A PALEOETHNOBOTANICAL APPROACH TO 14,000 YEARS OF GREAT BASIN PREHISTORY: ASSESSING HUMAN-ENVIRONMENTAL INTERACTIONS THROUGH THE ANALYSIS OF ARCHAEOLOGICAL PLANT DATA AT TWO OREGON ROCKSHELTERS

by

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DISSERTATION APPROVAL PAGE

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DISSERTATION ABSTRACT

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Doctor of Philosophy

Department of Anthropology

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Title: A Paleoethnobotanical Approach to 14,000 years of Great Basin Prehistory:
Assessing Human-Environmental Interactions through the Analysis of
Archaeological Plant Data at Two Oregon Rockshelters

Well-preserved plant remains recovered from archaeological deposits at the Paisley Five-Mile Point Caves and Little Steamboat Point-1 Rockshelter in southcentral Oregon provided a rare opportunity to study ancient plant resources used by northern Great Basin indigenous groups and their ancestors with Western Stemmed technologies. Macrobotanical analysis of cultural features and vertical columns spanning the Terminal Pleistocene and Holocene epochs in the rockshelter repositories yielded thousands of seeds and charcoal fragments that can be attributed to human activities. Data generated in this analysis have provided evidence of paleoenvironments along with the diets and social behaviors of people visiting northern Great Basin rockshelters as a stopover on their seasonal subsistence rounds.

The preponderance of upland shrubs and herbs in the assemblages at both archaeological sites indicates vegetation in the immediate vicinity of the rockshelters was fairly stable over the past 14,000 years. The macrobotanical data complemented local and regional pollen analyses to refine the paleoecological proxy data and address uncertainties regarding the proximity of wetland plants and pine (*Pinus* sp.) to the rockshelters in the past.

Samples originating from Younger Dryas deposits at the Paisley Caves and Late Holocene deposits at the Paisley Caves and LSP-1 Rockshelter suggest increased visitation frequency in these periods. The diverse assemblage of cultural plant remains during these times also indicate a broad diet breadth for Great Basin foragers, which included small seeds, nuts and berries, and root vegetables. The presence of an earth oven feature dating to the Terminal Pleistocene/Early Holocene (TP/EH) in Paisley Cave 5 further demonstrates sophisticated traditional knowledge of plant foods and cooking techniques as early as 12,000 cal BP. This study also generated data chronicling the deep historical roots of traditionally valued economic plant foods. Cheno-ams, grasses (Poaceae), and tansymustards (*Descurainia* sp.) are well-represented in fire hearths at the Paisley Caves and LSP-1 Rockshelter through time.

Analysis of a bushytailed woodrat (*Neotoma cinerea*) nest in deposits dating to the TP/EH demonstrates rodents living in the Paisley Caves routinely scavenged resources from cultural activity areas, and raised questions about whether people recognized the woodrats' nests as a reliable resource of cached edible seeds.

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CHAPTER I

INTRODUCTION

1.1. Project Introduction

Human-environmental interactions have far-reaching, significant effects on current biogeographic conditions as well as on the manifestation of culture and the inherited landscapes of our ancestors. For this reason, archaeological inquiry necessitates investigations that consider not only the human-crafted material traces of past cultures, but also the flora and fauna associated with archaeological contexts. Archaeological studies have shed light on several issues connected to people, plants, and animals. Some studies focus on the predator-prey relationships inherent in subsistence economies (e.g., human behavioral ecology), others on the genetic manipulation of plant and animal species (e.g., the use of fire in landscape management or domestication and agriculture), and still others on inherited ecologies (e.g., the onset of the Anthropocene or cultural niche construction theory). In the Great Basin desert of western North America, archaeological plant studies in cave and rockshelter settings can illuminate a broad understanding of long-term landscape adaptations practiced by anatomically modern humans.

Knowledge acquisition pertaining to prehistoric subsistence strategies has been an overarching goal of archaeological research in the Great Basin (Cressman 1940; Cressman et al. 1942; Helzer 2001; Prouty 2004; Stenholm 2004; Wingard 2001). My dissertation research follows in the tradition of scholarly works investigating the reciprocity of human-environmental interactions in the northern Great Basin (e.g., Aikens and Jenkins 1994; Aikens et al. 1977; Grayson 2011; Helzer 2001; Jenkins et al. 2004; Sanford 1983) by identifying and analyzing macroscopic plant remains found in archaeological contexts. Building on previous research conducted in North America's arid intermountain west, this project provides an independent avenue of investigation for detecting and interpreting the role of plant exploitation in the subsistence economies of the northern Great Basin throughout the terminal Pleistocene and Holocene epochs.

The current investigation focuses on paleoethnobotanical remains from dry rockshelter sites in southcentral Oregon's northern Great Basin (Figure 1.1). Dry cave sites are especially conducive to archaeological plant studies because delicate ecofacts preserve in arid conditions. This dissertation will make key contributions to understanding hunter-gatherer subsistence patterns by providing culturally-mediated paleovegetation data for the northern Great Basin. The study of macrobotanical ecofacts is essential to understanding evolutionarily reciprocal relationships between culture and environment, even though these data are not always available due to taphonomic considerations (Gallagher 2014). Superior preservation conditions in the rockshelters examined in this research permit the study of archaeological plant macrobotanical remains. Globally, rockshelter archaeology has provided insights into notable milestones of humanity since our ancient relatives immigrated out of Africa. Cultural deposits in rockshelters have revealed the independent origins of agriculture (e.g., Jones and Liu 2009; Piperno and Flannery 2001; Zeder 2011), provided the earliest evidence of art and symbolism (e.g., Aubert et al. 2014), and illuminated aspects of early ritual behaviors (e.g., Solecki 1977).

Figure 1.1. Location of study area in western North America.

Plant materials recovered from two rockshelter sites with well-documented episodes of human residency in the northern Great Basin provide the basis for this study: the Paisley Five Mile Point Caves (Paisley Caves), located along the margin of Summer Lake in Lake County, Oregon, and Little Steamboat Point-1 Rockshelter (LSP-1 Rockshelter) in the Northern Warner Valley, Harney County, Oregon (Figure 1.2). The Paisley Caves are situated along a remnant shoreline of pluvial Lake Chewaucan and LSP-1 Rockshelter lies north of pluvial Lake Warner.

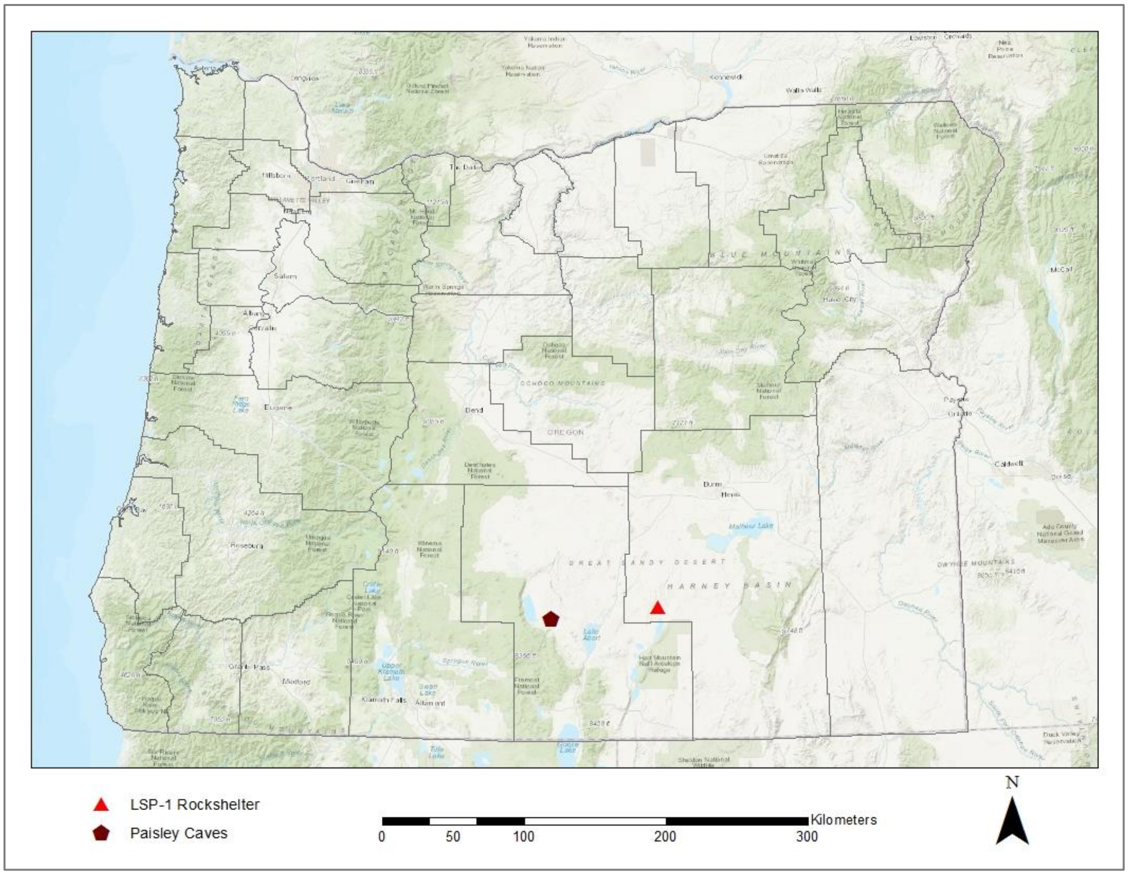


Figure 1.2. Mapped location of study sites in southcentral Oregon.

The Paisley caves were utilized as short-term campsites as early as 14,500 cal BP (Gilbert et al. 2008a, 2008b), with megafaunal remains documented as much as 14,600 cal BP (Jenkins 2007; Jenkins et al. 2012a, 2012b, 2013). The LSP-1 Rockshelter site displays evidence of intermittent human habitation beginning at 9700 cal BP. The well-defined stratigraphy of these two sites encompasses human occupations extending over the past 12,000-plus radiocarbon years. The protracted time depth of the research contributes to current knowledge of long-term cultural patterns in the Desert West, as it provides an exemplary study on human adaptation in changing climatic conditions.

The plant data are analyzed to address three lines of inquiry (see Chapter three for specific research hypotheses). The first set of questions relates to plant use among Paleoindians, the earliest hunting and gathering groups in the Americas at the boundary of the Late Pleistocene/Early Holocene and Younger Dryas periods. Presently, little is known of Paleoindian lifeways and subsistence in the Great Basin because most ancient sites occur in open settings with poor organic preservation (Smith and Kielhofer 2011). Rockshelters in the Great Basin were frequently used as temporary camp sites and thus have the potential to contain deposits reflecting the earliest traces of human culture and foraging behaviors in the Western Hemisphere.

The second set of questions considers whether cultural-environmental interactions identified in ancient times persisted into the Late Holocene and even to the non-indigenous contact period. Rockshelter utilization spans several millennia at some Oregon sites (Minor et al. 1979:7). Previous research has corroborated the premise that small bands of highly mobile foragers in the Great Basin repeatedly visited key sites (Minor et al. 1979; Jenkins et al. 2000; Smith and Kielhofer 2011), thereby amassing a diachronic record of individual site use.

Finally, I attempt to detect paleoenvironmental signatures by interpreting patterns of taxonomic diversity at each site. Recent studies have shown that rockshelter and cave deposits can be used to reconstruct local anthropogenic environments (de Porras et al. 2011). Paleoenvironmental data generated in this dissertation are evaluated in reference to regional paleoclimate data. Recently, scholars have called for a reorientation of cultural and environmental correlates in archaeological research that consider the intersectionality of multi-scalar data (Contreras 2017). By comparing the macroscopic plant remains to paleoclimate data from the northern Great Basin (e.g., Cohen et al. 2000; Davis 1985; Hansen 1947; Licciardi 2001; Minckley et al. 2007; Orme 2008), this work will evaluate variations in local plant taxa with respect to cultural practices and plant use.

This project also provides a foundation for future research that can begin to address larger landscape-scale questions related to the historical ecology of the region. The historical ecological approach provides a deeper understanding of biological and cultural evolution in its acknowledgement of the role of human agency. Using this approach, we can develop hermeneutic interpretations of hunter-gatherer lifeways in the Great Basin as they are shaped by the physical and biotic landscape.

1.2. Project Setting

1.2.1. The Physical Great Basin

During his explorations in 1844, John Fremont recognized that a vast portion of the intermountain west consists of hydrologically closed systems with interior drainage (Wharton et al. 1990; Grayson 2011; Orr and Orr 2002). He named the region the Great Basin. Although the size and extent of the Great Basin varies depending on whether it is defined hydrologically, physiographically, or floristically, the Great Basin covers hundreds of millions of acres of western North America including most of Nevada and portions of California, Idaho, Nevada, Oregon, and Utah (Grayson 2011; Figure 1.3).

Flanked by the Cascade and Sierra Nevada mountain ranges to the west, by the Columbia Plateau to the north, and on the east by the Rocky Mountains, the Basin and Range Province is a large depression characterized by north-south trending fault blocks

Figure 1.3. The Great Basin of western North America.

interspersed with wide desert valleys. Geology in the region is characterized by a mantle of Tertiary sediments and volcanic deposits stemming from the clockwise rotation of coastal mountains (Orr and Orr 2012:78-79). The thick deposits of lava and ash are underlain by Late Paleozoic and Mesozoic rock slabs. Extension, faulting, and volcanism in the Cenozoic resulted in the formation of the parallel, north-south trending uplifted fault blocks, and grabens (basins). The alternating basin and range topography is especially evident in the northern Great Basin (see Figure 1.4), which extends through Oregon east of the Cascade Range from its southern terminus northward to the Columbia

Plateau. The northern Great Basin also includes parts of western Idaho, northeastern California, and northwestern Nevada.

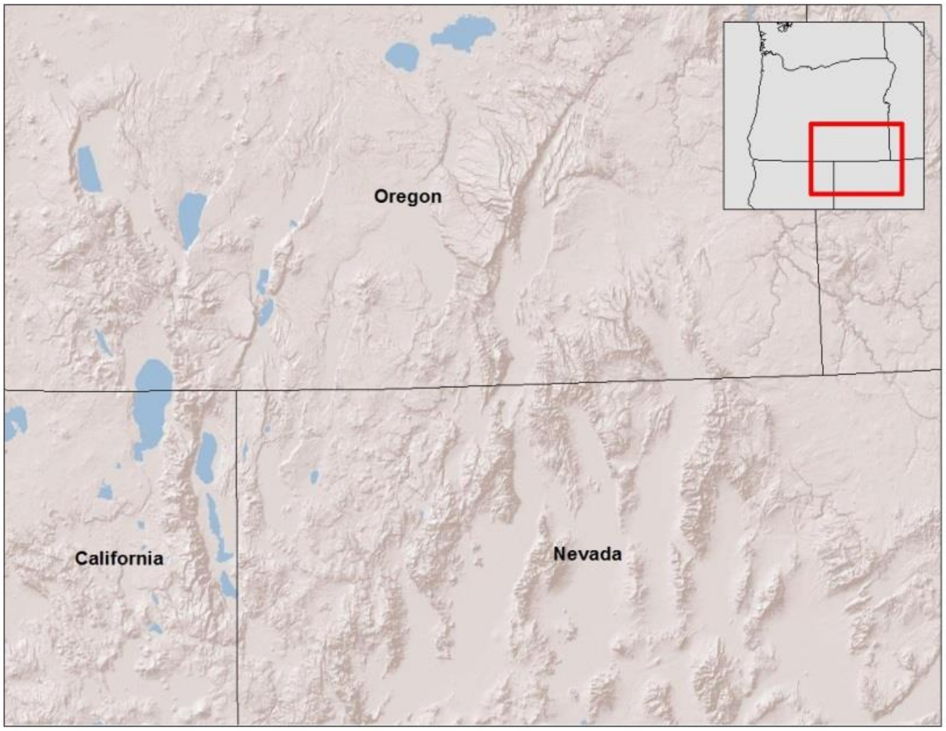


Figure 1.4. Basin and Range block faulting in the northern Great Basin, with north-south trending blocks resulting from tectonic uplift and crustal spreading accented in red box.

The hydrographic Great Basin is so defined by the fact that it is an internally-draining basin, with no outlets to the ocean. Rivers originating in the mountains terminate in the basin lakes or sinks, and the geography and nature of lakes, marshes, or playas is a function of changing rates of precipitation and evapotranspiration. Physiographic characteristics including aspect, slope, elevation, and mountain range orientation exert influence on delivery and cycling of water in the Great Basin (Dobrowolski et al. 1990; Wigand 1987). Topographic diversity affects orographic rainfall and results in several unique ecological communities across an elevation gradient (Wharton et al. 1990).

Precipitation in the northern Great Basin currently does not generally exceed 300 mm annually.

Although southcentral Oregon is currently characterized by a cool and dry climate, the relative water budgets of the lakes dictate the position of wetland ecological communities at any given time. Several of the Great Basin's mountains were glaciated during the Pleistocene. Storm tracks likely trended farther south during interglacial episodes, leading to a wetter and warmer climatic regime (Scott 1988). As deglaciation began, rainfall and mountain runoff resulted in the formation of large pluvial lakes in the basins. Lake Chewaucan and Warner Lake were among the largest during the Pliocene and Pleistocene (Figure 1.5; Meyers et al. 2015:43).

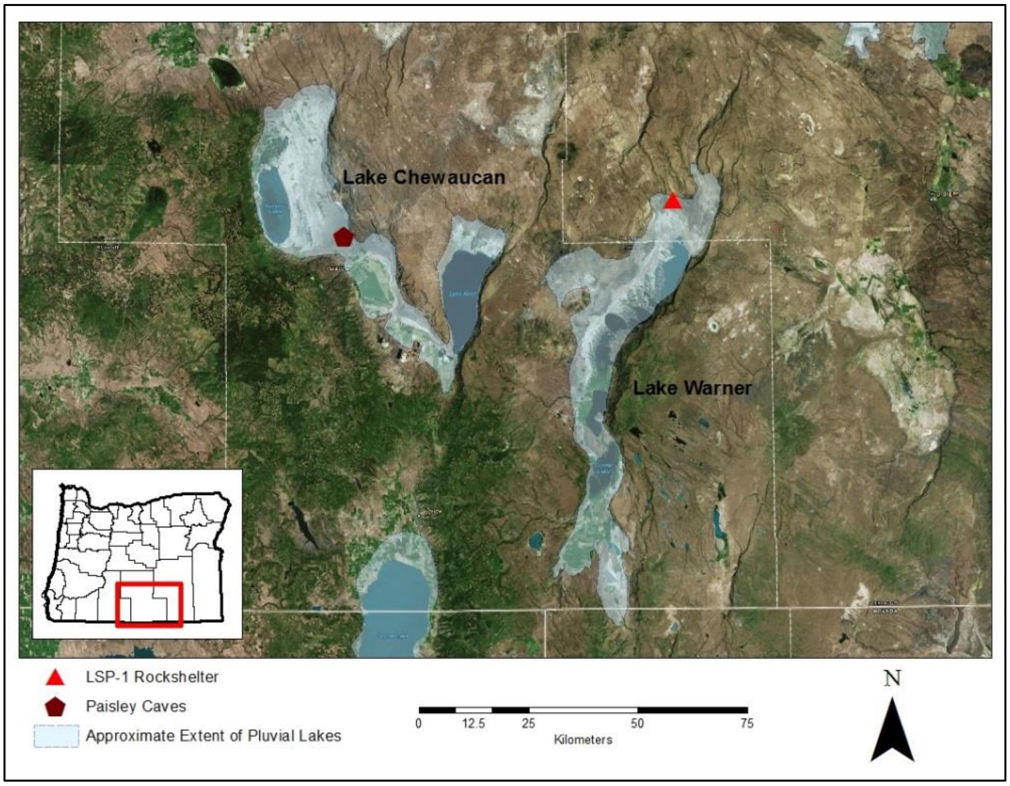


Figure 1.5. Pluvial lake extent of Lake Chewaucan and Lake Warner as mapped by Grayson (2011).

1.2.1.1. The Chewaucan Basin

Pluvial Lake Chewaucan reached depths of 114 m and covered 1243 km^2 at its high stand (Allison 1982:11). It encompassed the basins now holding Summer Lake, Upper and Lower Chewaucan Marshes, and Lake Abert (Figure 1.6; Licciardi 2001). A wide alluvial fan has been deposited by the Chewacuan River near the present-day town of Paisley. The fan featured prominently in the development of the hydrologic system in the basin during the terminal Pleistocene. Approximately 18,000 to 17,000 years ago, during the Last Glacial Maximum (LGM) when Lake Chewaucan receded, the river channel diverted to the south of the fan into Upper Chewaucan Marsh, dividing present day Summer Lake (pluvial Winter Lake) from Lake Chewaucan (Friedel 1993, 2001). During the period between 13,850 and 11,000 cal BP, higher lake levels overflowed the sub-basin threshholds before receding again (Friedel 1993, 2001; Licciardi 2001). Today the Chewaucan River drains 1606 km^2 in the basin (Orr and Orr 2012: 78).

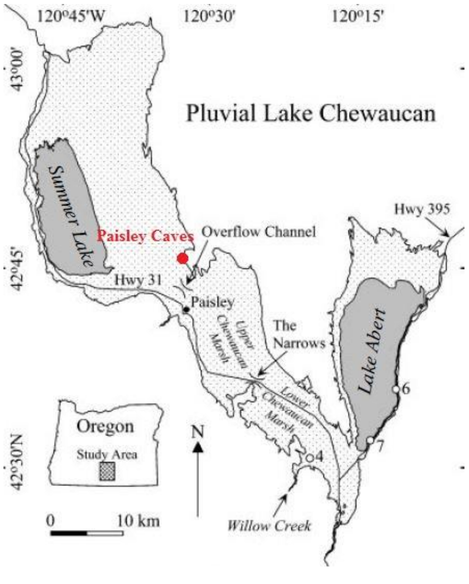


Figure 1.6. Pluvial Lake Chewaucan's extent (stippled fill) in relation to the Paisley Caves and modern day lake and marsh locations (Licciardi 2001:546).

1.2.1.2. The Warner Valley

The Warner Valley consists of a series of eight shallow lakes surrounded by tilted blocks of Tertiary volcanics (Figure 1.7). These lakes represent remnant portions of pluvial Lake Warner. Runoff from the Warner Mountains to the west provides water to the valley. To the east, Hart Mountain rises abruptly. The west-facing fault scarps have caused an eastward displacement of the long axis of the valley (Weide 1974:6).

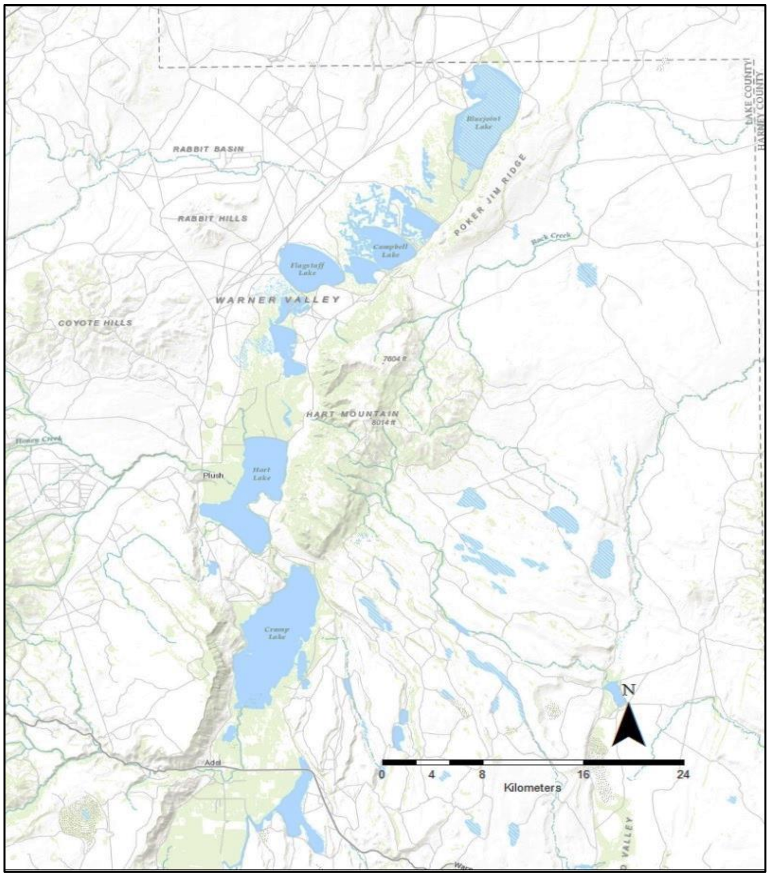


Figure 1.7. The Warner Valley, southcentral Oregon.

Elevations in the Warner Valley range from 1359 m AMSL on the valley floor to 2453 m AMSL on Hart Mountain. During the LGM, pluvial Lake Warner reached depths of 93 m (1466 m AMSL; Weide 1974:69). It receded from this high stand around 17,000 cal BP, continuing to decline throughout the terminal Pleistocene and early Holocene. At nearby Hart Lake and at Crump Lake in the southern Warner Valley, near modern paludal conditions prevailed before ca. 7700 cal BP (Smith et al. 2014:363).

1.2.2. Flora and Fauna

Today, the northern Great Basin is characterized by high-desert adapted species of grasses and shrubs dependent on precipitation and soil moisture (Franklin and Dyrness 1988). Native vegetation varies from bluegrasses, sedges, and rushes on drier areas to cattails and bulrushes around pond margins (some of which were constructed and maintained for wildlife management). Natural stands of western juniper (*Juniperus occidentalis*) are associated with rocky or very stony uplands, lava flows, and ridges where understory vegetation is insufficient to help create crown fires during burns (Anderson et al. 1998).

The project area lies in the Shrub-Steppe vegetation zone (Franklin and Dyrness 1988). The Shrub-Steppe environment contains several opportunistic species that respond to increases in precipitation through rapid vegetative growth and pollen and seed production (Wigand and Rhode 2002:311). Steep topographic gradients in the Great Basin permit plant taxa to relocate to higher or lower elevations to adjust to changing climate conditions with relatively little longitudinal movement.

The region is dominated by sagebrush (*Artemisia* sp.) and grass species including bluebunch wheatgrass (*Pseudoroegneria spicata*) in nearly every vegetational mosaic (Franklin and Dyrness 1988:234; Meyers et al. 2015:27). Several varieties of shrubs, including big sagebrush (*A. tridentata*), rabbitbrush (*Ericameria nauseosa*), and greasewood (*Sarcobatus vermiculatus*) are intermixed with grass taxa including Sandberg bluegrass (*Poa secunda*), Idaho fescue (*Festuca idahoensis*), Great Basin wildrye (*Leymus cinereus*) and squirreltail grass (*E. elymoides*). Western junipers are found on rocky outcrops, escarpments, and mesic northerly slopes (Franklin and Dyrness 1988:247).

The Summer Lake Basin lies on the boundary of the eastern Cascade pine woodlands and the sagebrush steppe. Associations of *Artemisia tridentata-Ericameria nauseosa-Festuca idahoensis* are very common in the lowlands (Franklin and Dyrness 1988:238). In the Warner Valley, desiccated lakebeds encourage the growth of salt desert shrubs including saltbush (*Atriplex spinescens* and *A. canescens*), shadscale (*A. confertifolia*), and spiny hopsage (*Grayia spinosa*), intermixed with the sagebrush and native grasses like Indian ricegrass (*Achnatherum hymenoides*), desert saltgrass (*Distichilis spicata*), and Sandberg bluegrass (*P. secunda*) (Meyers et al. 2015:43). Above the mid-elevations, increased moisture creates habitat for open ponderosa pine (*Pinus ponderosa*) and lodgepole pine (*P. contorta*) woodlands. Quaking aspen (*Populus tremuloides*) and mountain mahogany (*Cercocarpus ledifolius*) communities are located in the ecotone between upper elevation pine forests and lower elevation sagebrush zones (Franklin and Dyrness 1988:243).

Within the seasonally rejuvenated marshes, biotic productivity maintains refugia for several wet-adapted plant, bird, and fish taxa. Cattails (*Typha latifolia*), tules (*Schoenoplectus* spp.), rushes (*Juncus* spp.), sedges (*Carex* spp.), and grasses including wildrye (*Leymus triticoides*) and tufted hairgrass (*Deschampsia cespitosa*) proliferate in and around perennial paludal environments (Meyers et al. 2015:43). The shallow waters of remnant lakes attract ducks and geese (Anatidae), coots (*Fulica americana*), and other waterfowl. In years with wetland system overflow, populations of tui chubs (*Gila bicolor*) and suckers (Cyprinidae) can increase dramatically (Greenspan 1994).

Away from the wetlands, the northern Great Basin environment supports diverse species of mammals in the Arid Transition Life Zone (Bailey 1936:23). Verts and Carraway (1998:31) discuss 87 native mammalian species and identify eight that characterize the Basin and Range Province. These include Merriam's shrew (*Sorex merriami*), Preble's shrew (*S. prebei*), white-tailed antelope squirrel (*Ammospermophilus leucursus*), dark kangaroo mouse (*Microdipodops megacephalus*), California kangaroo rat (*Dipodomys californicus*), chisel-toothed kangaroo rat (*D. microps*), canyon mouse (*Peromyscus crinitus*), and desert woodrat (*Neotoma lepida*). Black-tailed jackrabbits (*Lepus californicus*) and cottontails (*Sylvilagus* spp.) are endemic, and mule deer (*Odocoileus hemionus*), bighorn mountain sheep (*Ovis canadensis*), and pronghorn (*Antillocapra americana*) are the most prevalent large game animals in the region.

Due to its heterogeneous topography, several researchers have proposed that the uplands in the Great Basin ecosystem strongly resemble a montane island (Brown 1971; Grayson and Livingston 1993; Lomolino and Davis 1997; Wells 1983). It is generally accepted that past climate change has affected the diversity of species in the area, as well as habitat fragmentation, and dispersal rates. Others have argued for tectonic activity as a biogeographic control (Davis 2005).

South central Oregon has been affected by land management practices implemented since the time of Euro-American settlement. Land use changes, marsh drainage, fire suppression, and non-native species invasion have altered local landscapes dramatically over the past few centuries (Franklin and Dyrness 1988:210). A large percentage of land cover has been converted for agriculture and grazing. Cattle ranching in the area began in the 1860s and remained virtually uncontrolled in the mountains until 1897, and on lower elevation public lands until 1934 (Wagner 2003).

1.3. Ethnographic Record

At the time of Euro-American contact, the Great Basin was home to tens of thousands of people (Leland 1986). Both study sites are situated in liminal zones with fluid territoriality reported by early ethnographers. The Northern Paiute, Klamath, and Modoc lived, with fluctuating boundaries, along the western margin of the northern Great Basin (Figure 1.8). Bands of Northern Paiute occupied most of the northern Great Basin, including Warner Valley, and the Klamath and Modoc territories were primarily focused on the marshes associated with the Klamath River and its tributaries on the southern Columbia Plateau and in northern California (Colville 1897; Gatschet 1891; Powers 1877; Ray 1963; Spier 1930; Stern 1966). Boundaries between the groups fluctuated, and treaty documents show neutral resource procurement areas and travel corridors north of Goose Lake (Wheeler Voegelin 1955). Archaeological data suggest the Klamath and Modoc may have had more pronounced geographic presence in earlier times (Connolly and Jenkins 1997; Oetting 1989).

The Surprise Valley Paiute’s range extended northward from California into Oregon’s Warner Valley and Warner Mountains at contact (Kelly 1932:72, 76). The Chewaucan Basin is located within a 22 million acre territory ceded by the Klamath,

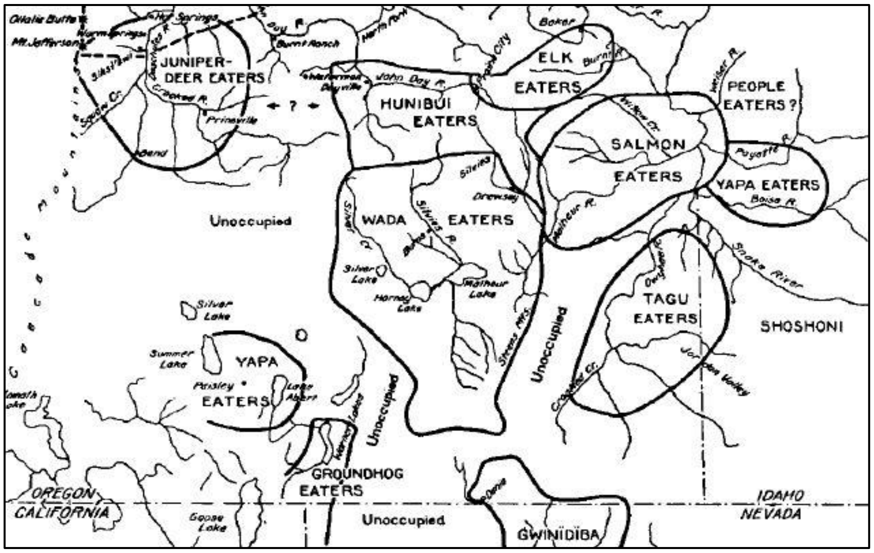


Figure 1.8. Historic tribal distribution in southern and eastern Oregon as depicted by Ray (1938:396).

Modoc, and Yahuskin, or *Göyatoka* (crawfish eaters,) as per the 1864 Klamath Treaty. Historically, the Northern Paiute Yahuskin group lived in a 5000 mile area between the eastern Klamath Basin and the margin of the northwestern Great Basin. Conflicting ethnographic accounts identify the Yahuskin as Northern Paiute (Wheeler Voegelin 1955), or a shared name for Northern Paiute from Silver-Summer-Abert lake region bands with affinal ties to upland Klamath village groups (Stern 1966). According to Kelly's (1932) Paiute informants, "*Göyatoka*" was a post-reservation era designation; people living in the vicinity of Summer Lake and Silver Lake were traditionally known as *Dühü'teyatika* (deer eaters), and Ray (1938) indicates people living around Paisley were known as *Yapa'tika* (epos, yampa (*Perideridia oregana*)) eaters. Other ethnographers also reported the Yahuskin name was a historically recent designation rather than an ancient one (Gatschet 1891; Stewart 1939).

1.3.1. Klamath and Modoc

Strong linguistic and cultural similarities exist between the Klamath and Modoc. Both groups speak a Penutian dialect, and share similar political organization. Settlement and subsistence varied between the two groups; the Klamath relied more heavily on fish and wokas (*Nuphar* sp.), and were therefore tied to the lakes and marshes, while the Modocs relied more on seeds and roots (Kroeber 1925). It is likely that the divergence of the two groups was relatively recent (Stern 1966:4). Traditionally, Klamath dwellings centered on Upper Klamath Lake and Klamath Marsh, and the Modoc traditionally resided on Lower Klamath Lake in the Lost River Valley (Figure 1.9).

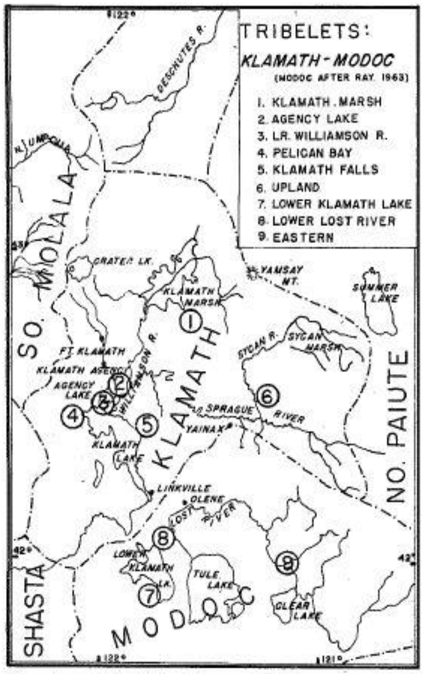


Figure 1.9. Historic tribal distribution in southern Oregon and northern California as depicted by Stern (1966:280).

Typically, winters were spent in permanent house pit villages near lakes, rivers, and marshes (Stern 1966). Winter earth lodges faced the east, and consisted of semisubterranean circular pits ranging in diameter from 12 to 35 ft. Central posts and split log beams were covered with layers of matting, grass, and dirt. An opening in the top of the house provided both an entrance and a smoke hole for the central fire hearth (Stern 1966:7). As winter snows subsided, the winter village was deconstructed and people moved to the surrounding valleys to fish suckers in the early spring (Ray 1963; Stern 1966).

Plants with nutritious underground storage organs, especially epos, were important dietary staples (Colville 1897; Ray 1963). After the spring fish run ended, semi-permanent villages were established in the root digging grounds located near streams and wetlands to fish trout and gather waterfowl eggs. Throughout the year, villages were relocated based on resource availability (Figure 1.10).

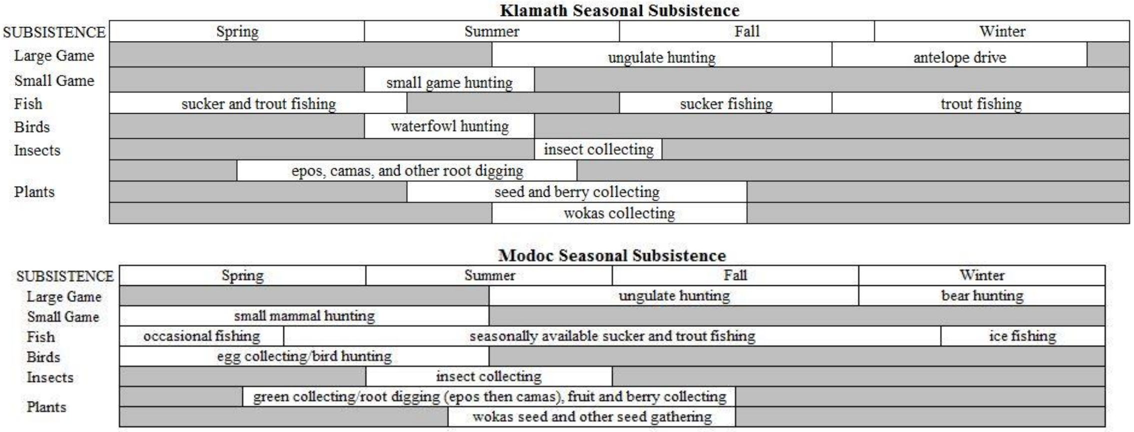


Figure 1.10. Subsistence rounds of the Klamath (top) and Modoc (bottom), after Masten (1985:316) and Eiselt (1997:22).

The months of June and July were spent harvesting camas, while the fall months saw the ripening of nutritious seeds (e.g., wokas). Fall fish runs were also accompanied by the hunting season, which persisted through December. In late fall, groups would return to the winter villages they had left behind months before, and houses were reconstructed, mainly using the materials they had carefully dismantled and stored the prior year.

1.3.2. Northern Paiute

Northern Paiute groups in Oregon shared several cultural attributes, but were geographically, socially, and ecologically distinct from one another (Steward 1933, 1938; Train 1941). Most Northern Paiute groups were organized into simple, egalitarian, and bilateral nuclear families (Fowler and Liljeblad 1986; Steward 1955; Stewart 1939). Small, self-sustained family groups formed the basis of political and socioeconomic units, although membership in the unit was relatively fluid. Groups were organized loosely into foraging districts named for food types. While the aforementioned *Göyatoka* hunted, gathered, and fished in and around the Summer Lake basin (Stewart 1939), the *Kidütöka* or *Gidi'tika* (groundhog eaters) historically occupied the Warner Valley in the vicinity of LSP-1 Rockshelter (Figure 1.11; Kelly 1932).

Among the Northern Paiute, these designations were largely bestowed by neighboring people rather than representing self-identifying monikers and no formal leaders led the foraging districts. Membership in each district varied annually depending on availability and predictability of food resources, with individuals and family units shifting affiliation between districts. Accordingly, band sizes varied and territorial boundaries remained flexible (Fowler 1982; Fowler and Liljeblad 1986:437; Whiting 1950:19).

Winter camps represented the most sedentary, longest recurring, and frequently renovated settlements. Winter encampments were present near the modern towns of

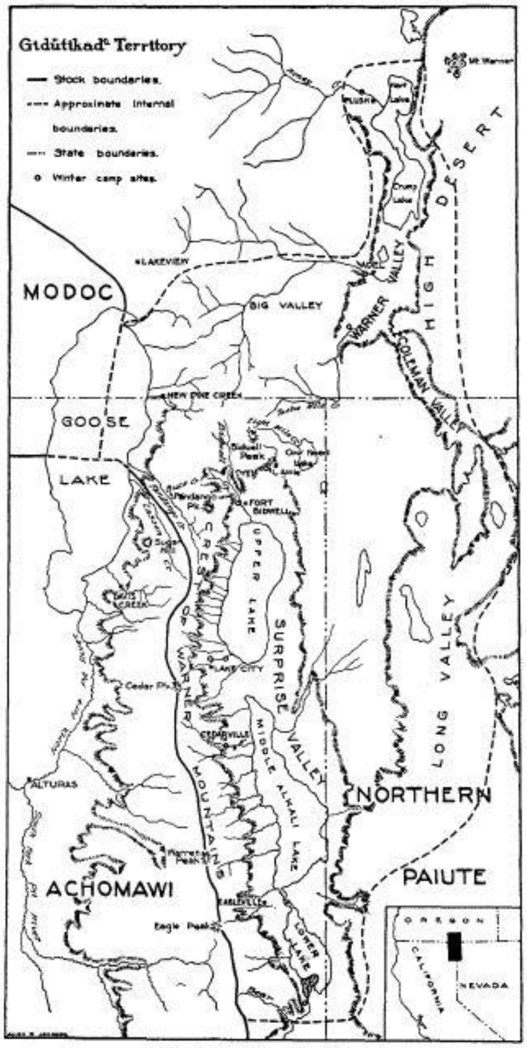
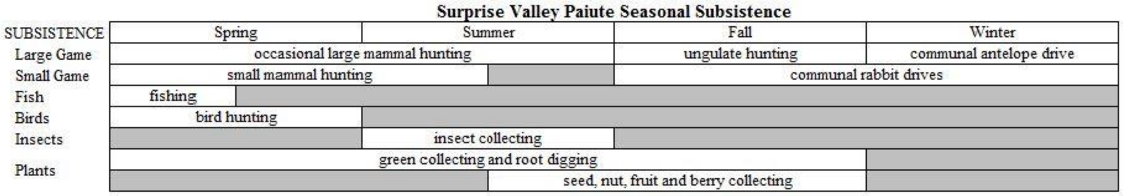


Figure 1.11. *Gidi'tika* territory as illustrated by Kelly (1932:71).

Plush, Adel, and Cedarville during the historic period, and various locations along the base of the Warner Mountains (Kelly 1932). Generally, camps consisted of one or two families, but camp size and composition varied depending on the supply of stored foods and availability of locally collectible resources (Steward 1938). Houses, or wikiups, had circular floors and a conical roof constructed of bark, grass, brush, and woven mats (Lowie 1909). Winter camps were occupied through the early spring, when roots, bulbs, and tubers were available for harvest on stony slopes and across the tops of rocky buttes (Fowler 1982:122, 133). The most important and abundant carbohydrate-rich roots included biscuitroot (*Lomatium* spp.), camas (*Camassia quamash*), yampah, bitterroot (*Lewisia rediviva*), wild onion (*Allium* spp.), and sego lilies (*Calochortus nuttallii*).

Seasonal movements were frequent and flexible. Availability of spring roots, late summer seeds, and summer and winter game dictated the pattern of seasonal rounds; fish, berries, greens, nuts, and crickets added variety to the Northern Paiute diet (Figure 1.12; Couture et al. 1986; Masten 1985). In the late summer, seeds were intensively harvested in the lower elevations. Chenopods (*Chenopodium* sp.), Indian ricegrass, Great Basin wild rye, saltbush, and waada (*Suaeda depressa*) seeds constituted dietary staples (Couture 1978).



Surprise Valley Paiute Seasonal Subsistence

<table>
<tr><th>SUBSISTENCE</th><th colspan="2">Spring</th><th colspan="2">Summer</th><th colspan="2">Fall</th><th colspan="2">Winter</th></tr>
<tr><td>Large Game</td><td colspan="4">occasional large mammal hunting</td><td colspan="2">ungulate hunting</td><td colspan="2">communal antelope drive</td></tr>
<tr><td>Small Game</td><td colspan="3">small mammal hunting</td><td>▨</td><td colspan="4">communal rabbit drives</td></tr>
<tr><td>Fish</td><td>fishing</td><td colspan="7">▨</td></tr>
<tr><td>Birds</td><td colspan="2">bird hunting</td><td colspan="6">▨</td></tr>
<tr><td>Insects</td><td colspan="2">▨</td><td colspan="2">insect collecting</td><td colspan="4">▨</td></tr>
<tr><td rowspan="2">Plants</td><td colspan="6">green collecting and root digging</td><td colspan="2">▨</td></tr>
<tr><td colspan="3">▨</td><td colspan="3">seed, nut, fruit and berry collecting</td><td colspan="2">▨</td></tr>
</table>

Figure 1.12. Subsistence rounds of the Surprise Valley Paiute, after Masten (1985:316).

Paiute language is a division of the Numic (Plateau-Shoshonean) language family. Northern Paiute languages include Bannock, Mono, and Paviotso. The rapid expansion of Numic-speaking peoples from their homeland in California into the Great Basin about 1000 years ago also may be of interest in the discussion of mobility and sedentism, though the uncertainty of the magnitude and timing of this migration is still debated (e.g., Aikens and Witherspoon 1986; Bettinger and Baumhoff 1982; Eiselt 2011; Madsen and Rhode 1994).

1.3.3. Ethnobotany of the Warner Valley and Chewaucan Basin

In the project area, both the tribal territories and use of economically important resources overlapped historically (Barrett 1910; Colville 1897; Fowler and Liljeblad 1986; Gatschet 1891; Kelly 1932; Ray 1938, 1963; Spier 1930; Stern 1966, 1998; Stewart 1939). Paleoethnobotanist Guy Prouty (1995) compiled a list of locally available food plants consumed by the Klamath, Modoc, and Surprise Valley Paiute tribal members (Prouty 2000:286-287). A summary of these plant types demonstrate not only the culturally-shared plant foods, but the broad spectrum of taxa targeted for resource acquisition (Table 1.1).

Table 1.1. Ethnographicaly reported plant foods for Northern Great Basin Native groups (after Prouty 2000: Table 16.1).

Taxon (Common Name)	Klamath and Modoc	Surprise Valley Paiute
Fruits		
Amelanchier alnifolia (serviceberry)	X	X
Arctostaphylos patula (manzanita)	X	
Crataegus douglasii (hawthorn)		X
Fragaria virginiana (western strawberry)	X	X
Juniperus occidentalis (western juniper)	X	X
Prunus emarginata (bittercherry)	X	
Prunus subcordata (Klamath plum)	X	X
Prunus virginiana (chokecherry)	X	X
Ribes aureum (golden currant)	X	X
Ribes cereum (squaw currant)	X	X
Rosa woodsii (rosehips)	X	X
Rubus spp. (blackberry)	X	X
Shepherdia argentea (buffaloberry)		X
Vaccinium membranaceum (mountain huckleberry)	X	X

Table 1.1. Continued.

Taxon (Common Name)	Klamath and Modoc	Surprise Valley Paiute
Roots/Tubers		
Allium spp. (wild onions)		X
Balsamorhiza terebinthacea (balsamroot)		X
Calochortus macrocarpus (sego lily)	X	
Camassia quamash (camas)	X	
Lewisia rediviva (bitterroot)		X
Lomatium canbyi (canby's biscuitroot)	X	
Lomatium leptocarpum (bicolor biscuitroot)		X
Lomatium macrocarpum (large fruited biscuitroot)		X
Perideridia spp. (epos, yampah)	X	
Sagittaria latifolia (wapato)	X	
Scirpus spp. (bulrush, tule)	X	
Typha latifolia (cattail)	X	
Seeds		
Achnatherum hymenoides (Indian ricegrass)		X
Agrostis exorata (spike bent grass)	X	
Amaranthus spp. (amaranth)	X	
Atriplex spp. (saltbush)	X	X
Balsamorhiza sagittata (balsamroot)	X	X
Carex spp. (sedge)	X	
Chenopodium spp. (goosefoot)	X	X
Descurainia sp. (tansy mustard)	X	X
Elymus elymoides (squirreltail grass)		X
Eriogonum spp. (buckwheat)	X	X
Glyceria occidentalis (manna grass)	X	X
Helianthus cusickii (sunflower)	X	X
Leymus cinereus (Great Basin wildrye)	X	X
Lomatium canbyi (canby's biscuitroot)	X	X
Mentzelia albicaulis (blazing star)	X	X
Nuphar polysepalum (water lily, wokas)	X	
Pinus ponderosa (ponderosa pine)	X	X
Poa nevadensis (Nevada bluegrass)		X
Polygonum douglasii (knotweed)	X	X
Suaeda depressa (waada)	X	X
Typha latifolia (cattail)	X	
Wyethia amplexicaulis (mule-ears)	X	X

The intimate tie between people with subsistence economies and the landscapes they inhabit affects all aspects culture. In this study, I draw on environmental and ethnographic data to inform and support the original archaeobotanical data.

1.4. Dissertation Outline

This dissertation is organized into ten chapters. Chapter II situates regional cultural chronologies and historical trajectories of economic plant use in southcentral Oregon within a broad context of western North American archaeology and paleoecology. Chapter III presents the theoretical framework of this study, focusing on current discourse of cultural ecology and paleoethnobotany as they relate to specific research questions. Chapter IV enumerates the materials employed to address questions and hypotheses. Chapter V outlines the methods used in this study. Chapter VI provides a list of species identified in the macrobotanical assemblage and describes ecological characteristics for each taxon. Chapters VII and VIII report the results of the macrobotanical analyses at Paisley Caves and LSP-1 Rockshelter and discuss interpretations based on intrasite analysis at each site. Chapter IX provides cultural interpretations of this dissertation's original data within the context of regional paleoclimate data and archaeological data. The final chapter addresses concluding arguments on findings and future research directions.

CHAPTER II

RESEARCH HISTORY

The timespan covered in this research project necessitates a broad understanding of archaeological findings and global climate oscillations over many millennia. This chapter serves as a literature review of the current scholarship of anatomically modern human dispersals into the western hemisphere, colonization of the western North American landscape, trajectories of cultural change in the Great Basin over the past 14,000 years, previous Great Basin paleoethnobotanical studies, and known paleoclimate data for the northern Great Basin.

2.1. Peopling of North America

The colonization of the western hemisphere reflects a large-scale continental migration, and archaeologists are eager to uncover traces of America’s first settlers while distinguishing and identifying their dispersal routes. The dominant explanatory paradigm of the 20th century held that Paleoindian groups with Clovis stone toolkits entered America through an ice-free corridor sometime after the Last Glacial Maximum (LGM). Even before any Late Pleistocene sites were identified in the Americas, archaeologists expected to find them. When such an occupation was found in Clovis, New Mexico, in the early 20th century, the large bifaces associated with megafaunal remains fit the picture of what archaeologists thought ice-aged-tool kits should resemble. Haynes (1969) suggested the originators of Clovis toolkits charted a mid-continental migration route through Canada and onto the United States Plains following Late Pleistocene mammoths and mastodons in a rapid colonization event. The term “Clovis-First” suggests Clovis peoples were the first to colonize large areas of the continent (Waguespack 2007:72).

Clovis tools have been identified through most of southern Canada, the continental United States, Mexico, and northern South America in varied settings from arctic tundra to the lowland tropics (Bradley et al. 2010; Ives et al. 2013). The rapid transmission of Clovis fluted point technology between either 13,400 and 12,700 cal BP (Ferring 2001; Haynes 2015; Sanchez et al. 2014) or between 12,900 to 12,600 cal BP (Waters and Stafford 2007) led researchers to believe that Clovis hunters populated an empty landscape after the last Ice Age. Alaska’s Nenana tool complex was proposed as a potential precursor to Clovis fluted point technology (Powers and Hoffecker 1989). The story of Clovis hunters spreading rapidly through the landscape as they followed big game from the Siberian tundra south through the Americas was a widely accepted theory for several decades (Hamilton and Buchanan 2007).

Alternatively, Fladmark (1979) proposed that people colonized America via a coastal migration route provided by a chain of sea-level refugia during, or shortly after, the LGM. Archaeologists have now embraced the explanation that the first colonists followed marine resources, namely a productive kelp ecosystem, along the Pacific Rim and coast of Alaska 16,000 to 15,000 years ago to colonize the Americas from the west coast (Erlandson et al. 2007). Isotopic analysis of human bones at On Your Knees Cave in Alaska confirmed that the individual (*Shuká Kaa*) subsisted off a diet extremely high in marine resources by 10,200 cal BP, suggesting that people living in the Pacific Northwest were well-adapted to marine environments by the end of the Pleistocene

(Dixon 2012). Although a coastal migration as at least part of the initial colonization of the Americas has been disputed for years (see Easton 1992), it is currently supported by a majority of Paleoindian scholars (Wheat 2012). This, in large part, is due to mounting paleoclimate and archaeological evidence revealing human presence on the landscape prior to a time when the Ice Free Corridor was accessible (Clague et al. 2004; Clark et al. 2009; Hoffecker et al. 2016; Misarti et al. 2012; Pedersen et al. 2016). The presence of mixed marine-terrestrial fauna here could have supported people along the coastline when uninhabitable conditions prevailed inland. Glacial refugia appeared along the coast of British Columbia as early as 17,000 cal BP (Misarti et al. 2012), and new, yet unvetted, archaeological research may indicate the presence of a 14,000 year old hearth in association with stone tools on Triquet Island, British Columbia (Wade 2017).

2.1.1. Western Stemmed Tradition

Mounting evidence supports the idea that people were in the Americas as early as 15,500 cal BP (Dillehay et al. 2008; Gilbert et al. 2008a; Halligan et al. 2016). Although rare, archaeological sites located south of the Cordilleran ice sheet that predate the Clovis horizon have been identified. The Debra L. Friedkin site (Texas), Huaca Prieta (Peru, South America), Manis Mastodon (Washington), Monte Verde (Chile, South America), Page-Ladson (Florida), and Paisley Caves (Oregon) all are widely accepted as representative of hunting and gathering groups in the Americas prior to 13,400 cal BP (Figure 2.1; Dillehay 1997; Dillehay et al. 2008, 2015, 2017; Gilbert et al. 2008a, 2008b; Halligan et al. 2016; Waters et al. 2011a, 2011b). At these sites, archaeologists have demonstrated secure stratigraphic associations between lithic tools and extinct mammal remains dating earlier than 12,900 cal BP.

Figure 2.1. Map of well-established pre-Clovis sites in the Americas.

Often, early sites contain Western Stemmed point technologies rather than fluted points (Davis and Schweger 2004; Davis et al. 2014; Dillehay et al. 2008, 2017; Erlandson et al. 2011; Goebel et al. 2010; Haynes 2015; Jenkins et al. 2012a, 2013, 2016, 2017; Waters et al. 2011a) indicating the Western Stemmed tradition may have greater antiquity than the Clovis tradition in Western North America (Beck and Jones 2010, 2012; Davis et al. 2012). As opposed to the ubiquitous nature of Clovis, Western Stemmed points appear to have restricted distribution in western North and South America. They differ significantly from Clovis morphologically. Typically, Western Stemmed points are large lanceolate tools with proximal stems and weak shoulders that differentiate the base from the blade (Beck and Jones 2010). In the far western United States, Western Stemmed points were first associated with the Western Pluvial Lakes Tradition (WPLT), a term originally coined by Stephen Bedwell (1973) who noted the occurrence of these points around pluvial lakes and marshes. The WPLT concept has since been reconfigured as the Western Stemmed Tradition (WST) to avoid biases related to ecological conditions. The WST persists until ca. 9000 to 8500 cal BP (Willig and Aikens 1988).

2.1.2. Coastal Migration and Archaeological Antecedents

If the earliest colonists of North America did travel along a coastal corridor, then an existing cultural antecedent should be traceable to the northern maritime regions of the Far East rather than the Siberian interior. Hoffecker et al. (2016) demonstrated that Beringia was populated prior to 30,000 cal BP in the same colonization wave that populated Eurasia. Powers and Hoffecker (1989:284-5) speculated that “the deterioration of Pleniglacial environments after 15 ka triggered a complex series of population movements and technological changes in northeast Asia that affected central Siberia, Japan, Beringia, and ultimately the entire New World.” Stemmed points found at Ushki-1 on the Kamchatka Peninsula between the Sea of Okhotsk and the Pacific Ocean prompted Russian archaeologist N.N. Dikov (1993:30) to speculate that Ushki culture represented a potential source for the first archaeological complexes in western North America. Although the AMS dates associated with the stemmed points at Ushki-1 were later reassigned to 13,000 cal BP (Goebel et al. 2010), their presence in Eastern Siberia does intimate a connection between the two geographic regions.

Erlandson and Braje (2011:34; 2012) considered the implications of a greater Pacific Rim interaction sphere based on the similarity of stemmed and leaf-shaped bifaces present in Late Pleistocene technological traditions from Japan, Kamchatka (Siberia), the Pacific Northwest, California, and South America. A strong cultural presence is suspected in the Sea of Japan prior to population dispersals to the Americas. Aikens et al. (2009) referred to this distinctive ecological and cultural interaction sphere as the “Japan Sea Oikumene.” They reported a lithic technology incorporating blade and elongate flake production, microblades, and bifacial blades and points. The large blades, elongate flakes, and leaf-shaped bifaces appear ca. 24,000 to 20,000 cal BP (Aikens et al. 2009:238). Stemmed (tanged) points have been identified in Northeastern Asia and Japan as early as 15,500 cal BP (Nagai 2007). Whether direct antecedents to the first inhabitants of the Americas can be identified in the Sea of Japan region still remains to be determined (Aikens et al. 2009).

2.2. Glacial Environments in North America

A suite of paleoclimate data exist from sediment records, speleothems, ice cores, loess records and the relative quantities of ice-rafted detritus present in marine sediment cores (Bartlein et al. 2011). Germane to the current project, the Wisconsin Glacial stage

(75 ka to 11,000 cal BP) is typically divided into three sub-stages: Early, Middle, and Late which correspond to marine isotope stages 4, 3, and 2 respectively. Massive ice sheets, the Laurentide and the Cordilleran, covered North America during the Wisconsin and influenced rapid and large climate changes in the Northern Hemisphere (Hemmings 2004). Glaciation periods in the Early Wisconsin and Late Wisconsin were interspersed by the Middle Wisconsin interglacial (65 ka to 29 ka; Clague et al. 2004). The marine oxygen isotope ($\delta^{18}O$) record of temperature change reveals repeated rapid cycles of climate change – Dansgaard-Oeschger (D-O) cycles – during the Middle and Late Wisconsin that are indicative of large-scale ocean-atmosphere coupling (Benson et al. 2003; Brigham-Grette et al. 2004).

Growth and decay of ice sheets and associated terrestrial isostatic rebound caused sea levels to rise and fall rapidly during this period, which resulted in the repeated submergence of portions of the continent near the ice sheets (Brigham-Grette et al. 2004; Clague et al. 2004). These records correlate with abrupt Heinrich warm/cold events resulting from massive discharge of Laurentide icebergs. Heinrich cold events, or glacial maximums, are recorded at 65 ka, 45 ka, 38ka, 30 ka, and 21 ka. Bassis et al. (2017) hypothesize that massive glacial discharge occurred in response to subsurface ocean warming, thereby initiating isostatic rebound that quickly triggered Heinrich events during D-O cycles when large scale ice shelves were minimized. The implication of these paleo-oceanographic findings for the terrestrial climate of the western United States is not known.

2.3. Northern Great Basin Climate and Cultures after the LGM

Prior to the advent of absolute radiocarbon dating methods, Antevs compiled a Holocene chronology of Great Basin climate regimes based on pioneering palynologist Henry Hansen’s volcanic ash correlations and published Finno-Swedish climate sequences (referenced in Madsen 2002; Wigand and Rhode 2002). Antevs (1955) inferred a cold and wet environment during the LGM followed by the Anathermal Period (11,000 to 8000 cal BP), represented by rising temperatures in the Early Holocene. In the Middle Holocene Altithermal Period (8000 to 5000 cal BP), climate was marked by increased aridity and rising temperatures, which he interpreted as a period of “abandonment” in the Great Basin (Antevs 1948). Finally, during the Late Holocene, mean annual temperatures stabilized at near current conditions in the Medithermal Period (5000 cal BP to present). In the northern Great Basin, pollen cores extracted from numerous study sites chronicle regional vegetation change spanning the last 10,000 to 14,000 years (Figure 2.2; Beck et al. 2017; Hansen 1947; Mehringer 1985; Minckley et al. 2007; Saban 2015; Wigand 1987, 1989; Wigand and Rhode 2002).

Pollen studies in Upper Chewaucan Marsh at the Paisley Caves (Beck et al. 2017; Saban 2015) and in the Warner Basin (Hansen 1947) are especially pertinent to the current study because the vegetation proxy data relate directly to the geographic location of my dissertation study sites. Two independently conducted pollen analyses of Cave 2 sediments at the Paisley Caves have recently been reported (Beck et al. 2017; Saban 2015). Both studies focus on the Terminal Pleistocene/Early Holocene transition. Beck et al.’s (2017) paleoclimate study included analysis of 38 samples collected in a continuous

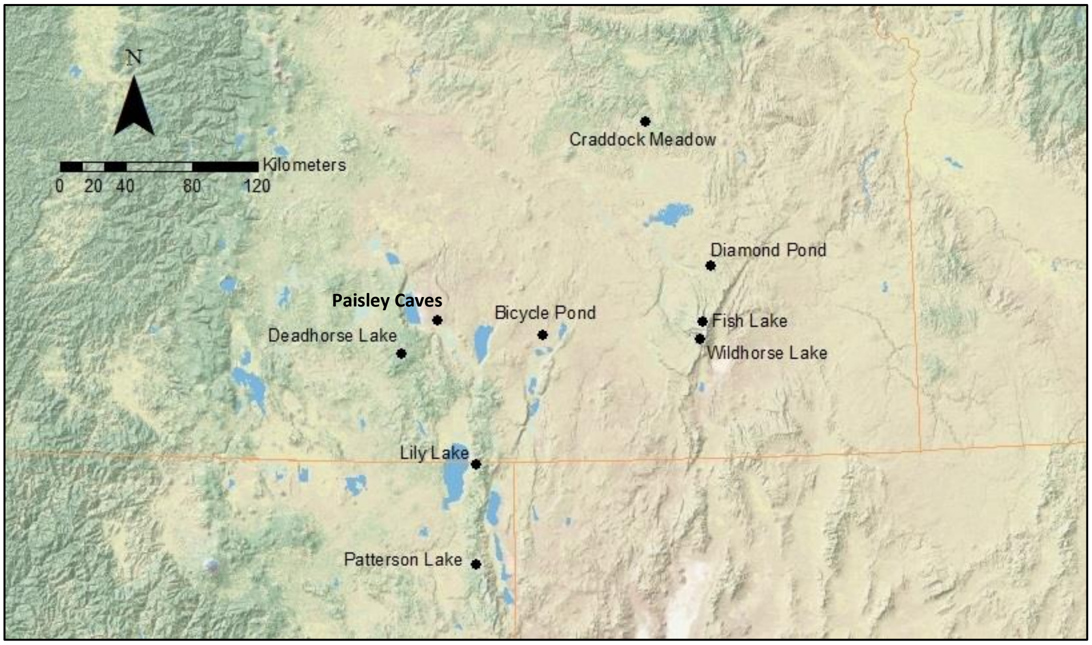


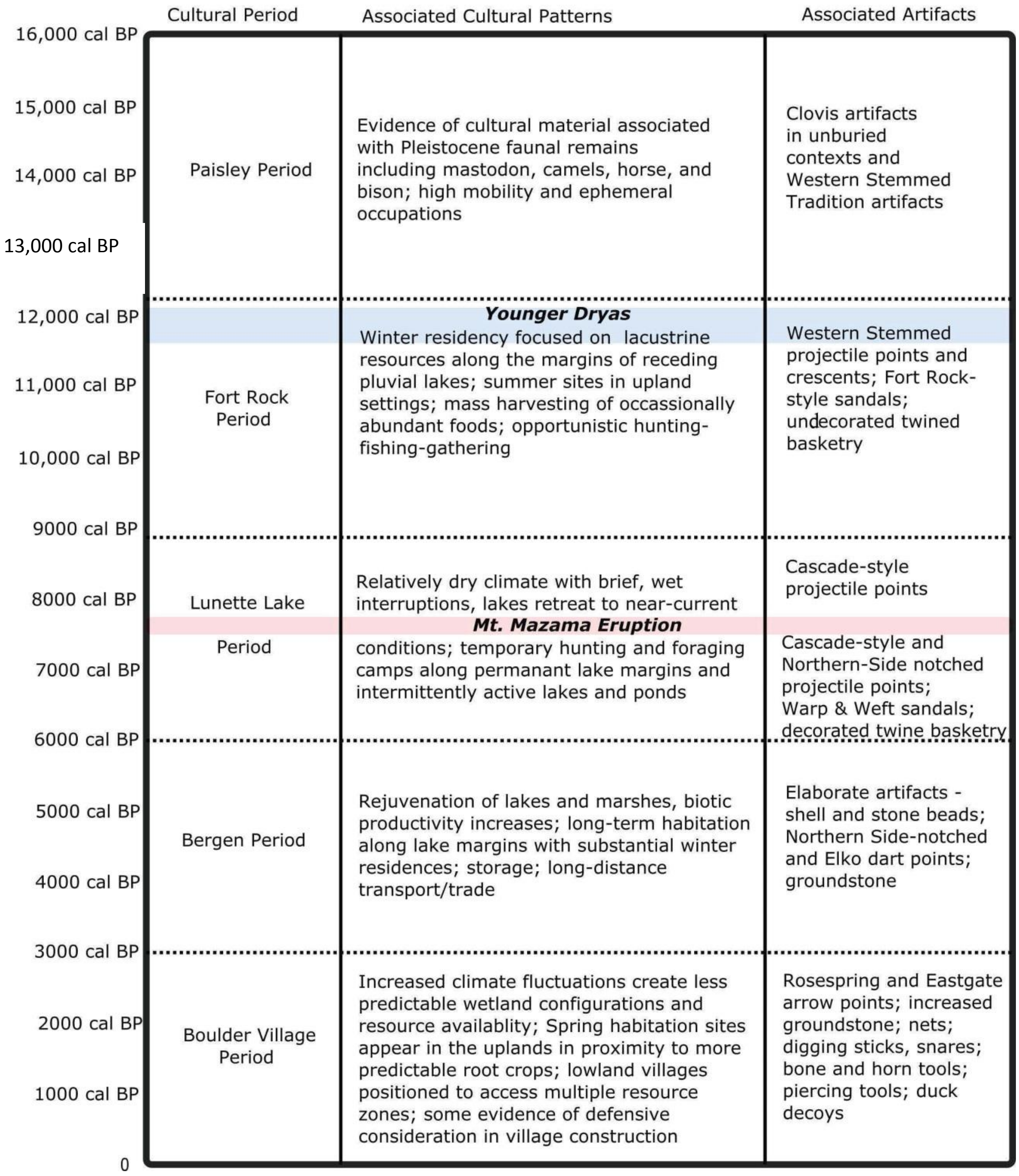
Figure 2.2. Locations of select pollen records in the northern Great Basin.

column from the southeast corner of the Unit 2/4C profile in Paisley Cave 2 and Saban's (2015) study included 21 pollen samples from Unit 2/6B. These pollen analyses are limited by low taxonomic resolution of dominant types (*Pinus*, Chenopodiaceae, and *Artemisia*), the high pollen productivity of and dispersal of these taxa, and the broad ecological amplitude of these taxa. Nuances in vegetation dynamics are obscured in the records due to a lack of emphasis on changing ratios of pollen types and on the presence of rare types representing taxa with low pollen productivity and dispersal (see Wigand 1987; Wigand and Rhode 2002).

Archaeological palynology involves identification and analysis of fossil-pollen taxa in cultural deposits. Paleoclimate reconstructions based on archaeological deposits are inherently limited by site formation processes occurring in aerobic conditions that can result in extreme variability in soil pH, oxidation, microbial activity, and the proliferation of fungal spores—all of which are deleterious to pollen (Bryant and Holloway 1983). In addition to corrosion of pollen grains caused by taphonomic effects, interpretation of pollen in archaeological settings is further complicated because the presence of pollen grains can never be disentangled from anthropogenic selection (Sandweiss 2003).

Although pollen analysis can only provide information on vegetation types, when the identified plant taxa are considered in light of cultural features and contexts, archaeologists can draw inferences about both climate and human disturbances (Bradshaw 1994; Bryant and Holloway 1983; Faegri and Iversen 1989; Weinstein-Evron 1994). Moreover, in archaeological sites, the climate signals obtained via palynological analysis are available in well-defined, discrete, and datable contexts directly linked to specific moments in the past (Sandweiss and Kelley 2012:372).

Several archaeologists have suggested cultural changes are intimately tied with environmental fluctuations in the Great Basin (Elston 1982; Grayson 2011). The northern Great Basin has been the subject of numerous long-term archaeological research projects investigating these linkages beginning with Luther Cressman’s excavations in the 1930s (Aikens and Jenkins 1994; Bedwell 1970, 1973; Connolly; Cressman 1940, 1942; Fowler; Jenkins 2004; Jenkins et al. 2012, 2014; Oetting; Pinson 2014; Smith et al. 2014; Willig 1989; Willig and Aikens 1988). Data generated from decades of archaeological research informs our current understandings of chronological phases of northern Great Basin archaeology (Aikens et al. 2011; Jenkins 2004). These chronologies provide useful analogs for interpreting indigenous behaviors at the Paisley Caves and LSP-1 Rockshelter and are summarized with respect to environmental trends in the following sections (Figure 2.3).



	Cultural Period	Associated Cultural Patterns	Associated Artifacts
16,000 cal BP 15,000 cal BP 14,000 cal BP 13,000 cal BP	Paisley Period	Evidence of cultural material associated with Pleistocene faunal remains including mastodon, camels, horse, and bison; high mobility and ephemeral occupations	Clovis artifacts in unburied contexts and Western Stemmed Tradition artifacts
12,000 cal BP 11,000 cal BP 10,000 cal BP	Fort Rock Period	***Younger Dryas*** Winter residency focused on lacustrine resources along the margins of receding pluvial lakes; summer sites in upland settings; mass harvesting of occassionally abundant foods; opportunistic hunting-fishing-gathering	Western Stemmed projectile points and crescents; Fort Rock-style sandals; undecorated twined basketry
9000 cal BP 8000 cal BP 7000 cal BP	Lunette Lake Period	Relatively dry climate with brief, wet interruptions, lakes retreat to near-current ***Mt. Mazama Eruption*** conditions; temporary hunting and foraging camps along permanant lake margins and intermittently active lakes and ponds	Cascade-style projectile points Cascade-style and Northern-Side notched projectile points; Warp & Weft sandals; decorated twine basketry
6000 cal BP 5000 cal BP 4000 cal BP	Bergen Period	Rejuvenation of lakes and marshes, biotic productivity increases; long-term habitation along lake margins with substantial winter residences; storage; long-distance transport/trade	Elaborate artifacts - shell and stone beads; Northern Side-notched and Elko dart points; groundstone
3000 cal BP 2000 cal BP 1000 cal BP 0	Boulder Village Period	Increased climate fluctuations create less predictable wetland configurations and resource availablity; Spring habitation sites appear in the uplands in proximity to more predictable root crops; lowland villages positioned to access multiple resource zones; some evidence of defensive consideration in village construction	Rosespring and Eastgate arrow points; increased groundstone; nets; digging sticks, snares; bone and horn tools; piercing tools; duck decoys

Figure 2.3. Cultural chronology in the northern Great Basin (adapted from Jenkins et al. 2004:8).

2.3.1. The Paisley Period (>15,700 to 12,900 cal BP)

The first evidence of humans in the Great Basin occurs by 14,300 cal BP (Gilbert 2008; Jenkins et al. 2012a, 2012b) when expansive pluvial lakes and wetlands characterized the ecozone (Grayson 2011). The earliest archaeological sites in the Great Basin clustered on lake and wetland margins during the Bolling-Allerød interstadial (Beck and Jones 2010; Jenkins et al. 2012a). The beginning of this interstadial warming trend correlates with the ages of cirque lakes throughout the Pacific Northwest and increases in pluvial lake levels in the northern Great Basin (Allison 1979, 1982; Weide 1974), demonstrating the significance of this warming event. Warmer temperatures during the Bolling-Allerød succeeded the LGM and prevailed until the onset of Younger Dryas cooling around 12,900 cal BP (Steffensen et al. 2008).

Following the LGM, increased runoff and precipitation coupled with reduced evaporation rates (Freidel 1993, 1994, 2001) caused the northern basins to fill to their highest lake stands at ca. 19,000 cal BP (Allison 1979, 1982; Freidel 1993, 1994, 2001; Licciardi 2001; Weide 1974). In the northern Great Basin, cooler (than present) temperatures are indicated by the expansion of sagebrush pollen and macrofossil evidence of mountain mahogany (Wigand and Rhode 2002:320). Pollen data from the Chewaucan and Warner basins also indicate significant shifts in climatic conditions during this period. Hansen (1947) reported a conifer (lodgepole and yellow pine) dominated post-glacial record and suggested the northern Great Basin was forested during the Terminal Pleistocene. He suggested pine forests grew in lower elevations above Great Basin lakes, but migrated upslope as temperature cooled (Hansen 1947:167). At the Paisley Caves, relative pollen percentages demonstrate the prevalence of cool and arid conditions with conifer trees dominating the record (Beck et al. 2017; Saban 2015:41). Based on the lack of modern pollen proxy analogs (see Minckley et al. 2008) resembling the Paisley Caves assemblages, Beck et al. (2017:10) determined vegetation in the immediate vicinity of the Paisley Caves resembled a sagebrush shrub-steppe environment in the Terminal Pleistocene and suggested pine forests never retreated below their current altitude. They suggested the preponderance of *Pinus* pollen resulted from long-distance transport; if pine grew near the caves, the pollen spectra would have accounted for a larger percentage of fossil pollen grains. The presence of or absence of pine macrofossils in the record will further resolve this issue as described in Chapter IX.

Archaeologically, the eponymous Paisley Period coincided with post-LGM warming and was defined by Jenkins (2007) as the first occurrence of Paleoindian artifacts in the northern Great Basin. The Terminal Pleistocene was thought to encapsulate a time when people generally relied on hunting large game animals with spear points in the 20th century. Currently, archaeologists understand that the period accounts for a wide variety of technological and adaptive variation (Jones and Beck 2012:108). Though occupations were ephemeral, subsistence evidence suggests Terminal Pleistocene foragers exploited a diverse array of flora and fauna, including megafauna (Grayson 2011). Diagnostic artifacts of this period include edge-ground fluted points associated with the Clovis toolkit, and lanceolate points and edge-ground stemmed points associated with the WST. Although fluted points have been found on the surface at northern Great Basin locations including the Dietz site (Willig 1989), Sagehen Gap (O’Grady et al. 2008), Sheep Mountain (O’Grady et al. 2009), and the Sunshine Locality

(Beck and Jones 2009) among others, no accounts of these tools in buried contexts have been published to date.

2.3.2. The Fort Rock Period (12,900 to 9000 cal BP)

Evidence of Paleoindian sites is widespread across the Great Basin at the advent of the Younger Dryas cooling event (12,900 to 11,600 cal BP), which also marks the beginning of the Fort Rock Period in the archaeological record. Globally, the Younger Dryas climate event is characterized by an abrupt temperature drop (recorded in the Greenland Ice Cores) accompanied by increased winds and storminess across the northern hemisphere, and a 1200 year cessation of North Atlantic glacial retreat (Steffensen et al. 2008). Regional responses to the Younger Dryas varied depending on other environmental parameters. Speleothem records indicate conditions gradually became cooler and wetter in nearby southwestern Oregon (Vacco et al. 2005:253). Lake levels fell, creating more biotically diverse shallow lakes and marshes (Wigand and Rhode 2002:321).

Regionally, increases in the relative abundance of grass and sagebrush pollen, along with the presence of juniper and buffaloberry pollen and cold-adapted spores in the northern Great Basin indicate a cool, moist steppe environment (Mehringer 1985; Wigand and Rhode 2002:321). Beck et al. (2017:9) also found evidence of buckthorns, antelope bitterbrush, and willow at the Paisley Caves at this time. Increases in the representation of herbaceous pollen taxa in the Younger Dryas deposits at the Paisley Caves suggested a shift to marsh-like conditions near the site, when moisture-loving plants thrived (Saban 2015:41). Saban (2015:50) also noted that increases in mesic-adapted plants correlate with increases in formed tools at the Paisley Caves.

Goebel et al. (2011) describe ten archaeological sites with components dated to the Younger Dryas chronozone for the Lahontan and Bonneville Basins combined. In the northwestern Great Basin, Connley Caves, Paisley Caves, sites associated with the Buffalo Flats Bunny Pits, Tule Lake Rockshelter, and Pyramid Lake all have Younger Dryas components (Aikens et al. 2011; Dansie and Jerrems 2005; Erlandson et al. 2014; Oetting 1993). The sites in southcentral Oregon are located within approximately 60 km of one another, and all are situated along the margins of pluvial lakes (Figure 2.4).

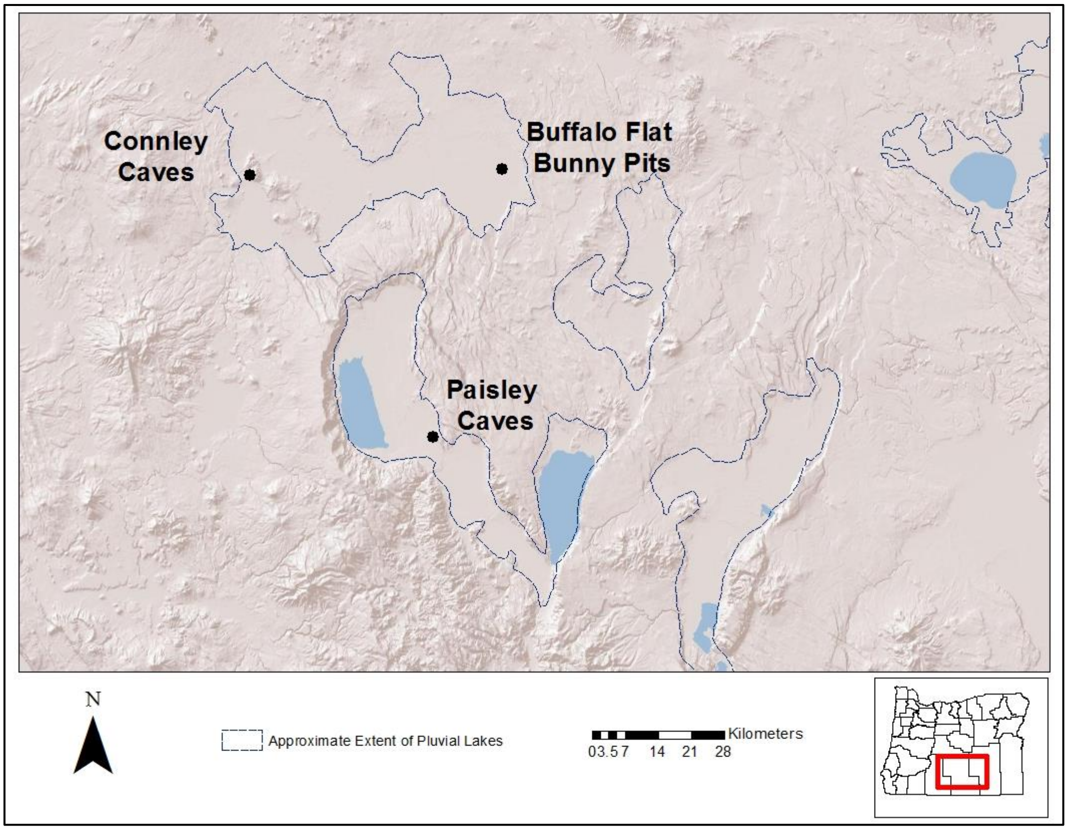


Figure 2.4. Map of northern Great Basin archaeological sites with confidently-dated Younger Dryas cultural components in southcentral Oregon.

Archaeological settlements distributed along lacustrine margins and associated wetland-adapted faunal assemblages in TP/EH sites prompted Bedwell (1973) to propose the aforementioned WPLT theory. He suggested that Paleoindian cultures in the Great Basin developed a specialized subsistence economy focused on wetland environments to exploit marsh and lake resources, especially waterfowl (Moss and Erlandson 2013; Sanchez et al. 2017). Although some researchers have implied the observed WPLT pattern reflects sampling bias rather than legitimate clustering of archaeological sites around pluvial lake margins (e.g., Felling 2015), correlations between the distribution of Paleoindian points and pluvial lake basins demonstrate that pluvial lake shorelines are the best predictors of terminal Pleistocene archaeological sites (Duke and King 2015; Mathews 2013).

Evidence for broad spectrum foraging and the continued manufacture of stemmed and lanceolate stone tools suggests the people occupying sites during this period represent a perpetuation of Paleoindian cultures with a Western Stemmed toolkit. Toolkits also expanded to include fine needles, bone awls, and chipped stone crescents in the Great Basin and on the southern California coast around 12,000 cal BP (Aikens et al. 2011; Erlandson et al. 2011). Moss and Erlandson (2013) argued that the crescents, which persisted in the archaeological record until ca. 8000 cal BP, represent a technology associated with the hunting of large waterfowl (specifically geese and swans) that bred in the Great Basin before the complete retreat of the Laurentide ice sheet. Textiles, including basketry, nets, sandals, and bags, are prevalent in Fort Rock period archaeological sites (Connolly 2013; Connolly and Barker; Connolly et al. 2016; Jones and Beck 2012).

Faunal and macrofloral evidence suggests Paleoindian groups continued broad spectrum foraging of a variety of prey species including megafauna until the Younger Dryas/Early Holocene transition. Large scale extinction of North American megafauna occurred during the terminal Pleistocene. By ca. 11,500 cal BP, mammoth (*Mammuthus*), mastodon (*Mammut*), camel (*Camelops*), horse (*Equus*), and ground sloth (*Nothrotheriops*) had all disappeared from the paleontological record (Faith and Surovell 2009; Grayson 2011). It is unclear whether the extinctions were in response to climate change (e.g., Faith and Surovell 2009), mounting human hunting pressures (Martin 1967; Mosimann and Martin 1975; Wolverton et al. 2009), niche construction processes triggered by disturbances associated with human colonization of North America (Doughty et al. 2010), or a combination of such factors.

The onset of the Early Holocene at the end of the Fort Rock Period was characterized by warmer and drier conditions in the Great Basin. At Patterson Lake (2743 m AMSL), Minckley et al. (2007:2175) documented decreases in pine and grass pollen and increases in sagebrush pollen. Beginning about 11,000 cal BP, increased aridity permitted the expansion of open forests and sagebrush steppe in higher elevations (Mehringer 1986:44). Juniper likely also expanded its range in Oregon at this time (Wigand and Rhode 2002:322).

At the Paisley Caves, the pollen record representing the beginning of the Early Holocene is less clear. Saban (2015:42) suggested increases in conifer pollen indicated a decrease in herbaceous groundcover after the Younger Dryas. Beck et al. (2017:10) recorded an increase in high-spine Asteraceae and decrease in amaranths/chenopods. They also noted pine once again became the dominant taxa in the pollen record after

9800 cal BP. The macrobotanical record could clarify these ambiguities and will be discussed in Chapter IX.

2.3.3. The Lunette Lake Period (9000 to 6000 cal BP)

Warmer and drier conditions persisted into the Lunette Lake Period of the Early Holocene. Relative abundances of drought-tolerant species continued to increase as desertification of the Basin commenced approximately 8500 cal BP. Water energy dissipated as the storms of the earlier period waned. Late Early Holocene vegetation was characterized by sagebrush, saltbush, and rabbitbrush scrub steppe (Hansen 1947; Minckley et al. 2007; Wigand and Rhode 2002). Woodlands in higher elevations declined, but juniper persisted in south-central Oregon (Wigand and Rhode 2002:323). Decreases in grass pollen reflect the continuation of drought-induced conditions. Paleoecological studies throughout the Great Basin indicate contraction, or disappearance, of lakes and wetlands by ca. 8300 cal BP (Grayson 2011). However, Saban (2015:42) reported increased relative abundances of grasses and decreased relative abundances of chenopods in the Paisley Caves pollen record after 8000 cal BP.

During the Holocene, a protracted warm period known as the Mid-Holocene Climate Optimum occurred from ca. 8000 to ca. 6000-5000 cal BP (with local fluctuations). This climate trend is well documented in Europe, Eurasia, and Africa, but the data are more variable for North America (Bartlein et al. 2011). Paleoclimate records for the Great Basin all indicate a 3000 year period of marked aridity with high temperature and precipitation variability through space and time (Grayson 2011:253).

Hansen’s generalized interpretation of pollen data suggests the northern Great Basin began warming prior to the eruption of Mt. Mazama (~7600 cal BP).

Beginning at 8000 cal BP, patterning in the Great Basin archaeological record shifts (Aikens and Jenkins 1994; Antevs 1948; Beck and Jones 2008; Grayson 2011; Jenkins et al. 2004; Smith et al. 2014). Reduced precipitation and lower overall biodiversity due to the desiccation of pluvial lakes resulted in abrupt changes in the archaeological record. Sites with extended habitation records in the terminal Pleistocene/Early Holocene are not visited as frequently (if at all), and occupation commences in previously unvisited sites. Evidence for specialized hunting and foraging camps are found in northern Great Basin sandy dunes rather than in caves during this time (Aikens et al. 2011). Cascade and Northern Side-notched projectile points characterize the lithic technology, although Northern side-notched points appear only after the Mt. Mazama eruption when increased moisture is noted before 6000 cal BP (Jenkins et al. 2004). Decorated twined basketry and multiple warp and spiral weft sandals are common.

Small seed processing seems to have taken on a greater role in forager subsistence practices after ca. 8900 cal BP (Louderback 2014; Rhode and Louderback 2007; Rhode 2008; Yoder et al. 2010), prompting some archaeologists to suggest Great Basin foragers struggled with resource depression through the early Middle Holocene (Grayson 2011). In the northern Great Basin, groundstone is present, but expediently made (Aikens et al. 2011); in the eastern Basin, intensive use of groundstone technology to process small seeds appears to have become normalized by ca. 9000 cal BP (Yoder et al. 2011).

2.3.4. The Bergen Period (6000 to 3000 cal BP)

According to Hansen, the Middle Holocene warming trend continued until about 4000 years ago. Although this period generally coincides with Antevs' Altithermal Period, subsequent research has demonstrated local climate fluctuations affected the hydrology of sub-basins differentially in the northern Great Basin (Jenkins et al. 2004). Generally, the climate became warmer and wetter after about 5400 cal BP, reviving the Great Basin wetlands (Wigand and Rhode 2002:325). Alternating wet/warm, cool/dry cycles persisted over the next three millennia (Wigand 1987). As a result, lakes and marshes expanded, contracted, and expanded again. Juniper woodlands expanded into lower elevation sagebrush approximately 4500 cal BP at Craddock Meadow, and Mehringer (1985) noted three respective episodes of fir expansion at Diamond Pond beginning around 3700 cal BP. This cooler/wetter episode is parallel with the regional neoglacial period documented in glacial advances and pollen records throughout the Pacific Northwest (Menounos et al. 2009; Porter and Denton 1967).

The number of archaeological sites dated to the Bergen Period increased dramatically from the Lunette Lake Period, suggesting the persistence of higher population levels. Sites are well distributed across the landscape, but far more frequently recorded in open contexts than in dry caves. The Bergen site is the largest Middle Holocene archaeological site in the northern Great Basin and is located along the shores of pluvial Lake Beasley in the Fort Rock Basin (Helzer 2004). Increased sedentism, decreased mobility, and larger assemblages of groundstone are all hallmarks of the Bergen Period (Aikens et al. 2011). Along with the Bergen site, the DJ Ranch and Bowling Dune open sites typify the residential sites of this period (Jenkins et al. 2004).

Dart points continued to decrease in size, with Northern-side notched and Elko points characterizing the period.

The predominance of large bodied mammals at the Dunn site diverged from the diversified diet breadth observed in older sites, where lacustrine resources were more prevalent (Aikens et al. 2011). Roots, collected in the uplands, took on more importance and rivaled the contribution of lacustrine resources in the diet (Aikens et al. 2011). During times of wetland expansion, marshy conditions permitted population explosions of small minnows, known as tui chubs. Tui chubs could be collected en masse as the marshes subsided seasonally (O'Grady 2004).

2.3.5. The Boulder Village Period (3,000 cal BP to historic contact)

Improved preservation of more recent geologic deposits permits higher resolution paleoclimate data for the Late Holocene. At Diamond Pond/Malheur Maar (1265 m AMSL) in Diamond Craters, Wigand (1987) describes quickly shifting vegetation regimes over the past few millennia (Table 2.1). In the western Great Basin, the Medieval Climate Anomaly (ca. 1100 to 600 cal BP) is marked by increased aridity (Bettinger 1999:68), but in the northern Great Basin, more mesic conditions prevailed (Wigand and Rhode 2002). The Little Ice Age (ca. 500 to 150 cal BP) is also not well represented in northern Great Basin paleoclimate records.

Table 2.1. Pollen proxy data for environmental moisture cycling at Diamond Pond (adapted from Wigand 1987).

Date	Representative Vegetation	Moisture Regime
Before 5400 BP	Shadscale desert	Drier
5400-4000 BP	Sagebrush steppe	Drier
4000-2000 BP	Juniper grasslands	Wetter
2000-1400 BP	Sagebrush steppe	Drier
1400-900 BP	Grass	Wetter
500-300 BP	Shadscale desert	Drier
300-150 BP	Juniper grasslands	Wetter

Overall, winter precipitation increased relative to summer rains during the late Holocene (Wigand 1987; Wigand and Rhode 2002). Unpredictable and fluctuating lake levels driven by wet/dry climate oscillations exerted push/pull controls on people living in the northern Great Basin. Settlement and mobility during this period represents an extension of earlier terminal Middle Holocene patterns with larger and more densely concentrated populations. Prior to 3500 cal BP, identified sites in the Warner Valley were limited to upland locations and consisted primarily of lithic scatters (Weide 1967). After 3500 cal BP, several winter village sites are documented around low-lying wetlands (Connolly et al. 2015, 2016; Eiselt 1997; Oetting 1989; O'Neill et al 2006; Pettigrew 1984; Weide 1968, etc.).

Diagnostic artifacts of this period reflect a transition to bow and arrow technology. Projectile points, typically classified as Rosespring or Eastgate in the northern Great Basin, are smaller than points recovered from Middle Holocene occupations (Aikens et al. 2011; Oetting 1989). Vast quantities of groundstone indicate a heavy reliance on small seed and root processing (Dexter 2010), and basketry types proliferated (Connolly 2013). Toolkits also included nets, digging sticks, snares, bone and horn tools, piercing tools, and duck decoys.

2.4. Great Basin Archaeological Plant Studies

Fowler and Rhode (2007:336-337) noted that although seed collecting practices varied across the Great Basin culture area, according to ethnographic informants, the taxa targeted for food include 16 key plants: Indian ricegrass, Great Basin wildrye, dropseed (*Sporobolus* sp.), biscuitroot, sunflower (*Helianthus* sp.), saltbush, goosefoot, waada, blazing star, evening primrose (*Oenothera* sp.), barnyard grass (*Echinochloa* sp.), wheatgrass (*Agropyron* sp.), bluegrass, cattail, bulrush, and amaranth. In the northern Great Basin this list can be expanded to include fiddleneck (*Amsinckia* sp.) and stickseed (*Lappula* sp.; Kelly 1932; Steward 1938). These 18 taxa are often mirrored in the archaeological record where botanical remains have been analyzed. Over the past 40 years, paleoethnobotanical research at sites in the northern Great Basin has provided a window onto economically important plants (Figure 2.4; Table 2.3). These analyses are summarized below, loosely grouped by site antiquity.

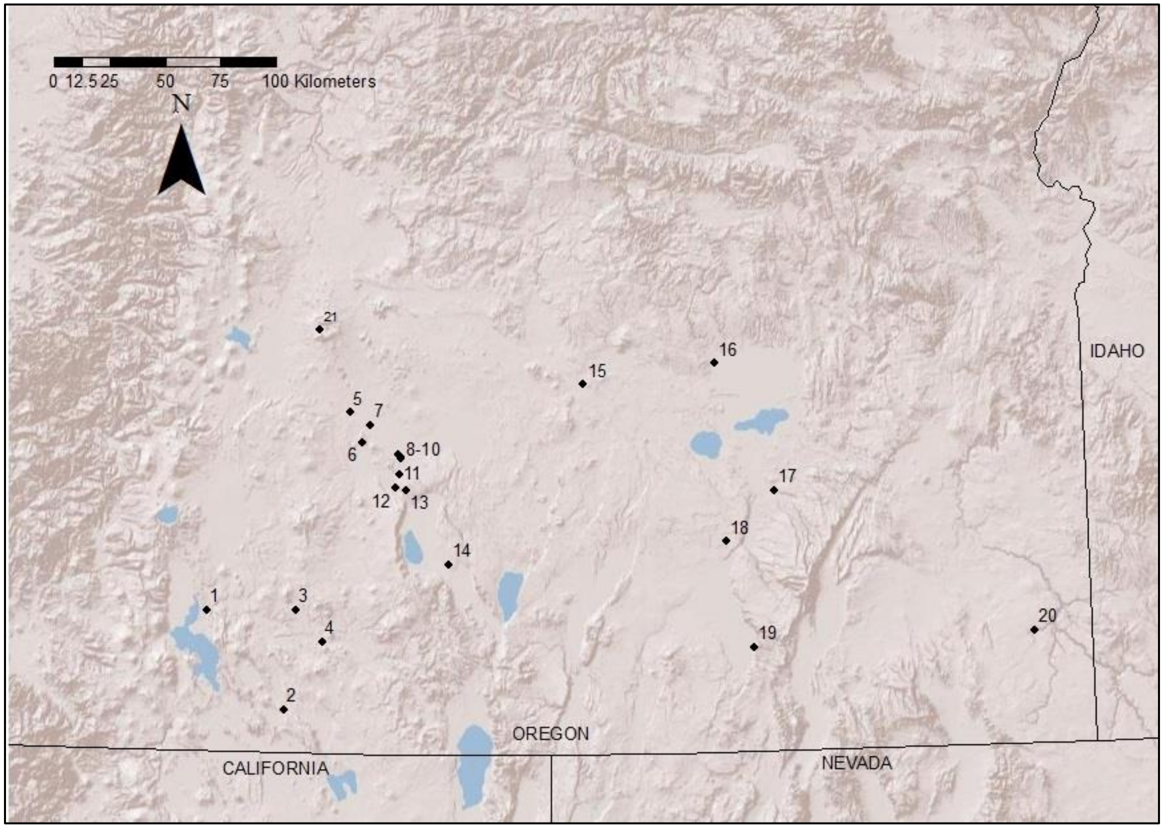


Figure 2.5. Paleoethnobotany research map: 1) Bezukewas Village; 2) Swan Lake house pits; 3) Williamson River fishing camp; 4) Beatty Curve; 5) Fort Rock Cave; 6) Connley Caves; 7) Bergen; 8) Bowling Dune; 9) DJ Ranch; 10) Locality III; 11) Big M; 12) Carlon Village; 13) Boulder Village; 14) Paisley Caves; 15) Rimrock Draw Rockshelter; 16) Burns; 17) Dunn; 18) Erin’s Cave; 19) Skull Creek Dunes; 20) Dirty Shame Rockshelter; 21) Paulina Lake.

Table 2.2. Macrobotanical remains recovered in northern Great Basin archaeological sites.

Identified Taxon	**Late Pleistocene/Early Holocene**	**Middle Holocene**	**Late Holocene**
Economically-important taxa mentioned in Fowler and Rhode (2007):			
APIACEAE			
Apiaceae	Locality III (Prouty 2004)		Erin's Cave (Dexter 2010)
Lomatium	Paisley Caves (Jenkins 2007); Paulina Lake (Connolly and Jenkins 1999)		Boulder Village (Prouty 1994); Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983)
ASTERACEAE			
Helianthus	Dirty Shame Rockshelter (Sanford 1983)		
BORAGINACEAE			
Boraginaceae			Beatty Curve East (Connolly et al. 2015)
Amsinckia	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983)
Lappula	Connley Caves (Appendix A); Dirty Shame Rockshelter (Sanford 1983)		Dirty Shame Rockshelter (Sanford 1983)
CHENO-AMS			
cheno-ams	Burns (Gilmour et al. 2015)	Bowling Dune (Prouty 1994)	Beatty Curve East and Beatty Curve West (Connolly et al. 2015); Dirty Shame Rockshelter (Puseman and Yost 2011); Skull Creek Dunes Locality 10 (Thomas et al. 2015)
Amaranthus	Dirty Shame Rockshelter (Sanford 1983)		Carlon Village (Wingard 2001)
Atriplex	Connley Caves (Appendix A); Dirty Shame Rockshelter (Sanford 1983)	Bergen (Helzer 2001); Dirty Shame Rockshelter (Sanford 1983)	Connley Caves (McDonough 2018); Dirty Shame Rockshelter (Sanford 1983); Skull Creek Dunes Locality 10 (Thomas et al. 2015)

Table 2.2. Macrobotanical remains recovered in northern Great Basin archaeological sites.

Identified Taxon	**Late Pleistocene/Early Holocene**	**Middle Holocene**	**Late Holocene**
Chenopodium	Connley Caves (Appendix A); Dirty Shame Rockshelter (Sanford 1983); Locality III (Prouty 2004)	Bergen (Helzer 2001); Dirty Shame Rockshelter (Sanford 1983); Dunn (Musil 1990); Locality III (Prouty 2004)	Boulder Village (Prouty 1994); Carlon Village (Wingard 2001); Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983); Erin's Cave (Dexter 2010); Skull Creek Dunes Locality 10 (Thomas et al. 2015); Swan Lake house pit (Kennedy 2017); Williamson River fishing village (Cheatham 1991)
Suaeda	Locality III (Prouty 2004)	Bergen (Helzer 2001); Locality III (Prouty 2004)	Boulder Village (Prouty 1994); Skull Creek Dunes Locality 10 (Thomas et al. 2015); Swan Lake house pit (Kennedy 2017)
CYPERACEAE			
Scirpus/ Schoenoplectus	Dirty Shame Rockshelter (Sanford 1983); Locality III; Paulina Lake (Connolly and Jenkins 1999); Rimrock Draw Rockshelter (Helzer and Kennedy 2016)	Bergen (Helzer 2001); Locality III (Prouty 2004)	Beatty Curve East and West (Connolly et al. 2015); Connley Caves (McDonough 2018); Dirty Shame Rockshelter (Puseman and Yost 2011); Skull Creek Dunes Locality 10 (Thomas et al. 2015); Swan Lake house pit (Kennedy 2017)
LOASACEAE			
Mentzelia	Connley Caves (Appendix A)		Connley Caves (McDonough 2018)
ONAGRACEAE			
Oenothera	Dirty Shame Rockshelter (Sanford 1983)		
POACEAE			
Poaceae	Dirty Shame Rockshelter (Sanford 1983); Locality III (Jenkins 1999)	Bowling Dune (Prouty 1994); Locality III (Prouty 2004)	Beatty Curve West (Connolly et al. 2015); Bezuksewas Village (Cheatham et al. 1995); Boulder Village (Prouty 1994); Connley Caves (McDonough 2018); Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983); Erin's Cave (Dexter 2010); Skull Creek Dunes Locality 10 (Thomas et al. 2015)
TYPHACEAE			

Table 2.2. Macrobotanical remains recovered in northern Great Basin archaeological sites.

Identified Taxon	**Late Pleistocene/Early Holocene**	**Middle Holocene**	**Late Holocene**
Typha	Dirty Shame Rockshelter (Sanford 1983); Rimrock Draw Rockshelter (Helzer and Kennedy 2016)	Dirty Shame Rockshelter (Sanford 1983)	Beatty Curve East (Connolly et al. 2015); Dirty Shame Rockshelter (Sanford 1983)
Other plant taxa identified in northern Great Basin sites:			
ADOXACEAE			
Sambucus			Beatty Curve East (Connolly et al. 2015)
AIZOACEAE			
Sesuvium	Rimrock Draw Rockshelter (Helzer and Kennedy 2016)		
ALISMATACEAE			
Sagittaria	Burns (Gilmour et al. 2015); Rimrock Draw Rockshelter (Helzer and Kennedy 2016)		Beatty Curve East (Connolly et al. 2015)
APOCYNACEAE			
Apocynum		Dirty Shame Rockshelter (Sanford 1983)	Beatty Curve West (Connolly et al. 2015); Dirty Shame Rockshelter (Sanford 1983)
ASTERACEAE			
Asteraceae			Dirty Shame Rockshelter (Puseman and Yost 2011)
Artemisia			Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983); Erin's Cave (Dexter 2010)
Brickellia		Dirty Shame Rockshelter (Sanford 1983)	
Chrysothamnus		Bergen (Helzer 2001)	
HYDROPHYLLACEAE			
Phacelia			Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983)
BRASSICACEAE			
Brassicaceae		Dunn (Musil 1990)	Beatty Curve East (Connolly et al. 2015)

Table 2.2. Macrobotanical remains recovered in northern Great Basin archaeological sites.

Identified Taxon	**Late Pleistocene/Early Holocene**	**Middle Holocene**	**Late Holocene**
Descurainia	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983); Erin's Cave (Dexter 2010); Skull Creek Dunes Locality 10 (Thomas et al. 2015)
Sysimbrium			Beatty Curve West (Connolly et al. 2015)
CAPRIFOLIACEAE			
Plectritis	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Sanford 1983)
CORNACEAE			
Cornus	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983)
CUPRESSACEAE			
Juniperus	Locality III (Prouty 2004)	Big M (Stenholm 1994); Bowling Dune (Prouty 1994); Dirty Shame Rockshelter (Sanford 1983); Dunn (Musil 1990)	Connley Caves (McDonough 2018.); Erin's Cave (Dexter 2010); Swan Lake house pit (Kennedy 2017)
CYPERACEAE			
Cyperaceae			Carlon Village (Wingard 2001); Skull Creek Dunes Locality 10 (Thomas et al. 2015)
Carex	Paulina Lake (Connolly and Jenkins 1999)		Erin's Cave (Dexter 2010)
Cyperus		Bergen (Helzer 2001)	
ELAEAGNACEAE			
			Erin's Cave (Dexter 2010)
ERICACEAE			
Vaccinium			Beatty Curve East (Connolly et al. 2015)
FABACEAE			
Fabaceae			Carlon Village (Stenholm 1994); Dirty Shame Rockshelter (Puseman and Yost 2011)
Lupinus			Beatty Curve West (Connolly et al. 2015)

Table 2.2. Macrobotanical remains recovered in northern Great Basin archaeological sites.

Identified Taxon	**Late Pleistocene/Early Holocene**	**Middle Holocene**	**Late Holocene**
Trifolium			Dirty Shame Rockshelter (Puseman and Yost 2011)
Salvia			Dirty Shame Rockshelter (Puseman and Yost 2011)
JUNCACEAE			
Juncus	Rimrock Draw Rockshelter (Helzer and Kennedy 2016)	Dirty Shame Rockshelter (Sanford 1983)	Beatty Curve East (Connolly et al. 2015); Connley Caves (McDonough 2018); Erin's Cave (Dexter 2010)
LAMIACEAE			
Mentha			Beatty Curve East (Connolly et al. 2015)
LILIACEAE s.l.			
Allium		Dirty Shame Rockshelter (Sanford 1983)	Carlon Village (Wingard 2001); Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983); Erin's Cave (Dexter 2010)
Camassia quamash	Locality III (Jenkins 1999)		Bezuksewas Village (Cheatham et al. 1995)
MALVACEAE			
Sphaeralcea			Dirty Shame Rockshelter (Puseman and Yost 2011)
NYMPHACEAE			
cf. *Nuphar lutea*			Beatty Curve West (Connolly et al. 2015)
PINACEAE			
Pinus		Dunn (Musil 1990)	Beatty Curve East (Connolly et al. 2015)
POLEMONIACEAE			
Gilia			Beatty Curve East (Connolly et al. 2015)
Polemonium			Dirty Shame Rockshelter (Sanford 1983)
POLYGONACEAE			
Polygonum	Locality III (Prouty 2004)	Locality III (Prouty 2004)	Bezuksewas Village (Cheatham et al. 1995); Carlon Village (Stenholm 1994); Connley Caves (McDonough 2018)
RANUNCULACEAE			

Table 2.2. Macrobotanical remains recovered in northern Great Basin archaeological sites.

Identified Taxon	**Late Pleistocene/Early Holocene**	**Middle Holocene**	**Late Holocene**
Ranunculus aquailis			Beatty Curve West (Connolly et al. 2015)
ROSACEAE			
Crataegus			Erin's Cave (Dexter 2010)
Prunus subcordata			Beatty Curve East (Connolly et al. 2015); Bezuksewas Village (Cheatham et al. 1995)
Prunus virginiana	Dirty Shame Rockshelter (Sanford 1983); Paulina Lake (Connolly and Jenkins 1999)		Beatty Curve East and West (Connolly et al. 2015); Carlon Village (Wingard 2001); Dirty Shame Rockshelter (Sanford 1983)
Rosa	Paisley Caves (Cummings and Puseman 2003); Dirty Shame Rockshelter (Sanford 1983)	Dirty Shame Rockshelter (Sanford 1983)	Carlon Village (Wingard 2001); Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983); Swan Lake house pit (Kennedy 2017)
Rubus	Paulina Lake (Connolly and Jenkins 1999)		Beatty Curve East (Connolly et al. 2015); Carlon Village (Wingard 2001)
RUBIACEAE			
Galium			Carlon Village (Wingard 2001); Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983)
SANTALACEAE			
Comandra			Bezuksewas Village (Cheatham et al. 1995)
SARCOBATACEAE			
Sarcobatus		Bergen (Helzer 2001)	
SCROPHULARIACEAE			
Collinsia			Dirty Shame Rockshelter (Puseman and Yost 2011)
SOLANACEAE			
Nicotiana			Beatty Curve West (Connolly et al. 2015); Bezuksewas Village (Cheatham et al. 1995)
URTICACEAE			

Table 2.2. Macrobotanical remains recovered in northern Great Basin archaeological sites.

Identified Taxon	**Late Pleistocene/Early Holocene**	**Middle Holocene**	**Late Holocene**
Urtica dioica			Beatty Curve East and West (Connolly et al. 2015)
VIOLACEAE			
Viola			Beatty Curve East (Connolly et al. 2015)
Processed edible tissue			
PET	Locality III (Prouty 2004)		Beatty Curve West (Connolly et al. 2015); Williamson River fishing camp (Cheatham 1991)
Introduced taxa			
Malus			Beatty Curve East (Connolly et al. 2015)
Prunus armeniaca			Beatty Curve East (Connolly et al. 2015)
Prunus avium			Beatty Curve East (Connolly et al. 2015)
Prunus domestica			Beatty Curve East (Connolly et al. 2015); Bezuksewas Village (Cheatham et al. 1995)
Prunus persica			Beatty Curve East (Connolly et al. 2015)
Phaseolus vulgaris			Bezuksewas Village (Cheatham et al. 1995)
Triticum aestivum			Beatty Curve East (Connolly et al. 2015)
Vitis			Beatty Curve East (Connolly et al. 2015)

2.4.1. Terminal Pleistocene/Early Holocene Paleoethnobotany

Due to the paucity of Terminal Pleistocene and Early Holocene sites with residential occupations, our current understanding of Paleoindian plant food exploitation is limited. Paleoethnobotany at a handful of temporary campsites provide some data on economically important plants, revealing evidence for a diversified diet that included roots and small seeds. Previous studies at the Paisley Caves identified a *Rosa* (wild rose) seed embedded in a coprolite and *Lomatium* starch on a ground hand stone found in association with an extinct Pleistocene horse bone (Cummings and Puseman 2003; Jenkins 2007).

In a preliminary macrobotanical analysis of Younger Dryas deposits at the Connley Caves (35LK50), I identified *Mentzelia albicaulis, Atriplex, Lappula,* and *Chenopodium* seeds (Appendix A). Ongoing macrobotanical research at Rimrock Draw Rockshelter also has the potential to yield interesting and significant finds pertinent to Paleoindian occupations. Charred *Sagittaria*, *Schoenoplectus*, *Typha*, *Sesuvium*, and *Juncus* seeds have been recovered from several Early Holocene hearth features (9500 cal BP) at or below a depth of 200 cm (Helzer and Kennedy 2014). Remarkably, carbonized *Sagittaria* and cheno-am (cf. *Chenopodium* sp. or *Suaeda depressa*) seeds were also found in a component associated with a Western Stemmed point at an open site near the city of Burns (Gilmour et al. 2015). Cultural deposits from the stratum produced two radiocarbon dates of 10,400 to 10,200 cal BP.

At Dirty Shame Rockshelter (35ML65), Sanford (1983) reported *Amsinckia*, *Atriplex*, *Chenopodium*, *Amaranthus, Cornus* (dogwood), *Rosa*, *Helianthus,* and *Typha* seeds from deposits dating between 10,800 and 10,030 cal BP (Zone VI). In Zone V sediments dating between 8700 and 7900 cal BP, the number and variety of seed types increased dramatically. *Rosa*, *Amsinckia*, *Plectritis* (sea blush), *Lappula*, Poaceae, *Helianthus*, *Chenopodium*, *Descurainia* (tansy mustard), *Typha*, *Oenothera*, *Scirpus*, and *Prunus* were all identified.

Remnants of *Prunus virginiana*, *Scirpus*, *Carex*, *Corylus* (hazelnut), *Lomatium*, and *Rubus* (brambles) were recovered from a 9500 cal BP hearth at Paulina Lake (Connolly and Jenkins 1999). Macrobotanical soil flotation at Locality III identified charred vegetative tissues along with *Artemisia*, *Chenopodium*, and *Juniperus* in Component I, dated to about 10,000 cal BP (Prouty 2004). Component II deposits, dated between 8580 and 7000 cal BP, yielded *Artemisia*, *Polygonum* (knotweed), *Suaeda depressa* (wada), *Chenopodium*, and charred processed edible tissue (PET). Pollen and starch analysis of a grinding slab revealed preserved Poaceae and possibly *Camassia quamash* microbotanical remains (Jenkins 1999).

2.4.2. Middle Holocene Paleoethnobotany

Increases in population density and sedentism during the Middle Holocene permit the study of anthropogenic plant use in habitation sites. Archaeobotanical remains from Middle Holocene components at Bergen, Locality III, Bowling Dune, DJ Ranch, Big M, and the Dunn sites suggest a focus on lowland marsh plants. Macrobotanical analysis conducted by Helzer (2001) at the Bergen site yielded information about plants associated with daily household life, providing a more complete understanding of settlement and subsistence in the Fort Rock Valley. Plant remains sampled from two house floors were examined. Helzer (2001) reports *Scirpus* and *Chenopodium* seeds dominated the assemblage along with numerous tui chub vertebrae. Other identified seed taxa included *Chrysothamnus*, *Cyperus*, *Scirpus*, *Suaeda*, and *Sarcobatus*. Very little evidence of upland root processing was noted indicating the people living at Bergen intensively used local wetland resources.

Sites located near Silver Lake yielded similar results. The Middle Holocene component at Locality III produced charred *Scirpus*, *Suaeda depressa*, *Chenopodium*, *Polygonum*, and Poaceae seeds as well as *Artemisia* and *Juniperus* charcoal (Prouty 2004). At Bowling Dune and DJ Ranch, Prouty (1994) found low taxonomic diversity in his analysis of cultural features. *Artemisia* charcoal was the solitary botanical type recovered from samples at DJ Ranch, while only *Artemisia*, *Juniperus*, Poaceae and cheno-ams were identified from house floors and hearths at Bowling Dune. Bulk soils processed for macrobotanical identification at Big M also produced little in the way of carbonized plant matter; Poaceae stems and minute fragments of *Juniperus*, *Artemisia*, and *Philadelphus lewisii* (mock orange) charcoal were the only flora identified (Stenholm 1994). Though no roots were found, all four of these sites contained groundstone artifacts.

A hearth at the Dunn site in the Harney Basin yielded a more diverse plant assemblage dating to the Middle Holocene, including charred *Pinus*, *Chenopodium*, *Juniperus*, Brassicaceae and Poaceae seeds, as well as conifer charcoal (Musil 1990). Nancy Stenholm, who conducted the investigation, interpreted the presence of these taxa as evidence of utilization of the higher elevation juniper woodlands in eastern Oregon toward the end of the Middle Holocene.

At Dirty Shame Rockshelter, Middle Holocene-aged seeds date from 7640 to 7410 cal BP in Zone IV (Sanford 1983:80-85). Analysis identified *Typha*, *Descurainia*, *Atriplex*, Poaceae, *Rosa*, *Chenopodium*, *Brickellia* (brickelbush), *Allium*, *Apocynum* (Indian hemp), *Juniperus*, and *Juncus* seeds. *Equisetum* (horsetail fern) fragments were also recovered. The seed spectra in Zone III, representing 7220 to 6600 cal BP, included *Typha*, *Atriplex*, *Chenopodium*, *Amsinckia*, *Descurainia*, *Scirpus*, Poaceae, *Plectritis*, *Prunus*, *Rosa*, and *Cornus* (Sanford 1983:85-87). Overall, the Middle Holocene macrobotanical array at Dirty Shame Rockshelter does not appear to differ greatly from the Early Holocene seed assemblage.

2.4.3. Late Holocene Paleoethnobotany

Intensive occupation episodes are reflected in the archaeobotanical record as well as the archaeological record during the Late Holocene. Extensive research at sites like Carlon Village and Boulder Village demonstrates an intensification of roots (geophytes) and small seed processing by inhabitants of the northern Great Basin (Jenkins and Brashear 1994). Late Holocene sites are located in both lowland and upland settings, and the botanical assemblages suggest plant resources collected from various elevations were important dietary staples. Carlon Village, situated on the edge of Silver Lake in the Fort Rock Basin, was occupied between 2300 and 600 BP (Wingard 2001). Archaeological seeds identified at Carlon Village include *Allium*, *Chenopodium*, *Amaranthus*, *Galium* (bedstraw), Cyperaceae, Fabaceae, *Prunus virginiana*, *Polygonum*, and *Rosa* types (Stenholm 1994; Wingard 2001). Close by, the Boulder Village upland habitation site yielded similar results. Although *Lomatium* species accounted for a large portion of the botanical assemblage, *Suaeda depressa*, *Chenopodium*, Poaceae and *Atriplex* are also highly represented (Prouty 1994).

Late Holocene occupations at Dirty Shame Rockshelter were analyzed by Sanford (1983) and Puseman and Yost (2011). Sanford (1983:87-94) reported the presence of *Amsinckia*, *Lappula*, *Plectritis*, Poaceae, *Rosa*, *Polemonium* (Jacob's ladder), *Phacelia* (tansy), *Artemisia*, *Typha*, *Cornus*, and *Apocynum* in Zone II (2850 to 1020 cal BP), and *Descurainia*, *Chenopodium*, Poaceae, *Rosa*, *Amsinckia*, *Cornus*, *Typha*, *Atriplex*, *Plectritis*, *Allium*, and *Prunus* in Zone I (1000 to 450 cal BP). Puseman and Yost analyzed Late Holocene plant remains associated with a wikiup feature demonstrating multiple habitation events between 1200 and 850 cal BP (Jenkins and Kennedy 2016). Charred seeds identified in their analysis included *Chenopodium*, *Descurainia*, Poaceae, *Rosa*, cheno-ams, *Amsinckia*, *Artemisia*, Asteraceae, *Collinsia* (blue eyed Mary), *Cornus*, Fabaceae, *Trifolium* (clover), *Galium*, *Salvia* (sage), *Mentzelia*, *Phacelia*, *Scirpus*, *Sphaeralcea* (mallow), and *Allium* (bulbs). As with the Early and Middle Holocene components at the site, Sanford's analysis does not discriminate between charred and uncharred seed/bulb types. Although Puseman and Yost did make the distinction, the two assemblages are quite similar. The exceptional botanical preservation at Dirty Shame Rockshelter is evidenced by the extensive assemblage of well-preserved cordage, basketry, and other botanical artifacts. In this context, uncharred remains are less likely to indicate intrusions than they do at other sites exposed to weathering (Aikens et al. 1977).

Preliminary analysis of coprolites from a Connley Caves (35LK50) latrine feature dated to ca. 3500 to 3300 cal BP revealed people were ingesting *Juniperus* berries along with *Mentzelia albicaulis*, *Schoenoplectus*, *Polygonum* (smartweed), *Atriplex*, and

Juncus, and Poaceae members as well as fish, including tui chubs, and mammals (McDonough 2018).

Paleoethnobotanical remains from a Late Holocene (ca. 500 cal BP) hearth at Erin's Cave Rockshelter, a short-term summer campsite in the Catlow Valley, contained several carbonized *Suaeda depressa*, *Chenopodium*, and Poaceae seeds, along with charred *Allium*, *Artemisia*, *Carex*, *Crataegus* (hawthorn), *Descurainia*, *Juncus*, *Juniperus*, *Polygonum*, and *Shepherdia* (buffaloberry) seeds (Dexter 2010). Starch grains recovered from the use-wear surfaces of groundstone artifacts reflected the processing of roots and tubers in the Apiaceae family (Dexter 2013).

Close by, a hearth associated with probable Shoshone Ware pottery excavated at Skull Creek Dunes Locality 10 (35HA496) yielded numerous cheno-ams including *Chenopodium*, *Suaeda*, and *Atriplex* seeds. Several Poaceae taxa (*Agrostis*, *Alopecurus*, *Hordeum*, *Leymus*, and *Poa*) were also identified along with *Descurainia*, Cyperaceae, and *Scirpus* seeds. Radiocarbon assays date the hearth to 900 cal BP (Helzer, personal communication, October 24, 2017; Thomas et al. 2015).

Macrobotanical research conducted by Stenholm at a Williamson River fishing camp in the Klamath Basin, Site 35KL667, yielded evidence of conifer and hardwood charcoal, an unidentified starchy edible tissue fragment, and *Chenopodium* seeds (Cheatham 1991). At the Bezuksewas Village Site (35KL778), Stenholm analyzed eight flotation samples and 16 individual botanic specimens (Cheatham et al. 1995). Site 35KL778 represents a major habitation site located near Chiloquin, Oregon, with residency extending from the Late Holocene into the Historic Era. Stenholm identified conifer charcoal, seeds, and edible tissues in the samples. Identified seeds included the

Eurasian imports *Phaseolus vulgaris* (green bean) and *Prunus domestica* (plum) along with native species including *P. subcordata* (Klamath plum), *Polygonum*, *Comandra* (toadflax), and Poaceae. A starchy liliaceous bulb, probably representing *Camassia* was also present in the assemblage. Additionally, residue recovered from the stem of a pipe was interpreted to represent *Nicotiana* (tobacco).

A large scale macrobotanical investigation I conducted at the Beatty Curve archaeological site (35KL95) included the processing and analysis of 48 bulk sediment samples and 137 individual botanic specimens (Connolly et al. 2015). Located along the Sprague River in the Klamath Basin, the site consists of two loci: the west locus reflects human residency in the Late Holocene (ca. 2500 cal BP) and the east locus represents the remains of a Klamath homestead occupied between AD 1864 and 1905. The macrobotanical assemblage consisted of seeds, charcoal, PET starchy tissues, and PET fruity tissues. The charred tissues represent taxonomically unidentifiable charred berry and tuber materials. The west locus assemblage consisted of only 38 charred seeds representing *Apocynum*, cheno-ams, *Lupinus* (lupine), *Nicotiana attenuata* (Indian tobacco), *Nuphar lutea* spp. *polysepala* (wokas), Poaceae, *Ranunculus aquatilis* (aquatic buttercup), *Prunus virginiana*, *Schoenoplectus*, *Sysimbrium* (hedgemustard), and *Urtica dioica* (stinging nettle). These taxa largely represent economically important flora utilized for food and fiber crafts (basketry, mats, etc.).

Macrobotanical studies at the East Locus were initiated to gain a better understanding of the association between Klamath tribal members and United States governmental policies as they related to diet, culture, and assimilation during the pre-Allotment period. Numerous seeds (n=1351) were present in bulk soil samples from the

East Locus. Twenty-eight identifiable taxa were observed: cheno-ams, a member of the Lamiaceae family including *Mentha* (mint), *Polygonum*, a member of the Boraginaceae family, members of the Rosaceae family including *Malus domestica* (apple), *Prunus armeniaca* (apricot), *P. avium* (cherry), *P. domestica* (plum), *P. persica* (peach), *P. subcordata*, *P. virginiana*, and *Rubus*, *Scirpus*, *Viola* (violet), cf. *Nuphar lutea* ssp. *polysepala*, *Juncus*, *Urtica dioica*, *Pinus*, *Sambucus*, *Typha*, *Vaccinium* (huckleberry), *Vitis* (grape), a member of the Brassicaceae family, *Gilia* (gilia), *Sagittaria*, and *Triticum aestivum* (wheat). Identified species included plants traditionally valued for food, medicine, and construction, as well as introduced Eurasian domesticates, demonstrating the persistence of traditional cultural practices even as federally imposed policies mandated assimilation of Klamath tribal members.

At a pit house village site in Klamath County (35KL2088), Kennedy (2017) analyzed sediments from within and outside the perimeter of a house pit feature. Radiocarbon dates from the house pit place residency at approximately 200 cal BP. Along with charcoal specimens, the center of the house pit yielded economically valued seeds, including *Chenopodium*, *Schoenoplectus*, *Juniperus*, *Poa*, *Rosa*, and *Suaeda*. The presence of *Suaeda* seeds in the Upper Klamath Basin is unusual, as this food source is typically associated with Northern Paiute populations in eastern Oregon. However, seeds have been found in other historically-documented Klamath resource areas. *Suaeda* seeds were recovered at Bergen in the Fort Rock Basin in Early, Middle, and Late Holocene deposits (Helzer 2001; Prouty 1994, 2004). Seeds identified in the house pit feature would have been available to harvest in the autumn. No introduced plant taxa were recovered in the house pit samples. If residency in these houses extended into the post-contact era, people were not consuming Eurasian domesticates here as they were at Beatty Curve and Bezuksewas Village.

2.5. Paleoecology and Archaeology Overview

In the northern Great Basin, WST sites pre-date the Clovis horizon, prompting archaeologists to question the nature and timing of human dispersals into North America. Significant environmental changes since the LGM have affected the demographic trends in North America generally, and in the Great Basin, specifically. The post-glacial climate history of the northern Great Basin has been historically mediated by local orographic and hydrographic fluctuations.

Persistence of upland forests, shrub-steppe, and marshy wetland resources may account for continued reliance on a core group of wild plants that supplemented diets of northern Great Basin residents. The survey of cultural plant remains discussed here reflects nearly 12,000 years of plant use in the northern Great Basin. Emerging patterns demonstrate the persistent use of culturally-important taxa through time, as Fowler and Rhode (2007) suggested for the Basin as a whole. Here, economically-important taxa include members of the Chenopodiaceae, Asteraceae, Apiaceae, Brassicaceae, Cyperaceae, Poaceae, Rosaceae, Polygonaceae, Loasaceae, and Juncaceae families. Diachronic trends hint at continued usage of resources across generations. The following chapters will compare the results from two sites, the Paisley Caves and LSP-1 Rockshelter, to determine how the archaeobotanical data reported here correspond with previously observed trends.

CHAPTER III

RESEARCH FRAMEWORK

Human-environmental interactions figure prominently in the study of Great Basin archaeology. Here, indigenous populations with varying levels of mobility practiced subsistence foraging over millennia. Hunting, gathering, and fishing activities were intermittently supplemented by small-scale cultivation conditioned by the historical period and regional environmental constraints. Historically, Great Basin archaeological research has been deeply entrenched in evolutionary ecology. Although the specific theoretical frameworks and research paradigms have vacillated over the past century, a core underlying idea about hunter-gatherer subsistence persists: people practicing foraging modes of subsistence are especially sensitive to ecosystem perturbations. As a result, cultural and behavioral adaptations – even those reflective of niche construction processes – are closely related to environmental factors (Aikens and Jenkins 1994; Bettinger 1991a; Jennings 1957, 1964).

Addressing perceived linkages between archaeological and paleoenvironmental datasets requires better understanding of connections between the data. As Contreras (2017:14) elegantly observes, interactions between people and environments occur at multiple spatial and temporal scales. The resolution of regional paleoclimate data does not necessarily correspond to the resolution of archaeological data in individual sites. Although difficult, especially in archaeological contexts with ephemeral footprints, identifying how, when, and where these processes articulate can be accomplished by working across scales to incorporate paleoecological and archaeological datasets, and by working between scales to explore the mechanisms through which articulation occurs. Historical ecology, in general, and paleoethnobotanical data, in particular, can fulfill the call for “an iterative process of tacking between local and regional, and perhaps also etic and emic, in exploring past human-environment interactions,” (Contreras 2017:14) because those data represent locally and regionally available taxonomic types in well-stratified and dated archaeological contexts.

Perspectives grounded in historical ecology value the importance of human dynamism, human agency, communication, cognition, and historical antecedents (Crumley 1994). The methods of historical ecology are multi-disciplinary, incorporating cultural, historical, biological, and geological lines of evidence (Egan and Howell 2001). Through this lens, I explore the interpretations of archaeological and paleoecological records and demonstrate how a historical ecology perspective can reshape our understanding of hunter-gatherer populations in the Great Basin and beyond.

3.1. Historical Foundations of Hunter-Gatherer Anthropology

The trajectory of research on hunter-gatherers emanates from two theoretical frameworks: the developmental model and the ecological model (Bettinger 1991a; Trigger 2006). The developmental model, which views hunter-gatherers as a primitive societal form, originated in 19th century British theory, although conceptions of “primitives” had developed as early as the 17th century, well before any notion of hunter-gatherer entered the British consciousness (Barnard 1999). Social Darwinists like Herbert Spencer viewed hunter-gatherers as the ontogenic precursors to modern British society. This attitude enforced a unilinear and teleological approach to anthropology common to the era (Spencer and Carneiro 1967; Trigger 2006). The perception that indigenous societies had no capacity for change transferred human inequality from the political realm to the natural realm (Trigger 2006:177). Cross-continental colonial anthropology also fostered racism, promoting the notion that because indigenous peoples were incapable of creating “civilized” culture, the establishment of colonial rule was beneficial to the ultimately doomed indigenous cultures (Trigger 2006:194).

The colonial attitude toward hunter-gatherer societies was also pervasive in North American schools where the ecological model developed in tandem with the Euro-American ideal/identity of discovery and mastery of “wild” landscapes. Euro-American anthropologists saw hunter-gatherers as existing in harmony with nature, albeit in a more simple (primitive) stage of cultural evolution (Bettinger 1991b; Morgan 1976; Trigger 2006). Anthropological research in the United States was predicated upon museum-affiliated field studies; therefore, hunter-gatherer populations observed in North America were conceived as being a part of the natural history of the continent. An environmental-materialist perspective dominated the hunter-gatherer discussion, validating the explanatory discourse that identified subsistence practice as a stage of cultural evolution.

These ideas are embodied in the work of Lewis Henry Morgan. Morgan (1976:18) focused on tracing evolution and concluded that material culture accumulated incrementally in seven principal stages of human development, but failed to explain the process itself. He attributed cultural progression through theses stages to both technological achievements and naturally unfolding institutional correlates. These institutions fell into seven connected categories: subsistence, government, language, the family, religion, house life and architecture, and property (Morgan 1976:12). Morgan understood cultural evolution as a unilinear evolutionary sequence involving an organic burgeoning of ideas. Because the subsistence mode is the first of these institutions, hunter-gatherers are viewed as occupying a lower stage of cultural evolution in his sequence.

In the 20th century, anthropologists increasingly adopted an environmentally-grounded model on hunter-gatherer societies. Cultural ecologists, particularly Julian Steward – a proponent of neoevolutionism – believed that given similar environments and resource availability, cultural forms and developmental trajectories would be similar among different groups of people (Steward 1968; Trigger 2006:389). Leslie White (1943) proposed that as a branch of natural science, anthropological research methods should be empirical and could reveal universal laws of culture. He attempted to resolve human-environmental relationships through nomothetic means. White suggested that both the human organism and the environmental habitat represented constants. He further assumed that race and ethnicity did not affect decision-making, and therefore contended that the efficiency of tools represented the expenditure of energy in evolving culture. Through a series of economically-rational formulas, he demonstrated that efficiency corresponded to advancement. The amount of energy available for culture-building in the hunter-gatherer stage was finite, whereas in agrarian systems, energy derived from domesticated plants and animals provided a potentially infinitely-increasing return on investment of human expenditure (White 1943:235). These two paradigms heavily influenced the research program of Great Basin archaeology in the western United States (Fowler 1972).

Nomothetic theories pertaining to North American desert hunter-gatherers waned in the mid-20th century as archaeologists recognized the shortcomings of ethnographic analogy in the Great Basin (Widlok 2005:20). The scope and depth of Great Basin ethnographic literature pales in comparison to Northwest Coast accounts, primarily because the latter studies provide a more theoretically productive baseline for anthropological inquiry. Decimation of desert hunter-gatherer populations driven by disease and Euro-American aggression limit the utility of ethnographic analogy so that hunter-gatherer data are primarily extrapolated from archaeological data itself.

3.1.1. Great Basin Research Paradigms

Archaeologists in the Great Basin have traditionally emphasized the Culture-Historical approach. The Culture-Historical approach traces chronologies based on changes in the material culture found in archaeological sites. In this approach, specific periods are defined by common artifact assemblages across wider swaths of geographic area rather than evaluating each archaeological site independently (Willey and Phillips 1958).

Although this tradition has been largely superseded by more scientific and nuanced approaches around the world, the practice of identifying cultural periods provides a baseline for understanding localized behavioral practices in the past. This is especially true in the Great Basin where Jesse Jennings devised the Desert Culture Hypothesis that posited cultures in the Great Basin had remained in a relatively stable state of “Archaic” (or Desert Archaic) development over the course of several millennia beginning with the recession of pluvial lakes around 8900 cal BP (Grayson 2011; Jennings 1957; Jennings and Norbeck 1955; Jones et al. 2003). Once the environment stabilized, so did the subsistence practices of Great Basin Natives.

Jennings deduced that small bands of hunter-gatherers followed seasonal rounds hunting, gathering and fishing, living in family bands, adhering to loosely affiliated political structures, and subscribing to similar cosmological beliefs across the Basin throughout the Holocene. In Jennings’ view, people lived exclusively off the land and were at the mercy of the environment, forced to migrate across sub-basins when conditions became unfavorable in particular locations. Culture change over time was considered negligible and related to climatically-mediated changes in resource availability (Jennings 1957, 1964). Not surprisingly, Steward’s Cultural Ecology model figured prominently in the scholarly works of Jennings and his colleagues. While archaeologists have since abandoned the notion that people persisted in a stagnant cultural system, the practice of developing cultural histories for Great Basin people remains an integral component of the archaeological literature.

Variations on the Desert Culture Hypothesis have been proposed by several archaeologists working regionally in the Great Basin. Willig (1989), for example, suggested Paleoindians shared similar cultural traits with later Desert Archaic populations that flexibly practiced broad spectrum foraging across a myriad array of environments, but remained tethered to mesic resources. The most generalized culture chronology was proposed by Willig and Aikens (1988) and is still widely used across much of the Basin today.

3.2. Historical Ecology

Theories of historical ecology (HE) view environments not as mere physical or biological units, but as contexts where human populations reside and shape their cultures. Historical ecology stems from two premises. First, space itself is considered a contingent product of human practice (Biersack 1999). This perspective, in line with a hermeneutic epistemology, provides a useful framework for viewing landscapes both as standpoints (Hicks and McAtackney 2007), and as encompassing the lives and times of predecessors who have moved around in them and participated in their formation through deep time (Ingold 2000). Second, the HE approach focuses on the "interpenetration of culture and the environment, rather than on the adaptation of human beings to the environment" (Balée 1998:14). In archaeological research, historical ecology approaches emphasize the dialectical relationships between people and their biotic and abiotic surroundings through time, and thus provide a methodologically explicit means of understanding the linking of ecosystem dynamics and human agency (Ellen 2006:S14).

HE approaches fundamentally dispute the concept of a “pristine” ecological condition in the age of anatomically modern humans. People affect and are affected by changes in landscapes (Balée 2006). Humans, especially in small-scale economies, episodically and cyclically induce intermediate disturbances through actions such as broadcast fires, tree cultivation, settlement, and soil enrichment. HE perspectives permit researchers to trace the vestiges of human behaviors to recognize persistent long-term relationships with the landscape and the inheritance of ecological knowledge pertaining to those relationships in diachronic studies. Traditional Ecological Knowledge (TEK) is defined as the knowledge and insights acquired through extensive observation of a particular landscape, including all taxa residing in that space. TEK may include knowledge passed down in an oral tradition or shared among users of a resource (Huntington 2000). TEK plays an important role in influencing how people react to and initiate environmental perturbations. This view can be applied to studies of small-scale subsistence economies despite the limited archaeological footprint left by hunter-gatherers. The legacy of human decisions and actions across landscapes is integral to ecological evolution itself and not merely a consequence of natural selection as has been historically portrayed for hunter-gatherer societies in North America.

The HE framework is particularly appropriate in research employing Paleoethnobotanical and zooarchaeological data because it connects ethnography with archaeology. Paleoethnobotany can reflect worldviews as it studies the practice of communing with food, drink, medicinal, stimulant, and depressant plants (Clément 1998). This also pertains to Paleoindian cultures that colonized the Great Basin and descendent populations that dwelled there for millennia.

Paleoethnobotany (or archaeobotany) refers to the study of the connection between ancient humans and ancient plants through analyzing and interpreting archaeological remains (Hastorf 1999; Vanderwarker et al. 2016). Macrobotanical analysis indicates the recovery and identification of seeds, bulbs, tissues, charcoal, and other macroscopic plant elements as opposed to microscopic elements like pollen, phytoliths, and starches. The extraordinary preservation environment in the arid Great Basin is ideal for archaeological research employing macrobotanical analyses. In contrast, microscopic plant data often compensate in mesic climate reconstructions in the absence of macroscopic data. Even though multiple lines of paleoethnobotanical evidence lend stronger support to building holistic subsistence models (Adams and Smith 2011), macrobotanical remains such as seeds and charcoal can offer direct information on anthropogenic use of plants, while starch, pollen, and phytoliths may merely offer proxy data of human involvement. Hence, when available, macrobotanical data can provide indispensable records.

Understanding human subsistence strategies is an overarching biological paradigm in anthropological research (Ellen 2006:S4). Paleoethnobotanical analyses can provide a wealth of information about local subsistence and the history of human-environment interactions. Wild plant foods have long been recognized as important components of human diet in hunter-gatherer lifeways. Even so, studies of subsistence economies tend to focus on the analysis of associated faunal taxa, whereas plant-based resources are more heavily weighted in studies of agricultural societies. To recognize and understand the whole picture of human-plant interactions, archaeologists need to incorporate more paleoethnobotanical analyses of subsistence systems (Hather and Mason 2002).

3.3. Research Questions

My dissertation research aims to examine the interconnectedness among hunter-gatherers' subsistence activities, settlement patterns, TEK, and changing climate conditions. In examining the linking mechanisms involved in human-environmental interactions, this project builds on previous archaeological research in the northern Great Basin, while also providing an independent dataset for detecting and interpreting human-environmental interactions in Oregon for the past 14,000 years. The key data of this research derive from macrobotanical datasets from the Paisley Caves and LSP-1 Rockshelter. Previously analyzed palynological data (Beck et al. 2017; Saban 2015) complements the original macrobotanical data reported here.

What plant taxa are represented in northern Great Basin Rockshelter deposits?

Plant macrofossils preserved in arid rockshelters provide local vegetation records spanning thousands of years (Wigand and Rhode 2002:312). Seeds deposited by both cultural and natural agents dispersed in archaeological sediments offer taxonomic data that can be interpreted in light of known environmental and ethnographic parameters. As a baseline, macrobotanical studies offer presence/absence observations for local plant taxa that can be used to calculate ubiquity and abundance measures. Moreover, macrobotanical counts form the basis of data analysis that can quantify relative contributions of specific taxa to the assemblage through time.

Is the plant macrofossil assemblage representative of collecting and processing efforts conducted by the site residents? Are seeds and charcoal deposited by non-human agents distinguishable from those deposited as a result of purposeful/intentional economic activity?

Direct and indirect resource utilization account for the majority of macrobotanical remains in archaeological sites (Minnis 1981). Accidental charring of seeds during the processing and use and/or consumption of plant resources preserve carbonized materials. Charred seeds resulting from other, natural sources (e.g., wildfire) are highly unlikely to be incorporated into archaeological contexts (Minnis 1981:147). In addition to charring, indicators of cultural involvement in seed deposition can include morphological traits. Breakage patterns in seeds can reveal whether the plant resource was subjected to threshing or grinding. Sanford (1983) describes three fracture types on grasses that indicate they represent waste products from grinding:

> …the archaeological specimens are empty florets with 1) the lemma variously longitudinally split, and either separate or still attached to the rest of the floret structure; 2) lemma still attached, but gaping open or twisted into one plane and spread out fanwise; or 3) floret crushed at the base (Sanford 1983:55).

Macrobotanical analyses are typically limited to the identification of carbonized materials because uncharred seeds rarely preserve for more than 100 years (Minnis 1981), but enhanced preservation conditions in the current study sites preclude making assumptions about the antiquity of plant remains based on carbonization. Therefore, uncharred seeds must be evaluated under additional criteria to determine modes of introduction. Factors other than human agency can contribute to the faunal and floral assemblages present in archaeological sites (Lyman 2004; Schiffer 1972). Any interpretations must consider ethnographic analogy, site formation processes and non-human environmental inputs (Ascher 1961; Binford 1980; Schiffer 1972).

Natural seed dispersal, bioturbation, and animal activities may all introduce seeds inside the dripline of caves and rockshelters. While the diversity of represented plant taxa and the morphological attributes of the seeds themselves are not adequate indicators of cultural activity, interpreting the presence of economically important plants in relation to regional paleoclimate records permits explanations for the plant remains in light of the broader environmental signature. To differentiate culturally-introduced macrobotanical remains from non-cultural remains, I consider both the effects of seed dispersal syndromes and residual contaminants on seed morphology, and the taxonomic diversity of seeds, fruits, and charcoal found in archaeological contexts at the Paisley Caves and LSP-1 Rockshelter.

Gravity (autochory), animals (zoochory), wind (anemochory), and water (hydrochory) all provide mechanisms by which plants spread their genetic material. Buoyancy, explosive dehiscence, and physical structures on seeds themselves (e.g., pappi, wings, plumes, and barbs) facilitate increased long-distance transport of some species of plants (Ellner and Shmida 1981; Howe and Smallwood 1982; Simpson 2006). Ecological adaptations for fleshy fruits also attract animals to aide in the broadcasting of propagules across long distances. Statistically, small-seeded species disperse across greater distances than large-seeded species, and tall species disperse farther than short species (Thomson et al. 2011).

In a global survey of dispersal syndromes, Flores-Moreno et al. (2013) found that the maximum dispersal distances varied by dispersal syndrome, but did not exceed 51.5 m for zoochorous seeds, 22.04 m for aneomchorous/hydrochorous seeds, and 2.5 m for autochorous seeds. The average mean dispersal distance for all plants ranged from 0.7 m to 33.4 m. Thus, if seeds are broadcast without the assistance of human intervention, then taxonomic diversity should be lower than in contexts where people are responsible for the introduction of seeds. Knowledge of plant habit and propagation syndromes of the identified plant taxa in this study will help inform whether seeds in the archaeological deposits were introduced by human activities or resulted from other processes.

Residual contaminants in archaeological contexts result when modern seeds filter downward through the site matrix from the surface due to plowing, trampling, root holes, drying cracks, downwashing, earthworms, ants, or burrowing animals (Keepax 1977:225-226). The protection of rock overhangs at the Paisley Caves and LSP-1 reduces the probability of freeze/thaw events that could result in downwashing and fluvial cracks. Evidence of bioturbation can be gleaned by the presence of rootlets and insects in the soil samples, and the occurrence of krotovina, and rodent dens in the archaeological deposits.

Bushytailed woodrats (*Neotoma cinerea*) have been observed in the vicinity of the Paisley Caves, and their nests reported in the caves. They typically inhabit boulder outcrops, vertical crevices, clefts or caves in cliffs, or talus slopes (Smith 1997). Middens usually contain hoarded plant materials and feces, with increasing caching behaviors occurring between late August and September. Foliage, rather than, seeds, fruits, and bark are preferred food items, and forbs are selected over grasses, although coprophagy is common and when consumed, fecal matter is swallowed whole (Verts and Carraway 1998:283). Plants targeted for food are contingent on locally available genera; but *Juniperus*, *Cercocarpus*, *Atriplex*, *Purshia*, *Pinus*, *Chrysothamnus*, *Descurainia*, *Sphaeralcea*, *Erigeron*, *Astragalus*, and *Vicia* have been recovered from the stomachs and feces of woodrats (Smith 1997:5-6; Verts and Carraway 1998:281). *Artemisia* foliage and seeds are generally avoided. Females seldom forage at distances greater than 50 to60 m from the den, but the home range is limited to 500 m (Frase and Sera 1993; Trapani 2003; Topping and Millar 1996). If seeds in archaeological deposits in the rockshelters are attributed to woodrat den-building, then species recovered from the midden should be locally available with preferential caching of the taxa listed above.

Can the macrobotanical constituents identified at the archaeological sites provide clarification regarding feature function and/or specific activity areas at the Paisley Caves and LSP-1 Rockshelter?

A benefit of analyzing archaeological plant remains is that the analysis can aid in determining feature function (Hastorf 1999; Pearsall 2016). The presence and abundance of charcoal and charred plant remains can indicate whether a feature was used to cook food, while the presence of a cache of seeds can indicate if the feature represents a storage pit. At the Bergen Site in the neighboring Fort Rock Valley, Helzer (2001) collected samples in a horizontal and vertical grid from the floor of a house. Based on the identification of macrobotanical remains, she was able to distinguish the location of the kitchen, a secondary outside hearth, and the sleeping area.

Questions related to feature function have arisen at both the Paisley Caves and LSP-1 Rockshelter. In Paisley Cave 5, a bowl-shaped probable cooking feature was identified in the basal deposits. It is unclear whether the feature is a fire hearth, earth oven, or related to a natural burn recorded in an adjacent unit. The feature has not been dated due to these ambiguities. Macrobotanical analysis may elucidate the function of the feature and guide future research in this portion of the site. At LSP-1 Rockshelter, the amorphous nature of some organic concentrations has led to skepticism regarding their cultural attribution.

Is the resolution of the macrobotanical assemblage detailed enough to identify seasonality of episodic residency?

Archaeobotanical data can enhance the resolution of the archaeological record because the presence of specific plants with known flowering and harvest times can indicate the seasonality of site occupation. If specific habitation events are well-documented, then the assemblage of plant taxa may offer clues to the timing of their collection and/or caching.

Do the culturally-introduced plant taxa identified in the study area indicate that the earliest settlers of North America were generalists in terms of the plant resources they exploited?

A useful result of paleoethnobotanical studies is the ability to place archaeological sites within a model of foraging behavior, which provides a framework for understanding prehistoric subsistence strategies. Previous research in the northern Great Basin proposed Paleoindian subsistence was highly adaptable at the TP/EH boundary. According to (Willig 1989:285), “the recognition of broad spectrum adaptations in the Far West as early as 11,500 B.P. extends the notions of cultural continuity and adaptability so essential to the Desert Culture concept. It means that the foundations of the Western Archaic were already in place at a time when the "desert" as we know it now was just coming into being.”

Paleoethnobotanical analyses at Monte Verde, Bonneville Estates Rockshelter, and Danger Cave have established broad dietary breadth among TP/EH populations (Dillehay et al. 2008; Rhode and Louderback 2007). I reconstruct a record of anthropogenic plant use and ecological interactions in the northern Great Basin during the terminal Pleistocene and early Holocene (ca. 14,000 to 7600 years cal BP) through the identification of plant taxa and artifact-feature associations and application of quantitative analyses. Plant data from hearths and cultural deposits will help reconstruct diet breadth, and quantification of botanical remains will demonstrate the importance of various plants.

Does the plant assemblage associated with the Western Stemmed Tradition reflect a distinctive subsistence pattern or is it similar to other Paleoindian traditions? Does the assemblage at Paisley Caves resemble any other assemblages in Paleoindian contexts in North America or along the Pacific Rim?

Although Willig (1989) suggested the broad spectrum utilization of resources for people with WST and Clovis toolkits, subsequent research appears to demonstrate otherwise. Where Clovis technology has been identified, it is typically associated with big-game hunting (Surovell and Waguespack 2009). Although Grayson and Meltzer (2015) describe only 15 well-defined Clovis sites found in direct association with extinct Pleistocene mammal kill sites, Haynes and Hutson (2013:304-5) assert that big game hunting comprised a majority of subsistence activities (but see Cannon and Meltzer 2008 for an alternative interpretation). Hemmings (2004) compiled a list of Clovis-era sites with plant remains assumed to represent food items, which included seven sites in the continental United States (Shawnee-Minisink, PA, Lubbock Lake, TX, Austin Cave, TN, Gault, TX, Lewisville, TX, Levi Rockshelter, TX, and Israel River, NH).

As opposed to the narrow diet breadth described for Clovis hunters, Western Stemmed points have been found in direct association with evidence of diversified floral and faunal remains indicative of a generalist diet (Erlandson et al. 2011, 2015; Hockett et al. 2017; Jenkins 2007; Jenkins et al. 2012a). On the Channel Islands, Erlandson et al. (2011) report a marine-based economy associated with Western Stemmed points dating to 12,200 cal BP. According to Lupo and Schmitt’s (2016) economic analysis of megafauna hunting, quantitative and qualitative data demonstrate that larger-sized prey has higher handling costs than smaller-sized game (Lupo and Schmitt 2016). If Pleistocene hunters associated with the WST did not focus on large game, then their diversified diets should include broad spectrum resources such as fruits, seeds, vegetables, and roots. Comparisons of TP/EH occupations at the Paisley Caves and other sites allow me to investigate linkages between Paleoindian macrobotanical assemblages in sites with different toolkits. I also explore the potential for the Paisley Caves and LSP-1 Rockshelter macrobotanical assemblages to provide insights about how Paleoindians learned landscapes (McGuire and Stevens 2016).

Do changes in the quantity and relative abundance of taxonomic types in the macrofossil assemblage reflect adaptive responses constrained by large scale climate fluctuations during the Alleröd (14,500 to 13,000 cal BP), Younger Dryas (12,900 to 11,600 cal BP), or the Mid Holocene Climate Optimum (7000 to 5000 cal BP)?

Correlations between climate amelioration and the emergence of cultural patterns associated with Jennings' Desert Culture concept have been proposed in the Great Basin (e.g., Grayson 2011; Weide 1968). While diversifying diet breadth is one logical response to environmental hardships, it is not the only employable rationale. Zeder (2012:259) argued that generalist diets associated with the Pleistocene Broad Spectrum Revolution were not predicated upon adaptation to marginalized ecosystems, but rather occurred "within a context of environmental opportunity where people were able to use their singular knowledge of the environment and their ingenuity in manipulating that environment to their benefit."

The antiquity of cultural deposits and the resolution of the micro-stratigraphy at the Paisley Caves and LSP-1 Rockshelter provide a unique opportunity to study changes in seed frequency over time. Because I focus on diachronic data sets, my research provides information about a high-resolution sequence of human-environmental interactions. I analyze botanical remains within a framework of known global climate oscillations, along with local and regional paleoecological records to test whether changes in the taxonomic assemblage of macrobotanical remains (or diet breadth) are related to environmental degradation or enhancements.

What are the traditional uses of each identified taxon? Are the traditional foodways of descendent Great Basin populations related to archaeological evidence of plant use in antiquity? If so, can we use ethnographic analogy to understand past people-plant relationships and behaviors?

I compare archaeological seed assemblages at the Paisley Caves, LSP-1 Rockshelter, and sites with previously reported archaeobotanical data to historic and contemporary ethnographic information. If the culturally-deposited taxa are statistically similar to the ethnographic data, then we may be able to extrapolate procurement and processing strategies from contact-era and post-contact descriptions. If the distribution of available plant resources in the immediate site vicinity and surrounding region changed over time, it could influence the behavior of people utilizing those resources. Those changes could be associated with variations in the material culture identified at the Paisley Caves, LSP-1, and at other archaeological sites in the area.

Another benefit of using analogy to interpret the archaeological record derives from the ability to trace TEK. The vegetation communities of the northern Great Basin contain several economically important plant taxa (see chapters I and II). TEK documented in the ethnohistoric record has implications for understanding behavior and material function in the past. Huntington (2000:1273) noted that quality research necessitates "…a broader willingness to consider [TEK's] relevance, to attend to the information it offers, and to incorporate the expertise that is available." Food-processing, including pre- and post-harvest knowledge and technology, is a tradition passed down to the present generation from ancient ancestors (Wollstonecraft 2011).

Repeated camping and habitation episodes at the sites may have affected vegetation communities in the immediate vicinity of cultural activity. High ecological biodiversity has been associated with the presence of Native populations (Hames 2007). Intermediate ecosystem disturbances initiated by foraging populations can induce edge effects and create habitat fragmentation, which can lead to net increases of biodiversity (Redman 2005). Camp followers, ruderal, and commensal plants thrive in disturbed habitats and often accompany habitation and camp sites; they are also usually highly represented in the archaeological record (Yarnell 1982).

Deur (2009) argued that Klamath and Modoc subsistence practices fall outside traditionally-defined hunter-gatherer activities, as they have actively managed plant communities across multiple scales. His observations are rooted in contemporary ethnographic interviews, but to evaluate the time depth of management strategies, archaeological plant data must be consulted. In the current study, I attempt to identify patterns of human-plant interactions that can aid in elucidating these strategies.

3.4. Research Overview

I analyze archaeological plant remains to learn about environmental conditions in the past and to make interpretations about the economic uses of plant remains as they relate to other aspects of material culture in the archaeological records (Hockett et al. 2017; Jenkins 2007; Jenkins et al. 2012a, 2013, 2016; Pelligrini 2014; Smith et al. 2014, 2015, 2016). I also investigate the exploratory potential of analogies to enhance the productivity of my study on desert hunter-gatherer populations. This dissertation utilizes an historical ecology approach to studying paleoethnobotanical data from arid cave sites in the northern Great Basin. Interpretation of macrobotanical remains with reference to local and regional pollen data provide a multi-scalar view of human-environmental interactions of Great Basin foragers over the past 14,000 years. I consult palynological studies of the Paisley Caves sediments (Beck et al. 2017; Saban 2015) to complement the macrobotanical data. Additionally, pollen data obtained from northern Great Basin lakes are used to contextualize regional paleoclimate data.

CHAPTER IV

MATERIALS

4.1. The Paisley Five-Mile Point Caves (35LK3400)

4.1.1. Site Setting and Formation

The Paisley Caves are a series of wave-cut rockshelters that formed during the Pleistocene at the highest stand of pluvial Lake Chewaucan approximately 19,000 to 18,000 years ago. The caves are located at 1377 m AMSL on the far southeastern edge of the Summer Lake Basin, a north-south trending valley flanked by Winter Ridge to the west and Diablo Rim to the east and watered by the Chewaucan River (Figure 4.1).

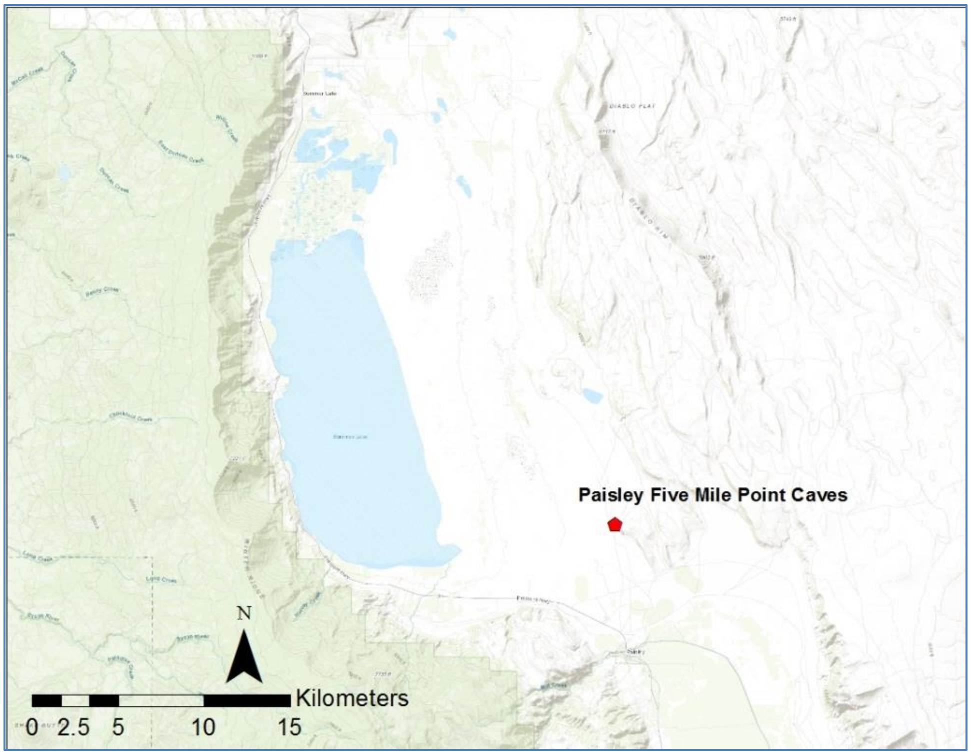


Figure 4.1. The Paisley Caves geographic setting.

As the lakebed was exposed, the silty-sand overlaying gravel substrates were transported by southwesterly winds. These sediments accumulated in the caves, forming basal lenses of organic sand and silt atop wave-rounded boulders and sandy gravels by approximately 14,700 years ago. Increasing local precipitation and reduced evaporation regimes beginning 14,500 years ago caused lake levels to increase and water once again inundated the fan (Jenkins et al. 2016:132). A stream formed that flowed north into the Summer Lake basin and cut a channel across the plain approximately 1.6 km southwest of the caves (Jenkins et al. 2016:132).

Although the Paisley Caves are currently situated far above the valley floor, during the terminal Pleistocene they would have provided ample access to nearby lacustrine resources when the revitalized lake, delta river marsh, and associated grasslands supported habitat for fish and waterfowl, and forage vegetation for large migratory mammals (Jenkins et al. 2013). The location of the caves at the confluence of local marshy resources and nearby upland root grounds to the east provided access to a variety of plants and animals, making it an ideal campsite.

Historic vegetation modeling shows the proximity of desert scrub, alkaline grasslands flats, ponderosa pine forest, aspen groves, montane meadows, and seasonal wetlands within 20 km of the Paisley Caves (Tobalske 2002). Today, ponderosa pine grows on the upper eastern slopes of Winter Rim, 10 km west of the site. The *Pinus Ponderosa* Zone near the site is characterized by a *Pinus ponderosa* overstory, with *P. contorta* and *Abies concolor* more common at higher elevations. *Arctostaphylos*, *Ceanothus*, and *Purshia tridentata* comprise much of the understory vegetation (Franklin and Dyrness 1988).

4.1.2. Previous Research

The Paisley Caves are located along a south cliff face above Summer Lake. Seven west-facing rock overhangs and the downslope cave apron exhibit evidence of human habitation (Figure 4.2). The site extends 144 m x 20 m, covering an area of approximately 3035 m^2. Three grottos, Caves 1, 2, and 5, were systematically investigated for archaeological materials (Figure 4.3). The site was listed on the National Register of Historic Places under Criterion D in 2014 (Dexter and Jenkins 2014).

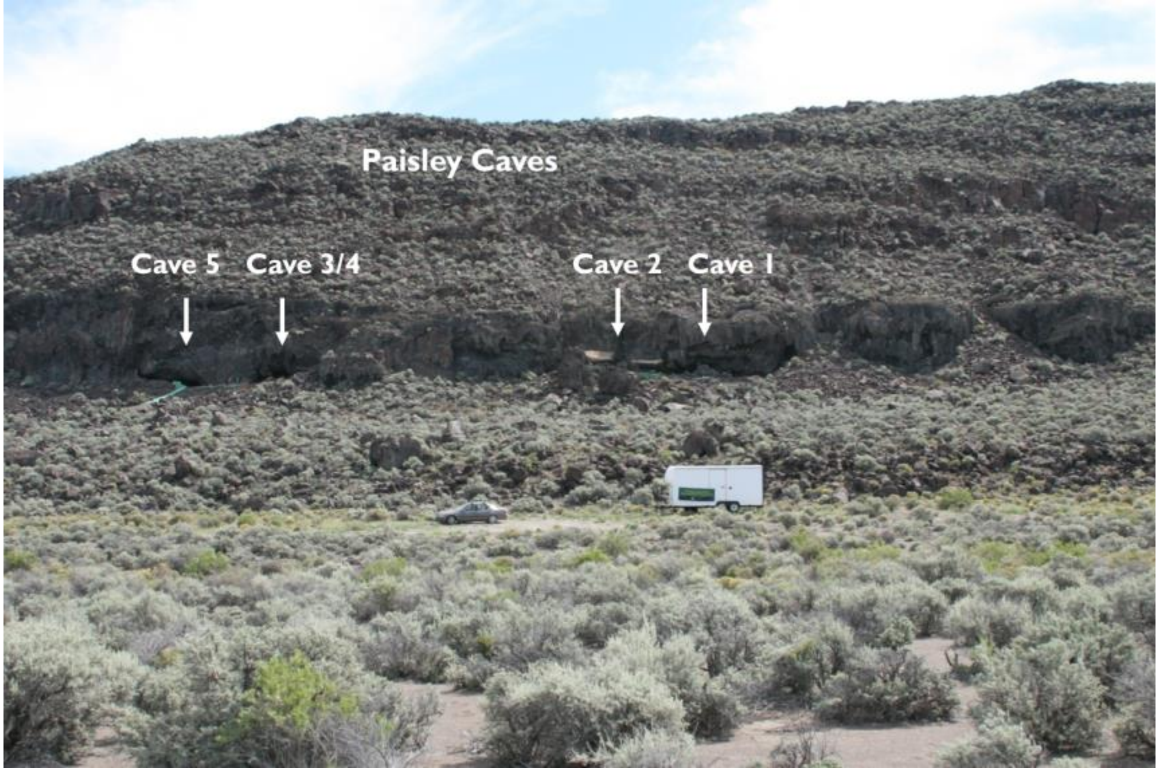


Figure 4.2. The Paisley Caves (35LK3400), view north (photo: D. Jenkins)

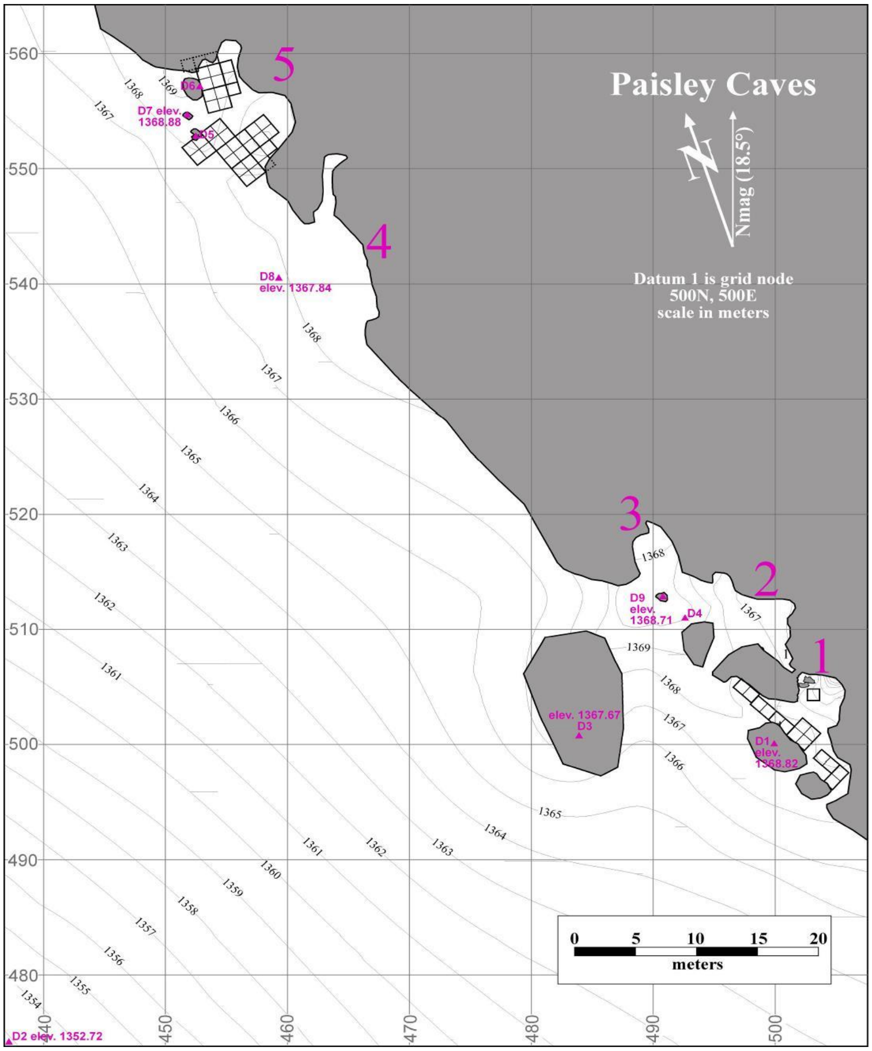


Figure 4.3. Paisley Caves site planview (Kennedy and Jenkins 2014).

The southern-most grotto, Paisley Cave 1, measures 14 m long and is 7 m deep from the drip line to the rear wall. Roof fall blocks a substantial area at the mouth of the cave (Figure 4.4). Cave l excavations covered 16 m^2 and removed 29.2 m^3 of sediments to depths up to 245 cm. Large roof fall debris (ca. 2000 cal BP) also blocks the primary access to the central and southern portions of Paisley Cave 2 (Figure 4.5). Jenkins (2007) noted prior to the collapse, the overhang would have provided additional covered habitable area within the cave. Cave 2 now measures 7 m long and 6 m from the entrance

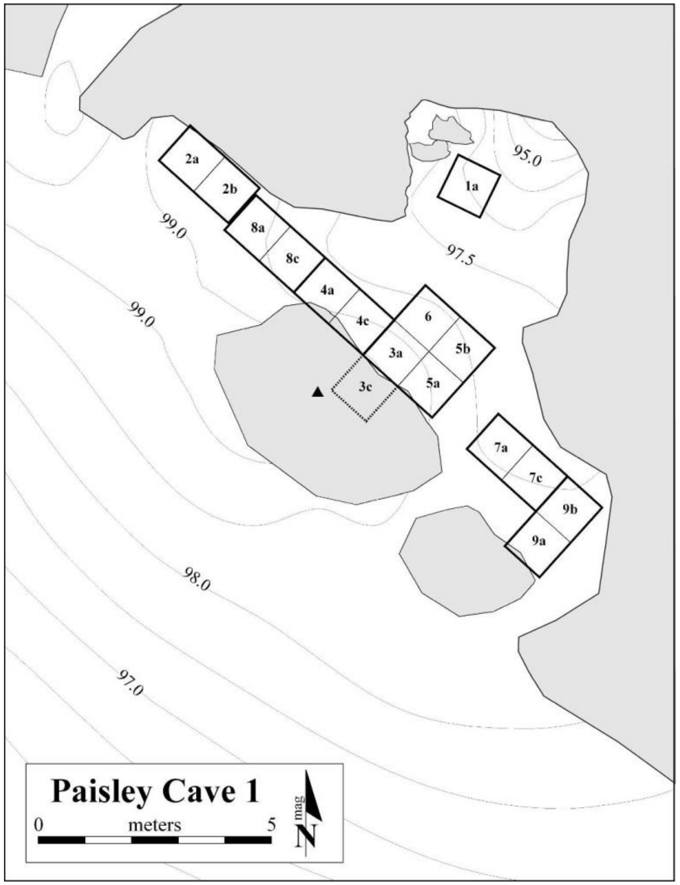


Figure 4.4. Map of Paisley Cave 1 excavation (Jenkins et al. 2016:185).

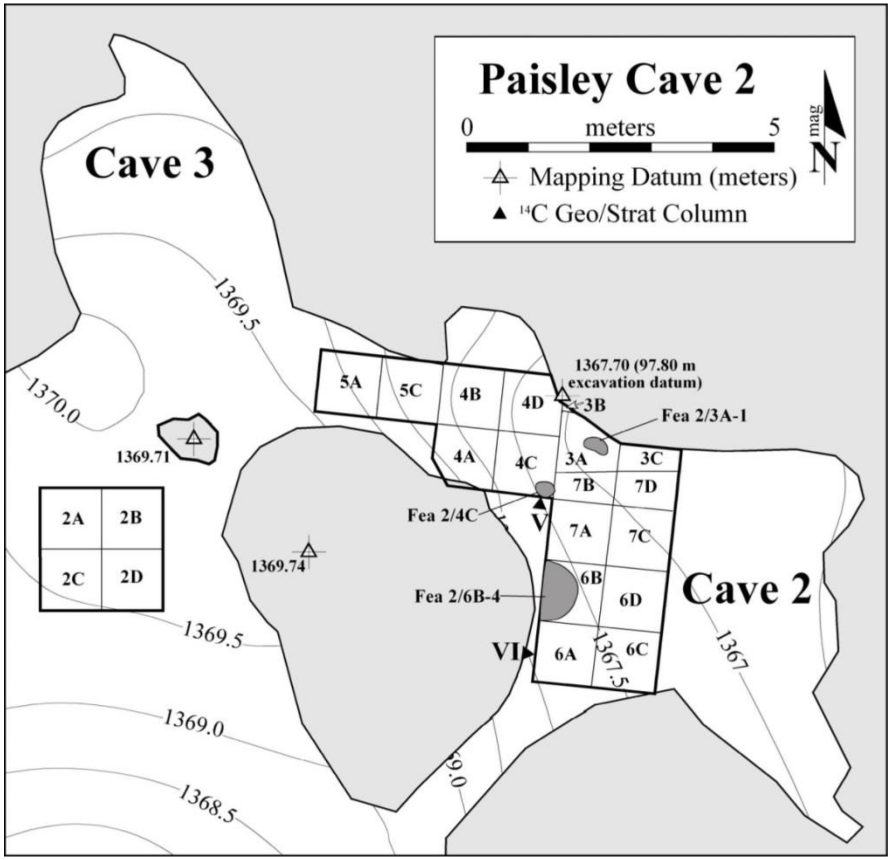


Figure 4.5. Map of Paisley Cave 2 excavation (Jenkins et al. 2016:135).

to the back of the cave. Excavations in Cave 2 removed 30.3 m^3 of sediments across 22 m^2. Bedrock was encountered at a maximum depth of 230 cm. Cave 5 is open to direct entry and measures 11 m across and 6 m deep (Figure 4.6). Systematic excavations covered 45 m^2 and removed 75.6 m^3 of sediments in the north and south blocks (Jenkins et al. 2013).

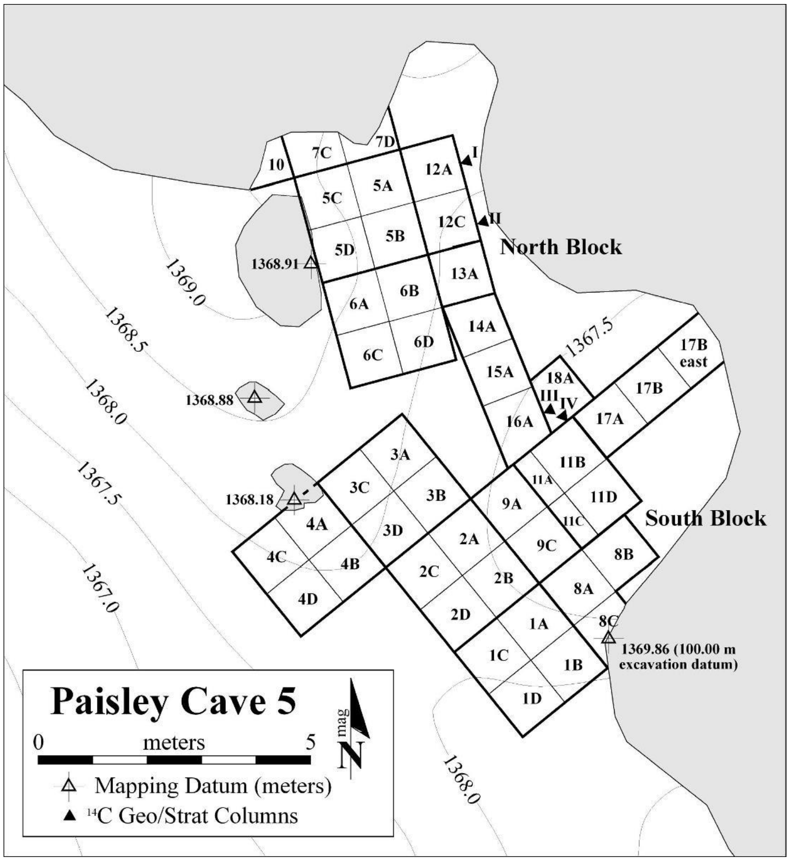


Figure 4.6. Map of Paisley Cave 5 excavation (Jenkins et al. 2012b: no page).

Before the advent of systematic archaeological analysis Luther Cressman (1940) excavated trenches in caves 1, 2, and 3 in 1938 (Cave 3 was later renumbered as Cave 4; Jenkins 2007). Cressman's investigations began only after the site was brought to his attention by locals who had previously vandalized the caves. Cressman discovered a boulder-outlined pre-Mazama living floor with associated artifacts and extinct megafaunal remains when he excavated the main rockshelter deposits in caves 1 and 3(4) the following year. The faunal elements were located primarily along the rear wall and included camel, bison, horse, and waterfowl, some of which exhibited charring. Although few artifacts were discovered *in situ*, obsidian biface fragments, scrapers, edge-modified flakes, and lithic waste flakes were also identified. Cressman contended that the extinct faunal remains represented food scraps discarded by hunters during the terminal Pleistocene (Cressman 1940, 1966; Cressman et al. 1942). This interpretation was questioned by his contemporaries who argued that the lack of provenience data introduced ambiguity and compromised the association between the megafaunal remains and the artifacts (Heizer and Baumhoff 1970; Jennings 1986; Krieger 1944). For six summers between the years of 2002 and 2011 crews from the University of Oregon systematically excavated deposits in caves 1, 2, and 5 to more adequately address questions raised by Cressman's work.

Jenkins' investigations confirmed Cressman's assessment and established horizontal, vertical, and stratigraphic association of cultural remains and megafaunal elements. Human coprolites were cotemporaneous with camel and horse remains between 14,300 and 13,255 cal BP (Gilbert et al. 2008a, Gilbert 2008b; Jenkins 2007; Jenkins et al. 2012). The integrity of the coprolites raised questions for some scholars (see Fiedel 2014; Goldberg et al. 2009; Poinar et al. 2009; Sistiaga et al. 2014), but the research team working at Paisley quelled most doubts in the archaeological community by carefully documenting stratigraphy, demonstrating reliable artifact associations, and reporting a suite of 241 well-ordered radiocarbon dates (Table 4.1) and 487 obsidian hydration dates.

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
AA-19151	100BP-1-5345	NP	NP	NP	*Scirpus* basketry	145±50	300 (270-0) 0	Connolly et al. 1999
Beta-195907	l294PC-1/4-C-19-1	1/4C	1366.98	4	Cotton cloth	1060±40	950 (990) 1040	Jenkins et al. 2013
Beta-249762	60-1-9035	NP	NP	NP	Multiple warp sandal	1590±40	1410 (1520) 1530	Jenkins et al. 2013
Beta-249767	60-1-9017	NP	NP	NP	Multiple warp sandal	1610±40	1400 (1520) 1570	Jenkins et al. 2013
UCIAMS-98926	2011PC-248	1/7A	1366.17	4	*Artemisia* charcoal	4290±15	4848 (4852) 4857	Jenkins et al. 2013
AA-19153	NP	NP	NP	NP	*Scirpus* basketry	6560±70	7560 (7460-7430) 7420	Connolly et al. 1999
OxA-16496	100BP-1-5344	1/2A	1366.33	Mazama	Human coprolite	6608±35	7469 (7510) 7551	Jenkins et al. 2013
Beta-213428	1374-PC-1/2A-28-2	1/2A	1366.33	Mazama	Coprolite	6640±40	7580 (7540) 7440	Jenkins et al. 2012
Beta-191540	1374-PC-12A-28-2	1/5A	1365.28	2	Charcoal, hearth	7600±70	8510 (8390) 8220	Jenkins et al. 2013
UCIAMS-98927	1294-PC-1/5A-23-F1	1/7C	1365.66	2	*Artemisia* charcoal	7680±20	8434 (8469) 8504	Jenkins et al. 2013
UCIAMS-98928	2011PC-249	1/7C	1365.07	2	Carnivore coprolite	8575±30	9534 (9542) 9549	Jenkins et al. 2013
UCIAMS-98930	2011PC-251	1/9B	1364.50	1	*Pinus ponderosa* nutshell	10,010±30	11,371 (11,508) 11,644	Jenkins et al. 2013
UCIAMS-98929	2011PC-254	1/7A	1364.88	1	*Artemisia* charcoal	10,095±30	11,502 (11,675) 11,847	Jenkins et al. 2013
UCIAMS-98930	2011PC-252	1/9B	1364.50	1	*Pinus ponderosa* nutshell	10,165±25	11,719 (11,844) 11,968	Jenkins et al. 2013
Beta-239084	2011PC-254	1/6A	1365.06	1	Cut artiodactyl bone	10,180±60	11,675 (11,844) 12,013	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
AA-96488	1294-PC-1/6A-7	1/9B	1364.65	1	2 strand 'S-Twist' cordage	10,476±56	12,231 (12,408) 12,584	Jenkins et al. 2013
UCIAMS-90578	1961-1/9B-49-12	1/7C	1364.72-1364.78	1	*Artemisia* charcoal	10,540±25	12,393 (12,521) 12,648	Jenkins et al. 2013
Beta-226554	1896-PC-1/7C-42-66	1/4A	1364.68	1	Rabbit bone	11,870±50	13,631 (13,772) 13,912	Jenkins et al. 2013
Beta-228916	l294-PC-2/3A-25	2/3A	1366.10	3	Rabbit bone	340±40	331 (400) 461	Jenkins et al. 2013
Beta-249763	61-1-10023	NP	NP	NP	Multiple warp sandal	1130±40	950 (1050) 1070	Jenkins et al. 2013
UCIAMS-111795	l961-PC-2/7D-19-61	2/7D	1365.77	2	Leather fringe	2040±20	1966 (2000) 2034	Jenkins et al. 2016
D-AMS1217407	1961-PC-2/7A-31-6	2/7A	1365.33-1365.39	1	S-Twist' basketry	2107±26	2041 (2081) 2121	Jenkins et al. 2016
AA-18990	1896-PC-2-LSC-14	NP	NP	NP	Human coprolite with hookworm	2124±25	2064 (2102) 2139	Jenkins et al. 2016
AA-18987	1896-PC-2-LSC-1 l	NP	NP	NP	Human coprolite with hookworm	2225±25	2185 (2246) 2307	Jenkins et al. 2016
AA-18988	1896-PC-2-LSC-12	NP	NP	NP	Human coprolite with hookworm	2230±25	2187 (2249) 2311	Jenkins et al. 2016
Beta-147424	100BP-1-5431	NP	NP	NP	*Scirpus* sandal	2270±50	2340 (2330) 2310	Connolly and Barker 2004

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	**FS* Number**	**Cave/ Unit**	**Elevation**	**LU**	**Dated Material**	**14C Age**	**1σ cal BP Range**	**Reference**
AA-96489	l961-PC-2/7A-31-6	2/7A	1365.33-1365.39	1	*Scirpus* 'S-Twist' fragment	2285±37	2206 (2274) 2341	Jenkins et al. 2013
UCIAMS-79714	l829-PC-2/6A-16-1	2/6A	1366.50	7	Human coprolite	2295±15	2335 (2340) 2345	Jenkins et al. 2013
AA-18989	1896-PC-2-LSC-13	NP	NP	NP	Human coprolite with hookworm	2425±25	2388 (2497) 2605	Jenkins et al. 2016
Beta-249765	61-1-10057	NP	NP	NP	Multiple warp sandal	2830±50	2870 (2940) 2990	Jenkins et al. 2013
UCIAMS-68046	2009PC-162	2/4C	1366.48	3	Bat guano	6790±15	7621 (7640) 7658	Jenkins et al. 2013
UCIAMS-761889	1830-PC-2/4A-35	2/4A	1366.32	3	Human coprolite	7000±15	7822 (7866) 7909	Jenkins et al. 2013
UCIAMS-79711	1830-PC-2/4A-35	2/4A	1366.32	3	Human coprolite	7020±15	7852 (7886) 7920	Jenkins et al. 2013
UCIAMS-79713	1830-PC-2/4D-33-2	2/4D	1366.38	3	Human coprolite	7025±15	7856 (7889) 7921	Jenkins et al. 2013
UCIAMS-79704	1830-PC-2/4C-34-101	2/4C	1366.35	3	Human coprolite	7490±20	8313 (8338) 8360	Jenkins et al. 2013
UCIAMS-76188	1830-PC-2/4D-33-1	2/4D	1366.39	3	Human coprolite	7595±15	8395 (8402) 8409	Jenkins et al. 2013
UCIAMS-79705	1830-PC-2/4C-34-101	2/4C	1366.35	3	Human coprolite	7605±20	8397 (8406) 8414	Jenkins et al. 2013
UCIAMS-79712	1830-PC-2/4D-33	2/4D	1366.39	3	Human coprolite	7645±20	8414 (8426) 8438	Jenkins et al. 2013
Beta-240513	1294-PC-2/3A-31-1	2/3A	1365.80	3	*Scirpus* basketry	7680±50	8430 (8480) 8530	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
Beta-213429	1294-PC-2/3C-19-6	2/3C	1366.4	3	Coprolite	7860±40	8610 (8667) 8723	Jenkins et al. 2013
UCIAMS-76192	2009PC-169	2/4C	1366.19	3	Coprolite	8180±15	9056 (9094) 9131	Jenkins et al. 2013
UCIAMS-14472	PC2/6B-1366.15	2/6B	1366.15	3	*Artemisia* twig	8740±20	9672 (9710) 9747	Jenkins et al. 2016
AAR-9687	1961-PC-2/7A-18-36	2/7A	1365.77	3	3-strand hemp cordage	9078±52	10,212 (10,246) 10,279	Jenkins et al. 2013
UCIAMS-68045	2009PC-166	2/4C	1365.85	3	*Atriplex* twig	9480±20	10,706 (10,725) 10,744	Jenkins et al. 2013
UCIAMS-68044	2009PC-165	2/4C	1365.85	3	Insoluble residue	9565±20	10,806 (10,922) 11,038	Jenkins et al. 2013
Beta-341731	1961-PC-2/7C-16-131	2/7C	1365.87	3	Human coprolite with hookworm	9620±30	10,862 (10,984) 11,106	Jenkins et al. 2016
UCIAMS-14474	PC2/6B-1365.9	2/6B	1365.9	3	*Artemisia* twig	9630±20	10,894 (11,006) 11,118	Jenkins et al. 2013
D-AMS1217410	1896-PC-2/6B-59-13	2/6B	1365.4	3	Cordage	9774±46	11,186 (11,209) 11,232	Jenkins et al. 2016
UCIAMS-85337	1896-PC-2/6B-59-13	2/6B	1365.4	3	Cordage	9995±25	11,370 (11,473) 11,575	Jenkins et al. 2013
UCIAMS-98931	1896-PC-2/6B-57-13	2/6B	1365.48	3	Hearth, *Artemisia* charcoal	10,020±30	11,387 (11,528) 11,669	Jenkins et al. 2013
UCIAMS-80385	1896-PC-2/6B-59-13	2/6B	1365.67	3	*Artemisia* twig	10,090±20	11,499 (11,658) 11,816	Jenkins et al. 2013
Beta-182920	l896-PC-2/6B-57-13	2/6B	1365.7	3	Processed tissues	10,160±60	12,320 (11,860) 11,440	Jenkins 2005
UCIAMS-80386	l896PC-2/6A-52-101	2/6A	1365.48	3	*Artemisia* twig	10,260±25	11,869 (12,008) 12,147	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	**FS Number**	**Cave/ Unit**	**Elevation**	**LU**	**Dated Material**	**14C Age**	**1σ cal BP Range**	**Reference**
Beta-239083	l294-PC-2/3A-33-7a	2/3A	1365.95	3	Cut artiodactyl bone	10,260±60	11,849 (12,048) 12,247	Jenkins et al. 2013
UCIAMS-103089	l896-PC-2/6B-60-1 l	2/6B	1365.35	2	Periosteum tissue on bone	10,290±30	11,976 (12,140) 12,304	Jenkins et al. 2013
UCIAMS-87420	l896-PC-2/6B-59-14	2/6B	1366.40	2	Cordage	10,290±35	11,970 (12,141) 12,311	Jenkins et al. 2013
Beta-195908	1294-PC-2/3C-31	2/3C	1365.80	3	*Artemisia* rope	10,290±40	12,360 (12,000) 11,870	Jenkins 2005
UCIAMS-14473	PC2/6B-1366.00	2/6B	1366.00	3	*Artemisia* bark	10,310±20	12,030 (12,187) 12,343	Jenkins et al. 2016
AA-96490	1961-PC-2/7D-18-2	2/7D	1365.83	2	Braided *Artemisia* cordage	10,319±56	12,016 (12,207) 12,398	Jenkins et al. 2013
UCIAMS-98933	2011PC-244b	2/7A	1365.73-1365.68	3	Cervid (pronghorn) hair	10,330±30	12,067 (12,230) 12,392	Jenkins et al. 2013
D-AMS-1217411	1829-PC-2/4D-48-1	2/4D	1365.65	3	*Artemisia* cordage	10,356±44	12,101 (12,284) 12,466	Jenkins et al. 2013
UCIAMS-103086	1896-PC-2/6B-60-11	2/6B	1365.35	2	Unidentified bone	10,365±30	12,123 (12,297) 12,471	Jenkins et al. 2013
UCIAMS-79680	1829-PC-2/4d-48-1	2/4D	1365.65	3	*Artemisia* cordage	10,365±30	12,123 (12,297) 12,471	Jenkins et al. 2013
UCIAMS-102112	1961-PC-2/7A-18-54	2/7A	1365.75	3	Human hair	10,585±35	12,457 (12,569) 12,680	Jenkins et al. 2013
UCIAMS-76191	1829-PC-2/4C-49	2/4C	1365.60	2	Human coprolite	10,980±20	12,803 (12,896) 12,989	Jenkins et al. 2013
UCIAMS-90577	1896-PC-2/6B-59-29	2/6B	1365.40	2	Hearth, *Artemisia* charcoal	11,005±30	12,816 (12,914) 13,012	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	**FS Number**	**Cave/ Unit**	**Elevation**	**LU**	**Dated Material**	**14C Age**	**1σ cal BP Range**	**Reference**
UCIAMS-102110	1896-PC-2/6B-60-37	2/6B	1365.35-1365.30	2	Hearth, *Artemisia* charcoal	11,055±35	12,848 (12,947) 13,046	Jenkins et al. 2013
UCIAMS-77100	1829-PC-2/4C-49	2/4C	1365.60	2	Human coprolite, water soluble	11,090±30	12,880 (12,977) 13,073	Jenkins et al. 2013
D-AMS1217406	1896-PC-2/6B-60-37	2/6B	1365.35-1365.30	2	Hearth, *Artemisia* charcoal	11,098±45	12,882 (12,988) 13,093	Jenkins et al. 2013
UCIAMS-77103	1830-PC-2/4C-51-101	2/4C	1365.53	2	Human coprolite, macrobot.	11,270±30	13,085 (13,174) 13,262	Jenkins et al. 2013
UCIAMS-68047	2009PC-167	2/4C	1365.53	2	Insoluble residue	11,560±40	13,339 (13,448) 13,557	Jenkins et al. 2013
D-AMS1217409	1961-PC-2/7D-21-4	2/7D	1365.63-1365.70	2	*Artemisia* branch	11,623±51	13,381 (13,510) 13,638	Jenkins et al. 2013
UCIAMS-77104	1830-PC-2/4C-51-102	2/4C	1365.52	2	Human coprolite, macrobot.	11,625±35	13,386 (13,510) 13,633	Jenkins et al. 2013
UCIAMS-86251	1896-PC-2/6B-62-3A	2/6B	1365.31	2	Horse maxilla	11,740±25	13,502 (13,624) 13,745	Jenkins et al. 2013
UCIAMS-79658	1829-PC-2/4C-51-11	2/4C	1365.50	2	Large mammal bone	11,790±35	13,582 (13,689) 13,795	Jenkins et al. 2013
UCIAMS-112742	1961-PC-2/7D-21-4	2/7D	1365.63-1365.70	2	*Artemisia* branch	11,810±50	13,595 (13,720) 13,844	Jenkins et al. 2013
UCIAMS-68018	2099PC-168	2/4C	1365.48	2	Rodent bone	11,830±25	13,613 (13,735) 13,857	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
UCIAMS-90593	1896-PC-2/6B-62-16	2/6B	1365.25	2	Cut artiodactyl bone	11,930±25	13,688 (13,828) 13,968	Hockett and Jenkins 2013
UCIAMS-103085	1896-PC-2/6B-61-11	2/6B	1365.34	2	Horse bone	11,980±35	13,753 (13,945) 14,136	Jenkins et al. 2013
Beta-228917	1294-PC-2/3A-38	2/3A	1365.45	1	Sagegrouse bone	11,980±40	13,752 (13,946) 14,140	Jenkins et al. 2013
UCIAMS-79659	1829-PC-2/4C-52a	2/4C	1365.48	2	Large mammal bone (light)	12,025±30	13,806 (14,003) 14,200	Jenkins et al. 2013
UCIAMS-68016	2009PC-168	2/4C	1365.48	2	Rodent bone	12,190±30	14,001 (14,222) 14,442	Jenkins et al. 2013
UCIAMS-79660	1829-PC-2/4C-52b	2/4C	1365.48	2	Large mammal bone (dark)	12,275±30	14,087 (14,360) 14,633	Jenkins et al. 2013
UCIAMS-79663	1829-PC-2/4C-54-101	2/4C	1365.40	2	Rodent ramus	12,320±35	14,136 (14,469) 14,801	Jenkins et al. 2013
UCIAMS-103084	1896-PC-2/4A-55-15	2/4A	1365.49	2	Horse bone	12,340±35	14,180 (14,513) 14,845	Jenkins et al. 2013
UCIAMS-90594	1896-PC-2/6D-61-4	2/6D	1365.30	1	Bone	12,425±30	14,356 (14,671) 14,986	Jenkins et al. 2013
Y-109	NP	NP	NP	NP	Rodent droppings	7610±1201	8630 (8390) 8180	Preston et al. 1955
AA-19685	A-39-29	NP	NP	NP	Camel bone, accepted)	9790±130	10,929 (11,170) 11,411	Jenkins et al. 2016
UCIAMS-142830	P5P-38-2	NP	NP	NP	Camel bone, not accepted	10,600±3025	12,528 (12,618) 12,688	Jenkins et al. 2016

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
AA-19682	P5P-38-2	3 NP	NP	NP	Camel bone, not accepted	10,640±5525	12,571 (12,641) 12,711	Jenkins et al. 2016
UCIAMS-142851	A-39-29	3 NP	NP	NP	Camelid bone	11,825±3026	13,609 (13,731) 13,853	Jenkins et al. 2016
AA-19684	A-39-36	3 NP	NP	NP	Horse bone	11,895±65	13,645 (13,797) 13,948	Jenkins et al. 2016
Beta-221344	1374-PC-5/2B-28-1	5/2B	1366.56	1	Cotton string	139.1	Modern	Jenkins et al. 2013
UCIAMS-79679	1374-PC-5/5D-30-1b	5/5D	1366.56	1b	Fabric	275±25	305 (362) 418	Jenkins et al. 2013
OxA-16377	1294-PC-5/7D-4	5/7D	1368.16	8	Human coprolite	1308±28	1203 (1242) 1282	Jenkins et al. 2013
GaK-1756	NP	NP	NP	NP	Tule matting	2480±100	2416 (2553) 2690	Jenkins et al. 2013
Beta-213427	1294-PC-5/10D-8-5	5/10D	1367.71	6	Coprolite	4130±40	4830 (4770) 4520	Gilbert et al. 2008
UCIAMS-79710	1704-PC-5/12C-13-6	5/12C	1367.36	5	Human coprolite	4950±15	5655 (5681) 5707	Jenkins et al. 2013
UCIAMS-79715	1704-PC-5/12C-13-4	5/12C	1367.36	5	Human coprolite	5380±15	6197 (6229) 6261	Jenkins et al. 2013
UCIAMS-79708	1704-PC-5/12C-13-5	5/12C	1367.36	5	Human coprolite	5545±20	6312 (6349) 6385	Jenkins et al. 2013
UCIAMS-79702	1704-PC-5/12C-12-6	5/12C	1367.41	5	Human coprolite	5595±15	6335 (6367) 6399	Jenkins et al. 2013
UCIAMS-79703	1704-PC-5/12C-12-6	5/12C	1367.41	5	human coprolite, sol. urine	5655±15	6421 (6439) 6457	Jenkins et al. 2013
UCIAMS-76186	1704-PC-5/12C-14-6	5/12C	1367.35	5	Human coprolite	5715±15	6479 (6502) 6525	Jenkins et al. 2013
Beta-226557	1374-PC-5/5B-23	5/5B	1367.21	5	Rabbit bone	5720±40	6460 (6527) 6588	Jenkins et al. 2013
UCIAMS-76184	1704-PC-5/12C-15-4	5/12C	1367.29	5	Human coprolite	5740±15	6507 (6532) 6557	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
UCIAMS-76182	1704-PC-5/12C-15-6	5/12C	1367.26	5	Human coprolite	5750±15	6515 (6557) 6599	Jenkins et al. 2013
UCIAMS-76187	1704-PC-5/12A-10-11	5/12A	1367.55	5	Human coprolite	5770±15	6546 (6584) 6622	Jenkins et al. 2013
Beta-226559	1374-PC-5/5D-22	5/5D	1367.31	2	Rabbit bone	5810±40	6560 (6612) 6663	Jenkins et al. 2013
UCIAMS-76185	1704-PC-5/12C-15-5	5/12C	1367.26	5	Human coprolite	6115±15	6966 (6986) 7006	Jenkins et al. 2013
UCIAMS-79709	1704-PC-5/12A-12-5	5/12A	1367.41	3	Human coprolite	6155±15	7019 (7080) 7141	Jenkins et al. 2013
Beta-226558	1374-PC-5/5C-23	5/5C	1367.26	2	Rabbit bone	6470±40	7340 (7382) 7424	Jenkins et al. 2013
UCIAMS-76180	1704-PC-5/12C-14-9	5/12C	1367.31	5	Human coprolite	6970±15	7792 (7813) 7833	Jenkins et al. 2013
UCIAMS-75109	2009PC-128	5/12C	1367.11	3	Macroflora	6980±15	7803 (7822) 7840	Jenkins et al. 2013
UCIAMS-75107	2009PC-214	5/12A	1367.46	3	Coprolite	7195±15	7986 (8000) 8014	Jenkins et al. 2013
UCIAMS-79673	1830-PC-5/12A-21	5/12A	1367.01	2	Human coprolite	7260±30	8036 (8090) 8143	Jenkins et al. 2013
Beta-191539	1374-PC-5/3B-21-F53	5/3B	1366.86	2	Charcoal, hearth	7640±50	8540 (8410) 8360	Jenkins et al. 2013
UCIAMS-79699	2009PC-151	5/11B	1366.49	3	Charcoal	7700±20	8450 (8485) 8520	Jenkins et al. 2013
UCIAMS-68022	2009PC-129	5/12C	1367.11	3	Insoluble residue	7805±20	8568 (8586) 8603	Jenkins et al. 2013
UCIAMS-76178	2009PC-110	5/12A	1367.45	3	Uriniferous sand, urine	8105±20	9015 (9040) 9064	Jenkins et al. 2013
UCIAMS-76177	2009PC-110	5/12A	1367.45	3	Uriniferous sand, macrofossil	8285±15	9283 (9330) 9377	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
UCIAMS-76179	2009PC-152	5/11B	1366.37	3	Uriniferous sand, charcoal	8355±20	9336 (9385) 9433	Jenkins et al. 2013
UCIAMS-75108	2009PC-130	5/12C	1367.08	11	Uriniferous sand	8510±20	9503 (9517) 9530	Jenkins et al. 2013
UCIAMS-79675	2009PC-112	5/12A	1367.41	3	Uriniferous sand, macroflora	8650±30	9561 (9601) 9641	Jenkins et al. 2013
UCIAMS-79700	2009PC-154	5/11B	1366.29	3	*Atriplex* twig	8935±20	9973 (10,074) 10,175	Jenkins et al. 2013
UCIAMS-79674	2009PC-111	5/12A	1367.43	3	Uriniferous sand, macroflora	8945±35	9973 (10,077) 10,180	Jenkins et al. 2013
UCIAMS-76183	1704-PC-5/12A-16-9	5/12A	1367.24	2	Human coprolite	9170±20	10,269 (10,318) 10,367	Jenkins et al. 2013
UCIAMS-79698	2009PC-156a	5/11B	1366.19	2	*Atriplex* twig	9410±20	10,606 (10,641) 10,676	Jenkins et al. 2013
UCIAMS-76193	2009PC-144	5/12A	1367.42	3	*Atriplex* twig	9470±20	10,696 (10,715) 10,734	Jenkins et al. 2013
UCIAMS-79696	2009PC-156b	5/11B	1366.19	2	Coprolite	9475±20	10,701 (10,720) 10,739	Jenkins et al. 2013
UCIAMS-76181	1704-PC-5/12A-16-10	5/12A	1367.24	2	Human coprolite	9585±20	10,823 (10,928) 11,032	Jenkins et al. 2013
UCIAMS-75104	1829-PC-5/11A-37-2	5/11A	1365.57	2	Cordage	9625±20	11,120 (11,146) 11,171	Jenkins et al. 2013
UCIAMS-79697	2009PC-145	5/12A	1367.36	3	Twig	9700±25	11,141 (11,165) 11,188	Jenkins et al. 2013
UCIAMS-68024	2009PC-132	5/12C	1367.04	3	Insoluble residue	9805±25	11,216 (11,227) 11,237	Jenkins et al. 2013
UCIAMS-90580	1895-PC-5/15A-29-8a	5/15A	1365.86	1	Soluble residue	9825±25	11,224 (11,235) 11,245	Jenkins et al. 2013
UCIAMS-79701	2009PC-145	5/12A	1367.36	3	*Achnatherum*	9850±25	11,235 (11,246) 11,257	Jenkins et al. 2013
UCIAMS-68048	2009PC-132	5/12C	1367.04	3	Urine extract	9860±25	11,240 (11,252) 11,263	Jenkins et al. 2013
UCIAMS-90579	1895-PC-5/15A-29-8a	5/15A	1365.86	1	Coprolite macrofossil	9895±25	11,256 (11,281) 11,306	Jenkins et al. 2013
UCIAMS-68023	2009PC-132	5/12C	1367.04	3	Urine extract	9945±25	11,290 (11,335) 11,379	Jenkins et al. 2013

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^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
UCIAMS-103090	2010PC-243	5/16A	1365.84	1	Carbonized uriniferous sands	9965±30	11,315 (11,399) 11,482	Jenkins et al. 2013
UCIAMS-68041	2009PC-157	5/11B	1366.16	2	Insoluble residue	10,000±25	11,358 (11,487) 11,615	Jenkins et al. 2013
UCIAMS-68020	1830-PC-5/11B-30-17	5/11B	1365.79	1	*Salix* dart shaft butt	10,030±25	11,406 (11,544) 11,682	Jenkins et al. 2013
UCIAMS-79678	1294-PC-5/6A-44-1	5/6A	1366.26	1a	Poaceae thread	10,030±90	11,375 (11,581) 11,787	Jenkins et al. 2013
Beta-213423	1294-PC-5/6B-40	5/6B	1366.36	1A	Coprolite	10,050±50	11,950 (11,560) 11,280	Jenkins et al. 2013
UCIAMS-87421	1896-PC-5/16A-25-5	5/16A	1365.86	2	Cordage	10,070±30	11,455 (11,611) 11,767	Jenkins et al. 2013
UCIAMS-68035	2009PC-136	5/12C	1367.02	2	Deer coprolite	10,135±25	11,639 (11,787) 11,934	Jenkins et al. 2013
UCIAMS-75106	2009PC-115	5/12A	1367.31	2	Macroflora	10,140±20	11,654 (11,797) 11,939	Jenkins et al. 2013
UCIAMS-79677	2009PC-158b	5/11B	1366.09	2	*Artemisia* twig	10,145±30	11,654 (11,800) 11,946	Jenkins et al. 2013
UCIAMS-68025	2009PC-133	5/12C	1367.00	2	*Atriplex* twig	10,195±25	11,781 (11,897) 12,012	Jenkins et al. 2013
UCIAMS-102111	1961-PC-5/17A-8-4	5/17A	1366.01-1365.96	2	*Pinus ponderosa* cone scale	10,195±30	11,776 (11,895) 12,014	Jenkins et al. 2013
UCIAMS-79676	2009PC-158a	5/11B	1366.09	2	Artemisia twig	10,200±35	11,778 (11,901) 12,024	Jenkins et al. 2013
UCIAMS-68027	2009PC-135	5/12C	1366.93	2	*Atriplex* twig	10,215±25	11,811 (11,926) 12,040	Jenkins et al. 2013
UCIAMS-85336	1896-PC-5/16A-25-5	5/16A	1365.86	2	Cordage	10,250±25	11,856 (11,985) 12,114	Jenkins et al. 2013
UCIAMS-68026	2009PC-134	5/12C	1366.97	2	*Atriplex* twig	10,270±25	11,893 (12,048) 12,203	Jenkins et al. 2013
UCIAMS-68028	2009PC-137	5/12C	1366.90	2	Rodent droppings	10,295±25	11,994 (12,154) 12,313	Jenkins et al. 2013
UCIAMS-115897	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,305±30	12,012 (12,177) 12,341	Jenkins et al. 2016

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
UCIAMS-75105	2009PC-102	5/12A	1366.98	2	Mummified lizard	10,320±20	12,053 (12,208) 12,362	Jenkins et al. 2013
UCIAMS-68043	2009PC-160	5/11B	1365.99	2	Charcoal	10,360±25	12,118 (12,291) 12,463	Jenkins et al. 2013
UCIAMS-115892	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,505±25	12,298 (12,457) 12,616	Jenkins et al. 2016
UCIAMS-115896	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,540±30	12,386 (12,517) 12,648	Jenkins et al. 2016
Beta-171938	1374-PC-5/5A-30-1	5/5A	1366.51	1b	Twisted grass threads	10,550±40	12,880 (12,750) 12,330	Jenkins 2005
UCIAMS-68042	2009PC-160	5/11B	1365.99	2	Insoluble residue	10,580±25	12,465 (12,572) 12,678	Jenkins et al. 2013
UCIAMS-115893	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,585±30	12,468 (12,575) 12,681	Jenkins et al. 2016
Beta-213425	1374-PC-5/5D-28	5/5D	1366.71	1b	Coprolite	10,690±60	12,960 (12,830) 12,380	Jenkins et al. 2012
UCIAMS-115894	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,750±30	12,690 (12,723) 12,755	Jenkins et al. 2016
UCIAMS-98932	2011PC-258	5/18A	1366.06-1366.01	2	Unid. Macroflora in sediment	10,855±30	12,748 (12,821) 12,893	Jenkins et al. 2013
UCIAMS-115901	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,860±50	12,749 (12,831) 12,913	Jenkins et al. 2016
UCIAMS-115900	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,925±35	12,781 (12,862) 12,943	Jenkins et al. 2016
UCIAMS-115898	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,965±30	12,796 (12,888) 12,980	Jenkins et al. 2016
OxA-16376	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,965±50	12,795 (12,891) 12,987	Jenkins et al. 2013
UCIAMS-115895	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,970±30	12,798 (12,891) 12,984	Jenkins et al. 2013
UCIAMS-103091	2010PC-243	5/16A	1365.84	2	Humic acids	10,995±30	12,811 (12,908) 13,005	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
UCIAMS-115899	1294-PC-5/6B-40	5/6B	1366.36	1a	Human coprolite	10,995±30	12,811 (12,908) 13,005	Jenkins et al. 2013
UCIAMS-80378	2010PC-223	5/16A	1365.97	2	*Artemisia* twig	11,070±25	12,864 (12,959) 13,054	Jenkins et al. 2013
Beta-185942	1374-PC-5/5B-27a	5/5B	1366.81	1b	Horse bone	11,130±40	13,190 (13,140) 12,990	Jenkins 2005
UCIAMS-80380	2010PC-223	5/16A	1365.97	2	Salts, water soluble	11,165±25	12,963 (13,076) 13,188	Jenkins et al. 2013
UCIAMS-77102	1830-PC-5/12A-23-101	5/12A	1366.89	2	Human coprolite, macro	11,190±30	12,992 (13,098) 13,203	Jenkins et al. 2013
UCIAMS-90583	1895-PC-5/16A-24-7	5/16A	1365.91-1365.96	2	Human coprolite, macro	11,205±25	13,010 (13,110) 13,210	Jenkins et al. 2013
UCIAMS-90584	1895-PC-5/16A-24-7	5/16A	1365.91-1365.96	2	Human coprolite, water soluble	11,250±25	13,072 (13,155) 13,237	Jenkins et al. 2013
UCIAMS-80379	2010PC-223	5/16A	1365.97	2	Water soluble proteins	11,295±25	13,100 (13,192) 13,284	Jenkins et al. 2013
UCIAMS-90586	1895-PC-5/16A-25-12	5/16A	1365.85	2	Camelid coprolite, water soluble	11,315±25	13,111 (13,206) 13,301	Jenkins et al. 2013
UCIAMS-90581	1895-PC-5/16A-25-12	5/16A	1365.88	2	Human coprolite, macro	11,340±30	13,124 (13,228) 13,331	Jenkins et al. 2013
UCIAMS-79665	1374-PC-5/5B-27a	5/5B	1366.71	1a	Horse bone	11,365±35	13,141 (13,255) 13,369	Jenkins et al. 2013
UCIAMS-68021	2009PC-175	5/12A	1366.89	1b	Bulb or growth	11,370±25	13,145 (13,259) 13,372	Jenkins et al. 2013
UCIAMS-78159	1374-PC-5/5B-27a	5/5B	1366.71	1a	Horse bone, ultrafiltration	11,420±35	13,204 (13,326) 13,447	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	**FS Number**	**Cave/ Unit**	**Elevation**	**LU**	**Dated Material**	**14C Age**	**1σ cal BP Range**	**Reference**
UCIAMS-78117	1374-PC-5/5B-27a	5/5B	1366.71	1a	Horse bone, XAD	11,435±35	13,233 (13,350) 13,467	Jenkins et al. 2013
UCIAMS-80381	2010PC-224	5/16A	1365.93	2	Ericaceae twig	11,500±30	13,293 (13,406) 13,519	Jenkins et al. 2013
UCIAMS-90582	1895-PC-5/16A-25-16	5/16A	1365.88	2	Human coprolite, water soluble	11,505±30	13,298 (13,410) 13,522	Jenkins et al. 2013
UCIAMS-68029	2009PC-138	5/12C	1366.78	1b	Rodent droppings	11,565±25	13,345 (13,451) 13,557	Jenkins et al. 2013
UCIAMS-68040	2009PC-146	5/12C	1366.80	1b	Midden macrobotanical	11,770±25	13,559 (13,666) 13,772	Jenkins et al. 2013
UCIAMS-79657	1830-PC-5/12A-23-8	5/12A	1366.89	1b	Camelops bone	11,795±30	13,588 (13,694) 13,799	Jenkins et al. 2013
UCIAMS-103088	1895-PC-5/16A-24-4	5/16A	1365.92	2	Horse bone	11,810±40	13,599 (13,717) 13,834	Jenkins et al. 2013
UCIAMS-80382	2010PC-225	5/16A	1365.89	2	*Artemisia* twig	11,815±25	13,604 (13,722) 13,839	Jenkins et al. 2013
UCIAMS-103087	1896-PC-5/14A-27-2	5/14A	1365.91	2	Horse bone	11,820±40	13,605 (13,728) 13,851	Jenkins et al. 2013
AA-18971	1294-PC-5/6B-43-2	5/6B	1366.24	1a	Horse bone	11,924±40	13,680 (13,824) 13,968	Jenkins et al. 2016
UCIAMS-79707	1830-PC-5/11B-33-101	5/11B	1365.61	1	Human coprolite, sol. Urine	12,050±25	13,828 (14,033) 14,238	Jenkins et al. 2013
UCIAMS-90585	1895-PC-5/16A-25-12	5/16A	1365.85	2	Camelid coprolite, macro	12,125±30	13,918 (14,146) 14,378	Jenkins et al. 2013
OxA-16495	1294-PC-5/6B-50	5/6B	1365.86	1a	Human coprolite	12,140±70	13,928 (14,171)14,414	Jenkins et al. 2013
UCIAMS-79706	1830-PC-5/11B-33-101	5/11B	1365.61	1	Human coprolite, macro	12,165±25	13,974 (14,196) 14,418	Jenkins et al. 2013
D-AMS-1217408	1961-PC-5/17B-2-11	5/17B	1365.77	2	Driftwood ecofact	12,170±44	13,976 (14,202) 14,428	Jenkins et al. 2013
AA-18972	1294-PC-5/10D-9-2	5/10D	1367.80	1a	Horse bone	12,175±40	13,984 (14,207) 14,432	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	**FS Number**	**Cave/ Unit**	**Elevation**	**LU**	**Dated Material**	**14C Age**	**1σ cal BP Range**	**Reference**
UCIAMS-68017	1830-PC-5/12C-24-1	5/12C	1366.84	1b	Saw-tooth bear bone artifact	12,195±30	14,007 (14,228) 14,448	Jenkins et al. 2013
UCIAMS-77099	1830-PC-5/11B-31-2	5/11B	1365.70	1	Human coprolite, water soluble	12,260±30	14,073 (14,329) 14,586	Jenkins et al. 2013
Beta-216474	1294-PC-5/6B-50	5/6B	1365.86	1b	Coprolite	12,260±60	15,340 (14,260) 13,880	Jenkins et al. 2013
UCIAMS-76190	1830-PC-5/11B-31-2	5/11B	1365.70	1	Human coprolite	12,265±25	14,079 (14,337) 14,595	Jenkins et al. 2013
OxA-16498	1374-PC-5/5D-31	5/5D	1366.41	1b	Human coprolite	12,275±55	14,084 (14,377) 14,670	Jenkins et al. 2013
BETA-213426	1294-PC-5/7C-31	5/7C	1366.81	1b	Coprolite	12,290±60	15360 (14,280) 14,100	Jenkins et al. 2013
UCI-78159	1294-PC-5/9A-28	5/9A	1365.48	1	Large mammal bone	12,290±40	14,100 (14,404) 14,708	Jenkins et al. 2013
Beta-239086	1294-PC-5/9A-28	5/9A	1365.48	1	Large mammal bone	12,290±70	14,095 (14,424) 14,753	Jenkins et al. 2013
Beta-172663	1374-PC-5/5B-30-2	5/5B	1366.51	1b	Camelid bone	12,300±40	15,340 (14,290) 12,170	Jenkins 2005
UCIAMS-68031	2009PC-140	5/12C	1366.60	1b	*Atriplex* twig	12,305±30	14,116 (14,435) 14,754	Jenkins et al. 2013
UCIAMS-90591	1896-PC-5/16A-CU-2a	5/16A	1365.96-1365.91	2	Horse bone	12,340±25	14,184 (14,513) 14,841	Jenkins et al. 2013
OxA-16497	1294-PC-5/7C-31	5/7C	1366.81	1b	Human coprolite	12,345±55	14,185 (14,525) 14,865	Jenkins et al. 2013
UCIAMS-68030	2009PC-139	5/12C	1366.70	1b	Rodent droppings	12,350±30	14,208 (14,535) 14862	Jenkins et al. 2013
UCIAMS-103081	1961-PC-5/17A-15-5	5/17A	1365.60	2	Camelid bone	12,360±35	14,229 (14,556) 14882	Jenkins et al. 2013
UCIAMS-68034	2009PC-143	5/12C	1366.46	1b	*Atriplex* twig	12,380±30	14,261 (14,587) 14,913	Jenkins et al. 2013

Table 4.1. AMS radiocarbon dates for the Paisley Caves.

^{14}C Lab Number	FS Number	Cave/ Unit	Elevation	LU	Dated Material	14C Age	1σ cal BP Range	Reference
Beta-239087	1374-PC-5/5D-30	5/5D	1366.56	1b	Cut mountain sheep bone	12,380±70	14,248 (14,591) 14,933	Hockett and Jenkins 2013
UCIAMS-90592	1896-PC-5/16A-CU-2b	5/16A	1365.96-1365.91	2	Horse tooth	12,385±30	14,268 (14,595) 14,921	Jenkins et al. 2013
UCIAMS-104663	1961-PC-5/17B-2-11	5/17B	1365.77	2	Driftwood ecofact	12,400±35[21]	14,289 (14,618) 14,947	Jenkins et al. 2013
Beta-213424	1374-PC-5/5D-31	5/5D	1366.41	1b	Human coprolite	12,400±60	15,430 (14,340) 14,130	Jenkins et al. 2013
UCIAMS-80377	2010PC-227	5/16A	1365.76	1	*Artemisia* twig	12,405±25	14,301 (14,627) 14,952	Jenkins et al. 2013
UCIAMS-80383	2010PC-226	5/16A	1365.83	2	Ericaceae twig	12,405±25	14,301 (14,627) 14,952	Jenkins et al. 2013
UCIAMS-80384	2010PC-233	5/16A	1365.74	1	*Artemisia* twig	12,410±25	14,312 (14,636) 14,960	Jenkins et al. 2013
UCIAMS-79656	1829-PC-5/11B-37-9	5/11B	1365.39	1	Horse tooth	12,410±35	14,308 (14,636) 14,963	Jenkins et al. 2013
UCIAMS-68032	2009PC-141	5/12C	1366.55	1b	*Atriplex* twig	12,430±30	14,368 (14,681) 14,994	Jenkins et al. 2013
UCIAMS-68033	2009PC-142	5/12C	1366.49	1b	*Atriplex* twig	12,450±30	14,423 (14,725) 15,027	Jenkins et al. 2013
Beta-239085	1294-PC-5/7C-19	5/7C	1367.41	4	Camelops bone	12,460±70	14,407 (14,734) 15,060	Jenkins et al. 2013
Beta-229783	1374-PC-5/5B-27b	5/5B	1366.81	1b	Pika bone	12,690±90	14,744 (15,070) 15,395	Jenkins et al. 2013
Beta-229782	1374-PC-5/5B-29	5/5B	1366.61	1b	Duck bone	13,260±60	15,780 (16,190) 16,600	Jenkins et al. 2013

FS=Field Sample

Deposits at the Paisley Caves are generally polygenetic and derive from aeolian, alluvial, biogenic, and colluvial processes (Jenkins et al. 2012b:10). Sediments in the caves are assigned to more than 20 lithostratigraphic units. Lithostratigraphic units (LUs) are not defined by the age of deposition, but rather sediment types and their associated characteristics (Stein 1987). The primary focus of the current research project centers on LUs 1, 2, and 3: the Late Pleistocene and Early Holocene strata. Due to lack of stratigraphic uniformity across the site, the LUs for Caves 1, 2, and 5 are discussed individually.

4.1.2.1. Cave 1

In Cave 1, LU 1 is characterized by water-rounded cobbles and boulders surrounded by medium brown, fine sandy silt (Jenkins et al. 2016:184). The deposits contain organic debris, fish, snail, waterfowl, microfauna and large mammal bone, along with obsidian debitage. Obsidian sourcing indicates most (~75%) of the lithic artifacts in LU 1 originated at Tucker Hill, located approximately 20 km south of the Paisley Caves. Ponderosa pine seed shells recovered from LU 1 returned radiocarbon dates of 10,010 ± 30 (UCIAMS-99462; 11,370-11,645 cal BP) and 10,165 ± 25 BP (UCIAMS-98930; 11,720-11,970 cal BP). Above LU 1, complex stratigraphy represents dramatically varied site formation processes. In the southern portion of the shelter, light gray to tan sand, gravel and cobbles are interspersed with thin alluvial silt lenses. The upper two meters of deposits were generally sterile, with artifact concentrations occurring between 195 and 200 cm below the surface.

In Unit 1/7A, two well-preserved, small hearth features were identified in LU 1. Feature 1/7-4a measured 85 x 47 cm and consisted of soft silt with charcoal flecking and surrounded by the remnants of a rock ring. The center of the hearth appeared dark brown to black, with burned reddish soil along the margins. Excavator notes indicate the fuel Feature 1/7-4a appeared to have been nearly completely consumed by fire; however, animal bones and obsidian flakes were mixed in the feature sediments. Feature 1/7-4b is described as dark, compact soil with charcoal flecks and staining that measured 60 cm x 55 cm. A fragment of *Artemisia* charcoal from the feature was dated to 10,540 ± 25 BP (UCIAMS-90578; 12,390-12,650 cal BP). Stratigraphic provenience suggests the two hearths are the same age (D. Jenkins, January 2016, personal communication). Cultural materials associated with the hearth included S-twist cordage and a few scrapers and edge modified flakes.

No diagnostic or formed tools were recovered during the University of Oregon excavations in Cave 1 pre-Mazama deposits, although several poorly-provenienced Western Stemmed points were collected by Cressman (Aikens et al. 2011; Jenkins et al. 2016:187). Natural deposits composed of roof spalls, gravels, sand, silts, bird and rodent nest materials, bone, rat pellets, and bat guano extend to 270 cm at the south end of the cave (Jenkins et al. 2016:184).

4.1.2.2. Cave 2

Stratum LU 1 in Cave 2, which accumulated on the floor of the cave prior to 18,000 year ago, is culturally sterile and not pertinent to the current study (Figure 4.x). LU 1 is overlain by LU 2, brown, gravelly sands 15-30 cm thick representing Younger Dryas deposits (Jenkins et al. 2016:135; Hockett et al. 2017). Above LU 2, two thin alluvial silt lenses (the Lower Mud and Upper Mud) are separated by a cultural deposit termed the Botanical Lens (Figure 4.8). The Botanical Lens represents "…an unusually detailed record of Western Stemmed Tradition cultural remains dating between ca. 12,600 and 11,500 cal BP" (Jenkins et al. 2016:128). The Upper Mud lens is overlain by LU 3, which is characterized by a sparse lithic assemblage, aeolian transported sand and silt, macrobotanical remains, *Neotoma* pellets, and abundant *Chiroptera* guano (Jenkins et al. 2013:495, 2016:137). Stratum LU 3 is 90 cm thick and spans from 10,000 ± 25 BP (11,500 cal BP) to 6790 ± 15 BP (UCIAMS-68046; 7660-7620 cal BP) at the base of a thick, laminated Mazama tephra layer.

The Lower Mud marks the start of the Younger Dryas chronozone. A human coprolite recovered in the Lower Mud lens returned a radiocarbon date of 10,980 ± 20 BP (UCIAMS-76191; 12,990-12,800). A hearth feature was identified north of the Lower Mud lens in Unit 2/6B. Feature 2/6-4 is a crescent shaped ash and charcoal deposit measuring 40 cm x 70 cm. *Artemisia* twigs from the hearth were dated to 11,005 ± 30 (UCIAMS-90577; 13,010-12,815 cal BP) and 11,055 ± 35 BP (UCIAMS-102110; 13,045-12,850 cal BP).

The Botanical Lens, 5-8 cm thick, consists mainly of sagebrush twigs and shredded bark, but dense clumps of cut pronghorn underbelly hair, culturally modified pronghorn bones, jackrabbit bones, hair and hides, charcoal fragments, and cordage are incorporated throughout (Figure 4.7; Hockett et al. 2017). Obsidian debitage, disaggregated coprolites, crystallized urine, bones, feathers, mummified flesh, claws, woodrat and bat feces, and hair and hides of marmot, hare, and vole were also commonly encountered (Jenkins et al. 2016:176). Dates obtained from the Botanical Lens suggest organic remains associated with the feature are *in situ* (Hockett et al. 2017:568).

Figure 4.7. Excavating the Botanical Lens in Cave 2 at the Paisley Caves (photo: D. Jenkins).

Two small unlined hearths (Features 2/3A-1 and 2/4C-4) were identified within the Botanical Lens. Feature 2/3A-1 measured 20 cm x 30 cm and was 11 cm thick. The loose feature matrix included charcoal, charred botanic macroremains, and calcined bone. Charred PET from Feature 2/3A-1 returned a radiocarbon date of 10,160 ± 60 BP (Beta-182920; 11,980-11,630 cal BP). Feature 2/4C-4 is an oval-shaped hearth with a 30-35 cm diameter that contained charcoal and sagebrush twigs. It was identified at the same elevation as Feature 2/3A-1 with a nearly identical distribution of similar cultural materials.

4.1.2.3. Cave 5

Excavation units were placed in two blocks in Cave 5, but only the north block bears on this dissertation. The north block excavation units were placed in a small interior alcove located between the east wall and a large boulder at the northwest end of the cave. Complex stratigraphy characterizes the deposits below the Mazama tephra, but the upper deposits are "loose, poorly sorted…comprised of sand, gravel, macrobotanical remains, fecal materials, [and] prehistoric and historic artifacts" (Jenkins et al. 2012b: 9). All Cave 5 LUs are described in detail elsewhere (Gilbert et al. 2008b:21-25; Jenkins 2007:63-65; Jenkins et al. 2012b:47).

In the north excavation block, the basal deposits, LU 1b, are generally characterized as poorly sorted, fine to loamy gray sands with subangular to angular pebbles and cobbles surrounding water-rounded boulders on the floor of the cave (Figure 4.x). Macrobotanical remains and *Neotoma* fecal pellets are common. These deposits are overlain by LU 2, composed of friable to hard fine sediments with varying amounts of macrobotanical remains and abundant *Neotoma* fecal material (Jenkins et al. 2012a:225). Both LU 1 and LU 2 are associated with human coprolites, cultural artifacts, and animal bone including megafauna in Cave 5. Identified macrobotanical specimens include ponderosa pine cone scales, willow twigs, and cactus (specifically, *Opuntia* sp.) needles suggesting a highly diverse local vegetation community in the Late Pleistocene. Densities of lithic waste flakes were low, but increased in the deposits dating to the Younger Dryas and earlier (Jenkins et al. 2016:190). Though infrequent, diagnostic tools are present in Cave 5 Younger Dryas-aged sediments, and include Western Stemmed and Foliate types.

Very tiny twisted threads composed of grass, sinew, and other fibers, are dated as early as 10,550 ± 40 BP (Beta-171938; 12,655-12,390 cal BP).

Feature 5/5-3 (also referred to as Feature 5/3 in published manuscripts; see Jenkins 2007) is a small, stratified hearth or earth oven located within the LU 1 deposits. When bisected the charcoal-rich feature appeared bowl-shaped with a 60 cm diameter and a depth of 30 cm. Charred rocks lined the bottom of the depression and it was surrounded by large mammal bones, including a horse phalanx (Jenkins 2007:71). Other cultural materials found in the vicinity of the feature include an obsidian flake and cordage of hair and fiber (Jenkins et al. 2013:502). The feature itself has not been directly dated because of its vertical proximity to a charcoal mat (LU 9) presumed to represent a natural burn. Dates on faunal material associated with the feature include a leporid humerus at 11,437 ± 63 (D-AMS-24769; 13,480-13,215 cal BP), and the aforementioned horse phalanx at 11,365 ± 35 (UCIAMS-79665; 13,370-13,140 cal BP).

Several *Neotoma* nests can be found throughout the Paisley Caves, but they are especially prevalent in the Younger Dryas deposits in the north block of Paisley Cave 5. Units 5/5, 5/7, and 5/12 contained light gray powdery ash representing the in-place burning of woodrat nests. According to Jenkins et al. (2013:501, 2016:194), fires were likely intentionally set by people for use as hearths or to drive out the woodrats. Ash from the fires eventually spread downslope and became incorporated with uncharred reconstructed nest materials. Extensive radiocarbon analysis on burned and unburned organics in Unit 5/12 establishes good chronological and stratigraphic ordering. An *Atriplex* twig from the base of a woodrat midden in Unit 5/12A&C returned a radiocarbon date of 12,380 ± 30 (UCIAMS-68034; 14,910-14,260).

4.1.3. Macrobotanical Sample Descriptions

Thirty-five bulk soil samples from the Paisley Caves site (35LK3400) were analyzed to provide a better understanding of the plant resources associated with the human residents of the site. The bulk samples represent cultural features in caves 1, 2, and 5, as well as stratigraphic samples from the north profile of excavation Unit 5/5 and 5-cm interval column samples collected in the west profile of Unit 2/6B (Table 4.2). Additionally, a single bulk soil sample was recovered from a TP/EH *Neotoma* midden in Unit 5/12 and analyzed to assess differences in taxonomic diversity in cultural and non-cultural features.

Cave 5 stratigraphic samples were collected from the west wall of Unit 5/5 during the 2002 field season and are represented in this study by strata I, II, III, IV, and VI. Stratum V consists of a sterile Mazama tephra layer. The strata designations were developed prior to the LU delineation, but likely represent some or all of the following: LU 2, and LU 5-10. The 22 bulk sediment samples from the Unit 2/6B column represent pre-Mazama deposits spanning 13,700 to 7640 cal BP. The column location was strategically selected as it incorporates elements from LU 3, the Upper Mud Lens, the Botanical Lens, the Lower Mud Lens, and LU 2 (Figures 4.8 and 4.9).

Bulk sediments from five hearths dating to the Terminal Pleistocene were analyzed. In Cave 1, Features 1/7-4a and 1/7-4b are each represented by a single bulk sediment sample. One bulk sediment sample was also processed from each of the Cave 2 hearths – Features 2/3A-1, 2/4C-4, and 2/6-4. Due to uncertainty regarding the cultural attribution of Feature 5/5-3 in Cave 5, two sediment samples were analyzed from the upper and lower extent of the feature

Table 4.2. Provenience information for the bulk soil samples at the Paisley Caves.

Sample No.	Sample Volume (L)	LU	Cave/Unit	Feature	Elevation	Description
CS-2	0.50	LU3	2/6B		1366.45	Column sample
CS-3	0.50	LU3	2/6B		1366.40	Column sample
CS-4	0.50	LU3	2/6B		1366.35	Column sample
CS-5	0.50	LU3	2/6B		1366.30	Column sample
CS-6	0.50	LU3	2/6B		1366.25	Column sample
CS-7	0.50	LU3	2/6B		1366.20	Column sample
CS-8	0.50	LU3	2/6B		1366.15	Column sample
CS-9	0.50	LU3	2/6B		1366.10	Column sample
CS-10	0.50	LU3	2/6B		1366.05	Column sample
CS-11	0.50	LU3	2/6B		1366.00	Column sample
CS-12	0.75	LU3	2/6B		1365.95	Column sample
CS-13	0.75	LU3	2/6B		1365.90	Column sample
CS-14	0.90	LU3	2/6B		1365.85	Column sample
CS-15	1.00	LU3	2/6B		1365.80	Column sample
CS-16	0.20	LU3	2/6B		1365.75	Column sample
CS-17	1.00	LU3	2/6B		1365.70	Column sample
CS-18a	0.35	LU3	2/6B		1365.68	Column sample
CS-18b	0.55	Botanical Lens	2/6B	Botanical Lens	1365.65	Column sample
CS-19a	0.30	Botanical Lens	2/6B	Botanical Lens	1365.62	Column sample
CS-19b	0.50	Lower Mud Lens	2/6B		1365.60	Column sample
CS-20	0.50	LU2	2/6B		1365.55	Column sample
CS-21	0.40	LU2	2/6B		1365.50	Column sample
5/5-Str. I	0.50		5/5			Strata sample
5/5-Str. II	0.25		5/5			Strata sample
5/5-Str. III	0.25		5/5			Strata sample
5/5-Str. IV	0.25		5/5			Strata sample
5/5-Str. VI	0.25		5/5			Strata sample

Table 4.2. Provenience information for the bulk soil samples at the Paisley Caves.

Sample No.	Sample Volume (L)	LU	Cave/Unit	Feature	Elevation	Description
F 5/5-3	0.50	LU1	5/5A	Hearth/Earth Oven Charcoal	1366.96	Feature sample
5/5A-26-8	0.50	LU1	5/5A	Hearth/Earth Oven Ash	1366.96	Feature sample
F 2/6-4	0.50	Lower Mud Lens	2/6B	Hearth	1365.45	Feature sample
2/3A-32-46	0.50	Botanical Lens	2/3A	Hearth		Feature sample
2/4C-4	0.50	Botanical Lens	2/4C	Hearth	1365.60	Feature sample
F 1/7-4a	0.50	LU1	1/7A&C	Hearth		Feature sample
F 1/7-4b	0.50	LU1	1/7A&C	Hearth		Feature sample
5/12A-34-19	0.40		5/12A	Woodrat Nest	1366.36	Nest sample

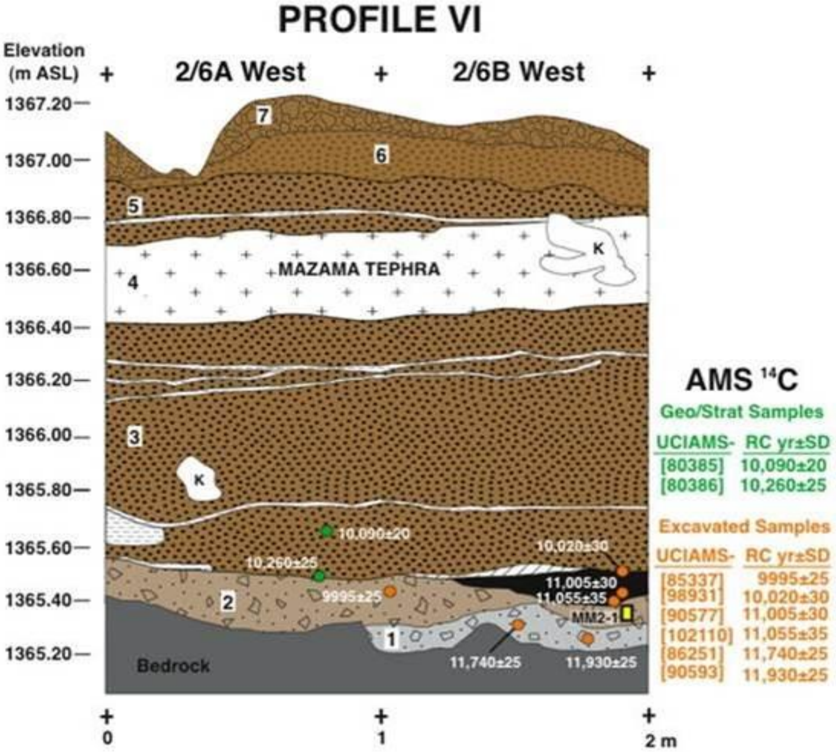

Figure 4.8. Lithostratigraphic profile of Unit 2/6B (Jenkins et al. 2013).

Figure 4.9. Location of Unit 2/6B column samples analyzed.

4.2. Little Steamboat Point-1 Rockshelter (35HA3735)

4.2.1. Site Setting

LSP-1 is the largest of several south-facing rockshelters along Little Steamboat Point, an escarpment located on the northern edge of the Warner Valley in Harney County, Oregon (Figure 4.10). It formed when Pleistocene Lake Warner was at or near its high stand (1417 m AMSL) approximately 17,000 years ago, and subsequently infilled with alluvial and aeolian sediment intermixed with roof fall (Smith et al. 2014).

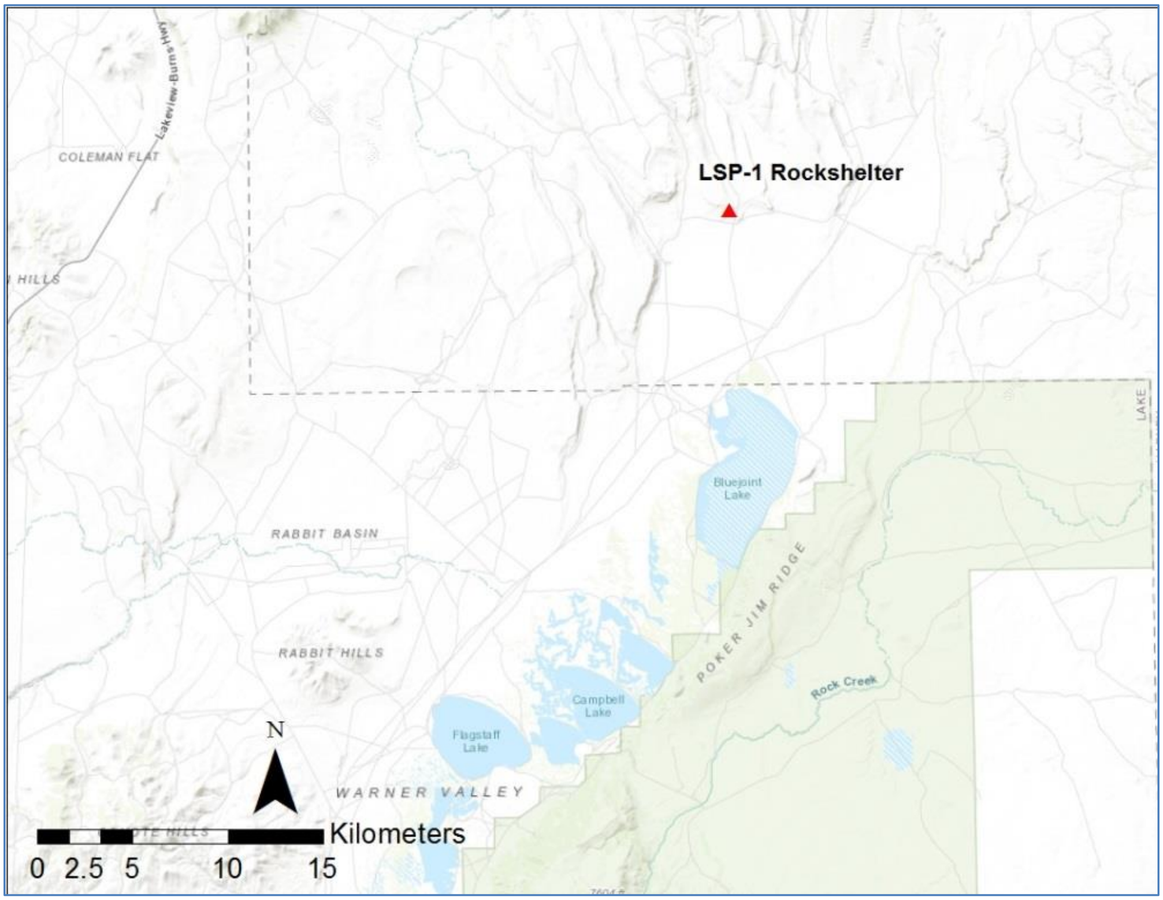

Figure 4.10. LSP-1 Rockshelter geographic setting.

A single fault-bounded block separates the Northern Warner Valley, including Hart Lake, North Warner swamp, and a series of smaller lakes connected by ephemeral stream channels and a network of sloughs (Smith et al. 2014:17), from the Southern Warner Valley. Local vegetation is dominated by various sagebrush taxa (Figure 4.11).

Figure 4.11. Example of sagebrush vegetation at LSP-1 Rockshelter.

4.2.2. Previous Research

Under the direction of Geoffrey Smith, the University of Nevada, Reno Great Basin Paleoindian Research Unit (GBPRU) field school excavated at the cave and surveyed the surrounding paleoshorelines during the summers of 2010 through 2015. As a result, crews excavated approximately 25 m^2 of deposits to depths of 1.5 to 2 m at the site (Figure 4.12; Kennedy and Smith 2016). The cave contains approximately 50 m^2 of habitable space from the dripline to its rear. Several of Smith's graduate students have produced master's theses reporting on the lithic tools and faunal assemblages from LSP-1 (e.g., Pattee 2014; Pellegrini 2014; Ware Van der Voort 2016). Together with research published by Smith (Smith et al. 2014), these studies provide critical data for evaluating the cultural significance of plant remains at the site.

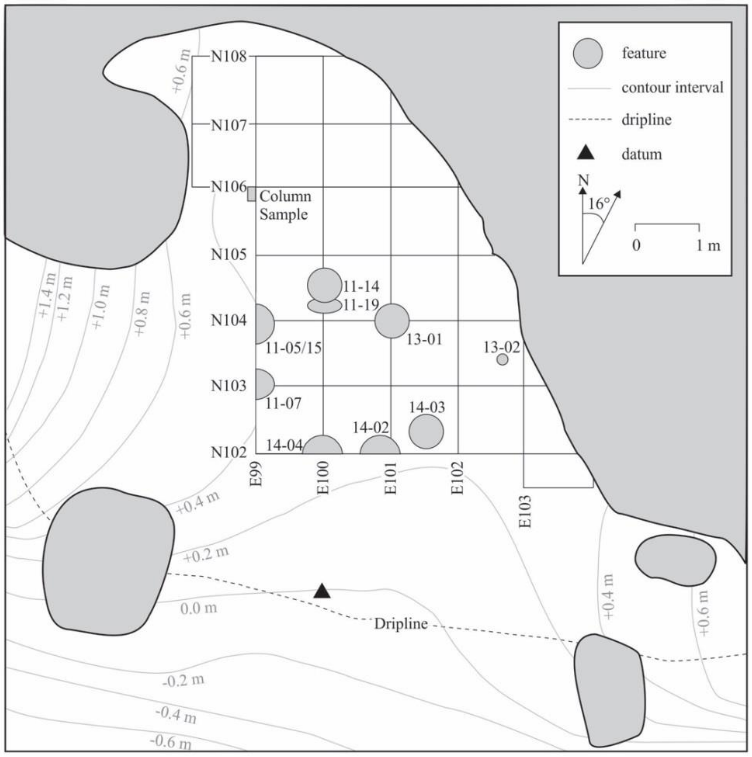

Figure 4.12. Planview of LSP-1 Rockshelter with feature locations (35HA3735) excavations.

Prior to this investigation, 21 radiocarbon dates were obtained for the site (Table 4.3). A dearth of radiocarbon samples from the Middle Holocene reflect the absence of cultural materials in these deposits, and are not a consequence of sampling bias at this particular site (Figure 4.13).

Table 4.3. AMS radiocarbon dates for LSP-1 Rockshelter.

Sample ID	FS Number	Excavation Unit	Cmbd	Stratum	Dated Material	^{14}C Age	2σ cal BP Range	Comments	Reference(s)
Beta-283901	45	N105E99	62	IV	Unidentified charcoal	880±40	915-706		Smith et al. 2014
UGA-16860	427	N103E102	82	V	Catlow Twine textile	1160±20	1,175-989	Woodrat nest	Smith et al. 2016
UGA-16859	426	N103E101	81	V	Catlow Twine textile	1200±20	1,180-1,063	Woodrat nest	Smith et al. 2016
AA-103861	n/a	n/a	n/a	n/a	Textile fragment	1230±36	1,264-1,065	Woodrat nest	Kennedy and Smith 2016
UGA-18238	1302	N102E103	66	n/a	sagebrush sandal	1300±20	1,287-1,183	Feature 14-10 (storage pit)	Smith et al. 2016
UGA-18237	1298	N102E103	59	n/a	sagebrush bark bundle	1340±20	1,302-1,190	Feature 14-10 (storage pit)	Smith et al. 2016
UGA-18239	1309	N102E103	62	n/a	sagebrush sandal	1760±20	1,721-1,610	Feature 14-10 (storage pit)	Smith et al. 2016
UGA-18235	1293	N101E103	52	n/a	Catlow Twine textile	1790±20	1,813-1,625	Feature 14-10 (storage pit)	Smith et al. 2016
UGA-16803	712	N102E99	33	IV	Unidentified charcoal	1850±25	1,865-1,716		Kennedy and Smith 2016
UGA-18236	1297	N102E103	62	n/a	sagebrush sandal	1860±20	1,865-1,729	Feature 14-10 (storage pit)	Smith et al. 2016
UGA-18240	1311	N102E103	76	n/a	sagebrush sandal	1880±20	1,879-1,737	Feature 14-10 (storage pit)	Smith et al. 2016
UGA-15596	715	N105E99	123	VII	*Artemisia* charcoal	2070±25	2,122-1,951		Kennedy and Smith 2016

Table 4.3. AMS radiocarbon dates for LSP-1 Rockshelter.

Sample ID	**FS Number**	**Excavation Unit**	**Cmbd**	**Stratum**	**Dated Material**	**^{14}C Age**	**2σ cal BP Range**	**Comments**	**Reference(s)**
Beta-317155	n/a	N104E99	72	IV	Unidentified charcoal	2910±30	3,158-2,960	Feature 11-19 (hearth)	Smith et al. 2012
UGA-15593	706	N105E99	67	IV/V	cf. *Rhus* charcoal	3140±25	3,444-3,257		Kennedy and Smith 2016
Beta-406150	1251	N102E102	72	IV	*Salix* charcoal	3160±30	3,450-3,272	Feature 14-06 (hearth)	Smith et al, 2016
UGA-14917	476	N103E101	96	V	*Artemisia* charcoal	4000±25	4,522-4,420		Smith et al. 2014
UGA-15260	409	N104E101	82	V	*Bison* femur	4010±25	4,525-4,422		Smith et al. 2014
UGA-15595	714	N105E99	45	III/IV	Unidentified charcoal	6550±20	7,490-7,425		Kennedy and Smith 2016
Beta-306418	38	N105E99	142	VII	Unidentified charcoal	7310±40	8,186-8,021		Smith et al. 2012
Beta-282809	46	N105E99	120	VI	Unidentified charcoal	8290±40	9,427-9,137		Smith et al. 2012
UGA-18011	1129	N107E99	131	VIII	*Lepus* ulna	8290±25	9,420-9,143	Presumably non-cultural	Kennedy and Smith 2016
UGA-15594	707	N105E99	106	V/VII	cf. *Rhus* charcoal	8300±20	9,422-9,252		Kennedy and Smith 2016
Beta-287251	48	N105E99	103	V	Unidentified charcoal	8340±40	9,470-9,261		Smith et al. 2012
PRI-14-069	1130	N107E99	124	VI/VII	*Artemisia* charcoal	8341±27	9,449-9,289		Kennedy and Smith 2016

Table 4.3. AMS radiocarbon dates for LSP-1 Rockshelter.

Sample ID	FS Number	Excavation Unit	Cmbd	Stratum	Dated Material	^{14}C Age	2σ cal BP Range	Comments	Reference(s)
UGA-14916	431	N103E101	86	V	*Artemisia* charcoal	8350±30	9,462-9,296		Smith et al. 2014
Beta-297186	47	N105E99	131	VI/VII	Unidentified charcoal	8400±50	9,520-9,301		Smith et al. 2012
Beta-306419	158	N102E99	97	V	Unidentified charcoal	8670±40	9,731-9,540		Smith et al. 2012
UGA-15142	n/a	N103E100	125	V	*Artemisia* charcoal	8700±30	9,735-9,550	Feature 13-01 (hearth)	Smith et al. 2014
UGA-15259	716	N105E99	141	VIII/IX	*Sylvilagus* humerus	9100±30	10,293-10,200	Presumably non-cultural	Smith et al. 2014

Note. All dates were calibrated using OxCal 4.2 (Ramsey, 2009) and the IntCal 13 Curve (Reimer et al., 2013).

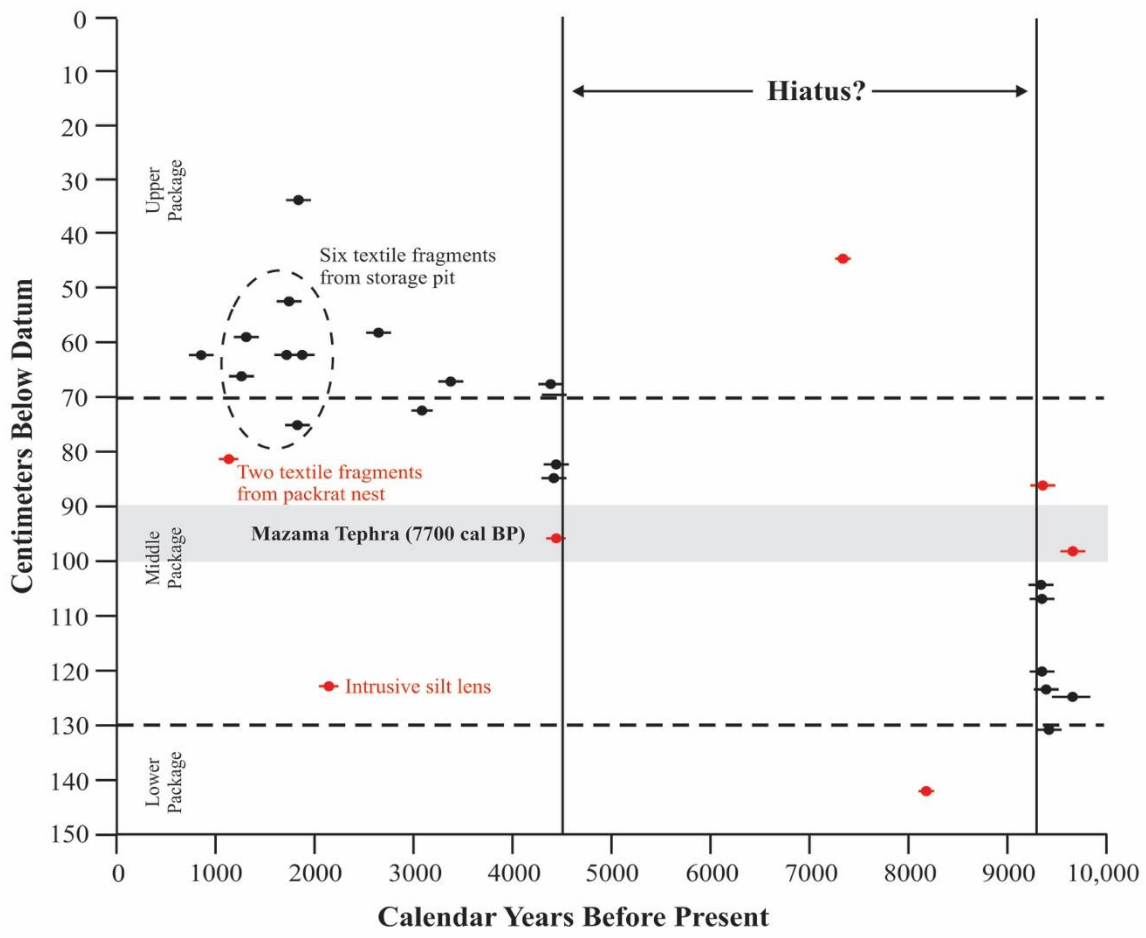

Figure 4.13. Vertical distribution of AMS radiocarbon dates at LSP-1 Rockshelter (Kennedy and Smith 2016).

Ten distinct strata were identified and described in detail by Smith et al. (2014). The ten strata were consolidated into three major sediment packages, and interpreted as reflecting three separate depositional periods (Smith et al. 2014; Table 2.4). The upper package consists of Strata II and IV, inter-fingering coarse and fine-grained facies of the alluvial fan that formed adjacent to the rockshelter during the Late Holocene. The upper package is overlain by Stratum I, a layer of cow manure. Strata II and IV are separated by Stratum III, a thin layer of aeolian sand. The middle package comprises Strata V and VI. Stratum V is a massive unit of poorly-sorted alluvial fan gravels mixed with fine to very fine sand, and Stratum VI is a distinct layer of silty, very fine aeolian sand. In some locations, Stratum V is bisected by small pockets of Mazama tephra. Most of the middle package accumulated as sediments were blown into the rockshelter as a result of climate aridification during the Early and Middle Holocene (Wriston and Smith 2012). Finally, the lower package consists of alternating coarse gravel units (Strata VII and IX) and black sand (Strata VIII and X).

The small rockshelter in the northern Warner Valley provided episodic habitation throughout much of the Holocene (Kennedy and Smith 2016; Smith et al. 2014, 2016). Previous faunal analysis suggests that groups processed large quantities of leporids, which were probably mass harvested nearby during the fall or winter seasons (Pellegrini 2014). The artifact assemblage also suggests a hiatus in rockshelter usage from approximately 9000 to 4000 cal BP.

4.2.3. Macrobotanical Sample Descriptions

Thirty-nine bulk soil samples were analyzed to better understand the plant resources associated with the human activity at LSP-1 Rockshelter (35HA3735) in pre-contact times. The soil samples selected for analysis were recovered in plant-processing features as well as individual strata in excavation unit (EU) 105N99E (Figure 4.14). The 39 bulk soil samples represent eleven cultural features, including hearths (n=9), an organic concentration (n=1), and a small carbon stain (n=1), as well as vertical, contiguous column sampling of the strata identified in the Upper, Middle, and Lower soil packages in EU 105N99E (Table 4.4).

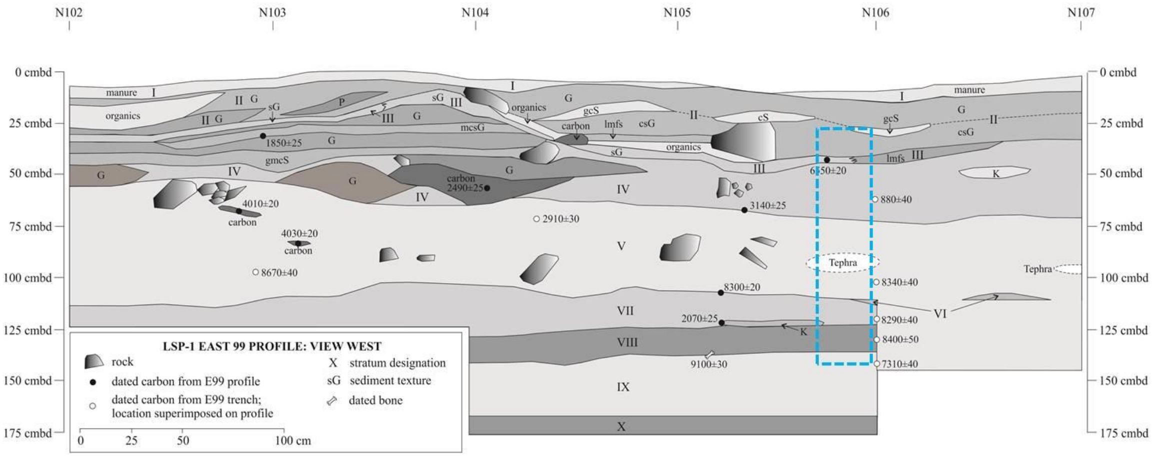

Figure 4.14. Position of the bulk sediment column along the east profile of Unit 105N99E (Kennedy and Smith 2016).

Generally, one sample from each feature was selected for analysis, unless the feature appeared stratified or demonstrated distinct loci. Feature 12-01/02, the organic concentration, is characterized by a southern locus (field designation Feature 12-01) represented by sample 1667, and a northern locus (field designation Feature 12-02) represented by sample 1666. Feature 11-05/15, a large hearth with ashy layers extending 1 m north-south, is also represented by multiple samples. Sample 1654 reflects its northern extension (field designation "Feature 11-15") while sample 1658 reflects the densest carbonized organic remains in the southern terminus and sample 11-05-3 reflects the ashy gray sediments overlying the charcoal concentration (both attributed to field designation "Feature 11-05"). Hearth features 11-07, 11-14, 11-19, 13-01, 13-02, 14-02, and 14-04, and a carbon stain – Feature 14-01, are each represented by a single bulk sample. The series of column samples collected in 5-cm vertical increments from the eastern profile of the excavation block represent Strata II – IX.

Table 4.4. Provenience information for bulk soil samples recovered at LSP-1 Rockshelter for macrobotanical analysis.

Sample No.	Sample Volume (L)	Sediment Package	Excavation Unit	Stratum	Feature	Depth (cmbd)	Description
5b	0.90	Upper	N105E99		-	28-31	Column Sample
6	1.00	Upper	N105E99		-	31-36	Column Sample
7	1.00	Upper	N105E99		-	36-41	Column Sample
8a	1.00	Upper	N105E99		-	41-44	Column Sample
8b	1.00	Upper	N105E99		-	44-46	Column Sample
9	1.00	Upper	N105E99		-	46-51	Column Sample
10	1.00	Upper	N105E99		-	51-56	Column Sample
11	1.00	Upper	N105E99		-	56-61	Column Sample
12	1.00	Upper	N105E99		-	61-66	Column Sample
13	1.00	Upper	N105E99		-	66-71	Column Sample
14	1.00	Middle	N105E99		-	71-76	Column Sample
15	1.00	Middle	N105E99		-	76-81	Column Sample
16	1.00	Middle	N105E99		-	81-86	Column Sample
17	1.00	Middle	N105E99		-	86-91	Column Sample
18	1.00	Middle	N105E99		-	91-96	Column Sample
19	1.00	Middle	N105E99		-	96-101	Column Sample
20	1.00	Middle	N105E99		-	101-106	Column Sample
21	1.00	Middle	N105E99		-	106-111	Column Sample
22	1.00	Middle	N105E99		-	111-116	Column Sample
23	1.00	Lower	N105E99		-	116-121	Column Sample
24	1.00	Lower	N105E99	VII	-	121-126	Column Sample
25a	0.20	Lower	N105E99	VII	-	126-128	Column Sample
25b	0.80	Lower	N105E99	VIII	-	128-131	Column Sample
26	0.75	Lower	N105E99	VIII	-	131-136	Column Sample
27	0.60	Lower	N105E99	IX	-	136-141	Column Sample
1653	0.90	Upper	N104E99/100	II/III	11-14	50	Hearth
2437	0.50	Upper	N102E101	III	14-03	58	Hearth
11-5-3	0.45	Upper	N104E99	IV	11-05/15		Hearth
1658	1.00	Upper	N104E99	IV	11-05/15	64	Hearth
1654	0.65	Upper	N104E99	IV	11-05/15	58	Hearth
2432	0.25	Upper	N102E100/101	IV	14-02	66	Hearth
2429	0.25	Middle	N102E99/100	IV	14-04	75	Hearth
1649	0.60	Middle	N104E99	IV	11-19	72	Hearth
2430	0.50	Middle	N102E100	V	14-01	81-86	Small carbon stain
1270	0.40	Middle	N103E102	V	13-02	122	Hearth
1657	0.70	Middle	N102E99	V	11-07	69	Hearth
1031	0.60	Lower	N103E100	V	13-01	125	Hearth
1667	0.65	Lower	N104E100	VII	12-01/02	122	Organic concentration
1666	0.70	Lower	N104E100	VII	12-01/02	123	Organic concentration

4.3. Bulk Soil Samples Overview

Bulk soil samples (n=74) collected at the Paisley Caves and LSP-1 Rockshelter chronicle several thousand years of continued use at each of these sites. The samples analyzed in this study were recovered from a variety of contexts to investigate plant use in ancient times. The detailed record of artifacts and well-anchored radiocarbon dates contextualize the macrobotanical remains in a secure chronological frame.

CHAPTER V

METHODS

By definition macrobotanical remains represent intact or more often plant fragments that can be identified using light microscopy with 10-40x magnification (Miller 1997; Pearsall 2016). This study focuses only on macrobotanical remains recovered from archaeological contexts at the Paisley Caves and LSP-1 Rockshelter. Microscopic remains reported elsewhere will be compared to the macroscpic data of this research in the discussion and conclusions (e.g., Beck et al. 2017; Cummings and Puseman 2003, Cummings et al. 2007; Saban 2015). The paleoethnobotanical terms used throughout this manuscript are loosely adapted from Lee (2003), and defined in Table 5.1.

Table 5.1. Macrobotanical analysis definitions and terms.

Bulk sediment sample	A single sediment unit of varying volume floated from a specific feature, column, point, and stratum sample
Feature sample	All sediment recovered from a single feature
Feature class	All features of similar use/function (e.g. hearths)
Column sample	Sediment representing a unique x, y, z location collected in a vertical column
Point sample	All sediment recovered from a single provenience
Strata sample	Grab sample of sediment representing a particular stratigraphic unit identified at the site(s)
Assemblage	All macrobotanical remains identified to a particular category (e.g., site assemblage, component assemblage, feature assemblage, etc.)
Element	Individual macrobotanical specimen, whole or fragmented

5.1. Sampling Strategies

Fieldwork was conducted in Lake and Harney counties, southcentral Oregon intermittently from the summer of 2012 through summer 2015.Samples were collected in August, 2012, at the Paisley Caves and in June, 2013, at LSP-1 Rockshelter. All additional fieldwork concerned vegetation surveys and herbarium visits.

5.1.1. Bulk Soil Collection

The main data of this study include three types of bulk soil samples: feature samples, column samples, and strata samples. All column samples were collected by the author during various field seasons. Locations of bulk samples were mapped based on permanent site datums. Feature samples were collected by archaeological field crews. Macrobotanical remains from hearth features can provide information on foods, or to a lesser extent, fuels collected by the site inhabitants. Furthermore, macrobotanical remains contained in the stratigraphic samples facilitate our understanding of local vegetation regimes and paleoenvironmental conditions in the northern Great Basin during the terminal Pleistocene and throughout the Holocene (Hastorf and Popper 1988; Miller 2014). Together, these two datasets may provide the best possible understanding of human-environmental relationships at the Paisley Caves and LSP-1 Rockshelter. Stratigraphic samples, the third sample type, were also recovered by field workers during site excavation.

5.1.1.1. Feature Samples

Feature samples were collected from both in and around cultural deposits, including hearths, charcoal stains, and organic concentrations. Sampling of cultural features may reflect human behaviors and the ability to identify economically important plant and animal taxa targeted for use. Hearths may provide a glimpse of food processing, where plant remains were charred and preserved. Ethnoarchaeological studies demonstrate that while samples recovered from the base of a hearth may produce plant remains, intense heat produced by the fire may result in highly fragmented remains impeding identification (Walsh 2017). Although Pearsall (2016) recommended collecting hearth samples adjacent to the area where the fire burned the hottest to recover the highest quantities of carbonized seed, plant tissue, and fruit remains, charred seeds can also be recovered from fuel wood concentrations. At the Erin’s Cave archaeological site in the Catlow Valley, I demonstrated the utility of recovering macrobotanical samples from within hearths by individually processing separate hearth areas as stratified deposits (Dexter 2010). However, when multiple samples were collected from a single feature in similar contexts, only the sample(s) conforming to Pearsall’s recommended methods were analyzed.

5.1.1.2. Column Samples

Column sample elements were collected from intact profiles exposed in excavation blocks. Bulk soil samples were extracted from the lowermost deposits in contiguous, 5-cm intervals from the uppermost undisturbed cultural strata through the basal Rockshelter deposits. To minimize contamination, samples were collected directly into sterile plastic bags. Sampling from side walls of previously excavated units is desirable because the strata are clearly delineated and mapped prior to sampling. Where stratum breaks occurred, the 5 cm bulk sample was bisected to reflect the natural stratigraphy and to avoid strata mixing. The column locations were selected based on the relative cohesion of soils and lack of observable disturbance (i.e., bioturbation, krotovinas, or other modern intrusions and soil perturbation) in the soil profiles.

Column samples, although potentially unrelated to specific cultural activities in the archaeological past, may still offer critical data. First, collecting column samples limits sampling bias. Pearsall (2016) noted that restricting sampling to hearths and ashy features results in a non-representative sample of plant remains. Second, column samples provide longitudinal data. Whereas processing soils from cultural features provides data specific to a particular event, the plant remains in column samples can offer a time-lapse picture of how both environmental conditions and cultural behaviors change over time. Analyzing contiguous samples from a single exposure allows for comparisons of weights and counts of cultural materials across time. By quantifying relative amounts of cultural remains, it is possible to pinpoint periods of intensified occupation and/or site abandonment. Third, by randomizing sampling locations within sites the analyst increases the potential for recovering plant remains associated with medicines, handicrafts, and household goods. While plants in hearths are representative of fuelwood and dietary scraps, food is only one possible use for plants. Finally, random sampling can provide information related to intrasite spatial patterning (e.g., Hastorf 1999; Helzer 2001; Lee 2003).

5.1.1.3. Stratigraphic Samples

The ongoing project at the Paisley Caves began well before I implemented paleoethnobotanical research. Soil samples recovered in the early 2000s, therefore, did not necessarily follow the rigorous collection methods outlined here. In particular, “Strata Samples” were collected from Paisley Cave 5, Unit 5. They represent grab samples from strata identified at the end of the 2002 field season. These samples were not subject to tight vertical-horizontal control, nor were volumes standardized. Despite these shortcomings, the samples still contain useful data. Technically, the strata samples can be considered museum collections, although they have not yet been curated with the Oregon State Museum of Anthropology repository in Eugene, Oregon. At the Paisley Caves, strata samples provide a window onto the post-Mazama local vegetation.

One of the drawbacks inherent in utilizing previously collected soil samples is that sample sizes are not typically standardized. To address this problem in the current study, all bulk samples were agitated to ensure mixing of sediments and botanical constituents before sub-samples were obtained. Initially, one liter (1.0 L) sub-samples were collected. However, after processing that volume of sediment, it became clear that 0.5 L samples were preferable due to the copious amounts of macrobotanical remains in the samples.

5.1.2. Plant Reference Material Collection

To aid taxonomic identification of archaeological plant remains, fruits, seeds, and vegetative material were collected from a variety of habitats at elevations in the vicinity of the Paisley Caves and LSP-1 Rockshelter. A conventional systematic grid system was not implemented, but I recorded a detailed inventory of the vegetation communities present in each specific ecological setting collected and labeled the reference plants. Rather than rely on personal encounter rates with plants to determine the taxonomic makeup of modern vegetation communities, the National Resources Conservation Service (NRCS) Soils Ecological Site Inventory database was consulted to ensure an accurate description of current vegetative conditions (NRCS 2014).

At the Paisley Caves, multiple plant surveys occurred intermittently from 2012 to 2015, primarily during the spring, summer, and fall months. Collection locales included the margins and marshes of Summer Lake, desert shrub communities adjacent to the Paisley Caves, various spots along the Chewaucan River, Ana Reservoir, and the pine forests along the top of Winter Rim (Figure 5.1).

I conducted a day-long field investigation in the vicinity of LSP-1 Rockshelter with Desert Research Institute archaeobotanist David Rhode. The field trip included visits to saline marsh flats near Bluejoint Lake, the margins of a marsh associated with Hart Lake, and high elevation meadows, alpine forests, and rimrock escarpments on Hart Mountain in July 2013 (Figure 5.2).

An additional field trip to the Malheur National Wildlife Refuge to collect reference specimens was made in July 2014. Although the Refuge is located in Harney County, approximately 40 km from either of the study sites, the perpetuity of lake conditions here may reflect past historic lacustrine conditions experienced at Summer Lake and/or Lake Warner. While a direct correlation between modern plant communities in Harney County and historic plant communities in Lake County is unlikely, the

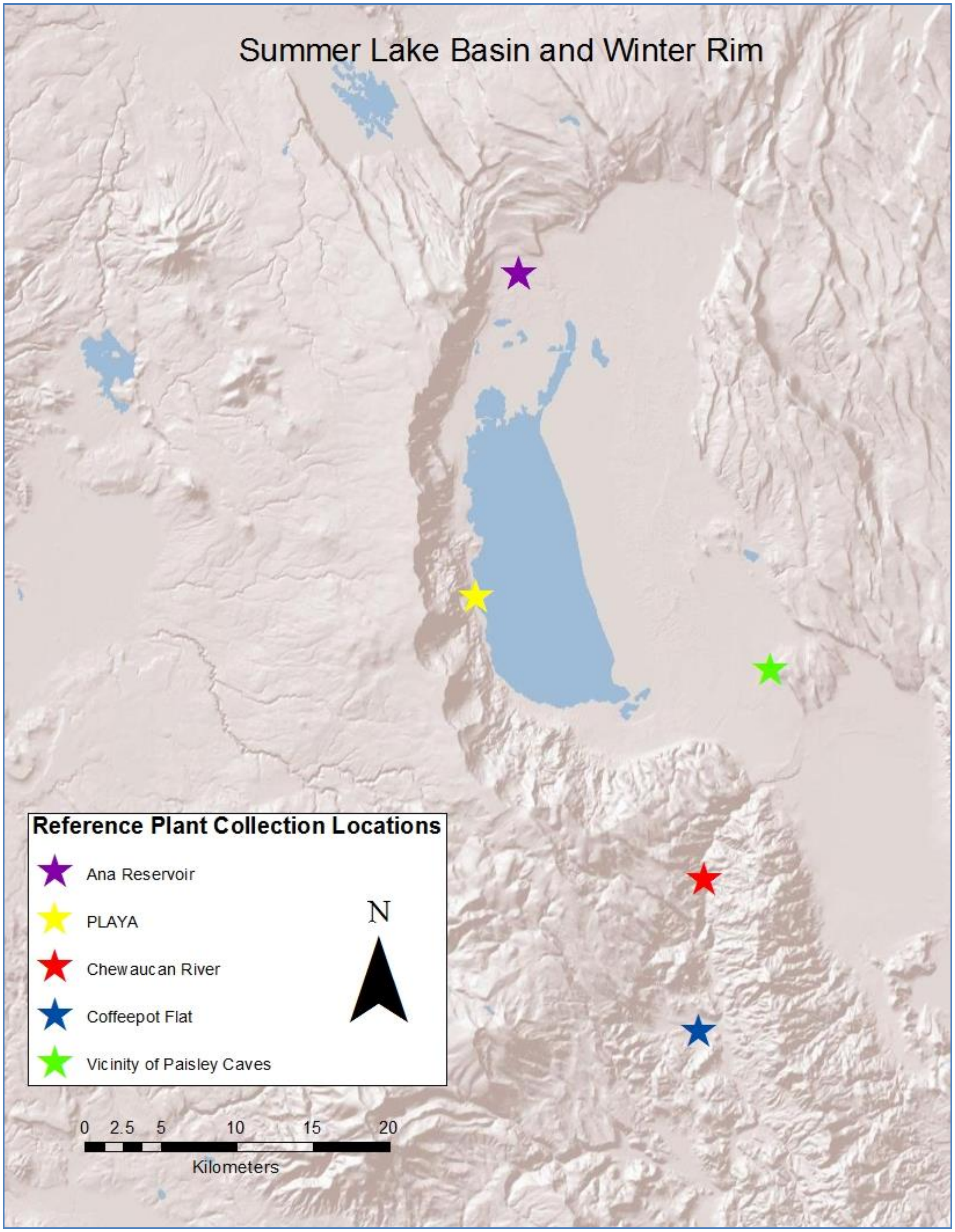

Figure 5.1. Mapped locations of plant reference collection in the Summer Lake sub-basin, Oregon.

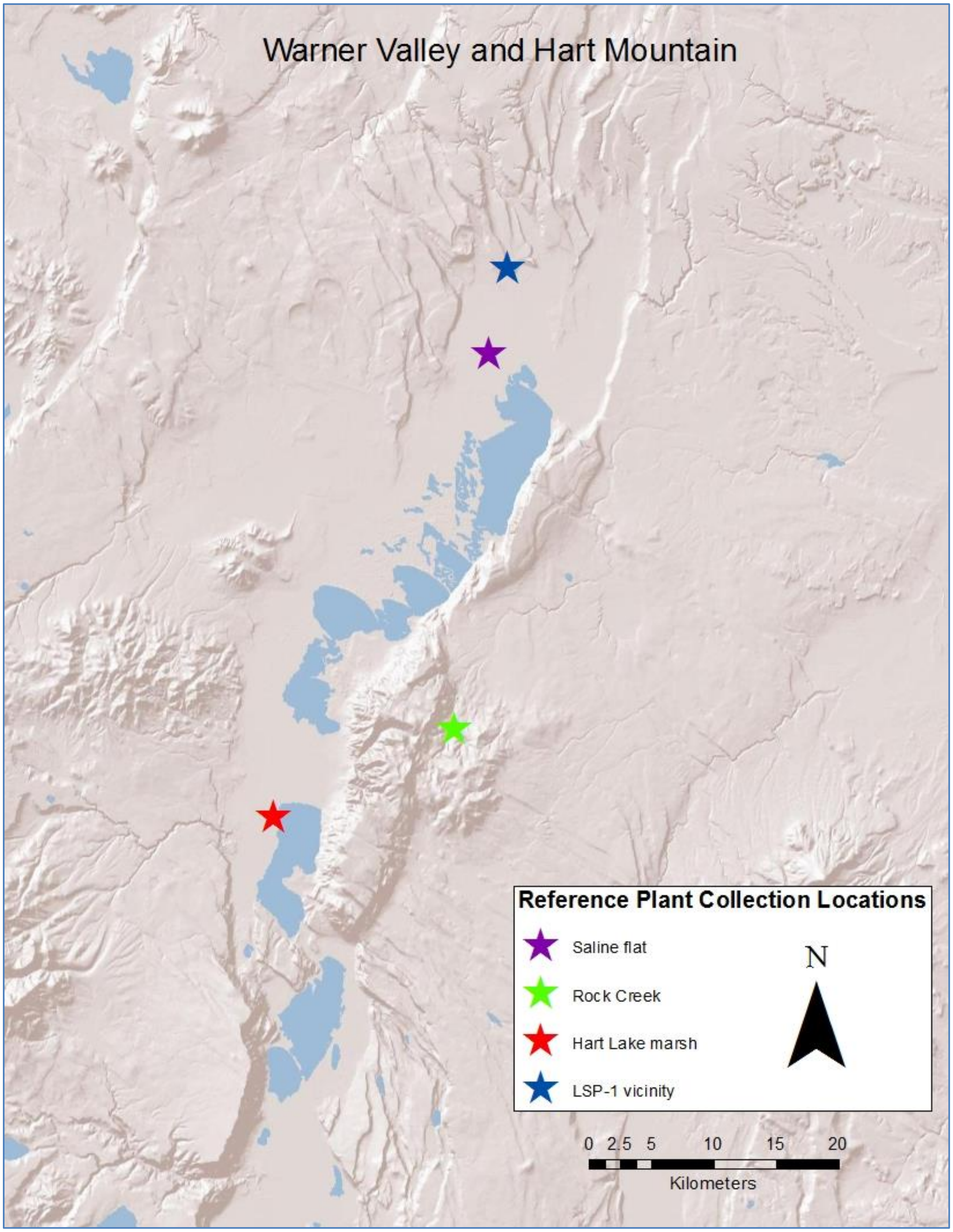

Figure 5.2. Mapped locations of plant reference collection in the Warner Valley, Oregon.

vegetation growing around Malheur Lake provided additional taxonomic diversity to the reference collection for this project.

In several instances, the plants recorded and collected were not fruiting, and thus no reference seeds were recovered. To circumvent this deficiency, I consulted herbarium data housed at Oregon State University, Corvallis. Seeds were collected from individual herbarium references there on two occasions in 2013 and 2014. Additionally, a field trip to the Malheur National Wildlife Refuge Headquarters herbarium in July 2015 provided seed references for plants previously collected on the Refuge. Additional reference specimens were acquired from the USDA seed repository in Sacramento, California.

5.2. Laboratory Methods

5.2.1. Bulk Soil Processing

Two types of separation methods, water flotation and dry sieving, were applied to the samples or subsamples selected for macrobotanical analysis. Flotation through wet screening is the preferred method of soil processing for macrobotanical analysis (Hastorf 1999; Pearsall 2016; VanDerwarker et al. 2016). In the manual extraction flotation process, a controlled volume of dry sediment was poured into a bucket. After water was added, the sediment was agitated and a vortex formed, causing light fraction materials to float to the surface of the water where they were either skimmed off or isolated by pouring the matrix through a 250 µm mesh sieve. The heavier constituents sank to the bottom of the bucket and were collected separately. All materials recovered from the flotation were passed through a set of nested screens to separate the constituents into size classes. In the dry sieving method, the entire sample volume, including the soil matrix, is passed through the screens without attempting to isolate the plant remains by introducing water beforehand. In dry sieving, the likelihood of damaging macrobotanical constituents through mechanical weathering is reduced.

5.2.1.1. Flotation – LSP-1 Rockshelter

For the current study, basic procedures for macrobotanical analysis were adopted from Paleo Research Institute, Inc. (Cummings 1989) and represent a modification of procedures outlined by Matthews (1979). Bulk soil samples analyzed for macrobotanical remains are processed by wash-over flotation procedures in which light fraction remains (such as seeds/fruits/nuts, charcoal, and other plant material) are recovered, along with heavy fraction remains, including small fragments of bone, shell, and lithic materials (White and Shelton 2014:100-101). Adams and Smith (2011:152) enumerate three benefits to using a good flotation system: it minimizes cross-contamination between samples, it is gentle enough to ensure fragile specimens are not exposed to undue stress, and because the plant parts are only briefly introduced to water, it prevents them from becoming waterlogged.

Soil from each bulk soil sample was added to approximately three gallons of water in a clean five-gallon bucket. The water was stirred manually and vigorously until a strong vortex was formed and botanical remains floated to the surface. Whenever possible, standardized one liter samples were processed, although the volume of sediment used in this analysis varied for two reasons. First, feature size restricted the available volume of sediment matrix in some instances. Second, permitting the use of varying volume sizes for column samples ensured that all natural strata were processed independently. To overcome any discrepancies stemming from the comparison of constituents recovered from samples of differing sizes, density calculations were made for each sample (see Section 5.3.2.1.).

The material that floats to the surface is called the light fraction. The light fraction was poured out of the bucket through a 250 µm mesh sieve. More water was then added to the bucket and mixing continued. This process was repeated as many times as necessary to ensure the entire light fraction was successfully transferred to the sieve. Typically, flotation continued until no visible light fraction was floating on the surface and the water turned relatively clear (i.e., clays and silts were washed through the screen).

The remaining sediment – the portion that sinks to the bottom of the bucket – is called the heavy fraction. After the light fraction was caught in the 250 µm screen, the heavy fraction was poured through a 500 µm mesh sieve. Any remaining clays, silts or sands were rinsed through the screen. Sediments and artifacts larger than 500 µm were captured in the screen and set aside for further study.

The light and heavy fractions from each sample were transferred to racks to be air-dried. Care was taken in this step to ensure that the entire remaining residue captured in the screens was effectively transferred. To avoid contamination risks, all potentially-datable material (i.e., the light fraction) was dried in aluminum containers, while the heavy fraction was dried on paper. Although drying occurs more quickly on paper, the carbon content of paper can potentially affect the results of radiocarbon analysis.

Drying of the samples usually took between 24 and 60 hours. After the light fractions were dried, they were weighed and passed through a series of graduated dry sieves with openings of 4 mm, 2 mm, 1 mm, 500 µm, and 250 µm, respectively. This step was important because it sorted dried samples into size categories, which eased the task of separating botanical contents from the remaining sediment. Heavy fractions were passed through the 4 mm, 2 mm, and 1 mm screens. Once the samples were mechanically separated, macrobotanical materials, such as seeds, seed fragments, charred tissues, and charcoal were removed from the sample to be identified.

5.2.1.2. Dry Sieving – Paisley Caves

The antiquity of sediments from the early Holocene and late Pleistocene epochs at the Paisley Caves resulted in highly fragile, desiccated remains. Although they appear intact, introducing them to water could cause the constituents to break down at an accelerated rate. To combat this potential decomposition, the Paisley Caves samples were dry-sieved rather than being subjected to a water flotation procedure. In dry sieving, a known sample volume is passed through a set of nested screens of varying mesh sizes and then inspected under a microscope (White and Shelton 2014:97). Here, the light fraction, the heavy fraction, and the associated soil matrix are combined so that it is impossible to determine a light fraction weight. Instead, the weight of each sieved size class (4 mm, 2 mm, 1 mm, 500 µm, 250 µm, and pan) was recorded prior to removing any constituents. Combined weights from each size class reflect the total sample weight, which can then be compared to the volumetric sample size. As with the samples subjected to flotation procedures, all macrobotanical materials, such as seeds, seed fragments, and charcoal were removed from the sample to be identified.

5.2.2. Plant Macrofossil Identification

All identifiable seeds and fruits were individually recovered and identified with the aid of a Nikon binocular stereo zoom microscope with10x-70x zoom optics. In this study, both carbonized and uncarbonized remains are analyzed. The preservation conditions at dry cave sites promote the survival of ancient perishable artifacts (Miksicek 1987). Typically, archaeobotanical analyses are limited to charred remains because, under normal circumstances (e.g., open sites), seeds do not generally preserve for more than 100 years (Minnis 1981). Incorporating the uncharred seeds into the botanical assemblage requires a secondary level of analysis to determine whether the botanical remains are of cultural origin or whether they are related to non-cultural agents that were incorporated into the assemblage via wind dispersal or carried in by nesting animals. In this study, only seeds recovered from securely identified cultural features are interpreted as anthropogenic.

Analysis of charcoal leads to the identification of wood used for fuel, tools, and shelter, and also provides regional vegetation data. Charred wood remains reflect arboreal species from nearby local forests (Behre and Jacomet 1991:82). Additionally, it has become standard practice to identify charcoal before it is submitted for radiocarbon analysis to determine whether old wood could be a problem for the resulting dates. The steps for flotation and separation of bulk soil sample constituents are outlined below.

As is standard archaeobotanical practice in North America, charcoal larger than 2 mm was weighed and a sub-sample of up to 20 fragments per sample was identified (Adams 2004). Analysis of charcoal was conducted by examining the tangential, transverse, and radial surfaces of each wood fragment (greater than or equal to 2 mm in diameter) using a binocular microscope. Identification of wood requires magnification up to at least 70x and is aided by the use of a fluorescent light ring attached to the microscope. To properly identify diagnostic charcoal attributes, some charcoal fragments were examined with a Nikon AZ 100 microscope with 200x zoom optics. Wood identification manuals (Adams and Murray 2004; Friedman 1978; Hoadley 1990; Minnis 1987; Sharp 1990) and a modern charcoal collection were used as references in making identifications to the most specific taxonomic level possible.

Identification of seeds was conducted with reference to seed manuals (Davis 1993; Cappers and Bekker 2013; Delorit 1970; Martin and Barkley 1973; Schopmeyer 1974) and modern reference collections described in the preceding section. Identification criteria include size, shape, surface texture, and points of attachment (Adams 2004:10). Ideally, all seeds were identified to species or genus, but in some cases broader categorizations were applied because a more precise determination was not possible.

5.3. Data Analysis

5.3.1. AMS Radiocarbon Dating

Although researchers at Paisley Caves had previously obtained numerous accelerator mass spectrometry (AMS) radiocarbon dates, additional dates were obtained at LSP-1 Rockshelter to anchor the column samples and to provide direct dates for cultural features. In total, eleven dates were obtained at LSP-1 Rockshelter for the purpose of this study. These data were previously published in the *Journal of*

Archaeological Science: Reports in tandem with my dissertation project (Kennedy and Smith 2016; Appendix B).

Ideally, charred organic materials submitted for AMS radiocarbon dating should originate from a local rather than foreign species, and from a short-lived plant type (Puseman and Klinger 2001; Schiffer 1986). Carbon was selected for AMS dating based on three criteria: cultural association, the potential lifespan of the species, and stratigraphic relevance. When possible, textile artifacts were dated, otherwise seeds and charcoal fragments were selected. All samples were processed and analyzed by Direct AMS in Bothell, Washington.

5.3.2. Quantitative Analyses

Documenting the presence of macrobotanical remains allows archaeologists to extrapolate data about past ecology and vegetation, diet, subsistence practices, trade, management practices, and seasonality of site habitation (Pearsall 2016:147). These observations are often descriptive rather than quantitative, but at minimum, descriptions can facilitate interpretation based on inferential statistics.

Quantification of presence/absence, abundance, counts, minimum number of individuals (MNI), density ratios, and other numerical approaches may not appropriately assess meaningful dietary contribution or economic importance of plant taxa (Jones 1991). For example, it is impossible to calculate MNI for botanical specimens because varying fruiting and pollination syndromes prohibit researchers from knowing how many seeds are produced by any single plant. Additionally, the nature of archaeobotanical samples themselves can complicate and misconstrue quantification of macrobotanical remains. The ambiguous origins of the Paisley Caves 5/5 strata samples (likely disturbed by looting and rodent activity), limit any interpretations beyond presence/absence and general ecological attributes. However, quantitative analysis of those macrobotanical remains recovered from unambiguous, primary contexts at the Paisley Caves and LSP-1 Rockshelter can provide additional data interpretation that facilitates better understanding of archaeological contexts and site formation processes (Pearsall 2016:148).

Multivariate statistics are best suited to archaeobotanical data because they are especially useful for detecting patterns after the data have been distilled for analysis. Rather than evaluating dependent and independent variables, multivariate methods compare data to recognize similarities and differences between the archaeological contexts from which they originated (Shennan 1988:216). All quantitative data were analyzed and graphed using Microsoft Excel and JMP software programs.

5.3.2.1. Inferential Statistics

Inferential statistics including ubiquity, density, and diversity measures are calculated for the macrobotanical data reported here. Taxon ubiquity is determined by dividing the number of samples in which the taxon occurs by the total number of samples analyzed (Adams 2004; Hastorf and Popper 1988:60-64). Taxon ubiquity is presented for each archaeological site and categorized using criteria such as time of deposition and cultural context. Results of both intrasite and intersite macrobotanical analyses are presented. As a baseline, these data can be integrated into a regional database that can provide more analytical power in interpretations of the archaeobotanical record for the northern Great Basin.

Density ratios are employed to compare taxonomic diversity across samples of varying volumes (Miller 1988). These measurements provide a greater understanding of intensification of particular resources as they are distributed in archaeological contexts. Additionally, when combined with ecological attributes of the represented taxa (e.g., USDA 2015; Weber and Hanks 2008), I use these data to assess seasonal patterns of site use and historic environmental trends.

I calculate diversity and richness indices to compare species diversity within and between samples and sample elements. Taxonomic diversity is presented as a Shannon-Wiener variability index of equitability:

$$H^1 = - \Sigma\ (p_i)(\log_e p_i),\ V^1 = H^1/\log_e S,$$

where p_i is the fraction of individuals belonging to the i-th species and S is the number of species in the community. These data are not indicative of the number of plant species introduced to cultural contexts; rather, they graphically demonstrate the taxonomic diversity for the archaeological context sampled.

5.3.2.2. Cluster Analysis

Cluster analysis allows large multivariate datasets to be summarized in terms of a “typical” member of each cluster (Gnanadesikan and National Research Council 1988). Values for all variables are unknown in cluster scenarios (Andrews and McNicholas 2014:143). Here, I use clustering to assess the similarities between samples based on the occurrence or non-occurrence of specific element types contained in a given sample and the attributes of those types (e.g., charcoal density, charred v. uncharred seeds, flower times, etc.).

5.3.2.3. Dissimilarity Indices

The populations of charred and uncharred seeds were compared to evaluate whether uncarbonized seeds in the rockshelter deposits likely reflect cultural activity. If the charred and uncharred seeds were deposited at the same time by the same agents, then the taxonomic makeup of both populations should be consistent for a given sample. Tests for heteroscedasticity determine chi square values to compare whether the two populations are statistically similar.

Analysis of variance (ANOVA) calculations can determine whether the populations of charred and uncharred seed assemblages originate from the same distribution. However, the non-normal distribution of dependent variables in macrobotanical datasets necessitates the use of a non-parametric analysis. A Kruskal-Wallis test was employed to assess for significant differences.

5.4. Methodological Limitations and Sampling Bias

5.4.1. Taphonomic Considerations

Several factors may contribute to the types and quantities of charred remains recovered from macrobotanical analyses of prehistoric archaeological deposits. Archaeologists attempt to understand target populations through identification of constituents present in sampled populations. Both natural and cultural transformations affect the population originally exploited in the living (or systemic) context.

An inherent bias results from the plants' structure and dispersal strategies. Because of variable seed production for each plant species, the number of seeds should not be interpreted as a strict indicator of individual consumption/disposal. While some plants produce several seeds per fruit, the fruits of other plants produce only a single seed. Likewise, seeds with soft coats are likely to decay and decompose, while seeds with hard seed coats allow for better preservation. Weed seeds also enjoy a higher preservation rate due to the fact that they are mature at the time of dispersal, as opposed to plants selected for their nutritional value, which are often picked before they are ripe. Additionally, not all plants exploited in prehistoric systemic contexts are necessarily incorporated into the archaeological context. For example, following Ringrose (1993), Lee (2003) defines those plants purposely harvested and processed at the campsite and those introduced accidentally to the campsite (both by people and commensal animals) as the ‘death assemblage.’ Under this premise, foods consumed *en route* to the campsite would not have the opportunity for incorporation into the death assemblage. Additionally, if non-diagnostic plant materials (bulbs, roots, tubers, etc.) are specifically harvested in the field, their incorporation into the death assemblage may not be recognized in the archaeological context.

Once remains are introduced to a campsite, several processes affect their survival from the death assemblage to the ‘deposited assemblage’ (Lee 2003). Inedible, discarded plant parts like nutshells and drupes are more likely to preserve than edible parts, because ostensibly the edible parts are eaten in camp. Those plants accidentally spilled during preparation may be incorporated into the deposited assemblage. Carbonization of plant remains increases the potential for survival over extended periods of time. Plants stored in campsites might also have a greater survival potential if storage vessels containing botanical remains are left behind at the campsite.

Finally, mechanical and chemical processes such as bioturbation and freeze/thaw cycles can reduce the number and types of plants that survive as the ‘fossil assemblage’ (Lee 2003). The fossil assemblage is the population which endures in the archaeological record, and thus a target population in this study.

Diet reconstructions that rely on ecofacts like macrobotanical remains and faunal assemblages suffer from three principal limitations: differential discard behaviors, quantification issues related to bioturbation and non-cultural site formation processes, and destructive processing techniques used by site residents to enhance the digestibility, nutritional value, or flavor of the resource (Pavesic et al. 2016:214).

Because the Paisley Caves and LSP-1 Rockshelter were inhabited intermittently, the irregular resolution of data diminishes intensive analyses of certain occupation events. For example, the detailed archaeological data at the Paisley Caves during the Younger Dryas allow me to pose specific questions related to the Terminal Pleistocene Paleoindian occupations, but limited archaeological data in Late Holocene components preclude such inquiries. Several pointed questions are raised to assist in the interpretation of paleoethnobotanical data.

5.4.2. Sample Size

Sample size bias may affect the ability to accurately compare constituents among samples. In this study, standardized volumes of sediments (1 L) were floated whenever possible, but in the case of feature samples, this quantity was not available, resulting in flotation of limited volumes of sediment. To eliminate a sample-size effect, I assigned volume-mediated density values to the raw frequency of charred seeds. Density was calculated by dividing the total number of charred seeds by the volume of sediment floated.

Soil volumes, rather than weights, are used to quantitatively compare the samples from the Paisley Caves and LSP-1 Rockshelter. Samples from LSP-1 Rockshelter were processed via standard flotation procedures (see 4.2.3), thus introducing a potential bias in recovery rates between the Paisley and LSP-1 assemblages. At the outset, I intended to dry sieve the Paisley samples and then subject them to flotation in order to maintain control over the methods. However, when I attempted to wet screen one half of a previously sorted column sample, the added moisture facilitated the growth of fungal spores and the sample took an excessive amount of time (nearly two weeks) to completely dry. Experimental flotation studies by Wright (2005:25) demonstrated that increased processing time directly correlates with greater potential for damage or loss to the botanical constituents. Additionally, the copious amounts of animal waste in the Paisley samples (especially owl pellets and large mammal coprolites) have the potential to introduce plant remains that represent neither cultural activities nor local vegetation. Wetting the sample dislodged seeds from the fecal matrix. Due to these limitations, the double processing method is not feasible, so direct intersite comparisons based on weighted samples between the Paisley Caves and LSP-1 Rockshelter are problematic. Macrobotanical assemblages from both sites, therefore, are discussed independently and any quantitative comparisons and observations are constricted by these data limitations.

5.4.3. Exploratory Nature of Research Objectives

Archaeobotanical analysis is a labor-intensive specialized field of study. Identification of constituents in individual samples often requires several days of effort. As a result, the number of samples analyzed for this project is limited, and not representative of every identified archaeological component. Consequently, only one non-cultural feature, the bushytailed woodrat nest, was included in the analysis. Data deriving from analysis of this feature is exploratory, and will not be compared to additional original data.

CHAPTER VI

SPECIES DESCRIPTIONS

Archaeological botanical remains recovered from northern Great Basin rockshelters reported here represent 35 plant families (Table 6.1). This chapter describes the seeds and charcoal recovered from the Paisley Caves and LSP-1 Rockshelter samples and summarizes the natural and cultural ecologies for each taxon. Following the Linnaean classification system, genera and species accounts are organized alphabetically by family. Nomenclature generally follows Meyers et al. (2015) and/or Hitchcock and Cronquist (1973). The use of a specific epithet indicates a confident species-level attribution; the use of genus name alone specifies certainty in genus-level attribution, but species-level attribution is undetermined or indeterminable. The moniker "cheno-am" refers to plants in either the genus *Amaranthus* or *Chenopodium* (Adams 2004). The two genera have been recently split into separate families: Amaranthaceae and Chenopodiaceae, respectively. Accordingly, the category of "cheno-am" encompasses both families in this analysis. The abbreviation "cf." is a taxonomic qualifier denoting uncertainty of identification. In this analysis, it means "similar to" and is derived from the Latin *conformis* (Lucas 1986). Qualifications of family or genus names with "-type" indicate more than one taxon exhibits the characteristics used for identification and no more specific identification could be made.

Table 6.1. Plants identified in the Paisley Caves and LSP-1 Rockshelter macrobotanical samples.

Family	**Genus/species**	**Common Name**	**Klamath name**	**Modoc name**	**Numu (Northern Paiute) name**	**Traditional Economic Uses**	**Available for Harvest**	**Specialized Ecological Attributes**
Adoxaceae	*Sambucus*	elderberry	*slō′-lös*	*clu'lusɑm; sapa'wal?*	*hubuiha; konugibɨ*	food; drug	fall	-
Aizoaceae	*Sesuvium*	sea purslane	-	-	-	-	?	halophyte
Amaranthaceae	*Amaranthus*	pigweed	*bä-lō′-ōch*	*ba'kai?*	*ɨapi*	food; drug	fall	drought-resistant
Anacardiaceae	*Rhus*	sumac	-	-	-	-	fall	-
Apiaceae		umbel family						
Asparagaceae	*Camassia*	camas	*pû'ks; pâks*	*bo'kc*	*passikoʾo*	food; drug	summer	facultative wetland
Asteraceae		sunflower family						-
	Artemsia	sagebrush	*ghät, or bōl′-whē*	*cqo't; bu'lxwɩ*	*sawabi*	fuel; textile; tools; drug	fall	drought resistant
	Chrysothamnus	rabbitbrush				drug	fall	-
Boraginaceae		borage family						
	Amsinckia	fiddleneck	-	-	-	food	summer/fall	-
	Cryptantha	cat's eye	-	-	-	-	summer	-
	Hackelia	stickseed	-	-	-	-		facultative upland
	Plagiobothyrus	popcorn flower	-	-	-	-	summer	facultative wetland
Brassicaceae		mustard family		-				
	Descurainia	tansymustard	-	*tci'pas*	*yɨnnaka*	food	summer	-
Cannabaceae	*Celtis*	hackberry	-	-	-	-	-	-
Chenopodiaceae		cheno-am	-	-	*apuza*	food	fall	halophyte
	Atriplex	saltbush/shadscale	-	-	*kangibbɨ; yɨnnaka*	food	fall/winter	halophyte; drought-resistant
	Chenopodium	goosefoot	*kōts-on'-iks*	*kotca'nɩks*	*ɨˀapɨ*	food	fall	halophyte; drought resistant;

Table 6.1. Plants identified in the Paisley Caves and LSP-1 Rockshelter macrobotanical samples.

Family	**Genus/species**	**Common Name**	**Klamath name**	**Modoc name**	**Numu (Northern Paiute) name**	**Traditional Economic Uses**	**Available for Harvest**	**Specialized Ecological Attributes**
								facultative upland
	Monolepis	blitum	-	-	-	-		halophyte
	Suaeda	seepweed	-	-	*wada*	food	fall	halophyte; facultative wetland
Cupressaceae	*Juniperus*	juniper	-	*qa’lu*	*wahapi*	food; fuel; drug; textile; dye	fall	drought-resistant
Cyperaceae		sedge family						
	Carex	sedge	*bha'-nē, or wich'pī*	*bϵ’ϵni*	-	textile; food	summer	obligate wetland
	Eleocharis	spikerush	-	-	*pamahabɨ*	food	summer-fall	obligate wetland
	Scirpus	bulrush; tule	*mä-i*	*ma’i; kla’na*	*sai-; abibɨbui*	textile	summer	obligate wetland
Fabaceae		legume family						
	Trifolium	clover	-	-	-	food	summer	facultative
	Vicia	vetch	-	-	-	-	summer	drought-resistant
Geraniaceae		geranium family						
Grossulariaceae	*Ribes*	currant; gooseberry	*chmâr'-läk*	-	*ohapogopissa; pogopisapui*	food; drug	summer	drought-resistant
Hydrophyllaceae	*Phacelia*	phacelia	-	-	-	?	summer/fall	-
Juncaceae	*Juncus*	rush	*tsin'ä'-ō*	-	*pamahabɨ*	food; textile	summer	halophyte; facultative wetland
Lamiaceae		mint family						
Liliaceae s.l.	cf. *Allium*	wild onion	*pâks*	-	*padɨssi*	food; drug	summer/fall	drought resistant; facultative upland

Table 6.1. Plants identified in the Paisley Caves and LSP-1 Rockshelter macrobotanical samples.

Family	**Genus/species**	**Common Name**	**Klamath name**	**Modoc name**	**Numu (Northern Paiute) name**	**Traditional Economic Uses**	**Available for Harvest**	**Specialized Ecological Attributes**
	cf. *Calochortus*	sego lily	*yänch*	*yɑ’nc*	*kogi*	food	summer	-
Loasaceae	*Mentzelia*	blazing star	*lō′-läs*	*lo’las*	*kuha*	food	fall	-
Malvaceae		mallow family						
	Sphaeralcea	globemallow	-	-	-	?	summer	drought-resistant; cold-adapted
Montiaceae	*Claytonia/Montia*	montia family	-	-	*nɨmɨzizinnayaˀa*	-	summer/fall	facultative
Onagraceae	*Chamerion*	fireweed	-	-	-	-	summer/fall	
	Oenothera	evening primrose	*wä'-säm chōn'-wäs*	-	-	food; repellent	summer/fall	drought-adapted
Pinaceae	*Pinus*	pine	*kō'sh*	*wa’qu*	*wogo-*	building material; drug; food; fuel; tool; adhesive	late summer	-
Plantaginaceae	*Plantago*	plantain	-	-	*papaya* (?)	-	summer/fall	-
Poaceae		grass family						
	Achnatherum hymenoides	Indian ricegrass	-	-	*wai; waipui*	food	summer	drought-adapted; upland obligate
	Agrostis	Bentgrass	*nō'-tӓk*	*no’taq*	*wasa* (?)	food	summer/fall	drought-adapted; facultative wetland
	Hesperostipa	needle and thread grass	-	-	-	-	summer	-
	Leymus cinereus	Great Basin wildrye	*gla'-i pi*	*gla’pi*	*wayabɨ*	food; drug; fiber	summer	drought adapted
Polygonaceae		knotweed family						
	Eriogonum	buckwheat	*ba-bäk"--bak-lha'-näm*	*qa’lupka*	*tazawazubɨ*	food; drug	summer	drought-adapted
	Rumex	dock	*gō-klaks*	*go’kca*	*pawiapɨ*	food; drug	summer/fall	facultative wetland

Table 6.1. Plants identified in the Paisley Caves and LSP-1 Rockshelter macrobotanical samples.

Family	**Genus/species**	**Common Name**	**Klamath name**	**Modoc name**	**Numu (Northern Paiute) name**	**Traditional Economic Uses**	**Available for Harvest**	**Specialized Ecological Attributes**
Rhamnaceae	*Ceanothus*	buckbrush	*ga-ga'-e-säm sä'-wäls;* *lúiluish*	*dza’kulu*	*wɨyɨpɨ*	food; drug; fiber	summer	drought-adapted
Rosaceae		rose family						
	Prunus	chokecherry or Klamath plum	*tuítchχash*	*dɑwɩtcqa’s;* *tumɑ’lo*	*toishabui*	food; drug	summer	drought-adapted
	Rosa	wild rose	*chō-it'-i-äm*	*tcuwɩ’di*	*tsiabui*	food; drug; tool	fall	-
Rubiaceae	*Galium*	bedstraw; cleaver	-	-	-	-	late summer	facultative upland
Salicaceae	*Salix*	willow	*yäs*	ya’c	sɨngaabi	drug; textile; building material	spring	facultative wetland
Solanaceae		nightshade family						
	Nicotiana	Indian tobacco	*käch'kul*	*qatklɑ’m*	*puibahmu*	drug	summer	-
Typhaceae	*Typha*	cattail	*pō'-päs*	*pu’pɑsɑm*	*tahuunatsɨ; toiˀi; toibɨ*	textile; food; building material; tool	summer	halophyte; obligate wetland
Urticaceae	*Urtica*	stinging nettle	*sleds*	-	*kwiibaanupɨ-*	textile	fall	facultative wetland

Descriptions for each taxon derive from botany manuals (Blackwell 2006; Hickman 1993; Hitchcock and Cronquist 1973; Meyers et al. 2015; Oregon Native Plant Society 2007; Simpson 2006; USDA 2017), seed identification guides (Davis 1993; Martin and Barkley 1961), queries of U.S. government-administered online databases (https://www.feis-crs.org/feis/; https://plants.usda.gov/core/wetlandSearch), and scholarly articles on plant adaptive strategies (e.g., Weber and Hanks 2008). Ecological data (habitat, seasonality, growing habit, etc.) for each identified taxon aid environmental interpretations presented in the results and discussion sections of this dissertation.

All identified taxa were cross-referenced against historic plant usage by Native groups living in the northern Great Basin at the time of Euro-American contact. The study area encompasses the traditional territories of the Klamath, Modoc, and Northern Paiute peoples, and the abstracts draw from ethnographies of these groups. The following abstracts provide a brief description of plant taxa identified in the Paisley Caves and LSP-1 macrobotanical assemblages, and list the possible uses of the plant remains in antiquity. Klamath plant name translations follow Colville (1897) and Gatschet (1891) and Modoc names appear in Ray (1963); Northern Paiute plant names are referenced in Liljeblad et al. (2012). As this project does not include original ethnographic research, the names transcribed in Table 6.1 are undoubtedly incomplete and/or misspelled.

Morphological attributes of the macrobotanical remains are presented in Appendix C along with representative images of each taxon. Invasive and non-native taxa identified in the samples are considered modern intrusions and not discussed.

6.1. Adoxaceae – The Moschatel Family

6.1.1. Sambucus sp. (elderberry)

Elderberry (*Sambucus*) seeds were recovered as charred and uncharred specimens from the Paisley Caves, but were not identified at LSP-1 Rockshelter. Red elderberry (*S. racemosa*) and blue elderberry (*S. mexicana*) are both large shrubs (2-6 m) common in the Great Basin. Found along streambanks in open forest, they prefer moist and bright conditions below ~3300 m AMSL. Both species exhibit 5-petaled whitish flowers in late spring through the early summer, but are distinguished by the color of the berry (red and blue) in late summer.

Elderberries were consumed raw, boiled, or dried by the Paiute (Kelly 1932:100; Mahar 1953:111; Park and Fowler 1989:50) while only blue elderberry is listed as a food source for the Klamath (Colville 1897:104; Spier 1930:165) and Modoc (Ray 1963:215). Reportedly, Bannock groups that historically lived to the east of the current study area would remove the pith from fresh stems, stuff them with crickets, and plug the ends to store the insects for winter food (Colville 1897:104). The blue elderberry plant’s medicinal properties were also exploited by the Northern Paiute. Infusions of dried flowers and root scrapings provided gastrointestinal relief, and poultices of heated stems were applied topically as an antirheumatic treatment (Kelly 1932:100; Mahar 1953:111; Train 1941:138).

6.2. Aizoaceae – The Fig-Marigold Family

6.2.1. Sesuvium sp. (sea purslane)

A single uncharred *Sesuvium* seed was recovered in a feature sample at the Paisley Caves. In the Great Basin, sea purslane is a perennial herb that grows mainly in alkali flats. Fruits and flowers appear anytime from April to November.

There are no reported uses of sea purslane in the ethnographic literature of the Great Basin.

6.3. Amaranthaceae – The Amaranth Family

6.3.1. Amaranthus sp. (pigweed)

Amaranthus seeds were recovered from hearth features at the Paisley Caves and LSP-1 Rockshelter. The perennial herb grows in disturbed soils, and is usually found below 800 m AMSL. Its flowers bloom in dense, spike-like clusters in late summer and early autumn. Most species found in southcentral Oregon today are native imports from tropical latitudes, but *A. powellii* is native to Lake County.

Ethnographers report the Klamath and Modoc ate the seeds of pigweed (Colville 1897:96; Ray 1968:218), but the species harvested at that time were introduced weeds. Spier (1930:163) mentions *Amaranth* seeds were used sporadically, although he may have been referring to *Chenopodium* (Spier:166). In the economy of the Surprise Valley Paiute, *Amaranth* was classified as a moderately-important plant (Masten 1985:310).

6. 4. Anacardiaceae – The Sumac Family

6.4.1. Rhus sp. (sumac)

In the current analysis, a single fragment of *Rhus* charcoal was recovered from a non-feature sample at LSP-1 rockshelter. *Rhus* (sumac) shrubs grow in association with grass communities and desert shrubland in northern California and the Great Basin, generally above 1200 m AMSL.

In the traditional economy of Northern Paiute peoples, the fruits were recognized for their astringent qualities, and dried, powdered berries were applied to smallpox sores (Train et al. 1941:129). In California, its berries provided food as well as serving medicinal purposes (Moerman 2009:413).

6.5. Apiaceae – The Umbel Family

A single uncharred Apiaceae-type schizocarp was recovered from Stratum I in Paisley Cave 5. Members of the umbel family number in the thousands, and several genera, including *Lomatium* and *Perideridia*, were traditionally harvested by indigenous groups in the Great Basin (Moerman 1998). The schizocarp recovered at the Paisley Caves did not resemble any of these types.

6.6. Asparagaceae – The Asparagus Family

6.6.1. Camassia quamash. (camas)

In this study, camas (*C. quamash*) is represented by two charred seeds in a feature sample at the Paisley Caves. Although camas has been reclassified to the Asparagus family (Asparagaceae), in this Camas is a perennial herb with basal leaves that range in height from 10-80 cm. Three subspecies of camas grow in vicinity of the Summer Lake basin and Warner Valley including small camas *C. quamash* (Pursh) Greene ssp. *brevifolia* Gould, *C. quamash* (Pursh) Greene ssp. *quamash*, and *C. quamash* (Pursh) Greene spp. *walpolei*. Camas can be propagated from seed or from its starchy bulbs. It is distributed through several ecoregions in the Pacific Northwest, but in the current study area, it generally grows in sunny, moist meadows of ponderosa pine woodlands below 3300 m AMSL. Distinctive bluish-purple flowers bloom on a raceme in the spring, but bulbs are typically harvested in early summer through mid-fall.

Camas is perhaps the most important traditional plant food identified by extant tribes in Oregon. Bulbs were dug, dried, and steamed in pits by the Klamath (Colville 1897:93). Although by most accounts, the camas bulbs would have been collected in the summer, Colville reported the Klamath began gathering as early as April 1st. Ray (1963:218) mentioned the role of camas as a food plant among the Modoc, but provided no details. The Paiute also valued camas bulbs as a food item. Bulbs were cooked in pits overnight and then eaten, or dried for winter consumption (Kelly 1932:102). The dried bulbs were also ground and made into a pudding (Mahar 1953:56).

6.7. Asteraceae – The Sunflower Family

Members of the sunflower family were commonly utilized by Great Basin Indian tribes; many genera were prized for their medicinal properties. Four genera belonging to this group were identified in the current study, along with Asteraceae seeds unidentifiable to species.

6.7.1. Artemisia sp. (sagebrush)

Sagebrush (*Artemisia* sp.) was primarily represented by charcoal in both the Paisley Caves and LSP-1 Rockshelter feature samples, but charcoal and uncharred seeds were also identified outside of cultural features at the Paisley Caves (additionally, a single charred seed specimen was recovered in the uppermost stratigraphic layer of Cave 5). The fragrant shrub is currently the dominant vegetation type in a majority of the Great Basin, and local paleoclimate records demonstrate that sagebrush has been ubiquitous on the northern Great Basin landscape throughout the Holocene (Minckley et al. 2007; Saban 2015). The *Artemisia* genus displays considerable morphological variation in size, but leaves are typically greyish green with dense hairs. Big sagebrush (*A. tridentata*), low sagebrush (*A. rigida*), gray sagewort (*A. ludoviciana* var. *latiloba*), silver wormwood (*A. ludoviciana* var. *ludoviciana*), and bud sage (*A. spinescens*) are the most frequently encountered species in the project area. Flowering time is dependent on the species, but they generally bloom from late spring through fall. Their vegetative growth provides forage and cover for several Great Basin animals.

Several ethnobotanical accounts suggest big sagebrush was burned for fuel by various Great Basin and Columbia Plateau groups (Colville 1897:105; Mahar 1953:119; Turner et al. 1980:78). Mahar noted *Artemisia* commonly acted as both tinder and primary fuel in Paiute hearths. Tightly wound dry *Artemisia* bark acted as a torch for Klamath and Modoc people living on the Yainax Agency (Barrett 1910:257). The wood also could be fashioned into drills and the bark was commonly woven into sandals and cloth. *A. tridentata*, the most widely distributed species, has been identified as an essential medicinal plant by the Klamath, Modoc and Paiute tribes. Klamath uses for sagebrush involved making decoctions that were ingested to treat diarrhea and applied externally as an eye wash (Colville 1897:105). Ray (1963:219) indicated that sagebrush leaves were used by the Modoc to treat aches, pains, fevers, and gastrointestinal problems. The Warm Springs Paiute made poultices of the leaves to treat burns and sores. The poultices were also applied to the scalp as a hair tonic. Both the Warm Springs and Owens Valley Paiute commonly chewed leaves or ingested decoctions of leaves to break fevers (Mahar 1953:119; Steward 1933:317).

6.7.2. Chrysothamnus sp. (rabbitbrush)

Rabbitbrush (*Chrysothamnus*) is present in these samples in the form of a single charcoal fragment and multiple uncharred leaves at the Paisley Caves. No rabbitbrush macrobotanical remains were identified in the LSP-1 samples. In the Shrub Steppe environment, *Chrysothamnus* bushes are commonly found in association with sagebrush at elevations up to 3350 m AMSL. The plant’s bright yellow flowers bloom from July to November.

Chrysothamnus served diverse purposes among the Paiute during the historic era (Stewart 1941:375). Mahar (1953:115) reported the stems were peeled and used to pierce ears in preparation for wearing earrings, and that the roots were chewed as gum or candy. Regionally, infusions and decoctions of the plants were used to relieve a variety of ailments including gastrointestinal problems, dermatitis, chest colds, and venereal diseases (Moerman 1998:159-161).

6.8. Boraginaceae – The Borage or Forget-Me-Not Family

6.8.1. Amsinckia sp. (fiddleneck)

In this study fiddleneck seeds were numerous in samples collected at the Paisley Caves and LSP-1 Rockshelter. Charred and uncharred seeds were both noted. At the Paisley Caves, *Amsinckia* was identified outside cultural features, but at LSP-1 its presence was noted in hearths as well and was ubiquitous in Early Holocene samples. Fiddlenecks are branched to erect annual herbs with bristly hairs that thrive in dry and open disturbed locations. Two species are native to the northern Great Basin: bristly fiddleneck (*A. tessellata*) and common fiddleneck (*A. menziesii*). Both types have yellow flowers arranged in helicoid form, which are visible in late spring through early summer. High levels of nitrates and alkaloids in the plant cause toxicity in grazing animals, especially cattle.

Amsinckia is not discussed in ethnographic literature pertaining to the northern Great Basin, but the leaves, seeds, and shoots are edible. They were traditionally consumed by Native American groups in California and the Southwest United States (Anderson 2012:10; Moerman 1998:70-71).

6.8.2. Cryptantha s.l.[1] (cat's eye)

Cat's eye (*Cryptantha*) was represented by charred and uncharred seeds in various contexts at the Paisley Caves. *Cryptantha* is an annual herb that attains heights of 10-50 cm. There are several native species of *Cryptantha* in the Great Basin. Most species are common in upland environments on gravelly and rocky flats and on slopes in the sagebrush steppe. Usually white, but occasionally yellow, pinwheel-like flowers bloom in the spring.

No economic uses for *Cryptantha* are documented for tribes of the Great Basin, California, or the Pacific Northwest.

6.8.3. Hackelia sp. (stickseed)

Hackelia seeds are present in stratigraphic (column; non-feature) samples at the Paisley Caves site. Stickseed plants are annual or perennial herbs with mostly basal leaves that are common to dry slopes in the sagebrush steppe at elevations between 1800

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[1] Recently, the genus *Cryptantha s.l.* has been divided into five separate genera: *Cryptantha s.s.*, *Eremocarya*, *Greeneocharis*, *Johnstonella*, and *Oreocarya* (Hasenstab-Lehman and Simpson 2012). However, the taxa are differentiated by flower characteristics, not seeds.

m and 3100 m AMSL. Its pinwheel-shaped, white flowers bloom all summer (June through August).

No evidence of indigenous use of *Hackelia* exists in the region’s ethnobotanical literature.

6.8.4. Plagiobothrys sp. (popcorn flower)

Uncharred *Plagiobothrys* seeds were identified in non-feature samples at the Paisley Caves and charred seeds were recovered from feature samples at LSP-1 Rockshelter. A single uncharred seed was also identified in a Late Holocene hearth at LSP-1 Rockshelter. Great Basin species of *Plagiobothrys* are herbs or forbs that thrive on dry, open slopes 1200-1300 m AMSL. Flowers are in bloom from May to July.

No cultural use has been recorded for this plant among the Klamath, Modoc, or Paiute, but the Mendocino peoples who traditionally lived south of the current study area ate the seeds as well as the crisp, tender shoots and flowers (Moerman 1998:415). Alfred Kroeber also reported *Plagiobothrys* seeds as a foodstuff among the Chukchansi (Anderson 2012:188).

6.9. Brassicaceae – The Mustard Family

6.9.1. Descurainia sp. (tansymustard)

Descurainia seeds were commonly observed in the LSP-1 Rockshelter samples. Tansymustards are native winter annuals with yellow flowers commonly found in open areas with little to no overstory vegetation and growing in association with sagebrush.Several corroborative reports for the use of tansymustard seeds exist in the ethnographic literature for the Northern Paiute. Seeds could be parched, ground and eaten as meal (Colville 1897). They could also be roasted, cooled, ground and mixed with water to create a cooling summertime beverage. The Northern Paiute used *D. pinnata* to brew such a beverage (Park and Fowler 1989). In the winter, stored seeds were mixed with snow to make ice cream. Additionally, tansymustard possesses medicinal properties and a poultice of ground seeds could be applied to sores on the skin (Kelly 1932:98; Mahar 1953:74; Park and Fowler 1989:47).

6.10. Cannabaceae – The Cannabis Family

6.10.1. Celtis sp. (hackberry)

Charred and uncharred cf. hackberry seeds were recovered from the Paisley Cave 5 upper strata samples and in a single column sample (CS-4) in Unit 2/6B. Hackberry trees do not currently grow in southcentral Oregon.

No ethnobotanic usage of hackberry has been reported for the Klamath, Modoc, or Northern Paiute.

6.11. Chenopodiaceae – The Goosefoot Family

Several seeds and seed perisperms belonging to the Chenopodiaceae family were present in the macrobotanical assemblages at both archaeological sites in the current investigation. Chenopodiaceae is represented by five identified genera and seeds categorized as cheno-ams. Each of these plants produces mostly starchy-perispermous seeds with curved embryos that are edible. These plants are related to the pseudo-grain crop quinoa (*Chenopodium* spp.), a popular alternative grain to wheat and rice in the contemporary American diet.

6.11.1. Atriplex spp. (saltbush), *A. confertifolia, A. palustris, A. rosea*

Several uncharred and charred *Atriplex* seeds and fruits were recovered at the Paisley Caves, while uncharred *Atriplex* seeds alone were present in the LSP-1 Rockshelter samples. Seemingly all Northern Paiute ethnographic sources mention *Atriplex* as an economically important plant taxon (e.g., de Angulo and Freeland 1929; Fowler 1982; Kelly 1932; Steward 1933; Stewart 1941). Saltbush plants were valuable both as a component of Paiute diet and for their medicinal properties. Fowler (1982:132-133) reported saltbush roots could be boiled with salt and water and taken as a cathartic. As a cold remedy or antirheumatic, a poultice of mashed leaves was applied to the chest or other affected areas of the body. Seeds were commonly parched and ground into a flour to be eaten in bread or mush (Park and Fowler 1989:47; Steward 1933:244).

*6.11.2. Chenopodium s*p. (goosefoot)

Chenopodium seeds were recovered as charred and uncharred specimens in the Paisley Caves and LSP-1 Rockshelter. Their distributions were not temporally constrained, but spikes in seed abundances were noted in cultural features. The genus is nearly ubiquitous across northern and temperate climates on Earth, as is its consumption among groups that live where it grows. The greens are high in calcium, and the fruits generate several seeds per plant that are high in protein (USDA 2015).

According to Ray's (1963:199) Modoc informants, chenopods were an extremely important seed plant. Seeds of goosefoot were also valued by the Klamath (Spier 1930:162) and Paiute (Kelly 1932:98; Park and Fowler 1989:48; Steward 1933:244). Seeds were parched, ground and eaten as meal. The leaves were also chewed to induce vomiting (Steward 1933:317).

6.11.3. Monolepis sp. (blitum)

Uncharred *Monolepis* seeds were recovered in Cave 5, Stratum I at the Paisley Caves. *Monolepis* are herbs that can commonly be found in disturbed places from 70-3580 m AMSL.

Monolepis use is not documented in the ethnographic literature for the Great Basin.

6.11.4. Suaeda sp. (seepweed; wada)

In this study, a single charred *Suaeda* seed was present in a non-feature column sample at the Paisley Caves site. *Suaeda* plants grow in xeric habitats and are adapted to high levels of salinity. They can be found in playas, salt flats, marshes and in wetland locations. Flowers and seeds ripen in the fall.

Historically, members of the Burns-Paiute tribe referred to themselves as Wadatika, which translates in English to “wada eaters.” Wada is the Paiute name for the seepweed plant (*Suaeda*). Seeds were collected, parched, ground into flour and eaten as meal (Kelly 1932:98; Park and Fowler 1989:47). Additionally, *Suaeda calceoliformis* was recognized for both its medicinal benefits as a dermatological aid and urinary tract cleanser. Crushed fresh leaves were applied to skin as an anti-inflammatory and itch-reliever, while a decoction of the plant was imbibed to treat bladder infections (Train et al. 1941:143).

6.12. Cupressaceae – The Cypress Family

6.12.1. Juniperus sp. (juniper)

At the Paisley Caves *Juniperus* seeds were present in features as well as non-feature column and strata samples, but they were absent in the LSP-1 Rockshelter samples. Two species of juniper are native to the northern Great Basin. Western junipers (*Juniperus occidentalis*) are dioecious evergreen trees with scaly leaves that commonly dot dry foothills and lower mountain slopes. The distribution of common juniper (*J. communis*), a low-growing shrub, is limited to upper elevations.

Juniper berries are edible, and were used as a flavoring by inhabitants of the Great Basin (Mahar 1953:47). Berries could be roasted for consumption, and *Juniperus* wood was an important fuel source (Mahar 1954:47; Moerman 1998:286-287; Murphey 1959:43). The plant served as an important medicinal resource for the Northern Paiute, Modoc, and Shoshone tribes during the historic era. The Modoc inhaled smoke from burned leaf infusions to combat colds, coughs, and pulmonary congestion, and took infusions of leaves and berries for urinary tract infections (Ray 1963:219).The Paiute also used the bark to fashion clothing and sandals. Bows and other tools were carved from *Juniperus* wood. Colville (1897:88) indicated that juniper wood was fashioned into bows only for younger Klamath boys—yew wood was preferred over juniper for making men's hunting bows. Elsewhere in the Great Basin, green juniper needles, bark and berries were used to create brown-tan dyes (Murphey 1959:53).

6.13. Cyperaceae – The Sedge Family

6.13.1. Carex sp. (sedge)

At Paisley Caves, *Carex* seeds were found in the Cave 5 Strata samples and in the woodrat nest. No *Carex* seeds were present in the LSP-1 Rockshelter samples. Sedges are grass-like plants common to both sagebrush shrub lands and ponderosa pine communities. Its small flowers bloom in the summer. Numerous *Carex* species can be found in association with wetlands in central and eastern Oregon.

Several species of sedges were used for food by tribes of the Pacific Northwest. The Klamath ate sedge stems and produced a juice from the stems' pith. The bulbous roots also provided a food source (Colville 1897:92).

6.13.2. Eleocharis sp. (spikerush)

Uncharred *Eleocharis* seeds were recovered only in non-feature column samples at the Paisley Caves. Spikerushes are grass-like, perennials found in fresh and saline marshes below 2100 m AMSL. Species of this taxon are obligate wetland plants. *E. palustris* grows throughout the Klamath Basin and flowers June through September.

Paiute informants informed early 20th century ethnographers that the sap and bulbs of spikerush were consumed (Park and Fowler 1989:49; Steward 1933:245). No ethnobotanic uses of the plant are reported for the Klamath and Modoc tribes.

6.13.3. Scirpus/Schoenoplectus sp. (bulrush; tule)

Uncharred *Scirpus/Schoenoplectus* seeds were present in Early Holocene column samples at Paisley Caves, while both charred and uncharred specimens were recovered from features at LSP-1 Rockshelter. *Schoenoplectus* is a rhizomatous perennial with round stems and is the common tule of marshes, lake borders, and wet ditches in southcentral Oregon. Its impressive height (up to 10 feet) provides nesting habitat for local waterfowl. Ethnographically, bulrush plants provided fibers for basketry. Mahar

(1953:52) reported the Paiutes of the Warm Springs reservation used bulrush stems to construct mats. Similarly, the Klamath and Modoc Indians harvested *mä'i* (bulrush) and wove thin strips of the stem into baskets, hats and mats (Colville 1897:92; Ray 1963:218). Tule also provided foundational construction material for houses and baby cradles (Barrett 1910:258).

6.14. Fabaceae – The Legume Family

Charred seeds with characteristic pea family attributes were observed in the Paisley Caves' Unit 5/5 upper stratum samples. Uncharred seeds were recovered from the Unit 5/5, Stratum III sample and from the Unit 2/6B column samples. Legumes native to the project area include hundreds of species of herbs and wildflowers.

6.14.1. Trifolium sp. (clover)

Uncharred *Trifolium* seeds were recovered in the woodrat nest at the Paisley Caves. In the Great Basin, clovers typically grow in open, grassy locations or sandy talus slopes. Flowers appear from May to July.

In the traditional economy of Paiute tribes, clover seeds and greens were identified as food (Steward 1933:243-244).

6.14.2. Vicia sp. (vetch)

A single charred *Vicia* seed was observed in Feature 5/5-3 at the Paisley Caves. Vetches are forbs growing in a wide variety of habitats across North America. Their deeply entrenched taproots facilitate drought-tolerance. Vetches flower from May to August with seed ripening approximately one month after flowering begins.

No uses of vetch are reported for Northern Great Basin tribes.

6.153. Geraniaceae – The Geranium Family

Six charred seeds resembling Geraniaceae family members were recovered in Feature 5/5-3at the Paisley Caves. Members of the Geraniaceae family native to the northern Great Basin are limited to *Geranium* sp., but no specific identification could be determined. Oregon geranium (*G. oreganum*) and sticky purple geranium (*G. viscossimum*) are both native to the Klamath Basin, although the habitat attributes of sticky purple geranium (ponderosa pine woodlands and dry slopes) are more commonly found in the project area (ONPS 2007:129-130). Geraniums are perennial wildflowers that bloom in the summer from June to July.

The ethnographic literature for Great Basin groups does not specifically mention geraniums, but they were used medicinally by indigenous tribes throughout the American West (Moerman 2009:214-216).

6.16. Grossulariaceae – The Gooseberry Family

6.16.1. Ribes sp. (gooseberry; wax currant)

Uncharred *Ribes* seeds were identified at the Paisley Caves in a non-feature column sample and at LSP-1 Rockshelter in feature samples. Although several species of currant and gooseberry are classified as *Ribes*, in the Great Basin wax currant (*R. cereum*) is the most widely distributed taxon. These bushes and shrubs often grow at high elevations in the mountains above the basin floors. Flowers are visible April through June and the berries ripen in the summer.

Among the Paiute, fresh and dried currants were consumed (Kelly 1932:100; Mahar 1953:78; Park and Fowler 1989:50; Steward 1933:245). The inner bark also had medicinal value (Train et al. 1941:129). Klamath people commonly collected *Ribes* berries, a principal fruit food, in upper elevations and ate them fresh or dried them for future consumption (Spier 1930:165).

6.17. Hydrophyllaceae – The Waterleaf Family

6.175.1. Phacelia sp. (phacelia)

Charred *Phacelia* seeds were recovered in both feature and non-feature contexts at LSP-1 Rockshelter. *Phacelia* is an annual herb with purplish-blue flowers that bloom in the late summer into the fall. It is common on sandy and rocky slopes and dry lakebeds.

No uses of this plant are reported in the ethnographic literature of northern Great Basin peoples.

6.18. Juncaceae – The Rush Family

6.18.1. Juncus sp. (rush)

Several *Juncus* seeds were identified in samples analyzed at the Paisley Caves. Rushes are water-adapted graminoid species. They can often be found growing in marshes and seeps.

The seeds and stems of *Juncus* provided another traditional food source for Paiute people. No specific account of how seeds were prepared is available in the ethnographic literature, but stems were made into a fermented beverage and sugars, which form along the top of the plants, were collected and eaten as candy (Park and Fowler 1989:53; Steward 1933:246). Mahar (1953:53) notes that during modern times rushes were commonly used as food for livestock. Twisted rush fibers were also used to create textiles (Fowler and Liljeblad 1986:444).

6.19. Lamiaceae – The Mint Family

In this analysis, a single, charred Lamiaceae seed resembling mint (*Mentha*) was observed in the Feature 11-05/15 hearth at LSP-1 Rockshelter. Plants in the mint family native to the Great Basin include field mint (*M. arvensis*), horsemint (*Agastache* sp.), pennyroyal (*Monardella* sp.), selfheal (*Prunella* sp.), sage (*Salvia* sp.), and skullcap (*Scutellaria* sp.). Mint family members generally grow in meadows, stream sides, ditches, and pond margins.

Spier (1930:166) listed mint as an herb utilized by the Klamath. The leaves were steeped to make tea (Colville 1897:104). Paiute informants report the use of mint to treat headaches, colds, fevers, and indigestion (Mahar 1953:107; Steward 1933:317; Train et al. 1941:104-105). Couture et al. (1986) also listed field mint among the plants utilized by contemporary Burns-Paiute tribal members.

6.20. Liliaceae (s.l.)[2] – The Lily-Amaryllis Family

Charred Liliaceae seeds were identified at the Paisley Caves in a Younger Dryas-aged hearth feature in Cave 2 and in the Stratum III sample in Cave 5. The seeds resemble wild onion (*Allium* sp.) or possibly sego lily (*Calochortus nutallii*). Several species of wild onion, including two-edged onion (*A. anceps*), taper-tip or Hooker's

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[2] Although *Allium* technically now belongs to the Amaryllidaceae family, it is discussed here as a *sensu lato* lily family member because the seeds encountered in this investigation were not distinguishable to genus.

onion (*A. acuminatum*), Sierra onion (*A. campulatum*), Lemmon's onion (*A. lemmonii*), dwarf onion (*A. parvum*), flat-stem onion (*A. platycaule*), and punctate onion (*A. punctum*), grow in the study area. The fragrant perennial herb thrives in sandy or gravelly flats and slopes in the sagebrush steppe at a variety of elevations. Its showy pink to purple flowers bloom in umbels from spring through late summer depending on the species. Onions reproduce through diving rhizomes. Although the seeds in this genus are not distinguishable, plants may be identified to species based on reticulation of the bulb surface.

Sego lilies are commonly found on sandy slopes below 2100 m AMSL in the northern Great Basin. Their distinctive white flowers blossom in May and June.

Wild onions are a common food source among Northern Paiute groups. They roasted its bulbs, parched its seeds, and made a relish of its leaves and stems (Kelly 1932:102; Park and Fowler 1989:44). The bulbs were also eaten fresh. Sego lilies were also reportedly an important resource in the subsistence of Northern Paiute people during the post-EuroAmerican contact era (Stewart 1941:375).

6.21. Loasaceae – The Loasa Family

6.21.1. Mentzelia albicaulis (white-stemmed blazing star)

Several charred and uncharred *Mentzelia* seeds were identified in samples from the Paisley Caves and LSP-1 Rockshelter. *M. albicaulis* is a lobed-leaved, annual with erect to decumbent stems that attains heights of 5-42 cm. Blazingstar is a low elevation forb/herb (<2300 m AMSL) common to sand dunes, gravel fans, washes, scrub, and pinyon/juniper woodlands. It flowers March-July with yellow petals, which are orange at the base.

Among the Klamath, *Mentzelia* seeds are gathered with a seed beater in the summer, ground into a meal and either consumed dry or mixed with boiling water (Spier 1930:163). Seeds were widely reported to have been harvested by Northern Paiutes residing in and around the Warner Mountains (Stewart 1941:375) and by Modoc peoples (Ray 1963:199, 218).

6.22. Malvaceae – The Mallow Family

6.22.1. Sphaeralcea sp. (globemallow/desert mallow)

Charred *Sphaeralcea* seeds were present in the Cave 5 hearths at the Paisley Caves. Mallows are warm season herbs common to both sandy slopes and flats, and meadows, bogs and seeps in the sagebrush steppe at elevations between 800 and 2300 m AMSL. The purple flowers begin blooming in late spring and continue through the summer.

No uses of globemallow or desert mallow are cited in the ethnobotanic literature of the northern Great Basin.

6.23. Montiacae – The Montia Family

Montiaceae seeds (likely miner's lettuce) were identified only in the woodrat midden at the Paisley Caves in the form of uncharred seeds, but several charred seeds were recovered from features at LSP-1 Rockshelter. Miner's lettuce (*Claytonia* sp.) is a native annual commonly found in wet meadows with numerous flowers that bloom from June to August and tiny fruit capsules that ripen in the summer and fall.

Leaves of miner's lettuce were eaten raw by Paiute groups in Nevada (Park and Fowler 1989:49).

6.24. Onagraceae – The Evening Primrose Family

6.24.1. Chamerion sp. (fireweed)

Spent, uncharred *Chamerion* capsules were identified in Cave 5 Stratum samples as well as in the rat midden at the Paisley Caves. Fireweed grows nearly everywhere in the Great Basin, but is most commonly encountered in disturbed soils; its ecological distribution is generally species-dependent. Its vibrant, pink flowers, which grow on stalks, are visible July through September.

Although *Chamerion* is acknowledged as an economically important taxon along the west coast of Northern America (Moerman 1998:212-13, discussed under the synonym *Epilobium*), Northern Paiute, Klamath, and Modoc informants do not specifically name the plant in ethnographic interviews.

6.24.2. Oenothera sp. (evening primrose)

At the Paisley Caves, a single uncharred *Oenothera* seed was present in Feature 1/7-4b, and four uncharred seeds were recovered in the Cave 5 woodrat nest. The genus consists of several species of wildflowers with showy, white blooms common to sandy or gravelly flats and dunes. Flowers blossom in spring or summer dependent on the species.

Seeds of evening primrose were consumed by the Owen's Valley Paiute in the southern Great Basin (Steward 1933:243). The plant's fragrant roots were rubbed onto hunter's moccasins both to repel snakes and to attract deer (Murphey 1990:50).

6.25. Pinaceae – The Pine Family

6.25.1. Pinus ponderosa (ponderosa pine)

Pine seeds were recovered in numerous contexts at the Paisley Caves, especially in Late Pleistocene contexts. *P. ponderosa*, a yellow pine, is an evergreen softwood tree that is widespread in the higher elevations of southcentral Oregon. Ponderosa pine is identifiable by its bark, which resembles puzzle pieces, and its needles, which grow in bundles of three.

Ethnographic reports indicate that every part of pine trees was traditionally used. The Klamath relied on ponderosa pine for their staple construction and timber materials. Dugout canoes were fashioned from single logs that were hollowed out by fire (Colville 1897:89). Aside from construction material, ponderosa pine seeds, bark and pitch provided a multitude of uses for Oregon tribes. The inner bark (cambium) was commonly peeled and eaten fresh or dried and stored for later consumption. Seeds were also occasionally eaten. The Klamath consumed pine gum in the spring (Spier 1930:165). The Paiute also chewed dried pitch as a type of gum and applied a poultice of dried pitch over boils and other wounds to promote healing. Fresh pitch was used as glue in the manufacture of arrows and other tools, and it could also be used as a preservation agent. Fresh pitch was smeared on woven baskets to prevent leaks and applied over rock art to preserve the painting (Colville 1897:89; Mahar 1953:40; Ray 1963:219).

6.26. Plantaginaceae – The Plantain Family

6.26.1. Plantago sp. (plantain)

Charred *Plantago* seeds were recovered from Cave 5 hearths at the Paisley Caves. No native *Plantago* species are listed for Oregon’s Great Basin province, but native taxa are reported for western Oregon, northern California and Nevada.

Although the seeds in the current study were not identified to species, roots and leaves of the non-native plant common plantain (*P. major*) were used to treat colds and pneumonia among the modern Paiute tribes of central Oregon (Train et al. 1941:119-120).

6.27. Poaceae – The Grass Family

Poaceae members are cereals that produce small, edible grains. Most major plant foods domesticated globally belong to the grass family (i.e., wheat, rye, barley, and corn). Several species of grasses in the northern Great Basin are recognized for their economic value. The seeds of some local grass species are reported as common Modoc foods, including wild rye (*Elymus triticoides*) and spike bentgrass (*Agrostis* sp.). Large quantities of grass seeds were also eaten by Klamath and Paiute people (Colville 1897:91; Gatschet 1891; Mahar 1953:41; Spier 1930:166). Colville (1897) reported numerous Klamath words indicating the recognition of at least five edible grasses. Traditionally, the Paiute routinely harvested Great Basin wildrye (*Leymus cinereus*) and Indian ricegrass (*Achnatherum hymenoides*) for consumption (Fowler and Liljeblad 1986:441).

6.27.1. Achnatherum hymenoides (Indian ricegrass)

Several feature and non-feature samples at both archaeological sites contained Indian ricegrass seeds. Although it thrives on well-drained, dry, sandy soils, Indian ricegrass is well adapted to several ecozones ranging from 50 to 1800 m AMSL. The spreading panicle inflorescences grow on diverging branches. Each plant produces several seeds available to harvest in the mid-summer months.

Historically, ricegrasses provided a staple food for Paiute tribes. The seeds were dried, roasted, and ground into flour to be made into a mush, or stored for winter use (Park and Fowler 1989:46; Steward 1933:243).

6.27.2. Agrostis sp. (bentgrass)

Bentgrass seeds were the predominant grass-type taxon identified in the LSP-1 seed assemblage. They were not identified in the Paisley Caves samples. Bentgrass is a perennial grass associated with pinyon-juniper and ponderosa pine woodlands in the Great Basin. It especially flourishes in disturbed habitats. Seeds ripen in the summer and fall. Introduced species are more common now, but native grasses are present in southcentral Oregon.

Spier (1930:163) and Colville (1897:91) listed *Agrostis* as a staple seed plant gathered by Klamath tribal members.

6.27.3. Hesperostipa sp. (needle-and-thread grass; needlegrass)

Needle-and-thread grass is represented by uncharred awns in non-feature samples at the Paisley Caves. Perennial needlegrass is common to shrub steppe environments, and grows at altitudes ranging from 50 to 1700 m AMSL.

No specific uses of needle-and-thread grass are documented in the ethnographies of the Klamath, Modoc, or Northern Paiute.

6.27.4. Leymus cinereus (Great Basin wildrye)

Great Basin wildrye seeds were recovered in the woodrat midden at Paisley Caves. At LSP-1 Rockshelter, *Leymus* caryopses and florets were present in both feature and non-feature samples. Great Basin wildrye is a large, cool-season perennial bunchgrass common to juniper woodlands and the sagebrush steppe at elevations up to

2300 m AMSL in southcentral Oregon. Flowers and fruits are available for harvest during the summer months.

Several sources cite northern Great Basin groups that rely on Great Basin wildrye grains for food. Rye grasses traditionally provided important seed foods to the Modoc (Ray 1963:199) and Klamath (Colville 1897:91). Seeds were parched or could be pulverized and mixed with water to form a mush (Spier 1930:162). Paiute groups in the northern Great Basin used the plant medicinally as well as a food source. Infusions of grass acted as a wash for sore eyes, and the blades of grass themselves were used to scrape sties and pimples (Mahar 1953:51; Train et al. 1941:67).

6.28. Polygonaceae – The Knotweed Family

6.28.1. Eriogonum sp. (buckwheat)

Charred and uncharred *Eriogonum* seeds were noted in column samples at the Paisley Caves. At least 13 buckwheat species are known in the Great Basin. They are typically found in juniper woodlands, the sagebrush steppe, or on sandy or rocky talus slopes at elevations to 3000 m AMSL. The perennial plants have flowers ranging in color from purple to yellow. Flowering season is species dependent, but generally ranges from May to October.

In the traditional economies of Paiute groups, stems, leaves, and roots were made into a decoction to treat various ailments, including tuberculosis and urinary tract ailments (Train et al. 1941:72). Ray (1963:199) identified buckwheat as one of the more important seed plants among the Modoc.

6.28.2. Rumex sp. (dock)

Appearing only in the woodrat midden at the Paisley Caves, *Rumex* is represented by two uncharred seeds. *Rumex* plants are generally found in disturbed contexts at elevations below 1200 m AMSL. They are often located in locations with high moisture content, like seeps and wet meadows.

In the economy of the Klamath, *Rumex* seeds were not a dietary staple, but infrequently consumed (Spier 1930:163). When harvested, the fresh leaves and stems were also eaten. The Modoc considered dock to be one of the more important seed plants (Ray 1963:199). The Paiute made decoctions of roots and externally-applied root poultices to treatcolds, coughs, gastrointestinal imbalances, and rheumatism among other illnesses (Mahar 1953:67; Murphey 1959:44; Steward 1933:317; Train et al. 1941:131-132).

6.29. Rhamnaceae – The Buckthorn Family

6.29.1. Ceanothus sp. (ceanothus)

Uncharred *Ceanothus* seeds were present in column and hearth samples at Paisley Caves. Buckthorns are bushes or shrubs found on dry, open slopes at elevations between

1525 and 3350 m AMSL in the northern Great Basin. The shrub has whitish flowers that bloom in the summer in June and July.

Among the Modoc, buckbrush infusions provided relief for colds and coughs. Buckbrush seeds were ingested to induce vomiting. Its leaves were macerated and applied to open wounds and sores, as well as sore joints and muscles (Ray 1963:219). The Paiute fashioned digging sticks from the branches (Steward 1933:244) and mixed dried, mashed leaves with tobacco for smoking (Mahar 1953:89).

6.30. Rosaceae – The Rose Family

6.30.1. Prunus sp. (Klamath plum, chokecherry, etc.)

A single charred *Prunus* seed was present at the LSP-1 Rockshelter site. Native *Prunus* species in the vicinity of the project area include Klamath plum (*P. subcordata*), chokecherry (*P. virginiana*), and bitter cherry (*P. emarginata*). Plants are shrubs or small trees that grow in open, disturbed areas 1500-2500 m AMSL. Fruits are drupes that are available to harvest in the summer.

Both Klamath plum and chokecherry were reported as principal fruit foods of the Klamath (Colville 1897:99; Spier 1930:165) and Modoc (Ray 1963:200). Chokecherries were gathered *en masse* during September and dried. Paiute tribal members also ate chokecherry berries – fresh, dried, baked into cakes, or brewed as a tea (Park and Fowler 1989:49; Kelly 1932:99; Mahar 1953:84).

6.30.2. Rosa sp. (wild rose)

Charred *Rosa* seeds were recovered in Paisley Cave 5 hearth samples and uncharred Rosaceae cf. *Rosa* seeds were present in a Paisley Cave 1 hearth sample. Great Basin *Rosa* taxa, including *R. woodsii,* are common to riparian uplands but can also be found in open areas of the sagebrush steppe at elevations up to 2750 m AMSL. Wild roses are shrubs with dark green compound leaves, branches with thorns and 5-petaled pale pink to dark rose-colored flowers that bloom in the summer. The plant's anterior ovary produces an engorged "fruit" known as rosehips. These fruits ripen in the fall.

Rosehips were dried and pounded by the Modoc and Klamath, who gathered them as they ripened in September (Colville 1897:99; Ray 1963:214, 217; Spier 1930:165). Wood provided construction material for arrow shafts and pipe stems (Colville 1897:99).

6.31. Rubiaceae – The Coffee Family

6.31.1. Galium sp. (bedstraw)

Charred *Galium* seeds were present in features, but only in late Holocene contexts at LSP-1 Rockshelter. In the Great Basin, bedstraw species grow along the edges of lakes and meadows in subalpine riparian habitats with adequate shade. Bedstraw is an annual forb with characteristic hooked hairs covering its seeds that promote clinging and climbing. Leaves are arranged in whorls and it displays white-greenish flowers in June and July.

Bedstraw is not listed among the economic plants in the ethnographic texts of indigenous Great Basin groups.

6.32. Salicaceae – The Willow Family

6.32.1. Salix sp. (willow)

Salix charcoal was present in the Botanical Lens and Mud Lens represented by the Paisley Cave 2, Unit 2/6B column samples. Willows in the Great Basin predominantly grow as shrubs, and are found along streams, in wetlands, and in wet meadows. They have tall, slender branches and can reach heights of more than 4 m. Although they typically flower around May to June, the wood of the shrub is best harvested in the fall, when it can be easily worked into baskets (Kelly 1932:120).

Willows were used extensively in the economies of Great Basin groups, not only as a textile for baskets (Colville 1987:94; Fowler 1990:75; Kelly 1932:120-121; Mahar 1953:61 , but also as building materials, hunting and fishing implements, household goods, and for medicinal purposes (Kelly 1932). Various uses of willow by the Northern Paiute include sagehen traps, baskets, wood for smoking meats, fish harpoons, fish weir latticing, trays for winnowing and parching seeds, bowls and other containers, and winter house construction, among others (Kelly 1932; Mahar 1953). Medicinally, decoctions of dried roots treated venereal disease (Park and Fowler 1989:128) and an infusion of burned stems provided a diuretic (Train et al. 1941:133-136). The limbs of willows were fashioned into poles and used in various construction pursuits by the Modoc (Ray 1963), but Colville (1897:94) does not report any uses for willow among the Klamath, save for using the wood to make snowshoe frames.

6.33. Solanaceae – The Nightshade Family

6.33.1. Nicotiana attenuata (Indian tobacco)

Uncharred *Nicotiana* seeds were identified in a feature at LSP-1 Rockshelter. Indian tobacco propagates most readily in disturbed areas under dry and hot conditions. It is recognizable by its white, trumpet-shaped flowers with lanceolate to elliptic leaves. Each plant produces numerous seeds in the summer.

Nicotiana seeds and leaves were valued by the Surprise Valley Paiute (Kelly 1932:181) and were found growing throughout the region. Aside from smoking tobacco, leaves and seeds were known to have medicinal properties. Decoctions and infusions of the plant provided pain relief, while poultices applied to the skin reduced swelling and calmed inflammations (Train et al. 1941:106-107). Tobacco was also smoked by the Modoc (Ray 1963:218)

6.34. Typhaceae – The Cattail Family

6.34.1. Typha latifolia (cattail)

At the Paisley Caves, a single uncharred *Typha* seed was identified in a feature sample, while at LSP-1 Rockshelter, charred seeds were found in features as well as basal deposits at the site. Cattails are emergent wetland species, and can thrive in both fresh water and salt marshes, typically at elevations less than 2000 m AMSL. The plants are perennial herbs with long stalks and fluffy, oblong flowering heads. Numerous, tiny flowers produce abundant pollen in the summer.

Typha roots were commonly gathered by the Klamath and constituted an important dietary element and were eaten late in the season (Spier 1930:163-164). Leaves and flowers were woven into mats and provided pillow stuffing (Colville 1897:90). The plant was also important in the traditional economy of the Northern Paiute, who ate the roots, seeds and pollen, and used the fiber in creating mats, clothing, duck decoys, basketry, and house construction (Fowler 1990:69, 1992; Park and Fowler 1989:48-49).

6.35. Urticaceae – The Nettle Family

6.35.1. Urtica dioica (stinging nettle)

Several *Urtica* (stinging nettle) seeds were recovered in samples at the Paisley Caves, though most were uncharred specimens located in the woodrat midden. A few uncharred *Urtica* seeds were also present in non-feature samples at LSP-1 Rockshelter. Stinging nettle is a perennial, rhizomatous forb that grows in riparian areas, marshes, and meadows at or below 3000 m AMSL. Each plant is characterized by stout stems and abundant seed production, especially when grown in full sunlight.

Colville's (1897:95) Klamath informants reported the use of stinging nettle stems in the manufacture of cords, nets, and snowshoes. Nettles were also woven into hats, mats, ropes, and burden baskets by the Klamath (Spier 1930:174-175, 182).Paiute ethnographies suggest stinging nettles were used medicinally rather than as a fiber. Decoctions of roots and leaves provided relief from itching and pain and the plant was inhaled in sweatbaths to treat pneumonia (Park and Fowler 1989:126; Train et al. 1941:146). Although the ethnographic literature of the region does not indicate Great Basin indigenous people ate the stems or leaves of stinging nettles, they were consumed by groups living on the Northwest Coast (Turner and Bell 1971:90).

CHAPTER VII

PAISLEY CAVES MACROBOTANICAL ANALYSES

At the Paisley Caves, ten classes of botanic remains were noted in the 35 bulk samples analyzed: seeds/fruits, charcoal, herbaceous stems, processed edible tissues (fruity and starchy), nutshells, wood, leaves, spines, and buds. At least 46 different taxa representing 24 plant families were identified. In some cases only the seed endosperm (perisperm) survived, necessitating broad identification categories. As anticipated, environmental conditions in the caves preserved uncarbonized ancient plants and fibers as well as charred specimens. The carbonized and uncarbonized plant parts represent both edible and non-edible tissues (Table 7.1).

Heavy fraction materials include obsidian waste flakes, fish, mammal, and snake bones, enamel/tooth fragments, fish scales, eggshell, and snail shell. Additionally, rabbit and pronghorn hair, bird feathers, fur, insects, fine threads, and cordage fibers were present. These items are not considered in the following analysis, but may be germane to future research.

Rodent droppings and bat guano comprised a significant portion of the soil matrices in caves 5 and 2, respectively. Leporidae, artiodactyl, and raptor pellets were also encountered, but with less frequency. Samples associated with features contained markedly less evidence of bioturbation in the form of insect chitin and fecal matter. A full accounting of the constiuents recovered in the Paisley Caves bulk soil samples is presented in Appendix D.

Table 7.1. Taxa identified at the Paisley Caves, Site 35LK3400, Lake County, Oregon.

Edible tissues	
Fruits	
Ceanothus sp.	buckbrush; snowbrush
Prunus sp.	native/wild cherries
Ribes sp.[1]	currant; gooseberry
Rosa sp.	rosehips
Sambucus sp.[3]	elderberry
PET fruity	X
PET starchy	X
Nuts/Berries	
Juniperus sp.[1]	juniper
Pinus ponderosa[1]	ponderosa pine
Seeds of Root Edibles	
Apiaceae[1,3]	carrot family
Camassia sp.	camas
Liliaceae-Amaryllidaceae	lily family *s.l.*
Typha latifolia[1]	cattail
Seeds	
Achnatherum hymenoides	Indian ricegrass
Amsinckia sp.	fiddleneck
Cheno-ams	goosefoot/amaranth families
Amaranthus sp.	amaranth
Atriplex confertifolia	scadshale saltbush
Atriplex palustris[1]	saltbush
Atriplex rosea[1]	tumbling saltbush
Chenopodium sp.	goosefoot
Suaeda sp.	wada
Descurainia sp.	tansymustard
Eleocharis sp.[1]	spikerush
Juncus sp.	rush
Leymus cinereus	Great Basin wildrye
Mentzelia albicaulis	white-stemmed blazing star
Oenothera sp.[1]	evening primrose
Scirpus/Schoenoplectus sp.[1]	bulrush

Table 7.1. Taxa identified at the Paisley Caves, Site 35LK3400, Lake County, Oregon.

Non-edible tissues

Seeds	
Asteraceae[1]	sunflower family
Tetradymia sp.[1,3]	horsebrush
Brassicaceae[1]	mustard family
Boraginaceae	borage family
Cryptantha sp.	catseye
Hackelia sp.[1]	stickseed
Plagiobothrys sp.[1]	popcorn flower
Cyperaceae[3]	sedge family
Carex sp.[1]	sedge
Chamerion sp.[1]	fireweed
Fabaceae[1,3]	pea family
Trifolium sp.[1,2]	clover
Vicia sp.	vetch
cf. Geraniaceae	geranium family
Malvaceae[1]	mallow family
Sphaeralcea	globemallow
Montiaceae[1]	miner's lettuce family
Monolepis sp.[3]	poverty weed
Phacelia sp.	tansy
Plantago sp.	plantain
Poaceae	grass family
Hesperostipa sp.	needle and thread grass
Polygonaceae[1]	knotweed family
Eriogonum sp.[1]	buckwheat
Rumex sp.[1,2]	dock
Rosaceae	rose family
Sesuvium sp.	sea purslane
Solanceae[1,3]	nightshade family
Urtica dioica	stinging nettle

Other tissues	
Herbaceous stems	X
Leaves	X
Spines	X
Unidentified buds	X
Wood	X

Charcoal	
Artemisia sp.	sagebrush
Atriplex sp.	saltbush

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[1] Only uncharred specimens observed

[2] Only occurring in the *Neotoma* nest

[3] Only occurring in the Cave 5 strata samples above the Mazama tephra

7.1. Unit 2/6B Stratigraphic Column Samples

In Cave 2, bulk samples collected in a continuous column from the base of Mazama tephra to the top of LU1 provide well-controlled stratigraphic data spanning 13,700 to 7640 cal BP. Seed, charcoal, and charred tissue distribution in these samples varied with depth. Increases in the density of macrobotanical remains were evident in samples CS-6 through CS-10 in LU3, samples CS-18b and CS-19a in the Botanical Lens, and sample CS-20 in LU2.

7.1.1. Charcoal and Charred Tissues in Cave 2 Column Samples

Charcoal taxa identified in the column samples were limited to *Artemisia, Atriplex,* and *Salix* types (Table 7.2). In some cases, I was unable to identify smaller pieces of charcoal and pith fragments to a specific taxon. Charcoal was absent in several samples, but spikes in charcoal densities are noted in LU3 in sample CS-7, and in those samples (CS-18b, CS-19a, CS-19b, CS-20, and CS-21) representing the Younger Dryas period (Figure 7.1). *Atriplex* charcoal was identified only in the LU3 samples, and did not occur in the Terminal Pleistocene samples. *Salix* charcoal was only identified in Younger-Dryas-aged samples.

Charred tissues in the column samples are represented by starchy (parenchymous) fragments and vitrified fragments. Parenchymous tissues contain starchy storage cells, likely from edible geophytes. Without chemical analysis, charred vegetative tissues cannot be identified to a specific taxonomic type. Charred starchy tissues are present in

Table 7.2. Distribution of identified charcoal taxa* and charred plant tissues in the Unit 2/6B column.

				Charcoal Taxa (wt.)					Charred Plant Tissues (wt.)	
Dates cal BP	Sample	Provenience	Depth (m AMSL)	*Artemisia* sp.	*Atriplex* sp.	*Salix* sp.	Pith	Unid.	Starchy	Vitirified
7640	CS-02	LU3	1366.45	-	-	-	-	-	-	-
	CS-03	LU3	1366.40	-	-	-	-	-	0.02 g	-
	CS-04	LU3	1366.35	-	-	-	-	-	-	<0.01 g
8338	CS-05	LU3	1366.30	0.01 g	-	-	-	-	0.01 g	-
	CS-06	LU3	1366.25	0.07 g	0.01 g	-	-	<0.01 g	0.01 g	-
	CS-07	LU3	1366.20	0.08 g	0.19 g	-	<0.01 g	<0.01 g	0.01 g	-
9094	CS-08	LU3	1366.15	0.07 g	0.01 g	-	<0.01 g	-	<0.01 g	-
9700	CS-09	LU3	1366.10	-	-	-	-	-	<0.01 g	-
	CS-10	LU3	1366.05	-	-	-	-	-	-	-
	CS-11	LU3	1366.00	-	-	-	-	-	-	-
	CS-12	LU3	1365.95	0.01 g	-	-	-	-	-	-
	CS-13	LU3	1365.90	-	-	-	-	-	-	-
11,095	CS-14	LU3	1365.85	0.03 g	-	-	-	-	-	-
	CS-15	LU3	1365.80	0.09 g	-	-	-	0.01 g	-	-
	CS-16	LU3	1365.75	0.01 g	-	-	-	-	-	-
12,569	CS-17	LU3	1365.70	0.06 g	-	-	-	-	-	-
	CS-18a	LU3	1365.68	0.07 g	-	-	-	-	-	-
	CS-18b	Botanical Lens	1365.65	0.31 g	-	-	-	-	0.01 g	-
	CS-19a	Botanical Lens	1365.62	0.32 g	-	0.01 g	-	-	-	-
	CS-19b	Mud Lens	1365.60	0.24 g	-	0.01 g	-	-	0.01 g	-
12,896	CS-20	LU2	1365.55	1.35 g	-		-	0.01 g	-	-
13,689	CS-21	LU2	1365.50	0.13 g	-	-	-	-	-	-

* Includes identified charcoal in the 20-fragment subsample analyzed

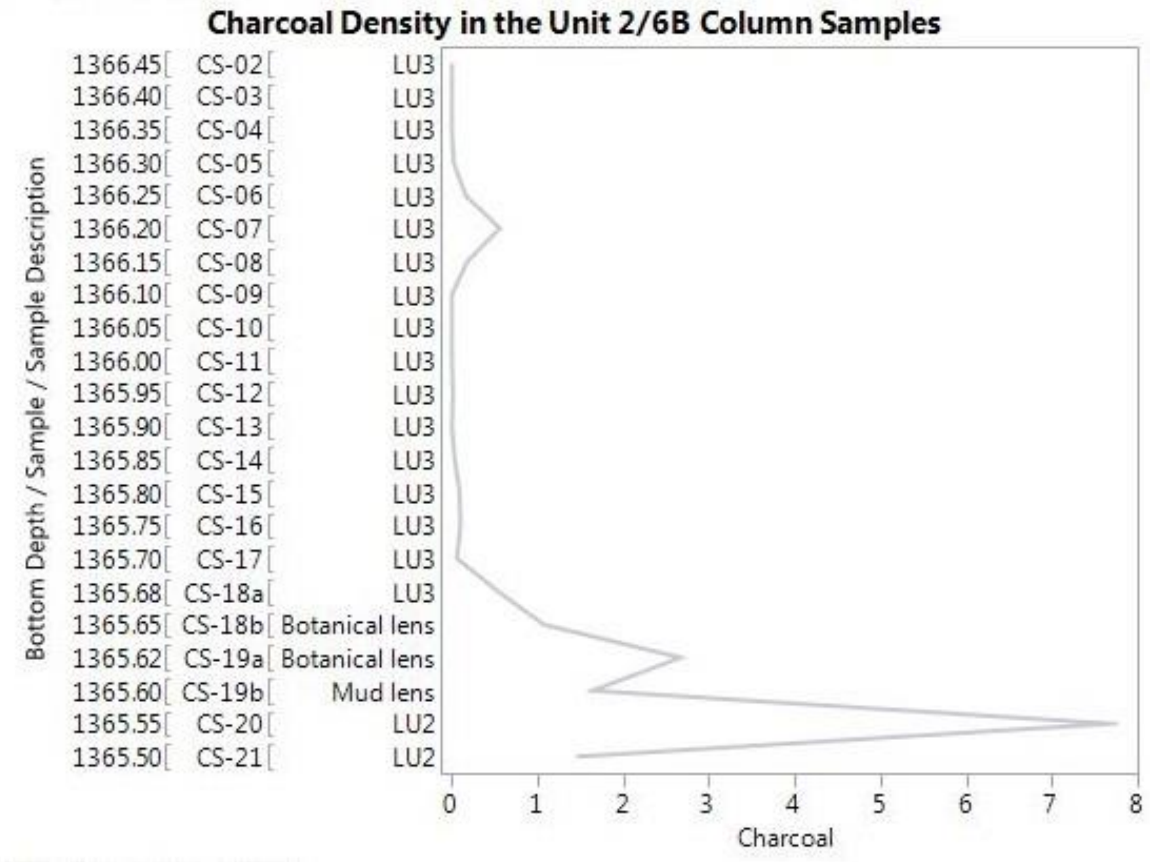


Figure 7.1. Distribution of charcoal density (g) in the column samples recovered from Unit 2/6B at the Paisley Caves.

LU3 samples CS-03, and CS-05 – CS-09 representing ca. 9700 to 8300 cal BP. Starchy fragments were also present in the Botanical Lens, and in the Lower Mud Lens.

Vitrified tissues are identified by their melted, bubbly, and glassy, appearance. They may represent intentional burning of green plant materials to generate smoke for cooking and/or tanning (but see McParland et al.2010 for a refutation of this claim). A single fragment of vitrified tissue was observed sample CS-04.

7.1.2. Seeds in Cave 2 Column Samples

Uncharred seeds vastly outnumbered charred seeds in the Unit 2/6B column samples. The LU3 samples (CS-2 through CS-17) yielded the most abundant number of uncharred seeds (n=1929). Identified taxa include *Chenopodium*, *Achnatherum hymenoides*, *Atriplex*, *Amsinckia*, *Artemisia*, *Amaranthus*, Poaceae-type, cheno-am perisperms, *Cryptantha*, Asteraceae-type, *Descurainia*, *Ceanothus*, *Hackelia*, Brassicaceae-type, *Hesperostipa*, *Mentzelia albicaulis*, *Pinus ponderosa*, cf. *Celtis*, Fabaceae-type, Malvaceae-type, *Phacelia*, *Plagiobothrys*, Polygonaceae-type, *Eleocharis*, *Eriogonum*, *Ribes*, Rosaceae-type, *Sambucus*, *Scirpus/Schoenoplectus*, and *Urtica dioica* (Table 7.3). Less than 3% of the assemblage (n=50) were not identified to at least family-level classification. Uncharred *Achnatherum* and *Chenopodium* were present in more than 80% of all column samples analyzed.

Two samples (CS-18 and CS-19a) represent the Botanical Lens, a culturally-introduced layer of sagebrush matting, pronghorn fur, and other organic materials. Here, uncharred seed types were dominated by *Achnatherum hymenoides* and other Poaceae members. *Chenopodium*, *Cryptantha*, *Atriplex*, Asteraceae-type, *Pinus ponderosa*, *Juniperus*, and *Phacelia* also were noted. Seven uncharred seeds in the Botanical Lens were unidentifiable.

Represented by sample CS-19B, the Lower Mud Lens is a thin silt layer underlying the Botanical Lens. Uncharred seeds were limited to *Achnatherum hymenoides*, other Poaceae, and cheno-am perisperms. Seeds in the LU2 samples (CS-20 and CS-21) were also dominated by *Achnatherum hymenoides*. Uncharred *Urtica dioica* seeds, which do not appear in any other Unit 2/6B samples accounted for nearly 20% of

Table 7.3. Uncharred seeds in the Paisley Caves column samples, Unit 2/6B.

Provenience	Sample	Elev. m AMSL	Volume (L)	*Amsinckia*	Asteraceae	*Artemisia*	Brassicaceae	*Descurainia*	*Ceanothus*	cf. *Celtis*	Cheno-am	*Amaranthus*	*Atriplex*	*Chenopodium*	*Cryptantha*	Fabaceae	*Hackelia*	*Juncus*	*Juniperus*	Malvaceae	*Mentzelia*	*Phacelia*	*Pinus*	*Plagiobothrys*	Poaceae	*Achnatherum*	*Hesperostipa*	Polygonaceae	*Eleocharis*	*Eriogonum*	*Ribes*	Rosaceae	*Sambucus*	*Schoenoplectus*	*Urtica*	Unidentified
Ubiquity of uncharred seed taxa				**55%**	**32%**	**27%**	**14%**	**18%**	**5%**	**5%**	**45%**	**36%**	**64%**	**86%**	**45%**	**5%**	**27%**	**5%**	**5%**	**5%**	**14%**	**9%**	**18%**	**5%**	**59%**	**91%**	**18%**	**5%**	**9%**	**9%**	**5%**	**9%**	**5%**	**5%**	**9%**	**n/a**
LU3	CS-2	1366.45	0.50	5	1	-	-	-	-	-	-	-	4	3	1	-	-	-	-	-	-	-	-	-	6	7	1	-	-	-	-	-	-	-	-	-
	CS-3	1366.40	0.50	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	12	-	-	-	-	-	-	-	-	-	-
	CS-4	1366.35	0.50	12	-	1	2	-	-	1	1	-	14	2	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
	CS-5	1366.30	0.50	2	1	2	-	-	-	-	-	-	9	8	1	-	-	-	-	-	-	-	-	-	10	13	-	-	-	-	-	-	-	-	-	-
	CS-6	1366.25	0.50	27	4	29	3	-	-	-	-	2	80	299	6	-	1	-	-	-	-	-	-	2	25	34	2	-	-	-	-	-	-	-	-	4
	CS-7	1366.20	0.50	28	-	72	-	-	-	-	23	6	36	7	7	-	2	-	-	-	-	-	-	-	11	19	2	-	-	-	-	-	-	-	-	9
	CS-8	1366.15	0.50	22	7	31	-	-	-	-	7	12	15	24	-	-	1	-	-	-	-	-	-	-	17	18	1	-	-	-	-	-	-	-	-	5
	CS-9	1366.10	0.50	9	7	5	1	-	-	-	13	25	7	32	-	-	-	-	-	-	-	-	-	-	6	3	-	-	-	-	-	-	-	-	-	5
	CS-10	1366.05	0.50	2	2	-	-	3	-	-	8	31	1	21	1	-	2	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	10
	CS-11	1366.00	0.50	1	-	-	-	-	-	-	2	16	-	17	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	CS-12	1365.95	0.75	18	-	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2
	CS-13	1365.90	0.75	26	-	-	-	1	-	-	2	18	9	27	4	-	1	-	-	-	-	-	3	-	1	39	-	-	-	1	-	1		-	-	5
	CS-14	1365.85	0.90	-	-	-	-	-	-	-	-	-	15	7	-	-	-	-	-	-	-	-	-	-	1	13	-	-	1	-	-	-	1	-	-	2
	CS-15	1365.80	1.00	-	-	-	-	-	-	-	-	-	12	2	-	-	-	-	-	-	-	-	-	-	-	36	-	-	1	-	-	-	-	-	-	5
	CS-16	1365.75	0.20	-	-	-	-	1	-	-	8	1	-	13	-	-	-	-	-	-	2	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-
	CS-17	1365.70	1.00	-	-	-	-	14	9	-	-	-	32	100	5	2	-	-	-	-	2	1	-	-	X	193	-	-	-	1	1	-	-	-	1	-
	CS-18a	1365.68	0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Total contribution of uncharred seed taxa				***8.0%***	***1.1%***	***7.3%***	***0.3%***	***1.0%***	***0.5%***	***0.1%***	***3.4%***	***5.8%***	***12.1%***	***29.3%***	***1.3%***	***0.1%***	***0.5%***	-	-	***0.1%***	***0.2%***	***0.1%***	***0.2%***	***0.1%***	***4.1%***	***21.3%***	***0.3%***	***0.1%***	***0.1%***	***0.1%***	***0.1%***	***0.1%***	***0.1%***	***0.1%***	***0.1%***	***2.6%***
Botanical Lens	CS-18b	1365.65	0.55	-	-	-	-	-	-	-	-	-	1	7	3	-	-	-	-	-	-	-	1	-	-	42	-	-	-	-	-	-	-	-	-	-
	CS-19a	1365.62	0.30	-	3	-	-	-	-	-	-	-	4	5	3	-	-	-	1	-	-	1	1	-	13	25	-	-	-	-	-	-	-	-	-	7
Total contribution of uncharred seed taxa				-	***2.6%***	-	-	-	-	-	-	-	***4.3%***	***10.3%***	***5.1%***	-	-	-	***0.9%***	-	-	***0.9%***	***1.7%***	-	***11.1%***	***57.3%***	-	-	-	-	-	-	-	-	-	***6.0%***
Mud Lens	CS-19b	1365.60	0.50	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	11	-	-	-	-	-	-	-	-	-	-
Total contribution of uncharred seed taxa				-	-	-	-	-	-	-	***5.9%***	-	-	-	-	-	-	-	-	-	-	-	-	-	***29.4%***	***64.7%***	-	-	-	-	-	-	-	-	-	-
LU2	CS-20	1365.55	0.50	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	2	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-
	CS-21	1365.50	0.40	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	2	8	-	-	-	-	-	1	-	-	7	6
Total contribution of uncharred seed taxa				-	-	-	-	-	-	-	-	-	-	***2.4%***	***2.4%***	-	-	***2.4%***	-	-	***4.9%***	-	***2.4%***	-	***4.9%***	***46.3%***	-	-	-	-	-	***2.4%***	-	-	***17.1%***	***14.6%***

the seeds identified in LU2. Other identified uncharred seeds include Poaceae, *Mentzelia albicaulis*, *Chenopodium*, *Cryptantha*, *Juncus*, *Pinus ponderosa*, and Rosaceae-type.

The charred seed assemblage yielded a much narrower range of seed types (Table 7.4). Generally, charred seeds in LU3 were composed of cheno-ams and Poaceae family members, although sample CS-10 also yielded two charred *Amsinckia* seeds. With the exception of one charred *Mentzelia* seed in the Lower Mud Lens (sample CS-19b), no other charred seeds were present in the Unit 2/6B column. Intensification in cultural activity is evidenced by increased quantities of charred seeds in samples CS-6 through CS-10; otherwise samples in LU3 yielded no charred seeds or fruits. This spike roughly mirrors the occurrence of charred starchy tissues recovered from the samples representing the same proveniences. No single taxon was represented in more than 18% (Poaceae) of the samples analyzed.

When the seed data are standardized to account for variations in sample volume, the density of charred and uncharred seeds is highest in samples CS-6 through CS-9 in LU3, which represent cave deposits dating between ca. 9700 and 8400 cal BP (Figure 7.2). Uncharred seed densities also increase during the Younger Dryas. No groundstone or formed lithic tools are reported for the excavated levels in Unit 2/6 associated with these column samples.

Table 7.4. Charred seeds in the Paisley Caves column samples,* Unit 2/6B.

Provenience	Sample	Elev. m (AMSL)	Volume (L)	*Amsinckia*	Cheno-am	*Atriplex*	*Chenopodium*	*Suaeda*	*Eriogonum*	*Mentzelia*	Poaceae	*Achnatherum*	Unidentified
Ubiquity of charred seed taxa				**5%**	**9%**	**5%**	**5%**	**5%**	**5%**	**5%**	**18%**	**9%**	**n/a**
LU3	CS-2	1366.45	0.50	-	-	-	-	-	-	-	-	-	-
	CS-3	1366.40	0.50	-	-	-	-	-	-	-	-	-	-
	CS-4	1366.35	0.50	-	-	-	-	-	-	-	-	-	-
	CS-5	1366.30	0.50	-	-	-	-	1	-	-	-	-	-
	CS-6	1366.25	0.50	-	3	1	46	-	-	-	4	4	1
	CS-7	1366.20	0.50	-	5	-	-	-	-	-	1	-	-
	CS-8	1366.15	0.50	-	-	-	-	-	1	-	11	-	-
	CS-9	1366.10	0.50	-	-	-	-	-	-	-	19	-	-
	CS-10	1366.05	0.50	2	-	-	-	-	-	-	-	-	-
	CS-11	1366.00	0.50	-	-	-	-	-	-	-	-	-	-
	CS-12	1365.95	0.75	-	-	-	-	-	-	-	-	-	-
	CS-13	1365.90	0.75	-	-	-	-	-	-	-	-	-	-
	CS-14	1365.85	0.90	-	-	-	-	-	-	-	-	-	-
	CS-15	1365.80	1.00	-	-	-	-	-	-	-	-	-	-
	CS-16	1365.75	0.20	-	-	-	-	-	-	-	-	-	-
	CS-17	1365.70	1.00	-	-	-	-	-	-	-	-	3	-
	CS-18a	1365.68	0.35	-	-	-	-	-	-	-	-	-	-
Total contribution of charred seed taxa				***2.0%***	***7.8%***	***1.0%***	***45.1%***	***1.0%***	***1.0%***	-	***34.3%***	***6.9%***	***1.0%***
Mud Lens	CS-19b	1365.60	0.50	-	-	-	-	-	-	1	-	-	-
Total contribution of charred seed taxa				-	-	-	-	-	-	***100.0%***	-	-	-

*Botanical Lens and LU2 samples omitted from this table because they contained no charred seeds.

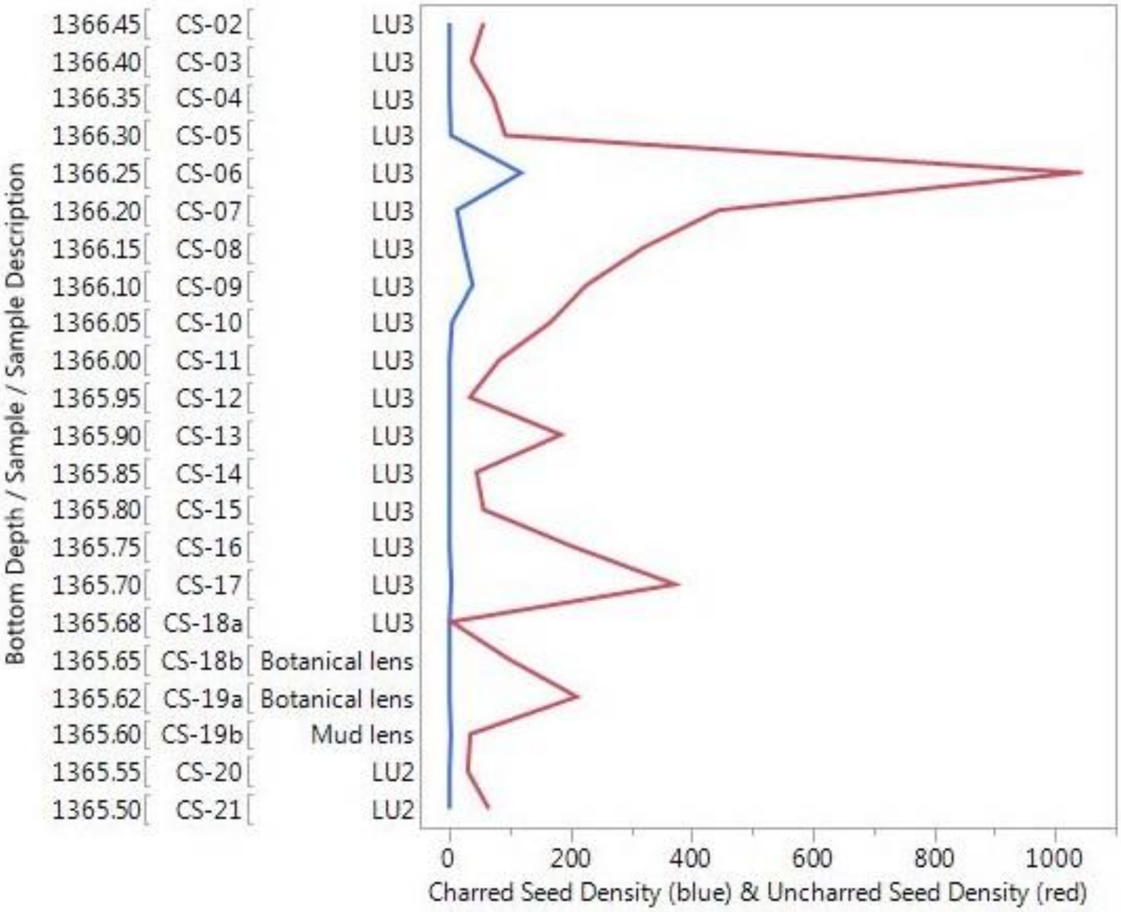


Figure 7.2. Density of charred and uncharred seed abundances in the Unit 2/6B column samples at the Paisley Caves.

7.2. Cave 5 Stratigraphic Grab Samples

Bulk grab samples representing pre- and post-Mazama deposits in Cave 5 provide low-resolution data pertaining to early, middle, and late Holocene human-environmental interactions at the Paisley Caves. These samples yielded several seeds representing 29 taxa.

7.2.1. Charcoal and Charred Tissues in Cave 5 Strata Samples

Of the 20-fragment subsample selected for identification, only *Artemisia* was represented. No charcoal was present in the Stratum VI sample that denotes pre-Mazama deposits (Figure 7.3). Minute fragments of cf. fruity tissues were present in Stratum II, Stratum III, Stratum IV, and Stratum VI.

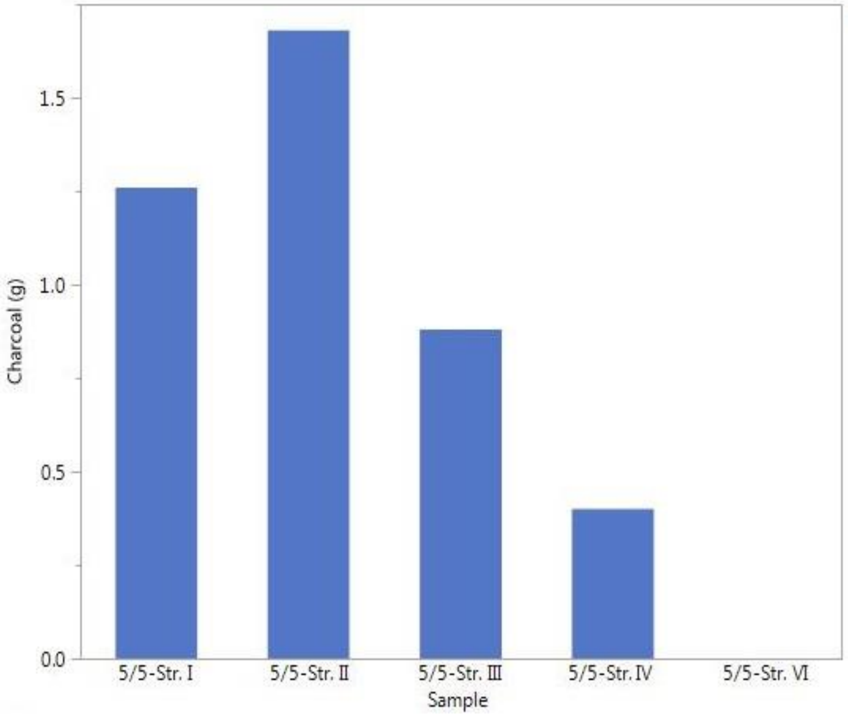


Figure 7.3. Charcoal abundance in Cave 5 strata samples at the Paisley Caves.

7.2.2. Seeds in Cave 5 Stata Samples

The seed assemblage from Cave 5 strata was dominated by uncharred types. Overall uncharred seeds comprised 89% of all seeds in the strata samples (Table 7.5). Nearly half of the uncharred seeds represent *Atriplex* taxa (44%; Figure 7.4). Other uncharred seed types include *Amsinckia* sp. (14%), *Achnatherum hymenoides* (10%) and other grasses identified as Poaceae (9%), *Mentzelia albicaulis* (5%), *Cryptantha* (4%),

Table 7.5. Uncharred seeds in the Paisley Cave 5 strata samples.

Family	Taxa	**Ubiquity**	Stratum				
			I	II	III	IV	VI
			0.50 L	*0.25 L*	*0.25 L*	*0.25 L*	*0.25 L*
Adoxaceae	*Sambucus*	**20%**	1	-	-	-	-
Apiaceae-type		**20%**	2	-	-	-	-
Asteraceae	Asteraceae-type	**100%**	5	2	3	4	6
	Artemisia	**40%**	21	17	-	-	-
	Tetradymia	**20%**	12	-	-	-	-
Boraginaceae	Boraginaceae perisperm	**20%**	-	2	-	-	-
	Amsinckia	**100%**	37	49	72	108	15
	Cryptantha	**100%**	44	14	9	5	1
	Plagiobothrys	**80%**	-	3	10	1	1
Brassicaceae	Brassicaceae-type	**20%**	-	-	-	1	-
	Descurainia	**100%**	30	13	15	14	1
Cannabaceae	cf. *Celtis*	**100%**	1	2	10	2	1
Chenopodiaceae	Cheno-am perisperm	**60%**	24	33	2	-	-
	Atriplex	**80%**	3	4	5	8	-
	A. confertifolia	**100%**	21	42	294	302	183
	A. rosea	**80%**	-	3	20	3	1
Cupressaceae	*Juniperus*	**8%**	1	13	2	-	1
Cyperaceae	*Carex*	**40%**	-	1	-	1	-
Fabaceae-type		**20%**	-	-	1	-	-
Hydrophyllaceae	*Phacelia*	**40%**	1	2	-	-	-
Juncaceae	*Juncus*	**40%**	4	1	-	-	-
Loasaceae	*Mentzelia albciaulis*	**80%**	46	23	6	21	-
Onagraceae	*Chamerion*	**40%**	1	-	-	-	1
Pinaceae	*Pinus*	**20%**	1	-	-	-	-
Poaceae	Poaceae-type	**100%**	44	27	35	32	39
	Achnatherum hymenoides	**100%**	36	28	34	49	46
	Hesperostipa	**60%**	3	1	-	-	1
Rosaceae-type		**20%**	-	-	1	-	-
Solanaceae-type		**40%**	4	1	-	-	-
Unidentified		**60%**	9	-	-	1	1

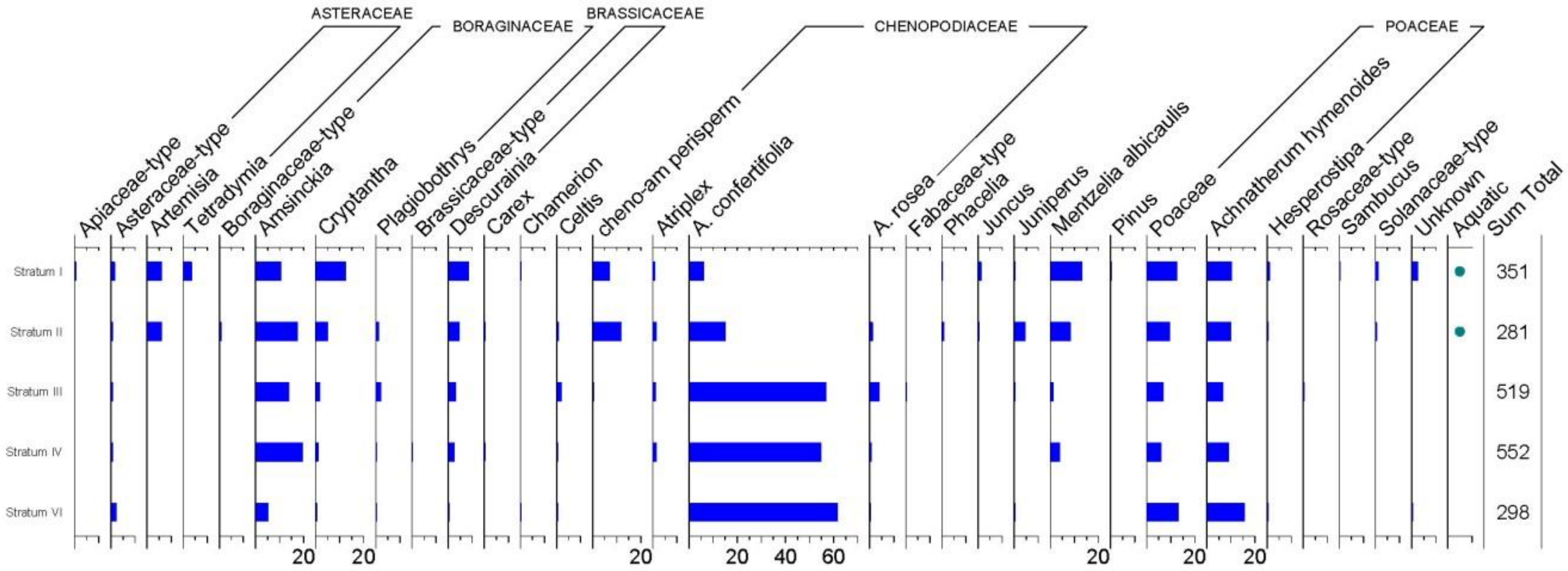


Figure 7.4. Relative abundance of uncharred seed taxa in the Cave 5 strata samples at the Paisley Caves.

Descurainia (4%), cheno-am perisperms (3%), *Artemisia* (2%), unidentified Asteraceae members (1%), cf. *Celtis* (1%), *Juniperus* (1%), and *Plagiobothrys* (1%). *Juncus*, *Hesperostipa*, Solanaceae-type, Apiaceae-type, Boraginaceae perisperm, *Carex*, *Chamerion*, and *Phacelia* each represent less than 1% of the assemblage. A Fabaceae-type seed, a *Pinus* seed, a Rosaceae seed, and a *Sambucus* sp. seed were also noted, but these taxa contributed less than 0.1% to the total uncharred seed assemblage.

Charred seeds in the strata samples were noticeably fragmented. A majority of the charred seed assemblage lacked seed coats necessitating more generalized taxonomic descriptors. Cheno-am perisperms (14%), *Achnatherum hymenoides* (12%), and Boraginaceae perisperms (12%) were the most commonly-identified types (Table 7.6). Other contributing taxa included *Descurainia* (9%), *Mentzelia albicaulis* (8%), *Juncus* (7%), *Atriplex* cf. *confertifolia* (5%), *Phacelia* (4%), Poaceae florets (3%), *Amsinckia* (3%), *Cryptantha* (3%), *Monolepis* (3%), *Hesperostipa* (2%), cf. *Celtis* (1%), *Sambucus* (1%), Rosaceae-type (1%), Asteraceae-type (1%), Cyperaceae-type (1%), Polygonaceae-type (1%). Amaryllidaceae-Liliaceae-type, *Artemisia*, *Juniperus*, Fabaceae-type, and *Pinus* each contributed less than 1% to the charred assemblage. Virtually all of the seeds were recovered in strata I and II. Approximately 7% of charred seeds were not identifiable to taxon (Figure 7.5).

The ratio of uncharred to charred seeds appears increasingly uneven with depth, so that there are significantly fewer charred seeds in the earlier deposits. No charred seeds at all were recovered from the pre-Mazama Stratum VI sample. Conversely, in Stratum I, which represents Late Holocene deposits in Cave 5, several thousand charred seeds were counted (Figure 7.6).

Table 7.6. Charred seeds in the Paisley Cave 5 strata samples.

Family	Taxa	**Ubiquity**	Stratum				
			I	II	III	IV	VI
			0.50 L	*0.25 L*	*0.25 L*	*0.25 L*	*0.25 L*
Adoxaceae	*Sambucus*	**20%**	3	-	-	-	-
Amaranthaceae	*Monolepis*	**20%**	6	-	-	-	-
Amaryllidaceae/Liliaceae-type		**20%**	-	-	1	-	-
Asteraceae	Asteraceae-type	**20%**	-	2	-	-	-
	Artemisia	**20%**	1	-	-	-	-
Boraginaceae	Boraginaceae perisperm	**40%**	22	7	-	-	-
	Amsinckia	**40%**	4	3	-	-	-
	Cryptantha	**20%**	-	7	-	-	-
Brassicaceae	*Descurainia*	**60%**	16	4	1	-	-
Cannabaceae	cf. *Celtis*	**40%**	2	1	-	-	-
Chenopodiaceae	Cheno-am perisperm	**60%**	22	9	4	-	-
	Atriplex	**60%**	1	2	1	-	-
	A. confertifolia	**60%**	-	3	2	3	-
Cupressaceae	*Juniperus*	**20%**	-	1	-	-	-
Cyperaceae-type		**20%**	2	-	-	-	-
Fabaceae-type		**20%**	1	-	-	-	-
Hydrophyllaceae	*Phacelia*	**40%**	4	6	-	-	-
Juncaceae	*Juncus*	**20%**	16	-	-	-	-
Loasaceae	*Mentzelia albicaulis*	**60%**	14	5	1	-	-
Pinaceae	*Pinus*	**20%**	1	-	-	-	-
Poaceae	Poaceae-type	**40%**	1	7	-	-	-
	Achnatherum hymenoides	**40%**	26	4	-	-	-
	Hesperostipa	**40%**	2	3	-	-	-
Polygonaceae-type		**20%**	2	-	-	-	-
Rosaceae-type		**20%**	3	-	-	-	-
Unidentified		**n/a**	10	5	2	1	-

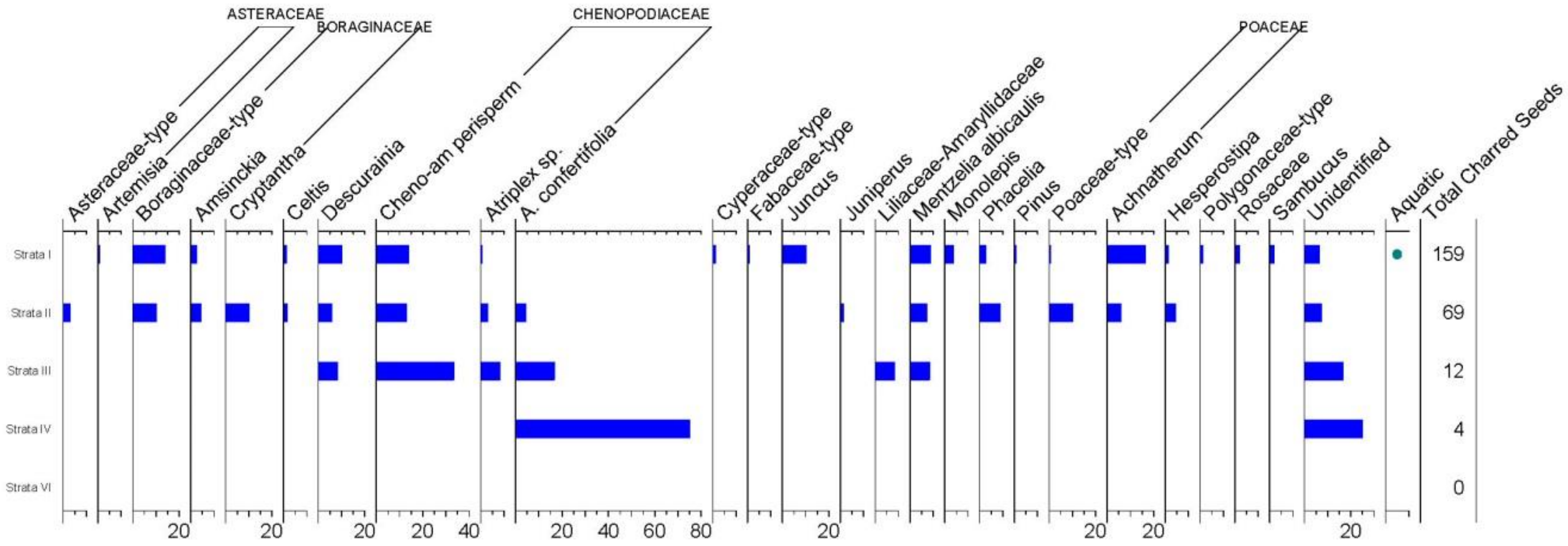


Figure 7.5. Relative abundance of charred seed taxa in the Cave 5 strata samples at the Paisley Caves.

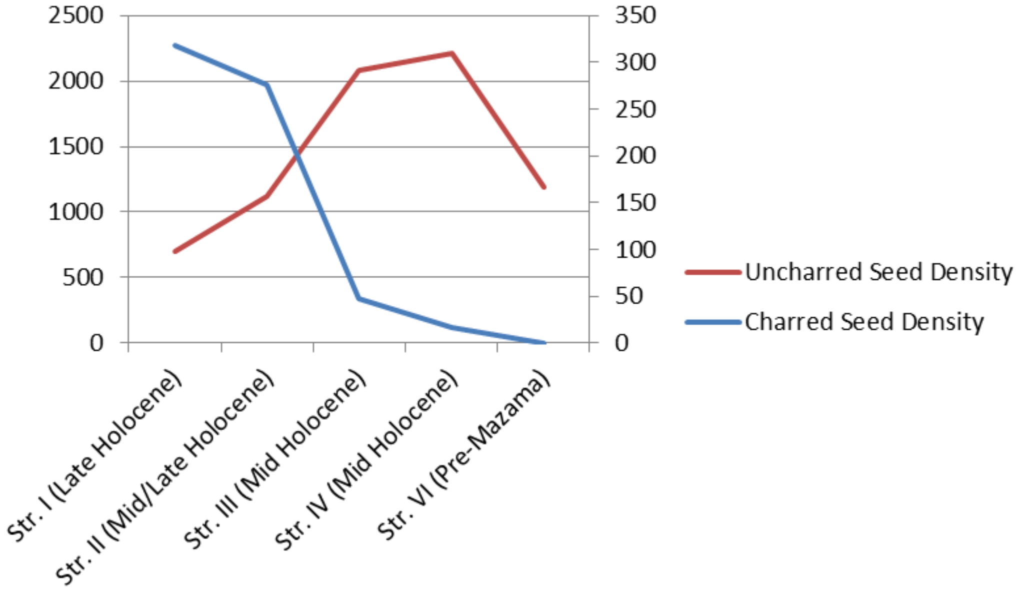


Figure 7.6. Density of charred and uncharred seeds in the Cave 5 strata samples.

7.3. Feature Samples

Younger Dryas-aged hearths and charcoal concentrations were analyzed to identify plant foods collected and processed by site inhabitants. These samples represent features in caves 1, 2, and 5.

7.3.1. Charcoal and Charred Tissues in Features

Charcoal is well represented in the Paisley Cave feature samples. The fragments of charcoal randomly selected for identification were all *Artemisia*. The preponderance of *Artemisia* charcoal in these contexts suggests that sagebrush was the preferred fuel source for people visiting the Paisley Caves during the Younger Dryas. Feature 1/7-4b displayed the highest charcoal density, while the possible hearth features/charcoal stains represented by 5/5A-26-8 and Feature 5/5-3 yielded the lowest charcoal abundance

(Figure 7.8). The presence of charred plant tissues in features was generally scant, but the Cave 5 hearth/oven feature 5/5A-26-8 and Cave 2 Botanical Lens hearth 2/3-32-46 contained relatively high abundances of charred starchy tissues (0.05 g and 0.03 g, respectively) representing the burning of geophytic roots (Table 7.7).

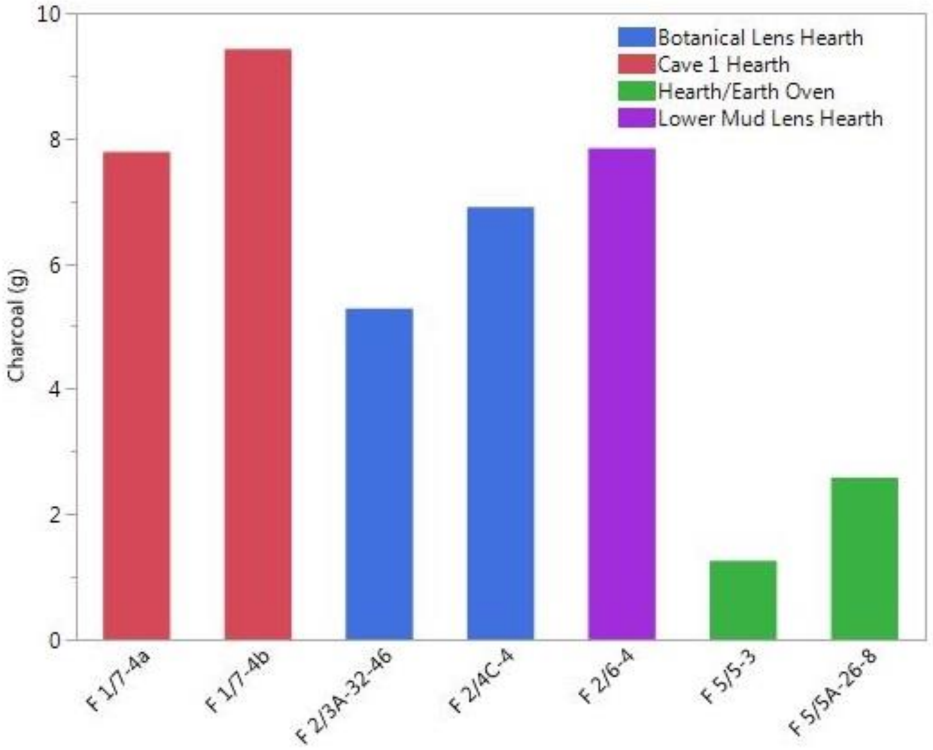


Figure 7.7. Charcoal density abundance in the Paisley Caves feature

Table 7.7. Distribution of charred tissue fragments in the Paisley Caves feature samples.

Charred Tissues	Feature						
	F 1/7-4a	F 1/7-4b	2/3A-32-46	2/4C-4	F 2/6-4	F 5/5-3	5/5A-26-8
	Cave 1 Hearths		Botanical Lens Hearths		Lower Mud Lens Hearth	Cave 5 Hearth/Earth Oven	
CH Fruity Tissue	<0.01 g	-	-	-	-	-	-
CH Starchy Tissue	-	-	0.03 g	<0.01 g	<0.01 g	-	0.05 g
Vitrified Tissue	-	<0.01 g	-	-	-	-	-

7.3.2. Seeds in Features

Analysis of feature samples yielded uncharred (n=183) and charred (n=340) seeds. Uncharred seed types in features were highly represented by *Achnatherum* (59%) and other Poaceae (17%) seed types (Table 7.8). The remainder of the uncharred assemblage included *Atriplex* (8%), *Cryptantha* (3%), unidentified Liliaceae-Amaryllidaceae (2%), Asteraceae-type (1%), Boraginaceae perisperms (1%), *Amsinckia* (1%), *Atriplex confertifolia* (1%), *Juniperus* (1%), *Mentzelia albicaulis* (1%), *Oenothera* sp. (1%), *Pinus* (1%), Rosaceae-type (1%), *Rosa* (1%), and *Typha* (1%). Unidentified seeds accounted for 2% of all uncharred seeds recovered in feature samples.

Taxonomic diversity among charred seeds exceeded the diversity of uncharred seed types identified. The charred assemblage included *Achnatherum hymenoides* (23%), *Atriplex* (19%), cheno-am perisperms (17%), Boraginaceae perisperms (10%), Poaceae-type (7%), *Amaranthus* (3%), *Hesperostipa* (2%), Geraniaceae-type (2%), Rosaceae-type (2%), *Descurainia* (2%), *Phacelia* (2%), *Cryptantha* (1%), *Urtica dioica* (1%), *Camassia* (1%), *Sphaeralcea* (1%), and *Plantago* (1%). Other identified taxa contributing less than 1% to the uncharred assemblage include Liliaceae-Amaryllidaceae-type, *Atriplex confertifolia*, *Chenopodium*, *Ceanothus*, *Juncus*, *Sesuvium*, and *Vicia*. Unidentified seeds constituted 5% of the charred assemblage.

When considered individually, feature macrobotanical assemblages varied greatly. The two samples representing hearths in the Botanical Lens (features 2/3A and 2/4C-4) contained very few charred seeds in comparison to the uncharred seeds. Charred seed types were limited to *Atriplex*, cheno-am perisperms, and *Descurainia*

Table 7.8. Abundance of uncharred seed taxa in the Paisley Caves feature samples.

Family	Taxa	**Ubiquity**	Feature						
			F 1/7-4a	F 1/7-4b	2/3A-32-46	2/4C-4	F 2/6-4	F 5/5-3	5/5A-26-8
			0.5 L	*0.5 L*	*0.5 L*	*0.5 L*	*0.5 L*	*0.5 L*	*0.5 L*
Liliaceae-Amaryllidaceae-type		**14%**	-	-	-	4	-	-	-
Asteraceae-type		**29%**	-	-	-	-	1	1	-
Boraginaceae	Boraginaceae perisperm	**14%**	-	-	-	-	-	1	-
	Amsinckia	**14%**	-	-	-	-	-	1	-
	Cryptantha	**29%**	-	-	-	-	4	2	-
Chenopodiaceae s.l.	*Amaranthus*	**29%**	-	-	1	-	-	1	-
	Atriplex	**57%**	-	-	4	1	3	6	-
	Atriplex confertifolia	**14%**	-	-	-	-	-	1	-
	Chenopodium	**14%**	-	-	-	-	2	-	-
Cupressaceae	*Juniperus*	**14%**	-	-	-	1	-	-	-
Loasaceae	*Mentzelia*	**14%**	-	-	-	-	1	-	-
Onagraceae	*Oenothera*	**14%**	-	1	-	-	-	-	-
Pinaceae	*Pinus*	**14%**	-	1	-	-	-	-	-
Poaceae	Poaceae-type	**57%**	-	-	4	10	9	8	-
	Achnatherum	**57%**	-	-	20	40	21	27	-
Rosaceae	Rosaceae	**14%**	-	1	-	-	-	-	-
Typhaceae	*Typha*	**14%**	-	-	1	-	-	-	-
Urticaceae	*Urtica dioica*	**14%**	-	-	-	-	-	2	-
Unidentified		**n/a**	-	-	-	1	2	-	-

Table 7.9 Abundance of charred seed taxa in the Paisley Caves feature samples.

Family	Taxa	**Ubiquity**	Feature						
			F 1/7-4a	F 1/7-4b	2/3A-32-46	2/4C-4	F 2/6-4	F 5/5-3	5/5A-26-8
			0.5 L	*0.5 L*	*0.5 L*	*0.5 L*	*0.5 L*	*0.5 L*	*0.5 L*
Asparagaceae	*Camassia*	**14%**	-	-	-	-	-	-	2
Boraginaceae	Boraginaceae perisperms	**43%**	-	-	-	-	12	18	5
	Cryptantha	**14%**	-	-	-	-	-	4	-
Brassicaceae	*Descurainia*	**43%**	-	-	1	-	1	3	-
Chenopodiaceae *s.l.*	Cheno-am perisperms	**71%**	1	-	1	-	6	21	30
	Amaranthus	**14%**	-	-	-	-	-	-	10
	Atriplex	**71%**	-	-	5	2	14	36	8
	Atriplex confertifolia	**14%**	-	-	-	-	-	1	-
	Chenopodium	**14%**	-	-	-	-	1	-	-
Fabaceae	*Vicia*	**14%**	-	-	-	-	-	1	-
Gereniaceae-type		**14%**	-	-	-	-	-	6	-
Hydrophyllaceae	*Phacelia*	**29%**	-	-	-	-	4	1	-
Juncaceae	*Juncus*	**14%**	-	-	-	-	-	-	1
Liliaceae-Amaryllidaceae	Liliaceae-Amyrillidaceae-type	**14%**	-	-	-	-	-	1	-
Malvaceae	*Sphaeralcea*	**14%**	-	-	-	-	-	2	-
Plantaginaceae	*Plantago*	**29%**	-	-	-	-	-	1	1
Poaceae	Poaceae-type	**57%**	-	1	-	-	4	14	4
	Achnatherum hymenoides	**43%**	-	-	-	-	4	43	31
	Hesperostipa	**14%**	-	-	-	-	-	8	-
Portulaceae	*Sesuvium*	**14%**	-	-	-	-	1	-	-
Rhamnaceae	*Ceanothus*	**14%**	-	-	-	-	-	-	1
Rosaceae	Rosaceae-type	**29%**	-	-	-	-	-	4	2
	Rosa sp.	**14%**	-	-	-	-	-	-	2
Urticaceae	*Urtica dioica*	**14%**	-	-	-	-	-	4	-
Unidentified		**n/a**	-	1	-	1	4	11	-

(Figure 7.8). In both hearths, *Atriplex* contributed ~70% to the charred assemblages. *Achnatherum hymenoides* dominated the uncharred seed assemblage in both features.

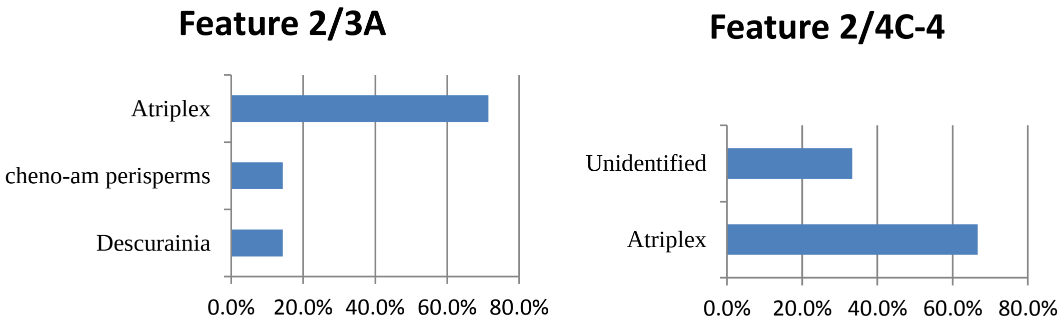


Figure 7.8. Relative abundance of charred seed taxa identified in Botanical Lens hearth Feature 2/3A (left) and Botanical Lens hearth Feature 2/4C-4 (right) in Paisley Cave 2.

Feature 2/6, the Cave 2 Lower Mud Lens hearth dated to 11,387 cal BP, yielded a more diverse array of charred (n=51) and uncharred (n=38) seeds (Figure 7.9). However, the dominant charred and uncharred seed types are similar to those identified in the Botanical Lens hearths.

Macrobotanical remains in the Cave 1 hearths, features 1/7-4a and 1/7-4b, bear little resemblance to the Cave 2 hearths. In Feature 1/7-4a, only a single charred cheno-am perisperm was present. No uncharred seeds were recovered from this hearth. Feature 1/7-4b yielded a single charred Poaceae seed and a single unidentified charred seed; uncharred seeds included a single *Oenothera* sp. seed, a single *Pinus* sp. seed, and a single Rosaceae-type seed.

The majority of seeds recovered in feature samples originated in the Cave hearth/earth oven feature represented by Feature 5/5-3 (charcoal lens) and Feature 5/5A-26-8 (ash lens). In these samples, *Achnatherum hymenoides* was the dominant charred

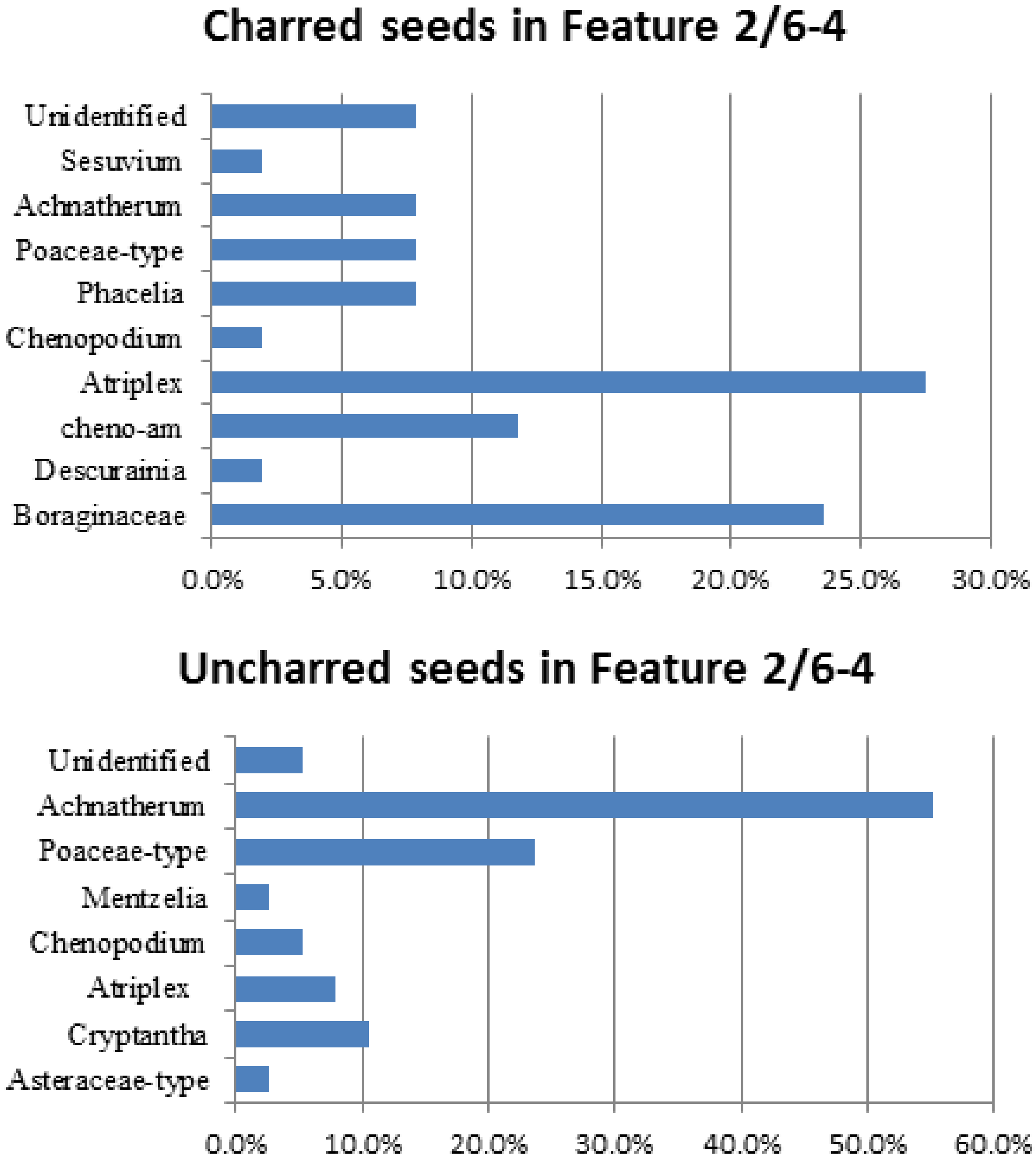


Figure 7.9 Relative abundance of charred (upper) and uncharred (lower) seed taxa identified in the Feature 2/6-4 hearth at Paisley Caves.

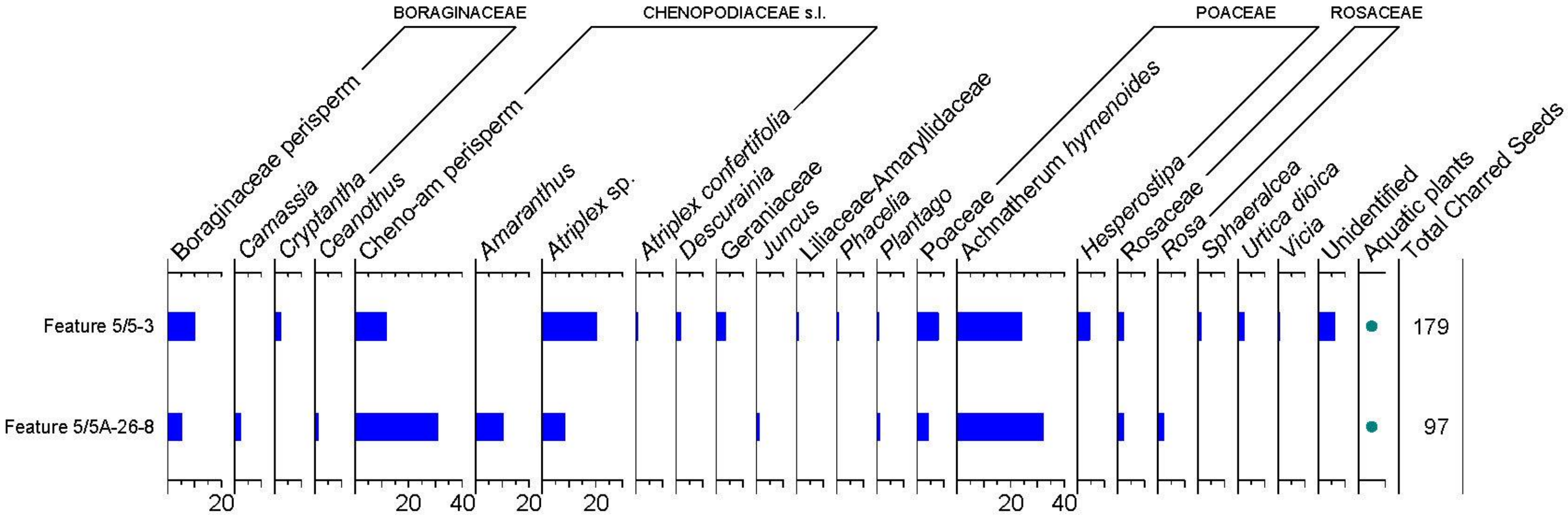


Figure 7.10. Relative abundance of charred seed taxa represented in the Cave 5 Hearth/Earth oven features.

seed type, although *Atriplex* sp. and other Chenopodiaceae members were also very well represented (Figure 7.10; previous page). Feature 5/5-26-8A contained no uncharred seeds. In contrast,

Feature 5/5-3 yielded several uncharred *Achnatherum hymenoides*, and *Atriplex* sp., in addition to a few other taxa (refer back to Table 7.8).

7.4. Woodrat (*Neotoma*) Midden

Uncharred seeds (n=615) were the only botanic material observed in sample 1829-PC-5/12A-34-19, the non-cultural *Neotoma* nest from a Younger Dryas-aged component of Paisley Cave 5 (Figure 7.11). The assemblage was dominated by *Urtica dioica* (47%), *Achnatherum hymenoides* (19%), and unidentified Poaceae members (9%)

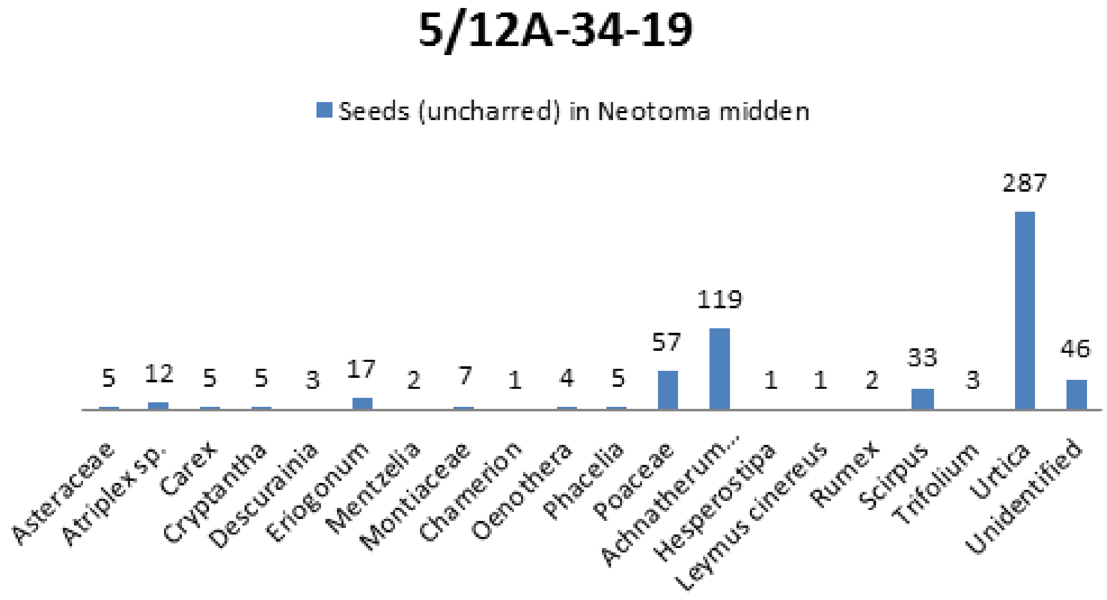


Figure 7.11. Macrobotanical remains recovered from the Younger Dryas *Neotoma* nest identified in Cave 5 at the Paisley Caves, Site 35LK3400.

not identified to genus. The rodent nest also contained scant amounts of *Scirpus* (5%), Boraginaceae (3%), *Atriplex* (2%), Montiaceae-type (1%), Asteraceae (1%), *Phacelia* (1%), *Cryptantha* (1%), *Carex* (1%), *Oenothera* (1%), *Descurainia* (1%), and *Trifolium* (1%). *Mentzelia albicaulis*, *Leymus cinereus*, and *Hesperostipa* were also noted, but contributed less than 1% to the seed assemblage. Additionally, 46 seeds (8%) remain unidentified.

7.5. Data Analysis and Interpretations

7.5.1. Richness and Diversity

Taxonomic richness and diversity fluctuate in the Paisley Caves bulk soil samples, but exhibit the highest levels in Feature 5/5-3, column samples CS-8, CS-9 and CS-10 (ca. 10,000 to 9000 cal BP), the *Neotoma* nest, and Cave 5 strata samples I and II (Figure 7.12). Differences in Shannon-Wiener diversity index rankings are not statistically significant between samples (chi square=9.1045, *df* =5, p=0.105).

7.5.2. Cluster Analysis

Cluster analysis, constructed using the density of charcoal, charred seeds, and uncharred seeds in each individual sample as variables, demonstrates clear patterning in the macrobotanical record. The first cluster (n=20) includes nearly all of the Unit 2/6B column samples, except for CS-6 in LU3 and CS-20 in LU2 (Figure 7.13). The second cluster (n=6) consists of the Cave 1 and Cave 2 hearths and column sample CS-20, representing the upper extent of LU2 below the Lower Mud Lens. The third cluster (n=5)

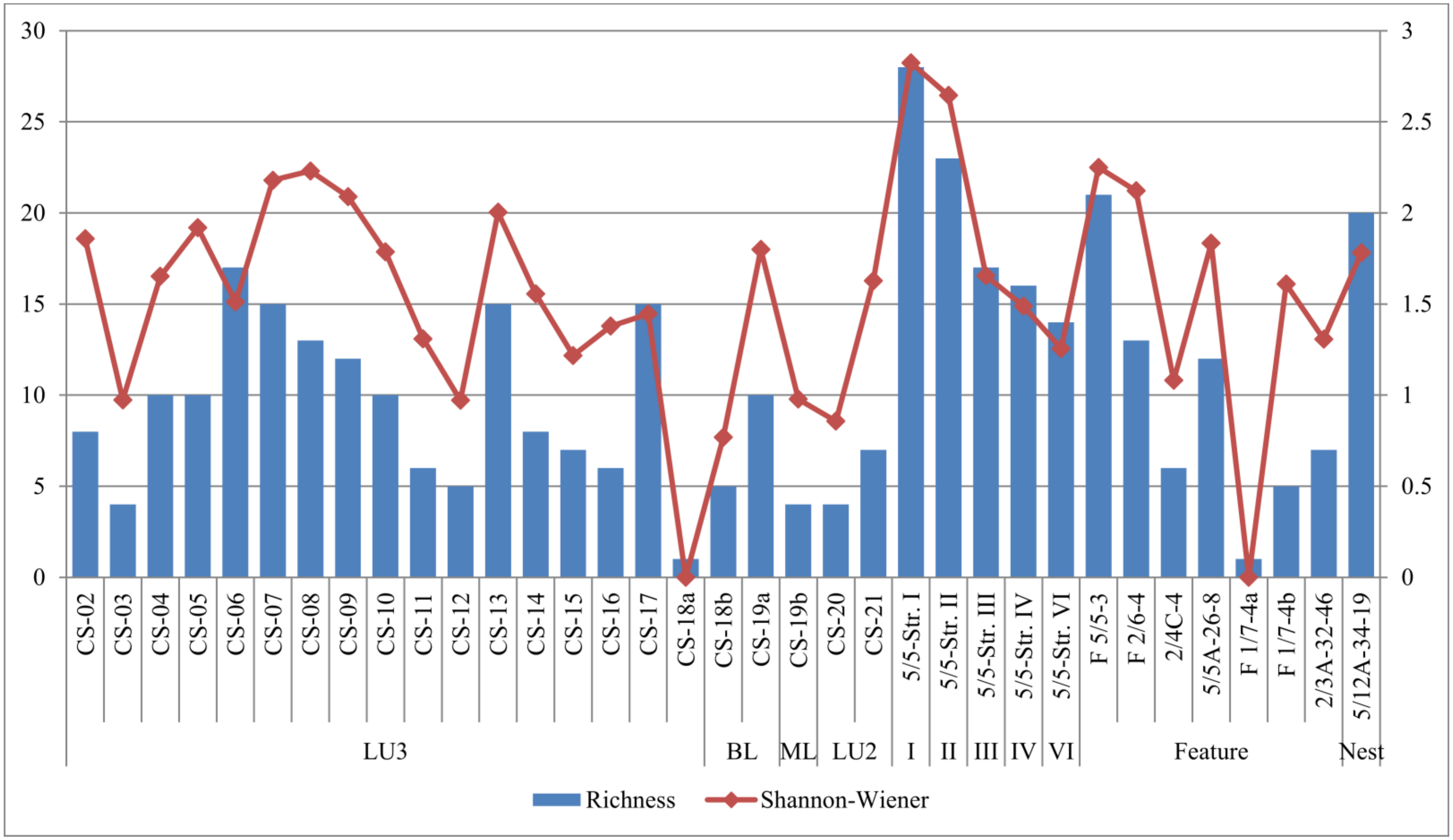


Figure 7.12. Species richness and evenness.

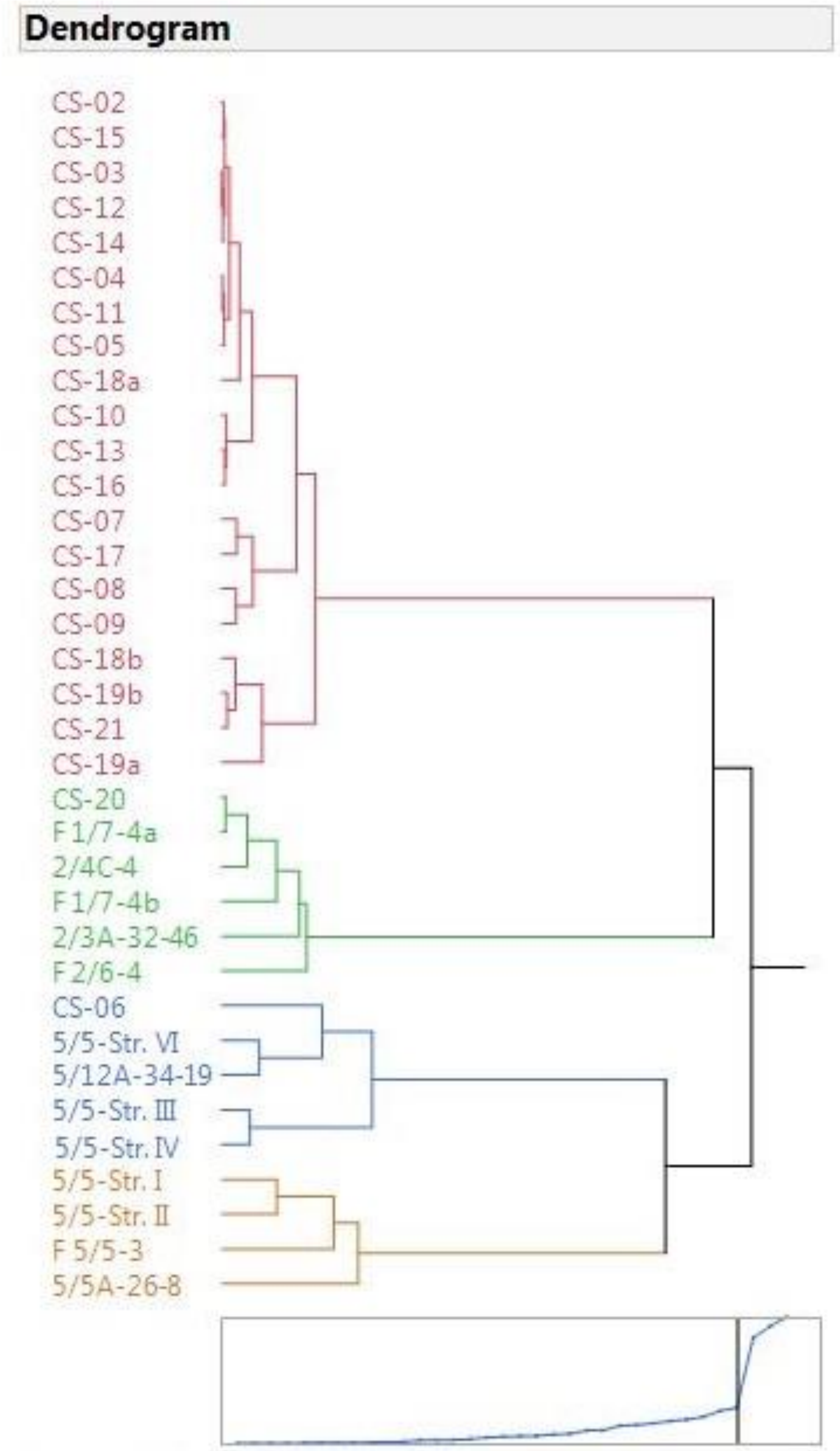


Figure 7.13. Dendrogram depicting clustering of Paisley Caves macrobotanical samples based on the density of charcoal, charred seeds, and uncharred seeds in each sample.

includes CS-6 from the Unit 2/6B column, the woodrat nest, and Cave 5 strata samples III, IV, and VI. Finally, Cave 5 strata samples I and II, and the Cave 5 hearth/earth oven features 5/5-3 and 5/5A comprise the fourth cluster (n=4).

The hearth/earth oven features do not cluster with the other hearths analyzed at the site, probably because they contain less charcoal and more charred seeds than the Cave 1 and Cave 2 hearths. This pattern could be reflective of differences in burning intensity and/or duration and may indicate they represent an oven feature rather than a fire hearth.

The inclusion of sample CS-6 with the woodrat midden sample and Cave 5 lower strata samples likely derives from the combined dearth of charcoal (0.16 g/liter) and relatively high uncharred seed count (n=1036/liter). When density-dependent data transformations are made for the Cave 5 strata III, IV, and VI samples, uncharred seed abundances are high (n=2208/liter, n=1192/liter, and n=8004/liter, respectively) and make up 68% of the uncharred seed assemblage in the Cave 5 samples. The uncharred seeds in sample CS-6 account for 27% of all uncharred seeds recovered in the Unit 2/6B column samples. Conversely, sample CS-20 almost certainly clusters with the hearth features due to its high charcoal content (7.70 g/liter), which contributes 47% to the total charcoal present in the Unit 2/6B column samples.

Results of the cluster analysis provide the basis for the establishment of six meaningful categories with which to analyze the seed data in the Paisley Caves bulk soil samples:

- Cave 2 column samples (2C),
- Younger Dryas hearths (YDH),
- Cave 5 hearths (5H),
- Cave 5 upper strata samples and possible hearths (5U),
- Cave 5 lower strata samples (5L), and
- *Neotoma* woodrat nest (N)

Even though sample CS-6 does not appear to fit the parameters for grouping the Unit 2/6B column samples together, it is not excluded from these analyses. These groups were selected as sample types to examine the spatial patterning of seed distribution.

7.5.3. Cultural vs. Non-human Seed Deposition

Uncharred seeds in the column and strata samples are assumed to represent inadvertent introduction into the sampled contexts because the taxonomic makeup of charred seeds differs significantly from uncharred seeds. A taxonomic heteroscedasticity test comparing uncharred and charred seed assemblages for each sample type demonstrates the two populations are different (Table 7.9). This assumption is in part supported by the recognition that charring is the primary indicator of culturally-mediated macrobotanical deposition (Micelisk 1987) and by

Table 7.10. Heteroscedasticity results for charred versus uncharred taxa* in Paisley Caves sample types.

Sample Type	Chi Square Value	*df*	p-Value
2C	210.92578	38	<0.00001
YDH	113.09942	16	<0.00001
5H	48.14293	23	0.00160
5U	253.32364	30	<0.00001
5L	366.88385	20	<0.00001
N	No charred seeds present		

*Unidentified seeds excluded from calculations the fact that charred seeds are absent in the rodent nest and in sterile cave deposits representing habitation hiatuses. This assumption cannot as easily be construed for uncharred macrobotanical remains in the features samples. For example, the statistical difference between charred and uncharred populations in the Botanical Lens may be indicative of distinct activity areas associated with habitation during the Younger Dryas (hearth vs. pronghorn processing area).

As noted above, charred seeds are absent in the woodrat nest, but relative abundances are also surprisingly low in the YDH sample type. Unique taxon ubiquity measures demonstrate only charred cheno-ams and charred *Atriplex* are represented in every sample type in the Paisley Caves macrobotanical analysis (Table 7.11).

Table 7.11. Ubiquity of individual charred taxon by sample type.

		Sample Type				
Charred Taxon	**Ubiquity**	**2C**	**5U**	**5L**	**5H**	**YDH**
Asteraceae	20%		X			
Artemisia	20%		X			
Boraginaceae	60%	X	X		X	
Amsinckia	40%	X	X			
Camassia	20%				X	
Cryptantha	40%		X		X	
Ceanothus	20%				X	
cf. *Celtis*	40%		X	X		
Cheno-am	100%	X	X	X	X	X
Amaranthus	20%				X	
Atriplex	100%	X	X	X	X	X
Chenopodium	20%	X				
Suaeda	20%	X				
Cyperaceae	20%		X			
Descurainia	80%		X	X	X	X
Fabaceae	20%		X			
Vicia	20%				X	
Gereniaceae	20%				X	
Juncus	40%		X		X	
Juniperus	20%		X			
Liliaceae s.l.	40%			X	X	
Mentzelia albicaulis	60%	X	X	X		
Monolepis	20%		X			
Phacelia	40%		X		X	
Pinus	20%		X			
Plantago	20%				X	
Poaceae	80%	X	X		X	X
Achnatherum	60%	X	X		X	
Polygonaceae	20%		X			
Rosaceae	40%		X		X	
Rosa	20%				X	
Sambucus	20%		X			
Sphaeralcea	20%				X	
Urtica dioica	20%				X	

Table 7.12. Charred plant taxa and counts identified for each sample type.

Sample Type	**Column 2/6B**	**Cave 5 Upper Strata**	**Cave 5 Lower Strata**	**Cave 5 Hearths**	**Younger Dryas Hearths**	**Sum**
N of samples	17	2	3	2	5	**19**
Soil volume (L)	12.20	0.75	0.75	1.00	2.00	**16.7**
Asteraceae		2				**2**
Artemisia		1				**1**
Boraginaceae	1	29		23		**53**
Amsinckia	2	7				**9**
Camassia				2		**2**
Cryptantha		7		4		**11**
Ceanothus				1		**1**
cf. *Celtis*		3	2			**5**
Cheno-am	8	31	4	51	2	**96**
Amaranthus				10		**10**
Atriplex[1]	1	6	6	45	7	**65**
Chenopodium	46					**46**
Suaeda	1					**1**
Cyperaceae		2				**2**
Descurainia		20	1	3	1	**25**
Fabaceae		1				**1**
Vicia				1		**1**
Gereniaceae				6		**6**
Juncus		16		1		**17**
Juniperus		1				**1**
Liliaceae s.l.			1	1		**2**
Mentzelia albicaulis	1	19	1			**21**
Monolepis		6				**6**
Phacelia		10		1		**11**
Pinus		1				**1**
Plantago				2		**2**
Poaceae[2]	35	13		26	1	**75**
Achnatherum	7	30		74		**111**
Polygonaceae		2				**2**
Rosaceae		3		6		**9**
Rosa				2		**2**
Sambucus		3				**3**
Sphaeralcea				2		**2**
Urtica dioica				4		**4**
Unidentified	1	15	1	11	2	**30**
Total seed N	**103**	**228**	**16**	**276**	**13**	**636**
Seed density	**8.4**	**304.0**	**21.3**	**276.0**	**6.5**	**38.1**

[1] including all *Atriplex* species

[2] all Poaceae except *A. hymenoides*

When seed types are assigned to broad family categories, charred seeds of cheno-ams, Poaceae, and Boraginaceae account for 75% of the total number of seeds and represented in all five sample types (Table 7.12; previous page). Charred seed densities are highest in the 5H and 5U sample types in Cave 5 (Figure 7.14).

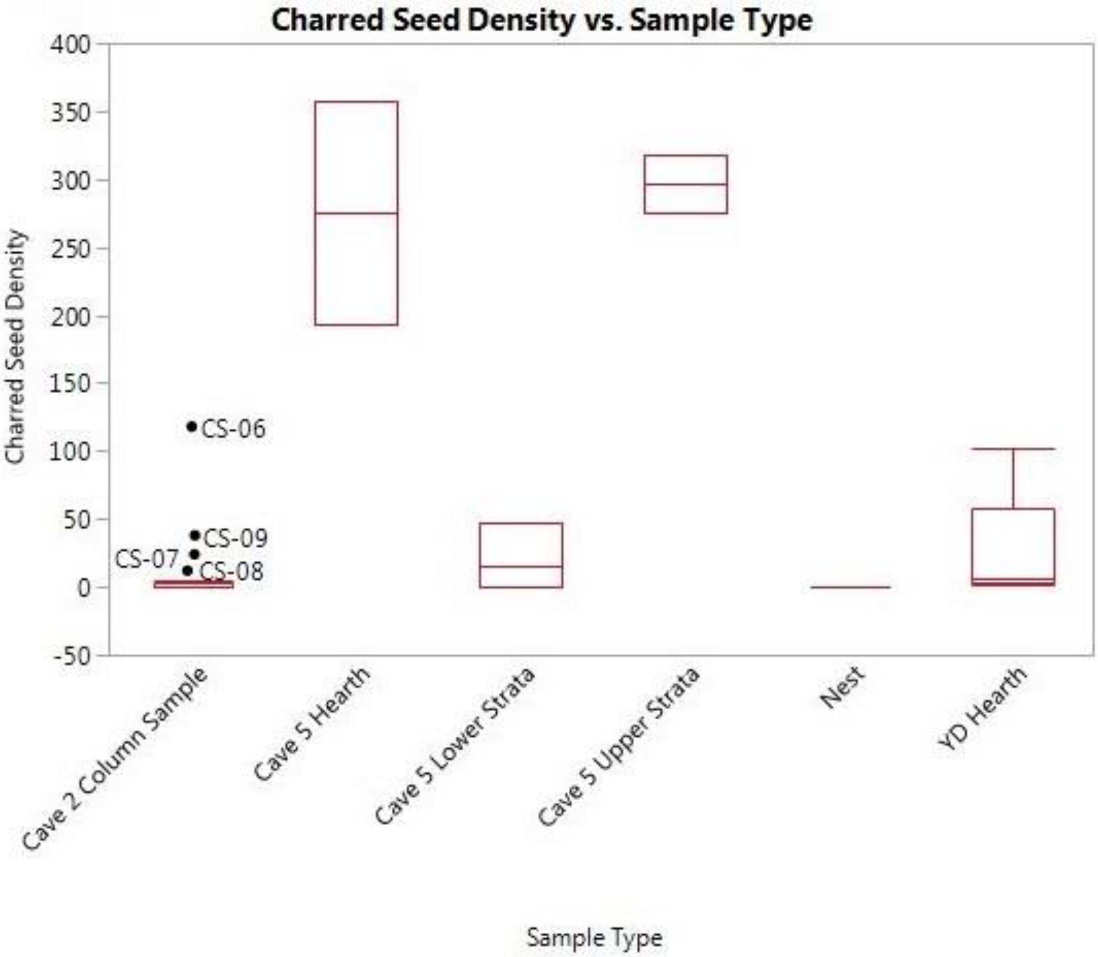


Figure 7.14. Box plot of total charred seed density by sample type.

7.5.4. Paleoenvironmental Trends

Ecological characteristics for plant taxa identified at the Paisley Caves, including drought and alkalinity tolerances and wetland obligation, were evaluated to assess broad, diachronic paleoenvironmental patterns. Both drought tolerant plants and halophytes gain prominence in the Paisley Caves archaeobotanical record during the Middle Holocene (Figure 7.15). A comparison of obligate wetland plants, which almost always occur in wetlands, and facultative wetland plants, which are usually found in wetlands, demonstrates higher instances of moisture-loving plants in Younger Dryas hearths (Figure 7.16; Table 7.13).

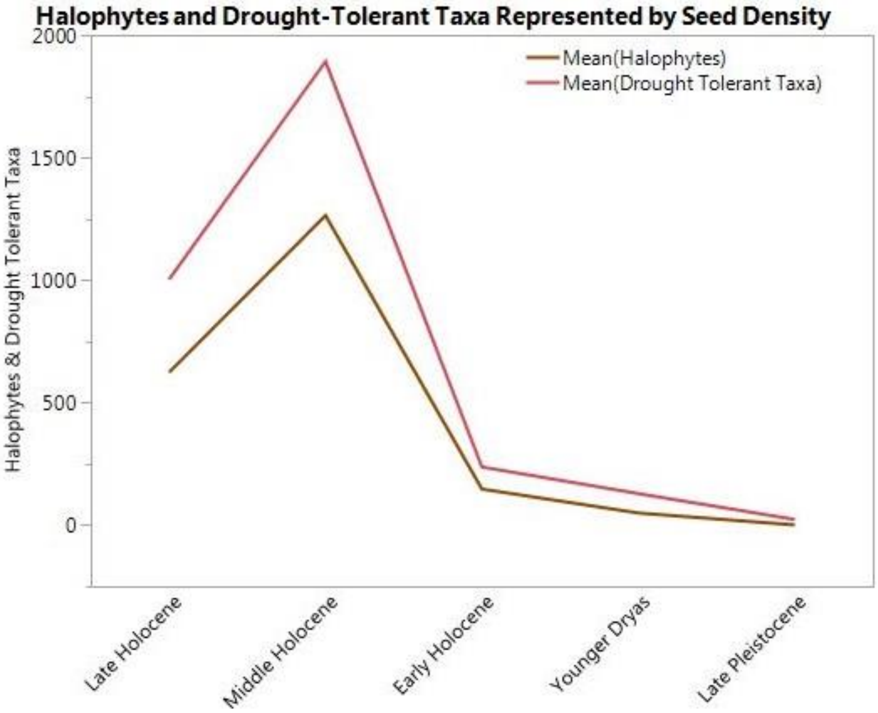


Figure 7.15. Temporal distribution of drought and alkaline adapted plant taxa represented in the Paisley Caves macrobotanical samples.

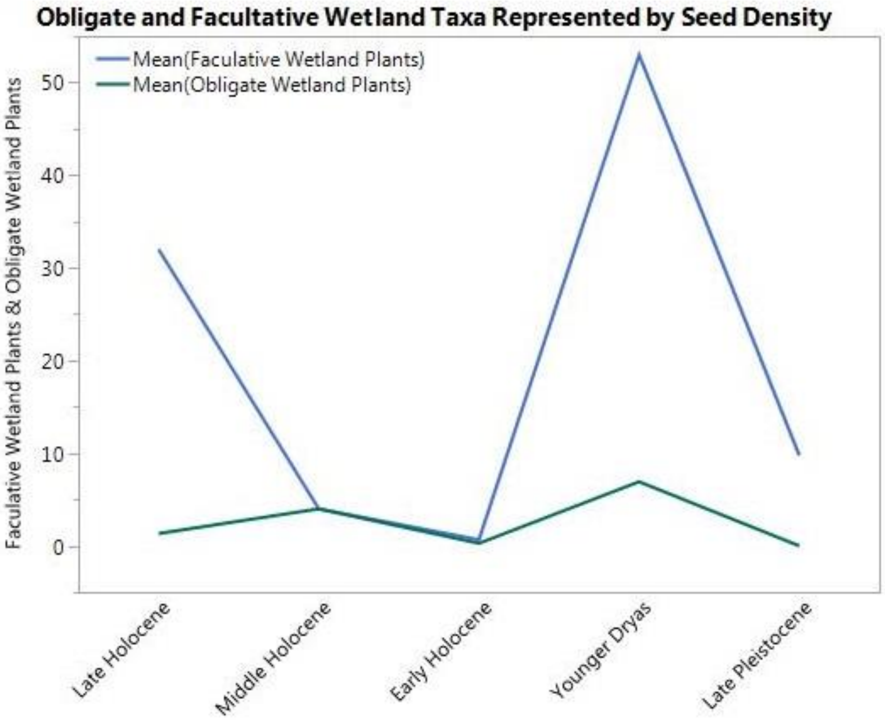


Figure 7.17. Temporal distribution of wetland adapted plant taxa represented in the Paisley Caves macrobotanical samples.

Table 7.13. Wetland plant indicator status (USDA 2014).

Indicator Code	Indicator Status	Comment
OBL	Obligate Wetland	Almost always occur in wetlands
FACW	Facultative Wetland	Usually occur in wetlands, but may occur in non-wetlands
FAC	Facultative	Occur in wetlands and non-wetlands
FACU	Facultative Upland	Usually occur in non-wetlands, but may occur in wetlands
UPL	Obligate Upland	Almost never occur in wetlands

Elevated occurrences of wetland plants in the Younger Dryas are represented in the charcoal and seed assemblages. Though the relative abundances are meager, *Salix* charcoal in the Younger Dryas Botanical Lens and Mud Lens suggest willow would have been growing near the site at that time. The uptick in wetland-adapted species primarily reflects the presence of *Urtica dioica*, *Scirpus/Schoenoplectus*, *Carex*, *Rumex*, and *Typha latifolia* seeds.

The increase in wetland-adapted taxa is driven not only by hearth and Botanical Lens constituents, but also the *Neotoma* nest materials. The seeds recovered from the nest are categorized as Facultative Wetland (64%), Upland (27%), Obligate Wetland (9%), and Facultative (1%) plants (Figure 7.17). The unusually diverse array of habitat characteristics in the plants represented suggests the woodrats scavenged seeds from cultural deposits in the caves.

If the overflow channel between Summer and ZX Lakes, which is situated at 1338 m AMSL (Allison 1982:52), was breached during the Younger Dryas (Friedel 1993), then wetland plants most likely grew more than 500 m (maximum bushytailed woodrat foraging distance) from the caves. It is even more unlikely that these taxa were available within the typical foraging range of 50-60 m (Topping and Millar 1995). Historically, woodrats have been reported to collect cultural materials from other archaeological sites (Smith 1997).

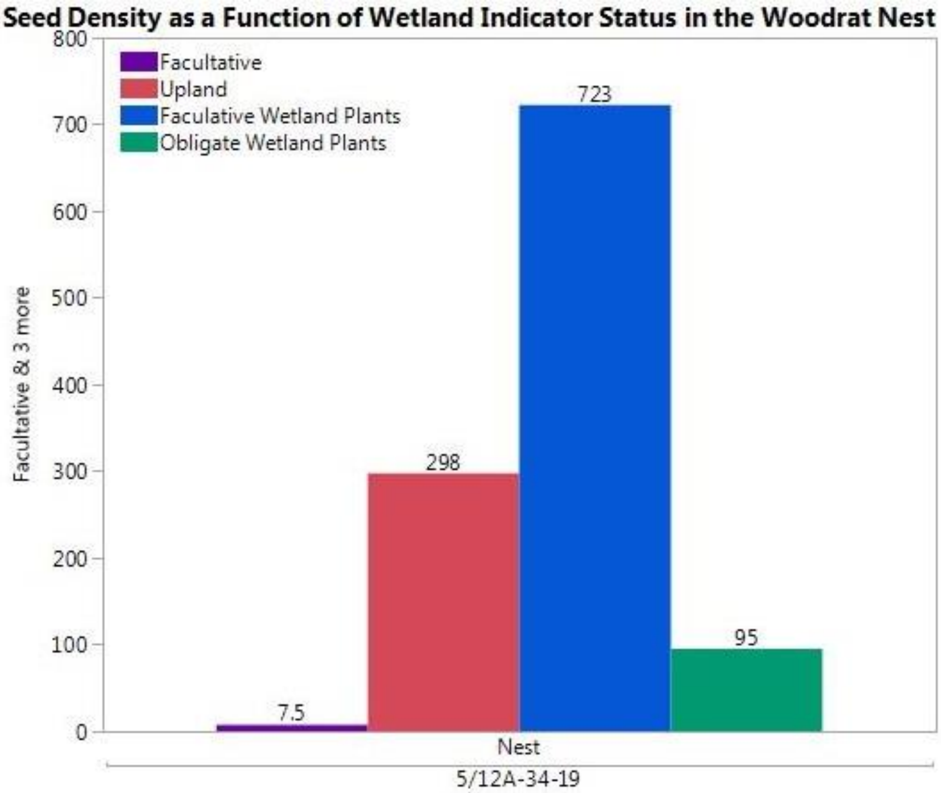


Figure 7.17. Ecological attributes of plants identified in the Cave 5, Younger Dryas-aged *Neotoma* nest.

7.5.5. Seasonality of Habitation

If charred seeds can be assumed to represent cultural deposition (see section 7.5.3), then comparing the charred and uncharred seed assemblages in the macrobotanical samples based on seed ripening times can provide a useful means for determining seasonal visitation. The clearest data patterns derive from the Middle Holocene-aged samples when charred seeds representation was limited to plants available for harvest in the late fall and winter (Figure 7.18). Likely, increased temperatures and aridity at this time compromised the bioproductivity of the lake margins and marshes surrounding the Paisley Caves. Although the Cave 5 strata samples cannot provide high-resolution data concerning habitation frequency, the data still strongly suggest Paisley Cave 5 was rarely visited in the Early and Middle Holocene.

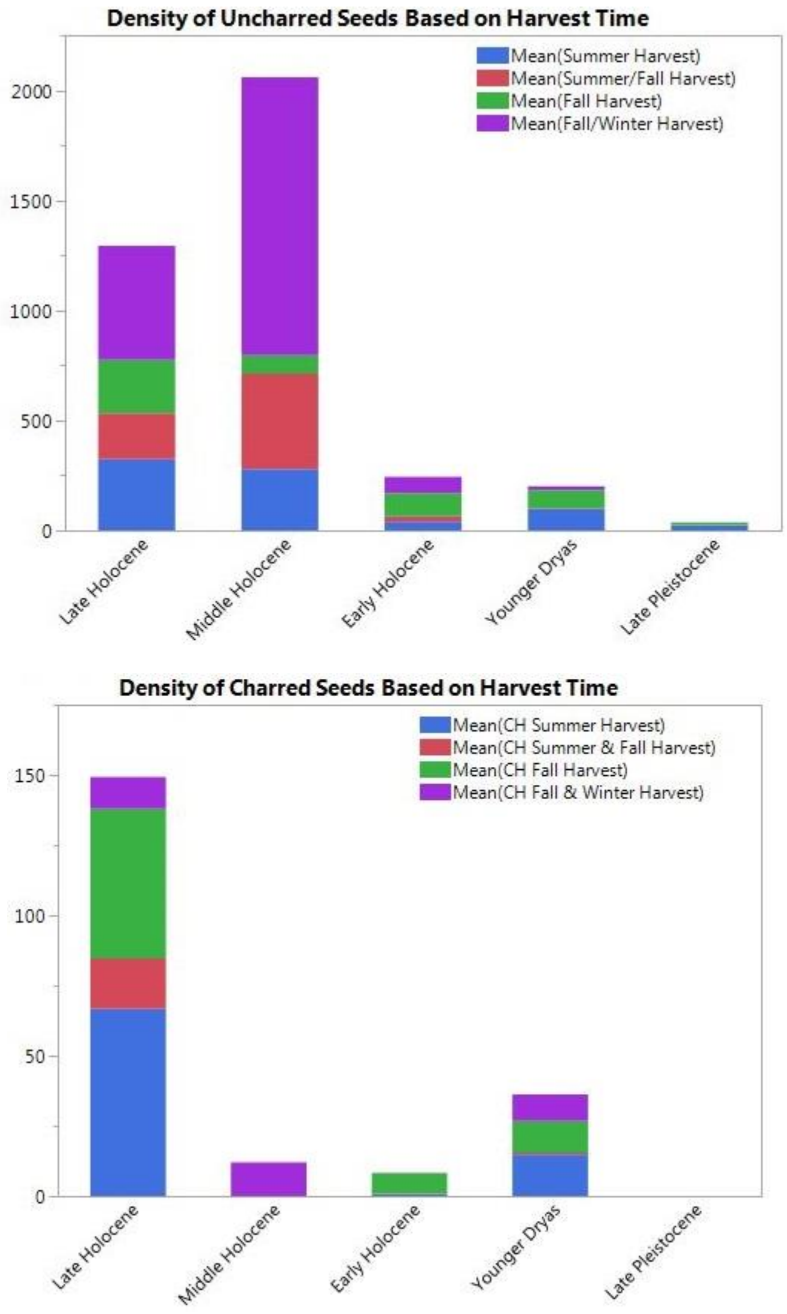


Figure 7.18. Seasonal availability of plant taxa represented in the Paisley Caves macrobotanical samples, presented as mean density of uncharred (upper) and charred seeds (lower).

The Early and Middle Holocene patterns of seasonal use differ from Late Holocene and Younger Dryas habitation events, which, at face value, appear to have intensified during the summer and fall months. Resources would have been more abundant near the Paisley Caves in the late summer and fall (Jenkins 2016:132), which may have prompted people to visit at this time of year during their seasonal rounds. Higher abundances of summer and fall-ripening seeds are also observed in the *Neotoma* nest (Figure 7.19). As discussed in Chapter III, woodrats also increase caching activities in late August and September (Smith 1997).

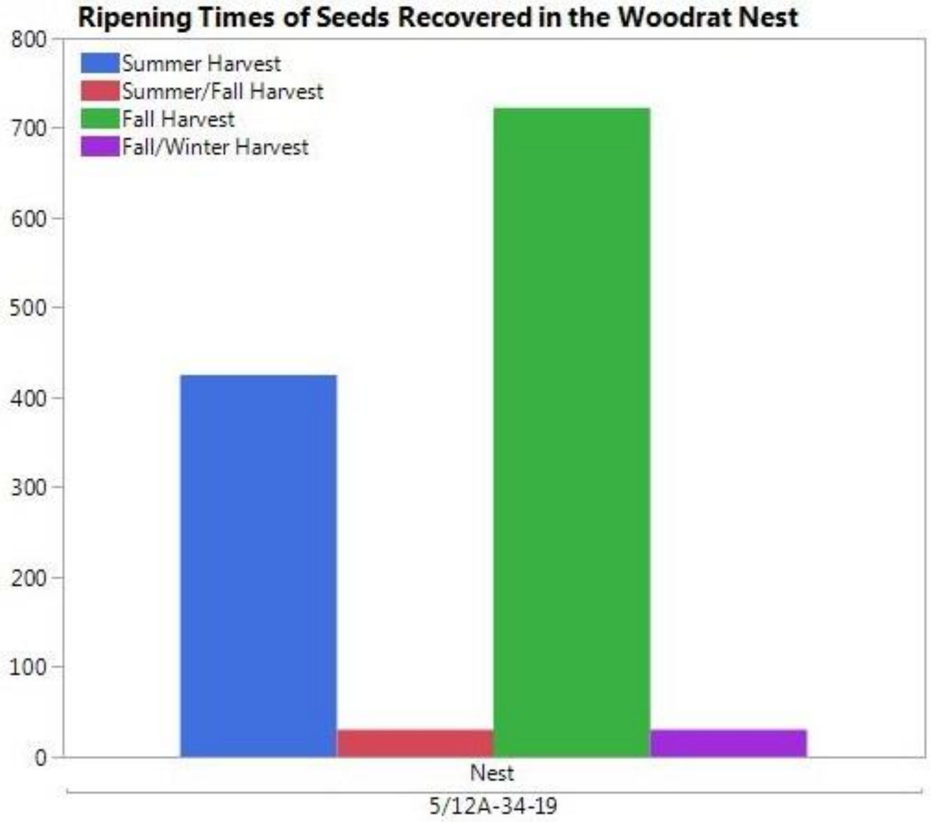


Figure 7.19. Seasonal availability of plant taxa represented in the *Neotoma* nest in Paisley Cave 5.

7.5.6. Taxon Ubiquity

Several taxa appear to have been targeted for processing by the visitors to the Paisley Caves, but the patterning of the data suggests people placed elevated importance on particular resources depending on the timing of the visit. No charred seeds are present in the LU 2 component representing the Terminal Pleistocene in Cave 2 (Table 7.14). Charcoal was observed in this context, though, and Western Stemmed artifacts have been found in association with human coprolites and megafauna remains (Jenkins et al. 2012a, 2012b; McDonough et al. 2012). While it is clear that people camped at the caves during this time, no strong evidence of plant food processing was detected in this study.

Several cooking features and the Botanical Lens feature provide detailed data regarding plant resources during the Younger Dryas. In the features, uncharred seeds may signal cultural deposition, and accordingly, ubiquity measures include both charred and uncharred seeds. While some taxa are represented solely by charred seeds – *Plantago, Cryptantha*, *Camassia*, *Vicia*, Geraniaceae, *Juncus*, *Hesperostipa*, *Rosa*, *Sesuvium*, and *Sphaeralcea* – others occur only as uncharred specimens, including Asteraceae, *Pinus*, *Juniperus*, *Oenothera*, and *Typha*. Taxa represented by both charred and uncharred seeds occurred in in greater abundance and with higher levels of ubiquity. They include *Achnatherum*, *Atriplex*, Poaceae, cheno-ams, *Chenopodium*, *Descurainia*, *Amaranthus*, Boraginaceae, *Mentzelia*, *Phacelia*, *Ceanothus*, Liliaceae-Amaryllidaceae, and *Urtica*. Seeds of plants with geophytic roots are only present in the Cave 5 hearth/earth oven sample, which also produced the highest weights of PET starchy tissues.

Table 7.14. Taxon ubiquity measures by period of habitation. Taxa represented by charred seeds are represented by black, taxa represented by charred and uncharred seeds represented by red, and taxa represented only by uncharred seeds represented by blue.

Period	**Late Holocene**	**Middle Holocene**	**Early Holocene**	**Younger Dryas**	**Terminal Pleistocene**
Number of Samples	**n=3**	**n=1**	**n=15**	**n=13**	**n=2**
Amaranthus				31%	
Asteraceae	33%			23%	
Artemisia	33%				
Boraginaceae	33%		7%	31%	
Amsinckia			7%		
Cryptantha	33%			8%	
Camassia				8%	
Ceanothus				15%	
cf. *Celtis*	100%				
Cheno-am	100%		13%	54%	
Atriplex	100%	100%	7%	62%	
Chenopodium			7%	38%	
Suaeda			7%		
Cyperaceae	33%				
Descurainia	100%			38%	
Fabaceae	33%				
Vicia				8%	
Geraniaceae				8%	
Juncus	33%			8%	
Juniperus	33%			15%	
Liliaceae-Amaryllidaceae	33%			15%	
Mentzelia	100%			31%	
Monolepis	33%				
Oenothera				8%	
Phacelia	67%			31%	
Pinus	33%			23%	
Plantago				15%	
Poaceae	67%		20%	62%	
Achnatherum	67%		7%	85%	
Hesperostipa	67%			8%	
Polygonaceae	33%				
Rosaceae	33%				
Rosa				8%	
Sambucus	33%				
Sesuvium				8%	
Sphaeralcea				8%	
Typha				8%	
Urtica				15%	

The Early Holocene samples at the Paisley Caves contain fewer macrobotanical remains. Charred taxa identified from this context include Poaceae, cheno-ams, *Achnatherum*, *Atriplex*, *Amsinckia*, Boraginaceae, *Chenopodium*, and *Suaeda*. Poaceae were identified in three out of the fifteen Early Holocene-aged samples, and cheno-ams were identified in two samples. Each of the other taxa appears only in a single sample. No cooking features have been encountered in the Early Holocene deposits, and the artifact record is sparse (Jenkins 2007). Only one sample in this study represents the Middle Holocene, and *Atriplex* was the only charred seed type recovered.

Taxonomic diversity of plants remains recovered in the bulk soil samples increased again by the Late Holocene. Although fewer types are represented in the Late Holocene than in the Younger Dryas, the taxa represented appear to have been targeted more intensely. Charred *Atriplex*, cf. *Celtis*, Cheno-ams, *Descurainia*, and *Mentzelia* were recovered in all three Cave 5 strata samples representing the Late Holocene. With the exception of the tenuous identification of *Celtis*, each of these taxa reflects the presence of plants Great Basin people traditionally harvested for food. Additionally, except for *Celtis*, each taxa produces numerous small seeds that could be mass harvested and are highly nutritious (USDA 2015).

7.5.7. Ethnobotany and Traditional Ecological Knowledge

Archaeobotanical data and ethnographic documentation provide hypothetical economic plant use information for each identified taxa represented by charred seeds (i.e., food, fuel, medicine, crafts). The majority of charred edible plant macrobotanical remains were recovered from the Cave 5 hearth/earth oven features and the Cave 5 upper strata samples, though they were also found in the Younger Dryas hearths, the Cave 5 lower strata samples, and column samples CS-6, CS-7, CS-17, and CS-19b (Figure 7.20). Among the charred seeds, six taxa identified by Fowler and Rhode (2007) as economically important plant foods in the traditional economies of Great Basin people show up in the Paisley Caves bulk soil samples: *Achnatherum*, *Amaranthus*, *Atriplex*, *Chenopodium*, *Mentzelia*, and *Suaeda*.

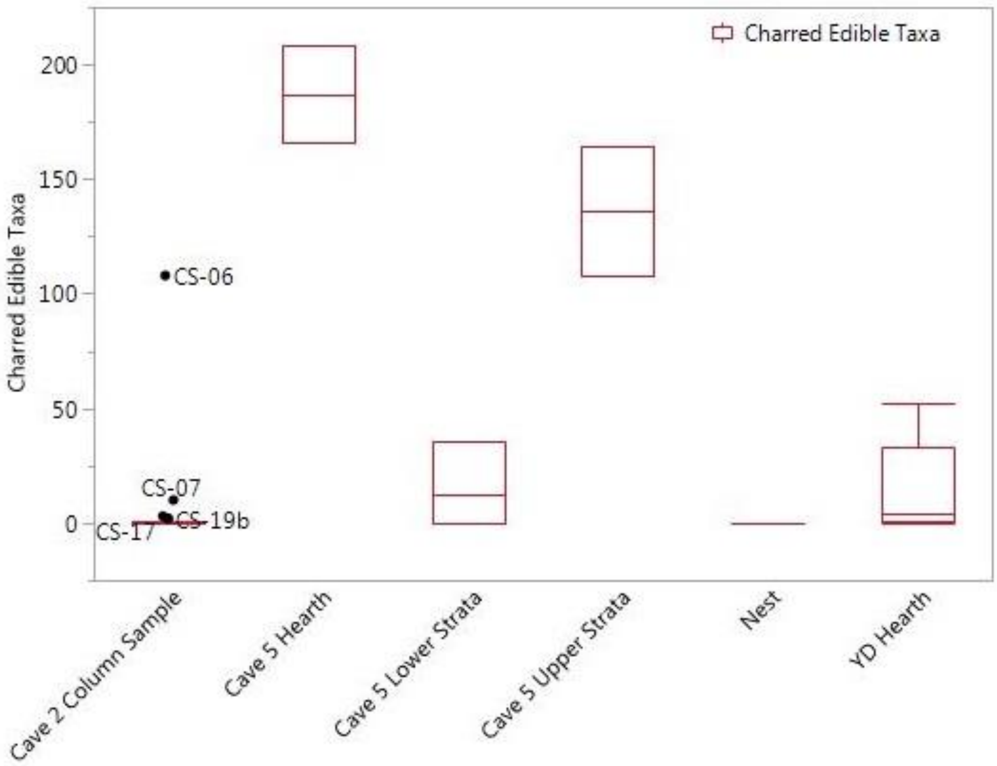


Figure 7.20. Frequency of seeds representing charred edible taxa in the Paisley Caves sample types.

The antiquity of foraging practices of Great Basin people is well represented in this study. As opposed to other taxa Fowler and Rhode highlight as having elevated importance in the subsistence economies of Great Basin indigenous populations, cheno-ams appear to have been targeted as food resource consistently over the past 12,000 years at the Paisley Caves (Figure 7.21). Although cheno-ams are well represented in both the Cave 5 hearths and the Cave 5 upper strata samples, the relative abundance of these taxonomic types is much greater in the Late Holocene, represented by the Cave 5 upper strata samples (Figure 7.22). Cheno-ams are present in the Botanical Lens hearths, but not in the Botanical Lens itself, suggesting the use of *Chenopodium* and *Atriplex* seeds are explicitly tied to cooking activities. Plants valued for attributes other than food were not well represented, appearing only in the Cave 5 upper strata samples and the Cave 5 hearth samples (Figure 7.23).

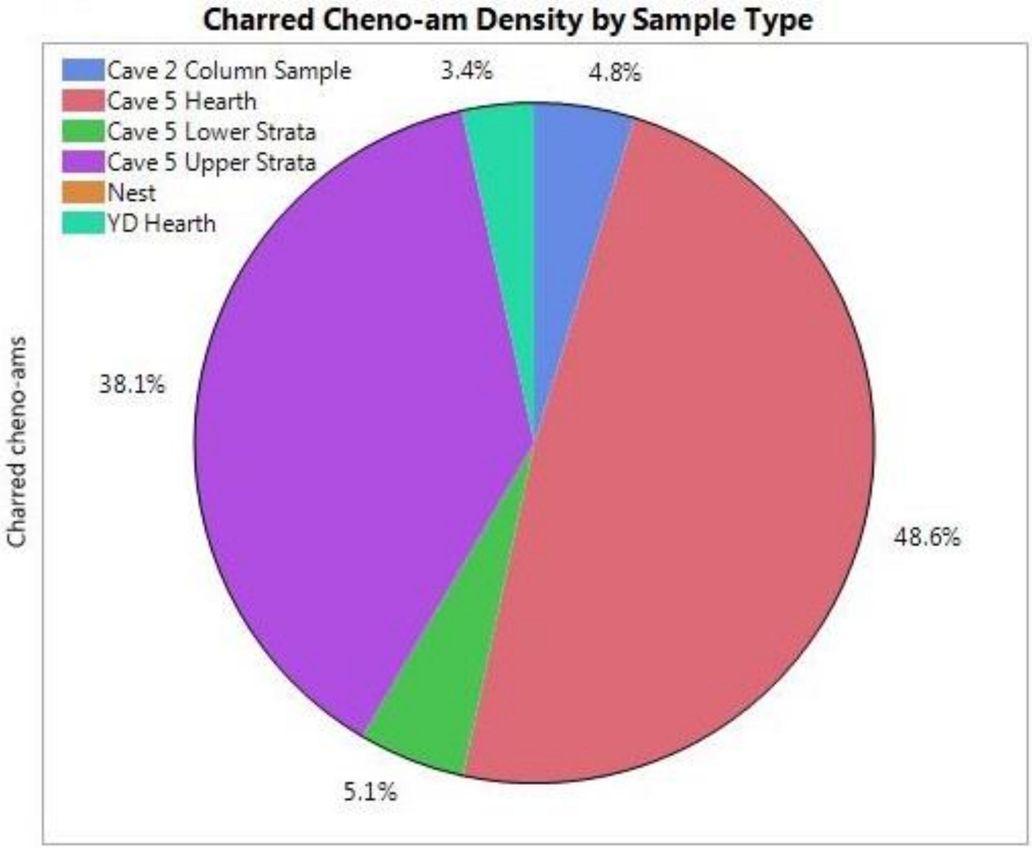


Figure 7.21. Distribution of charred cheno-ams (combined cheno-am, *Chenopodium*, and *Suaeda*) by sample type.

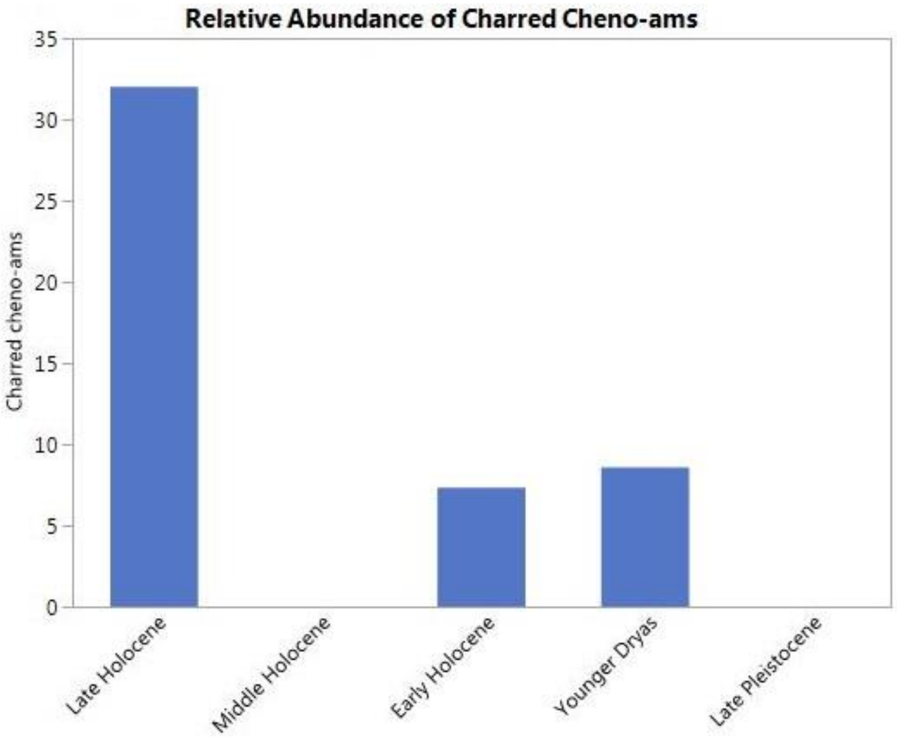


Figure 7.22. Distribution of charred cheno-ams (combined cheno-am, *Chenopodium*, and *Suaeda*) by period.

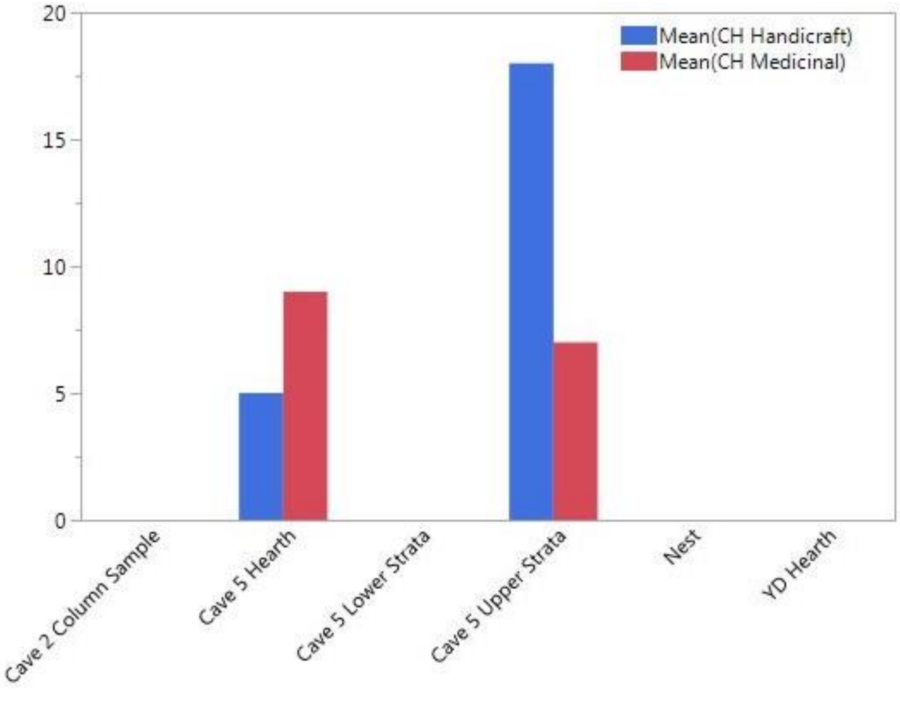


Figure 7.23. Frequency of charred seeds representing plants valued for medicinal properties and materials for handicrafts in the traditional economies of Great Basin tribes.

The ethnographic record both informs and complicates interpretations of macrobotanical data. Park and Fowler (1989) note that many edible seeds recovered in this investigation were often dried and stored for winter use. This observation may limit the reliability of the seasonality data presented in section 7.5.5. Another complicating factor involves the *Neotoma* nests in the caves. Many of the seeds recovered from the woodrat nest analyzed in this study also represent edible types, and many taxa identified in the nest were also identified in cooking features. These include *Achnatherum*, Boraginaceae, *Mentzelia*, and *Phacelia*. It is possible that visitors to the Paisley Caves plundered the nests to recover valuable plant materials. To date, there is no explicit evidence for the reappropriation of woodrat nest materials for food, fiber, medicine, or handicrafts in the northern Great Basin, but the behavior has been chronicled for several indigenous groups in Siberia and North America (Nabhan 2009; Lewis and Clark 2002; Moerman 1998; Ståhlberg and Svanberg 2010).

7.6. Paisley Caves Macrobotanical Overview

Macrobotanical analysis of 35 bulk soil samples from the Paisley Caves identified over 40 plant taxa. The majority of all identified charcoal in the Paisley Caves bulk soil samples represents *Artemisia*, although *Atriplex* and *Salix* are also present; *Salix* charcoal was only identified in the Younger Dryas-aged Botanical Lens and Lower Mud Lens samples. The ubiquity of *Artemisia* in the samples containing charcoal indicates sagebrush wood was intentionally burned during all human stopovers at the caves, and its presence in the Younger Dryas component suggests it was utilized discriminately as tinder and fuel for hearths as early as 12,380 cal BP. Unidentified charcoal accounted for less than 2% of the assemblage. Charcoal densities are more pronounced in Cave 1 and Cave 2 hearth features and Unit 2/6B column samples representing habitation episodes (Figure 7.24). The scant amount of charcoal in the Botanical Lens outside hearths suggests the sagebrush matting may have provided floor covering, perhaps to enhance the comfort of the campsite by providing padding and insulation.

Seeds and fruits were the most commonly identified plant remains in the analysis of soil from the Paisley Caves (n=5595). The taxonomic diversity of plant types identified at the Paisley Caves varies for each sample, but not in a statistically-significant manner. Statistical populations of charred seeds and uncharred seeds in the samples are differentially distributed, indicating charred seeds are more likely to represent cultural deposition than uncharred seeds outside of features. The majority of charred seeds were identified in cultural features and strata associated with a greater intensity of habitation. Seeds in the Chenopodiaceae, Boraginaceae, and Poaceae families occurred with the greatest frequency indicating processing and consumption of cheno-ams, fiddlenecks and other members of the borage family, and grasses, especially Indian ricegrass.

Uncharred seeds were encountered more frequently than charred seeds. Under non-exceptional circumstances (i.e., open archaeological sites), uncharred seeds always represent recently modern (less than 100 year old) intrusions. However, conditions at the Paisley Caves are exceptional, as evidenced by the preservation of delicate textiles and ecofacts. Radiocarbon dates from the site suggest the uncharred materials are stratigraphically well-ordered and cotemporaneous. This indicates site formation

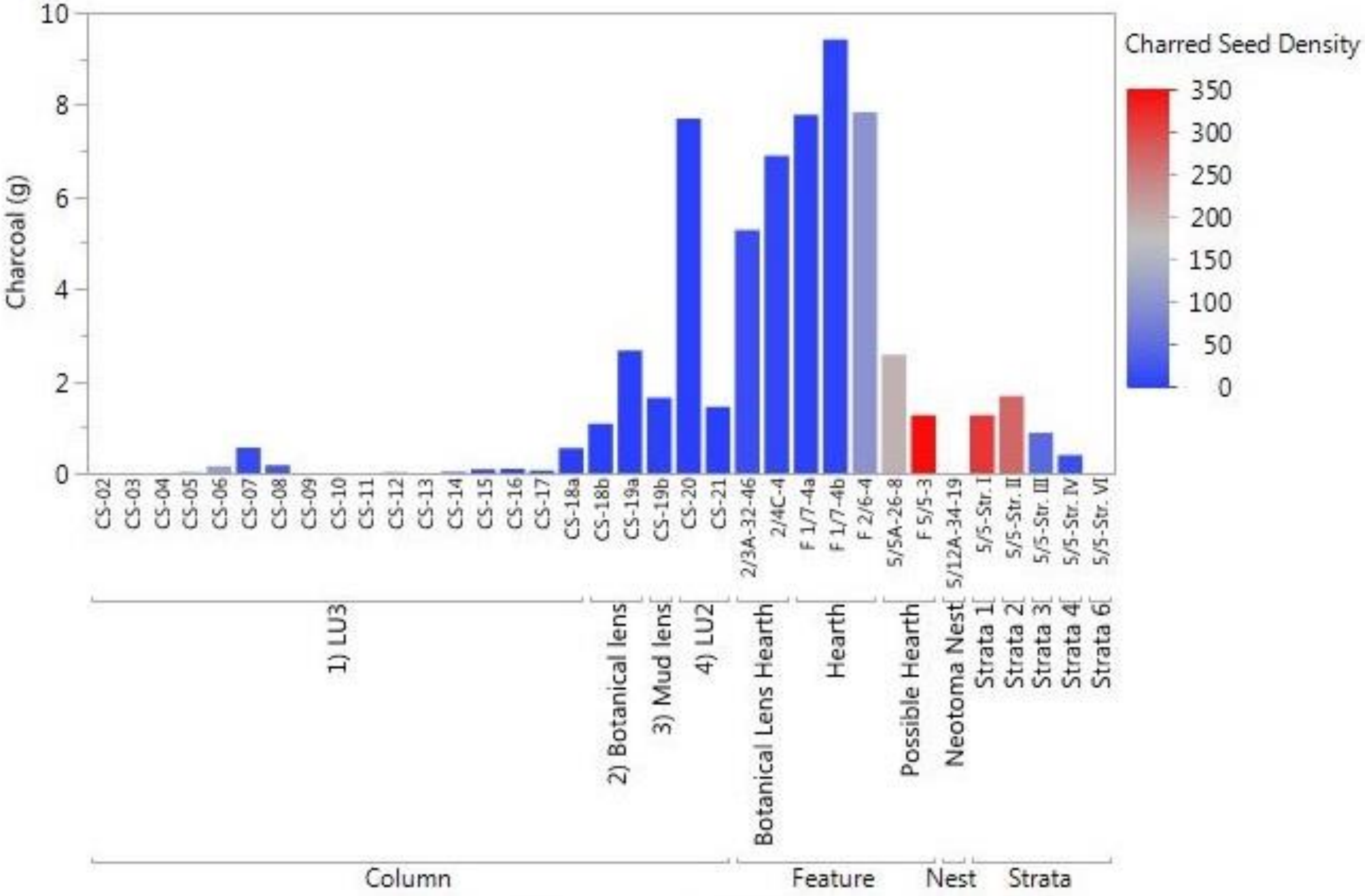


Figure 7.24. Charcoal and charred seed densities (coded by color map) across all bulk soil samples analyzed at the Paisley Caves.

processes included the introduction and incorporation of macrobotanical remains, either intentionally by human agents, or by wind or wave action, animal foraging, the “hitchhiking” qualities of seeds (as the result of an autochorous plant reproduction syndrome), or any combination of these factors.

The macrobotanical assemblage also provides data for interpretation of long-term trends at the Paisley Caves. Younger Dryas cooking features indicate visitors to the site at the TP/EH boundary consumed a diverse diet of plant foods. Hockett et al. (2017) also report a varied assemblage of faunal remains associated with Younger Dryas deposits. Together, these data indicate people were generalists in terms of foraging behaviors. The macrobotanical record is sparse in the Early and Middle Holocene, suggesting people did not visit the site as frequently as they did in the Terminal Pleistocene and Late Holocene. These data are consistent with the current understanding of the Paisley Caves archaeological site. In the Late Holocene, focus appears to have shifted toward a greater reliance on small-seed processing.

Ecological attributes of the plant taxa identified indicate Younger Dryas climatic conditions favored moisture-loving plants, while arid conditions associated with the Middle Holocene Climate Optimum in the northern Great Basin favored the growth of halophytes and drought-adapted plants. Plants represented in Late Holocene contexts seem to suggest climate amelioration to modern-day levels, but low data resolution for the associated samples reduces my confidence in this interpretation. In the Early Holocene, an abundance of *Atriplex* seeds suggest conditions became warmer and drier.

When controlled for sample volume differences, approximately 11% of all seeds identified at Paisley Caves were located in the woodrat nest. The nest contained no charred macrobotanical remains. Plant taxa identified in the nest suggest the woodrats foraged and scavenged plant parts from both inside and outside the cave. The abundance of *Urtica* seeds in the woodrat nest, along with habitat data demonstrating the representation of diverse environments, suggest the woodrats pilfered resources from people inhabiting the caves. During the Younger Dryas, when the nest was constructed, stinging nettles were not likely growing within the foraging territory of the Paisley Caves woodrats. Likely, the nettles were collected during the course of annual seasonal rounds and introduced to the caves by its human inhabitants.

To address the function of the hearth/earth oven cooking feature in Cave 5 (represented by a charcoal concentration, Feature 5/5-3, and an ash lens, Feature 5/5A-26-8), the distribution of charred economically-important plant taxa was evaluated. Quantile outliers demonstrate the samples representing features 5/5-3 and 5/5A-26-8 yielded significantly higher densities of seeds of plants valued for their edible, medicinal, and handicraft values. Coupled with the relatively lower abundance of charcoal, presence of starchy plant tissues, and presence of *Camassia* and Liliaceae-Amaryllidaceae seeds suggest the feature may represent an earth oven rather than a fire hearth.

Although the feature itself is discrete and small (ca. 60 cm x 15 cm) unlike typical ovens found elsewhere in North America (Black and Thoms 2014), it was bowl-shaped, the fill contained charred plants materials, and it was lined with fire altered rock amid an ash layer with hardened earth below. According to Black and Thoms (2014:205), earth ovens are composed of several layers with the intention of roasting or steaming foods: a prepared surface, a smoldering fire reduced to ash and coals, a layer of rocks acting as the heating element, a packing layer of green vegetation, a food layer, an upper packing layer, and an earthen cap.

Finally, analyses aimed at determining whether people preferred to camp at the Paisley Caves during particular times of the year provided more ambiguous data. Late Early Holocene and Middle Holocene visits appear to have happened during the late fall and winter months. During other periods, most of the seeds considered to have resulted from cultural deposition would have been available during the fall and summer months. However, if people had knowledge of rodent-cached food stores in the caves, they likely would have considered the woodrat nest as a valuable resource and may have collected seeds, which also predominantly featured plant materials available in the summer and fall, from the cache. Also, if, as the ethnographic record indicates, people often stored seeds harvested in the summer and fall for use in the winter, the presence of those seeds in cultural deposits may not be indicative of the timing of camping trips.

CHAPTER XIII

LSP-1 ROCKSHELTER MACROBOTANICAL ANALYSES

Seven classes of botanic remains were noted in the LSP-1 Rockshelter bulk soil samples, including wood, charcoal, seeds, processed edible tissues, nutshells, herbaceous stems, and leaves. Thirteen radiocarbon dates were obtained for LSP-1 features and stratigraphic samples to anchor the age of macrobotanical remains analyzed in this study (Appendix B). Identified remains represent both edible and non-edible tissues (Table 8.1).

Table 8.1. Taxa identified by macrobotanical analysis at LSP-1 Rockshelter

Non-edible tissues		**Edible tissues**	
Charcoal		Fruits	
Artemisia sp.	sagebrush	*Prunus* sp.	native/wild cherries
Atriplex sp.	saltbush	*Ribes* sp.	currant; gooseberry
Rhus sp.	wild sumac	PET fruity	X
Seeds		PET starchy	X
Brassicaceae	mustard family	Roots	
Eriogonum sp.	buckwheat	*Typha latifolia*	cattail
Galium sp.	cleavers	Nuts/Berries	
Lamiaceae	mint family	*Juniperus* sp.*	juniper
Montiaceae	miner's lettuce family	Unidentified berry	X
Nicotiana attenuata*	tobacco	Unidentified nutmeat	X
Phacelia sp.	tansy	Seeds	
Plagiobothrys	starwort	*Achnatherum hymenoides**	Indian ricegrass
Poaceae	grass family	*Leymus cinereus*	Great Basin wildrye
*Urtica dioica**	stinging nettle	Cheno-ams	goosefoot/amaranth families
Other tissues		*Amaranthus* sp.*	amaranth
Conifer needle	X	*Atriplex confertifolia*	scadshale saltbush
Dicotyledon stem	X	*Chenopodium* sp.	goosefoot
Monocotyledon stem	X	*Suaeda* sp.	wada
Unidentified buds	X	*Mentzelia albicaulis*	white-stemmed blazingstar
		Amsinckia sp.	fiddleneck
		Agrostis sp.	bentgrass
		Descurainia sp.	tansymustard
		Scirpus/Schoenoplectus sp.	bulrush

X = Taxon unknown
* = Represented by uncharred specimens only

Heavy fraction materials include fish and mammal bones and obsidian waste flakes. Additionally, cordage, bird feathers, and rabbit fur were observed. Nearly half of the samples yielded evidence of bioturbation in the form of rodent droppings and insect remains. A full description of LSP-1 Rockshelter macrobotanical remains identified in this analysis is presented in Appendix E.

8.1. Stratigraphic (Column) Samples N105E99

The macrobotancial remains present in the Unit N105E99 profile samples provide chronostratigraphic archaeological plant data throughout the history of site habitation. Charcoal, wood, seeds, starchy and fruity tissues, herbaceous stems, and nutshells represent evidence of human-plant interactions throughout the Holocene. Eight AMS radiocarbon dates were obtained on individual charred *Artemisia* twigs to directly verify the age of column sample sediments (Table 8.2). Some dates are not consistently ordered (Figure 8.1), but still fit into the general site chronology.

Table 8.2. AMS Dates, LSP-1 Rockshelter Column Samples, N105E99.

^{14}C Lab Number	FS Number	Unit	Cmbd	Stratum	^{14}C Age	2σ cal BP
D-AMS-10596	CS25B	N105 E99	128-131	VIII	1173±25	1,179-1,000
D-AMS-10590	CS8A	N105 E99	41-44	III	1255±24	1,277-1,088
D-AMS-10591	CS12	N105 E99	61-66	IV	3038±26	3,343-3,166
D-AMS-10593	CS16	N105 E99	81-86	V	3046±31	3,350-3,170
D-AMS-10592	CS13	N105 E99	66-71	IV	3090±26	3,371-3,231
D-AMS-10595	CS22	N105 E99	111-116	VII	5238±26	6,174-5,921
D-AMS-10597	CS26	N105 E99	131-136	VIII	7944±35	8,980-8,644
D-AMS-10594	CS20	N105 E99	101-106	V	8263±38	9,408-9,124

Note. Dates calibrated using OxCal 4.2 (Ramsey 2009) and IntCal 13 Curve (Reimer et al. 2013).

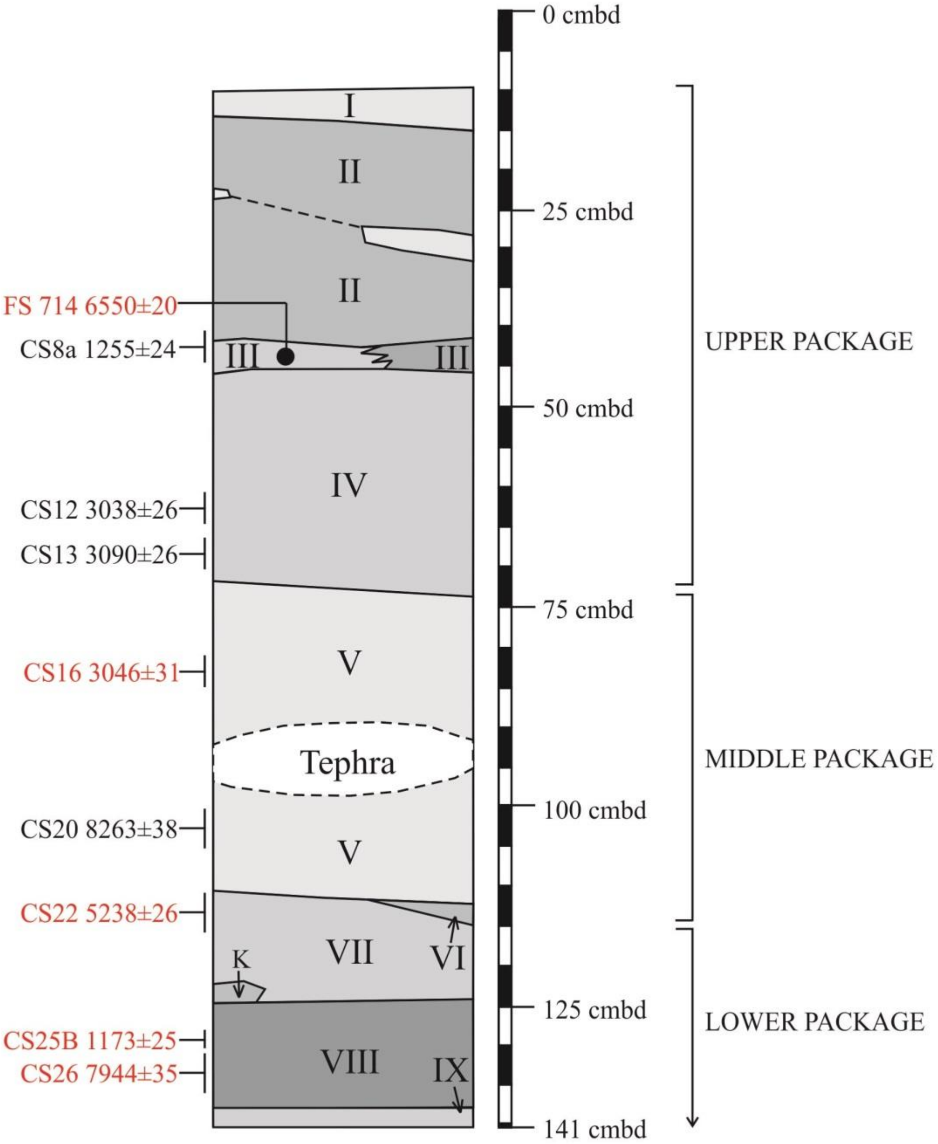


Figure 8.1. Depth and provenience information for radiocarbon dated samples (suspect dates shown in red; Kennedy and Smith 2016: Figure 3).

8.1.1. N105E99 Charcoal and Charred Tissues

Charcoal density fluctuated depending on the stratum represented by each sample (Figure 8.2). Although charcoal was ubiquitous throughout the vertical column, every bulk sample represented in this analysis contained charcoal weighing less than 0.5 g. The peaks in Stratum IV and Stratum VIII do not signal a significant increase in overall charcoal weight when regarded independently. *Artemisia* was the most commonly identified charcoal type identified in the column samples (Table 8.3). A cursory examination of the wood and charcoal revealed that on average, sagebrush comprises more than 99% of the total woody material in the samples. Sample 8a (41-44 cmbd) in Stratum III contained fragments of *Atriplex* and *Rhus* cf. *trilobata* charcoal in addition to *Artemisia* types.

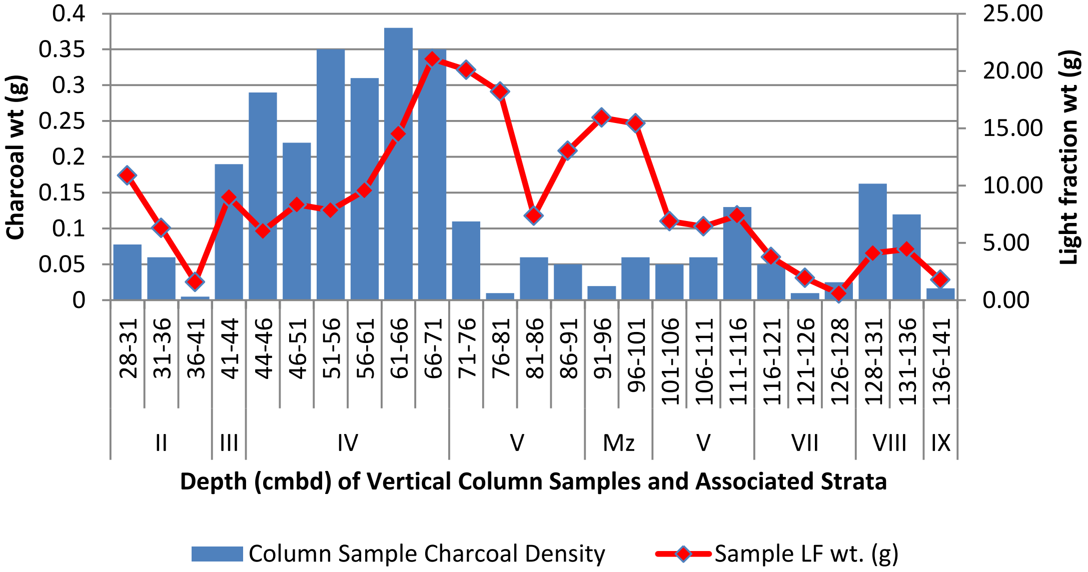


Figure 8.2. Charcoal density in stratigraphic column samples at LSP-1 Rockshelter.

Fragments of softer charred plant tissues were also present in stratigraphic column samples. Fruity edible tissues (likely representing berries or other sugar-laden vegetative material) were observed in Stratum IV at a depth of 61-66 cmbd and Stratum XIII at a depth of 128-131 cmbd. A single, relatively large, piece of starchy

Table 8.3. Distribution of identified charcoal types and charred plant tissues in N105E99 column.

Provenience			**Charcoal Taxa (wt.)**			**Charred Plant Tissues (wt.)**		
Stratum	**Sample No.**	**Depth (cmbd)**	***Artemisia* sp.**	***Atriplex* sp.**	***Rhus* sp.**	**Fruity Tissue**	**Starchy Tissue**	**Vitrified Tissue**
II	CS-5b	31	0.07 g	-	-	-	-	-
	CS-6	36	0.05 g	-	-	-	-	-
	CS-7	41	<0.01 g	-	-	-	-	-
III	CS-8a	44	0.07 g	0.01 g	0.01 g	-	-	-
IV	CS-8b	46	0.08 g	-	-	-	0.04 g	<0.01 g
	CS-9	51	0.11 g	-	-	-	-	-
	CS-10	56	0.07 g	-	-	-	-	-
	CS-11	61	0.11 g	-	-	-	-	-
	CS-12	66	0.13 g	-	-	-	-	-
	CS-13	71	0.15 g	-	-	-	-	-
post- Mazama V	CS-14	76	0.05 g	-	-	-	-	-
	CS-15	81	0.01 g	-	-	-	-	-
	CS-16	86	0.06 g	-	-	-	-	-
	CS-17	91	0.05 g	-	-	-	-	-
Mazama	CS-18	96	0.02 g	-	-	-	-	-
	CS-19	101	0.06 g	-	-	-	-	-
pre-Mazama V	CS-20	106	0.05 g	-	-	-	-	-
	CS-21	111	0.05 g	-	-	-	-	<0.01 g
	CS-22	116	0.07 g	-	-	-	-	<0.01 g
VII	CS-23	121	0.05 g	-	-	-	-	-
	CS-24	126	0.01 g	-	-	-	-	-
	CS-25a	128	<0.01 g	-	-	-	-	-
VIII	CS-25b	131	0.08 g	-	-	<0.01 g	-	-
	CS-26	136	0.09 g	-	-	-	-	-
IX	CS-27	141	0.01 g	-	-	-	-	-

tissue representing an unknown geophyte was present in the column at 44-46 cmbd in Stratum IV.

8.1.2. N105E99 Seeds

Seeds identified in the column samples represent ten taxa belonging to eight plant families. The seed assemblage was dominated by uncharred seeds, with relatively few charred specimens (roughly 17%). The assemblage was dominated by *Atriplex* (41%), cheno-am perisperms (28%), and *Chenopodium* (20%). The remaining seed types identified include *Amsinckia* (5%), *Agrostis* (2%), and *Descurainia* (2%; Table 8.4). Another member of the Brassicaceae family, *Eriogonum*, *Mentzelia albicaulis*, *Leymus cinereus*, *Urtica dioica*, *Phacelia*, a Poaceae family member, and *Typha latifolia* each contributed less than 1% to the assemblage, while unidentified seeds accounted for 1% of the assemblage.

Among the charred seeds in LSP-1 stratigraphic column samples, *Chenopodium* (64%) dominated the identified taxa. Other identified types include *Descurainia* (12%), *Agrostis* (9%) and cheno-am perisperms (6%). *Eriogonum*, *Atriplex*, *Leymus cinereus*, *Mentzelia albicaulis*, *Typha latifolia*, *Phacelia*, and another Poaceae member each contributed less than 1% to the total charred seed assemblage. Additionally, 8% of the charred seeds could not be identified to species.

When the seed data are normalized to account for volumetric differences in sample size, 88% of the total seed assemblage was recovered from samples in the upper sediment package, which postdates 3000 cal BP (Table 8.5). Samples from the

Table 8.4. Density-dependent occurrence of charred seeds in the N105E99 column samples.

Sediment Package	Stratum	Sample No.	Cheno-am	*Chenopodium*	*Descurainia*	*Eriogonum*	*Mentzelia*	*Phacelia*	Poaceae	*Agrostis*	*Leymus*	*Typha*	Unidentified
Upper (80.9%)*	II (0.2%)*	CS-5b	-	-	-	-	-	-	-	-	-	-	-
		CS-6	-	-	-	-	-	-	-	-	-	-	-
		CS-7	-	1	-	-	-	-	-	-	-	-	-
	III (10.0%)*	CS-8a	-	56	3	-	-	-	-	-	-	-	3
	IV (70.8%)*	CS-8b	23	73	-	2	1	1	1	32	-	-	5
		CS-9	-	51	7	-	-	-	-	3	-	-	4
		CS-10	-	58	12	-	-	-	-	-	-	-	1
		CS-11	-	43	16	-	-	-	-	4	-	-	5
		CS-12	-	37	14	-	-	-	-	3	-	-	5
		CS-13	-	20	11	-	-	-	-	2	-	-	4
Middle (7.1%)*	V (5.7%)*	CS-14	-	19	7	-	-	-	-	3	-	-	-
		CS-15	-	2	-	-	-	-	-	1	-	-	-
		CS-16	-	-	-	-	-	-	-	-	-	-	-
		CS-17	-	1	-	-	-	-	-	1	-	-	1
	Mazama	CS-18	-	-	-	-	-	-	-	-	-	-	-
		CS-19	-	-	-	-	-	-	-	-	-	-	-
	V (1.5%)*	CS-20	-	1	-	-	-	-	-	-	-	-	-
		CS-21	1	3	-	-	-	-	-	-	-	-	-
		CS-22	-	-	-	-	-	-	-	1	-	-	3
Lower (12.0%)*	VII (0.6%)*	CS-23	1	-	-	-	-	-	-	-	-	-	-
		CS-24	-	3	-	-	-	-	-	-	-	-	-
		CS-25a	-	-	-	-	-	-	-	-	-	-	-
	VIII (10.8%)*	CS-25b	10	6	-	-	-	-	-	5	1	1	5
		CS-26	-	11	-	-	-	-	-	-	1	-	12
	IX (0.5%)*	CS-27	-	-	-	-	-	-	-	1	-	-	1
Ubiquity			**16%**	**64%**	**28%**	**4%**	**4%**	**4%**	**4%**	**44%**	**8%**	**4%**	**n/a**

* indicates density dependent transformations were applied to determine the contribution of charred seeds from each provenience

Table 8.5. All identified seed macrobotanical remains recovered from the stratigraphic column sample grouped by sediment package and normalized to account for volumetric differences.

	Sediment Package						
	Upper		Middle		Lower		
Taxa	Uncharred	Charred	Uncharred	Charred	Uncharred	Charred	Total
Boraginaceae	1 (0.0%)	2 (0.4%)	1 (0.8%)	-	-	-	4
Amsinckia	39 (1.5%)	-	92 (76.0%)	-	65 (32.0%)	-	196
Cheno-am	849 (32.0%)	23 (4.6%)	2 (1.7%)	-	128 (63.0%)	14 (18.4%)	1016
Atriplex	1429 (53.8%)	-	4 (3.3%)	1 (2.3%)	-	1 (1.3%)	1435
Chenopodium	317 (11.9%)	339 (67.5%)	15 (12.4%)	26 (59.1%)	7 (3.5%)	25 (32.9%)	730
Poaceae	-	1 (0.2%)	-	-	-	-	1
Agrostis	-	44 (8.8%)	-	5 (11.3%)	-	8 (10.5%)	57
Leymus	-	-	-	-	-	3 (3.9%)	3
Brassicaceae	-	-	2 (1.7%)	-	-	-	2
Descurainia	-	63 (12.5%)	-	8 (18.2%)	-	-	71
Mentzelia	16 (0.6%)	2 (0.4%)	5 (4.1%)	-	3 (1.5%)	-	26
Typha	-	-	-	-	-	1 (1.3%)	1
Urtica	4 (0.2%)	-	-	-	-	-	4
Phacelia	-	1 (0.2%)	-	-	-	-	1
Unidentified	-	27 (5.4%)	-	4 (9.1%)	-	24 (31.7%)	55
Total	**2655 (100.0%)**	**502 (100.0%)**	**121 (100.0%)**	**44 (100.0%)**	**203 (100.0%)**	**76 (100.0%)**	**3601**

Numbers in parentheses represent percent of seeds within each column artifact-rich middle sediment package, which dates to ca. 9650 to 3000 cal BP, produced only 4.6% of the total seed assemblage. The primary taxa associated with the upper package samples are uncharred cheno-ams including *Chenopodium* and *Atriplex* seeds. Uncharred *Amsinckia* seeds are the dominant taxon identified in the middle package samples. The lower package samples primarily contained uncharred cheno-ams and *Amsinckia* seeds. Although relatively less abundant in the column samples, charred seeds represented unique taxonomic types, including Poaceae members and *Descurainia*. No single taxon was ubiquitous across all column samples.

8.2. Feature Samples

In total, 14 bulk soil samples representing 12 features were analyzed, including ten hearths, a carbon stain, and an organic concentration. Seeds/fruits, charcoal and wood, leaves, stems, and charred plant tissues were recovered from the feature samples. Five features analyzed here were previously undated. Carbon from these contexts was submitted for AMS dating as part of this study (Table 8.6, next page).

8.2.1. Feature Charcoal and Charred Tissues

Charcoal was recovered from all analyzed feature samples, although its density was highly dependent on the individual feature from which it was recovered

Table 8.6. AMS Dates, LSP-1 Rockshelter Features.

^{14}C Lab Number	Excavation Unit	Cmbd	Stratum	Feature	Dated Material	^{14}C Age	2σ cal BP Range
D-AMS-10587	N104E99/100	50	II/III	11-14	*Juniperus* seeds	1013±29	976-803
UGA-16800	N104E99	57	IV	11-05/15	Unidentified charcoal	2490±25	2,723-2,473
D-AMS-10588	N102E100/101	66	IV	14-02	Cordage	3987±26	4,522-4,415
D-AMS-10589	N102E99/100	74-75	IV	14-04	*Artemisia* charcoal	3990±26	4,522-4,416

All dates calibrated using OxCal 4.2 (Ramsey 2009) and the IntCal 13 Curve (Reimer et al. 2013).

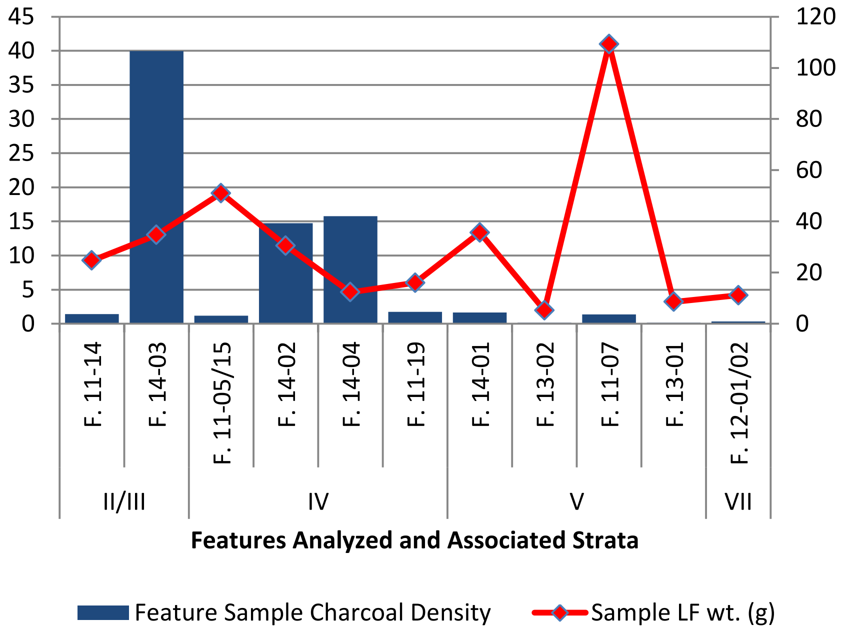


Figure 8.3. Density of charcoal in features (left axis) compared to the weight of the light fraction (right axis) of each processed feature.

(Figure 8.3; previous page). Patterns in the distribution of charcoal varied through time. The majority of charcoal was found in features excavated in strata II/III and IV. Because only a subsample of ~20 charcoal fragments was identified for each bulk sample, the relative weight of the analyzed charcoal is also presented as a percentage of the total charcoal weight for each bulk sample (Table 8.7). Several features also contained fragments of fruity PET and starchy PET fragment

Table 8.7. Total charcoal weight vs. weight of 20-fragment subsample analyzed for each feature.

	Total charcoal weight (g)	% Charcoal analyzed
Upper Sediment Package		
F. 11-14	1.30	28%
F. 14-03	19.97	33%
F. 11-05/15	2.48	37%
F. 14-02	3.68	11%
F. 14-04	3.94	14%
F. 11-19	1.04	18%
Middle Sediment Package		
F. 14-01	0.83	40%
F. 13-02	0.07	57%
F. 11-07	0.98	42%
F. 13-01	0.10	80%
Lower Sediment Package		
F. 12-01/02	0.46	35%

8.2.1.1. Charcoal and Charred Tissues in Hearths

Feature 14-03, an undated Late Holocene hearth, contained the most abundant charcoal. The 1253 fragments of charcoal accounted for 57% of the total weight of all charcoal observed in features. Several fragments were larger than 4 mm. *Artemisia* was the only charcoal taxon identified in Feature 14-03 (Table 8.8). Only hearth features 11-14 and 14-02 contained charcoal types other than *Artemisia*.

Fruity tissues were present in features 11-14, 11-05/15, 14-02, 11-07, 14-03, and 13-02. PET starchy tissue fragments appeared in features 11-14, 11-05/15, 14-02, and 14-03.

Table 8.8. Distribution of identified charcoal types and charred plant tissues in feature samples at LSP-1 Rockshelter.

Provenience			**Charcoal Taxa (wt.)**		**Charred Plant Tissues (wt.)**		
Feature		**Samples (n)**	***Artemisia* sp.**	***Atriplex* sp.**	**Fruity Tissue**	**Starchy Tissue**	**Vitrified Tissue**
Upper Sediment Package	F. 11-14	1	0.35 g	0.01 g	<0.01 g	<0.01 g	-
	F. 14-03	1	6.67 g	-	0.02 g	<0.01 g	-
	F. 11-05/15	3	0.91 g	-	<0.01 g	<0.01 g	-
	F. 14-02	1	0.36 g	0.06 g	<0.01 g	<0.01 g	-
	F. 14-04	1	0.55 g	-	-	-	-
	F. 11-19	1	0.19 g	-	-	-	-
Middle Sediment Package	F. 14-01	1	0.33 g	-	-	-	<0.01 g
	F. 13-02	1	0.04 g	-	-	-	-
	F. 11-07	1	0.41 g	-	<0.01 g	-	-
	F. 13-01	1	0.08 g	-	<0.01 g	-	-
Lower Sediment Package	F. 12-01/02	2	0.16 g	-	-	-	<0.01 g

8.2.1.2. Charcoal and Charred Tissues in Other Features

Feature 14-01 – the small carbon stain – contained 0.83 g of charcoal. The subset of analyzed charcoal was limited to *Artemisia*. Identified charcoal in the organic concentration, Feature 12-01/02, was also represented solely by *Artemisia*. No processed edible tissues were present in either of these features. The dearth of charcoal in these features suggests they do not represent cooking hearths.

8.2.2. Feature Seeds

Identified taxa in LSP-1 features include *Atriplex* (25%), *Chenopodium* (23%), *Amsinckia* (18%,) *Agrostis* (11%), cheno-ams (6%), Brassicaceae family members (6%) including *Descurainia* (4%), Poaceae members (3%), *Mentzelia albicaulis* (2%), and *Leymus cinereus* (1%). *Eriogonum*, *Nicotiana attenuata*, *Scirpus/Schoenoplectus*, *Achnatherum hymenoides*, Montiaceae members, *Phacelia*, *Plagiobothrys*, *Juniperus*, *Ribes*, *Galium*, and *Typha latifolia* contributed less than 1% to the assemblage. Other observed seed types – *Amaranthus*, Lamiaceae, and *Prunus* – accounted for less than 0.1% each. Unidentified seeds also accounted for 1% of the feature assemblage.

Charred seeds were generally more abundant in the feature samples than the column samples, and comprised approximately 27% of the overall assemblage. Although there is some overlap in the charred taxa identified in features and column samples, the botanical remains observed in the feature samples represent a wider range of plant types (Figures 8.4 and 8.5).

8.2.2.1. Seeds in Hearths

The hearth samples contained 98% of all feature seeds (charred, n=935; uncharred, n=3441). Plants exposed to charring in the fire hearths were dominated by *Agrostis* (41%) and *Chenopodium* (34%) (Table 8.9). Density calculations indicate the Feature 14-04 hearth contained the largest abundance of charred seeds (Figure 8.6).

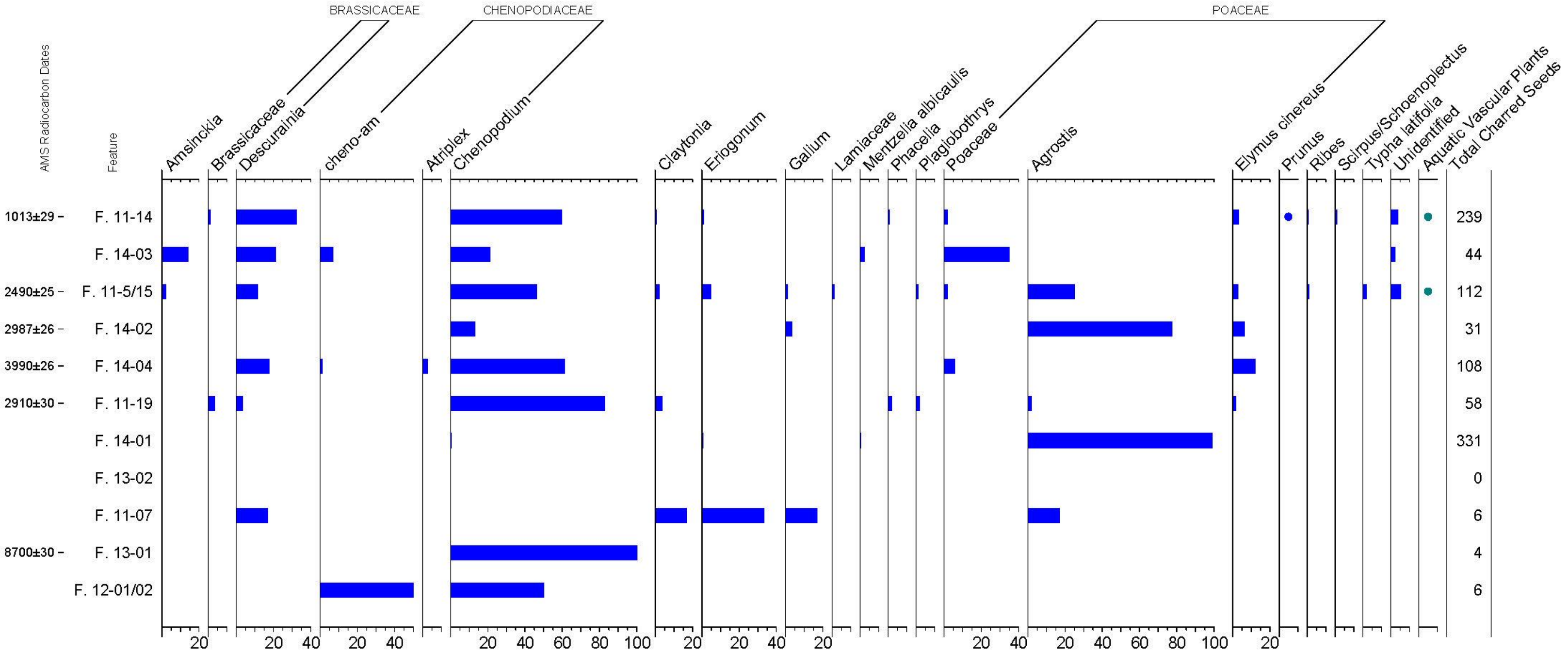


Figure 8.4. Relative abundance of charred seeds in LSP-1 Rockshelter feature samples.

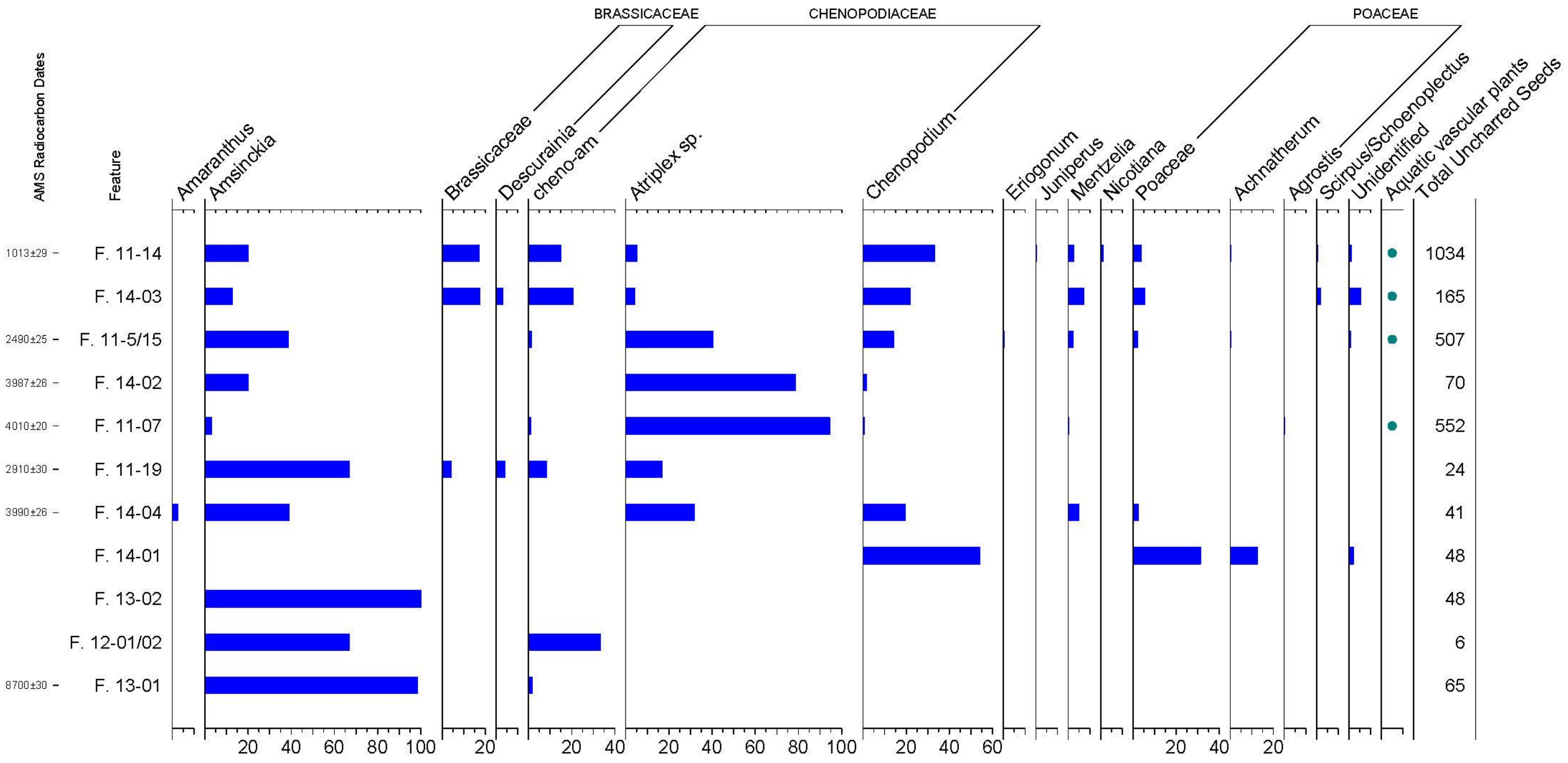


Figure 8.5. Relative abundance of uncharred seeds in LSP-1 Rockshelter feature samples.

Table 8.9. Charred seeds in hearths at LSP-1 Rockshelter.

			Taxa																					
Feature ID	**^{14}C Date**	**2σ cal BP Range**	**Amsinckia**	**Brassicaceae**	***Descurainia***	**Cheno-Am**	***A. confertifolia***	***Chenopodium***	**Montiaceae**	***Eriogonum***	***Galium***	**Lamiaceae**	***Mentzelia***	***Phacelia***	***Plagiobothrys***	**Poaceae**	***Agrostis***	***Leymus***	***Prunus***	***Ribes***	***Scirpus***	***Typha***	**Unidentified**	**Total Charred Seeds**
F. 11-14	1013 ± 29	976-803	-	2	73	-	-	136	1	2	-	-	-	1		4	-	7	1	1	2	-	9	**239**
F. 11-05/15	2490 ± 25	2723-2473	2	-	12	-	-	48	2	5	1	1	-	-	1	2	26	3	-	1	-	2	6	**110**
F. 11-19	2910 ± 30	3158-2960	-	2	2	-	-	48	2	-	-	-	-	1	1	-	1	1	-	-	-	-	-	**58**
F. 14-02	3987 ± 26	4522-4415	-	-	-	-	-	4	-	-	1	-	-	-	-	-	24	2	-	-	-	-	-	**31**
F. 14-04	3990 ± 26	4522-4416	-	-	-	-	-	1	-	2	-	-	1	-	-	-	327	-	-	-	-	-	-	**331**
F. 11-07	4010 ± 20	4522-4425	-	-	19	1	3	66	-	-	-	-	-	-	-	6	-	13	-	-	-	-	-	**108**
F. 14-03	Undated[1]		6	-	9	3	-	9	-	-	-	-	1	-	-	15	-	-	-	-	-	-	1	**38**
F. 13-01	8700 ± 30	9735-9550	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**6**
F. 13-02	Undated[2]		-	-	1	-	-	-	1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	**6**
Ubiquity			**22%**	**22%**	**67%**	**33%**	**11%**	**89%**	**44%**	**44%**	**33%**	**11%**	**22%**	**22%**	**22%**	**44%**	**56%**	**56%**	**11%**	**22%**	**11%**	**11%**	**33%**	**n/a**

[1] Feature 14-03 is currently undated but is likely late Holocene in age.

[2] Feature 13-02 is currently undated but is likely early Holocene in age.

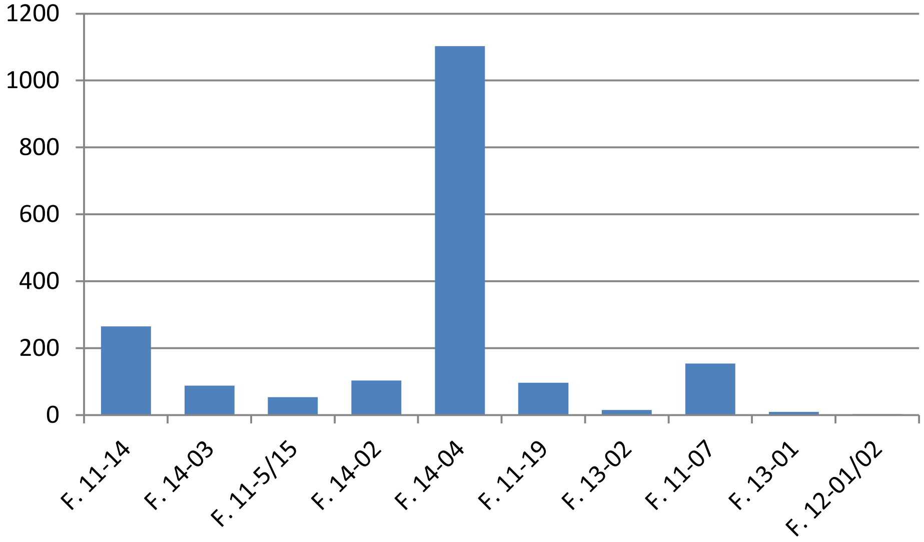


Figure 8.6. Charred seed density in LSP-1 Rockshelter feature samples.

Feature 13-01 yielded very few plant remains. The charred assemblage included *Chenopodium* seeds (50%) and cheno-am perisperms (50%). Uncharred seeds including *Amsinckia* (n=64; 99%) and cheno-am perisperms (n=1; 1%) were also present. Feature 13-02 also returned a lower seed count than expected in a fire hearth. No single taxon was ubiquitous in the hearth samples, but *Chenopodium* was identified in every sample except Feature 13-02.

8.2.1.2. Seeds in Other Features

Seeds were rarely encountered in Feature 12-01/02, and the entire assemblage consisted of only four uncharred *Amsinckia* seeds, two uncharred cheno-am perisperms, and four charred *Chenopodium* seeds. The 47 seeds present in Feature 14-01 were limited to uncharred *Chenopodium* (55%), uncharred Poaceae (32%), and uncharred *Achnatherum hymenoides* (13%) types. The lack of charred seeds also supports the position that these features were not utilized as cooking hearths.

8.3. Data Analysis and Interpretations

8.3.1. Richness and Diversity

At LSP-1 Rockshelter, taxonomic diversity and richness are highest in the hearth samples (Figure 8.7). However, a non-parametric Kruskall-Wallace rank sum test shows that the Shannon-Wiener indices are not statistically different between samples (chi square=11.9475, *df*=11, p-Value=0.3676).

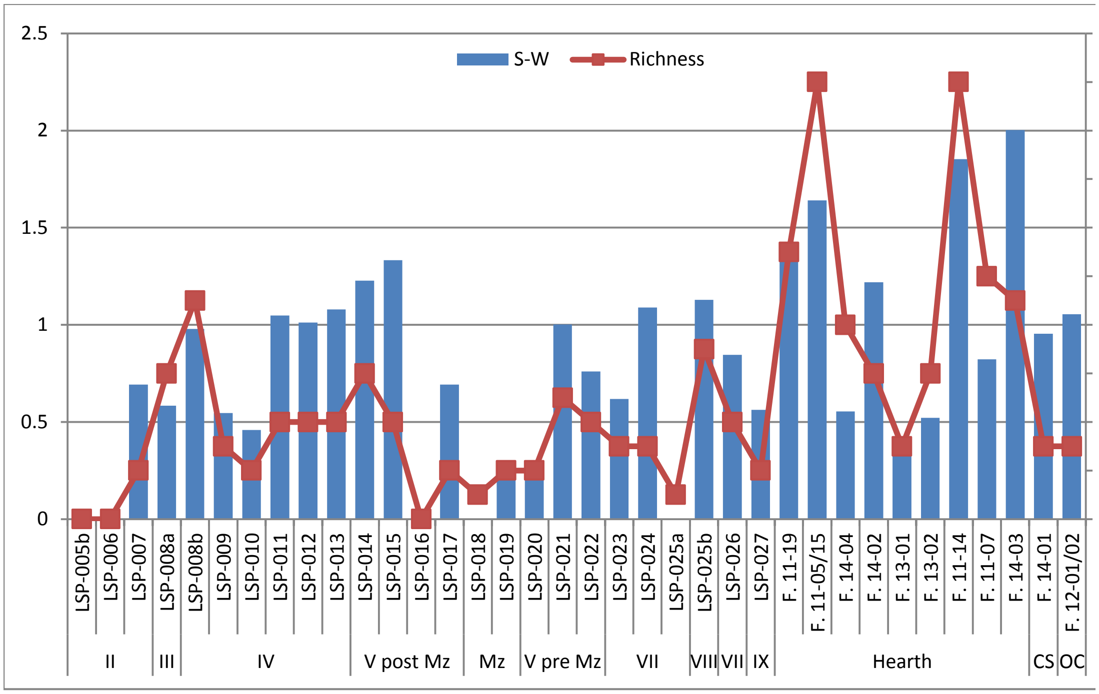


Figure 8.7. Shannon-Wiener Index and taxonomic richness at LSP-1 Rockshelter.

8.3.2. Cluster Analysis

Cluster analysis based on the densities of charcoal, charred seeds, and uncharred seeds yielded very weak results. All but three samples (Feature 14-03, Feature 14-04, and CS-8b) grouped together under the same cluster (Figure 8.8).

When the contributing variables are reduced to include only charcoal density and charred seed density, the analysis produced similar results; only samples representing Feature 14-02, Feature 14-03, and Feature 14-04 were isolated from all other samples.

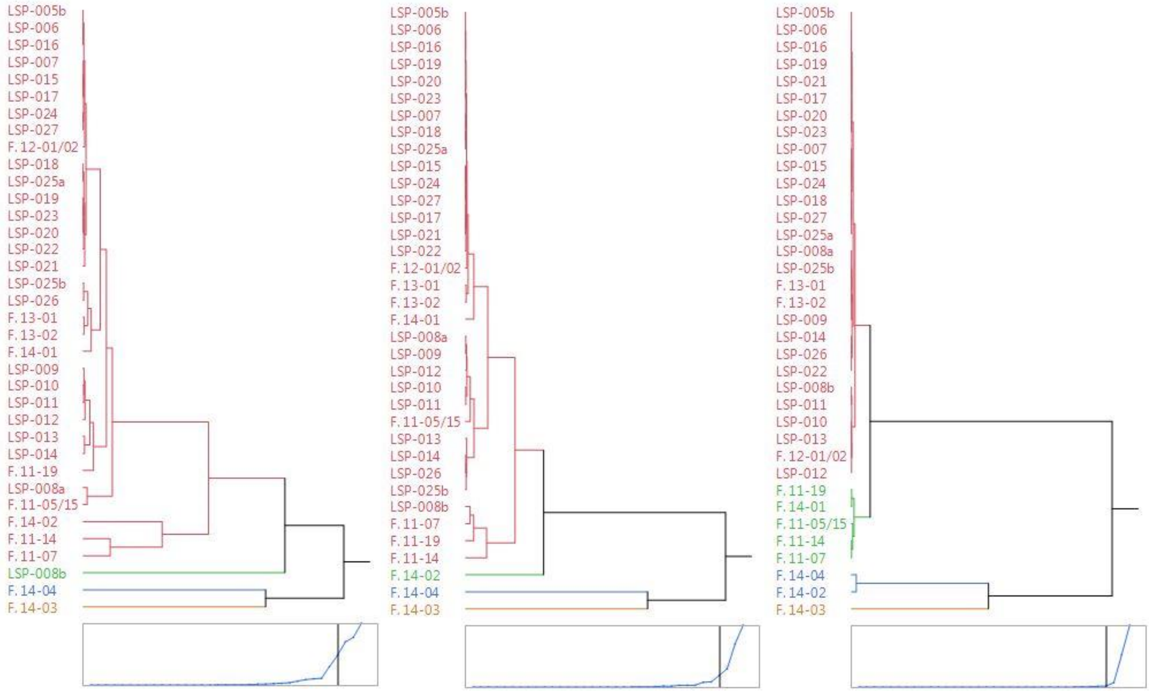


Figure 8.8. Results of cluster analysis of LSP-1 Rockshelter bulk sediment samples using charcoal density, charred seed density, and uncharred seed density (left), charcoal density and charred seed density (middle), and charcoal density alone (right).

It appears that charcoal density is the only single variable that delineates categories of groupings. The first group includes all column samples and features 12-01/02, 13-01, and 13-02. In the second group, features 11-05/15, 11-07, 11-14, 11-19, and 14-01 cluster together. The third group contains features 14-02 and 14-04, while in the fourth group Feature 14-03 is isolated. However, because the cluster analysis relies only on a single variable, I cannot confidently rely on these groupings to act as a basis for further analyses. Instead, sample types and provenience data are used to define meaningful categories for data analysis.

8.3.3. Cultural vs. Non-cultural Seed Deposition

Six categories of samples are used to compare seed data in the LSP-1 Rockshelter deposits:

- strata II, III, and IV in the N105E99 upper package column (UC),
- stratum V in the N105E99 middle package column (MC),
- strata VII and IX in the N105E99 lower package column (LC),
- hearth features (H),
- non-cultural feature samples (F. 12-01/02 and 14-01) (NCF), and
- Mazama tephra (Mz).

Statistically, the populations of charred and uncharred seed assemblages are differentially distributed in all but the NCF samples (Table 8.10). These results diminish the likelihood that uncharred seeds outside of feature contexts at the LSP-1 Rockshelter can confidently be considered the sole result of cultural deposition. The charred seeds, however, are considered to be indicative of cultural activity at this site both inside and outside of discrete cultural features.

Charred seed densities are highest in the hearths and in the UC samples representing strata III and IV. *Chenopodium*, *Descurainia*, and *Agrostis* taxa dominate the charred assemblages of both sample types (Table 8.11). These seeds account for more than 80% of all charred seeds identified in the LSP-1 Rockshelter samples. Cheno-am periosperms and *Agrostis* were ubiquitous in every sample type.

Table 8.10. Heteroscedasticity results for charred versus uncharred seed taxa* in the LSP-1 Rockshelter sample types.

Sample Type	Chi Square Value	*df*	p-Value
UC	1660.4265	10	<0.00001
MC	72.8529	6	<0.00001
LC	104.3626411	6	<0.00001
H	905.3512893	20	<0.00001
NCF	3.8717	4	0.42365
Mz	No charred seeds present		

*unidentified seeds excluded from this analysis

Table 8.11. Density, distribution, and ubiquity of charred seeds by sample type.

Feature types	**UC**	**MC**	**LC**	**Mz**	**H**	**NCF**	**Sum**	**Ubiquity***
Samples (n)	10	7	6	2	9	5	**39**	
Soil vol (L)	9.9	7	4.35	2	5.3	2.85	**31.4**	
CHARRED SEEDS								
Amsinckia	0	0	0	0	8	0	**8**	**20%**
Brassicaceae	0	0	0	0	4	0	**4**	**20%**
Descurainia	63	7	0	0	115	1	**186**	**80%**
Cheno-ams	23	1	11	0	4	3	**42**	**100%**
Atriplex	0	0	0	0	3	0	**3**	**20%**
Eriogonum	2	0	0	0	9	2	**13**	**60%**
Galium	0	0	0	0	2	1	**3**	**40%**
Lamiaceae	0	0	0	0	1	0	**1**	**20%**
Mentzelia	1	0	0	0	2	0	**3**	**40%**
Montiaceae	0	0	0	0	5	1	**6**	**40%**
Phacelia	1	0	0	0	2	0	**3**	**40%**
Plagiobothrys	0	0	0	0	2	0	**2**	**20%**
Poaceae	1	0	0	0	27	0	**28**	**40%**
Agrostis	44	6	6	0	378	1	**435**	**100%**
Leymus	0	0	2	0	26	0	**28**	**20%**
Prunus	0	0	0	0	1	0	**1**	**20%**
Ribes	0	0	0	0	2	0	**2**	**20%**
Scirpus	0	0	0	0	2	0	**2**	**20%**
Typha	0	0	1	0	2	0	**3**	**40%**
Unidentified	27	4	18	0	16	0	**65**	**n/a**
Total seed N	**501**	**44**	**58**	**0**	**923**	**16**	**1542**	
Seed density	**50.6**	**6.3**	**13.3**	**0**	**174.2**	**5.6**	**49.1**	

*Excluding sample type representing sterile Mazama tephra

8.3.4. Paleoenvironmental Trends

Evaluations of ecological habitat characteristics demonstrate warmer, drier conditions in the Middle Holocene based on the distribution and frequency of drought and salt tolerant plant taxa (Figure 8.9). This is the only clear trend in the seed data, as the frequency and distribution of plant taxa indicating wetland habitats change very little over time (Figure 8.10). Very few wetland plants are represented in the LSP-1 Rockshelter charred macrobotanical assemblage. The presence of these seeds may suggest the marshes associated with Bluejoint Lake seasonally rejuvenated during particularly wet years.

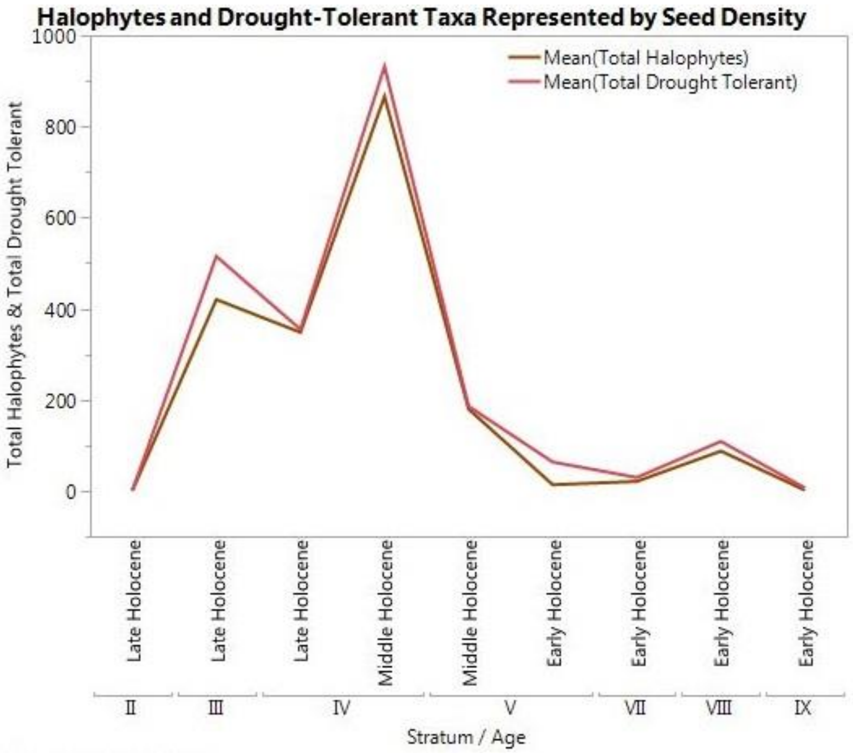


Figure 8.9. Temporal distribution of all drought and alkaline adapted plants in the LSP-1 Rockshelter macrobotanical samples.

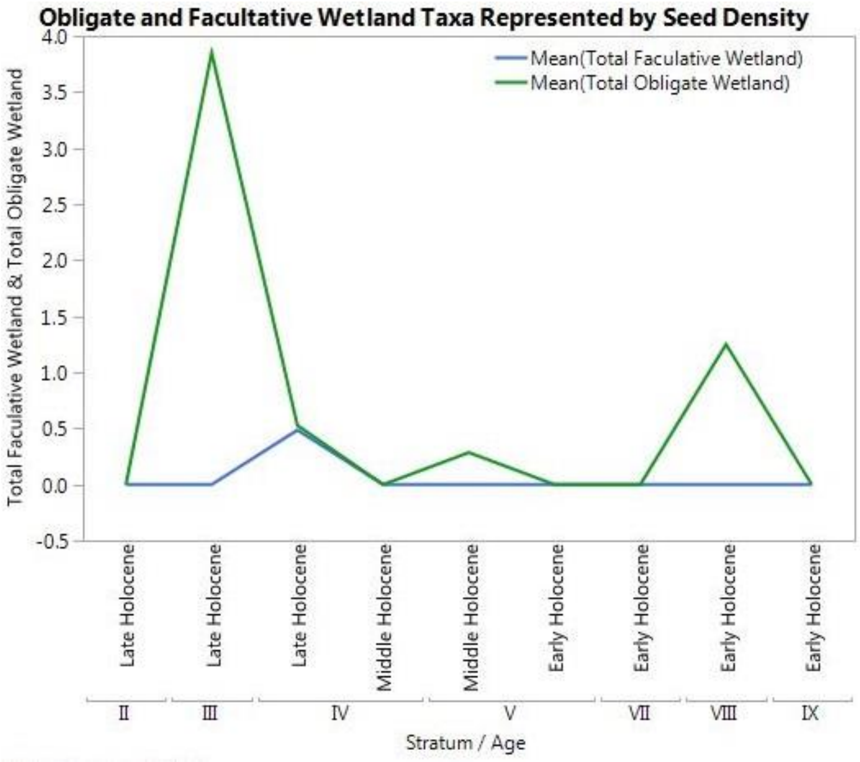


Figure 8.10. Temporal distribution of all obligate wetland and facultative wetland plants in the LSP-1 Rockshelter macrobotanical samples (note the largest contribution is four seeds in Stratum III).

A few uncharred *Achnatherum hymenoides* seeds were recovered in feature samples. According to the USDA (2014) wetland indicator status database, *Achnatherum hymenoides* is the only obligate upland plant that appears in the LSP-1 samples. Given the location of the site in upland habitat, it is likely that the uncharred *Achnatherum* seeds represent grasses growing in close proximity to the rockshelter. These seeds are cotemporaneous with the charred seeds in the same features. They represent contributions to the site formation process, regardless of whether their introduction was the product of purposeful resource targeting by human visitors.

8.3.5. Seasonality of Habitation

The known fruiting time of plant taxa represented by charred seeds in the macrobotanical assemblage indicates the seeds in cultural contexts were available for harvest in the summer and fall months at LSP-1 Rockshelter (Figure 8.11). In the hearths, the frequency of charred seeds available for harvest in the summer and fall mirrors the frequency of uncharred seeds that would have been available in the fall and winter months (Figure 8.12). *Atriplex* is the only taxon with seeds that ripen in late fall/early winter. For the most part, *Atriplex* seeds are uncharred in the samples; charred seeds (n=3) only appear in the Feature 11-07 hearth.

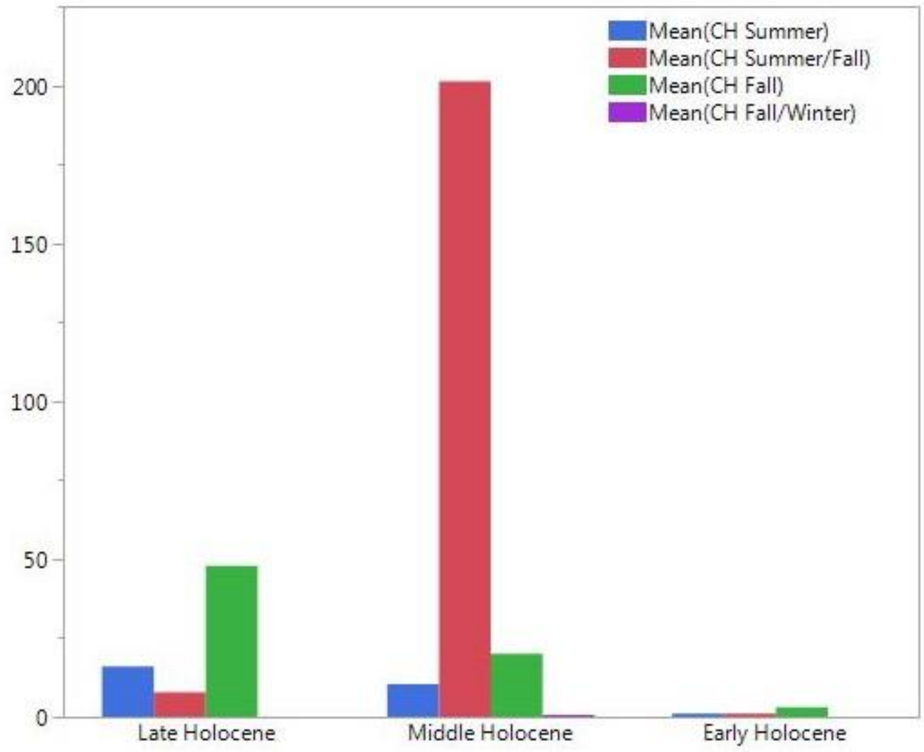


Figure 8.11. Seasonal availability of charred seeds in the LSP-1 Rockshelter bulk soil samples.

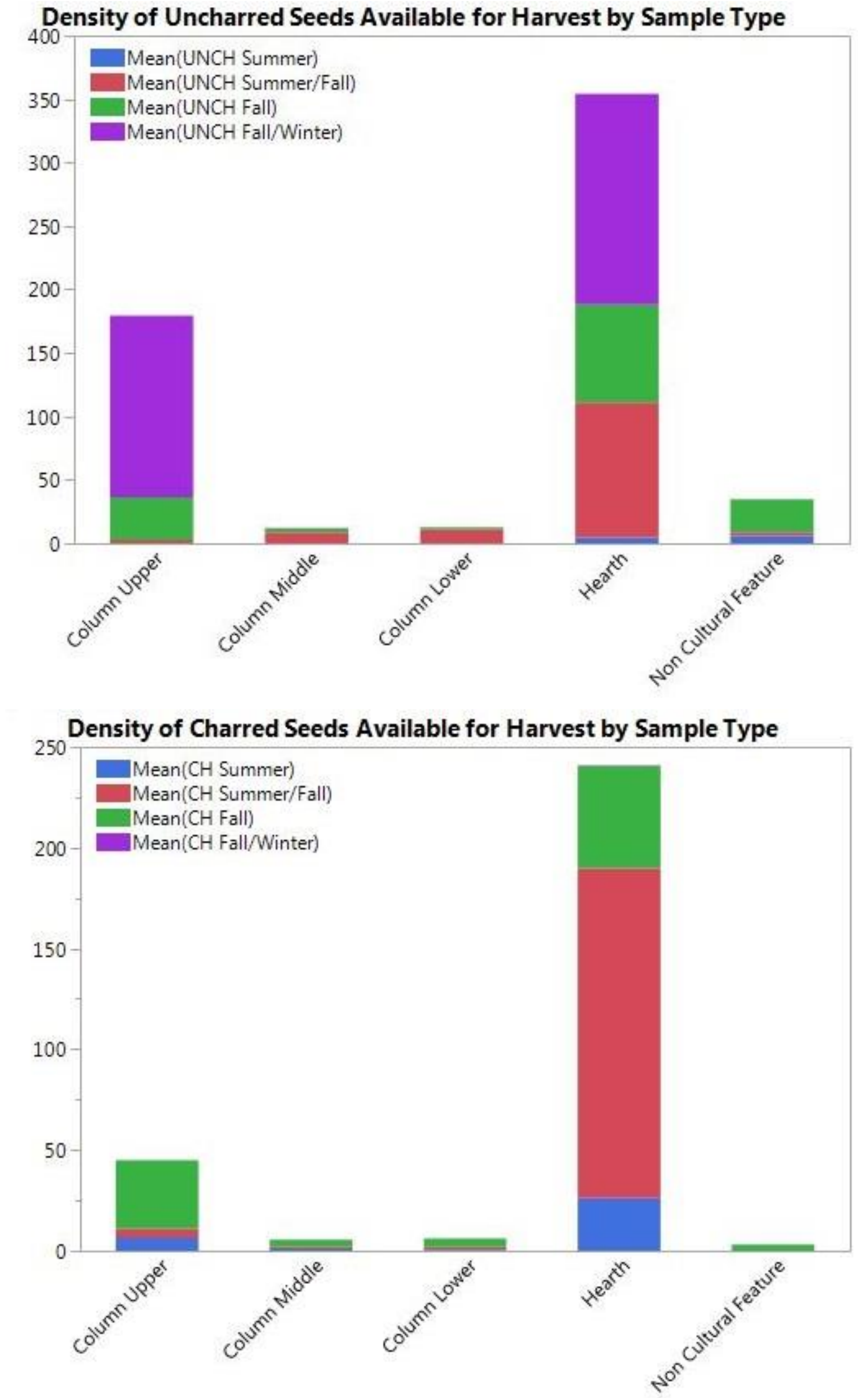


Figure 8.12. Seasonal availability of plant taxa represented in the LSP-1 macrobotanical samples, presented as mean density of uncharred seeds (upper) and charred seeds (lower).

The high incidence of charred plant remains with summer and fall harvest schedules recovered in hearths deviates from the faunal record at LSP-1, which suggests habitation centered around fall/winter leporid harvesting (Pellegrini 2014:118). As noted in the analysis of the Paisley Caves macrobotanical remains, the ethnographic record suggests seeds were collected in the summer and fall and then stored for winter use (Fowler and Rhode 2007:337; Kelly 1932:88). Although the supposition that communal rabbit drives and processing occurred in the fall and winter (when hare pelts were thickest) also partially rests on extrapolation from the post-contact period ethnographic record (Steward 1938), the faunal assemblage at LSP-1 Rockshelter record provides an additional line of evidence supporting the interpretation that people camped here during the fall and winter The assemblage of leporid (primarily *Lepus* sp.) bones consists mainly of adult specimens, which Pelligrini (2014:49-50) attributes to processing activities following communal rabbit drives. This assumption is based on the knowledge that leporid offspring are born from early spring to early September and juvenile mortality rates are high (Hockett 1991:668). If people were visiting the rockshelter in the late summer or early fall, more juveniles would be expected in the faunal assemblage.

If the ethnobotanical record holds true, then it is likely that the macrobotanical assemblage supports a fall/early winter habitation associated with the documented jackrabbit processing – the seeds in the fire hearth may have been harvested and stored prior to being prepared at the site.

8.3.6. Taxon Ubiquity

Throughout the Holocene, inhabitants of LSP-1 Rockshelter targeted a handful of economically important resources while visiting the site. As discussed in section 8.3.3., the unique distributions of charred and uncharred seed taxa suggest that uncharred seeds outside of distinguishable cultural features may reflect natural deposition rather than intentional introduction by human agents. Consequently, uncharred seeds from the column samples are not considered in the following survey of the distribution of economically important taxa through time.

The archaeological record from the Early Holocene at LSP-1 Rockshelter is meager, yet significant to understanding regional population demographics and people with Western Stemmed toolkits at this time (Smith and Barker 2017). The presence of a CCS flaked stone lunate crescent (Smith et al. 2014) and five *Callianax* (formerly *Olivella*) shell beads directly dated to the Early Holocene between 9650 and 8115 cal BP demonstrate an early connection between Great Basin people and people living along the coast. Macrobotanical data generated in this study also suggest the people utilizing the Warner Valley had an equally long relationship with plants. Fire hearth feature 13-01 yielded cheno-am and *Chenopodium* seeds, though their abundance was very low. Charred cheno-am, *Chenopodium*, were also identified along *Agrostis* and *Leymus* caryopses and *Typha* seeds in column samples representing Early Holocene deposits (Table 8.12).

Smith et al. (2014) documented a habitation hiatus at LSP-1 Rockshelter during most of the Middle Holocene. The macrobotanical record supports this observation with a break in heath features and charred remains from ca. 9125 to

Table 8.12. Taxon ubiquity by period of habitation at LSP-1 Rockshelter. Taxa represented by charred seeds are represented by black, taxa represented by charred and uncharred seeds represented by red, and taxa represented only by uncharred seeds represented by blue.

Period	**Late Holocene**	**(Late) Middle Holocene**	**Early Holocene**
Number of Samples	**n=14 4 Hearths, 10 Column Samples**	**n=8 4 Hearths, 4 Column Samples**	**n=12 3 Hearths, 9 Column Samples**
Amaranthus		13%	
Amsinckia	14%	50%	17%
Brassicaceae	21%		
Descurainia	71%	38%	
Cheno-am	43%	13%	42%
Atriplex sp.		13%	
A. confertifolia	29%	25%	
Chenopodium	86%	75%	58%
Claytonia	21%	13%	
Eriogonum	21%	25%	
Galium	7%	25%	
Juniperus	7%		
Lamiaceae	7%		
Mentzelia	29%	25%	
Nicotiana	7%		
Phacelia	21%		
Plagiobothrys	7%		
Poaceae	36%	25%	8%
Achnatherum	14%		8%
Agrostis	50%	88%	25%
Leymus	21%	25%	17%
Prunus	7%		
Ribes	14%		
Scirpus	29%	13%	
Typha	7%		8%

4500 cal BP. Charred seeds in late Middle Holocene hearths and column samples include *Chenopodium*, *Descurainia*, *Atriplex*, *Eriogonum*, *Galium*, *Mentzelia*, cheno-am perisperms, and *Claytonia*. Uncharred seeds in late Middle Holocene hearths also included *Amsinckia*, *Amaranthus*, and *Scirpus* seeds.

Together, the Early Holocene and late Middle Holocene are represented by the artifact-rich middle package, where the majority of artifacts and faunal remains were recovered. Charred seeds, however, were most abundant in the hearths and in the upper package column samples representing the Late Holocene. The taxonomic diversity of seed types expands to include plants growing in upland forested habitat, such as *Prunus* and *Ribes.* More wetland-adapted plants, including *Typha* and *Scirpus* are also incorporated into the assemblage in the Late Holocene.

Overall, the temporal distribution of culturally deposited seeds indicate that visitors to LSP-1 Rockshelter collected and processed plants with small seeds that were likely locally available. In the Late Holocene, the breadth of dietary constituents increased to include plants from a diversity of ecological niches .

8.3.7. Ethnobotany and Traditional Ecological Knowledge

Charred seeds of edible taxa also occurred with the greatest frequency in the upper package hearths and column samples (Figures 8.13 and 8.14). Taxonomic types in the LSP-1 Rockshelter charred macrobotanical assemblage that are deemed important in the traditional economies of Great Basin peoples (Fowler and Rhode 2007) include *Amsinckia*, *Atriplex*, *Chenopodium*, *Mentzelia*, and *Elymus* (*Leymus*). Plants valued for their medicinal attributes and those used in the production of handicrafts were not well represented in the assemblage.

In comparison, seeds of plants valued for nutrition and edibility were well represented. Charred specimens of edible seeds represented by *Agrostis* and *Descurainia* figure prominently in the samples. Cheno-ams (including *Atriplex* and

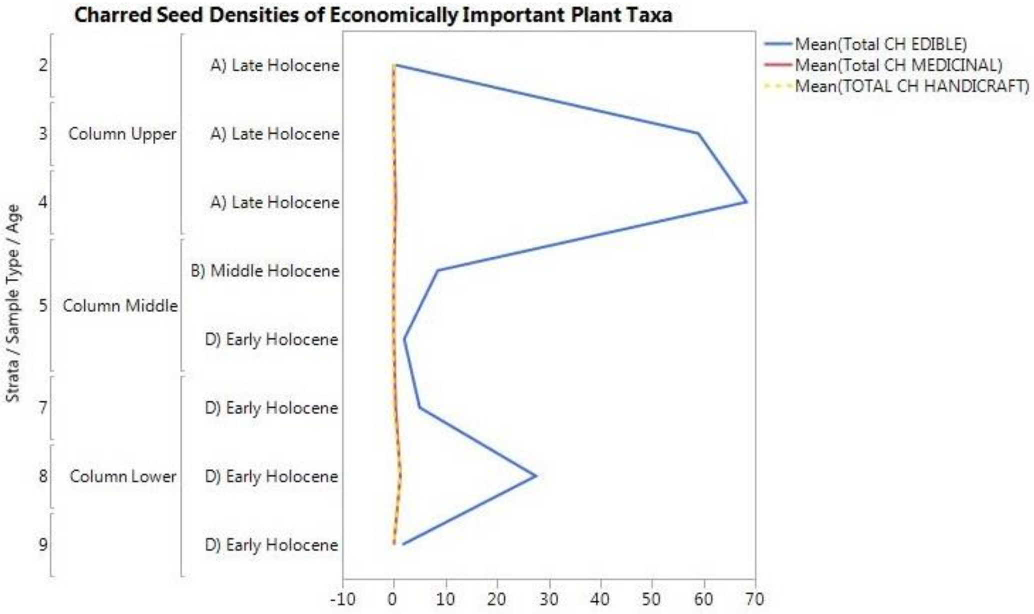


Figure 8.13. Frequency of seeds representing charred edible taxa in the LSP-1 Rockshelter sample types.

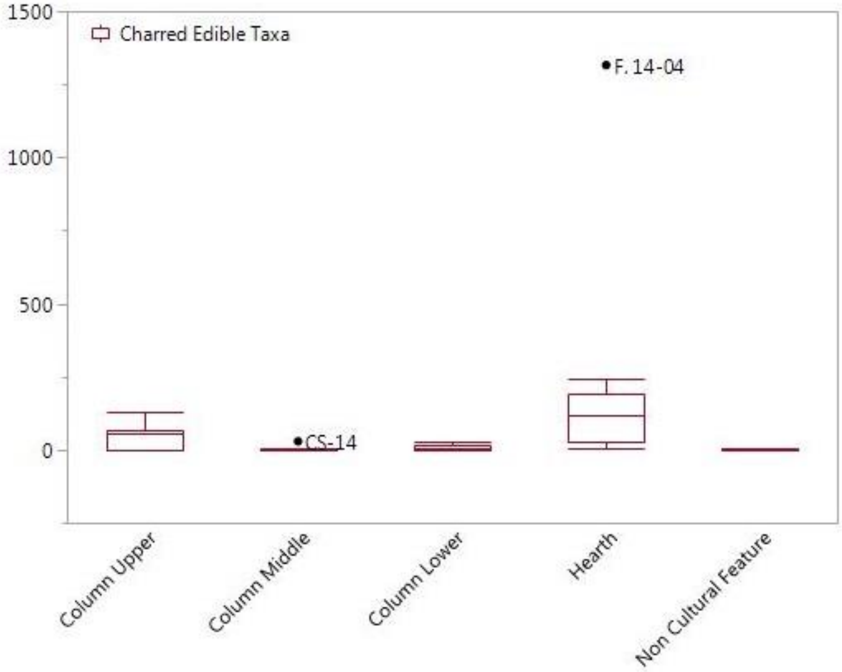
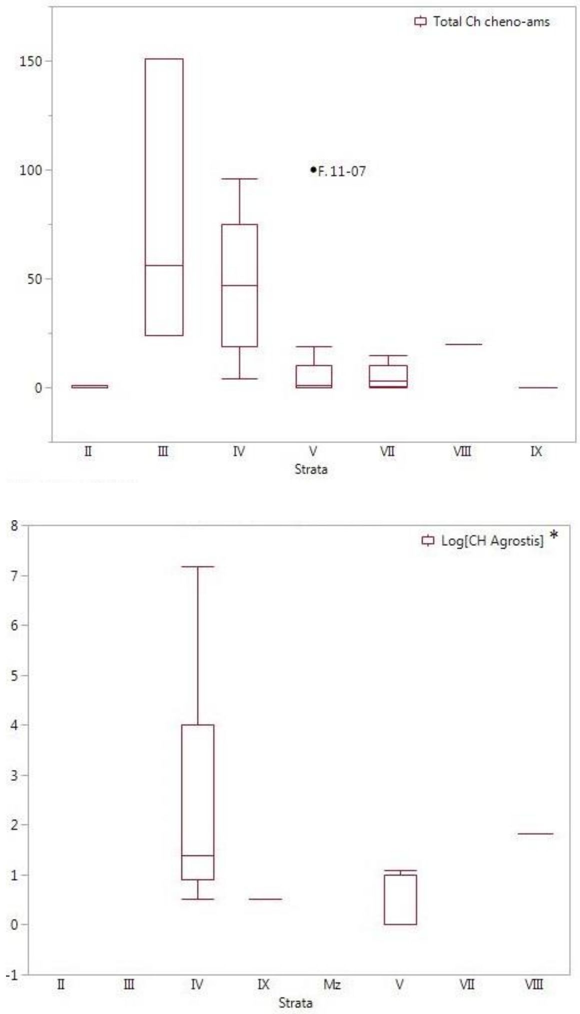


Figure 8.14. Frequency of seeds representing charred edible taxa in the LSP-1 Rockshelter sample types.



*Data log-transformed to account for skewed distribution.

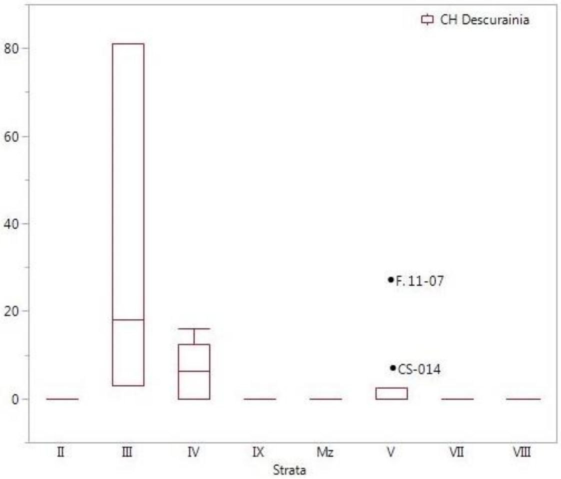


Figure 8.15. Distribution of cheno-ams (upper), *Agrostis* (middle), and *Descurainia* (lower) charred seed types by strata.

Chenopodium), *Agrostis*, and *Descurainia* occur more frequently in the upper strata representing the Late Holocene than during any other period represented by samples in this analysis (Figure 8.15; previous page). The ubiquity and abundances of charred cheno-ams and *Descurainia* across all sample types, and cheno-ams throughout the Holocene, illustrates the continued importance of these taxa to visitors at LSP-1 Rockshelter through time.

8.4. LSP-1 Rockshelter Macrobotanical Overview

Thirty-nine bulk sediment samples analyzed for macrobotanical remains at the LSP-1 Rockshelter identified at least 28 plant taxa. Charcoal was the primary botanical material identified at LSP-1 Rockshelter, with over 4911 fragments (37.92 g) observed in the samples. Of the pieces identified in this analysis, only *Artemisia* (99%), *Atriplex* (1%), and *Rhus* (< 1%) types were noted. All three shrubs were noted growing in the immediate vicinity of the site in 2013. Nearly all the charcoal (92%) was recovered from features (Figure 8.16). Amorphous charred tissues representing fruits and geophytes were not well represented, but were most commonly identified in the upper package hearth features.

Overall, 7024 seeds and seed fragments were present in the 39 samples processed for macrobtanical analysis. Both charred (n=1542) and uncharred (n=5482) seeds occurred in the column and feature samples. Although both seed assemblages accrued simultaneously and contributed to the archaeological site formation, the distribution and taxonomic makeup of the uncharred assemblage suggest differential deposition vectors. Outside of cultural features, only the charred seeds are considered to have been targeted, harvested, and processed by site inhabitants.

The seeds identified at 35HA3735 include 26 taxa in 17 families. *Atriplex* (33%) and *Chenopodium* (22%) occurred with the greatest frequency. Other identified seed taxa included cheno-ams (17%), *Amsinckia* (11%), *Agrostis* (6%), *Descurainia* (3%) and other Brassicaceae members (3%), Poaceae members not identified to species (2%), *Mentzelia albicaulis* (1%), *Leymus cinererus* (<1%), *Nicotiana attenuata* (<1%), *Eriogonum* sp. (<1%), *Achnatherum hymenoides* (<1%), Montiaceae (<1%), *Juniperus* sp. (<1%), *Scirpus/Schoenoplectus* sp. (<1%), and *Urtica dioica* (<1%). *Galium*, *Juncus*, *Prunus*, *Typha latifolia*, Lamiaceae, *Ribes*, *Phacelia*, *Plagiobothrys*, and *Amaranthus* each account for less than 0.1%. The *Atriplex* likely all represent *A. confertifolia*. In less than 1% of the specimens only the endosperm of the seed was present, preventing a confident identification to species. Unidentified types an additional 1% of the seed assemblage.

Long term trends identified in the data indicate the Middle Holocene climate favored plants with aridity and salinity tolerances. Both charred and uncharred seeds identified in the Middle Holocene samples reflect a higher number of drought-adapted and halophytic taxa at this time. Increased occurrences of carbonized plant remains in the Late Holocene indicate people visited the cave more frequently before the onset of the Middle Holocene Climate Optimum, and again after climatic conditions stabilized.

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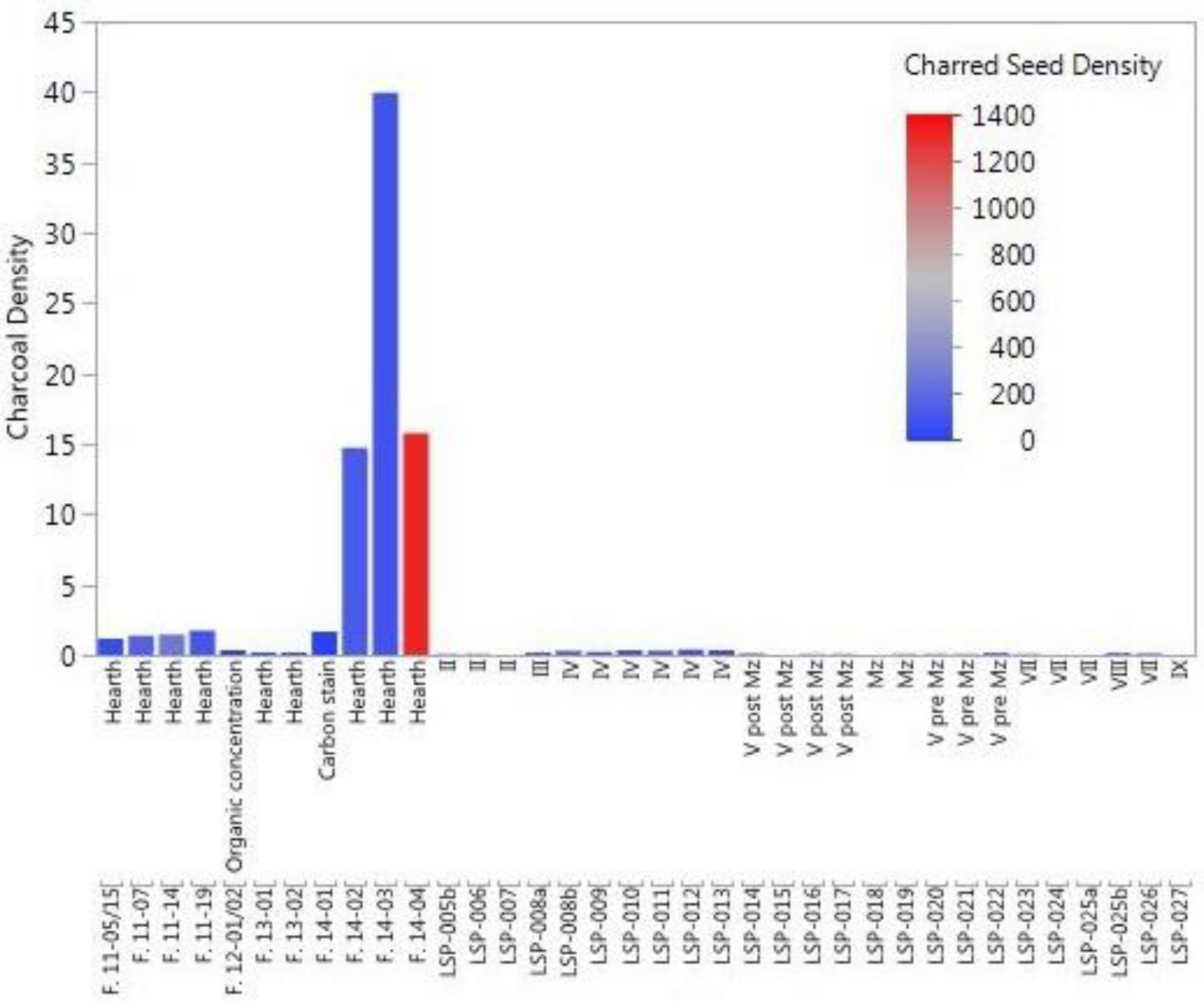

Figure 8.16. Charcoal and charred seed densities (coded by color map) across all bulk soil samples analyzed at LSP-1 Rockshelter.

The most commonly identified charred seeds include cheno-ams, tansymustard, and bentgrass. Each of these taxa is reported as food items in ethnographic literature of northern Great Basin tribes (Moerman 1998). The overwhelming majority of plants represented in the charred assemblage would have been available to harvest in the summer or fall. This pattern differs from the pattern established by the distribution of artifacts and faunal remains previously reported, which suggest people visited the site in the fall and winter months to process rabbits (Pelligrini 2014; Ware van der Voort 2016). If behaviors reported in the ethnographic literature of the Great Basin were also true of pre-contact cultural activities, then the charred seeds in LSP-1 Rockshelter hearths may have been harvested and stored weeks or months prior to their processing here (Fowler and Rhode 2007; Kelly 1932).

CHAPTER IX

NORTHERN GREAT BASIN ROCKSHELTER ARCHAEOBOTANY IN REGIONAL PERSPECTIVE

In total, 74 bulk soil samples from the Paisley Caves (35LK3400) and LSP-1 Rockshelter (35HA3735) were analyzed to identify macrofossil remains including seeds, fruits, and charcoal. Intersite variability between the macrobotanical assemblages described in chapters VII and VIII provide an additional level of data analysis that addresses the research questions contemplated in this dissertation. Briefly, these questions include:

- What plant taxa are represented in northern Great Basin rockshelters?
- Do the macrobotanical data reflect the intentional introduction of plants by people visiting the rockshelters?
- What does the macrobotanical record demonstrate about diet breadth in the Terminal Pleistocene/Early Holocene (TP/EH)?
- Does the patterning of macrobotanical data in features inform feature function?
- Can seasonal visitation patterns to northern Great Basin rockshelters be established?
- Does the macrobotanical assemblage reflect foraging behaviors representing adaptive responses to large scale climate constraints?
- How do the macrobotanical data relate to the ethnographic record?

9.1. Taxonomic Representation

Numerous plant taxa are represented in the northern Great Basin rockshelters evaluated in this analysis. Charcoal fragments of *Artemisia* are well represented in the macrobotanical assemblages at both the Paisley Caves and LSP-1 Rockshelter sites (over 90% of total weight of identified charcoal). Other charcoal types are limited to *Atriplex* and *Salix* at the Paisley Caves, and *Atriplex* and *Rhus* at LSP-1 Rockshelter. The data suggest sagebrush is the preferred fuel source in northern Great Basin rockshelters for the entirety of human presence in the area. Sagebrush ubiquity and availability likely drove this trend. *Salix* charcoal in Younger Dryas-aged deposits at the Paisley Caves indicate wetter conditions during this period; today, the closest willows grow more than 50 km southeast of the site.

At the Paisley Caves, the dominant seed taxa include *Atriplex* (21%), *Achnatherum* (19%), *Chenopodium* (11%), *Amsinckia* (8%), and Poaceae (8%). *Atriplex* (33%), *Chenopodium* (22%), cheno-ams (17%), *Amsinckia* (11%), and *Agrostis* (6%) seed taxa dominated the assemblage from LSP-1 Rockshelter. The taxa represent both charred and uncharred seeds, and the similarity in the two assemblages likely reflects comparable ecosystem constraints.

Other plants contributing to the seed assemblages at both sites demonstrate more taxonomic variation. Charred seeds at the Paisley Caves include Boraginaceae, *Amaranthus*, *Hesperostipa*, Geraniaceae, Rosaceae, *Descurainia*, *Phacelia*, *Cryptantha*, *Urtica dioica*, *Camassia*, *Sphaeralcea*, *Plantago*, Liliaceae-Amaryllidaceae, *Ceanothus*, *Juncus*, *Sesuvium*, and *Vicia* in addition to the types listed in the preceding paragraph. Charred seeds at LSP-1 Rockshelter also include Brassicaceae, *Descurainia*, Poaceae, cheno-ams, Montiaceae, *Galium*, Lamiaceae, *Mentzelia*, *Phacelia*, *Plagiobothrys*, *Leymus*, *Prunus*, *Ribes*, *Scirpus*, Polygonaceae, and *Typha*. Taxa that occur at both sites are limited to Poaceae, *Achnatherum*, cheno-ams, *Atriplex*, *Chenopodi*um, *Amsinckia*, *Descurainia*, and *Phacelia*. The taxonomic diversity of charred seeds and charcoal identified in this research is comparable to that of previous archaeobotanical studies in the northern Great Basin (see Table 2.3).

The majority of seeds identified in stratigraphic columns collected at LSP-1 Rockshelter and the Paisley Caves originate from upland herbs and shrubs (Figure 9.1). Seeds outside of cultural features are less likely to have culturally-mediated distributions, and therefore are more likely to reflect ecological conditions in the immediate vicinity of the site. The overall pattern suggests the modern day desert scrub vegetation characterizing both sites has persisted through time, with minor variations. Seeds representing wetland and upland plants in cultural features exhibit similar distributions. Higher abundances of wetland-adapted plants in Younger Dryas features may signal a cultural signature (Figure 9.2). It appears that foragers living in the northern Great Basin at the TP/EH boundary were harvesting flora from nearby marshes and lakes, and transporting these plants to the rockshelters.

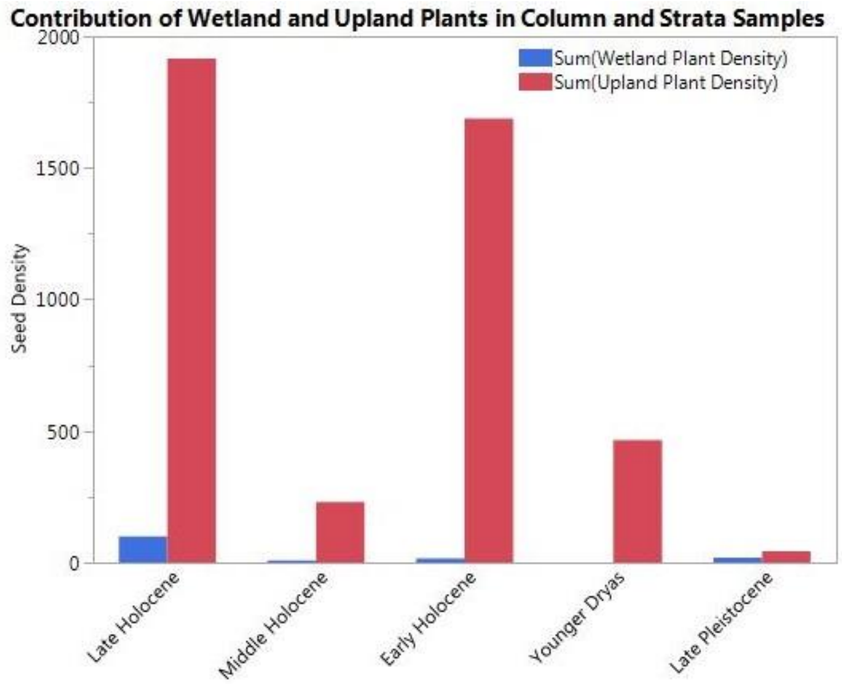

Figure 9.1. Contribution of plant taxa outside cultural features representing different ecological zones.

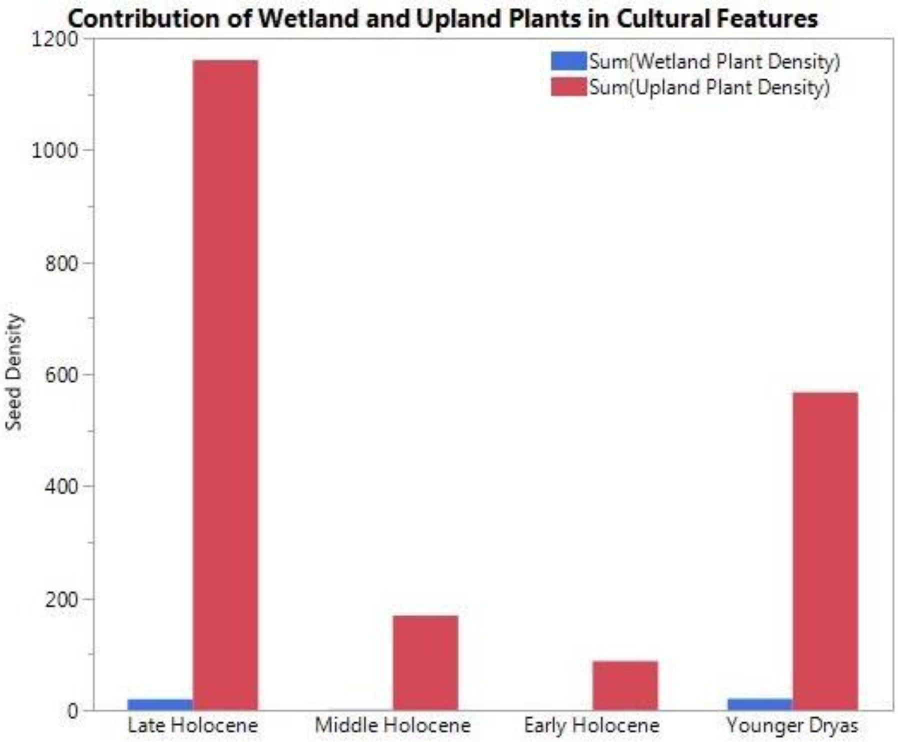

Figure 9.2. Contribution of plant taxa in cultural features representing different ecological zones.

9.2. Culturally-Deposited Seeds

As discussed in Chapter V, seeds in archaeological contexts represent secondary deposition (that is, either the seeds themselves or the plants bearing those seeds were moved from the location where the plant was rooted in the ground to the rockshelters). The crucial question lies in whether the secondary deposition resulted from cultural agents or other sources (i.e., animal waste, rodent-caching, zoochory). Pointedly, interpretations about the origins of uncharred, organic remains in arid rockshelters are complex because uncarbonized remains can preserve for thousands of years.

As reported in chapters VII and VIII, Kruskall-Wallace non-parametric tests resulted in the rejection of the null hypothesis that the statistical populations of charred and uncharred seeds at both the Paisley Caves and LSP-1 Rockshelter were distributed the same way. Because uncharred and charred seed assemblages demonstrate significant differences in their taxonomic compositions, unless seeds were charred and/or exhibited evidence of processing (see discussion in Sanford 1983), or were recovered in a cultural feature, they were not considered a product of cultural deposition in this study. Charred seeds and seeds exhibiting breakage and/or shattered seed coats were the most abundant among taxa of the Chenopodiaceae, Boraginaceae, Brassicaceae, and Poaceae families, many of which have economically important taxa.

This interpretation does not question the antiquity of the uncharred seeds. The sampling strategies employed in this study carefully avoided bulk soil collection in disturbed deposits. Even the less-rigorously selected Paisley Cave 5 strata samples were collected from an excavation profile with good stratigraphic context. Uncharred seeds may have been brought into the rockshelters by people living there, but without the benefit of contextualizing discrete cultural features, it is problematic to assign human agency to their provenience. The introduction and incorporation of uncharred seeds into the archaeological context could also stem from alluvial or aeolian transport, animal foraging, burrowing, or excrement, insect bioturbation, or represent unintentional deposition by people. The latter path of *de facto* introduction may include seeds picked up on an individual’s clothing or seeds incidentally incorporated when harvesting other plant materials, among other scenarios.

This caveat may also extend to charred and uncharred seeds in features. Uncharred plant remains in cultural features could reflect post-depositional fill, just as charred seeds in cooking feature fill may represent plant remains on the ground surface incidentally incorporated when the fire was ignited. However, associated archaeological evidence (formed tools, debitage, cut bones, etc.) and the taxonomic makeup of the seed assemblages corroborate the interpretation that charred seeds, in general, and uncharred seeds in features, can be attributed to the activities of people visiting the rockshelters.

9.3. Paleoindian Plant Use in the Younger Dryas

The Botanical Lens and hearth features at the Paisley Caves offer a rare opportunity to study the diet and behaviors of Paleoindians in North America during the Younger Dryas (Jenkins et al. 2012a, 2014, 2016; Hockett et al. 2017). The strategic placement of the Unit 2/6B macrobotanical column at the Paisley Caves comprised deposits spanning the Early Holocene and Terminal Pleistocene, including the Younger Dryas Botanical Lens feature. Column samples representing the Botanical Lens did not contain any charred seeds. In contrast, hearth features from the Botanical Lens did yield charred seeds. In Feature 2/4C-4, 67% of the total charred seeds represent edible taxa, and in Feature 2/3A-2-46, 100% of the charred seed assemblage represents edible taxa. The identified charred taxa in these features include cheno-ams, *Atriplex*, and *Descurainia*.

The Younger Dryas hearths in Paisley Cave 1 (features 1/7-4a and 1/7-4b) contained charred cheno-ams and Poaceae seeds. Feature 2/6-4 in Cave 2 yielded a more diverse assemblage of charred seeds, including Boraginaceae, cheno-ams, *Atriplex, Chenopodium*, Poaceae, *Achnatherum*, and *Sesuvium*. Each of the seed taxa present in the definitive Younger Dryas fire hearths are classified as upland plants and several possess documented drought and salinity tolerances. The presence of these types reflects the harvesting and processing of upland plants common to the vicinity of the Paisley Caves.

These findings support previous studies indicating diversified diet breadth among inhabitants of the Paisley Caves (Hockett et al. 2017:574). Visitors to the Paisley Caves during the Younger Dryas consumed small seeds of grasses, cheno-ams, mustards, and borages along with artiodactyl, rabbit, fish, sage grouse, and insects. Plant foods tend to be represented by upland seed extraction in the macrobotanical record. Utilization of marsh plant resources seems to be focused on collection of fibers for mats and basketry rather than on food acquisition during the Younger Dryas.

9.4. Interpreting Cooking Features

Feature samples at both sites were collected during the course of excavations spanning several years. In some cases, soil samples were recovered from charcoal stains or ash lenses that were assumed to represent fire hearths or earth ovens. Analysis of macrobotanical remains from perceived cooking features were compared to determine feature function. At LSP-1 Rockshelter, charcoal and charred seed abundances were significantly higher in nine out of eleven features, indicating their use as fire hearths. A dearth of charcoal and charred seeds in Feature 12-01/02 and Feature 14-01 indicate they are probably not cultural. The Paisley Caves cooking features were all identified as fire hearths with the exception of a stratified feature in Cave 5 represented by Feature 5/5A and Feature 5/5A-26-8. The bowl-shaped feature with stratified charcoal and ash lenses was lined with fire altered rocks, and differed from other TP/EH hearths identified at the site. These observations suggested the feature may represent an oven (see Black and Thoms 2014; Thoms 2009).

Analysis of macrobotanical remains in the cooking features by sample type illustrates differences between the density of charcoal, charred seeds, and charred plant tissues (Figure 9.3). The fire hearths contained abundant charcoal, moderate densities of charred seeds, and small amounts of charred fruity and starchy tissue. The Cave 5 earth oven features contained less charcoal, more charred seeds, and greater amounts of charred starchy tissue. The features deemed non-cultural contained scant amounts of charcoal and charred seeds, and no charred plant tissue.

Both features representing the earth oven contained several charred edible seeds, comprising 61% and 88% of the total number of charred seeds respectively. However, the Cave 5 earth ovens contain a wider array of charred seeds representing targeting of more diverse ecological settings than the Cave 1 and Cave 2 Younger Dryas hearths. The charred seed assemblage in Feature 5/5-3 included Boraginaceae, *Cryptantha*, *Phacelia*, *Descurainia*, cheno-ams, *Atriplex*, *Vicia*, Geraniaceae, Liliaceae, *Sphaeralcea*, *Plantago*, Poaceae, *Achnatherum*, and *Urtica* types.

In Feature 5/5A-26-8, *Amaranthus*, *Camas*, Boraginaceae, cheno-ams, *Atriplex*, and *Juncus* were identified. Some of these taxa are classified as facultative wetland plants, which suggest they were foraged from a different ecological zone than the charred seeds in the Cave 1 and Cave 2 Younger Dryas hearths. Moreover, *Camassia* and Liliaceae seeds and the presence of charred parenchymous tissue representing geophytic underground storage units (e.g., bulbs, corms, and roots) may represent the purposeful collection of upland roots to augment dietary intake. These behaviors are not without precedent in Terminal Pleistocene contexts at the Paisley Caves; a mano/handstone analyzed for protein residues and plant microremains yielded evidence of Apiaceae starches in association with horse proteins (Cummings and Puseman 2003).

9.5. The Role of Rockshelters in Northern Great Basin Seasonal Rounds

Rather than indicate a strict pattern of seasonal use, the macrobotanical records at the Paisley Caves and LSP-1 Rockshelter reflect flexible reactions to contemporaneous environmental conditions and changing cultural needs. Over the course of time, people with high residential and territorial mobility used the rockshelters during different seasons. Jenkins et al. (2016:132) speculated that the Paisley Caves represented just one stop in the seasonal rounds of Younger Dryas populations, most commonly visited during times of the year when resources were abundant, either in the spring or the late summer/fall. When non-culturally deposited seeds are omitted from the analysis, the Younger Dryas and Early Holocene macrobotanical record at the Paisley Caves demonstrates a focus on harvesting plants in the summer and fall (see Figures 7.21 and 7.22). Regardless of whether visitors to the caves scavenged seeds from the woodrat nests they encountered (as discussed in Chapter VII), the ripening times of seed taxa in cultural features that were not represented in the nest (especially cheno-ams) indicate summer and fall visitation during this period. Archaeological investigations have provided corroborating data suggesting that groups of 20-30 people camped at the rockshelters and processed pronghorn hides to make blankets for winter (Jenkins et al. 2013, 2016).

People visited the Paisley Caves less frequently and later in the year (during the fall and winter months) during the Altithermal when conditions would have been hotter and drier. Charred seeds recovered from hearths at LSP-1 Rockshelter and the Paisley Caves suggest the timing of rockshelter habitation vacillated over the past 14,000 years (Figure 9.3).

The data show increases in the abundance of seeds that would have been available to harvest in the summer during the early Middle Holocene. These data conflict with faunal and artifact records at LSP-1 Rockshelter which indicated the site was primarily visited in the late fall and early winter months when people conducted rabbit drives (Pelligrini 2014). The higher instance of plant taxa with summer-ripening times could reflect increased use of the site for upland plant processing independent of winter animal processing, but may suggest that seeds were harvested and stored prior to being cooked at the rockshelter as indicated in ethnographic accounts (Fowler and Rhode 2007:337; Kelly 1932:98).

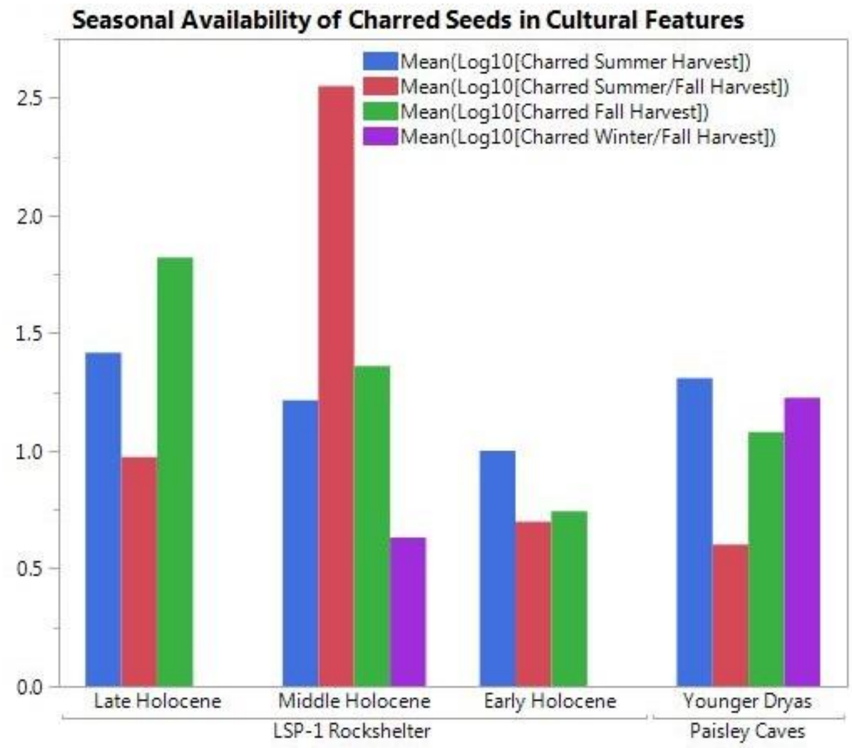

Figure 9.3. Seasonal availability of charred seeds in cultural features (log transformed for improved visualization).

Alternatively, shifting environmental parameters arising from the Middle Holocene Climate Optimum (Altithermal) could also affect the ripening times of seeds. Phenotypic plasticity and adaptive evolution among flora often results in plants adjusting flowering and ripening times based on short-term environmental conditions (Anderson et al. 2012; Nicotra et al. 2010). Warm and dry conditions in the Altithermal may have prolonged the duration of reproductive activity in plants, thereby extending the flowering phase into the fall.

Comparisons of macrobotanical to faunal datasets indicate the possibility that people visited LSP-1 Rockshelter during the fall months. As discussed in Chapter VIII, the leporid assemblage at the site contained very few juveniles, which indicates that offspring born that year had already reached maturity (Hockett 1991; Pelligrini 2014).

At LSP-1 people in the early Late Holocene used the site at different times and for different resources than those by people in the late Late Holocene. The preponderance of butchered faunal remains and diagnostic, formed tools recovered at LSP-1 are associated with strata IV and V in the middle sediment package (ca. 9650 to 3000 cal BP). Pelligrini (2014:80, 98) reports no faunal elements from deposits above 60 cmbd (ca. 3000 cal BP). In contrast, when the charred seed data are normalized to account for volumetric differences in sample size, 87.7% of the total seed assemblage for the column sample was recovered from samples in the upper sediment package, which postdates 3000 cal BP. Samples from the artifact-rich middle sediment package produced only 4.6% of the total seed assemblage. Finally, samples from the lower sediment package, which predates 9650 cal BP, produced 7.7% of all identified seeds. This pattern indicates more recent site use (after ca. 3000 cal BP) reflects cultural engagement in different activities at LSP-1 in the late Late Holocene than the behaviors represented when strata IV and V accumulated.

Charred macrobotanical remains in features 11-05/19 (ca. 2600 cal BP) and 11-14 (ca. 900 cal BP) included more abundant cheno-ams and *Descurainia* than the early Late Holocene hearths. *Ribes* and *Prunus* seeds also reflect the presence of upland berries in Feature 11-14, which do not appear in older features. It appears that the rockshelter may have been visited as a brief stopover in the late Late Holocene during the summer and fall in trips that were not related to communal rabbit drives.

9.6. The Role of Plants in Diet Breadth

As early as 12,500 cal BP, seeds of Poaceae including *Achnatherum hymenoides*, cheno-ams including *Amaranthus*, *Atriplex*, and *Chenopodium*, *Mentzelia albicaulis*, Boraginaceae, *Descurainia*, and *Phacelia* are all represented in the charred macrobotanical assemblage at the Paisley Caves, suggesting people were collecting and processing grasses including Indian ricegrass, cheno-ams including pigweed, saltbush, and goosefoot, whitestem blazingstar, members of the borage family, tansymustard, and tansy for consumption at this time.

The artifact and ecofact record left by inhabitants of the Paisley Caves suggest less frequent visitation after the onset of the Early Holocene, but charred seeds do occur in association with increases in the number of formed tools and charcoal densities between 9000 and 8000 cal BP. At this point in the Early Holocene, the charred seed assemblage is dominated by Poaceae and *Chenopodium*, but also includes cheno-ams, *Achnatherum*, *Amsinckia*, *Atriplex*, *Suaeda*, and *Eriogonum*. Their presence indicates the processing of small seeds including grasses, goosefoot, cheno-ams, Indian ricegrass, fiddlenecks, saltbush, wada, and buckwheat.

At Paisley Caves, the taxonomic diversity of charred seeds is different in the strata samples than in the column or feature samples. Seed types, including *Amsinckia* and *Mentzelia*, are significantly more abundant in the Late Holocene strata samples than in any other period at the Paisley Caves (Figure 9.4). The presence of charred *Sambucus* seeds in the Cave 5 Stratum I sample also suggests foraging territories expanded to include upland forests in the Late Holocene. This pattern could indicate a more diversified suite of plants targeted for consumption by people visiting the caves in the Late Holocene, or could stem from the poorly-provenienced nature of the samples themselves. A notable exception is *Chenopodium*, which seems to have been an important plant food for the duration of habitation events at the Paisley Caves.

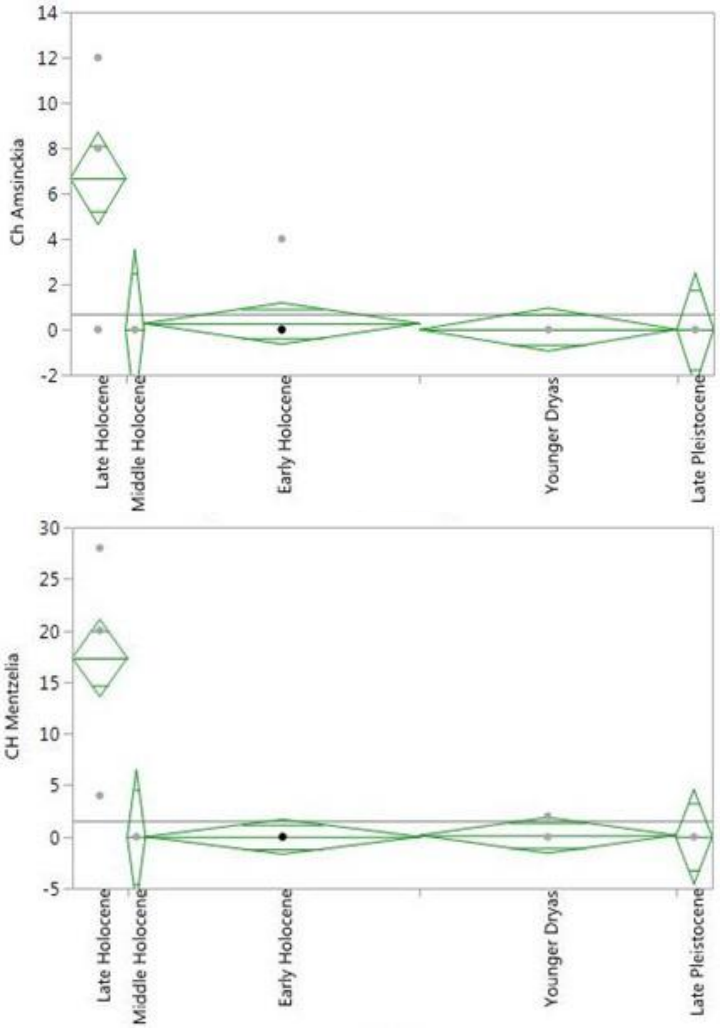

Figure 9.4. Oneway analysis of charred Amsinckia seed density (R-square = 0.568282, df = 34, p-value = <0.0001) by sample age (above) and oneway analysis of charred Mentzelia seed density (R-square = 0.730182, df = 34, p-value = <0.0001) by sample age (below) at the Paisley Caves.

The analysis of the LSP-1 Rockshelter hearths' contents indicates that the plant resources people consumed varied through time. In the terminal Early Holocene features (13-01 and 13-02), carbonized plant remains are limited to Poaceae members, cheno-ams, and Brassicaceae members. Conversely, the Late Holocene features (11-05/15, 11-07, 11-14, 11-19, 14-02, 14-03, and 14-04) contain hundreds of charred seeds indicating an elevated reliance on plant foods. These results also suggest increasingly diverse diet breadth during the Late Holocene. In addition to locally available Poaceae, cheno-ams, and Brassiccaceae, *Scirpus/Schoenoplectus* and *Typha* reflect the exploitation of nearby wetland resources, and *Ribes* and *Prunus* seed fragments suggest that groups foraged in upland contexts. A higher frequency of ground stone artifacts throughout the upper package deposits also signifies the increased importance of plant foods at this time (Geoff Smith, 2014, personal communication). The abundance of *Chenopodium* in the Late Holocene samples is also significantly greater than in any other period (Figure 9.5).

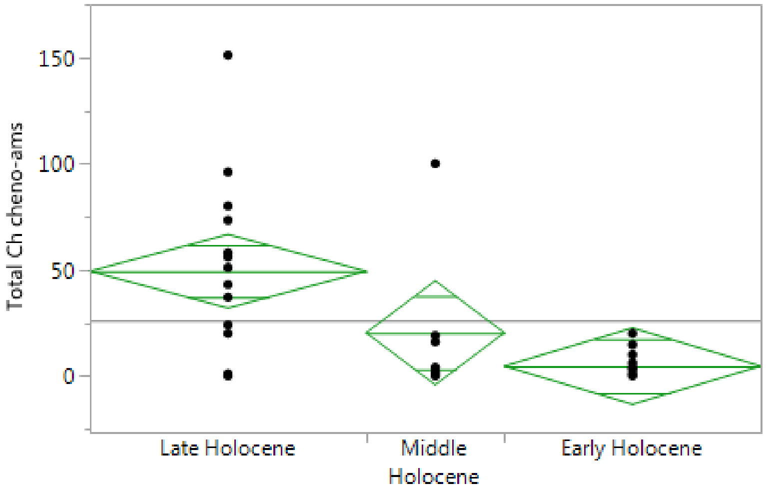

Figure 9.5. Oneway analysis of all charred Chenopodiaceae-Amaranthaceae (R-square = 0.305595, *df* = 33, p-value = 0.0035) by sample age at LSP-1

9.7. Paleoclimate and the Macrobotanical Record

Previous studies have demonstrated the utility in comparing macrobotanical data to local and regional pollen records (Jacomet 2013; Wigand and Mehringer 1985). Here, the macrobotanical remains are presented as percentage values to facilitate comparisons between the datasets (Birks 2014:313). One to one correlations between macrofossils and pollen grains lack real quantitative value due differences in the temporal and spatial scales each dataset represents; however, macobotanical data can validate climate reconstructions made from pollen data (Birks 2003). While both datasets can suffer from zero values representing false absences, when plant macrofossils are present, they do not signal the false presence of represented taxa (Birks 2014:312).

The Paisley Caves Unit 2/6B column samples provide plant macrofossil records documenting taxonomic change through time. The Paisley Caves macrobotanical column complements and enhances palynological records obtained from the profiles of Unit 2/6B and Unit 2/4C (Beck et al. 2017; Saban 2015) and pertains to the Late Pleistocene and Early Holocene epochs (ca. 13,700 to 7600 cal BP). The LSP-1 Unit N105E99 macrobotanical column provides paleoclimate data spanning the Holocene (ca. 10,200 to 1100 cal BP).

Pollen records from the Paisley Caves show conifer-dominated pollen assemblages prior to the Younger Dryas, with herbaceous plants increasing after its onset (Beck 2017:9; Saban 2015:41). Though regional post-glacial *Pinus*-dominated pollen assemblages suggested pine forests were present in lower altitudes (Hansen 1947), the relatively low *Pinus* pollen ratios at the Paisley Caves prompted Beck et al. (2017) to speculate pine trees never grew near the site. The macrobotanical record for pre-Younger Dryas deposits, represented by sample CS-21, included primarily Poaceae and *Urtica* seeds, reflecting mesic environmental conditions prior to 12,900 cal BP, but very few *Pinus* plant macrofossils (Figures 9.6 and 9.7). The dearth of *Pinus* in the macrobotanical column samples supports the assertion that the limited *Pinus* pollen spectra indicate pine trees did not grow locally. If pine trees had been growing above the caves, their needles, which shed copiously, should be incorporated into the Paisley Caves assemblages. The few *Pinus* seeds recovered in this study, and seeds and cone scales recovered *in situ* by excavators, were probably brought to the site from another location, possibly atop Winter Rim to the west, where pine trees are currently distributed.

During the Younger Dryas, low floristic diversity was reported in the Paisley Caves pollen records, which are dominated by *Pinus* and other conifers, *Artemisia*, Asteraceae, and Chenopodiaceae-Amaranathaceae (Beck et al. 2017:9; Saban 2015:38-39). Scattered shrubs and forbs are also noted, which support previous regional paleoclimate reconstructions suggesting cool and moist steppe-environment characterized the northern Great Basin (Mehringer 1985; Wigand and Rhode 2002). Saban (2015) did not report the occurrence of juniper, but Beck et al. (2017: Figure 6) noted the limited presence of Cupressaceae pollen throughout their samples, including the Late Pleistocene and Younger Dryas periods. Saban (2015:41) proposed marsh-like conditions prevailed near the site due to an increase in moisture-loving taxa in the pollen record.

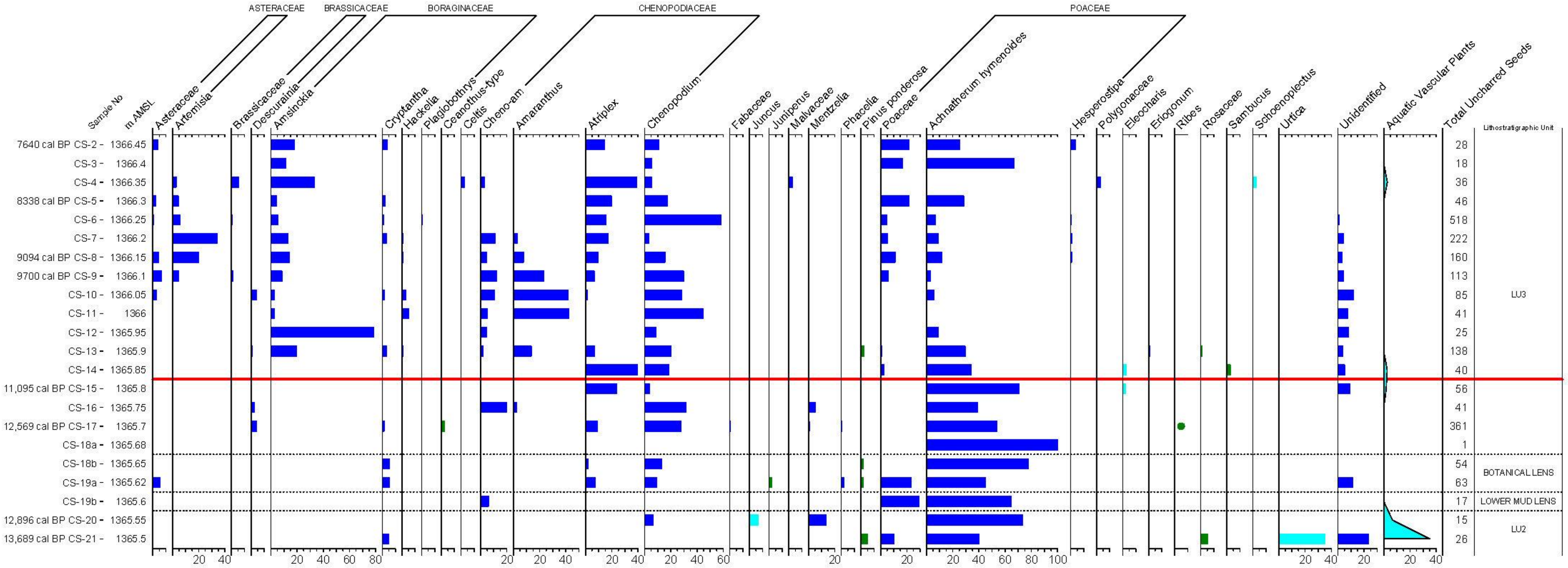

Figure 9.6. Relative abundances of uncharred seeds recovered from Unit 2/6B column samples, Site 35LK3400. The x-axis reflects percentages. Herbs/forbs graphed in blue, trees/shrubs graphed in green, and aquatic plants graphed in aqua. Red line designates the approximate Pleistocene-Holocene boundary.

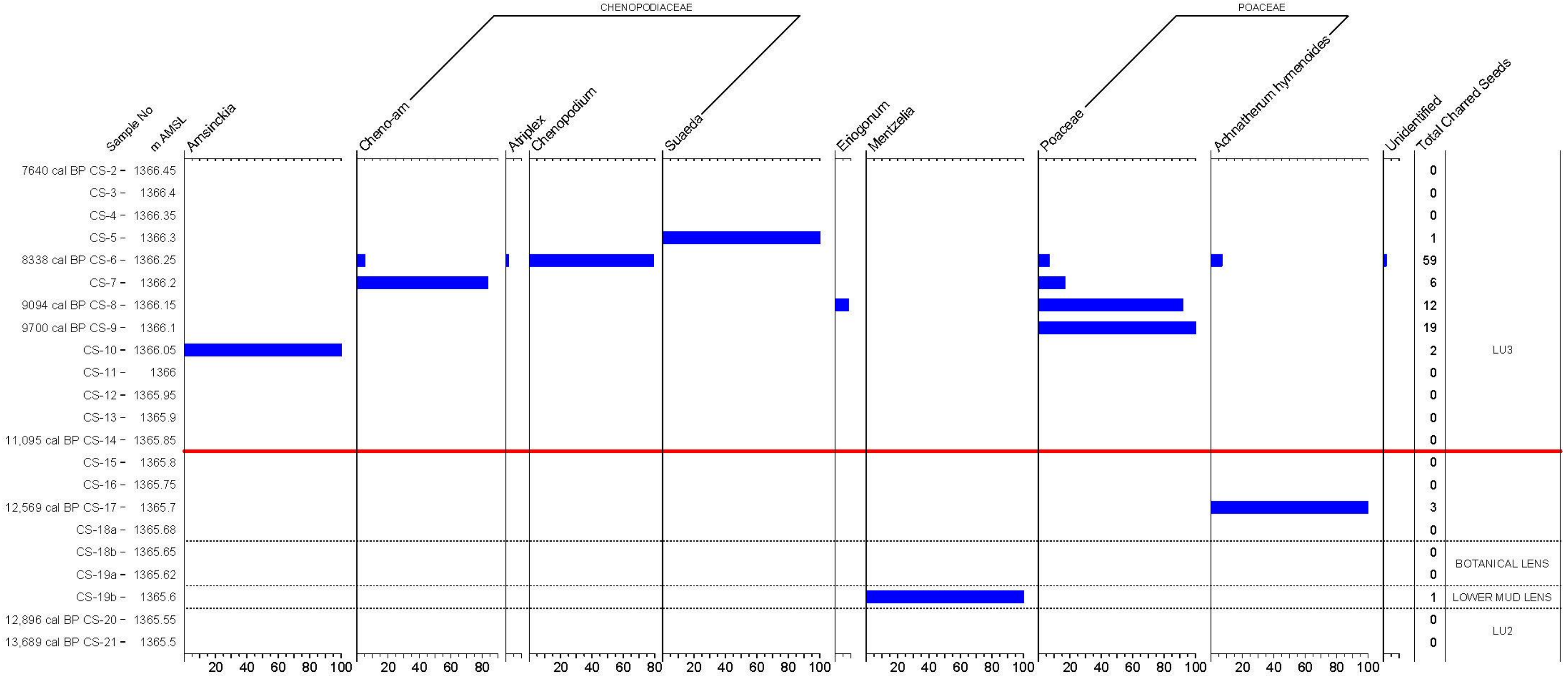

Figure 9.7. Relative abundances of charred seeds recovered from Unit 2/6B column samples, Site 35LK3400. The x-axis reflects percentages. All represented charred taxa consist of herbs and forbs. No arboreal or aquatic plants are represented in the charred macrobotanical assemblage. The red line approximates the timing of the Pleistocene-

This time span is represented by column samples CS-16 to CS-20 in the macrobotanical analysis. Here, *Pinus* seeds, but *not Pinus* needles, are noted in the Botanical Lens, along with *Juniperus* (Cupressaceae) seeds. Poaceae seeds dominate the macrobotanical record. Asteraceae seeds are not well represented during the Younger Dryas. *Ribes* and *Ceanothus* seeds are also present in the Younger Dryas macrobotanical assemblage. The presence of *Salix* charcoal and other wetland plants in the Younger-Dryas macrobotanical record specifically support Saban's suggestion people accessed nearby lacustrine and marsh resources at this time and generally support regional paleoclimate data indicating a cooler, wetter period. Toward the end of the Younger Dryas, increases in the number of cheno-am seeds are noted. Charred seeds are limited to *Achnatherum* and *Mentzelia*. *Mentzelia* (Loasaceae) is not represented in either pollen study, which could be due to the fact that *Mentzelia* is insect pollinated. It is also possible that blazingstar seeds were preferentially harvested and processed by people camping at the Paisley Caves and did not grow in the immediate vicinity of the site.

The Paisley Cave pollen records indicated the onset of the Early Holocene was marked by decreases in Chenopodiaceae-Amaranthaceae pollen and increases in conifer and Asteraceae pollen, while Poaceae and *Artemisia* pollen abundances remained stable (Beck et al. 2017). This period is represented by macrobotanical samples CS-10 to CS-15, which demonstrate increased abundances of Chenopodiaceae-Amaranthaceae and decreasing Poaceae seed abundances (from 54-100% in the Younger Dryas to 0-34% in the Early Holocene).

The diverging patterns of the macrobotanical to pollen records may result from dataset differences. Both pollen studies at the Paisley Caves demonstrate elevated abundances of *Pinus*, *Artemisia*, and Chenopodiaceae-Amaranathaceae types, and relatively few Poaceae types throughout the samples (Beck et al. 2017:8, 9; Saban 2015:36). These results are likely skewed due to the high pollen production of pine, sagebrush, and cheno-ams, and the low pollen production of grasses. The macrobotanical record more clearly depicts the local relative abundances of these taxa through time.

As the Early Holocene continued, records from the Paisley Caves identified palynomorphs include *Ceanothus*, *Shepherdia*, and Cactaceae (Saban 2015:42) and *Phacelia*, Fabaceae, *Eriogonum*, Rosaceae, Apiaceae, Polemoniaceae, *Rumex*, *Phlox*, *Corylus*, and *Dalea* (Beck et al. 2017:10). A higher diversity of herbs and forbs is also noted in the macrobotanical record. Macrobotanical column samples CS-5 to CS-9 coincide with this period. Seeds of Boraginaceae family members (especially *Amsinckia*) and *Artemisia* increase sharply at about 9700 cal BP. This increase is consistent with regional paleoclimate and GIS-modeled data that suggest the ecology of the Great Basin stabilized around 9800 years ago (Duke and King 2014). Boraginaceae pollen accounts for less than 1% of the pollen assemblages at the Paisley Caves. *Amsinckia* and other Boraginaceae members have high pollen-ovule ratios (Cruden 2000), but they are insect pollinated. Unless whole flowers were transported into the caves, Boraginaceae pollen would not likely be introduced to site deposits.

Saban (2015:42-43) reported another change in pollen abundances at the Paisley Caves just before the eruption of Mt. Mazama (7990 to7600 cal BP), when the relative contributions of Poaceae and *Pinus* increase. Macrobotanical samples CS-2 to CS-4 mirror the increase in the abundance of grass seeds accompanied by a decrease in Chenopodiaceae-Amaranthaceae seeds. However, no conifer seeds are present in the macroremains after ca. 11,000 cal BP. Lack of a detailed stratigraphic record post-dating the Mazama eruption ca. 7600 cal BP at the Paisley Caves …

At LSP-1 Rockshelter, very low taxonomic diversity is noted during the Holocene. The Early Holocene seed assemblage (represented by column samples CS-20 to CS-27) is dominated by *Amsinckia* at 10,200 cal BP. Over the next 1000 years, *Amsinckia* dominance alternates with Chenopodiaceae-Amaranathaceae seed dominance (Figures 9.8 and 9.9). *Mentzelia* seeds are the only other taxon observed in the uncharred seed assemblage during the Early Holocene. Charred seed types include *Agrostis* and *Typha* at this time. Following the eruption of Mt. Mazama (ca. 7600 cal BP), the column samples are sterile, indicating a period of low biodiversity in the vicinity of LSP-1 Rockshelter in the northern Warner Valley.

Towards the end of the Middle Holocene, *Amsinckia*, *Chenopodium*, and Brassicaceae seeds appear in column samples CS-14 and CS-15. The onset of the Late Holocene marks the return of flora dominated by *Amsinckia* and Chenopodiaceae-Amaranathaceae types. The distribution of charred seeds in the column sample also includes *Agrosits* and *Descurainia* seeds. These types probably represent the intentional harvesting and processing of spike bentgrass and tansymustard at LSP-1 Rockshelter.

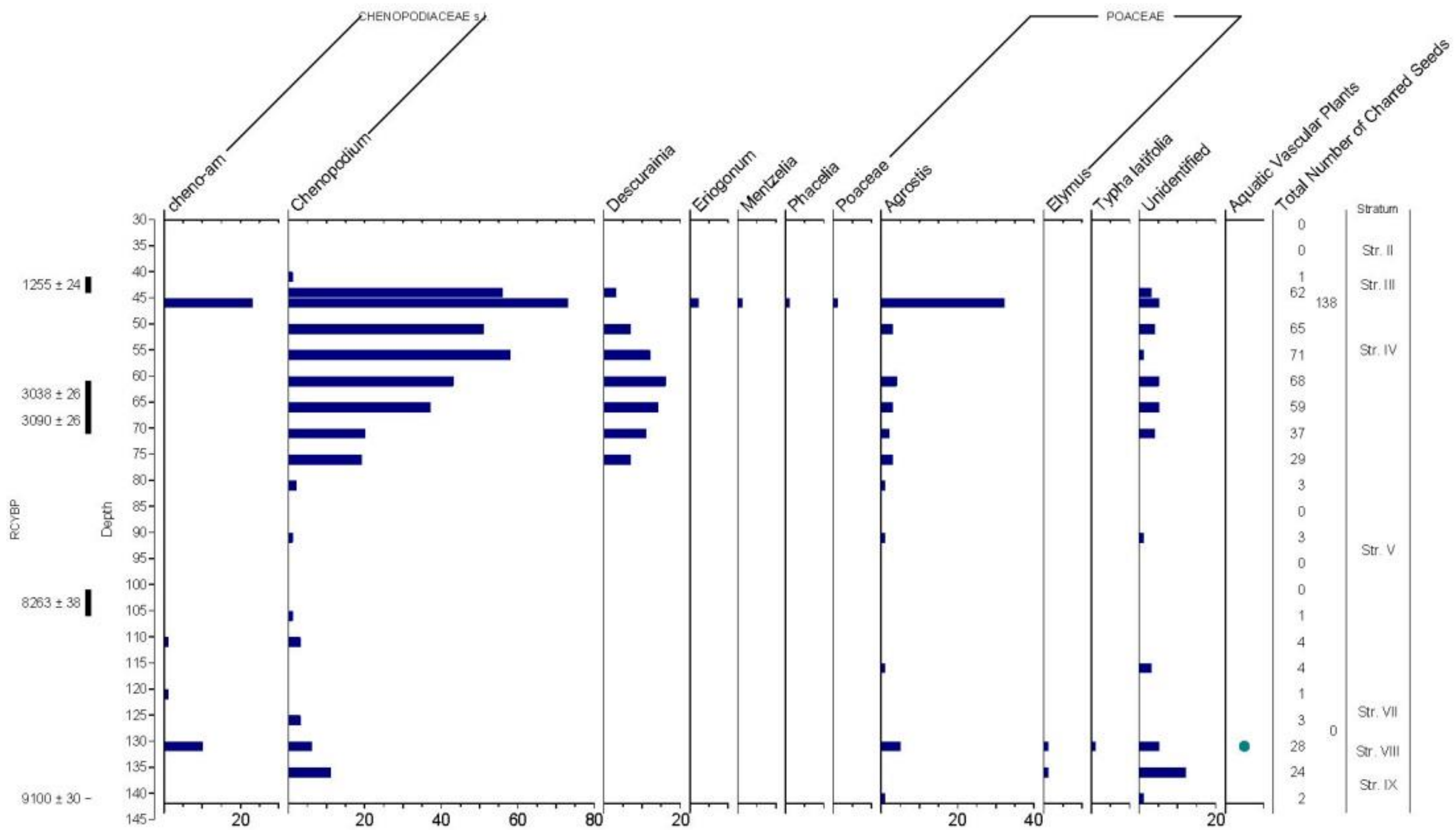

Figure 9.8. Relative abundances of charred seed taxa in N105E99 column, Site 35HA3735. The x-axis reflects percentages.

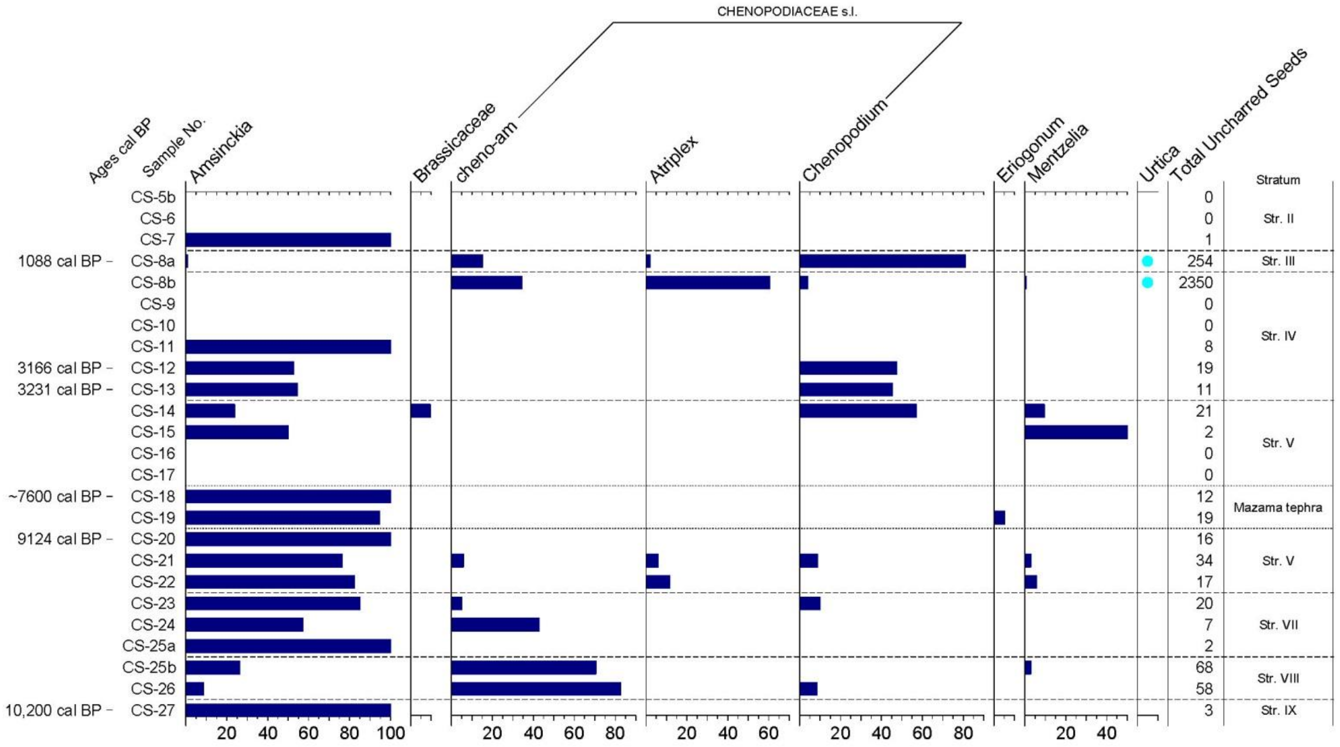

Figure 9.9. Relative abundances of uncharred seed taxa in N105E99 column, Site 35HA3735. The x-axis reflects percentages. Early Holocene-Middle Holocene boundary marked by eruption of Mt. Mazama, approximately 7600 cal BP.

Based on the relatively higher contribution of grass seeds and virtual absence of saltbush seeds in the Lower Package deposits, the Early Holocene at LSP-1 represented a period of increased moisture when compared to the Middle and Late Holocene. Wigand and Rhode's (2002) analysis of pollen from Bicycle Pond, located 300+ m above the valley floor in the southern Warner Valley, indicated grasses were more common during the Early Holocene while the Middle Holocene was marked by a retreat of juniper woodland and expansion of sagebrush.

In the southern Warner Valley, Hansen's (1947) analysis of pollen cores indicated saltbush peaked during the Middle Holocene, suggesting warmer and drier conditions at that time. The spike in saltbush seeds in the Late Holocene suggests that drier conditions in the immediate vicinity of the LSP-1 Rockshelter were not established until after ca. 3000 cal BP when the upper package deposits began accumulating.

When placed within the larger context of regional paleoclimate studies, these results demonstrate a record of fluctuations in local environmental conditions in the northern Warner Valley during the Holocene. Both Wriston and Smith (2012) and Weide (1974) suggested pluvial Lake Warner had retreated from the valley floor below LSP-1 by ca. 9650 cal BP, around the time the site was first occupied, but it is likely that the smaller lakes found in northern Warner Valley today (e.g., Bluejoint, Campbell) periodically rose and fell during the Holocene in a manner similar to that observed during historic times (Cannon et al. 1990).

Reviewed together, the pollen and macrobotanical records provide a holistic understanding of paleoclimate regimes. Although the charred seeds and charcoal recovered represent intentional harvesting from a variety of ecological niches, the assemblage of macroremains generally supports previous data relating to paleoclimate and micro-climate shifts in the northern Great Basin during the Younger Dryas and Early Holocene. Conditions were generally wetter after the Last Glacial Maximum, with increasing moisture and colder temperatures characterizing the Younger Dryas chronozone in the northern Great Basin. The Early Holocene ushered in a period of aridification, but local fluctuations in lake levels varied and the positions and sizes of marshes shifted differentially. Regionally, warmer and drier conditions intensified in the Middle Holocene, before ameliorating sometime between 6000 and 5000 cal BP. Local controls on vegetation varied from sub-basin to sub-basin throughout the Holocene, as evidenced by the macrobotanical records at LSP-1 Rockshelter and the Paisley Caves.

9.8. The Macrobotancial Record and Traditional Foodways

9.8.1. Traditional Ecological Knowledge in Novel Environments

Successful colonization of novel environments requires learning processes that can be long and slow (Meltzer 2009); however, the spread of the Western Stemmed Tradition (WST) and Clovis toolkits across western North and South America occurred relatively quickly (Dillehay et al. 2008, 2015; Ferring 2001; Gilbert et al. 2008a, 2008b; Halligan et al. 2016; Haynes 2015; Sanchez et al. 2014; Waters and Stafford 2007; Waters et al. 2010a, 2011b). Erlandson et al. (2011) linked Channel Island assemblages of Western Stemmed to those found in the interior sites around many lakes and marshes in North America’s Far West, including the Paisley Caves. “Such …assemblages may provide a logical technological link among Terminal Pleistocene stemmed point traditions of Northeast Asia, the Pacific Northwest, and possibly early stemmed point traditions widely distributed in South America” (Erlandson et al. 2011:1184).

Logical technological links, when understood through the lens of historical ecology, are not limited to the spread of formed tool types alone. Understanding the role of society-level and individual practice among Paleoindians in the Terminal Pleistocene facilitates more nuanced interpretations of the archaeological record because cultural, biological, and geological lines of evidence are incorporated in the analysis (Egan and Howell 2001).

Just as technological antecedents existed in the migratory landscapes of Paleoindians, so did biotic resources, and rapid cultural transmission through the Americas always included traditional ecological knowledge (TEK); environmental and cultural antecedents existed in migratory landscapes of Paleoindians. In a recent publication highlighting the importance of cattail in the diet of early North American inhabitants, McGuire and Stevens (2017:16) posed the question: “…what if one of the most important subsistence resources was the same species from Siberia to Mexico?” Though their hypothesis focuses on one specific resource, several plants and animals have extensive geographic distributions and would have been widely available in the Northern Hemisphere.

TEK pertaining to the ecology of rockshelters and their surrounding environments could potentially have aided visitors to the Paisley Caves during the

Late Pleistocene and Younger Dryas. Almost all (97.5%) of the seeds present in the woodrat nest ripen in the summer and fall months when bushytailed woodrats are known to increase caching behaviors. In addition to access to marsh and upland resources, the Paisley Caves may have offered an attractive location of known cached food stores. Early visitors to caves may have collected food and other items from the rodent stores. During times when high quality plant food items are scarce, people turned to rodent food stores to supplement their diets: “Today, we have evidence of indigenous peoples robbing the nests of food-hoarding rodents from Alaska and Canada down through the Rockies, Great Plains and Great Lakes regions, clear to the Sonoran and Chihuahuan Desert” (Nabhan 2009:5).

Upon arrival to the caves, humans evicted other animals living in the shelters. Evidence of smoldering fires representing the in-place burning of woodrat materials was documented in Paisley Cave 5 (Jenkins et al. 2016:194). Woodrat nests are also often scattered by predators, both human and non-human, which likely trap and eat the animals. Once the human occupants vacate the site, woodrats begin the reconstruction process, often collecting non-plant items along with vegetation (Smith 1997:564).

The contents of the woodrat nest analyzed for this project likely represent such a reconstruction episode. Of the 19 plant taxa identified in the rodent nest at the Paisley Caves, 11 represent food resources. These include *Achnatherum*, Poaceae, *Schoenoplectus/Scirpus, Atriplex*, *Oenothera*, *Descurainia*, *Trifolium*, *Rumex*, *Mentzelia*, *Leymus*, and *Carex*. Several uncharred *Urtica dioica* seeds in the woodrat nest represent the collection of stinging nettles. The paleoecological data generated in this analysis and in previous palynological studies (Beck et al. 2017; Saban 2015) suggest that although the proximity of marshy conditions to the caves was closer at the end of the Pleistocene than now, stinging nettles would have grown outside the foraging range of Paisley Caves woodrats. Those resources were likely foraged from culturally-deposited plant remains elsewhere in the caves. The macrobotanical data generated from the woodrat nest analysis suggests people's relationship with the rodents, and shared home in the caves may have provided mutualistic benefits (food caching, nesting material etc.) and disadvantages (competition for shelter, disease vectors, etc.) for both rodents and people.

At this time, there is no explicit evidence to determine whether people collected from the woodrat nests, but there is evidence suggesting the woodrats cached cultural materials. Threads and cordage fragments were recovered from the nest, and the presence of stinging nettles and bulrush seeds in the nest might reflect the collection of sleeping mat fragments, as well.

9.8.2. Traditionally Economically Important Plants

This analysis identified several seed and charcoal types that were important in the traditional economies of northern Great Basin tribes. In the Paisley Caves and LSP-1 Rockshelter assemblages, *Achnatherum*, *Amaranthus*, *Amsinckia*, *Atriplex*, *Chenopodium*, *Mentzelia*, and *Suaeda* charred seeds represent economically important plant taxa as defined by Fowler and Rhode (2007). Cheno-ams, in particular, appear to have been consistently collected and processed by Great Basin foragers over the past 12,000 years. Seeds of plants collected expressly for their roots and tubers included *Camassia* and Liliaceae-Amaryllidaceae types, reflecting the procurement of camas, wild onion, and other lilies. *Juncus*, *Urtica*, and *Scirpus/Schoenoplectus* seeds were likely collected for their fibers.

Hearths at LSP-1 Rockshelter demonstrate an elevated abundance of charred *Agrostis* and *Descurainia* seeds, reflecting an increased reliance on bentgrass and tansymustard seeds in the diet of LSP-1 inhabitants after 9650 cal BP. Neither bentgrass nor tansymustard are listed among the important subsistence foods in the Great Basin, but perhaps they should be added to the list compiled by Fowler and Rhode (2007). Ethnographic research in the late 18th and early 20th centuries indicates both plants were harvested and consumed by members of the Klamath and Modoc tribes (Colville 1897; Gatschet 1891; Jenkins 2000; Spier 1930). The documentation of the above-listed plants in ancient archaeological contexts demonstrates their sustained importance in the economies of Great Basin foragers throughout the Holocene and to present.

CHAPTER X

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

10.1. Research Conclusions

Among the foraging societies of the Great Basin, environmental constraints have always figured prominently in settlement, subsistence, technological change, and cultural practices. Archaeologists often investigate the relationship between human behavior and environmental permutations. Analysis of archaeobotanical assemblages provides a direct linkage to explore these interactions. The study of macrobotanical remains in archaeological contexts is especially useful because seeds, charcoal, roots, and vegetative tissues provide direct evidence of plant use and paleoenvironmental records. Arid conditions unique to rockshelters in the northern Great Basin are particularly valuable in reconstructing cultural and environmental sequences, because macrobotanical ecofacts are more likely to survive under these circumstances.

Rockshelters in the Great Basin were frequently visited by foragers throughout the Holocene, and even as early as the Terminal Pleistocene. Human coprolites at the Paisley Caves indicate people inhabited the northern Great Basin, and visited local rockshelters, as early as 14,300 years ago. These locations store thousands of years of material culture and paleoenvironmental indicators, including macrobotanical remains. This dissertation addressed questions related to hunter-gatherer subsistence and local permutations in the paleoecological record. Regional paleoecological data provided context for understanding not only fluctuations in local climate, but also a baseline for interpreting human foraging strategies and movement through the landscape. My investigation relied on a historical ecological approach to understand how traditional ecological knowledge may have structured foraging decisions and behaviors.

10.1.1. Northern Great Basin Plant Use

The macrobotanical data generated in this dissertation addressed several questions related to foraging behaviors and plant usage. When reviewed in tandem with regional data from the northern Great Basin, these data provide answers to the research questions raised in Chapter III.

The primary constituents of macrobotanical assemblages in this project were seeds. Both charred and uncharred seeds were present in and outside of cultural features at the Paisley Caves and LSP-1 Rockshelter. Because the rockshelters investigated here support exceptional preservation conditions, uncarbonized seeds may have substantial antiquity. Statistical tests demonstrated that the population of carbonized seeds differed significantly from the population of uncarbonized seeds, and therefore, only charred plant remains were considered part of the cultural assemblages. Although several charred seed taxa were identified, the assemblages at both sites were dominated by cheno-ams, including saltbush and goosefoot, grasses, and fiddleneck. Spike bentgrass was the most common grass seed in LSP-1 deposits, and Indian ricegrass was more common in the Paisley Caves samples. Grasses and cheno-ams are the primary seeds found in other investigations of archaeological plant remains, as well (see Table 2.3). Aside from this investigation, fiddleneck has only been documented at the Dirty Shame Rockshelter in southeast Oregon (Puseman and Yost 2011; Sanford 1983), and has not been recorded in archaeobotanical assemblages in the Fort Rock, Summer Lake, or Warner basins. The relative diversity of seed types in the Paisley Caves samples is higher than for any other archaeological site in the northern Great Basin except for Dirty Shame Rockshelter (Puseman and Yost 2011; Sanford 1983).

Remnant charcoal from campfires at both the Paisley Caves and LSP-1 Rockshelter was predominantly sagebrush fragments. This finding illustrates a heavy reliance on sagebrush for fuel by residents of both sites through every habitation episode documented here. This pattern is consistent with archaeobotanical records for the Great Basin, where sagebrush is ubiquitous on the landscape. Other common fuel types in the northern Great Basin, including juniper, pine, serviceberry, and mountain mahogany (e.g., Connolly et al. 2015; Helzer 2001; Prouty 2001), were not identified in this study.

The abundance of charred plant types fluctuates through time at the Paisley Caves and LSP-1 Rockshelter. In the Younger Dryas, people preferentially harvested cheno-ams including saltbush and goosefoot, along with grasses, especially Indian ricegrass, white-stem blazingstar, and tansymustard. Other identified types dating to Late Pleistocene contexts include pigweed, camas, purple tansy, vetch, lily, plantain, borages, geraniums, rushes, and desert mallow. The presence of liliaceous seeds (possibly wild onion or sego lily) and camas seeds, and charred parenchymous tissues representing geophytes, suggests roots also contributed to Paleoindian diet. No camas bulbs or onions were found in this study and it is possible that other parts of the plants were consumed 12,000 years ago. Northern Paiute informants in western Nevada report eating the raw stems and bulbs of wild onions (Park and Fowler 1989:44).

Starchy geophytic tissues, although present in cooking features, especially the Cave 5 earth oven, were not abundant in this study. Previous paleoethnobotanical research has demonstrated roots did not comprise a significant portion of hunter-gatherer diet in the northern Great Basin until after 6000 cal BP (Aikens et al. 2011). The presence of an earth oven at the Paisley Caves demonstrates a sophisticated understanding of ecological and cultural knowledge thousands of years prior to the Basin-wide intensification of root processing.

Macrobotanical remains from the Botanical Lens, a cultural deposit consisting mostly of sagebrush matting and pronghorn hair that dates to the Younger Dryas, also included uncharred stinging nettle seeds outside of hearths associated with the feature. Stinging nettles were probably collected for fiber in order to weave mats and other textiles. Stinging nettle seeds were also recovered in the Paisley Cave 5 earth oven. The greens may have been used as a vegetation layer in the cooking feature, or the seeds may have been inadvertently introduced from a nearby matting material. Juniper and pine seeds were also recovered in association with Younger Dryas deposits.

The varied ecologies of the taxa represented indicate visitors to the Paisley Caves with Western Stemmed toolkits foraged in multiple habitats near their campsite. Protein residue and Fourier-transform infrared spectroscopy (FTIR) analyses conducted on coprolites provide evidence for a varied diet that included large, medium, and small mammals, bird, and plant resources. Ongoing faunal research also demonstrated the incorporation of insects, especially Jerusalem crickets, into the diet, and has provided evidence for the consumption of fish (Hockett et al. 2017).

Early Holocene plant assemblages at both sites are dominated by cheno-ams, mustards, and grasses, but also included wada and buckwheat at the Paisley Caves between 9000 and 8000 cal BP. These data are consistent with macrobotanical records from other archaeological sites in the northern Great Basin (Gilmour et al. 2015; Prouty 2004; Sanford 1983). Seeds would have been available to harvest predominantly in the summer and fall during the Younger Dryas and Early Holocene. Because people may have scavenged seeds from existing woodrat nests upon arrival at the site, the seasonal data may only reflect the timing of woodrat foraging. Interpretations directly equating seed ripening times with habitation events are problematic without incorporating corroborating archaeological data.

A dearth of macrobotanical remains in the Middle Holocene at the Paisley Caves and LSP-1 Rockshelter beginning at approximately 8000 cal BP is consistent with observed patterns in the temporal distribution of artifacts and radiocarbon dates, as proxies for population demographics in northern Great Basin rockshelters during the Altithermal period (Aikens et al. 2011). During this time, residences and campsites were focused on lowland dune and marsh sites rather than upland rockshelters (Aikens et al. 2011; Jenkins et al. 1994, 2004). Intermittent visits to the Paisley Caves at this time appear to have occurred later in the autumn based on the known flowering times of the plant taxa represented. The presence of economically valuable plant taxa present in cultural contexts and absent in the woodrat nest demonstrate reliable seasonality data were generated in this study.

In the Late Holocene, seed consumption appears to have diversified at both sites. The presence of elderberry, pine, cherry, and wild rose seeds in Late Holocene contexts suggests the foraging ranges of visitors to the rockshelters expanded to include upland forests. Seeds of fiddlenecks and white-stemmed blazingstar were incorporated into the diet at a significantly higher rate. Although white-stemmed blazing star was considered an important food source in the traditional economies of Great Basin tribes (Colville 1897; Fowler and Rhode 2007; Kelly 1932; Park and Fowler 1989), it had not been identified in archaeological assemblages of the northern Great Bain until now. Ongoing research at the Connley Caves in the neighboring Fort Rock Valley has also detected the presence of this plant in human coprolites (McDonough 2018). The collection of this seed type may represent a local foraging behavior in southcentral Oregon.

The assemblage of culturally-deposited seeds at the Paisley Caves and LSP-1 Rockshelter reflect prolonged use of traditionally important plants by the indigenous communities of the northern Great Basin, but also contributes new observations related to pre-contact hunter-gatherer diets. Cheno-ams figure prominently in the diets of several Great Basin tribes, including the Northern Paiute and Modoc (Fowler and Rhode 2007; Park and Fowler 1989; Ray 1963). Although charred goosefoot seeds have been documented previously in Early Holocene macrobotanical assemblages at Dirty Shame Rockshelter (Sanford 1983) and Locality III in the Fort Rock Basin (Prouty 2004), their presence in Younger Dryas-aged hearths at the Paisley Caves illustrate the deep antiquity of cheno-am importance in the northern Great Basin.

Other taxa identified in this study, including bentgrass and tansymustard, are not mentioned in post-contact ethnographic accounts (but see Park and Fowler 1989:47 for an exception to this statement). Tansymustard has been identified in southeastern Oregon archaeological sites including Dirty Shame Rockshelter, Erin’s Cave, and Skull Creek Dunes Locality 10 (Dexter 2010; Puseman and Yost 2011; Thomas et al. 2015, Sanford 1983). These cases illustrate the value of incorporating indigenous perspectives and ethnographic analogy into interpretation of the archaeological record, but also highlight the need for rigorous archaeological research independent of such inductive premises.

10.1.2. Paleoecology of the Summer Lake Basin and Northern Warner Valley

Paleoecological investigations in the northern Great Basin demonstrate general climatic trends associated with the Alleröd (14,500 to 13,000 cal BP), the Younger Dryas (12,900 to 11,600 cal BP), and the Middle Holocene Climate Optimum (7000 to 5000 cal BP). Macrobotancial data from the Paisley Caves and LSP-1 Rockshelter were compared to local and regional pollen studies to refine existing paleoecological interpretations. At the Paisley Caves, the microbotanical and macrobotanical datasets indicate mesic conditions prior to the onset of the Younger Dryas as evidenced by copious conifer pollen and the presence of grass and stinging nettle macrofossils.

During the Younger Dryas, conditions cooled and the sagebrush steppe expanded (Beck et al. 2017; Saban 2015). Pine trees likely grew in closer proximity to the Paisley Caves than their current distribution on Winter Rim, although the lack of pine needles in the macrobotanical assemblage reported here suggests that the trees were not located in the immediate vicinity of the site. Increases in moisture-adapted plants are noted in the macrobotanical record and in the pollen record (Saban 2015). Although the presence of water-loving plants is seemingly counterintuitive to the expansion of the steppe environment, they probably represent increasing marsh habitat as the pluvial lakes receded.

Regional paleoecological records for the Early Holocene show a return to more mesic conditions after the Younger Dryas (Wigand and Rhode 2002). Elevated abundances of grass seeds at the Paisley Caves and LSP-1 Rockshelter after ca. 9000 cal BP support this interpretation. The archaeological pollen data at Paisley Caves indicate a decrease in grass during the same period, but the grass signature in the pollen record is likely drowned out by the abundance of sagebrush pollen grains (Beck et al. 2017).

Increases in saltbush and other drought-adapted plants in the Middle Holocene suggest that warmer and drier conditions prevailed in the project area. This observation is also noted in the paleoecological record of the Warner Valley and Summer Lake Basin, where Hansen (1947) reported similar spikes in saltbush pollen. Local fluctuations in ecological conditions probably varied from location to location within basins. At LSP-1 Rockshelter, the presence of saltbush seeds continued to increase into the Late Holocene, while at the Paisley Caves, the abundance of saltbush seeds dramatically decreased.

10.2. Future Directions

10.2.1. Future Research Avenues

While the research conducted in this dissertation answers several questions on paleoclimate and the role of plant foods in the lives of northern Great Basin indigenous peoples, the study is largely exploratory in nature. As such, the answers generated a novel set of research questions that should be addressed in future research endeavors. Future research will help clarify uncertainties in the archaeobotanical and archaeological record.

Quite a few identifications in this analysis were made only to the family level. Grasses, in particular, were only identified to genus when the taxa were encountered numerous times. Those specimens representing unique or infrequent types were not identified to genus or species. Additionally, incomplete grass floret fragments and rachis were identified only as Poaceae. Several uncharred grass specimens in Paisley Cave 5/5 remain unidentified. Future investigations that can make specific identifications may provide more detailed paleoclimate data for the Younger Dryas and Early Holocene components of the site. Forthcoming research in Cave 5, Unit 5/12 will include a multi-disciplinary analysis of micromorphology, faunal and botanical remains.

As a corollary to the research on cultural plant use at the Paisley Caves, I analyzed the constituents of a TP/EH *Neotoma cinerea* nest to investigate its paleoecological signature. The recovery of several edible seeds from the nest, and research on rodent caching behaviors and the mutualistic relationship between people and bushy-tailed woodrats, facilitated an original research question: were rodent nests and other animal middens explicitly scavenged to recover predictably reliable resources to supplement active foraging? Another significant question raised was whether woodrats scavenged from human foodstores, which could introduce botanical remains from distant habitats into woodrat middens. A more refined course of archaeobotanical research specifically targeting intact nests in Great Basin rockshelters is necessary to address these questions. Additionally, isotopic analyses may provide insights. The single sample analyzed in this dissertation certainly instigated the inquiry, but lacks the statistical power to test the hypothesis due to sample size constraints.

The presence of camas and other liliaceous seeds at the Paisley Caves, cattail at LSP-1 Rockshelter, and charred starchy plant tissues at both sites, suggest residents of the northern Great Basin may have consumed roots and tubers in the Terminal Pleistocene and Early Holocene – yet macrobotanical analysis does not adequately detect this signature. More microbotanical research including coprolite analysis and starch analysis on groundstone use surfaces could elucidate the importance of these resources in the diet. Cummings and Puseman (2003) successfully extracted Apiaceae (likely biscuitroot) starch on a handstone associated with megafaunal remains at the Paisley Caves, demonstrating a long history of Great Basin foragers harvesting roots. Palynologists at the University of Oregon and Texas A & M University are currently analyzing coprolites from Paleoindian archaeological sites in the northern Great Basin. Forthcoming publications will provide additional information on plant taxa consumed by site residents.

The detail and scale of the enormous dataset generated in this study needs to be replicated at other archaeological sites in order to answer some questions posited in Chapter III. For example, to fully investigate whether plant assemblages associated with the Western Stemmed Tradition reflect a distinctive subsistence pattern, archaeobotanical analysis at a number of sites should be conducted to address such a large-scale question. Refining regional and global archaeobotanical databases will provide the foundation necessary to addressing comprehensive archaeological inquiries. Additionally, the reliability of data from the Cave 5 strata samples at the Paisley Caves remains questionable due to poor stratigraphic association with artifacts and radiocarbon dates.

10.2.2. General Considerations

The ephemeral footprint of hunter-gatherer populations in western North America during the Late Pleistocene and Early Holocene epochs generates limited archaeological evidence, and even less archaeobotanical data, accentuating the importance of the archaeobotanical materials analyzed in this study. More investigations directed at understanding the role of plants in human-environmental relationships should be pursued when such signatures are detected. In the Great Basin, in particular, there is a need for more attention to the role of plants in subsistence economies throughout the Holocene.

Ecological studies in non-agrarian societies tend to focus more on the importance of animals than plants in considering subsistence and settlement patterns. Largely, this is due to taphonomic considerations and the sheer size of zooarchaeological elements compared to macrobotanical remains. Historically, in the Great Basin, plants contributed equally, if not more, to the diets of foraging populations. Fowler (1986) reports Great Basin foragers consumed taxa from over 50 families of plants. Several ethnographers note the importance of plants in studies of Great Basin people at contact:

> The search for vegetal foods occupied a large part of the Modoc woman's days, spring through autumn. Many of the movements of families and groups during the growing and ripening seasons were dictated by the succession of crops and the wide geographic spread of the many plants which had to be gathered of economic

> necessity…[M]any kinds of plants were found only in limited numbers and in widely distributed patches. (Ray 1963:197)

And:

> …the Paiutes ate everything they could find in their arid habitat, including grasshoppers, crickets, caterpillars, and dogs, but not snakes…They also ate fish, especially trout and salmon…Rabbits were a much more important article of diet than deer or antelope, for obvious reasons. They of course ate many water fowls, such as ducks, geese, swans, and so on, which visited in countless numbers of the lakes of that region. But the main food supply was undoubtedly wild roots and seeds…so much so that in this respect at least they belong in Wisler's [sic] "Area of wild seeds." (de Angulo and Freeland 1929:321)

Plants are integral to subsistence and settlement choice made by any foraging population following seasonally-available resources. In the Great Basin, plants in large part determined the cycle of the seasonal round.

Facilitating a broader understanding of plant resources through time requires a synthesis of regional paleoethnobotanical data to expand our understanding of plant exploitation in a larger perspective. Paleoethnobotanists must continue to expand archaeological inquiry to incorporate several datasets regionally, especially sites with ancient deposits such as Connley Caves in the Fort Rock Basin, Rimrock Draw Rockshelter in eastern Oregon, and Cooper's Ferry on the Snake River Plain (among others). To assess whether increased diet breadth in the Early Holocene influenced the territorial and population expansion of people using Western Stemmed technologies, future research should explicitly model the contributions of plant and animal resources documented in the archaeological record. Work at these sites is ongoing and will undoubtedly contribute data that will build upon the work reported in this dissertation. This can provide insights as to how the First Americans relied on their institutional knowledge of experienced landscapes to successfully settle in novel environments.

Traditional ecological knowledge is the accumulation of generational awareness and learning. This understanding is a process that necessitates the retention of existing inputs (indigenous knowledge of landscape) as well as the incorporation of new inputs (changing environmental conditions, cataclysmic events, colonization of new places). Understanding Great Basin archaeology from a landscape perspective requires collaboration across disciplines. We must incorporate not only paleoecological information, but also biological and biogeographic data to make more holistic assessments of the distribution and origins of plant remains.

Moreover, archaeological subsistence studies should aim to identify niche construction practices in foraging societies (Boivin et al. 2016; Smith 2007). Human behavioral ecologists create robust and elegant models for understanding foragers' decision-making in the past and how those decisions affect the distribution of archaeological materials on the landscape. As discussed in Chapter II, the intensification of small seed processing around 8000 cal BP is often cited as evidence for resource depression in the Great Basin. However, increased consumption rates of these resources alone are not sufficient evidence to demonstrate the scarcity of other resources. Adoption of niche constructing behaviors into these models can facilitate research in the Great Basin that moves beyond prey models that overemphasize net caloric gains as the primary motivator for subsistence decisions, to demonstrate how the whole landscape was utilized, pressured, and enhanced in the past. Like niche construction theory, historical ecology also envisions humans as dynamic participants in local ecosystems for millennia, responding to changes in natural systems while also managing and modifying biodiversity and biological productivity.

APPENDIX A

CONNLEY CAVES (35LK50) MACROBOTANICAL DATA

PILOT STUDY

Sample	Identification	Part/Type	Charred		Uncharred		Weight
			WH	FR	WH	FR	
1693	**FLORAL REMAINS**						
	Atriplex	Leaf				1	
Unit 4/3	*Chenopod*	Seed	1		9	3	
Level 53	*Lappula*	Seed				1	
Feature 3-3D floor							
sample	**CHARCOAL**	**Total charcoal ≥ 1 mm**		**2**			
1355.27 masl	*Artemisia* sp.	Charcoal		2			
Floated volume: 1.0 L	**NON-FLORAL REMAINS**						
Light fraction: 3.70 g	Flake ≥ 2 mm	Basalt				4	0.636 g
	Flake < 2 mm	Basalt				4	0.004 g
	Flake ≥ 2 mm	Obsidian				2	0.135 g
	Flake < 2 mm	CCS				2	<0.000 g
	Insect body				1		<0.000 g

APPENDIX B

LSP-1 ROCKSHELTER RADIOCARBON ASSAYS

```
                      RADIOCARBON CALIBRATION PROGRAM*
                                CALIB REV7.1.0
                 Copyright 1986-2015 M Stuiver and PJ Reimer
         *To be used in conjunction with:
         Stuiver, M., and Reimer, P.J., 1993, Radiocarbon, 35, 215-230.

CS 8A
D-AMS 0105
35HA3735
Radiocarbon Age BP   1255 +/-   24
Calibration data set: intcal13.14c                # Reimer et al. 2013
  % area enclosed       cal BP age ranges             relative area under
                                                  probability distribution
  68.3 (1 sigma)     cal BP 1179 - 1188                    0.128
                            1202 - 1257                    0.872
  95.4 (2 sigma)     cal BP 1088 - 1110                    0.030
                            1125 - 1138                    0.016
                            1146 - 1159                    0.021
                            1172 - 1276                    0.933
  Median Probability:  1219

CS 12
D-AMS 0105
35HA3735
Radiocarbon Age BP   3038 +/-   26
Calibration data set: intcal13.14c                # Reimer et al. 2013
  % area enclosed       cal BP age ranges             relative area under
                                                  probability distribution
  68.3 (1 sigma)     cal BP 3183 - 3194                    0.097
                            3207 - 3253                    0.571
                            3294 - 3326                    0.331
  95.4 (2 sigma)     cal BP 3166 - 3273                    0.668
                            3284 - 3342                    0.332
  Median Probability:  3242

CS 13
D-AMS 0105
35HA3735
Radiocarbon Age BP   3090 +/-   26
Calibration data set: intcal13.14c                # Reimer et al. 2013
  % area enclosed       cal BP age ranges             relative area under
                                                  probability distribution
  68.3 (1 sigma)     cal BP 3252 - 3297                    0.588
                            3325 - 3358                    0.412
  95.4 (2 sigma)     cal BP 3231 - 3369                    1.000
  Median Probability:  3296
```

```
CS 16
 D-AMS 0105
 35HA3735
 Radiocarbon Age BP   3046 +/-   31
 Calibration data set: intcal13.14c                # Reimer et al. 2013
   % area enclosed       cal BP age ranges            relative area under
                                                   probability distribution
   68.3 (1 sigma)     cal BP 3209 - 3260                    0.542
                             3289 - 3334                    0.458
   95.4 (2 sigma)     cal BP 3170 - 3349                    1.000
   Median Probability:  3255

 CS 20
 D-AMS 0105
 35HA3735
 Radiocarbon Age BP   8263 +/-   38
 Calibration data set: intcal13.14c                # Reimer et al. 2013
   % area enclosed       cal BP age ranges            relative area under
                                                   probability distribution
   68.3 (1 sigma)     cal BP 9136 - 9183                    0.290
                             9194 - 9305                    0.696
                             9364 - 9368                    0.014
   95.4 (2 sigma)     cal BP 9124 - 9408                    1.000
   Median Probability:  9253

 CS 22
 D-AMS 0105
 35HA3735
 Radiocarbon Age BP   5238 +/-   26
 Calibration data set: intcal13.14c                # Reimer et al. 2013
   % area enclosed       cal BP age ranges            relative area under
                                                   probability distribution
   68.3 (1 sigma)     cal BP 5939 - 5996                    1.000
   95.4 (2 sigma)     cal BP 5921 - 6022                    0.872
                             6079 - 6112                    0.087
                             6155 - 6174                    0.041
   Median Probability:  5973

 CS 25B
 D-AMS 0105
 35HA3735
 Radiocarbon Age BP   1173 +/-   25
 Calibration data set: intcal13.14c                # Reimer et al. 2013
   % area enclosed       cal BP age ranges            relative area under
                                                   probability distribution
   68.3 (1 sigma)     cal BP 1060 - 1093                    0.389
                             1106 - 1147                    0.426
                             1158 - 1173                    0.185
   95.4 (2 sigma)     cal BP 1002 - 1027                    0.082
                             1051 - 1178                    0.918
   Median Probability:  1108

 CS 26
 D-AMS 0105
 35HA3735
```

```
Radiocarbon Age BP   7944 +/-   35
Calibration data set: intcal13.14c                # Reimer et al. 2013
  % area enclosed       cal BP age ranges             relative area under
                                                  probability distribution
  68.3 (1 sigma)     cal BP 8656 - 8670                    0.060
                            8699 - 8789                    0.447
                            8829 - 8865                    0.176
                            8884 - 8896                    0.051
                            8915 - 8972                    0.266
  95.4 (2 sigma)     cal BP 8644 - 8816                    0.525
                            8823 - 8979                    0.475
  Median Probability:  8806

 References for calibration datasets:
Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE
Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Haflidason H,
Hajdas I, HattÃ© C, Heaton TJ, Hogg AG, Hughen KA, Kaiser KF, Kromer B,
Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Turney CSM,
van der Plicht J.
IntCal13 and MARINE13 radiocarbon age calibration curves 0-50000 years calBP
Radiocarbon 55(4). DOI: 10.2458/azu_js_rc.55.16947

Comments:
* This standard deviation (error) includes a lab error multiplier.
** 1 sigma = square root of (sample std. dev.^2 + curve std. dev.^2)
** 2 sigma = 2 x square root of (sample std. dev.^2 + curve std. dev.^2)
where ^2 = quantity squared.
[ ] = calibrated range impinges on end of calibration data set
0* represents a "negative" age BP
1955* or 1960* denote influence of nuclear testing C-14

NOTE:  Cal ages and ranges are rounded to the nearest year which
       may be too precise in many instances.  Users are advised to
       round results to the nearest 10 yr for samples with standard
       deviation in the radiocarbon age greater than 50 yr.
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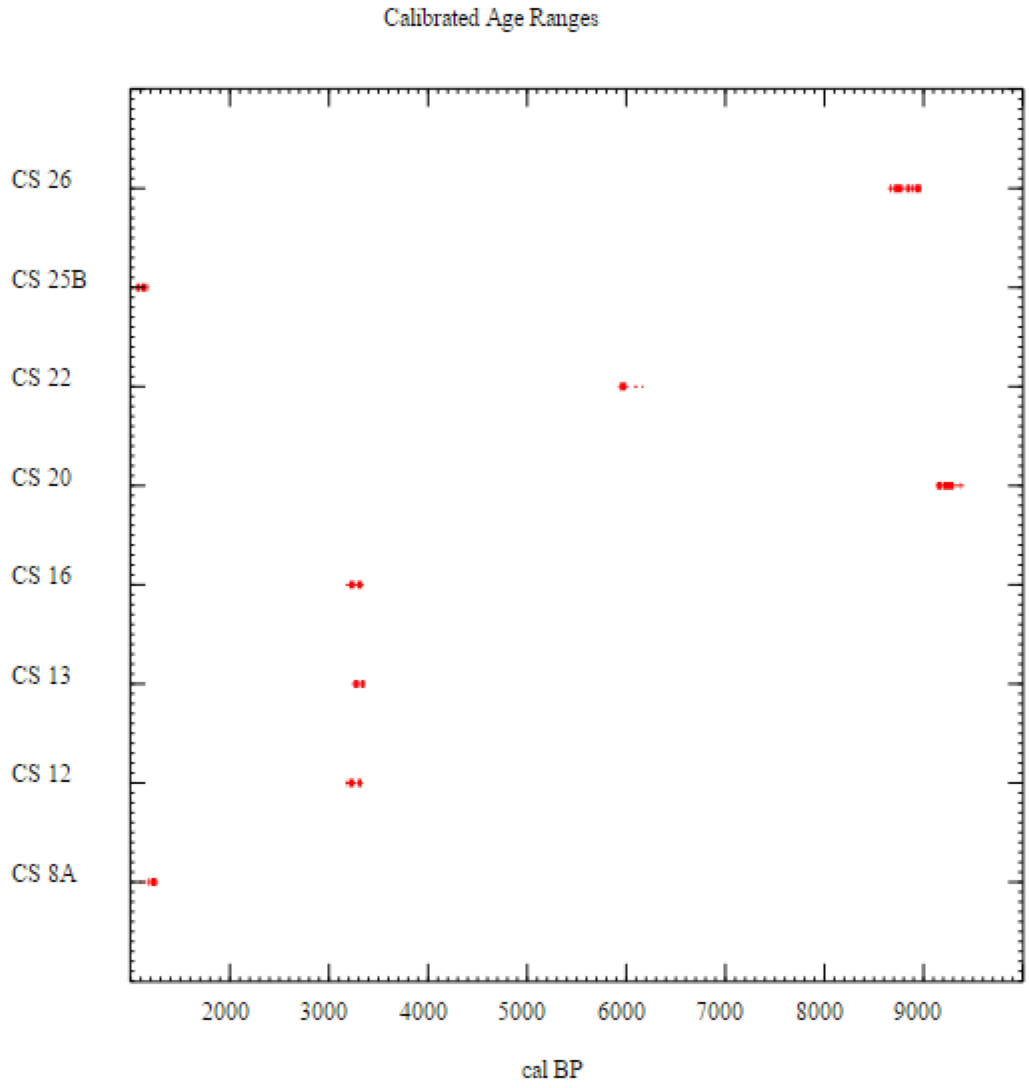
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CS 25B
CS 22
CS 20
CS 16
CS 13
CS 12
CS 8A
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3000
4000
5000
6000
7000
8000
9000
cal BP

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RADIOCARBON CALIBRATION PROGRAM*
                                 CALIB REV7.1.0
                  Copyright 1986-2015 M Stuiver and PJ Reimer
          *To be used in conjunction with:
          Stuiver, M., and Reimer, P.J., 1993, Radiocarbon, 35, 215-230.

 FS 1653
 D-AMS 0105
 35HA3735 F. 11-14
 Radiocarbon Age BP   1013 +/-   29
 Calibration data set: intcal13.14c                # Reimer et al. 2013
   % area enclosed       cal BP age ranges             relative area under
                                                   probability distribution
   68.3 (1 sigma)     cal BP 922 - 957                      1.000
   95.4 (2 sigma)     cal BP 803 - 810                      0.014
                             829 - 859                      0.072
                             904 - 976                      0.914
   Median Probability:   935

 FS 2432
 D-AMS 0105
 35HA3735 F. 14-02
 Radiocarbon Age BP   3987 +/-   26
 Calibration data set: intcal13.14c                # Reimer et al. 2013
   % area enclosed       cal BP age ranges             relative area under
                                                   probability distribution
   68.3 (1 sigma)     cal BP 4421 - 4444                    0.419
                             4481 - 4513                    0.581
   95.4 (2 sigma)     cal BP 4416 - 4453                    0.398
                             4461 - 4520                    0.602
   Median Probability:  4476

 FS 2429
 D-AMS 0105
 35HA3735 F. 14-04
 Radiocarbon Age BP   3990 +/-   26
 Calibration data set: intcal13.14c                # Reimer et al. 2013
   % area enclosed       cal BP age ranges             relative area under
                                                   probability distribution
   68.3 (1 sigma)     cal BP 4422 - 4444                    0.402
                             4481 - 4514                    0.598
   95.4 (2 sigma)     cal BP 4417 - 4454                    0.381
                             4461 - 4521                    0.619
   Median Probability:  4477

  References for calibration datasets:
 Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE
 Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Haflidason H,
 Hajdas I, HattÃ© C, Heaton TJ, Hogg AG, Hughen KA, Kaiser KF, Kromer B,
 Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Turney CSM,
 van der Plicht J.
 IntCal13 and MARINE13 radiocarbon age calibration curves 0-50000 years calBP
 Radiocarbon 55(4). DOI: 10.2458/azu_js_rc.55.16947

 Comments:
 * This standard deviation (error) includes a lab error multiplier.
```

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** 1 sigma = square root of (sample std. dev.^2 + curve std. dev.^2)
** 2 sigma = 2 x square root of (sample std. dev.^2 + curve std. dev.^2)
where ^2 = quantity squared.
[ ] = calibrated range impinges on end of calibration data set
0* represents a "negative" age BP
1955* or 1960* denote influence of nuclear testing C-14

NOTE:  Cal ages and ranges are rounded to the nearest year which
       may be too precise in many instances.  Users are advised to
       round results to the nearest 10 yr for samples with standard
       deviation in the radiocarbon age greater than 50 yr.
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PREVIOUS DATES:

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                      RADIOCARBON CALIBRATION PROGRAM*
                                CALIB REV7.1.0
                 Copyright 1986-2015 M Stuiver and PJ Reimer
         *To be used in conjunction with:
         Stuiver, M., and Reimer, P.J., 1993, Radiocarbon, 35, 215-230.

F. 11-05
Lab Code
35HA3735 FS 1658
Radiocarbon Age BP   2490 +/-   25
Calibration data set: intcal13.14c                # Reimer et al. 2013
  % area enclosed       cal BP age ranges             relative area under
                                                  probability distribution
  68.3 (1 sigma)     cal BP 2497 - 2596                    0.714
                            2612 - 2621                    0.070
                            2627 - 2637                    0.070
                            2686 - 2706                    0.146
  95.4 (2 sigma)     cal BP 2473 - 2475                    0.002
                            2485 - 2722                    0.998
  Median Probability:  2585

F. 11-19
Lab Code
35HA3735 FS 1649
Radiocarbon Age BP   2910 +/-   30
Calibration data set: intcal13.14c                # Reimer et al. 2013
  % area enclosed       cal BP age ranges             relative area under
                                                  probability distribution
  68.3 (1 sigma)     cal BP 2992 - 3078                    0.850
                            3094 - 3107                    0.090
                            3129 - 3138                    0.060
  95.4 (2 sigma)     cal BP 2961 - 3084                    0.744
                            3087 - 3157                    0.256
  Median Probability:  3048

F. 11-07
Lab Code
35HA3735 FS 1657
Radiocarbon Age BP   4010 +/-   20
Calibration data set: intcal13.14c                # Reimer et al. 2013
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```

```
                                                  probability distribution
  68.3 (1 sigma)     cal BP 4437 - 4448                     0.188
                            4467 - 4492                     0.434
                            4495 - 4517                     0.378
  95.4 (2 sigma)     cal BP 4425 - 4521                     1.000
  Median Probability:  4479

F. 13-01
Lab Code
35HA3735 FS 1031
Radiocarbon Age BP   8700 +/-   30
Calibration data set: intcal13.14c                # Reimer et al. 2013
  % area enclosed       cal BP age ranges             relative area under
                                                  probability distribution
  68.3 (1 sigma)     cal BP 9563 - 9571                     0.071
                            9584 - 9588                     0.026
                            9593 - 9682                     0.904
  95.4 (2 sigma)     cal BP 9550 - 9708                     0.971
                            9717 - 9734                     0.029
  Median Probability:  9635

 References for calibration datasets:
Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE
Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Haflidason H,
Hajdas I, HattÃ© C, Heaton TJ, Hogg AG, Hughen KA, Kaiser KF, Kromer B,
Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Turney CSM,
van der Plicht J.
IntCal13 and MARINE13 radiocarbon age calibration curves 0-50000 years calBP
Radiocarbon 55(4). DOI: 10.2458/azu_js_rc.55.16947

Comments:
* This standard deviation (error) includes a lab error multiplier.
** 1 sigma = square root of (sample std. dev.^2 + curve std. dev.^2)
** 2 sigma = 2 x square root of (sample std. dev.^2 + curve std. dev.^2)
where ^2 = quantity squared.
[ ] = calibrated range impinges on end of calibration data set
0* represents a "negative" age BP
1955* or 1960* denote influence of nuclear testing C-14

NOTE:  Cal ages and ranges are rounded to the nearest year which
       may be too precise in many instances.  Users are advised to
       round results to the nearest 10 yr for samples with standard
       deviation in the radiocarbon age greater than 50 yr.
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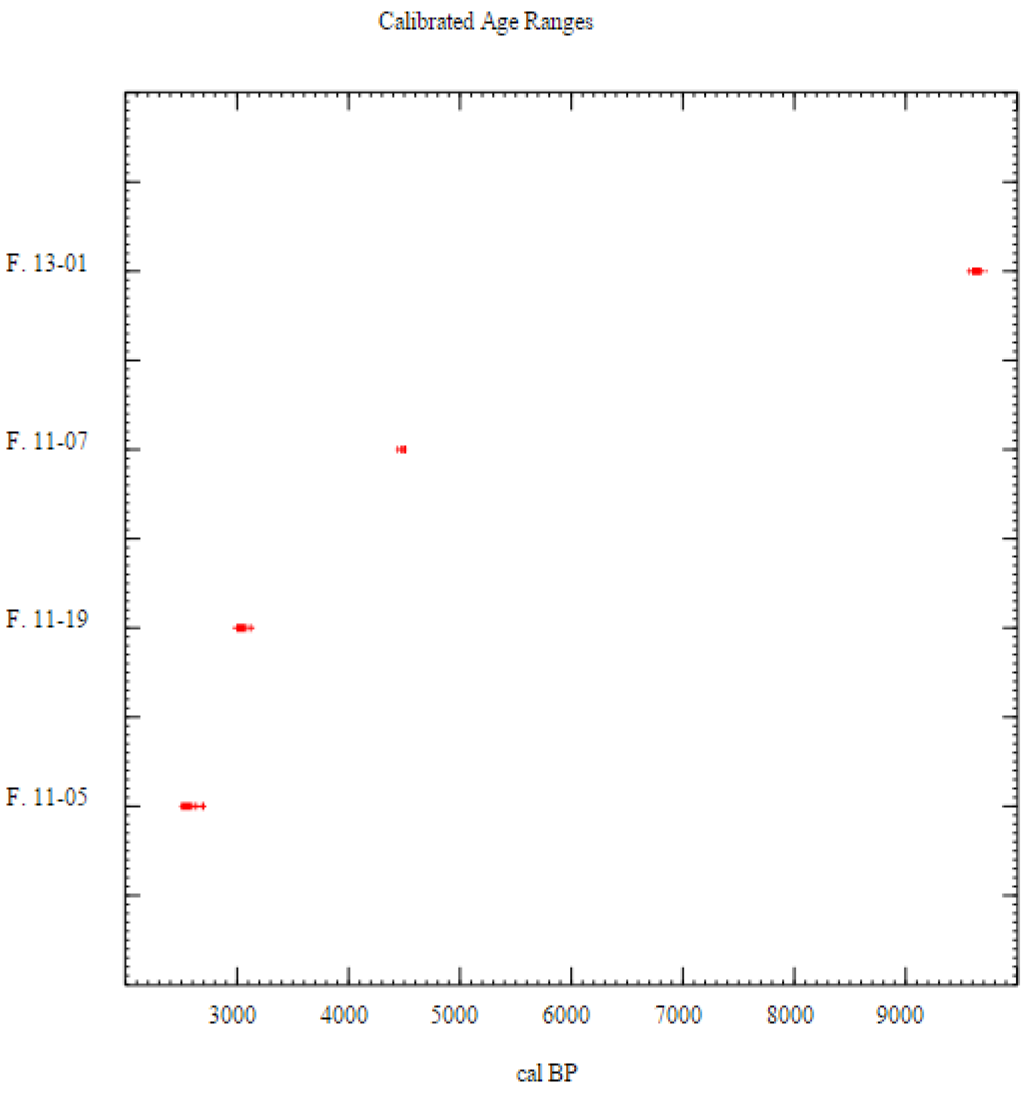
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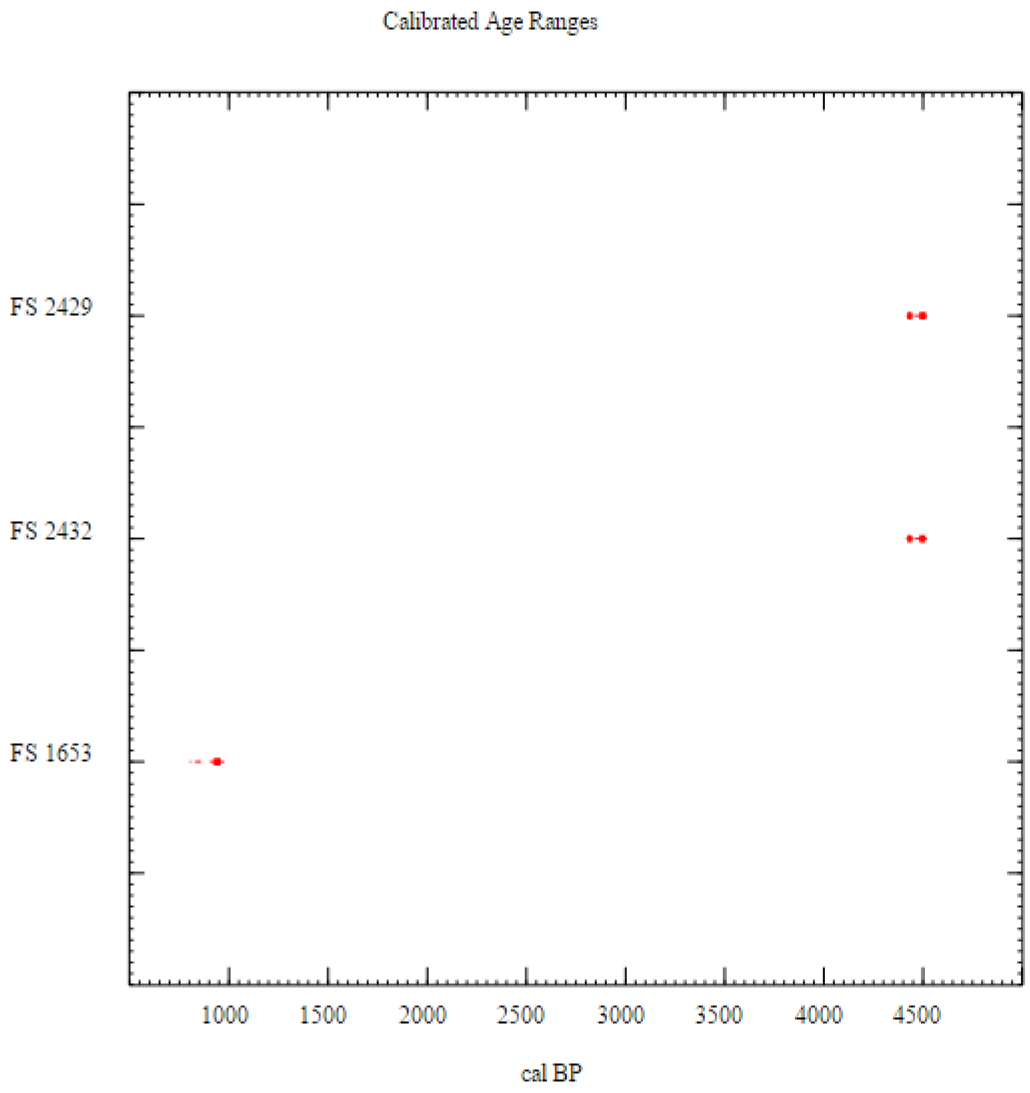
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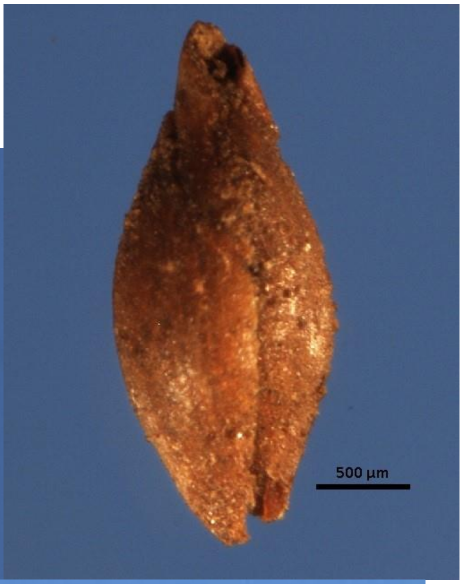
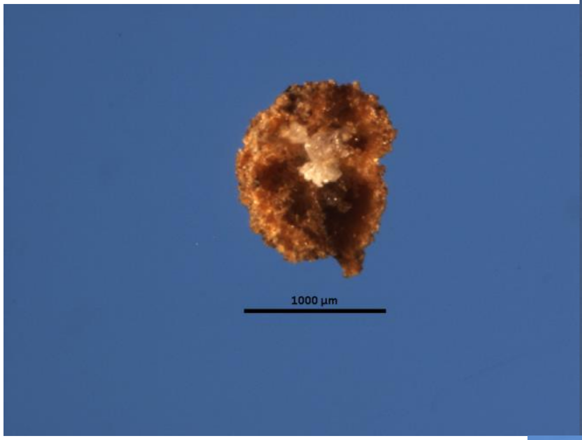
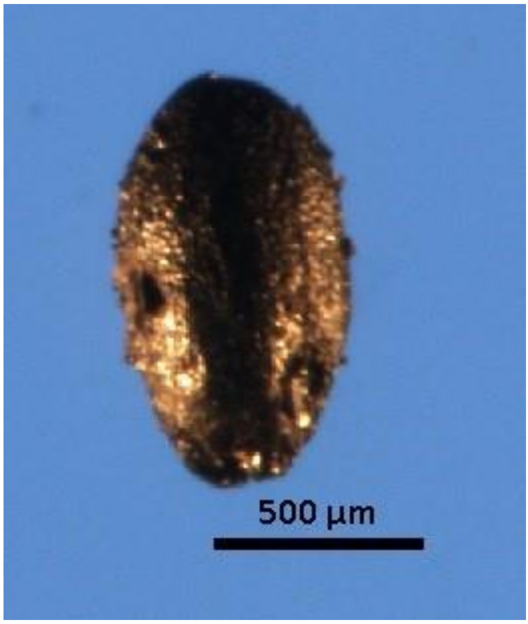
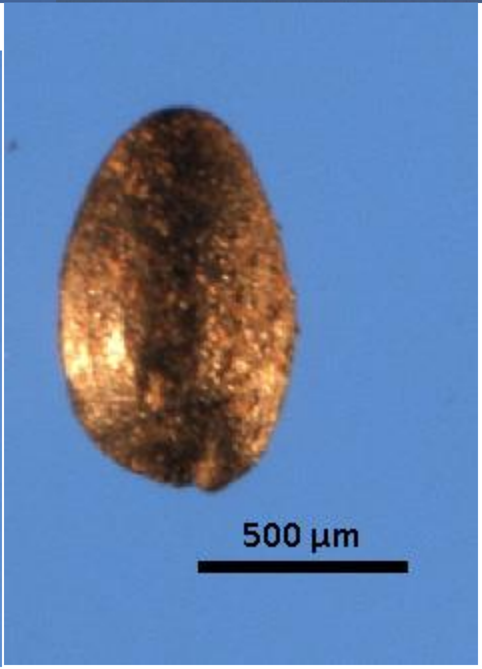
APPENDIX C

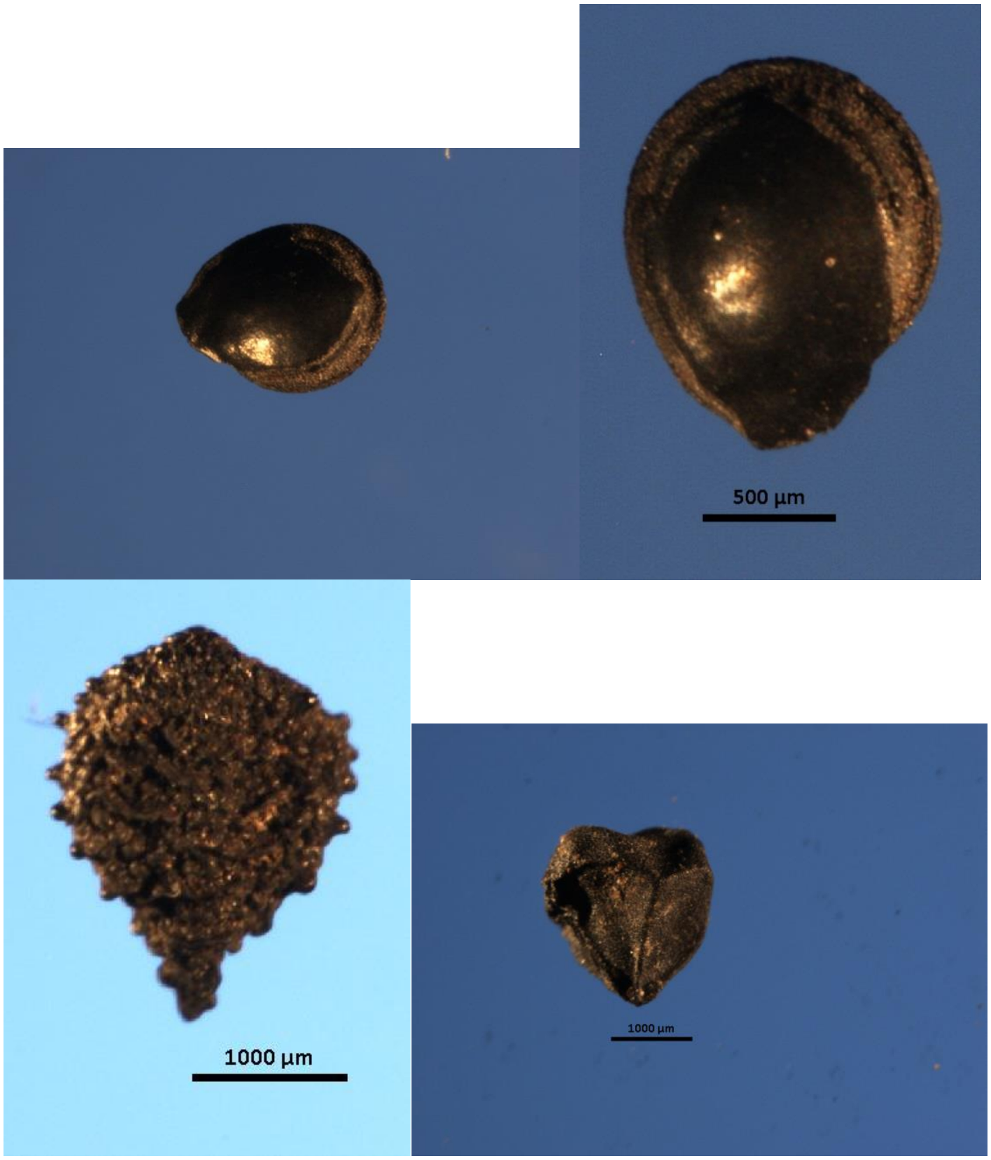
SEED IMAGES







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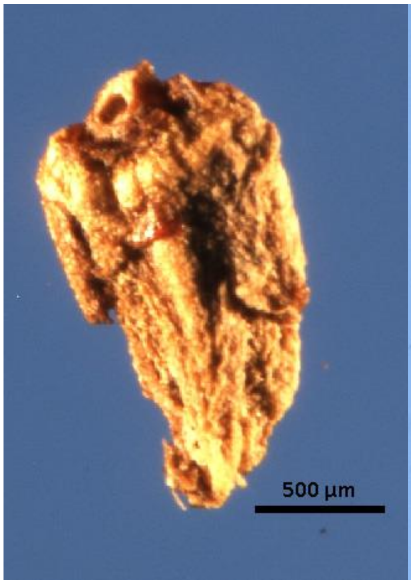
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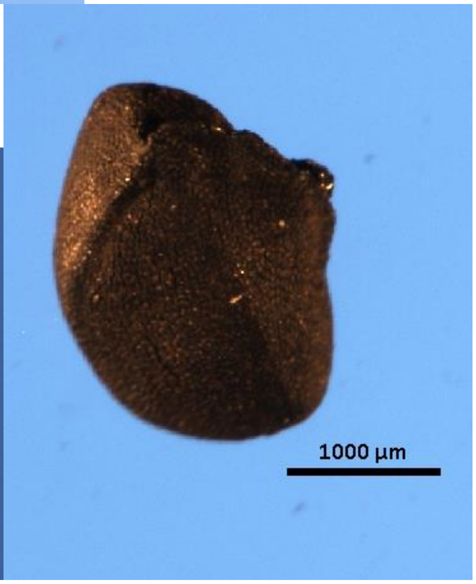
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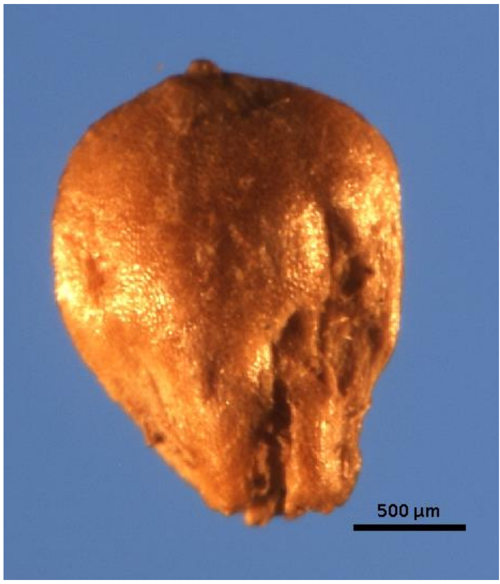
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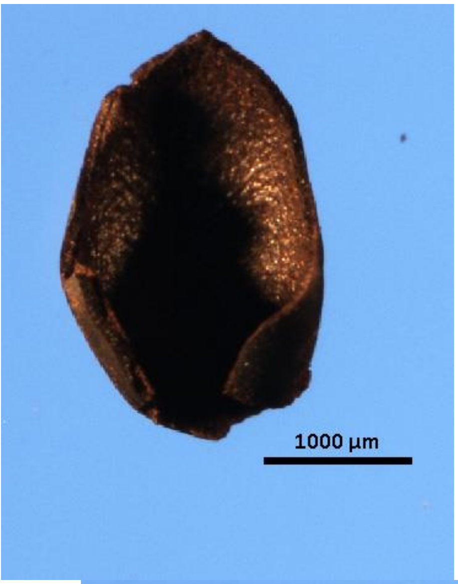
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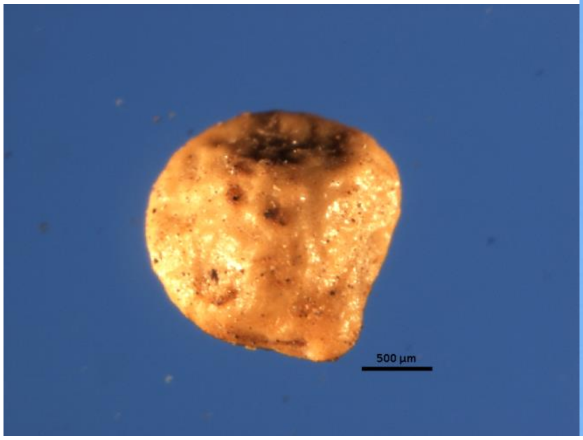
1000 µm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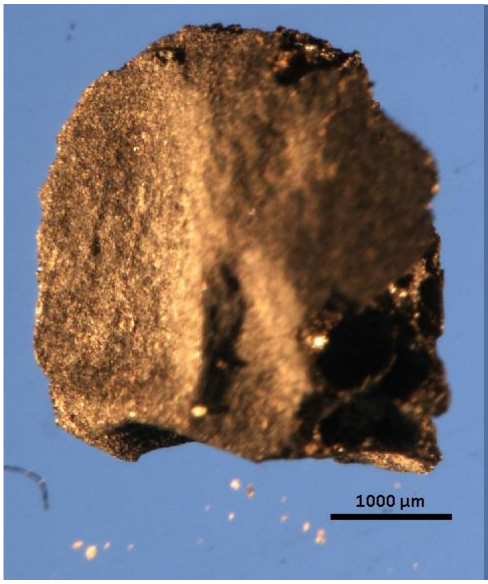
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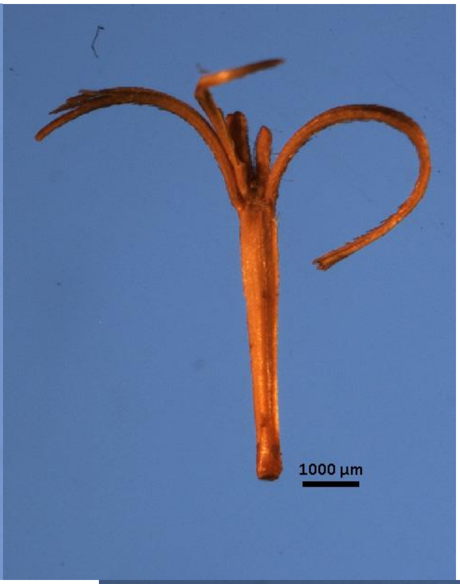
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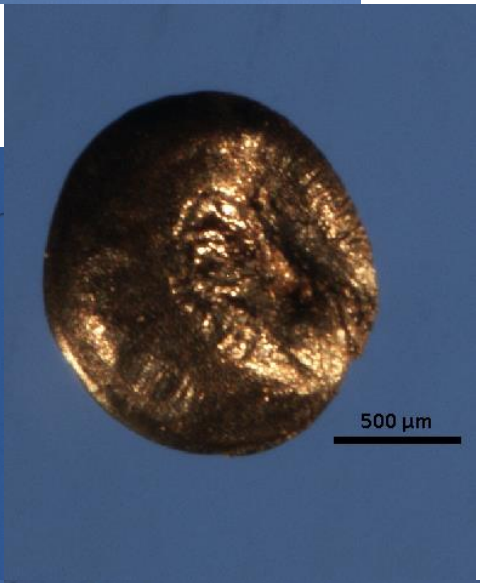
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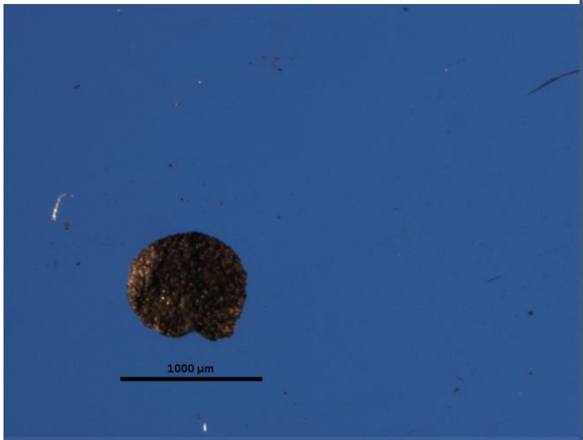
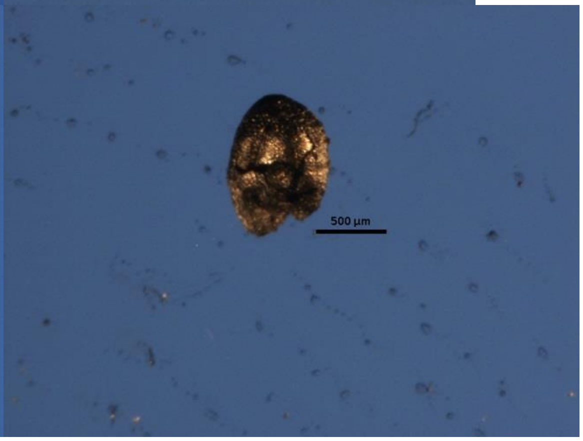
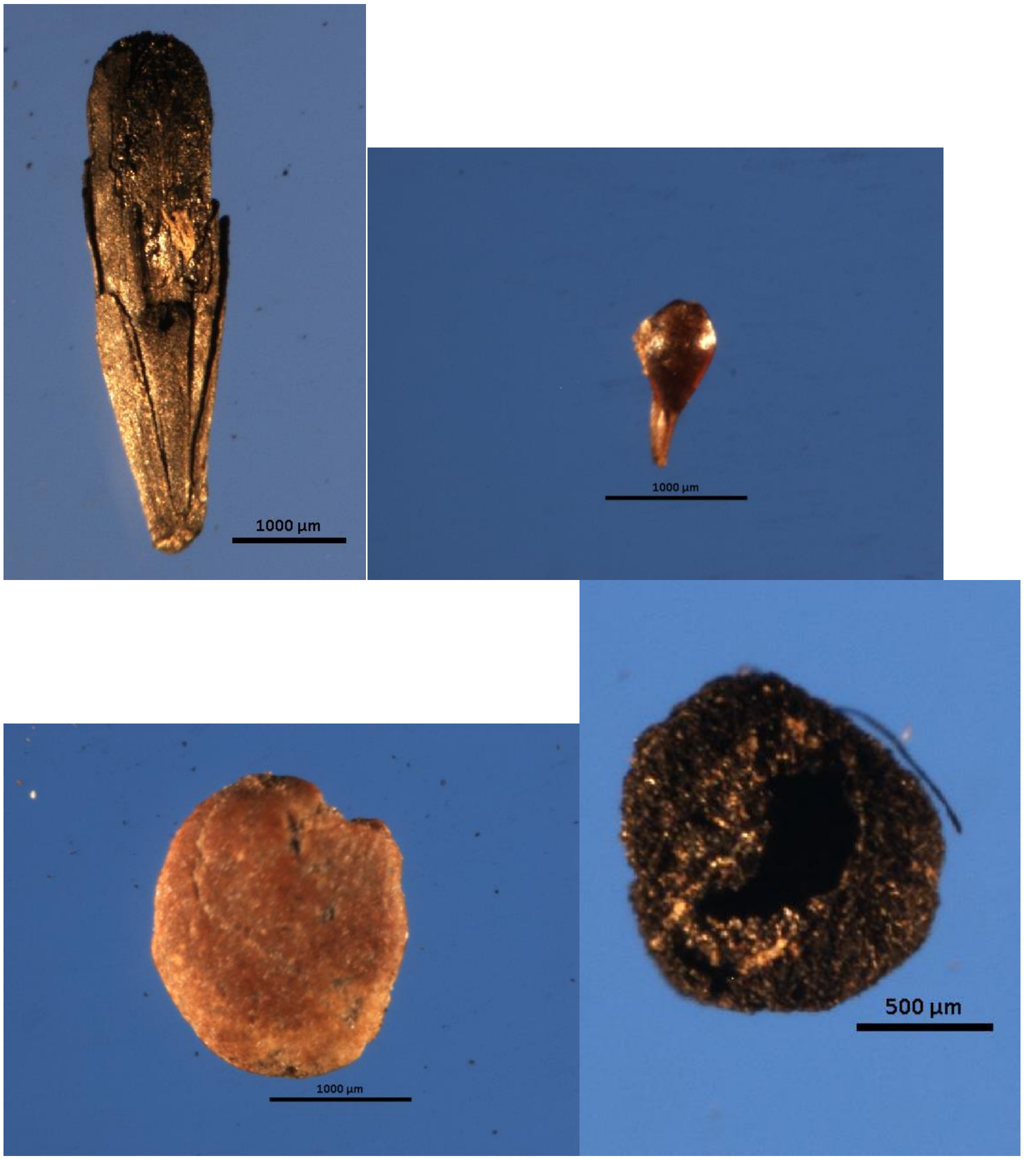
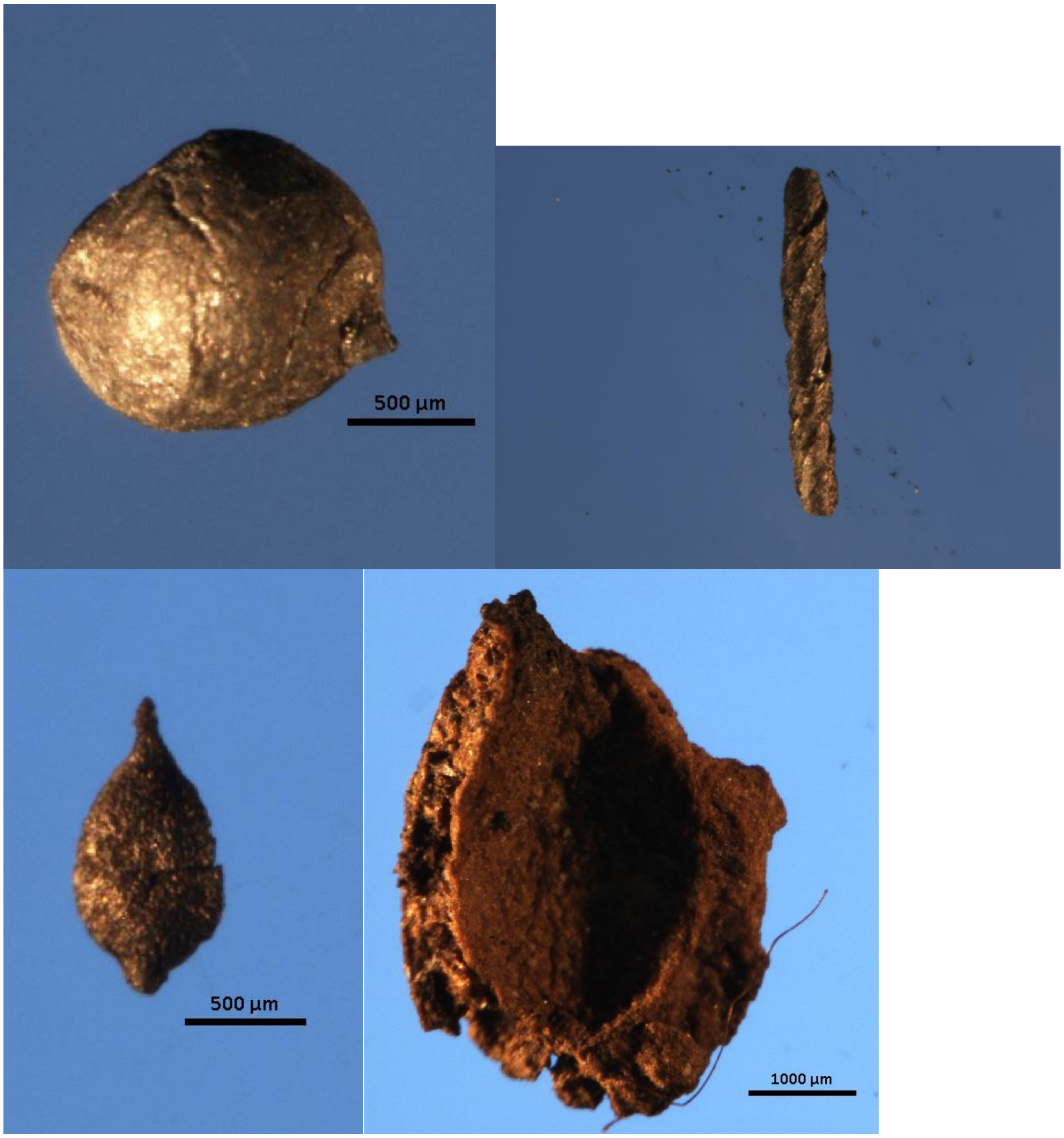

1000 µm


1000 µm


500 µm


1000 µm
1000 µm
1000 µm
500 µm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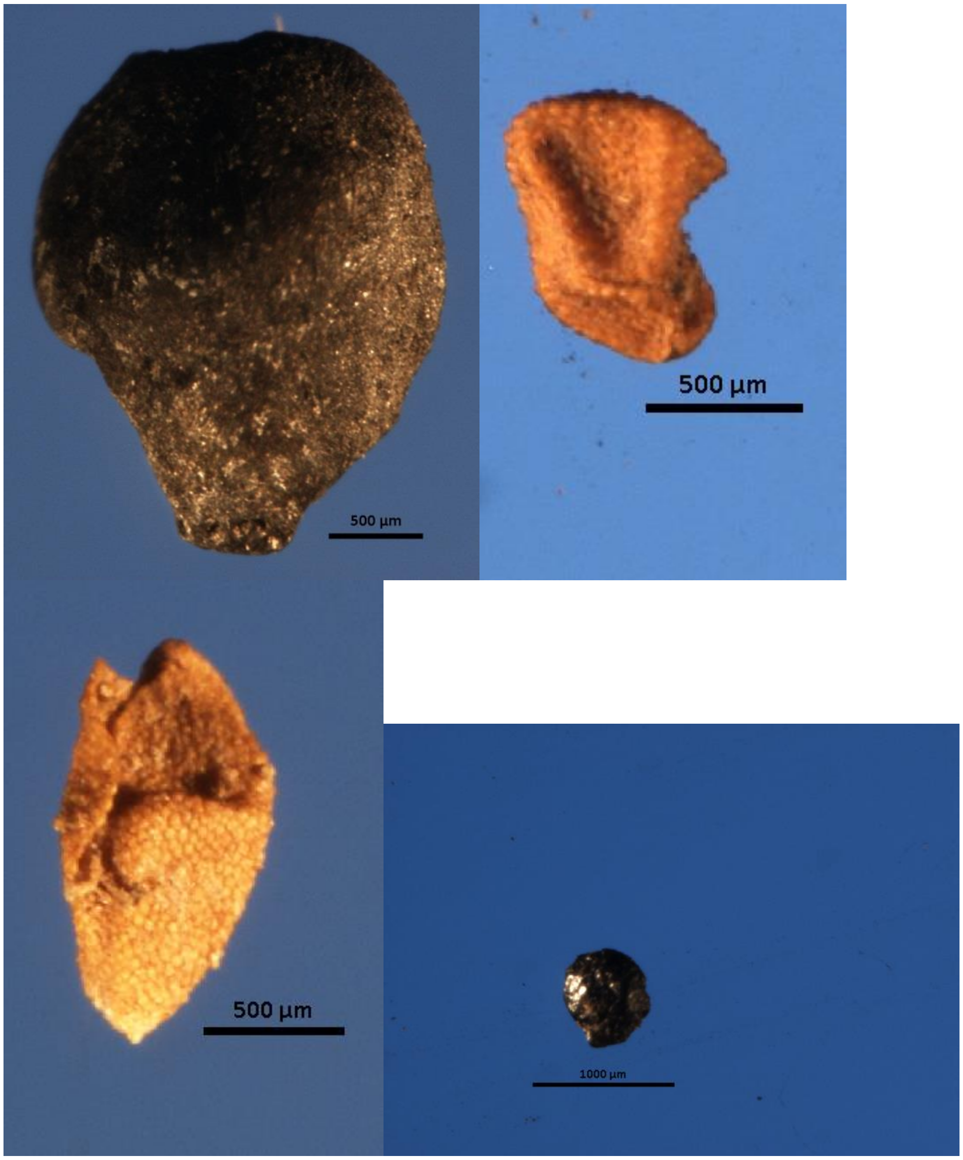
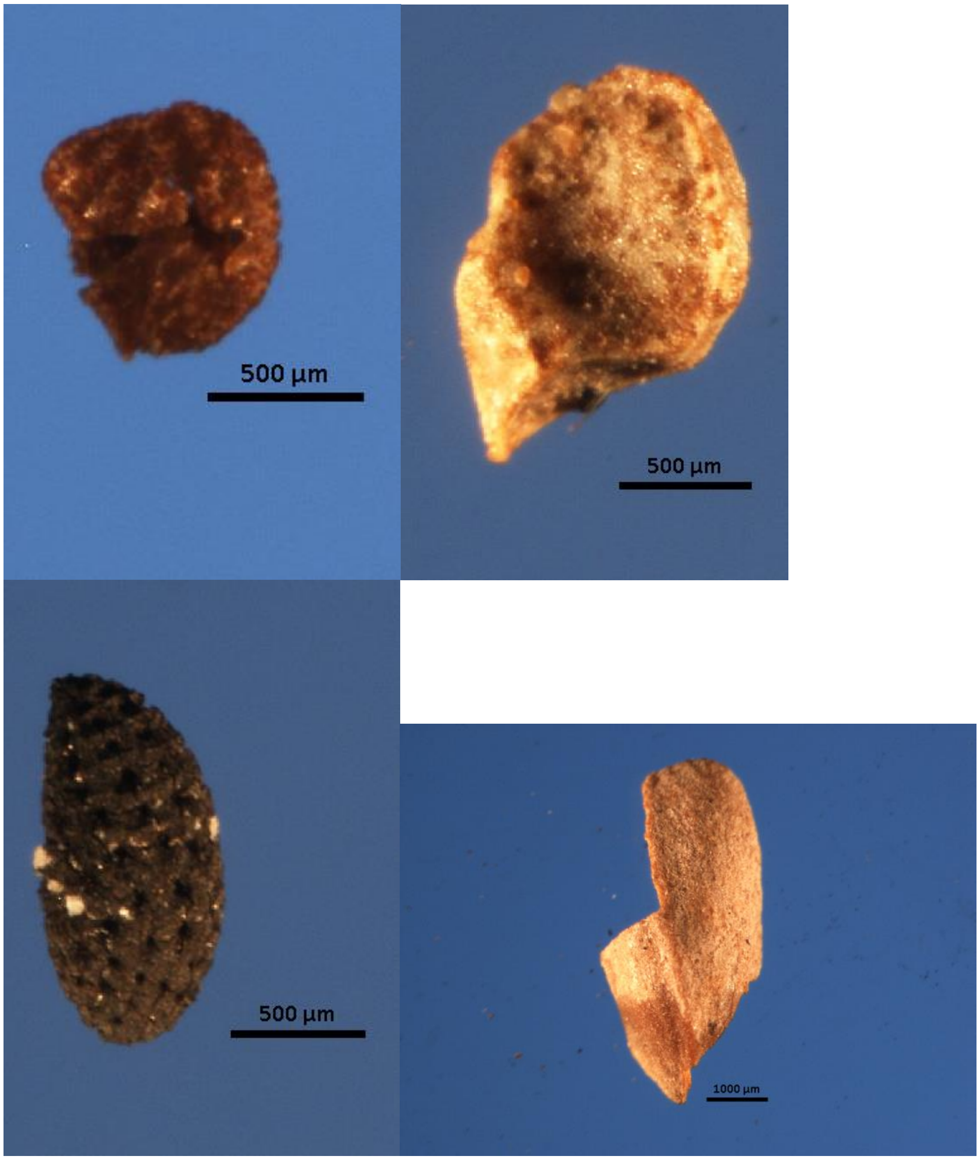
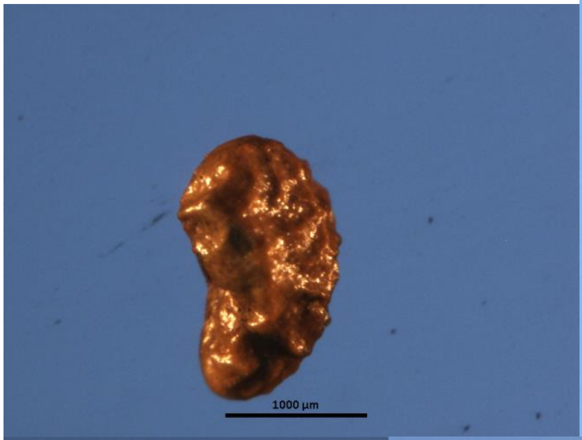
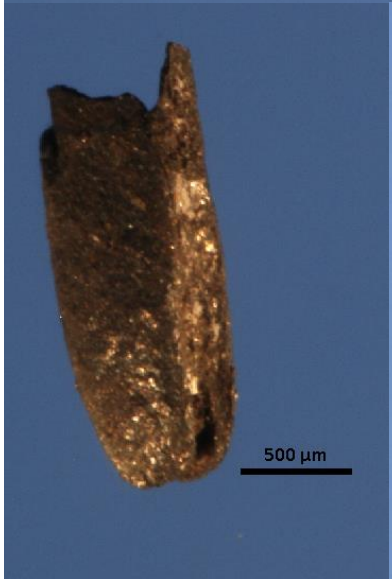

500 µm
500 µm
500 µm
1000 µm

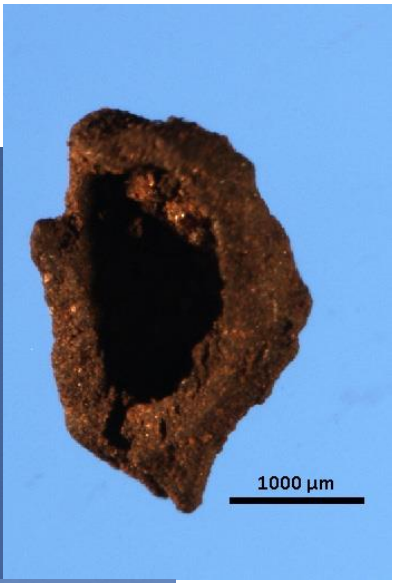

500 µm
500 µm
500 µm
1000 µm

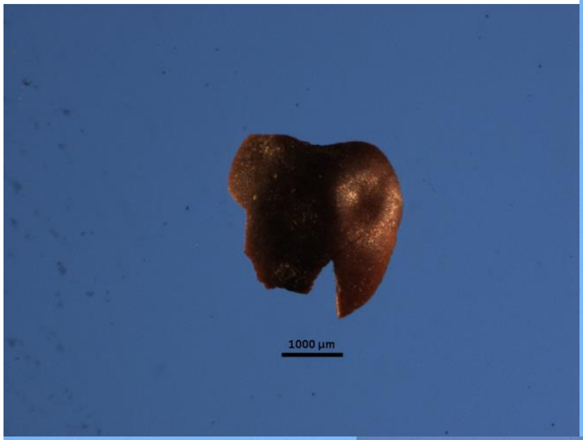

1000 µm


1000 µm


500 µm

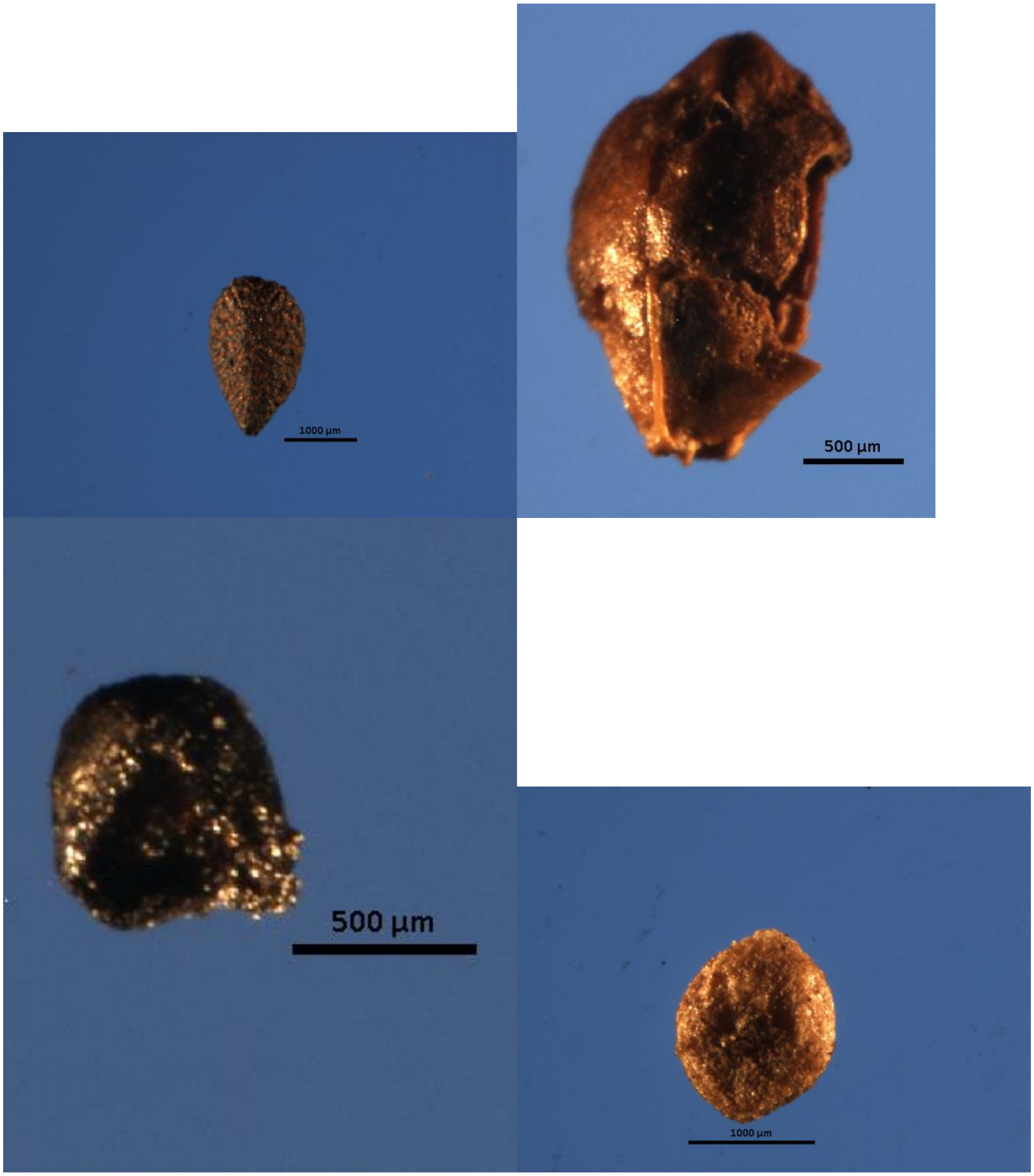

1000 µm

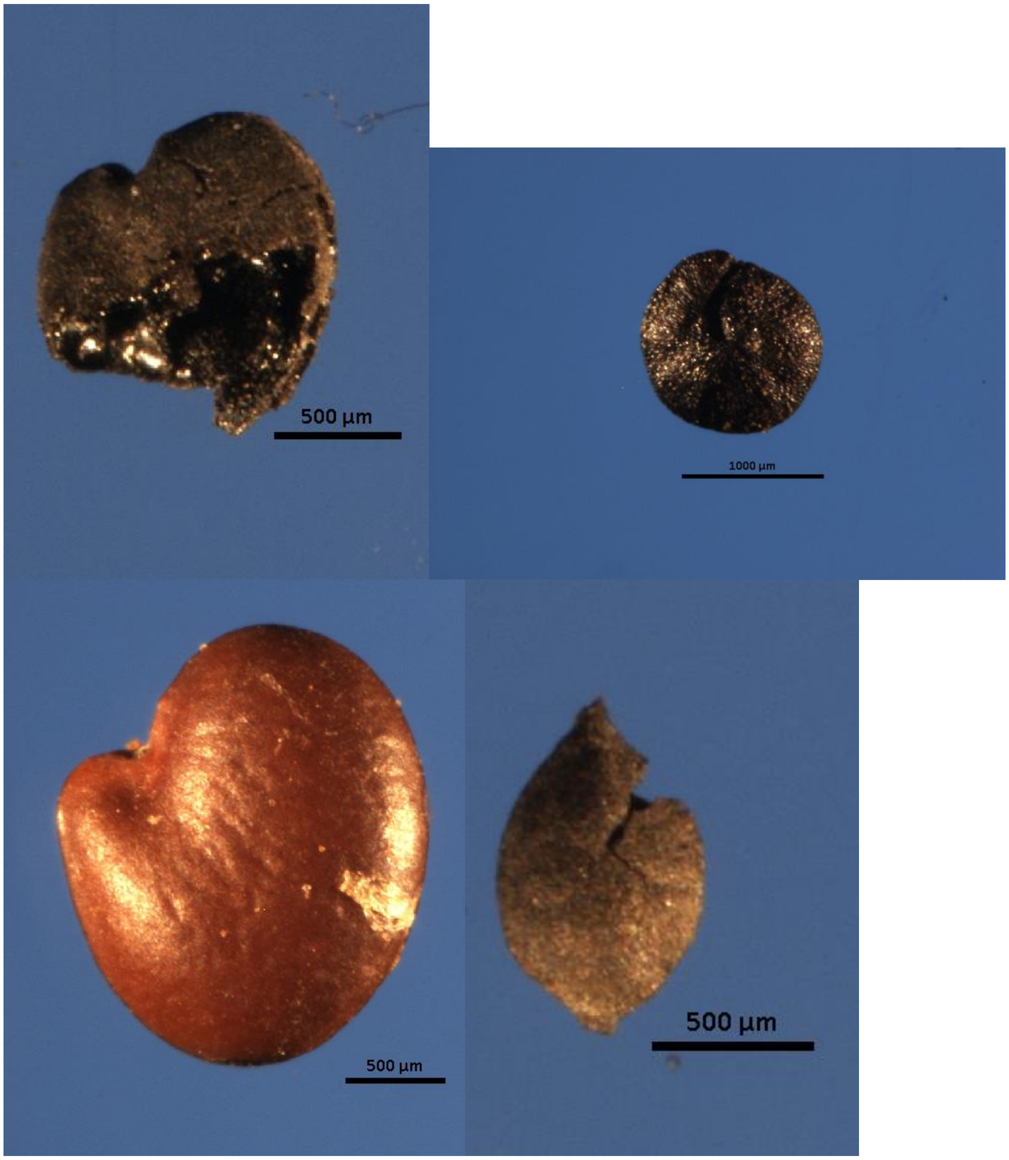

1000 µm


1000 µm


1000 µm


500 µm


1000 µm
500 µm
500 µm
1000 µm


500 µm
1000 µm
500 µm
500 µm

APPENDIX D

PAISLEY CAVES DATA TABLES

Sample	Sample Type	Sample Description	Bottom Depth	Volume	Charcoal (g)	Ch Sambucus	Ch Amarnathus	Sample	CH Monolepis	CH Camas
CS-02	Cave 2 Column Sample	1) LU3	1366.45	0.5	0	0	0	CS-02	0	0
CS-03	Cave 2 Column Sample	1) LU3	1366.4	0.5	0	0	0	CS-03	0	0
CS-04	Cave 2 Column Sample	1) LU3	1366.35	0.5	0	0	0	CS-04	0	0
CS-05	Cave 2 Column Sample	1) LU3	1366.3	0.5	0.02	0	0	CS-05	0	0
CS-06	Cave 2 Column Sample	1) LU3	1366.25	0.5	0.16	0	0	CS-06	0	0
CS-07	Cave 2 Column Sample	1) LU3	1366.2	0.5	0.56	0	0	CS-07	0	0
CS-08	Cave 2 Column Sample	1) LU3	1366.15	0.5	0.18	0	0	CS-08	0	0
CS-09	Cave 2 Column Sample	1) LU3	1366.1	0.5	0	0	0	CS-09	0	0
CS-10	Cave 2 Column Sample	1) LU3	1366.05	0.5	0	0	0	CS-10	0	0
CS-11	Cave 2 Column Sample	1) LU3	1366	0.5	0	0	0	CS-11	0	0
CS-12	Cave 2 Column Sample	1) LU3	1365.95	0.75	0.0133333	0	0	CS-12	0	0
CS-13	Cave 2 Column Sample	1) LU3	1365.9	0.75	0	0	0	CS-13	0	0
CS-14	Cave 2 Column Sample	1) LU3	1365.85	0.9	0.0333333	0	0	CS-14	0	0
CS-15	Cave 2 Column Sample	1) LU3	1365.8	1	0.09	0	0	CS-15	0	0
CS-16	Cave 2 Column Sample	1) LU3	1365.75	0.2	0.1	0	0	CS-16	0	0
CS-17	Cave 2 Column Sample	1) LU3	1365.7	1	0.06	0	0	CS-17	0	0
CS-18a	Cave 2 Column Sample	1) LU3	1365.68	0.35	0.5428571	0	0	CS-18a	0	0
CS-18b	Cave 2 Column Sample	Botanical Lens column sample	1365.65	0.55	1.0727273	0	0	CS-18b	0	0
CS-19a	Cave 2 Column Sample	Botanical Lens column sample	1365.62	0.3	2.6666667	0	0	CS-19a	0	0
CS-19b	Cave 2 Column Sample	3) Mud lens	1365.6	0.5	1.64	0	0	CS-19b	0	0
CS-20	Cave 2 Column Sample	4) LU2	1365.55	0.5	7.7	0	0	CS-20	0	0
CS-21	Cave 2 Column Sample	4) LU2	1365.5	0.4	1.45	0	0	CS-21	0	0
5/5-Str. I	Cave 5 Upper Strata	Cave 5 Stratum 1		0.5	1.26	6	0	5/5-Str. I	12	0
5/5-Str. II	Cave 5 Upper Strata	Cave 5 Stratum 2		0.25	1.68	0	0	5/5-Str. II	0	0
5/5-Str. III	Cave 5 Lower Strata	Cave 5 Stratum 3		0.25	0.88	0	0	5/5-Str. III	0	0
5/5-Str. IV	Cave 5 Lower Strata	Cave 5 Stratum 4		0.25	0.4	0	0	5/5-Str. IV	0	0
5/5-Str. VI	Cave 5 Lower Strata	Cave 5 Stratum 6		0.25	0	0	0	5/5-Str. VI	0	0
F 1/7-4a	YD Hearth	Cave 1 Hearth		0.5	7.78	0	0	F 1/7-4a	0	0
F 1/7-4b	YD Hearth	Cave 1 Hearth		0.5	9.42	0	0	F 1/7-4b	0	0
F 2/4C-4	YD Hearth	Botanical Lens Hearth		0.5	6.9	0	0	F 2/4C-4	0	0
F 2/3A-32-46	YD Hearth	Botanical Lens Hearth		0.5	5.28	0	0	F 2/3A-32-46	0	0
F 2/6-4	YD Hearth	Lower Mud Lens Hearth		0.5	7.84	0	0	F 2/6-4	0	0
F 5/5-3	Cave 5 Hearth	Hearth/Earth Oven		0.5	1.26	0	0	F 5/5-3	0	0
F 5/5A-26-8	Cave 5 Hearth	Hearth/Earth Oven		0.5	2.58	0	20	F 5/5A-26-8	0	4
5/12A-34-19	Nest	Woodrat Nest	1366.36	0.4	0	0	0	5/12A-34-19	0	0

Sample	CH Asteraceae	CH Artemisia	CH Boraginaceae	Ch Amsinckia	CH Cryptantha winged	CH Cryptantha small
CS-02	0	0	0	0	0	
CS-03	0	0	0	0	0	
CS-04	0	0	0	0	0	
CS-05	0	0	0	0	0	
CS-06	0	0	0	0	0	
CS-07	0	0	0	0	0	
CS-08	0	0	2	0	0	
CS-09	0	0	0	0	0	
CS-10	0	0	0	4	0	
CS-11	0	0	0	0	0	
CS-12	0	0	0	0	0	
CS-13	0	0	0	0	0	
CS-14	0	0	0	0	0	
CS-15	0	0	0	0	0	
CS-16	0	0	0	0	0	
CS-17	0	0	0	0	0	
CS-18a	0	0	0	0	0	
CS-18b	0	0	0	0	0	
CS-19a	0	0	0	0	0	
CS-19b	0	0	0	0	0	
CS-20	0	0	0	0	0	
CS-21	0	0	0	0	0	
5/5-Str. I	0	2	44	8	0	
5/5-Str. II	8	0	28	12	8	
5/5-Str. III	0	0	0	0	0	
5/5-Str. IV	0	0	0	0	0	
5/5-Str. VI	0	0	0	0	0	
F 1/7-4a	0	0	0	0	0	
F 1/7-4b	0	0	0	0	0	
F 2/4C-4	0	0	0	0	0	
F 2/3A-32-46	0	0	0	0	0	
F 2/6-4	0	0	24	0	0	
F 5/5-3	0	0	36	0	0	
F 5/5A-26-8	0	0	10	0	0	
5/12A-34-19	0	0	0	0	0	

Sample	CH Atriplex	CH A. confertifolia	Ch Chenopod	Ch Suaeda	CH Juniperus	Ch Cyperaceae	Ch Fabaceae	CH Vicia	CH Geraniaceae
CS-02	0	0	0	0	0	0	0	0	
CS-03	0	0	0	0	0	0	0	0	
CS-04	0	0	0	0	0	0	0	0	
CS-05	0	0	0	2	0	0	0	0	
CS-06	0	2	92	0	0	0	0	0	
CS-07	0	0	0	0	0	0	0	0	
CS-08	0	0	0	0	0	0	0	0	
CS-09	0	0	0	0	0	0	0	0	
CS-10	0	0	0	0	0	0	0	0	
CS-11	0	0	0	0	0	0	0	0	
CS-12	0	0	0	0	0	0	0	0	
CS-13	0	0	0	0	0	0	0	0	
CS-14	0	0	0	0	0	0	0	0	
CS-15	0	0	0	0	0	0	0	0	
CS-16	0	0	0	0	0	0	0	0	
CS-17	0	0	0	0	0	0	0	0	
CS-18a	0	0	0	0	0	0	0	0	
CS-18b	0	0	0	0	0	0	0	0	
CS-19a	0	0	0	0	0	0	0	0	
CS-19b	0	0	0	0	0	0	0	0	
CS-20	0	0	0	0	0	0	0	0	
CS-21	0	0	0	0	0	0	0	0	
5/5-Str. I	2	0	0	0	0	4	2	0	
5/5-Str. II	8	12	0	0	4	0	0	0	
5/5-Str. III	4	8	0	0	0	0	0	0	
5/5-Str. IV	0	12	0	0	0	0	0	0	
5/5-Str. VI	0	0	0	0	0	0	0	0	
F 1/7-4a	0	0	0	0	0	0	0	0	
F 1/7-4b	0	0	0	0	0	0	0	0	
F 2/4C-4	4	0	0	0	0	0	0	0	
F 2/3A-32-46	10	0	0	0	0	0	0	0	
F 2/6-4	28	0	2	0	0	0	0	0	
F 5/5-3	72	2	0	0	0	0	0	2	1
F 5/5A-26-8	16	0	0	0	0	0	0	0	
5/12A-34-19	0	0	0	0	0	0	0	0	

Sample	CH Liliaceae	CH Mentzelia	CH Sphaeralcea	CH Pinus	CH Plantago	CH Poaceae	CH Achnathnatherum	CH Hesperostipa	CH Polygonaceae	CH Sesuvium
CS-02	0	0	0	0	0	0	0	0	0	0
CS-03	0	0	0	0	0	0	0	0	0	0
CS-04	0	0	0	0	0	0	0	0	0	0
CS-05	0	0	0	0	0	0	0	0	0	0
CS-06	0	0	0	0	0	8	8	0	0	0
CS-07	0	0	0	0	0	2	0	0	0	0
CS-08	0	0	0	0	0	22	0	0	0	0
CS-09	0	0	0	0	0	38	0	0	0	0
CS-10	0	0	0	0	0	0	0	0	0	0
CS-11	0	0	0	0	0	0	0	0	0	0
CS-12	0	0	0	0	0	0	0	0	0	0
CS-13	0	0	0	0	0	0	0	0	0	0
CS-14	0	0	0	0	0	0	0	0	0	0
CS-15	0	0	0	0	0	0	0	0	0	0
CS-16	0	0	0	0	0	0	0	0	0	0
CS-17	0	0	0	0	0	0	3	0	0	0
CS-18a	0	0	0	0	0	0	0	0	0	0
CS-18b	0	0	0	0	0	0	0	0	0	0
CS-19a	0	0	0	0	0	0	0	0	0	0
CS-19b	0	2	0	0	0	0	0	0	0	0
CS-20	0	0	0	0	0	0	0	0	0	0
CS-21	0	0	0	0	0	0	0	0	0	0
5/5-Str. I	0	28	0	2	0	2	52	4	4	0
5/5-Str. II	0	20	0	0	0	28	16	12	0	0
5/5-Str. III	4	4	0	0	0	0	0	0	0	0
5/5-Str. IV	0	0	0	0	0	0	0	0	0	0
5/5-Str. VI	0	0	0	0	0	0	0	0	0	0
F 1/7-4a	0	0	0	0	0	0	0	0	0	0
F 1/7-4b	0	0	0	0	0	2	0	0	0	0
F 2/4C-4	0	0	0	0	0	0	0	0	0	0
F 2/3A-32-46	0	0	0	0	0	0	0	0	0	0
F 2/6-4	0	0	0	0	0	8	8	0	0	2
F 5/5-3	2	0	4	0	2	28	86	16	0	0
F 5/5A-26-8	0	0	0	0	2	8	62	0	0	0
5/12A-34-19	0	0	0	0	0	0	0	0	0	0

Sample	Ch Ceanothus	CH Rosaceae	Ch Rosa	CH Urtica	CH Unid	Sum charred cheno-ams	Charred Seed Density	Sambucus	Amaranthus	Asteraceae
CS-02	0	0	0	0	0	0	0	0	0	2
CS-03	0	0	0	0	0	0	0	0	0	0
CS-04	0	0	0	0	0	0	0	0	0	0
CS-05	0	0	0	0	0	2	2	0	0	2
CS-06	0	0	0	0	2	100	118	0	4	8
CS-07	0	0	0	0	0	10	12	0	12	0
CS-08	0	0	0	0	0	0	24	0	24	14
CS-09	0	0	0	0	0	0	38	0	50	14
CS-10	0	0	0	0	0	0	4	0	62	0
CS-11	0	0	0	0	0	0	0	0	32	0
CS-12	0	0	0	0	0	0	0	0	0	0
CS-13	0	0	0	0	0	0	0	0	24	0
CS-14	0	0	0	0	0	0	0	1.1111111	0	0
CS-15	0	0	0	0	0	0	0	0	0	0
CS-16	0	0	0	0	0	0	0	0	5	0
CS-17	0	0	0	0	0	0	3	0	0	0
CS-18a	0	0	0	0	0	0	0	0	0	0
CS-18b	0	0	0	0	0	0	0	0	0	0
CS-19a	0	0	0	0	0	0	0	0	0	10
CS-19b	0	0	0	0	0	0	2	0	0	0
CS-20	0	0	0	0	0	0	0	0	0	0
CS-21	0	0	0	0	0	0	0	0	0	0
5/5-Str. I	0	6	0	0	20	46	318	2	0	10
5/5-Str. II	0	0	0	0	20	56	276	0	0	8
5/5-Str. III	0	0	0	0	0	28	48	0	0	12
5/5-Str. IV	0	0	0	0	4	12	16	0	0	16
5/5-Str. VI	0	0	0	0	0	0	0	0	0	24
F 1/7-4a	0	0	0	0	0	2	2	0	0	0
F 1/7-4b	0	0	0	0	2	0	4	0	0	0
F 2/4C-4	0	0	0	0	2	4	6	0	0	0
F 2/3A-32-46	0	0	0	0	0	12	14	0	2	0
F 2/6-4	0	0	0	0	8	42	102	0	0	2
F 5/5-3	0	8	0	8	22	116	358	0	2	2
F 5/5A-26-8	2	4	4	0	0	96	194	0	0	0
5/12A-34-19	0	0	0	0	0	0	0	0	0	12.5

Sample	Artemsia	Tetradymia	Boraginaceae perisperm	Amsinckia	Cryptantha winged	Cryptantha small	Hackelia	Other Cryptantha	Phacelia	Plagiobothyrus
CS-02	0	0	0	10	2	0	0	0	0	0
CS-03	0	0	0	4	0	0	0	0	0	0
CS-04	2	0	0	24	0	0	0	0	0	0
CS-05	4	0	0	4	0	2	0	0	0	0
CS-06	58	0	0	54	10	2	2	0	0	4
CS-07	144	0	0	56	6	4	4	4	0	0
CS-08	62	0	0	44	0	0	2	0	0	0
CS-09	10	0	0	18	0	0	0	0	0	0
CS-10	0	0	0	4	0	2	4	0	0	0
CS-11	0	0	0	2	0	0	4	0	0	0
CS-12	0	0	0	24	0	0	0	0	0	0
CS-13	0	0	0	34.666667	0	5.3333333	1.3333333	0	0	0
CS-14	0	0	0	0	0	0	0	0	0	0
CS-15	0	0	0	0	0	0	0	0	0	0
CS-16	0	0	0	0	0	0	0	0	0	0
CS-17	0	0	1	0	0	5	0	0	1	0
CS-18a	0	0	0	0	0	0	0	0	0	0
CS-18b	0	0	0	0	0	5.4545455	0	0	0	0
CS-19a	0	0	0	0	0	10	0	0	3.3333333	0
CS-19b	0	0	0	0	0	0	0	0	0	0
CS-20	0	0	0	0	0	0	0	0	0	0
CS-21	0	0	0	0	0	2.5	0	0	0	0
5/5-Str. I	42	24	0	74	24	64	0	0	2	0
5/5-Str. II	68	0	8	196	0	56	0	0	8	12
5/5-Str. III	0	0	0	288	24	12	0	0	0	40
5/5-Str. IV	0	0	0	432	4	16	0	0	0	4
5/5-Str. VI	0	0	0	60	4	0	0	0	0	4
F 1/7-4a	0	0	0	0	0	0	0	0	0	0
F 1/7-4b	0	0	0	0	0	0	0	0	0	0
F 2/4C-4	0	0	0	0	0	0	0	0	0	0
F 2/3A-32-46	0	0	0	0	0	0	0	0	0	0
F 2/6-4	0	0	0	0	0	8	0	0	0	0
F 5/5-3	0	0	2	2	0	4	0	0	0	0
F 5/5A-26-8	0	0	0	0	0	0	0	0	0	0
5/12A-34-19	0	0	42.5	0	0	12.5	0	0	12.5	0

Sample	Brassicaceae	Descurainia	Cannabis	Cheno-Am	Atriplex sp.endosperm	A. confertifolia	A. palustris	A. rosea	Chenopodium	Juniperus
CS-02	0	0	0	0	0	8	0	0	6	0
CS-03	0	0	0	0	0	0	0	0	2	0
CS-04	4	0	2	2	0	28	0	0	4	0
CS-05	0	0	0	0	0	14	0	4	16	0
CS-06	6	0	0	0	0	140	0	20	598	0
CS-07	0	0	0	46	0	52	0	20	14	0
CS-08	0	0	0	14	0	30	0	0	48	0
CS-09	2	0	0	26	0	12	0	2	64	0
CS-10	0	6	0	16	0	2	0	0	42	0
CS-11	0	0	0	4	0	0	0	0	34	0
CS-12	0	0	0	1.3333333	0	0	0	0	2.6666667	0
CS-13	0	1.3333333	0	2.6666667	0	10.666667	0	1.3333333	36	0
CS-14	0	0	0	0	1.1111111	15.555556	0	0	7.7777778	0
CS-15	0	0	0	0	5	6	0	1	2	0
CS-16	0	5	0	40	0	0	0	0	65	0
CS-17	0	14	0	0	4	25	3	0	100	0
CS-18a	0	0	0	0	0	0	0	0	0	0
CS-18b	0	0	0	0	1.8181818	0	0	0	12.727273	0
CS-19a	0	0	0	0	13.333333	0	0	0	16.666667	3.3333333
CS-19b	0	0	0	2	0	0	0	0	0	0
CS-20	0	0	0	0	0	0	0	0	2	0
CS-21	0	0	0	0	0	0	0	0	0	0
5/5-Str. I	0	60	2	48	6	42	0	0	0	0
5/5-Str. II	0	52	8	132	16	168	0	12	0	52
5/5-Str. III	0	60	40	8	20	1176	0	80	0	8
5/5-Str. IV	4	56	8	0	32	1208	0	12	0	0
5/5-Str. VI	0	4	4	0	0	732	0	4	0	4
F 1/7-4a	0	0	0	0	0	0	0	0	0	0
F 1/7-4b	0	0	0	0	0	0	0	0	0	0
F 2/4C-4	0	0	0	0	2	0	0	0	0	2
F 2/3A-32-46	0	0	0	0	8	0	0	0	0	0
F 2/6-4	0	0	0	0	6	0	0	0	4	0
F 5/5-3	0	0	0	0	12	2	0	0	0	0
F 5/5A-26-8	0	0	0	0	0	0	0	0	0	0
5/12A-34-19	0	7.5	0	0	30	0	0	0	0	0

Sample	Carex	Eleocharis	Scirpus	Trifolium	Ribes	Juncus	Lili-Amaryll	Mentzelia	Malvaceae	Montia
CS-02	0	0	0	0	0	0	0	0	0	0
CS-03	0	0	0	0	0	0	0	0	0	0
CS-04	0	0	2	0	0	0	0	0	2	0
CS-05	0	0	0	0	0	0	0	0	0	0
CS-06	0	0	0	0	0	0	0	0	0	0
CS-07	0	0	0	0	0	0	0	0	0	0
CS-08	0	0	0	0	0	0	0	0	0	0
CS-09	0	0	0	0	0	0	0	0	0	0
CS-10	0	0	0	0	0	0	0	0	0	0
CS-11	0	0	0	0	0	0	0	0	0	0
CS-12	0	0	0	0	0	0	0	0	0	0
CS-13	0	0	0	0	0	0	0	0	0	0
CS-14	0	1.1111111	0	0	0	0	0	0	0	0
CS-15	0	1	0	0	0	0	0	0	0	0
CS-16	0	0	0	0	0	0	0	10	0	0
CS-17	0	0	0	1	1	0	0	2	0	0
CS-18a	0	0	0	0	0	0	0	0	0	0
CS-18b	0	0	0	0	0	0	0	0	0	0
CS-19a	0	0	0	0	0	0	0	0	0	0
CS-19b	0	0	0	0	0	0	0	0	0	0
CS-20	0	0	0	0	0	2	0	4	0	0
CS-21	0	0	0	0	0	0	0	0	0	0
5/5-Str. I	0	0	0	0	0	8	0	92	0	0
5/5-Str. II	4	0	0	0	0	4	0	92	0	0
5/5-Str. III	0	0	0	0	0	0	0	24	0	0
5/5-Str. IV	4	0	0	0	0	0	0	84	0	0
5/5-Str. VI	0	0	0	0	0	0	0	0	0	0
F 1/7-4a	0	0	0	0	0	0	0	0	0	0
F 1/7-4b	0	0	0	0	0	0	0	0	0	0
F 2/4C-4	0	0	0	0	0	0	8	0	0	0
F 2/3A-32-46	0	0	0	0	0	0	0	0	0	0
F 2/6-4	0	0	0	0	0	0	0	2	0	0
F 5/5-3	0	0	0	0	0	0	0	0	0	0
F 5/5A-26-8	0	0	0	0	0	0	0	0	0	0
5/12A-34-19	12.5	0	82.5	7.5	0	0	0	5	0	17.5

Sample	Chamerion	Oenothera	Pinus
CS-02	0	0	
CS-03	0	0	
CS-04	0	0	
CS-05	0	0	
CS-06	0	0	
CS-07	0	0	
CS-08	0	0	
CS-09	0	0	
CS-10	0	0	
CS-11	0	0	
CS-12	0	0	
CS-13	0	0	
CS-14	0	0	
CS-15	0	0	
CS-16	0	0	
CS-17	0	0	
CS-18a	0	0	
CS-18b	0	0	
CS-19a	0	0	
CS-19b	0	0	
CS-20	0	0	
CS-21	0	0	
5/5-Str. I	2	0	
5/5-Str. II	0	0	
5/5-Str. III	0	0	
5/5-Str. IV	0	0	
5/5-Str. VI	4	0	
F 1/7-4a	0	0	
F 1/7-4b	0	2	
F 2/4C-4	0	0	
F 2/3A-32-46	0	0	
F 2/6-4	0	0	
F 5/5-3	0	0	
F 5/5A-26-8	0	0	
5/12A-34-19	2.5	10	

Sample	Ceanothus	Rosaceae	Solanaceae	Typha	Urtica	Unid	Uncharred Seed Density	Shannon-Wiener	Charred Edible Taxa
CS-02	0	0	0	0	0	0	56	1.8586284	
CS-03	0	0	0	0	0	0	36	0.9736489	
CS-04	0	0	0	0	0	0	72	1.6519003	
CS-05	0	0	0	0	0	0	92	1.918531	
CS-06	0	0	0	0	0	8	1036	1.5110345	
CS-07	0	0	0	0	0	18	444	2.1792976	
CS-08	0	0	0	0	0	10	320	2.2301235	
CS-09	0	0	0	0	0	10	226	2.0894016	
CS-10	0	0	0	0	0	20	166	1.7859166	
CS-11	0	0	0	0	0	6	82	1.3088288	
CS-12	0	0	0	0	0	2.6666667	33.333333	0.9714528	
CS-13	0	1.3333333	0	0	0	6.6666667	184	2.0032411	
CS-14	0	0	0	0	0	2.2222222	44.444444	1.5564092	
CS-15	0	0	0	0	0	5	56	1.2175318	
CS-16	0	0	0	0	0	0	205	1.3787529	
CS-17	9	0	0	0	1	0	372	1.4460871	
CS-18a	0	0	0	0	0	0	2.8571429	0	
CS-18b	0	0	0	0	0	0	98.181818	0.768626	
CS-19a	0	0	0	0	0	23.333333	210	1.7999339	
CS-19b	0	0	0	0	0	0	34	0.9779252	
CS-20	0	0	0	0	0	0	30	0.857174	
CS-21	0	2.5	0	0	17.5	15	65	1.6275675	
5/5-Str. I	0	0	8	0	0	18	696	2.8242632	
5/5-Str. II	0	0	4	0	0	0	1124	2.6446732	
5/5-Str. III	0	4	0	0	0	0	2072	1.6548174	
5/5-Str. IV	0	0	0	0	0	4	2208	1.4886746	
5/5-Str. VI	0	0	0	0	0	4	1192	1.2551348	
F 1/7-4a	0	0	0	0	0	0	0	0	
F 1/7-4b	0	2	0	0	0	0	6	1.6094379	
F 2/4C-4	0	0	0	0	0	2	114	1.0808723	
F 2/3A-32-46	0	0	0	2	0	0	60	1.3072735	
F 2/6-4	0	0	0	0	0	4	86	2.1210921	
F 5/5-3	0	0	0	0	4	0	100	2.249719	
F 5/5A-26-8	0	0	0	0	0	0	0	1.8334516	
5/12A-34-19	0	0	0	0	717.5	115	1537.5	1.7815469	

Sample	CH Medicinal	Unch Med	CH Handicraft	Unch Handi	ShannonWiener	Richness	Cluster	Shannon-Wiener Index Charred Seeds	Period 2	Ch Edible Plants (including fam
CS-02	0	0	0	0	1.8586284	8	1	0	Early Holocene	
CS-03	0	0	0	0	0.9736489	4	1	0	Early Holocene	
CS-04	0	2	0	2	1.6519003	10	1	0	Early Holocene	
CS-05	0	4	0	0	1.918531	10	1	0	Early Holocene	
CS-06	0	58	0	0	1.5110345	17	3	0.7758965	Early Holocene	
CS-07	0	144	0	0	2.1792976	15	1	0.4505612	Early Holocene	
CS-08	0	62	0	0	2.2301235	13	1	0.286836	Early Holocene	
CS-09	0	10	0	0	2.0894016	12	1	0	Early Holocene	
CS-10	0	0	0	0	1.7859166	10	1	0	Early Holocene	
CS-11	0	0	0	0	1.3088288	6	1	0	Early Holocene	
CS-12	0	0	0	0	0.9714528	5	1	0	Early Holocene	
CS-13	0	4	0	0	2.0032411	15	1	0	Early Holocene	
CS-14	0	1.1111111	0	0	1.5564092	8	1	0	Early Holocene	
CS-15	0	0	0	0	1.2175318	7	1	0	Early Holocene	
CS-16	0	0	0	0	1.3787529	6	1	0	Younger Dryas	
CS-17	0	10	0	1	1.4460871	15	1	0	Younger Dryas	
CS-18a	0	0	0	0	0	1	1	0	Younger Dryas	
CS-18b	0	1.8181818	0	0	0.768626	5	1	0	Younger Dryas	
CS-19a	0	3.3333333	0	3.3333333	1.7999339	10	1	0	Younger Dryas	
CS-19b	0	0	0	0	0.9779252	4	1	0	Younger Dryas	
CS-20	0	0	0	2	0.857174	4	2	0	Late Pleistocene	
CS-21	0	20	0	17.5	1.6275675	7	1	0	Late Pleistocene	
5/5-Str. I	10	70	32	8	2.8242632	28	4	2.4511692	Late Holocene	
5/5-Str. II	4	68	4	60	2.6446732	23	4	2.6120167	Late Holocene	
5/5-Str. III	0	0	0	8	1.6548174	17	3	1.7917595	Late Holocene	
5/5-Str. IV	0	0	0	4	1.4886746	16	3	0	Middle Holocene	
5/5-Str. VI	0	0	0	4	1.2551348	14	3	0	Early Holocene	
F 1/7-4a	0	0	0	0	0	1	2	0	Younger Dryas	
F 1/7-4b	0	2	0	0	1.6094379	5	2	0	Younger Dryas	
F 2/4C-4	0	0	0	2	1.0808723	6	2	0	Younger Dryas	
F 2/3A-32-46	0	0	0	2	1.3072735	7	2	0.7963116	Younger Dryas	
F 2/6-4	0	0	0	0	2.1210921	13	2	1.8469184	Younger Dryas	
F 5/5-3	10	4	8	4	2.249719	21	4	2.1933062	Younger Dryas	
F 5/5A-26-8	8	0	2	0	1.8334516	12	4	1.8334516	Younger Dryas	
5/12A-34-19	0	722.5	0	812.5	1.7815469	20	3	0	Younger Dryas	

Sample	Ch Edible Seeds/Total Ch Seeds	Sum uncharred edible seeds	Edible uncharred seeds/total unchar
CS-02		38	
CS-03		30	
CS-04		60	
CS-05	1	64	
CS-06	0.9152542	884	
CS-07	0.8333333	238	
CS-08	0	196	
CS-09	0	178	
CS-10	1	140	
CS-11		72	
CS-12		30.666667	
CS-13		168	
CS-14		40	
CS-15		50	
CS-16		205	
CS-17	1	343	
CS-18a		2.8571429	
CS-18b		92.727273	
CS-19a		116.66667	
CS-19b	1	24	
CS-20		28	
CS-21		22.5	
5/5-Str. I	0.591195	398	
5/5-Str. II	0.4347826	792	
5/5-Str. III	0.8333333	1792	
5/5-Str. IV	0.75	2024	
5/5-Str. VI		984	
F 1/7-4a	1	0	
F 1/7-4b	0	4	
F 2/4C-4	0.6666667	90	
F 2/3A-32-46	1	52	
F 2/6-4	0.5098039	54	
F 5/5-3	0.6089385	74	
F 5/5A-26-8	0.8762887	0	
5/12A-34-19		495	

Sample	Density Carex	Density Eleocharis	Density Scirpus	Density Typha	**UNCH OBL**	Density CH Camas	Density CH Juncus	Density Ch Suaeda	Density CH Urtica	**CH FACW**	Density Plagiobothyru	Density Juncus	Density Rumex
CS-02	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-03	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-04	0	0	2	0	**2**	0	0	0	0	**0**	0	0	0
CS0-5	0	0	0	0	**0**	0	0	2	0	**2**	0	0	0
CS-06	0	0	0	0	**0**	0	0	0	0	**0**	4	0	0
CS-07	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-08	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-09	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-10	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-11	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-12	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-13	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-14	0	1.11111111	0	0	**1.11111111**	0	0	0	0	**0**	0	0	0
CS-15	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0
CS-16	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-17	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-18a	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-18b	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-19a	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-19b	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
CS-20	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0
CS-21	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
5/5-Str. I	0	0	0	0	**0**	0	32	0	0	**32**	0	8	0
5/5-Str. II	4	0	0	0	**4**	0	0	0	0	**0**	12	4	0
5/5-Str. III	0	0	0	0	**0**	0	0	0	0	**0**	40	0	0
5/5-Str. IV	4	0	0	0	**4**	0	0	0	0	**0**	4	0	0
5/5-Str. VI	0	0	0	0	**0**	0	0	0	0	**0**	4	0	0
F 5/5-3	0	0	0	0	**0**	0	0	0	8	**8**	0	0	0
F 2/6-4	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
2/4C-4	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
5/5A-26-8	0	0	0	0	**0**	4	2	0	0	**6**	0	0	0
F 1/7-4a	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
F 1/7-4b	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0
2/3A-32-46	0	0	0	2	**2**	0	0	0	0	**0**	0	0	0
5/12A-34-19	12.5	0	82.5	0	**95**	0	0	0	0	**0**	0	0	5
	obl					facw							
											64	14	5

Density Urtica	UNCH FACW	Density Ch Chenopod	CH FACU	Density Hackelia	Density Chenopodium	CH FACU	Density CH Achnath	Density Achnatherum	FAC RI	Upl RI	FACW RI	FACU RI
0	**0**	0	**0**	0	6	**6**	0	14	**0**	**14**	**0**	**6**
0	**0**	0	**0**	0	2	**2**	0	24	**0**	**24**	**0**	**2**
0	**0**	0	**0**	0	4	**4**	0	0	**0**	**0**	**0**	**4**
0	**0**	0	**0**	0	16	**16**	0	26	**0**	**26**	**2**	**16**
0	**4**	92	**92**	2	598	**600**	8	68	**0**	**76**	**4**	**692**
0	**0**	0	**0**	4	14	**18**	0	38	**0**	**38**	**0**	**18**
0	**0**	0	**0**	2	48	**50**	0	36	**0**	**36**	**0**	**50**
0	**0**	0	**0**	0	64	**64**	0	6	**0**	**6**	**0**	**64**
0	**0**	0	**0**	4	42	**46**	0	8	**0**	**8**	**0**	**46**
0	**0**	0	**0**	4	34	**38**	0	0	**0**	**0**	**0**	**38**
0	**0**	0	**0**	0	2.66666667	**2.66666667**	0	2.66666667	**0**	**2.66666667**	**0**	**2.66666667**
0	**0**	0	**0**	1.33333333	36	**37.3333333**	0	52	**0**	**52**	**0**	**37.3333333**
0	**0**	0	**0**	0	7.77777778	**7.77777778**	0	14.4444444	**0**	**14.4444444**	**0**	**7.77777778**
0	**0**	0	**0**	0	2	**2**	0	36	**0**	**36**	**0**	**2**
0	**0**	0	**0**	0	65	**65**	0	80	**0**	**80**	**0**	**65**
1	**1**	0	**0**	0	100	**100**	3	193	**1**	**196**	**1**	**100**
0	**0**	0	**0**	0	0	**0**	0	2.85714286	**0**	**2.85714286**	**0**	**0**
0	**0**	0	**0**	0	12.7272727	**12.7272727**	0	76.3636364	**0**	**76.3636364**	**0**	**12.7272727**
0	**0**	0	**0**	0	16.6666667	**16.6666667**	0	83.3333333	**0**	**83.3333333**	**0**	**16.6666667**
0	**0**	0	**0**	0	0	**0**	0	22	**0**	**22**	**0**	**0**
0	**2**	0	**0**	0	2	**2**	0	22	**0**	**22**	**2**	**2**
17.5	**17.5**	0	**0**	0	0	**0**	0	20	**0**	**20**	**17.5**	**0**
0	**8**	0	**0**	0	0	**0**	52	72	**0**	**124**	**40**	**0**
0	**16**	0	**0**	0	0	**0**	16	112	**0**	**128**	**16**	**0**
0	**40**	0	**0**	0	0	**0**	0	136	**0**	**136**	**40**	**0**
0	**4**	0	**0**	0	0	**0**	0	196	**0**	**196**	**4**	**0**
0	**4**	0	**0**	0	0	**0**	0	184	**0**	**184**	**4**	**0**
4	**4**	0	**0**	0	0	**0**	86	54	**0**	**140**	**12**	**0**
0	**0**	2	**2**	0	4	**4**	8	42	**0**	**50**	**0**	**6**
0	**0**	0	**0**	0	0	**0**	0	80	**0**	**80**	**0**	**0**
0	**0**	0	**0**	0	0	**0**	62	0	**0**	**62**	**6**	**0**
0	**0**	0	**0**	0	0	**0**	0	0	**0**	**0**	**0**	**0**
0	**0**	0	**0**	0	0	**0**	0	0	**0**	**0**	**0**	**0**
0	**0**	0	**0**	0	0	**0**	0	40	**0**	**40**	**0**	**0**
717.5	**722.5**	0	**0**	0	0	**0**	0	297.5	**7.5**	**297.5**	**722.5**	**0**
		facu										
740							235	2038.16522	**8.5**			

APPENDIX E

LSP-1 ROCKSHELTER DATA TABLES

Sample No.	Bottom depth	Sample Category	Provenience	Period	Sample Type	Strata and Feature	Strata	Sediment Package	Volume (L)	LF Weight
LSP-005b	28-31	Column	Column Upper	Late Holocene	Column Upper	II	II	Upper	0.9	10.87
LSP-006	31-36	Column	Column Upper	Late Holocene	Column Upper	II	II	Upper	1	6.3
LSP-007	36-41	Column	Column Upper	Late Holocene	Column Upper	II	II	Upper	1	1.59
LSP-008a	41-44	Column	Column Upper	Late Holocene	Column Upper	III	III	Upper	1	8.99
LSP-008b	44-46	Column	Column Upper	Late Holocene	Column Upper	IV	IV	Upper	1	6.03
LSP-009	46-51	Column	Column Upper	Late Holocene	Column Upper	IV	IV	Upper	1	8.35
LSP-010	51-56	Column	Column Upper	Late Holocene	Column Upper	IV	IV	Upper	1	7.85
LSP-011	56-61	Column	Column Upper	Late Holocene	Column Upper	IV	IV	Upper	1	9.58
LSP-012	61-66	Column	Column Upper	Late Holocene	Column Upper	IV	IV	Upper	1	14.5
LSP-013	66-71	Column	Column Upper	Late Holocene	Column Upper	IV	IV	Upper	1	21.04
LSP-014	71-76	Column	Column Middle	Middle Holocene	Column Middle	V post Mz	V	Middle	1	20.09
LSP-015	76-81	Column	Column Middle	Middle Holocene	Column Middle	V post Mz	V	Middle	1	18.19
LSP-016	81-86	Column	Column Middle	Middle Holocene	Column Middle	V post Mz	V	Middle	1	7.35
LSP-017	86-91	Column	Column Middle	Middle Holocene	Column Middle	V post Mz	V	Middle	1	13.04
LSP-018	91-96	Column	Column Middle	Mazama Tephra	Mazama	Mz	Mz	Middle	1	15.92
LSP-019	96-101	Column	Column Middle	Mazama Tephra	Mazama	Mz	Mz	Middle	1	15.42
LSP-020	101-106	Column	Column Middle	Early Holocene	Column Middle	V pre Mz	V	Middle	1	6.9
LSP-021	106-111	Column	Column Middle	Early Holocene	Column Middle	V pre Mz	V	Middle	1	6.44
LSP-022	111-116	Column	Column Middle	Early Holocene	Column Middle	V pre Mz	V	Middle	1	7.39
LSP-023	116-121	Column	Column Lower	Early Holocene	Column Lower	VII	VII	Lower	1	3.76
LSP-024	121-126	Column	Column Lower	Early Holocene	Column Lower	VII	VII	Lower	1	1.94
LSP-025a	126-128	Column	Column Lower	Early Holocene	Column Lower	VII	VII	Lower	0.2	0.59
LSP-025b	128-131	Column	Column Lower	Early	Column Lower	VIII	VIII	Lower	0.8	4.1

Sample No.	Bottom depth	Sample Category	Provenience	Period	Sample Type	Strata and Feature	Strata	Sediment Package	Volume (L)	LF Weight
LSP-026	131-136	Column	Column Lower	Holocene Early Holocene	Column Lower	VII	VII	Lower	0.75	4.45
LSP-027	136-141	Column	Column Lower	Early Holocene	Column Lower	IX	IX	Lower	0.6	1.78
F. 11-19		Feature	Hearth Upper	Late Holocene	Hearth	Hearth	IV	Upper	0.6	16
F. 11-05/15		Feature	Hearth Upper	Late Holocene	Hearth	Hearth	IV	Upper	2.1	51
F. 14-01		Feature	Carbon stain	Early Holocene	Non Cultural Feature	Non Cultural Feature	V	Middle	0.5	35.66
F. 12-01/02		Feature	Organic concentration	Early Holocene	Non Cultural Feature	Non Cultural Feature	VII	Lower	1.35	11.15
F. 14-04		Feature	Hearth Upper	Middle Holocene	Hearth	Hearth	IV	Upper	0.25	12.31
F. 14-02		Feature	Hearth Upper	Middle Holocene	Hearth	Hearth	IV	Upper	0.25	30.5
F. 13-01		Feature	Hearth Middle	Early Holocene	Hearth	Hearth	V	Middle	0.6	8.56
F. 13-02		Feature	Hearth Middle	Early Holocene	Hearth	Hearth	V	Middle	0.4	5.27
F. 11-14		Feature	Hearth Upper	Late Holocene	Hearth	Hearth	II/III	Upper	0.9	24.7
F. 11-07		Feature	Hearth Middle	Middle Holocene	Hearth	Hearth	V	Middle	0.7	109.3

Sample No.	Charcoal Density	CH Eriogonum	CH Amsinckia	CH Phacelia	CH Plagio	CH BRASS	CH Descurainia	CH Cheno-Am	CH A confert	CH Chenopod
LSP-005b	0.0777778	0	0	0	0	0	0	0	0	0
LSP-006	0.06	0	0	0	0	0	0	0	0	0
LSP-007	0.005	0	0	0	0	0	0	0	0	1
LSP-008a	0.19	0	0	0	0	0	3	0	0	56
LSP-008b	0.29	2	0	1	0	0	0	23	0	73
LSP-009	0.22	0	0	0	0	0	7	0	0	51
LSP-010	0.35	0	0	0	0	0	12	0	0	58
LSP-011	0.31	0	0	0	0	0	16	0	0	43
LSP-012	0.38	0	0	0	0	0	14	0	0	37
LSP-013	0.35	0	0	0	0	0	11	0	0	20
LSP-014	0.11	0	0	0	0	0	7	0	0	19
LSP-015	0.01	0	0	0	0	0	0	0	0	2
LSP-016	0.06	0	0	0	0	0	0	0	0	0
LSP-017	0.05	0	0	0	0	0	0	0	0	1
LSP-018	0.02	0	0	0	0	0	0	0	0	0
LSP-019	0.06	0	0	0	0	0	0	0	0	0
LSP-020	0.05	0	0	0	0	0	0	0	0	1
LSP-021	0.06	0	0	0	0	0	0	1	0	3
LSP-022	0.13	0	0	0	0	0	0	0	0	0
LSP-023	0.05	0	0	0	0	0	0	1	0	0
LSP-024	0.01	0	0	0	0	0	0	0	0	3
LSP-025a	0.025	0	0	0	0	0	0	0	0	0
LSP-025b	0.1625	0	0	0	0	0	0	12.5	0	7.5
LSP-026	0.12	0	0	0	0	0	0	0	0	14.666667
LSP-027	0.0166667	0	0	0	0	0	0	0	0	0
F. 11-19	1.7333333	0	0	1.6666667	1.6666667	3.3333333	3.3333333	0	0	80
F. 11-05/15	1.180952	2.380952	0.952381	0	0.47619	0	5.714286	0	0	22.85714
F. 14-01	1.66	0	0	0	0	0	0	0	0	0
F. 12-01/02	0.340741	0	0	0	0	0	0	0	0	2.962963
F. 14-04	15.76	8	0	0	0	0	0	0	0	4
F. 14-02	14.72	0	0	0	0	0	0	0	0	16
F. 13-01	0.1666667	0	0	0	0	0	0	5	0	5
F. 13-02	0.175	5	0	0	0	0	2.5	0	0	0
F. 11-14	1.4444444	2.2222222	0	1.1111111	0	2.2222222	81.111111	0	0	151.11111
F. 11-07	1.4	0	0	0	0	0	27.142857	1.4285714	4.2857143	94.285714
F. 14-03	39.94	0	12	0	0	0	18	6	0	18

Sample No.	CH Scirpus	CH Ribes	CH LAMIA	CH Mentzelia	CH Montia	CH POA	CH Agrostis	CH Leymus	CH Prunus	CH Galium
LSP-005b	0	0	0	0	0	0	0	0	0	0
LSP-006	0	0	0	0	0	0	0	0	0	0
LSP-007	0	0	0	0	0	0	0	0	0	0
LSP-008a	0	0	0	0	0	0	0	0	0	0
LSP-008b	0	0	0	1	0	1	32	0	0	0
LSP-009	0	0	0	0	0	0	3	0	0	0
LSP-010	0	0	0	0	0	0	0	0	0	0
LSP-011	0	0	0	0	0	0	4	0	0	0
LSP-012	0	0	0	0	0	0	3	0	0	0
LSP-013	0	0	0	0	0	0	2	0	0	0
LSP-014	0	0	0	0	0	0	3	0	0	0
LSP-015	0	0	0	0	0	0	1	0	0	0
LSP-016	0	0	0	0	0	0	0	0	0	0
LSP-017	0	0	0	0	0	0	1	0	0	0
LSP-018	0	0	0	0	0	0	0	0	0	0
LSP-019	0	0	0	0	0	0	0	0	0	0
LSP-020	0	0	0	0	0	0	0	0	0	0
LSP-021	0	0	0	0	0	0	0	0	0	0
LSP-022	0	0	0	0	0	0	1	0	0	0
LSP-023	0	0	0	0	0	0	0	0	0	0
LSP-024	0	0	0	0	0	0	0	0	0	0
LSP-025a	0	0	0	0	0	0	0	0	0	0
LSP-025b	0	0	0	0	0	0	6.25	1.25	0	0
LSP-026	0	0	0	0	0	0	0	1.3333333	0	0
LSP-027	0	0	0	0	0	0	1.6666667	0	0	0
F. 11-19	0	0	0	0	3.3333333	0	1.6666667	1.6666667	0	0
F. 11-05/15	0	0.47619	0.47619	0	0.952381	0.952381	12.38095	1.428571	0	0.47619
F. 14-01	0	0	0	0	0	0	0	0	0	0
F. 12-01/02	0	0	0	0	0	0	0	0	0	0
F. 14-04	0	0	0	4	0	0	1308	0	0	0
F. 14-02	0	0	0	0	0	0	96	8	0	4
F. 13-01	0	0	0	0	0	0	0	0	0	0
F. 13-02	0	0	0	0	2.5	0	2.5	0	0	2.5
F. 11-14	2.2222222	1.1111111	0	0	1.1111111	4.4444444	0	7.7777778	1.1111111	0
F. 11-07	0	0	0	0	0	8.5714286	0	18.571429	0	0
F. 14-03	0	0	0	2	0	30	0	0	0	0

Sample No.	CH Typha	CH Unid	Unch Eriogonum	UNCH Amsinckia	UNCH BRASS	UNCH Descurania	UNCH Cheno-Am	UNCH Amaranthus	UNCH Atriplex	UNCH A confert
LSP-005b	0	0	0	0	0	0	0	0	0	0
LSP-006	0	0	0	0	0	0	0	0	0	0
LSP-007	0	0	0	1	0	0	0	0	0	0
LSP-008a	0	3	0	2	0	0	39	0	0	5
LSP-008b	0	5	1	0	0	0	810	0	0	1424
LSP-009	0	4	0	0	0	0	0	0	0	0
LSP-010	0	1	0	0	0	0	0	0	0	0
LSP-011	0	5	0	8	0	0	0	0	0	0
LSP-012	0	5	0	10	0	0	0	0	0	0
LSP-013	0	4	0	6	0	0	0	0	0	0
LSP-014	0	0	0	5	2	0	0	0	0	0
LSP-015	0	0	0	1	0	0	0	0	0	0
LSP-016	0	0	0	0	0	0	0	0	0	0
LSP-017	0	1	0	0	0	0	0	0	0	0
LSP-018	0	0	0	12	0	0	0	0	0	0
LSP-019	0	0	1	18	0	0	0	0	0	0
LSP-020	0	0	0	16	0	0	0	0	0	0
LSP-021	0	0	0	26	0	0	2	0	0	2
LSP-022	0	3	0	14	0	0	0	0	0	2
LSP-023	0	0	0	17	0	0	1	0	0	0
LSP-024	0	0	0	4	0	0	3	0	0	0
LSP-025a	0	0	0	10	0	0	0	0	0	0
LSP-025b	1.25	6.25	0	22.5	0	0	60	0	0	0
LSP-026	0	16	0	6.6666667	0	0	64	0	0	0
LSP-027	0	1.6666667	0	5	0	0	0	0	0	0
F. 11-19	0	0	0	26.666667	1.6666667	1.6666667	3.3333333	0	0	6.6666667
F. 11-05/15	0.952381	2.857143	0.952381	92.85714	0	0	2.857143	0	0	97.61905
F. 14-01	0	0	0	0	0	0	0	0	0	0
F. 12-01/02	0	0	0	2.962963	0	0	1.481481	0	0	0
F. 14-04	0	0	0	64	0	0	0	4	0	52
F. 14-02	0	0	0	56	0	0	0	0	220	0
F. 13-01	0	0	0	106.66667	0	0	1.6666667	0	0	0
F. 13-02	0	0	0	120	0	0	0	0	0	0
F. 11-14	0	10	0	230	196.66667	0	172.22222	0	0	61.111111
F. 11-07	0	0	0	25.714286	0	0	8.5714286	0	0	744.28571
F. 14-03	0	2	0	42	58	10	68	0	0	14

Sample No.	UNCH Chenopo	UNCH Juniper	UNCH Scirpus	UNCH Mentzelia	UNCH POA	Unch Achnather	UNCH Agrostis	UNCH Nicotiana	UNCH Unid	Total Ch Seed Density
LSP-005b	0	0	0	0	0	0	0	0	0	0
LSP-006	0	0	0	0	0	0	0	0	0	0
LSP-007	0	0	0	0	0	0	0	0	0	1
LSP-008a	206	0	0	0	0	0	0	0	0	62
LSP-008b	97	0	0	16	0	0	0	0	0	138
LSP-009	0	0	0	0	0	0	0	0	0	65
LSP-010	0	0	0	0	0	0	0	0	0	71
LSP-011	0	0	0	0	0	0	0	0	0	68
LSP-012	9	0	0	0	0	0	0	0	0	59
LSP-013	5	0	0	0	0	0	0	0	0	37
LSP-014	12	0	0	2	0	0	0	0	0	29
LSP-015	0	0	0	1	0	0	0	0	0	3
LSP-016	0	0	0	0	0	0	0	0	0	0
LSP-017	0	0	0	0	0	0	0	0	0	3
LSP-018	0	0	0	0	0	0	0	0	0	0
LSP-019	0	0	0	0	0	0	0	0	0	0
LSP-020	0	0	0	0	0	0	0	0	0	1
LSP-021	3	0	0	1	0	0	0	0	0	4
LSP-022	0	0	0	1	0	0	0	0	0	4
LSP-023	2	0	0	0	0	0	0	0	0	1
LSP-024	0	0	0	0	0	0	0	0	0	3
LSP-025a	0	0	0	0	0	0	0	0	0	0
LSP-025b	0	0	0	2.5	0	0	0	0	0	35
LSP-026	6.6666667	0	0	0	0	0	0	0	0	32
LSP-027	0	0	0	0	0	0	0	0	0	3.3333333
F. 11-19	0	0	0	0	0	0	0	0	0	96.666667
F. 11-05/15	34.28571	0	0.47619	5.238095	5.238095	0.47619	0	0	1.428571	53.333326
F. 14-01	52	0	0	0	30	12	0	0	2	0
F. 12-01/02	0	0	0	0	0	0	0	0	0	2.962963
F. 14-04	32	0	0	8	4	0	0	0	0	1324
F. 14-02	4	0	0	0	0	0	0	0	0	124
F. 13-01	0	0	0	0	0	0	0	0	0	10
F. 13-02	0	0	0	0	0	0	0	0	0	15
F. 11-14	381.11111	4.4444444	3.3333333	30	43.333333	1.1111111	0	12.222222	13.333333	265.55556
F. 11-07	4.2857143	0	1.4285714	1.4285714	1.4285714	0	1.4285714	0	0	154.28571

F. 14-03	72	0	6	24	18	0	0	0	18	88

Sample No.	Richness	Shannon-Wiener	Uncharred Seed Density	Shannon-Wiener Charred Seeds
LSP-005b	0	0	0	0
LSP-006	0	0	0	0
LSP-007	2	0.6931472	1	0
LSP-008a	6	0.5835809	254	0.201003
LSP-008b	9	0.9792149	2350	1.1489224
LSP-009	3	0.5462785	0	0.5462785
LSP-010	2	0.4581442	0	0.4581442
LSP-011	4	1.0475569	8	0.7837982
LSP-012	4	1.0111992	19	0.7696025
LSP-013	4	1.0799716	11	0.8396049
LSP-014	6	1.2282112	21	0.8548286
LSP-015	4	1.332179	2	0.6365142
LSP-016	0	0	0	0
LSP-017	2	0.6931472	0	0.6931472
LSP-018	1	0	12	0
LSP-019	2	0.2061921	19	0
LSP-020	2	0.2237181	16	0
LSP-021	5	1.0022388	34	0.5623351
LSP-022	4	0.7607553	17	0
LSP-023	3	0.6189407	20	0
LSP-024	3	1.0889	7	0
LSP-025a	1	0	10	0
LSP-025b	7	1.1293603	85	1.3170769
LSP-026	4	0.845263	77.333333	0.286836
LSP-027	2	0.5623351	5	0
F. 11-19	11	1.417835	40	0.7849856
F. 11-05/15	18	1.641003	241	1.6706537
F. 14-01	3	0.9547897	96	0
F. 12-01/02	3	1.0549202	4.44	0
F. 14-04	8	0.5547006	164	0.0779393
F. 14-02	6	1.2185175	280	0.7499626
F. 13-01	3	0.3893062	108	0.6931472

F. 13-02	6	0.5222444	120	1.5607104
F. 11-14	18	1.8531898	1149	1.0700357
F. 11-07	10	0.8229472	789	1.1649804
F. 14-03	9	2.001724	165	1.5701027

LSP-1 Rockshelter (35HA3735) Column Samples, n = 25

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-5b **Unit N 105/E 99** **West Profile** **28-31 cmbd** **Stratum II** **Sample Volume: 0.9 L** **Light Fraction (wt): 10.87 g**	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**19**			**0.07 g**
	Artemisia sp.	Charcoal		19			0.07 g

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-6 **Unit N 105/E 99** **West Profile** **31-36 cmbd** **Stratum II** **Sample Volume: 1.0 L** **Light Fraction (wt): 6.30 g**	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**26**			**0.06 g**
	Artemisia sp.	Charcoal		20			0.05 g

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-7 **Unit N 105/E 99** **West Profile** **36-41 cmbd** **Stratum II** **Sample Volume: 1.0 L** **Light Fraction (wt): 1.59 g**	**SEEDS**						
	Amsinckia sp.	Seed			1		
	Chenopodium sp.	Seed	1				
	CHARCOAL	**Total charcoal ≥ 2 mm**		**2**			**<0.01 g**
	Artemisia sp.	Charcoal		2			<0.01 g

Sample	**Identification**	**Part/Type**	**Charred**	**Uncharred**	**Weig**

			WH	**FR**	**WH**	**FR**	**ht**
CS-8a	**SEEDS**						
	Amsinckia sp.	Seed				2	
Unit N 105/E 99	Cheno-Am	Perisperm			39		
West Profile	*Atriplex confertifolia*	Seed			5		
41-44 cmbd	*Chenopodium* sp.	Seed	18	38	160	46	
Stratum III	*Descurania* sp.	Seed	3				
	Uritca dioica	Seed			2		
Sample Volume: 1.0 L	Unidentified	Seed		3			
Light Fraction (wt): 8.99 g	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**58**			**0.19 g**

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-8b	**SEEDS**						
	Boraginaceae	Perisperm	2		1		
Unit N 105/E 99	*Amsinckia* sp.	Seed			3	9	
West Profile	Cheno-Am	Perisperm	23			810	
44-46 cmbd	*Atriplex confertifolia*	Seed			1424		
Stratum IV	*Chenopodium* sp.	Seed	68	5	90	7	
	Mentzelia albicaulis	Seed	2		15	1	
	Phacelia sp.	Seed		1			
Sample Volume: 1.0 L	Poaceae	Floret		1			
Light Fraction (wt): 6.03 g	cf. *Agrostis*sp.	Caryopsis	32				
	Urtica dioica	Seed			2		
	Unidentified	Seed		5			
	CHARCOAL	**Total charcoal ≥ 2 mm**		**86**			**0.29 g**
	OTHER FLORAL REMAINS						
	Parenchyma	Tissue		3			0.04 g
	Vitirified tissue	Tissue		X			Few

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-9	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	3				
Unit N 105/E 99	*Chenopodium*	Seed	51				

	sp.						
West Profile	*Descurania* sp.	Seed	7				
46-51 cmbd	Unidentified	Seed		4			
Stratum IV	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**45**			**0.22 g**
Sample Volume: 1.0 L							
Light Fraction (wt): 8.35 g							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-10	**SEEDS**						
	Chenopodium sp.	Seed	58				
Unit N 105/E 99	*Descurania* sp.	Seed	12				
West Profile	Unidentified	SEed	1				
51-56 cmbd	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**91**			**0.35 g**
Stratum IV							
Sample Volume: 1.0 L							
Light Fraction (wt): 7.85 g							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-11	**SEEDS**						
	cf. *Agrostis*sp.	Caryopsis	4				
Unit N 105/E 99	*Amsinckia* sp.	Seed			8		
West Profile	*Chenopodium* sp.	Seed	43				
56-61 cmbd	*Descurania* sp.	Seed	16				
Stratum IV	Unidentified	Seed	1	4			
Sample Volume: 1.0 L	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**78**			**0.31 g**
Light Fraction (wt): 9.58 g							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-12	**SEEDS**						
	cf. *Agrostis*sp.	Caryopsis	3				
Unit N 105/E 99	*Amsinckia* sp.	Seed			10		
West Profile	*Chenopodium* sp.	Seed	37		9		
61-66 cmbd	*Descurania* sp.	Seed	14				
Stratum IV	Unidentified	Seed		5			

Sample Volume: 1.0 L **Light Fraction (wt): 14.50 g**	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**110**			**0.38 g**
	OTHER FLORAL REMAINS						
	PET Fruity	Tissue		8			?

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-13	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	2				
Unit N 105/E 99	*Amsinckia* sp.	Seed			6		
West Profile	*Chenopodium* sp.	Seed	20		5		
66-71 cmbd	*Descurania* sp.	Seed	11				
Stratum IV	Unidentified	Seed	2	2			
Sample Volume: 1.0 L **Light Fraction (wt): 21.04 g**	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**94**			**0.35 g**

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-14	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	3				
Unit N 105/E 99	*Amsinckia* sp.	Seed			5		
West Profile	Brassicaceae	Seed				2	
71-76 cmbd	*Descurania* sp.	Seed	7				
Stratum IV	*Chenopodium* sp.	Seed	19		12		
	Mentzelia albicaulis	Seed			2		
Sample Volume: 1.0 L **Light Fraction (wt): 20.09 g**	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**37**			**0.11 g**

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-15	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	1				
Unit N 105/E 99	*Amsinckia* sp.	Seed			1		
West Profile	*Chenopodium* sp.	Seed	2				
76-81 cmbd	*Mentzelia*	Seed			1		

	albicaulis						
Stratum V **Sample Volume: 1.0 L** **Light Fraction (wt): 18.19 g**	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**5**			**0.01 g**
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-16 **Unit N 105/E 99** **West Profile** **81-86 cmbd** **Stratum V** **Sample Volume: 1.0 L** **Light Fraction (wt): 7.35 g**	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**10**			**0.06 g**
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-17 **Unit N 105/E 99** **West Profile** **86-91 cmbd** **Stratum V** **Sample Volume: 1.0 L** **Light Fraction (wt): 13.04 g**	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	1				
	Chenopodium sp.	Seed	1				
	Unidentified	Seed	1				
	CHARCOAL	**Total charcoal ≥ 2 mm**		**11**			**0.05 g**
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-18 **Unit N 105/E 99** **West Profile** **91-96 cmbd** **Mazama tephra** **Sample Volume: 1.0 L**	**SEEDS**						
	Amsinckia sp.	Seed				12	
	CHARCOAL	**Total charcoal ≥ 2 mm**		**4**			**0.02 g**
	Artemisia sp.	Charcoal		4			0.02 g
	OTHER FLORAL REMAINS						

Light Fraction (wt): 15.92 g							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-19	**SEEDS**						
	Boraginaceae	Perisperm			1		
Unit N 105/E 99	*Amsinckia* sp.	Seed				18	
West Profile	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**10**			**0.06 g**
96-101 cmbd	*Artemisia* sp.	Charcoal		10			0.06 g
Mazama tephra							
Sample Volume: 1.0 L							
Light Fraction (wt): 15.42 g							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-20	**SEEDS**						
	Amsinckia sp.	Seed			1	15	
Unit N 105/E 99	*Chenopodium* sp.	Seed	1				
West Profile	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**14**			**0.05 g**
101-106 cmbd	*Artemisia* sp.	Charcoal		14			0.05 g
Stratum V							
Sample Volume: 1.0 L							
Light Fraction (wt): 6.90 g							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-21	**SEEDS**						
	Amsinckia sp.	Seed			2	24	
Unit N 105/E 99	Cheno-Am	Perisperm			2		
West Profile	*Atriplex confertifolia*	Seed	1		2		
106-111 cmbd	*Chenopodium* sp.	Seed	2	1		3	
Stratum V	*Mentzelia albicaulis*	Seed			1		
	CHARCOAL	**Total charcoal ≥ 2 mm**		**24**			**0.06 g**
Sample Volume: 1.0 L							
Light Fraction (wt): 6.44 g	**OTHER FLORAL REMAINS**						
	Dicotyledon	Stem		1			

	Monocotyledon	Stem		1			
	Vitrified tissue	Tissue		X			Few

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-22	**SEEDS**						
	cf. *Agrostis* sp.	Seed	1				
Unit N 105/E 99	*Amsinckia* sp.	Seed				14	
West Profile	*Atriplex confertifolia*	Seed			2		
111-116 cmbd	*Mentzelia albicaulis*	Seed			1		
Stratum V	Unidentified	Seed		3			
Sample Volume: 1.0 L	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**39**			**0.13 g**
Light Fraction (wt): 7.39 g	**OTHER FLORAL REMAINS**						
	Vitrified tissue	Tissue		X			Few

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-23	**SEEDS**						
	Amsinckia sp.	Seed			2	15	
Unit N 105/E 99	Cheno-Am	Perisperm	1		1		
West Profile	*Chenopodium* sp.	Seed			2		
116-121 cmbd	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**17**			**0.05 g**
Stratum VII	*Artemisia* sp.	Charcoal		17			0.05 g
	OTHER FLORAL REMAINS						
Sample Volume: 1.0 L	*Artemisia sp.*	Leaf		1			
Light Fraction (wt): 3.76 g	Monocotyledon	Stem		1			

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-24	**SEEDS**						
	Amsinckia sp.	Seed			1	3	
Unit N 105/E 99	Cheno-Am	Perisperm			3		
West Profile	*Chenopodium* sp.	Seed		3			
121-126 cmbd	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**3**			**0.01 g**
Stratum VII	*Artemisia* sp.	Charcoal		3			0.01 g

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Sample Volume: 1.0 L							
Light Fraction (wt): 1.94 g							
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-25a	**SEEDS**						
	Amsinckia sp.	Seed				2	
Unit N 105/E 99	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**1**			**<0.01 g**
West Profile	*Artemisia* sp.	Charcoal		1			<0.01 g
126-128 cmbd							
Stratum VII							
Sample Volume: 0.2 L							
Light Fraction (wt): 0.59 g							
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-25b	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	4	1			
Unit N 105/E 99	*Amsinckia* sp.	Seed				18	
West Profile	Cheno-Am	Perisperm	9		48		
128-131 cmbd	*Atriplex confertifolia*	Seed		1			
Stratum VIII	*Chenopodium* sp.	Seed	4	2			
	Leymus cinerus	Caryopsis	1				
Sample Volume: 0.8 L	*Mentzelia albicaulis*	Seed			1	1	
Light Fraction (wt): 4.10 g	*Typha* sp.	Seed	1				
	Unidentified	Nutshell		1			
	Unidentified	Seed		5			
	CHARCOAL	**Total charcoal ≥ 2 mm**		**37**			**0.13 g**
	Artemisia sp.	Charcoal		20			0.08 g
	OTHER FLORAL REMAINS						
	PET Fruity	Tissue		5			<0.01 g
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-26	**SEEDS**						
	Amsinckia sp.	Seed				5	

Unit N 105/E 99	Cheno-Am	Perisperm			48		
West Profile	*Chenopodium* sp.	Seed	4	7		4	1
131-136 cmbd	*Leymus cinerus*	Caryopsis	1				
Stratum VIII	Unidentified	Seed	12				
	CHARCOAL	**Total charcoal ≥ 2 mm**		**18**			**0.09 g**
Sample Volume: 0.75 L	*Artemisia* sp.	Charcoal		18			0.09 g
Light Fraction (wt): 4.45 g							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
CS-27	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	1				
Unit N 105/E 99	*Amsinckia* sp.	Seed			3		
West Profile	Cheno-Am	Perisperm		1			
136-141 cmbd	Unidentified	Seed	1				
Stratum IX	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**5**			**0.01 g**
	Artemisia sp.	Charcoal		5			0.01 g
Sample Volume: 0.6 L							
Light Fraction (wt): 1.78 g							

LSP-1 Rockshelter (35HA3735) Feature Samples, n = 14

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Feature 11-05	**SEEDS**						
	Atriplex confertifolia	Seed			12		
# 010-39-1658	Boraginaceae	Perisperm			1		
Unit N 103/E 99	*Amsinckia* sp.	Seed			10	66	
~64 cmbd	*Chenopodium* sp.	Seed	7	7	12		
Stratum IV	*Mentzelia albicaulis*	Seed			4		
	Poaceae	Floret			3		
Sample Volume: 0.9 L	cf. *Agrostis* sp.	Caryopsis	18				
Light Fraction (wt): 18.03 g	*Scirpus* sp.	Seed				1	
	Typha sp.	Seed	1				
	Unidentified	Seed		3			
	CHARCOAL	**Total charcoal ≥ 2 mm**		**188**			**0.86 g**
	Artemisia sp.	Charcoal		20			0.24 g
	OTHER FLORAL REMAINS						

	Juniperus	Leaf		2		1	
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Feature 11-05-3 **# JD excavation** **Unit N 103/E 99** **X cmbd** **Stratum IV** **Sample Volume: 0.45 L** **Light Fraction (wt): 23.64 g**	**SEEDS**						
	Atriplex confertifolia	Seed			124		
	Boraginaceae	Perisperm	1				
	Amsinckia sp.	Seed	1		18	17	
	cf. *Plagiobothrys* sp.	Seed	1				
	Claytonia sp.	Seed		2			
	Chenopodium sp.	Seed	8	11	15		
	Galium sp.	Seed	1				
	Mentzelia albicaulis	Seed			7		
	Lamiaceae	Seed	1				
	Poaceae	Floret				1	
	Achnatherum hymenoides	Caryopsis			1		
	cf. *Agrostis* sp.	Caryopsis	8				
	Ribes sanguineum	Seed	1				
	Typha sp.	Seed	1				
	Unidentified	Seed	1	2			
	CHARCOAL	**Total charcoal ≥ 2 mm**		**172**			**0.82 g**
	Artemisia sp.	Charcoal		20			0.28 g
	OTHER FLORAL REMAINS						
	Parenchymous tissue	Tissue		1			<0.01 g
	PET Fruity	Tissue		3			<0.01 g
Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Feature 11-07 **# 010-39-1657** **Unit N 102/E 99** **~69 cmbd**	**SEEDS**						
	Amsinckia sp.	Seed			2	16	
	Cheno-Am	Perisperm	1		6		
	Atriplex confertifolia	Fruit		3			
	Atriplex	Seed			52		

	confertifolia				1		
Stratum V	*Chenopodium* sp.	Seed	49	17	3		
	Descurania sp.	Seed	19				
Sample Volume: 0.7 L	*Mentzelia albicaulis*	Seed			1		
Light Fraction (wt): 109.30 g	Poaceae	Floret		5		1	
	Poaceae	Caryopsis	1				
	cf. *Agrostis* sp.	Caryopsis			1		
	Leymus cinereus	Caryopsis		13			
	Scirpus sp.	Seed			1		
	CHARCOAL	**Total charcoal ≥ 2 mm**		**178**			**0.98 g**
	Artemisia sp.	Charcoal		20			0.41 g
	OTHER FLORAL REMAINS						
	Monocotyledon	Stem		1			
	PET Fruity	Tissue		2			<0.01 g
	Unidentified	Bud				3	

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Feature 11-14	**SEEDS**						
	Boraginaceae	Perisperm	2				
# 010-39-1653	*Amsinckia* sp.	Seed			100	107	
Unit N 104/E 99	Brassicaceae	Seed		2			
50 cmbd	*Descurania* sp.	Seed	64	9	111	66	
Stratum II/III	*Claytonia* sp.	Seed		1			
	Cheno-Am	Perisperm			145	10	
Sample Volume: 0.9 L	*Atriplex confertifolia*	Seed			54	1	
Light Fraction (wt): 24.70 g	*Chenopodium* sp.	Seed	82	54	255	88	
	Juniperus sp.	Seed				4	
	Mentzelia albicaulis	Seed			25	2	
	Nicotiana attenuata	Seed			11		
	Phacelia sp.	Seed	1				
	Poaceae	Floret		4		39	

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
	Achnatherum hymenoides	Caryopsis				1	
	Leymus cinereus	Caryopsis	2				
	Leymus cinereus	Floret		5			
	Prunus sp.	Seed	1				
	cf. *Ribes* sp.	Berry		1			
	Scirpus sp.	Seed	1	1	1	2	
	Unidentified	Nutshell		8			
	Unidentified	Seeds	8	1	12		
	CHARCOAL	**Total charcoal ≥ 2 mm**		**284**			**1.30 g**
	Artemisia sp.	Charcoal		19			0.35 g
	Atriplex sp.	Charcoal		1			0.01 g
	OTHER FLORAL REMAINS						
	Artemisia sp.	Leaf		3			
	Parenchymous tissue	Tissue		40			0.02 g
	PET Fruity	Tissue		173			0.02 g
Feature 11-15 **# 010-39-1654** **Unit N 103/E 99** **58 cmbd** **Stratum IV** **Sample Volume: 0.65 L** **Light Fraction (wt): 9.33 g**	**SEEDS**						
	Boraginaceae	Perisperm	4		1		
	Amsinckia sp.	Seed	1		28	56	
	Cheno-Am	Perisperm			6		
	Atriplex confertifolia	Seed			66	3	
	Chenopodium sp.	Seed	8	7	17	28	
	Descurania sp.	Seed	12				
	Poaceae	Caryopsis w/glume	1				
	Poaceae	Floret		1		7	
	Leymus cinereus	Caryopsis		3			
	Unidentified	Seed			3		
	CHARCOAL	**Total charcoal ≥ 2 mm**		**128**			**0.80 g**
	Artemisia sp.	Charcoal		20			0.39 g
	OTHER FLORAL						

	REMAINS						
	Artemisia sp.	Leaf		15			
	Dicotyledon	Stem		10			
	Monocotyledon	Stem		5			

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Feature 11-19	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	1				
# 010-39-1649	*Amsinckia* sp.	Seed			1	15	
Unit N 104/E 99	Brassicaceae	Seed	2		1		
72 cmbd	*Descurania* sp.	Seed	2		1		
Stratum IV	*Claytonia* sp.	Seed		2			
	Cheno-Am	Perisperm			2		
Sample Volume: 0.6 L	*Atriplex confertifolia*	Seed			4		
Light Fraction (wt): 16.00 g	*Chenopodium* sp.	Seed	4	44			
	Leymus cinereus	Caryopsis	1				
	Phacelia sp.	Seed	1				
	cf. *Plagiobothrys* sp.	Seed	1				
	CHARCOAL	**Total charcoal ≥ 2 mm**		**374**			**1.04 g**
	Artemisia sp.	Charcoal		20			0.19 g

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Feature 12-01	**SEEDS**						
	Amaranthus sp.	Seed				2	
# 010-39-1667	*Amsinckia* sp.	Seed				1	
Unit N 104/E 100	Chenopodium sp.	Seed		4			
122 cmbd	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**15**			**0.04 g**
Stratum V/VII	*Artemisia* sp.	Charcoal		15			0.04 g
Sample Volume: 0.65 L **Light Fraction (wt): 3.38 g**							

Sample	**Identification**	**Part/Type**	**Charred**		**Uncharred**		**Weight**
			WH	**FR**	**WH**	**FR**	
Feature 12-02 **# 010-39-1666** **Unit N 104/E 100** **123 cmbd** **Stratum V/VII** **Sample Volume: 0.7 L** **Light Fraction (wt): 7.77 g**	**SEEDS**						
	Amsinckia sp.	Seed			1	2	
	CHARCOAL	**Total charcoal ≥ 2 mm**		**127**			**0.42 g**
	Artemisia sp.	Charcoal		20			0.12 g
Feature 13-01 **# 010-39-1031** **Unit N 103/E 100** **125 cmbd** **Stratum V** **Sample Volume: 0.6 L** **Light Fraction (wt): 8.56 g**	**SEEDS**						
	Amsinckia sp.	Seed			8	58	
	Cheno-Am	Perisperm	3		1		
	Chenopodium sp.	Seed	1	2			
	CHARCOAL	**Total charcoal ≥ 2 mm**		**28**			**0.10 g**
	Artemisia sp.	Charcoal		20			
	OTHER FLORAL REMAINS						
	Artemisia sp.	Leaf		4			
	Dicotyledon	Stem		3			
	Monocotyledon	Stem		2			
Feature 13-02 **# 010-39-1270** **Unit N 103/E 102** **N 103.47/E 102.69** **122 cmbd** **Stratum V** **Sample Volume: 0.4 L** **Light Fraction (wt): 5.27 g**	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis	1				
	Boraginaceae	Perisperm	2				
	Amsinckia sp.	Seed			5	43	
	Claytonia sp.	Seed		1			
	Descurania sp.	Seed	1				
	Galium sp.	Seed		1			
	CHARCOAL	**Total charcoal ≥ 2 mm**		**36**			**0.07 g**
	Artemisia sp.	Charcoal		20			0.04 g
	OTHER FLORAL REMAINS						
	Artemisia sp.	Leaf		21			
	Dicotyledon	Stem		7			
	Monocotyledon	Stem		8			
	PET Fruity	Tissue		11			<0.0

							1 g
	Vitrified tissue	Tissue		X			Few
Feature 14-01	**SEEDS**						
	Poaceae	Floret			15		
# 010-39-2430	*Achnatherum hymenoides*	Caryopsis				6	
Unit N 102/E 100	*Chenopodium* sp.	Seed			26		
N 102.99/E 100.50	Unidentified	Seed			1		
81-86 cmbd	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**76**			**0.83 g**
Stratum V	*Artemisia sp.*	Charcoal		20			0.33 g
	OTHER FLORAL REMAINS						
Sample Volume: 0.5 L	Vitrified tissue	Tissue		X			Few
Light Fraction (wt): 35.66 g							
Feature 14-02	**SEEDS**						
	cf. *Agrostis* sp.	Caryopsis					
# 010-39-2432	*Amsinckia sp.*	Seed			2	12	
Unit N 102/E 100	*Atriplex* sp.	Seed			55		
~66 cmbd	Chenopodium sp.	Seed	3	1	1		
Stratum IV	*Galium* sp.	Seed	1				
	Leymus cinereus	Floret		2	2		
Sample Volume: 0.25 L	**CHARCOAL**	**Total charcoal ≥ 2 mm**		**735**			**3.68 g**
Light Fraction (wt): 30.50 g	*Artemisia* sp.	Charcoal		18			0.36 g
	Atriplex sp.	Charcoal		2			0.06 g
	OTHER FLORAL REMAINS						
	Artemisia sp.	Leaf		100			
	Hordeum sp.	Pedicel		3			
	Cordage	Fibers		21			0.24 g
	Dicotyledon	Stem		3			
	Monocotyledon	Stem		3			
	Parenchymous tissue	Tissue		1			<0.01 g
	PET Fruity	Tissue		2			<0.01 g
Feature 14-03	**SEEDS**						
	Amsinckia sp.	Seed	5	1	2	19	

# 010-39-2437	Brassciaceae	Seed			28	1	
Unit N 102/E 101	*Descurania* sp.	Seed	9		4	1	
58 cmbd	Cheno-Am	Seed			25	1	
Stratum IV	Cheno-Am	Perisperm	3		8		
	Atriplex confertifolia	Seed			4	3	
Sample Volume: 0.5 L	*Chenopodium* sp.	Seed	9		36		
Light Fraction (wt): 34.72 g	*Mentzelia albicaulis*	Seed	1		10	2	
	Poaceae	Caryopsis	1	4			
	Poaceae	Floret		10		9	
	Scirpus sp.	Seed			1	2	
	Unidentified	Seed	1		8	1	
	CHARCOAL	**Total charcoal ≥ 2 mm**		**1253**			**19.97 g**
	Artemisia sp.	Charcoal		20			6.67 g
	OTHER FLORAL REMAINS						
	Artemisia sp.	Leaf		23	1		
	Atriplex sp.	Leaf				1	
	Cordage	Fibers		1			<0.01 g
	Dicotyledon	Stem		3			
	Monocotyledon	Stem		3			
	Parenchymous tissue	Tissue		26			<0.01 g
	PET Fruity	Tissue/Cake		34			0.02 g
Feature 14-04	**SEEDS**						
	Amaranthus sp.	Seed			1		
# 010-39-2429	Boraginaceae	Perisperm	2				
Unit N 102/E 100	*Amsinckia* sp.	Seed				16	
74-75 cmbd	*Atriplex confertifolia*	Seed			13		
Stratum IV	*Chenopodium* sp.	Seed		1	4	4	
	Mentzelia albicaulis	Seed		1	2		
Sample Volume: 0.25 L	Poaceae	Floret				1	
Light Fraction (wt): 12.31 g	cf. *Agrostis* sp.	Caryopsis		327			
	CHARCOAL	**Total charcoal ≥ 2 mm**		**473**			**3.94 g**
	Artemisia sp.	Charcoal		20			0.55

							g
	OTHER FLORAL REMAINS						
	Artemisia sp.	Leaf		29			
	Juniperus sp.	Leaf		1			
	Dicotyledon	Stem		1			
	Monocotyledon	Stem		4			

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