a drought in northeastern Nevada at ~450–250 cal B.P. but relatively mesic conditions before and after.

Periods of high interannual variance in climate may have important effects on human foraging strategies such as mobility, diet breadth, storage, intergroup interaction, and other risk-minimizing activities. The importance of interannual variation may differ depending on whether climatic conditions are relatively "good" (i.e., mesic) or "bad" (xeric) for native resource productivity. The reconstructed tree-ring record of drought severity not only shows the sequence and severity of droughts over the past 2000 years, but the data can also be used to calculate interannual variance over a period of years (e.g., 20 years). Using these two reconstructions in tandem can provide insights into how people responded to particular periods of environmental change over the last two millennia.

CHAPTER 3

CULTURAL CONTEXT OF THE NORTHERN TIER

This chapter reviews the prehistoric and ethnographic records of Nevada's Northern Tier. The prehistoric record begins nearly 14,500 years ago and has been organized by archaeologists into a series of broad temporal periods. The following discussion of each period includes a description of critical artifact assemblages, features, subsistence remains, and land-use reconstructions generated by previous studies in the region. Based on these findings, we highlight dominant trends in the archaeological record, with the goal of identifying a series of outstanding research themes that can be addressed with the findings from this project.

Ethnographic information from the Northern Paiute and Western Shoshone help us interpret the archaeological record in a variety of ways. Day-to-day and season-to-season subsistence pursuits described by these accounts are tightly linked to the late-period artifacts and subsistence remains we discover; they enhance our ability to understand how these basic economic systems operated during the last few hundred years, as well as how these systems may have differed further back in time. With regard to questions about higher levels of social organization, not to mention the more spiritual aspects of life, linkages with the archaeological record are less direct, and ethnographic accounts take on a bigger role in helping us understand and appreciate the dynamic nature of the multiple cultures that occupied these lands in the past.

Prehistoric Background

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The chronological framework used for this study is heavily influenced by reference to a series of time-sensitive projectile point types. The middle and late Holocene assemblages in this region appear to comport generally with the so-called *short chronology* of Great Basin projectile point types (Heizer, 1951; Grosscup, 1956; Baumhoff and Byrne, 1959; Heizer and Baumhoff, 1961; Lanning, 1963; Clewlow, 1967; Heizer et al., 1968; Bettinger and Taylor, 1974; O'Connell, 1975; Heizer and Hester, 1978; Thomas, 1981a, 1982; Elston, 1986; O'Connell and Inoway, 1994; McGuire, 2002). The short chronology holds that certain key dart forms, namely Northern Side-notched, Gatecliff, and Humboldt variants, did not appear in this region of the Great Basin until about 7000 years ago, and that Elko Corner-notched points did not appear until about 4000 years ago.

But as we repeatedly make clear in the following discussion, the temporal parameters

TABLE 8
Chronological Sequence for the Project Area with Concordance Between Calibrated and Conventional Radiocarbon Ages

Time Period	Radiocarbon Years (B.P.)	Calibrated Date (cal B.P.)
Terminal Prehistoric	650–Contact	600–Contact
Late Archaic	1350–650	1300–600
Middle Archaic	3500–1350	3800–1300
Early Archaic	5000–3500	5700–3800
Post-Mazama	7000–5000	7800–5700
Paleoarchaic	10,900–7000	12,800–7800
Paleoindian	12,400–10,900	14,500–12,800
Clovis	11,500–10,900	13,400–12,800
Pre-Clovis	12,400–12,000	14,500–13,800

for many of these types are not completely understood and likely do not comprise a lockstep unilineal sequence. In this sense, the temporal periods identified herein, and their association with particular point types, remain very much an ongoing research question. Tables 7 and 8 and the subsequent discussion represent our best attempt at a projectwide chronological sequence. We explicitly state both the conventional (uncalibrated) radiocarbon years and the calibrated derivation for each period, relying on the latter in all discussions unless otherwise noted. This borrows heavily from previous formulations from the northwestern Great Basin (Delacorte, 1997; Hildebrandt and King, 2002), lower Humboldt and Carson sinks (Loud and Harrington, 1929; Heizer, 1951; Grosscup, 1956; Heizer and Krieger, 1956; Bennyhoff and Heizer, 1958; Heizer and Napton, 1970; Elston, 1986), and middle and upper Humboldt River watersheds (Elston and Budy, 1990; McGuire et al., 2004; McGuire and King, 2011). A concordance of this projectwide sequence with more local but still widely used sequences is also provided (fig. 13).

Paleoindian (14,500–12,800 cal B.P.)

Until relatively recently, most archaeologists believed that artifacts produced by Clovis people represented the oldest evidence of human occupation in North America (Haynes, 1967; Waters, 1985). These artifacts typically include fluted projectile points, large bifaces, and a variety of formal flake tools. Based on an analysis of radiocarbon dates from these ancient sites, Haynes (1992) argued that the Clovis adaptation dates between 13,390 and 12,810 cal B.P. More recently, Waters and Stafford (2007) argue for a more narrow range of 12,960 to 12,740 cal B.P., but this time range has been rejected by many other Paleoindian researchers (see Haynes et al., 2007). There are numerous cases in the Great Plains and Southwest where this rather narrow, hunting-oriented assemblage has been found in association with the butchered remains of extinct Pleistocene megafauna (Haynes and Hutson, 2014), but the association between fluted points and megafauna has never been clearly documented in the Great Basin. However, the lack of this association is not definitive, as almost all

Duration (yrs)	cal B.P.	Current project	Surprise Valley [1]	High Rock[2]	Carson Desert[3]	Carson Desert[4]	Sierran Front[5]	Central Basin[6]	Upper Humboldt[7]
600	0–600	Terminal Prehistoric	Bidwell Phase	Last Supper Phase; Hanging Rock Phase	Dune Springs	Desert	Terminal Prehistoric	Yankee Blade	Eagle Rock
700	1300	Late Archaic	Alkali Phase	sparse occupation	Lovelock: Late	Rosegate	Late Archaic [Rose Spring]	Underdown [Rose Spring]	Maggie Creek [Rose Spring]
2500	3800	Middle Archaic	Emerson Phase; Bare Creek Phase	Smokey Creek Phase	Lovelock: Transitional; Early	Elko	Middle Archaic [Elko]	Revielle [Elko]	James Creek [Elko]
1900	5700	Early Archaic	Bare Creek Phase	Silent Snake Phase	Carson	Gatecliff	Early Archaic [Gatecliff, Bare Creek, Martis]	Devils Gate [Gatecliff]	South Fork [Gatecliff]
1900	7800	Post-Mazama	Menlo Phase	altithermal abandonment	Carson	Unnamed	Post-Mazama	Clipper Gap [Triple T]	Pie Creek
5000	12,800	Paleo-archaic		Calico Phase; Parman Phase	Hidden Cave	Stemmed; Clovis	Early Holocene		
1700	14,500	Paleoindian			Fallon		Terminal Pleistocene		

[1] O'Connell, 1975; [2] Layton, 1971; [3] Grosscup, 1960; [4] Elston et al., 1988; [5] McGuire, 2002; [6] Thomas, 1982; [7] Elston and Budy, 1990; McGuire et al., 2004.

Fig. 13. Concordance with other local and regional sequences.

fluted point sites in the Great Basin are surface manifestations where faunal remains do not preserve. It follows, therefore, that a great deal remains to be learned about the subsistence orientation of these early people in the Great Basin.

The search for a pre-Clovis archaeological record has been an ongoing concern for several decades, and many archaeologists have claimed such a discovery. But most of these so-called discoveries have been flawed in one way or another. According to Grayson (2011), a legitimate pre-Clovis site must provide an affirmative answer to the following questions: (1) Are the findings truly archaeological (created by humans)? (2) Have they been firmly dated with radiocarbon or some other reliable means? (3) Is the deposit free from disturbance, ensuring tight associations between the artifacts and dateable material? And (4) are the findings published with a level of detail that allows an independent analysis?

Grayson (2011) identifies only one purported pre-Clovis site in North America that meets all four criteria: the Paisley Caves in south-central Oregon (Jenkins et al., 2012, 2014). To this we would add the Buttermilk Creek Complex in Texas (Waters et al., 2011a) and the Manis Mastodon site in the state of Washington (Waters et al., 2011b). The following discussion focuses on the Paisley Caves and the Manis Mastodon site, due their proximity to the current project area.

Pre-Clovis (14,500–13,800 cal b.p.): The Paisley Caves are located in the northwestern Great Basin on the margins of Summer Lake Basin, about 75 km north of Lakeview, Oregon. Paisley Cave #5 has a deep stratified deposit that includes a lower component dating from about 14,500 to 14,100 cal b.p. (12,400 to 12,200 radiocarbon years before present), which predates the earliest estimates for Clovis by 800 years. This component includes Pleistocene megafauna, as well as bifaces, debitage, cordage, butchered bone, and human coprolites, the latter documented by the presence of human DNA. Multiple radiocarbon dates were obtained from the human coprolites (Jenkins, 2007; Gilbert et al., 2008; Jenkins et al., 2012; Hockett and Jenkins, 2013).

Due to the great antiquity of this these materials, they have been subject to a great deal of scrutiny, including independent research efforts. Goldberg et al. (2009) conducted detailed analysis of the coprolites and thought that their structure and composition were more consistent with ungulate dung than with human waste; Sistiaga et al. (2014) came to similar conclusions based on their analysis of lipids from the same samples. Poinar et al. (2009) argued that the human DNA found in the specimens could have leached in from later-dating components, and they identified some carbon isotope anomalies that lead them to question the radiocarbon dates as well. Rasmussen et al. (2009), Gilbert et al. (2008), and Jenkins et al. (2012, 2014) responded to these critiques by: (1) producing comparative samples of definitive human coprolites with similar structure and composition as the Paisley specimens; (2) clearing up issues with the radiocarbon assays; and (3) making a strong case for the absence of DNA-leaching through the analysis of a series of control samples from the deposit. Based on these responses, the case for a pre-14,000 cal b.p. human occupation at the site seems quite strong (see also Grayson, 2011, for a discussion of the site).

Evidence for a pre-Clovis presence is more straightforward at the Manis Mastodon site.

It is composed of a disarticulated mastodon skeleton that exhibits butchering damage and, most importantly, a bone projectile point embedded in its rib. Four radiocarbon dates from the mastodon, including the rib with the bone point, produced statistically identical ages, averaging 11,960 radiocarbon years before present, or 13,819 cal B.P. (Waters et al., 2011b). Similar to the dates from Paisley Caves, this finding predates Clovis by a significant amount (at least 400 years).

Although unequivocal evidence for pre-Clovis people is quite rare, and documented in areas only to the north, it seems possible that people were present in northern Nevada at this time. It is important to emphasize that if these people used rather simple flaked stone technologies similar to those used later in time (i.e., lacking distinctive attributes like fluted points), it might be difficult at first glance to spot archaeological materials dating to the Pleistocene. Nevertheless, our search for this material will focus on Pleistocene-aged landforms and the judicious use of obsidian hydration data.

CLOVIS (13,400–12,800 CAL B.P.): Fluted points are relatively common in the Great Basin and the larger intermontane west, but less plentiful than east of the Rocky Mountains and in the Southwest, perhaps due to a lower intensity of archaeological survey in the former regions (Prasciumas, 2011). As noted above, the vast majority of points found in the Great Basin are from surface contexts lacking material suitable for radiocarbon assay, and none have been associated with the remains of Pleistocene megafauna. They usually occur in isolated contexts but are sometimes found in major concentrations, the most important being in the Alkali Lake Basin of southeastern Oregon (Fagan, 1988; Pinson, 2004, 2011), the Sunshine Locality of eastern Nevada (Beck and Jones, 1997, 2009, 2010), and Pleistocene Lake Tonopah in western Nevada (Pendleton, 1979; Tuohy, 1988). These concentrations show that fluted points are often associated with bifacial blanks, knives, scrapers, and gravers—but not milling tools. Both the isolates and concentrations are typically found adjacent to wetland habitats, while they almost never occur in upland settings.

Although some researchers have assumed a large-game hunting orientation in the Great Basin based on findings from the Great Plains and Southwest, Heizer and Baumhoff (1970) noted early on that the close association between fluted points and lake basins seems to indicate an adaptation to lacustrine resources rather than big-game hunting. Madsen (2002) agrees, arguing that populations dating to this early time period followed a lowland strategy that focused on higher ranked marsh resources, following an adaptation much like later Archaic people but without the extensive grinding of seeds.

The precise age of fluted points in the Great Basin remains an open question due to the lack of specimens associated with reliable radiocarbon dates (Beck and Jones, 2010; Grayson, 2011). Although Pinson (2011) argues that the projectile points from the Dietz site are essentially identical to Clovis points found farther east, Beck and Jones (2010) found that fluted points from the Great Basin are sometimes smaller than Clovis points, and tend to have deeper indentations on their bases. They also note that Great Basin assemblages often lack the blade technologies commonly associated with classic Clovis sites of the Great Plains and the Southwest. As a result of these findings, Beck and Jones

(2010) argue that the Great Basin samples should be classified as Western Fluted points and not Clovis. They also hypothesize that these forms were probably derived from Clovis and arrived in the Great Basin later in time. Given the lack of robust chronological data for Western Fluted points, however, it is difficult to evaluate the temporal accuracy of their proposal.

Paleoarchaic (12,800–7800 cal B.P.)

Paleoarchaic archaeological sites are much more common than Clovis sites, and are marked by Great Basin Stemmed projectile points, large bifacial knives, crescents, gravers, scrapers and, in rare cases, hand stones and milling slabs. The Great Basin Stemmed series includes a variety of regional variants (e.g., Cougar Mountain, Parman, Lind Coulee, and Windust; Tuohy and Layton, 1979), and is characterized by weakly shouldered specimens with long, square-to-contracting stems that are often edge ground. Flaked stone crescents are also diagnostic of this time period and, as with the projectile points, exhibit grinding along their concave and convex surfaces but not on their tips. Although the function of crescents remains unknown, they are almost always made of chert, even when associated projectile points are made from obsidian, which probably indicates they were used for more heavy-duty tasks. This is partially confirmed by wear patterns on their tips, which often have been resharpened to prolong their use-life (Beck and Jones, 1997, 2009).

Most researchers have traditionally thought that Great Basin Stemmed sites postdate Clovis, which is consistent with the post-12,800 cal B.P. age of the Paleoarchaic Period used here (Fiedel and Morrow, 2012). Beck and Jones (2010, 2012), following in the footsteps of Bryan (1979), have critiqued this position, arguing that stemmed points can be older than Clovis and reflect an entirely different culture that may have entered North America via a coastal route (see also Davis et al., 2012). This hypothesis is quite intriguing, particularly given the ancient findings at Paisley Caves and the Manis Mastodon site outlined above, and the recent reporting of stemmed points within a 13,223–12,964 cal B.P. component at Paisley Caves (Jenkins et al., 2012). This component is coeval with the Haynes et al. (2007) definition of Clovis (13,400–12,800 cal B.P.), but slightly older than the extremely narrow range (12,960–12,740 cal B.P.) proposed by Waters and Stafford (2007).

Beck and Jones' (2010: 104) summary of the oldest radiocarbon dates associated with stemmed points in the western United States shows similar findings, as only five of 25 overlap with Clovis, and none predate the Clovis interval (see also Goebel and Kenne, 2014). There are also no radiocarbon dates from the California coast or adjacent Channel Islands that overlap or predate the age of Clovis, as the oldest known date is 12,900 cal B.P. on human bone from Santa Rosa Island (Johnson et al., 2000; Rosenthal and Fitzgerald, 2012).

Early Holocene subsistence economies continued to focus on marshland habitats, but the addition of a few ground stone tools in a limited number of locations appears to signal a widening of the diet breadth, perhaps in response to the aridification of the northern Great Basin at this time (Rhode, 2000; Madsen et al., 2001; Wigand and Rhode, 2002; Grayson, 2011; see also chap. 2). A more intensive subsistence economy is also reflected by a variety of settlement-pattern shifts, with people exploiting resource patches that were never used before. Multiple rock-shelters located away from wetland areas were occupied for the first time (Beck and Jones, 1997; Graf, 2007), as were upland areas along the Sierran-Cascade Front. With regard to the latter, substantial Paleoarchaic occupations have been recognized in the Lake Tahoe/Truckee region, evinced by more than 60 Great Basin Stemmed points associated with a minimum of 15 site components (McGuire et al., 2006) and a major house structure found at Newberry Crater (Connolly, 1999). Both of these locations would have been quite marginal during the late Pleistocene and earliest Holocene, but may have become more productive later as the climate began to warm (Grayson, 2011).

Due to the dominance of tools assumed to be associated with hunting and butchering, some researchers argue that large game must also have been a primary subsistence resource during the Paleoarchaic (Amick, 1997; Elston and Zeanah, 2002; Elston et al., 2014). This position has not been borne out by the vast majority of archaeological sites with faunal remains (which are much more prevalent relative to the earlier Clovis interval), as these assemblages are dominated by small mammals, birds, fish, and insects, and have only minimal contributions from large game (Layton, 1970; Thomas, 1970; Grayson, 1988, 1993, 2011; Hockett, 2007; Madsen, 2007; Pinson, 2007; Broughton et al., 2008). Although ground stone tools remained rare before 10,200 cal B.P., they increased thereafter, particularly after 7800 cal B.P. Plant remains obtained from a number of components in eastern Nevada (e.g., Bonneville Estates, Danger Cave) include small-seeded plants like ricegrass, sand dropseed, and goosefoot (Rhode and Louderback, 2007), while sites farther north in Oregon (e.g., Newberry Crater) have yielded a wide range of fruits like chokecherry, salmon berry, and blackberry, as well as wetland plants like bulrush and a variety of other sedges (Beck and Jones, 2007).

Despite the broad-spectrum character of these adaptations, an analysis of flaked stone material types has led many researchers to conclude that Paleoarchaic settlement systems relied on a high degree of residential mobility (Kelly and Todd, 1988; Amick, 1996; Jones et al., 2003; Goebel, 2007). Similar to the work of Pinson (2011), the size of these settlement systems is determined by tracing the geographic distribution of obsidian artifacts known to originate from geochemically discrete quarry areas. These geographic distributions are often referred to as conveyance zones, with some researchers arguing that they reflect actual prehistoric foraging territories. Jones et al. (2003), for example, define three conveyance zones/foraging territories that overlap the project corridor. All three cover extremely large territories, ranging between 46,000 and 107,000 km^2, and extend from the northern Nevada border down to the central and south-central portions of the state.

Smith's (2010) more recent analysis of data from northwestern Nevada found that the Jones et al. (2003) reconstructions were much too large (see also Beck and Jones, 2011; Jones et al., 2012). His study, which included information from multiple sites located immediately adjacent to our project corridor, showed that early Holocene people occupying Fivemile Flat did not use obsidian from sources south of the Black Rock Desert, indicating that they spent most of their time in northwestern Nevada and southeastern Oregon. This suggests a conveyance zone less than half the size of what Jones et al. (2003) estimated. Smith (2010) also compared these findings to later dating assemblages (Northern Side-notched, Gatecliff, and Elko points) and found that their conveyance zones were smaller than the Paleoarchaic zones, indicating that people focused on a smaller number of high quality obsidian sources, perhaps through special logistical forays from more permanent residential sites. After 1300 cal B.P., however, the size of the of conveyance zone increased again (but not to the early Holocene level), perhaps indicating an increase in residential mobility (see also McGuire, 2002).

Even with the reduced size of the Paleoarchaic settlement systems proposed by these researchers (Smith, 2010; Beck and Jones, 2011; Jones et al., 2012), they are still more than 10 times larger than the largest systems observed in the worldwide ethnographic record (Kelly, 2011). The reliance on wetland plants, birds, fish, and small mammals also indicates that high levels of mobility would make little sense, as these resources would be difficult to deplete from a local basin, leading Madsen (2007) to hypothesize that high tool-stone diversity could have resulted from long-distance logistical forays by hunters, and/or the congregation of distinct populations during "jamborees" when people got together to share information, exchange goods, and find mates. Although few have seriously investigated this alternative perspective, it has received some mention in a few recent publications (Beck and Jones, 2012).

Despite the fact that most of the identified Paleoarchaic sites are surface phenomena, there are a handful of rock-shelters that have produced rich assemblages of perishable items dating to this period. Much of this material appears to be part of a single, widespread Catlow Twining basketry tradition composed of rectangular mats and flexible bags (Baumhoff, 1957; Adovasio, 1986). This tradition is represented in early Holocene components in southeastern Oregon (e.g., Fort Rock and Paisley caves), as well as western Nevada, where direct radiocarbon dates ranging from ca. 10,500 to 10,200 cal B.P. have been obtained from specimens excavated from Shinner Site A and Horse Cave. It is also expressed in the mats and bags associated with the Spirit Cave burial dated to ca. 12,600 cal B.P. (Cressman, 1942; Connolly et al., 1998; Fowler and Hattori, 2011).

Catlow Twining persisted for thousands of years in western Nevada until about 4800 cal B.P., when the more rigid Lovelock Wickerware and coiled baskets took over as the dominant basketry tradition in the Winnemucca, Humboldt, and Carson basins. Catlow Twining remained dominant farther north in the vicinity of the project corridor, however, where it is common in components dating between 1500 and 750 cal B.P. at Elephant Mountain and Last Supper caves. By about 1000 cal B.P., a completely different coiled basketry technology, as well as abundant seed beaters and winnowing trays, appeared in most of the western Great Basin with the arrival of Numic-speaking peoples (Bettinger and Baumhoff, 1982; Adovasio, 1986; but see Connolly, 2013), while Catlow Twining appears to have survived in northeastern California where it was traded to outlying areas by "ancestors of the Modoc or the Achomawi/Atsugewi peoples, among whom aspects of the tradition persist" (Fowler and Hattori, 2011: 215).

Finally, although human skeletal remains dating to the Paleoarchaic are quite rare, discovery of burials at Spirit Cave (ca. 12,600 cal B.P.) and the Buhl site of southern Idaho have produced some interesting findings. Morphological analyses of these skeletons, when combined with the findings from the Kennewick skeleton from the Columbia River, show a great deal of variability in the configuration of the skull, suggesting to some researchers that these early people had little affinity to modern native American populations, and that there were multiple waves of migration with some populations dying off deep in antiquity (Chatters, 2000, 2012). Subsequent DNA analysis of the Buhl skeleton and an additional ancient burial from Colorado, however, show that both individuals belonged to Haplogroup B, which persists in multiple modern native North American populations (Kaestle and Smith, 2001; Eshleman et al., 2003; Goebel et al., 2008).

Post-Mazama (7800–5700 cal B.P.)

We assign the beginning of this time period to 7800 cal B.P. but recognize that the environmental and cultural changes associated with it vary considerably across the Great Basin. Beck and Jones (2012), for example, argue that a major period of drought occurred between 8900 and 7800 cal B.P. and essentially ended the Paleoarchaic Period, including the use of Great Basin Stemmed projectile points and the adaptive focus on wetland habitats, which were either eliminated or severely compromised in many locations. They also argue that corner- and side-notched dart points originated at this time in the eastern and northern Great Basin but did not reach the western Great Basin until much later (hence the distinction between the long and short chronologies outlined above).

We favor the 7800 cal B.P. dividing line because: (1) there is no doubt that people no longer used Great Basin Stemmed points; (2) this was about the time of the Mt. Mazama volcanic eruptions that sent ash over wide areas of the northern Great Basin, including parts of the project corridor; (3) it generally corresponds to a continuance of middle Holocene drought conditions; and (4) it marks the appearance of Northern Side-notched projectile points and a wholly different adaptation than what had come before.

A number of researchers have speculated that middle Holocene climatic warming may have either reduced human populations or led them to totally abandon the central Great Basin during this period (Baumhoff and Heizer, 1965; Layton, 1985; Grayson, 1993, 2011; Beck, 1995; Schroedl, 1995; Milliken and Hildebrandt, 1997; Beck and Jones, 2012). These conditions appear to have been most severe, and their effects on human populations most extreme, between ca. 8500 and 6300 cal B.P., but it is likely that xeric conditions prevailed until ca. 4500 cal B.P. (see chap. 2; Wigand and Rhode, 2002). In this scenario, better-watered areas along the western, northern, and eastern portions of the Great Basin—perhaps including the more well-watered regions of the Humboldt River watershed—may have sustained human occupation during this time or even acted as refugia for populations who once occupied the hinterland areas of the northern and central Great Basin (Milliken and Hildebrandt, 1997; McGuire, 2007: 170–172). As supporting evidence for depopulation, Beck (1995: 229) points to a series of six rock-shelters in the central Great Basin that have occupation sequences of at least 7800 years, but apparently were abandoned from about 7400 to 5700 cal B.P. because of adverse climatic conditions that presumably affected the resource base. Instead of abandonment, Madsen (2002: 399–400) suggests that as marsh settings became increasingly stressed during the middle Holocene, populations simply shifted to more productive upland land-use strategies. Similarly, a recent compilation of Great Basin radiocarbon dates by Louderback et al. (2011) led them to conclude that most regions were probably not abandoned altogether, but population densities definitely declined. Whatever the larger pan-regional conditions were during the middle Holocene, it is reasonable to conclude that populations across the Great Basin, including the study corridor, were subject to increased levels of environmental and resource stress during this time.

As previously mentioned, the primary time-sensitive artifacts for this period are Northern Side-notched projectile points. They have been found in a variety of contexts in central and eastern Nevada (Delacorte et al., 1992; Hockett, 1995; Thomas, 2013) and western Utah (Graf, 2007), but most are found in an arclike distribution across the northern Great Basin (Delacorte and Basgall, 2012; Thomas, 2013). Important locations in the vicinity of the current study area include Tule Valley (McGuire et al., 2004), the Tosawihi quarry area, where its presence was used to help date the inception of quarry production (Elston and Raven, 1992), the Humboldt River at Battle Mountain Pasture (McGuire and King, 2011), Rye Patch Reservoir (Davis et al., 1976; Rusco and Davis, 1979; Elston and Raven, 1992; King and McGuire, 2011), the High Rock Country (Layton, 1985), and Surprise Valley (O'Connell, 1975; O'Connell and Inoway, 1994).

The northern distribution of Northern Side-notched points has led several researchers to suggest that these points are "ethnic markers" of more northerly populations who occupied the Columbia Plateau (O'Connell, 1975; Layton, 1985; Delacorte and Basgall, 2012). Along these lines, Chatters (2012: 148–151) argues that the eruption of Mt. Mazama at around 7600 cal B.P., and the resulting tephra blanket across much of southern Oregon, had the effect of pushing Plateau peoples deeper into northern Great Basin. As Layton (1985: 192–194) argues, these Plateau groups were eventually displaced by populations emanating from the south in the central Great Basin at the beginning of the Early Archaic Period. He bases this argument primarily on abrupt discontinuities of hydration values associated with Northern Side-notched and Gatecliff series projectile points at Last Supper Cave and Hanging Rock Shelter (see also Layton, 1970).

Probably the most well-known Post-Mazama manifestation in the larger study region is found in Surprise Valley and is represented by a series of highly formalized, semisubterranean house structures. O'Connell (1971, 1975) includes these features in his Menlo Phase, dating between 7400 and 5200 cal B.P. Morphologically distinctive artifacts from this period and associated with Northern Side-notched points include antler wedges, mortars with V-shaped bowls and pointed pestles, T-shaped drills, tanged blades, and flaked stone pendants. Significantly, all these artifacts appear to be of generally northern derivation, with comparable forms identified at numerous sites on the Columbia Plateau but rarely at more southern Great Basin localities. Subsistence remains at sites of this period in Surprise Valley, the Klamath Basin, and other localities show some hunting of bison and elk, which decrease in abundance or disappear altogether in the record of later occupations from more southern localities (O'Connell, 1971, 1975; James, 1983; Sampson, 1985; Grayson, 2011). Given the extreme climatic conditions of the middle Holocene, it is perhaps not surprising that sites dating to this time occur in northern latitudes of the Great Basin and are generally associated with marshes or permanent water sources; contemporaneous components manifesting much the same lakeshore adaptation have been identified at Nightfire Island on Lower Klamath Lake (Sampson, 1985) and at Fort Rock Basin in Oregon.

Chatters (2012: 149–151) characterizes the land-use strategy associated with these Post-Mazama foragers as "opportunistic sedentism" and relates it specifically to the Surprise Valley pattern. He suggests that during periods of resource abundance, these residentially mobile people, who normally had little reliance on either storage or use of temporary field camps, would build substantial semisubterranean houses in which they would reside for several months to several years. Chatters identifies a number of similar archaeological manifestations across the Columbia Plateau and northern Great Basin, and argues that opportunistic sedentism prevailed until about 6000 cal B.P.

It should be emphasized, however, that the Surprise Valley variant of the Post-Mazama Period, with its formal earthen structures and unique assemblage profile, remains somewhat of an anomaly with regard to the more arid regions to the east. Notwithstanding the occasional presence of Northern Side-notched projectile points, the archaeological record in these areas is decidedly less dramatic, often characterized by small hunting camps and stoneworking areas. Based on the co-occurrence of Northern Side-notched projectile points, sagebrush/grassland habitats, and the faunal remains of bison, elk, and other large game at a limited number of archaeological sites dating to this interval, Delacorte and Basgall (2012) hypothesize that the hunting of these animals may have been a primary focus of the economy.

Early Archaic (5700–3800 cal B.P.)

Climatic conditions began to improve a little after 6300 cal B.P. and became significantly cooler and wetter between about 4500 and 2600 cal B.P. (see chap. 2; Wigand and Rhode, 2002). The amelioration of drought conditions at the beginning the Early Archaic Period is marked by major changes in the archaeological record. Gatecliff and Humboldt series points became dominant throughout the region, largely replacing Northern Side-notched points. In Surprise Valley, the large, semisubterranean earth lodges of earlier times were replaced by generally smaller brush wickiups, built atop comparatively shallow depressions (O'Connell and Ericson, 1974; see also Creger, 1991). Mortars with V-shaped bowls and pointed pestles apparently were replaced with U-shaped grinding bowls and flat- or round-ended pestles, and perhaps greater use of the milling stone (O'Connell, 1975). Subsistence remains suggest an increasing reliance on waterfowl, lagomorphs, fish, and other small animals that could be captured en masse with the aid of nets (James, 1983).

Elston (1982: 193) notes that Early Archaic toolkits represent a break with their earlier counterparts. Projectile points and other tools from this period tend to be smaller, have less regularized forms, and were probably less specialized with regard to function.

The use of unretouched flakes increased, while steep-angled scraper forms decreased in popularity. Milling slabs and hand stones for processing seeds are quite common in Early Archaic components for the first time. It is also at this time that shell beads—most notably spire-lopped *Olivella* variants from the Pacific coast—made their way into the Great Basin, suggesting increased levels of exchange (Bennyhoff and Hughes, 1987). In the Upper Humboldt River watershed, McGuire et al. (2004) characterize the Early Archaic Period (Pie Creek Phase) as exhibiting more generalized assemblages with somewhat more informal, core-flake-based lithic toolkits; a fully developed plant-processing technology represented by an increased number of milling stones; and dietary remains consisting mostly of easily obtainable plants, small game, and small fish.

These more generalized Early Archaic assemblages may have been produced within a settlement framework of comparatively brief occupations by residentially mobile, bandlike foragers. As observed elsewhere in the Great Basin, intersite differences in assemblages dating to this time are minor regardless of their size or proximity to resources (Delacorte, 1999: 359–389; McGuire et al., 2004). Missing are the task-specific sites that suggest logistically well-organized systems, which are recognized in the later-dating Middle Archaic components (see also Leach, 1988: 183).

Middle Archaic (3800–1300 cal B.P.)

The higher degrees of effective moisture continued into the Middle Archaic Period (see chap. 2; Wigand and Rhode, 2002). When placed within a wider context, this period is seen across much of the Great Basin and California as having been a cultural florescence or "golden age." Along with the increasing sophistication in material culture, as represented by the Lovelock Culture in the western Great Basin, other dramatic developments included the rise of true settlement hierarchies and, notwithstanding Surprise Valley, the first substantiated occupation of large semisedentary base camps. Such large, semisedentary residential complexes have been documented along the Humboldt Lake bed (Livingston, 1986), Carson Sink (Raven and Elston, 1988; Raymond and Parks, 1990; Kelly, 2001; Madsen, 2002), the Humboldt River near Battle Mountain (McGuire and King, 2011), and the northern Great Basin in the Lake Albert–Chewacan marsh basin (Oetting, 1990; see also Jenkins et al., 2000). These findings are consistent with various excavations in the northwestern Great Basin, including the Honey Lake region and the Reno area, where large accumulations of Middle Archaic middens and artifacts have been identified at a series of ecological "sweet spots" (Elston et al., 1994; see also Riddell, 1960; McGuire, 1997). Similar manifestations have been reported in northeastern Nevada (McGuire et al., 2004) and the eastern Great Basin, where in the latter case a stable, pithouse-oriented residential pattern is recognized well before the rise of Fremont horticulture (Madsen and Simms, 1998). McGuire and Hildebrandt (2005; Hildebrandt and McGuire, 2002) argue that the Middle Archaic Period may actually represent the "trans-Holocene highpoint" of residential stability in the nonagricultural areas of the Great Basin, but others note that relatively high degrees of tool-stone diversity found in some of these assemblages actually reflect continued far-ranging residential mobility (Delacorte and Basgall, 2012).

Closer to the eastern sector of the project corridor, this settlement transition is accompanied by across-the-board increases in regional archaeological visibility, with initial occupations of James Creek (Elston and Budy, 1990) and Lower South Fork (Heizer et al., 1968; Spencer et al., 1987) shelters, and expanded use of Pie Creek Shelter (McGuire et al., 2004). Noteworthy in this regard is the Dry Susie Creek Site (Reust et al., 1994), located near Carlin, which contains five prehistoric house structures radiocarbon dated to between about 3800 and 2600 cal B.P., and which yielded an abundance of Elko points and large-mammal remains. The Middle Archaic component of the site is inferred to have functioned as a residential base camp.

Along the western edge of the Great Basin, proximal to the western portion of the project corridor, the most dramatic examples of this increased visibility are found at expansive midden complexes such as Karlo (CA-LAS-7; Riddell, 1960; Hughes and Bennyhoff, 1986), and adjacent base camps in Secret Valley (LAS-206 and -1705/H; McGuire, 1997). These sites contain a proliferation of house structures, hearths, ovens, and burials, as well as some of the richest and most diverse assemblages of artifacts and subsistence remains identified in the region. Along the southwestern shore of Honey Lake, the recently identified Tufa Village Site (26Wa2640) contains the remnants of six house structures radiocarbon dated to between 2780 and 3830 cal B.P. (Young et al., 2009). Similar settlement elaborations have also been observed in Surprise Valley (O'Connell, 1971, 1975) and Massacre Lake (Leach, 1988: 183), with the latter showing the rise of residential sites with midden for the first time.

It is from this time in the Middle and Upper Humboldt watershed that we also see proxy evidence of population increase in the form of radiocarbon dates and projectile point frequencies. At Little Boulder Basin, Cannon (2010; see also Schroedl, 1995) has compiled 124 radiocarbon dates, nearly 1000 projectile points, and several hundred obsidian hydration readings. This record indicates only sporadic occupation prior to about 3200 cal B.P., with subsequent increases in population density and occupation intensity. Large-scale surveys of Humboldt River bottomlands near Battle Mountain (McGuire and King, 2011) documented a preponderance of Elko series projectile points, followed by fewer Late Archaic variants. When this frequency trend is standardized for time and landform association, McGuire and King, conclude, the most intense period of occupation appears to have been between 2300 and 650 cal B.P., i.e., toward the latter half of the Middle Archaic and into the Late Archaic Period. In upland areas adjacent to Battle Mountain in Whirlwind Valley, a similar profile of Middle and Late Archaic projectile point frequencies was also documented (Elston and Bullock, 1994). In the James Creek Shelter area, Elston and Budy (1990) also report increasing projectile point frequencies though the Middle and Late Archaic, culminating in the highest representation in the latter. In reviewing the frequency of dated components from a large-scale sample survey in the Crescent Valley/Cortez area, Delacorte et al. (1992: 118–120) conclude that there was almost no significant occupation of this area prior to 4500 years ago. The record indicates a full-blown settlement hierarchy replete with lowland residential bases, upland root camps, collecting stations, and logistical hunting sites after this time.

This period has also been associated with the rise of logistical large-game hunting (Hildebrandt and McGuire, 2002; McGuire and Hildebrandt, 2005; see also Broughton and Bayham, 2003), although there is a growing body of data indicating that this trend was initiated in the Early Archaic Period (see chap. 12). A keystone site in this analysis is Pie Creek Shelter, located less than 10 km from the project corridor north of Elko (McGuire et al., 2004). Pie Creek Shelter contains a 3.5 m deep stratified cultural deposit spanning the past 5600 years. Four stratigraphic components were identified. The most important break is between middle Holocene deposits and those dating to the Middle Archaic. Not only does the density of large mammal remains increase sevenfold, but the ratio of artiodactyls and other large game to rabbits and small game (the "artiodactyl index") shows a marked increase (McGuire and Hildebrandt, 2005: 700–701). Of equal importance is the fact that the increased focus on large mammals was accompanied by an expansion in both the density and frequency of economic plants, including high-cost small-seeded taxa believed to be associated with women's subsistence activities. McGuire and Hildebrandt (2005) note a nearly identical faunal trend at Gatecliff Shelter (Thomas et al., 1986), as well as an explosion in the frequency of milling equipment in components postdating 4500 cal B.P. (see also Thomas, 2013). Similarly, Middle Archaic strata at South Fork Shelter contain higher relative frequencies of large-mammal remains than do later-dating components (Heizer et al., 1968; Spencer et al., 1987).

The results from Pie Creek and Gatecliff shelters, along with a variety of other archaeological and ethnographic data, have fueled a wider theoretical debate about the role of long-range logistical hunting by males in prehistoric and other traditional societies. This debate is rooted in human behavioral ecology and revolves around the question of whether the taking of large mammals is simply a reflection of efficient provisioning or a signal of participation in other spheres of culture only indirectly tied to subsistence, such as various prestige-garnering strategies that are thought to bestow on their participants—successful male hunters—greater individual fitness in the form of increased social attention, improved access to alliance networks, and ultimately expanded mating opportunities (McGuire and Hildebrandt, 2005: 696). In contrast to this focus on hunting by males at this time, the more intensive use of high-cost plants by women, as well as a tendency to locate base camps in settings that optimize women's foraging activities (Zeanah, 2004), may have compensated for the problematic energetics of large-game hunting.

While aspects of this hypothesis have been contested (Broughton and Bayham, 2003; Byers and Broughton, 2004; Hockett, 2005; Codding and Jones, 2007; Jones et al., 2008; Broughton and Cannon, 2010; Jones and Codding, 2010; Winterhalder and Bettinger, 2010; Broughton et al., 2011), much of the basic subsistence and settlement framework has not (e.g., increases in the ratio of artiodactyl remains to smaller-sized taxa; expansion of female foraging production; increased logistical activity and the rise of settlement hierarchies; relative increases in sedentism). These are applicable to Middle Archaic assemblages across much of the Great Basin.

Another aspect of Middle Archaic hunting activity is the communal antelope drive trap. Hockett and Murphy (2009) summarize the evidence for these facilities from north-central Nevada, arguing that their use dates from at least 5000 years ago up through the Terminal Prehistoric Period (see also Hockett et al., 2013). The most recent dating of these features is based on their still-extant wing and corral walls fashioned from juniper wood; indeed, several such trap superstructures have been identified within the project area and were subject to study (see chap. 16). Hockett and Murphy (2009) argue that spatially restricted, high concentrations of contemporaneous projectile points represent kill zones at trap locations that have otherwise deteriorated away. They note that many of these projectile point concentrations containing Archaic dart points cluster very near traps of recent vintage (i.e., those with juniper superstructures), concluding that this particular type of hunting has a long history, and that these locations have been productive antelope migration and habitat areas over several millennia. The highly visible communal nature of this hunting practice, no doubt including the participation of much of the available male hierarchy, suggests an obvious venue for prestige and other signaling behaviors to play out, and may be related to the rise in logistical hunting described above (Jensen, 2007; see also Hockett, 2005 for a differing view of the social context of this form of communal hunting).

The Middle Archaic also saw the rise and development of an unprecedented phase of tool-stone-quarry production and biface manufacturing in the Great Basin, associated with major obsidian, basalt, and cryptocrystalline silicate (CCS) sources (Basgall and McGuire, 1988; Elston and Raven, 1992; Gilreath and Hildebrandt, 1997, 2011; Hildebrandt and McGuire, 2002; McGuire, 2002, 2007; Smith, 2010; McGuire and King, 2011). In the western Great Basin, this includes increases in biface production associated with the South Warners, Bordwell Springs, and Buffalo Hills obsidian source groups (McGuire, 2007: 173). Also observed in this same area is a decline in the diversity of obsidian sources in regional assemblages dating to the Middle Archaic (McGuire, 2002, 2007). This suggests that populations were regularly targeting a few quarry localities, as contrasted with more ad hoc tool-stone procurement conducted during the course of the seasonal subsistence round practiced by earlier populations. This same pattern has been confirmed by Smith (2010: 880–881) in his analysis of trans-Holocene obsidian source variability in the northwestern Great Basin. This form of Middle Archaic obsidian production, ultimately resulting from the manufacture of hunting-related tools and weapons, may be tied to the rise in long-range logistical hunting activity and prestige systems (Hildebrandt and McGuire, 2002; Smith, 2010: 880; see also Byrd et al., 2010).

Along similar lines, and with particular significance for tool-stone production in the Willow Creek area (northeast of Battle Mountain) of the project corridor, the Tosawihi quarry stands out. This distinctive white, opalitic tool stone dominates local and regional assemblages and has been the focus of intensive archaeological investigations conducted by Elston and Raven and their associates (1992), as well as others (Rusco, 1976, 1979). Tosawihi is the only tool-stone quarry in the Great Basin for which there is an unambiguous ethnographic reference—the Tosawihi ("White Knife") Shoshone (Steward, 1938: 162). This would certainly indicate late-prehistoric use of the quarry and, indeed, almost all the radiocarbon dates obtained from actual quarry pits at Tosawihi range from approximately 1000 to 200 B.P. (Elston and Raven, 1992: 606). On the other hand, projectile points recovered from the quarries and surrounding area suggest quarry visitation for a much longer period. Elston (personal commun., 2004) believes that much of the potentially older quarry deposits at Tosawihi have been buried by colluvial movement, and that the radiocarbon profile simply reflects the last episodes of pit excavation, not an accurate measure of quarry production over time. Elston observes that it is entirely possible that Tosawihi quarry production peaked during the Middle Archaic in much the same manner observed at obsidian quarries elsewhere in the western Great Basin, although archaeological investigations have yet to adequately demonstrate this.

THE LOVELOCK CULTURE (CA. 4000–1000 CAL B.P.). As we mentioned at the outset of our discussion of the Middle Archaic, there seems to have been increasing sophistication in material culture and other cultural developments at this time. This is represented by the Lovelock Culture in the western Great Basin. The study corridor passes somewhat north of the lake country in which the Lovelock Culture was originally defined, but it seems increasingly clear that its influence may have extended across a much wider area, including the middle and upper reaches of the Humboldt River watershed. Also in this regard, the project corridor passes directly through the distributary channel system of the Quinn River into the Black Rock Desert.

The Lovelock Culture label was first coined by Loud and Harrington in 1929 based on their work at Lovelock Cave. It has been applied since by Heizer (1951), Heizer and Krieger (1956), Grosscup (1956), Bennyhoff and Heizer (1958), Heizer and Napton (1970), and Elston (1986) to many cave and cache assemblages from the lake areas of western Nevada. It is synonymous with a spectacular array of material culture—most notably perishable items—represented in many cave sites of this region. These sites often contain large numbers of baskets (e.g., various coiled forms, Lovelock Wickerware), nets, fur and bird-skin robes, mats, cordage, atlatls, darts, bone awls, ornaments, and finished projectile points, but little debitage or food waste. Also noteworthy in this regard, Bennyhoff and Hughes (1987: 161) argue that trade of marine shell beads into the Great Basin from California reached its peak in the first part of the Middle Archaic, between roughly 3700 and 3400 cal B.P.

Basketry at the start of this period in both the northern Great Basin (Oregon, northwestern Nevada) and western Great Basin (Carson and Humboldt Sinks; Pyramid Lake) appears to have been dominated by various twined forms, including the Catlow Twining mentioned earlier (Adovasio, 1986; Fowler and Hattori, 2011). At Kramer Cave in the Winnemucca Lake area, Catlow Twining accounts for 72% of the assemblage and dates to around 4700 cal B.P. It remained the dominant form in the northern Great Basin well into the Late Prehistoric Period, but was relegated to a minority type (perhaps a trade or exchange item) in the western Great Basin, replaced by various coiled forms and then by the distinctive Lovelock Wickerware at about 2600 cal B.P. (Fowler and Hattori, 2011). Interestingly, Fowler and Hattori (2011: 21) place the boundary between these northern and western basketry traditions near the Black Rock Desert, i.e., just south of the project corridor.

While early iterations of the Lovelock Culture emphasized trait lists, more recent studies have focused on its adaptive characteristics associated with riverine, lake, and other wetland habitats. At Stillwater Marsh, Raven and Elston (1988) document expansive middens replete with human burials, a high frequency of structures and features, flaked and ground stone artifacts, and a variety of marsh-taxa faunal remains (fish, waterfowl, shellfish, small mammals). These sites are in all likelihood semisedentary base camps from which long-range logistical forays emanated, and are generally consistent with our characterization of Middle Archaic lifeways. For example, osteopathologies such as knee and ankle arthritis documented in male skeletal remains from Stillwater Marsh (Hemphill and Larson, 1999; Larsen and Hutchinson, 1999) show extreme levels of mobility, probably tied to reoccurring long-distance hunting forays in pursuit of large game; in contrast, these same pathologies are less frequently expressed in female remains, suggesting more sedentary activities (McGuire and Hildebrandt, 2005: 706). Several researchers have argued that the Lovelock adaptation, crosscutting both the Middle and Late Archaic in the western Great Basin, was the result of wetland resource intensification (Raymond and Parks, 1990; Hildebrandt, 1997; McGuire and King, 2011). Madsen (2002) goes further, suggesting that this wetland adaptation (i.e., his “lowland adaptive strategy”) is instrumental in understanding prehistoric adaptations throughout the Great Basin.

Moreover, recent studies suggest that this Lovelock pattern was not restricted to lacustrine zones in the western Great Basin but was similarly manifested in the middle reaches of the Humboldt River near Battle Mountain (McGuire and King, 2011). Insofar as the Humboldt River drainage encompasses well over half the project corridor, it is reasonable to consider the implications of this adaptive pose with respect to project assemblages. Furthermore, in a region otherwise bereft of major staples, such as pinyon pine, the proximity of the Humboldt River and its tributaries may have been crucial to the occupation of this region. At Battle Mountain Pasture (also known as the Argenta Marsh) at the confluence of the Humboldt River, Rock Creek, and Reese River, there is evidence of an explosion of settlement activity on the floodplains and meander belts associated with remnant stream channels dating to between about 5600 and 700 cal B.P. (McGuire and King, 2011). Increases in the frequency of fire-affected rock features and milling equipment suggest that wetland resource intensification, similar to that identified at Stillwater Marsh, reached its apogee between 2300 and 700 cal B.P. (i.e., the latter part of the Middle Archaic and Late Archaic periods) before falling off dramatically.

As to the people representing the Lovelock Culture, Hattori (1982; see also Moratto, 1984; Fowler and Hattori, 2011: 213) has noted many similarities with Windmilller and other California Central Valley cultures, postulating a transregional Penutian ethnolinguistic affiliation. Recent mitochondrial DNA studies conducted on both prehistoric skeletal remains and modern Native American populations lend further support to this hypothesis (Kaestle and Smith, 2001). Using skeletal material from the Stillwater and Pyramid Lake regions radiocarbon dated to the Lovelock time frame, Kaestle and Smith demonstrate that the remains are most closely affiliated with modern Californian Penutian speakers. Conversely, the Stillwater and Pyramid Lake skeletal populations show little statistical haplogroup affiliation with modern Numic groups. At least in the western Great Basin, so-called pre-Numic populations, including those peoples represented by the Lovelock Culture, may have had a strong genetic, linguistic, and cultural affiliation with central California.

Late Archaic (1300–600 cal B.P.)

Most researchers would now agree that the period between 1300 and 600 cal B.P. was a time of profound cultural change along the Northern Tier of the Great Basin, possibly induced by severe drought, population increases, resource intensification, ethnic displacements, changes in technology, social conflict, or some combination of these. Some of these changes are thought to have occurred in the latter half of this period after approximately 1000 cal B.P., thus potentially splitting the Late Archaic into an earlier phase, where conditions may have been more like the preceding Middle Archaic Period, and a later phase marked by environmental and social disruptions.

To illustrate this issue, consider the Medieval Climatic Anomaly (MCA). This was an era composed of two distinct periods of severe drought dated between 1100 and 890 cal B.P. and 790 and 650 cal B.P., and separated by an interval of relatively high effective moisture (see chap. 2). Its impact appears to have been felt across the West, and it is thought to have severely disrupted settlement-subsistence systems in both California and the Great Basin (Jones et al., 1999; Graham et al., 2007). The MCA probably had its most profound effects during the latter half of the Late Archaic, although its more regional effect on cultural patterns in the northern Great Basin is not well understood. It is the case, however, that the changes in population densities, technology, and resource intensification, and perhaps even the Numic expansion into the northern Great Basin, must be considered in light of these important climatic events.

Our understanding of the Late Archaic is further complicated by the Great Basin projectile point sequence, which marks this period by a series of small corner-notched projectile points variously referred to as Rose Spring, Eastgate, or Rosegate (called Rosegate here). As a group, they signal the introduction of bow-and-arrow technology in the area but *crosscut the entire time period* (i.e., there is no way to break up the Late Archaic Period into smaller temporal intervals using projectile points alone). There seems to be a great deal of regional variability regarding the temporal span of these point forms, both on the early and late ends of their tenure. Although a significant amount of debate surrounds the origin of bow-and-arrow technology (e.g., Ames et al., 2010; Hildebrandt and King, 2012), the majority of data show that it appeared first on the Columbia Plateau around 2300 years ago (Webster, 1980: 65; Chatters et al., 1995: 757; Ames et al., 1998: 116) and along the Sierran/Cascade Front in the northwestern Great Basin at about 1800 cal B.P. (Hildebrandt and King, 2002), with progressively later (post-1400 cal B.P.) introductions elsewhere in the Great Basin. Rosegate points seem to have persisted a few hundred years beyond the post-600 cal B.P. close of the Late Archaic in much of the northern Great Basin as well (Milliken, 2000; Hildebrandt and King, 2002; Delacorte, 2008; Delacorte and Basgall, 2012).

Unlike the continuity represented in the projectile points, basketry types and technology seem to have completely turned over sometime after 1000 B.P. within the western Great Basin. Gone is the several-thousand-year tradition of Lovelock Wickerware, replaced by various open, simple and diagonally twined forms, including the seed beater and triangular winnowing tray, and coiled basketry characteristic of the prehistoric and historic-period Numa. Based on these findings, many have concluded that some form of ethnic or cultural replacement also occurred at this time, perhaps in the latter half of this period or slightly thereafter (Bettinger and Baumhoff, 1982; Adovasio, 1986; Adovasio and Pedler, 1994). It is important to note, however, that coiled basketry presumed to be quite late in southeastern Oregon has recently been shown to be at least 2500 years old based on direct radiocarbon dating, arguing against it being a signature trait of the Numa (Connolly, 2013).

Despite these issues with coiled basketry, the population replacement model is supported by mitochondrial DNA studies that show a statistically different haplogroup affiliation between contemporary Numic groups in the western Great Basin and prehistoric skeletal populations found at Stillwater Marsh and Pyramid Lake (Kaestle and Smith, 2001). If, indeed, Desert Series projectile points are Numic markers (Delacorte, 2008; see also Holmer, 1986; Janetski, 1993; Reed, 1994; Hildebrandt and King, 2002) and Numic populations were relatively late arrivals to northern fringe of the Great Basin (i.e., perhaps after 600 cal B.P.), the question arises whether Rose Spring points continued to be used into the Terminal Prehistoric Period in this region.

As we reviewed in the Middle Archaic discussion, most researchers argue that prehistoric populations began to ramp up at some point during the Middle Archaic and that this increase extended into the Late Archaic. This is supported by cumulative frequencies of radiocarbon dates from the western Great Basin (Louderback et al., 2011; cf. Surovell et al., 2009), as well as increases in the frequency of time-sensitive projectile points. With regard to using projectile points as proxies for population density, virtually every large excavation or survey project from the region reports either Elko or Rosegate series points as the dominant form (Thomas, 1971, 1988; Livingston, 1986; Elston and Budy, 1990; Delacorte et al., 1992; Elston and Raven, 1992: 613; Elston and Bullock, 1994; Hildebrandt and King, 2002, 2012; Delacorte, 2008; Cannon, 2010: 83; McGuire and King, 2011). Furthermore, most researchers attempt to adjust these absolute counts by time (e.g., points per century for each period) and it is almost always the case that Rosegate points predominate, for the simple fact that the Middle Archaic lasted five times longer than the Late Archaic. There are any number of serious issues that affect the use of projectile points as proxies for population density (which are further reviewed in subsequent chapters of this volume). Notwithstanding these concerns, the evidence at hand would indicate an increase in prehistoric populations along the project corridor, commencing at some point during the Middle Archaic, and that this increase extended into the Late Archaic. As to whether these population increases extended through the *entire* Middle and Late Archaic periods (including the MCA) is an ongoing research question.

Often tied to population growth documented at this time is the concept of resource intensification, i.e., as population density approaches the carrying capacity of the environment, people will intensify their resource procurement by adding a variety of lower-ranked foods to the diet (Elston, 1986: 145). For example, Late Archaic occupation of James Creek Shelter (Elston and Budy, 1990) is represented by a complex series of overlapping and intersecting living surfaces and associated hearths. Absolute densities of many artifact categories (including perishable items) reach their highest levels in deposits dating to this period, and there are sharp increases in the number of smaller mammals, such as rabbits, hares, and ground squirrels. Local tool stones dominate the assemblage, and exotic cherts and obsidians virtually disappear. Similarly, at South Fork Shelter (Spencer et al., 1987), deposits dating to the early part of the Late Archaic Period have yielded a wealth of organic materials and artifacts suggestive of a much more intensive occupation. Local cherts were the preferred tool stone at this time; obsidian virtually drops out of the assemblage. Similarly dated deposits at Pie Creek Shelter (McGuire et al., 2004) also yielded the highest densities of cultural materials (artifacts, debitage, bone, perishable materials)—all suggesting more intensified occupation. Subsistence practices were increasingly directed at locally available small mammals, fish, and seeds. The use of exotic tool stones dropped to its lowest level, replaced in part by a focus on the local chert emanating from a nearby quarry site.

Late Archaic intensification is also reflected in the eastern Great Basin record of semisedentary Fremont peoples, some of which came into contact with eastern Nevada hunter-gatherers during this interval. The Fremont were centered in Utah and relied on a range of subsistence practices, from full-time foraging to full-time horticulture (Madsen and Simms, 1998; Hockett and Morgenstein, 2003). Archaeological evidence indicates that the Parowan Fremont migrated westward from Utah into the region beginning about 1600 cal B.P. They disappeared by about 700 cal B.P., replaced by more mobile hunter and gatherer groups (Marwitt, 1986: 161). The reason for their decline in the study region is not clear, but the Fremont may simply have been outcompeted for natural resources by the mobile groups (Bettinger and Baumhoff, 1982).

In the northwestern Great Basin and on the Modoc Plateau, there was a significant decline in the use of large game relative to small game during the Late Archaic (Carpenter, 2002), as well as a dramatically expanded use of upland habitats at about 1000 cal B.P. (Delacorte, 2002). The latter appears to have depended heavily upon the seasonal exploitation of root crops, such as epos (yampah). Although these root crops were important resources in earlier times, their more intensive use and storage during the Late Archaic might reflect a fundamental shift in land-use patterns and economic organization, which seems to have been duplicated over most of the northwestern Great Basin. Similarly, Waechter and Andolina (2005) report on a massive camus root processing complex, with multiple oven and hearth features, dating to the latter half of the Late Archaic along the eastern front of the Sierra Nevada north of Reno. A similar pattern of root intensification is observed along the northern margins of the Great Basin in the Fort Rock area (Jenkins et al., 2000: 55): at about 1500 cal B.P., there was a concentration of residential activity in productive upland root habitats that included a proliferation of talus slope storage facilities. As both Delacorte and Jenkins point out, the consistently late appearance of this upland pattern suggests that it developed in response to a similarly widespread population/resource imbalance.

Noteworthy here is that the western portion of the pipeline corridor passes through particularly productive epos habitat in the Barrel Springs area (O'Connell et al., 2008; Trammell et al., 2008). The return rates associated with epos procurement may have been orders of magnitude higher than those for seed collecting, and epos should have been collected whenever possible (Jenkins et al., 2000: 52; see also Thoms, 1989). Outside these identified root zones to the east, Leach (1988) documents more intensified occupation and resource intensification in the Massacre Lake area beginning in the Middle Archaic and accelerating in the Late Archaic Period.

An exception to this prevailing consensus is provided by Cannon (2010) at Little Boulder Basin, north of Carlin (see also Schroedl, 1995). Summarizing excavations at more than 50 prehistoric sites conducted over several decades, Cannon and his associates (see also Ugan and Bright, 2001; Bright, 2002; Ugan et al., 2003; Broughton et al., 2011) conclude that, due to changes in foraging efficiency and technological investment, Late Archaic populations appear to have hunted large game more and processed plant foods less than either previous Middle Archaic groups or later Numic peoples.

This alternative view appears to be inconsistent not only with the local evidence for resource intensification enumerated above, but also with the florescence of agriculture at this time in the Fremont culture zones located directly to the east. Agriculture is perhaps the ultimate expression of prehistoric resource intensification, and it is hard to imagine that the conditions that gave rise to such a development would have the opposite expression in a nearby area. Evidence of farming has not been documented along the study corridor, but components containing Fremont-like pottery have been identified in the Elko area and elsewhere in northeastern Nevada (Hockett and Morgenstein, 2002). Given this larger context, it seems possible that the primary locus of habitation may have shifted to another location during the Late Archaic, leaving Little Boulder Basin as an area used primarily for hunting. Such a settlement-pattern change would create significantly different fauna profiles between adjacent areas, differences that are increasingly being documented through the Great Basin (see Hockett, 2015).

As described above for the more eastern areas of the project, resource intensification during the Late Archaic was often accompanied by the use of more locally available tool stone, such as cherts and other CCS, and a corresponding drop-off in more exotic material such as obsidian. This trend has been interpreted in a variety of Great Basin contexts as reflecting local resource intensification, settlement contraction, and overall territorial circumscription (Basgall and McGuire, 1988; Elston and Budy, 1990; Gilreath and Hildebrandt, 1997; Bettinger, 1999a; Smith, 2010). To the west where obsidian dominates local assemblages, these settlement shifts have been tracked by changes in obsidian source diversity. In the northwestern Great Basin and on the Modoc Plateau, Middle Archaic populations may have been targeting a few key quarry zones for the purpose of biface production, but by about 1000 cal B.P., this form of production had ceased, giving way to a more disparate pattern of tool-stone procurement by more locally based populations that perhaps featured increased reliance on trade and exchange, as well as scavenging of older archaeological materials. Such a pattern apparently had the effect of *increasing* source diversity during this time (McGuire, 2002; see also Chatters and Cleland, 1995; Smith, 2007, 2010). This inference is complicated in this region, however, by the geographically extensive profusion of obsidian pebbles and cobbles, often originating from disparate source locations, found in secondary alluvial contexts (Young, 2002a; also see chap. 2).

While changes in tool-stone source profiles have been useful for reconstructing mobility patterns, the evidence is less conclusive with regard to major changes in flaked stone technology. Profiles of obsidian quarry use at the Coso source in southeastern California have identified an early and middle Holocene pattern of both core and biface production; during the Middle Archaic, this was followed by a much more intense period of activity directed almost exclusively at the production of standardized bifaces (Gilreath and Hildebrandt, 1997, 2011). As we have noted, a similar shift may have occurred at the Tosawihi Quarry. Though much has been made of the relative advantages of biface production with regard to mobile land-use patterns (Kelly, 1988), there is no clear evidence for a major break in overall flaked stone technology between the Middle and Late Archaic periods at Pie Creek Shelter or Little Boulder Basin (Seddon et al., 2010), when mobility patterns are thought to have changed significantly. An apparent reliance on biface production (as opposed to core-flake production) appears to crosscut these periods. The issue, however, is far from resolved and remains a central focus of this investigation.

Terminal Prehistoric (600 cal B.P. to Contact)

Terminal Prehistoric occupation of this region of the western Great Basin is generally thought to be associated with the arrival of Numic-speaking peoples who entered the area from a homeland near the desert margins of the southern Sierra Nevada (Lamb, 1958; Bettinger and Baumhoff, 1982; Madsen and Rhode, 1994; Kaestle and Smith, 2001). This would include the Western Shoshone in the eastern portion of the project corridor, and the Northern Paiute in the western zone. Signature artifacts of this period include Desert Series projectile points (i.e., Desert Side-notched and Cottonwood) and brownware pottery among the Western Shoshone. As previously mentioned, several researchers (e.g., Delacorte, 1995; Bettinger and Eerkens, 1999; see also Holmer, 1986; Janetski, 1993; Reed, 1994) have posited that the Desert Side-notched variant represents an actual ethnic marker of the Numa in much the same manner as the unique basketry complex (i.e., Adovasio, 1986, Stage 5) identified in regional shelters and caves has been tied to the ancestors of the Northern Paiute and Western Shoshone. As we have noted, however, the arrival of the Numa along this Northern Tier of the Great Basin, perhaps postdating 600 cal B.P., raises important cultural and historical issues associated with the Terminal Prehistoric Period.

The Terminal Prehistoric represents a distinct break from preceding late Holocene land use. In a pattern mostly substantiated by subsequent research, Elston (1982: 198) recognized that residential group size in the western Great Basin decreased during this time, and settlement systems became more dispersed. This may explain why many Terminal Prehistoric settlements throughout this region have almost a "stand alone" domestic quality about them, as might be expected by a series of very dispersed and short-term occupations by small family units. Many multicomponent village localities, such as those described for Surprise Valley (O'Connell, 1975; O'Connell and Inoway, 1994), the Humboldt Lake bed (Livingston, 1986), and Secret Valley (Riddell, 1960; McGuire, 1997), which contain large numbers of house structures apparently constructed at various intervals throughout the late Holocene, show an abrupt reduction in Terminal Prehistoric residential activity (McGuire, 2002: 29–39). Work, domestic, and residential activities appear to have been much less segregated during this time period, often reduced to a small apron surrounding a single house structure and/or hearth. Of course, this characterization is not unlike the ethnographic descriptions of Numic family bands provided by Steward (1938) and others.

A good example of this settlement pose is found at Tule Valley Shelter, located only several kilometers from the project corridor north of Elko (Delacorte, 2004: 137–162). This shelter contains a small, single-component Numic occupation. The small but eclectic assemblage contains milling and other processing tools, flaked stone implements (but little debitage), pottery, and bone beads, and is typical of other small-scale Numic sites documented elsewhere in the Great Basin. The assemblage speaks to a simple family-band level of organization that includes the activities of both men and women. These sorts of sites often show no sign of previous occupation, and suggest increasing land-use intensity directed at resource patches that were previously ignored (Delacorte, 2004: 161).

Similarly, there is some evidence that certain productive habitats targeted by Middle and Late Archaic groups were used much less during the Terminal Prehistoric Period. For example, large-scale surveys of Humboldt River bottomlands near Battle Mountain (McGuire and King, 2011) document an abrupt decline of Desert-series projectile points relative to Middle and Late Archaic markers. In addition, site densities on post-700 cal B.P. floodplain and meander-belt landforms collapse when compared to those observed on older landforms (McGuire and King, 2011: 172–182). These results are in keeping with a more dispersed land-use system that targeted a variety of new resources and habitats, but are also consistent with a small, family-band settlement structure that may not have left as visible an archaeological footprint.

If Tule Valley Shelter is a small-scale example of Numic occupation of a previously ignored habitat, Little Boulder Basin may be another example on a much larger scale. In an altogether different pattern from that observed on the Humboldt River at Battle Mountain Pasture, the Terminal Prehistoric record at Little Boulder Basin is definitively more robust. Of the 124 radiocarbon dates from this locality, the majority date to the Terminal Prehistoric. The cumulative Paradise Valley obsidian hydration profile for the basin abruptly spikes in the 1.0–2.0 micron range, also indicating very late-dating occupation. Similarly, there is a large relative frequency of Desert Series projectile points, which provides additional proxy evidence of an intense Terminal Prehistoric occupation of this area.

Most of the radiocarbon dates at Little Boulder Basin were obtained from the several hundred thermal features identified (described as fire hearths), some of which contain rock. Archaeobotanical remains found in these features are dominated by grass seeds (*Stipa arida, Poa* spp.) and goosefoot (*Chenopodium*). This emphasis on plant resources is also indicated in higher frequencies of ground stone tools from components dating to this time. High ratios of milling equipment to flaked stone tools from components dating to the Terminal Prehistoric Period also characterize a number of locations in the northwestern Great Basin, including Secret Valley (McGuire, 1997), the Black Rock Desert (Seck, 1980), the Buffalo Hills region (Kolvet, 1995), and Duck Lake (Creger, 1991). In many respects, the intensification of these seed-resource tracts is not unlike that described for epos and other root crops in the western zone of the project corridor, although the latter appears to have occurred earlier in time (see chap. 13).

Along with root and seed intensification, there are a variety of places where archaeofaunal data indicate an increasing reliance on small-game resources and less focus on the taking of artiodactyls during the Terminal Prehistoric Period (Spencer et al., 1987; McGuire et al., 2004; McGuire and Hildebrandt, 2005). This profile is in keeping with the broader pattern of resource intensification described above. It is important to emphasize, however, that there are several exceptions to this generalized trend. Within the northwestern Great Basin and Cascade Range, for example, high frequencies of artiodactyl remains were documented in Terminal Prehistoric components (Carpenter, 2002). This pattern has been tied to high levels of territorial circumscription and social conflict creating buffer zones where artiodactyls were less subject to predation. An emphasis on large-game hunting during the Terminal Prehistoric is also documented by the numerous antelope traps identified in the northeastern Great Basin (Hockett, 2005; Hockett and Murphy, 2009; Hockett et al., 2013), including some investigated during the current project (see chap. 16).

Changes in the distribution of Desert-series projectile points may also reflect alterations in hunting organization. In the Crescent Valley/Cortez area, it is noteworthy that Desert-series points, in contrast to earlier variants, generally do not occur as isolated finds (Delacorte et al., 1992). This suggests that individual/small-group, logistically based activities may have been comparatively less important than more communal activities. At the Tosawihi Quarry, Desert Side-notched points, although well represented, tend not be dispersed across the landscape, but are found primarily in residential feature contexts (Elston and Raven, 1992: 613).

Flaked stone assemblages dating to this time are generally characterized as the result of opportunistic exploitation of whatever tool stone was locally available, including in some instances the scavenging of older obsidian debris from earlier occupations (Delacorte, 2004: 149–150). Given the potentially wide territorial swath covered in the seasonal round of these groups, these behaviors can result in increased tool-stone source diversity, although the relationship of this diversity to mobility and other land-use constructs may not always be straightforward. Flaked stone densities at components dating to this time are also often sparse, as tool-stone needs were limited to the needs of the family band. Often such components are dominated by pressure flake debris, as knapping activities centered on tool maintenance and refurbishing (Basgall and McGuire, 1988; Eerkens et al., 2004). Biface manufacturing and early-stage reduction are often represented but, again, at a level to supply only the needs of the immediate family group. As a result, Terminal Prehistoric components can be difficult to recognize in multicomponent site contexts where earlier and more prolific tool-stone reduction can mask the more ephemeral character of these later occupations (Gilreath and Hildebrandt, 1997, 2011).

Ethnographic Background

Pat Barker

> In the old days they used to dig food all summer—until it was gone. They gathered seeds and roots and buried them in the ground. In winter they stayed until the buried food was gone and then moved on to the next place. They hunted every day, all year. In those days there were many sage hen, ducks, geese, swans, jackrabbits, cottontails, deer and antelope.
>
> –Kelly, 1932: 76

The project corridor passes through the aboriginal homelands of the Northern Paiute and Western Shoshone (fig. 14). While the following discussion provides some general information on the traditional lifeways of these people, it is not a dense ethnographic description. Its primary purpose is to analyze ethnographic information from an archaeological perspective and use the results to help interpret the archaeological record discovered during this project. To do this, we will focus on information found in the ethnographic record about settlement and subsistence systems and discuss general attributes of aboriginal lifeways mainly as they relate to these systems. Then, we discuss each of the four regions defined for the project in light of this record.

Using the ethnographic record to illuminate the archaeological record can be problematic (e.g., Wobst, 1977). It is important to note that professional ethnographic fieldwork in northern Nevada did not include participant observation while the ethnographer lived among people practicing aboriginal lifeways. Instead, professional ethnographers had to consult with people who were living on reservations or in communities attached to Euro-American settlements. None of the consultants were still living aboriginal lifeways in traditional territories. While full participant observation was not possible, some aspects of traditional lifeways could be observed, discussed, and recorded (e.g., Gleason, 2001). Other traditional activities, however, did not continue forward and could only be accessed as memories or as part of an oral tradition.

Many subsistence activities did persist and were used to supplement the diet even after Native people entered the western cash economy (Crum, 1994); some activities like plant gathering (Couture, 1978; Couture et al., 1986; Gleason, 2001) and communal jackrabbit drives (Peden, 1995) still survive today. An outstanding example of contemporary plant collecting along the study corridor is found at Barrel Springs, where epos is an important economic resource (Deur, 2010).

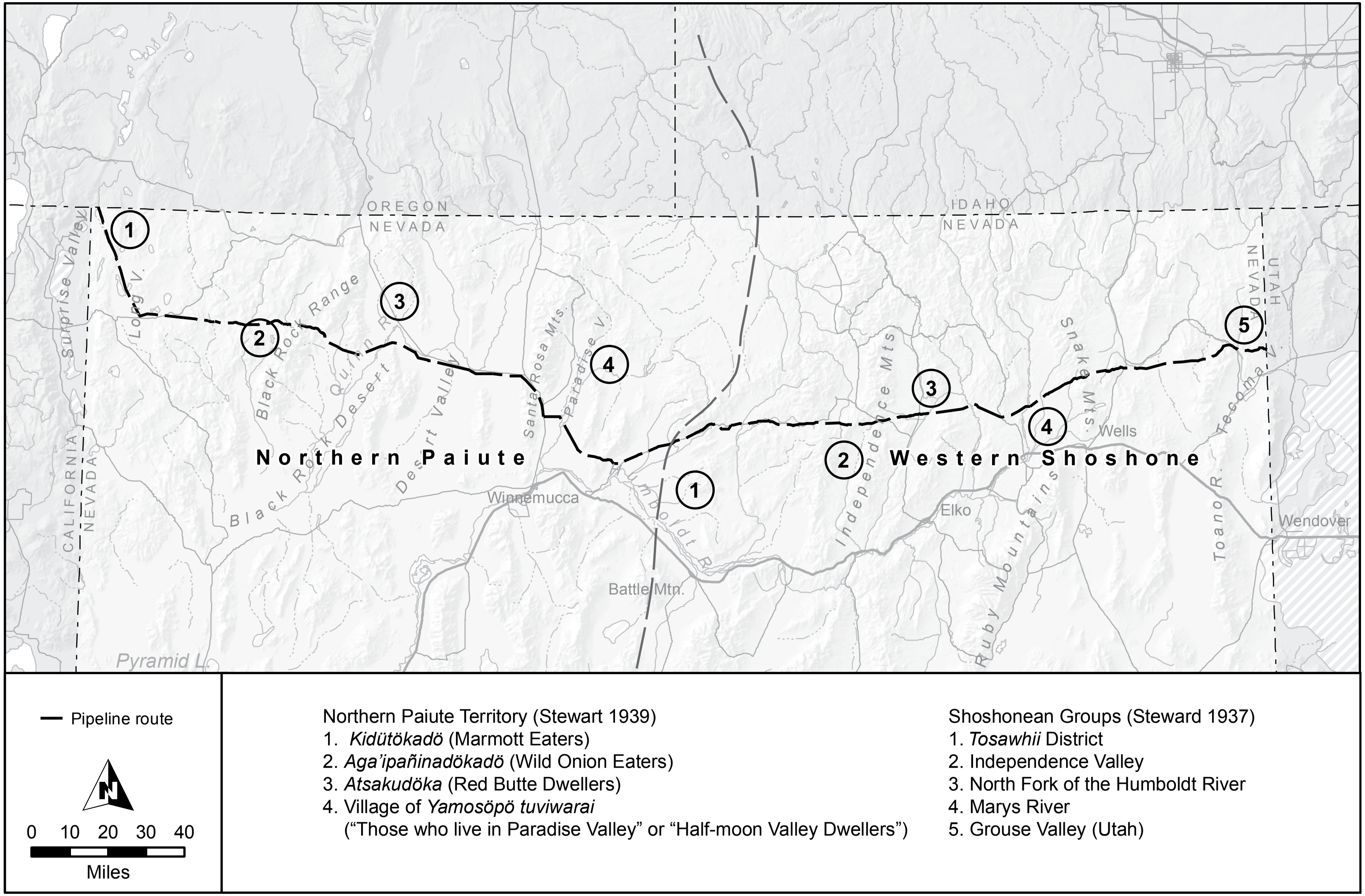


Fig. 14. Approximate locations of Northern Paiute and Western Shoshone bands.

Sources

Although explorers and travelers have been writing descriptions of native lifeways in parts of the Great Basin since 1776, ethnographic observations by trained anthropologists began with A.L. Kroeber, who gathered information between 1902 and 1917 in California and Nevada (D. Fowler, 1986: 22–27). As we have noted, traditional lifeways in traditional territories had collapsed by about 1870, and participant-observation anthropology was no longer possible (Fowler and Fowler, 1971; D. Fowler, 1986: 29).

This problem notwithstanding, professional anthropological research continued with fieldwork by C. Hart Merriam between 1902 and 1936, S.A. Barrett in 1915, and Robert Lowie between 1906 and 1926. The most active period of anthropological fieldwork began in 1927 and ended with the start of World War II in 1940. In this period, Julian Steward initiated fieldwork among the Owens Valley Paiute, Western Shoshone, and Northern Paiute; he also did culture-element distribution surveys for Kroeber in 1935 and 1936. Omar C. Stewart conducted similar surveys between 1937 and 1939. They were joined by Isabel Kelly, working among the Surprise Valley Paiute from 1929 to 1934; Demitri Shimkin, working among the Eastern Shoshone between 1937 and 1939; and Willard Z. Park, working among the Northern Paiute between 1933 and 1940. During the War, Sven Liljeblad began his ethnographic and linguistic studies. Francis Riddell worked with the Honey Lake Paiute in 1950, and Margaret Wheat began working with Northern Paiute in 1959. Catherine S. Fowler began extensive comparative studies in 1964.

For this project, the best primary ethnographic sources include Francis Riddell (1978) on the Honey Lake Paiute; Isabel T. Kelly (1932) on the Surprise Valley Paiute; Omar C. Stewart (1941) on the Northern Paiute; Julian Steward (1937, 1938, 1941, 1955) on the Western Shoshone; and Catherine Fowler (1992) on the Northern Paiute at Stillwater Marsh. Major secondary sources include several articles in volume 11 (Great Basin) of the *Handbook of North American Indians* (Fowler and Liljeblad, 1986; Thomas et al., 1986); unpublished reports by Rucks (2002) on the Northern Paiute and Bengston (2003) on the Northern Paiute and Western Shoshone; and a book by Crum (1994) on the Western Shoshone.

Ethnohistoric Interactions (1750–1900)

British and American fur companies began trapping in northern Nevada and along the Humboldt River drainage in the mid-1820s (Cline, 1963). However, direct contact does not mark the beginning of ethnohistoric interactions. If anything, it is the end stage of a long process of indirect Euro-American encroachment on traditional lifeways. The process began when late prehistoric adaptations in northern Nevada started changing to accommodate the influence of Euro-Americans (Malouf and Findlay, 1986; Shimkin, 1986). As early as the 18th century, indigenous groups felt the effects of indirect trade, slave raiding, horses, and epidemic diseases. For example, in the late 18th century, the Bannock, formerly a traditionally organized Northern Paiute group, traded for horses, migrated from Oregon to the Snake River Plain and into southern Montana, and adopted mounted buffalo hunting and other Plains-style lifeways (Murphy and Murphy, 1986: 284). These kinds of changes mean that the ethnohistoric process needs to be stretched back in time to the point when indirect impacts began, and forward to when native lifeways collapsed and Native Americans moved to Euro-American settlements or reservations. In northern Nevada, this is the period from about 1750 to 1900.

While there may have been sporadic, undocumented incursions into northern Nevada prior to 1825, continuous, direct contact between Native Americans and Euro-Americans began in 1826 when fur trappers working on the Snake River moved south to exploit the Humboldt drainage (Cline, 1963). Led by Peter Skene Ogden of the Hudson's Bay Company (1826–1829) and Jedediah Strong Smith of the Rocky Mountain Fur Company (1827), many fur trappers explored northern Nevada and initiated direct contact with the Western Shoshone and Northern Paiute (hereafter referred to collectively as the Numa).

Between 1850 and 1880, land acquisitions, ecological changes, and cultural disruptions caused by non-Indian immigration into northern Nevada curtailed traditional lifeways among the Numa to the extent that they were becoming dependent on non-Indian communities, especially along the Humboldt River and other wetlands (Fowler and Liljeblad, 1986; Malouf and Findlay, 1986; Thomas et al., 1986). Early impacts were less severe farther from these areas, and some Western Shoshone groups were among the last to come into continuous contact (Scoggan, 2009). As Euro-Americans moved into an area, mining and domestic woodcutting could severely impact woodlands, and ranchers excluded indigenous people from traditional water sources by converting native grass fields to hay (Thomas et al., 1986). As a result, Western Shoshone and Northern Paiute men sought work as ranch hands, miners, or woodcutters, and women as domestics, cooks, and laundresses (Riddell, 1978; Scoggan, 2009).

Euro-Americans began negotiating treaties with Western Shoshone leaders for rights-of-way across central Nevada as early as 1859, when Jacob Forney, Superintendent of Indian Affairs for the Utah Territory, negotiated an agreement with the White Knife Shoshone that was never ratified. In 1862, James Nye, territorial governor for Nevada, negotiated another (unratified) treaty with Western Shoshone living around Austin. Finally, the U.S. government negotiated the Treaty of Ruby Valley of 1863 that stands as the only ratified treaty with any Western Shoshone group. In this treaty, the band led by Te Moak (also spelled Temoke and Temoak) granted the government a right-of-way through their ancestral lands in exchange for peace, friendship, and annuities, but did not include any land cessions (Crum, 1994). It did, however, open the route for immigrant passage to California and became a mechanism for establishing reservations and colonies.

The first exclusive Western Shoshone Reservation, Carlin Farms, was established in 1875 and closed in 1879 (Clemmer and Stewart, 1986). Duck Valley, the first permanent reservation, was established in 1877 to accommodate both Western Shoshone and Northern Paiute. The same groups were accommodated at Fort McDermitt (1892), Fallon (1906 and 1917), and Reno-Sparks (1917). The Bishop (1913), Fort Independence (1915), Big Pine (1922), and Lone Pine (1939) colonies were reserved for Western Shoshone and Owens Valley Paiute. In 1917, the Battle Mountain Colony was exclusively reserved for Western Shoshone, as were Elko (1918, reorganized in 1938), Ely (1931), Yomba (1937), Odgers Ranch–South Fork (1937 and 1941), Ruby Valley (1940), Duckwater (1940–1944), and finally Wells (1977).

The first reservations for the Northern Paiute were identified and occupied in 1859 at Walker Lake and Pyramid Lake, although they were not formally established by Congress until 1874 (Clemmer and Stewart, 1986). The Malheur Reservation was established in 1873. It was followed by Burns (1889), Fallon (1902), Lovelock (1910), Benton (1919), Yerington and Reno-Sparks (1917), Winnemucca (1928), and XL Ranch (1938). In the vicinity of the corridor, Fort Bidwell was established in 1887 and expanded in 1917, while Summit Lake and Susanville were established in 1913 and 1923, respectively. The last Northern Paiute reservation was established at Bridgeport in 1972 (Clemmer and Stewart, 1986). Between 1887 and 1930, Northern Paiute had their reservation lands allotted to individuals and families, with at least 50% (335,000 acres) of reservation lands passing to non-Indians (Clemmer and Stewart, 1986).

Linguistics

The history of Numic languages in the Great Basin is somewhat controversial, but most archaeologists and linguists think that Northern Paiute and Western Shoshone speakers spread from eastern California north and east across the Great Basin less than 2000 years ago (Miller, 1966; Goss, 1968; Miller et al., 1971; Fowler, 1972; Bettinger and Baumhoff, 1982; Rhode and Madsen, 1994; Golla, 2011; but see Goss, 1977; Aikens and Witherspoon, 1986; Aikens, 1994; Grayson, 2011). Although the exact timing of their arrival in northern Nevada is yet to be established, it is clear that by 1830 they were well established and had been in the area for a significant amount of time. Due to many similarities in their material culture, John Wesley Powell used the term "Numa" to refer to Numic speakers in the arid west (Fowler and Fowler, 1971). It will also be used here to refer to the Northern Paiute and Western Shoshone, collectively.

Linguistic territory: Given the fluid social and territorial systems characteristic of Numa ethnographic lifeways, identifying kinship connections, group membership, ethnohistoric sites, and tribal territoriality at any point in time (synchronic view) represents a single snapshot of sociopolitical relationships that actually flow through time (diachronic view). Synchronic views of dynamic systems necessarily give a false impression of territorial stability among groups and language communities. One such point in time was when Euro-Americans entered the area and early ethnographers recorded the nature and distribution of historic-era Numic groups (Fowler and Fowler, 1971). This is also the point at which traditional lifeways collapsed and modern tribal governments were created through treaties, agreements, executive orders, or congressional action (Crum, 1994). Modern tribal governments were as much a product of national political forces as of Numic group dynamics (Clemmer and Stewart, 1986), and modern identity and population patterns are only one source of information on ethnohistoric geography and adaptations.

At historic contact, people speaking Northern Paiute occupied a large region in Oregon, Idaho, and Nevada (Stewart, 1939; Fowler and Liljeblad, 1986; Fowler, 1992;

Rucks, 2002). It stretched from the John Day River, Oregon in the north; east to the edge of the Snake River Plain, Idaho; south to the Mono Lake Basin, California; and west to the California/Nevada border north of Honey Lake (Fowler, 1992). The boundaries of this area blended onto the boundaries of adjacent groups, including the Western Shoshone to the east, the Owens Valley Paiute to the south, the Bannock and Northern Shoshone to the north, the Klamath to the northwest, and the Washoe to the west (Fowler, 1992; Rucks, 2002). In the project area, Northern Paiute occupied the High Rock Country and Upper Lahontan Basin.

People speaking Western Shoshone occupied a territory (Steward, 1937) extending from Death Valley in the southwest through central Nevada and into northeastern Wyoming (Stewart, 1966). To the east, they blended into areas occupied by the Gosiute, and to the north, their territorial boundary was along the divide between the Snake River and Humboldt River drainages (Thomas et al., 1986).

Although people intermingled along these linguistic boundaries, Steward (1938) and Fowler and Liljeblad (1986) suggest that the territorial boundary between the Northern Paiute and the Western Shoshone ran along the crest of the Desatoya Mountains. Steward (1938) also noted that in the Humboldt River drainage, the boundary runs roughly north to south near Iron Point between Battle Mountain (Western Shoshone) and Winnemucca (Northern Paiute). In the project area, Western Shoshone occupied the Upper Humboldt Plains and Thousand Springs Valley. The eastern edge of the Upper Lahontan Basin may have been a joint-use area.

Foragers and Collectors

On a global scale, Binford (1980) defined a forager-collector model to explain residential choices among hunter-gathers. At one end of the spectrum, people living as foragers in relatively homogenous and predictable environments use residential mobility (moving the entire group from camp to camp) to move consumers to resources (Binford, 1980: 5–10). At the other end, people living as collectors, in relatively varied and unpredictable environments, use logistical mobility (task groups move out and back from a residential camp) to bring resources to consumers (Binford, 1980: 10–13). Subsequently, Bettinger and Baumhoff, (1982: 485–488) adapted Binford's model to the Great Basin by developing a refined processor-traveler model as an explanation for the late prehistoric spread of Northern Paiute and Western Shoshone people from a presumed homeland in the southwestern Great Basin.

Recently, Great Basin archaeologists have tried to explain residential movement by looking at the gendered division of labor and have independently modeled women's and men's activities as a way to understand past residential patterns (Elston and Zeanah, 2002; Zeanah, 2002, 2004). In these models, women act as if they are processors (foragers) and men as if they are travelers (collectors). That is, women acquire food and materials to meet daily needs with a gathering strategy aimed at a wide diet breadth, emphasizing resources with low return rates, high handling costs, and low search costs. Men, on the other hand, provide large game by practicing a strategy aimed at a narrow diet breadth, with high return rates, high search costs, and low handling costs (Zeanah, 2004: 1–4). This division of labor is not absolute. Women and men work together to collect plants or participate in multifamily communal game drives; when in camp, men help women gather and process plant foods, and women opportunistically take fish and small game while gathering plants (Zeanah, 2004: 1–4).

Sharing and the Gendered Division of Labor

As noted by Steward (1941: 254), "the principle of property rights was simple: things to which human effort had been applied were owned by the person or persons who had worked on them."

Egalitarian hunting and gathering societies tend to have explicit reciprocity rules governing the distribution of food (Kelly, 1995: 161–168; Hawkes, 2006: 269–274). Under these rules, people expect hunters to share the results of their targeted hunting trips with everyone in a camp (Woodburn, 1982: 440–442). In return, hunters gain prestige for helping the group (Woodburn, 1982; Kelly, 1995: 298–302). In contrast, gathered resources, including incidental animals taken while gathering, are not automatically shared with the larger group, but may be shared as needed outside of the immediate family (Woodburn, 1982: 440–442). Unlike food, tools and raw materials do not have to be shared (Woodburn, 1982: 440–442). Group members actively enforce sharing rules through social ostracism or physical violence (Woodburn, 1982: 442–443; Hawkes, 2006: 273–374). In unpredictable environments, like northern Nevada, sharing is usually explained as a mechanism for reducing long-term risk by giving when you have resources and receiving when you are in need (Hawkes, 1996: 291–298). Since hunting is much more uncertain than gathering, this explanation also accounts for differences in hunting and gathering sharing rules.

The gendered division of labor among the Surprise Valley Paiute (Kelly, 1932: 79) was typical of the rest of northern and central Nevada. Tasks that were violent, sporadic, or distant tended to be defined as men's work, while the definition of women's work included tasks that were close to the base camp, required daily effort, and were nonviolent (Steward, 1941: 253). In any given situation, however, either gender would engage in cross-gender activities. Men hunted, but women assisted with communal drives and waterfowl hunts. In their daily gathering activities, women and girls set traps for small game. Both men and women worked hides and made rabbit skin blankets. In net making, women made cordage while men knotted the net. All hunting equipment (including sewn quivers) was made by men. Women usually made baskets, sewed, and made handicrafts. Women gathered roots, berries, and insects with sporadic male assistance. Women prepared food, hauled fired wood and water, and did general domestic chores, but when in camp, men helped with these tasks. Steward (1941: 253) reported a similar division among the Western Shoshone, except that people tended to make (and own) the tools they needed for daily tasks. He also reported that there might have been specialized bow makers and ceramicists. Kelly (1932: 79) also noted that Surprise Valley sharing rules reflected this division of labor. The results of a women's daily gathering belonged to her family and did not have to be shared with the camp. In contrast, any game that hunters brought back was shared with everyone in camp.

Gender and Residential Mobility

When women's resource needs controlled camp location, men hunted as well as they could in less than optimal resource patches close to home, or on logistical forays to better hunting grounds (Thomas, 1981b: 40–44). This strategic hunting choice would depend in part on target-animal seasonal behavior and on food storage needs. For example, cottontail rabbits are not amenable to drive hunting because, unlike jackrabbits, they hide rather than run when startled. Individual or small-group logistical hunting would prevail when game was dispersed and settlement was governed by women's acquisition needs. In this case, hunters, using specialized gear and staging areas, hunted artiodactyls as individuals or in very small groups and carried their finds back to larger settlements. Dispersed small hunting groups also covered a larger area with higher probability of encountering game and procuring sufficient meat to share beyond the daily needs.

When game was aggregated, however, men's resource needs governed camp location and communal activities such as multifamily or group drives. Deer and antelope aggregate in the spring and fall as they move from summer to winter range, while bighorn sheep tend to aggregate in the summer and fall. When conditions were right, or when stockpiles were needed, people would come together to gather large amounts of food (communal jackrabbit drives, communal antelope drives) to be stored for winter use or consumed in large social gatherings.

Core and Periphery

Traditional views of Great Basin hunter-gatherers usually emphasize an adaptation focused on pinyon, which is reasonable because its distribution is coincident with the core Numa territory in the central Great Basin (fig. 15). The Numa core is bounded on the north by the Humboldt River drainage, on the west by the east slope of the Sierra Nevada Mountains, on the south by the boundary between the Great Basin and the Mojave Desert, and on the east by the mountains forming the western edge of the Bonneville Basin. Under this definition, all of the project area is in the Numa periphery and none is in the core territory.

Numa settlement and subsistence activities differed depending on the availability of water and pinyon (Thomas, 1981: 19–52; C. Fowler, 1986: 64–65). In the Nevada core area, pinyon occurs between 5000 and 8000 ft in elevation in areas where there is between 12 and 18 inches of annual precipitation. Temperature confines this elevation-bounded habitat and causes pinyon stands to narrow and eventually disappear in northern Nevada as inversion-caused thermal belts disappear. It is also apparent that pinyon, if it arrived at all, became available at different times in different places in the past (Wigand and Nowak, 1992; Nowak et al., 1994; Wigand and Rhode, 2002). In fact, most of the central Great Basin did not have pinyon prior to 7000 years ago (Charlet, 1996; Grayson, 2011: 253–258).

Core area – life with pinyon: Numa lived by foraging in relatively small groups from the spring through the fall; their movements were keyed largely to the availability of plant foods (Steward, 1938, 1941; Stewart, 1941; Fowler and Liljeblad, 1986; Thomas et al., 1986). In the fall, people gathered for festivals, communal hunting, or communal plant processing to prepare for winter living. In winter, the Numa were more sedentary. Family houses were loosely grouped

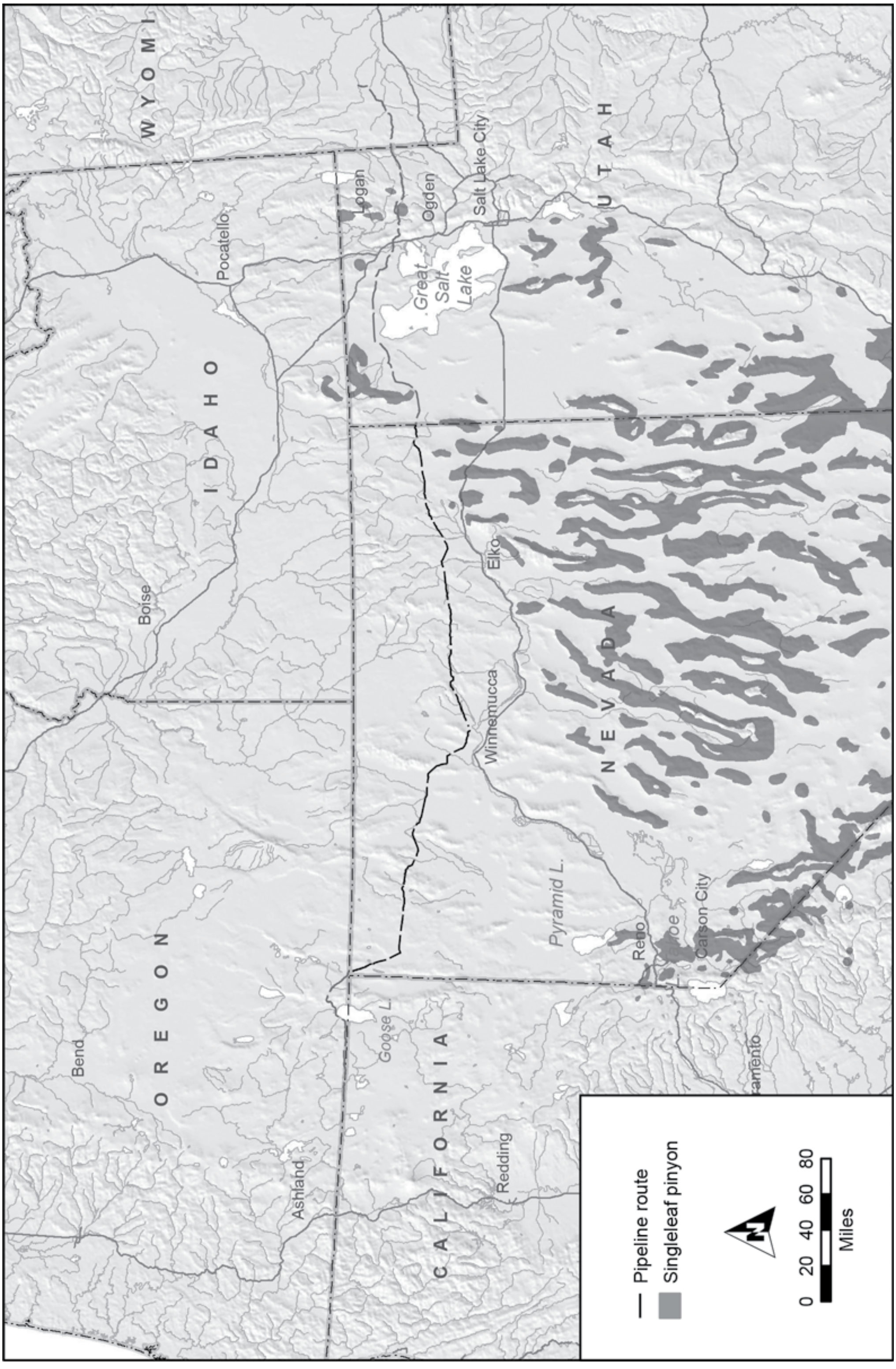


Fig. 15. Distribution of singleleaf pinyon (*Pinus monophylla*).

into winter villages of up to 50 people, and villages were typically established in relatively warmer places, not far from caches of nuts, seeds, dried fish, meat, or other foods (Fowler and Liljeblad, 1986; Thomas et al., 1986). The typical winter house was a conical hut housing an extended family. Northern Paiute did not use the semisubterranean sweathouse that was nearly universal among the Western Shoshone (Fowler and Liljeblad, 1986; Thomas et al., 1986).

In the core area, plants dominated Numa subsistence, with animals accounting for no more than 20% of caloric intake (Steward, 1938, 1941; Stewart, 1941; Fowler and Liljeblad, 1986; Thomas et al., 1986; Fowler, 1992). The core annual subsistence round focused on pinyon nuts, seeds, geophytes, and grasses, with several species of animals regularly hunted in conjunction with movement to gather plants. Pinyon nuts, where available, were a staple gathered by family groups on extended logistical forays. The pinyon harvest was predictable but also somewhat unreliable. A given grove might fail one year out of three, so people needed access to at least three dispersed groves (Grayson, 2011: 253–258). Hunted animals included bighorn sheep, antelope, deer, rabbits, upland birds, and migratory waterfowl. People used a number of different game enclosures, including traps and corrals, in communal antelope and jackrabbit hunting (Fowler and Liljeblad, 1986; Thomas et al., 1986). Fish could be an important food in well-watered lacustrine and riparian areas (Fowler and Liljeblad, 1986; Fowler, 1992).

Periphery – life without pinyon: In contrast to the Numa core area, subsistence efforts north of the pinyon line were more continuous and less seasonal (Kelly, 1932: 75–103; Steward, 1941: 218–232; Riddell, 1978: 48–56; C. Fowler, 1992: 43–88). Food accumulation and storage sufficient to avoid late winter shortages was more problematic, and starvation was more likely than in the core territory. As a result, there was a greater emphasis placed on geophyte gathering and animal procurement, especially of antelope. The unique nature of northern periphery adaptations is best summarized along three dimensions: seasonal round, geophyte use, and hunting.

Seasonal round: The Northern Paiute people living in Surprise Valley are a good example of the northern, nonpinyon adaptation. Beginning in spring, when snow was still on the ground, people fished along creeks and streams on the valley bottom. But as the snow melted, winter settlements were abandoned and people moved into the eastern hills for early shoot and root gathering, and supplemented their diet with food from hill-area caches. All spring and well into summer people stayed in relatively fixed camps where both the valley bottom and hill country could be exploited for food. They did not make logistical trips to known resource patches but instead foraged opportunistically in an expanding radius from camp to gather in areas where food supplies were most promising. Plants and small game were gathered for daily consumption, and dense root patches were exploited for winter food drying and storage. Depending on local conditions, gathering could be wide-ranging, from getting camas in swamps to gathering epos and other roots in higher and drier country. Women's access to plant resources, especially roots, determined camp locations, and men either hunted from the gathering base camp, or more often, went on short logistical large-game hunting trips (Kelly, 1932: 75–103).

As fall approached, plant gathering declined and subsistence efforts turned to hunting for winter storage. From late summer into fall, people concentrated for communal jackrabbit drives and group waterfowl hunting. They then returned to more or less permanent settlements in Surprise Valley to subsist on seeds, dried roots, and dried meat from caches (Kelly, 1932: 75–103). Most groups had at least two winter settlements and moved to a new camp when food was exhausted. People also traveled in winter among several camp areas to cooperate in communal antelope and jackrabbit drives.

Geophytes: While geophytes were a secondary, seasonal resource in the core Numa area (Steward, 1941: 218–232), they were more of a dietary staple in northern Nevada (Kelly, 1932: 75–103; Riddell, 1978: 48–56; Trammell et al., 2008; Scholze, 2011: 35–37). Important root crops occur in valley bottom wetland habitats, on sandy or rocky sagebrush-covered slopes, and in upland meadows and flats. They become available in spring when they sprout and their stems and flowers become visible, and are harvested with simple tools, mainly digging sticks. Lowland plants were harvested first in the early spring, and were especially valuable to stave off starvation as winter stores were exhausted. As conditions ameliorated through spring and into summer, different geophytes became available at higher elevations away from the valley bottoms. The most important of these were dry land taxa like epos, biscuitroot, and bitterroot. People gathered dry land taxa for daily consumption and, more importantly, dried them for winter storage.

Hunting: Winter hunting was extremely important on the northern periphery (Kelly, 1932: 75–103; Riddell, 1978: 48–56). In addition to daily individual and small group hunts for deer, rabbits, and other small game, hunters organized large communal jackrabbit drives using nets and very large communal antelope drives using corrals and wing traps. Riddell's (1978: 55–56) consultants said "all" families gathered for drives, and meat was shared equally among participating families. These communal hunts provided much needed winter food, but equally important, they were also social gatherings for finding mates, developing trade relationships, and nurturing alliances to gain access to alternative resource areas (Kelly, 1932: 75–103). While a boss managed the drive itself, the social gathering was managed by a group of household heads.

Antelope drives were usually held in mid or late winter, as the wet ground tended to tire the animals more quickly. When antelope congregated, forming herds of up to 400 animals in the Surprise Valley area, a recognized antelope boss (charmer) located a large herd and organized a communal hunt in which the herd was driven into a large sagebrush corral and killed (Kelly, 1932: 75–103). Up to 20 camps, and as many as 100 men, would move to the trapping area and construct the trap. The boss led a round dance and sang on the night before the hunt, during which he "charmed" the herd to bring it to the trap. In the corral, runners kept the herd moving until it was exhausted and as many animals as possible were killed. The meat and hides were shared equally among all hunters, including the boss. If the division was not equal, it was believed that a future hunt organized by the boss would fail. Most families dried their meat for later use. Towards the end of the hunt, the corral was usually burned to clear the way for butchering.

From late September through January, people in Surprise Valley (Kelly, 1932: 75–103) organized or participated in communal jackrabbit hunts, using individuals who owned large nets (3 × 100 ft or more). One or more net owners (bosses) would organize a hunt involving four or five camps. They strung their nets in a straight line across a valley, and men and women would drive jackrabbits to the nets and club them. As an area was exhausted, the bosses shifted their nets to continue the hunt. The boss divided the catch among all families and, as with the antelope drives, people mostly dried the meat for later use.

Trade and External Relationships

Perishables made up the majority of the items traded in ethnohistoric times (Hughes and Bennyhoff, 1986). Trade among local groups focused on buckskins, moccasins, rabbit-skin blankets, woven goods, stone and shell beads, fish, pinyon nuts, and obsidian, while external trade with western peoples yielded acorns, salt, Pacific coast shell, woven goods, and nonlocal obsidian (Hughes and Bennyhoff, 1986). When trade for European goods (horses, metal artifacts, glass beads, and munitions) began, possibly in the late 1600s in the eastern Great Basin, trade shifted from primarily perishables to primarily nonperishable goods (Hughes and Bennyhoff, 1986).

Depending on resource abundance and the state of intergroup relationships in any given year, the Numa shared resource areas with their neighbors. Root-gathering areas in Warner Valley, for example, were shared by multiple Northern Paiute groups. To the northwest, they shared a hunting area with the Klamath/Modoc, while fishing and hunting areas on Fandango and Lassen Creeks were shared with the Achomawi (Kelly, 1932: 70–74). The boundary between the Northern Paiute and Western Shoshone just east of Winnemucca was also considered a joint-use area (Fowler and Liljeblad, 1986: 437).

Leadership and group dynamics: Households based on the biological family (parents and children) were the basis for social, political, and economic life (Steward, 1938: 239–246). They were largely economically self-sufficient and socially and politically independent. It would have been difficult for an individual to survive while living alone. Thus, people actively worked to live in a household and, in turn, a household was an individual's daily face-to-face group. All food, except large game, belonged to the household of the person acquiring it. Although the household was the most stable social and economic unit among the Numa, it could be disrupted by death or divorce, or enlarged by adding relatives, especially grandparents and a child's spouse (Steward, 1938: 239–246). A year of matrilocal residence (often part of the bride price) to establish a man's economic potential was common; this was often followed by a similar period of patrilocal residence. In this way, a young couple lived with one set of parents or the other until they reproduced and established an independent household.

Marriage created a new household that was embedded in an alliance between two larger bilateral kindreds (Kelly, 1932: 164–167; Steward, 1938: 240–241). After an initial arranged marriage, the alliance could be maintained by the common practice of fraternal polyandry (two or more brothers married to the same wife; Steward, 1936; Park, 1937; Stewart, 1937). Polyandry also included hospitality and sexual access extended to the household head's brother if he lived in the household. In this context, a woman would have two men hunting for her household but would also have more mouths to feed. Other, similar marriage forms were also practiced. If the wife could not perform her role in a household, the husband was offered the chance to marry one of her sisters and keep the alliance alive (sororate: sisters as serial wives). Upon remarriage to a sister, the wife's family did not have to return the bride price. In the same way, when a man failed to perform his household duties, his brother was offered the opportunity to marry the wife and maintain the kindred alliance (levirate: brothers as serial husbands).

Political organization and group leadership beyond the family depended on the need for cooperation and management for specific activities. A household head led the family in daily activities and represented the family in winter villages and at other multifamily activities (Steward, 1938: 246–253). The eldest or most experienced household head directed activities when several families informally worked or camped together. His authority rested on willing deference by other household heads.

After the household, the next largest social grouping was the winter camp or village, which consisted of a group of up to 20 related households, including those of the parents, married children, and parental brothers and sisters. Within a named foraging territory, village families tended to travel together and camp near each other. Village members shared resources and defended each other, especially against wife abduction, or helped each other with wife abduction or horse rustling. A village head's authority was normally limited to specific activities—hunts, dances, wars, and ceremonies—at specific places and times. However, a leader's continuing success and longevity in office could lead to an expansion of his or her advice and counsel beyond a specific activity or group. Village heads could use larger gatherings to talk together and manage intervillage relationships.

Smaller villages did not have identified heads. However, larger villages had two kinds of leaders, called *poinabi* in Northern Paiute (Steward, 1938: 246–253; Fowler, 1992: 164–167). One was the spokesman (*nimɨnaa* in Northern Paiute; *teg'wani* in Western Shoshone) for the group, and the others were persons who organized specific activities (Fowler, 1992: 164–167). The spokesman received visitors, offered advice, and kept the village informed about resource conditions and upcoming events or activities (Fowler, 1992: 164–165). The spokesman would be replaced if people lost confidence in his advice and counsel. When village families chose to follow the spokesman's lead in residential movement and subsistence activities, he organized the trip and managed daily activities while away from the village. However, any household or family within a household was at liberty to pursue an independent course at any time.

There were no permanently constituted groups above the village. Periodically, various villages or households from different villages gathered for specific events, such as dances (fandangos), communal hunting, communal gathering, or other activities. These events, which could last several weeks, were organized and managed by temporary leaders with a reputation for conducting successful events. At larger events, village headmen talked together and assisted the event leader by exhorting their people to behave, have a good time, cook for everyone, and help with communal activates.

Event leaders obtained authority primarily through visions that gave them the power (*puha*) to be skilled in doctoring, hunting, antelope charming, jackrabbit drives, war, ceremonies, or dances. Through time, successful leaders became widely known and respected and assumed a greater role in general political and social life. In other words, their achieved status at a particular activity could become generalized through time.

Leadership and Group Dynamics

The nature of Numa political organization and leadership in Nevada has been debated over the years and never resolved (C. Fowler, 1992: 164–167). For example, Steward (1938: 246–253) reported that village heads did not settle individual disputes, but Kelly (1932: 182–183) reported that they did. In general, Stewart (1939) argued for a band-level organization with geographically fixed territories in which political leaders directed daily activities, settled disputes, determined camp moves, and maintained external relationships. On the other hand, Steward (1937) claimed that bands were the result of Euro-American contact and that in the past, territoriality and leadership had been much more ephemeral. According to Steward there were no chiefs per se, just individuals who could direct group activities at specific places and for a limited time. Territories waxed and waned depending on group membership, which could change whimsically based on individual residence decisions. However, Kelly and Steward agreed that leadership and group dynamics were fluid and determined by personal initiative rather than by birth.

Understanding Numa leadership requires an understanding of the concept of spirit power or life force (*puha*) and its impact on places, people, or events. As described in the ethnographic literature (Fowler and Liljeblad, 1986; Thomas et al., 1986; Fowler, 1992; Bengston, 2003; Rucks, 2003), Great Basin groups believe in a universe that is literally a living entity. In this animated universe, everything is imbued with differing amounts of volition and spirit power. The amount, nature, or intensity of power can change through time and across space in ways that cause events at particular places and times, or that allow individuals or groups to succeed or fail. Important events happen at particular places because those places have more spirit power than do others. Important people and groups arise because they have high spirit power relative to others. Conversely, people and places can lose spirit power and fall into obscurity. Once acquired, power can be used for good or evil (Lowie, 1924: 291; Riddell, 1978: 77–78).

The length of time a leader can control a group's labor, and the size of the group that can be controlled, depends on the leader's reputation. Group and event leaders with appropriate *puha* are allowed to direct group activities and, as they are repeatedly successful, their *puha* is assumed to rise according. Successful leaders attract people to them and can maintain a group as long as their *puha* lasts—sometimes for years or decades (Kelly, 1932; Steward, 1938; Riddell, 1978). However, if an individual starts to fail, his or her *puha* is assumed to be waning and eventually people will no longer turn to him or her for leadership. Instead, they will drop their association with the failing leader and affiliate with an up-and-coming, successful leader. If the old leader is recognized as a group asset, this transition will be easier than if they are not. This means that people have to continue to be good at what they do to be known as an asset to a group. That is, they must continually signal success at economic and social activities.

The loosely bounded groups characteristic of the Numa were held together by bilateral kinship connections and consensus group membership (Fowler and Liljeblad, 1986; Thomas et al., 1986; Fowler, 1992; Bengston, 2003; Rucks, 2003). Active participation in the group's political, social, and economic activities reinforced kinship to such an extent that there was mutual agreement as to membership (Steward, 1938). In this system, group membership is fluid and not necessarily congruent with language. A person could abandon a group and take up with another. Groups could expel or recruit members. While this flexibility was available in principle, most people lived in one or two groups throughout their lives—usually the group into which they were born or the group into which they married. Over time, groups formed, prospered, declined, and disappeared as people made pragmatic decisions about which kinship connections to cultivate and which to let wither.

Local Land-use Patterns

Based on their group dynamics, ethnohistoric Numa families and individuals became generally identified with loosely bounded districts that were named geographically or for a primary food resource they used (Steward, 1937, 1938; Stewart, 1939, 1941). The Northern Paiute focused on resource-based place names, while the Western Shoshone also used geographic designations. Named districts tended to be valley bottoms bounded by mountain crests that included camping places, water sources, and resource areas habitually used by the people identified with the district (Steward, 1938; Stewart, 1939). The people in the district maintained use-rights to the resources and could control access to them (Bengston, 2003; Rucks, 2003). Among the Western Shoshone, but apparently not the Paiute in northern Nevada, individual families effectively owned particular resource patches, such as pinyon groves or willow stands. However, people also maintained extensive kinship and sharing connections outside their home districts that allowed access to exotic goods and provided a safety net during hard times.

In the 1930s and again during the Indian Claims Commission hearings (1978–1973), anthropologists spent considerable time trying to define Numa aboriginal territories (Park et al., 1938; Ray et al., 1938; Steward, 1938, 1939; Stewart, 1939, 1941, 1966). The territorial discussions focused on defining boundaries and identifying chiefs, and did not usually identify villages or traditional use areas. However, Kelly (1932) identified Northern Paiute villages, as did Steward (1938).

Other than the Barrel Springs Traditional Cultural Property (Deur, 2010) and the reroute of the project corridor north of the Summit Lake Prayer Rocks in the High Rock Country, recent ethnographic work and consultations for this project identified only general areas of contemporary and historical importance, most of which were not in or close to the project corridor (Bengston, 2003). For the Northern Paiute, these included the Hot Springs Range, Paradise Valley, Kelly Creek, and the Santa Rosa Mountains in the Upper Lahontan Basin (Bengston, 2003). For the Western Shoshone, the only area crossed by the route was Upper Rock Creek in the Upper Humboldt Plain (Bengston, 2003). Other than a general identification, specific locations for specific concerns were not provided.

High Rock Country (Northern Paiute): Among the four regions defined for the project, the High Rock Country offered the best opportunity for reasonably stable and predictable settlement and subsistence patterns. The northwestern part of the region had good geophyte patches and abundant antelope populations. This area is also highlighted by Fowler and Liljeblad (1986: 437) as a Northern Paiute population concentration.

Kidütökadö (Marmot Eaters) were the Northern Paiute people occupying northwest Nevada, northeast California, and south central Oregon (see fig. 14; Kelly, 1932: 77–78; Stewart, 1939: 135; Fowler and Liljeblad, 1986: 437;). Most of the information on these people comes from Surprise Valley, where they lived in more or less permanent villages composed of five to six families occupying separate houses. As we have mentioned, most people had at least two winter settlements, moving between them as food resources were exhausted.

Most villages were in the rain shadow of the eastern escarpment of the Warner Mountains along Modoc County Road 1, the paved north-south route through Surprise Valley and its unpaved extension to Adel, Oregon. Their northernmost winter camp was in the vicinity of Plush, Oregon. Adel was also a favored winter settlement, as was Lake Annie north of Fort Bidwell in Surprise Valley. There was a major camp at Fort Bidwell, three near Lake City, and several along the creek at the foot of Cedar Pass near Cedarville. There were no winter villages on the east side of Surprise Valley, nor in the uplands near Barrel Springs. Although not mentioned in the ethnographic accounts, it seems possible that the lowland areas in Long Valley east of the Barrel Springs upland could have served as winter settlements as well.

In addition to the *Kidütökadö*, the High Rock Country included the Northern Paiute district of the *Aga' ipañinadökadö* (Fish Lake Eaters), or the *Moadökadö* (Wild Onion Eaters), around Summit Lake. This district is not considered to have been a population concentration (Fowler and Liljeblad, 1986: 437), and little is known about the people living here, as they were identified only by their neighbors (i.e., Stewart [1939: 135–136] could not find any consultants from these groups).

Upper Lahontan Basin (Northern Paiute): The Upper Lahontan Basin was not as productive as the High Rock Country, as it was measurably hotter and drier. Fowler and Liljeblad (1986: 437) do, however, note two population concentrations: one on the Quinn River and the other along the Little Humboldt River. These drainages also facilitated north-south travel between the Humboldt and Snake river areas.

The *Atsakudöka* (Red Butte Dwellers) district centered on the Quinn River, and Stewart (1939: 136) notes that marshland habitat at its base was an important resource patch for local people. *Yamosöpö tuviwarai* (Those Who Live in Paradise Valley, or Half-Moon Valley Dwellers) was on the Little Humboldt River in Paradise Valley (Stewart, 1939: 136). The district was organized around the village of *Yamosöpö tuviwarai*, and included Paradise Valley, the Santa Rosa Mountains, the Snowstorm Mountains, the northern half of the Osgood Mountains, and the entire Little Humboldt River drainage. The eastern boundary of the district, along Milligan Creek, formed the approximate boundary between the Northern Paiute and the Western Shoshone (Stewart, 1941).

Upper Humboldt Plains (Western Shoshone): The Upper Humboldt Plains mark the northern expanse of the Humboldt River watershed. While Steward (1938:

152–154) identifies the Humboldt River Valley as one of the most fertile habitats in Nevada, he also notes that districts north of the river were much less productive and dependable. Most people tended to winter along the Humboldt or Snake River and occupy outlying areas, like most of the project corridor, during the rest of year. It follows, therefore, that the Upper Humboldt Plains were not a major habitation area. Instead, the area was used mostly by people traveling between the Snake and Humboldt rivers, for chert quarrying, and for short-term subsistence forays, particularly focused on dry land root crops, small seeds, and the opportunistic hunting of small and large game.

Four of Steward's (1938) districts overlap the corridor, including *Tosawhii*, Independence Valley, North Fork, and Mary's River (see fig. 14). The *Tosawhii* District was a large territory running along the border with the Northern Paiute from the north end of Reese River to the Oregon border. Steward (1937) locates the main *Tosawhii* winter village between Iron Point and Battle Mountain but does not identify any villages on or near the project corridor. He also notes that there was "little occupation" of the area on both sides of the Nevada/Idaho border. This lack of northern villages is also the case in the Independence Valley and Mary's River districts, although the latter area had multiple villages extending six miles north of the Humboldt River (but still located about six miles south of the study corridor).

The North Fork of the Humboldt River was slightly different. Although Steward (1938: 140) views it as a hinterland largely used to hunt antelope and small game or traverse on the way to the Jarbidge Mountains to hunt deer, he does report two villages not too far away from the project corridor. These villages were thought to contain four to five families, but up to 10 on some occasions. He also states that there were no fish in the North Fork (Steward, 1938: 159), but this appears to be incorrect, as fish remains have been found in archaeological deposits along its banks in Tule Valley (McGuire et al., 2004), and fish are present in the river today.

Thousand Springs Valley (Western Shoshone): Population densities appear to have been quite low in the Thousand Springs Valley, but Steward (1938: ix) does note the presence of two villages along Thousand Springs Creek quite close to the project corridor. He also mentions that Montello could have been a population center, but presents little information to support this idea (Steward, 1938: 157). Groups living in the area during historic times were known to winter at Fort Hall and may have had some connection with the people of the Grouse Creek District of northwestern Utah (also known as the Pine Nut Eaters), perhaps wintering with them as well. It is also important to note that pinyon groves currently exist in the mountains along the eastern margins of the basin and probably played a significant role in the land-use patterns of the region.

Generally speaking, however, the area was sparsely occupied and typically used as a transportation corridor between the Humboldt and Snake River drainages, and, when conditions were right, for antelope drives. Although ethnographic information is limited in this regard, the archaeological record is well known for its juniper drive fences and associated artifacts (Jensen, 2007; Hockett and Murphy, 2009; Hockett et al., 2013).

CHAPTER 4

FIELD AND ANALYTICAL METHODS

Jerome King

This chapter outlines the field and analytical methods used during the project. Due to the large scale of the effort, only a general outline is presented here. More detailed descriptions are available in Hildebrandt et al. (2015).

Field Methods

Formal data recovery work took place at 578 prehistoric sites—326 in the High Rock Country, 67 in the Upper Lahontan Basin, 145 in the Upper Humboldt Plains, and 40 in Thousand Springs Valley.

Fieldwork strategies followed the same basic pattern throughout the project area. Work began with a close-interval walkover and surface collection. All surface artifacts, including tools and debitage, were pin flagged. At larger sites, debitage concentrations were flagged without marking every item. With the exception of larger ground stone artifacts, all formal tools within the impact zone (e.g., projectile points, bifaces, hand stones) were piece plotted and collected. Large pieces of milling equipment were subjected to a detailed in-field analysis, using the same set of attributes used for collected specimens (see Laboratory and Analytical Methods, page 116). Surface debitage was not collected, except in circumstances where samples for sourcing and obsidian hydration would have been unavailable otherwise.

Systematic excavation followed surface collections at all but a few sites. Excavation units were dug in surface-parallel levels, except where warranted by the presence of features. All excavated sediment was screened through 1/8″ hardware mesh, and all cultural materials were collected. Excavation typically began with a series of shovel probes to determine the presence or absence of subsurface deposit. Shovel probes measured 50 × 25 centimeters and were excavated in 10 cm levels to sterile soil, or as deep as practical, generally no more than 60 cm. Where shovel probes indicated possible depth, 1 × 1 m and/or 1 × 2 m control units were excavated. These were also dug in 10 cm levels, except in feature contexts. Where warranted by features or other findings, contiguous units were opened to create larger exposures. In cases where shovel probes showed that artifacts were restricted to surface or near-surface contexts, surface scrapes were used. These were typically 2 × 2 m in size and excavated to a depth of 5 cm. Finally, rapid recovery units were used in addition to control units at one particularly productive site (26HU4943); these were similar to control

TABLE 9
Unit Counts and Excavated Volumes

Unit Type	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Unit Counts					
Control unit	356	77	154	77	664
Rapid recovery	3	–	–	–	3
Surface scrape	854	124	601	166	1745
Shovel probe	1651	310	765	226	2952
Surface collection unit	278	–	3	1	283
Controlled Excavation Volume (m^3)					
Control unit	238.25	71.50	86.71	43.35	439.81
Rapid recovery	9.00	–	–	–	9.00
Surface scrape	171.85	25.04	128.30	34.80	359.99
Shovel probe	53.85	14.35	30.87	8.39	107.46
Total Volume	472.95	110.89	245.88	86.54	916.26

units except that only tools were retained from the screen, not debitage. Along with standard documentation of the excavation efforts (e.g., level records), stratigraphic profiles and plan views for block exposures and features were drawn and photographed as necessary. Excavation totals by unit type are shown in table 9.

Some sites, particularly those in the Barrel Springs lava uplands at the northwest end of the High Rock Country, were dominated by bare rock, with very little sediment from which subsurface cultural materials could be recovered. At these sites, systematic surface collection units were laid out in lieu of surface scrapes, and all cultural materials within them were collected.

A total of 203 sediment samples was collected during fieldwork, typically from feature contexts, but also including column samples from selected sites. All samples were processed for flotation analysis, as described below.

Site maps were produced depicting the location of site and locus boundaries, surface tools, excavation units, and features, as well as prominent topographic features, vegetation, and hydrology. All excavation units, features, and surface artifacts were plotted using high-precision GPS units. All cartography was completed in a projectwide geographic information system (GIS). At the two large pronghorn trap complexes (sites 26EK3959 and 26EK12310), we also commissioned aerial photography and digital topographic mapping from Olympus Aerial Surveys, Inc., of Salt Lake City.

Data recovery efforts are listed individually by site in the regional summary chapters below (see chaps. 6 through 9), as well in the data appendices provided by Hildebrandt et al. (2015).

TABLE 10
Prehistoric Artifact Totals by Region

Artifact Type	Treated Sites					Isolates/Untreated Sites					Grand Totals
	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals	
Flaked Stone											
Projectile Point	1069	425	404	189	2087	77	42	28	12	159	2246
Projectile Point/Drill	2	1	–	1	4	–	–	–	–	–	4
Crescent	3	–	–	–	3	1	–	–	–	1	4
Drill	32	21	20	5	78	–	–	–	–	–	78
Biface	4031	608	1266	501	6406	26	17	10	5	58	6464
Formed Flake Tool	132	10	29	10	181	–	–	–	–	–	181
Flake Tool	1879	48	110	31	2068	4	–	–	–	4	2072
Core Tool	23	2	5	3	33	–	–	–	–	–	33
Core	727	3	108	95	933	3	–	1	–	4	937
Debitage	378,076	49,619	123,406	52,435	603,536	354	105	66	10	535	604,071
Ground Stone											
Millingstone	221	13	32	45	311	1	–	–	–	1	312
Handstone	102	7	20	12	141	1	–	1	–	2	143
Bowl Mortar	5	–	–	–	5	1	–	–	–	1	6
Pestle	16	1	5	3	25	–	–	1	–	1	26
Battered Cobble	9	5	6	–	20	–	–	–	–	–	20
Miscellaneous Ground Stone	29	12	3	8	52	–	–	–	–	–	52
Miscellaneous											
Bead, Glass	–	–	1	–	1	–	–	–	–	–	1
Bead, Shell	–	7	–	–	7	–	–	–	–	–	7
Bead, Stone	–	–	–	4	4	–	–	–	–	–	4
Manuport	5	1	4	–	10	–	–	–	–	–	10
Modified Bone	7	8	6	16	37	–	–	–	–	–	37
Modified Stone	3	3	–	5	11	–	–	1	–	1	12
Ochre	1	–	1	–	2	–	–	–	–	–	2
Pottery Sherd	–	–	102	33	135	–	–	–	–	–	135

Laboratory and Analytical Methods

The collections were cataloged by Far Western Lab Director Elizabeth Honeysett and her staff under accession numbers obtained from the Nevada State Museum, where they will be curated in perpetuity. Cataloging procedures followed a standardized format, with all materials processed in sequential order (by site, unit, or feature and by level, from top to bottom). Each tool received an individual catalog number, while fauna, flora, debitage, etc., was assigned a group or lot number; debitage was grouped by basic raw material type (e.g., obsidian, CCS, basalt). Recovered materials were washed, placed in 4 mil plastic bags with acid-free specimen tags, and labeled with indelible ink. Catalog data were entered into a Microsoft SQL Server database. Selected artifacts (e.g., projectile points, beads) were scanned using a flatbed color scanner, and the images were stored in the catalog database.

Table 10 lists prehistoric artifacts collected from each site, as well as other materials collected primarily during the survey phase, such as isolates, and surface collections from sites that were not part of the data recovery program. These were subjected to all of the same artifact analyses as those from the excavated sites, despite not being part of the data recovery program. A small proportion of survey-phase materials was deaccessioned and returned to private landowners early in the project, so detailed analytical data could not be collected for all of these materials. The catalog, which includes materials from both survey and data recovery phases, is presented as an appendix in Hildebrandt et al. (2015), as are all other analytical data generated by the project.

Artifact Analyses

Beyond cataloging, a variety of special studies and analyses were carried out on most artifact types, as summarized below. Further detail on temporally sensitive artifacts, including projectile points, pottery, and beads, is provided in chapter 5.

Flaked stone: Flaked stone artifacts include projectile points, bifaces, crescents, drills, formed flake tools, simple flake tools, cores, core tools, and debitage. All tools, as well as a sample of debitage, were subjected to technological analyses. These analyses were carried out by lithic analyst William Bloomer.

Projectile points, as the name implies, are the bifacially flaked tips of darts or arrows, or fragments thereof that retain characteristic basal or hafting elements. These were subjected to a metric analysis and classified by type, as described in detail in chapter 5.

Bifaces show percussion and/or pressure flaking on opposing sides of a continuous margin. Most are basically symmetrical in plan and cross section. In addition to the basic measurements, technological observations noted during analysis of the biface assemblage included reduction stage, presence of cortex, fracture type, presence of a flake detachment scar, and reason for rejection or discard (structural flaw, human error). Reduction stage is the primary attribute used throughout the study and, hence, warrants additional discussion. Stage 1 bifaces display rough bifacial edges and thick, sinuous margins, with fewer than 60% of the perimeter edge shaped. Stage 2 bifaces are percussion-shaped specimens with a rough outline. Stage 3 bifaces are percussion-thinned, well-formed items. Evidence of intermittent pressure flaking is seen on Stage 4 bifaces, which are further reduced, more or less symmetrical preforms. Stage 5 bifaces are fragments of extensively pressure-flaked implements and are considered (nondiagnostic) finished tools (e.g., projectile points, knives).

Crescents are crescent-shaped bifaces. Horizontal plan-view symmetry of each end distinguishes crescents from other bifacial tools. Edge-grinding is often present along both lateral margins of the curved crescent body. Body section edge-grinding is considered a distinctive attribute of Great Basin crescents.

Drills have a unique morphology, consisting of a narrowly constricted bit used to bore a hole or perforate. Drills can be large or small, ranging from extensively shaped bifacial forms to flakes with minimal modification. The drill base is typically broader than the bit, shaped or unshaped, for holding or hafting. Morphological attributes specifically recorded for the drills include base modification, bit cross-section shape, bit length, and bit width. Some projectile points showing reworking into drills are cataloged as "projectile point/drill" and are included in both analyses.

Formed flake tools are flakes that have been modified, usually unifacially, to the degree that the original edge shape has been highly altered. They typically show steep, intrusive flaking on one or more margins. Technological observations on formed flake tools include flake type, presence of cortex, flake termination angle, whether the item might have been intended as a flake blank (i.e., a biface formed by fairly minimal modification on the margins of a flake), striking platform type, number and shape of worked edges, working edge angle, length and thickness of the tooled edge, and edge modification type (unifacial microchipping, bifacial pressure flaking, etc.). Simple flake tools exhibit limited edge modification and/or retouch that may be intentional or may result from casual use. In contrast to formed flake tools, the basic outline of the original flake remains essentially unaltered; these are equivalent to "used" or "utilized" flakes. Simple flake tools were subjected to the same analysis as the formed flake tools.

Attributes collected for cores and core tools include the pattern of flake removals (unpatterned, unidirectional, etc.), original artifact form (flake, cobble, etc.), and primary and secondary platform types (cortical, interior). For core tools, number of worked edges (if applicable), shape and length of worked edges, and type of edge modification were also recorded. Core tools also show flake removals, with subsequent damage or use evident, such as grinding or battering of a flaked edge. We also examined type of modification (e.g., end-battering, edge-grinding, edge-flaking), its extent, and the angle of the working edge, as well as the attributes recorded for cores.

A sample of the debitage from each single-component area was subjected to technological analysis, unless there were fewer than 20 items or no 1/8″ controlled excavations took place (i.e., surface-collected samples were avoided, due to their propensity to lack small items like pressure flakes). Diagnostic flakes were grouped initially into two primary types: percussion and pressure. Percussion flake types were then sorted into primary decortication, secondary decortication, simple interior, complex interior, edge preparation, early-stage biface thinning, and late-stage biface thinning. Pressure flakes include early pressure, late pressure, and notching pressure. Several nondiagnostic flake types are recognized, including edge preparation/pressure, angular shatter, and indeterminate fragments.

In addition to these technological analyses, a micrographic edge-wear analysis of selected flake tools and formed flake tools was carried out by Nathan Stevens.

Ground and battered stone: Technological analyses for all collected ground and battered stone specimens were carried out by Allika Ruby. Also included in the analysis are a number of larger specimens that were analyzed in the field but not collected. Ground and battered stone artifacts include milling stones, hand stones, pestles, bowl mortars, battered cobbles, and fragmented portions of milling equipment that could not be ascribed to a specific category (miscellaneous ground stone). Attributes noted for all tools included material type, condition (complete or fragmented), basic metrical information (maximum length, width, and thickness), number of wear surfaces, wear intensity, and evidence for shaping, burning, secondary use, and residues. For milling stones and hand stones, additional attributes included overall planar shape and cross section, number of facets on each wear surface, wear surface planar shape and dimensions, and evidence for wear direction (striations) and rejuvenation (pecking). These attributes were also noted where present for miscellaneous ground stone fragments. Measurements for bowl mortars included interior cup and rim dimensions. The battered cobble analysis focused on characterization of both face and edge wear.

Other artifacts: Other artifacts recovered during the project include beads of various types (*Olivella* shell, stone, and a single glass trade bead); pottery; modified/shaped stone implements (e.g., abraders/shaft straighteners); modified bone; unmodified stone clearly transported to the site (i.e., manuports); and a few small pieces of baked clay and hematite/ochre. An analysis of the pottery was carried out by Sharlyn Street, the results of which are presented in chapter 5. A typological analysis of the shell and stone beads is also presented in chapter 5. Bone tools were subjected to the same taxonomic identification program as the rest of the bone (see Faunal Analysis, directly below).

Faunal Analysis

Faunal remains were sorted initially by Maureen Carpenter and identified by Tim and Kim Carpenter, using comparative collections at the University of California, Davis; University of California, Berkeley Museum of Vertebrate Zoology; and collections in possession of the analysts. All specimens were sorted by identifiable element and taxonomic grouping. When possible, each specimen was identified to anatomical element (ulna, femur, etc.). Portion of the element such as proximal, distal, or shaft fragment was also recorded. Fragmentary specimens for which the element could not be determined were divided into general categories including long bone, flat bone, cancellous bone, or indeterminate bone fragment. Degree of burning was then noted for each specimen. If an element (or group of elements) was identified as of natural rather than cultural origin, it was noted as likely intrusive. Any element that showed immature features such as epiphyseal lines were noted as such, but no attempt was made to determine the age of the animal.

Specimens were identified to the most specific taxonomic level possible. When

TABLE 11
Size Categories Used to Classify Unidentified Mammal and Bird Bone

Size Category	Typical Species
Mammals	
Very small[a]	Mice, voles, insectivores
Small[a]	Small rodents, pygmy rabbits
Small-medium	Hares, marmots, larger squirrels
Medium	Coyotes, raccoons, dogs
Medium+	Mammals larger than medium
Medium-large	Deer, pronghorn, bighorn
Large	Elk, cattle, bison
Birds	
Very small[a]	Smaller perching birds
Small[a]	Perching birds, doves, quail
Small-medium	Teals, grebes, crows, egrets
Medium	Ducks, gulls, terns, shovelers
Medium+	Birds larger than medium
Medium-large	Ducks, medium-large raptors
Large	Geese, pelicans

[a] Very small and small categories are combined in this analysis.

condition of the bone (i.e., fragmentation or burning) precluded genus- or species-level identification, fragments were identified to the family, order, or size/class level. Whenever specimens resembled a particular species but could not be conclusively identified as such, the note "(cf.)" (compares [favorably] with) was included in the comment section of the appendices and tables.

Mammalian specimens, including those that could not be identified beyond the level of class, were separated into general size categories similar to those defined by Thomas (1969; table 11). *Small mammals* include small rodents such as squirrels, pocket gophers, mice, voles, and the smaller rabbits (cottontails and pygmy rabbits). *Small-medium mammals* include primarily jackrabbits (hares), marmots, and larger squirrels and may include, on occasion, some of the smaller carnivores. *Medium mammals* include mostly medium-sized carnivorous mammals such as bobcats, foxes, coyotes, dogs, etc. *Medium-plus mammals* (Medium+) are likely the remains of *medium-large mammals* but cannot be definitively assigned. *Medium-large mammals* include most of the artiodactyls, such as deer, pronghorn, bighorn, and the like. *Large mammals* in this region include primarily elk, domestic cow, and bison.

Unidentified species of birds were similarly sorted into small, medium, medium+, large and extra-large size classes (table 11). Again, the size distinctions are somewhat arbitrary and were compiled by the analysts based on average weight for each species. In general, class and order of birds tend to group in the same arrangement as their families and body size. Unidentified vertebrate remains (mostly unidentified small mammals or birds) were also size sorted. Any cultural and noncultural modifications to the bone were also recorded. Cultural modifications may include burning, cut marks, polishing, striations, etc. Modified bone was noted as such. Noncultural modifications include weathering such as water wear or sandblasting, as well as gnawing and digestive pitting or staining by rodents, carnivores, and birds of prey.

Flotation Analysis

The 203 sediment samples were flotation processed by Angela Tingey, Gina Caretti, and William Stillman, employing a manual technique used throughout California and Nevada (Wohlgemuth, 1989). Buoyant light fraction was collected using 40 mesh/inch (0.4 mm) screen, with heavy fraction washed through 3 mm (1/8″) and 1 mm (window screen) mesh. Inasmuch as recovery effectiveness measured at other sites ranges from 85% to 95% of dense nutshell and more than 98% of small seeds, only the buoyant light fraction material was sorted for charred plant remains. The 0.3 mm screened portion of the heavy fraction was also sorted, with all cultural materials retained and cataloged.

Light fraction was size sorted using 2 mm, 1 mm, 0.7 mm, and 0.5 mm mesh. Wendy Pierce, assisted by Eric Wohlgemuth, sorted light fractions for charred seeds, nutshell, and other dietary debris. Each size grade, including samples of the 0.4 mm residue, was examined at using a binocular microscope at ×10–15 magnifications. Wood charcoal was sorted to the 1 mm grade but was not identified to species. All segregated constituents were counted, and fragments of nutshell and wood charcoal were weighed to 0.1 mg. Constituents were stored in translucent, hard plastic centrifuge tubes with acid-free paper tags denoting site number, sample number, size grade, and a constituent type code. All items of a single type or taxon were stored (in separate centrifuge tubes for each provenience and size grade) in 4 mil plastic bags with acid-free paper labels. All tags were labeled with a #2 pencil.

Radiocarbon Dating

A total of 101 radiocarbon assays was made during the project, most from plant charcoal pulled from flotation sample light fractions, but also including juniper limbs from the two pronghorn trap complexes (26EK3959 and 26EK12310), charcoal recovered during feature excavation, bison bone collagen, and bulk soil. All assays were done by Beta Analytic, Inc., of Miami, Florida. See chapter 5 for further discussion and a summary of results.

Obsidian Hydration and Geochemical Sourcing

Source-specific obsidian hydration measurements were a key method of dating many of the project sites. Accordingly, a very large sample of artifacts was submitted for these analyses from both the survey and the data recovery phases, totaling more than 8000 items (table 12). In all, 6669 viable source-specific hydration measurements were obtained from these specimens.

Survey-phase sourcing and hydration were done on selected projectile points and bifaces, as well as small surface samples from selected sites, numbering about 1500 specimens. The survey-phase hydration/sourcing program was halted at agency re-

TABLE 12
Summary of Obsidian Sourcing and Hydration Measurements

Obsidian Status	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Measurable	4880	1008	473	308	6669
Not measurable	594	75	107	63	839
Not cut (opaque)	754	1	–	–	755
Totals	6228	1084	580	371	8263

quest partway through the survey fieldwork, so not all sites were sampled during that phase. Hydration from the survey phase was measured at Pacific Legacy's in-house laboratory; geochemical sourcing was done by Richard Hughes.

The data recovery sampling program included all diagnostic projectile points, plus a random sample of debitage from a controlled excavation or surface-collection context. Typically, 10 items were analyzed per site or locus. Sampling was random in all but a very few cases, where glassy obsidian was preferentially selected over nonglassy varieties (likely representing Nut Mountain and Unknown B). Some debitage samples were also selected from radiocarbon-dated contexts, to help develop hydration brackets (see chap. 5). Finally, some samples were selected from the lower levels of excavation units with intact stratigraphy, to explore possible vertical separation of components.

Treatment-phase geochemical sourcing was done by Richard Hughes, as during the survey phase. All specimens subjected to hydration measurement were also geochemically sourced (i.e., no visual sourcing was attempted), except at one site (26HU4926), a Massacre Lake/Guano Valley quarry site where a subset of the analyzed specimens (20 of 58) were assumed to be from that source.

All treatment-phase hydration measurement was carried out by Tom Origer. During this phase, projectile points were sampled for hydration analysis by removing a small flake, rather than by making the typical cut into the artifact, to minimize damage and maintain the visual integrity of the specimens. Also, after learning that certain obsidian types with a grainy texture failed to produce viable hydration rims, it was decided to stop preparing hydration slides for specimens made from this material. Geochemical sourcing showed that these primarily included Nut Mountain and Unknown B. A few specimens from these sources did have a glassy texture and could be measured, however.

CHAPTER 5

CHRONOLOGICAL CONTROLS

Jerome King

Establishing the age of an archaeological deposit is fundamental to its interpretation. This section describes the various methods used to determine the age of the project sites, including the use of temporally diagnostic artifacts, radiocarbon dates, and obsidian hydration measurements. The goal of these dating procedures was to isolate sites, or parts thereof, into discrete spatiotemporal components, and to place those components into the larger project chronology described earlier (see chap. 3).

Diagnostic Artifacts

Diagnostic artifacts recovered from the project sites primarily included projectile points, but we also recovered a small assemblage of pottery and a few shell, stone, and glass beads. Some of these artifacts were collected as isolated finds, or from sites along the pipeline that were not subjected to data recovery treatment; however, they are discussed here because they provide useful additional data points for some of the landscape-level studies presented later.

Projectile Points and Crescents

A very large collection of projectile points was assembled during survey and data recovery, totaling 2249 unique specimens. Many of these could be assigned to commonly known types, some with well-established time ranges during which they were produced, others less so. Type assignments were made using a set of morphological and metrical attributes originally described by Thomas (1981a) for use in the central Great Basin, with some additions and modifications to accommodate local types (table 13; Hildebrandt and King, 2002). The type assignments also employed a "dart-arrow index" for notched points, to make the key distinction between those generally larger point types that were made to tip darts versus those made to tip arrows (Hildebrandt and King, 2012). This index is simply the neck width plus thickness, which gives an easily measured proxy for the overall robustness of the hafting area. As discussed by Hildebrandt and King (2012), an index value of 11.8 mm proves effective at distinguishing between still-hafted archaeological darts and arrows, and provides a workable split between similarly shaped point types that differ mostly according to size, and that are commonly interpreted as dart points versus arrow points (e.g., Elko versus Rosegate).

All points were scanned on a flatbed color scanner as a part of the type assignment process. Angular measurements (proximal

TABLE 13
Metric and Morphological Attributes of Projectile Point Types
NOA = notch opening angle; MTH = maximum thickness.

Type	Proximal shoulder angle	Distal shoulder angle	Dart-arrow index	Other attributes
Notched/shouldered				
Desert Side-notched	≥145	–	<11.8	Flat to strongly indented/ notched base
Rosegate	≥90, <145	<180 (or NOA<80)	<11.8	Typically rounded base
Small Stemmed	<90	>180	<11.8	–
Elko	≥100, <145	<180 (or NOA<80)	≥11.8	–
Gatecliff Split Stem	<100	>=180 (or NOA≥80)	≥11.8	Split stem
Contracting Stem Dart	<100	≥180	≥11.8	–
Northern Side-notched	≥145		≥11.8	Flat to arcuate incurved base, notches high on sides
Great Basin Stemmed	<90	≥200	≥11.8	Often edge-ground
Unnotched				
Cottonwood Triangular	–	–	–	Thickness typically <3.0, slightly incurved or flat base
Humboldt Concave Base	–	–	–	Thickness ≥4.7, parallel or flaring sides, arcuate basal indentation
Lanceolate	–	–	–	Thickness ≥4.7, leaf shaped, may have small basal indentation
Great Basin Concave Base	–	–	–	Thickness ≥4.7, basal width typically ≥20, parallel or flaring sides, basally thinned, often edge-ground
Indeterminate				
Arrow-sized	–	–	≥11.8 (or MTH≥4.7)	PSA not measurable
Dart-sized	–	–	<11.8 (or MTH<4.7)	PSA not measurable

and distal shoulder angles) were made onscreen on the digital images of the points, using the TPSdig digital measurement program (Rohlf, 2009). Many calls remained tentative because metrical attributes were incomplete or violated the criteria set out in table 13 in a minor way, while still suggesting the overall form of the type. Results of typological assignment of the 2249 points are shown in table 14. Metrical attributes and assigned types of individual projectile points are presented in Hildebrandt et al. (2015).

An additional 392 points were noted during fieldwork but not collected, typically because they were outside the pipeline project area. While direct metrical analysis of these items obviously was not possible, we created scaled digital images from in-field photographs and used those in conjunction with

TABLE 14
Projectile Points and Crescents

Point Type	Collected					Not Collected					Grand Totals
	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals	
Typed Points											
Cottonwood	16	9	18	3	46	4	2	4	–	10	56
Desert Side-notched	14	23	31	10	78	3	4	6	1	14	92
Small Stemmed	17	8	5	–	30	3	3	–	–	6	36
Rosegate	120	130	56	46	352	20	10	18	2	50	402
Lanceolate	24	3	3	1	31	4	–	2	1	7	38
Elko	311	87	125	39	562	68	6	35	1	110	672
Contracting Stem Dart	12	1	5	3	21	–	–	2	–	2	23
Gatecliff Split Stem	68	19	35	16	138	15	3	10	2	30	168
Humboldt Concave Base	175	48	47	15	285	39	6	14	4	63	348
Northern Side-notched	64	32	15	10	121	12	3	5	1	21	142
Crescent	4	–	–	–	4	1	–	–	–	1	5
Great Basin Stemmed	41	8	7	2	58	3	–	–	1	4	62
Great Basin Concave Base	10	2	–	–	12	1	–	–	–	1	13
Subtotals	876	370	347	145	1738	173	37	96	13	319	2057
Untyped/ nondiagnostic											
Other Dart	12	1	3	3	19	–	–	–	–	0	19
Other Arrow	–	1	1	1	3	–	–	–	–	0	3
Dart-sized	130	29	25	14	198	21	2	9	3	35	233
Arrow-sized	28	19	17	11	75	2	–	3	–	5	80
Indeterminate	105	48	39	28	220	14	4	9	6	33	253
Refits another point	1	–	–	–	1	–	–	2	–	2	3
Subtotals (not counting refits)	275	98	85	57	515	37	6	21	9	73	588
Totals (not counting refits)	1151	468	432	202	2253	210	43	117	22	392	2645

Fig. 16. Great Basin Concave Base, Great Basin Stemmed, and Crescent projectile points.

in-field measurements to arrive at typological assignments.

As discussed in the Obsidian Hydration section on page 140, a large body of source-specific hydration measurements provides some independent support for the temporal integrity of many of the types described here, if not their actual age ranges.

Great Basin Concave Base: This projectile point series includes concave-based lanceolate forms exhibiting edge-grinding and variable amounts of fluting/basal thinning (fig. 16). Few of the 12 specimens recovered show definitive characteristics of Clovis points, so they are classified collectively as Great Basin Concave Base, following the lead of Clewlow (1968), Layton (1970), Beck and Jones (2009), and Smith (2010). Their exact age is difficult to determine, as they are rarely found in buried, dateable contexts. Instead, they are usually found in surface contexts associated with both fluted and Great Basin Stemmed points. For the purpose of this project, they are assigned to the Paleoindian Period, as most researchers think they are probably intermediate in age between Clovis and Great Basin Stemmed points (see Beck and Jones, 2009, for an in-depth discussion of this issue). We admit, however, that this assignment is far from definitive.

Great Basin Stemmed: Great Basin Stemmed–series points are weakly shouldered projectiles with relatively long contracting stems and rounded bases (fig. 16). Stem margins are often ground. This series subsumes an assortment of forms recognized throughout the Great Basin, including Cougar Mountain, Parman, Lind Coulee, and Windust (Layton, 1979; Pendleton, 1979; Tuohy and Layton, 1979; Beck and Jones, 2009). They are classic indicators of the Paleoarchaic Period (12,800–7800 cal B.P.) but, as noted in chapter 3, there is some limited evidence that they might be coeval or even predate Clovis (Beck and Jones, 2010, 2012; Jenkins et al., 2012; cf. Goebel and Keene, 2014).

Crescents: The four crescents recovered during the project fall within the Type I (Quarter Moon Crescent; see fig. 16) subgroup established by Tadlock (1966). They are often associated with Great Basin Stemmed points, particularly in wetland habitats, and are considered outstanding indicators of the Paleoarchaic Period (Beck and Jones, 2009).

Northern Side-notched: Northern Side-notched points are primarily a Plateau and northern Great Basin phenomenon (Leonhardy and Rice, 1970; O'Connell, 1971, 1975; Layton, 1985; Sampson, 1985; Wilde, 1985; Delacorte and Basgall, 2012; Thomas, 2013). They are relatively large and triangular in outline, with notches placed high on the blade (fig. 17). Notches are typically deep and rounded, often resulting in a relatively narrow neck for dart points. The base typically has an arcuate incurving shape. Some specimens lacking this distinctive shape (and often referred to more generically as "Large Side-notched") are included here, however. Although Northern Side-notched points are thought to date primarily to the Post-Mazama interval, there is some evidence that they may persist into the Early Archaic on the Modoc Plateau (Hildebrandt and Mikkelsen, 1994; Mikkelsen and Bryson, 1997; Hildebrandt and King, 2002).

Humboldt Concave Base: Initially defined by Heizer and Baumhoff (1961), these are unshouldered points with slightly to deeply concave bases and margins that are

Fig. 17. Northern Side-notched and Humboldt Concave Base projectile points.

parallel or contract toward the base (fig. 17). Here, they are distinguished from Cottonwood forms by their larger size, particularly thickness (>4.7 mm thick; Cottonwood forms are typically well under 3 mm). Unfortunately, the temporal significance of these points remains poorly established. Delacorte (1997: 78–80) argues that, in contrast to other dating schemes for the Great Basin (Thomas, 1981a; Hall, 1983; Jackson, 1985; Basgall and McGuire, 1988; Delacorte and McGuire, 1993), the series appears to be predominantly an Early Archaic marker. In the current project area, Humboldt points are common in both Post-Mazama and Early Archaic contexts, which is largely consistent with obsidian hydration data generated by Layton (1985) from Last Supper Cave and Hanging Rock Shelter.

Gatecliff Split Stem: As defined by Thomas (1981), Gatecliff Split Stem points are shouldered dart points with parallel-sided stems and notched or concave bases (fig. 18). Radiocarbon dates from Gatecliff Shelter and other central Great Basin sites have established these as Early Archaic time markers. However, a wide range of contexts in the western and northwestern Great Basin indicate that they may have persisted well into the Middle Archaic, often occurring with Elko points (Bennyhoff and Hughes, 1987: 163; O'Connell and Inoway, 1994; McGuire, 1997: 171–172). Obsidian hydration results also suggest a high degree of overlap between Gatecliff and Elko forms (see Obsidian Hydration, page 140).

Contracting Stem dart: The temporal sensitivity of the few specimens assigned to this type is unclear, except for their general classification as dart points (fig. 18). Thomas' (1981a) key identifies a Gatecliff Contracting Stem form coeval with Gatecliff Split Stem points, which would make them an Early Archaic marker. Delacorte (1997) argues that contracting stem forms lack the temporal resolution of Gatecliff Split Stem forms in the western Great Basin. Others have argued that the type may have an Early Archaic affiliation, based on their similarity to the Martis type from the northern Sierra Nevada (Milliken and Hildebrandt, 1997).

Elko series: Elko series points are corner-notched dart points with a flared base (fig. 19). As defined here, the Elko series includes only the Corner-notched and Eared varieties (cf. Heizer and Baumhoff, 1961; O'Connell, 1967; Heizer et al., 1968); in this study no attempt was made to differentiate these two variants. Elko points are generally considered Middle Archaic markers in the central and western Great Basin (Bettinger and Taylor, 1974; O'Connell, 1975; Thomas, 1981). However, some have proposed that Elko forms extend back to the Early Archaic (Mikkelsen and Bryson, 1997: 136; see also Hildebrandt and Mikkelsen, 1994; Milliken and Hildebrandt, 1997; Smith et al., 2013).

Lanceolate: These are leaf-shaped bifaces with convex edges and rounded bases, believed to be dart points because of their size and degree of finish (fig. 19). Variously referred to as "Steamboat" along the Sierran-Cascade Front (Elston and Davis, 1972; Elston et al., 1977; Elston, 1979) and "Gold Hill Leaf" to the north (Cressman, 1933; Davis, 1968, 1970), they have often been considered Middle Archaic markers. However, Hildebrandt and King (2002) saw little temporal sensitivity in the type along the Sierran-Cascade Front. Many may simply be projectile point blanks.

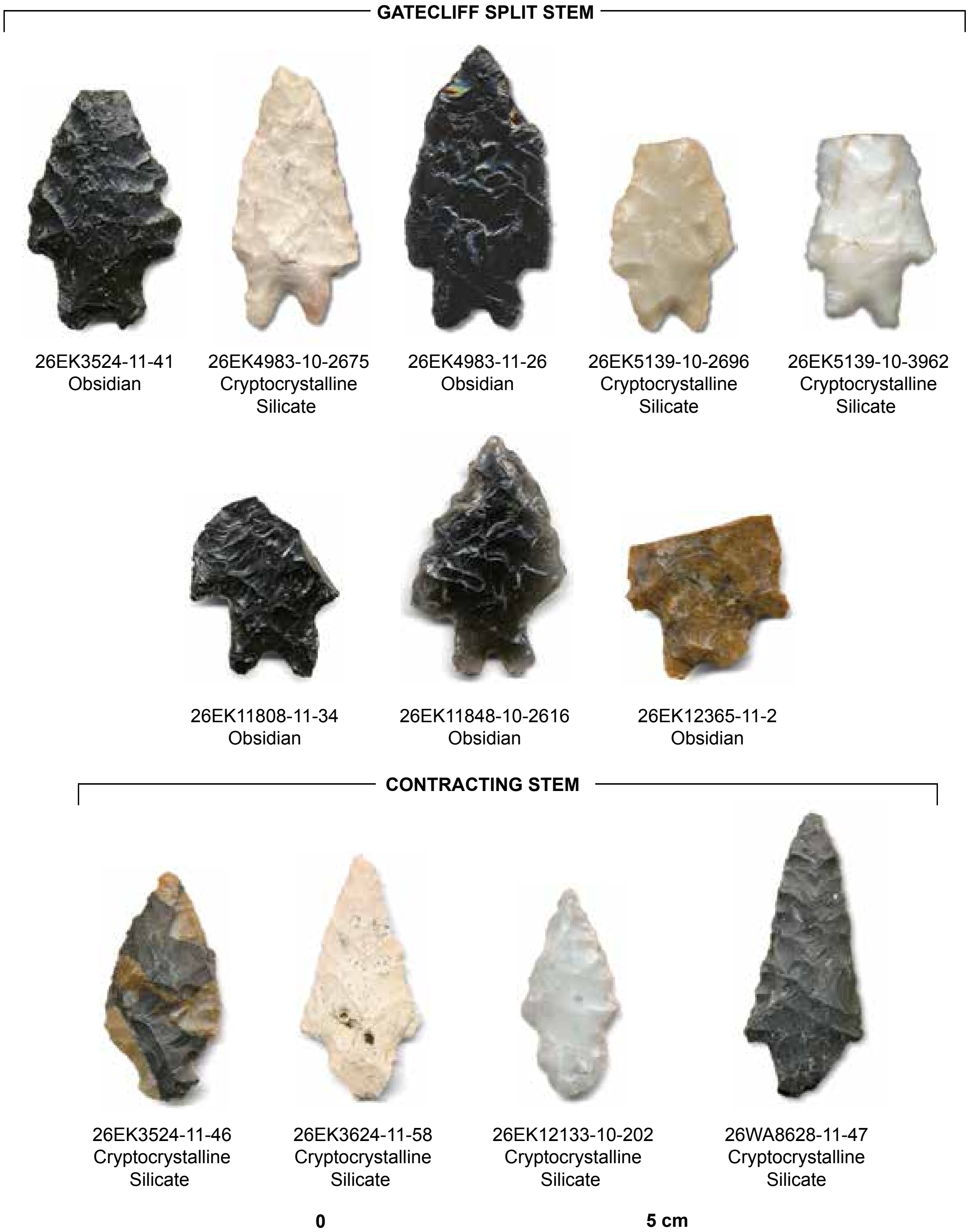


Fig. 18. Gatecliff Split Stem and Contracting Stem projectile points.

Fig. 19. Elko projectile points.

Fig. 20. Lanceolate and Rosegate projectile points.

Rose Spring and Eastgate Series ("Rosegate"): The Rose Spring series comprises notched triangular arrow points with expanding stems, the bases of which vary from straight to moderately convex, sometimes with a central notch (Heizer and Baumhoff, 1961; Lanning, 1963). They can generally be described as corner notched, though many specimens are notched more or less vertically from the base, forming long barbs (fig. 20). No attempt was made in this study to distinguish the few longer-barbed specimens that would have been attributable to the contemporaneous Eastgate type (Heizer and Baumhoff, 1961; Bettinger, 1989), so the inclusive term "Rosegate" is used.

This type is largely a Late Archaic time marker. However, Hildebrandt and King (2002) argue that these points (and hence bow-and-arrow technology) may have been introduced to the western Great Basin somewhat earlier than previously believed, perhaps as early as 1900 B.P. This proposal is supported by a direct date of 1900 cal B.P. on a bag with two probable Rose Spring points from Dessication Cave, located less than 100 km south of the High Rock Country.

Small Stemmed: The Small Stemmed type (see Alkali Stemmed in O'Connell, 1971) was introduced during previous work along the Sierra-Cascade Front (Delacorte, 1997: 92–94), in part as a means to sort out some of the difficulties in classifying arrow points in the Modoc Plateau region (Hughes, 1986: 95). Small Stemmed points are arrow sized, with parallel-sided to slightly contracting stems (fig. 20). They are distinguished from Rosegate points by their generally lighter weight, broader notch-opening angles, and more parallel stem morphology. Small Stemmed points lack the characteristic hanging barbs of Gunther series points. Based on hydration data, as well as contextual evidence from Surprise Valley (O'Connell, 1971, 1975), Delacorte (1997: 94–95) concludes that Small Stemmed points are temporally distinct from the Gunther series, representing a Late Archaic to Terminal Prehistoric occupation possibly linked to pre-Numic populations.

Desert Side-notched: Originally described by Baumhoff and Byrne (1959), Desert Side-notched points are small triangular arrow points with notches placed high on the sides; most are comparatively thin and long in relation to width (fig. 21). Many display a deep indentation or notch in the base. They are well-established markers of the Terminal Prehistoric Period (post-600 cal B.P.) in the southwestern Great Basin and may be ethnic markers for Numic populations (Delacorte, 2008). Because the Northern Paiute and Western Shoshone appear to have colonized northern Nevada relatively late in time (i.e., after 600 cal B.P.), it is possible that this point type arrived in the project corridor at that same time.

Cottonwood Triangular: This point form is not well represented within the project area. These are small, unnotched triangular points (see fig. 21) considered to be Terminal Prehistoric markers in the Great Basin (Bettinger and Taylor, 1974; Thomas, 1981a). They tend to occur with Desert Side-notched points and the two are often combined into a single Desert Series. Cottonwoods could also be indicators of Numic populations within the project corridor.

Other types (dart sized, arrow sized, indeterminate): Points in the generic dart-sized category include fragmen-

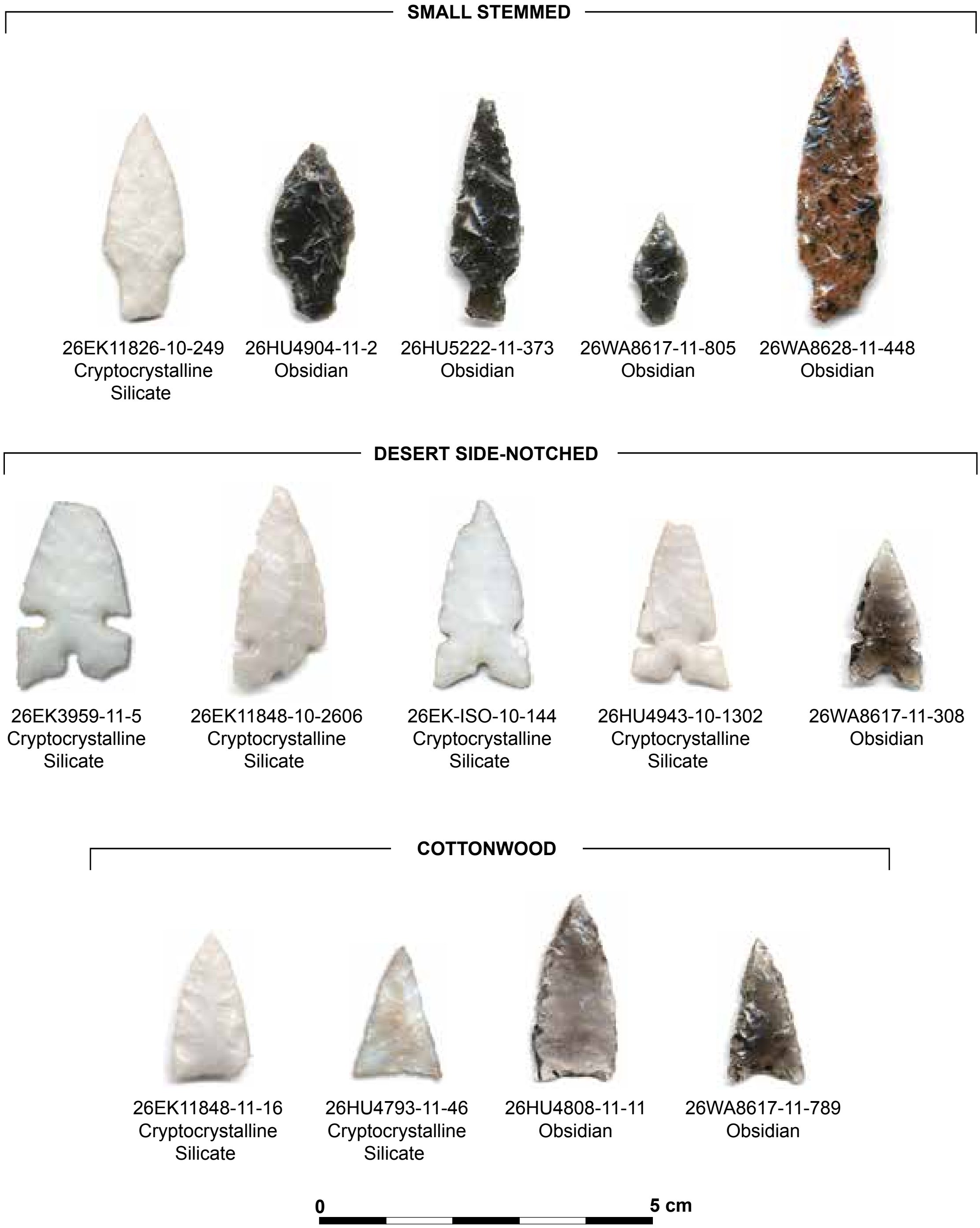


Fig. 21. Small Stemmed, Desert Side-notched, and Cottonwood projectile points.

TABLE 15
Pottery

Site (CRNV-)	Great Salt Lake Grayware	Snake Valley Grayware	Great Basin Brownware	Indeterminate	Totals
Upper Humboldt Plains					
26EK9200/12031	–	–	3	–	3
26EK9484	–	–	3	–	3
26EK11836	11	–	–	–	11
26EK11888	–	–	16	–	16
26EK11960	–	–	–	1	1
26EK12130	–	–	62	5	67
26EK12333	–	–	1	–	1
Thousand Springs Valley					
26EK9178/12133	5	1	23	3	32
26EK11808	–	–	1	–	1
Totals	16	1	109	9	135

tary, typologically ambiguous, or morphologically unique specimens with thicknesses or dart-arrow index values identifying them as dart points. As such, all were presumably used to tip atlatl darts, dating them to the Middle Archaic or earlier.

As their name implies, arrow-sized points are distinguished from dart points in that they have dart/arrow indices of <11.8 and thus were presumably used to tip arrows. As with the dart points, nearly all of the arrow-sized specimens are incomplete, but given that they postdate the introduction of the bow, they are assumed to be Late Archaic or Terminal Prehistoric in age.

Points categorized as indeterminate are generally fragmentary specimens identifiable as points by the presence of a notch or other telltale hafting element, but not sufficiently complete or distinctive to be assigned to a particular type or even to the generic dart/arrow point categories. Thus they lack temporal utility, although they do serve as a functional indicator of hunting.

Pottery

Three types of pottery were recovered: Great Basin Brownware (*N* = 109), Great Salt Lake Grayware (*N* = 16), and Snake Valley Grayware (*N* = 1; table 15). Classification of these materials was based a variety of factors including wall color, wall thickness, decoration, artifact part, and ceramic paste and temper. Sherds were classified using typologies defined by Colton (1952) as well as Smith and Gratz (1977).

The Great Basin Brownware sherds include a large variety of interior and exterior wall colors that range from light to dark gray and light to dark brown. Average wall thickness is 6.2 mm, and all except two rim sherds are plain ware, lacking any decoration. The two decorated rims have incising along the exterior rim edge and a stamped circular pat-

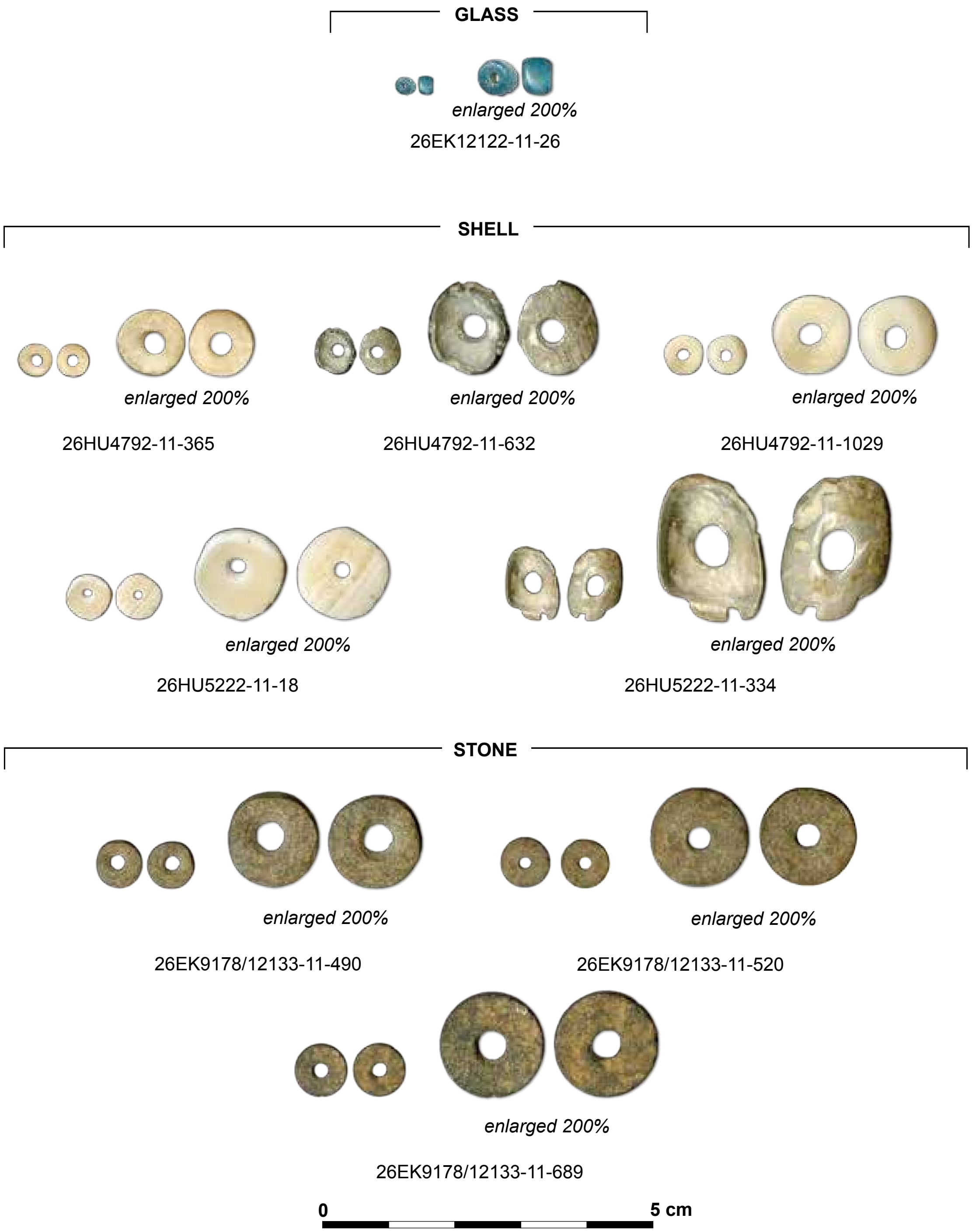

GLASS
enlarged 200%
26EK12122-11-26
SHELL
enlarged 200%
26HU4792-11-365
enlarged 200%
26HU4792-11-632
enlarged 200%
26HU4792-11-1029
enlarged 200%
26HU5222-11-18
enlarged 200%
26HU5222-11-334
STONE
enlarged 200%
26EK9178/12133-11-490
enlarged 200%
26EK9178/12133-11-520
enlarged 200%
26EK9178/12133-11-689
0
5 cm

Fig. 22. Beads.

TABLE 16
Beads

Site	Locus	Provenience	Cat. No. (11-)	Material	Type
High Rock Country					
26WA8748	A	CU 6, 0-10	54	Bone	Tube/bead
26WA8748	A	CU 7, 0-10	59	Bone	Tube/ bead
26WA8748	A	CU 12, 0-10	73	Bone	Tube/ bead
26WA8748	A	CU 21, 0-10	111	Bone	Tube/ bead
Upper Lahontan Basin					
26HU4791	A	CU 2, 20-30	139	Bone	Bead/tube
26HU4791	A	CU 2, 20-30	140	Bone	Bead/tube
26HU4791	A	CU 3, 10-20	141	Bone	Bead/tube
26HU4792	AB	CU AB2, 20-30	365	Shell	*Olivella* G1
26HU4792	AB	CU AB8, 0-10	632	Shell	*Olivella* G5
26HU4792	IJ	CU IJ14, 0-10	1029	Shell	*Olivella* G4
26HU4792	IJ	CU IJ16, 20-30	1064	Shell	*Olivella* indeterminate
26HU4792	AB	CU AB6, 20-30	1070	Bone	Bead
26HU5222	C	Artifact 18	18	Shell	*Olivella* F2D
26HU5222	C	CU 4, 10-20	334	Shell	*Olivella* C7 or C2
26HU5222	C	CU 5, 0-10	347	Shell	*Olivella* G1
Upper Humboldt Plains					
26EK9200/12031	K	CU 5, 10-20	233	Bone	Tube/bead
26EK12122	-	SS 4, 0-05	26	Glass	Trade bead
Thousand Springs Valley					
26EK9178/12133	E	CU 5, 0-10	466	Bone	Tube/bead
26EK9178/12133	E	CU 5, 10-20	490	Stone	Perforated disk
26EK9178/12133	E	CU 7, 0-10	520	Stone	Perforated disk
26EK9178/12133	E	CU 7, 30-40	619	Bone	Bead
26EK9178/12133	E	CU 1, 5-10	689	Stone	Perforated disk
26EK11808	A	CU 10, 20-30	239	Bone	Bead
26EK11808	A	CU 24, 10-20	493	Bone	Bead
26EK11808	A	CU 7, 60-70	540	Bone	Bead detritus
26EK11808	A	CU 11, 10-20	541	Bone	Bead/tube
26EK11808	A	CU 11, 30-40	542	Bone	Bead fragment
26EK11808	B	CU 20, 10-20	543	Bone	Bead fragment
26EK11808	A	CU 23, 0-10	544	Bone	Bead fragment
26EK12394	C1	CU 3, 0-10 (Feat. 2)	68	Stone	Perforated disk

tern along the top of the rim. The core (or paste) also comprises a variety of colors, ranging from light to dark gray, light to dark brown, and black carbon most likely due to an uncontrolled firing atmosphere. Temper is extremely variable and unsorted, consisting of a mixture of angular to subangular clear to milky white quartz, mica, and traces of plagioclase, feldspar, and basalt in a few pieces. Brownware sherds postdate 600 cal B.P. and are outstanding indicators of the Terminal Prehistoric Period.

The Great Salt Lake Grayware sherds have a more limited array of interior and exterior wall colors—light brown and light gray. The average wall thickness is 4.4 mm, and all sherds are plain ware wall fragments. The core has a larger variety of colors ranging from medium to dark brown, light brown, and light to dark gray. Temper is composed of small, well-sorted pieces of angular clear and white quartz and/or mica. Great Salt Lake Grayware is one of the most common Fremont pottery types known and tends to be concentrated in northwestern Utah (Madsen, 1986). The current sample probably represents trade items from the east dating to the Late Archaic Period (1300–600 cal B.P.), which is consistent with Fremont pottery found by Hockett and Morgenstein (2003) at the Scorpion Ridge site near Elko, Nevada.

The one piece of Snake Valley Grayware has a light brown interior and exterior wall color and an average thickness of 4.7 mm. It is a plain ware wall fragment with a light brown core. The temper consists of a mixture of small, rounded clear quartz and large, angular milky quartz. It is also a Fremont artifact type but is most commonly found in southeastern Utah. It also corresponds to the Late Archaic Period (Madsen, 1986).

Beads

Seven *Olivella* shell, four stone, one glass, and 17 bone beads were recovered from project sites (fig. 22; table 16). The shell beads all come from just two sites (26HU4792 and 26HU5222). These were classified and dated following Bennyhoff and Hughes (1987) and Groza et al. (2011). The *Olivella* beads include two Tiny Saucers (G1; 2000–110 cal B.P.), one Tiny Saucer/Irregular Saucer (G5; 2000–110 cal B.P.), one Ground Saucer (G4; 1530–1360 cal B.P.), one Elliptical Saddle (F2D; 1530–1200 cal B.P.), one item that is either a Split Amorphous (C7; 930–680 cal B.P.) or a Split Drilled (C2; 2150–1530 cal B.P.), and one indeterminate fragment.

The four stone beads come from two sites (26EK9178/12133 and 26EK12394). All are perforated disks. One is made from steatite, while the others are made from an indeterminate stone. Their age is unknown. The single glass trade bead, from site 26EK12122, is a turquoise drawn/tumbled specimen of a type often referred to as *seed*, *pound*, and *embroidery* beads (Karklins, 1982; Ross, 1990). They are quite common in ethnohistoric sites in this region dating to the 1820s or later.

Seventeen bone beads and one piece of bead detritus were recovered (table 16; fig. 23). Most are made from the long bones of small mammals like jackrabbits and cottontails and all but one are fragmentary. They are manufactured by first being scored and then snapped, with the discarded ends falling into the detritus category. The resulting blank can be further scored and snapped, creating beads with short lengths (not much longer than they are wide) or left as relatively long tubular items. Additional modifications include polish and striations on their ends and lateral surfaces. Some also have decorations

Fig. 23. Modified bone.

carved into their bodies. All but four from the current project appear to be undecorated fragments. Three of the remaining specimens have deep grooves encircling their bodies, while the others look similar in shape and size to the small "seed beads" traded during ethnohistoric times.

Bone beads are usually found in Late Archaic and Terminal Prehistoric components in the western Great Basin but are sometimes found in earlier contexts as well. Significant numbers have been recovered from late prehistoric structures in the Pah Rah Uplands northeast of Reno (McGuire et al., 2008) and along the Humboldt River near Lovelock (McGuire and Hildebrandt, 2013). A wider temporal affiliation was documented at Pie Creek Shelter (McGuire et al., 2004), Gatecliff Shelter (Thomas, 1983), and James Creek Shelter (Elston and Budy, 1990), where they date to the last 3200 years. This is also the case for the current study, where they occur in both Middle and Late Archaic contexts.

Radiocarbon

Data recovery yielded 101 radiocarbon dates. Most come from charred plant remains from flotation sample light fractions; the samples were taken from a variety of feature contexts (e.g., hearths, living surfaces) or more generalized midden deposits. They also include an assay from a bison bone and from wood samples taken from a series of pronghorn traps in Thousand Springs Valley (table 17). The calibrated intercept (or median of multiple intercepts) is the primary data point used in all components of this study.

Obsidian Hydration

Obsidian hydration is a key element of chronological control at the project sites. At many of the sites, in fact, it is the only method available to establish age. As a result, an extensive program of hydration measurement was undertaken, focusing on typed projectile points, contexts with radiocarbon dates, and samples of debitage from representative contexts within each site.

The rate of obsidian hydration is strongly affected by the geochemistry of the raw material, as well as ambient temperature. Thus, obsidian hydration results must be interpreted on a source-specific basis, and any interpretations must also take climatic factors into account. The project sites present a challenge for interpretation of hydration results, because of the huge geographical area over which the sites are spread, and because there is such a wide variety of obsidian sources represented. Further, hydration characteristics of most of these obsidians are not well understood.

Here we develop estimated hydration measurement ranges by time period ("brackets") for eight of the nine most common obsidian sources in the sample, including Massacre Lake/Guano Valley, Mosquito Lake, Bidwell Mountain/Cowhead Lake, Bordwell Group, Craine Creek, Double H, Paradise Valley, and Browns Bench. (While Nut Mountain obsidian is also common in the sample, it is usually opaque and usually cannot be measured for hydration.) These eight sources comprise more than 85% of the viable source-specific hydration measurements obtained during the project, with the remainder including minor sources and unknowns (table 18).

We steer clear of proposing actual hydration rate equations for these sources because of the many uncertainties involved, most prominent among them being a lack of temperature data that would allow accurate estimates of effective hydration temperature.

TABLE 17
Radiocarbon Assays

Site	Locus	Provenience	Cat. no.	Lab no. (Beta-)	Sample Material	^{14}C Age	Intercepts (cal B.P.)	Calibration (2σ)
High Rock Country								
26HU4907	B	CU 12, 25-30	446	304841	LFC	960 ± 30	920	930–790
26HU4907	B	CU 9, 56-68 (Feat. 1)	457	304842	LFC	2120 ± 30	2120	2290–2280, 2150–2000
26HU4907	C	CU 3, 24-40	441	304840	LFC	1450 ± 30	1340	1390–1300
26HU4907	C	CU 10, 70-80	463	304843	LFC	1920 ± 30	1870	1930–1820
26HU4923	B	CU 8, 40-50	514	304844	LFC	1980 ± 30	1930	1990–1870
26HU4923	B	CU 8, 100-110	521	304846	LFC	3390 ± 30	3640	3700–3570
26HU4923	B	CU3/CU7, 100-110	517	304845	LFC	1950 ± 30	1890	1960–1830
26HU4943	Lower	CU 2, 79-93	266	304847	LFC	9660 ± 50	11130	11200–11060, 11030–11000, 10970–10790
26HU4943	Lower	RR 2, 9-40	269	304848	LFC	1340 ± 30	1280	1300–1260
26HU5105	A	CU 1, 30-50	187	304833	LFC	9720 ± 40	11180	11220–11100
26HU5109	–	CU 4, 40-50	219	304834	LFC	180 ± 30	280, 180, 150, 10, 0	290–260, 220–140, 30–0
26HU5124	A	CU 8, 20-30	312	304835	LFC	180 ± 30	280, 180, 150, 10, 0	290–260, 220–140, 30–0
26HU5728	-	CU Feat. 7, 0-10 (Feat. 7)	32	328597	LFC	2040 ± 30	1990	2110–2080, 2060–1930
26HU5728	-	CU Feat. 2, 0-10 (Feat. 2)	37	328596	LFC	1840 ± 30	1810	1860–1710
26HU5728	-	CU Feat. 9, 0-10 (Feat. 9)	40	328598	LFC	640 ± 30	650, 580, 570	670–620, 610–550
26WA4251/ 8825	A	CU 6, 20-30	124	311805	LFC	1360 ± 30	1290	1310–1270
26WA5086/ 5087	E	CU 5, 20-30 (Feat. 1)	642	311803	LFC	1260 ± 30	1230, 1210, 1180	1280–1170, 1160–1140, 1100–1100
26WA8621	A	CU 5, 8-20 (Feat. 1)	467	304855	LFC	620 ± 30	640, 590, 560	660–550
26WA8621	A	CU 6, 10-20	472	304856	LFC	2000 ± 30	1940	2000–1880
26WA8621	A	CU 6, 20-30	493	332843	LFC	2560 ± 30	2730	2750–2700, 2630–2620, 2560–2550
26WA8621	A	CU 6, 30-40	478	304857	LFC	2070 ± 30	2010	2120–1960
26WA8704	B	CU 2, 30-40	175	311804	LFC	6340 ± 30	7270	7320–7250, 7190–7180
26WA8739	-	CU 2, 0-10 (Feat. 1)	61	311806	LFC	1640 ± 70	1540	1710–1380
26WA8740	-	CU 10, 40-50 (Feat. 1)	230	304852	LFC	2210 ± 30	2300, 2240, 2170	2330–2140
26WA8766	K	CU 16, 30-55 (Feat. 6)	404	304851	LFC	3000 ± 30	3210	3320–3290, 3270–3080
26WA8766	K	CU 20, 15-20 (Feat. 6)	402	304850	LFC	2040 ± 30	1990	2100–2090, 2060–1930

TABLE 17—*(continued)*.

Site	Locus	Provenience	Cat. no.	Lab no. (Beta-)	Sample Material	^{14}C Age	Intercepts (cal B.P.)	Calibration (2σ)
High Rock Country *(continued)*								
26WA8766	NL	SP 5 & 23, 0-5 (Feat. 1)	399	304849	LFC	610 ± 30	630, 600, 560	660–540
26WA8766	T	(Feat. M2)	407	304863	LFC	3440 ± 30	3690	3820–3790, 3770–3740, 3730–3630
26WA8769	A	CU 8, 5-25	565	304853	LFC	4000 ± 30	4500, 4490, 4440	4530–4420
26WA8769	A	CU 8, 55-70	575	304854	LFC	4380 ± 30	4960, 4920, 4910	5040–4860
26WA8820	-	CU 1, 10-20 (Feat. 1)	141	349960	LFC	110 ± 30	250, 230, 140, 120, 120, 70, 30, modern	260–220, 140–60, 50–20, modern
26WA9052	A	CU 8, 10-20	405	311807	LFC	160 ± 30	270, 210, 190, 150, 10, modern	290–240, 230–120, 120–60, 40–0+
26WA9052	B	CU 3, 20-30 (Feat. P1)	410	304865	LFC	4040 ± 30	4520	4580–4430
Upper Lahontan Basin								
26HU4791	A	CU 1, 13-21 (Feat. 1)	129	304836	LFC	1710 ± 30	1610	1700–1540
26HU4791	A	CU 1, 20-32 (Feat. 2)	133	304837	LFC	1720 ± 30	1620	1710–1550
26HU4792	AB	CU AB7, 90-110	1066	334374	Soil sample	2430 ± 30	2460	2700–2640, 2620–2590, 2540–2530, 2520–2350
26HU4793	B	CU 2, 10-20 (Feat. 1)	105	304838	LFC	50 ± 30	0	250–230, 130–110, 70–40, 0–0
26HU5222	C	CU 5, 30-40	398	304839	LFC	940 ± 30	910, 850, 830	930–780
Upper Humboldt Plains								
26EK1511	-	CU 4, 30-40	132	305121	LFC	2180 ± 30	2290, 2280, 2150	2310–2120
26EK3524	A	CU 5, 20-30	261	311799	LFC	1050 ± 30	960	1050–1030, 980–930
26EK4983	C1	CU 4/CU 7, 31-45 (Feat. 1)	293	340761	LFC	3000 ± 30	3211	3322–3290, 3267–3136, 3132–3101, 3096–3078
26EK6134	A	CU 3, 20-30	141	311800	LFC	3820 ± 30	4230, 4200, 4180, 4170, 4160	4350–4330, 4300–4150, 4120–4100
26EK9200/12031	F	(Feat. 3)	490	304866	LFC	20 ± 30	modern	
26EK9200/12031	L	CU 2, 30-35 (Feat. 1)	482	304831	LFC	1490 ± 40	1370	1500–1500, 1490–1470, 1420–1300
26EK9200/12031	L	CU 2, 50-60 (Feat. 2)	485	304832	LFC	1550 ± 30	1410	1520–1370

TABLE 17—*(continued)*.

Site	Locus	Provenience	Cat. no.	Lab no. (Beta-)	Sample Material	^{14}C Age	Intercepts (cal B.P.)	Calibration (2σ)
Upper Humboldt Plains *(continued)*								
26EK9484	A	CU 2, 10-20 (Feat. 2)	86	304829	LFC	350 ± 40	440, 350, 340	500–300
26EK11793	A	CU 1, 10-17 (Feat. 1)	13	305122	LFC	260 ± 30	300	420–390, 320–280, 170–160
26EK11799	C1	CU 3, 25-38	128	311796	LFC	3590 ± 30	3890	3980–3830
26EK11833	A	SS 13/15, 10-20 (Feat. 1)	93	329943	LFC	250 ± 30	300	420–410, 400–400, 320–280, 170–150, modern
26EK11836	NL	CU 4, 40-50	83	338056	LFC	3280 ± 30	3480	3570–3440
26EK11836	B	(Feat. 3)	87	304825	LFC	1280 ± 40	1260	1290–1140
26EK11836	B	(Feat. 5)	91	304826	LFC	1170 ± 40	1070	1180–970
26EK11836	B	(Feat. 7)	94	304827	LFC	1520 ± 30	1400	1510–1460, 1430–1340
26EK11836	B	(Feat. 9)	97	304828	LFC	1220 ± 40	1170	1270–1060
26EK11836	NL	(Feat. 2)	104	304861	LFC	250 ± 30	300	420–400, 320–280, 170–150, 0–0
26EK11888	A	CU 6, 10-20	76	311801	LFC	470 ± 30	510	540-500
26EK11888	A	SS 7, 15-25 (Feat. 1)	295	329944	LFC	140 ± 30	260, 220, 140, 20, modern	280–170, 150–60, 50–0, modern
26EK11959	NL	CU 2, 40-50	241	304822	LFC	1220 ± 30	1170	1260–1060
26EK11959	NL	CU 2, 110-120	265	304823	LFC	180 ± 30	280, 180, 150, 10, 0	290–260, 220–140, 30–0
26EK11960	-	CU 1, 33-50	50	304824	LFC	530 ± 40	540	630–600, 560–510
26EK12030	C1	CU 1, 20-30	40	304830	LFC	230 ± 30	290	310–270, 180–150, 10–0
26EK12105	NL	CU 1, 30-40	54	345371	Bone collagen	3810 ± 30	4230, 4200, 4180, 4170, 4160	4290–4140, 4130–4090
26EK12111	-	CU 2, 16-30	45	311802	LFC	1650 ± 30	1540	1610–1520
26EK12130	NL	CU 1, 0-10 (Feat. 3)	200	304821	LFC	500 ± 30	520	550–510
26EK12678	-	(Feat. 1)	4	304862	LFC	3610 ± 30	3910	3980–3840
Thousand Springs Valley								
26EK3959	1	C-14 Sample 1	18	329270	Juniper limb	70 ± 30	50, modern	260–220, 140–30, modern
26EK3959	1	C-14 Sample 2	19	329271	Juniper limb	190 ± 30	280, 170, 150, 0	300–260, 220–140, 30–modern
26EK3959	1	C-14 Sample 3	20	329272	Juniper limb	140 ± 30	260, 220, 140, 20, modern	280–170, 150–60, 50–0, modern

TABLE 17—*(continued)*.

Site	Locus	Provenience	Cat. no.	Lab no. (Beta-)	Sample Material	^{14}C Age	Intercepts (cal B.P.)	Calibration (2σ)
Thousand Springs Valley *(continued)*								
26EK3959	1	C-14 Sample 4	21	329273	Juniper limb	160 ± 30	270, 210, 190, 190, 150, 10, modern	290–240, 230–120, 120–60, 40–modern
26EK3959	2	C-14 Sample 5	22	329274	Juniper limb	60 ± 30	modern	260–220, 140–110, 110–100, 90–90, 80–30, modern
26EK3959	2	C-14 Sample 6	23	329275	Juniper limb	280 ± 30	310	430–360, 330–290
26EK3959	2	C-14 Sample 7	24	329276	Juniper limb	340 ± 30	430, 360, 330	500–310
26EK3959	2	C-14 Sample 8	25	329277	Juniper limb	330 ± 30	430, 380, 360, 360, 320	490–300
26EK3959	2	C-14 Sample 9	26	329278	Juniper limb	130 ± 30	260, 220, 140, 30	280–170, 150–50, 50–0, modern
26EK3959	45	C-14 Sample 10	27	329279	Juniper limb	330 ± 30	430, 380, 360, 360, 320	490–300
26EK3959	45	C-14 Sample 11	28	329280	Juniper limb	230 ± 30	290	310–270, 190–180, 170–150, 10–modern
26EK3959	45	C-14 Sample 12	29	329281	Juniper limb	180 ± 30	280, 170, 150, 10, modern	300–260, 220–140, 110–110, 100–90, 90–80, 30–modern
26EK3959	45	C-14 Sample 13	30	329282	Juniper limb	70 ± 30	50, 50, modern	260–220, 140–30, modern
26EK3959	45	C-14 Sample 14	31	329283	Juniper limb	260 ± 30	300	420–390, 320–280, 170–150, 0–0
26EK3959	45	C-14 Sample 15	32	329284	Juniper limb	300 ± 30	310	460–350, 340–300
26EK3959	36	CU 2, 0-10 (Feat. 1)	34	329940	LFC	1690 ± 30	1570	1690–1650, 1630–1530
26EK9178/ 12133	E	CU 1, 10-20	396	311808	Screen charcoal	30 ± 30	modern	
26EK9183/ 12131	NL	CU 3, 35-45 (Feat. 1)	57	304858	LFC	1860 ± 30	1820	1870–1720
26EK11808	A	CU 11, 21-28 (Feat. 9)	516	304816	LFC	1610 ± 30	1520	1560–1410
26EK11808	B	CU 3, 30-40	531	304817	LFC	1570 ± 40	1500, 1490, 1470, 1420	1540–1370

TABLE 17—*(continued).*

Site	Locus	Provenience	Cat. no.	Lab no. (Beta-)	Sample Material	^{14}C Age	Intercepts (cal B.P.)	Calibration (2σ)
Thousand Springs Valley *(continued)*								
26EK11808	B	CU 3, 80-90	538	304818	LFC	430 ± 30	500	520–470
26EK11808	B	CU 3, 26-36 (Feat. 1)	511	304815	LFC	1620 ± 40	1530	1600–1410
26EK12310	NL	C-14 Sample 1	18	329285	Juniper limb	310 ± 30	420, 410, 400, 400, 320	470–300
26EK12310	NL	C-14 Sample 2	19	329286	Juniper limb	170 ± 30	270, 190, 180, 170, 150, 10, modern	290–250, 230–140, 120–70, 30–modern
26EK12310	NL	C-14 Sample 3	20	329287	Juniper limb	40 ± 30	modern	240–230, 120–120, 60–40, modern
26EK12310	NL	C-14 Sample 4	21	329288	Juniper limb	370 ± 30	470	500–420, 410–400, 400–320
26EK12310	NL	C-14 Sample 5	22	329289	Juniper limb	160 ± 30	270, 210, 190, 190, 150, 10, modern	290–240, 230–120, 120–60, 40–modern
26EK12326	A	CU 5, 20-30	321	311797	LFC	1000 ± 30	930	960–910, 850–830, 810–800
26EK12326	A	CU 19, 10-20	327	311798	LFC	340 ± 30	430, 360, 330	500–310
26EK12329	C3	CU 3, 18-30 (Feat. 1)	84	304819	LFC	2640 ± 30	2750	2780–2740
26EK12329	C3	CU 5, 33-46 (Feat. 1)	92	304820	LFC	2150 ± 40	2140	2310–2230, 2200–2010
26EK12394	C2	CU 1, 44-61 (Feat. 3)	52	304864	LFC	840 ± 30	740	790–690
26EK12394	C1	CU 7, 20-37 (Feat. 1)	101	329942	LFC	1820 ± 30	1730	1820–1700
26EK12394	C1	CU 6, 15-20 (Feat. 2)	97	329941	LFC	220 ± 30	290	310–270, 210–190, 190–150, 10–modern
26EK12677	-	CU 2, 35-45 (Feat. 2)	6	304859	LFC	1280 ± 30	1260	1280–1170
26EK12677	-	CU 1, 35-45 (Feat. 1)	7	304860	LFC	1170 ± 30	1070	1170–1050, 1040–990

TABLE 18
Obsidian Hydration Measurements for Major Obsidian Sources

Source Group	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Massacre Lake/Guano Valley	2245	67	–	–	2312
Bidwell Mountain	400	1	–	–	401
Mosquito Lake	444	–	–	–	444
Bordwell Group	72	14	–	–	86
Craine Creek	902	141	–	–	1043
Double H	26	447	15	–	488
Paradise Valley	1	283	285	–	569
Browns Bench	–	–	133	269	402
Other sources/unknowns	790	55	40	39	924
Totals	4880	1008	473	308	6669

Some measure of control over temperature is provided, however, by developing our brackets on a region-specific basis. We assume that the temperature regime is sufficiently uniform over each of the four project regions that the brackets can be applied to all sites in a particular region.

We take two approaches in developing these estimates: (1) correlations between average hydration measurements and radiocarbon dates from the same feature context or unit level; and (2) correlations between average hydration measurements for samples of various projectile point types versus the midpoint of the commonly accepted age ranges of those point types. The latter approach, while common in obsidian studies regionally (e.g., Leach, 1988; Hall and Jackson, 1989), involves additional layers of inference and is obviously less reliable than the former. In both cases, however, we take the same general approach, which is to run a simple regression of averaged hydration measurements versus calendar age, with outlying hydration measurements removed using Chauvenet's criterion. The regression takes the form $y = x^2$, where y is time in calendar years B.P. and x is the hydration measurement in microns. A large body of theoretical and experimental data shows that the hydration process follows this form; i.e., it slows as the square root of time (Doremus, 2000; Rogers, 2007). Thus, while marginally better results might be obtained by letting the regression take other forms, we constrain it to this one.

Next, having calculated these regressions, we calculate the hydration brackets by using the regressions to find the hydration measurement equivalent to each time period boundary. While these regressions may in fact be interpreted as hydration rate equations, we do not employ them as such, since we feel that would imply an unwarranted level of precision. In addition, our general approach to hydration is to use it for identifying temporal components, not as an absolute chronometric tool; therefore, we feel the brackets are a more appropriate expression of our results.

TABLE 19
Massacre Lake/Guano Valley Obsidian Hydration Samples from Radiocarbon-Dated Contexts
s = standard deviation.

Site	Locus	Provenience	Hydration Sample			Age (cal B.P.)
			n	x̄	s	
26HU4943	Lower	RR 2, 9–40 cm	10	3.88	1.52	1280
26HU4943	Lower	CU 2, 79–93 cm	19	6.93	2.00	11,130
26HU5105	A	CU 1, 30–50 cm	16	7.10	1.21	11,180
26WA5086/5087	E	CU 5, Feature 1, 20–30 cm	5	3.98	0.70	1210
26WA8704	B	CU 2, 30–40 cm	6	6.04	0.60	7270
26WA8739	–	CU 2, Feature 1, 0–10 cm	10	4.03	0.76	1540
26WA8740	–	CU 10, Feature 1, 40–50 cm	10	3.45	0.77	2240
26WA8766	K	CU 20, Feature 6, 15–20 cm	9	4.59	1.33	1990
26WA8766	T	Feature 2, 0–20 cm	8	3.77	1.25	3690
26WA8769	A	CU 8, 55–70 cm	5	5.30	0.59	4920

Massacre Lake/Guano Valley

The Massacre Lake/Guano Valley source is by far the most common in our study, representing 35% of the entire sample of hydration measurements. It is also one of the few for which a hydration rate has been previously proposed. Leach (1988) develops a rate based on a sample of 28 typed projectile points from the immediate area of Massacre Lake, using the midpoint-age approach. Leach proposes several different formulations but ultimately settles on a power-function rate of $y = 14.81x^{3.2}$. She notes that this rate equation performs reasonably well for smaller measurements but gives unacceptably early age estimates for larger ones. Because Leach's rate equation does not follow theoretical expectations about the hydration process, and because a much larger sample of hydration measurements is now available, we start afresh in developing age estimates for this source.

This is also the only source for which a suitably large sample of hydration measurements from radiocarbon-dated contexts is available to calculate a regression of hydration measurements versus radiometric ages. All of these contexts are in the High Rock Country. A regression of the average hydration readings in these contexts versus radiometric age is shown in table 19 and figure 24. While there are additional pairings that could be made, only those with five or more Massacre Lake/Guano Valley hydration readings are shown. As figure 24 shows, the correlation between radiocarbon dates and hydration readings is reasonably good. However, some of the pairs fall well below the regression line. This results from situations where the radiocarbon date and the hydration specimens appear not to be functionally associated, in particular, where Middle Archaic or earlier lithics are found with a Late Archaic or Terminal Prehistoric feature. This palimpsest problem is a common one in Great Basin archaeology, particularly in the surface and near-surface contexts from which many

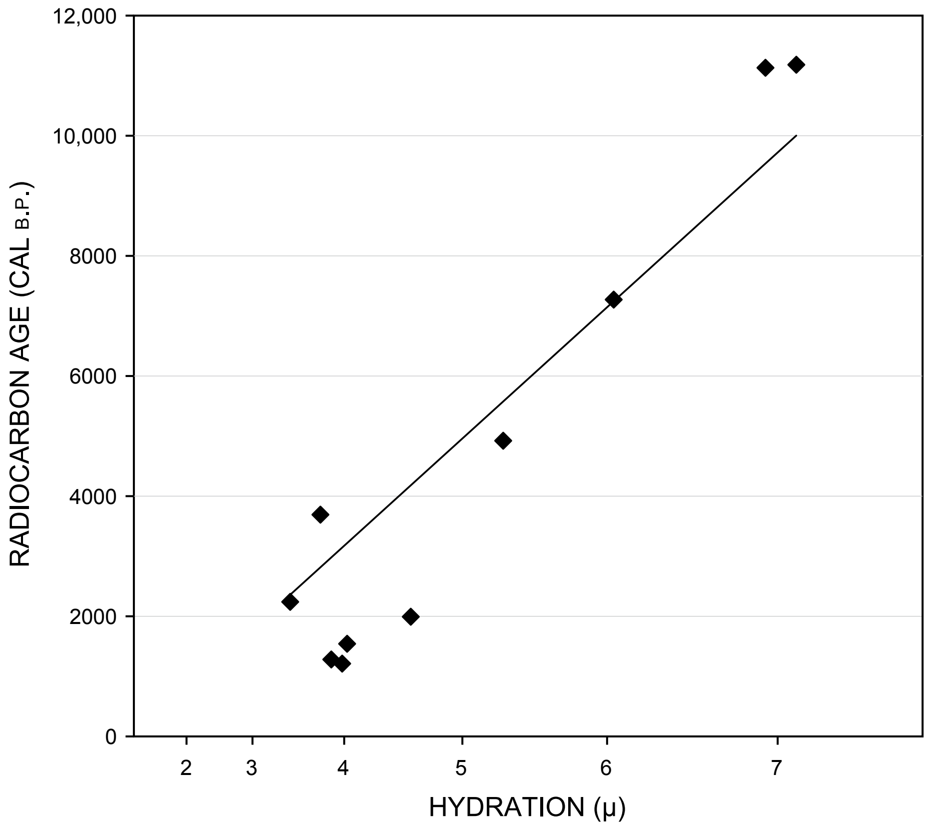


Fig. 24. Regression of Massacre Lake hydration/radiocarbon pairs.

of these pairings come. Even retaining these apparently spurious associations, the overall correlation between radiocarbon age and average hydration measurement is strong ($y = 198.47x^2$; $r^2 = 0.86$). The most important data points in the regression are the two earliest sites, 26HU4943 and 26HU5105, both of which date to about 11,000 cal B.P., with hydration averaging about 7 μm.

A very large sample of typed projectile points from the Massacre Lake/Guano Valley source is also available, which we can use to employ the midpoint-age approach as an independent verification. The projectile points used are shown in table 20. As the table shows, 270 typed points are available, including 23 of those reported by Leach (1988). The regression given by the averages for each type versus the midpoint of their commonly accepted age ranges gives a strikingly similar result to that given by the radiocarbon associations ($y = 196.40x^2$; $r^2 = 0.89$).

Mosquito Lake

This source is restricted to the westernmost parts of the project area. A relatively small sample of only 30 typed points is available, including two reported by Leach (1988). Nonetheless, the regression of midpoint age versus hydration mean works reasonably well (table 20).

TABLE 20
Source-specific Obsidian Hydration Statistics for Typed Projectile Points

n = number of specimens (outliers); ; x̄ = mean; s = standard deviation; y/x^2, where y = calendar years B.P. and x = hydration measurement in microns.

	High Rock Country					Upper Lahontan	Upper Lahontan, Upper Humboldt, Thousand Springs	
	Massacre Lake	Mosquito Lake	Bidwell/ Cowhead	Bordwell Group	Craine Creek	Double H	Paradise Valley	Browns Bench
Desert Series (midpoint age = 300 cal B.P.)								
n	0 (3)	0	1	0	2	4 (1)	27 (3)	46 (8)
x̄	–	–	1.60	–	1.20	2.50	1.88	1.99
s	–	–	–	–	–	1.21	0.91	0.63
Rosegate (midpoint age = 950 cal B.P.)								
n	24 (2)	4	12 (1)	0 (3)	7 (1)	37	50 (1)	31
x̄	2.63	2.11	2.02	–	1.51	2.55	2.42	3.73
s	0.65	0.77	0.67	–	0.24	1.02	1.04	1.40
Elko (midpoint age = 2550 cal B.P.)								
n	107	14 (1)	32 (1)	15	24	17	56 (4)	50 (5)
x̄	4.42	3.74	2.93	3.69	2.05	3.91	4.34	5.50
s	1.77	1.23	1.23	1.83	0.95	1.25	1.29	1.26
Gatecliff (midpoint age = 4400 cal B.P.)								
n	30 (2)	2	10 (1)	0 (2)	9	4 (1)	23 (2)	56 (8)
x̄	4.56	3.80	3.03	–	2.22	3.17	4.67	7.37
s	1.78	0.85	0.86	–	0.69	0.62	1.25	1.60
Humboldt (midpoint age = 4400 cal B.P.)								
n	72 (1)	8	0 (4)	10	16	8	29 (5)	21 (3)
x̄	5.37	2.97	–	5.01	2.86	4.38	4.89	7.61
s	2.06	1.20	–	1.41	1.22	0.94	1.19	1.77
Northern Side-notched (midpoint age = 6400 cal B.P.)								
n	22	0 (1)	7 (1)	7	2	0 (3)	16 (1)	12 (5)
x̄	5.04	–	4.51	6.41	3.83	–	5.97	7.85
s	2.06	–	1.18	1.62	0.25	–	1.35	1.92
Great Basin Stemmed (midpoint age = 10,300 cal B.P.)								
n	15 (1)	2	1	7	1	1	0 (1)	9 (3)
x̄	7.09	6.30	5.20	7.71	4.70	6.50	–	10.40
S	1.62	0.14	–	1.18	–	–	–	2.07
Rate Equation (based on estimated midpoint ages for each type)								
y/x^2	196.40	265.34	358.56	168.93	478.96	237.78	177.96	91.33
r^2	0.89	0.87	0.95	0.99	0.92	0.89	0.96	0.97

Bidwell Mountain/Cowhead Lake

This source is also limited to the westernmost project area. A relatively large sample of typed projectile points is available. The midpoint-age regression appears to work quite well (table 20), indicating that this source hydrates more slowly than most others in the region.

Bordwell group

This group of sources includes Bordwell Spring, Pinto Peak, and Fox Mountain. While geochemically distinguishable, these are treated as a group for the purposes of interpreting hydration measurements, following the approach taken by the Tuscarora and Alturas projects (Hildebrandt and King, 2002). This is the only source group common in both the Ruby and Tuscarora/Alturas datasets. While a relatively small sample of 39 typed points is available with which to develop brackets, the regression of mean ages versus mean hydration works extremely well (table 20). In addition, the resulting brackets are in excellent agreement with those proposed for the northern reaches of the Tuscarora and Alturas projects (Hildebrandt and King, 2002: 21), despite using entirely independent datasets.

Craine Creek

A sample of 61 typed projectile points is available from the newly identified Craine Creek source. Despite the relatively small sample size, the regression of mean hydration readings versus midpoint ages works very well (see table 20), and indicates that this material hydrates quite slowly compared to other sources.

Double H

A sample of 71 typed projectile points is available for this source, which, for the purposes of interpreting hydration measurements, is grouped with the geochemically similar Whitehorse source (Young et al., 2008). The regression of mean hydration versus midpoint age works reasonably well (see table 20).

Paradise Valley

For the Paradise Valley source, a sample of 201 projectile points is available. In addition to the projectile points from the Ruby project, this sample includes a number of points from throughout the eastern part of the project area, provided by Elko BLM archaeologist William Fawcett (personal commun., 2011). As table 20 shows, the regression versus midpoint ages works well.

Browns Bench

There have been at least two previous discussions of Browns Bench obsidian hydration. Hockett (1995) presents a compilation of hydration readings for selected projectile point types, as part of a study intended to show the usefulness of hydration in seriating those types. He does not propose a formal hydration rate or present age brackets. McGuire et al. (2004: 71) do propose a hydration rate, based on materials recovered from Pie Creek Shelter, using solid associations with radiocarbon dates. Unfortunately, the shelter context apparently results in a lower effective hydration temperature than at open-air sites, because the resulting rate does not compare well with those obtained from the current study, or with the corresponding averages for the projectile points presented in Hockett's (1995) study. Thus, we develop our own hydration brackets for this study, based on midpoint ages for a large sample of projectile points.

TABLE 21
Obsidian Hydration Brackets for Major Obsidian Sources

Time Period	High Rock Country					Upper Lahontan Basin	Upper Lahontan, Upper Humboldt, Thousand Springs	
	Massacre Lake	Mosquito Lake	Bidwell/ Cowhead	Bordwell Group	Craine Creek	Double H	Paradise Valley	Browns Bench
Terminal Prehistoric	<1.7	<1.5	<1.3	<1.9	<1.1	<1.6	<1.8	<2.6
Late Archaic	1.7–2.6	1.5–2.2	1.3–1.9	1.9–2.8	1.1–1.6	1.6–2.3	1.8–2.7	2.6–3.8
Middle Archaic	2.6–4.4	2.2–3.8	1.9–3.3	2.8–4.7	1.6–2.8	2.3–4.0	2.7–4.6	3.8–6.5
Early Archaic	4.4–5.4	3.8–4.6	3.3–4.0	4.7–5.8	2.8–3.4	4.0–4.9	4.6–5.7	6.5–7.9
Post-Mazama	5.4–6.3	4.6–5.4	4.0–4.7	5.8–6.8	3.4–4.0	4.9–5.7	5.7–6.6	7.9–9.2
Paleoarchaic	6.3–8.0	5.4–6.9	4.7–6.0	6.8–8.7	4.0–5.2	5.7–7.3	6.6–8.5	9.2–11.8
Paleoindian	8.0–8.6	6.9–7.4	6.0–6.4	8.7–9.3	5.2–5.5	7.3–7.8	8.5–9.0	11.8–12.6

As with Paradise Valley, this study includes a number of additional points from sites throughout the region, provided by William Fawcett (personal commun., 2011). This allows us to employ a robust sample of 225 points (see table 20). These have measurement ranges that are in substantial agreement with the smaller samples listed by Hockett (1995), with the exception of Great Basin Stemmed points, which have much lower measurements on average (10.4 μm) than the measurements that Hockett reports on two specimens (14.0 and 15.0 μm). Table 21 shows the resulting brackets, which indicate that Browns Bench is the fastest hydrating of any of the sources studied here.

Obsidian Hydration Summary

The hydration brackets for the eight major obsidian sources are shown in table 21. As the table shows, there are substantial differences in hydration rates among these sources, ranging from Craine Creek at the slow end to Browns Bench at the fast end. Some of this variability can be ascribed to climatic/temperature differences among the regions in which these obsidians are typically found, but much of it likely has to do with differences in their geochemistry.

It should be cautioned that these brackets are based primarily on regressions of hydration means against the midpoint ages of our time periods, and hence they are only as accurate as our understanding of those periods. Additionally, variation in these means is admittedly high, and there are many examples of individual typed points whose hydration measurements lie outside the bracket for their assigned time period. In particular, average hydration measurements for Gatecliff and Humboldt series points often lie well away from the regression lines used to develop these brackets, suggesting that these types have rather less temporal sensitivity than others. However, the overall success of the approach lends credence both to the typological/temporal scheme in use here for projectile points, and to the validity of obsidian hydration as a tool for general temporal assignment, if not direct chronometric dating.

Building Spatiotemporal Components

Where possible, we use diagnostic artifacts, radiocarbon, and obsidian hydration together to place sites, or parts of sites, into discrete spatiotemporal components. These components can range from single features or flaked stone reduction events, to large occupation areas, but each is identifiable to a specific period and each represents a discrete episode of prehistoric land use. Larger sites may contain multiple components, even multiple components dating to the same time period, if they are judged to be functionally unrelated. Smaller, more briefly occupied sites may in fact be more amenable to component-building than larger, more continuously occupied sites, because they are more likely to provide an unmixed picture of a given time period.

Obsidian hydration is the most common basis on which our components are built. This presents challenges because of its relatively poor temporal resolution. Sites that appear on other evidence to have been very briefly occupied can often show a wide range of hydration readings. To account for this, we calculate the coefficient of variation (i.e., the standard deviation divided by the mean) for each source-specific group of readings, with outliers excluded. We use a threshold value of 0.25 to identify potential single components; values above this are considered to represent a mixed deposit.

Table 22 presents the counts of identified components by time period and region. There are 399 components in all. Several components in the Upper Humboldt Plains region are more loosely defined than most, spanning time period boundaries.

For interpretive purposes, each of these components is also assigned to type, according to its assemblage and its association with features. *Flaked stone* components, as the name implies, contain flaked stone tools and/or debitage only, and reflect brief occupations by hunting parties, with on-site activities limited to retooling or butchering of game. Flaked stone-dominated components are typed as *quarries* when raw material procurement is a primary on-site activity. *Simple habitation* components contain ground stone tools and/or pottery in addition to flaked stone, indicating a wider range of subsistence activities, including plant-food processing. *Complex habitations* also contain thermal features and/or the remains of residential structures, indicating intensive occupation and an accompanying complete suite of subsistence activities. A small number of habitation components also contain evidence of quarrying activity, and the component type is modified accordingly. A few components consist of isolated thermal features, or thermal features in association with a small flaked stone assemblage, and these are typed as *feature only* and *flaked stone with feature* respectively. The four large *pronghorn traps* in the Thousand Springs Valley zone make up the final type.

Some feature types, including the petroglyphs, rock alignments, and rock emplacements common in the Barrel Springs area (see chap. 6), do not play a part in the component typology because they were rarely found in clear association with an assemblage of artifacts whose components had been reliably dated during our field investigations, and because they lack an independent means of dating.

TABLE 22
Component Counts by Age

Time Period	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Terminal Prehistoric	3	3	16	8	30
Late Archaic/Terminal Prehistoric	–	–	1	–	1
Late Archaic	19	8	18	3	48
Middle Archaic	97	13	28	9	148
Early/Middle Archaic	–	–	2	–	2
Early Archaic	65	4	19	5	93
Post-Mazama	20	7	3	–	31
Paleoarchaic	33	5	–	1	37
Paleoindian	8	1	–	–	9
Totals	245	41	87	26	399

CHAPTER 6

HIGH ROCK COUNTRY SUMMARY OF FINDINGS

Allika Ruby

The High Rock Country comprises the westernmost 84 miles of the study corridor in Nevada, extending eastward from the Oregon border to roughly Leonard Creek, a western tributary of the Quinn River (fig. 25). This region mostly consists of dissected lava plains and rocky uplands above 5000 ft that are dominated by sagebrush-steppe communities. The corridor winds across three subzones within the High Rock Country. Barrel Springs consists of some 16 miles of volcanic rimrock and tablelands extending from Oregon to the eastern edge of Mosquito Valley north of Mosquito Rim. From here, the corridor descends southward about 17 miles into Long Valley, onto the former bed of Pleistocene Lake Meinzer, and turns east roughly at Painted Point. It then continues eastward some 51 miles across the volcanic Black Rock Range. The corridor passes adjacent to several dry lakes in Long Valley, including Alkali and Mosquito lakes, and springs and seeps occur throughout the High Rock Country. This region also contains multiple obsidian sources, the most extensive of which, Nut Mountain and Massacre Lake/Guano Valley (as well as Craine Creek), lie along the route in the Black Rock Range. A more minor source, Surveyor Spring, is located along the corridor in the northwestern portion of Barrel Springs.

In total, 326 prehistoric sites were subject to some level of data recovery treatment. Some 473 m^3 were hand excavated, entailing 356 control units, 854 surface scrapes, three rapid-recovery units, and 1651 shovel probes; additionally, 278 surface collection units were used (table 23).

The greatest density of sites lies within the Barrel Springs subzone. Some 76 sites were recorded across 789 acres, or approximately 96 sites per 1000 acres. The Black Rock Range subzone contains the greatest number of sites, with 234 across 2839 acres, or 82 per 1000 acres. The Long Valley subzone contains the fewest sites, with only 16 encountered during survey of 1057 acres, or 15 per 1000 acres.

Chronological Overview

Of the 326 treated prehistoric sites, 188 yielded chronometric data sufficient for component definition, while the remaining 138 sites either lacked such information or contained evidence for overlapping occupations spanning more than one prehistoric era. In all, 245 components are present at these 188 sites, consisting of 153 sites with

Fig. 25. High Rock Country.

TABLE 23

Summary of Work Performed and Components Represented at Treated Sites, High Rock Country

Column Headings: PM = approximate pipeline postmile; Comp. Ct. = number of components identified at the site; PPT = projectile points; FLS = other flaked stone tools; COR/DEB = cores/debitage; GDS = ground stone. ^{14}C – Radiocarbon; XRF/OH = X-ray fluorescence/obsidian hydration; Flot. = flotation.

Ages: EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; NC = noncomponent; PA = Paleoarchaic; PI = Paleoindian; PM = Post-Mazama; TP = Terminal Prehistoric.

Types: CH = complex habitation; FO =feature only; FS = flaked stone; FS/F = flaked stone/feature; PTC = pronghorn trap complex; Q = quarry; SH = simple habitation.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Alignments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Barrel Springs subzone																		
26WA2550/8891	587.8	1	EA (C1)	FS	0.050	–	–	–	–	–	–	2	100	–	–	–	13	–
			NC	–	0.413	–	–	–	–	–	–	19	162	–	–	–	12	–
26WA8614	585.2	1	MA	FS	1.863	–	–	–	–	–	2	24	235	–	–	–	14	–
26WA8615	585.2	1	PA	FS	0.050	–	–	–	–	–	–	2	14	–	–	–	13	–
			NC	–	0.000	–	4	–	–	–	–	–	–	–	–	–	–	–
26WA8616	585.1	1	MA (Loc. B)	FS	0.025	–	–	–	–	–	–	2	35	–	–	–	12	–
			NC	–	0.050	–	4	–	–	–	3	16	1090	–	–	–	23	–
26WA8617	584.8	2	MA (Loc. A)	CH	0.900	1	–	–	–	–	6	78	1347	5	–	–	21	–
			MA (Loc. F)	SH	1.800	–	–	–	–	–	7	66	1526	4	–	–	21	–
			NC	–	9.587	20	23	6	–	3	70	701	58,376	15	–	–	134	–
26WA8618	584.4	0	NC	–	0.050	–	–	–	–	–	–	5	16	–	–	–	13	–
26WA8619	584.4	0	NC	–	0.050	–	–	–	–	–	–	5	23	–	–	–	13	–
26WA8620	584.3	0	NC	–	0.050	–	–	–	–	–	–	3	9	–	–	–	12	–
26WA8621	584.2	2	MA (Loc. A)	SH	7.138	–	–	–	–	–	16	264	8005	18	–	4	44	10
			EA (Loc. B)	FS	0.025	–	–	–	–	–	3	3	–	–	–	–	6	–
			NC	–	0.088	–	–	–	–	–	1	7	2	–	–	–	2	–
26WA8622	583.1	0	NC	–	0.350	–	–	–	–	–	–	9	105	–	–	–	15	–
26WA8623	583.0	0	NC	–	1.113	–	–	–	–	–	2	21	90	2	–	–	17	–
26WA8624	582.9	0	NC	–	0.925	–	–	–	–	–	–	10	30	–	–	–	14	–
26WA8625	582.7	1	PA (Loc. A)	FS	0.025	–	–	–	–	–	–	7	17	–	–	–	11	–
			NC	–	0.050	–	–	–	–	–	–	2	7	–	–	–	4	–
26WA8626	580.7	1	PM	FS	0.075	–	–	–	–	–	–	6	18	–	–	–	13	–
26WA8627	580.4	0	NC	–	0.125	–	–	–	–	–	1	6	16	–	–	–	14	–
26WA8628	579.6	4	LA (Loc. B)	FS	0.000	–	–	–	–	–	–	2	3	–	–	–	2	–
			MA (Loc. D)	FS	1.663	–	–	–	–	–	8	52	1690	–	–	–	16	–
			MA (Loc. E)	SH	5.750	–	–	–	–	–	52	578	26,602	11	–	–	68	–
			MA (Loc. F)	SH	4.200	–	–	–	–	–	10	143	11,154	1	–	–	17	–
			NC	–	4.550	2	18	–	–	–	30	137	7796	1	–	–	42	–

TABLE 23—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Barrel Springs subzone *(continued)*																		
26WA8630	579.4	0	NC	–	0.063	–	1	–	–	–	1	4	11	–	–	–	13	–
26WA8631	579.3	0	NC	–	0.000	–	–	–	–	–	–	1	13	–	–	–	13	–
26WA8633	578.7	1	MA (Loc. A)	FS	0.000	–	–	–	–	–	–	–	11	–	–	–	11	–
			NC	–	0.050	1	–	–	–	–	–	–	8	–	–	–	3	–
26WA8635	578.4	0	NC	–	0.050	–	–	–	–	–	–	3	4	–	–	–	2	–
26WA8636	577.9	0	NC	–	11.575	–	26	–	–	–	31	194	7075	8	–	–	53	–
26WA8637	577.7	0	NC	–	0.075	–	2	–	–	–	3	5	27	–	–	–	14	–
26WA8640	583.6	0	NC	–	0.463	–	–	–	–	–	–	5	17	–	–	–	13	–
26WA8641	583.1	0	NC	–	0.738	–	–	–	–	–	1	4	61	–	–	–	11	–
26WA8642	586.9	1	MA	FS	0.000	–	–	–	–	–	–	3	10	–	–	–	11	–
26WA8654	584.0	1	PA (Loc. A)	FS	0.050	–	–	–	–	–	–	8	14	–	–	–	15	–
			NC	–	0.000	–	1	–	–	–	1	–	–	–	–	–	1	–
26WA8657	583.7	0	NC	–	0.325	–	1	–	–	–	9	69	452	–	–	–	31	–
26WA8659	583.6	0	NC	–	0.063	–	–	–	–	–	1	5	10	–	–	–	14	–
26WA8660	583.3	0	NC	–	0.050	–	–	–	–	–	1	2	5	–	–	–	6	–
26WA8661	583.3	0	NC	–	0.000	–	–	–	–	–	1	–	9	–	–	–	9	–
26WA8662	583.2	0	NC	–	2.088	–	–	–	–	–	3	3	156	–	–	–	17	–
26WA8664	582.5	0	NC	–	0.000	–	–	–	–	–	–	1	10	–	–	–	8	–
26WA8665	582.5	1	EA	FS	0.075	–	–	–	–	–	–	10	12	–	–	–	14	–
26WA8667	582.0	0	NC	–	0.363	–	6	–	–	–	5	25	65	–	–	–	19	–
26WA8668	581.7	1	MA (C3)	FS	1.288	–	–	–	–	–	2	26	1493	–	–	–	12	–
			NC	–	1.350	–	16	–	–	–	4	53	302	1	–	–	37	–
26WA8670	581.0	0	NC	–	0.050	–	–	–	–	–	–	4	16	–	–	–	15	–
26WA8671	580.9	0	NC	–	0.000	–	1	–	–	–	–	3	16	–	–	–	12	–
26WA8672	580.8	0	NC	–	0.075	–	1	–	–	–	–	5	29	–	–	–	13	–
26WA8673	578.2	0	NC	–	0.000	–	–	–	–	–	–	3	10	–	–	–	13	–
26WA8675	578.1	0	NC	–	0.000	–	–	–	–	–	–	2	8	–	–	–	10	–
26WA8676	578.1	0	NC	–	0.075	–	–	–	–	–	1	5	23	–	–	–	14	–
26WA8677	576.2	0	NC	–	0.663	–	–	–	–	–	1	11	38	–	–	–	15	–
26WA8678	576.1	1	MA	FS	0.425	–	–	–	–	–	1	6	52	–	–	–	14	–
26WA8679	575.9	0	NC	–	0.000	–	–	–	–	–	3	4	25	–	–	–	16	–
26WA8707	587.4	0	NC	–	0.863	–	–	–	–	–	–	3	104	–	–	–	13	–
26WA8709	586.7	1	PI	FS	0.025	–	–	–	–	–	1	4	31	–	–	–	13	–
26WA8710	584.5	0	NC	–	0.088	–	–	–	–	–	1	3	6	–	–	–	10	–
26WA8711	584.5	0	NC	–	0.025	–	–	–	–	–	–	1	15	–	–	–	11	–
26WA8712	582.7	0	NC	–	0.000	–	–	–	–	–	–	2	13	–	–	–	13	–
26WA8729	575.0	1	PA	FS	0.275	–	–	–	–	–	–	3	23	–	–	–	13	–
26WA8730	579.0	0	NC	–	0.150	–	–	–	–	–	4	21	8	–	–	–	16	–
26WA8731	578.3	0	NC	–	0.050	–	–	–	–	–	–	9	30	–	–	–	13	–
26WA8732	578.2	1	MA	FS	0.125	–	–	–	–	–	1	12	109	–	–	–	14	–
26WA8752	575.7	0	NC	–	0.463	–	–	–	–	–	3	2	33	–	–	–	13	–
26WA8754	575.1	0	NC	–	1.738	–	–	–	–	–	5	23	370	–	–	–	23	–
26WA8756	574.2	0	NC	–	3.375	–	–	–	–	–	1	15	2134	–	–	–	11	–

TABLE 23—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Barrel Springs subzone *(continued)*																		
26WA8772	573.5	2	MA (Loc. B)	FS	3.450	–	–	–	–	–	5	25	3200	–	–	–	14	–
			EA (Loc. A)	FS	2.438	–	–	–	–	–	1	10	1021	–	–	–	11	–
			NC	–	1.275	–	–	–	–	–	1	5	115	–	–	–	21	–
26WA8829	577.5	0	NC	–	0.450	–	–	–	–	–	–	1	37	–	–	–	10	–
26WA8834	574.5	1	MA	SH	1.588	–	–	–	–	–	–	4	204	3	–	–	10	–
26WA8836	575.1	0	NC	–	0.275	–	–	–	–	–	2	5	5	–	–	–	11	–
26WA8837	574.8	0	NC	–	0.850	–	–	–	–	–	2	4	22	–	–	–	10	–
26WA8843	575.4	1	MA	FS	0.000	–	–	–	–	–	2	3	10	–	–	–	12	–
26WA8845	574.2	1	MA (Loc. B)	FS	1.288	–	–	–	–	–	2	2	430	–	–	–	12	–
			NC	–	1.650	–	–	–	–	–	1	9	319	–	–	–	11	–
26WA8850	574.0	0	NC	–	1.475	–	–	–	–	–	2	5	191	–	–	–	12	–
26WA8851	574.0	1	MA	SH	1.313	–	–	–	–	–	2	12	424	1	–	–	11	–
26WA8860	–	1	EA	FS	1.338	–	–	–	–	–	–	5	88	–	–	–	10	–
26WA8861	573.6	0	NC	–	0.850	–	–	–	–	–	–	–	13	–	–	–	10	–
26WA8862	574.2	1	EA	SH	1.313	–	–	–	–	–	–	3	40	1	–	–	10	–
26WA8864	573.4	1	MA	FS	3.088	–	–	3	–	–	4	17	179	–	–	–	13	–
26WA8865	572.6	1	EA	SH	0.650	–	–	–	–	–	1	10	130	4	–	–	10	–
26WA8866	584.1	0	NC	–	0.038	–	–	–	–	–	1	5	19	–	–	–	11	–
26WA8867	580.5	0	NC	–	0.075	–	–	–	–	–	–	2	–	–	–	–	–	–
26WA8892	587.5	1	PM (Loc. A)	FS	0.025	–	–	–	–	–	–	6	297	–	–	–	10	–
			NC	–	0.175	–	–	–	–	–	6	23	319	–	–	–	30	–
26WA9057	578.7	0	NC	–	0.063	–	–	–	–	–	–	2	2	–	–	–	–	–
26WA9110	582.0	0	NC	–	0.600	–	–	12	–	–	11	206	3084	–	–	–	19	–
26WA9123	–	0	NC	–	0.363	–	–	–	–	–	5	22	712	–	–	–	14	–
Subtotal		**34**			**92.7125**	**24**	**104**	**21**	**0**	**3**	**344**	**3118**	**142,187**	**75**	**0**	**4**	**1480**	**10**
Long Valley Subzone																		
26WA8613	568.9	0	NC	–	0.250	–	–	–	–	–	–	–	1	1	–	–	–	–
26WA8645	561.5	1	MA (Loc. A)	FS	0.863	–	–	–	–	–	–	2	96	–	–	–	13	–
			NC	–	0.875	–	–	–	–	–	–	1	6	3	1	–	–	–
26WA8696	570.9	1	EA (C1)	SH	1.238	–	–	–	–	–	–	–	253	1	–	–	11	–
			NC	–	0.150	–	–	–	–	–	2	–	3	–	–	–	4	–
26WA8697	569.8	1	PA	FS	1.250	–	–	–	–	–	1	2	65	–	–	–	14	–
26WA8701	568.7	0	NC	–	4.125	–	–	–	–	–	17	10	106	7	–	–	50	–
26WA8716	557.7	1	MA	SH	1.000	–	–	–	–	–	–	1	55	–	–	–	13	–
26WA8722	563.4	1	PA	FS	0.500	–	–	–	–	–	–	–	25	–	–	–	13	–
26WA8723	563.2	0	NC	–	4.175	–	–	–	–	–	4	18	805	1	–	–	27	–
26WA8727	562.6	1	PM	FS	0.875	–	–	–	–	–	–	–	31	–	–	–	13	–
26WA8728	561.6	1	PA (C1/C2)	SH	1.225	–	–	–	–	–	–	1	88	1	–	–	21	–
			NC	–	0.100	–	–	–	–	–	2	1	11	–	–	–	4	–
26WA8748	561.7	1	MA (Loc. A)	SH	5.100	–	–	–	–	–	2	12	391	18	6	–	12	–

TABLE 23—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/ DEB	GDS	Other	^{14}C	OH/ XRF	Flot
Long Valley Subzone *(continued)*																		
			NC	–	1.550	–	–	–	–	–	2	–	6	2	–	–	2	–
26WA8751	569.2	0	NC	–	0.263	–	–	–	–	–	1	3	7	–	–	–	11	–
26WA8766	557.4	7	MA (Loc. K)	FS/F	5.013	–	–	–	1	–	2	22	11,970	–	1	2	21	3
			MA (Loc. S)	FS	0.875	–	–	–	–	–	–	2	289	–	–	–	10	–
			MA (Loc. T)	FO	0.000	–	–	–	1	–	–	–	–	–	–	1	–	1
			EA (Loc. Q)	FS	1.350	–	–	–	–	–	–	4	1232	–	–	–	10	–
			PM (Loc. DH)	SH	2.575	–	–	–	–	–	5	27	4529	2	–	–	19	–
			PM (Loc. R)	FS	0.888	–	–	–	–	–	–	3	821	–	–	–	10	–
			PM (Loc. T)	FS/F	0.800	–	–	–	–	–	–	1	1076	–	–	–	10	–
			NC	–	5.225	–	–	–	6	–	16	23	3016	4	–	1	64	3
26WA8768	570.6	1	MA (Loc. C)	SH	6.600	–	–	–	–	–	8	30	2492	13	–	–	34	–
			NC	–	0.725	–	–	–	1	–	9	8	24	3	–	–	8	–
26WA8769	569.7	0	NC	–	14.937	–	–	–	–	–	37	171	13,536	81	2	2	89	4
26WA8770	569.4	0	NC	–		–	–	–	–	–	5	4	13	–	–	–	13	–
Subtotal		**16**			**62.525**	**0**	**0**	**0**	**9**	**0**	**113**	**346**	**40,947**	**137**	**10**	**6**	**496**	**11**
Black Rock Range subzone																		
26HU186/ 5174	511.7	0	NC	–	3.275	–	–	–	–	–	35	154	2677	5	–	–	37	–
26HU1131	525.0	1	PI	FS	1.513	–	–	–	–	–	–	1	147	–	–	–	10	–
26HU1248	–	1	EA (Loc. A)	SH	2.075	–	–	–	–	–	6	20	1238	3	–	–	15	–
			NC	–	0.288	–	–	–	–	–	4	3	37	–	–	–	2	–
26HU3983	–	0	NC	–	0.150	–	–	–	–	–	–	1	134	–	–	–	10	–
26HU4755	532.7	0	NC	–	1.113	–	–	–	–	–	4	4	65	1	–	–	12	–
26HU4897	505.8	1	PM (C1)	FS	0.750	–	–	–	–	–	–	2	121	–	–	–	15	–
			NC	–	0.000	–	–	–	–	–	1	–	–	–	–	–	1	–
26HU4898	505.7	1	PA (Loc. A/B)	FS	0.750	–	–	–	–	–	–	3	49	–	–	–	5	–
			NC	–	0.000	–	–	–	–	–	4	5	13	–	–	–	9	–
26HU4899	505.6	0	NC	–	0.275	–	–	–	–	–	–	1	14	–	–	–	10	–
26HU4900	505.5	1	EA	FS	0.375	–	–	–	–	–	1	1	76	–	–	–	11	–
26HU4902	505.5	1	MA (Loc. A)	FS	0.238	–	–	–	–	–	–	2	12	–	–	–	5	–
			NC	–	0.550	–	–	–	–	–	2	2	25	–	–	–	7	–
26HU4903	505.0	0	NC	–	0.275	–	–	–	–	–	1	–	6	–	–	–	6	–
26HU4905	509.4	1	MA	FS	0.525	–	–	–	–	–	–	7	126	–	–	–	15	–
26HU4906	509.8	1	MA (Loc. A/C1)	FS	0.488	–	–	–	–	–	–	3	205	–	–	–	25	–
			NC	–	0.588	–	–	–	–	–	4	14	108	–	–	–	22	–
26HU4907	511.3	3	LA (Loc. B)	SH	2.800	–	–	–	–	–	1	8	806	–	–	1	10	2

TABLE 23—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m³)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Black Rock Range subzone *(continued)*																		
			MA (Loc. B)	CH	2.155	–	–	–	1	–	–	6	1516	–	–	1	8	3
			MA (Loc. C)	FS	7.075	–	–	–	–	–	8	18	5448	–	1	2	24	3
			NC	–	3.713	–	–	–	–	–	10	37	2342	–	–	–	13	–
26HU4908	511.0	1	MA	FS	0.000	–	–	–	–	–	1	5	27	–	–	–	16	–
26HU4909	510.8	1	EA (Loc. A)	FS	0.863	–	–	–	–	–	3	8	940	–	–	–	12	–
			NC	–	0.787	–	–	–	–	–	5	11	233	–	–	–	18	–
26HU4910	510.6	2	EA (Loc. A)	FS	0.238	–	–	–	–	–	2	–	9	–	–	–	7	–
			EA (Loc. C)	FS	0.238	–	–	–	–	–	–	1	26	–	–	–	15	–
			NC	–	0.275	–	–	–	–	–	–	1	20	–	–	–	15	–
26HU4911	510.4	0	NC	–	0.862	–	–	–	–	–	4	8	17	–	–	–	22	–
26HU4913	510.0	1	MA	FS	1.400	–	–	–	–	–	–	5	304	–	–	–	14	–
26HU4914	515.9	1	EA	FS	0.000	–	–	–	–	–	1	5	46	–	–	–	11	–
26HU4916	515.5	1	MA	FS	0.000	–	–	–	–	–	2	3	45	–	–	–	12	–
26HU4917	515.2	1	MA	FS	0.000	–	–	–	–	–	–	–	21	–	–	–	10	–
26HU4918	515.1	1	MA	FS	0.000	–	–	–	–	–	1	9	45	–	–	–	11	–
26HU4919	515.0	1	LA	FS	0.000	–	–	–	–	–	–	4	66	–	–	–	10	–
26HU4920	515.0	3	MA (Loc. A)	FS	0.000	–	–	–	–	–	–	–	26	–	–	–	10	–
			MA (Loc. B)	FS	0.000	–	–	–	–	–	–	–	21	–	–	–	10	–
			MA (Loc. C)	FS	0.000	–	–	–	–	–	–	–	9	–	–	–	9	–
			NC	–	0.000	–	–	–	–	–	1	1	11	–	–	–	–	–
26HU4921	514.9	1	MA	FS	0.450	–	–	–	–	–	–	–	41	–	–	–	15	–
26HU4923	516.5	1	MA (Loc. B)	SH	13.663	–	–	–	–	–	53	164	10,315	16	2	3	71	9
			NC	–	0.863	–	–	–	–	–	3	1	279	–	–	–	2	–
26HU4924	516.2	1	MA	FS	0.000	–	–	–	–	–	–	–	24	–	–	–	10	–
			NC	–	0.000	–	–	–	–	–	1	1	22	–	–	–	10	–
26HU4926	528.2	8	EA (Loc. B)	Q	0.038	–	–	–	–	–	–	–	57	–	–	–	5	–
			EA (Loc. I)	Q	0.000	–	–	–	–	–	–	5	79	–	–	–	5	–
			EA (Loc. M)	Q	0.000	–	–	–	–	–	–	–	166	–	–	–	5	–
			EA (Loc. O)	Q	0.038	–	–	–	–	–	–	1	414	–	–	–	5	–
			EA (Loc. P)	Q	0.000	–	–	–	–	–	–	4	208	–	–	–	5	–
			EA (Loc. Q)	Q	0.038	–	–	–	–	–	–	12	731	–	–	–	10	–
			PA (Loc. N)	Q	0.000	–	–	–	–	–	–	–	80	–	–	–	5	–
			PI (Loc. L)	Q	0.000	–	–	–	–	–	–	–	90	–	–	–	5	–

TABLE 23—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/ DEB	GDS	Other	^{14}C	OH/ XRF	Flot
Black Rock Range subzone *(continued)*																		
			NC	–	0.525	–	–	–	–	–	3	14	1127	–	–	–	13	–
26HU4927	527.7	1	EA (Loc. B)	Q	0.238	–	–	–	–	–	–	–	133	–	–	–	10	–
			NC	–	0.325	–	–	–	–	–	3	–	36	–	–	–	8	–
26HU4934	526.6	1	MA	FS	0.000	–	–	–	–	–	–	2	17	–	–	–	15	–
26HU4939	525.9	1	EA	FS	0.425	–	–	–	–	–	–	1	35	–	–	–	15	–
26HU4940	525.9	0	NC	–	1.075	–	–	–	–	–	1	3	385	–	–	–	15	–
26HU4941	525.7	2	EA (Loc. A)	FS	0.238	–	–	–	–	–	–	2	81	–	–	–	15	–
			PM (Loc. D)	FS	1.296	–	–	–	–	–	1	13	1275	–	–	–	15	–
			NC	–	0.288	–	–	–	–	–	–	–	11	–	–	–	10	–
26HU4943	525.0	2	MA	FS	5.000	–	–	–	–	–	1	4	2424	–	–	1	10	1
			PA	FS	18.163	–	–	–	–	–	2	22	10,366	–	–	1	31	7
			NC	–	2.250	–	–	–	–	–	4	6	616	–	–	–	4	–
26HU4945	535.1	1	MA (Loc. D)	FS	0.200	–	–	–	–	–	–	–	1112	–	–	–	10	–
			NC	–	2.025	–	–	–	–	–	24	50	2666	2	–	–	32	–
26HU4954	532.9	0	NC	–	0.275	–	–	–	–	–	2	–	13	–	–	–	2	–
26HU4967	507.2	1	PA (Loc. A)	FS	0.450	–	–	–	–	–	–	–	17	–	–	–	5	–
			NC	–	0.000	–	–	–	–	–	2	2	72	–	–	–	16	–
26HU4969	506.0	0	NC	–	2.563	–	–	–	–	–	8	27	411	1	–	–	19	–
26HU4970	509.1	1	MA	FS	0.475	–	–	–	–	–	–	2	31	–	–	–	15	–
26HU4971	509.0	1	MA	FS	0.475	–	–	–	–	–	1	–	33	–	–	–	16	–
26HU4972	508.7	1	EA (C1)	FS	0.638	–	–	–	–	–	1	4	65	–	–	–	11	–
			NC	–	1.200	–	–	–	–	–	5	9	97	–	–	–	20	–
26HU4973	508.2	1	PM	FS	0.238	–	–	–	–	–	1	–	21	–	–	–	16	–
26HU4974	512.9	1	MA (Loc. A)	FS	0.438	–	–	–	–	–	–	–	24	–	–	–	10	–
			NC	–	0.225	–	–	–	–	–	2	5	26	–	–	–	7	–
26HU4975	512.6	1	LA	FS	0.238	–	–	–	–	–	–	–	25	–	–	–	10	–
26HU4976	512.5	1	MA	FS	0.000	–	–	–	–	–	1	2	14	–	–	–	15	–
26HU4977	512.4	0	NC	–	0.000	–	–	–	–	–	2	3	20	–	–	–	15	–
26HU4978	511.9	1	EA	FS	0.450	–	–	–	–	–	–	4	154	–	–	–	14	–
26HU4979	511.9	0	NC	–	0.413	–	–	–	–	–	–	3	47	–	–	–	15	–
26HU4980	511.8	0	NC	–	0.000	–	–	–	–	–	2	1	21	–	–	–	17	–
26HU4981	513.6	0	NC	–	1.013	–	–	–	–	–	–	3	354	–	–	–	15	–
26HU4983	514.6	1	MA	FS	0.750	–	–	–	–	–	–	9	482	–	–	–	20	–
26HU4985	513.1	0	NC	–	0.000	–	–	–	–	–	1	1	14	–	–	–	16	–
26HU4986	513.3	0	NC	–	1.400	–	–	–	–	–	10	36	4189	–	–	–	43	–
26HU4987	513.4	3	MA (Loc. B)	FS	0.425	–	–	–	–	–	–	1	577	–	–	–	15	–
			MA (Loc. D)	FS	0.463	–	–	–	–	–	–	1	177	–	–	–	10	–
			MA (Loc. E)	FS	0.638	–	–	–	–	–	–	3	469	–	–	–	10	–
			NC	–	0.150	–	–	–	–	–	1	13	20	–	–	–	11	–

TABLE 23—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Alignments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Black Rock Range subzone *(continued)*																		
26HU4989	518.3	0	NC	–	1.000	1	–	–	–	–	1	1	41	–	–	–	11	–
26HU4992	523.8	2	PA (Loc. BCD)	SH	1.725	–	–	–	–	–	4	12	1613	–	–	–	14	–
			PA (Loc. F)	FS	0.713	–	–	–	–	–	–	8	610	–	–	–	10	–
			NC	–	0.150	–	–	–	–	–	24	11	19	–	–	–	24	–
26HU4993	523.9	1	PM (Loc. A)	FS	0.425	–	–	–	–	–	–	–	28	–	–	–	10	–
			NC	–	0.725	–	–	–	–	–	4	1	5	–	–	–	4	–
26HU4994	524.4	1	MA	FS	0.400	–	–	–	–	–	1	–	18	–	–	–	11	–
26HU4997	524.7	0	NC	–	0.263	–	–	–	–	–	–	1	9	–	–	–	–	–
26HU4998	529.5	0	NC	–	0.138	–	–	–	–	–	2	8	581	–	–	–	22	–
26HU5001	528.8	2	MA (Loci C/E/F)	FS	0.800	–	–	–	–	–	–	5	242	–	–	–	30	–
			MA (Loc. A)	FS	1.225	–	–	–	–	–	–	3	408	–	–	–	15	–
			NC	–	0.125	–	–	–	–	–	–	2	41	–	–	–	10	–
26HU5004	530.7	1	MA	FS	0.038	–	–	–	–	–	–	–	71	–	–	–	15	–
26HU5005	530.2	1	EA (Loc. A)	FS	1.213	–	–	–	–	–	–	–	58	–	–	–	10	–
			NC	–	0.125	–	–	–	–	–	1	–	–	–	–	–	1	–
26HU5006	530.1	1	MA	Q	0.975	–	–	–	–	–	–	–	49	–	–	–	2	–
26HU5007	514.7	1	MA	FS	0.000	–	–	–	–	–	2	7	107	–	–	–	16	–
26HU5086	–	1	EA	Q	1.000	–	–	–	–	–	–	–	44	–	–	–	6	–
			NC	–	0.263	–	–	–	–	–	–	1	20	–	–	–	4	–
26HU5093	531.5	0	NC	–	0.088	–	–	–	–	–	–	–	29	–	–	–	–	–
26HU5095	532.6	1	EA (Loc. A)	SH	1.250	–	–	–	–	–	9	44	991	3	–	–	15	–
			NC	–	0.038	–	–	–	–	–	3	11	1	–	–	–	2	–
26HU5096	532.6	0	NC	–	3.563	–	–	–	–	–	2	10	276	–	–	–	12	–
26HU5097	532.9	0	NC	–	0.863	–	–	–	–	–	7	1	117	–	–	–	14	–
26HU5098	533.3	0	NC	–	0.875	–	–	–	–	–	2	1	26	–	–	–	12	–
26HU5105	524.4	1	PA	CH	6.025	–	–	–	–	1	4	15	3802	–	–	1	34	3
26HU5109	517.1	1	MA	SH	11.225	–	–	–	–	–	10	26	7230	13	–	1	19	4
26HU5110	516.2	1	EA	FS	0.650	–	–	–	–	–	–	–	144	–	–	–	10	–
26HU5111	515.8	0	NC	–	0.000	–	2	–	–	–	1	–	12	–	–	–	10	–
26HU5112	515.4	0	NC	–	0.000	–	–	–	–	–	2	2	22	–	–	–	11	–
26HU5115/5125	–	1	PI	FS	0.000	–	–	–	–	–	–	2	20	–	–	–	10	–
26HU5116	–	3	LA (C3)	FS	0.238	–	–	–	–	–	–	–	29	–	–	–	10	–
			MA (C1)	FS	0.238	–	–	–	–	–	–	1	63	–	–	–	10	–
			EA (C2)	FS	0.200	–	–	–	–	–	–	–	26	–	–	–	10	–
			NC	–	0.475	–	–	–	–	–	1	2	1	–	–	–	1	–
26HU5118	516.6	0	NC	–	0.275	–	–	–	–	–	–	1	8	–	–	–	–	–
26HU5119	516.5	1	EA	FS	0.388	–	–	–	–	–	–	7	24	–	–	–	10	–
26HU5120	516.1	1	EA	FS	0.000	–	–	–	–	–	–	1	44	–	–	–	10	–
26HU5122	515.3	1	MA	FS	0.050	–	–	–	–	–	1	–	19	–	–	–	10	–

TABLE 23—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m³)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/ DEB	GDS	Other	^{14}C	OH/ XRF	Flot
Black Rock Range subzone *(continued)*																		
26HU5123	–	1	MA	SH	0.513	–	–	–	–	–	–	3	140	2	–	–	10	–
26HU5124	–	0	NC	–	10.600	–	–	–	–	–	9	67	9781	9	–	1	18	4
26HU5127	–	1	PA	FS	1.050	–	–	–	–	–	1	3	45	–	–	–	11	–
26HU5128	510.7	1	MA	FS	0.275	–	–	–	–	–	1	2	17	–	–	–	10	–
26HU5129	510.7	1	PA	FS	0.887	–	–	–	–	–	–	1	37	–	–	–	10	–
26HU5165	509.6	1	EA	FS	0.000	–	–	–	–	–	–	–	12	–	–	–	10	–
26HU5172	513.0	1	MA	FS	1.200	–	–	–	–	–	–	–	17	–	–	–	10	–
26HU5173	513.0	1	MA (Loc. A)	SH	0.663	–	–	–	–	–	2	11	1342	–	–	–	12	–
			NC	–	2.350	–	–	–	–	–	8	31	213	1	–	–	7	–
26HU5175	511.3	1	MA	FS	0.713	–	–	–	–	–	–	4	89	–	–	–	10	–
26HU5176	511.4	1	MA	FS	0.713	–	–	–	–	–	–	11	99	–	–	–	10	–
26HU5177	511.0	1	MA	FS	0.738	–	–	–	–	–	1	4	164	–	–	–	10	–
26HU5233	510.0	0	NC	–	0.275	–	–	–	–	–	–	–	8	–	–	–	–	–
26HU5237	529.6	1	EA	FS	0.900	–	–	–	–	–	–	2	65	–	–	–	10	–
26HU5241	510.8	1	EA	FS	1.375	–	–	–	–	–	1	3	144	–	–	–	10	–
26HU5242	510.9	0	NC	–	1.175	–	–	–	–	–	1	3	142	–	–	–	10	–
26HU5248	–	0	NC	–	0.825	–	–	–	–	–	1	11	42	2	–	–	11	–
26HU5249	–	1	PA	FS	0.000	–	–	–	–	–	–	–	13	–	–	–	10	–
26HU5265	–	2	EA (Loc. B)	FS	0.200	–	–	–	–	–	4	7	1872	–	–	–	11	–
			PM (Loc. B)	FS	0.200	–	–	–	–	–	1	–	944	–	–	–	9	–
			NC	–	1.175	–	–	–	–	–	14	62	4790	3	–	–	26	–
26HU5278	514.2	2	LA (Loc. A)	Q	0.000	–	–	–	–	–	–	1	67	–	–	–	15	–
			MA (SCU B)	Q	0.000	–	–	–	–	–	–	–	39	–	–	–	10	–
			NC	–	0.000	–	–	–	–	–	–	4	6	–	–	–	5	–
26HU5505	535.7	1	PM	FS	0.475	–	–	–	–	–	–	1	46	–	–	–	10	–
26HU5506	535.8	1	MA (C1)	FS	1.225	–	–	–	–	–	8	24	1516	–	–	–	12	–
			NC	–	0.250	–	–	–	–	–	–	1	1	–	–	–	–	–
26HU5509	535.6	0	NC	–	1.275	–	–	–	–	–	–	6	206	–	–	–	10	–
26HU5513	525.2	2	PA (Loc. A)	FS	1.225	–	–	–	–	–	–	4	260	–	–	–	10	1
			PA (Loc. B)	FS	0.450	–	–	–	–	–	–	3	69	–	–	–	10	–
			NC	–	0.100	–	–	–	–	–	–	3	4	–	–	–	–	–
26HU5514	525.9	1	MA	FS	0.713	–	–	–	–	–	–	–	359	–	–	–	20	–
26HU5515	526.3	1	EA	FS	0.238	–	–	–	–	–	–	1	51	–	–	–	10	–
26HU5516	526.5	1	EA	FS	0.288	–	–	–	–	–	–	–	192	–	–	–	10	–
26HU5517	527.0	0	NC	–	0.275	–	–	–	–	–	–	–	59	–	–	–	10	–
26HU5519	527.1	0	NC	–	0.225	–	–	–	–	–	–	–	4	–	–	–	–	–
26HU5520	527.7	1	MA	FS	0.625	–	–	–	–	–	–	–	132	–	–	–	10	–
26HU5521	527.8	0	NC	–	0.250	–	–	–	–	–	–	–	2	–	–	–	–	–
26HU5522	528.2	1	PA	FS	0.313	–	–	–	–	–	–	–	20	–	–	–	10	–
26HU5523	528.7	1	MA	FS	0.500	–	–	–	–	–	–	1	269	–	–	–	10	–
			NC	–	0.000	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE 23—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Black Rock Range subzone *(continued)*																		
26HU5524	529.5	0	NC	–	0.513	–	–	–	–	–	–	–	136	–	–	–	10	–
26HU5525	529.6	0	NC	–	0.275	–	–	–	–	–	–	–	4	–	–	–	–	–
26HU5528	521.3	0	NC	–	0.263	–	–	–	–	–	–	3	75	–	–	–	10	–
26HU5529	522.8	1	MA	FS	0.263	–	–	–	–	–	1	3	43	–	–	–	6	–
26HU5530	523.5	0	NC	–	0.000	–	–	–	–	–	–	6	44	–	–	–	10	–
26HU5531	520.8	0	NC	–	1.525	–	–	–	–	–	11	52	754	1	–	–	30	–
26HU5532	520.7	1	EA (C1)	FS	0.450	–	–	–	–	–	–	3	92	–	–	–	10	–
			NC	–	0.275	–	–	–	–	–	1	2	2	–	–	–	1	–
26HU5534	519.9	0	NC	–	0.250	–	–	–	–	–	–	–	52	–	–	–	10	–
26HU5537	–	0	NC	–	0.550	–	–	–	–	–	–	2	49	–	–	–	10	–
26HU5538	–	1	EA	FS	0.275	–	–	–	–	–	–	1	29	–	–	–	10	–
26HU5728	534.9	0	NC	–	0.700	–	–	–	9	–	5	4	119	–	–	3	22	4
26WA4098/8912	548.8	1	PA	FS	0.038	–	–	–	–	–	–	1	87	–	–	–	10	–
26WA4104/8911	548.8	2	EA (Loc. A)	FS	0.013	–	–	–	–	–	–	1	542	–	–	–	10	–
			PA (Loc. B)	FS	0.013	–	–	–	–	–	–	–	138	–	–	–	10	–
			NC	–	0.000	–	–	–	–	–	–	1	2	–	–	–	–	–
26WA4114/8917	549.5	1	LA	Q	0.925	–	–	–	–	–	–	13	146	–	–	–	10	–
26WA4131/8910	546.9	2	LA (Loc. G)	Q	0.200	–	–	–	–	–	–	–	155	–	–	–	10	–
			EA (Loc. A)	Q	0.200	–	–	–	–	–	–	1	261	–	–	–	10	–
			NC	–	0.675	–	–	–	–	–	–	16	521	–	–	–	10	–
26WA4251/8825	–	0	NC	–	6.419	–	–	–	–	–	3	13	1241	2	–	1	33	1
26WA4280	547.1	4	LA (C2)	Q	0.200	–	–	–	–	–	–	–	391	–	–	–	10	–
			MA (C11)	Q	0.238	–	–	–	–	–	–	2	363	–	–	–	10	–
			MA (C6)	Q	0.238	–	–	–	–	–	–	–	144	–	–	–	10	–
			EA (C10)	Q	0.400	–	–	–	–	–	–	2	785	–	–	–	10	–
			NC	–	0.975	–	–	–	–	–	–	22	946	–	–	–	–	–
26WA5086/5087	–	3	LA (Loc. E)	FS/F	0.000	–	–	–	1	–	–	–	108	–	–	1	–	1
			MA (Loc. A)	SH	1.438	–	–	–	–	–	–	22	1329	2	–	–	10	–
			MA (Loc. E)	FS	0.200	–	–	–	–	–	–	–	258	–	–	–	10	–
			NC	–	11.956	–	–	–	–	–	34	245	9168	9	–	–	39	3
26WA8603	552.9	1	PM	Q	1.688	–	–	–	–	–	–	2	2004	–	–	–	10	–
			NC	–	0.000	–	–	–	–	–	2	–	5	–	–	–	1	–
26WA8604	539.4	1	EA	FS	0.675	–	–	–	–	–	1	–	37	–	–	–	14	–
26WA8605	539.5	2	EA (Loc. D)	FS	0.675	–	–	–	–	–	2	2	315	–	–	–	16	–
			PA (Loc. C)	FS	0.638	–	–	–	–	–	–	–	26	–	–	–	14	–

TABLE 23—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m³)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Black Rock Range subzone *(continued)*																		
			NC	–	0.713	–	–	–	–	–	3	5	81	–	–	–	15	–
26WA8606	538.5	1	EA	Q	0.000	–	–	–	–	–	1	1	114	–	–	–	13	–
26WA8607	538.4	1	MA	FS	0.000	–	–	–	–	–	–	1	104	–	–	–	13	–
26WA8608	537.9	1	EA	FS	0.000	–	–	–	–	–	–	–	59	–	–	–	13	–
26WA8611	538.9	3	TP (Loc. F)	Q	1.638	–	–	–	–	–	2	6	519	–	–	–	11	–
			MA (Loc. A)	Q	0.475	–	–	–	–	–	–	–	216	–	–	–	10	–
			PA (Loc. B/C/D)	Q	1.838	–	–	–	–	–	1	13	672	–	–	–	11	–
			NC	–	0.800	–	–	–	–	–	5	2	4	–	–	–	3	–
26WA8612	539.0	0	NC	–	0.050	–	–	–	–	–	1	1	6	–	–	–	1	–
26WA8646	–	1	PA	Q	0.300	–	–	–	–	–	–	–	46	–	–	–	13	–
26WA8647	–	2	MA (Loc. B)	FS	0.825	–	–	–	–	–	–	3	498	–	–	–	10	–
			EA (Loc. A)	SH	1.475	–	–	–	–	–	–	6	317	1	–	–	10	1
			NC	–	1.113	–	–	–	–	–	6	19	88	4	–	–	16	–
26WA8648	–	0	NC	–	0.475	–	–	–	–	–	1	4	70	–	–	–	15	–
26WA8649	–	0	NC	–	0.575	–	–	–	–	–	1	3	65	–	–	–	10	–
26WA8650	–	0	NC	–	0.350	–	–	–	–	–	1	–	43	–	–	–	10	–
26WA8651	–	0	NC	–	1.375	–	–	–	–	–	1	3	88	–	–	–	11	–
26WA8686	550.3	1	MA	Q	0.225	–	–	–	–	–	–	1	207	–	–	–	11	–
26WA8687	547.6	0	NC	–	0.838	–	–	–	–	–	–	–	86	–	–	–	13	–
26WA8688	547.6	0	NC	–	0.050	–	–	–	–	–	–	1	33	–	–	–	11	–
26WA8689	–	0	NC	–	1.400	–	–	–	–	–	–	6	1794	–	–	–	43	–
26WA8690	–	2	PM (Loc. B)	Q	0.025	–	–	–	–	–	–	14	1675	–	–	–	11	–
			PA (Loc. C)	Q	1.700	–	–	–	–	–	1	11	1033	–	–	–	11	–
			NC	–	1.500	–	–	–	–	–	3	37	4834	–	–	–	15	–
26WA8691	–	1	PI (Loc. A)	Q	1.625	–	–	–	–	–	–	3	466	–	–	–	10	–
			NC	–	0.625	–	–	–	–	–	1	25	1569	1	–	–	34	–
26WA8692	–	0	NC	–	0.663	–	–	–	–	–	2	3	144	–	–	–	15	–
26WA8693	–	1	EA	FS	0.075	–	–	–	–	–	–	1	33	–	–	–	13	–
26WA8694	–	1	PI	FS	0.025	–	–	–	–	–	–	1	27	–	–	–	13	–
26WA8695	–	1	PA	FS	0.875	–	–	–	–	–	–	1	28	–	–	–	13	–
26WA8704	542.1	1	PM (Loc. B)	FS	2.225	–	–	–	–	–	2	7	665	–	–	1	11	1
			NC	–	2.988	–	–	–	–	–	13	51	407	7	–	–	29	–
26WA8724	–	0	NC	–	0.588	–	–	–	–	–	–	5	557	–	–	–	31	–
26WA8725	544.5	2	EA (Loc. C)	Q	0.525	–	–	–	–	–	1	16	1277	–	–	–	14	–
			PM (Loc. B)	Q	0.525	–	–	–	–	–	–	–	215	–	–	–	12	–
			NC	–	1.788	–	–	–	–	–	2	13	765	–	–	–	25	–

TABLE 23—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/ DEB	GDS	Other	^{14}C	OH/ XRF	Flot
Black Rock Range subzone *(continued)*																		
26WA8733	543.1	0	NC	–	1.313	–	–	–	–	–	–	3	109	–	–	–	13	–
26WA8734	540.4	1	EA (Loc. A)	Q	0.600	–	–	–	–	–	–	–	110	–	–	–	10	–
			NC	–	0.063	–	–	–	–	–	–	–	3	–	–	–	–	–
26WA8735	542.3	1	MA (C1)	FS	0.025	–	–	–	–	–	–	–	54	–	–	–	10	–
			NC	–	0.075	–	–	–	–	–	6	24	858	–	–	–	25	–
26WA8736	542.9	1	EA (Loc. B)	FS	0.800	–	–	–	–	–	2	–	37	–	–	–	11	–
			NC	–	0.625	–	–	–	–	–	4	16	257	–	–	–	11	–
26WA8737	544.4	0	NC	–	1.669	–	–	–	–	–	–	24	1270	–	–	–	30	–
26WA8739	553.0	1	MA	CH/Q	3.000	–	–	–	1	–	2	7	290	7	–	1	12	1
26WA8740	553.0	1	MA	CH/Q	12.975	–	–	–	1	–	4	6	1729	50	2	1	24	2
26WA8742	552.4	1	MA	Q	0.050	–	–	–	–	–	1	3	20	–	–	–	10	–
26WA8743	552.4	1	EA	Q	0.250	–	–	–	–	–	–	–	112	–	–	–	10	–
26WA8744	552.3	2	EA (Loc. B)	Q	0.238	–	–	–	–	–	–	–	536	–	–	–	10	–
			PM (Loc. A)	Q	0.238	–	–	–	–	–	–	–	168	–	–	–	10	–
			NC	–	0.250	–	–	–	–	–	–	6	384	–	–	–	–	–
26WA8745	551.8	3	MA (Loci A/B)	Q	0.400	–	–	–	–	–	–	6	620	–	–	–	20	–
			EA (Loc. C)	Q	0.200	–	–	–	–	–	–	1	427	–	–	–	10	–
			PM (Loc. D)	Q	0.200	–	–	–	–	–	–	–	72	–	–	–	10	–
			NC	–	0.000	–	–	–	–	–	2	–	5	–	–	–	2	–
26WA8764	540.9	2	MA (Loc. C)	FS	0.000	–	–	–	–	–	–	2	111	–	–	–	10	–
			MA (Loc. D)	FS	0.000	–	–	–	–	–	–	–	51	–	–	–	10	–
			NC	–	0.000	–	–	–	–	–	2	2	4	–	–	–	–	–
26WA8775	535.9	0	NC	–	1.925	–	–	–	–	–	3	14	468	–	–	–	16	–
26WA8776	535.8	2	MA (Loc. A)	FS	2.250	–	–	–	–	–	–	–	235	–	–	–	11	–
			MA (Loc. B)	FS	0.000	–	–	–	–	–	–	2	75	–	–	–	11	–
			NC	–	0.000	–	–	–	–	–	1	1	1	–	–	–	1	–
26WA8777	536.2	1	PA (Loc. A)	FS	1.200	–	–	–	–	–	16	44	1134	–	–	–	22	–
			NC	–	10.846	–	–	–	1	–	34	129	6533	1	–	–	66	–
26WA8778	536.4	1	EA (Loc. A)	FS	0.000	–	–	–	–	–	–	2	287	–	–	–	11	–
			NC	–	2.518	–	–	–	–	–	4	8	2159	–	–	–	13	–
26WA8796	548.8	0	NC	–	0.025	–	–	–	–	–	–	–	35	–	–	–	10	–
26WA8797	550.6	1	PA	Q	0.400	–	–	–	–	–	–	4	1260	–	–	–	10	–
26WA8800	542.9	0	NC	–	0.088	–	–	–	–	–	–	–	16	–	–	–	10	–
26WA8801	543.0	0	NC	–	0.188	–	–	–	–	–	–	1	209	–	–	–	10	–

TABLE 23—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/DEB	GDS	Other	^{14}C	OH/XRF	Flot
Black Rock Range subzone *(continued)*																		
26WA8802	546.0	0	NC	–	1.150	–	–	–	–	–	–	2	392	–	–	–	10	–
26WA8803	546.0	0	NC	–	0.275	–	–	–	–	–	–	1	52	–	–	–	10	–
26WA8804	545.9	0	NC	–	1.475	–	–	–	–	–	–	9	290	4	–	–	10	–
26WA8808	542.4	1	EA	FS	0.050	–	–	–	–	–	–	–	102	–	–	–	10	–
26WA8810	–	0	NC	–	0.050	–	–	–	–	–	–	1	5	–	–	–	–	–
26WA8811	–	1	TP	FS	0.025	–	–	–	–	–	–	1	66	–	–	–	10	–
26WA8819	–	0	NC	–	0.050	–	–	–	–	–	–	–	51	–	–	–	10	–
26WA8820	–	1	TP	FO	0.000	–	–	–	1	–	–	–	46	–	–	1	–	1
			NC	–	2.878	–	–	–	–	–	6	62	2004	5	–	–	13	–
26WA8821	–	0	NC	–	0.050	–	–	–	–	–	–	–	–	–	–	–	–	–
26WA8823	–	0	NC	–	1.400	–	–	–	–	–	1	19	2316	–	–	–	11	–
26WA8824	–	0	NC	–	5.175	–	–	–	–	–	5	18	2357	4	–	–	25	1
26WA8826	–	0	NC	–	0.038	–	–	–	–	–	–	1	210	–	–	–	10	–
26WA8828	–	0	NC	–	0.250	–	–	–	–	–	–	–	33	–	–	–	10	–
26WA8869	–	0	NC	–	0.425	–	–	–	–	–	–	1	114	–	–	–	10	–
26WA8870	–	0	NC	–	0.250	–	–	–	–	–	–	1	7	–	–	–	–	–
26WA8871	–	1	EA	Q	0.288	–	–	–	–	–	–	–	76	–	–	–	10	–
26WA8872	–	1	MA	Q	0.250	–	–	–	–	–	–	–	40	–	–	–	10	–
26WA8873	–	1	EA	FS	1.088	–	–	–	–	–	2	9	147	–	–	–	11	–
			NC	–	0.000	–	–	–	–	–	–	–	–	–	–	–	–	–
26WA8874	–	0	NC	–	0.000	–	–	–	–	–	–	1	24	–	–	–	10	–
26WA8875	–	1	MA	Q	0.250	–	–	–	–	–	–	–	111	–	–	–	10	–
26WA8877	–	2	PM (Loc. A)	Q	0.025	–	–	–	–	–	–	1	25	–	–	–	10	–
			PM (Loc. C)	Q	0.000	–	–	–	–	–	–	2	13	–	–	–	10	–
			NC	–	0.025	–	–	–	–	–	–	–	16	–	–	–	10	–
26WA8878	–	0	NC	–	0.250	–	–	–	–	–	–	–	8	–	–	–	–	–
26WA8880	–	0	NC	–	0.388	–	–	–	–	–	1	–	23	–	–	–	10	–
26WA8882	–	1	PA	Q	0.713	–	–	–	–	–	–	2	208	–	–	–	10	–
26WA8883	–	0	NC	–	0.050	–	–	–	–	–	–	1	36	–	–	–	10	–
26WA8884	–	0	NC	–	0.250	–	–	–	–	–	–	1	8	–	–	–	–	–
26WA8893	550.0	1	LA	Q	0.663	–	–	–	–	–	–	2	1775	–	–	–	38	–
26WA8894	550.3	1	MA (Loc. A)	Q	0.400	–	–	–	–	–	–	6	2262	–	–	–	10	–
			NC	–	0.400	–	–	–	–	–	–	4	799	–	–	–	–	–
26WA8899	550.0	1	LA	Q	0.238	–	–	–	–	–	–	–	774	–	–	–	13	–
26WA8902	550.0	1	LA	Q	0.225	–	–	–	–	–	–	1	613	–	–	–	12	–
26WA8903	550.1	2	LA (Loc. D)	Q	0.350	–	–	–	–	–	–	1	669	–	–	–	10	–
			EA (Loc. B)	Q	0.200	–	–	–	–	–	–	–	629	–	–	–	13	–
			NC	–	0.050	–	–	–	–	–	–	7	24	–	–	–	12	–
26WA8904	550.1	0	NC	–	0.225	–	–	–	–	–	–	1	100	–	–	–	12	–
26WA8913	549.0	0	NC	–	0.850	–	–	–	–	–	1	4	40	–	–	–	10	–
26WA8914	549.1	2	EA (Loc. A)	FS	1.238	–	–	–	–	–	–	4	323	–	–	–	10	–

TABLE 23—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features					Catalog Counts					Special Studies		
			Age	Type	Vol (m^3)	Rock Align-ments	Rock Stacks	Rock Art	Thermal Features	Other Features	PPT	FLS	COR/ DEB	GDS	Other	^{14}C	OH/ XRF	Flot
Black Rock Range subzone *(continued)*																		
			PA (Loc. C)	FS	1.225	–	–	–	–	–	2	2	64	–	–	–	12	–
			NC	–	0.025	–	–	–	–	–	2	2	5	–	–	–	1	–
26WA8916	549.4	1	MA	Q	0.863	–	–	–	–	–	–	4	204	–	–	–	10	–
26WA8918	549.7	1	LA	Q	0.888	–	–	–	–	–	–	2	538	–	–	–	15	–
26WA8920	550.4	1	EA	Q	0.200	–	–	–	–	–	–	2	331	–	–	–	10	–
26WA8921	550.8	1	LA	Q	0.713	–	–	–	–	–	1	2	3557	–	–	–	10	–
26WA8922	550.9	1	LA (Loc. S)	Q	0.200	–	–	–	–	–	–	–	424	–	–	–	10	–
			NC	–	2.050	–	–	–	–	–	–	6	5879	–	–	–	50	–
26WA9035	543.6	0	NC	–	1.038	–	–	–	–	–	1	–	16	–	–	–	–	–
26WA9036	539.2	1	PA (Loc. A/B)	FS	2.113	–	–	–	–	–	2	10	582	–	–	–	22	–
			NC	–	0.175	–	–	–	–	–	1	3	9	–	–	–	1	–
26WA9037	539.4	1	PI	FS	1.313	–	–	–	–	–	2	1	123	–	–	–	10	–
26WA9038	540.0	0	NC	–	0.313	–	–	–	–	–	4	12	402	–	–	–	14	–
26WA9039	538.7	0	NC	–	1.575	–	–	–	–	–	5	14	731	–	–	–	13	–
26WA9040	538.9	0	NC	–	1.588	–	–	–	–	–	4	4	481	–	–	–	14	–
26WA9041	536.1	0	NC	–	0.250	–	–	–	–	–	–	6	6	–	–	–	–	–
26WA9043	–	1	LA (C1)	FS	1.250	–	–	–	–	–	–	1	323	–	–	–	10	–
			NC	–	0.025	–	–	–	–	–	2	1	–	–	–	–	1	–
26WA9045	–	0	NC	–	0.000	–	–	–	–	–	–	–	15	–	–	–	10	–
26WA9046	–	1	PI	FS	1.063	–	–	–	–	–	–	1	82	–	–	–	10	–
26WA9047	–	1	LA	FS	0.050	–	–	–	–	–	–	–	20	–	–	–	10	–
26WA9049	–	0	NC	–	0.000	–	–	–	–	–	–	–	20	–	–	–	10	–
26WA9050	–	1	EA	FS	0.950	–	–	–	–	–	1	1	138	–	–	–	10	–
26WA9051	–	1	PA	FS	0.938	–	–	–	–	–	1	–	48	–	–	–	11	–
26WA9052	–	2	MA (Loc. A)	FS	0.800	–	–	–	–	–	4	17	1576	–	–	1	13	1
			EA (Loc. B)	CH	2.250	–	–	–	1	–	1	39	3823	6	1	1	10	4
			NC	–	2.438	–	–	–	–	–	10	108	3349	5	–	–	8	–
Subtotal		**195**			**317.711**	**1**	**2**	**0**	**16**	**1**	**617**	**2633**	**195,669**	**170**	**6**	**23**	**4035**	**58**
Grand total		**245**			**472.949**	**25**	**106**	**21**	**25**	**4**	**1074**	**6097**	**378,803**	**382**	**16**	**33**	**6011**	**79**

TABLE 24
Summary of Time-sensitive Data Sets for the High Rock Country

Major Sources = Massacre Lake/Guano Valley, Mosquito Lake, Bidwell Mountain, Bordwell Group, and Craine Creek.

Period	Temporal Interval (cal B.P.)	Components		Surface Projectile Points		Obsidian Hydration (Major Sources)	
		n	Per 1000 years	*n*	Per 1,000 years	*n*	Per 1000 years
Terminal Prehistoric	600–100	3	6.0	14	28.0	142	284.0
Late Archaic	1300–600	19	27.1	83	118.6	464	662.9
Middle Archaic	3800–1300	97	38.8	202	80.8	1476	590.4
Early Archaic	5700–3800	65	34.2	196	103.2	679	357.4
Post-Mazama	7800–5700	20	9.5	53	25.2	535	254.8
Paleoarchaic	12,800–7800	33	6.6	26	5.2	532	106.4
Paleoindian	14,500–12,800	8	4.7	5	2.9	89	52.4
Totals	–	245	17.0	579	40.2	3917	272.0

single components and 35 with two or more components.

Table 24 presents a summary of chronological data for High Rock Country sites. All prehistoric eras are well represented in the High Rock Country, unlike other regions in the project area where evidence for early occupations predating the Post-Mazama interval is minimal or absent. Nearly all of the Paleoindian components were found in the Black Rock Range portion of the High Rock Country zone.

Time-adjusted site occupations (components) in the High Rock Country increase consistently through time until the Middle Archaic Period. Occupations during the Paleoindian, Paleoarchaic, and Post-Mazama periods demonstrate a fairly steady progression upward, but jump markedly during the Early Archaic Period by a factor of 3.4. During the subsequent Middle Archaic Period, occupations increase only marginally, from 34.2 occupations per 1000 years in the Early Archaic to 38.8. After the Middle Archaic Period, however, the number of dated components drops, with 27.1 in the Late Archaic Period and only 6.0 during the Terminal Prehistoric—the lowest in terms of both raw and time-adjusted frequencies in the entire project corridor.

The sharp increase in Early Archaic Period components is seen elsewhere across the project area as well (see discussion in chaps. 7 and 8) and may be a response to improved climatic conditions at the end of the middle Holocene. The steep decline in Terminal Prehistoric occupations, however, is not mirrored in the other regions. It is not entirely clear whether these data indicate a depopulation of the High Rock Country or if Terminal Prehistoric components are present but have been masked through mixing with older materials from previous occupations.

Additional proxies of land-use intensity are provided by the frequencies of time-sensitive projectile points and obsidian hydration rim values for each period, standardized by time (table 24). With some variation, both data sets track reasonably well with the component profile, with marked increases in activity in the Early Archaic and sharp decreases in the Terminal Prehistoric Period. Whereas the component frequencies peak in the Middle Archaic Period, the standardized frequencies for both projectile points and obsidian hydration rim values peak slightly later, during the Late Archaic Period.

In total, 33 radiocarbon dates were derived from 26 contexts within High Rock Country sites (see table 17). Consistent with the projectile point and component data, the dates include the earliest recovered during the project. Excepting the Paleoindian Period, all prehistoric eras are represented in the radiocarbon data. After omitting seven redundant dates, most (*N* = 10) fall within the Middle Archaic Period, followed by the Terminal Prehistoric (*N* = 6), Late Archaic (*N* = 5), Early Archaic and Paleoarchaic (two each), and Post-Mazama (*N* = 1). Half (*N* = 13) of the dates are derived from features generally containing quantities of fire-affected rock. Of these, only five (38%) postdate the Middle Archaic Period. These results contrast with the other regions, where radiocarbon-dated thermal features are more prevalent in Late Archaic and Terminal Prehistoric contexts (see chap. 8). Notable is a radiocarbon date from site 26HU5105, located just below the high stand of pluvial Lake Parman at Fivemile Flat. Excavations here revealed a living floor that was radiocarbon dated to 11,180 cal B.P., the oldest such feature reported in this region.

Assemblage and Feature Overview

In total, 245 spatiotemporal components are documented in the High Rock Country (table 23; see also table 22). The Black Rock Range contains nearly 80% (*N* = 195) of the region's dated components, while Barrel Springs has 34 (14%) and Long Valley has 16 (7%). In the westernmost areas, Late Archaic Period and Terminal Prehistoric components are either absent (Long Valley) or nearly so (Barrel Springs). They are both present in the Black Rock Range, however.

The most striking pattern is the dominance of flaked stone scatters throughout all eras (table 25). Altogether, this type represents more than half (*N* = 152) of all the dated components. Many of these flaked stone scatters represent quarrying events associated with one of the four obsidian sources located within the project corridor.

The number of habitation sites in the High Rock Country is low for all time periods, accounting for only 13% of all sites. Perhaps the most relevant measure is the ratio of flaked stone scatters and quarries to habitation components, the latter including both simple and complex habitation sites, as well as sites containing features. The ratio of habitation sites is highest for the Middle Archaic Period (20%), while it ranges between 9% and 11% for the Paleoarchaic, Post-Mazama, Early Archaic, and Late Archaic periods. The increases in land-use intensity previously identified for the Middle Archaic Period appear to have been tied to greater habitation activity.

Features

Rock accumulations make up the most common feature type in the High Rock Country sites (see table 23). These comprise large, clearly defined alignments such as house rings and hunting blinds (*N* = 25), as well as subtle emplacements of one or a few basalt rocks (*N* = 106). With the exception of

TABLE 25
Summary of Treated Component Types for the High Rock Country
PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric.

Type	PI	PA	PM	EA	MA	LA	TP	Totals
Flaked stone	6	24	11	39	65	6	1	152
Quarry	2	6	7	19	12	11	1	58
Simple habitation	–	2	1	6	14	1	–	24
Complex habitation	–	1	–	1	2	–	–	4
Complex habitation/quarry	–	–	–	–	2	–	–	2
Flaked stone/feature	–	–	1	–	1	1	–	3
Feature Only	–	–	–	–	1	–	1	2
Totals	8	33	20	65	97	19	3	245
Combined types								
Flaked stone + quarry	8	30	18	58	77	17	2	210
Habitation + feature	–	3	2	7	19	2	–	33
Percentage of habitation sites	–	9.1	10.0	10.8	19.6	10.5	–	13.5

three features in the Black Rock Range subzone, all these features are located in the basalt tablelands of the Barrel Springs subzone.

The 25 larger rock features include nine large rock rings at site 26WA8617, interpreted as the bases of dwellings; all except one are located in the dense but temporally mixed deposit at Locus C of that site. An additional eight features are semicircular alignments interpreted as hunting blinds; four of these are also at site 26WA8617, while two other possible blinds are located at site 26WA8628, and another is nearby at site 26WA8633. The one hunting blind outside the Barrel Springs area is in the Black Rock Range subzone, at site 26HU4989. Finally, eight small circular alignments/cleared areas at site 26WA8617 are interpreted as possible caches. Of these 25 features, only one could be clearly associated with a dated component: the single rock ring at 26WA8617 Locus A, dated to the Middle Archaic period.

The remaining 106 rock features are much more subtle emplacements of one or a few rocks placed on a base boulder. All except two of these features are found in the Barrel Springs subzone, where they are widespread on the landscape. (Many additional such features were recorded as isolates during archaeological surveys for the pipeline.) These can be difficult to distinguish from natural, noncultural phenomena (e.g., resulting from frost wedging or exfoliation) that commonly occur across exposed basalt surfaces (see Hildebrandt et al., 2014, for discussion). However, the use of these features by nearby ethnographic groups to the northwest is well documented, and many are likely to be the result of intentional human placement. Such features were reportedly built during religious activities geared toward obtaining power, as well as wisdom, to help overcome periods of grief and hardship encountered during one's life; they were also associated with boys' puberty rites. These features may demonstrate cultural affinity with south-central Oregon and Modoc Plateau groups. While these features are widespread in the Barrel Springs subzone, none were unequivocally associated with a dated artifact assemblage. The distribution of the rock emplacements does not correlate strongly with that of artifact scatters, suggesting that they are functionally unrelated, and that apparent associations between them are fortuitous.

The next most common feature type in the High Rock region comprises hearths, concentrations of charcoal-stained sediments, and clusters of fire-affected rock. In all, 25 such thermal features are located in the Black Rock Range subzone (eight sites) and Long Valley subzone (two sites); none are present at Barrel Springs sites. Two sites, 26HU5728 and 26WA8766, are notable for containing relatively large numbers of these features. Site 26WA8766 contains eight such features, of which two were radiocarbon dated to the Middle Archaic Period and one to the Terminal Prehistoric. Site 26HU5728 contains nine of these features, three of which were radiocarbon dated; two dated to the Middle Archaic and one to the Late Archaic. None of the thermal features excavated in the High Rock Country contained much in the way of cultural material.

Three of the sites (26WA8617, 26WA8864, and 26WA9110) contain petroglyphs, all of them in the Barrel Springs subzone (four other sites in the Barrel Springs area also contain petroglyphs, but were avoided entirely during construction and are not reported here). The rock art motifs are generally indistinct abstract forms pecked onto varnished basalt outcrops. Marked repatination on some of the elements indicate that they likely predate the Terminal Prehistoric Period, when Numic groups are thought to have entered the region, although a possible horse and rider element was recorded at one site. Few of the petroglyphs could be clearly associated with a dated component assemblage; however, the rock art elements at site 26WA8864 do appear to be associated with its Middle Archaic artifact assemblage.

Three milling slicks are present at site 26WA8617, in association with the rock art panels, rock rings, and other features at Locus C of that site.

Finally, and most notably, the oldest radiocarbon date on a living surface ever recorded in the Great Basin was documented at 26HU5105. This feature, dated to 11,180 cal B.P., consists of a compacted, circular fill zone approximately 10 cm thick and 4 m in diameter. The occupants of this Paleoarchaic site may have been drawn to the wetlands that likely flourished in the area as Lake Parman began its retreat sometime after 15,000 years ago.

Assemblages

A comparison of artifact types demonstrates that Middle Archaic Period groups in the High Rock region were more dependent on plant procurement and processing than were earlier occupants (table 26). The ratio of ground and battered stone (milling stones, hand stones, pestles, battered cobbles, and miscellaneous ground stone) to flaked stone tools (projectile points, bifaces, drills, formed flake tools, and simple flake tools) reached a peak of 1:13 during the Middle Archaic Period. Ground stone tools were also more common during the Early Archaic Period, with a ratio of 1:17. The Post-Mazama and Paleoarchaic period components contain only trace

TABLE 26
Assemblages by Time Period for the High Rock Country
PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Assemblage	PI	PA	PM	EA	MA	LA	TP	NC	Other[a]	Totals
Flaked Stone										
Projectile point	3	35	10	44	236	2	2	737	77	1146
Projectile point/ drill	–	–	–	–	1	–	–	1	–	2
Crescent	–	–	–	–	1	–	–	2	1	4
Drill	–	1	–	–	9	–	–	22	–	32
Biface	8	142	69	236	982	34	4	2556	26	4057
Formed flake tool	2	10	1	8	30	1	–	80	–	132
Flake tool	3	29	15	27	791	2	3	1009	4	1883
Core tool	–	–	–	1	7	–	–	15	–	23
Core	1	20	10	53	180	65	2	396	3	730
Debitage	985	22,533	14,034	21,887	118,304	10,424	629	189,277	354	378,430
Ground Stone										
Millingstone	–	1	–	12	89	–	–	119	1	222
Handstone	–	–	2	5	39	–	–	56	1	103
Bowl mortar	–	–	–	–	5	–	–	–	1	6
Pestle	–	–	–	1	7	–	–	8	–	16
Battered cobble	–	–	–	–	7	–	–	2	–	9
Misc. ground stone	–	–	–	1	17	–	–	11	–	29
Other										
Modified bone	–	–	–	–	7	–	–	–	–	7
Modified stone	–	–	–	–	3	–	–	–	–	3
Manuport	–	–	–	1	1	–	–	3	–	5
Ochre	–	–	–	–	1	–	–	–	–	1

[a] Includes isolates and surface collections from untreated sites.

amounts of ground stone, as reflected by ratios of 1:51 and 1:210, respectively. Ground stone is absent from Late Archaic and Terminal Prehistoric sites, which is a surprising finding given their abundance elsewhere along the project corridor.

Several pestles recovered from Barrel Springs sites are unique to that area; these items have wide, nearly flat ends indicative of use on flat or nearly flat base rock and were used for both grinding and pounding; they display hand stone use as well. Their ends are typically irregular in shape. Starch-grain analyses conducted on three of the items were inconclusive, although two yielded grains consistent with biscuit-root and grass,

TABLE 27
Flaked Stone Material Types by Time Period for the High Rock Country
PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Material	PI	PA	PM	EA	MA	LA	TP	NC	Other[a]	Totals
Obsidian	949	21,883	13,754	19,783	114,298	10,502	516	181,256	441	363,382
CCS	39	733	351	2230	2837	26	124	8812	20	15,172
Other	14	154	34	243	3406	–	–	4030	4	7885
Totals	1002	22,770	14,139	22,256	120,541	10,528	640	194,098	465	386,439

[a] Includes isolates and surface collections from untreated sites.

possibly from maize (a likely contaminant). Also unique to Barrel Springs are bowl mortars. Five of these items were recovered from sites and one was collected from an isolated location. The five from site contexts were recovered from the Middle Archaic Period components of three habitation sites (26WA8617, 26WA8621, and 26WA8628).

The four crescents recovered during the project were all found in the High Rock Country. Two were at a single site in Long Valley (26WA8766) that overlooks the overflow drainage from Massacre Basin, and one was in Barrel Springs (26WA8730). The other was collected as an isolated artifact in the Black Rock Range. Two are obsidian, one each from the Surveyor Spring and possible Unknown A sources, whereas two are cryptocrystalline silicate (CCS) material.

Flake tools are uncommonly abundant in the High Rock Country (see table 26), with some 402 simple flake tools collected per 1000 acres. By contrast, the Upper Humboldt Plains (19 per 1000 acres), Upper Lahontan Basin (9 per 1000 acres), and Thousand Springs Valley (7 per 1000 acres) regions show much lower densities. The trend is particularly striking in Barrel Springs, where the density of collected simple flake tools reaches 2054 per 1000 acres. The high density of flake tools may relate to the manufacture and maintenance of digging sticks for the harvesting of epos (yampah), which is abundant at Barrel Springs (see chap. 13). Long Valley (45 per 1000 acres) and the Black Rock Range (54 per 1000 acres), have much lower densities, although they are still high relative to the other project regions. Similar to other tool types within the High Rock Country region, most of the formed and simple flake tools associated with dated components fall within the Middle Archaic Period (58% and 91%, respectively).

Obsidian is the dominant flaked tool stone represented in High Rock Country sites, accounting for 94% of the collected assemblage (table 27). CCS accounts for another 4%, while other materials (e.g., basalt, rhyolite) make up the remaining 2% of the assemblage. In total, some 32 distinct sources are represented in the analyzed assemblage of obsidian tools and debitage (table 28). Of the 6228 sourced items, nearly 40% are Massacre Lake/Guano Valley obsidian, 17% are Craine Creek, and 13% are Nut Mountain. Other local sources present in significant quantities include Mosquito Lake (8%), Bidwell Mountain (7%), Surveyor Spring (3%), and Long

TABLE 28
Obsidian Source Representation by Time Period for the High Rock Country

PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Source	PI	PA	PM	EA	MA	LA	TP	NC	Other[a]	Totals
Badger Creek	3	5	–	5	2	–	–	29	8	52
Beatys Butte	–	–	–	1	2	2	–	11	–	16
Bidwell Mountain	1	28	7	27	76	–	–	266	11	416
Blue Spring	–	1	–	–	4	–	–	10	–	15
Bodie Hills	–	–	–	–	–	–	–	–	2	2
Bordwell Spring	1	2	1	1	4	1	–	16	6	32
Buck Mountain	–	2	1	–	9	–	–	36	5	53
Buffalo Hills	–	1	–	–	1	–	–	3	–	5
Craine Creek	10	22	27	134	431	55	–	340	19	1038
Double H	–	1	3	–	7	–	–	17	1	29
Double O	–	–	–	–	–	–	–	2	–	2
Drews Creek/ Butcher Flat	–	–	–	–	1	–	–	2	–	3
East Medicine Lake	–	–	–	–	–	–	–	1	–	1
Fox Mountain	–	3	–	–	1	–	–	15	4	23
Hawks Valley	–	1	2	2	2	–	–	6	1	14
Horse Mountain	–	–	–	–	–	–	–	1	–	1
Long Valley	–	5	4	1	34	–	–	64	1	109
Majuba Mountain	–	1	–	–	1	–	–	2	–	4
Massacre Lake/ Guano Valley	31	255	127	395	502	146	15	826	112	2409
McComb Butte	–	–	–	–	1	–	–	–	–	1
Mosquito Lake	1	12	7	44	113	2	–	310	15	504
Nut Mountain	23	65	45	62	30	7	6	571	5	814
Paradise Valley	–	–	–	–	–	–	–	1	–	1
Pinto Peak	–	–	–	2	3	2	–	11	2	20
Rainbow Mine	–	3	–	–	–	–	–	7	1	11
South Warners	–	1	–	–	1	–	–	4	–	6
Spodue Mountain	–	–	–	–	–	–	–	1	–	1
Sugar Hill	–	–	–	–	2	–	–	10	1	13
Summit Lake	–	–	–	4	–	–	–	2	–	6
Surveyor Spring	7	11	5	3	43	–	–	134	10	213
Tucker Hill	–	–	–	–	–	–	–	1	1	2
Whitehorse	–	–	–	–	1	–	–	2	–	3
Unknown	4	15	5	6	112	–	–	251	16	409
Totals	81	434	234	687	1383	215	21	2952	221	6228

[a] Includes isolates and surface collections from untreated sites.

TABLE 29
Summary of Faunal Remains by Time Period for the High Rock Country
PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Common Name	PA	PM	EA	MA	LA	TP	NC	Totals
Large Mammals								
Horse	–	–	–	–	–	–	3	3
Bighorn sheep	–	–	–	–	–	–	1	1
Pronghorn/bighorn	–	–	–	1	–	–	–	1
Pronghorn/deer	–	–	–	1	–	–	–	1
Artiodactyl	–	4	10	48	10	–	45	117
Ungulate	–	–	1	3	–	–	3	7
Mammal, large	–	–	–	10	–	–	100	110
Mammal, medium-large	1	2	2	547	6	–	254	812
Subtotal	1	6	13	610	16	–	406	1052
Medium Mammals								
Badger	–	–	–	1	–	–	–	1
Coyote	–	–	–	–	–	–	2	2
Carnivore	–	–	–	2	–	–	–	2
Mammal, medium	–	–	–	–	–	–	15	15
Subtotal	–	–	–	3	–	–	17	20
Small/medium mammals								
Marmot	–	–	–	1	–	–	3	4
Rabbit	–	1	–	44	–	–	10	55
Pigmy rabbit	–	–	–	2	–	–	1	3
Cottontail/pigmy	–	–	–	–	1	–	8	9
Hare	–	1	–	2	–	–	–	3
Rabbit/hare	–	2	–	40	–	–	7	49
Mammal, small-medium	10	4	2	877	11	–	272	1176
Subtotal	10	8	2	966	12	–	301	1299
Small Mammals								
Deer mouse	–	–	–	3	–	–	–	3
Ground squirrel	–	–	1	15	–	1	1	18
Kangaroo rat	–	–	–	–	–	–	1	1
Pocket gopher	1	–	–	11	1	–	4	17
Rodent	1	1	–	37	1	2	11	53
Squirrel	1	–	–	29	–	–	11	41
Vole	–	–	–	2	–	–	–	2
Mammal, small	2	–	1	24	–	–	7	34
Subtotal	5	1	2	121	2	3	35	169
Mammals, indeterminate								
Mammal	2	–	5	102	10	–	84	203
Birds								
Eared grebe	–	–	–	2	–	–	–	2
Perching bird	–	–	–	1	–	–	–	1
Bird	1	–	–	2	–	–	18	21
Other								
Fish	–	–	–	–	–	–	1	1
Vertebrate	1	–	7	40	2	–	71	121

Valley (2%). Materials from nonlocal sources are rare and derived from western sources such as the Bordwell Group (Bordwell Spring/Pinto Peak/Fox Mountain), Double H, Sugar Hill, and Hawks Valley. Eastern sources, such as Browns Bench and Ferguson Wash, are absent.

With respect to source representation through time, Mosquito Lake, Craine Creek, and Bidwell Mountain obsidian use peaked during the Middle Archaic Period, dropped off sharply during the ensuing Late Archaic Period, and apparently ended by the Terminal Prehistoric. Massacre Lake/Guano Valley obsidian, however, maintained its high levels through the Late Archaic Period, before dropping off during the Terminal Prehistoric Period. The Nut Mountain obsidian materials demonstrate a peak in use during the Early Archaic but then a sharp drop during the ensuing Middle and Late Archaic periods.

In total, 2889 faunal bone elements and fragments were recovered from 39 sites within High Rock Country (table 29). Of these, about 2000 bones and bone fragments are associated with 17 dated components. A significant amount of this bone is derived from the Middle Archaic component of site 26WA8748, which yielded some 1209 bones and bone fragments. The Middle Archaic component data are clearly the most robust, with some 1847 faunal bones, including the 1209 elements from 26WA8748.

Since half of the total assemblage is derived from a single period, it is difficult to analyze the findings at a regional scale. However, some general trends can be observed. Lagomorph-sized mammal remains are the most frequent, comprising more than half (51%) of the dated assemblage, whereas artiodactyl-sized mammal remains account for about 33%. A trace amount of bird remains (1%) was recovered, while fish remains are nearly absent.

Across the High Rock Country, 1100 charred seeds were recovered from 19 components, of which 896 could be identified to family, genus, or species (table 30). There were also eight fragments of nutshell, 21,917 grams of wood charcoal, and 269 miscellaneous remains (e.g., buds, roots). In all, 32 taxa are recognized. Seed counts and densities are greatest in the Middle Archaic components (N = 625, 109.8 seeds per liter), a finding that makes sense given the high relative frequencies of milling equipment from these contexts. Much lower seed frequencies were observed in Late Archaic and Terminal Prehistoric components, and only trace levels in Paleoarchaic and Early Archaic contexts.

Identifiable nutshell consists of four pinyon and one juniper, all but one of which were recovered from Middle Archaic components. Pinyon is not found in the High Rock Country and was mostly likely transported to the site over some distance. The most abundant seeds by count include blue-eyed Mary, goosefoot, tansey mustard, grass family, and saltbush. Goosefoot and blue-eyed Mary seeds have a long seed-ripening period, from early summer to late fall. Other notable taxa include bluegrass seeds, which are available in the late summer to early fall. Cattail seeds, indicating wetland use, were recovered from a single site (26HU4923) in the Black Rock Range.

Summary

The High Rock Country exhibits the longest record of human occupation along the project corridor, extending back to the Paleoindian era. Prior to the Early Archaic Period,

TABLE 30
Summary of Archaeobotanical Remains by Time Period for the High Rock Country
Raw seed counts are not corrected for sample volume or sampling fraction.
PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

		PA	PM	EA	MA	LA	TP	NC	Totals
	No. samples	11	1	5	38	3	1	20	79
	Total Volume (L)	102.5	9.0	57.0	387.0	61.3	6.5	165.6	788.9
Taxon	Common Name								
Nutshell									
Juniperus spp.	Juniper	–	–	–	1	–	–	–	1
Pinus monophylla	Pinyon	–	–	–	3	–	–	1	4
Unidentified nutshell		–	–	–	12	–	–	1	13
Small seeds									
Achnatherum hymenoides	Ricegrass	–	–	–	3	–	–	1	4
Artemisia tridentata	Big sagebrush	–	–	–	7	–	1	2	10
Atriplex spp.	Salt bush	–	–	–	39	3	1	26	69
Camissonia/Oenothera spp.	Evening primrose	–	–	–	5	–	–	–	5
Caryophyllaceae	Pink family	–	–	–	1	–	–	–	1
Chenopodiaceae	Goosefoot family	–	–	1	9	–	–	34	44
Chenopodium spp.	Goosefoot	–	–	1	153	44	–	36	234
Collinsia spp.	Blue-eyed Mary	–	–	–	15	2	32	12	61
Cyperaceae	Sedge family	–	–	–	1	1	–	1	3
Descurainia spp.	Tansy mustard	–	–	–	66	52	–	4	122
Elymus spp.	Wild rye	–	–	–	8	2	17	1	28
Erodium spp.	Filaree	–	–	–	1	–	–	–	1
Fabaceae	Bean family	–	–	1	9	3	–	8	21
Lamiaceae	Mint family	–	–	–	27	–	–	–	27
Large Poaceae	Grass family	–	–	–	3	–	2	–	5
Malvaceae	Mallow family	–	–	–	1	–	–	–	1
Mentzelia spp.	Blazing star	–	–	–	–	3	–	2	5
Phacelia spp.	Phacelia	–	–	–	18	–	–	9	27
Poa spp.	Bluegrass	–	–	–	14	13	4	1	32
Poaceae fragments	Grass family	–	–	1	50	17	–	2	70
Purshia spp.	Antelope bush	–	–	–	–	–	7	–	7
Rosa spp.	Wild rose	–	–	–	6	–	–	–	6
Rumex spp.	Dock	–	–	–	3	–	–	1	4
Salvia spp.	Sage	–	–	–	8	–	–	–	8
Scirpus spp.	Tule	1	–	–	1	–	–	–	2
Small Poaceae	Grass family	1	–	–	8	18	11	–	38
Suaeda spp.	Seepweed	–	–	–	9	–	–	43	52
Triticum spp.	Wheat	–	–	–	4	–	2	–	6
Typha spp.	Cattail	–	–	–	3	–	–	–	3
Seed fragments		1	–	–	101	14	5	23	144
Unidentified seeds		–	–	–	48	1	–	11	60
Miscellaneous									
Bud		–	–	–	11	–	–	–	11
Large nonseed		–	–	–	17	2	2	–	21
Nongrain pieces		2	–	2	70	2	–	7	83
Roots		2	–	–	10	1	–	–	13
Small nonseed		–	–	–	107	–	–	–	107
Unknown A		–	–	–	–	–	14	7	21

however, population densities were low and grew only incrementally. Commencing in the Early Archaic, land-use intensity, as measured by the frequency of components standardized by time, ramped up, peaking during the Middle Archaic, and was sustained at high levels through the Late Archaic Period. This Middle Archaic peak was accompanied by a shift in settlement pose as reflected in an increase in habitation sites, as well as by increased use of milling equipment. Archaeobotanical assemblages dating to this time indicate a greater reliance on small seeds. There is also some evidence for the intensification of geophyte resources, particularly in the Barrel Springs area. But perhaps the most surprising result of this investigation is the lack of visibility of the Terminal Prehistoric record in the High Rock Country. This absence may reflect an actual decrease in land-use intensity at this time, or perhaps a shift to a Numic family-band settlement structure that left a more diffuse and less visible archaeological record.

The High Rock Country, however, is neither environmentally nor archaeologically homogeneous. The Black Rock Range to the east contains a high density of sites reflecting long-term quarry exploitation of the Massacre Lake/Guano Valley, Nut Mountain, and Craine Creek obsidian flows. Long Valley, in contrast, contains the lowest density of sites in the High Rock Country, with a relatively large proportion of habitation sites and lower overall quantities of hunting-related tools. The Barrel Springs area is marked by high site densities and a large numbers of plant processing and hunting tools, and may have served as a prime geophyte collection zone. There are also distinctive artifact and feature categories at Barrel Springs (such as bowl mortars and pestles, rock-stack features, and extremely high numbers of flake tools), many of which may reflect occupation or influence by Penutian groups from south-central Oregon and the Modoc Plateau.

CHAPTER 7

UPPER LAHONTAN BASIN SUMMARY OF FINDINGS

Kelly McGuire

The Upper Lahontan Basin includes approximately 119 miles of corridor from where it descends from the High Rock Country into the eastern arm of the Black Rock Desert near Leonard Creek and east to the headwaters of Evans Creek, southeast of Midas, Nevada (fig. 26). As described in chapter 2, this region is generally coterminous with the basin of pluvial Lake Lahontan and exhibits the lowest overall elevation of the four project areas (between about 4000 and 5500 ft). Lake Lahontan's bed is vegetated with an open mosaic of greasewood, seepweed, saltbush, and shadscale desert scrub; at slightly higher elevations, sagebrush steppe dominates. Major streams and creeks of this region include the Quinn River, which empties into the eastern arm of the Black Rock Desert, the Little Humboldt River north of Winnemucca, and Evans Creek at the eastern end of this project segment.

In total, 67 sites with prehistoric components in this corridor segment received some level of data recovery treatment (fig. 26). Some 111 m^3 were hand-excavated during treatment, entailing 77 control units, 124 surface scrapes, and 310 shovel probes (table 31). General surface collection was also done at most sites.

Chronological Overview

Of the 67 treated prehistoric sites, 36 contained chronometric data sufficient for component definition. The remaining 31 sites could not be assigned to a component. In all, 41 components are present at these 36 sites, consisting of 32 sites with single components, three with two components, and one with three components.

Table 32 presents a summary of chronological data for Upper Lahontan Basin sites. As the table shows, all major component periods are represented, although the earliest periods (Paleoindian, Paleoarchaic, and Post-Mazama) are not well represented. Perhaps more surprising is the robust Late Archaic representation; that period seems to have been the highpoint of occupational intensity in the Upper Lahontan Basin. This project segment is characterized by a large number of dune fields in the Quinn River area, as well as in Paradise Valley north of Winnemucca, which appear to have been attractive locations during the Late Prehistoric era.

Projectile point frequencies associated with each time period generally corroborate the component frequencies, with the Late Archaic Period exhibiting both the highest absolute and the highest time-standardized frequencies (table 32). However, unlike the

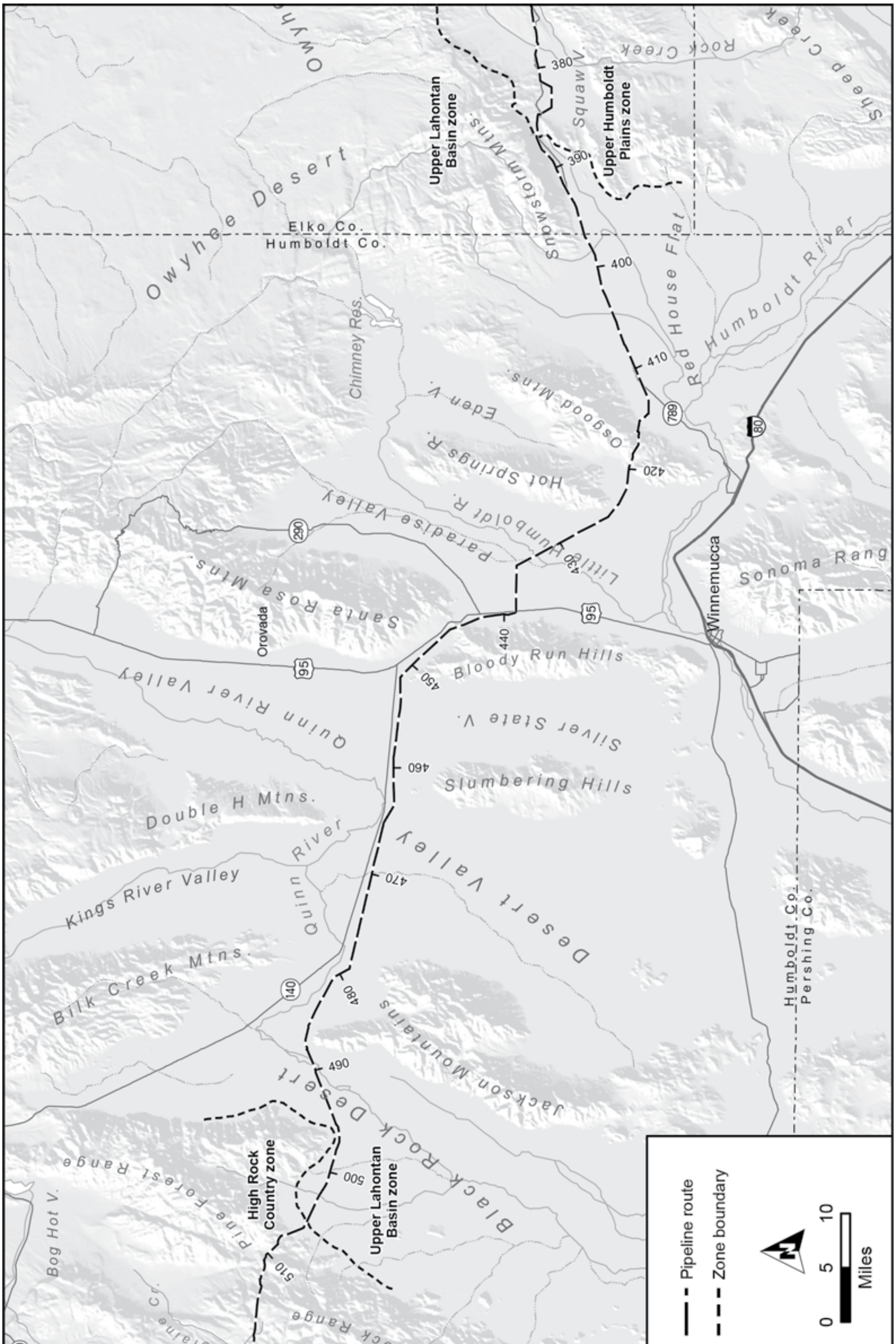


Fig. 26. Upper Lahontan Basin.

TABLE 31
Summary of Work Performed and Components Represented at Treated Sites, Upper Lahontan Basin

Column Headings: PM = approximate pipeline postmile; Comp. Ct. = number of components identified at the site; PPT = projectile points; FLS = other flaked stone tools; COR/DEB = cores/debitage; GDS = ground stone; ^{14}C = radiocarbon; XRF/OH = X-ray fluorescence/obsidian hydration; Flot. = flotation.

Ages: PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

FS = flaked stone; FS/F = flaked stone/feature; FO = feature only; SH = simple habitation; CH = complex habitation; PTC = pronghorn trap complex; Q = quarry.

Trinomial	PM	Comp. Ct.	Component Definition			Features	Catalog Counts						Special Studies		
			Age	Type	Vol (m^3)	Thermal	PPT	FLS	COR/DEB	GDS	Beads	Other	^{14}C	OH/XRF	Flot.
26EK11930	387.9	0	NC	–	0.700	–	–	3	584	–	–	–	–	–	–
26EK11935	391.7	0	NC	–	0.075	–	1	–	1	–	–	–	–	–	–
26EK11936	392.0	0	NC	–	0.375	–	–	–	2	–	–	–	–	–	–
26EK11939	393.8	1	LA (C1)	SH	1.050	–	1	3	148	2	–	–	–	5	–
			NC	–	0.075	–	–	–	–	–	–	–	–	–	–
26EK11950	391.6	0	NC	–	0.500	–	–	3	157	–	–	–	–	–	–
26HU2184/5272	461.5	2	MA (Loc. FW-C)	FS	0.238	–	–	–	197	–	–	–	–	10	–
			MA (Loc. PL-AD)	FS	0.250	–	–	3	342	–	–	–	–	10	–
			NC	–	1.975	1	90	33	1109	–	–	–	–	96	–
26HU2261/5277	503.3	1	PM	FS	0.513	–	–	–	11	–	–	–	–	10	–
26HU2915/5156	404.4	0	NC	–	1.338	–	1	4	57	–	–	–	–	11	–
26HU4067/5143	416.0	1	LA (Loc. B)	FS	1.613	–	1	1	1232	–	–	–	–	21	–
			NC	–	0.812	–	1	5	49	2	–	–	–	1	–
26HU4756	445.2	1	EA	FS	0.675	–	–	1	15	–	–	–	–	10	–
26HU4790	434.6	1	MA	FS	0.425	–	1	–	41	–	–	–	–	5	–
26HU4791	434.9	1	MA (Loc. A)	CH	6.238	2	4	12	453	4	–	5	2	22	3
			NC	–	0.813	–	2	1	205	–	–	–	–	4	–
26HU4792	433.8	3	LA (Loc. AB)	SH	19.025	–	40	91	9571	3	2	4	1	54	1
			LA (Loc. IJ)	FS	8.000	–	7	38	7309	–	2	–	–	18	–
			PM (Loc. IJ)	FS	1.800	–	–	3	982	–	–	–	–	20	–
			NC	–	14.650	–	42	88	4532	3	–	1	–	64	–
26HU4793	431.8	2	TP (Loc. B)	FS/F	0.912	1	1	1	261	–	–	1	1	10	2
			TP (Loc. C)	FS	0.400	–	1	–	109	–	–	–	–	10	–
			NC	–	2.213	3	19	16	218	–	–	–	–	8	–
26HU4798	469.9	0	NC	–	0.275	–	–	1	7	–	–	–	–	5	–
26HU4799	470.3	1	PA	FS	0.313	–	1	–	8	–	–	–	–	5	–
26HU4805	431.4	1	LA (Loc. A)	SH	1.400	–	1	9	94	3	–	–	–	10	–
			NC	–		–	2	2	–	–	–	–	–	–	–
26HU4806	430.8	1	LA (C1)	FS	1.888	–	3	10	582	–	–	–	–	13	–
				NC	–	–	3	–	–	–	–	–	–	3	–
26HU4808	429.4	1	TP	FS	0.688	–	3	3	142	–	–	–	–	15	–

TABLE 31—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features	Catalog Counts						Special Studies		
			Age	Type	Vol (m ^{3})	Thermal	PPT	FLS	COR/ DEB	GDS	Beads	Other	^{14}C	OH/ XRF	Flot.
26HU4809	429.3	0	NC	–	0.425	–	1	2	24	–	–	–	–	6	–
26HU4810	429.2	0	NC	–	0.388	–	–	3	5	–	–	–	–	4	–
26HU4846	480.5	1	MA (Loc. A)	FS	0.550	–	–	–	780	–	–	–	–	15	–
			NC	–	0.088	–	2	5	6	–	–	–	–	7	–
26HU4849	482.5	1	EA	FS	0.500	–	2	–	121	–	–	–	–	17	–
26HU4850	482.5	1	PA	FS	0.275	–	1	–	2	–	–	–	–	3	–
26HU4851	482.2	0	NC	–	0.313	–	3	3	7	–	–	–	–	10	–
26HU4852	480.9	1	MA	FS	0.113	–	–	–	5	–	–	–	–	5	–
26HU4853	481.1	2	MA (Loc. B)	FS	0.375	–	1	1	11	–	–	–	–	4	–
			PM (Loc. A)	FS	0.988	–	–	–	114	–	–	–	–	3	–
			NC	–	0.038	–	–	–	–	–	–	–	–	–	–
26HU4855	481.4	1	MA (Loc. A)	FS	0.238	–	1	–	19	–	–	–	–	1	–
			NC	–	0.775	–	1	–	24	–	–	–	–	–	–
26HU4856	481.7	0	NC	–	1.075	1	5	10	24	3	–	1	–	13	–
26HU4869	458.8	0	NC	–	0.275	–	1	2	3	–	–	–	–	4	–
26HU4870	458.2	0	NC	–	0.275	–	1	–	–	–	–	–	–	1	–
26HU4877	479.3	0	NC	–	0.163	–	–	2	6	–	–	–	–	5	–
26HU4879	480.3	1	PM	FS	0.313	–	–	1	59	–	–	–	–	15	–
26HU4884	491.4	0	NC	–	0.550	–	2	2	12	–	–	–	–	1	–
26HU4885	491.4	0	NC	–	0.275	–	–	2	4	–	–	–	–	–	–
26HU4886	491.3	1	PA	FS	0.113	–	2	5	12	–	–	–	–	17	–
26HU4887	491.2	0	NC	–	0.513	–	2	2	11	–	–	–	–	2	–
26HU4888	490.9	1	EA (C1)	FS	0.838	–	–	1	40	–	–	–	–	10	–
			NC	–	0.225	–	6	1	5	2	–	–	–	5	–
26HU4889	495.1	0	NC	–	0.513	–	–	2	29	–	–	–	–	15	–
26HU4890	495.4	1	PA	FS	0.475	–	–	1	25	–	–	–	–	15	–
26HU4891	495.5	1	PI	FS	0.475	–	2	1	23	–	–	–	–	12	–
26HU4892	496.6	1	PM	FS	0.488	–	–	–	96	–	–	–	–	15	–
26HU4893	496.8	1	PM	SH	0.325	–	1	–	23	1	–	–	–	13	–
26HU4894	500.6	1	EA (Loc. A)	FS	0.638	–	2	3	497	–	–	–	–	16	–
			NC	–	0.113	–	5	1	–	–	–	–	–	2	–
26HU4895	501.2	1	PM	FS	0.250	–	–	–	547	–	–	–	–	15	–
26HU4904	504.4	0	NC	–	1.075	–	1	3	73	–	–	–	–	16	–
26HU4959	488.7	1	MA	FS	0.513	–	2	1	27	–	–	–	–	2	–
26HU4960	489.1	0	NC	–	2.863	–	12	18	493	–	–	–	–	18	–
26HU4961	489.8	1	MA	FS	0.275	–	1	–	5	–	–	–	–	–	–
26HU4962	490.2	0	NC	–	8.200	–	79	88	4686	7	–	–	–	99	–
26HU4964	502.7	0	NC	–	0.350	–	–	–	14	–	–	–	–	5	–
26HU4966	504.3	1	PA	FS	0.713	–	1	2	21	–	–	–	–	10	–
26HU5153	430.4	1	LA	SH	1.025	–	1	4	210	1	–	–	–	11	–

TABLE 31—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features	Catalog Counts						Special Studies		
			Age	Type	Vol (m ^{3})	Thermal	PPT	FLS	COR/ DEB	GDS	Beads	Other	^{14}C	OH/ XRF	Flot.
26HU5158	405.2	0	NC	–	0.525	–	1	1	3	–	–	–	–	1	–
26HU5159	406.5	0	NC	–	0.300	–	–	1	2	–	–	–	–	–	–
26HU5161	406.9	0	NC	–	0.275	–	–	2	6	–	–	–	–	–	–
26HU5167	473.4	0	NC	–	0.275	–	–	–	5	–	–	–	–	–	–
26HU5168	484.7	0	NC	–	0.275	–	–	–	6	–	–	–	–	–	–
26HU5197	435.2	0	NC	–	0.663	–	1	4	86	–	–	–	–	11	–
26HU5202	397.2	0	NC	–	0.300	–	1	2	4	–	–	–	–	–	–
26HU5206	407.7	1	MA (Loc. A)	FS	1.725	–	1	1	274	–	–	–	–	11	–
26HU5218	465.2	0	NC	–	2.025	–	3	24	3012	1	–	–	–	31	–
26HU5219	–	0	NC	–	0.288	–	–	2	7	–	–	–	–	–	–
26HU5221	–	1	MA (Loc. A)	FS	0.200	–	–	–	67	–	–	–	–	10	–
			NC	–	0.163	–	–	–	2	–	–	–	–	–	–
26HU5222	–	1	LA (Loc. C)	SH/Q	2.688	–	24	43	3097	1	3	–	1	32	2
			NC	–	3.178	–	32	111	6524	4	–	–	–	44	–
26HU5232	491.0	0	NC	–	0.513	–	–	1	9	–	–	–	–	–	–
26HU5727	416.3	1	MA	SH	0.263	–	–	–	35	1	–	–	–	10	–
Totals		41			110.89	8	426	689	49,622	38	7	12	5	1002	8

component frequencies, projectile point frequencies appear to have ramped up beginning in the Early Archaic Period, rather than the Middle Archaic. The sharp increase in Early Archaic Period occupations is reflected elsewhere across the project area (see chaps. 6 and 8) as well, and may have been a response to improved climatic conditions at the end of the middle Holocene.

A total of 924 obsidian hydration readings was obtained from dated component contexts from Upper Lahontan Basin sites; these data were then standardized according to source and hydration rate, as well as deposition rate (number per 1000 years; table 32). In this case, the time-standardized frequencies jump in the Middle Archaic Period and then peak during the Late Archaic Period. The Terminal Prehistoric standardized frequency drops somewhat but remains comparable to the Middle Archaic Period.

Finally, five radiocarbon dates were obtained from this project segment, ranging between 2460 and 50 cal B.P. (see table 17). Although the sample is small, they tend to corroborate the increase in late Holocene settlement activity indicated by the other proxy data.

Assemblage and Feature Overview

The 41 spatiotemporal components documented in the Upper Lahontan Basin are dominated by flaked stone scatters, which comprise 78% of all components for all time periods (table 33). It is interesting to note, however, that this ratio almost reversed during the Late Archaic Period, with habitation sites comprising 63% of all components. As

TABLE 32
Summary of Time-sensitive Data Sets for the Upper Lahontan Basin

Major Sources: Massacre Lake/Guano Valley, Mosquito Lake, Bidwell Mountain, Bordwell Group, and Craine Creek.

Period	Temporal Interval (cal B.P.)	Components		Surface Projectile Points		Obsidian Hydration (Major Sources)	
		n	Per 1000 years	*n*	Per 1000 years	*n*	Per 1000 years
Terminal Prehistoric	600–100	3	6.0	26	52.0	63	126.0
Late Archaic	1300–600	8	11.4	96	137.1	164	234.3
Middle Archaic	3800–1300	13	5.2	56	22.4	308	123.2
Early Archaic	5700–3800	4	2.1	56	29.5	145	76.3
Post-Mazama	7800–5700	7	3.3	23	11.0	135	64.3
Paleoarchaic	12,800–7800	5	1.0	4	0.8	97	19.4
Paleoindian	14,500–12,800	1	0.6	0	0.0	12	7.1
Totals		41	2.8	261	18.1	924	64.2

TABLE 33
Summary of Treated Component Types for the Upper Lahontan Basin

PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Type	PI	PA	PM	EA	MA	LA	TP	Totals
Flaked stone	1	5	6	4	11	3	2	32
Flaked stone/feature	–	–	–	–	–	–	1	1
Simple habitation	–	–	1	–	1	4	–	6
Simple habitation/quarry	–	–	–	–	–	1	–	1
Complex habitation	–	–	–	–	1	–	–	1
Totals	1	5	7	4	13	8	3	41

we have noted, much of the increase in settlement intensity associated with this period appears to have been directed at the many dune contexts found in this lowland setting. Typical of these types of sites are 26HU4792, 26HU4805, and 26HU5153, all located among a series of small dunes near the Little Humboldt River in Paradise Valley. These data suggest that this intensification is associated with increased habitation activity in these contexts.

Features

Eight prehistoric features were documented in this project segment. All are characterized as either charcoal stains or fire-affected rock concentrations, or combinations of the two.

TABLE 34

Assemblages by Time Period for the Upper Lahontan Basin

PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Assemblage	PI	PA	PM	EA	MA	LA	TP	NC	Other[a]	Totals
Flaked Stone										
Projectile point	2	5	1	4	11	78	5	319	42	467
Projectile point/drill	–	–	–	–	–	–	–	1	–	1
Drill	–	1	–	–	1	6	–	13	–	21
Biface	1	6	4	5	16	169	3	404	17	625
Formed flake tool	–	–	–	–	–	2	–	8	–	10
Flake tool	–	1	–	–	1	21	1	24	–	48
Core tool	–	–	–	–	–	1	–	1	–	2
Core	–	–	–	–	–	–	–	3	–	3
Debitage	23	68	1832	673	2256	22,243	512	22,012	105	49,724
Ground stone										
Millingstone	–	–	–	–	–	4	–	9	–	13
Handstone	–	–	1	–	2	2	–	2	–	7
Pestle	–	–	–	–	–	–	–	1	–	1
Battered cobble	–	–	–	–	–	–	–	5	–	5
Misc. ground stone	–	–	–	–	3	4	–	5	–	12
Other										
Bead, shell	–	–	–	–	–	7	–	–	–	7
Modified bone	–	–	–	–	4	4	–	–	–	8
Modified stone	–	–	–	–	1	–	–	2	–	3
Manuport	–	–	–	–	–	–	1	–	–	1

[a] Includes isolates and surface collections from untreated sites.

TABLE 35

Flaked Stone Material Types by Time Period for the Upper Lahontan Basin

PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Material	PI	PA	PM	EA	MA	LA	TP	NC	Other[a]	Totals
Obsidian	20	70	1742	679	2001	15,693	196	17,949	155	38,505
CCS	6	10	85	2	241	6668	320	4626	9	11,967
Other	–	1	10	1	43	159	5	210	–	429
Totals	26	81	1837	682	2285	22,520	521	22,785	164	50,901

[a] Includes isolates and surface collections from untreated sites.

TABLE 36
Obsidian Source Representation by Time Period for the Upper Lahontan Basin

PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Source	PI	PA	PM	EA	MA	LA	TP	NC	Other[a]	Totals
Badger Creek	–	–	–	–	–	–	–	2	–	2
Beatys Butte	–	–	–	–	–	1	1	1	–	3
Bidwell Mountain	–	–	–	–	–	–	–	1	–	1
Bordwell Spring	–	–	–	–	–	3	–	2	–	5
Browns Bench Area	–	–	–	–	–	–	–	2	–	2
Buck Mountain	–	1	–	–	–	–	–	–	–	1
Buffalo Hills	–	–	–	–	–	–	–	1	–	1
Craine Creek	3	13	49	16	–	5	–	62	12	160
Double H	–	30	19	24	65	35	7	245	46	471
Fox Mountain	–	1	–	–	–	2	–	1	2	6
Hawks Valley	–	–	–	–	–	–	–	5	2	7
Majuba Mountain	–	–	–	1	–	–	–	7	1	9
Massacre Lake/ Guano Valley	9	4	2	1	1	2	–	43	6	68
Mount Hicks	–	–	–	–	–	–	10	–	–	10
Owyhee	–	–	–	–	–	–	2	2	–	4
Paradise Valley	–	–	19	10	37	112	13	98	11	300
Pinto Peak	–	–	–	–	–	1	–	2	1	4
South Warners	–	–	–	–	–	–	–	1	1	2
Whitehorse	–	–	–	–	–	–	–	3	2	5
Unknown	–	–	1	1	1	3	2	12	3	23
Totals	12	49	90	53	104	164	35	490	87	1084

[a] Includes isolates and items from untreated sites.

Radiocarbon dates of 1620, 1610, and 50 cal B.P. were obtained on three of these features.

Assemblages

Analysis of artifact classes by time period (table 34) shows a distinction between flaked stone tools and ground stone tools with regard to broad subsistence patterns and gender-specific work organization, as described in chapter 3. Virtually all the ground stone recovered from this project segment was obtained from either Middle or Late Archaic contexts, which comports with the component type profiles described above. Paradoxically, there is little evidence of the Terminal Prehistoric habitation observed in several other project segments (see chap. 8); the handful of Terminal Prehistoric components here are bereft of ground stone. High frequencies and a diversity of flaked stone tools were also recovered from Late Archaic contexts; upwards of 10 times the number of bi-

TABLE 37
Summary of Faunal Remains by Time Period for the Upper Lahontan Basin

PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Common Name	PM	EA	MA	LA	TP	NC	Totals
Large Mammals							
Bighorn sheep	–	–	1	–	–	–	1
Mule deer	–	–	1	–	–	–	1
Deer	–	–	–	1	–	–	1
Pronghorn/deer	–	–	–	1	–	–	1
Artiodactyl	–	–	4	26	2	7	39
Ungulate	–	–	–	5	–	–	5
Mammal, medium-large	–	–	93	153	–	9	255
Subtotal	–	–	99	186	2	16	303
Medium Mammals							
Carnivore	–	–	–	3	–	–	3
Mammal, medium	–	–	–	2	–	–	2
Subtotal	–	–	–	5	–	–	5
Small/medium mammals							
Cottontail	–	–	–	1	–	–	1
Cottontail/pigmy rabbit	–	–	11	15	3	2	31
Hare	–	–	7	33	–	4	44
Rabbit	–	–	–	68	–	–	68
Rabbit/hare	–	–	6	46	1	5	58
Mammal, small-medium	4	–	193	518	36	72	823
Subtotal	4	–	217	681	40	83	1025
Small Mammals							
Ground squirrel	–	–	–	3	–	1	4
Pocket gopher	–	–	5	13	–	3	21
Squirrel	–	–	3	6	–	3	12
New World mice and rats	–	–	–	–	–	1	1
Rodent	–	–	1	30	–	7	38
Vole	–	–	–	2	–	1	3
Mammal, small	–	–	7	28	1	2	38
Subtotal	–	–	16	82	1	18	117
Mammals, indeterminate							
Mammal	–	–	20	151	2	1	174
Birds							
Duck	–	–	–	12	–	–	12
Teal	–	–	–	1	–	–	1
Perching bird	–	–	–	2	–	–	2
Bird, large	–	–	–	3	–	1	4

TABLE 37—*(continued).*

Common Name	PM	EA	MA	LA	TP	NC	Totals
Bird, medium	–	–	–	12	–	1	13
Bird, small	–	–	–	4	–	–	4
Bird	–	–	1	234	–	7	242
Other							
Lizard	–	–	–	–	–	2	2
Reptile	–	–	–	3	–	–	3
Frog	–	–	1	2	–	1	4
Frog/toad	–	–	3	1	–	–	4
Minnow	–	–	–	1	–	–	1
Sucker/minnow	–	–	–	1	–	–	1
Vertebrate	–	–	15	637	18	9	679

faces were found in Late Archaic components compared to other contexts. As we have described elsewhere (see chap. 11), most bifaces from the Upper Lahontan Basin are pressure-finished, stages 4 and 5 implements, as opposed to early-stage forms. Broadly speaking, hunting and plant processing both appear to have been important to the Late Archaic Period occupants.

In terms of the broad lithic landscape and tool-stone use associated with the Upper Lahontan Basin, obsidian is the dominant material, comprising more than 76% of the entire flaked stone assemblage recovered from this project segment (table 35). Lesser amounts of CCS were documented (24%); most of this material was recovered from components excavated in the eastern portion of the segment, closer to major CCS quarry zones situated on the Upper Humboldt Plains. The dominant obsidian source groups represented in this segment include Double H and Paradise Valley, followed by Craine Creek and Massacre Lake/Guano Valley (table 36). Paradise Valley obsidian, the easternmost source group, is more abundant in components situated toward the eastern part of the segment, whereas Double H is more common in the western and central regions (see fig. 6). The Craine Creek and Massacre Lake/Guano Valley quarries are situated nearby to the west in the High Rock Country, and are thus more common in assemblages recovered in the western portion of the project segment. There are six other sources with only minor levels of representation, as well as a number of specimens of unknown source origin. Most of these minor source groups are located in the northwestern Great Basin, although a cluster of Mount Hicks obsidian was recovered from a Terminal Prehistoric component at 26HU4808. The Mount Hicks source is located in the Inyo-Mono region almost 300 km southwest of this study corridor. High representation of long-distance, exotic obsidians during the Terminal Prehistoric Period has been observed across the study corridor and has implications for Numic mobility and exchange patterns (see chaps. 14 and 16).

TABLE 38
Summary of Archaeobotanical Remains by Time Period for the Upper Lahontan Basin
Raw seed counts are not corrected for sample volume or sampling fraction.

		Middle Archaic	Late Archaic	Terminal Prehistoric	Totals
	No. Samples	3	3	2	8
	Total Volume (L)	41.5	13	19	73.5
Taxon	Common Name				
Nutshell					
Pinus monophylla	Pinyon	–	–	27	27
Unidentified nutshell		–	–	2	2
Small seed					
Achnatherum hymenoides	Ricegrass	–	1	–	1
Atriplex spp.	Salt bush	253	6	27	286
Camissonia/Oenothera spp.	Evening primrose	1	–	–	1
Chenopodiaceae	Goosefoot family	15	8	2	25
Chenopodium spp.	Goosefoot	57	3	1	61
Cyperaceae	Sedge family	–	3	–	3
Descurainia spp.	Tansy mustard	–	1	2	3
Elymus spp.	Wild rye	6	9	–	15
Fabaceae	Bean family	7	–	2	9
Hordeum spp.	Wild barley	1	–	–	1
Juncus spp.	Rush	–	1	–	1
Large Poaceae	Grass family	3	–	–	3
Mentzelia spp.	Blazing star	–	–	1	1
Phalaris spp.	Canary grass	35	1	–	36
Poa spp.	Bluegrass	–	4	–	4
Poaceae fragments	Grass family	5	2	–	7
Rumex spp.	Dock	2	4	–	6
Scirpus spp.	Tule	44	255	3	302
Small Poaceae	Grass family	–	2	–	2
Suaeda spp.	Seepweed	–	2	–	2
Typha spp.	Cattail	45	36	1	82
Seed fragments		36	5	2	43
Unidentified seeds		–	3	–	3
Miscellaneous					
Nongrain pieces		2	12	2	16
Small nonseed		–	–	7	7
Unidentified embryo		–	4	–	4

In total, 2596 faunal bone elements and fragments were recovered from sites in the Upper Lahontan Basin (table 37). The sample, however, is uneven, as bone was obtained from only 11 site contexts, of which only six contained robust samples. Almost all the bone assignable to component period is Middle Archaic or younger, with the Late Archaic sample the largest. Noteworthy is the comparatively large sample of bird bone—91% of all project bird bone was recovered from the Upper Lahontan Basin. Most of this is unidentifiable to the species level, although the high percentage of ducks in the identifiable assemblage suggests that a large measure of the unidentifiable fraction is also waterfowl. As we have mentioned previously, the Upper Lahontan Basin is at the lowest elevation of the project segments and contains a number of drainages and bottomlands that at various times may have featured productive wetlands suitable for waterfowl. This is consistent with the small sample of fish bone recovered from these contexts (table 37). With regard to the ratio of artiodactyl-sized mammals to smaller animals, the highest Artiodactyl Index is found in Middle Archaic components (0.41), followed distantly by the Late Archaic (0.09), and then by the Terminal Prehistoric (0.03).

A total of 953 charred seeds was obtained from 73.5 liters of deposit, representing eight flotation samples (table 38). Temporal components included in this sample are limited to Middle and Late Archaic contexts. Confirming the broad wetland orientation of this region, more than 43% of the seeds are either cattail or tule. Furthermore, the representation of these two taxa in the projectwide database is almost wholly confined to the Upper Lahontan Basin. Other major taxa represented in flotation samples from this region include saltbush, goosefoot, canary grass, and wild rye. Comparing the Middle and Late Archaic profiles, we find that cattail and tule comprise only 17% of the Middle Archaic sample, but 84% of the Late Archaic sample. These data clearly suggest a stronger wetland emphasis during the Late Archaic Period.

Summary

The Upper Lahontan Basin exhibits some major differences from the other three regions, owing primarily to its low-elevation setting confined to mostly basins, bottomlands, and adjacent piedmonts. Likely due to its proximity to the shorelines and deltaic environments of pluvial Lake Lahontan, there is some indication of Paleoindian and Paleoarchaic occupation. The overall assemblage profile, however, suggests an increase in habitation activity commencing in the Middle Archaic and peaking during the Late Archaic Period. Both faunal and archaeobotanical profiles indicate a strong orientation toward wetland resources found in these contexts, particularly during the Late Archaic Period. Flaked stone acquisition systems in this region were focused on obsidian, particularly glass emanating from the nearby Double H and Paradise Valley sources. Use of CCS is increasingly evident along the eastern portion of segment near the major source zones of this tool stone in the Upper Humboldt Plains.

CHAPTER 8

UPPER HUMBOLDT PLAINS SUMMARY OF FINDINGS

Kelly McGuire

The Upper Humboldt Plains comprises about 102 miles of pipeline corridor between the Snowstorm Mountains in the west and the Snake Mountains in the east (fig. 27). As described in chapter 2, this region is slightly more elevated (between 5000 and 7000 ft) than the adjoining Upper Lahontan Basin to the west and is characterized by mostly dry sagebrush and sagebrush steppe plant communities with some low-density stands of juniper woodland at higher elevations. The entire area is contained within the Upper Humboldt River watershed, and perhaps the most critical resources in this area are the tributaries of the Humboldt: Marys River, the North Fork of the Humboldt, Pie Creek, and Willow Creek.

In total, 145 sites with prehistoric components in this corridor segment received some level of data recovery treatment (fig. 27). Some 246 m^3 were hand-excavated, entailing 154 control units, 601 surface scrapes, and 765 shovel probes; additionally, three surface collection units were used, along with general surface collection at most of the sites (table 39).

Chronological Overview

Of the 145 treated prehistoric sites, 67 contained chronometric data sufficient for component definition; the remaining 78 sites could not be assigned to discrete components. In all, 84 components are identified at these 67 sites: 55 sites with single components, nine sites with two components, one site with four components, and two sites with five components.

Table 40 presents a summary of chronological data for Upper Humboldt Plains sites. Along with the standard component designations, there are also several combined time periods (i.e., Early Archaic/Middle Archaic and Late Archaic/Terminal Prehistoric) that are not included on this table. Several chronological trends are immediately apparent, the first being that Paleoindian and Paleoarchaic components are absent, and the Post-Mazama Period is only minimally represented. However, projectile points associated with the Paleoarchaic and Post-Mazama periods were recovered, indicating at least some early visitation to this region (table 40). The low frequency of older components in the Upper Humboldt Plains may reflect the sequence of colonization in the northern Great Basin (see chap. 10), as well as the lack of pluvial lakeshores and marshes that were the focus of these early land-use systems.

In a pattern observed elsewhere along the project corridor, the raw frequencies of components, projectile points, and obsidian hydra-

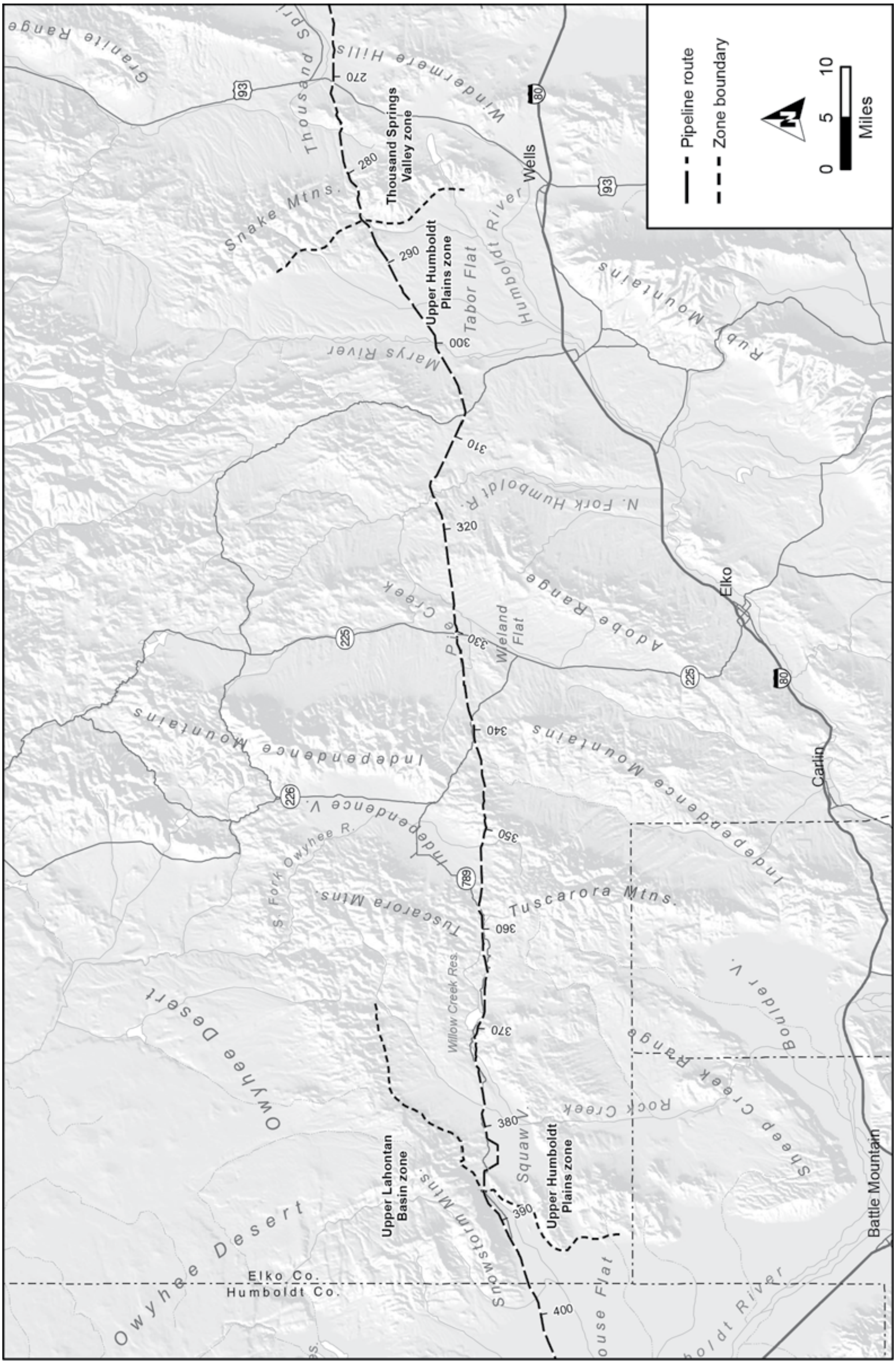


Fig. 27. Upper Humboldt Plains.

TABLE 39

Summary of Work Performed and Components Represented at Treated Sites, Upper Humboldt Plains

Column Headings: PM = approximate pipeline postmile; Comp. Ct. = number of components identified at the site; PPT = projectile points; FLS = other flaked stone tools; COR/DEB = Cores/debitage; GDS = Ground stone. ^{14}C = Radiocarbon; XRF/OH = X-ray fluorescence/obsidian hydration; Flot. = flotation.

Ages: PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Types: FS = flaked stone; FS/F = flaked stone/feature; FO = feature only; SH = simple habitation; CH = complex habitation; PTC = pronghorn trap complex; Q = quarry.

Trinomial	PM	Comp. Ct.	Component Definition			Features		Catalog Counts							Special Studies		
			Age	Type	Vol	Thermal	Other	PPT	FLS	COR/DEB	GDS	Beads	Pottery	Other Artifacts	^{14}C	OH/XRF	Flot.
26EK506	386.4	0	NC	–	1.338	–	–	1	3	484	–	–	–	–	–	–	–
26EK1511	345.9	1	MA	FS	2.725	–	–	2	2	464	–	–	–	–	1	2	1
			NC	–	2.625	2	–	3	19	815	–	–	–	–	–	9	–
26EK1524	345.4	0	NC	–	0.488	–	–	1	–	6	–	–	–	–	–	1	–
26EK2021	339.1	1	EA	SH	1.525	–	–	5	8	136	1	–	–	–	–	1	–
26EK2024/6169	326.7	1	TP	FS	0.800	–	–	1	–	108	–	–	–	–	–	–	–
			NC	–	0.163	–	–	1	–	7	–	–	–	–	–	–	–
26EK2025	308.7	1	PM	FS	0.600	–	–	1	1	184	–	–	–	–	–	5	–
			NC	–	1.925	–	–	8	5	122	2	–	–	–	–	12	–
26EK3524	–	2	LA (C1)	FS	1.663	–	–	8	20	3231	–	–	–	–	–	11	–
			LA (C2)	FS	0.663	–	–	1	4	720	–	–	–	–	–	–	–
			NC	–	6.563	1	–	28	56	1974	1	–	–	2	1	12	2
26EK4981	385.5	0	NC	–	1.588	–	–	3	14	33	–	–	–	–	–	–	–
26EK4982	385.3	0	NC	–	2.638	–	–	2	8	399	–	–	–	–	–	11	–
26EK4983	384.7	1	MA (C1)	CH	6.000	1	–	22	83	8292	6	–	–	2	1	30	2
			NC	–	0.950	–	–	5	–	43	–	–	–	–	–	13	–
26EK5139	384.9	1	EA (Loc. PC)	FS	0.712	–	–	7	2	127	–	–	–	–	–	14	–
			NC	–	1.550	–	–	17	5	113	–	–	–	–	–	6	–
26EK6134	–	1	EA (Loc. A)	FS	2.913	–	–	4	59	1726	–	–	–	–	1	5	2
			NC	–	1.038	–	–	–	5	39	–	–	–	–	–	–	–
26EK9186/12087	355.3	1	LA	FS	1.788	–	–	–	3	377	–	–	–	–	–	–	–
26EK9187/12002	355.9	0	NC	–	0.688	–	–	–	2	13	–	–	–	–	–	–	–
26EK9188/12005	356.4	0	NC	–	2.625	–	–	4	15	354	–	–	–	–	–	–	–
26EK9189/12008	357.5	0	NC	–	1.625	–	–	3	13	63	–	–	–	–	–	–	–
26EK9190/12088	359.8	1	TP (Loc. B)	FS	0.450	–	–	2	1	524	–	–	–	–	–	–	–
			NC	–	1.213	–	–	5	21	833	–	–	–	–	–	1	–
26EK9192/12015	360.7	2	LA (Loc. B)	FS	0.238	–	–	1	3	18	–	–	–	–	–	1	–

TABLE 39—*(continued).*

			Component Definition			Features		Catalog Counts							Special Studies		
Trinomial	PM	Comp. Ct.	Age	Type	Vol	Ther-mal	Other	PPT	FLS	COR/ DEB	GDS	Beads	Pottery	Other Arti-facts	^{14}C	OH/ XRF	Flot.
			LA (Loc. C)	FS	0.538	–	–	–	5	125	–	–	–	–	–	–	–
			NC	–	0.825	–	–	3	4	147	–	–	–	–	–	–	–
26EK9193/ 12016	360.9	2	LA (Loc. A)	FS	0.850	–	–	1	2	399	–	–	–	–	–	5	–
			EA (Loc. A)	FS	0.988	–	–	–	–	235	–	–	–	–	–	3	–
			NC	–	2.300	–	–	4	20	1129	–	–	–	–	–	3	–
26EK9195/ 12017	361.6	5	LA (Loc. B)	FS	0.500	–	–	3	3	232	–	–	–	–	–	–	–
			LA (Loc. R)	FS	0.200	–	–	–	2	301	–	–	–	–	–	3	–
			MA (Loc. D)	FS	0.513	–	–	1	2	200	–	–	–	–	–	–	–
			MA (Loc. L)	FS	0.925	–	–	1	3	549	–	–	–	–	–	–	–
			EA (Loc. O)	FS	1.688	–	–	1	8	1772	–	–	–	–	–	11	–
			NC	–	1.763	–	–	3	29	1605	–	–	–	–	–	–	–
26EK9199/ 12018	362.2	1	EA (Loc. B)	FS	1.038	–	–	–	6	547	–	–	–	–	–	9	–
			NC	–	2.163	–	–	1	19	546	–	–	–	–	–	2	–
26EK9200/ 12031	373.1	5	TP (Loc. A)	FS	1.638	–	–	–	4	5903	–	–	3	–	–	10	–
			LA (Loc. I)	SH	2.063	–	–	1	20	1618	–	–	–	–	–	4	–
			MA (Loc. C)	SH	1.288	–	–	3	17	1069	1	–	–	–	–	–	–
			MA (Loc. L)	FS/F	1.900	2	–	–	13	4509	–	–	–	–	2	–	3
			EA (Loc. F)	SH	2.563	–	–	1	11	2958	–	–	–	–	1	10	2
			NC	–	6.300	–	–	11	82	6087	7	–	–	3	–	13	–
26EK9201/ 12033	374.2	0	NC	–	0.925	–	–	–	–	333	–	–	–	–	–	–	–
26EK9484	306.1	2	TP (Loc. A)	FS/F	0.600	1	–	–	1	42	–	–	–	–	1	–	1
			MA (Loc. C)	FS	1.438	–	–	4	2	329	–	–	–	–	–	–	–
			NC	–	2.025	1	–	5	1	229	–	–	3	–	–	20	1
26EK11778	364.2	1	TP (Loc. A)	SH	0.238	–	–	–	2	269	1	–	–	–	–	5	–
			NC	–	0.038	–	–	–	–	1	–	–	–	–	–	–	–
26EK11787	345.3	0	NC	–	0.088	–	–	–	–	1	–	–	–	–	–	1	–
26EK11789	343.5	0	NC	–	1.375	–	–	2	2	294	–	–	–	–	–	3	–
26EK11790	343.0	2	TP	FS	0.313	–	–	–	2	263	–	–	–	–	–	10	–
			MA	FS	0.600	–	–	3	4	436	–	–	–	–	–	–	–

TABLE 39—*(continued)*.

Trinomial	PM	Comp. Ct.	Component Definition			Features		Catalog Counts							Special Studies		
			Age	Type	Vol	Thermal	Other	PPT	FLS	COR/DEB	GDS	Beads	Pottery	Other Artifacts	^{14}C	OH/XRF	Flot.
			NC	–	2.338	–	–	5	15	630	–	–	–	–	–	1	–
26EK11791	342.7	0	NC	–	1.000	–	–	–	10	80	–	–	–	–	–	6	–
26EK11792	342.5	1	EA/MA	FS	2.825	–	–	8	31	803	–	–	–	–	–	8	–
26EK11793	334.0	1	TP (Loc. A)	FS/F	1.263	1	–	–	1	87	–	–	–	–	1	1	1
			NC	–	0.050	–	–	–	1	1	–	–	–	–	–	1	–
26EK11795	307.8	1	EA	FS	0.238	–	–	1	1	–	–	–	–	–	–	–	–
26EK11796	317.4	0	NC	–	0.888	–	–	1	1	840	–	–	–	–	–	–	–
26EK11798	327.1	0	NC	–	0.675	–	–	–	3	500	–	–	–	–	–	–	–
26EK11799	286.0	1	MA (C1)	SH	4.213	–	–	6	18	1651	1	–	–	–	1	11	7
			NC	–	0.475	–	–	2	5	60	1	–	–	–	–	2	–
26EK11812	377.8	0	NC	–	1.175	–	–	4	1	88	1	–	–	–	–	7	–
26EK11833	341.0	2	TP (Loc. A)	CH	4.400	1	–	–	10	90	3	–	–	–	1	–	1
			MA	FS	1.675	–	–	5	5	263	–	–	–	–	–	10	–
			NC	–	0.400	–	–	1	3	7	1	–	–	–	–	3	1
26EK11836	329.0	4	TP	FS/F	0.438	1	–	1	–	17	–	–	–	–	1	–	3
			LA (Loc. B)	FO		8	–	–	–	1	–	–	–	–	4	–	8
			LA (SE Area)	SH	1.638	1	–	–	–	116	–	–	10	–	–	1	–
			EA	FS	2.663	–	–	1	8	707	–	–	–	–	1	4	1
			NC	–	0.063	–	–	1	4	6	–	–	1	–	–	1	–
26EK11843	352.8	0	NC	–	0.075	–	–	–	2	1	–	–	–	–	–	3	–
26EK11844	353.0	1	MA	FS	0.200	–	–	–	1	33	–	–	–	–	–	2	–
			NC	–	1.150	–	–	3	8	120	1	–	–	–	–	5	–
26EK11848	385.2	1	EA (Loc. C/O)	FS	0.725	–	–	10	12	2624	1	–	–	–	–	12	–
			NC	–	4.513	–	–	27	22	6792	4	–	–	1	–	15	–
26EK11849	384.3	0	NC	–	0.538	–	–	2	1	16	1	–	–	–	–	1	–
26EK11850	342.8	0	NC	–	0.950	–	–	1	2	36	–	–	–	–	–	–	–
26EK11882	345.7	0	NC	–	0.750	–	–	1	2	12	–	–	–	–	–	–	–
26EK11883	345.7	0	NC	–	0.050	–	–	–	–	–	–	–	–	–	–	–	–
26EK11887	344.4	0	NC	–	0.275	–	–	–	–	–	–	–	–	–	–	–	–
26EK11888	344.0	1	LA/TP (Loc. A)	CH	8.663	1	–	29	119	5295	1	–	16	–	2	11	3
			NC	–		–	–	–	–	–	–	–	–	–	–	–	–
26EK11894	333.1	1	LA	FS	0.863	–	–	1	2	10	–	–	–	–	–	–	–
26EK11900	315.3	0	NC	–	0.875	–	–	–	–	41	1	–	–	–	–	–	–
26EK11903	325.0	0	NC	–	0.863	–	–	–	1	7	–	–	–	–	–	–	–
26EK11904	326.0	0	NC	–	0.225	–	–	–	1	49	–	–	–	–	–	–	–
26EK11905	286.8	0	NC	–	0.500	–	–	1	–	9	–	–	–	–	–	–	–

TABLE 39—*(continued)*.

			Component Definition			Features		Catalog Counts							Special Studies		
Trinomial	PM	Comp. Ct.	Age	Type	Vol	Thermal	Other	PPT	FLS	COR/ DEB	GDS	Beads	Pottery	Other Artifacts	^{14}C	OH/ XRF	Flot.
26EK11921	364.1	0	NC	–	0.288	–	–	–	–	65	–	–	–	–	–	–	–
26EK11923	367.1	0	NC	–	0.275	–	–	–	–	1	–	–	–	–	–	–	–
26EK11924	367.3	1	EA	FS	0.900	–	–	1	2	23	–	–	–	–	–	–	–
26EK11948	344.7	0	NC	–	0.987	–	1	1	4	22	–	–	–	–	–	5	–
26EK11952	374.2	0	NC	–	0.712	–	–	–	–	15	–	–	–	–	–	–	–
26EK11953	374.2	1	LA	FS	0.513	–	–	1	–	115	–	–	–	–	–	–	–
26EK11955	374.0	0	NC	–	1.013	–	–	–	1	452	–	–	–	–	–	–	–
26EK11956	372.7	1	EA/MA	SH	2.075	–	–	3	14	647	4	–	–	–	–	4	–
26EK11957	363.0	0	NC	–	0.275	–	–	–	1	19	–	–	–	–	–	–	–
26EK11959	361.4	2	LA	SH	2.275	–	–	1	6	1846	1	–	–	2	1	11	13
			EA	FS	0.600	–	–	1	1	302	–	–	–	–	1	–	4
			NC	–	1.994	–	–	4	49	4297	–	–	–	–	–	3	–
26EK11960	355.0	1	TP	FS	3.088	–	–	2	4	381	–	–	1	–	1	10	1
26EK11983	340.8	0	NC	–	0.900	–	–	–	1	67	–	–	–	–	–	–	–
26EK11984	340.5	0	NC	–	0.888	–	–	–	6	191	–	–	–	–	–	–	–
26EK11988	304.9	0	NC	–	0.675	–	–	–	–	6	–	–	–	–	–	–	–
26EK12003	356.0	0	NC	–	0.700	–	–	–	–	33	–	–	–	–	–	–	–
26EK12004	356.2	0	NC	–	0.938	–	–	–	–	29	–	–	–	–	–	–	–
26EK12006	356.6	0	NC	–	1.038	–	–	–	1	23	–	–	–	–	–	–	–
26EK12007	356.7	0	NC	–	0.075	–	–	–	–	3	–	–	–	–	–	–	–
26EK12012	359.4	1	MA	SH	1.425	–	–	1	10	39	–	–	–	–	–	–	–
26EK12013	359.6	0	NC	–	1.425	–	–	2	6	173	–	–	–	–	–	–	–
26EK12014	360.2	0	NC	–	1.475	–	–	3	7	339	–	–	–	–	–	4	–
26EK12020	362.6	0	NC	–	1.325	–	–	1	15	41	–	–	–	–	–	–	–
26EK12021	363.3	0	NC	–	0.875	–	–	1	3	104	–	–	–	–	–	–	–
26EK12023	363.7	2	TP (Loc. C)	FS	0.838	–	–	–	1	3584	–	–	–	–	–	5	–
			MA	FS	0.638	–	–	1	7	794	–	–	–	–	–	1	–
			NC	–	1.550	–	–	5	49	3056	4	–	–	–	–	6	–
26EK12024	363.9	0	NC	–	1.000	–	–	–	2	10	–	–	–	–	–	–	–
26EK12025	368.5	0	NC	–	0.925	–	–	–	1	149	–	–	–	–	–	–	–
26EK12026	369.2	0	NC	–	0.475	–	–	–	–	60	–	–	–	–	–	–	–
26EK12030	371.8	1	TP	Q	0.837	–	–	–	–	4159	–	–	–	–	1	–	1
26EK12043	386.3	0	NC	–	0.863	–	–	–	4	31	–	–	–	–	–	–	–
26EK12044	368.0	0	NC	–	0.475	–	–	–	–	5	–	–	–	–	–	–	–
26EK12045	356.8	0	NC	–	0.925	–	–	–	5	609	–	–	–	–	–	–	–
26EK12046	356.5	1	MA	SH	1.013	–	–	3	–	116	1	–	–	–	–	1	–
26EK12052	299.8	0	NC	–	0.250	–	–	–	–	–	–	–	–	–	–	–	–
26EK12054	351.5	0	NC	–	0.863	–	–	1	3	14	–	–	–	–	–	–	–
26EK12057	375.3	0	NC	–	0.288	–	–	–	–	2	–	–	–	–	–	–	–

TABLE 39—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features		Catalog Counts							Special Studies		
			Age	Type	Vol	Ther-mal	Other	PPT	FLS	COR/ DEB	GDS	Beads	Pottery	Other Arti-facts	^{14}C	OH/ XRF	Flot.
26EK12058	371.7	0	NC	–	1.038	–	–	–	4	545	1	–	–	–	–	4	–
26EK12059	371.9	0	NC	–	1.450	–	–	–	1	364	1	–	–	–	–	–	–
26EK12065	372.5	0	NC	–	0.075	–	–	–	–	1	–	–	–	–	–	–	–
26EK12066	372.6	0	NC	–	0.588	–	–	–	1	22	–	–	–	–	–	–	–
26EK12068	333.3	1	LA (Loc. A)	FS	1.250	–	–	1	–	94	–	–	–	–	–	–	–
			NC	–	1.025	–	–	–	–	105	–	–	–	–	–	–	–
26EK12077	364.2	0	NC	–	0.275	–	–	–	–	7	–	–	–	–	–	–	–
26EK12079	361.7	1	MA (C1)	SH	0.763	–	–	–	2	980	3	–	–	–	–	10	–
			NC	–	0.975	–	–	–	7	342	–	–	–	–	–	–	–
26EK12089	368.3	1	LA (Loc. A)	FS	0.688	–	–	1	10	15	–	–	–	–	–	3	–
			NC	–	0.738	–	–	1	2	113	–	–	–	–	–	–	–
26EK12090	370.5	1	MA (Loc. A)	FS	0.450	–	–	–	2	505	–	–	–	–	–	2	–
			NC	–	0.588	–	–	1	2	132	–	–	–	–	–	–	–
26EK12093	300.1	0	NC	–	1.500	–	–	4	6	30	2	–	–	–	–	11	–
26EK12094	373.7	1	MA	FS	0.488	–	–	1	–	20	–	–	–	–	–	1	–
26EK12095	360.7	1	MA	FS	0.475	–	–	1	–	3	–	–	–	–	–	1	–
26EK12096	360.8	0	NC	–	0.275	–	–	–	–	–	–	–	–	–	–	–	–
26EK12099	355.0	1	MA	SH	1.888	–	–	3	31	556	1	–	–	–	–	7	–
26EK12100	301.8	1	MA	FS	0.925	–	–	5	2	77	–	–	–	–	–	7	–
26EK12101	301.8	0	NC	–	0.475	–	–	–	–	3	–	–	–	–	–	–	–
26EK12102	301.9	1	EA	FS	0.900	–	–	1	1	4	–	–	–	–	–	4	–
26EK12105	327.4	1	EA	Q	1.550	–	–	–	8	607	–	–	–	–	1	–	–
			NC	–	1.900	1	–	3	16	2000	2	–	–	1	–	6	–
26EK12106	384.2	0	NC	–	0.475	–	–	–	–	13	–	–	–	–	–	–	–
26EK12107	371.1	0	NC	–	0.463	–	–	–	–	48	–	–	–	–	–	6	–
26EK12108	355.3	0	NC	–	0.100	–	–	–	1	–	–	–	–	–	–	–	–
26EK12109	355.3	1	EA	SH	2.050	–	–	1	9	275	2	–	–	–	–	10	–
26EK12110	355.1	1	TP	FS	1.863	–	–	2	4	120	–	–	–	–	–	1	–
26EK12111	355.0	1	LA	FS	2.638	–	–	2	8	1423	–	–	–	–	1	6	1
26EK12112	354.9	0	NC	–	0.050	–	–	–	–	1	–	–	–	–	–	–	–
26EK12113	354.8	1	PM	FS	2.400	–	–	1	11	321	–	–	–	–	–	3	–
26EK12114	300.2	0	NC	–	0.863	–	–	–	–	3	–	–	–	–	–	–	–
26EK12115	327.3	1	MA	FS	1.263	–	–	–	5	747	–	–	–	–	–	15	–
26EK12117	384.9	0	NC	–	0.275	–	–	–	–	29	–	–	–	–	–	–	–
26EK12118	384.8	0	NC	–	0.475	–	–	–	1	17	–	–	–	–	–	–	–
26EK12119	384.6	0	NC	–	0.475	–	–	–	1	3	–	–	–	–	–	–	–
26EK12121	384.4	0	NC	–	0.987	–	–	–	3	13	–	–	–	–	–	–	–
26EK12122	384.7	1	TP	FS	1.288	–	–	–	14	94	–	1	–	–	–	10	–

TABLE 39—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features		Catalog Counts							Special Studies		
			Age	Type	Vol	Ther-mal	Other	PPT	FLS	COR/ DEB	GDS	Beads	Pottery	Other Arti-facts	^{14}C	OH/ XRF	Flot.
26EK12127	344.8	1	MA	FS	2.100	–	–	2	9	315	–	–	–	–	–	6	–
26EK12128	343.6	0	NC	–	0.075	–	–	–	–	1	2	–	–	–	–	1	–
26EK12129	327.7	1	LA (Loc. D)	FS	1.088	–	–	1	3	764	–	–	–	–	–	–	–
			NC	–	3.025	–	–	2	14	420	–	–	–	–	–	–	–
26EK12130	327.9	1	TP	CH	5.400	4	1	21	55	11,395	6	–	67	–	1	23	7
26EK12134	384.6	2	MA (C1)	FS	1.125	–	–	3	7	241	–	–	–	–	–	1	–
			MA (Loc. A)	FS	0.225	–	–	–	–	33	–	–	–	–	–	10	–
			NC	–	1.513	–	–	8	9	193	–	–	–	–	–	3	–
26EK12309	343.6	0	NC	–	3.725	–	–	2	15	147	–	–	–	–	–	2	–
26EK12312	385.2	1	MA (C1)	FS	0.200	–	–	–	–	29	–	–	–	–	–	5	–
			NC	–	0.650	–	–	1	2	84	–	–	–	–	–	6	–
26EK12315	384.8	0	NC	–	0.488	–	–	–	2	309	–	–	–	–	–	–	–
26EK12316	328.4	0	NC	–	2.300	–	–	–	5	162	1	–	–	–	–	–	–
26EK12317	328.3	1	PM	FS	0.900	–	–	1	3	131	–	–	–	–	–	3	–
26EK12318	328.1	0	NC	–	1.150	–	–	–	2	44	–	–	–	–	–	–	–
26EK12320	327.1	0	NC	–	0.900	–	–	–	3	492	–	–	–	–	–	–	–
26EK12321	324.8	0	NC	–	1.063	–	–	–	4	48	–	–	–	–	–	–	–
26EK12322	323.8	0	NC	–	1.275	–	–	1	–	450	–	–	–	–	–	–	–
26EK12323	341.8	1	MA	FS	1.400	–	–	1	6	431	–	–	–	–	–	–	–
26EK12324	–	0	NC	–	0.913	–	–	–	–	19	–	–	–	–	–	–	–
26EK12332	328.7	1	EA	FS	0.950	–	–	1	3	409	–	–	–	–	–	1	–
26EK12333	328.4	1	TP	SH	3.025	–	–	–	5	305	–	–	1	–	–	–	–
26EK12334	384.8	0	NC	–	0.713	–	–	–	1	8	–	–	–	–	–	–	–
26EK12365	329.4	1	EA	FS	0.725	–	–	1	1	25	–	–	–	–	–	–	–
26EK12369	329.4	0	NC	–	1.238	–	–	2	–	51	–	–	–	–	–	–	–
26EK12370	329.2	1	MA	FS	0.275	–	–	–	2	3	–	–	–	–	–	–	–
26EK12371	329.0	1	EA	FS	1.163	–	–	2	3	389	–	–	–	–	–	10	–
26EK12384	–	1	MA	FS	2.288	–	–	1	15	837	–	–	–	–	–	–	–
26EK12678	302.1	1	EA	FO	–	1	–	–	–	–	–	–	–	–	1	–	2
Total		87		245.88		27	2	404	1430	123,514	66	1	102	11	27	579	68

TABLE 40
Summary of Time-sensitive Data Sets for the Upper Humboldt Plains
Major Sources: Massacre Lake/Guano Valley, Mosquito Lake, Bidwell Mountain, Bordwell Group, and Craine Creek.

Period	Temporal Interval (cal B.P.)	Components		Surface Projectile Points		Obsidian Hydration (Major Sources)	
		n	Per 1000 years	*n*	Per 1000 years	*n*	Per 1000 years
Terminal Prehistoric	600–100	16	32.0	25	50.0	55	110.0
Late Archaic	1300–600	18	25.7	46	65.7	55	78.6
Middle Archaic	3800–1300	28	11.2	94	37.6	136	54.4
Early Archaic	5700–3800	19	10.0	92	48.4	103	54.2
Post-Mazama	7800–5700	3	1.4	13	6.2	60	28.6
Paleoarchaic	12,800–7800	0	0.0	5	1.0	21	4.2
Paleoindian	14,500–12,800	0	0.0	0	0.0	0	0.0
Totals	–	84	5.8	275	19.1	430	29.9

TABLE 41
Summary of Treated Component Types for the Upper Humboldt Plains
PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric.

Type	PM	EA	EA/MA	MA	LA	LA/TP	TP	Totals
Flaked stone	3	14	1	20	14	–	8	60
Flaked stone/feature	–	–	–	1	–	–	3	4
Quarry	–	1	–	–	–	–	1	2
Simple habitation	–	3	1	6	3	–	2	15
Complex habitation	–	–	–	1	–	1	2	4
Feature(s) only	–	1	–	–	1	–	–	2
Totals	3	19	2	28	18	1	16	87

tion readings associated with each temporal period appear to ramp up, commencing in the Early Archaic Period and reaching its highest levels during the Middle Archaic Period. As a broad characterization, land-use intensity in Upper Humboldt Plains dramatically increases at the start of the Early Archaic Period probably due in part to ameliorating climatic conditions associated with the late Holocene, which took hold about 4000 to 5000 years ago.

A somewhat different picture emerges when the raw counts of components, projectile points, and hydration readings are standardized by time (per 1000 years). While the increase in Early and Middle Archaic activity is still very much in evidence, this upward trend now continues through the Late Archaic and Terminal Prehistoric periods, the only exception to this being a slight decrease in the frequency of projectile points during

TABLE 42
Assemblages by Time Period for the Upper Humboldt Plains

PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Assemblage	PM	EA	EA/MA	MA	LA	LA/TP	TP	NC	Other[a]	Totals
Flaked stone										
Projectile point	3	38	11	69	23	29	29	202	28	432
Drill	1	1	1	–	2	1	2	12	–	20
Biface	13	135	41	218	86	103	83	587	10	1276
Formed flake tool	–	1	1	6	1	–	3	17	–	29
Flake tool	1	5	2	24	2	15	16	45	–	110
Core tool	–	1	–	–	–	–	–	4	–	5
Core	–	13	–	13	7	–	19	56	1	109
Debitage	636	12,853	1450	23,508	11,398	5295	27,322	40,944	66	123,472
Ground stone										
Millingstone	–	3	–	9	–	–	6	14	–	32
Handstone	–	–	3	1	–	1	3	12	1	21
Pestle	–	–	1	1	–	–	–	3	1	6
Battered cobble	–	1	–	1	–	–	1	3	–	6
Misc. ground stone	–	–	–	1	1	–	–	1	–	3
Other items										
Bead, glass	–	–	–	–	–	–	1	–	–	1
Modified bone	–	–	–	2	1	–	–	3	–	6
Modified stone	–	–	–	–	–	–	–	–	1	1
Manuport	–	–	–	–	1	–	–	3	–	4
Ochre	–	–	–	–	–	–	–	1	–	1
Pottery sherd	–	–	–	–	10	16	72	4	–	102

[a] Includes isolates and surface collections from untreated sites.

the Terminal Prehistoric Period. To the extent that chronological data associated with each temporal period represent broad proxies for land-use intensity, we conclude that settlement activity in the Upper Humboldt Plains remained high through the Late Archaic and Terminal Prehistoric periods.

A total of 24 radiocarbon dates was obtained from sites located in this region (see table 17). While spanning most of the prehistoric era from the Early Archaic to the Terminal Prehistoric periods, most are confined to the past 1500 years, with two distinct clusters: one in the Late Archaic Period between 1100 and 1500 cal B.P., and the other mostly reflective of the Terminal Prehistoric Period between 100 and 600 cal B.P. Most of these dates were obtained from thermal features that often contained charred seeds and/or faunal remains, suggesting that this kind of processing facility was in ascendance later in time.

TABLE 43
Flaked Stone Material Types by Time Period for the Upper Humboldt Plains
PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Material	PM	EA	EA/MA	MA	LA	LA/TP	TP	NC	Other[a]	Totals
Obsidian	39	168	12	3311	84	28	744	742	44	5172
CCS	515	12,772	1421	20,122	11,412	5274	26,676	40,622	61	118,875
Other	100	107	73	405	23	141	54	503	–	1406
Totals	654	13,047	1506	23,838	11,519	5443	27,474	41,867	105	125,453

[a] Includes isolates and surface collections from untreated sites.

In summarizing the chronology of prehistoric occupation in the Upper Humboldt Plains, we observe that virtually all proxies indicate a substantial increase in settlement activity associated with the Early Archaic Period. Certainly this region was used before this time, but visitation seems to have been sporadic and observable only in the smattering of projectile points and occasional hydration readings associated with this era. This increase in settlement activity appears to have been sustained throughout subsequent periods and into the Terminal Prehistoric Period, except with a short break between 1100 and 600 cal B.P. that may be associated with the Medieval Climatic Anomaly (MCA; see chaps. 2 and 10).

Assemblage and Feature Overview

In total, 87 spatiotemporal components are documented in the Upper Humboldt Plains (table 41). Flaked stone scatters comprise 69% of all components for all periods. Perhaps the most relevant measure of land-use patterns is the ratio of flaked stone scatters to habitation components, the latter including both simple and complex habitation sites, as well as sites containing features. The percentage of habitation sites is 27% for the Early Archaic, increases to 40% for the Middle Archaic, dips to 29% during the Late Archaic, and then spikes to 78% during the Terminal Prehistoric Period. The comparatively high percentage of habitation components during the Terminal Prehistoric Period may relate to arrival in the northern Great Basin of Numic speakers with their "family band" settlement organization (see chap. 15).

Assemblages

Analysis of artifact classes by time period (table 42), specifically the distinction between flaked stone tools and ground stone tools, reveals implications for subsistence patterns and gender-specific work organization. The ratio of flaked stone tools (projectile points, bifaces, drills, formed flake tools, and simple flake tools) to ground and battered stone (milling stones, hand stones, pestles, battered cobbles, and miscellaneous ground stone) was highest during the Late Archaic Period, at about 114 to 1.

Conversely, the lowest ratio is 13:1, for the Terminal Prehistoric; i.e., the highest relative frequencies of milling and other processing equipment occur in Terminal Prehistoric

TABLE 44
Obsidian Source Representation by Time Period for the Upper Humboldt Plains
EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Source	PM	EA	EA/MA	MA	LA	LA/TP	TP	NC	Other[a]	Totals
Badlands	–	–	–	–	–	–	–	1	–	1
Bear Gulch	–	–	–	–	–	–	1	–	–	1
Big Southern Butte	–	–	–	–	–	–	5	–	–	5
Browns Bench	5	15	6	29	12	2	24	52	–	145
Browns Bench Area	4	7	–	15	3	3	–	23	1	56
Coal Bank Spring (Browns Bench Area)	–	–	–	–	–	–	–	5	–	5
Double H	–	1	2	1	1	1	3	7	–	16
Majuba Mountain	–	–	–	3	–	–	1	5	–	9
Malad	–	–	–	–	2	–	–	1	–	3
Owyhee	–	–	–	–	–	–	9	5	–	14
Paradise Valley	1	70	4	71	27	4	32	101	–	310
Queen	–	–	–	–	–	1	–	–	–	1
Topaz Mountain	–	–	–	–	–	–	–	1	–	1
Unknown	1	1	–	3	–	–	–	8	–	13
Totals	11	94	12	122	45	11	75	209	1	580

[a] Includes isolates and surface collections from untreated sites.

components. The Early and Middle Archaic ratios are 45:1 and 24:1, respectively. Broadly speaking, hunting and the production of hunting-related tools appears to have been more important during Middle and Late Archaic times, whereas plant procurement and processing were more common during the Terminal Prehistoric Period. This period is also represented by the highest frequency of thermal features, many used at least in part for plant processing.

Related to late prehistoric occupation are the 102 pottery sherds recovered from seven sites along this region (see table 42). Of those ascribable to type, 91 are Great Basin Brownware sherds dating to the Terminal Prehistoric Period, and 11 thin-walled Great Salt Lake Grayware specimens thought to be associated with Fremont/Late Archaic occupations; the latter were all recovered from 26EK11836. Great Basin Brownware sherds were recovered from the Upper Humboldt Plains and Thousand Springs Valley regions, but not from the High Rock Country or the Upper Lahontan Basin. This distribution mostly mirrors the ethnographic territory of the Western Shoshone. To the extent that pottery may have proved crucial in the processing of seeds (Eerkens, 2004), brownware distribution may also track the relative significance of seed resources to prehistoric inhabitants along the project corridor (see chap. 15).

In terms of the broad lithic landscape and tool-stone use associated with the Upper Humboldt Plains, it is clear that cryp-

TABLE 45
Summary of Faunal Remains by Time Period for the Upper Humboldt Plains

PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Raw seed counts are not corrected for sample volume or sampling fraction.

Common Name	PM	EA	MA	LA	LA/TP	TP	NC	Totals
Large mammals								
Bison	–	1	–	–	–	–	–	1
Bos/bison	–	–	–	–	–	1	–	1
Cow	–	–	–	–	–	2	–	2
Artiodactyl	–	–	–	–	–	1	1	2
Ungulate	–	6	47	2	4	61	35	155
Mammal, large	–	–	–	1	–	1040	5	1046
Mammal, medium-large	–	73	24	12	3	1618	20	1750
Subtotal	–	80	71	15	7	2723	61	2957
Medium mammals								
Carnivore	–	–	–	–	–	1	–	1
Mammal, medium	–	–	1	1	–	2	–	4
Subtotal	–	–	1	1	–	3	–	5
Small/medium mammals								
Marmot	–	–	–	–	–	–	1	1
Rabbit	–	–	–	7	–	5	34	46
Pigmy rabbit	–	–	–	2	–	5	–	7
Cottontail/pigmy	–	–	–	–	–	–	1	1
Hare	–	–	–	3	–	–	–	3
Rabbit/hare	–	–	–	1	–	3	–	4
Mammal, small-medium	–	3	10	5	–	75	53	146
Subtotal	–	3	10	18	–	88	89	208
Small mammals								
Ground squirrel	1	9	–	10	1	14	5	40
Kangaroo rat	–	–	–	1	–	–	–	1
Mammal, small	–	1	1	16	–	9	7	34
New World mice and rats	–	–	–	–	–	3	–	3
Rodent	–	2	2	6	–	22	13	45
Squirrel	–	77	3	1	–	8	2	91
Vole	–	–	–	–	–	1	1	2
Subtotal	1	89	6	34	1	57	28	216
Mammals, indeterminate								
Mammal	–	20	22	15	5	561	33	656
Birds								
Ross goose	–	–	–	–	–	–	1	1
Other								
Fish	–	–	–	–	–	1	–	1
Vertebrate	–	6	13	48	17	63	24	171

TABLE 46
Summary of Archaeobotanical Remains by Time Period for the Upper Humboldt Plains
EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

		EA	MA	LA	LA/TP	TP	NC	Totals
	No. Samples	11	13	22	3	15	4	68
	Total Volume (L)	190.7	144.5	245.6	18.3	260.0	52.8	911.9
Taxon	Common Name							
Nutshell								
Pinus monophylla	Pinyon	–	–	–	–	1	–	1
Unidentified nutshell		–	15	5	1	–	–	21
Small seed								
Achnatherum hymenoides	Ricegrass	–	2	2	–	–	–	4
Artemisia tridentata	Big sagebrush	–	–	18	3	2	1	24
Asteraceae	Sunflower family	–	3	–	–	2	–	5
Cactaceae	Cactus family	–	–	1	–	–	–	1
Camissonia/Oenothera spp.	Evening primrose	–	3	1	–	–	–	4
Chenopodiaceae	Goosefoot family	–	–	2	–	–	–	2
Chenopodium spp.	Goosefoot	5	2	1	–	45	–	53
Collinsia spp.	Blue-eyed Mary	2	71	217	8	20	2	320
Descurainia spp.	Tansy mustard	–	2	5	–	1	–	8
Elymus spp.	Wild rye	–	18	3	1	6	–	28
Fabaceae	Bean family	–	3	5	–	8	–	16
Large Poaceae	Grass family	–	23	1	–	–	–	24
Mammillaria spp.	Fishhook cactus	–	–	1	–	–	–	1
Phacelia spp.	Phacelia	–	–	–	–	1	–	1
Poa spp.	Bluegrass	–	17	3	–	4	–	24
Poaceae fragments	Grass family	–	89	32	1	13	7	142
Purshia spp.	Antelope bush	–	–	49	186	–	41	276
Rosa spp.	Wild rose	–	10	–	–	–	–	10
Rumex spp.	Dock	–	104	–	–	2	–	106
Scirpus spp.	Tule	–	3	–	–	–	–	3
Small Poaceae	Grass family	–	11	3	–	–	–	14
Sporobolus spp.	Dropseed	–	–	1	–	–	–	1
Suaeda spp.	Seepweed	–	–	1	–	–	–	1
Seed fragments		2	75	59	–	43	2	181
Unidentified seeds		–	50	17	1	19	–	87
Miscellaneous								
Large nonseed		–	27	4	–	10	–	41
Nongrain pieces		6	51	55	3	30	1	146
Roots		–	23	–	–	1	–	24
Small nonseed		–	15	3	–	–	–	18
Unknown A		–	4	–	–	–	–	4

tocrystalline silicate (CCS) is the dominant material, comprising 95% of the flaked stone assemblage (table 43). Obsidian is a distant second, representing only 4% of all materials. The easiest explanation for this is that, unlike other project regions, there are no obsidian sources located in the vicinity of this area, but there are a number of CCS outcrops and quarry sites and localities within and proximal to the project corridor, the most famous of which is the Tosawihi quarry located south of the Willow Creek area. Three other, smaller CCS quarry sites were documented within the project corridor, and it is likely that opportunistic tool-stone procurement occurred at any number of CCS exposures found throughout this region.

The primary obsidian source represented in the Upper Humboldt Plains sites is Paradise Valley, followed by Browns Bench/Browns Bench Area (table 44). At least eight other sources are represented in trace amounts (<3.0%), and there are a number of samples of "unknown" source affiliation. This seems to be a case of proximity, as the two primary source groups are located closest to this project segment. Not unexpectedly, given their geographic orientation to this project segment, Paradise Valley obsidian tends to be more prevalent in assemblages in the western part of the segment, whereas Browns Bench is more common in the east.

In total, 4215 faunal bone elements and fragments were recovered as part of the Upper Humboldt Plains excavations (table 45). The sample, however, has very little utility with regard to a regional assessment of hunting practices and subsistence patterns, as more than 78% of these remains were obtained from the Terminal Prehistoric component at 26EK12130. Notwithstanding this severely unbalanced sample, several observations can be made. First, there is a high frequency of artiodactyl remains, dominated by unidentified artiodactyl-sized fragments, resulting in high Artiodactyl Index values for all component periods. Again, this is hardly definitive, but it does suggest the sustained importance of large-game procurement through much of the late Holocene. Also noteworthy is a single bison element from an Early Archaic component at 26EK12105. This element, a phalanx, was radiocarbon dated to 3810 cal B.P., at the very end of the Early Archaic Period.

A total of 1337 charred seeds was recovered from 68 samples, originating from 19 component contexts investigated in the Upper Humboldt Plains. These include 1069 seeds identified to family, genus, or species, and 268 fragments that remain unidentified (table 46). Twenty-two taxa are recognized: the five that dominate are blue-eyed Mary, antelope bush, grass family, dock, and goosefoot. Most of these are late spring to summer ripening seeds from a variety of habitats. Taxon representation is greatest in Late Archaic components, although seed frequencies and densities are higher in Middle Archaic components.

Summary

Unlike the adjoining Upper Lahontan Basin, the Upper Humboldt Plains region of the project corridor contains no Paleoindian or Paleoarchaic deposit, and only a very limited number of Post-Mazama components. The archaeological record of this region really begins near the end of the middle Holocene, during the Early Archaic Period. From there, settlement intensity appears to have increased during each subsequent period, reaching its highest levels during the Terminal Prehistoric Period. Settlements reflecting habitation also increased in number during the Early and Middle Archaic periods, declined slightly during the Late Archaic, and reached their highest percentage during the Terminal Prehistoric Period. We suggest that the brownware pottery found in Terminal Prehistoric contexts in both the Upper Humboldt Plains and Thousand Springs Valley is a marker of the Western Shoshone and that the peak in habitation sites during this period reflects the arrival of these Numic speakers in the region. Unlike the other project regions, the Upper Humboldt Plains is dominated by CCS tool stone. When it is found, obsidian is mostly from the two nearest sources, Paradise Valley and Browns Bench.

CHAPTER 9

THOUSAND SPRINGS VALLEY SUMMARY OF FINDINGS

Albert Garner

The Thousand Springs Valley region includes approximately 54 miles of project corridor, extending westward from the Nevada-Utah border through the southern extent of the Delano Mountains, the northern end of the Toano Range, and the central portion of Thousand Springs Valley, and terminating near the western foothills of the Snake Mountains north of Wells, Nevada (fig. 28). The majority of this region is part of the Bonneville Basin watershed, while the area west of the Snake Mountains drains into the Upper Humboldt River watershed. As noted in chapter 2, the region is set in the northern Basin and Range province, characterized by dissected plains, semiarid hills, mountains, and valleys generally ranging between 5000 and 7500 ft in elevation. The valley floors host greasewood and shadscale communities interspersed with a variety of grasses and sagebrush species, while sagebrush steppe continues into the higher elevations along with scattered juniper woodlands and sporadic occurrences of pinyon pine. The major water sources are Thousand Springs Creek and its tributaries. Small creeks, like Burnt Creek in the western foothills of the Snake Mountains, and springs, like Jackson Spring in the uplands near the Nevada-Utah border, are also notable.

In total, 40 sites with prehistoric components in this corridor segment received some level of data recovery treatment. Just less than 87 m^3 were hand excavated, entailing 77 control units, 166 surface scrapes, and 226 shovel probes; additionally, one surface collection unit was used, along with general surface collection at most of the sites (table 47).

Chronological Overview

Of the 40 treated prehistoric sites, 17 yielded chronometric data sufficient for component definition, while the remaining 23 sites could not be assigned to a component. In all, 26 individual components are present at these 17 sites, consisting of 13 sites with single components, three with three components, and one with four components.

Table 48 presents a summary of chronological data for the Thousand Springs Valley sites. Only one site (26EK12352), represents an occupation prior to 5700 B.P. Standardized by time, the frequency of components per 1000 years gradually increases from the Early Archaic through the Middle Archaic, jumping dramatically during the Terminal Prehistoric Period. Much the same trend is manifested in the number of hydration readings associated with each time period, also standardized by time (table 48). The frequency of

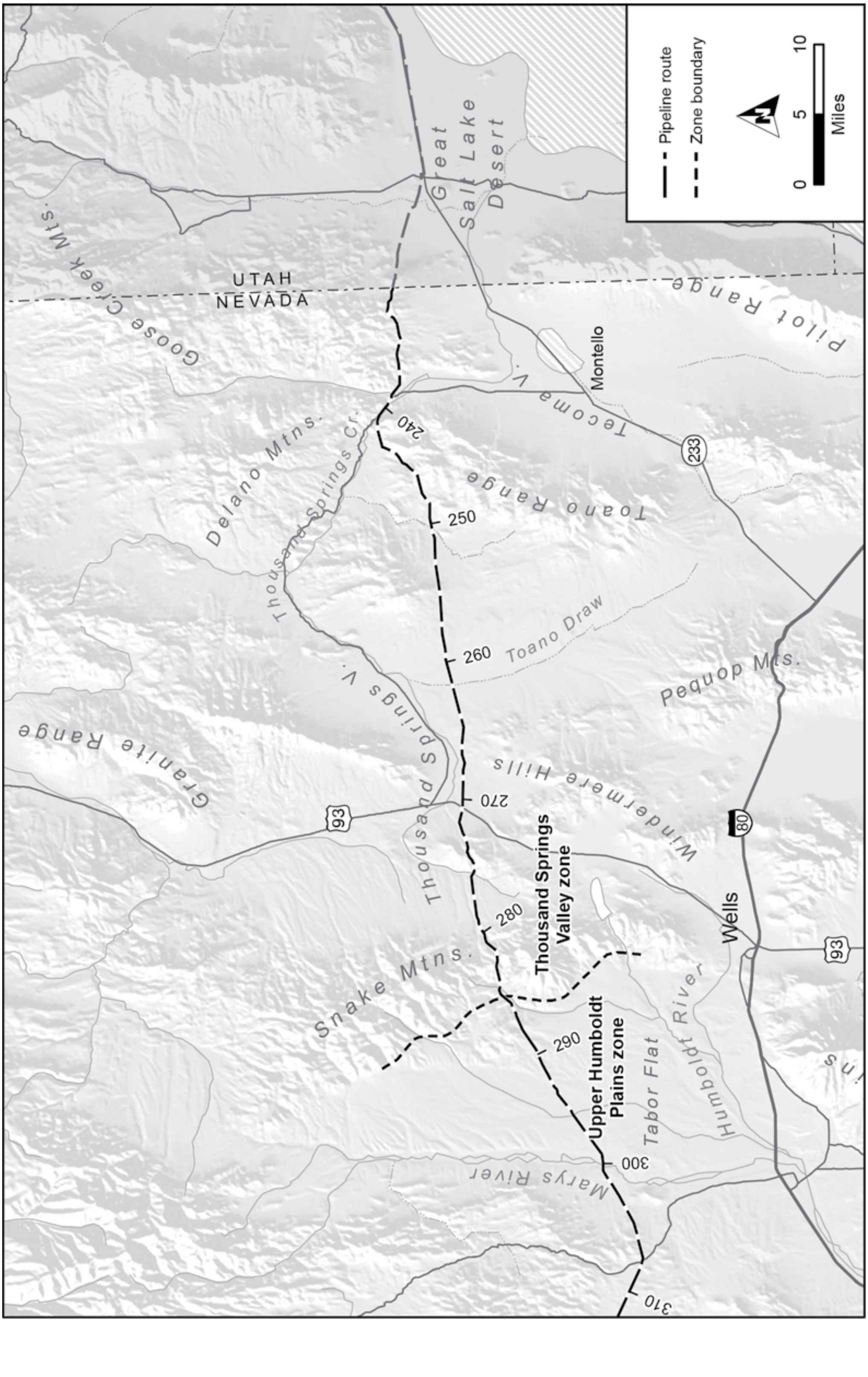


Fig. 28. Thousand Springs Valley.

TABLE 47

Summary of Work Performed and Components Represented at Treated Sites, Thousand Springs Valley

Column Headings: PM = approximate pipeline postmile; Comp. Ct. = number of components identified at the site; PPT = projectile points; FLS = other flaked stone tools; COR/DEB = cores/debitage; GDS = ground stone. 14C = radiocarbon; XRF/OH = X-ray fluorescence/obsidian hydration; Flot. = flotation.

Ages: PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Types: FS = flaked stone; FS/F = flaked stone/feature; FO = feature only; SH = simple habitation; CH = complex habitation; PTC = pronghorn trap complex; Q = quarry.

Trinomial	PM	Comp. Ct.	Component Definition			Features		Catalog Counts							Special Studies		
			Age	Type	Vol	Thermal	Other	PPT	FLS	COR/DEB	GDS	Beads	Pottery	Other	^{14}C	OH/XRF	Flot.
26EK651	231.0	0	NC	–	0.938	–	–	1	14	5529	–	–	–	–	–	–	–
26EK3359	–	1	EA (C1/C3/C4)	FS	0.787	–	–	1	7	3172	–	–	–	–	–	21	–
			NC	–	0.400	–	–	1	–	24	1	–	–	–	–	1	–
26EK3959	–	4	TP (Loc. 1)	PTC		–	1	1	1	–	–	–	–	–	4	1	–
			TP (Loc. 2)	PTC		–	1	–	–	–	–	–	–	–	5	–	–
			TP (Loc. 45)	PTC	0.675	–	1	–	–	–	–	–	–	–	6	–	–
			MA (Loc. 36)	FS/F	0.450	1	–	4	6	–	–	–	–	–	1	2	1
			NC	–		–	–	1	–	–	–	–	–	–	–	–	–
26EK9177/12132	230.8	0	NC	–	0.950	–	–	–	2	531	–	–	–	–	–	1	–
26EK9178/12133	232.8	3	TP (Loc. C)	Q	0.425	–	–	1	8	324	–	–	–	–	–	3	–
			LA (Loc. E)	CH/Q	1.700	–	1	40	156	21,324	5	3	31	10	1	55	5
			MA (Loc. A)	SH/Q	0.825	–	–	4	4	224	1	–	–	–	–	9	–
			NC	–	6.425	–	–	31	117	6844	6	–	1	2	–	48	1
26EK9183/12131	267.2	1	EA (Loc. G)	FS	0.500	–	–	1	2	326	–	–	–	–	–	10	–
			NC	–	0.900	3	–	13	6	225	1	–	–	–	1	5	4
26EK11800	285.3	1	MA (Loc. B)	FS	0.688	–	–	1	9	25	–	–	–	–	–	1	–
			NC	–	0.450	–	–	–	3	16	–	–	–	–	–	–	–
26EK11802	268.3	0	NC	–	1.300	–	–	2	3	155	–	–	–	–	–	10	–
26EK11805	254.3	0	NC	–	3.663	–	–	19	23	459	–	–	–	1	–	25	–
26EK11806	254.2	0	NC	–	1.350	–	–	–	2	294	–	–	–	–	–	12	–
26EK11807	248.5	0	NC	–	1.325	–	–	–	1	42	–	–	–	–	–	1	–
26EK11808	239.3	1	MA (Loc. A)	CH	10.225	1	–	8	22	2473	9	–	–	6	1	19	2
26EK11851	267.9	0	NC	–	1.300	–	–	3	4	69	–	–	–	1	–	15	–

TABLE 47—*(continued).*

Trinomial	PM	Comp. Ct.	Component Definition			Features		Catalog Counts							Special Studies		
			Age	Type	Vol	Thermal	Other	PPT	FLS	COR/DEB	GDS	Beads	Pottery	Other	^{14}C	OH/XRF	Flot.
26EK11911	261.7	0	NC	–	0.450	1	–	–	–	3	–	–	–	–	–	–	–
26EK11914	253.8	0	NC	–	0.250	–	–	–	–	1	–	–	–	–	–	–	–
26EK11920	267.3	1	MA	FS	1.275	–	–	1	5	443	–	–	–	–	–	11	–
26EK12072	248.3	0	NC	–	0.250	–	–	–	–	–	–	–	–	–	–	–	–
26EK12076	234.4	0	NC	–	1.275	–	–	1	15	79	–	–	–	–	–	–	–
26EK12082	257.2	1	MA	FS	1.838	–	–	–	3	53	–	–	–	–	–	10	–
26EK12083	243.0	0	NC	–	0.875	–	–	–	–	–	–	–	–	–	–	–	–
26EK12085	247.5	0	NC	–	0.863	–	–	–	–	3	–	–	–	–	–	–	–
26EK12310	–	3	TP (Loc. 1)	SH	0.200	–	–	–	1	–	11	–	–	–	–	–	–
			TP (Loc. 2)	SH	0.200	–	–	–	2	10	1	–	–	–	–	–	–
			TP (Non-Loc.)	PTC	0.900	–	1	1	–	–	–	–	–	–	5	1	–
26EK12326	284.4	1	EA (Loc. A)	SH	10.013	–	–	23	37	3625	3	–	–	–	2	42	7
			NC	–	0.812	–	–	4	19	111	–	–	–	–	–	2	–
26EK12327	266.6	0	NC	–	0.250	–	–	–	–	6	–	–	–	–	–	–	–
26EK12328	–	0	NC	–	0.363	–	–	–	–	49	–	–	–	–	–	–	–
26EK12329	238.3	1	MA	CH	3.425	1	–	4	6	658	1	–	–	–	2	14	4
26EK12335	–	1	EA	FS	2.238	–	–	3	11	573	–	–	–	–	–	11	–
26EK12336	–	0	NC	–	0.275	–	–	–	–	5	–	–	–	–	–	–	–
26EK12337	–	1	EA	FS	1.763	–	–	1	5	660	–	–	–	–	–	11	1
26EK12352	–	1	PA	FS	0.913	–	–	1	4	7	–	–	–	–	–	1	–
26EK12357	230.9	0	NC	–	0.213	–	–	–	–	20	–	–	–	–	–	–	–
26EK12359	230.8	1	MA	FS	1.550	–	–	2	4	86	–	–	–	–	–	1	–
26EK12363	–	0	NC	–	0.450	–	–	–	2	3	–	–	–	–	–	–	–
26EK12389	261.7	0	NC	–	0.550	–	–	–	–	3	–	–	–	–	–	–	–
26EK12390	235.5	0	NC	–	1.125	–	–	–	3	20	–	–	–	–	–	–	–
26EK12391	–	0	NC	–	0.250	–	–	–	–	–	–	–	–	–	–	–	–
26EK12392	–	0	NC	–	0.800	–	–	–	3	20	–	–	–	–	–	–	–
26EK12393	–	0	NC	–	0.563	–	–	–	–	19	–	–	–	–	–	–	–
26EK12394	–	3	TP (C1)	CH	1.000	1	–	–	–	91	1	1	–	–	1	–	2
			LA (C2)	CH	2.550	1	–	–	–	93	15	–	–	–	1	–	4
			MA (C1)	FO	0.400	1	–	–	–	7	–	–	–	–	1	–	3
			NC	–	3.125	–	–	2	8	231	1	–	–	–	–	–	–
26EK12677	266.9	1	LA	FO		2	–	–	–	–	–	–	–	–	2	–	4
Totals		26			86.538	13	12	190	550	52,530	68	4	33	21	36	361	48

TABLE 48
Summary of Time-sensitive Data Sets for Thousand Springs Valley
Major Sources: Massacre Lake/Guano Valley, Mosquito Lake, Bidwell Mountain, Bordwell Group, and Craine Creek.

Period	Temporal Interval (cal B.P.)	Components		Surface Projectile Points		Obsidian Hydration (Major Sources)	
		n	Per 1000 years	*n*	Per 1000 years	*n*	Per 1000 years
Terminal Prehistoric	600–100	8	16.0	6	12.0	42	84.0
Late Archaic	1300–600	3	4.3	14	20.0	34	48.6
Middle Archaic	3800–1300	9	3.6	14	5.6	102	40.8
Early Archaic	5700–3800	5	2.6	26	13.7	63	33.2
Post-Mazama	7800–5700	0	0.0	4	1.9	15	7.1
Paleoarchaic	12,800–7800	1	0.2	1	0.2	12	2.4
Paleoindian	14,500–12,800	0	0.0	0	0.0	0	0.0
Totals	–	26	1.8	65	4.5	268	18.6

projectile points diverges somewhat from the component and hydration trends, with relative decreases during the Middle Archaic and Terminal Prehistoric periods.

Additionally, 36 radiocarbon dates were obtained from this region, ranging between 2750 and 50 (modern) cal B.P. (see table 17). Twenty of these dates were obtained from juniper limb wood associated with a series of antelope traps (see chap. 16); all date to about the past 400 years. The remaining 16 dates were obtained from screen or light-fraction charcoal from archaeological deposits, many from thermal features. Of this total, nine correspond to a Middle Archaic time frame (56%), three are Late Archaic (19%), and four are Terminal Prehistoric (25%).

As we have noted, there is only modest evidence for occupation of this project segment prior to the Early Archaic Period. Most proxy data show a sustained increase in land-use intensity at that time that continued for the remainder of the prehistoric period. The one exception to this general trend is associated with projectile points, which are somewhat more variable, with notable decreases in frequency during the Middle Archaic and Terminal Prehistoric periods. As projectile points are associated with hunting, this could be emblematic of changes in hunting intensity associated with these periods, although the data at hand are hardly definitive in this regard.

The low frequency of older components in the Thousand Springs Valley region may reflect the sequence of colonization in the northern Great Basin (see chap. 10), as well as the lack of pluvial lake shores and large marshes that were the focus of these early land-use systems (pluvial shorelines of Lake Bonneville are situated well east of the study area). Conversely, the dramatic increase in occupation at the start of the Early Archaic Period may be due in large measure to the ameliorating climatic conditions associated with the late Holocene.

TABLE 49
Summary of Treated Component Types for Thousand Springs Valley

Type	Paleo–archaic	Early Archaic	Middle Archaic	Late Archaic	Terminal Prehistoric	Totals
Flaked stone	1	4	4	–	–	9
Flaked stone/quarry	–	–	–	–	1	1
Flaked stone/feature	–	–	1	–	–	1
Simple habitation	–	1	–	–	2	3
Simple habitation/quarry	–	–	1	–	–	1
Complex habitation	–	–	2	1	1	4
Complex habitation/quarry	–	–	–	1	–	1
Feature	–	–	1	1	–	2
Trap complex	–	–	–	–	4	4
Totals	1	5	9	3	8	26

Assemblage and Feature Overview

In total, 26 spatiotemporal components are documented in the Thousand Springs Valley region (table 49); especially unique are a series of large antelope trap complexes (see chap. 16).

The sample of components by time period is much smaller than for any other project segment; thus, it is difficult to attribute much significance to changes in component types through time. We note, however, that the overall ratio of habitation components to other component types is similar to that observed in the adjacent Upper Humboldt Plains: earlier components are primarily flaked stone sites (although, one habitation site dates to the Early Archaic), while the number of habitation components increases during the Middle Archaic to nearly the same number as flaked stone sites. This trend continues during the Late Archaic and Terminal Prehistoric periods, where habitation and feature components are dominant. All the trap complexes date to the Terminal Prehistoric Period (see chap. 16).

Features

As previously noted, a variety of features were documented in this region. All are characterized as thermal features or charcoal stains that produced samples suitable for radiocarbon analysis (see table 17). The bulk of radiocarbon dates from features ($N = 7$) fall into the Middle Archaic and range from 2750 to 1500 cal B.P. Late Archaic feature dates ($N = 3$) range from 1260 to 740 cal B.P., while a single charcoal sample from a bowl-shaped hearth produced a Terminal Prehistoric date of 310 cal B.P. Interestingly, the three hearth features identified at site 26EK12394 date to different periods: one each to the Middle Archaic, Late Archaic, and Terminal Prehistoric. This pattern could suggest repeated or sustained use of the Thousand Springs Creek floodplain (in the vicinity of modern-day Dake Reservoir) beginning in the Middle Archaic Period and continuing through the rest of the prehistoric era.

Assemblages

Analysis of artifact classes by time period (table 50) reveal certain noteworthy trends

TABLE 50
Assemblages by Time Period for Thousand Springs Valley
PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic;
LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Description	PA	EA	MA	LA	TP	NC	Other[a]	Totals
Flaked stone								
Projectile point	1	29	24	40	3	92	12	201
Projectile point/drill	–	–	–	–	–	1	–	1
Drill	–	–	1	–	1	3	–	5
Biface	3	53	47	151	10	237	5	506
Formed flake tool	1	2	2	–	–	5	–	10
Flake tool	–	5	8	5	1	12	–	31
Core tool	–	2	1	–	–	–	–	3
Core	–	3	1	9	–	82	–	95
Debitage	7	8353	3968	21,408	425	18,274	10	52,445
Ground stone								
Millingstone	–	1	8	14	11	11	–	45
Handstone	–	2	1	3	2	4	–	12
Pestle	–	–	–	1	–	2	–	3
Misc. ground stone	–	–	2	2	–	4	–	8
Other								
Bead, stone	–	–	–	3	1	–	–	4
Sherd	–	–	–	31	–	2	–	33
Modified bone	–	–	6	9	–	1	–	16
Modified stone	–	–	–	1	–	4	–	5

[a] Includes isolates and surface collections from untreated sites.

with regard to the ratio of flaked stone to ground stone tools for each period. Broadly speaking, this ratio ramps up during the Middle Archaic, where ground stone comprises 13% of the assemblage, remains relatively steady during the Late Archaic at 10%, and then spikes in the Terminal Prehistoric where it comprises 87% of these tools. To the extent that the presence of ground stone within component assemblages is reflective of the activities of women and more generalized habitation, this trend appears to have commenced during the Middle Archaic and become dominant by the Terminal Prehistoric Period; this latter expression perhaps marked the arrival of family residential bands typical of the Numa.

With regard to the lithic landscape of Thousand Springs Valley, cryptocrystalline silicate (CCS) is the dominant tool stone for the flaked stone assemblages for virtually all time periods (table 51). There is, however, a fundamental shift in the preference for obsidian over time. Early and Middle Archaic components are characterized by 35% and 28% obsidian, respectively, whereas Late Ar-

TABLE 51
Flaked Stone Material Types by Time Period for Thousand Springs Valley
PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Material	PA	EA	MA	LA	TP	NC	Other[a]	Totals
Obsidian	7	2937	1134	1563	22	2768	20	8451
CCS	4	5484	2906	20,043	406	15,636	7	44,486
Other	1	26	12	7	12	302	–	360
Totals	12	8447	4052	21,613	440	18,706	27	53,297

[a] Includes isolates and surface collections from untreated sites.

TABLE 52
Obsidian Source Representation by Time Period Thousand Springs Valley
PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Source	PA	PM	EA	MA	LA	TP	NC	Other[a]	Totals
Big Southern Butte	–	–	–	–	–	1	–	1	2
Browns Bench	1	–	82	53	34	3	113	10	296
Browns Bench Area	–	–	11	10	1	–	4	–	26
Coal Bank Spring (Browns Bench Area)	–	–	–	–	–	–	4	–	4
Ferguson Wash	–	–	–	–	1	–	–	–	1
Malad	–	–	1	–	12	1	6	–	20
Timber Butte	–	–	–	–	1	–	–	–	1
Topaz Mountain	–	–	–	–	3	–	9	–	12
Walcott Tuff	–	–	–	–	1	–	–	–	1
Unknown	–	–	–	4	2	–	2	–	8
Totals	1	0	94	67	55	5	138	11	371

[a] Includes isolates and items from untreated sites.

chaic and Terminal Prehistoric components contain 7% and 5% obsidian.

The CCS materials identified at sites in this region appear to have been procured both locally and nonlocally. Several toolstone-quality CCS outcrops and quarries were documented at sites along the study corridor in this region; however, other CCS visually resembles material from distant areas, such as the Tosawihi quarry located on the Upper Humboldt Plains. The local sources include two CCS quarry sites situated on the Nevada-Utah border: sites 26EK651 and 26EK9177/12132 contain bedrock outcrops as well as residual and colluvial deposits of pinkish, reddish, and whitish chalcedony of varying quality. Usable material occurs in low, but uplifted, naturally weathered and

TABLE 53
Summary of Faunal Remains by Time Period for Thousand Springs Valley
EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

Common name	EA	MA	LA	TP	NC	Totals
Large mammals						
Cow	–	–	1	–	–	1
Bos/bison	–	–	1	–	–	1
Mule deer	–	–	7	–	–	7
Pronghorn	–	–	–	–	1	1
Cervid	–	–	6	–	–	6
Artiodactyl	1	3	43	–	10	57
Ungulate	25	57	526	–	104	712
Mammal, large	–	–	3	–	1	4
Mammal, medium-large	17	92	1549	1	279	1938
Subtotal	43	152	2136	1	395	2727
Medium mammals						
Carnivore	–	1	1	–	–	2
Mammal, medium	1	2	24	–	–	27
Subtotal	1	3	25	–	–	29
Small/medium mammals						
Marmot	–	–	6	–	–	6
Hare	3	3	21	–	7	34
Rabbit	3	1	54	4	8	70
Rabbit/hare	–	2	27	–	1	30
Mammal, small-medium	12	67	550	–	104	733
Subtotal	18	73	658	4	120	873
Small mammals						
Deer mouse	–	–	1	–	–	1
Ground squirrel	–	7	3	–	8	18
Kangaroo rat	–	–	10	–	–	10
New World mice and rats	–	2	5	–	1	8
Pocket gopher	–	4	3	–	1	8
Rodent	–	79	58	–	32	169
Squirrel	–	5	13	–	9	27
Vole	–	–	3	–	–	3
Woodrat	–	–	5	–	–	5
Mammal, small	–	9	67	–	4	80
Subtotal	–	106	168	–	55	329
Mammals, indeterminate						
Mammal	27	36	1389	3	114	1569
Birds						
Raptor	–	1	–	–	–	1
Bird	–	–	3	–	1	4
Other						
Lizard	–	–	–	–	2	2
Nonvenomous snake	1	–	3	–	1	5
Reptile	–	2	3	–	–	5
Frog/toad	–	5	1	–	3	9
Vertebrate	11	8	361	8	5	393

TABLE 54
Summary of Archaeobotanical Remains by Time Period for Thousand Springs Valley
Raw seed counts are not corrected for sample volume or sampling fraction.
EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

		EA	MA	LA	TP	NC	Totals
	No. Samples	8	10	13	2	15	48
	Total Volume (L)	81.3	97.1	114.9	11.5	80.6	385.4
Taxon	Common name						
Nutshell							
Juniperus spp.	Juniper	–	1	54	–	–	55
Small Seed							
Achnatherum hymenoides	Ricegrass	2	–	1	–	–	3
Artemisia tridentata	Big sagebrush	2	–	1	–	1	4
Atriplex spp.	Salt bush	–	8	–	–	2	10
Cactaceae	Cactus family	–	1	–	–	–	1
Camissonia/Oenothera spp.	Evening primrose	1	–	–	–	–	1
Chenopodiaceae	Goosefoot family	–	14	1	–	4	19
Chenopodium spp.	Goosefoot	–	8	20	–	52	80
Collinsia spp.	Blue-eyed Mary	17	–	7	–	–	24
Cyperaceae	Sedge family	1	–	–	–	–	1
Descurainia spp.	Tansy mustard	1	6	1	–	–	8
Elymus spp.	Wild rye	1	4	–	–	–	5
Fabaceae	Bean family	2	1	1	–	–	4
Large Poaceae	Grass family	1	–	2	–	–	3
Nicotiana spp.	Tobacco	–	–	1	–	–	1
Opuntia spp.	Prickly pear	–	1	–	–	–	1
Papaveraceae	Poppy family	5	–	–	–	–	5
Poa spp.	Bluegrass	51	–	4	–	1	56
Poaceae fragments	Grass family	24	16	–	–	1	41
Rumex spp.	Dock	3	–	–	–	–	3
Scirpus spp.	Tule	–	1	–	–	–	1
Seed fragments		22	15	10	–	2	49
Small Poaceae	Grass family	31	1	2	–	–	34
Unidentified seeds		13	3	6	–	–	22
Miscellaneous							
Large nonseed		–	–	19	–	–	19
Nongrain pieces		7	28	109	–	22	166
Roots		–	2	–	–	–	2
Small nonseed		–	–	1	–	–	1
Unknown A		–	–	13	–	–	13

fractured outcrops. This allowed for hand removal of large clasts or boulders for assay. Visual similarities in material and texture were identified during analysis, enabling us to link CCS-dominated assemblages with nearby quarries.

The dominant obsidian source represented in the Thousand Springs Valley assemblages is Browns Bench (including Browns Bench Area), which is located 50–70 km north of the project corridor (table 52; see fig. 6). There are, however, observable shifts in conveyance patterns through time. Obsidian samples from Early Archaic and Middle Archaic contexts are almost exclusively from Browns Bench, whereas Late Archaic components contain 36% from other source groups, primarily Malad, more than 200 km distant in southern Idaho, and Topaz Mountain, located more than 250 km to the southeast in Utah. As obsidian became less important later in time (during the Terminal Prehistoric), this trend was also accompanied by a greater emphasis on exotic obsidian from quarries to the east (see chap. 15).

Twenty-five brownware pottery sherds were recovered from this corridor segment. Most of these are from a rock-shelter at site 26EK9178/12133, Locus E, near Jackson Spring, that was otherwise dominated by Late Archaic time markers, suggesting some mixing. Also recovered from this context were several Fremont wares, including Great Salt Lake and Snake Valley Graywares that are more typically Late Archaic. As we review in chapter 15, the Late Prehistoric introduction of brownware pottery is reflected only in the eastern portion of the study corridor and indicates the importance of small seeds during that period.

In total, 5946 faunal bone elements and fragments were recovered from eight components in the Thousand Springs Valley region (table 53). The overwhelming majority of bone (80%) was obtained from Late Archaic contexts at a single site, 26EK9178/12133, Locus E, with much smaller amounts from Middle Archaic deposits at site 26EK11808, and traces of fauna from other dated contexts. Large-game procurement is well represented in all periods, with the Artiodactyl Index approaching 0.45 for Late Archaic components and 0.39 for Middle Archaic contexts.

A total of 577 charred seeds was obtained from 385 liters of deposit, representing 48 flotation samples from the Thousand Springs Valley (table 54). Temporal components represented by viable seed counts are confined to the Early, Middle, and Late Archaic periods, with the bulk of identifiable materials coming from Early Archaic contexts. Twenty-one separate taxonomic categories are recognized in the small-seed assemblage; the most dominant are goosefoot and various grasses. Also found were a number of juniper nut fragments (table 54). With respect to temporal trends, generic grasses predominate in Early Archaic samples, whereas goosefoot is more common in Middle and Late Archaic contexts. Juniper nut fragments are confined mostly to Late Archaic samples. Interestingly, the only tobacco seed obtained from the entire study corridor was recovered from Locus E at 26EK9178/12133, perhaps indicating a ceremonial activity not tied to subsistence.

Summary

As is the case for the other eastern project region (the Upper Humboldt Plains), the Thousand Springs Valley region is, with the exception of a few older projectile points, lacking in evidence of occupation prior to the

Early Archaic Period. Starting at the end of the middle Holocene, there was a sustained increase in land-use intensity that continued for the remainder of the prehistoric period. The representation of ground stone tools in project components shows a similar trend, for the most part increasing in relationship to flaked stone tools with each successive period. These tools appear to have been used mostly for the processing of small seeds, predominately grasses and goosefoot. The documentation of brownware pottery may also relate to this increasing reliance on small seeds. While the use of CCS flaked stone predominates during all periods, major shifts in tool-stone procurement are documented for the Middle–Late Archaic transition. Components dating before this time exhibit higher use of obsidian, primarily Browns Bench glass. Communal hunting was clearly important during the Terminal Prehistoric, as suggested by the four trap complexes identified within the study corridor (see chap. 16). Although the faunal assemblage from this segment is both limited and unevenly distributed, the data at hand indicate that artiodactyl hunting was also important during the Middle and Late Archaic periods.

CHAPTER 10

COLONIZATION OF NORTHERN NEVADA

William Hildebrandt and Allika Ruby

The Ruby Pipeline corridor provides a rare opportunity to monitor the Native settlement history of northern Nevada. It crosses through a variety of regions with differing economic potentials and contains an archaeological record spanning at least 13,000 years. These data sets allow us to discover which places were favored by the first Native Americans to reach the region, and how the remaining areas were infilled by people as their populations increased over the millennia.

Several recent studies have used ideal free distribution models (IFD) to help explain the prehistoric colonization and settlement of a variety of parts of California (Kennett et al., 2009; Winterhalder et al., 2010; Codding et al., 2012; Codding and Jones, 2013), and we feel that this approach is appropriate here as well. The basic model proposes that differing habitat types vary in their suitability for habitation based largely on differences in their subsistence returns. It also proposes that the suitability of these habitats will decline as human population densities increase, because increased competition for resources lowers people's ability to obtain them.

Based on this model, initial colonizers should occupy the highest-ranked habitats first (fig. 29) and stay there until human populations increase to the point (A) where suitability decreases to a level that is equal to the second ranked habitat (H2). As populations continue to grow, reaching the next threshold (B), lower ranked habitats should fill in (H3) and do so in the rank order of their suitability/productivity. Even after multiple habitats have been infilled over time, either through local population growth or in-migration, the highest-ranking habitats should always have higher population densities due to their higher level of suitability/productivity.

As summarized by Codding and Jones (2013: 14569), "the IFD provides two main qualitative predictions: (1) the most suitable habitats should always be occupied first; and (2) they should always have the highest population densities."

Habitat Variability

As outlined in chapter 2, the project corridor traverses four major regions: the High Rock Country, the Upper Lahontan Basin, the Upper Humboldt Plains, and Thousand Springs Valley. These areas are generally composed of a sea of sagebrush-grass steppe, but there are key differences among them that may have influenced the intensity of settlement over time. Most of these differences in habitat are due to variable amounts of ef-

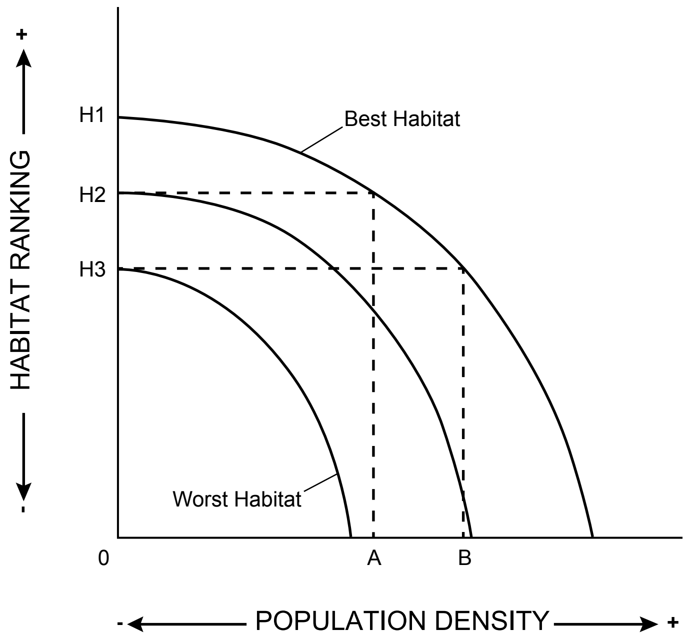


Fig. 29. Ideal free distribution model (from Kennett et al., 2009).

fective moisture based on elevation and relationship to winter storm systems originating in the Pacific Ocean, and the nature of local soil conditions (e.g., volcanic lithosols versus old lake-bed sediments). Because of the large size of and internal variability within each of the regions, we make no attempt to formally quantify these differences. Instead, the following discussion provides a qualitative assessment of habitat productivity, and these assessments are evaluated with quantitative patterns produced by the archaeological record. More detailed descriptions of the regions are provided in chapter 2.

The High Rock Country is generally better watered than most of the other regions, due to its higher elevation and proximity to winter storms originating from the Pacific. These relationships result in sagebrush steppe and juniper woodland habitats with high quality browse and grazing for large game, and cool-season grasses mixed with more typical Great Basin species. Probably most importantly, however, are the vast tracts of high lava plains that produce copious amounts of root crops, especially epos (yampah), along the western end of the corridor at Barrel Springs. The importance of this area is supported by Fowler and Liljeblad's (1986: 437) ethnographic study of the Northern Paiute, where this area is highlighted as one of the few population concentrations in northern Nevada (see also chap. 3).

The Upper Lahontan Basin is warmer and drier than the High Rock Country, because of its lower elevations and more easterly location. Much of the habitat is composed of old lake-bed deposits and adjacent slopes originally associated with Pleistocene Lake Lahontan. These low-lying areas are composed of arid greasewood-saltbush scrub associations, which are not conducive to populations of large game but do produce important small-seeded plants like Indian rice grass, tansy mustard, and many others. Moving out of the basin into higher elevations, substrates with rocky soils produce dry-adapted root crops like bitterroot and mariposa lily. As in the High Rock Country, Fowler and Liljeblad (1986: 437) identify the Quinn and Little Humboldt rivers as areas with relatively high population densities.

Elevations increase again in the Upper Humboldt Plains, creating greater annual precipitation than in the Upper Lahontan Basin. Most of this area is vegetated by dry sagebrush or sagebrush-steppe communities. Several important grasses and other small-seeded plants exist here, and some dryland slopes produce root crops including bitterroot, epos, and biscuit-root. Although the corridor bypasses most upland areas, nearby mountain peaks reaching nearly 10,000 ft are important habitats for artiodactyl populations. These mountains also feed several permanent tributaries of the Humboldt River that contain fish and support riparian habitats where camas and tobacco root grow, and provide forage for large game populations. Steward (1938: 152–154) identifies the Humboldt River valley as one of the most fertile habitats in northern Nevada, but he does not identify any Western Shoshone winter villages or population concentrations along the project corridor.

Elevations progressively drop as we cross the Thousand Springs Valley, reducing precipitation. Due to the valley's easterly location, up to 25% of the annual rainfall occurs as monsoonal thunderstorms during the summer. Lower-lying areas are dominated by communities of greasewood-saltbush scrub where small-seeded resources are particularly abundant. These habitats were also conducive to antelope populations, evidenced by the large number of traps found in the region (see chap. 16). The project corridor avoids most upland areas, but many are covered by juniper woodland, and some contain pinyon as well. Western Shoshone populations appear to have been rather small throughout the region, as no villages or population concentrations are identified by Steward (1938: ix) along the corridor. He does, however, note a few villages along Thousand Springs Creek and near Montello, south of the corridor.

As outlined in chapter 2, a great deal of change occurred between the late Pleistocene and the Terminal Prehistoric Period. During the Paleoindian Period (14,500–12,800 cal B.P.), rapid warming associated with the Bølling-Allerød Interstadial brought a decline in Pleistocene pluvial lake levels. With the beginning of the Paleoarchaic Period (12,800–7800 cal B.P.) and the Younger Dryas interval, colder conditions returned and lakes recharged until about 11,700 cal B.P., when warmer conditions took hold again. While all parts of the corridor probably benefited from periods of increased effective moisture, areas with lake basins (e.g., Parman Basin in the High Rock Country) may have had relatively higher levels of productivity than other places, due to the development of marshland habitats.

As aridity increased during the latter end of the Paleoarchaic and into the Post-Mazama Period (7800–5700 cal B.P.), habitat suitability was probably depressed everywhere, but upland areas adjacent to the corridor may have been relatively more productive than other locations. Drought conditions ameliorated during the Early (5700–3800 cal B.P.) and Middle (3800–1300 cal B.P.) Archaic periods, except for persistent droughts between about 2600 and 2000 cal B.P. With the exception of this dry interval, the productivity of all habitats improved during these periods of increased effective moisture, and it seems likely that many of the environmental patterns we see today began to take shape at this time.

Severe drought conditions occurred again during the Late Archaic (roughly between 1100 and 700 cal B.P.) as part of the Medieval Climatic Anomaly (MCA), producing lower habitat suitability everywhere. As with the arid periods during the middle Holocene, a limited number of well-watered areas within and adjacent to certain upland areas may have served as refugia. Finally, effective moisture increased during the Little Ice Age after 600 cal B.P. and improved conditions continued through the Terminal Prehistoric Period, with habitat productivity similar to modern times.

Discussion

Although there is a great deal of environmental similarity across the Northern Tier of Nevada, there are some important differences in resource productivity along the study corridor. First, the High Rock County is obviously highly ranked with its relatively high effective moisture, artiodactyl populations, and root crops. This ranking may have been particularly high early on, when upland basins held marshland habitats. It is also important to note that the western end of the High Rock Country supported high population densities during the ethnographic period.

The Upper Humboldt Plains also has relatively high effective moisture, a large number of perennial streams, and a good potential for root crops. Artiodactyls are also abundant in nearby upland areas but not immediately along the project corridor. Resource productivity seems lower in the Upper Lahonton Basin due to its lower precipitation, and lower frequency of perennial streams, root crops, and artiodactyls. It does, however, have abundant small-seeded resources. Finally, Thousand Springs Valley also has low overall productivity with exception of its small-seeded resources and potential for significant antelope populations; in addition, the ethnographic record identifies no population concentrations in the local area.

Although these differences could be used to rank the four regions and develop a series of predictions following the expectations of the IFD model, the coarse-grained nature of the subsistence productivity measures make it prudent to avoid this level of formality. Instead, the following presentation simply presents a series of land-use indicators across the four regions and observes how these zones were initially colonized and ultimately filled in over time.

Land-Use Indicators

Four data sets are used to monitor the settlement history of the four regions and of the project corridor as a whole. We begin with the frequency of time-sensitive projectile points from surface contexts only, followed by an analysis of the time-space distribution of single-component areas. The component areas were defined by some combination of projectile points, radiocarbon dates, obsidian hydration readings, and in a few cases, pottery sherds and beads. We then present a short discussion of ground stone tools recovered from the single-component areas. Finally, we present the radiocarbon dates obtained during the project, using only one assay per single-component context.

Projectile Points

Temporally diagnostic projectile points provide one avenue for tracking human land-use through time, and changes in point frequencies are commonly interpreted as proxy measures for changes in regional human population densities (see Bettinger, 1999, 2015). Because projectile points were typically used for hunting, however, some have argued that they are a better measure of hunting intensity and less related to human population densities (see Hockett, 2009, 2015). While we appreciate the latter point, and will consider it below, we find their time-space distributions to be quite meaningful with regard to land-use histories, especially when combined with the other measures used in this study.

Our projectile point data are limited to temporally diagnostic types collected from surface contexts; although the function of crescents is debated, they are included in this dataset (table 55). The resulting assemblage was retrieved from sites (*N* = 1134) and isolated contexts (*N* = 50). To correct for the differential amount of time that each point type was used, and differences in the area of land encompassed by the four regions, these data have been converted to the frequency of points per 1000 years of time and per 1000 acres of land (table 56).

All five of the small sample of Great Basin Concave Base points (Paleoindian Period) were found in the High Rock Country (table 56; fig. 30). The overall density of Great Basin Stemmed points (Paleoarchaic Period) increases by a factor of 4.0 (0.1 versus 0.4; table 56) and they still occur mostly in the High Rock Country (75%), with a few trickling out into some of the other regions. All four of the crescents recovered on this project are from the High Rock Country, further supporting early occupation of this region.

Densities increase again (by a factor of 5.5) with Northern Side-notched points (Post-Mazama) and, continuing the preceding trend, the High Rock Country shows the highest density (5.4). Humboldt/Gatecliff points largely correspond to the Early Archaic Period, but we expand the length of their occurrence to a limited degree because many Humboldt points are found in earlier contexts (see chap. 5). Overall densities of these types increase again by a factor of 3.4, and again the High Rock Country accounts for the largest proportion (16.7), followed by a minor switch in the ordering of the Upper Lahontan Basin (4.2) and Upper Humboldt Plains (6.4); Thousand Springs Valley (2.5) continues to its lowest density status. Projectwide densities remain essentially the same during the Middle Archaic Period, so the IFD model would predict that the relationship between the four ecosystems should also remain the same. This expectation is met, as the proportion and rank order of projectile point densities are quite similar across the region.

If the most suitable habitats should always be occupied first, and these habitats should always have the highest population densities (Codding and Jones, 2013: 14569), the above data show that the High Rock County was the highest-ranking region during the Paleoindian through the Middle Archaic periods. The Upper Lahontan Basin and Upper Humboldt Plains are similar to one another (the latter perhaps ranking somewhat higher), while the Thousand Springs Valley consistently lags behind.

TABLE 55
Frequency of Key Surface Projectile Point Types by Region
Minor types excluded; includes isolates and noncollected surface points.

Point Type	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Desert Series	14	26	25	6	71
Rosegate	83	96	46	14	239
Elko	202	56	94	14	366
Humboldt/Gatecliff	196	56	92	26	370
Northern Side-notched	53	23	13	4	93
Great Basin Stemmed/Crescent	30	4	5	1	40
Great Basin Concave Base	5	–	–	–	5
Totals	583	261	275	65	1184

TABLE 56
Frequency of Key Surface Projectile Points by Region, based on the Number Deposited per 1000 Years and 1000 Acres of Land
Minor types excluded; includes isolates and noncollected surface points.

Point Type	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals	Temporal Length (years)	Temporal Interval (cal B.P.)
Desert Series/ Small Stemmed	6.0	9.7	8.8	2.9	7.2	500	600–100
Rosegate	25.3	25.7	11.5	4.8	17.1	700	1300–600
Elko	17.3	4.2	6.6	1.3	7.4	2500	3800–1300
Humboldt/Gatecliff	16.7	4.2	6.4	2.5	7.4	2500	6300–3800
Northern Side-notched	5.4	2.1	1.1	0.5	2.2	2100	7800–5700
Great Basin Stemmed/ Crescent	1.3	0.1	0.2	<0.1	0.4	5000	12,800–7800
Great Basin Concave Base	0.6	–	–	–	0.1	1700	14,500–12,800
Totals	8.6	3.4	3.3	1.1	4.1	–	–

This trend begins to shift during the Late Archaic Period. Rosegate projectile point densities make a major jump (increase by a factor of 2.3), but their mix across the project corridor changes significantly from what came before. The main change is an abrupt increase in the density of these artifacts in the Upper Lahontan Basin (25.7), which is nearly equivalent to that in High Rock Country (25.3). The rank order of the other two regions, however, remains the same.

Much more radical violations of the original trend appear in the Terminal Prehistoric Period sample with Desert Series projectile points. First, their overall density drops nearly in half, which is surprising given previous

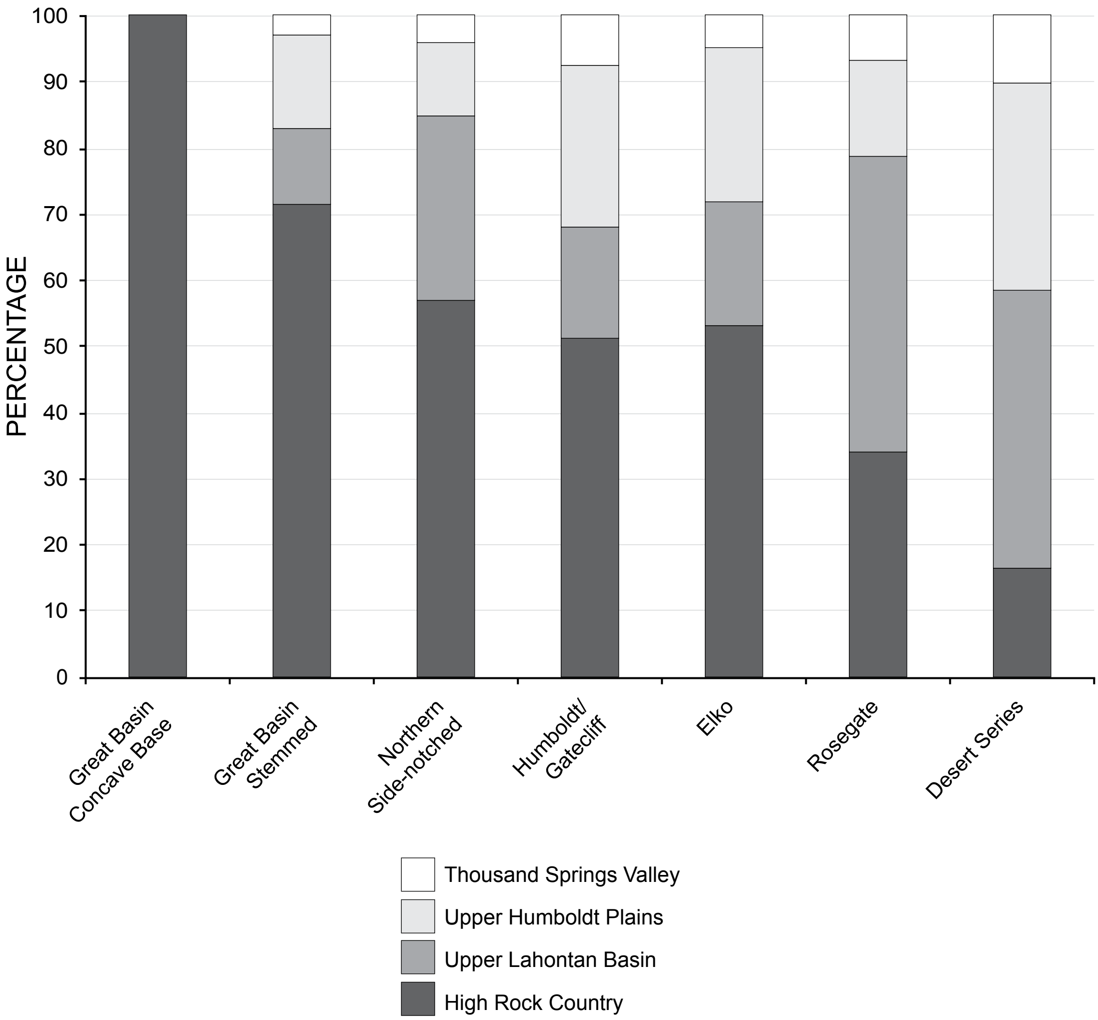


Fig. 30. Percentage of key surface-collected projectile points by region, based on the number deposited per 1000 years and 1,00 acres of land.

models regarding the expansion of Numic peoples late in time (i.e., that it was partially fueled by higher population densities). Second, if population densities did decrease, we would expect the distribution of projectile points to revert back to what appear to be the higher-ranked habitats, producing a pattern similar to that exhibited during the Middle Archaic Period, as the overall density of material from the two time periods is similar. This does not occur: the Upper Lahontan Basin has the highest density of projectile points (9.7), followed by the Upper Humboldt Plains (8.8) and the High Rock Country (6.0). Thousand Springs Valley maintains the lowest density of points (2.9), as it does throughout the sample.

Rather than signaling declining human population levels, the decline in projectile point de-

TABLE 57
Frequency of Single-Component Areas by Region

Component	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Terminal Prehistoric	3	3	16	8	30
Late Archaic	19	8	18	3	48
Middle Archaic	97	13	28	9	147
Early Archaic	65	4	19	5	93
Post-Mazama	20	7	3	–	30
Paleoarchaic	33	5	–	1	39
Paleoindian	8	1	–	–	9
Totals	245	41	84	26	396

TABLE 58
Frequency of Single-Component Areas per 1000 Years and 1000 Acres of Land

Component	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Terminal Prehistoric	1.3	1.1	5.6	3.8	3.0
Late Archaic	5.8	2.1	4.5	1.0	3.4
Middle Archaic	8.3	1.0	2.0	0.9	3.0
Early Archaic	7.3	0.4	1.8	0.6	2.5
Post-Mazama	2.0	0.6	0.3	–	0.7
Paleoarchaic	1.4	0.2	–	<0.1	0.4
Paleoindian	1.0	0.1	–	–	0.3
Totals	3.6	0.5	1.0	0.4	1.4

position during the Terminal Prehistoric Period may reflect a different approach to large-game hunting by Numic peoples. The newly arrived Numa were organized into small family-based bands that moved frequently as a group, and tended to create less evidence for specialized hunting camps than was the case during the preceding time periods. Numic groups did participate in communal hunting drives, but, unlike earlier drive sites (Hockett and Murphy, 2009), many of the Numic sites lack projectile points (Jensen, 2007; see also chap. 16), which might also contribute to the perception of declining human populations in the region.

Components

We now turn our attention to the frequency of single-component areas across time and space. Almost 400 such areas were identified (table 57). These data differ from the projectile points in that they come only from sites, and most of them were discov-

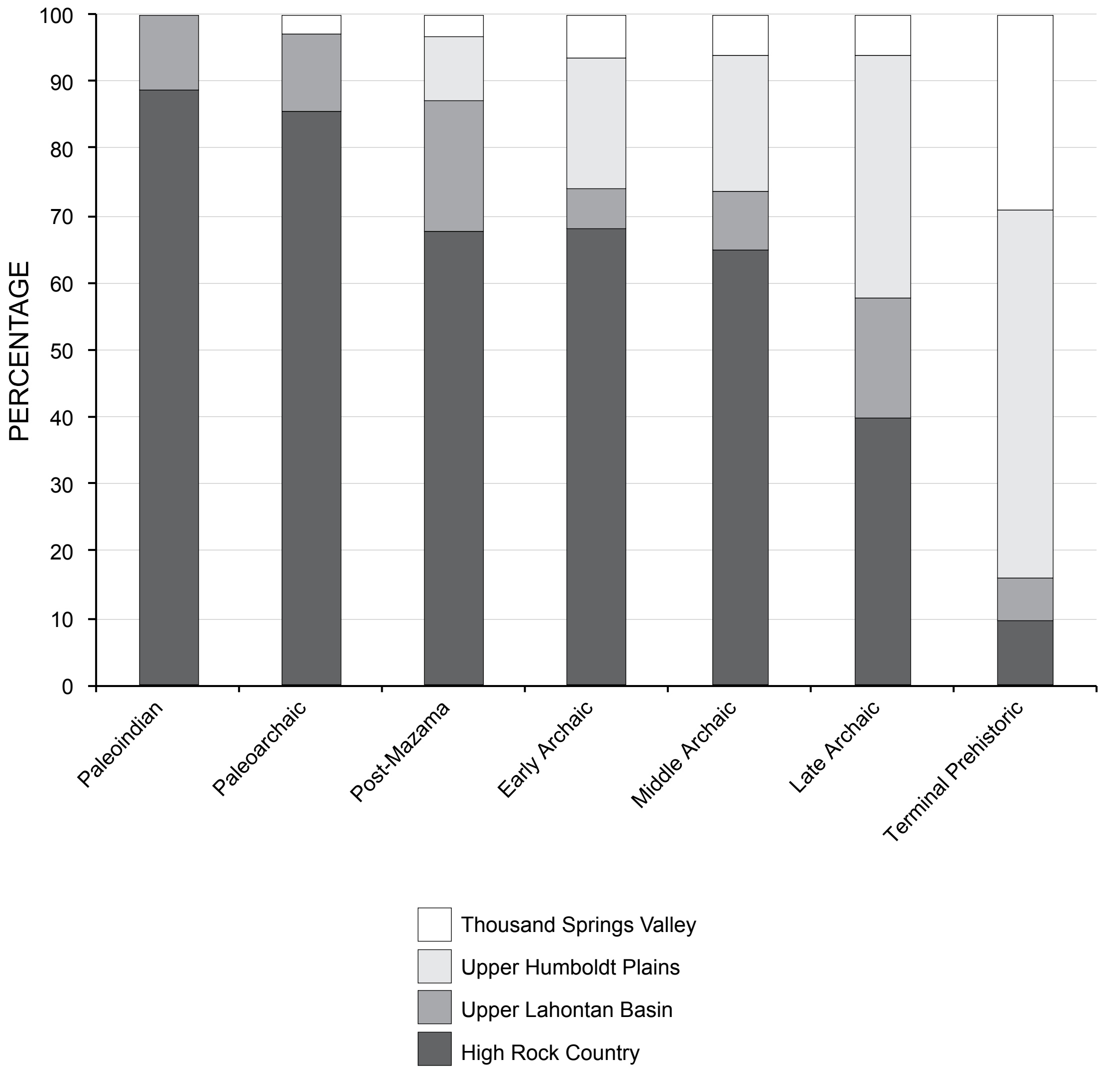


Fig. 31. Percentage of single-component areas per 1000 years and 1000 acres of land.

ered through excavation. They also represent a broader range of settlement activity, expanding beyond the probable hunting focus reflected by the points.

The density of components per 1000 years and 1000 acres of land is presented in table 58. As with the projectile point data, almost all of the Paleoindian (89%) and most of the Paleoarchaic (83%) components are found in the High Rock County (fig. 31). Component densities nearly double when we move into the Post-Mazama Period (0.7/1000 years). They stay relatively high in the High Rock Country (2.1 components per 1000 years per 1000 acres) during this interval, but also begin to increase in the Upper Lahontan Basin (0.6) and the Upper Humboldt Plains (0.3). Overall densities increase 370% in the Early Archaic

Period (2.5 per 1000 years/acres), but the relationship between the regions shifts, such that the Upper Lahontan Basin (0.4) and the Upper Humboldt Plains (1.8) shift their rank order, similar to what we see with the projectile points (see table 56); the High Rock County remains dominant (7.3) and Thousand Springs remains rather low (0.6). Component densities increase only slightly in the Middle Archaic Period, also similar to the projectile point trends, and the relationship among the regions remains the same.

Overall densities increase by a factor of only 1.2 in the Late Archaic Period, and the rank order of the regions is preserved, but the components are more evenly distributed across the four regions. The density of components in the High Rock Country drops to a level nearly equal to that in the Upper Humboldt Plains, while that of the Upper Lahontan Basin more than doubles relative to its Middle Archaic density, although it is still low. The density of Thousand Springs Valley components remains essentially unchanged.

Major changes occurred again with the arrival of the Terminal Prehistoric Period. First, unlike the density of projectile points (which dropped by nearly half), the density of Terminal Prehistoric components (3.0 per 1000 years/acres) is only slightly lower than that of the Late Archaic Period (3.4 per 1000 years/acres). This finding supports the hypothesis that the extreme drop in projectile point densities is at least partially due to a change in large-game hunting strategies. Second, component densities lessen in the High Rock County (1.3) and Upper Lahontan Basin (1.1), and increase in the more easterly Upper Humboldt Plains (5.6) and Thousand Springs Valley (3.8) regions. Like the projectile points, these findings reflect a total reorganization in settlement pattern and major changes in how people viewed the economic potential of these environments.

Ground Stone

Ground stone implements typically signify plant processing and can be used to monitor resource intensification, and how these activities changed over time and space. The data presented here consist of 101 ground stone tools recovered from single-component surface contexts across the project (table 59). They demonstrate a striking west-to-east pattern of deposition through time that is consistent with the trends of the other data sets. Ground stone was initially confined to the High Rock Country, appeared in the Upper Lahontan Basin in the ensuing Post-Mazama Period, was used on the Upper Humboldt Plains in the Early Archaic Period, and appeared in the Thousand Springs Valley by the Middle Archaic Period. When time averaged, the resulting densities per 1000 acres of land demonstrate a steady progression in artifact deposition until the peak in the Middle Archaic Period, driven largely by a sharp increase of ground stone in sites within the High Rock Country (table 60). By the Terminal Prehistoric Period, ground stone was confined to the Upper Humboldt Plains and Thousand Springs Valley, where we also find more single-component areas (see table 58).

Radiocarbon Dates

Sixty-nine radiocarbon dates are used for this analysis (table 61; fig. 32). They represent the entire sample obtained during the project (see chap. 5), minus those from the antelope traps, modern dates, and duplicate dates from single-component areas. This data set is more limited relative to the projectile point and

TABLE 59
Frequency of Surface-Ground Stone Tools by Region

Component	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Terminal Prehistoric	–	–	6	2	8
Late Archaic	–	5	–	5	10
Middle Archaic	47	1	5	11	64
Early Archaic	11	1	3	–	15
Post-Mazama	2	1	–	–	3
Paleoarchaic	1	–	–	–	1
Paleoindian	–	–	–	–	–
Totals	61	8	14	18	101

TABLE 60
Frequency of Surface-Ground Stone Tools per 1000 Years and 1000 Acres of Land

Component	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Terminal Prehistoric	–	–	2.1	1.0	0.8
Late Archaic	–	1.3	–	1.7	0.7
Middle Archaic	4.0	0.1	0.4	1.1	1.3
Early Archaic	1.2	0.1	0.3	–	0.4
Post-Mazama	0.2	0.1	–	–	0.1
Paleoarchaic	<0.1	–	–	–	<0.1
Paleoindian	–	–	–	–	–
Totals	0.9	0.1	0.2	0.3	0.3

component data, because of the lower number of observations, the low frequency of assays predating the late Holocene, and the low number of dates from the Upper Lahontan Basin ($N = 4$). Previous researchers have experienced similar difficulties in obtaining radiocarbon dates from early and middle Holocene contexts, probably because dateable materials from these eras are less likely to be preserved due to destructive processes such as erosion and weathering (Surovell and Brantingham, 2007; Surovell et al., 2009). Thus, the frequency of dates tends to be heavily weighted toward the later eras. Before moving forward, however, it should be noted that Louderback et al. (2011) have summarized a significantly larger sample of nearly 1000 radiocarbon dates from the Bonneville Basin, Fort Rock Basin, and Western Lahonton Basin. This larger data set provides a much higher level of resolution for the early and middle Holocene than is available form the current project corridor.

TABLE 61
Frequency of Radiocarbon Dates by Region

Component	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Terminal Prehistoric	6	–	10	3	19
Late Archaic	5	1	5	4	15
Middle Archaic	10	3	7	6	26
Early Archaic	2	–	4	–	6
Post-Mazama	1	–	–	–	1
Paleoarchaic	2	–	–	–	2
Paleoindian	–	–	–	–	0
Totals	26	4	26	13	69

The paucity of dates from the Upper Lahontan Basin appears to be related to the low density of identified single-component areas in this region throughout the sequence (see table 58), which is linked to the low frequency of residential sites here, as well (see chap. 7). Although they are included in table 61 (also see fig. 32), the Upper Lahontan Basin dates figure little in the discussions that follow.

Despite these sampling issues, the distribution of radiocarbon dates across time and space show some similarities with the patterns produced by the projectile points, single-component areas, and ground stone (table 62). First, all three assays predating 7000 cal B.P. are from the High Rock Country. Dates corresponding to the Early Archaic Period are most common in the Upper Humboldt Plains (*N* = 4; 0.11 per 1000 years/acres). The overall frequency radiocarbon dates jumps by a factor of 3.2 in the Middle Archaic (table 62), with the greatest frequency in the High Rock Country (0.20 per 1000 years/acres), the Upper Humboldt Plains second (0.14 per 1000 years/acres), and Thousand Springs Valley (0.12 per 1000 years/acres) and the Upper Lahontan Basin (0.06 per 1000 years/acres) represented for the first time. All but one of the Thousand Springs Valley dates fall at the end of this interval (i.e., after 2000 cal B.P.), however.

The overall density of radiocarbon dates doubles in the Late Archaic sample and shows a more even distribution across the High Rock Country (0.36), the Upper Humboldt Plains (0.36), and Thousand Springs Valley (0.29). This finding is consistent with the component-area data presented above. Despite the overall increase in assays, it is important to note that there is a major drop between 1000 and 600 cal B.P., probably corresponding to the MCA (see fig. 32).

Unlike the patterns produced by the projectile points and the component areas, the density of radiocarbon samples increases again (almost doubling), peaking in the Terminal Prehistoric. Their distribution across the regions is similar for this latest prehistoric period.

Summary and Conclusion

The data sets we have reviewed here indicate that the High Rock Country was the

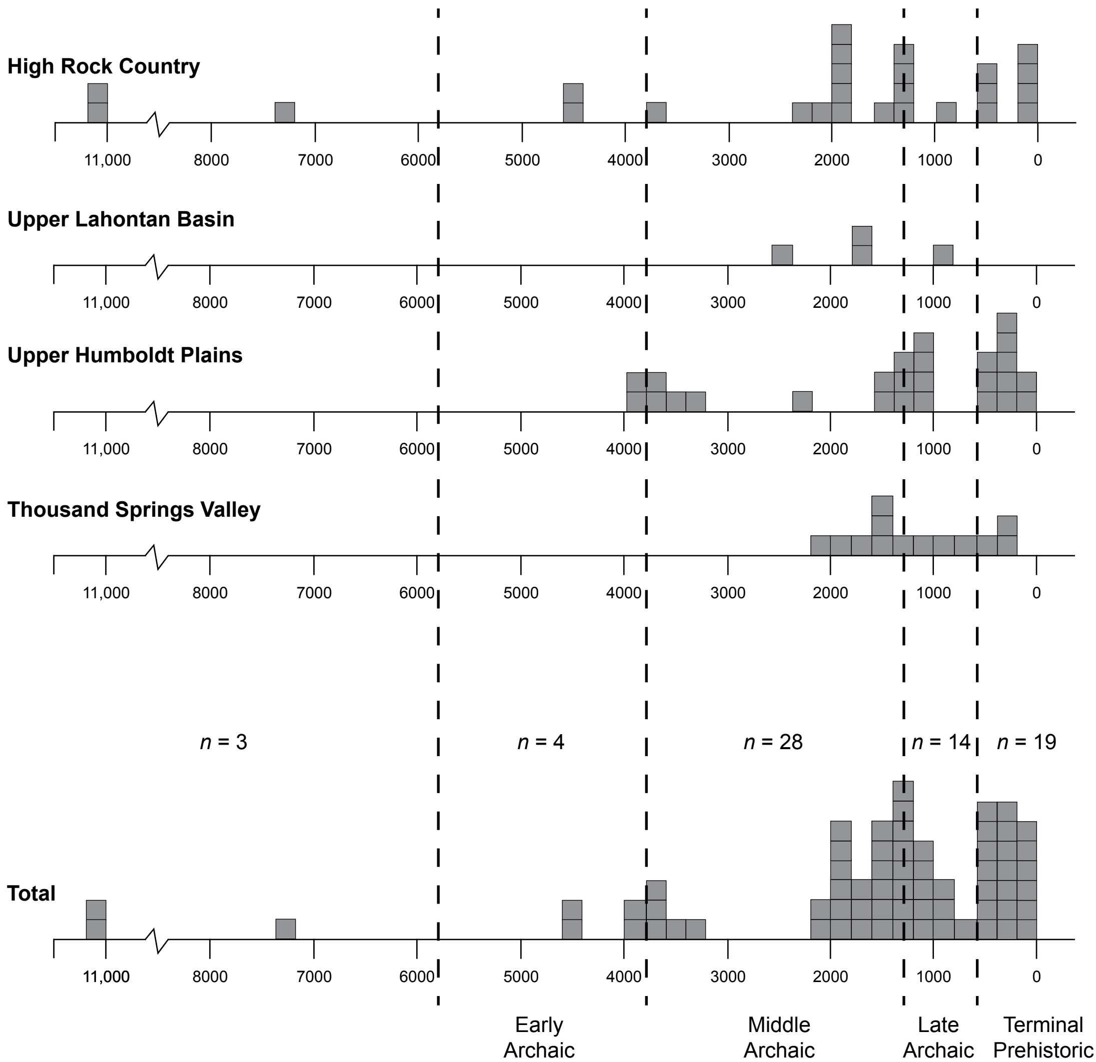


Fig. 32. Radiocarbon-dated locations by region and time period.

highest-ranked region until the very end of the prehistoric record. Projectile point densities increased across the entire project corridor over time, remaining dominant in the High Rock Country but progressively increasing in the other regions as well. This general finding indicates that when human population densities were low, people focused most of their foraging activities in the High Rock Country, where key resources like large game and root crops were more abundant than elsewhere. As human population densities in the High Rock Country reached levels that lowered return rates for local resources to a level equal to those in the Upper Humboldt Plains and Upper Lahontan Basin, people started using those areas more than they had before. They also incorporated resources with lower

TABLE 62
Frequency of Radiocarbon Dates per 1000 Years and 1000 Acres of Land

Component	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Terminal Prehistoric	0.60	0.00	1.00	0.30	1.91
Late Archaic	0.36	0.07	0.36	0.29	1.08
Middle Archaic	0.20	0.06	0.14	0.12	0.52
Early Archaic	0.05	0.00	0.11	0.00	0.16
Post-Mazama	0.02	0.00	0.00	0.00	0.02
Paleoarchaic	0.02	0.00	0.00	0.00	0.02
Paleoindian	0.00	0.00	0.00	0.00	0.00
Totals	1.26	0.13	1.61	0.71	3.71

return rates, as signaled by the steady increase in plant processing tools.

Projectile point densities dropped almost threefold during the Terminal Prehistoric Period, but rather than seeing a shift in their distribution back to the High Rock Country—which would be expected with lower human population densities—there was a radical reordering of habitat use, with the High Rock Country ranking third behind the Upper Lahontan Basin and Upper Humboldt Plains. These findings lead us to hypothesize that the drop in projectile points may have been more strongly linked to a shift in large-game hunting strategies and a broadening of the diet breadth, which included use of a greater variety of resources zones, rather than to a major drop in human population densities.

An analysis of the time-space distribution of single-component areas provides support for this proposal, as reorganization of land-use preferences (as signaled by projectile points) also occurred, but there is only minor evidence for a decline in population density during the Terminal Prehistoric Period: component densities dropped by only 14%, compared to a drop of nearly 300% among the projectile points. Although we fully appreciate the taphonomic issues associated with composite samples of radiocarbon dates, this dataset also suggests no major population decline.

These data indicate that hunting (and probably epos collection) was a high priority during much of prehistory—and that much of it took place in the High Rock Country. This focus on hunting can be seen by the high number of specialized flaked stone scatters that dominate the project corridor prior to the late Holocene (see chap. 11) as well as by the greater numbers of projectile points that predate the Late Archaic Period. With the onset of the late Holocene, particularly during the Middle Archaic Period, use of the corridor diversified, as habitation sites (e.g., those with milling gear) increased in frequency and people spread out into a wider range of habitats. This general progression, which is fully consistent with the IFD model, reached a zenith sometime during the Late Archaic but broke down thereafter. This violates the IFD predictions that (1) the most suitable habitats should always be occupied first; and (2) those habitats should always have the highest population densities, especially the latter. Instead the data seem to indicate a reorganization of the habitat ranking with the arrival of the Terminal Prehistoric Period. What would have caused such a reorganization? Why would the High Rock Country become less suitable?

If the decline in projectile points reflects a decline in large-game hunting opportunities, this could explain the change in habitat preference/ranking. Using a strictly ecological perspective, we might argue that human population increases led to the depletion of large game across northern Nevada, lowering the productivity of hunting (and the importance of the High Rock Country) and catalyzing greater focus on alternative resources and resource zones. But there is little evidence for a population explosion during the Terminal Prehistoric Period large enough to maintain such a level of exploitation. In fact, much of our data shows that human population densities may have been slightly lower at this time.

Instead, a series of historical contingencies, one environmental and one cultural, provide a better explanation for these changes. Several researchers have argued that the MCA disrupted human adaptations throughout the American West (Berry and Berry, 1986; Madsen, 1989; Larson and Michaelsen, 1990; Jones et al., 1999; Grayson, 2011; McGuire et al., 2013), and severe droughts associated with this interval could have adversely affected northern Nevada as well (see chap. 2). The major break in the radiocarbon record outlined above corresponds to this interval (see the 1000–600 cal B.P. interval on fig. 32) and may represent a disruption in settlement across much of the project corridor.

The reorganization of habitat preference and settlement patterns that we observe in our data corresponds to the second historical contingency—the northern spread of Numic-speaking peoples across much of the western Great Basin. Although the timing of their arrival is debated (Hildebrandt and King, 2002; Delacorte, 2008), there is general agreement that Numic peoples practiced an adaptation fundamentally different from the people who occupied the region before them. They tended to live in smaller, dispersed family groups that were more reliant on small-seeded resources, with the harvesting of these foods facilitated by the development of the seed beater and the triangular winnowing tray (Bettinger and Baumhoff, 1982). This change in adaptation was also accompanied by shifts in settlement patterns similar to those observed in our study, as people spread into new habitats that had rarely been used before (Delacorte, 2004; McGuire and King, 2011; McGuire et al., 2013). A more detailed assessment of these proposed land-use pattern changes will be presented in the chapters that follow, giving particular focus to the artifact assemblages and subsistence remains recovered from the project sites.

CHAPTER 11

FLAKED STONE PRODUCTION PATTERNS

William Hildebrandt, Kaely Colligan, and William Bloomer

Previous research in the Great Basin has identified a great deal of variability in how prehistoric peoples obtained and used tool stone over the millennia. Several scholars have noted that Paleoindian and Paleoarchaic foragers practiced a high degree of residential mobility, visiting widely dispersed quarries during their travels. This pattern of settlement is reflected archaeologically by high levels of tool-stone source diversity (particularly among projectile points) as people discarded worn-out implements made from distant sources of stone and replaced them with new tools when they encountered new sources (Jones et al., 2003, 2012; Smith, 2010; Beck and Jones, 2011).

Settlement mobility appears to have decreased significantly during the Early and Middle Archaic periods; this is reflected by reduced levels of tool-stone diversity and the emergence of substantial residential bases (McGuire, 2002; McGuire and Hildebrandt, 2005; Smith, 2010, 2011). Although there is some debate regarding the degree of settlement stability that developed at this time (Delacorte and Basgall, 2012), it seems clear that these land-use pattern changes were accompanied by a rise in logistical mobility. The latter is reflected by intensive hunting in distant high-elevation areas for the first time and special visits to major obsidian quarries where artisans produced bifaces not only for their own use, but for exchange with neighboring peoples as well. This surplus production for exchange is most pronounced at quarries along the Sierran-Cascade Front, adjacent to the large consumer populations living across the mountains in cismontane California (Hall, 1983; Hildebrandt et al., 1994; Gilreath and Hildebrandt, 1997, 2011; Ramos, 2000; Hildebrandt and McGuire, 2002; King et al., 2011).

This system of obsidian production and exchange appears to have crashed during the latter half of the Late Archaic and into the Terminal Prehistoric Period. Most quarries show little or no evidence of production, and obsidian becomes rare in the archaeological record of outlying areas where it was once abundant. In most of these places, local tool stone became more important. This is usually marked by a higher frequency of cryptocrystalline silicate (CCS) stone, or by quantities of obsidian from low-quality pebble sources scattered across the landscape. The reasons for the collapse in obsidian production and exchange are not entirely clear, but most researchers think it resulted from two main factors: social and economic disintegration stemming from the Medieval Climatic

TABLE 63
Chronological Changes in Frequency of Obsidian versus CCS Tool Stone by Region

Period	High Rock Country				Upper Lahontan Basin				Upper Humboldt Plains				Thousand Springs Valley				Totals				
	Obs	%	CCS	%	Obs	%	CCS	%	Obs	%	CCS	%	Obs	%	CCS	%	Obs	%	CCS	%	All
Terminal Prehistoric	516	81	124	19	196	38	320	62	744	3	26,676	97	22	5	406	95	1478	5	27,526	95	29,004
Late Archaic	10,502	99.8	26	0.2	15,693	70	6668	30	84	1	11,412	99	1563	7	20,043	93	27,842	42	38,149	58	65,991
Middle Archaic	114,321	98	2837	2	2001	89	241	11	3311	14	20,122	86	1134	28	2906	72	120,767	82	26,106	18	146,873
Early Archaic	19,783	90	2230	10	679	100	2	0	168	1	12,772	99	2937	35	5484	65	23,567	53	20,488	47	44,055
Post-Mazama	13,777	98	351	2	1742	95	85	5	39	7	515	93	–	–	–	–	15,558	94	951	6	16,509
Paleoarchaic	21,840	97	733	3	70	88	10	13	–	–	–	–	7	64	4	36	21,917	97	747	3	22,664
Paleoindian	949	96	39	4	20	77	6	23	–	–	–	–	–	–	–	–	969	96	45	4	1014
Subtotal	181,688	97	6340	3	20,401	74	7332	26	4346	6	71,497	94	5663	16	28,843	84	212,098	65	114,012	35	
Totals	188,028				27,733				75,843				34,506				326,110				

Anomaly (MCA; Jones et al., 1999; Moratto, 2011), and the reduced need for tool stone with introduction of the bow and arrow (Gilreath and Hildebrandt, 1997, 2011; Hildebrandt and McGuire, 2002; Delacorte, 2004).

Previous work in northwestern Nevada and northeastern California has shown a different set of patterns, especially during the latter end of the sequence (McGuire, 2002; Smith, 2010; Smith et al., 2012). Although actual production intensity could not be measured because they were not working in quarry areas, these studies did not reveal the contraction of flaked stone procurement zones outlined above. Instead, transport distance of obsidian artifacts actually increased after 1000 cal B.P., indicating that interregional exchange may have also increased at this time.

The current project corridor provides an outstanding opportunity to study these alternative senarios, as it passes through a variety of lithic landscapes, some with obsidian and some without. As outlined above (see chap. 2), the western end of the corridor lies adjacent to multiple obsidian sources, including substantial Massacre Lake/Guano Valley quarry areas, while in the east obsidian sources are much fewer and more distant. The eastern area is also close to large concentrations of CCS stone, including the well-known Tosawihi chert quarries located only 10 km to the south along the Upper Humboldt Plains.

We begin our discussion with a general review of tool-stone use across the project area, documenting changes in the availability and use of obsidian along the corridor. Next, we measure the intensity of obsidian production, using obsidian hydration data from across the project corridor to determine whether there were any particular places or times when flaked stone production reached peaks

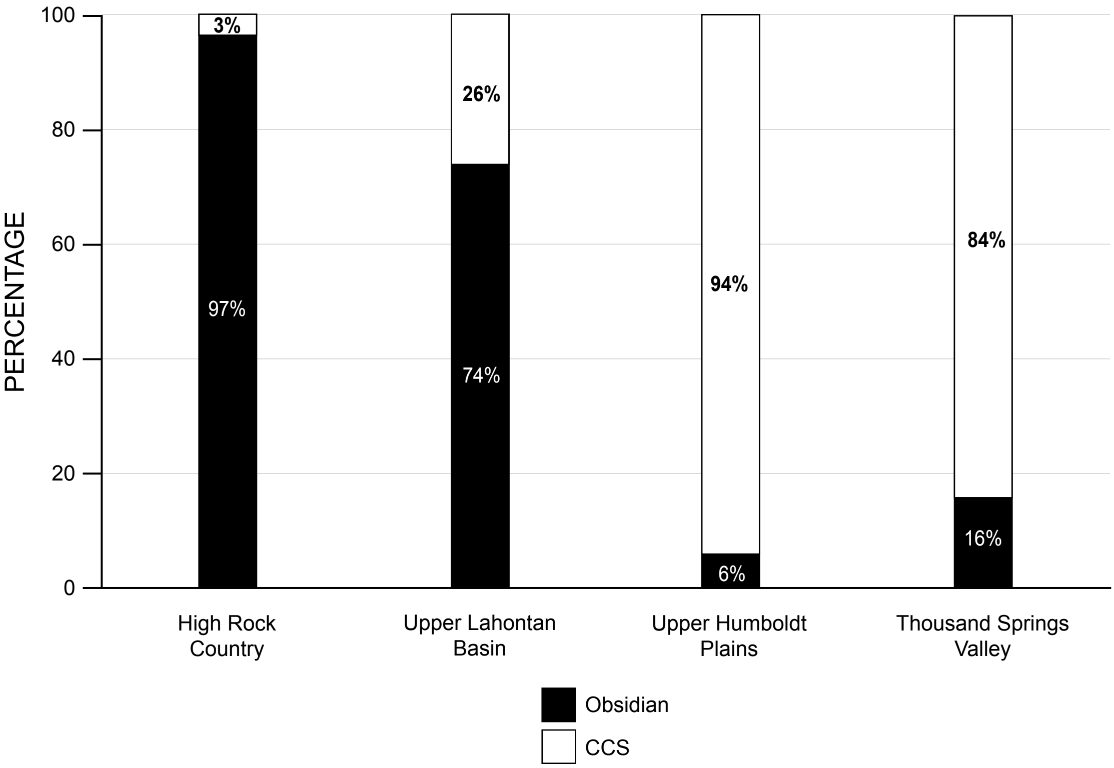


Fig. 33. Relative frequency of obsidian and cryptocrystalline silicate (CCS) tool stone along the project corridor.

similar to those outlined above. Finally, we present a technological analysis of the flaked stone tools and debitage, giving special attention to variations in biface reduction strategies across time, space, and material type.

Lithic Landscapes and Variability in Tool-stone Use

Obsidian and CCS account for almost all the tool stone used across the project corridor. Although some fine-grained volcanic materials were used (e.g., basalt), 95.5% of the projectile points (which tend to have high source diversity) were made from obsidian and CCS.

The west-to-east variability in tool-stone availability is easily seen by comparing the frequency of obsidian versus CCS recovered from the Ruby Pipeline sites (table 63; fig. 33). Combining all time periods, flaked stone tools and debitage from the High Rock County are dominated by obsidian (97%). Obsidian remains important in the Upper Lahontan Basin (74%) but drops significantly thereafter, accounting for only 6% of the Upper Humboldt Plains assemblages (partially due to the proximity of the Tosawihi chert quarries) and 16% in the Thousand Springs Valley.

From a projectwide chronological perspective, obsidian maintains a strong dominance during the Paleoindian, Paleoarchaic, and Post-Mazama periods (90% to 95%), drops in the Early Archaic (53%), increases again the Middle Archaic (82%), and trends down-

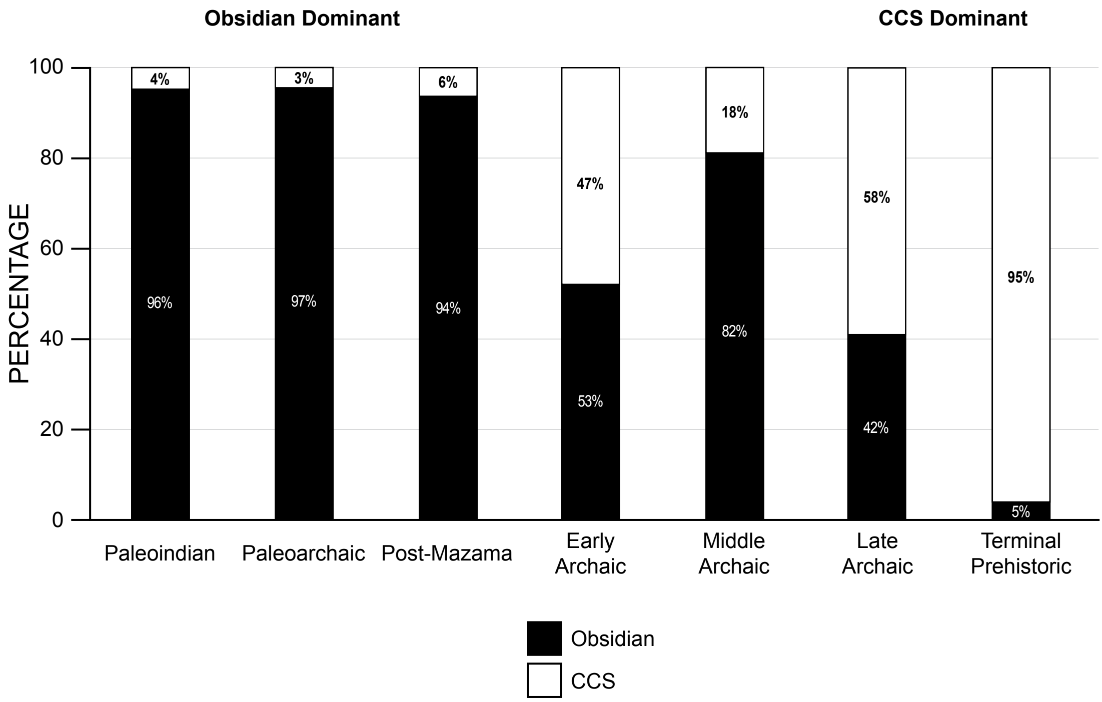


Fig. 34. Relative frequency of obsidian and CCS tool stone by time period.

ward in the Late Archaic (42%) and Terminal Prehistoric (5%) periods (table 63; fig. 34). At first glance, this shift from obsidian to CCS material in late prehistoric times is consistent with the generalized pattern of people relying more on lower quality, local materials. But it is important to emphasize that much of this trend was heavily influenced by how the project area was sequentially populated in a west-to-east fashion through most of the Holocene (see chap. 10). That is, as human populations continued to infill the less productive eastern portions of the project corridor, where obsidian was also less abundant, the overall importance of obsidian relative to CCS materials decreased over time.

Before moving on, however, we should note that there is some minor evidence for localized shifts from obsidian to CCS that are not related to the macrosettlement changes outlined below (table 64). Beginning in the Thousand Springs Valley, components dating to the early and middle Holocene (Paleoindian, Paleoarchaic, and Post-Mazama) have relatively high contributions of obsidian (64%) compared to those dating to the Early and Middle Archaic periods (33%), and late prehistoric times (7%). A similar pattern is exhibited in the Upper Humboldt Plains, where obsidian makes up 7% of the early and middle Holocene assemblages, 10% of those dating to the Early and Middle Archaic, and 2% in late prehistoric contexts. This progression is unilinear in Upper Lahontan Basin (95% to 92% to 69%), while obsidian use remains high throughout the sequence in the High Rock Country (97% to 96% to 99%).

TABLE 64
Chronological Changes in Frequency of Obsidian versus CCS Tool Stone across the Four Regions by Combined Time Periods

Combined Time Periods	High Rock Country				Upper Lahontan Basin				Upper Humboldt Plains				Thousand Springs Valley				Totals				
	Obs	%	CCS	%	Obs	%	CCS	%	Obs	%	CCS	%	Obs	%	CCS	%	Obs	%	CCS	%	All
Early and Middle Archaic	134,104	96	5067	4	2680	92	243	8	3479	10	32,894	90	4071	33	8390	67	144,334	76	46,594	24	190,928
Late Pre-historic[b]	11,018	99	150	1	15,889	69	6988	31	828	2	38,088	98	1585	7	20,449	93	29,320	31	65,675	69	94,995
Early-Middle Holocene[a]	36,566	97	1123	3	1832	95	101	5	39	7	515	93	7	64	4	36	38,444	96	1743	4	40,187
Subtotal	181,688	97	6,40	3	20,401	74	7332	26	4346	6	71,497	94	5663	16	28,843	84	212,098	65	114,012	35	
Totals	188,028				27,733				75,843				34,506				326,110				

[a] Includes Paleoindian, Paleoarchaic, and Post-Mazama.
[b] Includes Late Archaic and Terminal Prehistoric.

TABLE 65
Spatial Distribution of the Primary Obsidian Sources by Region

Table includes tools and debitage.

Source	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Nut Mountain[a]	806	–	–	–	806
Mosquito Lake	506	–	–	–	506
Bidwell Mountain	413	1	–	–	414
Massacre Lake/ Guano Valley	2388	65	–	–	2453
Craine Creek	1039	155	–	–	1194
Double H	29	464	16	–	509
Paradise Valley	1	297	310	–	608
Browns Bench	–	1	145	295	441
Subtotals	5182	983	471	295	6931
Other Sources	1031	87	108	76	1302
Totals	6213	1070	579	371	8233

[a] Nut Mountain obsidian hydration typically cannot be measured; this table includes tools and debitage.

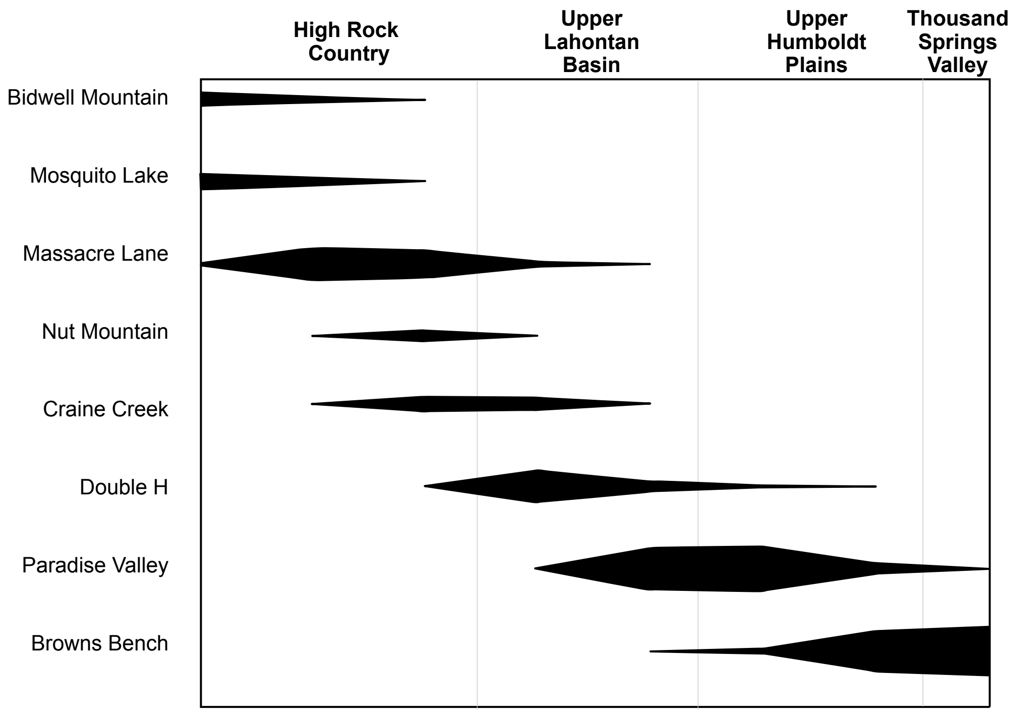


Fig. 35. Relative frequency of the primary obsidian sources along the project corridor.

Similar to the relationship between obsidian and CCS, the mix of obsidian types also shows a high level of variability across the project corridor (table 65; fig. 35). Eight geochemical sources account for 85% of the obsidian that was used, and some combination of them dominates across all four regions. Beginning in the west, the High Rock Country includes a substantial amount of Massacre Lake/Guano Valley (46%), followed by lesser amounts of Craine Creek (20%), Nut Mountain (16%), Mosquito Lake (10%), and Bidwell Mountain (8%), and little or none of the other three primary sources.

Obsidian source composition changes significantly when we move to the Upper Lahontan Basin, as Double H (47%) becomes the dominant source, followed by Paradise Valley (30%) and Craine Creek (16%), with only minor contributions from Massacre Lake/Guano Valley (7%). Source diversity decreases when farther to the east, as Paradise Valley (66%), Browns Bench (31%), and Double H (3%) are the only primary obsidians represented in Upper Humboldt Plains, while Browns Bench (100%) is the only one found in Thousand Springs Valley.

Although the minor obsidian sources make up only 15% of the total sample, they include about 50 geochemical groups (table 66). Over half of these are represented by fewer than 10 items, and only five sources individually comprise more than 2% of the overall sample. Most of these minor sources (N = 25) occur at sites in the High Rock Country. Twelve of these are also found in the Upper Lahontan Basin, along with the three additional new sources. The frequency of minor sources drops to 11 in the Upper Humboldt Plains, including five from the western regions and seven found for the first time at the project sites. Finally, nine sources are represented in Thousand Springs Valley, six from the west and three appearing for the first time.

Intensity of Production of the Eight Primary Obsidian Sources

Changes in the intensity of obsidian production and use can be measured by tracking the frequency of hydration readings over time. Beginning in the west, the Massacre Lake/Guano Valley obsidian hydration readings (*N* = 2173) start in the Paleoindian Period and steadily increase over time (fig. 36A). They reach peak frequency in the Middle Archaic Period and drop thereafter, reaching a low in the Terminal Prehistoric Period. When these numbers are time averaged to correct for the differential length of the individual time periods, however, the Middle Archaic increase (281 readings per 1000 years) continues into the Late Archaic Period (334 readings per 1000 years), but still drops in the Terminal Prehistoric Period (only 138 readings per 1000 years).

Craine Creek obsidian produces a similar profile, but its peak is largely restricted to the Middle Archaic Period (fig. 36B). This is true for both the absolute counts and the time-averaged data. The decline from the Middle Archaic (188/1000 years) to the Late Archaic (166/1000 years) is rather slow, the numbers show a precipitous drop at the Terminal Prehistoric Period (12/1000 years).

The other three major western obsidian sources include Mosquito Lake, Bidwell Mountain, and Nut Mountain. For the most part, Nut Mountain obsidian does not produce visible hydration rims, so it cannot contribute to this analysis. Reasonable samples are available for Mosquito Lake (*N* = 435) and Bidwell Mountain (*N* = 380), and both source groups appear to produce much flatter, less dynamic profiles than Massacre Lake/Guano Valley and Craine Creek (fig. 37). When we average by time, however, they show patterns comparable to the larger obsidian samples. Mosquito Lake obsidian hydration frequencies stay rather low and flat through the Paleoindian and Paleoarchaic periods, increase during the Post-Mazama and Early Archaic periods, and again during the Middle and Late Archaic, and drop thereafter. Bidwell Mountain is similar, except that the Paleoindian and Paleoarchaic periods have slightly higher representation than for the other sources.

Moving east to the Upper Lahontan Basin, the Double H obsidian hydration profile is quite similar to that for Mosquito Lake, staying rather low and flat through the Paleoindian and Paleoarchaic periods, increasing somewhat during the Post-Mazama and Early Archaic periods, reaching a peak in the Middle and Late Archaic, and dropping again thereafter (fig. 38).

Farther east, however, the patterns begin to change, perhaps due to the increased presence of late prehistoric peoples in these areas. Beginning with Paradise Valley obsidian, hydration frequencies increase through time, but the Late Archaic Period produces much higher time-averaged values (153/1000 years) than the Middle Archaic (81/1000 years), and the Terminal Prehistoric decline seen in the other profiles is now quite muted (104/1000 years). The most ex-

TABLE 66
Spatial Distribution of Minor Obsidian Sources by Region

Source	High Rock Country	Upper Lahontan Basin	Upper Humboldt Plains	Thousand Springs Valley	Totals
Unknown	415	23	13	8	459
Surveyor Spring	211	–	–	–	211
Long Valley	109	–	–	–	109
Browns Bench area	–	1	55	26	82
Buck Mountain	53	1	–	–	54
Badger Creek	48	2	–	–	50
Bordwell Spring	27	5	–	–	32
Fox Mountain	21	6	–	–	27
Pinto Peak	20	4	–	–	24
Malad	–	–	3	20	23
Majuba Mountain	4	9	9	–	22
Hawks Valley	14	6	–	–	20
Summit Lake	20	–	–	–	20
Beatys Butte	16	3	–	–	19
Blue Spring	18	–	–	–	18
Owyhee	–	4	14	–	18
Sugar Hill	13	–	–	–	13
Topaz Mountain	–	–	1	12	13
Mount Hicks	–	10	–	–	10
Rainbow Mine	10	–	–	–	10
Coal Bank Spring (Browns Bench area)	–	–	5	4	9
Big Southern Butte	–	–	5	2	7
South Warners	6	1	–	–	7
Whitehorse	3	4	–	–	7
Buffalo Hills	5	1	–	–	6
Drews Creek/Butcher Flat	3	–	–	–	3
Bodie Hills	2	–	–	–	2
Double O	2	–	–	–	2
Badlands	–	–	1	–	1
Bear Gulch	–	–	1	–	1
East Medicine Lake	1	–	–	–	1
Ferguson Wash	–	–	–	1	1
Horse Mountain	1	–	–	–	1
McComb Butte	1	–	–	–	1
Queen	–	–	1	–	1
Spodue Mountain	1	–	–	–	1
Timber Butte	–	–	–	1	1
Tucker Hill	1	–	–	–	1
Walcott Tuff	–	–	–	1	1
Totals	1025	80	108	75	1288

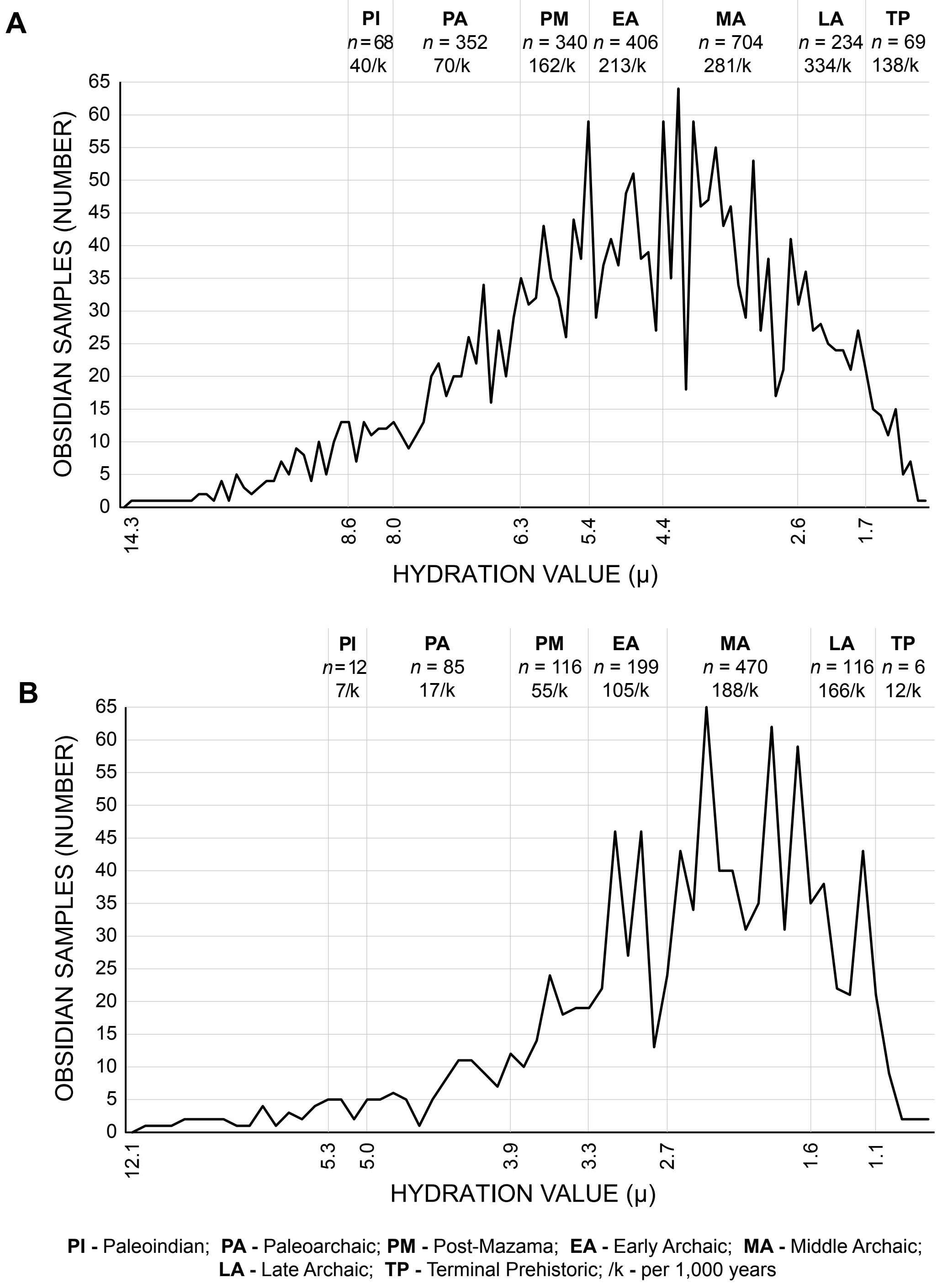
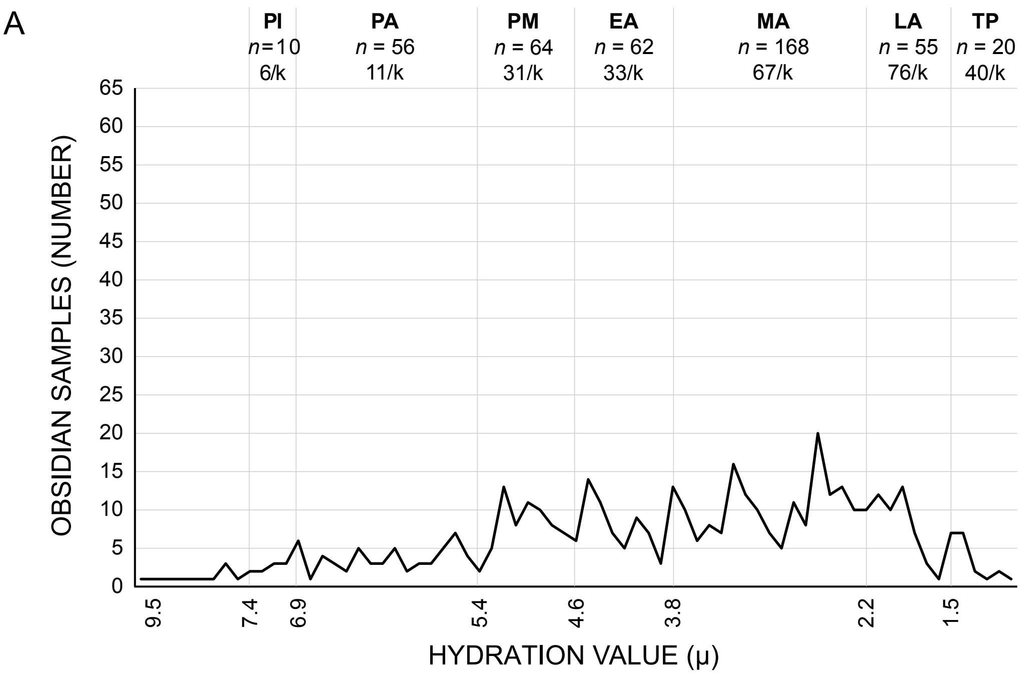
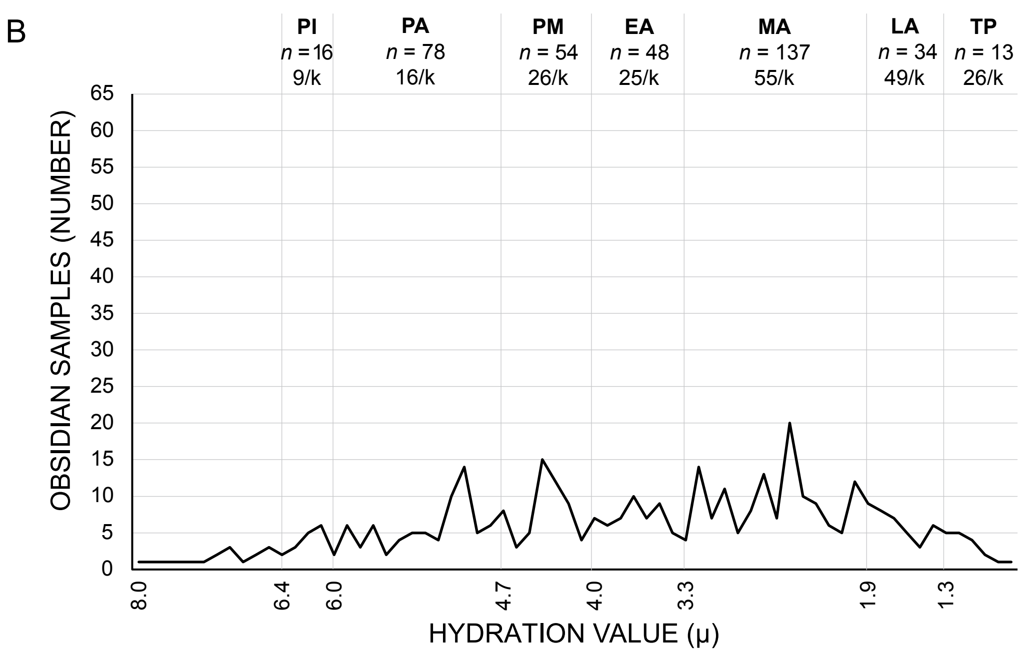


Fig. 36. Composite obsidian hydration profiles for (**A**) Massacre Lake/Guano Valley and (**B**) Craine Creek obsidians.





PI - Paleoindian; **PA -** Paleoarchaic; **PM -** Post-Mazama; **EA -** Early Archaic; **MA -** Middle Archaic; **LA -** Late Archaic; **TP -** Terminal Prehistoric; /k - per 1,000 years

Fig. 37. Composite obsidian hydration profiles for (**A**) Mosquito Lake and (**B**) Bidwell Mountain obsidians.

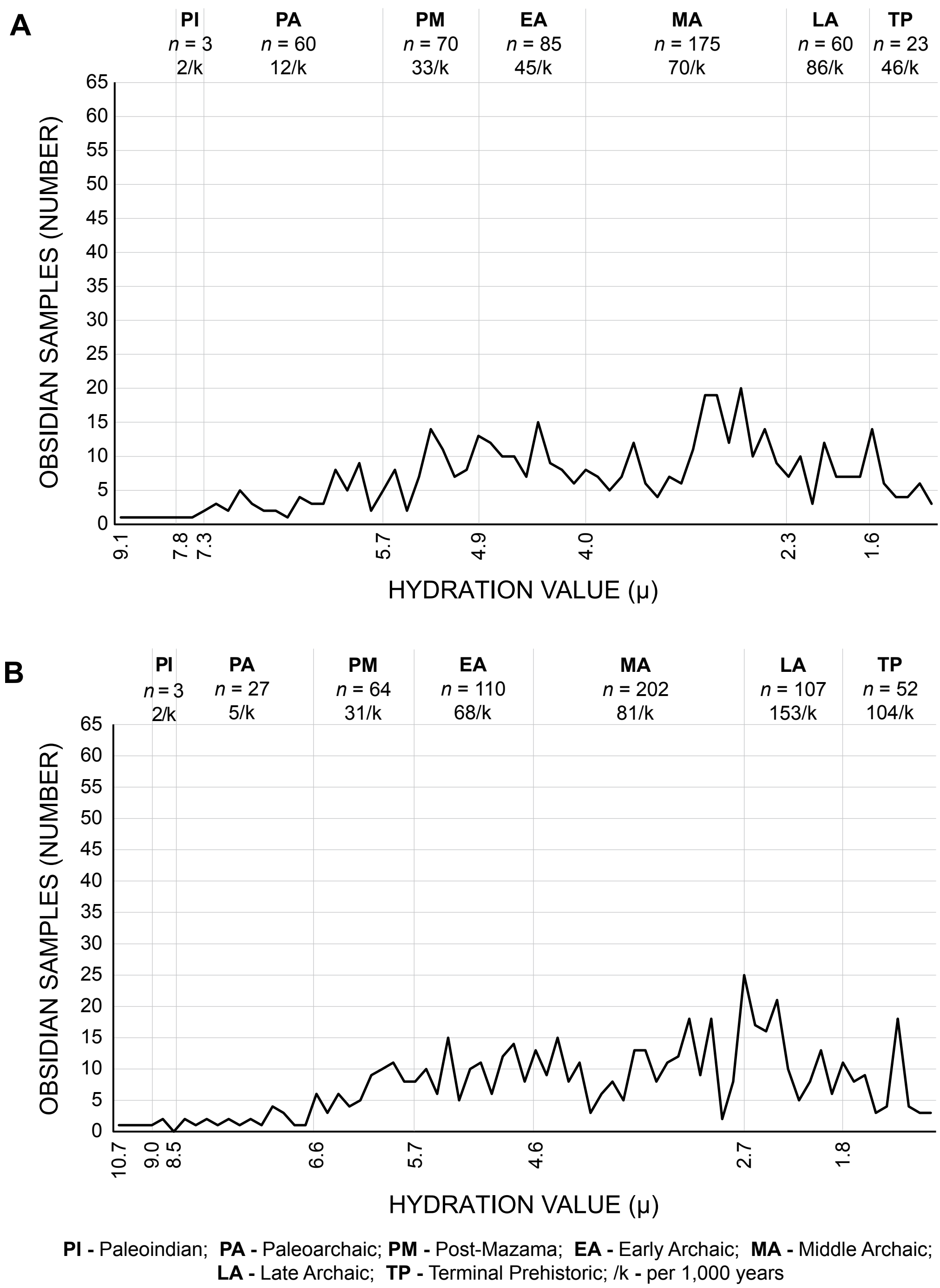
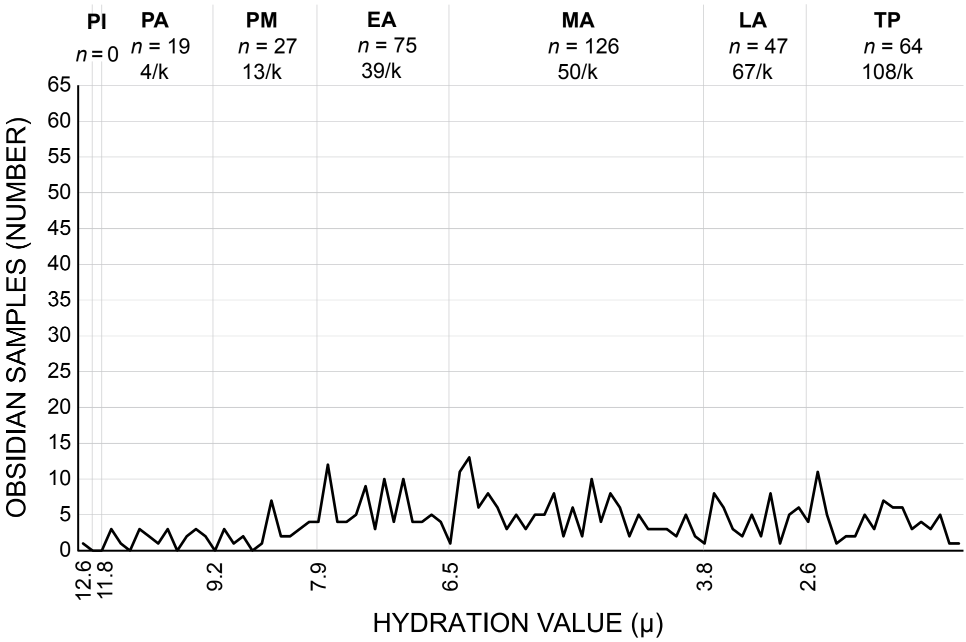


Fig. 38. Composite obsidian hydration profiles for (**A**) Double H and (**B**) Paradise Valley obsidians.



PI - Paleoindian; **PA -** Paleoarchaic; **PM -** Post-Mazama; **EA -** Early Archaic; **MA -** Middle Archaic; **LA -** Late Archaic; **TP -** Terminal Prehistoric; /k - per 1,000 years

Fig. 39. Composite obsidian hydration profiles for Browns Bench obsidian.

treme version of this change is illustrated by Browns Bench obsidian (fig. 39), which occurs at sites in the Upper Humboldt Plains and is the only primary obsidian source in Thousand Springs Valley (closest to the source). It shows a rather slow unilinear increase over time, with a Terminal Prehistoric time-averaged value of 108/1000 years, much higher than for any other time period.

Discussion

With the exception of Paradise Valley and Browns Bench, which are the two easternmost obsidian sources along the project corridor, the production profiles for the major obsidian sources found at the project site are somewhat similar to those observed for other obsidian quarries along the Sierra-Cascade Front (Hall, 1983; Gilreath and Hildebrandt, 1997, 2011; Ramos, 2000; Hildebrandt and McGuire, 2002; McGuire, 2002; King et al., 2011), but also differ in a variety of ways. First, the size of the Middle and Late Archaic peaks in the current study area are smaller than those exhibited in most of these other areas. For example, the time-averaged hydration values from the Coso Volcanic Field go up threefold from the Early to the Middle Archaic (Gilreath and Hildebrandt, 1997), while this factor of increase is only 1.3 and 1.8 for Massacre Lake/Guano Valley and Craine Creek, respectively.

Secondly, the relationship between Massacre Lake/Guano Valley and Craine Creek (the only true obsidian quarry complexes physically intersecting the pipeline corridor) and Mosquito Lake and Bidwell Mountain obsidian (represented by a few places where low-density float material enters the corridor) also differs from other outlying areas. Farther west along the Sierran-Cascade Front in northeastern California, McGuire (2002) found that a wide range of obsidian sources were used on a casual-encounter basis until the Middle Archaic Period, when a smaller number of high quality sources became the focus of tool-stone production activity. He attributed this change in strategy to an overall decrease in residential mobility accompanied by targeted, logistically based exploitation of fewer but higher-quality sources (see also Smith, 2010, 2011). This decrease in diversity is not apparent in the current sample, as use of all four of the obsidian sources, both major and minor, followed parallel patterns over time.

Based on the abbreviated Middle and Late Archaic production peaks, and the lack of a specialized focus on a limited number of high-quality obsidian outcrops during these intervals, we conclude that the production of surplus obsidian for exchange was probably not a primary activity in the High Rock Country. This is not too surprising, given the lack of large consumer populations living in adjacent areas (unlike cismontane California), as well as the presence of many obsidian and high-quality CCS sources that adjoining people could have easily accessed themselves. This is clearly illustrated by how quickly the mix of obsidian sources changes along the project transect, and how CCS becomes so important in the Upper Humboldt Plains and Thousand Springs Valley (see figs. 33 and 35).

A final topic involving the obsidian hydration profiles is the apparent decrease in production activity during late prehistoric times among the western sources (and similar to the major quarries along the Sierra-Cascade Front). Attributing this decline to the collapse of large-scale exchange systems during the MCA is obviously not appropriate here, if we are correct that obsidian trade was never a major activity for the occupants of this region. The introduction of bow-and-arrow technology is a more likely cause, as the smaller arrow tips did not require the large-scale bifacing industries of earlier times, reducing the need for raw tool stone. It is important to remember, however, that Paradise Valley obsidian densities decreased only slightly in the Terminal Prehistoric Period, and the Browns Bench sample actually shows an increase, further complicating our reconstruction of these relationships.

Flaked Stone Technology

We now turn our attention to flaked stone technological patterns, with the goal of addressing the possible late prehistoric decline in stoneworking discussed above, and reviewing the variety of reduction strategies that were used across the Holocene. Beginning with an atemporal analysis of biface stages and material types (table 67), we see that their composition is quite similar to the full assemblages described above. Obsidian specimens make up 95% of the High Rock County tools but drop to 75% in the Upper Lahontan Basin, 7% in the Upper Humboldt Plains, and 28% in Thousand Springs Valley. Early-stage obsidian bifaces (i.e., stages 1, 2, and 3) comprise 33% of the High Rock County assemblage (consistent with the high number of quarry areas there), while this frequency drops to 11% in the Upper Lahontan Basin, 15% in Upper Humboldt Plains, and 14% in Thousand

TABLE 67
Biface Stages by Region and Material Type

Material	Stages							
	1	2	3	4	5	Pressure Flaking Only	Totals	Indeterminate
High Rock Country								
Obsidian	27	387	544	468	1396	63	2885	893
CCS	2	18	26	26	50	15	137	61
Totals	29	405	570	494	1446	78	3022	954
Upper Lahontan Basin								
Obsidian	–	10	26	34	224	45	339	101
CCS	–	11	4	6	64	21	106	43
Totals	–	21	30	40	288	66	445	144
Upper Humboldt Plains								
Obsidian	–	6	5	4	45	13	73	7
CCS	–	121	275	181	241	91	909	228
Totals	–	127	280	185	286	104	982	235
Thousand Springs Valley								
Obsidian		7	11	12	96	3	129	9
CCS	1	41	87	58	65	40	292	57
Totals	1	48	98	70	161	43	421	66

Springs Valley, due to the lack of nearby obsidian sources (table 67; fig. 40).

Biface stages for nonobsidian (largely CCS) specimens follow a reciprocal pattern in the east, as early-stage forms are relatively abundant in Thousand Springs Valley (44%) and Upper Humboldt Plains (44%) where CCS tool stone is more abundant (table 67; fig. 40). Upper Lahontan Valley has only 15% early-stage bifaces, probably reflecting the overall lack of naturally occurring CCS and obsidian tool stone in the region, while they are twice as frequent in the High Rock Country (34%), where a limited number of CCS sources were exploited.

A chronological analysis of bifaces from the entire project corridor shows a variety of interesting patterns (Paleoindian assemblages are excluded from further discussion because there are so few bifaces from this interval). First, the raw frequency of bifaces (and debitage) changes significantly over time: they show a sharp increase from the Post-Mazama to the Early Archaic Period, reach an all-time high during the Middle Archaic Period, and drop precipitously thereafter (table 68; fig. 41A). In fact, there are 10 times as many bifaces and 30 times as many pieces of debitage in Middle Archaic components than in those dating to the Terminal Prehistoric Period. When the raw-frequency data are converted to the number of items per 1000 years (fig. 41B), the peak in bifaces moves to the Late Archaic (as does the debitage). The significant decline in flaked stone production activity during the Terminal Prehistoric Period is still apparent.

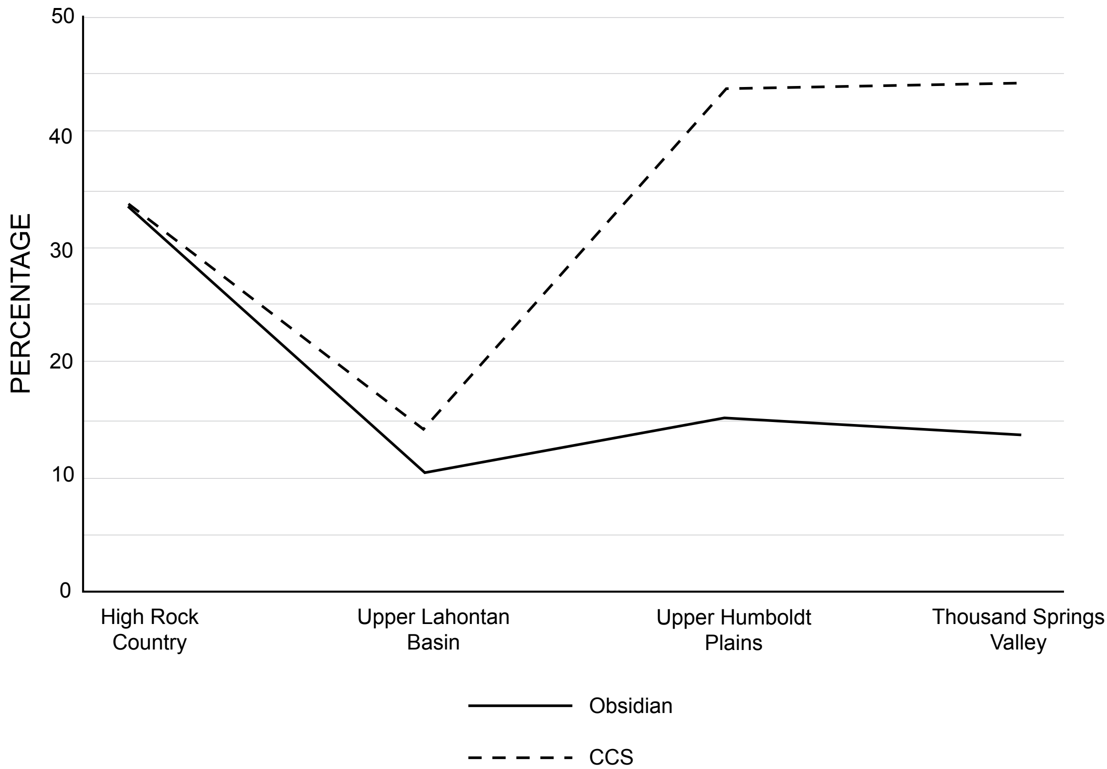


Fig. 40. Relative frequency of early-stage bifaces (stages 1, 2, and 3) by material type.

Biface size profiles also show some interesting changes over time (table 69). We use thickness as a proxy measure, because it is least affected by fragmentation. Although some small fragments (e.g., margins) lack their full thicknesses, we are willing to live with this problem, as it allows us to use the largest possible sample of specimens for the analysis. As we would expect, obsidian bifaces become thinner as they move down the reduction sequence. This basic progression holds for all time periods, but it is important to note that artifacts from the earlier time periods tend to be thicker than the later ones, across all stages. Stage 5 bifaces are a good example: there is a decrease in size, beginning with the Paleoarchaic (6.7 mm) and progressing forward through time (Post-Mazama, 5.5 mm; Early Archaic, 5.0 mm; Middle Archaic, 5.2 mm; Late Archaic, 2.9 mm; and Terminal Prehistoric, 2.6 mm). The major decrease in size between the Middle and Late Archaic periods appears to represent the shift to the bow and arrow, as the mean thickness of Elko points within the larger projectwide sample is 4.9 mm, while that for Rosegate is only 3.3 mm.

The CCS sample follows the same basic pattern, as these specimens also tend to get thinner over time (table 69). They differ from the obsidian bifaces from the Terminal Prehistoric Period, however, as the Stage 4 and 5 specimens seem too thick to reflect an arrow-point reduction sequence. It may be

TABLE 68
Biface Stages by Time Period and Material Type

Material	Stages							
	1	2	3	4	5	Pressure Flaking Only	Totals	Indeterminate
Terminal Prehistoric								
Obsidian	–	3	–	1	7	3	14	1
Other	–	13	14	12	24	10	73	12
Totals	–	16	14	13	31	13	87	13
Late Archaic								
Obsidian	–	10	13	8	116	14	161	35
Other	–	19	41	25	72	31	188	56
Totals	–	29	54	33	188	45	349	91
Middle Archaic								
Obsidian	1	72	103	110	387	20	693	281
Other	–	39	62	36	61	23	221	67
Totals	1	111	165	146	448	43	914	348
Early Archaic								
Obsidian	3	33	50	28	91	4	209	46
Other	1	26	47	30	22	11	137	34
Totals	4	59	97	58	113	15	346	80
Post-Mazama								
Obsidian	2	12	13	8	16	–	51	20
Other	–	1	3	5	4	1	14	3
Totals	2	13	16	13	20	1	65	23
Paleoarchaic								
Obsidian	1	16	24	26	40	1	108	26
Other	–	1	2	4	4	1	12	3
Totals	1	17	26	30	44	2	120	29
Paleoindian								
Obsidian	–	1	1	2	4	–	8	–
Other	–	–	–	–	1	–	1	–
Totals	1	3	4	6	10	0	9	0

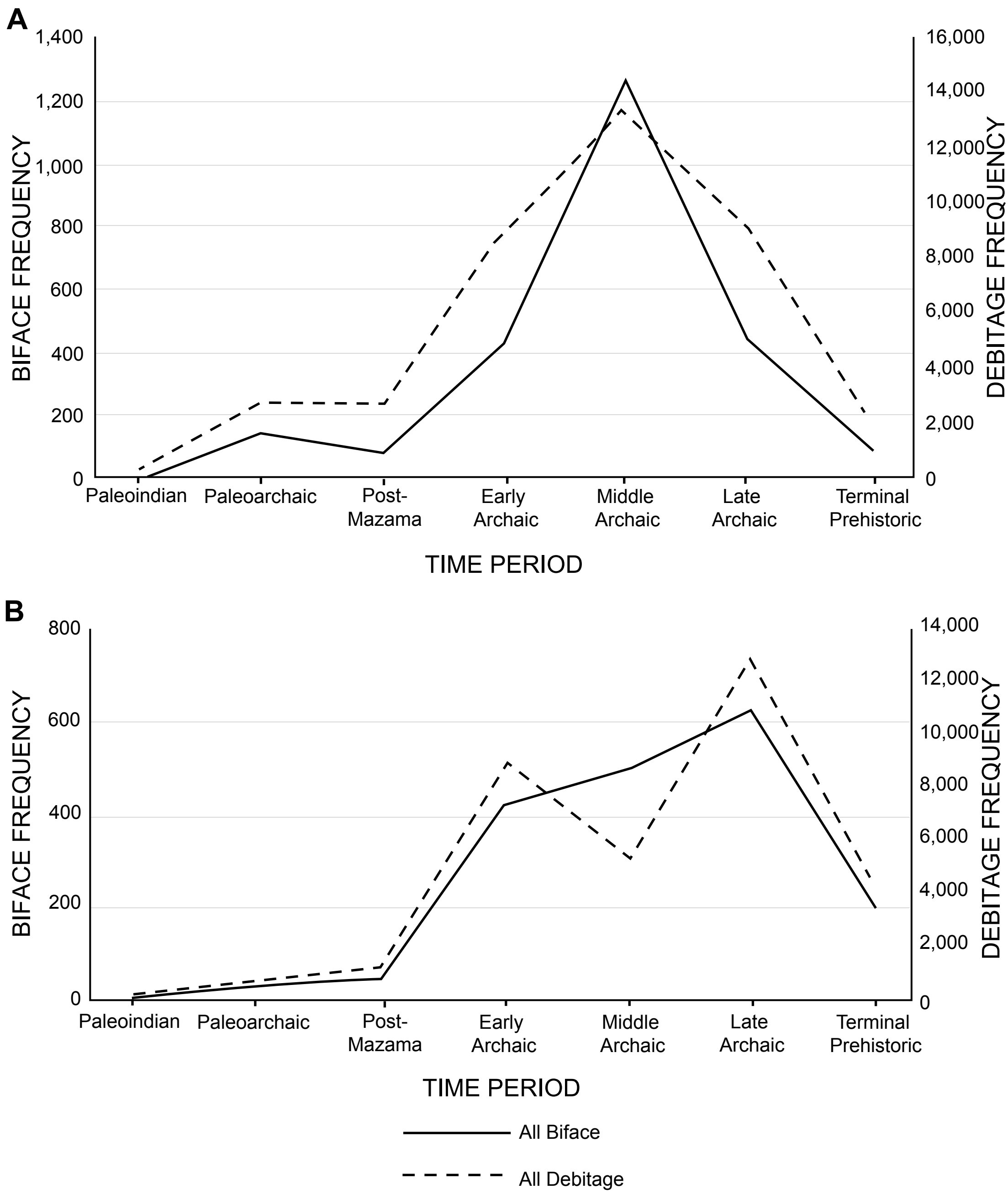


Fig. 41. **A.** Absolute frequency of bifaces and debitage by time period. **B.** Time-averaged frequency of biface and debitage by time period (items per 1000 years).

TABLE 69
Biface Thickness by Material Type, Reduction Stage, and Time Period
CCS = cryptocrystalline silicate.

Reduction Stage	Average Thickness (mm)				Reduction Stage	Average Thickness (mm)			
	Obsidian	*n*	CCS	*n*		Obsidian	*n*	CCS	*n*
Terminal Prehistoric					Late Archaic				
Stage 5	2.6	7	4.7	23	Stage 5	2.9	116	3.7	71
Stage 4	4.2	1	9.3	11	Stage 4	6.5	8	6.7	25
Stage 3	–	–	13.1	14	Stage 3	17.1	13	9.8	41
Stage 2	15.2	3	14.9	13	Stage 2	20.1	10	11.4	19
Stage 1	–	–	–	–	Stage 1	–	–	–	–
Middle Archaic					Early Archaic				
Stage 5	5.2	387	5.8	57	Stage 5	5	91	6.2	21
Stage 4	7.4	110	8	32	Stage 4	8	28	8.2	28
Stage 3	10.7	103	13	53	Stage 3	10.9	50	12	44
Stage 2	13.5	72	14.4	28	Stage 2	23.3	33	15.2	20
Stage 1	18.1	1	–	–	Stage 1	27.1	3	5.5	1
Post-Mazama					Paleoarchaic				
Stage 5	5.5	16	5.1	3	Stage 5	6.7	40	8	3
Stage 4	8	8	8.4	4	Stage 4	8.5	26	8.6	4
Stage 3	14.8	13	14.9	1	Stage 3	11	24	11.3	2
Stage 2	12.9	12	–	–	Stage 2	19.3	16	21.8	1
Stage 1	24.4	2	–	–	Stage 1	41.6	1	–	–

that some of the CCS specimens were designed to be used a knives or as some other multifunction tool.

We now focus on the relative frequency of biface stages over time. The profile changes little during the Paleoarchaic and Post-Mazama periods, with Stage 5/pressure-only specimens being slightly more abundant (fig. 42). Stage 5 bifaces begin to increase in frequency in the Early Archaic, culminating in a Late Archaic peak (67%) and a modest decrease thereafter (51%). So why would the frequency of Stage 5 bifaces increase in this manner over time? One possibility is that many Stage 5 bifaces are worn-out tools (projectile points and knives) that were discarded and replaced with new ones, a possibility that is supported by the thickness data, and that much of this activity occurred in residential settings when people had the time to refurbish their toolkits.

This hypothesis is partially confirmed by changes in the mix of site component types over time (fig. 43). For the Paleoarchaic and Post-Mazama periods (particularly the latter), there is a low percentage of habitation components (both simple and complex) relative to flaked stone components. The percentage of habitation components increases in a unilinear fashion through the Late Archaic Period and drops slightly thereafter, following a pattern quite similar to the Stage 5/pressure-only bifaces.

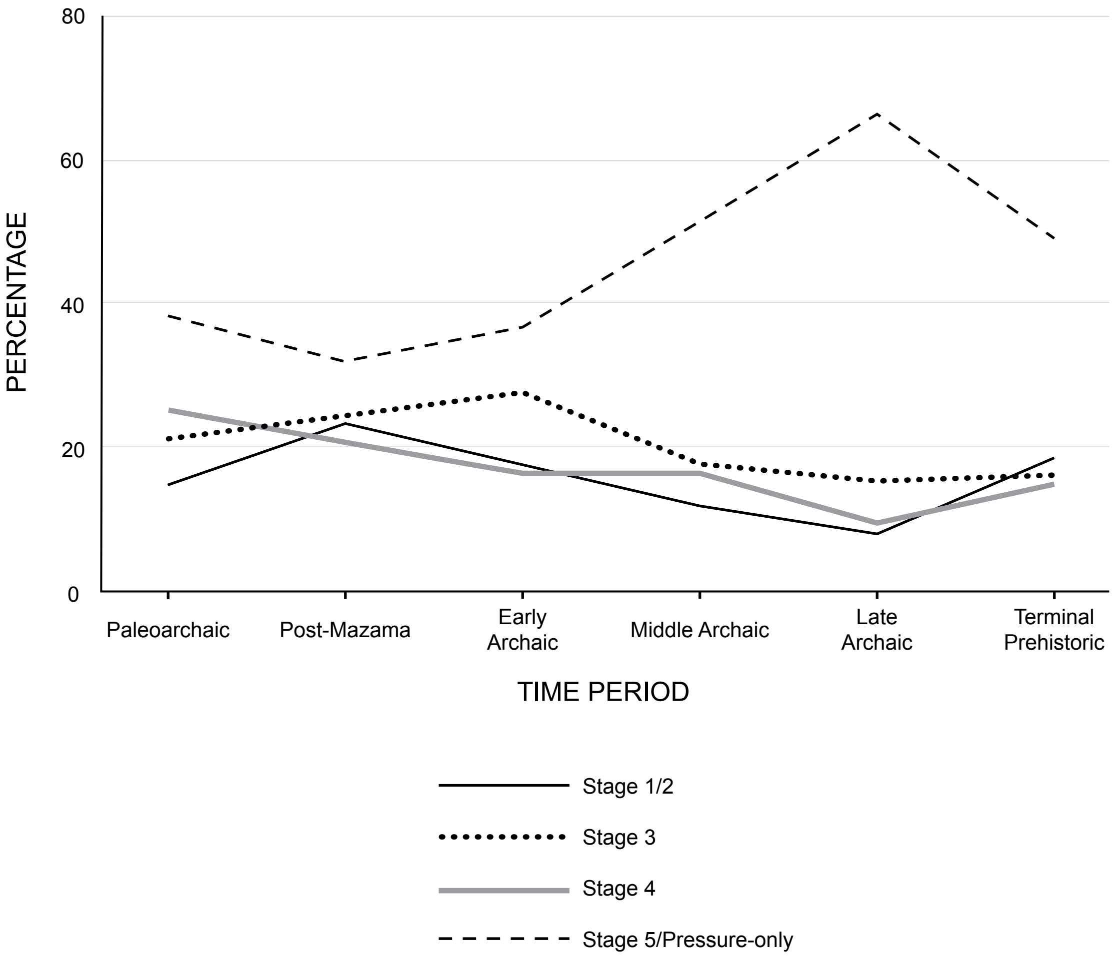


Fig. 42. Biface stages by time period.

Reduction patterns produced by the debitage are largely consistent with those of the bifaces (table 70; fig. 44). In the Paleoarchaic, Post-Mazama, Early Archaic, and Middle Archaic samples, obsidian cobble-core reduction debris is dominant, followed by near-equal amounts of biface thinning and finishing debris. This basic biface reduction sequence changed with the advent of the Late Archaic and Terminal Prehistoric periods, and finishing-debris surpasses biface-thinning flakes in those samples. The CCS debitage trends are similar (table 70; fig. 44), also showing higher frequencies of finishing debris than biface thinning during the Late Archaic and Terminal Prehistoric periods. The increased abundance of finishing debris late in time, like the bifaces, seems to correlate with the discard and replacement of worn-out tools at residential sites.

The Late Archaic and Terminal Prehistoric shift in reduction strategy is also illustrated by tracking the relative percentage of “pressure only” bifaces and biface thinning

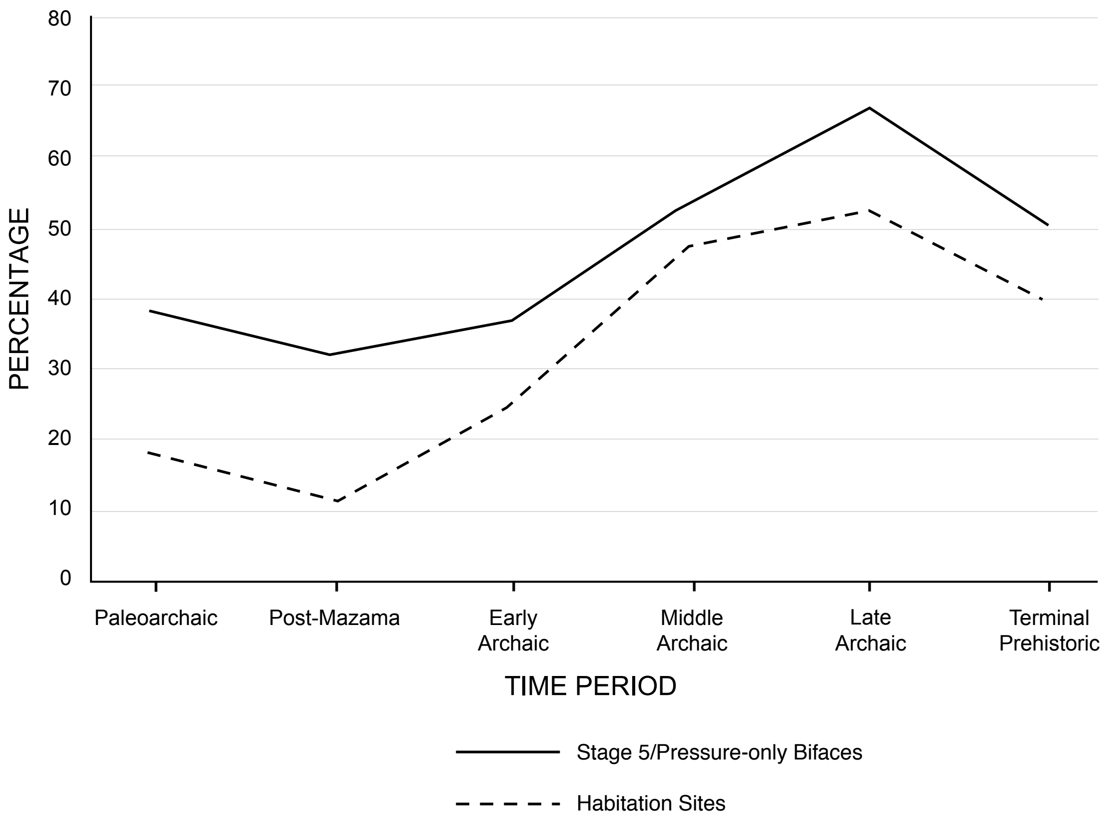


Fig. 43. Relationship between late-stage bifaces and habitation sites.

debris over time (fig. 45). As outlined in chapter 4, pressure-only bifaces are simple flake blanks that did not go through the standard biface reduction trajectory (i.e., they were not thinned) but show pressure-flake removal (finishing). Their relative abundance remained low until the Late Archaic and Terminal Prehistoric periods, when they doubled in frequency, at the same time that the percentage of biface-thinning flakes dropped by half. These findings, when combined with the larger debitage sample, indicate that Late Archaic and Terminal Prehistoric people were not always tied to the full biface reduction strategy.

Summary and Conclusions

The foregoing discussion demonstrates that obsidian tool stone was quite abundant along the western end of the project corridor but decreased in availability as we head east out of the High Rock Country. All forms of tool stone appear to have been relatively rare in the Upper Lahontan Basin, but the abundance of high quality CCS material increases significantly in the Upper Humboldt Plains and Thousand Springs Valley regions. Reconstruction of flaked stone production patterns was much easier for obsidian than for CCS, as we were able to identify the locations of key obsidian quarry areas through X-ray flu-

TABLE 70

Technological Analysis of Debitage according to Time Period and Material Type

Tables do not include unassigned (noncomponent) debitage analysis. CORT = cortical; SINT = simple interior; SINT/CP = simple interior/complex platform; LIN = linear; CINT = complex interior; EP = edge preparation; EBT = early biface thinning; LBT = late biface thinning; EPR = early pressure; LPR = late pressure; NPR = notching pressure; PP = platform preparation/pressure.

Period	Diagnostic Flake Attributes															Totals
	CORT	SINT	SINT/CP	LIN	CINT	%	EP	EBT	LBT	%	EPR	LPR	NPR	PP	%	
Obsidian																
Terminal Prehistoric	26	139	6	0	8	45	3	13	34	12	8	91	0	74	43	402
Late Archaic	630	1501	85	61	70	60	49	116	258	11	42	431	7	662	29	3912
Middle Archaic	1241	3394	461	5	287	52	230	940	1423	25	79	756	14	1483	23	10,313
Early Archaic	920	1784	122	5	233	59	110	445	603	22	61	415	12	515	19	5225
Post-Mazama	289	910	143	0	68	59	44	233	334	25	8	92	2	287	16	2410
Paleoarchaic	264	870	92	0	83	51	63	260	314	25	37	231	1	377	25	2592
Paleoindian	38	126	9	0	27	65	16	38	42	31	0	2	0	9	4	307
Totals	3408	8724	918	71	776	55	515	2045	3008	22	235	2018	36	3407	23	25,161
CCS																
Terminal Prehistoric	25	655	100	0	4	44	65	205	210	27	79	184	1	260	29	1788
Late Archaic	46	1701	329	0	17	40	161	448	558	22	201	859	9	871	37	5200
Middle Archaic	60	1286	179	0	20	49	91	339	367	25	86	340	4	392	26	3164
Early Archaic	63	1577	419	0	22	55	177	567	437	31	40	152	2	360	15	3816
Post-Mazama	2	116	12	0	1	56	3	21	19	19	4	25	0	29	25	232
Paleoarchaic	4	62	3	0	0	51	2	18	14	25	1	11	0	21	24	136
Paleoindian	2	4	1	0	0	88	0	1	0	13	0	0	0	0	0	8
Totals	202	5401	1043	0	64	47	499	1599	1605	26	411	,571	16	1933	27	14,344

orescence analysis and generate age estimates through obsidian hydration dating. Despite these differences in analytical resolution, our focus on both CCS and obsidian materials from single-component areas allowed us to learn a great deal about the changes in settlement and flaked stone reduction strategies that took place over time.

During the Paleoindian Period, for which we have only small samples, people probably used multiple obsidian quarry areas on a casual-encounter basis as they moved through the area. This generalized approach appears to have continued during the Paleoarchaic and Post-Mazama periods, with much of the record composed of scatters of flaked stone with a high proportion of early-stage reduction debris. With the exception of a handful of habitation areas, it appears that most people did not stay very long within the project corridor, content to obtain flaked stone material in relatively rough form and move on to other locations before modifying it further.

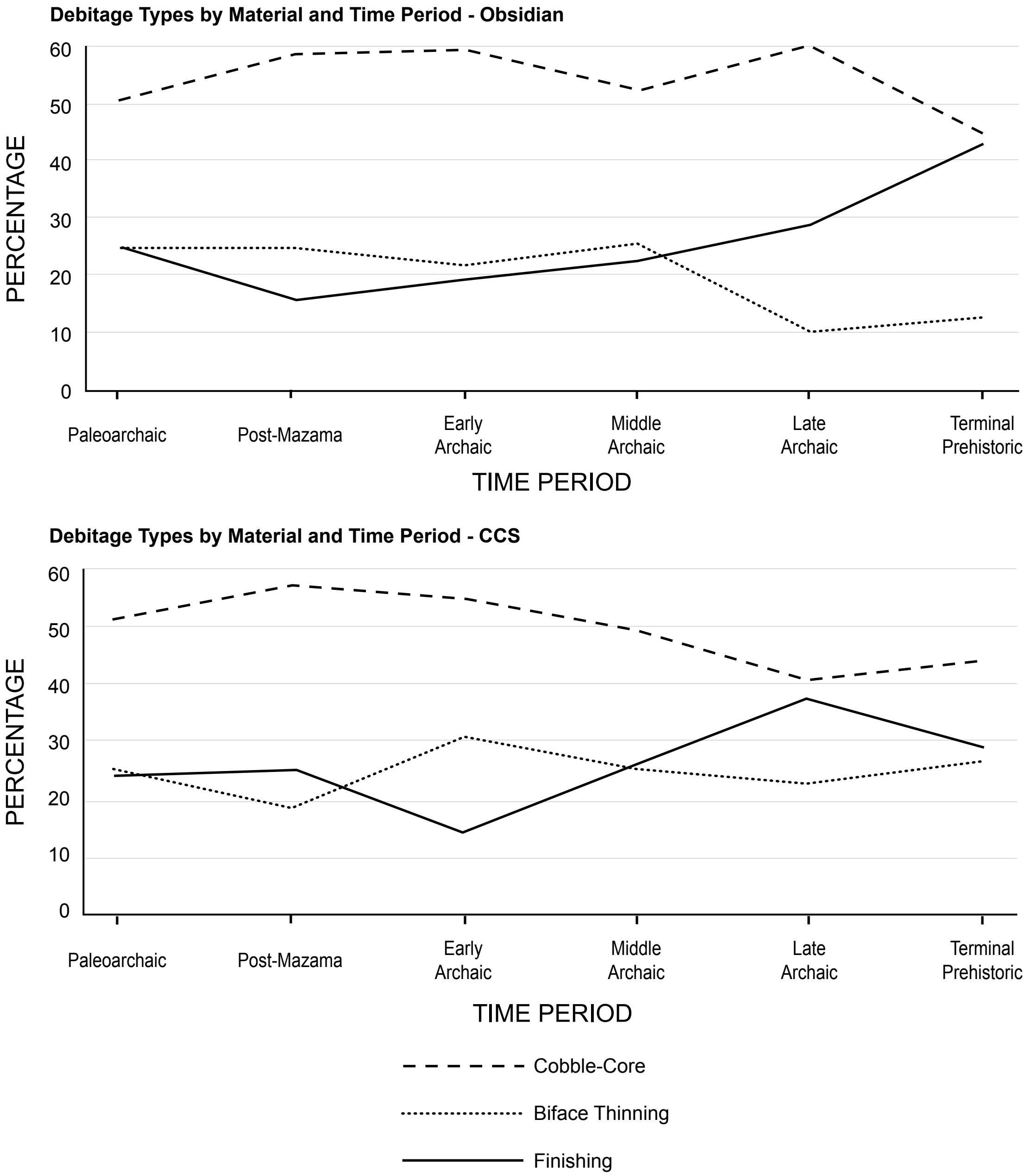


Fig. 44. Debitage types by material and time period.

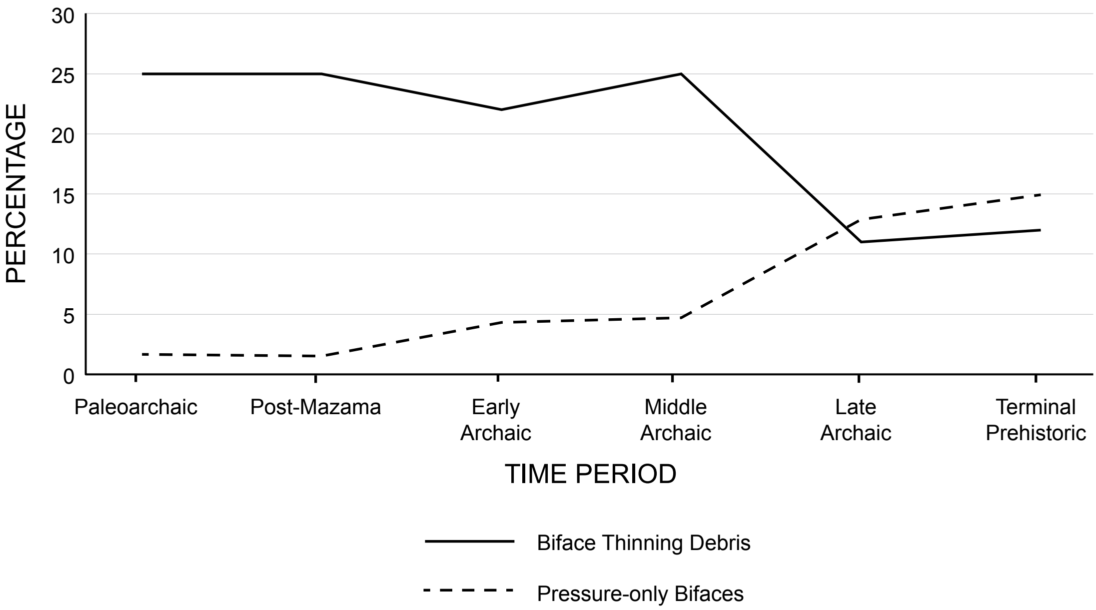


Fig. 45. Biface thinning debris versus pressure-only bifaces.

Beginning in the Early Archaic Period, and extending into Middle and Late Archaic, populations increased within the region, and people began to intensify their production of flaked stone tools, particularly using Massacre Lake/Guano Valley and Craine Creek obsidians. We suspect that this also occurred at the Tosawihi chert quarries, but it is difficult to confirm due to our inability to directly date CCS material. Because there was a higher degree of residential settlement in the area at this time, it is possible that specialized visits to the quarries took place more often than had been the case earlier in time.

The Middle and Late Archaic peak in obsidian production has been observed elsewhere along the Sierran-Cascade Front and is often attributed to the production of surplus bifacial blanks for exchange. This does not seem to be the case in the current project, where the peak is less dramatic. There are multiple obsidian sources located to the west and east of the primary quarries in the High Rock Country, so it appears that there was not much of a market for the primary obsidian sources like Massacre Lake/Guano Valley in these areas, as they did not travel very far. If some of the Massacre Lake/Guano Valley obsidian was produced for exchange, it should be found in more southerly locations and in abundances much greater than the lesser sources like Mosquito Lake and Bidwell Mountain, which never experienced the same level of production. Additional research is necessary to determine whether this was the case.

As flaked stone production continued to intensify into the Late Archaic Period, greater emphasis was placed on the use of CCS material as the overall population of northern Nevada increased and people started flowing into the less productive eastern portions of the corridor. The Late Archaic and Terminal Prehistoric periods also saw a change in flaked stone reduction strategies. Rather than always implementing the full biface reduction sequence that had been followed for thousands of years, many people took flake blanks and pressure flaked them into finished implements, entirely bypassing the biface-thinning phase of production.

Finally, irrespective of the flaked stone technology, there was a truly remarkable overall decrease in flaked stone activity during the Terminal Prehistoric Period. As outlined above (see fig. 41), the number of items deposited per unit time is almost identical to that found during the Early Archaic Period (more than 4000 years earlier), when most researchers think population densities were much lower. There was also a fourfold decrease in the intensity of flaked stoneworking compared to the preceding Late Archaic Period. Although some might argue that this could reflect major decreases in population, this seems highly unlikely based on our component and radiocarbon data (see chap. 10), as well as previous studies seeking to explain the expansion of Numic-speaking people into northern Nevada and elsewhere (Bettinger and Baumhoff, 1982).

Of the alternative proposals used to explain this abrupt change in technology, the current data favor the idea that the introduction of the bow and arrow required less tool stone overall and reduced the need for the full biface reduction strategy. While we have provided some evidence for this scenario, it also seems that something more significant and more elusive must have taken place. Take, for instance, the large Terminal Prehistoric antelope drives investigated along the eastern end of the corridor (see chap. 16). Although these features include structural remains built to obtain large game, most of them lack well-developed flaked stone assemblages (also see Jensen, 2007). Conversely, high concentrations of Early and Middle Archaic projectile points found in the same habitats (but lacking the perishable fences) are thought to signal the same kind of activity—antelope drives (Hockett and Murphy, 2009).

This distinction has led Jensen (2007) to conclude that the earlier artifact concentrations do not mark actual corrals, but surrounds created by numerous male hunters armed with atlatls and darts. The Numic corrals, in contrast, were built by all members of the group, and the animals, once tired from being pursued in the corral, could be dispatched rather easily without sophisticated weapons. If this is true, it could indicate that Numic peoples invested greater amounts of up-front labor in the production of hunting facilities than did their predecessors. By putting a greater emphasis on corrals, large nets, deadfalls, and traps, their need for formalized flaked stone tools may have been reduced. It is also important to note that the nature of tool-stone quarries changed over time, especially for people willing to use more limited amounts of stone. Whereas the first people entering an area needed to find the primary sources of tool stone, 10,000 years of occupation created thousands of flaked stone scatters across much of the landscape—scatters that could have been harvested by Numic peoples when the need arose.

CHAPTER 12

TRANS-HOLOCENE SUBSISTENCE-SETTLEMENT CHANGE IN NORTHERN NEVADA

Kelly McGuire, Andrew Ugan, Kimberley Carpenter, and Laura Brink

Elsewhere in this presentation we have focused on the human colonization of northern Nevada and population reconstructions using a variety of archaeological proxy measures (chap. 10). We have also more narrowly addressed issues of assemblage structure, subsistence, and settlement in summaries developed for each of the four project regions, and again with regard to the evolution of geophyte procurement in the High Rock Country (chaps. 6–9 and 13). In this chapter, we assess subsistence-settlement change along the entire project corridor, with a focus on interregional trends.

We start with the trans-Holocene population profile for northern Nevada developed in chapter 10, as some portion of the assemblage variation through time is explained by population growth. Population growth among hunter-gatherers, along with effective environment and available technology, informs various foraging decisions through time. To track these decisions, we rely not only on direct subsistence data, such as faunal and archaeobotanical remains, but also on the frequency and distribution of major artifact classes that are reflective of plant procurement on the one hand (e.g., milling stones and hand stones), and hunting and hunting-related activities on the other (e.g., projectile points and bifaces). These artifact classes also have clear gender attributions, and their representation in certain contexts has broad implications for work organization, demography, and land use. We conclude this chapter with a period-based discussion of the archaeological record from the Ruby Pipeline project and how it is situated with regard to various hypotheses of prehistoric culture change in the Great Basin. These include shifts in subsistence settlement, changes in residential patterns and mobility, and broad trends in tool-stone production and hunting practices.

Population Change

Although several proxies of projectwide population density through time are presented in chapter 10, the frequency of single components standardized per 1000 acres and 1000 years is arguably the most comprehensive. This frequency is graphed in figure 46 and arrayed by region on table 58 in chapter 10 (page 228).

As can be seen, population density remains comparative low from the Paleoindian through the Post-Mazama periods. It nearly quadruples during the Early Archaic Period and continues advancing through the Middle and Late Archaic periods before declining somewhat during the Terminal Prehistoric Period.

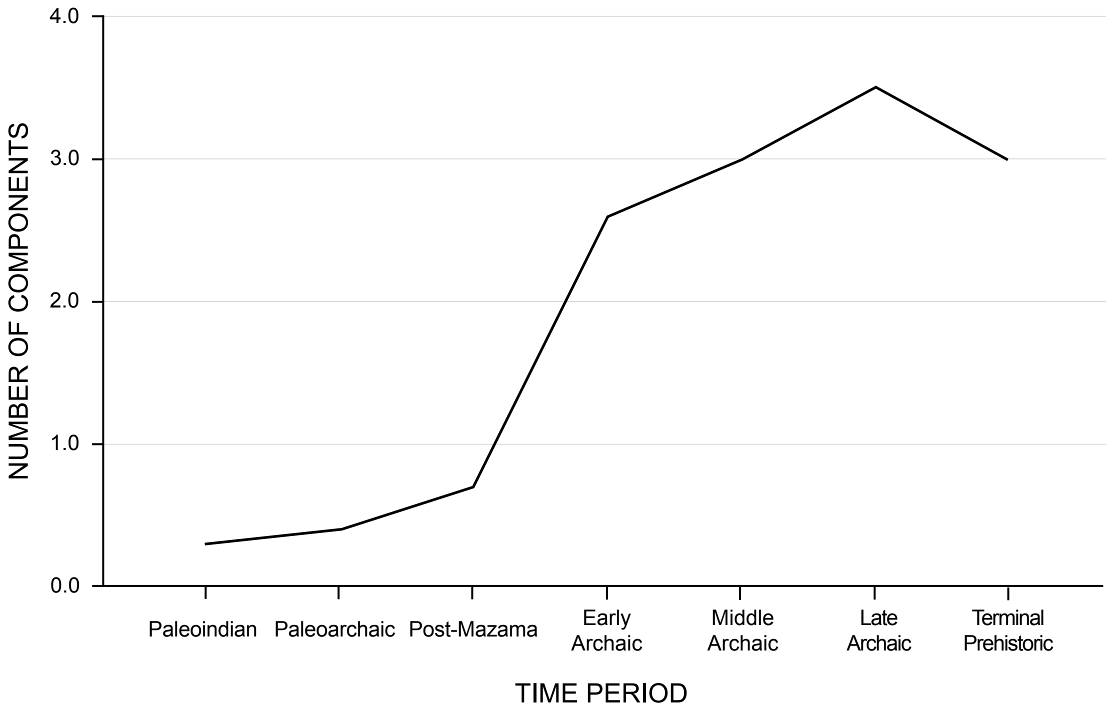


Fig. 46. Frequency of single-component areas per 1000 years and 1000 acres of land.

Settlement Change

Elsewhere (see chaps. 6–9), we have defined a series of site component types that characterize the structural complexity of the assemblages and features associated with dated project components. These are considered rough settlement types and include the following categories: *flaked stone, quarry, simple habitation, complex habitation, flaked stone with feature,* and *feature only*. The simple and complex habitation sites are distinguished by the presence of milling equipment and thus indicate a broader range of subsistence activities and component occupation by a more inclusive demographic group that included women. Those settlement types that include features—virtually all are rock and charcoal-stained processing features—are also suggestive of subsistence activities carried out by women. By contrast, both the flaked stone and quarry categories are limited to hunting weaponry and hunting-related tool manufacturing debris typically associated with males.

Against the backdrop of changes in population density enumerated above, we attempt to measure shifts in settlement configuration through time. We are particularly interested in the ratio through time of the habitation components (simple, complex, flaked stone with feature, and feature only) to those components that are represented solely by flaked stone (both simple and complex). While we admit that milling equipment is a poor behavioral indicator for the Paleoindian Period (because it wasn't used), and to some degree during the Paleoarchaic Period for the

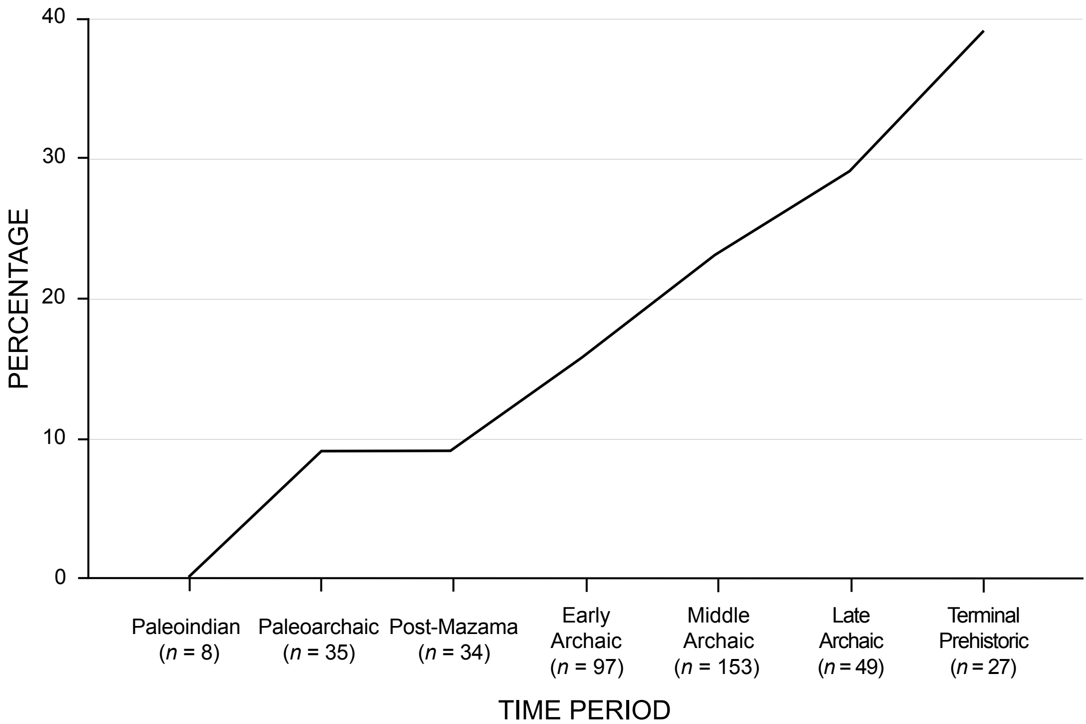


Fig. 47. Ratio of habitation components to nonhabitation components through time.

same reasons, we still feel that it provides the broadest measure of habitation and residential behavior when considering trans-Holocene trends across the Northern Tier.

This ratio is graphed by time period in figure 47, and as can be seen, closely resembles the trend line for population growth (see fig. 46). As might be expected, earlier time periods—Paleoindian, Paleoarchaic, Post-Mazama—are characterized by comparatively low frequencies of habitation components. Commencing in the Early Archaic Period, the percentage of habitation components begins to increase, and it rises through each subsequent period. At this gross level we can conclude that, prior to about 5000 or 6000 years ago, the Northern Tier was probably the locus of more transitory logistical hunting forays and tool-stone resupply activities that resulted mostly in flaked stone scatters. The earliest occupations along the project corridor, documented in the Parman Basin, potentially predate the widespread use of milling implements, but they represent only a very small percentage of the total project component inventory. After about 5000 years ago, we see a more robust trend for greater habitation activity, with residential sites that were occupied by more extended social groups that included both men and women.

It seems likely that at the close of the middle Holocene warm/dry period, favorable environmental conditions provided opportunities for more stable residential use of the study area, which in turn allowed for greater population densities. This concor-

TABLE 71
Density of Milling Tools and Bifaces by Component for Each Time Period
PI = Paleoindian; PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric; NC = Noncomponent.

	PI	PA	PM	EA	MA	LA	TP
Bifaces per component							
Bifaces	9	148	90	436	1413	428	105
Components	8	35	34	97	153	49	31
Density	1.1	4.2	2.6	4.5	9.2	8.7	3.4
Milling tools per component							
Milling tools	–	1	3	27	165	24	22
Components	–	35	34	97	153	49	31
Density	–	0.0	0.1	0.3	1.1	0.5	0.7

dance between rising population density and the frequency of habitation components breaks down only in the Terminal Prehistoric Period. At this time, population proxies show a decline, whereas the relative frequency of habitation sites continues to rise.

We suspect that this signals a basic shift in land use resulting from the arrival of the Numa along the Northern Tier sometime after 600 cal B.P. Their family band structure would have been weighted toward a series of small residential settlements dispersed across the landscape, although (the data suggest) at lower overall population densities.

Changes in Assemblage Structure

Having established the broad outline of trans-Holocene population growth and major shifts in settlement structure, it remains to explore the underlying changes in assemblage structure and lifeways that are linked to these macrotrends. We first review major artifact profiles by time period and then follow with an assessment of dietary constituents, including faunal and archaeobotanical remains.

With respect to the primary classes of artifacts, the frequency by component of both bifaces and milling equipment provides an important gauge of subsistence orientation. The former, including all reduction stages, provides an overall measure of flaked stone tool production, most of which is focused on hunting-related implements. The latter provides a direct measure of the intensity of plant processing generally assumed to be domain of women. The density by component of each of these tool classes is arrayed in table 71.

What is noteworthy in the trends for both artifact classes is that they diverge somewhat from the population curve and settlement profile (see fig. 46; fig. 47), especially at the latter end of the sequence. Middle Archaic components contain the highest densities of *both* bifaces and milling equipment. This suggests more intensive occupation of settlements by larger demographic groups that tended to include both men and women—a higher degree of residential stability. This residential pattern during the Middle Archaic Period has been recognized elsewhere in the Great Basin (McGuire and Hildebrandt,

TABLE 72
Summary of Projectwide Archaeobotanical Data by Time Period

The following categories were removed: Asteraceae, Cactaceae, Poaceae, Lamiaceae, Cyperaceae, Chenopodiaceae, *Purshia* spp., seed fragments, and unidentified seeds.

PA = Paleoarchaic; PM = Post-Mazama; EA = Early Archaic; MA = Middle Archaic; LA = Late Archaic; TP = Terminal Prehistoric.

	PA	PM	EA	MA	LA	TP	Undated	Totals
Number of samples	7	1	12	74	41	50	18	203
Volume (L)	70	9	169.8	737.35	459	578.5	136	2159.65
Number of seeds (adjusted by sampling fraction)	1	0	172	7691.33	3208	600	93	11,765.33
Number of identified genera	1	0	6	22	19	23	8	79
Simpson index (inverse)	1.00	–	2.50	3.71	2.82	5.73	2.54	

2005), and it may have provided important central places from which logistical hunting forays were based, thus explaining why hunting-related tools are found in abundance.

Population densities are modestly higher during the Late Archaic, and the ratio of habitation to nonhabitation components continues to rise, while the density of milling equipment in these components shows a marked drop. We suspect that while the Middle Archaic residential pattern may have continued well into the Late Archaic Period, populations may have been more widely dispersed at this time and somewhat less likely to concentrate in central residential bases. As we review below, some researchers have also suggested that a regional Late Archaic increase in foraging efficiency and technological investment led to greater reliance on hunting, with less effort directed at the processing of plant foods (Cannon, 2010; Broughton et al., 2011).

Given the settlement profile illustrated in figure 47, it is not surprising that the Terminal Prehistoric is also characterized by high densities of milling equipment, albeit somewhat lower than the Middle Archaic Period. There is, however, a substantial falloff in biface density during the Terminal Prehistoric Period, almost by a factor of three. Projectile point frequencies (see chap. 10) and a number of other measures of tool-stone production (chap. 11) also decline.

This reduction in tool-stone production and the frequency of hunting-related flaked stone artifacts may not necessarily reflect an overall reduction in the hunting of large game. Alternative explanations include lower demand for tool stone resulting from the introduction of the bow and arrow; greater use of hunting facilities, such as corrals, larger nets, deadfalls, and traps; and scavenging of previously reduced tool stone from older archaeological sites.

Up to this point, we have addressed subsistence change indirectly through the use of general broad artifact classes, such as milling equipment (plant procurement) and bifaces (hunting-related activities). Next, we focus on the dietary remains recovered from across the project transect. The most important of these are the archaeobotanical remains recovered

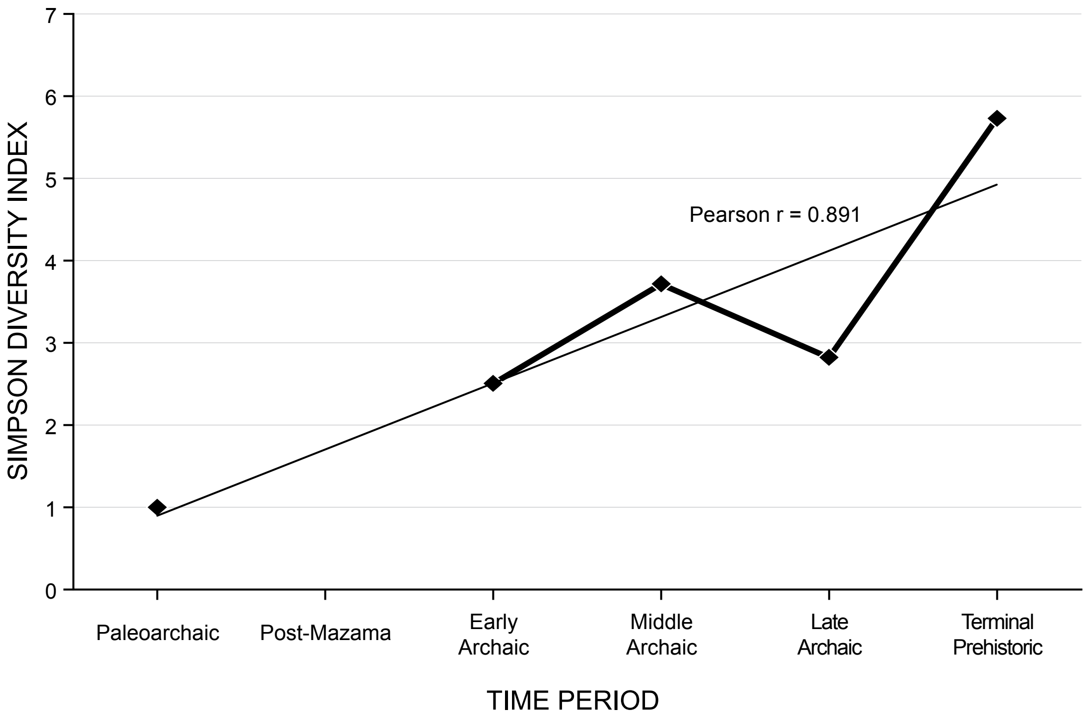


Fig. 48. Simpson diversity index for all project archaeobotanical remains by time period.

from 203 project samples. As they were recovered from flotation samples that also yielded abundant wood charcoal, most have associated radiocarbon dates that allow for more precise temporal period assignment. The project inventory of faunal remains is much more uneven and is characterized by only a small number of spatially and temporally disparate sites that have viable assemblages. We have addressed this issue by expanding the database to include a number of previously reported faunal assemblages from elsewhere in the northern Great Basin.

Archaeobotanical Remains

A total of 3709 small seeds and 33 nutshell fragments was recovered from the 203 flotation samples analyzed. Of these, 32 small-seed and two nutshell genera are recognized; these results are reported in the regional summary discussions in chapters 6–9.

Our approach here focuses on project-wide diet breadth through time as measured by plant diversity and richness for each time period. The former is computed by use of the Simpson's diversity index, and the latter is represented by the total number of genera identified by time period. As diversity statistics are key to this discussion, a Pearson's *r* value correlation was calculated for the Simpson index, and the number of seeds present in each temporal component was adjusted by sampling fraction (Grayson, 1984). This relationship yielded a Pearson's *r* value calculated at 0.198, affirming that seed diversity is explained by factors other than sample size.

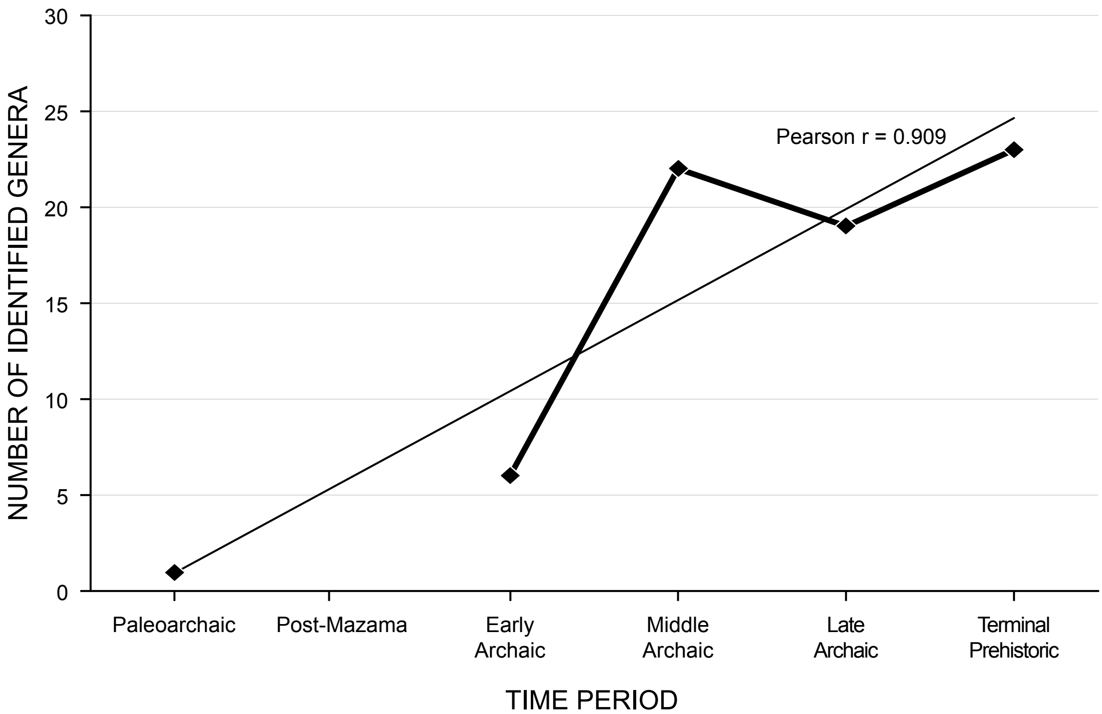


Fig. 49. Taxa richness for all project archaeobotanical remains by time period.

Both the diversity and richness data are provided in table 72 and plotted for the entire project area in figures 48 and 49. Most seed remains were recovered from components dating to the Early, Middle, and Late Archaic and Terminal Prehistoric periods. The indices show broadly similar trend lines with marked expansion of plant diet breadth from the Early Archaic into the Middle Archaic. There is a falloff during the Late Archaic Period, followed by new increases in the Terminal Prehistoric Period where they reach their highest levels.

What is most noteworthy about these indices is the degree to which they correspond to the density of milling equipment for each temporal component detailed in table 71. Thus, for example, the increase in plant diet breadth between the Early and Middle Archaic periods is mirrored in an increase in milling tool density, and the falloff in diet breadth during the Late Archaic Period is reflected by a decrease in milling tool density. The highest levels of plant diet breadth are documented in the Terminal Prehistoric Period, which is also represented by high densities of milling equipment (although, as we have indicated earlier, at a slightly lower level than observed for the Middle Archaic Period).

One additional aspect of plant resource intensification includes geophytes, which are not typically well represented in flotation samples. This subject is treated in detail in chapter 13, with a geographic focus on the High Rock Country and in particular, epos (yampah) ex-

TABLE 73
Animal Size Classes

Class	Example	Weight
1	Mice, shrews	<100g
2	Squirrels, woodrats	100–500 g
3	Hares, muskrats	500–7500 g
4	Coyote, bobcat	7500 g–20 kg
5	Deer, mountain sheep	20–100 kg
6	Bison, elk	>100 kg

ploitation in the Barrel Springs uplands. Noteworthy is the conclusion that this type of procurement system may have begun during the Early Archaic Period and reached its highest expression during the Middle Archaic Period. In this sense, it appears to be part and parcel of the Middle Archaic elaboration in plant resource exploitation noted in the milling assemblage and archaeobotanical data reviewed above. This same expansion in geophyte use may have occurred along the entire project corridor, although there are no definitive data to confirm this.

Faunal Remains

A total of 15,669 pieces of animal bone was recovered from 97 different sites in the project corridor. Of these, 13,655 were assigned to a specific temporal component and 11,573 were assigned to both a time frame and (at least) a broad size class (table 73). The latter group includes 48 temporal components from 40 different sites. Detailed results are presented in each of the regional summaries (chaps. 6–9). As previously mentioned, there are two reasons that some caution should be taken in treating these faunal remains as a metasample for subsistence and land-use reconstructions similar to those applied to the archaeobotanical data. First, the vast majority of specimens are assignable only to broad size class—much of the assemblage is identified only as mammalian, primarily small-medium, medium-large, and large mammals. Only a smattering of birds, fish, reptiles, and amphibians were documented. Second, the sample is uneven with regard to both size and geography—54 of 97 sites yielding faunal remains have 10 or fewer identifiable bone specimens, and the five largest sites (all spatially disparate) contain 75% of all fauna.

Notwithstanding these limitations, size-classified fauna are relatively abundant and permit an examination of changing reliance on big game through time. This is done by computing an abundance index (AI) based on the ratio of large-bodied animals to the sum of large and small ones. Given a generally close correspondence between a prey's body size and its energetic return rate (Bayham, 1979; Broughton, 1994, and references therein), declines in large-bodied animals relative to small ones imply declining foraging returns, although it can be difficult to know whether declining availability of large-game animals resulted from overhunting or nonhuman activities (e.g., environmental shifts and changes in habitat productivity).

There has also been an acknowledgment of potential difficulties in the use and interpretations of these indices. These include possible violations of the assumption that small-bodied organisms provide lower return rates than larger ones (Bettinger, 1993; Madsen and Schmitt, 1998; Grayson and Cannon, 1999); discussions of "mass collecting" and the value of large numbers of small resources (Steele and Baker, 1993; Madsen and Schmitt, 1998; Ugan, 2005); questions concerning prey mobility and hunter success rate as they affect the value of large versus small game (Bird et al., 2009; Broughton et al., 2011; Ugan and Simms, 2012; Jones et al., 2013); and issues of nonenergetic foraging goals and the social context of foraging (Hildebrandt and McGuire, 2002; Hockett, 2005; McGuire and Hildebrandt, 2005; Bird et al., 2013). Whether dealing with changing energetic returns or some other interpretation, however, all approaches rely on the same type of index.

With that in mind, we examine changes in the relative AI of small and large animals through time and space. The individual component is the basic unit of analysis, with trends graphed as the mean AI value of all components falling in the same period. Individual components are equally weighted regardless of sample size (number of individual specimens present [NISP]), although we also explore the effects of excluding smaller components.

In order to place the Ruby fauna in a broader context, we have also collated previously published faunal data from nearly two dozen other projects conducted throughout the northern Great Basin and very southern Columbia Plateau (Shutler and Shutler, 1963; Heizer et al., 1968; Aikens, 1970; Cowan, 1972; Dalley, 1977; Grayson, 1979a, 1979b, 1988; Kobori, 1979; Bard et al., 1980; Follett, 1980; Dansie, 1987; Elston and Budy, 1990; Schmitt and Sharp, 1990; Greenspan, 1993; Dean, 1994; Delacorte et al., 1997; Kelly, 2001, 2007; Young, 2002b; McGuire et al., 2004; Cannon, 2012). These represent 142,375 specimens from 88 additional sites, each of which could be assigned to size class and temporal component. The chronological framework used at these sites typically differed from that used on the Ruby Pipeline, often crosscutting temporal components. For example, a particular stratum may date between 3000 and 1000 B.P., which would straddle the Middle and Late Archaic as defined here. In these cases, deposition was assumed to occur uniformly across the entire time span, and fauna were assigned proportionately to each temporal component. After standardizing the timescales, relevant abundances were calculated based on the proportion of large and small fauna falling into each component, as described earlier.

Figure 50 plots AI values across time for (1) all Ruby component assemblages; and (2) all non-Ruby component assemblages. As can be seen, large game are generally rare in the early components of Ruby sites, but increase quickly from 6% of the assemblage in the Paleoarchaic Period to almost 36% of the assemblage by the Post-Mazama. They then rise to a high of 63% during the Early Archaic before dropping to between 42% and 53% of the assemblage thereafter. Of note is a slight uptick in the AI associated with the Terminal Prehistoric Period. The overall pattern for the non-Ruby fauna is roughly similar—increasing AIs as a function of time—but without the dramatic increases observed in the Ruby fauna for the Early and Middle Archaic periods. It is also noteworthy that the highest AI in the non-Ruby sample was documented during the Terminal Prehistoric Period.

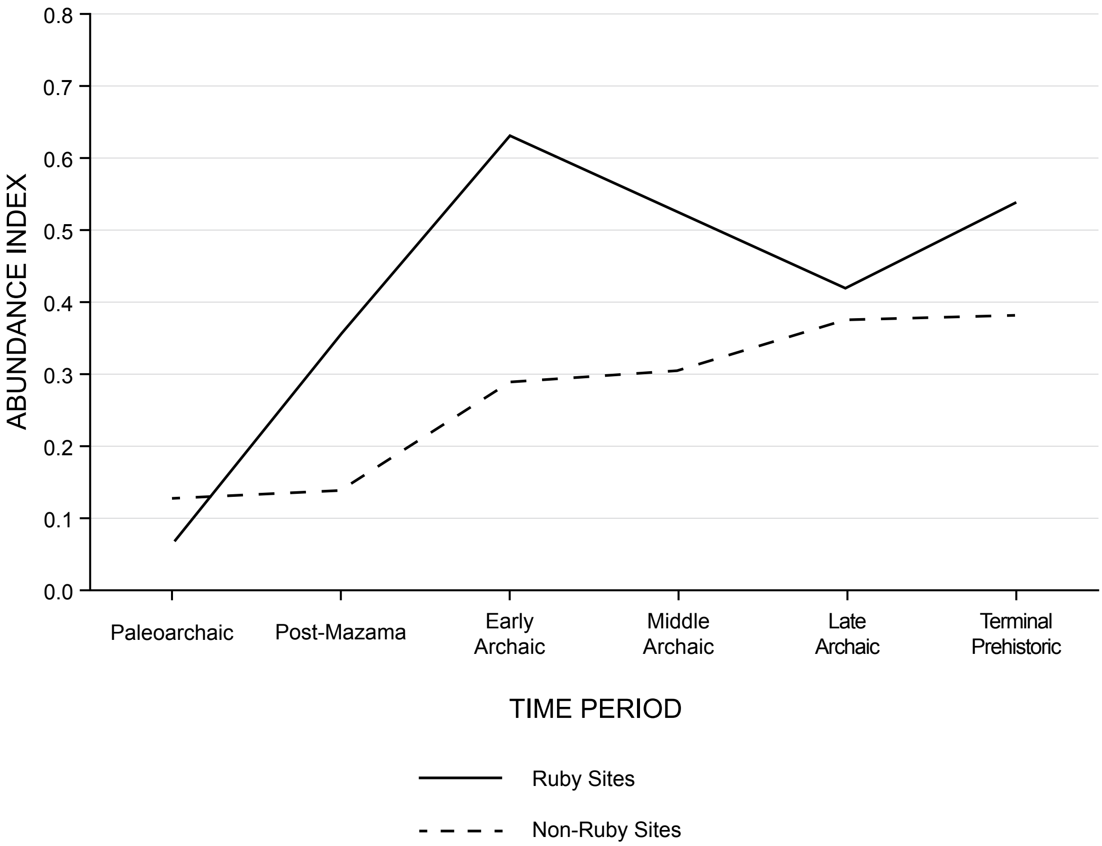


Fig. 50. Artiodactyl abundance indices for ruby and non-Ruby faunal assemblages.

When Ruby and non-Ruby fauna are considered together, the dataset suggests a major transition in large-game hunting beginning in the Early Archaic Period. Prior to this time, AI values are comparatively low, whereas later in time they are generally higher. The Ruby data in particular point to a peak in large-game procurement during the Early and Middle Archaic. Similar patterns have been identified elsewhere, both at individual sites (McGuire et al., 2007) and across larger catchments such as the western Great Basin and western Wyoming Basin (Delacorte et al., 1997; McGuire, 2004; Byers et al., 2005). Somewhat unexpected is the importance of large game at the latest end of the prehistoric sequence, during the Terminal Prehistoric Period (see the Discussion section immediately below).

Finally, it is worth noting the substantial variability underlying both trend lines in figure 50. In any given time period, individual components exhibit a wide array of AI values (fig. 51). This variation almost certainly reflects the underlying reality of human foraging where a wide range of habitats and species were hunted throughout the seasonal subsistence round, and were processed and consumed in a variety of settlement contexts. Still, the trends exhibited in these metadata track the shifting reliance on particular class-

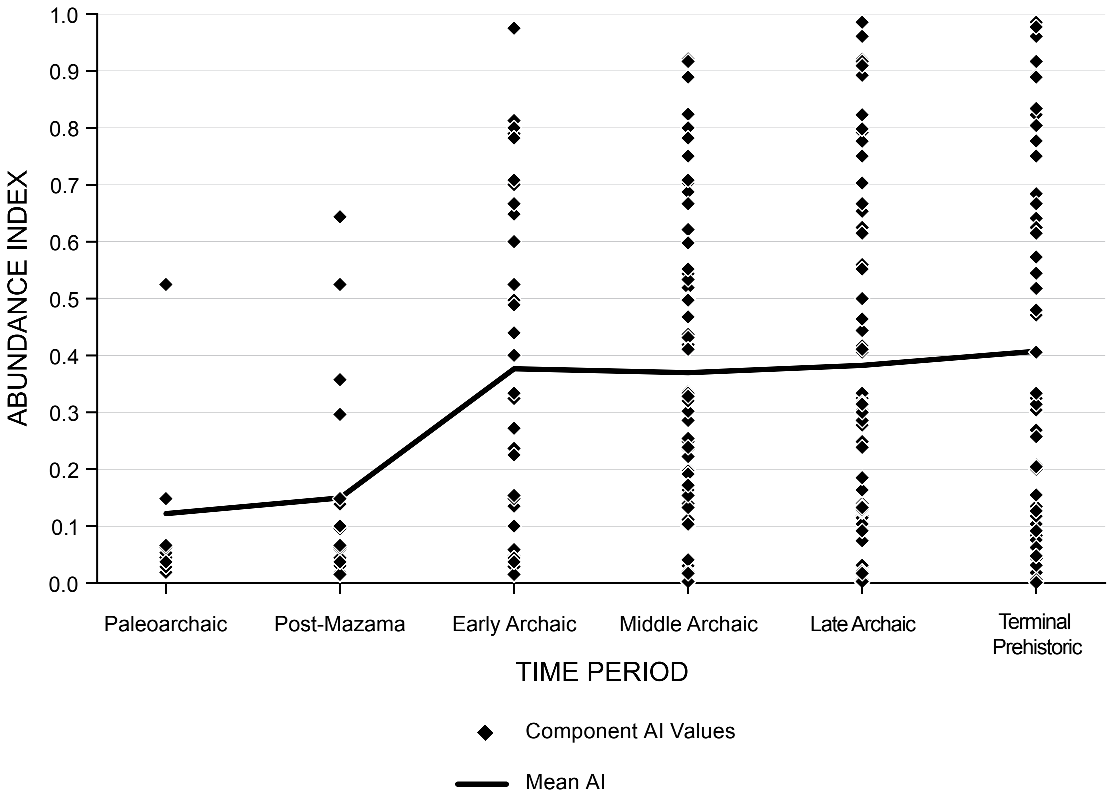


Fig. 51. Individual component variation and mean component values in artiodactyl abundance indices for both Ruby and non-Ruby sites.

es of fauna and potentially provide insight into important environmental, settlement, technological, and social trends.

Discussion

It should be reiterated at the outset that the Northern Tier was and still remains a relatively resource-poor region of the Great Basin, lacking keystone crops such as pinyon and generally bereft of the marshes and lake basins that sustained populations elsewhere. Through much of the Holocene, it remained comparatively underutilized, being mostly the domain of the occasional long-range logistical hunter and a supply area for tool stone. As we have demonstrated, however, land use was not static. Indeed, it may be that subtle changes in subsistence and settlement exhibit greater archaeological visibility along our transect because most sites were not subjected to repeated occupations and the resulting overprinting and mixing of assemblages. We see this in the large number of low-density, single-component contexts identified in the study area. It also helps that our project sample is both methodologically uniform and spatially extensive and thus, arguably representative along its entire 360 mile length. Presented below is a discussion of subsistence and settlement practices for each time period.

Paleoindian and Paleoarchaic

With regard to the earliest occupations documented along the study corridor, including those attributed to both the Paleoindian and Paleoarchaic periods, there is ample evidence that these initial colonizers targeted the comparatively resource-rich High Rock Country (chap. 10). As might be expected, reconstructed population densities are the lowest of any period (see fig. 46) and components are typically flaked stone scatters bereft of any milling equipment. Bifaces show a tendency toward early-stage forms, and debitage profiles are consistent with a standard biface-reduction sequence (chap. 10).

The only evidence of longer-term habitation during this time frame was documented at 26HU4943 and 26HU5105, located along the shoreline of pluvial Lake Parman. A living surface, perhaps a house floor, was documented at the latter site, and both sites produced radiocarbon dates of 11,180 cal B.P. Artifacts from these locations, as well as several others in this same lakeshore context, include stemmed-series projectile points, bifaces, unifaces, and other formed flaked tools typical of assemblages across the Great Basin dating to this time.

There is little direct dietary evidence in the form of either faunal or archaeobotanical materials from the earliest project components, although the assemblages, with their emphasis on flaked stone tools, certainly suggest some attention to hunting-related activities. As we review in chapters 10 and 13, we also suspect that geophyte productivity, particular for epos, was of critical importance and also sustained these early colonizers in the High Rock Country. As detailed in chapter 13, the procurement, processing, and consumption of epos does not, in the absence of storage, require milling tools. It does, however, involve an assemblage of simple and formed flake tools for the manufacture and maintenance of digging sticks to harvest these geophytes.

The obsidian source profiles for this time frame (chap. 14) generally confirm a previously recognized pattern of geographically extensive residential mobility (Kelly and Todd, 1988; Amick, 1996; McGuire, 2002; Jones et al., 2003, 2012; Smith, 2010, 2011; Beck and Jones, 2011). Note, however, as reflected on table 82 in chapter 14 (page 309), that while the procurement premium for projectile points (measured as average kilometer distance beyond the first available source) is higher than in the Early, Middle, and Late Archaic periods, it is not as high as in the Terminal Prehistoric Period.

Post-Mazama

As this period includes the most intense era of middle Holocene warming (chap. 2), it is not surprising that the archaeological visibility of components dating to this time remains very low, with population densities little changed from the previous Paleoarchaic Period (see fig. 46). Although other researchers have postulated a more definitive population decline at this time (Grayson, 2011: 304–307), there is no evidence for the wholesale abandonment of the Northern Tier, though most components dating to this time are concentrated in the relatively well-watered and more productive High Rock Country (chap. 10). We do not view this as a "retreat" to so-called well-watered refugia (Grayson, 1993, 2011; Beck, 1995; McGuire, 2007: 170–172; Milliken and Hildebrandt, 1997), however, because previous Paleoindian and early Holocene Archaic populations were not well established in the central and eastern regions of the project corridor to begin with.

Simple and complex habitation components, defined primarily by the presence of milling equipment, are represented at the same low frequency as Paleoarchaic components, despite the widespread use of milling gear elsewhere by this time (see fig. 47 and table 71). This is not the Post-Mazama residential pattern observed at Menlo Phase components in Surprise Valley (O'Connell, 1971, 1975), nor does it bear much resemblance to Chatters' (2012) conception of "opportunistic sedentism" for foragers dating to this time. Indeed, most Post-Mazama project components are scatters of flakes and the odd projectile point or biface—more indicative of the occasional long-range hunting foray into this region rather than any sustained habitation. This level of mobility, presumably resulting from logistical hunting activities, is confirmed by the relatively high transport distances for obsidian projectile points that is slightly less than the Paleoarchaic value but still higher than those values for the ensuing Early, Middle, and Late Archaic periods (see table 82, page 309).

Early and Middle Archaic

The Early and Middle Archaic time frame marks the initiation and subsequent acceleration of sustained habitation along the Northern Tier. The simplest measures of this are an abrupt rise in population density (see fig. 46) coupled with an increase in habitation components (see fig. 47). These trends are accompanied by the increasing occupation of more marginal resource tracks located in the eastern regions of the project area (chap. 10), no doubt driven by the transition to more favorable late Holocene climatic conditions. While climate may have begun to improve slightly as early as 6300 cal B.P., it was not until about 4500 cal B.P.—well into the Early Archaic—that this transition was more or less complete (chap. 2).

Densities of major artifact categories, including milling tools and bifaces, peak during the Middle Archaic Period (see table 71). Archaeobotanical diversity indices (see figs. 48 and 49) spike in the Middle Archaic Period, suggesting a marked expansion of plant diet breadth from the Early Archaic into the Middle Archaic (McGuire et al., 2004; Wohlgemuth, 2004). Related to this, there appears to have been an expansion of geophyte procurement in the High Rock Country that may also have been expressed in other areas (chap. 13). This all appears to have been accompanied by an increased reliance on the taking of large game (see fig. 50).

We are inclined to tie these transformations to similar changes observed throughout the Great Basin and parts of California. As noted in chapter 3, this is the time that true settlement hierarchies emerge, along with the first substantiated occupation of large semisedentary base camps (Zeanah, 2004). Such large, semisedentary residential complexes have been documented along the Humboldt Lakebed (Livingston, 1986), Carson Sink (Raven and Elston, 1988; Raymond and Parks, 1990; Kelly, 2001; Madsen, 2002), Humboldt River near Battle Mountain (McGuire and King, 2011), the Lake Albert–Chewacan marsh basin (Oetting, 1990; see also Jenkins et al., 2000), and the northwestern Great Basin (Elston et al., 1994; see also Riddell, 1960; McGuire, 1997). Similar manifestations have been reported in northeastern Nevada (McGuire et al., 2004) and the eastern Great Basin (Madsen and Simms, 1998). We have previously argued that the Middle Archaic Period may actually represent the "trans-Holocene highpoint" of residential stability in most areas of the Great Basin (Hildebrandt and McGuire, 2002; McGuire and Hildebrandt, 2005).

Increasing levels of habitation within the project corridor contributed to major shifts in flaked stone procurement and production. At some key obsidian source areas, notably Massacre Lake/Guano Valley and Craine Creek, there was a shift from casual, low-intensity use to a more targeted and sustained procurement, with production peaking in the Middle Archaic Period (chap. 11). The emphasis was on biface production and, as previously indicated, in both an absolute sense and when measured as average component density, biface production reached its highest level during the Middle Archaic.

Interestingly, projectwide obsidian source diversity reached its lowest Holocene levels at this time, as indicated in the transport distances for projectile points (see table 82, page 309). As a measure of overall mobility, this trend is the result of the increased residential stability described above. In this scenario, rather than a more geographically expansive pursuit of tool stone that might be expected in a residentially mobile population, effort was directed more intensively at a fewer number of key source locations. This same pattern of decreasing mobility during the Middle Archaic Period has been observed with large-scale data sets from elsewhere in the northwestern Great Basin (McGuire, 2002, 2007; Smith, 2010).

Given the density of bifaces in Middle Archaic components, as well as the relative abundance of projectile points dating to both the Middle and Late Archaic periods (see chap. 10), it is hard not to conclude that hunting as measured by hunting-related tool production was in ascendance at this time; this appears to be confirmed in the faunal profiles from the Northern Tier (see fig. 50).

In sum, and as promulgated by several researchers (Hildebrandt and McGuire, 2002; Zeanah, 2004; McGuire and Hildebrandt, 2005), a land-use framework featuring relatively high levels of residential stability and increased diet breadth related to plant resources and women's work organization was operable during this time along the Northern Tier. This appears to have been coupled with, and perhaps allowed for, relatively high levels of logistical mobility associated with long-range logistical hunting undertaken by men.

Late Archaic

Reconstructing land use during this period is particularly challenging, as it was time of profound cultural change possibly induced by severe drought associated with the Medieval Climatic Anomaly (MCA), changes in technology, and perhaps social conflict, or some combination of these. As we have previously reviewed (chap. 3), most of these changes are thought to have occurred in the latter half of this period, after approximately 1000 cal B.P., thus potentially splitting the Late Archaic into an earlier phase, where conditions may have been more like the preceding Middle Archaic Period, and a later-dating phase marked by environmental and social disruptions.

Against this backdrop, we compute that population density along the Northern Tier probably peaked at this time, as have a number of other researchers using the ubiquitous Rose Spring and Eastgate point forms as population proxies (Thomas, 1971, 1988; Livingston, 1986; Elston and Budy, 1990; Delacorte et al., 1992; Elston and Raven, 1992: 613; Elston and Bullock, 1994; Hildebrandt and King, 2002, 2012; Delacorte, 2008; Cannon, 2010: 83; McGuire and King, 2011). However, if we narrow our focus to radiocarbon dates as a population proxy (see chap. 10), we see that most project radiocarbon dates associated with the Late Archaic Period—13 of 17 dates—fall before 1000 B.P. Although not definitive, this correlation would suggest that population growth was more robust during the first half of the Late Archaic Period.

With respect to settlement structure, we have also demonstrated the continuing expansion of habitation components as a ratio of all other settlement types during this time (see fig. 47). Surprisingly, however, this increase in habitation is accompanied by a sharp decline in the component density of milling equipment. We suspect that while the Middle Archaic residential pattern may have continued well into the Late Archaic Period, populations may have been more widely dispersed at this time and somewhat less likely to concentrate in central residential bases.

More intriguing is the fact that this falloff in the density of milling equipment is accompanied by a noticeable decline in diet breath related to small-seed and nut procurement (see figs. 48 and 49). A similar pattern was observed at Little Boulder Basin, located immediately south of the project corridor in the Upper Humboldt Plains region (Cannon, 2010; Broughton et al., 2011). In comparison to Middle Archaic and Terminal Prehistoric components, Late Archaic components are characterized by high relative frequencies of projectile points, a high artiodactyl AI, low relative frequencies of milling tools, and lower aggregate archaeobotanical richness from radiocarbon-dated features. This overall pattern is linked to increases in foraging efficiency associated with the taking of large-bodied prey (Broughton et al., 2011).

By contrast, there are any number of regional studies that identify comparatively lower AI values (Carpenter, 2002; McGuire et al., 2004), as well as a broad trend toward resource intensification, i.e., broadening of the diet breadth, during the Late Archaic Period (Elston, 1986: 145; Leach, 1988; Elston and Budy, 1990; Delacorte, 1997, 2002; McGuire et al., 2004). Similarly, the notion of increased foraging efficiency during the Late Archaic is at odds with the florescence of agriculture (perhaps the ultimate expression of resource intensification) in the Fremont culture zones located immediately to the east.

The data at hand are probably not sufficient to adequately reconcile these two competing perspectives; however, it is clear that Late Archaic land-use patterns were more complex than have been previously acknowledged. We suspect that much of this complexity is rooted in this issue of a pre-1000 cal B.P. versus post-1000 cal B.P. Late Archaic—with the start of the MCA as early as 1100 cal B.P., both climate and land-use patterns abruptly changed, and this distinction is lost when lumping together all assemblages that date from 1300 to 600 cal B.P.

With respect to changes in tool-stone procurement and production, the Late Archaic Period begins to show signs of an emerging Late Prehistoric pattern. The high ratio of obsidian to nonobsidian tool stone in the Middle Archaic begins to reverse, with nonobsidian tool stone (primarily cryptocrystalline silicate, or CCS) becoming dominant in Late Archaic components (chap. 11). The increased use of CCS may have more to do with intensified late occupation in project segments that are rich in CCS, although this trend has also been viewed as reflecting local resource intensification, settlement contraction, and overall territorial circumscription (Basgall and McGuire, 1988; Elston and Budy, 1990; Gilreath and Hildebrandt, 1997; Bettinger, 1999b; Smith, 2010). Obsidian source diversity and transport distances for projectile points, however, begin to increase from their Early and Middle Archaic lows, reaching a zenith in the Terminal Prehistoric Period (see ahead to table 82, page 309). In a subject we will return to below, this may have less to do with mobility and territorial range than it does with Late Prehistoric social networks, including trade and exchange.

Terminal Prehistoric

In consideration of the broad late Holocene population and assemblage trends previously described, the Terminal Prehistoric Period exhibits perhaps the most significant break. It is at this time that our primary proxy for population density—single-component areas per 1000 years—shows its first decrease (see fig. 46). Terminal Prehistoric population decline has been identified in other specific geographic contexts, such as the Middle Humboldt River drainage (McGuire and King, 2011), but its corroboration along the entire study corridor suggests that a wider demographic shift was at play. Causal factors include the arrival of the Numa with their new family-band sociopolitical organization (Steward, 1938), and the lingering effects of the MCA, which may have disrupted subsistence-settlement systems and entire cultures throughout California, the Great Basin, and the Southwest (Jones et al., 1999).

Work and residential activities were much less segregated at Numic settlements, possibly producing a “stand alone” quality that might be expected by a series of dispersed and short-term occupations by small family units. It is not surprising, therefore, that the archaeological manifestations of these small residential occupations—simple and complex habitation components—reach their highest expression relative to all other component types in the Terminal Prehistoric Period (see fig. 47).

Given that these components were occupied by family units composed of both men and women, it is not surprising that the density of milling equipment rises in these contexts relative to Late Archaic levels (see table 71). This same pattern has been noted in a number of other regional contexts near the study corridor, including Secret Valley (McGuire, 1997), Black Rock Desert (Seck, 1980), the Buffalo Hills region (Kolvet, 1995), Duck Lake (Creger, 1991), and Little Boulder Basin (Cannon, 2010). It is notable also that diet breadth associated with plant procurement, as indicated in archaeobotanical diversity indices from the project corridor (see figs. 48 and 49), reaches its highest levels during the Terminal Prehistoric Period. As we review in chapter 15, the introduction of pottery at this time, in the eastern portion of the study corridor is probably a reflection of the importance of small seeds. When considered together, these data point to a subsistence regime characterized by resource intensification.

One of the more interesting trends for this time period is the apparent continued reliance on large game at both the project sites and throughout the northern Great Basin (see fig. 50). This generally does not comport with more traditional conceptions of Numic lifeways, where several local studies point to an increasing reliance on small game and less focus on the taking of artiodactyls during the Terminal Prehistoric Period (Spencer et al., 1987; McGuire et al., 2004; McGuire and Hildebrandt, 2005; Cannon, 2010). However, it is consistent with findings in a variety of other places recently documented by Hockett (2015). Finally, we see a decrease in component densities of projectile points as well as overall flaked stone production (chaps. 10 and 11).

One explanation may relate to the continuance and perhaps increased use of large game drive facilities and traps (Hockett and Murphy, 2009). Several such late-dating drive complexes were documented in the eastern portion of the study area (26EK3959 and 26EK12310) and others are reported from northeastern Nevada (chap. 16). As we mentioned earlier, the greater use of hunting facilities, such as corrals, larger nets, deadfalls, and traps, may have somewhat mitigated the need for weaponry. Such activities, although episodic, may have created resource bonanzas, the remains of which are concentrated in certain habitation sites.

As we describe in chapter 11, obsidian quarry production, particularly for Massacre Lake/Guano Valley and Craine Creek, abruptly declines during the Terminal Prehistoric Period—a pattern also observed at a number of major quarry zones located in the Inyo-Mono region (Coso, Casa Diablo, Bodie Hills, and Modoc Plateau [Medicine Lake Highlands]). As we also note in chapter 11, biface reduction falls off and is replaced to some extent by the use of less formalized tools. This quarry trend suggests a decentralization of tool-stone production away from quarry zones and toward endpoint users, in this case a series of widely dispersed family bands.

Finally, one of the more noteworthy results of this study is the very high obsidian transport distance for obsidian projectile points, which reaches its highest level during this time compared to any other period (see chap. 11). This pattern has been observed before with large point assemblages in the northwestern Great Basin and Modoc Plateau, where it is seen less as a reflection of logistical or residential mobility, and more as attributable to factors such as increasing trade and exchange, scavenging and reuse of older archaeological materials, and increasing use of obsidian nodules in a dispersed, secondary context (McGuire, 2002: 85–104; see also Smith, 2010). Even more impressive is the distance that obsidian debitage travels at this time—nearly sixfold that of any other period. The figure is actually higher than that for projectile points dating to this time, indicating that, along with value-added finished tools, more minimally reduced tool stone was also being conveyed over large distances. This represents a major break in tool-stone production and conveyance from previous periods. As we review in chapter 15, this sudden reorganization of obsidian conveyance may reflect the arrival of the horse as a means of transportation in the northern and central Great Basin at the very end of the prehistoric period.

CHAPTER 13

THE ARCHAEOLOGICAL CORRELATES AND EVOLUTION OF GEOPHYTE PROCUREMENT IN THE NORTHWESTERN GREAT BASIN

Kelly McGuire and Nathan Stevens

As we have noted in chapter 2, the western portion of the pipeline corridor in the High Rock Country provides a more suitable habitat for geophytes than the eastern portion. Geophytes are perennial herbs that store their energy reserves (such as starch) in belowground structures like bulbs, tubers, corms, and enlarged roots. The economic importance of geophytes north of the Humboldt River and along the northwestern rim of the Great Basin is such that the entire region has been broadly categorized as the "root complex" with respect to Great Basin ethnographic lifeways (Fowler and Liljeblad, 1986: 435–465).

For such an important food staple, however, the archaeological manifestations of geophyte gathering, processing, storing, and consuming are not well understood. This results in part from the fact that their physical remains are usually underrepresented in the archaeological record, at least in comparison to more ubiquitous charred seeds. In addition, the specific artifact signatures associated with geophyte harvesting and processing are not easily recognized.

The project corridor provides a unique opportunity to address the archaeology of geophyte use, as it traverses from eastern Nevada where geophyte productivity was comparatively low, to the High Rock Country where such resources were more abundant. How do specific tool types, assemblages, and even settlement patterns shift along this transect in response to an increasing subsistence focus on geophytes? Can we identify a toolkit and technology associated with geophyte procurement, and with the added dimension of time, can we chart the prehistoric evolution of geophyte use?

In this chapter, we briefly assess geophyte productivity across the project transect, and then turn to two subregions of the High Rock Country: the Barrel Springs volcanic tablelands and adjacent Long Valley. We review regional ethnographic and archaeological evidence of geophyte procurement and processing technologies, including the work of Susan Gleason (2001) in the Upper Klamath River area. We then compare assemblage trends in the Barrel Springs and Long Valley areas in an effort to correlate certain tool types with productive geophyte zones, and to establish a settlement context of geophyte use. Particular attention is given to formed flake tools and simple flake tools and their role in the manufacture and maintenance of digging sticks, a central element of the geophyte harvest. The results of a use-wear analysis on a sample of formed flake tools from the project area are used to further evaluate this relationship. The chapter concludes with a discussion of the energetic returns associated with geophyte procurement and its role in foraging systems through time in this region.

Geophyte Habitats along the Project Corridor

Geophytes are found along the entire length of the project corridor. From a subsistence standpoint, the most important taxa include epos (yampah), biscuit-root, bitterroot, sego lily, wild onion, and balsamroot. Many of these are most productive and best harvested from spring to early summer, when they comprise a critical food resource after lean winter months. The productivity of these geophytes in any particular habitat or environmental region within the project corridor, however, is difficult to measure. What we can say is that the cooler and better-watered uplands, especially those that also contain thin volcanic lithosols, represent prime geophyte habitat. Thus, the High Rock Country would rank highest in this regard, while the Upper Lahontan Basin would be lowest. The Upper Humboldt Plains and Thousand Springs Valley regions are intermediate but probably well below the geophyte potential of the High Rock Country.

This broad environmental characterization is borne out by the ethnographic record. Geophytes comprised a dietary staple for the Surprise Valley Paiute, whose traditional gathering area extended well into the project corridor in northwestern Nevada (Kelly, 1932; Fowler and Liljeblad , 1986: 435–465; Fowler and Rhode, 2006: 331–350), as well as for the neighboring Modoc, Klamath, and other Plateau groups (Barrett, 1910; Kroeber, 1925; Spier, 1930; Ray, 1963). It is estimated that for these root-adapted groups, geophytes may have provided upwards of 50% of the annual caloric intake for a family.

In Western Shoshone territory in the eastern portion of the project corridor, Steward (1938: 138–158) notes that several root crops, including epos, bitterroot, and wild onion, were seasonally harvested, along with a variety of important seed crops. Geophytes, however, are not singled out as a subsistence staple or the anchor of a resource "complex," as they are to the north and west, or as pinyon nuts are to the south. Noting that most Western Shoshone subsistence-settlement activity was concentrated primarily along the Humboldt River, Steward implies that areas immediately north (which would include the project corridor) were used more for resource procurement and as an occasional travel corridor.

Barrel Springs

Returning to the High Rock Country, geophyte productivity can be further broken down by taking a closer look at the Barrel Springs volcanic uplands immediately east of Surprise Valley, which is traversed by the pipeline corridor. The Barrel Springs uplands (5500–6500 ft in elevation) are part of a prominent volcanic plateau that rises above surrounding valleys and alluvial basins. This area is specifically identified as an important geophyte collection area by Isabel Kelly (1932) in her work with the Surprise Valley Paiute, as well as by members of the contemporary Fort Bidwell Paiute (Deuer, 2010). The biological productivity of geophytes at Barrel Springs, particularly epos (fig. 52), has also been confirmed by recent scientific study (O'Connell and Bird, 2005; O'Connell et al., 2008; Trammell et

Fig. 52. A late-spring, early summer epos (yampah) bloom at Barrel Springs.

al., 2008). In high-density tracts at Barrel Springs, upwards of 80 epos plant stems per square meter have been observed, and caloric content has been estimated as high as four million kcals/hectare (O'Connell and Bird, 2005). Furthermore, controlled burning experiments have demonstrated that fire management of epos tracts further increases productivity (Trammell et al., 2008).

The productivity of geophytes at Barrel Springs is the result of its unique geology and geomorphology, at least with respect to the rest of the project corridor. Barrel Springs rests on a partially forested (juniper) volcanic steppe or scabland characterized by a series of open meadows, rocky ground surfaces, and shallow clay soils. These forest-fringed meadows (known as lithosol meadows) are found throughout the Modoc Plateau and in southern Oregon, and are recognized as prime geophyte habitat (Gleason, 2001: 348–390). Epos requires extended, low winter temperatures (below 5° C) to bud and shallow clay soils that encourage local soil saturation during the wet season. Warm conditions in late spring and early summer create a short-lived photosynthesizing period that encourages bulb growth before summer ground desiccation leads to plant dormancy (Gleason, 2001: 348–349). The Barrel Springs volcanic uplands meet most of these environmental requirements.

Approximately 25 km of the project corridor passes through Barrel Springs, including areas immediately adjacent to the scientific study plots described above (fig. 53). More

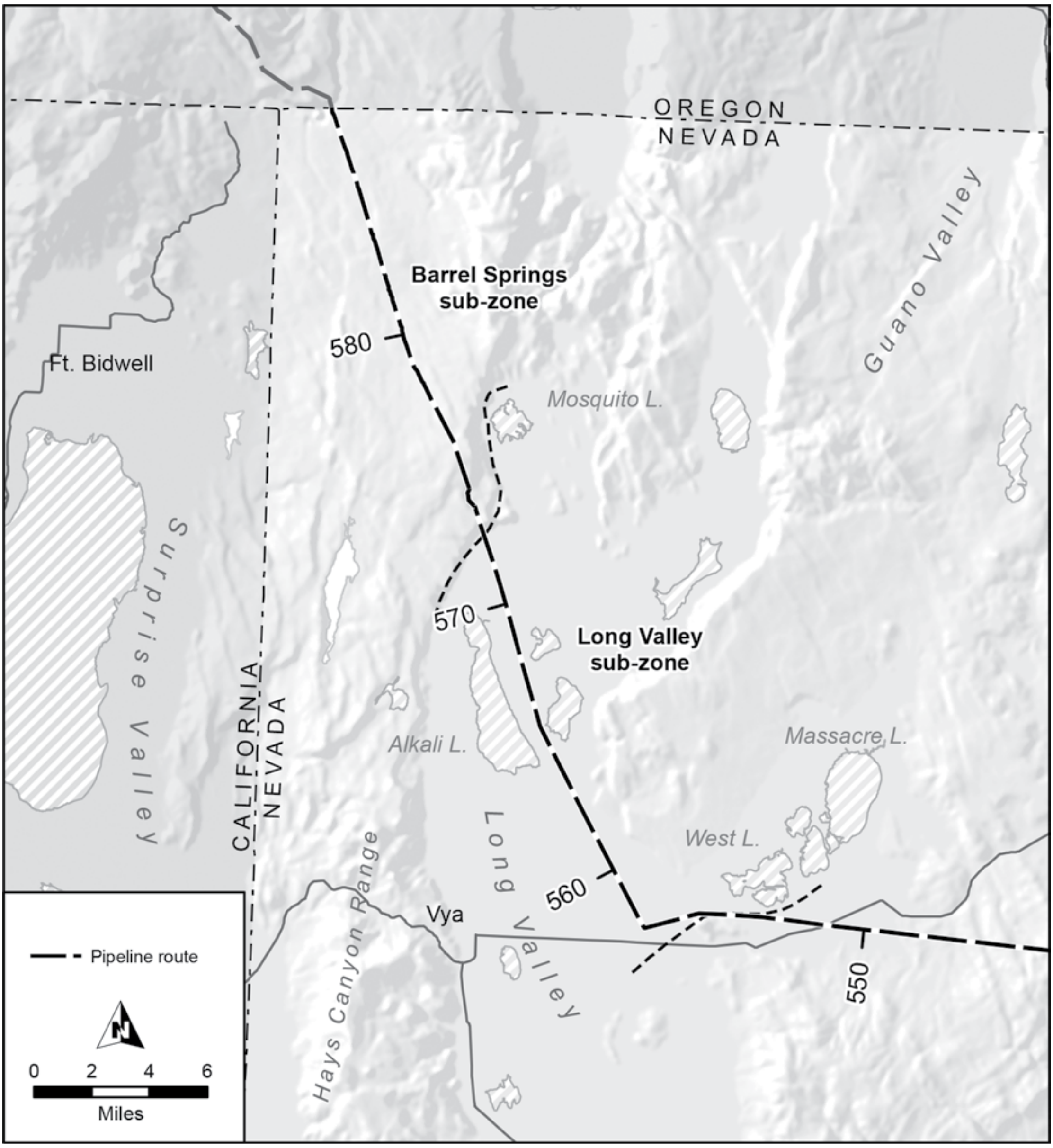


Fig. 53. Barrel Springs/Long Valley area.

Fig. 54. Northern Paiute women harvesting biscuit-root with a metal digging stick. (Photo courtesy of Marilyn Couture)

than 75 prehistoric sites were subject to data recovery excavations at Barrel Springs. Assemblages associated with these sites can be expected to reflect in some measure the procurement and processing of geophytes, and specifically that directed at epos.

Geophyte Procurement and Processing Technologies

Digging sticks

The role of the digging stick in geophyte procurement worldwide is incontestable (Thoms, 1989: 84–93). Indeed, the digging stick appears in some of the earliest assemblages ascribed to modern humans in Africa 42,000 to 44,000 years ago (Villa et al., 2012). Closer to home, the digging stick was the essential tool for the harvesting of geophytes by northern Great Basin and Plateau populations (fig. 54; Fowler and Liljeblad, 1986: 441; Hunn et al., 1998: 526–527; Walker, 1998; Fowler and Rhode, 2006: 331–350). Given the hard clay soils that characterize many geophyte habitats, the digging stick was "an extremely personal object that was carefully selected and maintained to last as long as possible…and noted by Barrett and Gifford (1933: 197) as being more effective than a steel spade 'for digging bulbs from the sun-baked, hard ground'" (Gleason, 2001: 237).

As such, digging sticks were manufactured from the hardest woods available, which along the project corridor would have included mountain mahogany (Voegelin, 1942: 175). As described by Gleason (2001: 237), digging sticks were usually about a meter long and fashioned from limb wood, which was first stripped and then sharpened at one or both ends; the final shape was determined by cultural preference and the digging situation at hand. The "business" end of this implement was shaped by both whittling and abrasion, and made more durable by charring. These tools were subjected to an intensity of use that is difficult to overestimate, with the area harvested by just one woman often looking like a "ploughed field" after a day's work (Curtin, 1971: 318). These tools were no doubt in need of constant maintenance (sharpening), but also either broke or wore out with regularity. Along these lines, Goddard (1903) noted that Hupa women were often accompanied by men on geophyte foraging rounds "to keep their digging sticks sharp with stone knives."

Insofar as digging sticks were wooden and generally do not preserve in the archaeological record, the key to tracking their prehistoric use—and geophyte procurement in general—is through the flaked stone tools used in their manufacture. Gleason (2001: 555–558) explores this relationship, as well as other archeological signatures of geophyte use, and points to the critical role of utilized flakes, scrapers, choppers, and other implements used in this process. Such tools may not have been deliberately shaped, but they are characterized by their long, durable working edges. Gleason also suggests that such tools might not occur in association with the usual reduction debris at site locations, but would be distributed in more scattered contexts across productive geophyte tracts.

Other Archaeological Correlates of Geophyte Use

Relying mostly on ethnographic accounts of the nearby Shasta, Gleason (2001: 241–266) also outlines a behavioral chain associated with epos processing, consumption, and storage with potential settlement implications. Initial processing occurred either within the actual harvest area or at nearby temporary "root camps" and involved cleaning and husking the thin outer skin of epos and drying them for eventual storage. No specialized tools were necessary to husk epos, the skin of which was usually popped off by simple rubbing. Epos is also noteworthy because it can be consumed in its raw form and does not require roasting to properly digest, as is necessary for camas. Some pounding into a mush or flour could occur at this initial stage, usually incorporating a mortar and pestle, but by far the largest portion of the harvest was destined for storage and winter consumption.

Epos was generally stored in baskets or bags in an aboveground granary structure either in winter camps or strategically located elsewhere to facilitate reasonable access during winter. In the Barrel Springs region, ethnographic accounts place these winter camps in lower-lying valleys and basins, such as Surprise Valley or Long Valley (Kelly, 1932). It is at these winter camps that a fuller range of consumption activities would have occurred. As with the harvest, processing was primarily the domain of women. The dried epos roots were ground, most often using hand stones and milling stones, and the resulting flour was formed into cakes or bread or added to a variety of stews, soups, or mushes. Cooking activities associated with the roasting, baking, or boiling of epos, and marked by the accumulation of fire-affected rock, would have been focused at these winter camps. In sum, the most direct archaeological signatures of the epos harvest are related to the manufacture and maintenance of digging sticks, and include a variety acute and steep-sided flake stone tools, such as simple flake tools and formed flake tools. The ready availability of tool-stone mass (cores, for example) to produce large flakes for carving and shaping tools may also be manifested in the archaeological record. Conversely, and with the possible exception of the mortar and pestle, milling equipment would not be directly associated with these harvest tracts. Greater evidence of epos processing and consumption, including more robust accumulations of hand stones, milling stones, and fire-affected rock, should be found in long-term base camps at lower elevations.

Archaeological Assemblages from Barrel Springs versus Long Valley: An Atemporal Assessment

The project corridor traverses approximately 25 km of the Barrel Springs volcanic uplands before abruptly dropping down into the pluvial basin of Long Valley, where it crosses another 25 km of land. The environmental contrast could not be starker, with the juniper-studded savannahs and lithosol meadows of Barrel Springs giving way to treeless desert shrub and sagebrush steppe communities of Long Valley. The latter is composed mainly of greasewood shadscale, and saltbush, as well as salt grass along sodic lake beds. These low basins are not prime geophyte habitat, but they do contain important economic plants such as seepweed, shadscale, various grasses including Indian ricegrass, bluegrass, alkali sacaton, and wild rye, and annual herbs such as blazing star (see chap. 2).

The broad assemblage profiles associated with these two adjacent regions provide corroboration of some of the archaeological signatures of geophyte use enumerated above. We are aided here by rigorous project

TABLE 74
Frequency and Density of Major Tool Classes: Barrel Springs versus Long Valley

Density (per 100 acres) is configured on total area of Barrel Springs (788.5 acres) and Long Valley (1127 acres) project segments.

Description	Barrel Springs		Long Valley	
	n	Density	*n*	Density
Projectile point	351	44.5	118	10.5
Drill	14	1.8	4	0.4
Biface	1364	172.9	296	26.3
Formed flake tool	57	7.2	0	0.0
Flake tool	1679	212.9	48	4.3
Core tool	15	1.9	1	0.1
Core	255	32.3	14	1.2
Flaked stone tool totals	3735	473.5	481	42.8
Millingstone	20	2.5	83	7.4
Handstone	30	3.8	43	3.8
Bowl mortar	5	0.6	0	0
Pestle	12	1.5	1	0.1
Milling tool totals	67	8.4	127	11.3

sampling and methodological protocols that allow us to compare these two regions in a statistically representative way. This effort is also facilitated by the large number of sites subjected to data recovery and artifact collection. At Barrel Springs, a total of 75 sites was investigated and more than 3800 flaked and ground stone tools were recovered. In Long Valley, these totals include 16 sites and 608 tools. The data are presented for both regions by artifact class and density in each subregion (table 74).

Several broad patterns are immediately apparent in table 74. First, substantially more artifacts were recovered from Barrel Springs, with respect to both absolute counts and density. But breaking this down further reveals a striking divergence between flaked stone tools and milling equipment, with the latter actually slightly higher in Long Valley. While settlement intensity, as measured by the number of sites and densities of key flaked stone artifact classes, is demonstrably much higher at Barrel Springs, this increase does not extend to plant processing.

To understand this, it is useful to return to Gleason's behavioral chain associated with epos procurement, particularly the role of milling equipment and settlement organization. Secondary processing activities, such as roasting and milling, generally do not occur at root camps in epos harvest zones, as the bulk of the crop is stored for consumption in winter camps at lower elevations, where dried epos is processed using a hand stone and milling stone. The project assemblage data from these two environments tentatively supports this description, with the preponderance of hand stone/milling stone processing activity occurring at lower elevations away from epos harvest zones. Noteworthy also is Gleason's (2001: 250) observation that the ground stone processing that does occur with fresh epos (within the context of harvest and occupation of local root camps) is usually done with a mortar and pestle, as this requires pounding and containment of the pulp. In an opposite pattern to the handstone/milling-stone trend, virtually all the bowl mortars and pestles from the two environmental regions were documented in the Barrel Springs Uplands.

Along with the ground stone signatures of epos procurement, it is important to understand the settlement implications of the patterns discussed above. This atemporal assessment supports the notion of a hierarchical settlement structure of harvest stations, upland root camps, storage facilities, and low-elevation winter base camps similar to that described for regional ethnographic groups. Below (see A Temporal Profile of Geophyte Procurement, page 294), we review the temporal dimensions associated with the evolution of this settlement system, as well as its implications for resource intensification.

Flaked Stone Correlates of Epos Procurement

As previously mentioned, the counts and densities of major flaked stone tools are clearly higher in the Barrel Springs Uplands than in Long Valley. This includes projectile points and bifaces, which range from four to more than six times greater than at Long Valley and probably indicate an increased level of hunting and hunting-related tool production in upland contexts. However, it is the flake tools, formed flake tools, and cores that show increases in densities by orders of magnitude: flake tools are nearly 50 times denser and cores 26 times denser at Barrel Springs. Furthermore, 57 formed flake tools were recovered in the Barrel Springs sites, whereas *none* were found in Long Valley. If these tools were simply part of hunting-related toolkits, we would expect increases in densities roughly corresponding to those of projectile points and bifaces. Because they do not show such increases, we conclude that they probably functioned in some other capacity—namely, the manufacture and maintenance of digging sticks associated with the epos harvest.

Gleason (2001: 240) identifies tools used in digging stick maintenance, singling out "utilized flakes" as the most likely archaeological signature of the epos harvest, because the digging sticks were in constant need of sharpening. However, she notes (2001: 550) that flake tools are the "Swiss Army knives" of the prehistoric toolkit, used for a variety of tasks. But it is their stunning ubiquity in epos resource tracts at Barrel Springs that is compelling. Of course, the demand for high-quality flakes for digging stick maintenance must be met by a supply, and this may explain the superabundance of cores at Barrel Springs. The emerging personal toolkit for epos harvesting may have also included cores from which flakes could be struck off as needed for digging stick maintenance.

Gleason is less specific about the manufacture of digging sticks; she includes such tools as large, hafted flakes and so-called choppers and scrapers in the ensemble of whittling and shaping implements potentially associated with digging sticks (2001: 552). Thoms (1989) is somewhat more specific about the flaked stone tools expected: "heavy tools include cobble choppers and large flake tools with notched edges or

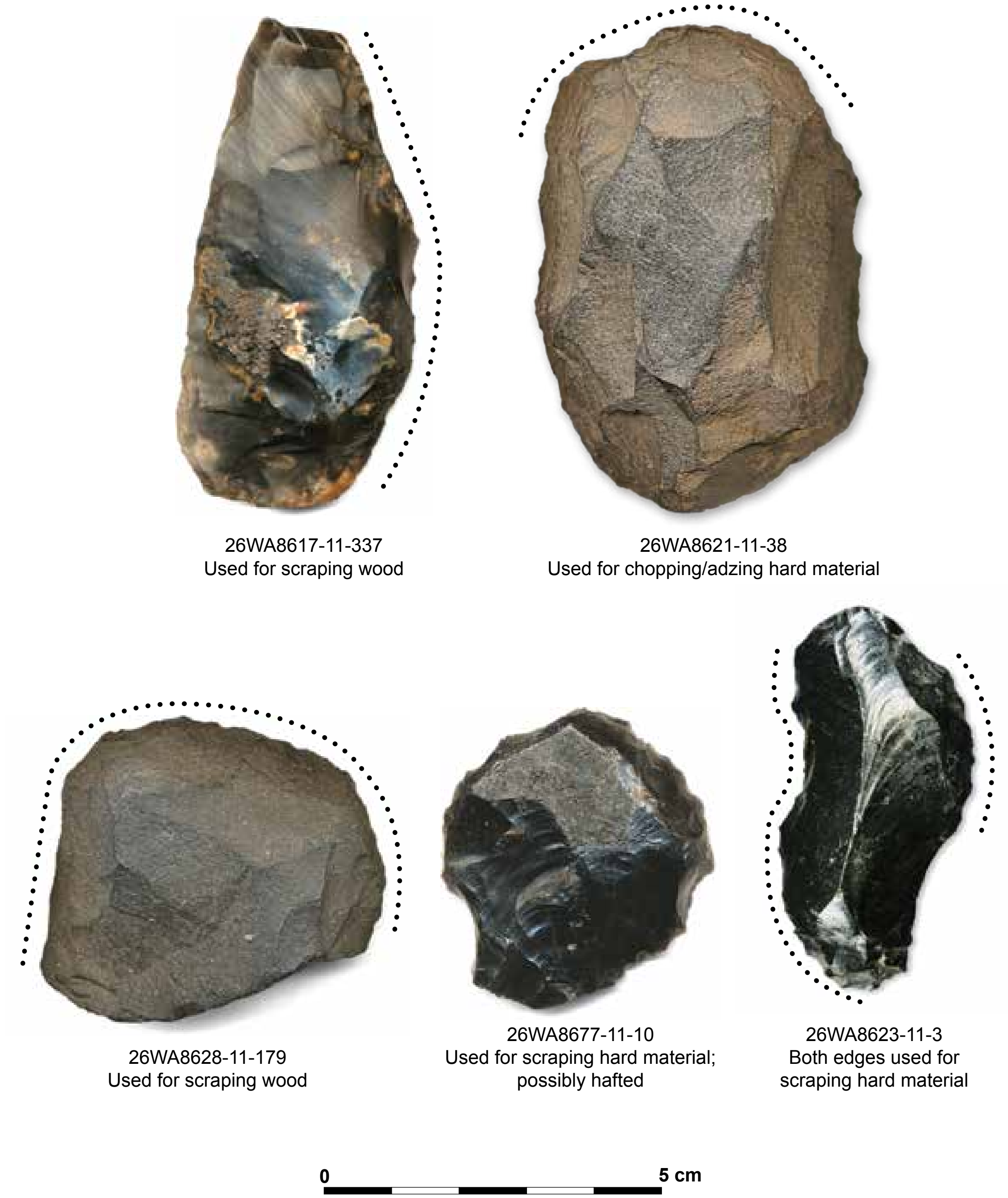
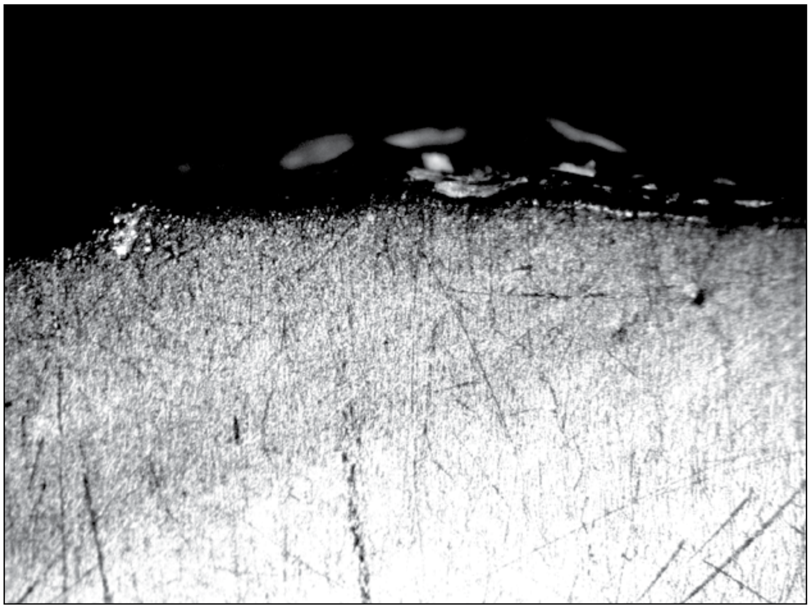


Fig. 55. Formed flake tools from Barrel Springs.

A



B

Fig. 56. Use-wear examples from formed flake tools recovered from Barrel Springs: **A.** 26HU5513-42, obsidian formed flake tool used for scraping hard material. Ventral edge at 40× magnification. Note edge-rounding, dorsal step-fractures, and ventral perpendicular striations. **B.** 26WA8690-33, CCS formed flake tool used for scraping wood. Ventral edge at 40× magnification. Note edge-rounding, dorsal step-fractures, and bright ventral polish.

spokeshavelike indentations, as well as the thick scraper edges frequently interpreted as woodworking tools." As a class, these would be roughly analogous to our project category of formed flake tools, which are defined as large flakes with purposefully modified (often retouched), steep-angled edges (fig. 55). These tools would be more valuable for stripping and shaping the shafts of digging sticks during manufacture than as tools for sharpening the point on a stick. The frequency distribution of the formed flake tools recovered from the two environmental regions supports this hypothesis: formed flake tools are found only in the geophyte-rich habitats of the Barrel Springs uplands, while simple flake tools are ubiquitous.

A Functional Analysis of Formed and Simple Flake Tools

Formed flake tools: To better assess the functional aspects of formed flake tools, a replicative analysis of use-wear was conducted on all such tools recovered along the entire project corridor. A total of 180 formed flake tools was analyzed, of which 138 were found to retain either edge damage or polish caused by the interaction of the tool with an opposing material. Of these, 120 tools (87%) were determined to have functioned in a scraping capacity (as opposed to being used as saws, knives, drills, choppers/adzes, or planing tools). Of the total number of tools classified as "scrapers," 130 modified edges were documented. Use-wear on 111 of these edges (85%) was the result of interaction with a hard material, most likely wood (mountain mahogany was used in the replicative study). The remaining 19 edges (15%) appear to have been used in association with softer materials, such as hide, meat, or the fleshy parts of plants.

As a general characterization, most of the formed flake tools that functioned as scrapers have a ventral-to-dorsal orientation (i.e., with the ventral flake face contacting the worked material). Accordingly, edge damage is most prevalent on dorsal sides of tools, with 91% of used dorsal edges having some type of edge damage, but only 39% of ventral edges exhibiting edge damage. This is consistent with a transverse (i.e., scraping) motion where the contact material exerts force on the ventral surface, causing flakes and step fractures to propagate on the opposite (dorsal) side (Tringham et al., 1974: 189; Keeley, 1980: 38). When ventral edge damage was present, it tended to be in the form of perpendicular striations indicative of scraping a hard and possibly gritty material (fig. 56).

In sum, a high percentage of formed flake tools found along the project corridor probably functioned as scrapers for working wood. Furthermore, there is a geographic distinction among the four project regions, with an indication that the use of these tools to scrape wood (as opposed to other materials) was more prevalent in the High Rock Country than elsewhere along the project corridor. Coupled with the behavioral and spatial data previously presented, the inference that formed flake tools were used for scraping and shaping digging sticks is strongly supported.

Use-wear results on formed flake tools from the Barrel Springs area specifically provide an even stronger contrast between this geophyte-rich area and other project regions. If formed flake tool use in Barrel Springs was geared toward one primary activity, such as digging stick manufacture and maintenance, we might expect their functional diversity at Barrel Springs to be narrower than in other project areas. To measure functional diver-

TABLE 75
Comparison of Formed Flake Tool Functional Diversity and Contact Materials

Diversity measure is Simpson's 1-D; larger values signify greater diversity. For calculation, each function was defined as a tool action plus a contact material (e.g., "scraping + wood").

	Barrel Springs	Other Areas
Functional diversity	0.63	0.83
% Hard contact materials	84	66
% Soft contact materials	2	17

sity, Simpson's index values were calculated from the distributions of tool actions and contact materials (table 75). As expected, formed flake tools from the Barrel Springs area are less functionally diverse, and they are more likely to have been used on hard materials rather than soft materials when compared to tools from other areas. This suggests that, while formed flake tools were used for a wide variety of tasks over the project area as a whole, at Barrel Springs there was a greater emphasis on tasks (such as woodworking) that involved the scraping of hard materials.

Simple flake tools: While the use of formed flake tools for heavy-duty woodworking is well supported, what about the functions of simple flake tools, which are much more common at Barrel Springs? As a class, simple flake tools are morphologically similar to formed flake tools, but generally lack evidence of purposeful edge modification in the form of retouch (fig. 57). Evidence from both microscopic use-wear and conventional analyses suggests that simple flake tools were used for a variety of tasks but overlapped significantly with the uses of formed flake tools, with the latter perhaps used for the heavier-duty woodworking tasks.

This relationship is illustrated in fig. 58, which plots edge angle against weight for formed flake tools and simple flake tools. Formed flake tools are generally heavier and have steeper edge angles than simple flake tools, but there is also considerable overlap between the two. In general, steeper edge angles are better suited to woodworking (Crabtree and Davis, 1968; Gould et al., 1971; Crabtree, 1977; Siegel, 1985; Cane, 1992). Likewise, greater tool mass should provide added efficiency for heavy woodworking tasks (Gould, 1977; Kuhn, 1994). Thus, in figure 58 tools better suited to heavy woodworking should occupy the upper right quadrant.

This is not to say, however, that more acutely angled flake tools were not also used for woodworking tasks. A 20% random sample of flake tools from two sites in the Barrel Springs area was subjected to use-wear analysis. Of the analyzed sample, 63% were used for scraping hard materials—most likely wood—and none showed evidence of use on soft materials (fig. 59). The Barrel Springs flake tools also have a distinct bimodality with respect to edge angle (fig. 60). Whereas the Long Valley flake tools have a fairly uniform distribution centered around 30°, those from Barrel Springs have a bimodal distribution with peaks at 30° and 60°. These steeper-edged tools from Barrel Springs likely represent heavier-duty woodworking tools that were functionally similar to formed flake tools.

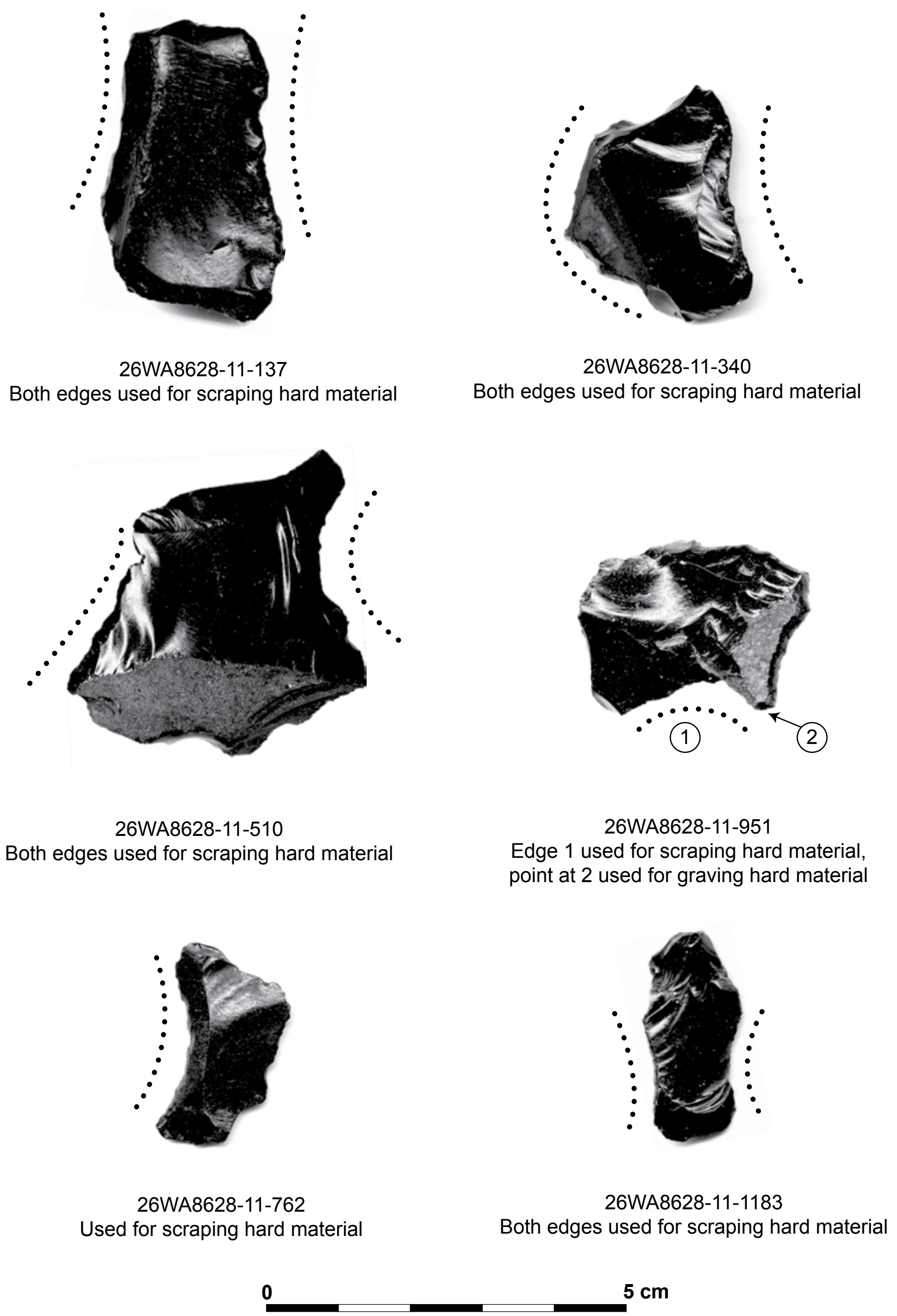


Fig. 57. Simple flake tools from Barrel Springs.

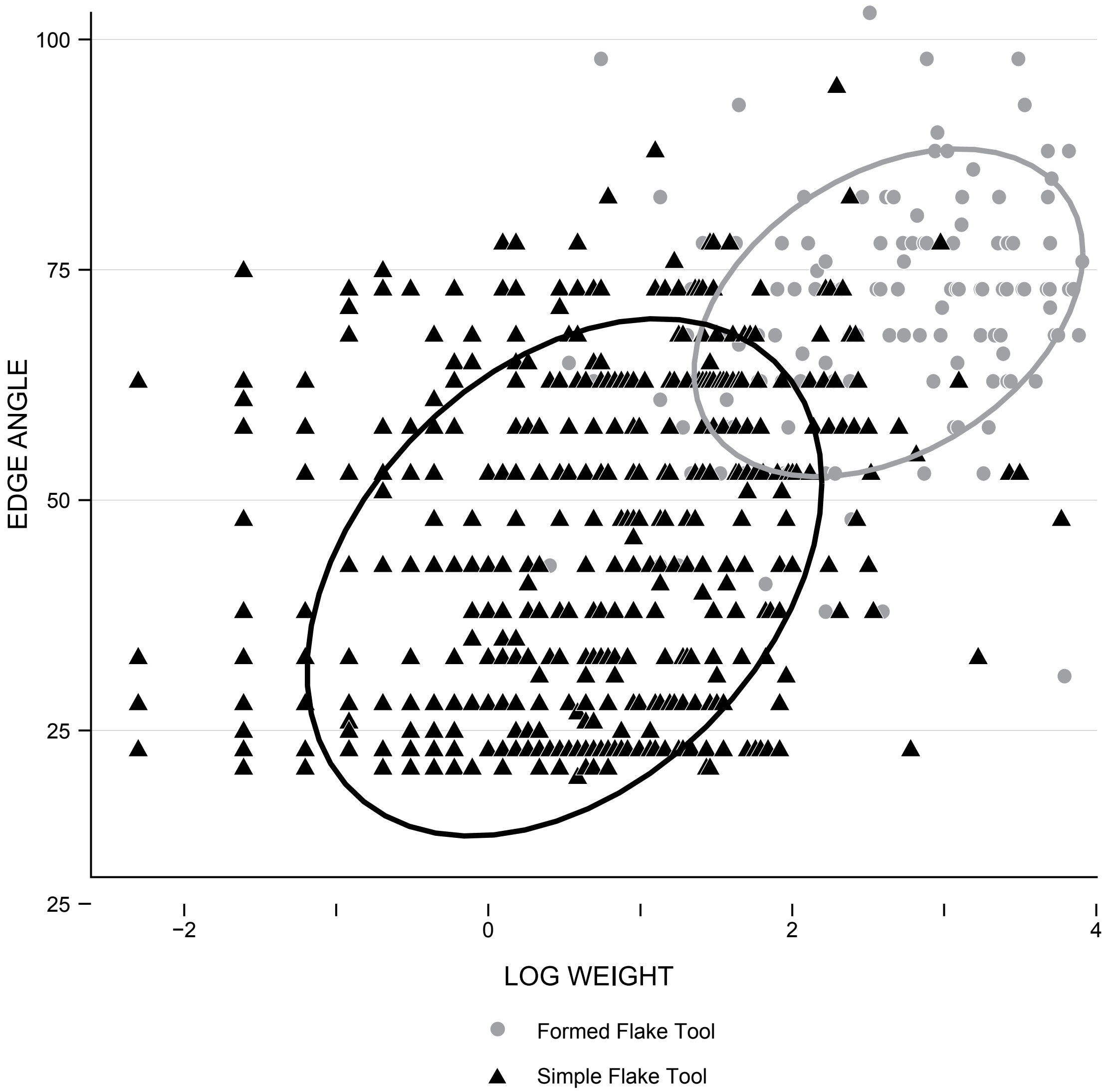


Fig. 58. The relationship of edge angle and weight for simple and formed flake tools. Ellipses represent 95% confidence intervals.

Edge shapes of flake tools also suggest digging stick maintenance. Thoms (1989) identified tools with "notched edges or spokeshave-like indentations" as indicative of digging stick manufacture and maintenance. Among the four regions, the High Rock Country is the only one where the majority of flake tools have concave edges. The contrast is even stronger between Barrel Springs and other areas, with 37% of Barrel Springs flake tools exhibiting concave edges and versus only 15% of those from other areas (fig. 61).

In sum, both formed flake tools and simple flake tools from Barrel Springs show strong

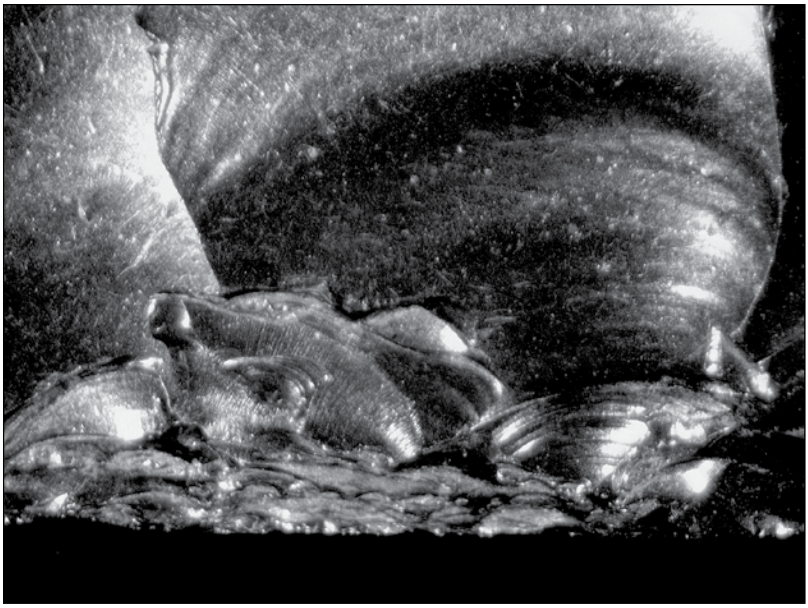


Fig. 59. Edge damage on flake tools indicative of likely use on wood: 26WA8628-907, Obsidian flake tool used for scraping hard material. Dorsal edge at 10× magnification. Note extensive dorsal step-fractures and flake removals.

evidence for woodworking activity. The former may have been used for heavier-duty tasks, such as the actual manufacture of digging sticks, whereas the latter may have been used for more expedient and recurring sharpening and maintenance tasks. Aside from zones of retouch, however, these tools show broad morphological similarity and together probably represent a continuum of use associated with woodworking activities. The sheer number of these tools in prime geophyte procurement zones argues for a distinct flaked stone technology associated with the manufacture and maintenance of digging sticks.

A Temporal Profile of Geophyte Procurement

In the absence of dateable organic residues or other directly dated evidence of geophyte use, we are obliged to consider more indirect proxy data to establish the intensity of prehistoric occupation of the Barrel Springs uplands. These data, which rely primarily on the overall frequencies of dated project archaeological components, and secondarily on the frequencies of time-sensitive projectile points, provide a broad measure of land-use intensity through time. To the extent that Barrel Springs was a prime geophyte habitat, and that a significant portion of the resulting archaeological record is related either directly or indirectly to the procurement of this staple resource type, these proxy data provide a rough measure of their use through time.

The frequency of dated project components at Barrel Springs is derived from an assessment of obsidian hydration and projectile point data, as well as a smaller number of radiocarbon dates (see chap. 4 for a complete discussion of component definition). It pro-

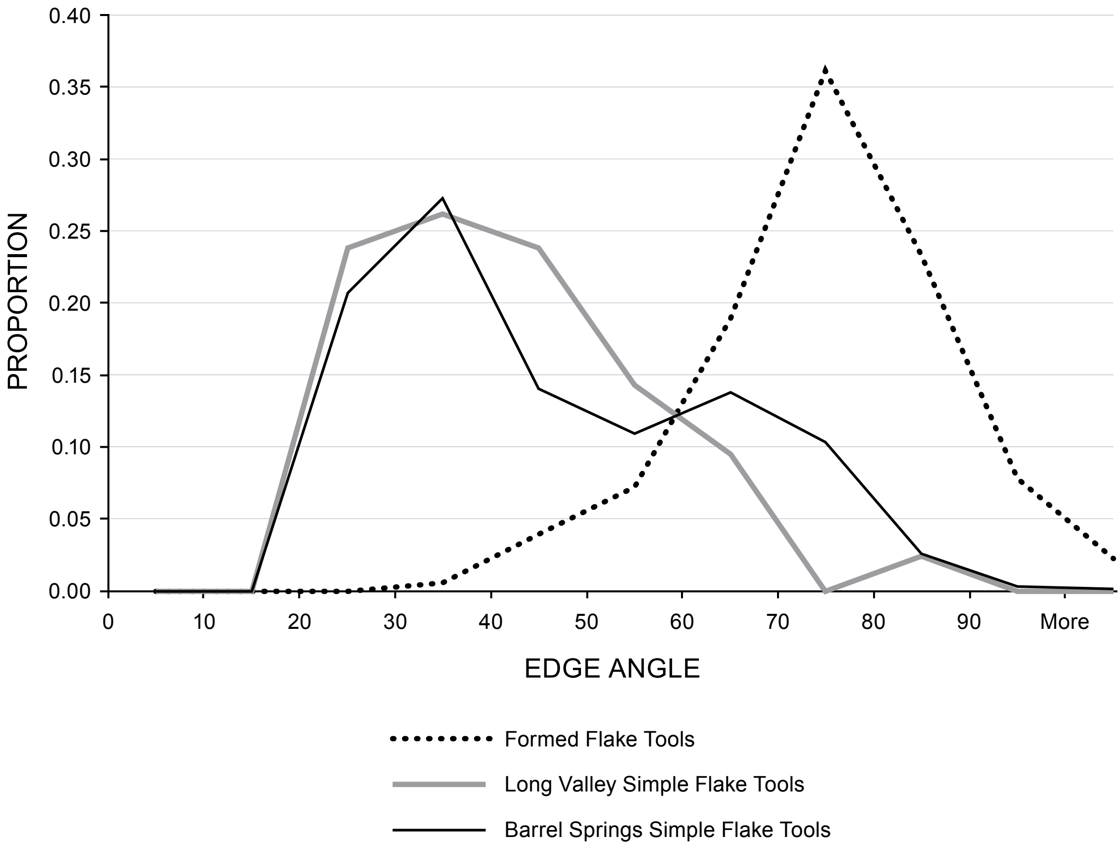


Fig. 60. Edge angles of flake tools from Barrel Springs and Long Valley. Note: formed flake tool edge angles from entire Ruby Pipeline Project Corridor provided for comparison.

vides a broad index of archaeological visibility through time and is used throughout this report as the primary proxy for relative population densities. Component frequencies are presented in table 76 and standardized by time interval (i.e., components/1000 years); absolute component counts are also presented. As can be seen, component frequencies ramp up in the Early Archaic and peak during the Middle Archaic Period. They drop in the Late Archaic and are altogether absent during the Terminal Prehistoric Period.

The minimal representation of Late Prehistoric components is puzzling and may relate to issues of archaeological overprinting in this high-use area and the resulting difficulties in identifying potentially more ephemeral spatiotemporal components. As a cross-check, we also review the projectile point frequency data from Barrel Springs in table 76, again standardized by time interval (i.e., points/1000 years); absolute counts are also presented. Except for the Late Archaic Period, these data confirm the trend profile from the component data, including the comparatively lower level of Terminal Prehistoric activity. The standardized Late Archaic point frequencies actually reach the highest level of any period.

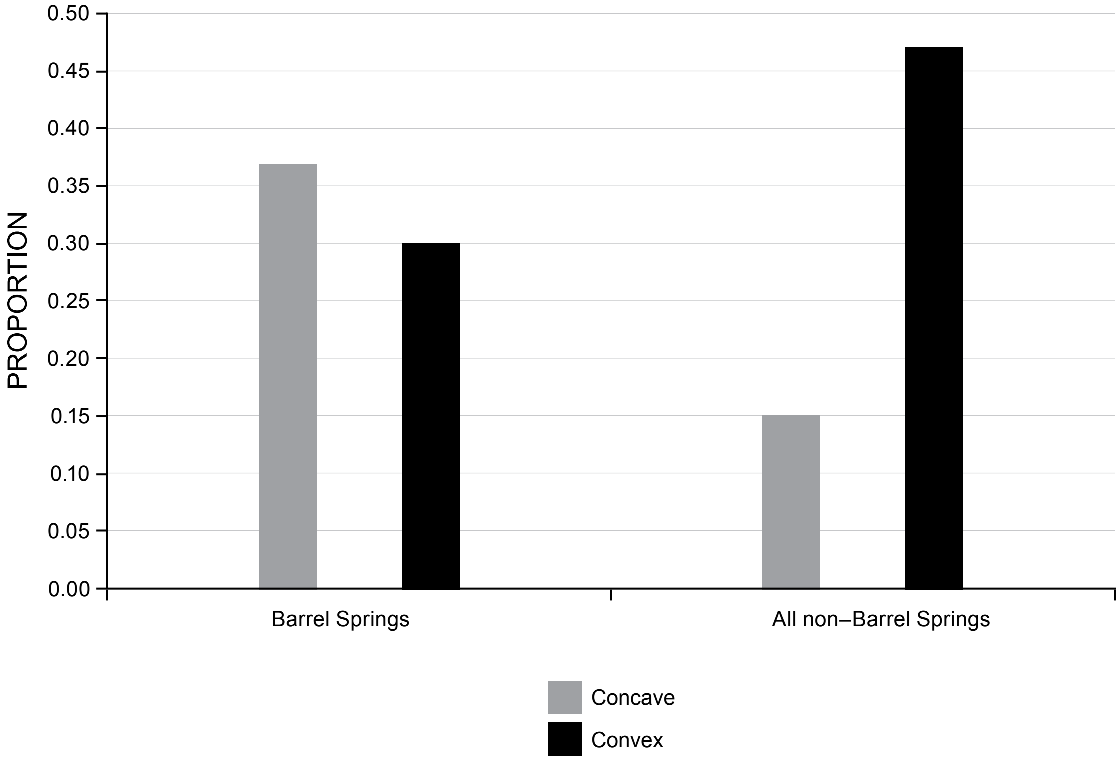


Fig. 61. Proportions of concave and convex edge shapes of simple flake tools from Barrel Springs versus non–Barrel Springs project regions.

Several trends are apparent. First, the most consistent result is the dramatic increase beginning in the Early Archaic Period and continuing through the Middle Archaic. There is also a reasonably strong indication that land-use intensity fell off during the Terminal Prehistoric Period. What is less clear is the dating of the peak in land-use intensity at Barrel Springs. We are inclined toward a broad temporal assignment that probably extended through the Middle Archaic and into some portion of the Late Archaic Period.

To the extent that geophyte procurement conditioned overall land use at Barrel Springs, this activity appears to have begun intensifying as early as 5700 years ago, reached its highest expression sometime between 3800 and 1300 B.P., and continued for perhaps several centuries beyond that. After 600 B.P., the intensity of geophyte procurement appears to have declined.

The Evolution of a Geophyte-Based Settlement-Subsistence System at Barrel Springs

To understand the trans-Holocene evolution of geophyte use in this region of the Great Basin, it is useful to consider the energetic returns provided by these staples, particularly epos. Figure 62 provides a ranking of key Great Basin and California plant resources with regard to their postencounter

TABLE 76
Chronological Profile of Barrel Springs: Dated Components and Time-Sensitive Projectile Points

Major obsidian sources: Massacre Lake/Guano Valley, Mosquito Lake, Bidwell Mountain, Bordwell Group, and Craine Creek.

Period	Temporal Interval (cal B.P.)	Components		Surface Projectile Points	
		n	Per 1000 years	*n*	Per 1000 years
Terminal Prehistoric	600–100	0	0.0	1	2.0
Late Archaic	1300–600	1	1.4	25	35.7
Middle Archaic	3800–1300	19	7.6	66	26.4
Early Archaic	5700–3800	7	3.7	43	22.6
Post-Mazama	7800–5700	3	1.4	11	5.2
Paleoarchaic	12,800–7800	3	0.6	2	0.4
Paleoindian	14,500–12,800	1	0.6	1	0.6
Totals	–	34	2.4	149	10.3

return rates measured in kcals/hour of effort to procure and process (table 77). What is clear is that geophytes, particularly epos and bitterroot, rank at the top, ahead of even pinyon pine and various oak taxa. Return rates of epos are estimated at between 2000 and 2600 kcal/hour (O'Connell et al., 2008). Coupled with the sheer density of epos at Barrel Springs, which has been estimated to be as high as four million kcals/hectare (O'Connell and Bird, 2005) in productive tracts, O'Connell et al. (2008) are no doubt correct in noting that epos should *always be taken* when available in preference to other plant foods (see also Middleton et al., 2014).

With respect to diet breadth and the evolution of foraging systems that incorporated epos, we would therefore expect that this resource was targeted by the earliest inhabitants of Barrel Springs, and indeed the proxy data previously reviewed provide some hints of visitation as early as the Paleoindian Period and more ample evidence of occupation during the Paleoarchaic Period. These populations, however, were wide-ranging, mobile foragers (Amick, 1996; McGuire, 2002; Jones et al., 2003), notwithstanding some debate as to the actual size of their foraging ranges (Smith, 2010). Without the benefit of long-term storage or a stable residential pattern, these early inhabitants were probably relegated to a pattern of harvest and immediate consumption confined to a short time in May and June when epos was readily available. Given the worldwide antiquity of the digging stick, it is unlikely that actual prehistoric harvesting technology was much different than that observed during ethnographic times. Coupled with what were probably low overall population densities to begin with, we would expect the archaeological visibility of this form of geophyte procurement at this time to be low. We can broadly characterize these kinds of foragers as *time minimizers* (Bettinger, 1999b).

What may have been instrumental in the rise of a true geophyte-based subsistence economy—transforming this resource class

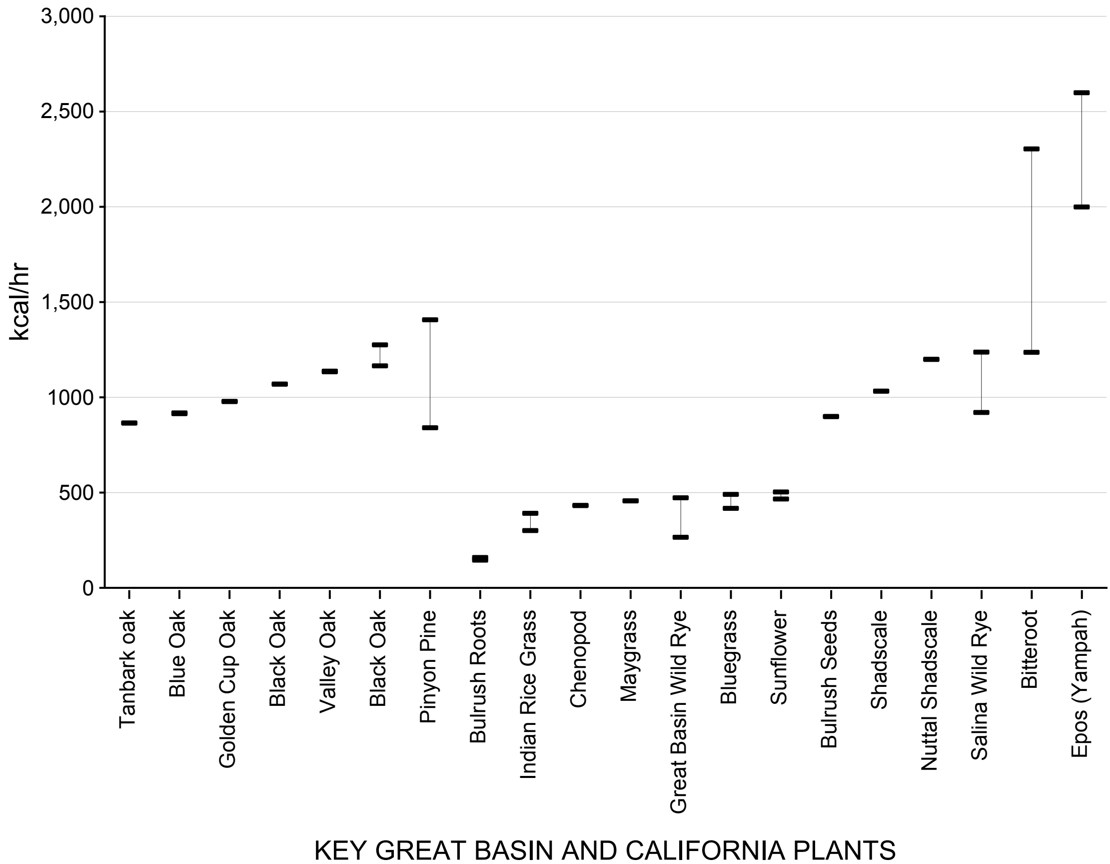


Fig. 62. Comparison of energetic return rates for key Great Basin and California plants (adapted from Rosenthal and Fitzgerald, 2012: 85, fig. 4.6).

from an abundant but seasonally restricted crop to a keystone staple—was a change in land-use strategies and the development of storage technology. To briefly review, the comparative abundance of milling equipment in lowland (Long Valley) versus upland (Barrel Springs) contexts (see table 74) suggests a hierarchical settlement system, with the former the locus of longer-term, perhaps winter, habitation where the processing of dried epos using a hand stone and milling slab occurred, and the latter the domain of harvesting stations and upland root camps containing an abundance of flake tools, formed flake tools, and cores for the manufacture and maintenance of diggings sticks. We lack direct evidence of storage at either location, but the relative abundance of hand stones and milling stones, which would have been more effectively used to process dried epos, suggests that a large portion of the crop was transported and stored at or near these lowland base camps. We can characterize this class of foragers as *energy maximizers* (Bettinger, 1999b).

This pattern of geophyte use at Barrel Springs appears to have begun around 5700 years ago, perhaps reached its highest levels

TABLE 77
Comparison of Energetic Return Rates for Key Great Basin and California Plants

Common Name	Scientific Name	kcal/hour		Source
		Low	High	
Tanbark oak	*Lithocarpus densiflorus*	866	866	Barlow and Heck (2002
Blue oak	*Quercus douglasii*	915	919	Barlow and Heck (2002)
Golden cup oak	*Quercus chrysolepis*	979	979	Barlow and Heck (2002)
Black oak	*Quercus kelloggii*	1070	1070	Gremillion (2004)
Valley oak	*Quercus lobata*	1135	1138	Barlow and Heck (2002)
Black oak	*Quercus kelloggii*	1166	1276	Barlow and Heck (2002)
Pinyon pne	*Pinus monophylla*	841	1408	Simms (1987)
Bulrush roots	*Scirpus* spp.	146	160	Simms (1987)
Indian rice grass	*Oryzopsis hymenoides*	301	392	–
Chenopod		433	433	Gremillion (2004)
Maygrass		457	457	Gremillion (2004)
Great Basin wild rye	*Elymus cinereus*	266	473	Simms (1987)
Bluegrass	*Poa* spp.	418	491	Simms (1987)
Sunflower	*Helianthus annuus*	467	504	Simms (1987)
Bulrush seeds	*Scirpus* spp.	900	900	Simms (1987)
Shadscale	*Atriplex confertifolia*	1033	1033	Simms (1987)
Nuttal shadscale	*Atriplex nuttallii*	1200	1200	Simms (1987)
Salina wild rye	*Elymus salina*	921	1238	Simms (1987)
Bitteroot	*Lewisia rediviva*	1237	2305	Simms (1987)
Epos/yampah	*Perideridia*	2000	2600	O'Connell et al. (2008)

during the Middle Archaic, and continued well into the Late Archaic before declining during the Terminal Prehistoric Period. A very similar pattern of rising sedentism tied to increased reliance on geophytes (in this case lomatiums and camas) is described for the Fort Rock area north of our study area (Jenkins et al., 2000: 46–55). It also began about 6000 years ago, with a peak in sedentism between 3800 and 3000 B.P. and identified in part by an abundance of Gatecliff, Humboldt, and Elko projectile points.

The transition from an early, *time-minimizer* foraging pattern, to one that involved an energy-maximizing strategy that included storage would have substantially increased epos procurement, allowing surpluses to be banked for critical winter consumption. The potential net energetic gains of such a transition can be easily modeled (table 78). We first compute the daily plant-based caloric requirements for a band of 15 foragers, employing the *time-minimizer* strategy that includes five root harvesters over a 45 day harvest period (i.e., the number of plant-based calories required to maintain the group over this harvest period). Assumptions include a return rate of 2300 kcal/hour for epos, an average daily caloric requirement of 2600 calories/person, and the likelihood that approxi-

TABLE 78
Time Minimizers versus Energy Maximizers: A Comparison of Group Return Rates for Epos

Time maximizer strategy (early pattern, no storage)	
1,755,000 calories	Total caloric requirement of 15-person group over 45 day harvest period.
877,500 calories	Total maximum group caloric contribution potentially supplied by epos over a 45 day harvest period (estimated 50% of total).
381 hours	Time required to harvest and process epos (877,500 calories/2300 kcal/hour/person).
1.7 hours/day	Time required per epos harvester to harvest and process (381 hours/45 days/5 harvesters).
Energy maximizer strategy (late pattern, with storage)	
1,755,000 calories	Total caloric requirement of 15-person group over 45 day harvest period.
2,587,500 calories	Total maximum group caloric contribution provided by 5 harvesters foraging 5 hours/day for a 45 day harvest period (2300 kcal/hour/person × 5 hours × 5 harvesters × 45 days).
1250 hours	Time required to harvest and process epos (2,587,500 calories/2300 kcal/hour/person).
5.0 hours/day	Time required per epos harvester to harvest and process (1250 hours/45 days/5 harvesters).
Net group energetic increase provided by energy-maximizer strategy	
1,710,000 calories	Total logistical caloric output (2,587,500 calories; see above) minus maintenance group caloric requirement from epos over a 45 day period (877,500 calories; see above). At 50% of the total caloric requirement, this will provide approximately 88 days of the plant-based caloric needs for a 15-person group.
Assumptions	
Group Size: 15 people; five active epos harvesters Average daily caloric requirement per person: 2600 calories Average daily caloric requirement for 15-person group: 39,000 calories Epos caloric yield: 2300 kcal/hour Maximum percentage of plant-based calories/day: 50% Total epos harvest period: 45 days	

mately 50% of this daily caloric need will be supplied by plant-based nutrients. We calculate that it would take about 1.7 hr for these five harvesters to meet the daily caloric needs for the entire group. In the *energy-maximizer* model, we increase the daily harvest time from 1.7 hr to 5.0 hr per harvester, and the net caloric surplus per day amounts to 38,000 calories. Over a 45 day harvest period this surplus yield is calculated at 1,710,000 calories. If the surplus is stored, it is enough to provide a 15 person band about 88 days of its total plant-based caloric requirement. Put another way, this stored surplus would be enough to cover virtually the entire plant-based caloric requirement for 15 people over the three resource-poor winter months (December through February).

The transformative potential of this type of food production should now be readily apparent and no doubt would have conditioned major aspects of northern Great Basin subsistence-settlement as climatic conditions began to improve toward the end of the middle Holocene. It tethered winter base camps to stored resources, thereby increasing overall sedentism. It required a more robust gendered division of labor and, to some extent, probably underwrote the activities of adult males. It may, therefore, be no coincidence that the timing of geophyte intensification coincided with the rise of long-range logistical hunting observed throughout much of the Great Basin (Hildebrandt and McGuire, 2002; Broughton and Bayham, 2003; McGuire and Hildebrandt, 2005). This could also help explain the high relative frequencies of projectile points and bifaces that were recovered from Barrel Springs (see table 74).

This particular type of geophyte procurement appears to have increased gradually through the Early, Middle, and Late Archaic periods, before declining again. As we observed in the energetic analysis, the net caloric returns that can be devoted to storage are highly sensitive to even minor adjustments in daily harvesting time or the number of individuals engaged in active harvesting. For example, the addition of one extra individual (from five to six) in the foraging effort for a 5 hr harvesting bout would result in a net increase in caloric return of about 30% for a 15 person group. Similarly, the addition of an extra hour of harvest time for five harvesters supporting a 15 person group can increase net caloric return on the order of 20% to 25%. The point here is that this type of intensive geophyte procurement has an unusual amount of capacity built into it. As our proxy data indicate, land use and presumably population density increased through much of the late Holocene, and this procurement system had the flexibility and capacity to respond in kind.

Recent experiments in fire management within epos tracks at Barrel Springs provide insight into additional levels of geophyte intensification. Trammell et al. (2008) report that burning increases both epos yield and distribution, presumably by altering either soil nutrients or plant community dynamics. This yield increase can be on the order of 50% with no effect on the plant nutrient content. There is no direct archaeological evidence for fire management at Barrel Springs, but all proxy data indicate that land-use intensity reached its zenith around the Middle-Late Archaic transition, perhaps between 3800 and 1000 cal B.P. If systematic fire management was ever practiced by prehistoric peoples at Barrel Springs, it probably occurred within this time frame.

Given the stability of the late Holocene geophyte procurement system described above (measured in millennia), it is surprising that the proxies of land-use intensity at Barrel Springs drop off near the Late Archaic–Terminal Prehistoric transition. This is especially true given the importance of epos to the Surprise Valley Paiute in the ethnographic period (Kelly, 1932). The diminution of land-use intensity, however, is not unusual and has been observed in a variety of contexts elsewhere in the Great Basin and California (Jones et al., 1999; McGuire and King, 2011). Two potentially related explanations come to mind, one being severe climatic conditions perhaps associated with the Medieval Climatic Anomaly (MCA), and the other being the arrival of Numic-speaking populations with new systems of land use.

The MCA typically shows two major episodes, roughly 1100–900 and 800–650 cal B.P., i.e., occurring toward the end of the Late Archaic Period (chap. 2). This would predate the appearance of Numic speakers, who may have entered this area of the northern Great Basin about 300 or 400 years ago (Delacorte, 2008: 11–129; see also chap. 15). Still, there may be some overall cause and effect in that the environmental changes wrought by the MCA would have severely affected geophyte productivity, as well as other subsistence pursuits, to the extent of disrupting what had been a stable, long-term land-use system.

It may also be that the family-band organization that is diagnostic of most Great Basin Numic populations resulted in a much more diffuse archaeological record. The large root camps and other seasonal base camps that characterized early periods could have given way to small, standalone residential camps that would have been occupied for only a short period of time over single, or perhaps several, seasons. The archaeological record of such an occupation is much less visible and no doubt swamped to some extent by the debris of past, more intensive occupations. In this scenario, land-use intensity may not have changed all that much but may have been reorganized in such a way as to limit its archaeological visibility.

CHAPTER 14

OBSIDIAN CONVEYANCE PATTERNS

Jerome King

Changes over time in prehistoric settlement patterns are often reflected by parallel changes in how raw material for flaked stone tools was acquired. These changes are most readily apparent in the proportions of different raw materials at archaeological sites. Also, because obsidian can be traced to its specific source area via geochemical analysis, it is possible to look at the specific directionality and distances involved in obtaining it. Indeed, entire prehistoric settlement systems have been reconstructed on the basis of obsidian source profiles (Bettinger, 1999a; Delacorte, 1999; Jones et al., 2003; Beck and Jones, 2009).

The earliest inhabitants of the western Great Basin are generally thought to have been highly mobile, based on the diverse profile of obsidian sources at many Paleoindian localities, including sources hundreds of kilometers away (Kelly and Todd, 1988; Amick, 1996, 1997; Jones et al., 2003; Smith, 2010), though researchers have differed on what this implies about the nature of early settlement systems. Some researchers define "lithic conveyance zones" based on observed trends in directionality and distance of obsidian transport, and equate these with foraging ranges (e.g., Jones et al., 2003, 2012; Smith, 2010). In this scenario, lithic procurement would have been opportunistic, embedded within an extremely far-ranging seasonal settlement round. Other researchers argue that the diverse profile of obsidian sources may reflect high logistical mobility by hunting parties, who could have targeted distant sources as part of their forays, with seasonal moves between residential bases covering a much smaller area (Elston and Zeanah, 2002; Madsen, 2007). Trade is generally not thought to have been a significant factor in early obsidian procurement.

The archaeological record for subsequent periods of prehistory generally shows reduced diversity in obsidian source profiles and lower overall distances between source and site, likely reflecting a contraction in foraging areas, as well as an increasingly systematized approach to obsidian procurement that emerged in the Early and Middle Archaic periods (Basgall, 1989; Bettinger, 1999a; Delacorte, 1999; McGuire, 2002; Eerkens et al., 2008a). Quarrying activity rose toward a pronounced peak in the Middle Archaic at many obsidian source areas in the westernmost Great Basin (Gilreath and Hildebrandt, 1997, 2011; Ramos, 2000, 2008; King et al., 2011). Whether this quarrying activity resulted from increased trade with outside groups (Gilreath and Hildebrandt, 1997, 2011; King et al., 2011) or from a technological adaptation to the demands of high seasonal mobility (Basgall, 1989; Delacorte and Basgall, 2012) remains a matter of continued debate.

In McGuire's (2002) review of obsidian source profiles from the Tuscarora and Alturas projects in northeastern California and northwestern Nevada, Middle Archaic sites show the lowest overall diversity of obsidian sources at any time in prehistory, consonant with the idea of scheduled access to a relatively small number of sources. Similarly, Smith's (2010) compilation of projectile points from the Black Rock Range shows the lowest source diversity among the point types diagnostic of the Early and Middle Archaic.

During the Late Archaic and Terminal Prehistoric, quarry production at the major obsidian sources dropped precipitously, perhaps partially as a result of reduced toolstone needs accompanying the introduction of the bow and arrow, but likely also because of the collapse of previously established trade networks (Hildebrandt and McGuire, 2002; Gilreath and Hildebrandt, 2011). Additionally, the Numic groups that settled the region in the Terminal Prehistoric are thought to have had smaller overall foraging ranges (Bettinger, 1999a; Delacorte, 1999), with reduced opportunities for direct access to preferred obsidian sources. In the absence of renewed external trade, we would expect still lower diversity of obsidian sources in Terminal Prehistoric sites, and in obsidian-poor areas, a shift toward other locally available materials. In fact, however, obsidian source diversity appears to increase in many late sites. McGuire's (2002) review of obsidian source profiles from northeasternmost California, as well as Smith's (2010) Black Rock study, show a substantial rebound in obsidian source diversity during the Late Archaic and Terminal Prehistoric periods. Similarly, Eerkens et al.'s (2008b) study of Owens Valley house features shows substantially higher source diversity in Terminal Prehistoric houses than in Late or Middle Archaic ones, as well as higher variation between individual houses.

McGuire's (2002) and Smith's (2010) studies provide an excellent jumping-off point for a similar study of the current project sites. These sites boast a large assemblage of geochemically sourced artifacts, including not only projectile points, but also debitage from dated components. This study attempts to document whether the patterns observed by McGuire and Smith hold true not only for the westernmost project regions, but for the project area as a whole. A brief review of raw material profiles is offered (see chap. 11), followed by a more detailed examination of obsidian source profiles. Following Smith (2010), this study characterizes source profiles in terms both of diversity and average transport distances from source to site, although a somewhat different analysis of transport distances is used here. Given the limitations inherent in this linear transect through Nevada, no attempt is made to define or critique the "lithic conveyance zones" proposed by Smith and others.

Material Profiles

Rather than examining the complete profile of different material types, this review focuses on the ratio of obsidian to other lithic materials. This approach assumes that obsidian is typically preferred over other lithic materials (since obsidian does not require heat treatment and is comparatively easy to work), and that other materials, such as chert and

TABLE 79
Average Percentage of Obsidian in Debitage Assemblages from Dated Components
n = number; OBS = obsidian.

Age	High Rock Country		Upper Lahontan Basin		Upper Humboldt Plains		Thousand Springs Valley		All	
	% OBS	*n*	% OBS	*n*	% OBS	*n*	% OBS	*n*	% OBS	*n*
Terminal Prehistoric	92.3	3	41.5	3	3.8	16	1.6	3	18.7	25
Late Archaic	99.3	19	55.7	8	0.7	18	3.6	2	50.0	47
Middle Archaic	93.7	97	83.1	13	7.3	28	25.1	8	72.4	146
Early Archaic	92.7	64	99.4	4	5.8	17	33.8	5	73.3	90
Post-Mazama	93.4	21	89.0	7	6.5	3	–	–	84.0	31
Paleoarchaic	94.4	31	90.2	5	–	–	42.9	1	92.4	37
Paleoindian	93.9	8	78.3	1	–	–	–	–	92.2	9
Totals	–	243	–	41	–	82	–	19	–	385

basalt, are generally more abundant across the landscape than obsidian and thus require less effort to obtain. Thus, in areas where obsidian is not locally available, changes over time in the ratio of obsidian to nonobsidian in archaeological sites can serve as a rough measure of changes in a group's ability to get access to remote source areas, whether by direct access or by exchange.

Given these assumptions, in combination with the trend toward decreasing overall foraging range throughout prehistory, one should expect to see a consistent decline in the proportion of obsidian. Indeed, this is what the project sites show. Table 79 shows the average proportion of obsidian in debitage assemblages from the 390 dated temporal components containing flaked stone (each component is weighted equally, regardless of the overall size of the component assemblage). The overall proportion of obsidian drops steadily throughout the chronological sequence, starting at 92% in the earliest periods and reaching a low of 18% in the Terminal Prehistoric. This trend is apparent outside the High Rock Country region; there obsidian is more or less ubiquitous, and its use remains high through time. Particularly in the Upper Lahontan Basin and Thousand Springs Valley regions, there seems to have been a very pronounced shift away from use of obsidian at the transition between the Middle and Late Archaic.

While this projectwide trend is striking, it arose at least partially from overall shifts in settlement throughout the project area. Most of the early components are in the obsidian-rich western project area, while later periods show increasing representation in the obsidian-poor eastern areas (see chap. 10). Thus, it is best to consider the four regions individually, within each of which the distance from archaeological sites to obsidian sources is more or less stable through time. (It should be noted that small sample sizes do render some of the individual averages suspect.) In all but the High Rock Country region, the biggest change is between the Middle and

TABLE 80
Percentage of Obsidian for Selected Projectile Point Types

n = number; OBS = obsidian.

Type	High Rock Country		Upper Lahontan Basin		Upper Humboldt Plains		Thousand Springs Valley		All	
	% OBS	*n*	% OBS	*n*	% OBS	*n*	% OBS	*n*	% OBS	*n*
Desert Series	83.3	30	53.1	32	18.4	49	30.8	13	44.4	124
Rosegate	88.3	120	84.6	130	12.5	56	28.3	46	67.0	352
Elko Series	98.1	311	95.4	87	18.4	125	53.8	39	76.9	562
Gatecliff Split Stem	98.5	68	89.5	19	37.1	35	81.3	16	79.7	138
Humboldt Concave Base	97.7	175	93.8	48	31.9	47	73.3	15	84.9	285
Northern Side-notched	100.0	64	90.6	32	40.0	15	50.0	10	86.0	121
Great Basin Stemmed	90.2	41	62.5	8	42.9	7	50.0	2	79.3	58
Great Basin Concave Base	100.0	10	100.0	2	–	–	–	–	100.0	12
Totals	–	819	–	358	–	334	–	141	–	1652

Late Archaic, where there is evidence of a major shift away from use of obsidian. This would seem to suggest that technological change accompanying adoption of the bow and arrow played the biggest single role in changing patterns of lithic raw material use.

Time-sensitive projectile points show a similar pattern. Table 80 shows the proportion of obsidian in each of eight diagnostic projectile point types collected during the project (both from treated sites and from isolated contexts and surface collections from unexcavated sites). As with debitage from dated components, the overall project trend is of decreasing obsidian use over time, although the same caveat applies: earlier-dating types tend to be found in the obsidian-rich western region, while higher proportions of later-dating types are found in the obsidian-poor eastern regions. Within each area, the trend is still one of overall decreasing use of obsidian, although the eastern regions actually show a small rebound in the proportion of obsidian in Terminal Prehistoric Desert Series points relative to Late Archaic Rosegate points.

It is also worth considering contrasts between the component debitage and the projectile point datasets. Throughout the Great Basin, finished tools such as projectile points are often made of more exotic materials than debitage from the same settings, whether because of trade in finished tools, or curation and discard of tools by mobile groups with access to exotic materials at a previous point in a seasonal round, or some combination of these. Consistent with that pattern, our projectile points are more commonly fashioned from obsidian than is the debitage in nearly all regions and time periods. The exception is the High Rock Country, where later point types are actually slightly less commonly made from obsidian than is debitage.

Obsidian Source Diversity Statistics

Diversity is a quantitative measure of how many different types (e.g., obsidian sources)

TABLE 81
Average Shannon Source Diversity Statistics for Obsidian Debitage from Dated Components
SDI = Shannon diversity index.

Age	High Rock Country		Upper Lahontan Basin		Upper Humboldt Plains		Thousand Springs Valley		All	
	SDI	*n*	SDI	*n*	SDI	*n*	SDI	*n*	SDI	*n*
Terminal Prehistoric	0.35	2	0.48	2	0.61	5	–	–	0.52	9
Late Archaic	0.10	17	0.33	7	0.60	2	0.94	1	0.23	27
Middle Archaic	0.19	77	0.14	7	0.24	6	0.00	4	0.19	94
Early Archaic	0.15	53	0.08	4	0.37	4	0.00	4	0.15	65
Post-Mazama	0.44	19	0.24	5	–	–	–	–	0.40	24
Paleoarchaic	0.41	27	0.82	3	–	–	–	–	0.45	30
Paleoindian	0.62	6	0.61	1	–	–	–	–	0.62	7
Totals	–	201	–	29	–	17	–	9	–	256

are represented in a sample, and how evenly those types are distributed within the sample. The Shannon diversity index used here is based on the weighted geometric mean of the abundances of each type in the sample, and approaches zero in samples composed mostly or entirely of one type. As a result, the higher the index value, the greater amount of diversity is represented by the sample. In archaeological sites, changes over time in the diversity statistics for obsidian sources could result from some combination of changes in the overall number of sources available, as well as changes in patterns of acquisition, i.e., regularity of access. As discussed above, previous studies in the region have shown the highest overall diversity in the Paleoindian/Paleoarchaic periods, when overall mobility is thought to have been extremely high, providing access to a range of far-flung sources; the lowest overall diversity occurred during the Middle Archaic, when overall foraging ranges were smaller, and obsidian procurement tended to be focused on a smaller number of preferred sources.

Table 81 shows the average diversity statistic for the 256 temporal components with 10 or more sourced pieces of obsidian debitage (all components are weighted equally, regardless of sample size). It should be noted that the overall number of components in the easternmost project area is low, due to the general scarcity of obsidian, and that early components are poorly represented projectwide. Notwithstanding these cautions, the data closely parallel the trends previously observed by McGuire (2002) and Smith (2010). The highest overall diversity statistics are from the Paleoindian and Paleoarchaic sites, while Early and Middle Archaic sources show the lowest overall diversity, perfectly in line with the trends documented by earlier studies. The previously documented rebound in source diversity late in time is also borne out by the project components. The exact timing of this increase appears to have varied, however. In the High Rock Country, the Late Archaic record shows very low diversity, where in other (relatively obsidian-poor) regions, a pronounced upswing in diversity is already apparent by the Late Archaic Period. By the Terminal Prehistoric Period, all areas show high diversity, though not approaching the values seen in the Paleoindian and Paleoarchaic periods.

Some of this late increase in diversity could have been the result of technological changes associated with the introduction of the bow and arrow, which could have rendered a wider range of obsidian sources suitable for use if, for example, a local obsidian source was only available as small pebbles. However, this does not appear to be the primary reason for the change, as revealed by transport-distance statistics.

Transport Distances and the Obsidian Procurement Premium

While the source diversity statistics suggest some substantial changes through time regarding how obsidian was obtained, the exact nature of those changes remains open to interpretation. The trends could reflect some combination of changes in overall settlement range; the pattern of procurement, whether embedded, logistical, or trade based; and other factors, such as changes in lithic technology and size requirements. A consideration of average transport distance, as presented by Smith (2010), might serve to disentangle some of these factors. For example, the high diversity in early components in the High Rock region could reflect a mix that includes many distant sources, or simply a more eclectic selection of the many locally available sources; an examination of transport distances could resolve this question.

However, average transport distances cannot be compared across larger areas such as the study corridor, because obsidian-rich areas (such as the High Rock region) will naturally tend to have lower average transport distances than obsidian-poor areas. A more desirable complement to diversity statistics would be a measurement of transport distance that reduces the effect of source proximity. Toward that end, we introduce the concept of an "obsidian procurement premium," which is simply the extra distance traveled to obtain the raw obsidian actually used, beyond the shortest possible distance to any source of obsidian. Thus, a projectile point fashioned of obsidian from the nearest source would have a procurement premium of zero, regardless of the distance of that source. A point made from an obsidian source 50 km distant, while an equally suitable obsidian source is only 30 km distant, would have a premium value of 20 km. As with transport distance, the procurement premium can be calculated for single artifacts and as an average of all (sourced) obsidian from a site or component area. The premium is thus a measure of how rational an artifact or assemblage source profile appears to be, from the perspective of a person whose foraging range is centered on the site. From this simplistic least-effort perspective, of course, the most rational choice would be to obtain obsidian only from the closest source. Since this is rarely the case, one can expect average obsidian procurement premiums to be somewhat above zero. However, premiums should rise significantly when other considerations beyond the simple economics of travel to a source area come into play, such as territorial circumscription or long-distance trade in finished tools, or any number of other factors not directly related to lithic procurement. The procurement premium should allow us to identify when and where those factors be-

TABLE 82
Average Obsidian Procurement Premium Statistics for Debitage from Dated Components
Prem = procurment premium.

Age	High Rock Country		Upper Lahontan Basin		Upper Humboldt Plains		Thousand Springs Valley		All	
	Prem	*n*	Prem	*n*	Prem	*n*	Prem	*n*	Prem	*n*
Terminal Prehistoric	0.0	2	76.1	3	53.5	8	55.9	1	50.9	14
Late Archaic	1.6	18	8.0	8	16.7	8	42.3	1	7.7	35
Middle Archaic	1.2	97	0.9	10	8.2	14	0.0	5	1.9	126
Early Archaic	1.1	64	2.1	4	12.4	11	3.1	5	2.8	84
Post-Mazama	2.5	21	2.9	7	3.0	3	–	–	2.6	31
Paleoarchaic	2.8	31	14.6	5	–	–	–	–	4.4	36
Paleoindian	1.9	8	12.1	1	–	–	–	–	3.0	9
Totals	–	241	–	38	–	44	–	12	–	335

come more important, if not what those factors are specifically.

As with any analysis of obsidian transport distances, this analysis makes a number of assumptions, most important of which are the following: source area extents are reasonably well known; the proportion of unknowns is small enough not to skew the analysis; various sources of obsidian are reasonably equal as far as their potential to be made into tools; and linear distance is a sufficient proxy for the actual effort involved in obtaining source material.

These procurement premium values are calculated for individual diagnostic projectile points, as well as for debitage assemblages from dated components, using a simple analysis carried out in a geographic information system (GIS). For each component area (or projectile point), we calculate its distance to the nearest obsidian source. Then, for each item, we calculate the distance to the actual source area from which the item was fashioned; the difference between these two numbers is the procurement premium. For debitage assemblages, an average procurement premium is calculated for each component. These component averages are in turn averaged over the entire period/region, with individual components weighted equally.

The source extents come from several places, including the Northwest Research (2013) online obsidian source database, Richard Hughes' field visits during this project, and the 59 project sites identified as primary quarry areas. Most of these data are available only as point locations, so they are simply enclosed by a polygon drawn freehand around them in the GIS. While many of these polygons could undoubtedly use some refinement, it seems unlikely that this would affect the calculated premiums substantially.

For both the component debitage and the projectile point analyses, we include tentative source assignments. Unknowns are not included in the analysis, however, since their distance to source cannot be calculated. Unknowns make up only 136 of the 3759 sourced pieces of debitage (3.6%), and 89 of the 1218 typed points (7.3%).

Debitage from Dated Components

Table 82 shows the average procurement premiums for the 340 dated components with sourced obsidian, summarizing more than 3600 individually sourced flakes. Note that some of the individual averages are based on small sample sizes, so those values should be interpreted with caution. Unlike the material profiles presented above, however, these premium values should theoretically be independent of overall distance to source, so in this case it is appropriate to look at the projectwide average.

For most time periods, the average procurement premium for debitage is low, on the order of only a few kilometers, even in the earliest periods of prehistory. Thus it appears the previously remarked high source diversity in the Paleoindian and Paleoarchaic periods originates from a more eclectic selection of nearby sources, rather than from significant inclusion of far-distant sources. The only hint of elevated distance-to-source in debitage profiles during these periods comes from the few components in the Upper Lahontan Basin, though these numbers originate from use of comparatively nearby sources (e.g., use of Double H obsidian at sites where Massacre Lake/Guano Valley is marginally closer, and vice versa). Figure 63 shows the paths from source to site graphically for these time periods.

Post-Mazama, Early Archaic, and Middle Archaic debitage premiums are also low (figs. 64–66). The comparatively high Early Archaic premium for the Upper Humboldt Plains is driven by two components (26EK9200/12031 Locus F and 26EK11836), but in these cases it is only the comparatively nearby Browns Bench and Paradise Valley sources that are overrepresented in each, not the extremely distant sources common in the latest periods. One notable pattern that does not register statistically is the presence of a few pieces of Mt. Majuba obsidian in three Upper Humboldt Plains components (fig. 66); this source is almost entirely absent from other debitage assemblages.

Late Archaic debitage assemblages show an upswing in the premium statistic, reflecting the addition of sources absent from earlier assemblages (fig. 67). The single Late Archaic component in the Thousand Springs Valley region (26EK9178/12133 Locus E) has an atypically high premium of 42.3 km, including two distant sources not seen in any other debitage assemblage (Walcott Tuff and Timber Butte, both in Idaho; fig. 64), and another seen in only one other assemblage (Topaz Mountain, in Utah). This component, it should be noted, is one of the few from the project containing grayware pottery. Together with the generally eastern-oriented source profile, this suggests a Fremont interaction (see chap. 5). If other Late Archaic components could be identified from the region, would they show a similarly diverse, high-premium profile? And, if so, would this be the precursor to the Terminal Prehistoric pattern seen throughout the central and eastern project area?

This leads to the most striking feature of the table, namely the extremely high average premium in the Terminal Prehistoric, more than 10 times higher than the average for any other period. Notable in this sample is the obsidian from an otherwise unremarkable site in the Upper Lahontan Basin (26HU4808), the majority of which was sourced to Mount

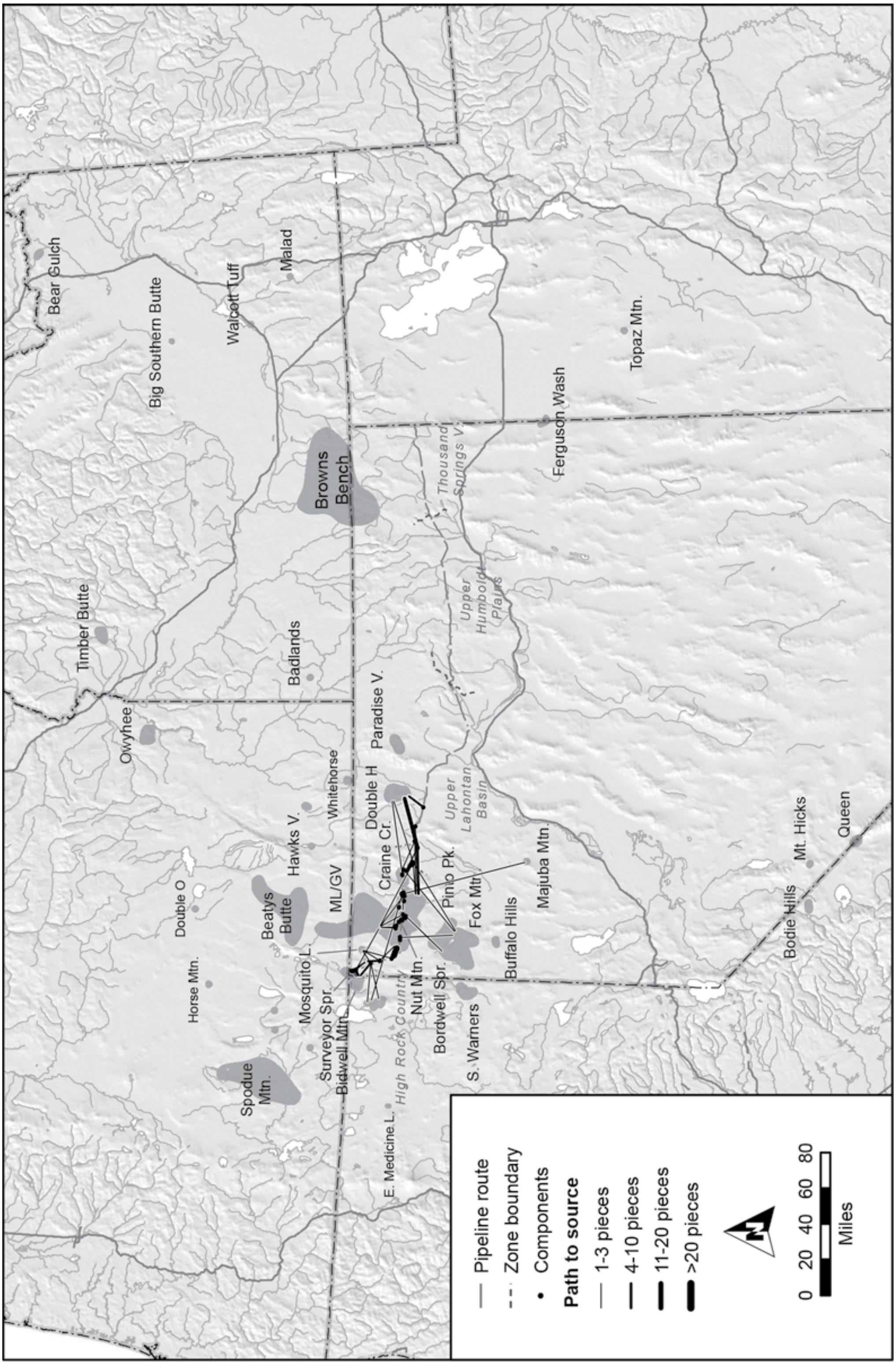


Fig. 63. Paths from source to site for Paleoindian and Paleoarchaic Period components.

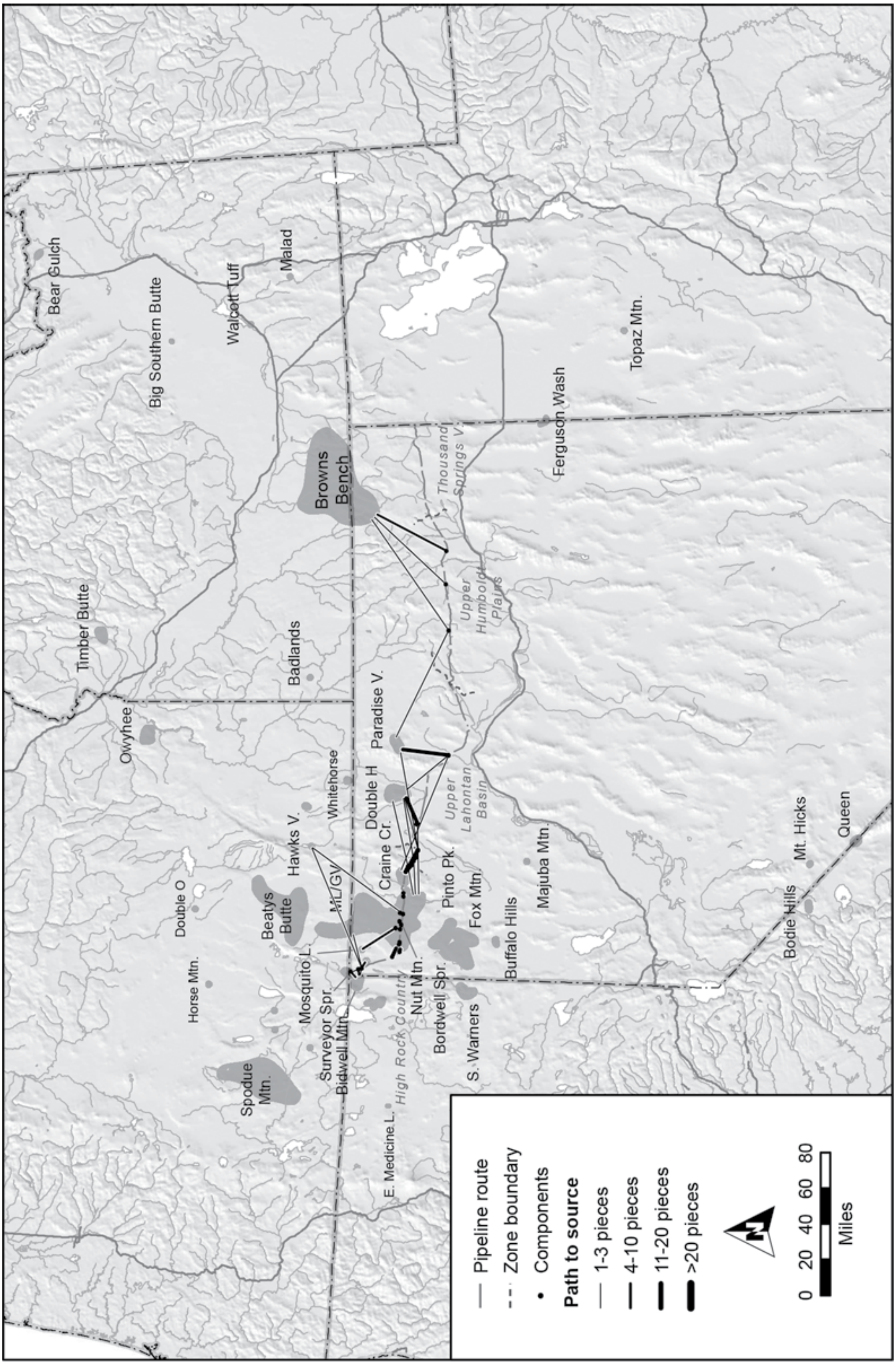


Fig. 64. Paths from source to site for Post-Mazama Period components.

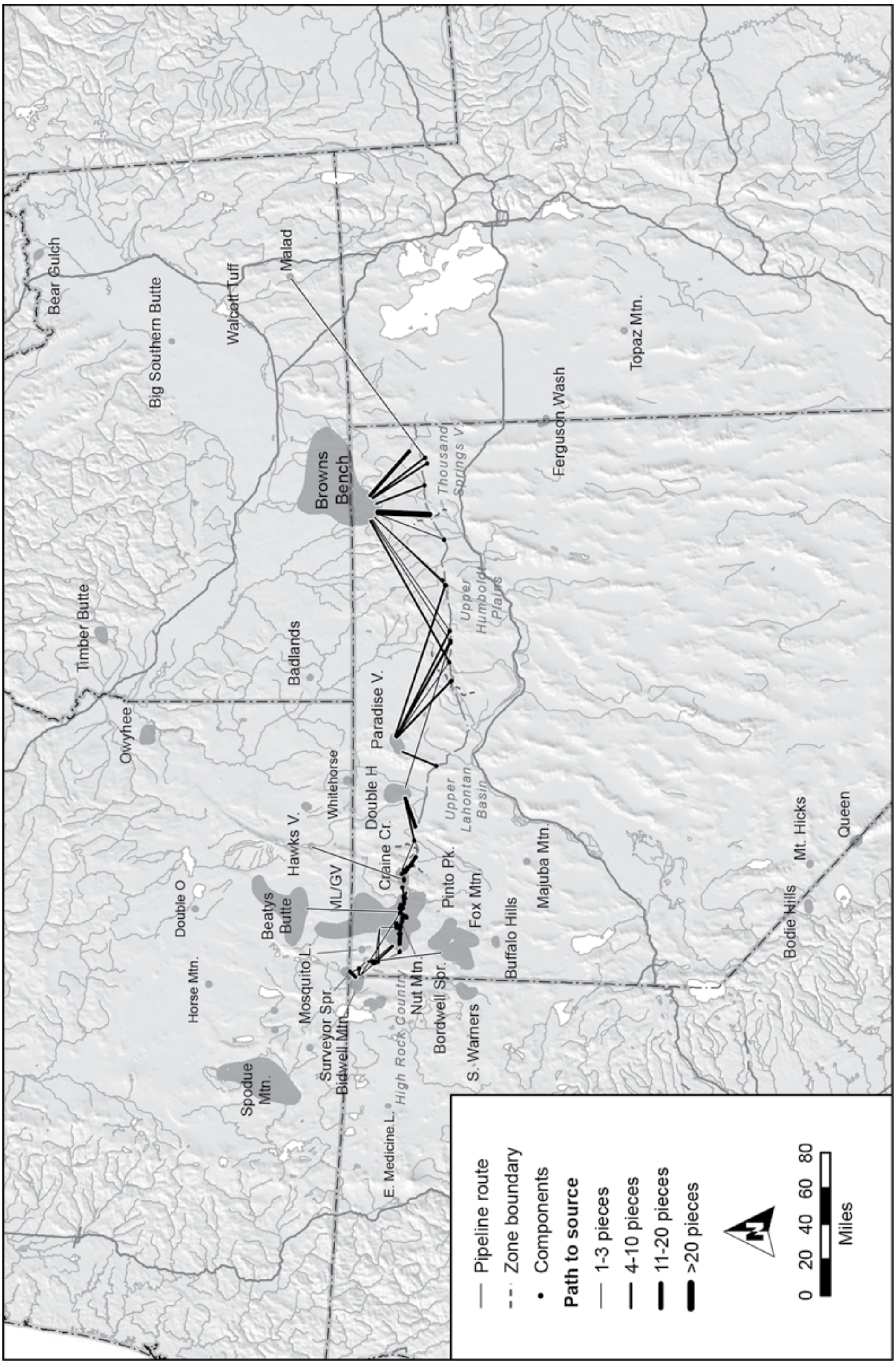


Fig. 65. Paths from source to site for Early Archaic Period components.

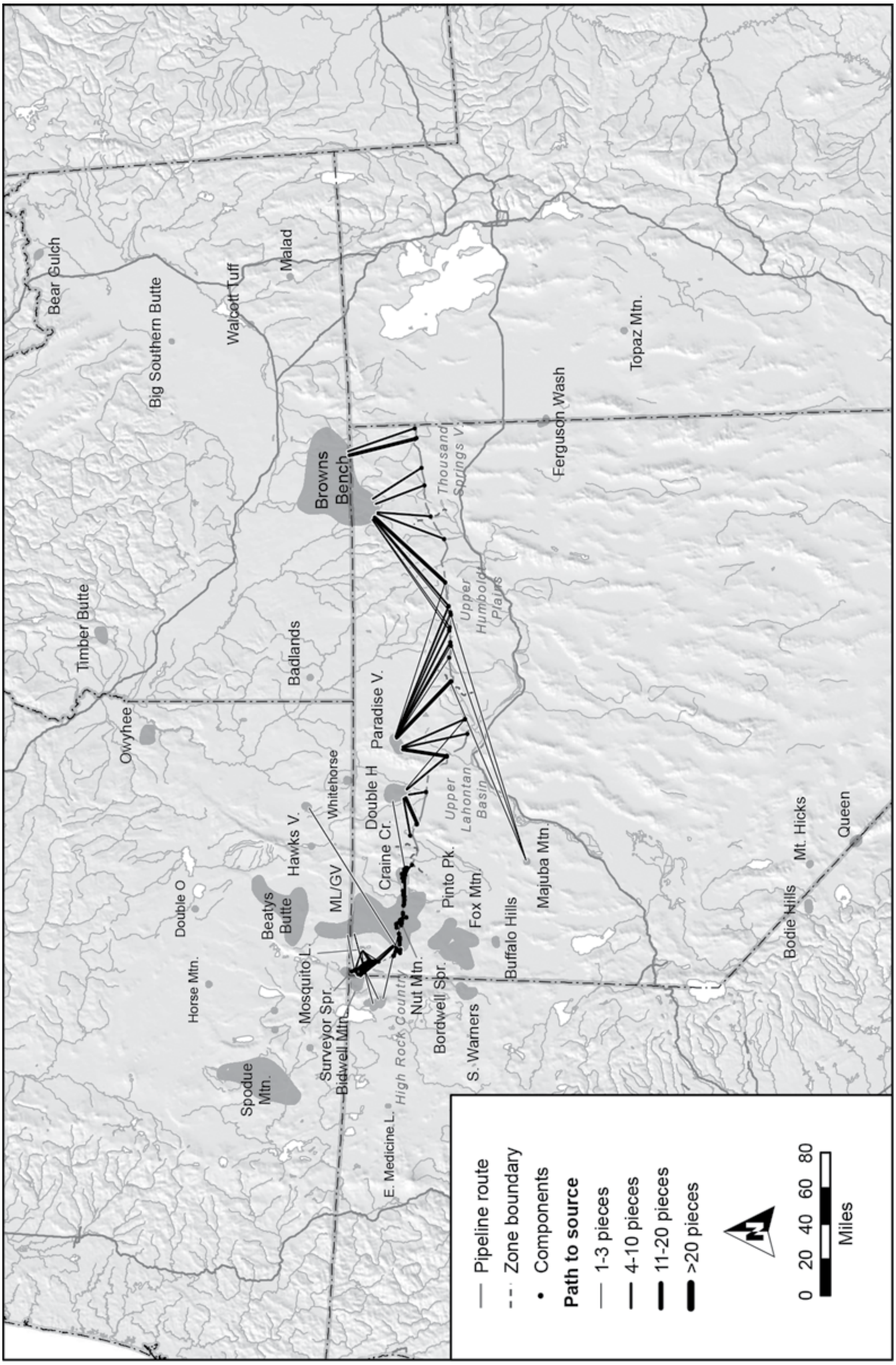


Fig. 66. Paths from source to site for Middle Archaic Period components.

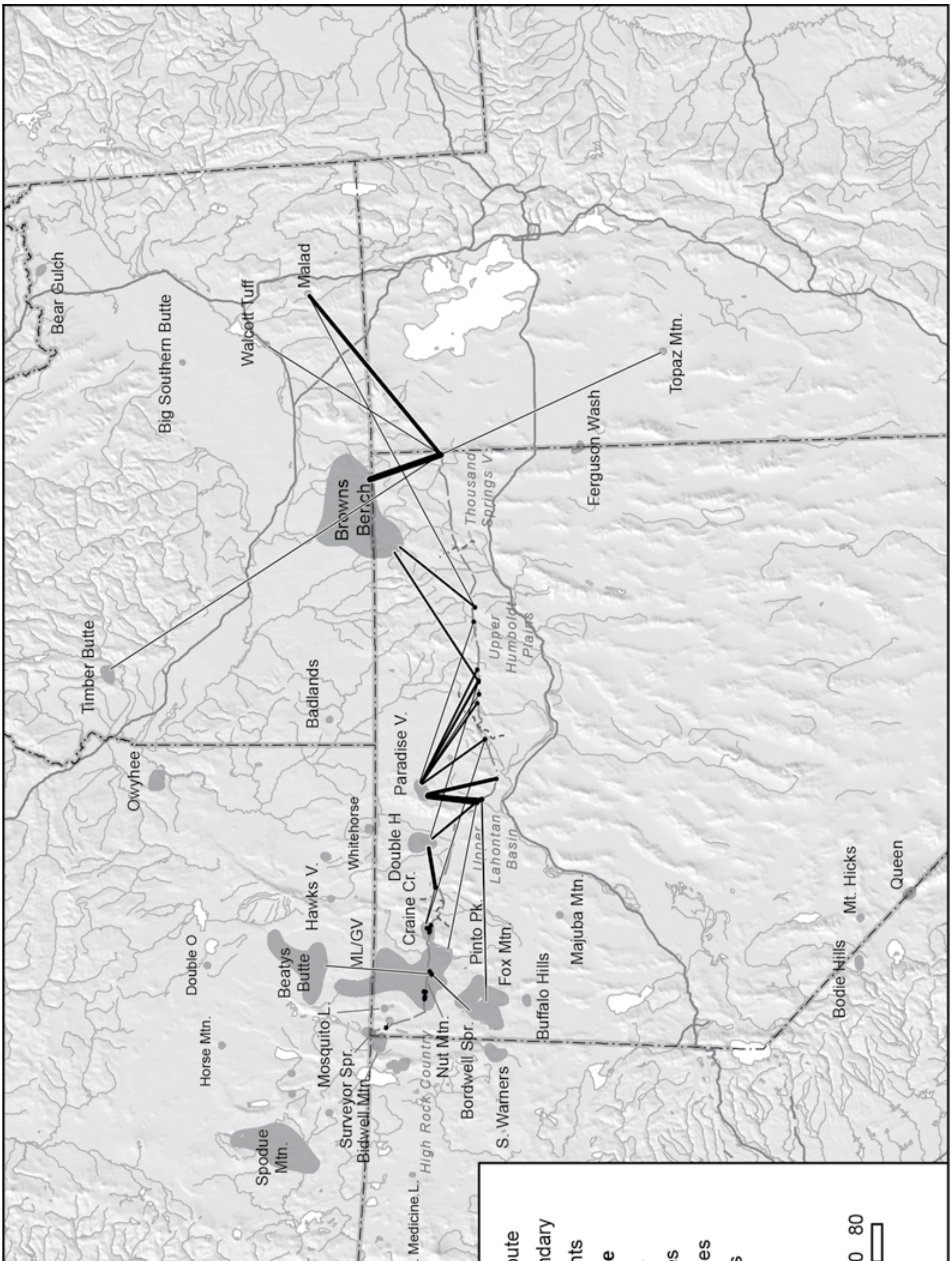


Fig. 67. Paths from source to site for Late Archaic Period components.

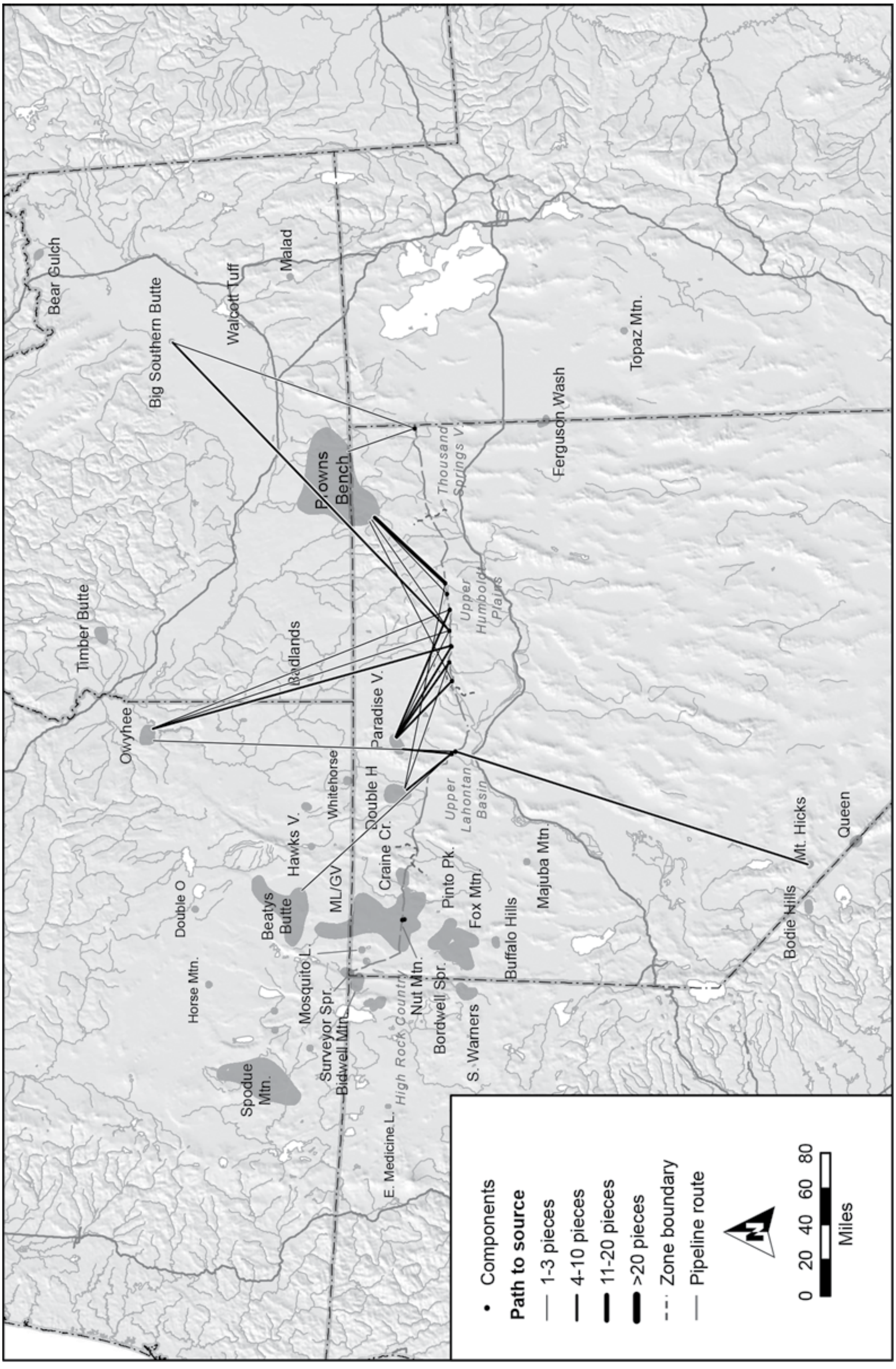


Fig. 68. Paths from source to site for Terminal Prehistoric Period components.

TABLE 83

Obsidian Procurement Premium Statistics for Selected Diagnostic Projectile Points/Types

Prem = procurment premium

Type	High Rock Country		Upper Lahontan Basin		Upper Humboldt Plains		Thousand Springs Valley		All	
	Prem	*n*	Prem	*n*	Prem	*n*	Prem	*n*	Prem	*n*
Desert Series	22.7	21	71.4	17	12.3	9	38.7	4	38.3	51
Rosegate	16.8	93	20.7	106	63.0	7	4.4	11	19.5	217
Elko Series	19.0	269	14.7	72	5.9	21	6.2	18	16.9	380
Gatecliff Split Stem	14.4	64	20.7	17	9.1	12	0.0	13	13.0	106
Humboldt Concave Base	17.8	158	16.8	43	8.5	15	0.0	10	16.2	226
Northern Side-notched	21.5	60	25.4	28	9.4	6	0.0	5	20.8	99
Great Basin Stemmed	26.0	34	53.2	5	0.0	3	0.0	1	26.8	43
Great Basin Concave Base	20.5	9	–	–	–	–	–	–	20.5	9
Totals	–	708	–	288	–	73	–	62	–	1131

Hicks more than 300 km away. This site also contains a few pieces of Owyhee obsidian, a source nearly as far away in the opposite direction. While this one component has an average premium of 204 km, it is by no means an extreme outlier; five of the 14 Terminal Prehistoric components have premiums exceeding 50 km. Terminal Prehistoric premiums are not only higher on average, but also much more variable than in earlier periods, with several of the remaining components showing premiums near or equal to zero. The primary sources driving higher premiums in the Terminal Prehistoric assemblages make their first appearance during this period: Owyhee, in southeastern Oregon, and Big Southern Butte, in central Idaho. Figure 68 shows the travel pattern for Terminal Prehistoric components. Interestingly, hardly any sources from the western parts of the project area are represented in Terminal Prehistoric components, even though several significantly more distant sources are represented. This suggests a primarily north-south pattern of conveyance rather than east-west. Might this reflect the Paiute/Shoshone ethnographic boundary?

Projectile Points

Table 83 shows the procurement premium statistics for the 1131 diagnostic obsidian points from the project. Projectwide, just as McGuire (2002) and Smith (2010) observed, distant sources are better represented in the earliest periods, reach a minimum in the Early and Middle Archaic, and rebound strongly in the Terminal Prehistoric. This pattern is strikingly unlike the trends for debitage, where premiums remain low throughout prehistory until they rise substantially in the Terminal Prehistoric. It should be noted that this trend is not uniform across regions; the early pattern is represented very weakly in the Upper Humboldt Plains and not at all in the Thousand Springs Valley region. The reason is that both these areas have very small samples of early types (see chap. 10).

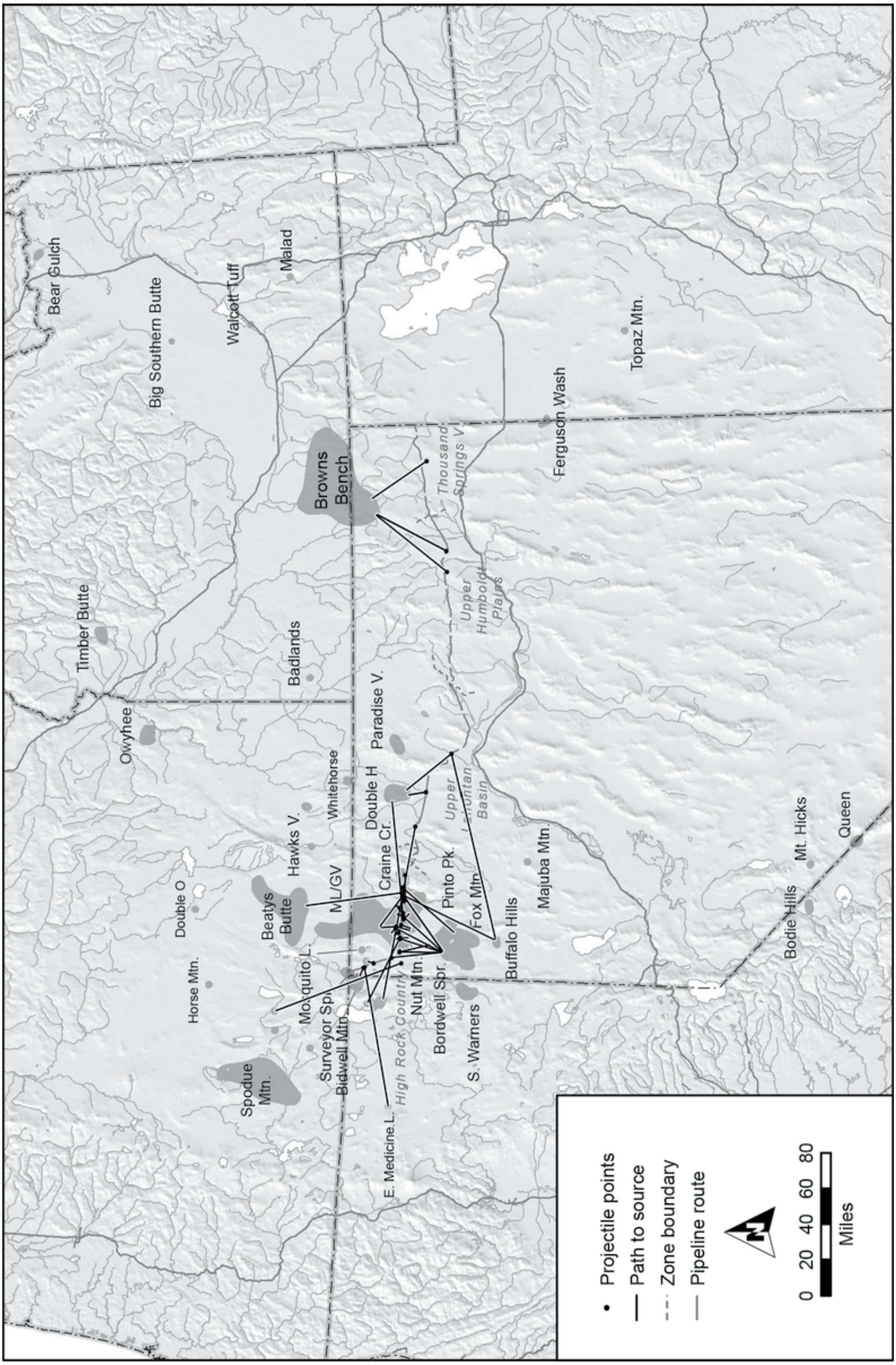


Fig. 69. Paths from source to site for Great Basin Concave Base and Great Basin Stemmed points.

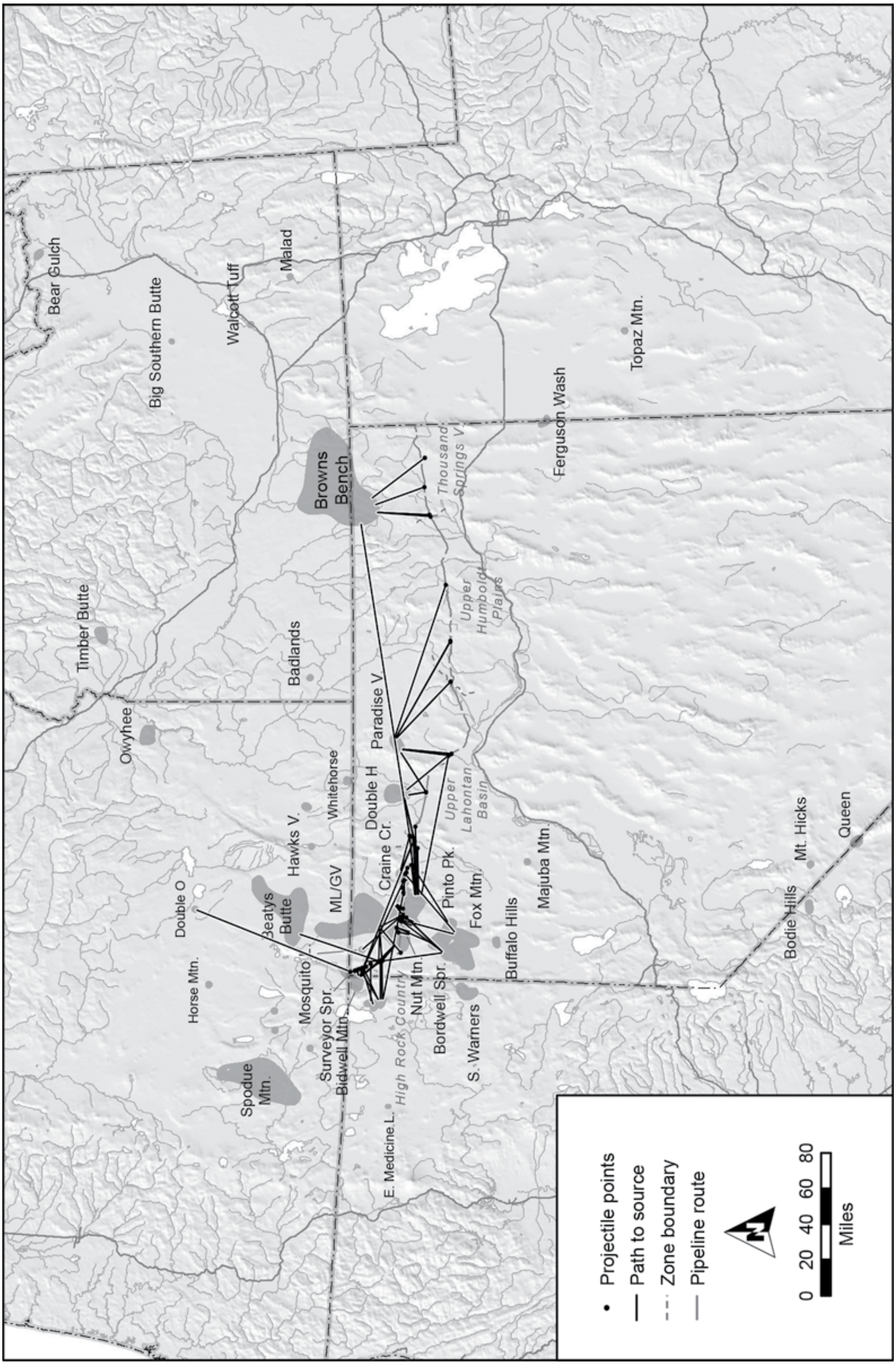


Fig. 70. Paths from source to site for Northern Side-notched points.

Figure 69 shows travel paths for Great Basin Concave Base and Great Basin Stemmed points. The nonlocal sources driving the higher premiums primarily include Bordwell Group obsidians as well as a few more distant outliers, such as the single piece of East Medicine Lake obsidian from the project (a Great Basin Concave Base point from site 26WA8730).

Figure 70 shows travel paths for Northern Side-notched points, considered a Post-Mazama Period marker. Noteworthy here is a point from site 26HU5222 fashioned from Browns Bench obsidian, representing one of the only pieces of Browns Bench obsidian found in the western project areas.

Travel paths for Humboldt and Gatecliff points, both primarily Early Archaic types, are shown in figure 71 and figure 72, respectively. In keeping with their lower average procurement premium values, most points from these periods are made from obsidian from nearby sources, though there are a few distant outliers made of Malad and Double O obsidians. There seems to be an interesting preference for Mt. Majuba obsidian in Humboldt points that is not seen in later types. Also, both Humboldt and Gatecliff point types seem to reflect a preference for Bordwell Group obsidians that is hardly reflected in the corresponding debitage assemblages.

Middle Archaic Elko points (fig. 73) show some of the lowest average premiums of any point type, consistent with the expected pattern of regularized access to a smaller number of preferred sources. There does seem to be a continuing preference for Bordwell Group obsidians that is reflected only in finished tools, similar to the Early Archaic pattern.

Rosegate points show a slight increase in overall premiums, though there are some interesting outliers, including a single point from site 26EK11888 made from Queen obsidian, more than 400 km from the site where it was found (fig. 74); this is the only piece of Queen obsidian from the entire project area. This point is responsible for the very high average for Rosegate points from the Upper Humboldt Plains; without it, the average for the region would be only 22.1 km, which is still much higher than previous averages for this region. Also noteworthy is a Rosegate point from site 26HU2184/5272 in the Upper Lahontan Basin area that is fashioned from Owyhee obsidian. This is the only piece of Owyhee obsidian from a dated context or point type previous to the Terminal Prehistoric Period.

Desert Series points (fig. 75) show an extremely chaotic travel pattern, as reflected in their high premium statistics, and are similar to corresponding Terminal Prehistoric debitage assemblages (see fig. 63). As with debitage, premium statistics are not only higher on average, but also much more variable than in earlier periods. Worthy of particular note are three Desert Series points from site 26HU4808, all made from Mount Hicks obsidian, which are partially responsible for the very high premium value of 71.4 km from the Upper Lahontan Basin region. As noted above, much of the debitage from this site is also of Mount Hicks obsidian.

Projectwide, and in most time periods, premiums for diagnostic projectile points are generally higher than for debitage assemblages from their corresponding periods (fig. 76). The exception is the Terminal Prehistoric, where debitage premiums are higher than those for projectile points, indicating that obsidian debitage from nonlocal sources is at least as often as finished tools.

Discussion

As we have shown, there are several complementary pictures of obsidian procurement, provided by diversity statistics for debitage and procurement-premium statistics for debitage and projectile points. Source diversity shows the same trends documented by McGuire (2002) and Smith (2010), with the widest range of sources represented in the earliest periods, followed by minimum diversity in the Early and Middle Archaic and a spike in diversity in the Late Archaic and Terminal Prehistoric periods. Average travel distances, as reported here via the procurement premium statistic, mirror this pattern to some extent. While projectile points show corresponding changes in travel distances, this is not reflected in the debitage, which is much more consistently made from local sources throughout prehistory, until a sudden upswing in the proportion of distant sources in the Terminal Prehistoric Period.

The early pattern can be explained most easily as a result of lithic procurement that is embedded within the highly mobile settlement system thought to have been typical of these populations. Debitage is composed of local sources because it reflects retooling activity, while projectile points were manufactured earlier in the settlement round out of the source materials that were then the most locally available. Debitage source diversity is high in the western project areas, not because distant sources are included, but because each component tends to have a wide assortment of nearby sources. This indicates an opportunistic, unsystematized approach to lithic procurement relative to later periods.

The Early and Middle Archaic pattern, with its comparatively low source diversity, as well as low premium statistics for both points and debitage, reflects relatively regularized access to a smaller number of sources. This pattern can be seen in the increased use of the major sources in the project area, such as Massacre Lake/Guano Valley and Craine Creek (see chap. 11). Certain nonlocal sources, such as Bordwell Group obsidians, also seem to have been favored to an extent, being disproportionately common among finished tools. Whether this reflects a regular pattern of residential mobility between the western part of the current study area and areas to the south or targeted logistical procurement of these sources remains unclear.

The Terminal Prehistoric pattern, with high source diversity as well as high (and highly variable) premium statistics for both points and debitage, likely reflects the growth of trade interactions, but in a much more ad hoc, happenstance fashion than the purported Middle Archaic obsidian trade (e.g., Gilreath and Hildebrandt, 2011; King et al., 2011), and with seemingly greater disregard for the economics of transporting the material. The transported obsidian included some quantity of raw material, not just finished tools or biface blanks. The near absence of western sources is notable. It could be that the cultural connections shared by the Numic groups thought to have expanded into the region during the Terminal Prehistoric somewhat dictated the directionality of this late movement.

It should be kept in mind that obsidian makes up a small proportion of the late prehistoric lithic record in the eastern project areas, less than 5% of raw material and less than one third of finished points, and that the Terminal Prehistoric has among the lowest proportions of obsidian of any period (see table 79 and table 80). High-quality lithic material,

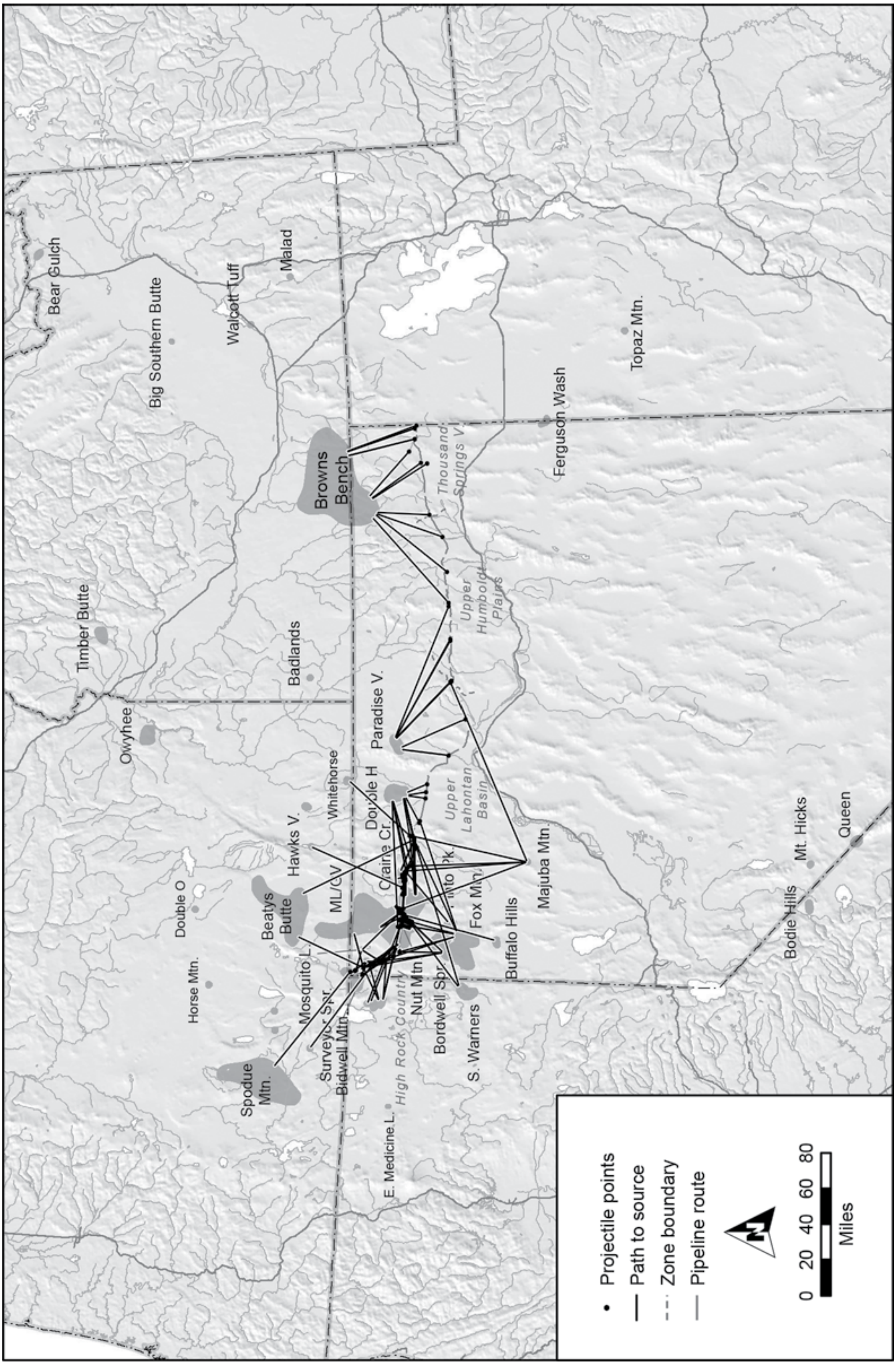


Fig. 71. Paths from source to site for Humboldt points.

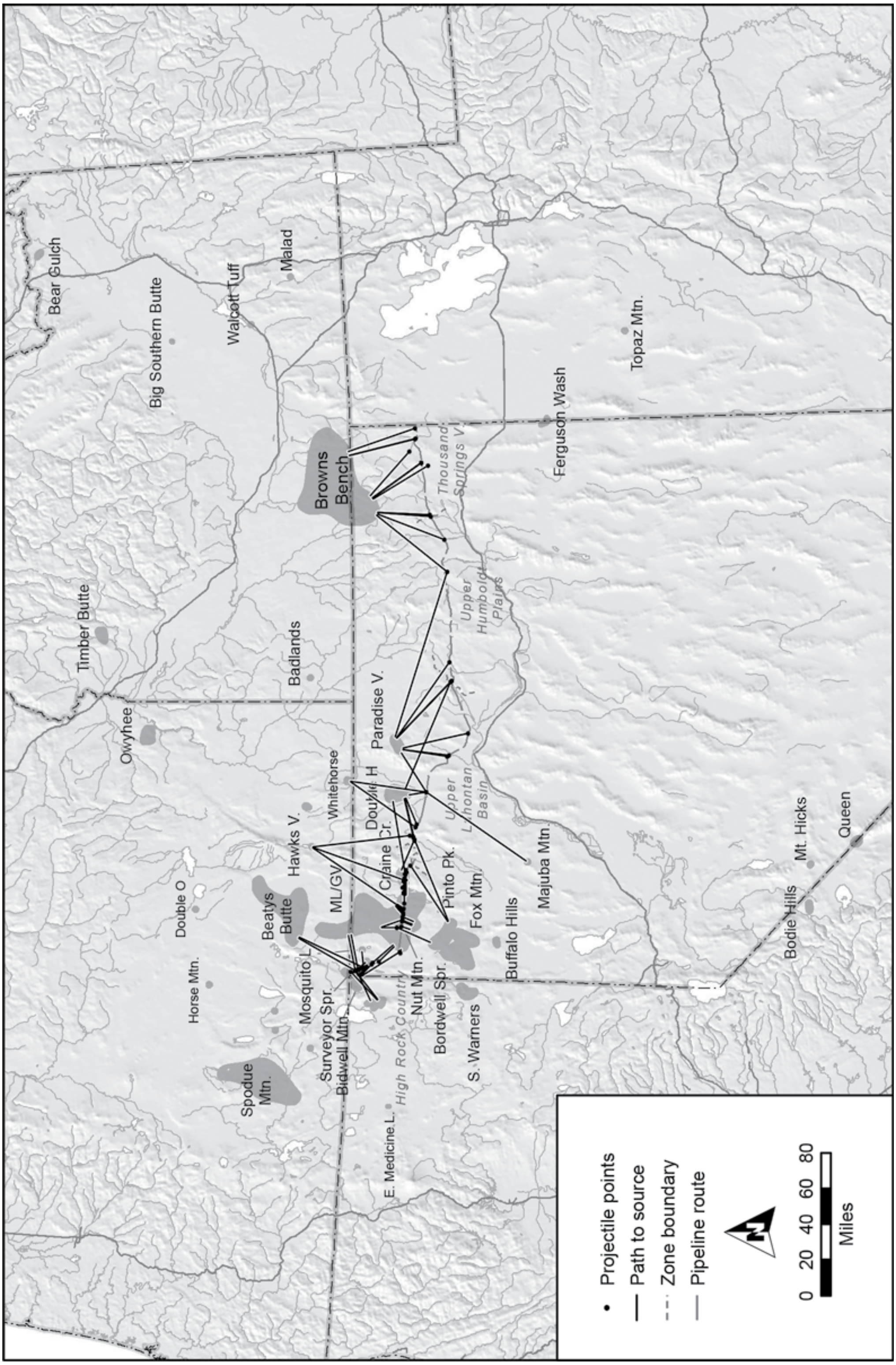


Fig. 72. Paths from source to site for Gatecliff points.

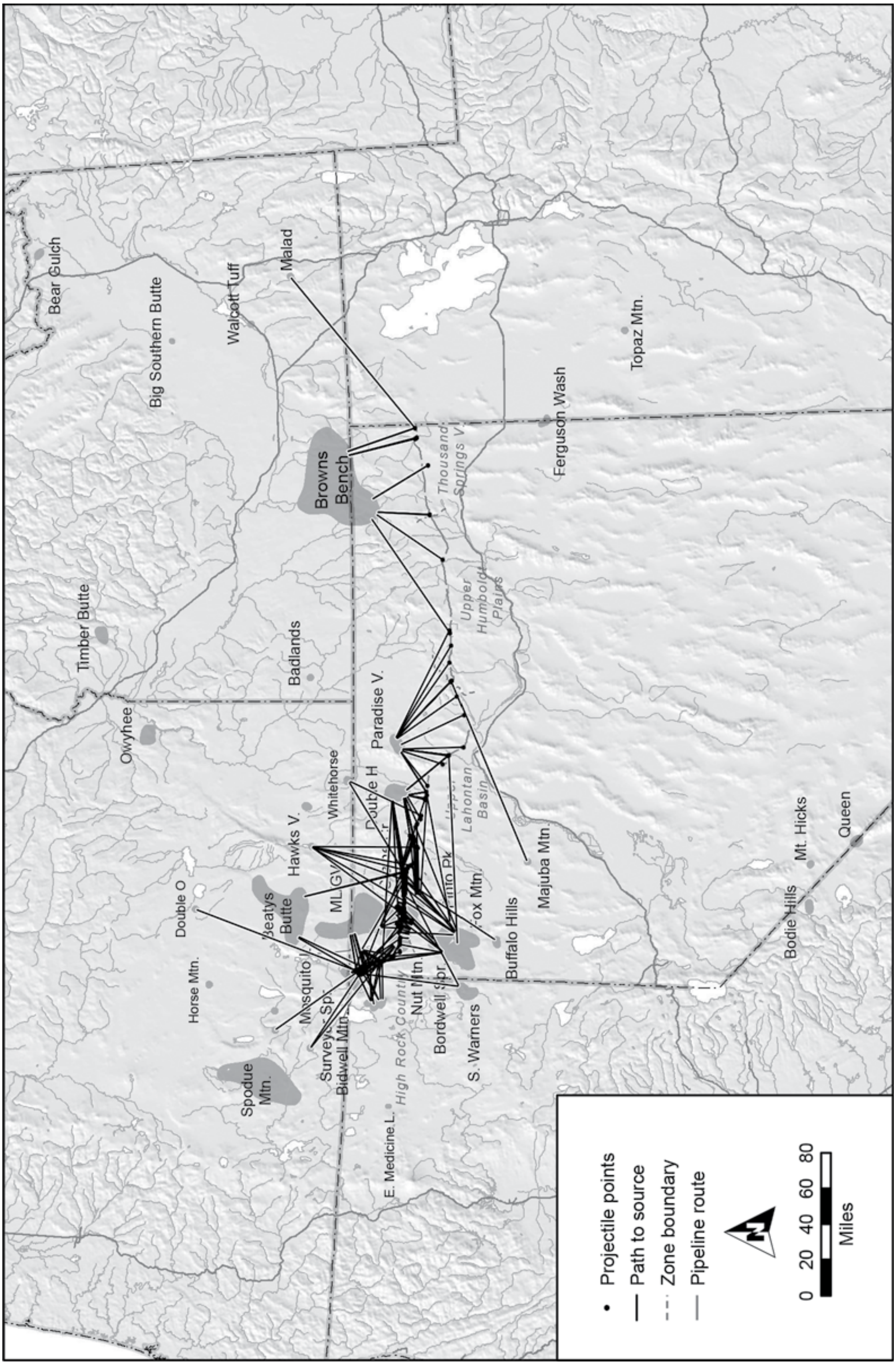


Fig. 73. Paths from source to site for Elko points.

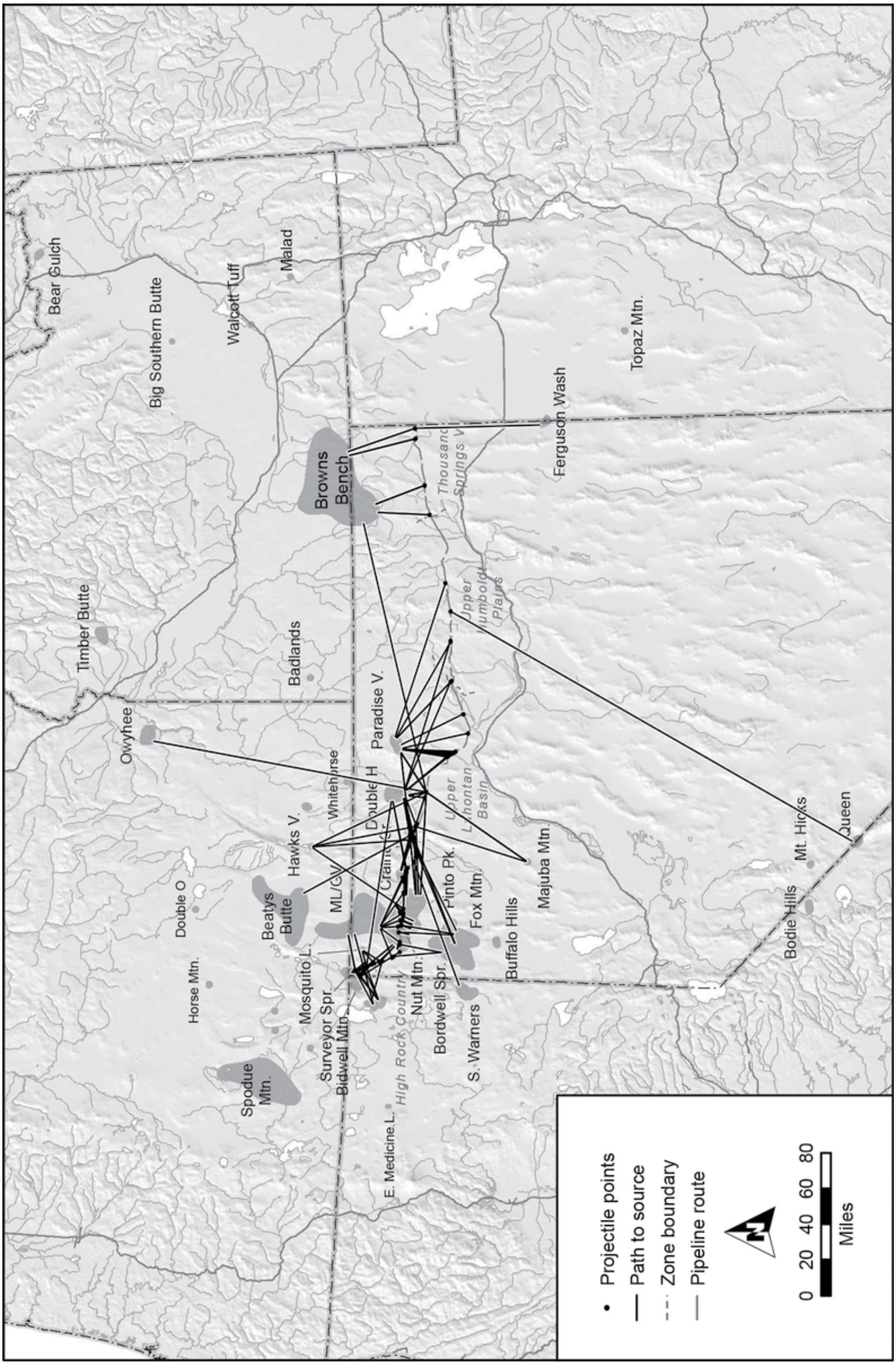


Fig. 74. Paths from source to site for Rosegate Points.

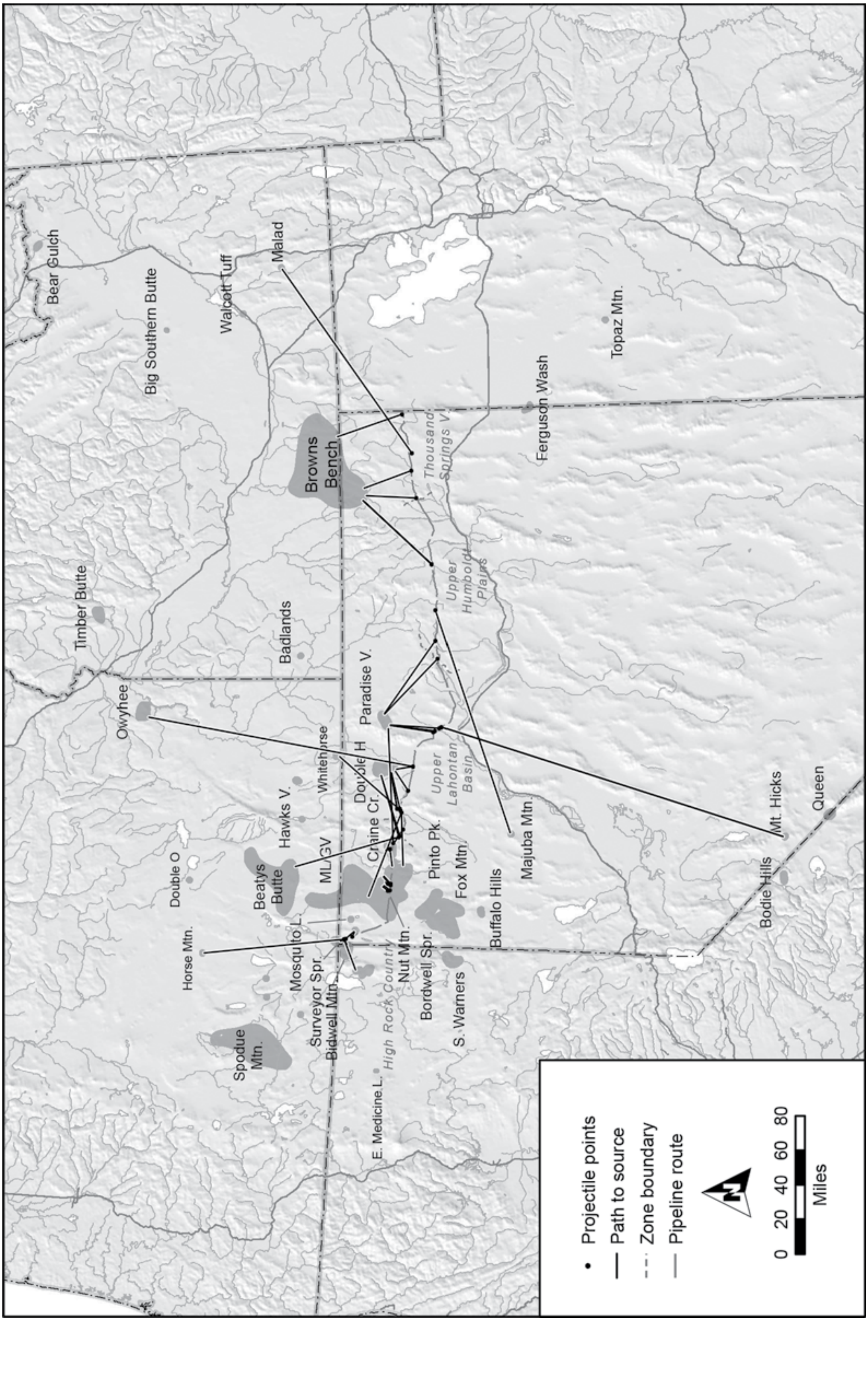


Fig. 75. Paths from source to site for Desert Series points.

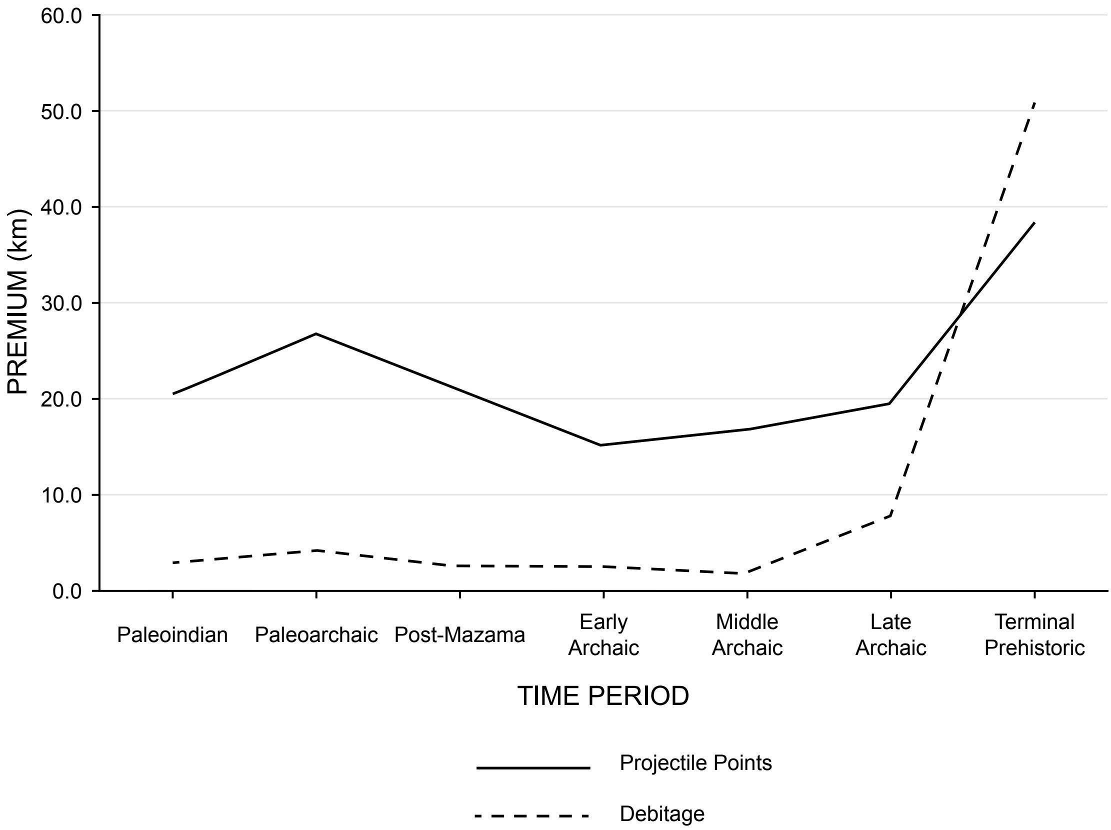


Fig. 76. Procurement premiums for Debitage and Projectile points.

in the form of Tosawihi chert, is available relatively close to many of the Terminal Prehistoric components in this study. Why did obsidian source diversity and travel distance go up so drastically while overall use of obsidian was so low? It seems likely that the Western Shoshone bands occupying these sites, with their relatively low mobility relative to earlier populations, had little or no direct access to local obsidian in most settings nor any compelling technological reason for seeking it out. For these groups, obsidian may have played the role of a luxury or novelty item, available only by down-the-line trade (Eerkens et al., 2008a), or perhaps via interactions with Northern Shoshone on horseback (see Northern Paiute, Western Shoshone, and the Numic Expansion, page 329). The initial appearance of Owyhee obsidian in Terminal Prehistoric components lends some credence to the latter idea.

However obsidian was obtained, its trade was likely undertaken not on the economic merits of the material itself, but as a means of facilitating relations with outside groups, including the exchange of other, more economically important items. Thus, obsidian as a trade item could have had a functional role similar to that of shell beads (Rosenthal, 2011), which traveled even greater distances through the prehistoric Great Basin.

CHAPTER 15

NORTHERN PAIUTE, WESTERN SHOSHONE, AND THE NUMIC EXPANSION

William Hildebrandt

A great deal of debate surrounds the origin and dispersal of Numic languages in the Great Basin. Most of the historical linguistic literature, however, shows that both the Northern Paiute and Western Shoshone probably separated from their linguistic progenitors in southeastern California relatively late in time (post-1000 cal B.P.) and spread northward rather quickly in two discrete migrations (Lamb, 1958; Miller, 1966; Goss, 1968; Miller et al., 1971; Fowler, 1972; Golla, 2011; but see Aikens, 1994; Grayson, 2011). Possible archaeological correlates for these migrations have been forwarded by multiple researchers (Bettinger and Baumhoff, 1982; Delacorte, 2008; Delacorte and Basgall, 2012), including a shift from Lovelock Wickerware to coiled basketry (Adovasio, 1986; Fowler and Dawson, 1986; Adovasio and Pedler, 1994; cf. Connolly, 2013) and a new reliance on seed beaters and triangular winnowing trays for the collection and processing of small-seed resources (Bettinger and Baumhoff, 1982).

These studies typically combine the Northern Paiute and Western Shoshone as part of the more generalized *Numic expansion*, as most researchers feel that the archaeological and linguistic records lack a sufficient level of cultural or temporal resolution to differentiate between them, let alone determine which migration occurred first. But there are actually significant differences in the archaeological records of the two groups that have been underappreciated until now. This is especially the case for pottery, which was used by the Western Shoshone and not the Northern Paiute. Pottery and its linkage to small-seed intensification combined with contrasts in the cultural and ecological landscapes that were traversed by each of the two groups, indicate that the Western Shoshone expanded at a much quicker rate than the Northern Paiute, creating an older and more robust archaeological record along the eastern end of the project corridor.

Explaining the Distribution of Brownware Pottery across Northern Nevada

Previous studies of brownware pottery have shown that it is distributed throughout the Great Basin except for northwestern Nevada and southern Oregon where, with few exceptions, it is essentially absent (Tuohy, 1973; Madsen, 1986; Pippen, 1986). The lack of pottery in northwestern Nevada, which Tuohy (1973) called *Nevada's non-ceramic culture sphere*, largely corresponds to Northern Paiute lands—easily seen by overlaying

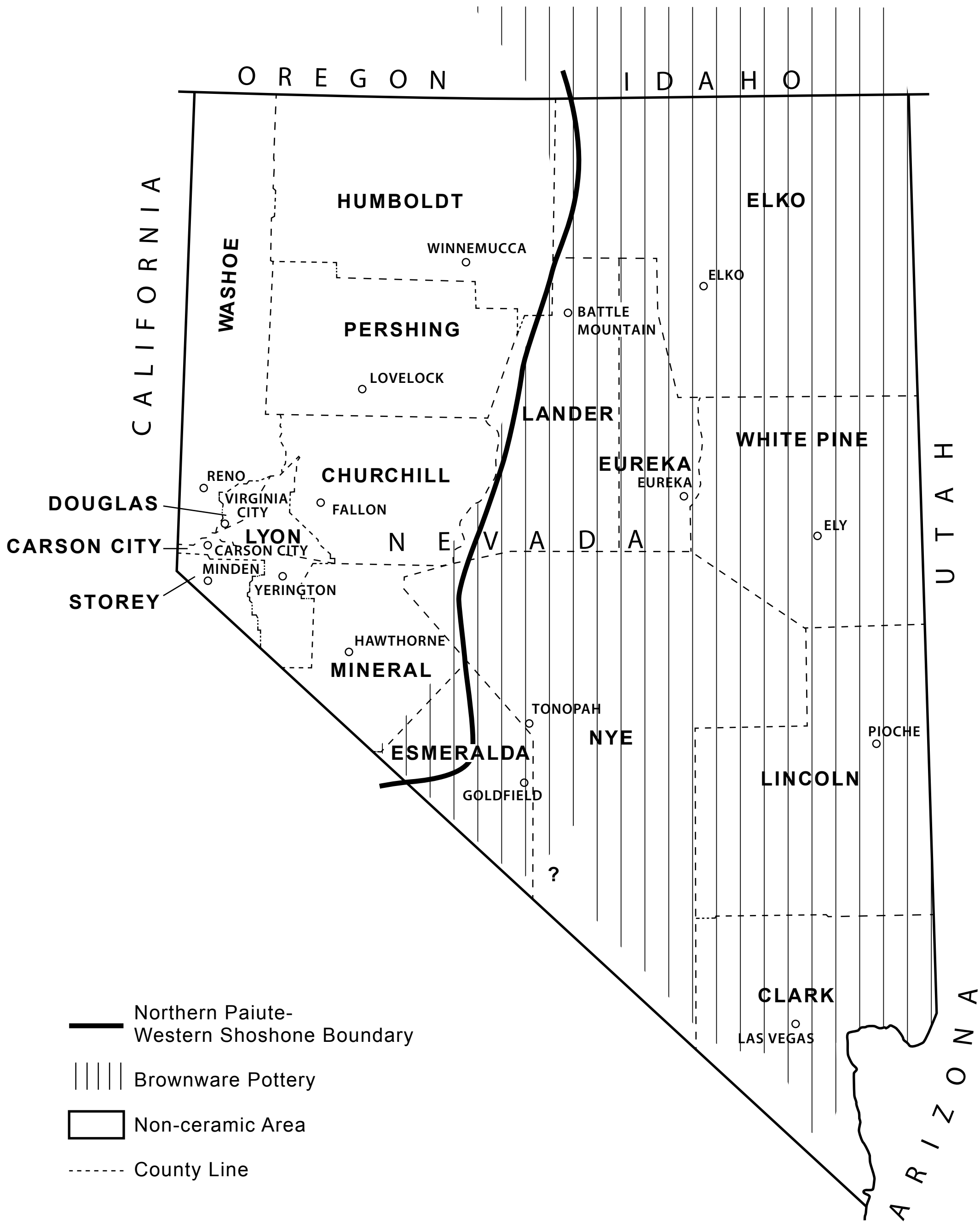


Fig. 77. Distribution of brownware pottery in Nevada from Tuohy (1973) overlain with the Northern Paiute–Western Shoshone boundary (Fowler and Liljeblad, 1986; Thomas et al., 1986).

the boundary between Northern Paiute and Western Shoshone territory onto Tuohy's (1973) original pottery distribution map (fig. 77). This relationship is confirmed by the current findings, as all sites containing pottery are east of the Paiute-Shoshone boundary, within the Upper Humboldt Plains and Thousand Springs Valley regions (fig. 78). These archaeological patterns are also consistent with the ethnographic record, documented by Steward (1941: 242, 1941: 295, 1943: 375) in regard to pottery among the Shoshonian groups, and by Stewart (1941: 389), who noted the lack of this technology among the Northern Paiute.

So why would one group use ceramics and the other not? Tuohy (1973) hypothesized that brownware pottery originated in the Numic homeland of southeastern California as an offshoot of earlier Puebloan ceramic traditions from the Southwest, and that the Northern Paiute left their ancestral homeland before the arrival of pottery in the area. Later, after pottery was introduced to the Numic homeland, the Western Shoshone migrated outward, bringing the technology with them. To our knowledge, no other researchers have seriously evaluated Tuohy's hypothesis, nor have alternative hypotheses been forwarded to explain this rather strange geographic distribution of such an important technology.

Eerkens' Small-Seed/ Pottery Hypothesis

A major problem with Tuohy's (1973) hypothesis, however, is that there was a great deal of interaction among Northern Paiute and Western Shoshone groups, including frequent occurrences of bilingualism and intermarriage (Fowler and Liljeblad, 1986). It seems likely, therefore, that the Northern Paiute chose not to use pottery for reasons beyond historical contingencies linked to their ethnolinguistic heritage. One possible technoecological explanation can be developed from Hockett's (2008) studies in northeastern Nevada where he encountered higher frequencies of pottery within pinyon habitats than in other environmental zones. These findings led him to conclude that there must be some sort of functional association between the two. There is some support for this association in the ethnographic record, as Steward (1933) noted that pinyon nuts were cooked in pots by the Owens Valley Paiute. More pertinent to the present study, however, Steward (1941) also stated that the Western Shoshone did not use pots for this purpose. Furthermore, the Northern Paiute were known to intensively use pinyon (Fowler, 1986; Wheat, 1967) despite the absence of pottery within their subsistence technology.

With these considerations in mind, we favor an alternative hypothesis stemming from the work of Eerkens in the Numic homeland of southeastern California (Eerkens and Rosenthal, 2002; Eerkens, 2004, 2008). Eerkens' analysis of plant macrofossil data from multiple sites throughout southeastern California shows that the use of small seeds intensified at about 600 cal B.P., becoming a major component of the subsistence economy after that time. This change in subsistence focus largely correlates with the introduction of brownware pottery in the local area, which was used in earnest by about 500 cal B.P. (Pippen, 1986; Rhode, 1994; Delacorte, 1999; Eerkens, 2004) but could have started earlier, based on a large brownware assemblage more recently discovered in an Owens Valley house structure dating to 680 cal B.P. (Jackson et al., 2009). Importantly, pottery was found much

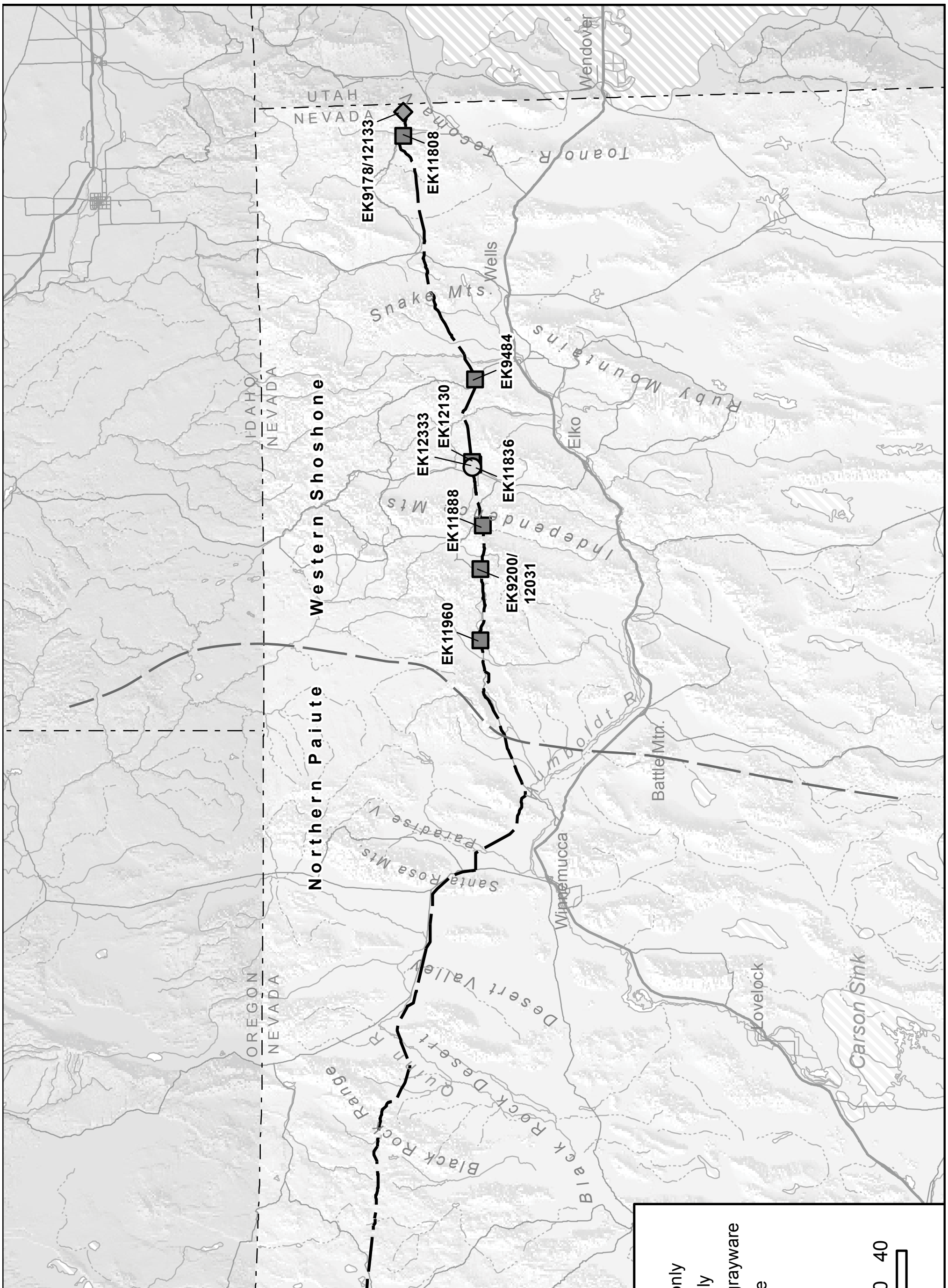


Fig. 78. Distribution of pottery along the project corridor.

more often in lowland areas, where small seeds are abundant, than in adjacent pinyon habitats (Eerkens, 2004: 660).

Eerkens (2004: 659) also has shown that cooking was one of the primary purposes for the pots, as they often have sooting or blackening on their exteriors. Moreover, gas chromatography–mass spectrometry (GC-MS) analysis of organic residues preserved within the interior walls shows they were primarily used to boil seeds, which is consistent with ethnographic studies on the subject. Extended boiling, in addition to grinding, is particularly important for small seeds, as it helps break down complex organic compounds that are otherwise difficult for humans to digest. While stone boiling in baskets can accomplish this task, it requires constant stirring of the stones so they do not burn the bottom of the basket, and regular replacement of the stones as they cool down. Pots, therefore, are more advantageous than stone boiling in baskets, because they can be put on an open fire or a set of coals to simmer with much less maintenance required by the cook.

But pots have their downside too, especially among mobile peoples like those occupying the Great Basin. They are much heavier and more fragile than baskets, and they require significant amounts of time and energy to produce (Eerkens, 2008). This explains why pottery is much more common among sedentary peoples than mobile peoples the world over (Arnold, 1985) and, where pottery occurs among mobile peoples, investment in its manufacture decreases with increasing levels of residential mobility (Simms et al., 1997; Bright and Ugan, 1999). Brownware appears to be a good example of the low investment strategy, with its thick-walled construction and absence of painted motifs.

With these considerations in mind, it seems likely that the Western Shoshone were more dependent on small seeds than the Northern Paiute and, following the ideas of Ugan et al. (2003) and Bettinger et al. (2006), this dependency justified greater investment in processing technology. While the costs of pottery outlined above are significant, and probably not worth the trouble if the technology was used on a sporadic basis, the intensity of small-seed use must have surpassed an important threshold among the Western Shoshone, making ceramic production a profitable enterprise.

Small-Seed Dependency among the Northern Paiute and Western Shoshone

Fowler and Liljeblad (1986) divide Northern Paiute lands into five subareas: Piedmont, Lake-River, Freshwater Marsh, Columbia–Snake River, and generalized. With the exception of the generalized subarea, all have significant wetland/riverine resources including fish, waterfowl, and various root crops, while small seeds are not considered primary resources in any of them (although they were still extensively used). Small seeds are much more important within the generalized subarea, which includes cold desert habitats scattered between the more productive wetland settings found in the other subareas.

Thomas et al. (1986: 266) painted a completely different picture for the Western Shoshone, stating that “plant procurement provided the economic mainstay for the Western Shoshone people.” Small-seed resources were important to all groups, and blazing star and goosefoot were known to have been purposely planted across much of north-central Nevada, with some people

TABLE 84
Number of Ethnographic Groups Named after Primary Resource Types

Resource Type	Northern Paiute[a]	Western Shoshone[b]	Totals
Fish	5	1	6
Roots	5	3	8
Game	4	–	4
Seeds	2[c]	6[d]	8
Totals	16	10	26

[a] From Fowler and Liljeblad (1986: 463–465).
[b] From Thomas et al. (1986: 280–282).
[c] Both are seepweed from wetland habitats.
[d] Includes redtop grass, porcupine grass, pickleweed, ricegrass, blazing star, and ryegrass.

actually protecting their plots from trespass (Steward, 1938: 104, 1940: 482).

One of the more compelling lines of evidence for the contrasting importance of small seeds between the Northern Paiute and Western Shoshone comes from the names of the various groups occupying these lands. Many group names corresponded to the primary food resource in their districts, like the *Trout Eaters* along the lower Walker River and Walker Lake, or *Eaters of Ryegrass Seed* in Ruby Valley. When groups with food-related names are tallied, we find that 62% of the Northern Paiute bands have names associated with fish or root crops, but only 12% with small seeds—and both of the latter were named after seepweed from wetland habitats (table 84). Western Shoshone groups, in contrast, are named after seed plants 60% of the time, and most correspond to a unique dryland taxa (e.g., redtop grass, porcupine grass, ricegrass, blazing star, and ryegrass), clearly showing a much greater dependence on this resource type than was the case among Northern Paiute groups.

Archaeological Findings from the Ruby Pipeline Corridor

The eight project sites where brownware pottery sherds were found are: 26EK9178/12133 (*N* = 23), 26EK9200/12031 (*N* = 3), 26EK9484 (*N* = 3), 26EK11808 (*N* = 1), 26EK11888 (*N* = 16), 26EK11960 (*N* = 1), 26EK12130 (*N* = 62), and 26EK12333 (*N* = 1). While these sites produced radiocarbon dates of 540, 520, 510, 430, 400, and 140 cal B.P. (chap. 5), direct associations with pottery were quite rare. Tight associations occur only at 26EK11888, where four sherds were found with a date of 510 cal B.P., and one sherd with a date of 140 cal B.P. (see Hildebrandt et al., 2015). These findings fall within the Terminal Prehistoric Period and probably reflect a Western Shoshone occupation of the area.

Economically important plants recovered from Terminal Prehistoric components along the eastern half of the corridor are dominated by goosefoot, followed by wild rye, blue-eyed Mary, and several other small-seeded plants, consistent with the small-seed focus outlined above. Unfortunately, however, the remains of root crops do not preserve within the project sites for a variety reasons (chap. 13), so we cannot show contrasting dependencies on roots and small seeds among the Northern Paiute and Western Shoshone. Nevertheless, the greater importance of root crops out west appears to be reflected by an explosion in the density of flaked stone implements probably used to produce digging sticks, especially in parts of the High Rock Country where important root crops like epos (yampah) are abundantly present today (e.g., Barrel Springs; see chap. 13).

Timing of the Northern Paiute and Western Shoshone Spread across Nevada

Bettinger and Baumhoff (1982) characterized pre-Numic people in the western Great Basin as residentially mobile “travelers” who lived in relatively small groups, moving from one high-ranked resource patch to another on a regular basis. Because of their low densities and high level of mobility, they could be outcompeted by Numic peoples (characterized as “processors”) who were less mobile and had higher population densities, the latter made possible by their more intensive use of lower-ranked (but abundant) resources.

McGuire and Hildebrandt (2005) have taken exception to the “traveler” characterization of pre-Numic people, arguing that a critical look at the Middle/Late Archaic archaeological record (often linked to the Lovelock Culture) reveals that a high point of settlement stability took place at this time, with relatively large hunter-gatherer villages established in a variety of locations including the Humboldt Lake Bed (Livingston, 1986), Carson Sink (Raven and Elston, 1988; Raymond and Parks, 1990; Kelly, 2001; Madsen, 2002), Humboldt River (McGuire and King, 2011), Lake Abert–Chewacan Marsh (Oetting, 1990; Jenkins et al., 2000), and the Honey Lake–Reno area (Riddell, 1960; Elston et al., 1994; McGuire, 1997; Young et al., 2009). Although those groups were less sedentary than the agricultural villagers among the Fremont and western Puebloans, McGuire and Hildebrandt (2005) drew parallels among these settlement systems, emphasizing that the Fremont and western Puebloan people could hardly be considered “travelers,” but they too were replaced by Numic speakers (see also Simms, 2008).

Archaeological research at numerous Fremont and western Puebloan site complexes has shown that most were abandoned around 700 cal B.P., probably due to adverse weather conditions associated with the Medieval Climatic Anomaly (MCA; Berry and Berry, 1986; Madsen, 1989; Larson and Michaelsen, 1990; Grayson, 2011; McGuire et al., 2013). Some researchers think that Numic speakers moved into these areas after the agricultural settlements collapsed on their own; this conclusion is based on significant temporal gaps between the contrasting archaeological complexes (Pippen, 1986; Larson and Michaelsen, 1990; Lyneis, 1995; McGuire et al., 2013). Others think there were more direct interactions among these groups, based on sites where Fremont, Puebloan, and brownware pottery appear to co-occur in time (Fowler et al., 1973; Madsen, 1975; Ambler and Sutton, 1989; Janetski, 1993; Rhode, 1994).

The settlement history of the Middle/Late Archaic hunter-gatherer sites in the central and western Great Basin is much more subtle, as their occupants did not build large villages with masonry architectural remains, nor did they have distinctive pottery traditions. Nevertheless, many of these multihouse villages also show significant decreases in residential use at this time (Riddell, 1960; O'Connell and Inoway, 1994; McGuire, 2002; Young et al., 2009; McGuire and King, 2011). Benson et al. (2007), in fact, argued that the droughts associated with the MCA probably reduced wetland productivity in the western Great Basin, leading to the demise of the Lovelock Culture at about 700 cal B.P. (see also Aikens, 1994). It is also important to emphasize that the project corridor experienced a settlement disruption at about the same time, evidenced by a major dip in the frequency of radiocarbon dates between 1000 and 600 cal B.P. (chap. 10).

Irrespective of the degree of disruption associated with the MCA, it is important to remember that the western edge of the Great Basin was always better watered than the interior, and population densities were probably always higher. This is demonstrated by the geographic distribution of the Middle/Late Archaic villages listed above (and their association with the Lovelock Culture), which are restricted to what would become Northern Paiute lands. Proxy measures of Middle/Late Archaic population densities along the project corridor also show this pattern, as they are significantly higher in the west (Northern Paiute lands) than in the east, where the Western Shoshone ultimately settled. Surprisingly, however, this long-term demographic profile changed during the Terminal Prehistoric Period when, it appears, population densities were higher within Western Shoshone territory for the first time in prehistory (chap. 10).

The Not-so-ideal or Free Distribution of Northern Paiute and Western Shoshone Peoples

If the MCA led to major population declines across the entire Great Basin, leaving most of the land open for Numic-speaking groups, then IFD modeling would predict that the Northern Paiute expanded into the wetland areas of the west first, while the drier, less productive areas to the east would be infilled later by the Western Shoshone (Codding and Jones, 2013). But if human populations were not entirely depleted, it seems likely that densities would have been higher and more stable in the west, making it more difficult for a new people to displace them. If this were the case, it would have been easier for the Western Shoshone to expand into the arid lands of the central Great Basin, and they could have occupied the eastern end of the project corridor earlier than the Northern Paiute. If so, their earlier arrival might have left a more robust Numic archaeological signature on the landscape, contributing to the apparent shift in demography outlined above.

This hypothesis can easily be tested following the lead of Delacorte (2008) and his use of projectile point indexing. Though far from perfect, Desert Series points can be used as a rough indicator of Numic-speaking people, and the ratio of Desert Series to Rosegate points can be used to measure time lags in the movement and arrival of Numic-speaking groups during their northern migrations. Delacorte (2008) used this analytical approach along a latitudinal gradient within Northern Paiute lands, and found that the ratio of Desert Side-notched to Rosegate points was relatively high in the Numic homeland of southeastern California, where both point series were used for similar periods of time, but decreased with distance in more northerly latitudes in response to time lags in the arrival of Northern Paiute people to these locations (Hildebrandt and King, 2002; Delacorte and Basgall, 2012).

Although Delacorte (2008) used only Desert Side-notched points and we combine Desert Side-notched with Cottonwood points together into a single Desert Series, our ratio for the Northern Paiute portion of the corridor of 0.18:1 (table 85) is quite similar to Delacorte's (0.19:1) from the same latitude in Massacre Lake Basin. Moving into Western Shoshone lands along the corridor, however, our ratio jumps to 0.49:1 (almost a threefold increase), indicating that this population must have arrived much earlier. The higher relative frequency of Desert Series points is also accompanied by greater quantities of milling gear and pottery, all pointing toward the intensive use of small-seeded resources. The fact that this robust Terminal Prehistoric record is only visible within Western Shoshone territory is rather surprising, especially because it violates the expectations of IFD modeling (i.e., high-quality western habitats should always have the highest population densities). Multiple factors probably contribute to this unexpected finding, including the greater longevity of the Western Shoshone occupation, seed beater technology serving to increase the value of the previously low-ranking eastern habitats, and the lack of a small-seed focus within the root-oriented lands of the Northern Paiute, creating a more subtle archaeological record where milling gear and pottery were not always essential components of local subsistence activities.

Evidence of the Horse during the Terminal Prehistoric/Ethnohistoric Period

We close this chapter with one of the most intriguing findings from the project corridor—an explosion in the frequency of distant, exotic obsidian types during the Terminal Prehistoric Period. As outlined in more detail in chapter 14, projectwide obsidian source studies produced results that are largely consistent with previous investigations for the early intervals of prehistory (Jones et al., 2003, 2012; Smith, 2010), with relatively high conveyance distances found during the Paleoarchaic Period, followed by the use of more local tool stones later in time, especially during the Early and Middle Archaic periods. This general pattern probably reflects high levels of residential mobility early on, when human population densities were low, and less mobility later in time, when population densities were significantly higher. Many researchers believe that human populations continued to increase during the Terminal Prehistoric Period (Bettinger, 1999a; Simms, 2008), or at least held their own (chap. 10), so it follows that obsidian conveyance distances should have declined, or at least remained the same (Delacorte and Basgall, 2012).

Although the expectation for reduced obsidian conveyance distances late in time has not always been met (McGuire, 2002; Eerkens et al., 2008a; Smith, 2010), we were completely surprised by the scale of the distances reflected by the current Terminal Prehistoric findings (see chap. 14). The average distance traveled by projectile points and debitage was much greater than any other time period. Some of the most conspicuous findings include obsidian from Mount Hicks in western Nevada (340 km away), Big Southern Butte in Southern Idaho (360 km), and Owyhee in southeastern

TABLE 85
Frequency of Rosegate and Desert Series Projectile Points in Lands Ultimately Occupied by Northern Paiute and Western Shoshone Speakers

Type	Northern Paiute	Western Shoshone	Totals
Desert Series	28	20	48
Rosegate	152	41	193
Totals	180	61	241
Desert Series:Rosegate Ratio	0.18:1	0.49:1	0.25:1

Oregon (260 km). The fact that these findings include debitage indicates that some of material arrived as unfinished items, despite traveling hundreds of kilometers from the quarry.

What could account for this strange development? While we acknowledge the great distances people can cover on foot (Aikens, 2009), we think that the magnitude of these changes could reflect the introduction of the horse to the northern Great Basin. Horses were introduced to the Southwest in earnest about A.D. 1600 when the Spanish established a settlement in Santa Fe and began trading them to local Native American populations. Some of the earliest recipients of the horse were the Utes, who then traded them northward to the Northern Shoshone, with the latter receiving them by about 1690 (260 cal B.P.; Wissler, 1914; Haines, 1938; Sutton, 1986). While there is no evidence for the regular use of the horse among the Western Shoshone, it is important to emphasize that several Northern Shoshone groups occupied lands on the Snake River drainage, only 50 miles north of the project corridor.

The Northern Shoshone made good use of the horse largely because their territory included superior grassland habitats, which supported large herds of bison and provided forage for their herds of horses. The addition of the horse revolutionized their economy, allowing them to travel great distances and acquire great wealth in the form of food and hides, which could (along with horses) be traded with their neighbors for a variety of commodities. Some of these trips covered 1200 miles, reaching the east side of the Rocky Mountains as bison populations began to dwindle along the western margins of their range. Many of these excursions also included the raiding of neighboring peoples, including theft of their women, with nonequestrian people especially vulnerable to these attacks (Steward, 1938; Murphy and Murphy, 1986).

Little is known about the extent of these activities in northern Nevada, because no early chroniclers were around to observe and record them. By 1742, however, the explorer Chevalier de la Verendrye noted that the Northern Shoshone had fully integrated the horse into their culture, traveling out to North Dakota where (Blegen, 1925: 118): "They are friendly to no tribe. We are told that in 1741 they had entirely destroyed 17 villages, and killed all the old men and old women, and made slaves of the young women and had traded them to the seacoast for horses and merchandise."

It seems clear, therefore, that the Northern Shoshone were more than capable of covering a great deal of ground by the early 1700s, and could have done so in the Great Basin with little difficulty. It was not until 1827 that the first Euro-American (Jedediah Smith) crossed through the Great Basin and made notes of his travels (Layton, 1981). During this trip he camped at the south end of Walker Lake, only 20 miles north of the Mount Hicks obsidian source. During the night, he was awakened by the arrival of 20 to 30 horsemen. "I observed these indians had some Buffalo Robes…which appears they have some communication with the indians on Lewis' river…" (Brooks, 1977: 176); Lewis' "river" refers to the Snake or Columbia River drainages.

The first written record from the Humboldt River comes from Peter Ogden in 1828, who found a trail near Golconda (10 miles south of the project corridor), where Williams (1971: 108) noted:

> [A] number of horses have traveled in this quarter, probably not less than 400, and if I may judge from appearances in one of their camps there could not have been less than 300 Indians. In the afternoon eight paid us a visit. An elderly man of the party who understands the lower Snake language, informed me that the distance was great to the sources [of the Humboldt River].

Finally, Ogden also noted about a week later that "three Snake Indians with their horses arrived and informed us they were from the Main Falls of the Snake River" (Williams, 1971: 110).

It is clear from these accounts that Northern Shoshone horsemen traveled freely across the Great Basin and could have expanded local exchange systems in a significant way. Moving obsidian from sources like Mount Hicks up to the project corridor and beyond was obviously possible, judging from the visit to Jedediah Smith's camp only 20 miles from the source. We must admit, however, that we currently lack the chronological precision necessary to distinguish between Terminal Prehistoric materials postdating 260 cal B.P. and those dating to earlier times. This is particularly the case for time-sensitive projectile points (i.e., Desert Side-notched and Cottonwood forms) and obsidian hydration readings, which comprise the majority of the data we have. Nevertheless, we feel that this is an important hypothesis that should be actively pursued into the future.

CHAPTER 16

NUMIC USE OF WOODEN PRONGHORN ENCLOSURES

Allika Ruby

Two of the project sites, 26EK3959 and 26EK12310, contain the remains of wooden animal enclosures that are thought to have been used by prehistoric hunting groups to capture pronghorn. In all, four prehistoric and one historic-era enclosures built of juniper wood were found within a 3 × 2 km area along Fivemile Draw (fig. 79).

Other similar "trap" features have been identified in the Great Basin and have stimulated lively scholarly debate concerning their use, age, and importance to prehistoric groups (fig. 80). Most are found in Nevada east of the Ruby Mountains and between Walker and Mono lakes (Hockett et al., 2013; Arkush, 2014). Aside from their obvious subsistence function—the mass capture of artiodactyls—they are important in the Great Basin because they represent one of the few archaeological manifestations of communal effort. Prior studies have generally been conducted at the survey level, and the current project has provided a rare opportunity to conduct a more intensive investigation.

Available reports of traps in northeastern Nevada (e.g., Hockett, 2005; Hockett and Murphy, 2009; Murphy and Frampton, 1986; Polk, 1987; Jensen, 2007) almost uniformly describe these features as circular to elliptical enclosures spanning 200 to 600 m in diameter, each having an opening at one end, and made from juniper limbs and/or trunks. These features tend to be located on alluvial fans or fan piedmonts along the margins of the juniper zone on the lower flanks of mountain ranges. Many retain evidence of wing walls as well. Their openings tend to be at lower elevations than the back ends and are placed in locales that screen at least a portion of the enclosure from view downslope (figs. 81 and 82). Thus, an animal being driven upslope toward a corral would not be able to see the rear of the trap until it was well within the enclosure. In Nevada, known wooden enclosures are documented mainly in areas occupied by Western Shoshone groups, although they are also present in historic-era Paiute territory and in aboriginal Washoe territory in western Nevada (Hockett et al., 2013; Arkush, 2014).

The dating of these hunting features has mostly relied on artifact associations, as few have been directly dated. In their study of the Spruce Mountain trap complex, Bryan Hockett and Tim Murphy (2009) found that associated Gatecliff projectile points indicated use extending to 5700–3800 cal B.P., and argued that several projectile point clusters likely represent locations of traps

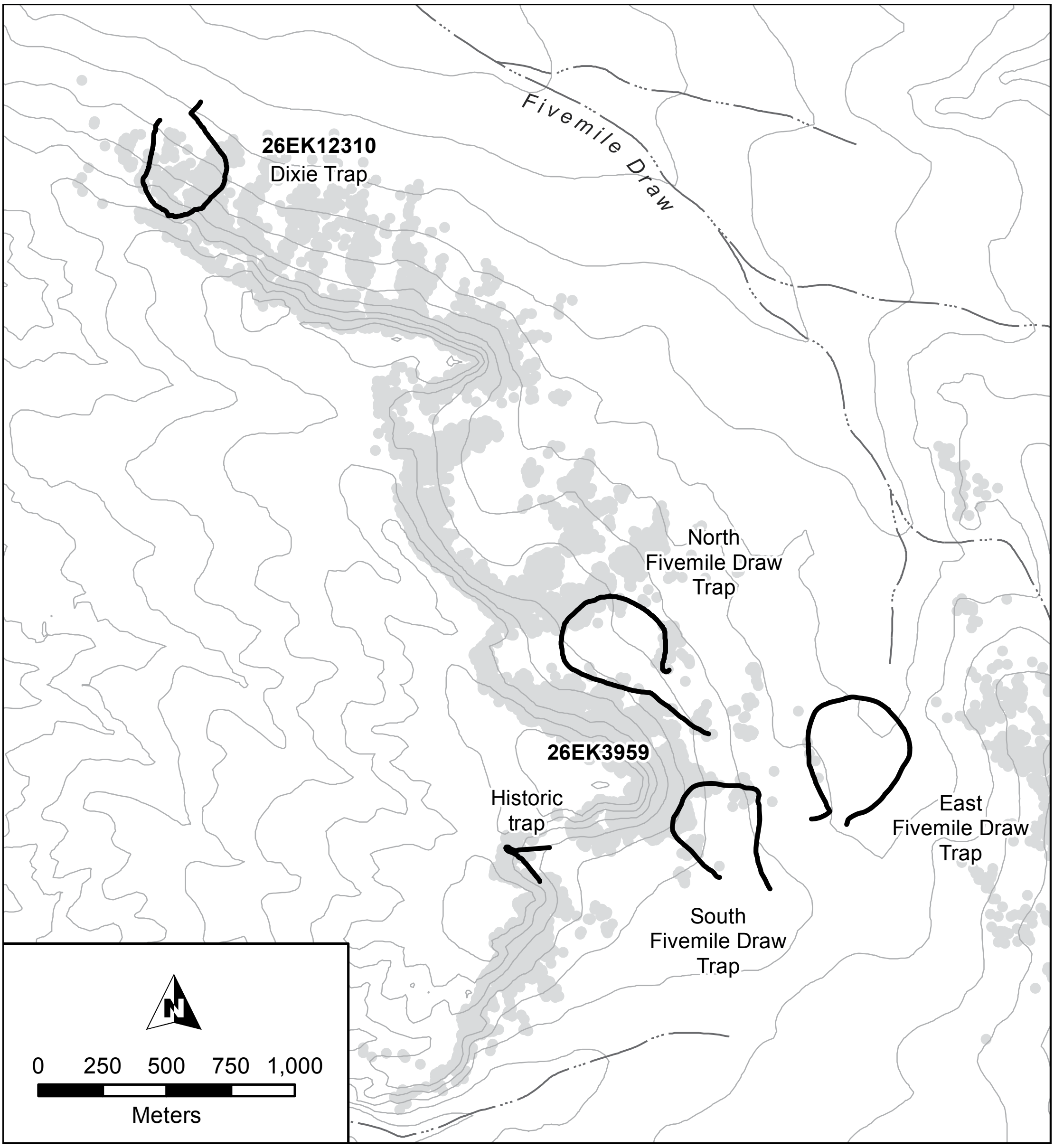


Fig. 79. Fivemile Draw and Dixie pronghorn traps.

that have since decayed. Jill Jensen obtained 18 accelerator mass spectrometry (AMS) radiocarbon dates from six traps that span A.D. 1450 to 1800, with most dates overlapping at ca. A.D. 1650 (Jensen, 2007). She concluded that these features predated the ethnographic period and cautioned that ethnographic accounts may not adequately describe the processes used during their construction. In another study (Polk, 1987),

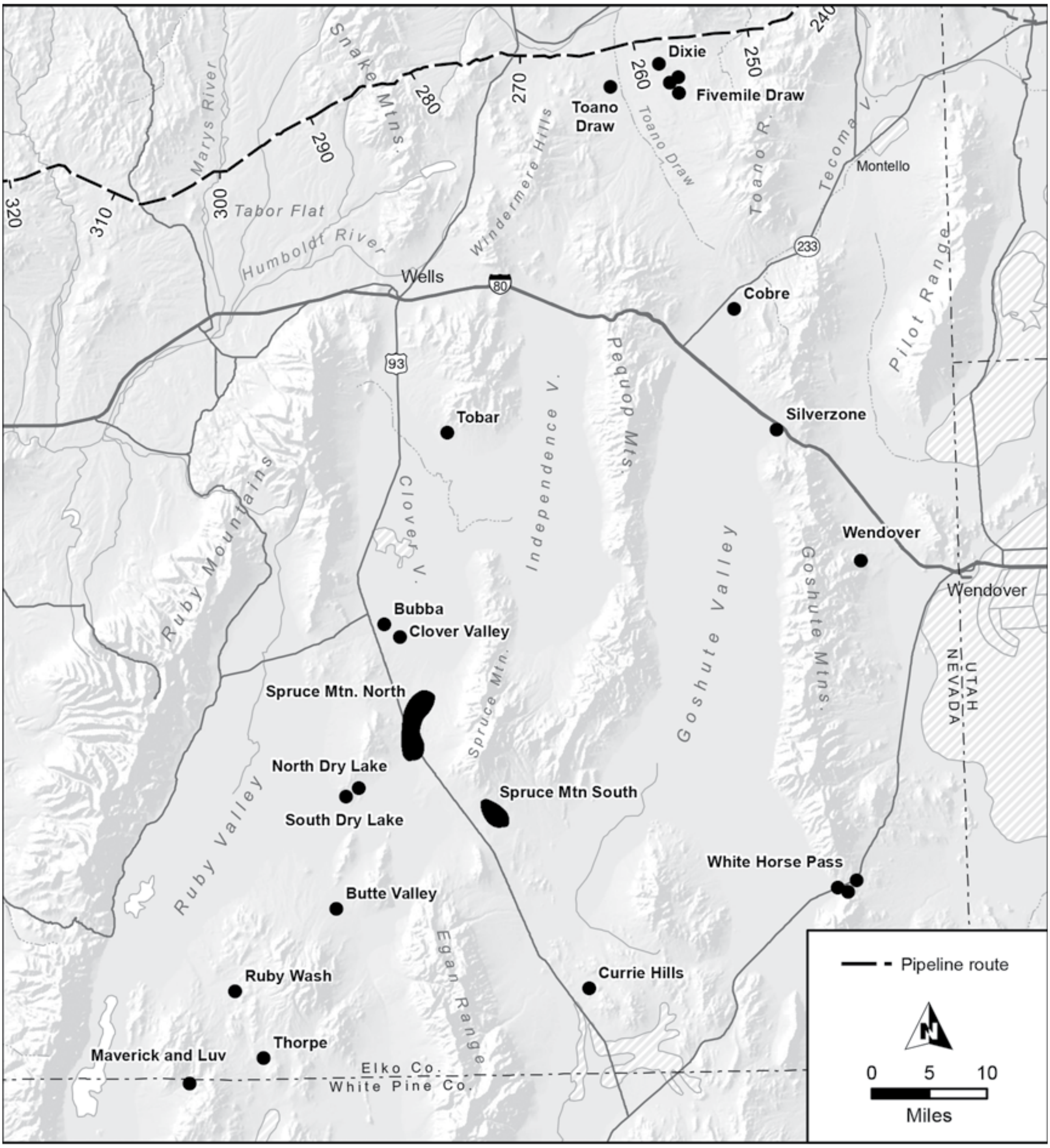


Fig. 80. Prehistoric wooden animal enclosures in northeastern Nevada.

seven traps were subjected to dendrochronology analysis, but the results were inconclusive; they were "grossly" dated to the late prehistoric or early historic period based on the estimated ages of the wood.

Pronghorn Behavior

The construction techniques used in archaeological traps reflect an intimate understanding of pronghorn behavior. These animals are adapted to the open plains and

Fig. 81. Panoramic view from mouth of Dixie Trap, into the trap.

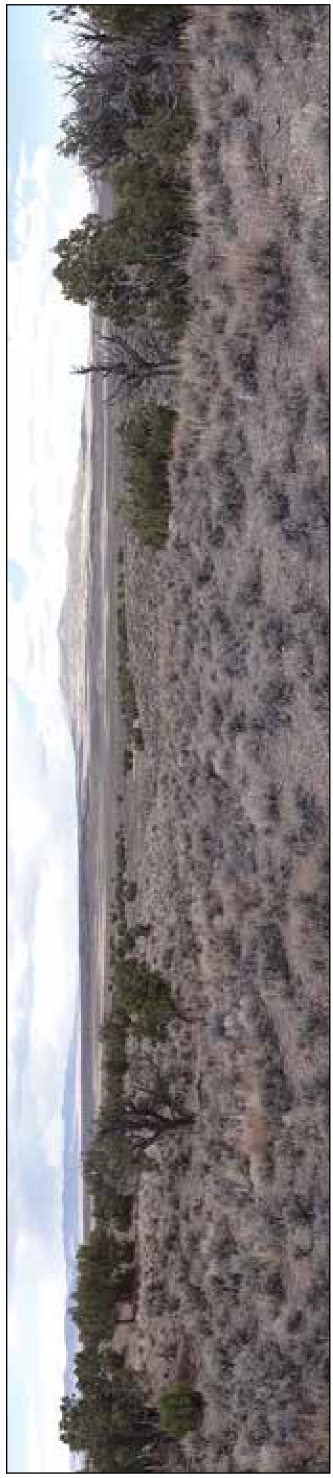


Fig. 82. Panoramic view from apex of Dixie Trap, down toward mouth of trap.

are naturally social. In winter, they aggregate with all sexes and classes present, ranging from two to thousands (Lubinski, 1999). They are also somewhat predictable in their daily and seasonal movements, and their modern migration routes are highly regular. Their excellent vision enables them to spot objects sometimes miles away. They are capable of short bursts of speed, sometimes 60–70 mph, and broad-jumping (4.3–8.2 m), but they are poor vertical jumpers and cannot maintain fast speeds. Modern drives conducted by wildlife biologists demonstrate that their aversion to vertical jumping is a key exploitable characteristic, as they are relatively easy to keep in an enclosure once they are driven in. They prefer to search for openings to escape, but may jump if panicked and are capable of clearing obstacles six feet tall. Larger enclosures thus tend to be more successful, as the animals will expend energy seeking an opening and are less likely to panic and jump. A barrier height as low as four feet (1.2 m) can be sufficient to contain pronghorn that are not crowded in a pen, according to one study conducted in Wyoming (Spillett and Zobell, 1967). They are wary and will tend to bolt and scatter if spooked, unlike other herding animals (e.g., bison) that tend to stampede as a group. Thus, a successful hunt requires careful planning and stealth by the hunters.

Ethnographic Evidence

Ethnographic accounts (e.g., Steward, 1938) often mention constructed facilities used during hunting, although few accounts describe wooden facilities such as those at 26EK3959 and 26EK12310. For developed discussions of the ethnographic literature relevant to "antelope" [pronghorn] drives, refer to Jensen (2007: 21–27) and Lubinski (1999).

These facilities likely required group participation. Small-scale communal efforts are thought to have produced blinds, drive lines, or V-wings, but not the large wooden enclosures (e.g., Jensen, 2007). Jensen (2007), for example, estimates that a wooden trap might require 133 person-days to build. A trapping group might involve several drivers, one or more archers, and a number of butchers. Some accounts note that a shaman would lead the hunt, and Steward (1938: 163) describes "large crowds" participating. Some accounts noted that the hunts were conducted only rarely, while others stated they occurred once or twice a year. The effects of Euro-American settlement may have reduced their frequency, however.

Hunts were reported during the spring, fall, and winter seasons (Steward, 1941). Notably, most accounts describe sagebrush as the dominant construction material and not wood, which is more labor-intensive to gather. Some records note that pronghorn meat was undesirable compared to other large game, but that the hides were valued for clothing. The frequency of hunts attested to by the participants vary widely, with some suggesting that local pronghorn populations would require several years to recover before another hunt could proceed (e.g., Egan, 1917), while others indicated they were an annual event (Steward, 1938).

The following is excerpted from Major Howard Egan's diary, which covers the years 1846 to 1878 (Egan, 1917). He vividly describes a Gosiute Shoshone "antelope" drive that was conducted about 20 miles northwest of Deep Creek in northwestern Utah. His narrative indicates full participation of the group, including women and children:

> [They] were busy repairing and extending the flanking arms of the old corral, or trap pen….
>
> Each knew just what part and place he or she was to take. By daylight all were ready for the start and, in fact, a number of the young men had left early in the evening before to go to the extreme south end of the ground to be covered and about 20 miles from the pen. They were to spread apart across the valley, travel in open order back to the north, being careful that not one of the antelope jumped would run, except in a northerly direction.
>
> This valley has a good many hills or knolls along the base of the mountains and a few of them scattered more to the center of the level ground in the middle of the valley. An antelope, when started up, will always run directly for one of these, that lay opposite from where he gets his scare from, and they run from hill to hill.
>
> Thus it goes till they come to the line between the outer ends of the arms, which, there, are about four miles apart but gradually closing in as they get nearer the pen. The arms or leads are started at the extreme ends by simply prying or pulling up a large sagebrush and standing it roots up on the top of another brush, thus making a tall, black object visible for miles. The standing of these brush were at first some 10 to 20 feet apart, but were placed more and more near together the nearer towards the pen, and when the two lines came to about 100 yards apart they were built so the buts [sic] of the brush were as close as the tops would allow them to be joined and by this time both wings had swung to the east side of the valley, where there were many ravines to cross and plenty of cedar and pine to use for fencing.
>
> There were many turns to the lane thus formed, but was getting narrower and stronger till finally, around a sharp turn through a large, thick bunch of cedars, the game were in one corral, which was about two hundred feet in diameter and built strong and high enough to withstand the charges of a herd of buffalo.
>
> The drive came to an end with a rush and everyone working desperately closing up the entrance, a few small children appearing on the wall at different points around the pen.
>
> There had been left three or four young men to guard the place and see that none of the animals broke through. The antelope had run themselves down and were huddled in the center of the enclosure, most all laying down. The Indians soon picked out five or six of the largest, which were killed and soon on the way to camp to be made into jerked meat, as it was called….the skins may be washed clean and rung [sic] as dry as possible, then stretched and pulled and rubbed till dry, when they are soft, white and pliable. Then they are ready for trade or use.
>
> The Indians told me that the last drive, before this one at this place, was nearly 12 years ago and the old men never expected to see another at this place, for it would take many years for the animals to increase in sufficient numbers to make it pay to drive. These drives are mostly in the desert valleys, where the poor horseless natives live.

Chronology

Altogether, some 20 radiocarbon dates were obtained from juniper timbers in the four trap features. Consistent with the methods employed by Jensen (2007), structural elements exhibiting evidence of active harvesting (e.g., ripping, tearing) were targeted to minimize the problem of "old wood" during radiocarbon analysis (fig. 83). Samples were spaced along the corral wall to reduce the likelihood of obtaining multiple dates from a single tree. The data are presented using the 2σ calibrated

Fig. 83. Dixie Trap limb sampled for radiocarbon study (AMS-5).

calendar dates derived using the OxCal 4.2 program (Ramsey, 2009, 2014).

All of the dates fall within the Terminal Prehistoric Period (600–150 cal B.P.) and produced multiple intercepts due to variations in atmospheric radiocarbon concentrations (fig. 84). Following the lead by Jensen (2007: 97), the intercepts that fall between A.D. 1870 and 1950 can likely be disregarded, as no historic-era artifacts are associated with the traps and the timbers lack evidence of metal tool use.

Three of the traps demonstrate two significant areas of overlap. Their combined dates demonstrate an early cluster of seven dates falling between A.D. 1490 and 1660 and a later cluster of 12 dates falling between about A.D. 1680 and the modern period; the intercept from a single date at the East Fivemile Draw Trap encompasses both ranges. The medians for these early dates range from cal A.D. 1534 at the Dixie Trap to cal A.D. 1592 at the North Fivemile Draw Trap, while the medians for the later dates range from cal A.D. 1734 at the East Fivemile Draw Trap to cal A.D. 1843 at the Dixie Trap. The dates derived from South Fivemile Trap all fall within this later era, with medians ranging from cal A.D. 1784 to 1829.

It is clear that all the traps witnessed at least one construction episode during the late pre-

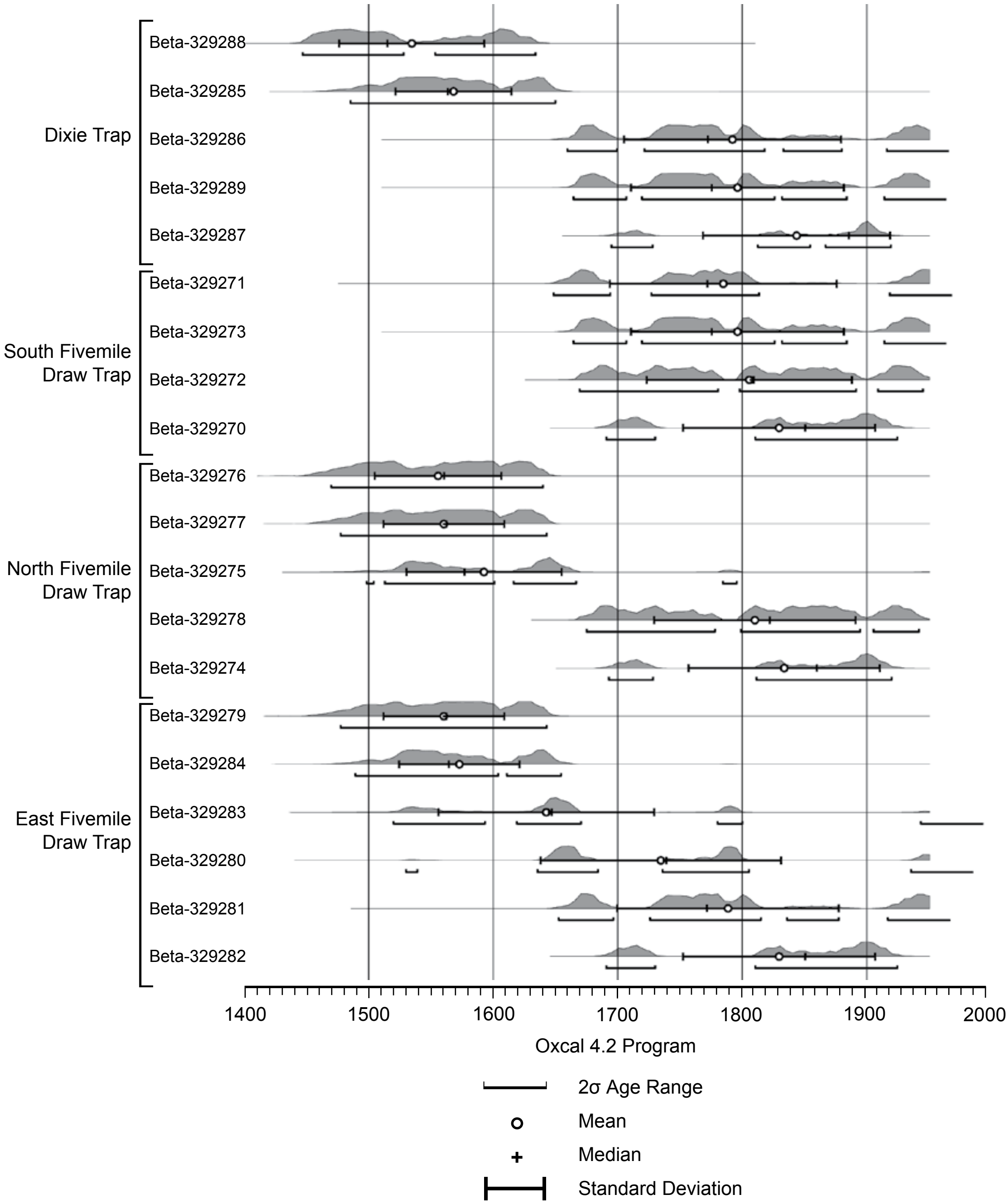


Fig. 84. Accelerator mass spectrometry dates from Fivemile Draw and Dixie traps using the Oxcal 4.2 program. (C.B. Ramsey, 2013; r5 IntCal13 atmospheric curve [Reimer et al., 2013])

TABLE 86
Summary of Characteristics of Project Wood Enclosure Features

Site	Trap Name	Dimensions (m)						
		Circumference	N/S	E/W	Opening	Acres Enclosed	Wing Length	Opening Axis
26EK3959	South Fivemile (Locus 1)	1030	350	350	125	25	85	160°
26EK3959	North Fivemile (Locus 2)	1150	340	400	100	28	270	132°
26EK3959	East Fivemile (Locus 45)	1290	480	395	80	33	75 (west), 16 (east)	218°
26EK3959	Historic-era (Locus 4)	95	40	12	12	0.1	130 (north), 145 (south)	125°
26EK12310	Dixie	1015	380	300	120	23	60	355°

historic era, likely just prior to the Contact Period. There is evidence for prior construction episodes at three of the traps (North Fivemile Draw, East Fivemile Draw, and Dixie) with mean dates spanning a brief 60 year period between cal A.D. 1534 and 1592. There is no evidence for earlier construction at the South Fivemile Draw Trap. It is possible that the earlier dates are from dead wood that was scavenged during construction in the later period, but a wider span of dates would be expected if that were the case.

These dates are similar to those derived from the traps reported in Jensen (2007). In that study, both the Clover Valley and Cobre traps produced radiocarbon dates with similar distributions and clustering (Jensen, 2007: 104).

Construction Techniques

The four wooden prehistoric enclosures at 26EK3959 and 26EK12310 display highly similar construction techniques (table 86). All are placed on gentle alluvial slopes west of Fivemile Draw. The backsides of three (Dixie, North Fivemile Draw, and South Fivemile Draw) are incorporated into the juniper tree line and are partially hidden by the trees (figs. 85 through 87). East Fivemile Draw Trap, however, is entirely within open sagebrush and has a gentler slope than the other three (fig. 88). All four traps open at their lowest elevation, and their rears are at the uppermost elevation. All four have wings, with the longest incorporated into North Fivemile Draw Trap (270 meters). Based on ethnographic accounts, these wings likely incorporated sagebrush that has since decayed, which served to funnel herds into the enclosure.

The traps are composed of juniper limbs or trunks placed in a nearly continuous alignment and are devoid of rock walls or footings (table 87; fig. 90 and fig. 91). The construction techniques are similar to those described for other wooden facilities in eastern Nevada (Murphy and Frampton, 1986; Polk, 1987; Jensen, 2007). The timbers tend to be laid end to end with little spacing between them, and portions of each of the enclosures are formed from crisscrossed timbers that appear to have fallen from an upright configuration (figs. 92–94). Very few upright elements are present, although living trees appear to have been intentionally incorporated in all but East Fivemile

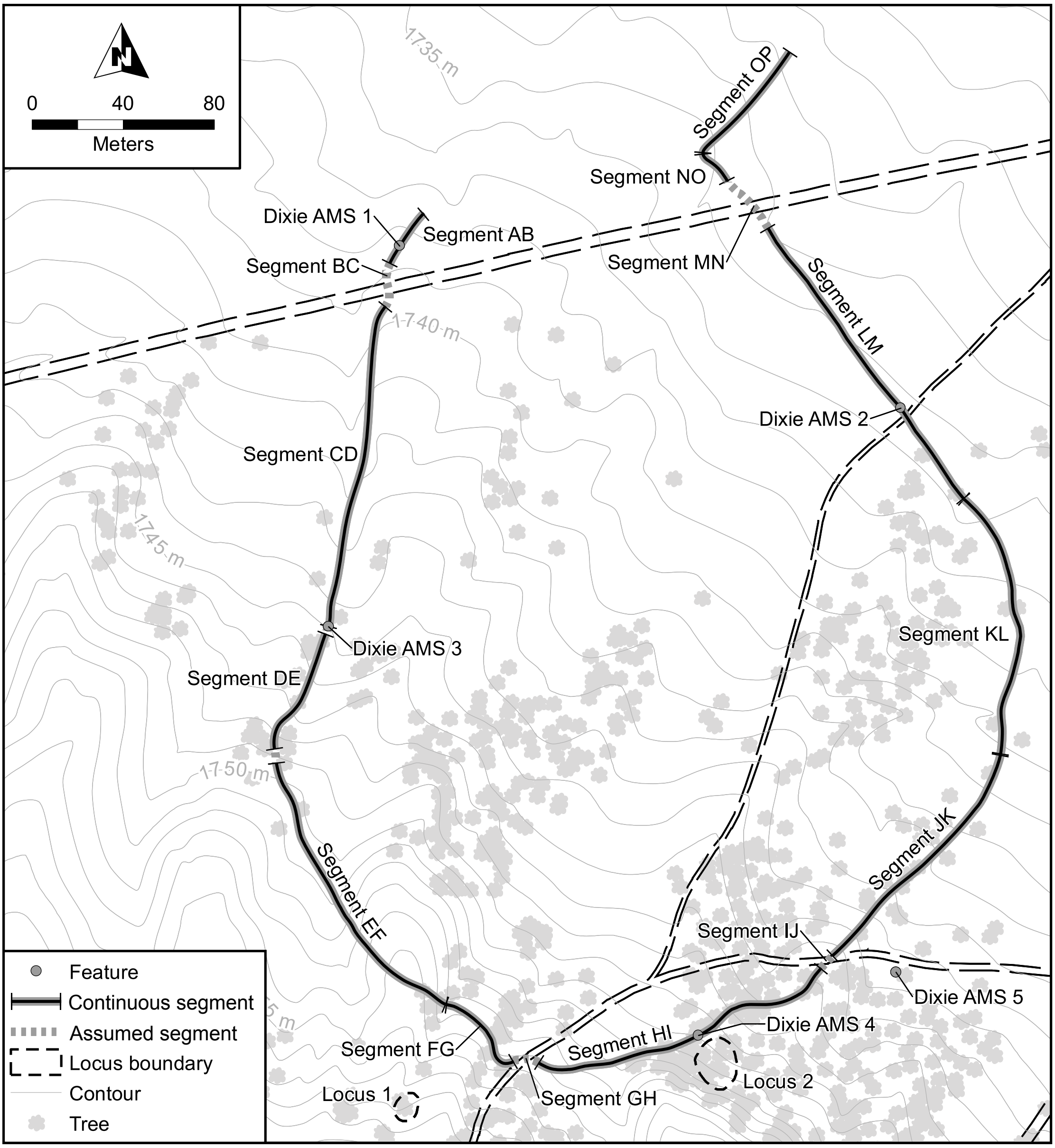


Fig. 85. Dixie pronghorn trap.

Draw Trap. Evidence of ripping and/or tearing could be confirmed for relatively few timbers, as the wood is weathered to a degree that such evidence is difficult to identify. Many of the timbers have been trampled by cattle.

Historic-era Animal Enclosure

A fifth juniper wood animal enclosure was documented as part of this project. Locus 4 at 26EK3959 is a V-shaped alignment of standing juniper posts and fallen axe-

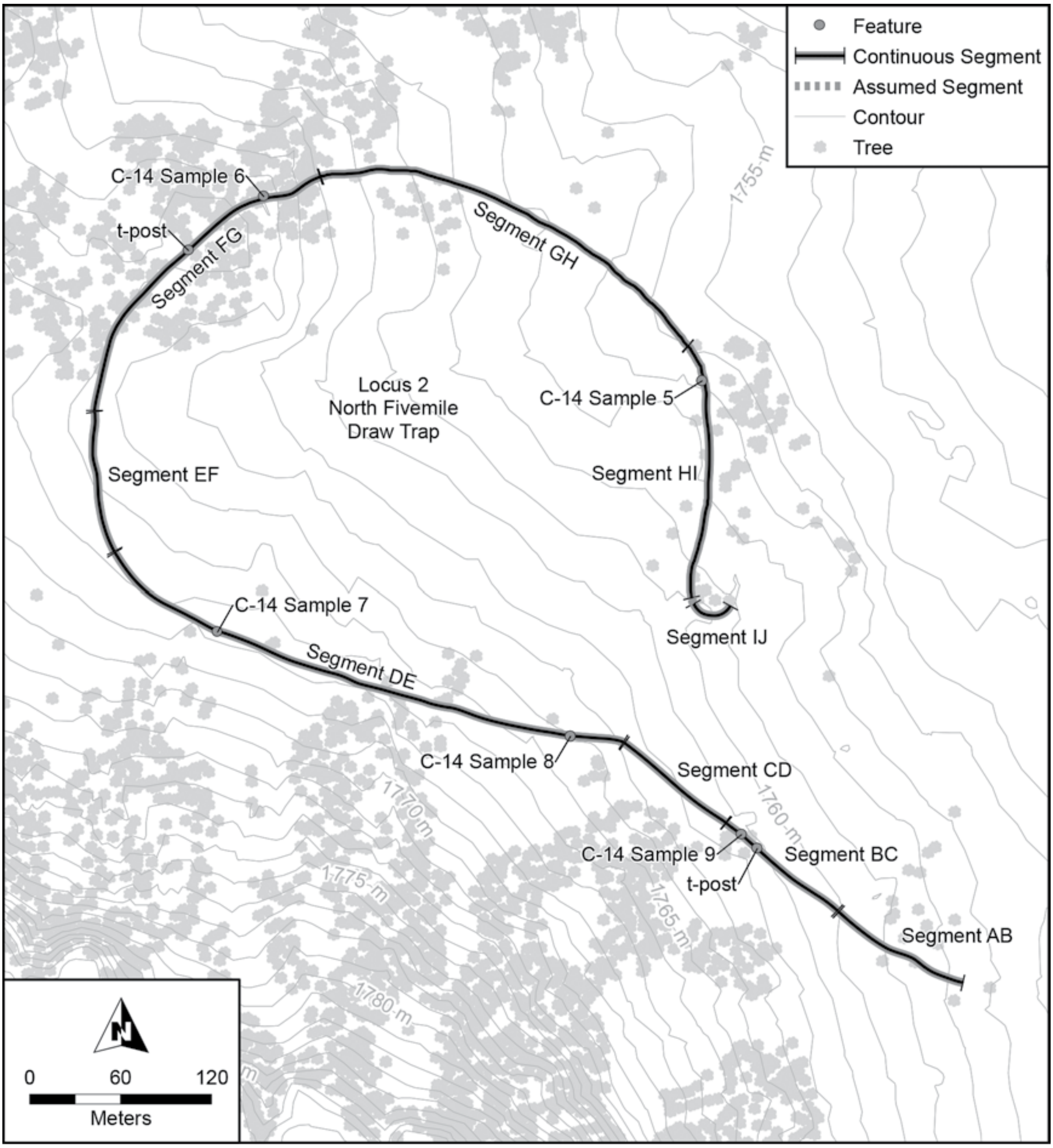


Fig. 86. North Fivemile Draw pronghorn trap.

cut limbs, some of which are linked with two-strand, two-pronged barbed wire (figs. 89 and 95). It is located approximately 500 m west of South Fivemile Draw Trap. Two lines of sparsely arranged juniper timbers and fallen posts funnel sharply into a steep drainage emanating from the tableland above (fig. 96). The drainage appears to be a natural travel corridor for animals, as evidenced by a well-defined cow path leading

TABLE 87
Characteristics of Pronghorn Traps by Segment, 26EK3959 and 26EK12310

AMS = accelerator mass spectrometry; RYBP = radiocarbon years before present; NR = not recorded; C = continuous; NC = near continuous; S = sparse; VS = very sparse.

Segment	Live Trees (*n*)	Max. Tree Ht (cm)	Max. Tree D (cm)	Limbs (*n*)	Max. Limb Length (cm)	Max. Limb Depth (cm)	Limb Spacing	Ripping/ Tearing Present	Artifacts	AMS Dates RYBP	Comments[a]
South Trap, 26EK3959											
A-B	–	–	–	38	100	8	S	–	–	–	Segment is very fragmented and small; poor condition.
B-C	–	–	–	1	NR	NR	VS	–	–	–	Segment is washed out with only one branch present.
C-D	–	–	–	41	100	5	NC	+	–	–	Limbs are placed both parallel and perpendicular to trapline with a 5 m gap midway through; fair to poor condition.
D-E	–	–	–	–	–	–	–	–	–	–	Segment consists of a small pile of juniper limbs under a live juniper tree; large gap present.
E-F	4	300	40	100	210	20	C	+	–	70 ± 30	Limbs are placed both parallel and perpendicular to trapline; good section.
F-G	–	–	–	2	NR	NR	VS	–	+	–	Segment consists of 2 small scraps of wood; 12 flakes just upslope.
G-H	20	NR	NR	178	250	20	C	+	+	190 ± 30, 140 ± 30	Possible crisscrossing of timbers; chopping evident on one timber; obsidian biface (Artifact 2), possible drill.
H-I	–	–	–	Yes	NR	NR	VS	–	–	160 ± 30	Segment is a large gap in the trapline; individual limbs were GPSed.
I-J	–	–	–	22	75	NR	S	–	–	–	Segment consists of widely scattered small limbs.
J-K	–	–	–	4	NR	NR	VS	–	–	–	Segment is a large gap in the trapline; individual limbs were GPSed.
K-L	–	–	–	60	170	10	NC	–	–	–	Some portions of the segment are sparsely placed; most timbers are small segment; ends at two-track road.
North Trap, 26EK3959											
A-B	–	–	–	25	242	44	S	+	–	–	Segment is a single layer of trampled timbers.
B-C	–	–	–	65	200	40	C		–	130 ± 30	Slight overlapping of limbs and trunk; fallen metal T-post midway.
C-D	–	–	–	20	100	5	VS	+	–	–	Difficult to view the line.
D-E	11	200	50	308	240	71	C		–	340 ± 30, 330 ± 30	Slight crisscrossing of limbs; 3 upright stumps present; rock possibly placed in trapline but could be due to trampling. North end very trampled.
E-F	–	–	–	75	240	25	C	+	–	–	Segment in open area with no trees present; limbs are slightly smaller than in D-E.
F-G	10–15	NR	NR	207	260	34	NC	+	–	280 ± 30	Segment is very visible within juniper grove; branches woven in at least once; crisscrossing present; some evidence of stacking; metal T-post present.

TABLE 87—*(continued).*

Segment	Live Trees (*n*)	Max. Tree Ht (cm)	Max. Tree D (cm)	Limbs (*n*)	Max. Limb Length (cm)	Max. Limb Depth (cm)	Limb Spacing	Ripping/ Tearing Present	Artifacts	AMS Dates RYBP	Comments[a]
North Trap, 26EK3959 *(continued)*											
G-H	1	150	15	234	270	38	NC	+	–	–	Limbs seem to have fallen outward as if they had been leaning against one another; upright stump present; limbs and trucks are larger at upper, west end and smaller in the lower, more open area.
H-I	5	190	15	115	250	45	NC	+	–	60 ± 30	Limbs laid end-to-end and crosswise; upright stump present; good condition overall.
I-J	1	200	15	13	290	20	NC		–	–	This segment is at the lower end and curves to the north as a "hook" likely designed to confuse the prey or for hunter concealment.
East Trap, 26EK3959											
A-B	–	–	–	3	NR	NR	S	–	–	–	Segment consists of small limbs; individual limbs were GPSed.
B-C	–	–	–	73	160	80	C	–	–	–	Limbs are placed closely together, end-to-end.
C-D	–	–	–	336	200	20	C	–	–	330 ± 30, 230 ± 30	Crisscrossed timbers with close spacing; portions well preserved; two-track road crosses through the segment; segment is below a slight rise, not visible from trap entrance.
D-E	1	NR	NR	207	200	33	C	–	–	180 ± 30	Segment begins at live juniper tree; limbs are placed parallel and perpendicular to trapline; 2 upright posts present.
E-F	–	–	–	5	400	NR	S	–	–	–	Segment consists of small limbs on flat ground; heavy trampling noted.
F-G	–	–	–	30	NR	NR	NC	–	–	–	Heavy trampling noted; on flat ground; segment ends at access road.
G-H	–	–	–	200	230	12	C	–	–	70 ± 30	Limbs are placed in a crisscross fashion; also fairly heavy trampling; upright post present; segment extends into a sandy area east of access road.
H-I	–	–	–	222	270	13	NC	–	–	260 ± 30	Segment begins at barbed fenceline.
I-J	–	–	–	178	260	20	C	–	–	300 ± 30	Segment is farthest from juniper trees; some limbs placed in a crisscross fashion; 4 upright posts present.
J-K	–	–	–	242	210	20	NC	–	–	–	Some limbs placed in a crisscross fashion.
K-L	–	–	–	40	140	20	NC	–	–	–	Segment is end of trapline/wingwall.
Dixie Trap, 26EK12310											
A-B	–	–	–	11	280	25	NC	+	–	310 ± 30	Segment terminates at active cow wallow; freshly broken limbs present at wallow.
B-C	–	–	–	–	–	–	–		–	–	Obliterated by access road.
C-D	2	250	30	Yes	250	30	C	+	–	40 ± 30	Segment includes downed chainsaw-cut juniper logs; extensive cattle trampling at lower end.
D-E	5	NR	NR	–	–	–	–		–	–	Segment consists of tree line.

TABLE 87—*(continued).*

Segment	Live Trees (*n*)	Max. Tree Ht (cm)	Max. Tree D (cm)	Limbs (*n*)	Max. Limb Length (cm)	Max. Limb Depth (cm)	Limb Spacing	Ripping/ Tearing Present	Artifacts	AMS Dates RYBP	Comments[a]
Dixie Trap, 26EK12310 *(continued)*											
E-F	4	200	20	66	250	25	NC	unclear	–	–	Timbers more visible as segment approaches apex upslope; within open sage; Locus 1 is to the south near the top of ridge.
F-G	4	NR	NR	10	NR	NR	S	unclear	+	–	Segment is very patchy through tree line; large burnt tree is present, possibly cultural? Evaporated milk can present.
G-H	–	–	–	–	–	–	–	–	–	–	Segment obliterated by two-track road.
H-I	20	300	20	66	200	20	NC	–	–	370 ± 30	Segment is single alignment; begins and ends at two-track roads; Locus 2 is adjacent to the segment.
I-J	–	–	–	–	–	–	–	–	–	–	Obliterated by two-track road.
J-K	7	400	30	32	300	20	NC	–	–	160 ± 30	Portion of segment in treeline; heavy cattle trampling at lower end.
K-L	2	250	40	18	200	15	S	–	–	–	Wide limb spacing, partially due to cattle trampling but also fewer appear to have been placed; lower, flatter elevation.
L-M	2	NR	NR	66	200	15	NC	–	–	170 ± 30	Some appear to have been supports with timbers placed crosswise; segment ends at access road.
M-N	–	–	–	–	–	–	–	–	–	–	Obliterated by access road.
N-O	–	–	–	11	250	20	NC	–	–	–	Spacing is continuous, but timbers are sparse in some sections.
O-P	–	–	–	26	280	20	C	–	–	–	Wing-wall; trampling evident.

[a] All segments are weathered and cattle trampled.

through it. Several trees in the vicinity bear evidence of limb removals by axe or saw.

This trap demonstrates similarities of construction to the three prehistoric enclosures described above, as all are defined by a linear arrangement of juniper limbs and trunks. In contrast to the prehistoric traps, the historic-era trap additionally utilizes large posts that were set upright into the ground, between which barbed wire was strung. The historic-era enclosure is triangular and has a tighter constriction at its apex, which suggests it was not intended for pronghorn, who tend to panic and jump in small enclosures, but rather to capture horses. However, pronghorn use cannot be ruled out, as the use of guns instead of arrows or clubs might have made such a trap adequate for pronghorn use. No other features or artifacts were observed. It is unclear whether the builders of the historic-era trap were of Euro-American or Native American affiliation, although the presence of the three prehistoric antelope traps nearby would strongly suggest a Native cultural affiliation for this historic-era feature.

Archaeological Context

One of the goals of this study was to place these wooden features within a larger settlement and subsistence context. If these

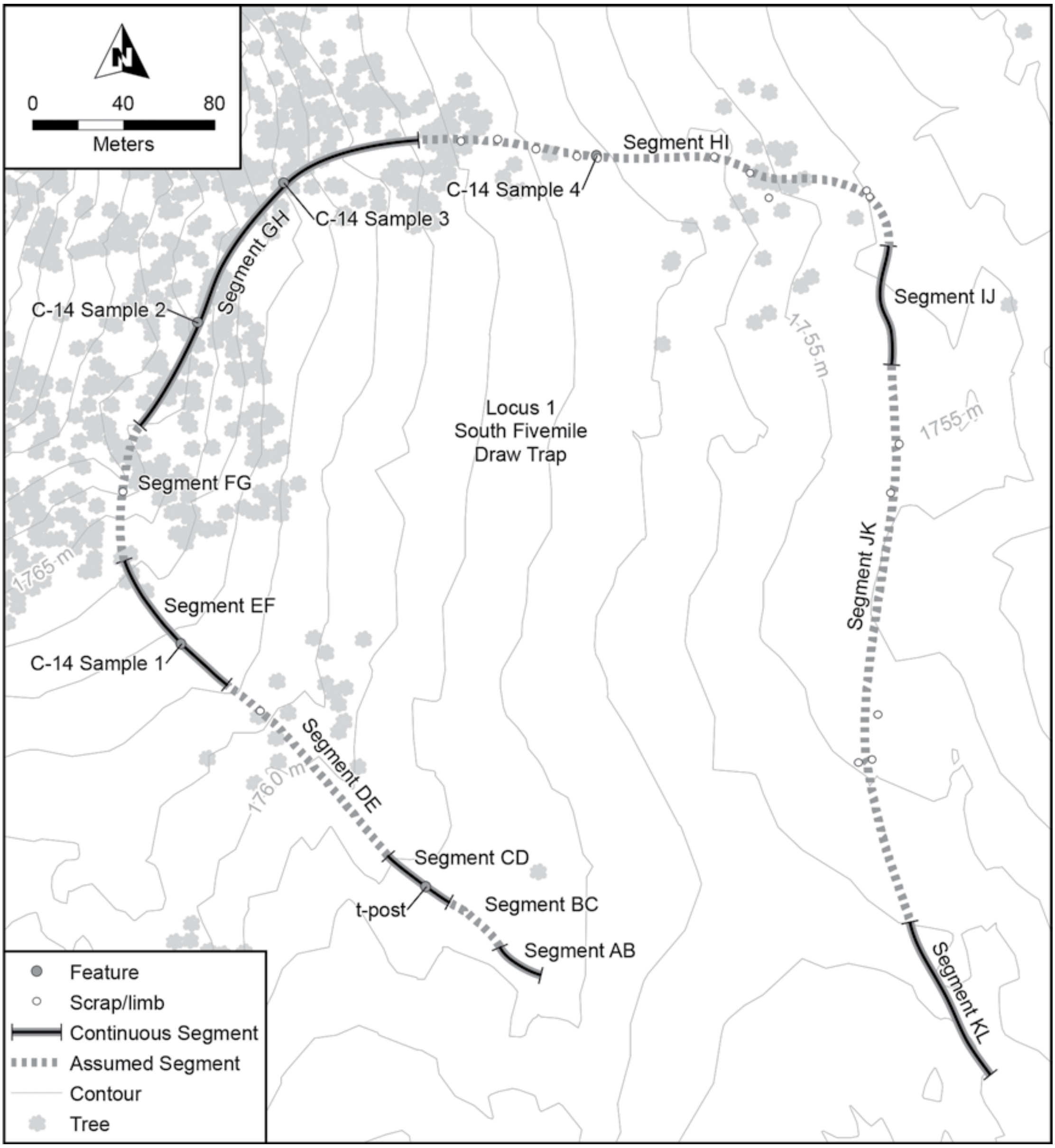


Fig. 87. South Fivemile Draw pronghorn trap.

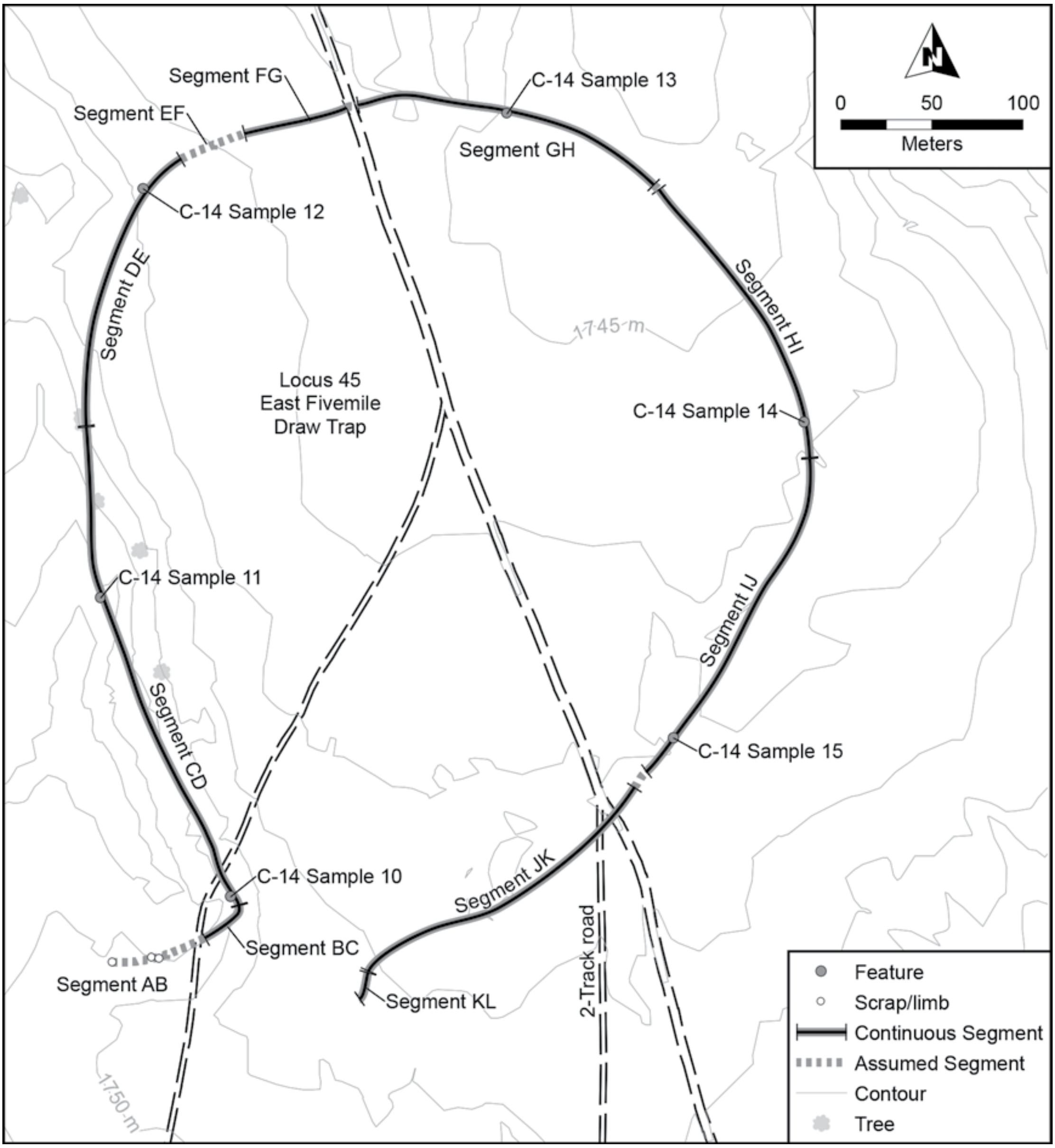


Fig. 88. East Fivemile Draw pronghorn trap.

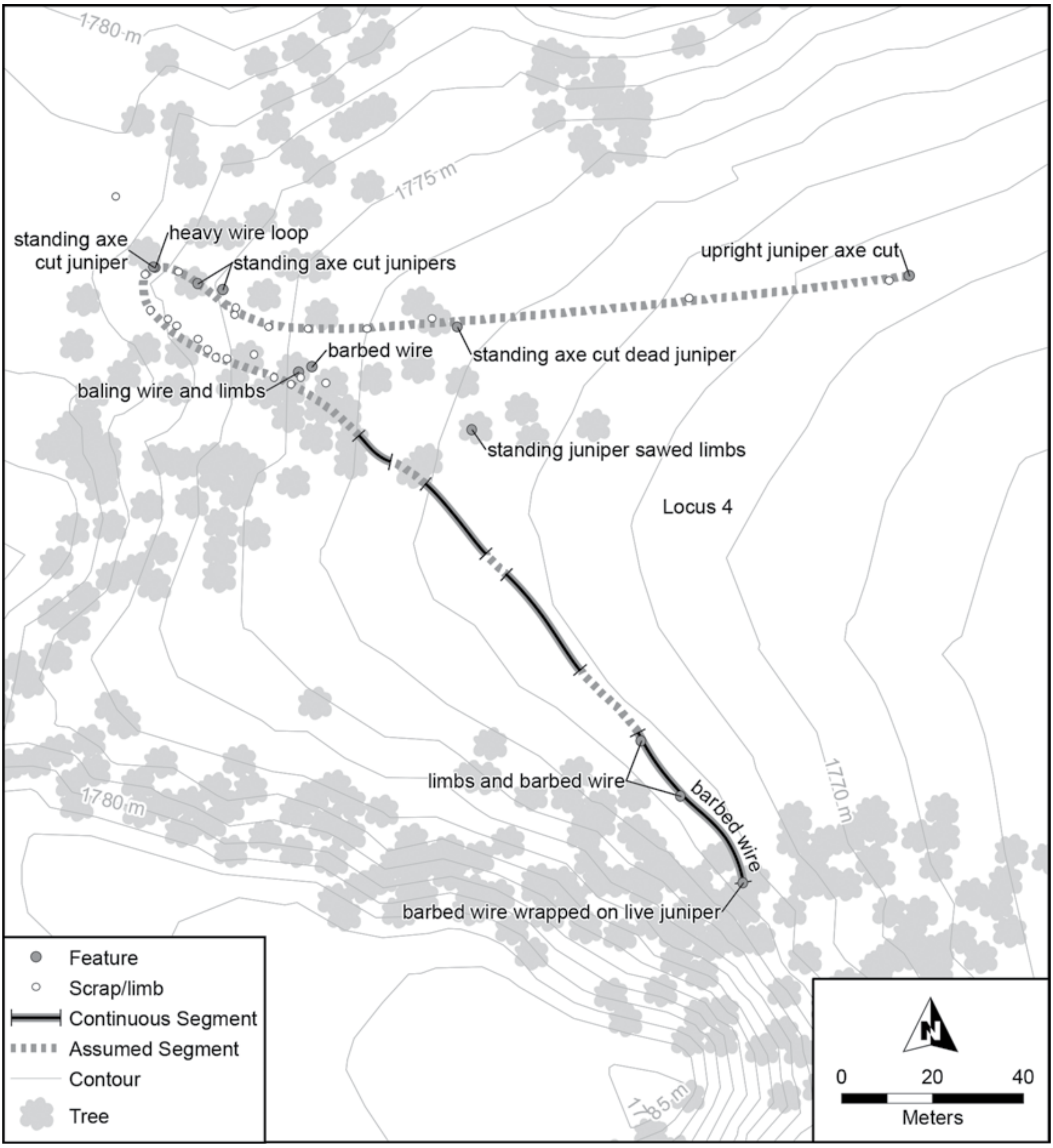


Fig. 89. Historic Fivemile Draw horse trap.

Fig. 90. Dixie Trap, Section E-F.

hunting facilities represent communal work, the participants likely would have made their base camp nearby, along with possible animal-processing locales. Archaeologically, such an occupation would reflect use by a large group.

Cultural materials across the rest of the site areas are scant, however, and no habitations were identified. The Dixie Trap appears to be associated with just two flaked stone tools, three ground stone implements, and a very small quantity of flakes. A single Desert Side-notched projectile point was recovered, but it was located nearly 125 m from the enclosure and may not have been associated with its use. Although a hearth containing charcoal and fire-affected rock is present at 26EK3959, it is not associated with the site's trap features, as it lies nearly 700 m from the nearest trap and was radiocarbon dated to the Middle Archaic Period (3800–1300 cal B.P.). It is possible that the now decayed upright juniper branches at 26EK3959 represent habitations, as suggested by Hindley (1985); however, no supporting evidence for occupation or significant use by a large group or groups during the Terminal Prehistoric Period was observed. If the drives were utilized by a large group, those people

Fig. 91. North Fivemile trap, Section B-C.

appear to have made their camp elsewhere, possibly where water was available. Currently, the closest water source is Fivemile Draw Well (26EK12346), which was developed around 1937 to water livestock and has been maintained for that purpose. The well is located approximately 1 km east of 26EK12310 and 2 km north of 26EK3959. No prehistoric materials were observed in its vicinity during survey for this project. The most recent topographic maps for the site areas (Wine Cup Ranch NE, Wine Cup Ranch SE, Ninemile Mountain and Ninemile Mountain SW) indicate no other perennial sources of water in the vicinity.

However, the 1881 General Land Office map for this region depicts two springs located approximately 1 km from 26EK12310. These springs feed into a marked creek that drains into a large oval area labeled "Meadow." A road and "ditch" trend past a marked house within this meadow area, indicating the water source was sufficient to support a historic-era occupation. None of these elements are depicted on the current USGS topographic map, although the meadow area and house are close to where Fivemile Draw Well is currently situated. The springs feeding into this meadow may have been

Fig. 92. North Fivemile trap, Section H-I.

disrupted by historic-era ranching activities, a scenario that could have occurred at other trap sites in northeastern Nevada as well (see Jensen, 2007: 87, for discussion). This creek might have influenced placement of the traps, as it would have provided a reliable source of water for both animals and humans; it is also a possible residential location for the people who constructed the traps.

Summary

The complex of four wooden animal enclosures described above were likely used to trap pronghorn between A.D. 1600 and 1850. Archival evidence indicates that now absent springs were present to the north, possibly influencing placement of the traps. The features are very similar in form, size, and construction, indicating cultural continuity in the group or groups who used them. The general overall completeness of the features suggests any one of them could have been used successfully, so the reason for three existing in such a relatively small area is unclear. It is possible the three traps were used together to provide a fail-safe method for capture. Alternatively, the very

Fig. 93. East Fivemile trap, Section C-D.

act of constructing new traps may have been important for social reasons. Despite extensive survey and subsurface explorations, no significant number of artifacts or features consistent with associated occupations were identified; it is possible that if a hunt was successful, animal processing was conducted at a base camp located elsewhere, perhaps near the springs to the north. An additional wooden animal trap was documented nearby. Although it was clearly built during the historic era, its nearby location and construction similarities suggest cultural affiliation and continuity with the Numic groups who built the prehistoric traps.

Discussion

The archaeological record of the northern Great Basin during the Terminal Prehistoric Period demonstrates radical changes relative to the previous Late Archaic Period and is thought to signal the arrival of Numic-speaking peoples who migrated from the southwestern Great Basin (see chap. 10). These changes are thought to reflect a fundamental social reorganization in which plant resource use conditioned settlement patterns, while logistical hunting was de-

Fig. 94. North Fivemile trap, Section F-G.

emphasized. Because of the emphasis on plants, Terminal Prehistoric sites are dispersed and reflect short-term occupations by small family groups in areas that were previously ignored.

Given that Numic settlements are more dispersed, smaller in size, more briefly occupied, and more oriented toward the acquisition and processing of plants and small seeds, these large, fixed, and labor-intensive hunting features present something of a conundrum. That there are four of these facilities in a relatively small area signals strongly that this Numic population was very much concerned with artiodactyl hunting, which accords with the fact that artiodactyl remains increase across the project area in the Terminal Prehistoric record relative to the preceding Late Archaic Period (see chap. 12).

Ethnographic accounts uniformly stress the participation of large groups of people, much larger than the typical Numic small family band. Due to the increased group size involved with traps, Jensen (2007) asserts that their hunting return rates were lower than with pursuit strategies, which require fewer participants. Instead, she cites the very act of social aggregation as the main benefit to trapping events. Hockett et al. (2013) reached a similar conclusion, asserting that communal

Fig. 95. Upright cut juniper trunk, historic-era trap.

gatherings required procurement of food in quantities allowed by seasonally abundant and predictable resources (e.g., pinyon nuts, pronghorn migrations, fish spawning runs). They estimate that the mass capture of between 50 and 200 pronghorn antelope could support a 14 day gathering of between seven and 10 families. Jensen (2007) stresses that the main benefit of such an event would be to provide better mating opportunities for its participants due to the large number of nonrelated people. There are, of course, other potential benefits to such a gathering, where alliances could be made or strengthened, skills learned and honed, and information and goods exchanged.

Based on projectile point associations, other trap features in northeastern Nevada contain evidence for use extending to the onset of the Late Holocene, well before the presumed Numic expansion into the region (e.g., Spruce Ridge, Spruce Pond, Liza Jane North, Valley Mountain, Hill, Spruce Knoll, and Cobre traps; Murphy and Frampton, 1986; Hockett and Murphy, 2009). This strongly suggests that pronghorn drives were the setting for communal hunting events since at least the Early Archaic Period.

The near absence of projectile points at the four prehistoric traps in this study ac-

Fig. 96. View up drainage to apex of historic-era trap.

cords with ethnographic accounts that describe the use of other weapons, such as wooden clubs, which are unlikely to leave an archaeological signature. Several other traps that have been radiocarbon dated to the Late Prehistoric Period in northeastern Nevada similarly contain few or no projectile points (e.g., Clover Valley, Currie Hills, Silverzone, and South Dry Lake traps; Jensen, 2007) as do many others that have not been radiocarbon dated (e.g., Wiseman, Spruce Well, Sprucemont, Storey, Mitzpah, and Pygmy Rabbit traps; Hockett and Murphy, 2009: 716; see also Jensen, 2007: 92). These absences may suggest that Western Shoshone hunting-tool investment in this region was not focused on projectile points but on the drives and corrals, which required relatively less skill to construct and whose construction could be carried out by all the group's members and not just skilled hunters.

CHAPTER 17

SUMMARY AND CONCLUSIONS

William Hildebrandt

The Ruby Pipeline corridor travels 360 miles across the Northern Tier of Nevada, crossing through some of the most remote, sparsely populated lands in the lower 48 states. This corridor lies far from subsistence resource concentrations associated with large stands of pinyon-juniper woodland, major waterways like the Humboldt and Snake rivers, and marshlands like those found in Warner Valley and the Humboldt Sink. Despite its remoteness, the corridor was regularly used by people who produced a dynamic archaeological record reflecting several important land-use pattern changes over the last 13,000 years.

Data recovery excavations took place at 578 sites. These efforts ranged from limited surface collections and scrapes to large-scale excavations. Chronological control of the recovered materials was made possible through the analysis of more than 2250 time-sensitive projectile points, 6650 source-specific obsidian hydration readings, 100 radiocarbon dates, and a limited amount of pottery and beads. Based on these findings, we were able to isolate 399 single-component areas within the project corridor.

These single-component areas were distributed across four regions, including the High Rock Country, Upper Lahontan Basin, Upper Humboldt Plains, and Thousand Springs Valley. By calculating the frequency of components per 1000 years of time and 1000 acres of land within each region, and determining the composition and density of artifacts within each component area, we have been able to monitor changes in human population density and land-use intensity along the project corridor, providing a unique glimpse of the prehistoric developments that took place across the Northern Tier.

Our first evidence of human occupation dates to the Paleoindian (14,500–12,800 cal B.P.) and Paleoarchaic (12,800–7800 cal B.P.) periods, when local people spent most of their time in the High Rock Country. Paleoindian findings are limited to a series of Great Basin Concave Base projectile points and small obsidian flaked stone concentrations with hydration readings linking them to this ancient interval of time. Because of the course-grained nature of these temporal indicators, chronological assignment of our Paleoindian components are rough estimates and, therefore, provide little commentary on the exact time these first colonists arrived and whether or not they predate the age of Clovis. It is also important to note that the small assemblages of flaked stone lack any evidence for the specialized blade technologies that are often linked to Clovis-age sites.

Paleoarchaic sites are much more common and tend to be represented by Great Basin Stemmed projectile points, bifaces, and a limited number of other flaked stone tools. Most of these assemblages reflect small groups of hunters refurbishing their toolkits with material obtained from the Massacre Lake/Guano Valley and Nut Mountain obsidian quarries as they traveled through the region. The worn-out tools they left behind testify to the distance of their travels, as many of these implements were made of obsidian from far-distant sources. An important exception to the specialized character of most Paleoarchaic assemblages was found at Fivemile Flat along the west end of pluvial Lake Parman, where two significant habitation sites were discovered, both dating to 11,180 cal B.P. Although lacking milling gear, they included diversified flaked stone tool assemblages that seem to reflect longer-term occupations by relatively complete social groups. This conclusion is supported by the discovery of a house floor, 4 m in diameter, at one of the sites, which is the oldest domicile ever found in the Great Basin. Unfortunately, however, subsistence remains from these sites were limited to a handful of small mammal bone fragments and a few small seeds, restricting our ability to obtain a fuller picture of the activities that took place there. While the 11,180 cal B.P. assays postdate the Younger Dryas and mark the beginning warmer-drier conditions, the presence of a tule seed in the plant macrofossil assemblage suggests that wetland habitats were still present in the local area at this time.

Despite the warm-dry conditions that characterized much of the middle Holocene, it appears that local human populations nearly doubled during the Post-Mazama Period (7800–5700 cal B.P.). Most of their activity was still concentrated in the High Rock Country, but evidence for occupation begins to trickle out into the Upper Lahontan Basin and Upper Humboldt Plains regions as well. Most of the artifact assemblages remained rather narrow, often composed of Northern Side-notched and Humboldt Concave Base points, bifaces, and debitage, and seem to reflect use of the region by mobile groups of hunters. Similar to the Paleoarchaic Period, travel distances seem to have been relatively high, judging by the presence of nonlocal obsidian types within many of the assemblages.

Major changes take place with the onset of the Early Archaic (5700–3800 cal B.P.) and continue forward into the Middle Archaic (3800–1300 cal B.P.). Early Archaic projectile points are largely represented by Humboldt and Gatecliff forms, and component counts indicate that population densities increased almost fourfold from the preceding interval. Radiocarbon dates pick up in frequency just after 4600 cal B.P., indicating that much of the population increases took place after this date and may have been triggered in part by the onset of cooler and wetter conditions at this time. Although the High Rock Country remained the focus of habitation, all four regions experienced significant human occupation for the first time.

Simultaneous to this population increase and dispersal, a full complement of site types began to emerge, with large-scale residential areas becoming significant for the first time. This trend continued forward into the Middle Archaic Period, where the relative frequency of residential sites almost doubled compared to the Early Archaic interval.

Moreover, the density of milling gear within these areas increased almost fourfold during the Middle Archaic, compounding the significance of this land-use pattern change. The more intensive, localized occupation of the corridor and adjacent areas is also evidenced by a reduction in the use of distant obsidian sources, as it appears that people became more familiar with the local area, focusing on known, high-quality sources of stone.

Consistent with the higher degree of settlement stability and differentiation, plant macrofossil assemblages became more abundant and much more diversified during the Middle Archaic, probably marking a broadening of the diet. Use of geophytes also seems to have increased, and may signal the beginnings of intensive epos (yampah) storage in the High Rock Country and adjacent regions. Finally, the Early and Middle Archaic records show an increased use of large game, probably assisted by the rise of logistical hunting organization supported by higher degrees of residential stability.

This general trajectory continued into the Late Archaic Period (1300–600 cal B.P.), but with some important exceptions. Increases in population density continued forward, as did the dispersal of people into a wider range of habitats (especially the Upper Humboldt Plains). These changes were accompanied by continued increases in the relative frequency of residential sites, but most of the latter activity occurred within the easternmost regions. In fact, while the High Rock Country still maintained the highest concentration of people, its population density surprisingly dropped compared to the Middle Archaic, particularly with regard to the abundance of residential sites, which dropped to levels below any of the other regions along the corridor.

Despite the expansion of Late Archaic residential sites in the eastern regions, the abundance of milling gear at these locations is much lower than at Middle Archaic Period sites. This change is accompanied by a slight drop in the diversity of plant macrofossils and minor increases in the use of large game. These findings may show that residential activity was widely dispersed, with people occupying smaller sites for shorter periods of time and using a narrower suite of local resources.

Population dispersion and the focus on local resource use is also documented by flaked stone material profiles at Late Archaic sites that show that locally available cryptocrystalline silicate (CCS) was used more than obsidian for the first time in prehistory. This change in raw material use is accompanied by change in lithic technology, where biface thinning is often replaced by simply converting flake blanks into finished tools through pressure flaking. Finally, while we observed a gap in the radiocarbon record corresponding to the Medieval Climatic Anomaly (MCA), it is difficult to know its full effects on population densities during critical portions of the Late Archaic interval, as many of our single-component areas were identified on the basis of Rosegate projectile points and source-specific obsidian hydration readings that lack the chronological resolution necessary for this level of analysis.

Many of the changes initiated in the Late Archaic Period reach radical proportions during the Terminal Prehistoric Period, and could correspond to the arrival of Numic-speaking populations along the corridor. Habitat preferences that made sense for more than 12,000 years are upended, with population densities highest in the Upper Humboldt Plains and Thousand Springs Valley, followed by much lower densities in the High Rock Country. Much of this reorientation could be linked to small-seeded plants that are especially abundant in Thousand Spring Valley. Although low ranked compared to many other foods, with the proper technology and work organization, they could support higher population densities than was the case earlier in time. Numic peoples practiced an adaptation that worked well in these environments, as they tended to live in smaller, dispersed family groups more reliant on small-seeded resources, with the latter made possible by the development important tools like the seed beater and triangular winnowing tray.

Most archaeologists have tended to combine Northern Paiute and Western Shoshone groups when thinking about the expansion of Numic populations, but there are actually major differences between the two. First, previous research has shown that the Western Shoshone used pottery and the Northern Paiute did not, and our data are fully consistent with this finding. In our quest to explain this strange disjunction in technology, we found that brownware pottery in the southwestern Great Basin is tightly linked to the intensification of seed use, especially with regard to their synchronous origins, co-occurrence of pots and seed-bearing habitats on the land, and food residues found within the pots themselves. Because the Northern Paiute lived in habitats that contained a greater abundance of fish, waterfowl, and geophyte resources than did the Western Shoshone, who relied more on plant resources (including small seeds), it must have made more sense for the Western Shoshone to invest in pottery than it did for the Northern Paiute.

This distinction is also fundamental in tracking differences in the expansion of peoples speaking the two languages. Given the lower subsistence productivity of the central Great Basin compared to the better watered areas in the west, and the major differences in population density that resulted (which is clearly demonstrated by the current project corridor), it stands to reason that there would have been far fewer obstacles for the Western Shoshone to overcome during their northward expansion than was the case among the Northern Paiute. This seems to have been the case, as the ratio of Desert Series to Rosegate projectile points, which is a useful way to monitor the northward movement of Numic-speaking peoples, is 2.7 times higher in Western Shoshone territory than in Northern Paiute lands along the project corridor, indicating that the Shoshone arrived at a much earlier date. This temporal difference, along with the reranking of small-seeded resources brought to the area by the Western Shoshone, no doubt contributed to the more robust Terminal Prehistoric record along the eastern half of the corridor, as key markers like Desert Series projectile points were deposited on the landscape for a longer period of time.

The focus on low-ranked small-seeded resources and their influence on the expansion of Numic populations has also been linked to a greater focus on the use of small game. In the southwestern Great Basin, for example, logistical hunting of large game in distant localities was commonplace during the Middle Archaic and part of the Late Archaic Period, but was supplanted by a small-game focus in the Terminal Prehistoric Period, presumably related to people living in smaller family groups that focused on more localized resources. While the current study shows a significant decrease in the frequency of flaked stone production activities, which could be linked to a reduction in hunting, faunal assemblages from the study corridor and adjacent areas tell a different story. These data show that the frequency of large game use continued unabated into the Terminal Prehistoric Period. This should probably not be so surprising, however, given the high frequency of large-scale animal drive features that are commonly found across Nevada, including the Terminal Prehistoric features investigated as part of this study. The fact that these features were framed with juniper tree trunks and large branches, and that they regularly measure more than 500 m across, reflects the gathering of major groups of people with the willingness to make significant investments in the pursuit of large game.

One of our most surprising findings is the explosion of distant, exotic obsidian sources found in a series of sites dating to the Terminal Prehistoric Period. Many previous studies have shown that obsidian conveyance distances reached their maximum extent during the Paleoindian and Paleoarchaic periods and declined thereafter, largely due to increased population densities that acted to reduce foraging territories and/or the size of social interaction spheres. This was largely the case here until the Terminal Prehistoric Period, when conveyance distances were much higher than at any other time in prehistory. Moreover, this exotic stone is not restricted to worn-out tools, which is usually the case during earlier intervals, but is found in both the tools and debitage, indicating that larger masses of stone were being moved distances like never before. In fact, debitage conveyance distances are 12 times greater than those found in the Paleoarchaic components and include sources like Mount Hicks, located 340 km to the south.

We think that there is a good possibility that these findings mark the introduction of the horse to the northern Great Basin. Although we lack the chronological resolution to fully confirm this hypothesis, archival research shows that the Northern Shoshone had horses by A.D. 1690 (260 cal B.P.) and traveled widely to the north and east. There are no archival records of any kind for the central Great Basin until about 135 years later. Significantly, however, the first one came from Jedediah Smith, who observed a band of northern horsemen at the south end of Walker Lake, only 20 miles from the Mount Hicks obsidian source. This account confirms that people traveled on horses to the locations documented by our findings, and we think there good reason to think that such behavior occurred deeper in the past as well. This was a dynamic time marked by significant alterations to the traditional settlement systems that came before, and our findings show how it is important to investigate the archaeological record with these developments in mind. They also emphasize how small parts of the archaeological record sometimes have the ability to tell us big stories about the past.

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