Article

Diachronic variability in prehistoric land use in Oregon's Warner Valley

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Abstract

Pedestrian survey in northern Warner Valley, Oregon, has provided data capable of contributing to reconstructions of prehistoric land use. Such information is complementary to data generated by recent work at the stratified LSP-1 rockshelter situated in the Northern Warner Valley Study Area (NWVSA). Here, we present results of our survey and focus on when the area was visited, how it was used, and from where visitors to the area originated and/or obtained toolstone. Our results indicate that the NWVSA saw heavy use by Paleoindians before being largely abandoned during the Middle Holocene. During the Late Holocene, groups likely operating from residential bases further south in the better-watered parts of Warner Valley returned to the NWVSA. Compared to other nearby areas, the NWVSA was utilized less intensively during much of the Holocene.

Keywords

Northern Great Basin archaeology, Obsidian conveyance, Land-use patterns

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Introduction

While stratified and well-dated sites are critical to understanding a region's culture history, extensive pedestrian surveys offer the opportunity to study land use at a scale that single-site excavations cannot. With some notable exceptions (e.g., Aikens and Jenkins, 1994; Jenkins et al., 2004), reconstructions of northern Great Basin prehistory are largely based on data collected during surveys (e.g., Jones, 1984; Leach, 1988; Pettigrew, 1984), and such projects have demonstrated that prehistoric lifeways varied considerably across time in response to environmental and/or social factors. In this paper, we present the results of three seasons of survey in northern Warner Valley, Oregon. Our work has revealed a rich surface record of prehistoric occupation that, when considered together with the results of ongoing analyses of materials from the nearby stratified and well-dated LSP-1 rockshelter, contributes to our understanding of diachronic variability in land-use strategies in the region.

Warner Valley, Oregon

Warner Valley is one of several north–south trending valleys that characterize the northern Great Basin. It measures ~130 km long by ~5–15 km wide and rises gradually to the west to form the Abert Rim (Figure 1). To the east, the fault-blocks of Poker Jim Ridge and Hart Mountain rise abruptly from the valley floor. The valley contains two internally draining sub-basins, North Warner (herein referred to as northern Warner Valley) and South Warner; a small fault-block between Crump and Hart lakes separates the two sub-basins (Weide, 1975). Today, a sagebrush and perennial grass-dominated shrub-steppe environment, where big sagebrush (*Artemisia tridentata*) and rabbitbrush (*Ericameria* sp.) cover much of the valley floor, characterizes far northern Warner Valley. At the lowest elevations (~1360 m above sea level (ASL)), greasewood (*Sarcobatus* sp.) and saltbush (*Atriplex* sp.) are also common. In wetter years, low-lying areas hold water and as recently as the mid-19th century, Bluejoint Lake may have contained a shallow marsh with stands of both tule (*Schoenoplectus acutus*) and cattail (*Typha latifolia*) (Whistler and Lewis, 1916), although it likely desiccated quickly during dry periods much like many of the Warner lakes do today (Cannon et al., 1990). Black-tailed jackrabbits (*Lepus californicus*) and cottontail rabbits (*Sylvilagus* sp.) are abundant while pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and bighorn sheep (*Ovis canadensis*) are found at higher elevations. Faunal remains from the nearby LSP-1 rockshelter, which contains a record of human occupation spanning much of the Holocene (Kennedy and Smith, 2016; Smith et al., 2012, 2014, 2016), show that leporids were common in the past as well (Pellegrini, 2014).

During the Terminal Pleistocene, pluvial Lake Warner reached a maximum elevation of ~1450 m ASL before receding (Weide, 1975). In far northern

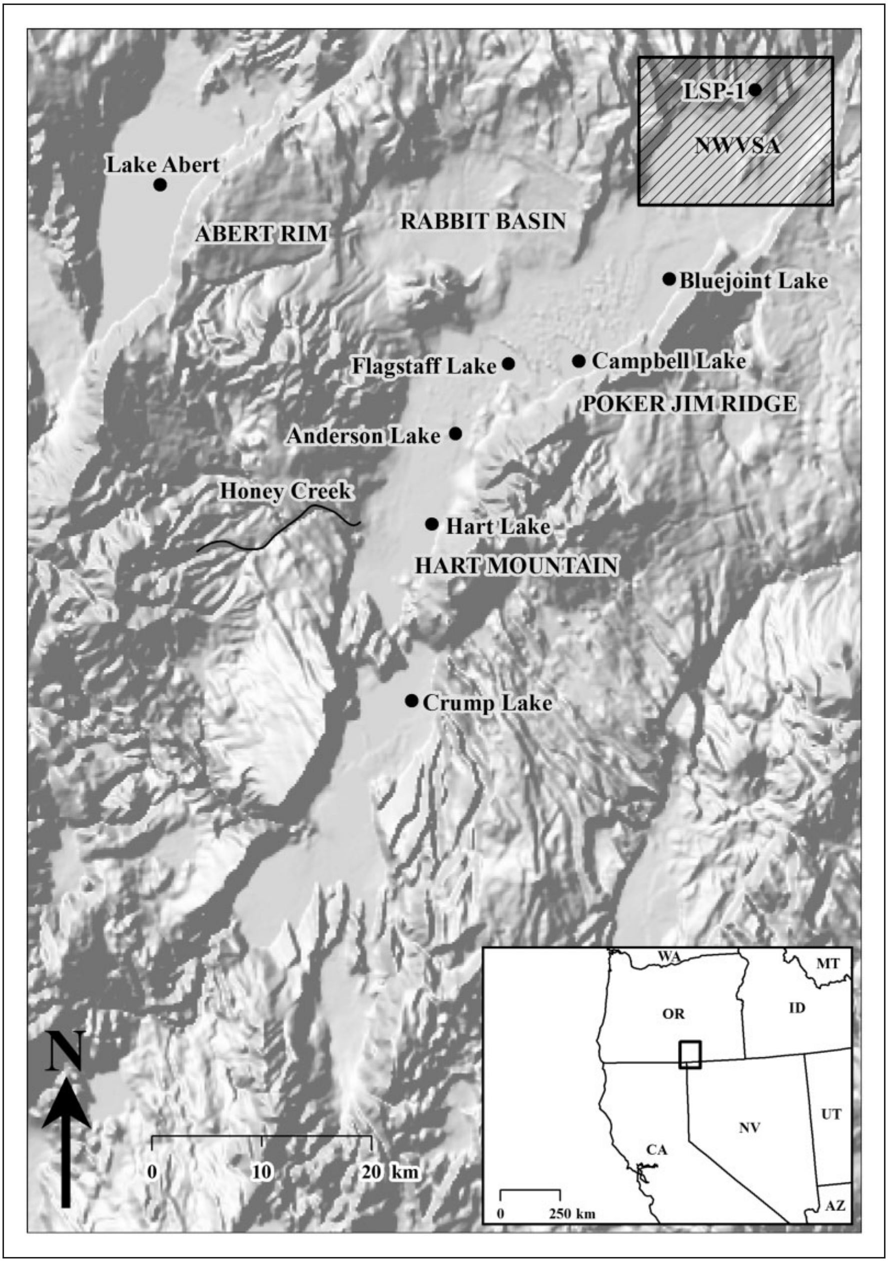

Figure 1. Overview of Warner Valley, Oregon showing the location of the Northern Warner Valley Study Area (NWVSA) and other places discussed in text.

Warner Valley, parallel gravel and sand ridges mark stalls in the lake's regression. Between ~14,500 and 12,500 cal BP, Lake Warner cut a prominent shoreline at ~1390 m ASL and remained stable at that level for an unknown amount of time (Smith et al., 2015). Our understanding of the lake's recession is less well understood after the end of the Pleistocene. When Mazama tephra fell ~7700 cal BP, ~1 m of marsh peats had accumulated at Crump Lake, located ~50 km south of and ~18 m lower than northern Warner Valley (Hansen, 1947; Weide, 1975), indicating that marsh conditions marking the absence of a deep lake had developed during the terminal Early Holocene or initial Middle Holocene (Smith et al., 2015). Weide (1975) suggested that far northern Warner Valley was largely dry by ~9650 cal BP, an interpretation supported by the presence of Western Stemmed Tradition (WST) sites on the valley floor (Smith et al., 2015). Although not dated directly, those sites were likely occupied before ~8900 cal BP, after which time WST points fell out of use (Jones and Beck, 2012).

Warmer and drier conditions characterized Warner Valley during the Middle Holocene, as evidenced by a peak in saltbush pollen in the Bicycle Pond pollen record (Wigand and Rhode, 2002). There is no evidence that the far northern valley on which we focus here (see below) fostered widespread lakes or marshes within the last ~5000 years, a possibility supported by a spike in saltbush seeds in Late Holocene deposits at the nearby LSP-1 rockshelter (Kennedy and Smith, 2016) and the fact that most of our study area sits higher than both the pre-2000 cal BP 1365.5 m ASL Campbell Bench and post-2000 cal BP 1361 m ASL Plush Delta lake/marsh levels identified by Young (1998). While the general proximity of those lakes/marshes to our study area is reflected by charred pieces of tule and cattail in two hearth features at the LSP-1 rockshelter dated to ~890 and ~2600 cal BP (Kennedy and Smith, 2016), we are fairly confident that following the Early Holocene retreat of Lake Warner, far northern Warner Valley remained mostly dry.

Previous archaeological research in Warner Valley

Luther Cressman (1937, 1942; Cressman et al., 1940) was the first to conduct professional research in Warner Valley. He collected basketry fragments and an atlatl from the backdirt of two looted caves in southern Warner Valley and recorded several rock art sites in the area. Three decades later, Weide (1968) conducted archaeological surveys in the valley bottom and adjacent uplands, which formed the basis for her settlement-subsistence model. She proposed that residential sites were generally located adjacent to lower elevation wetlands; from there, groups targeted marsh resources as well as plants and game in the adjacent foothills. Uplands were only visited to procure toolstone and large game (Weide, 1968). Using projectile points as coarse-grained time markers and proxies for population levels, Weide (1968) suggested that the valley floor saw limited use before ~3500 cal BP, was used most intensively ~3500–1500 cal BP, and again saw limited use after ~1500 cal BP. She attributed this shift to fluctuating marsh productivity and the arrival of the Northern Paiute after ~1500 cal BP (Weide, 1968).

In the late 1980s and early 1990s, the University of Nevada, Reno (UNR), conducted a series of field schools focused on habitation sites adjacent to many of the Warner Valley lakes (Eiselt, 1998; Fowler, 1993; Tipps, 1998; Young, 1998). Data generated from those projects and information collected by the Bureau of Land Management (BLM) suggested that Weide's (1968) settlement-subsistence model should be modified. Cannon et al. (1990) proposed a model in which populations used uplands to a greater extent than Weide (1968) had suggested; in the nearby Fort Rock Basin, Jenkins (1994) linked similar increased upland use to more intensive use of root crop grounds. Cannon et al. (1990) also suggested that a transhumance strategy of lowland–upland land use had been in place since at least ~7000 cal BP. Middleton et al. (2014) subsequently pushed the initiation of that pattern back to the Terminal Pleistocene/Early Holocene (TP/EH). Based on her analysis of valley bottom sites, Tipps (1998) concluded that habitation sites near Campbell, Flagstaff, Swamp, and other smaller lakes were occupied primarily after ~2900 cal BP with a particularly heavy focus during the last 200–400 years. Subsistence remains from those sites were dominated by fish and leporids (Tipps, 1998). Both of Tipps' (1998) findings are at odds with Weide's (1968) suggestion that valley bottom occupations decreased after 1500 cal BP. Oetting (1989, 1990) also noted a similar focus on valley bottoms after 1500 cal BP in the adjacent Lake Abert/Chewaucan Marsh Basin. Finally, Young (1998) suggested that during the Late Holocene, groups employed an adaptive strategy that was well suited to both short- and long-term changes in wetland productivity. Additionally, he noted that large residential sites became more common after ~2000 cal BP, a trend that likely corresponded with increased marsh productivity.

The northern Warner Valley study area

The studies outlined above and numerous smaller scale compliance projects have provided a good understanding of how prehistoric groups used parts of Warner Valley; however, with the exception of Weide's (1968) pioneering work, the far northern valley has received relatively little attention from professional archaeologists. In 2011, Bill Cannon (Lakeview District BLM) invited UNR to return to Warner Valley and evaluate the potential for Paleoindian sites in the far northern valley. UNR initiated a three-year survey of a ~221 km^2 area that became known as the Northern Warner Valley Study Area (NWVSA) (Figure 2). Elsewhere (Smith et al., 2015), we have presented a detailed overview of the Paleoindian record of the NWVSA and how it has contributed to ongoing debates about how and when the northern Great Basin was colonized. Here, we

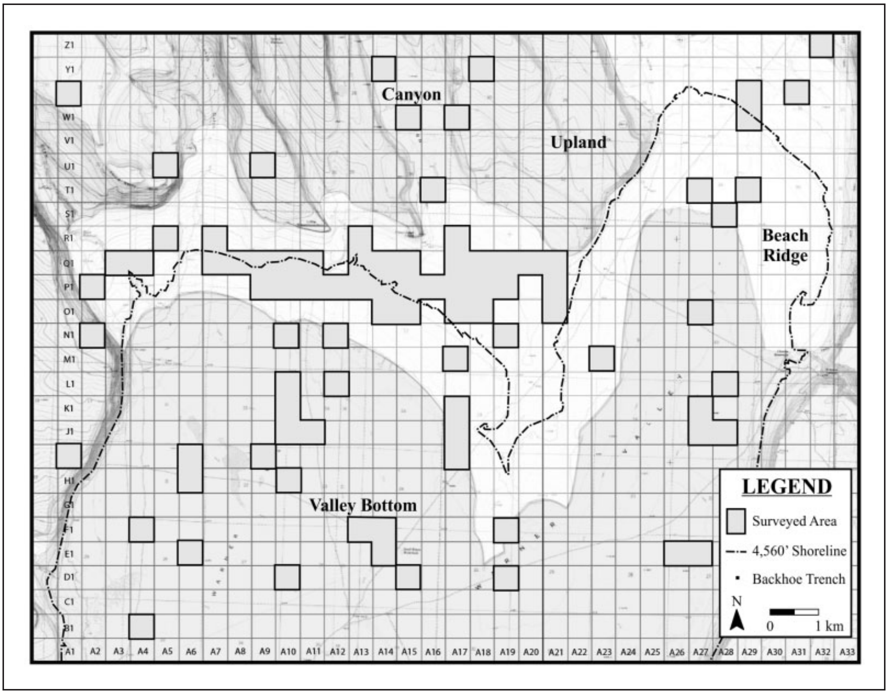

Figure 2. The NWVSA showing locations of surveyed parcels and different landform types (adapted from Smith et al., 2015).

use the entire dataset generated by three years of survey (see Pattee, 2014 for a more detailed presentation of these data) to address the following questions: (1) To what degree was the NWVSA occupied in the past and did use intensity vary across time? (2) How did prehistoric use of the NWVSA compare to adjacent areas? (3) Did land-use strategies within the NWVSA vary diachronically?; and (4) From where did visitors to the NWVSA originate and/or obtain obsidian and did it change over time? In the remainder of this paper, we describe the materials and methods used to address these questions, present our results, and situate them within the broader context of northern Great Basin prehistory.

Materials and methods

The NWVSA encompasses multiple physiographic features, which we grouped into four general landform types: (1) uplands (tablelands surrounding northern Warner Valley); (2); canyons (drainages cut into tablelands); (3) beach ridges (locations characterized by relict lakeshore features sometimes capped with sand sheets); and (4) valley bottoms (areas that would have been underwater prior to ~9650 cal BP). As the project progressed, we grouped canyons and uplands into

Table 1. Sampling fractions of landform types in the NWVSA.

Landform type	Area (km^2)	No. of quadrats	Area surveyed (km^2)	Sample fraction (%)
Valley bottom	82.0	29.5	7.1	8.7
Beach ridge	61.0	48.0	12.2	20.0
Upland/canyon	78.0	10.5	2.7	3.5
Total	221.0	88.0	22.0	10.0

a single landform type (upland/canyon) due to insufficient sampling of canyons. In 2011, we employed a stratified random sampling strategy, selecting 500 m 500 m parcels and surveying them at 20–30 m intervals. In 2012 and 2013, we switched to a non-random survey strategy focused on beach ridge and valley bottom parcels that we felt held the best potential to contain Paleoindian sites. In total, we surveyed 21.2 km^2, or ~10% of the NWVSA; this area consisted of differing sample fractions of each landform type (Table 1).

We recorded 116 prehistoric sites (10 associated artifacts) and 58 isolated resources (<10 associated artifacts) within the NWVSA; most are low- to moderate-density scatters of obsidian tools and debitage. Ground stone artifacts are uncommon and no habitation, midden, or hearth features were found. Backhoe trenching at several locales suggests that the NWVSA record is predominantly a surface one and that Holocene-aged sediments are missing in some areas (Smith et al., 2015). While archaeological "sites" are the basic unit of analysis in many land-use studies (e.g., Jones, 1984; Kelly, 2001), time-sensitive projectile points are used in others (e.g., Pettigrew, 1984). Often, our site boundaries were arbitrary and designed to split large artifact concentrations that may represent single occupations into more manageable units. As such, comparisons of site frequency/density across time are unlikely to yield an accurate picture of changing land-use patterns. Instead, we used projectile point frequencies/densities as a proxy for occupation intensity in the NWVSA. While projectile points admittedly reflect a single aspect of prehistoric behavior (hunting), the lack of habitation features and low frequencies of ground stone artifacts suggest that hunting was a major activity in northern Warner Valley. For this study, we adopted the projectile point chronology developed by Oetting (1994) for the nearby Lake Abert-Chewaucan Basin (Table 2). While the cultural periods in Table 2 are fairly broad, they are generally consistent with the age ranges for time-sensitive projectile points recovered from the stratified and well-dated LSP-1 rockshelter located within the NWVSA.

To gauge the intensity to which northern Warner Valley was used across both time and relative to other nearby areas, we applied three approaches. First, we tallied the number of projectile points found in the NWVSA by cultural period. Second, because the time periods (e.g., Paleoindian, Early Archaic, etc.)

Table 2. Time-sensitive projectile point types by cultural period (adapted from Oetting, 1994).

Point series by period	Cal BP range[a]
Paleoindian (13,000–8000 cal BP)	
Fluted	pre-8000
Western Stemmed	pre-8000
Black Rock Concave Base	pre-8000
Crescent	pre-8000
Early Archaic (8000–5750 cal BP)	
Northern Side-notched	~8000–5000
Middle Archaic (5750–2000 cal BP)	
Humboldt	~6900–1200
Gatecliff	~5700–2200
Elko	~4500–1000
Late Archaic (2000–150 cal BP)	
Rosegate	post-2000
Desert	post-1000

[a]Oetting's (1994) ^{14}C age ranges converted to cal BP ranges using Appendix 1 in Grayson (2011).

represented by the projectile point types differ in duration, we calculated the rate of point discard by dividing the number of years contained within each period by the number of points dating to that time period. Finally, to consider how northern Warner Valley fit within broader patterns of prehistoric land use, we compared the frequencies of projectile points found in the NWVSA to frequencies of points reported by other researchers working in the nearby Lake Abert-Chewaucan Marsh Basin (Oetting, 1995), Massacre Lake Basin (Leach, 1988), Fort Rock Basin (Aikens and Jenkins, 1994), and Steens Mountain area (Jones, 1984).[1] To determine if and how prehistoric land-use patterns within the NWVSA varied diachronically, we compared the distribution of projectile points across landform types. We also divided the area surveyed within each landform type by the number of projectile points associated with each landform type to provide point densities for each period. Finally, to determine from where visitors to northern Warner Valley originated and/or obtained toolstone, we submitted 185 projectile points made on obsidian or other fine-grained volcanic (FGV) toolstone (e.g., basalt) to the Northwest Research Obsidian Studies Laboratory for geochemical characterization. We calculated the "as-the-crow-flies" distances between the nearest known sources of different obsidian types and the sites at which artifacts made on those raw materials were discarded. We also calculated source diversity for sourced projectile point samples from each period, taking the effects of samples size into consideration.[2] Finally, we calculated the directions from which people conveyed obsidian and FGV projectile points into Warner Valley; following Connolly and Jenkins (1997:243), we grouped these into two "source directions" (north and south).

Results

Prehistoric use of northern Warner Valley: Projectile point frequencies in the NWVSA and adjacent areas

Paleoindian points (WST, fluted, Black Rock Concave Base, and crescents) were the most common ($n = 149$; 61% of sample) diagnostic artifacts recovered in the NWVSA (Table 3). While the high number of such artifacts attests to the importance of northern Warner Valley to early groups, it also likely reflects our heavy focus on areas likely to contain Paleoindian occupations (i.e., beach ridges). Later period point types are less common—in particular, Early Archaic Northern Side-notched points ($n = 7$; 3% of the sample)—suggesting that the NWVSA was not visited to any great extent during the Middle Holocene. Higher numbers of both Middle Archaic (Gatecliff, Elko, and Humboldt series) ($n = 58$; 24.0% of the sample) and Late Archaic (Rosegate and Desert series) ($n = 30$; 12% of the sample) points suggest that groups used northern Warner Valley more often during the Late Holocene.

The annual rate of projectile point discard by cultural period paints a similar picture of diachronic use of northern Warner Valley. Points were most frequently discarded during the Paleoindian period (1 point per 34 years) followed by the Late Archaic (1 point per 65 years) and Middle Archaic (1 point per 62 years) periods. Early Archaic points were discarded at a very slow rate (1 point per 321 years), again suggesting infrequent visits to the NWVSA during the Middle Holocene.

Table 4 shows paired comparisons of projectile point types from the NWVSA and other nearby study areas. Like the simple point counts and rates of point discard indicate, the comparisons of point frequencies between regions show that northern Warner Valley was visited frequently by early groups: Paleoindian points are significantly overrepresented in the NWVSA compared to the Fort Rock, Chewaucan-Abert, and Massacre Lake basins as well as Steens Mountain. With the exception of the Fort Rock Basin, Early Archaic (i.e., Northern Side-notched) points are significantly underrepresented in the NWVSA relative to other nearby areas. Finally, both Middle and Late Archaic points are significantly underrepresented in northern Warner Valley compared to other places. These results generally conform to the trends suggested by projectile point frequencies shown in Table 3: the NWVSA was attractive early but was all but abandoned during the Early Archaic period before moderate use by Middle and Late Archaic groups resumed during the Late Holocene.

Table 3. Projectile points recovered from the NWVSA.

Paleoindian ($n = 149$)				Early Archaic $n = 7$	Middle Archaic ($n = 58$)			Late Archaic ($n = 30$)		
Fluted	WST[1]	BRCB[2]	Crescent	Northern Side-notched	Humboldt series	Gatecliff series	Elko series	Rosegate series	Desert series	Total
11 (4.5%)	125 (51.2%)	2 (0.8%)	11 (4.5%)	7 (2.9%)	14 (5.7%)	28 (11.5%)	16 (6.6%)	17 (7.0%)	13 (5.3%)	244 (100.0%)

[1]WST: Western Stemmed Tradition; [2]BRCB: Black Rock Concave Base.

Table 4. Paired comparisons of projectile point frequencies from the NWVSA and other study areas.

	Period			
Comparisons of study areas	Paleoindian	Early Archaic	Middle Archaic	Late Archaic
Warner Valley, OR	149 (**+13.42**)	7 (1.18)	58 (**2.11**)	30 (**7.29**)
Fort Rock Basin, OR	52 (**7.94**)	35 (+0.70)	237 (+1.25)	373 (**+4.31**)
$^{2} = 322.74$, $df = 3$, $p < .0001$				
Warner Valley, OR	149 (**+11.12**)	7 (**3.68**)	58 (**2.05**)	30 (**5.65**)
Chewaucan-Abert Basin, OR	29 (**8.10**)	67 (**+2.68**)	161 (+1.50)	203 (**+4.11**)
$^{2} = 265.13$, $df = 3$, $p < .0001$				
Warner Valley, OR	149 (**+20.60**)	7 (**3.70**)	58 (**5.38**)	30 (**4.79**)
Steens Mountain, OR	12 (**10.29**)	122 (+1.85)	522 (**+2.69**)	321 (**+2.40**)
$^{2} = 612.12$, $df = 3$, $p < .0001$				
Warner Valley, OR	149 (**+8.10**)	7 (**1.99**)	58 (**4.34**)	30 (**2.82**)
Massacre Lake, NV	5 (**8.17**)	22 (**+2.01**)	144 (**+4.38**)	69 (**+2.84**)

Note. $^{2} = 194.37$, $df = 3$, $p < .0001$.
Numbers in parentheses represent standardized residuals with significant values bolded. Projectile point frequencies for each study area provided by Bettinger (1999).

Table 5. Projectile points by landform type.

	Period				
Landform type	Paleoindian	Early Archaic	Middle Archaic	Late Archaic	Total
Beach	103 (69.1%)	3 (42.9%)	33 (56.9%)	19 (63.3%)	158 (64.8%)
Valley	46 (30.9%)	3 (42.9%)	25 (43.1%)	10 (33.3%)	84 (34.4%)
Upland/Canyon	–	1 (14.2%)	–	1 (3.4%)	2 (0.8%)
Total	149 (100.0%)	7 (100.0%)	58 (100.0%)	30 (100.0%)	244 (100.0%)

Diachronic variability in land-use patterns: Projectile point distributions within the NWVSA

The distribution of projectile points across landform types indicates that the land-use strategies employed within the NWVSA remained fairly consistent over time (Table 5). Sixty-nine percent of all Paleoindian projectile points ($n = 103$) were found along or near the beach ridges, whereas the rest were

Table 6. Projectile point densities by landform type.

		Point density per km^2			
Landform type	Area surveyed (km^2)	Paleoindian	Early Archaic	Middle Archaic	Late Archaic
Beach	7.1	14.5	0.4	4.6	2.7
Valley	12.2	3.8	0.2	2.0	0.8
Upland/canyon	2.7	0.0	0.4	0.0	0.4
Total	22.0	6.8	0.3	2.0	1.4

found on the valley bottom. Smith et al. (2015) noted that virtually all of the fluted and many of the WST points were found along the 1390 m ASL shoreline, which represents a pause in pluvial Lake Warner's recession sometime around the beginning of the Younger Dryas (~12,900 cal BP). No Paleoindian points were recovered in the surrounding uplands/canyons. A little under half ($n = 3$; 43%) of the Early Archaic points were found in areas surrounding the beach ridges with an equal number found on the valley bottom. Only one Early Archaic point (14%) was recovered in the uplands/canyons. The distribution of Middle Archaic points mirrors that exhibited by Paleoindian points, with the majority ($n = 33$; 57%) recovered within beach ridge parcels and the rest ($n = 25$; 43%) spread across the valley bottom. This same pattern is evident in the distribution of Late Archaic points with the majority ($n = 19$; 64%) located on beach ridges, 10 (33%) situated on the valley bottom, and 1 (3%) in the uplands/canyons. Table 6 lists the density of projectile points from different cultural periods by landform type. When the amount of area surveyed is taken into account, the general patterns suggested by raw point counts alone (see Table 5) remain unchanged: during all periods groups primarily focused on beach ridges (and the sand sheets that formed atop them) and to a lesser extent the valley bottom.

Toolstone procurement in the NWVSA: Reconstructing prehistoric settlement and/or exchange systems

Forty known and three unknown types of obsidian and FGV are represented in the projectile point sample submitted for geochemical characterization (Table 7). Sources of these materials lie between 7 and 745 km from northern Warner Valley. Most points in the NWVSA are made on raw materials available in southcentral Oregon but a few are made on obsidian and FGV from northeastern California and northwestern Nevada. Although the closest raw material source, Buck Spring obsidian (7 km), is represented in point samples from all time periods, Beatys Butte (33 km) dominates each period, accounting for

Table 7. Geochemical Types of Obsdian and FGV Represented in the NWVSA Sample.

Geochemical source	Distance to source	Direction to source	Period				Total
			Paleoindian	Early Archaic	Middle Archaic	Late Archaic	
Alturas FGV	166 km	SW	1 (0.9%)				1
Badger Creek	119 km	SE	1 (0.9%)				1
Bald Butte	50 km	NW	3 (2.8%)				3
Beatys Butte	33 km	SE	18 (16.8%)	1 (14.3%)	20 (44.4%)	6 (23.1%)	45
Big Stick	48 km	NW	4 (3.7%)		1 (2.2%)	1 (3.8%)	6
Blue Spring	126 km	NW	1 (0.9%)		1 (2.2%)		2
BS/PP/FM	161 km	SW	1 (0.9%)				1
Buck Mountain	123 km	SW	2 (1.9%)		1 (2.2%)	2 (7.7%)	5
Buck Spring	7 km	various	7 (6.5%)	1 (14.3%)	3 (6.7%)	3 (11.5%)	14
Camp Creek FGV	110 km	NE	1 (0.9%)				1
Coglan Buttes	59 km	SW	1 (0.9%)				1
Cowhead Lake	104 km	SW	1 (0.9%)	2 (28.6%)	2 (4.4%)	2 (7.7%)	7
Coyote Spring FGV	122 km	SE	1 (0.9%)				1
Delintment Lake	79 km	NE			1 (2.2%)		1
Double O	48 km	NE	4 (3.7%)	1 (14.3%)	1 (2.2%)		6
DH/WH	129 km	SE	1 (0.9%)				1
Glass Buttes[1]	76 km	NW	7 (6.5%)			7 (26.9%)	14
Gregory Creek	177 km	NW	2 (1.9%)				2
Hawks Valley	100 km	SE	1 (0.9%)				1
Horse Mountain[2]	57 km	NW	16 (15.0%)			2 (7.7%)	18
Indian Creek Buttes	118 km	NE	1 (0.9%)		2 (4.4%)		3
Long Valley	104 km	SW	1 (0.9%)				1
McComb Butte	55 km	NW	1 (0.9%)		1 (2.2%)		2
ML/GV	64 km	SE	5 (4.7%)		2 (4.4%)		7
Mosquito Lake	110 km	SW	2 (1.9%)		2 (4.4%)		2
Mud Ridge	99 km	NE	1 (0.9%)				1
Obsidian Cliffs	236 km	NW			1 (2.2%)		1
Riley	81 km	NE	2 (1.9%)			1 (3.8%)	3
Round Top Butte	76 km	NW			1 (2.2%)		1
SL/SM	98 km	NW	1 (0.9%)				1
South Creek	57 km	NW	1 (0.9%)				1
Sugar Hill	128 km	SW	1 (0.9%)				1
Surveyor Spring	93 km	SW	1 (0.9%)				1

(continued)

Table 7. Continued

Geochemical source	Distance to source	Direction to source	Paleoindian	Early Archaic	Middle Archaic	Late Archaic	Total
			Period				
Tank Creek	48 km	SW	4 (3.7%)	1 (14.3%)	1 (2.2%)	1 (3.8%)	7
Tucker Hill	115 km	SW	2 (1.9%)	1 (14.3%)	1 (2.2%)		4
Tule Spring	120 km				1 (2.2%)		1
Venator FGV	163 km	NE	1 (0.9%)			1 (3.8%)	2
Wagontire	58 km	NW	2 (1.9%)				2
Wild Horse Canyon	745 km	SE	1 (0.9%)				1
Yreka Butte	106 km	NW	2 (1.9%)		1 (2.2%)		3
Unknown FGV	?	–	2 (1.9%)				2
Unknown Obsidian	?	–	1 (0.9%)		1 (2.2%)		2
Warner Valley FGV	?	SW	2 (1.9%)		1 (2.2%)		3
Total	–	–	107 (100%)	7 (100%)	45 (100%)	26 (100%)	185

FGV: fine-grained volcanic; BS/PP/FM: Bordwell Spring/Pinto Peak/Fox Mountain; Double O: Obsidian and FGV combined; DH/WH: Double H/Whitehorse; ML/GV: Massacre Lake/Guano Valley; SL/SM: Silver Lake/Sycan Marsh.
[1]All varieties combined.
[2]Horse Mountain/Horse Mountain B combined.

roughly one-quarter of all sourced points in the NWVSA. Horse Mountain (57 km) and Glass Buttes obsidian (76 km) are also relatively common, accounting for ~10% and 8% of all sourced points, respectively. A variety of other toolstone types from more distant sources are represented in very low frequencies, often as single artifacts. The most notable of these is a WST point made on obsidian from Utah's Wild Horse Canyon, located over 700 km from the NWVSA. Eastern Great Basin toolstone sources are not typically found in northwestern Great Basin assemblages (King, 2016; Smith, 2010); however, the presence of small quantities of Paradise Valley and Double H/Whitehorse obsidians, both located not far from the NWVSA in the northwestern Great Basin, in WST assemblages in Utah's Old River Bed (Page and Duke, 2015) indicates that at least some long-distance east–west conveyance of toolstone occurred during the TP/EH.

Table 8 shows the average transport distances and adjusted richness (i.e., source diversity) for projectile point samples from the four time periods. Average transport distances range between 62.0 and 73.8 km; these do not differ significantly between periods.[3] This lack of significant differences, especially between the Paleoindian and later samples, was unexpected given that similar diachronic studies of obsidian conveyance in nearby parts of

Table 8. Average transport distances and source diversity for projectile points by cultural period.

Cultural period	Average transport distance (km)	Average # of sources
Paleoindian	73.8 km	5.8
Early Archaic	65.6 km	6.0
Middle Archaic	62.0 km	4.5
Late Archaic	63.8 km	5.0

northwestern Nevada and northeastern California have demonstrated major shifts across time. Smith (2010), McGuire (2002), and King (2016) all report substantial transport distances for Paleoindian points, reduced distances for Early and Middle Archaic points, and increased distances for Late Archaic points (although not as substantial as for Paleoindian points).

In terms of source diversity, the Middle Archaic point sample is significantly less diverse than most of the other samples; the Late Archaic sample is also significantly less diverse than the Paleoindian sample.[4] Whereas the lack of significant differences in artifact transport distances between periods in the NWVSA contrasts sharply with results reported by other researchers working in nearby areas, the trends in source diversity in the NWVSA closely parallel those observed in northwestern Nevada and northeastern California (King, 2016; McGuire, 2002; Smith, 2010). There, Paleoindian points display higher diversity, Early and Middle Archaic points display reduced diversity, and Late Archaic samples are moderately diverse relative to the other periods.

Table 9 indicates that there are significant differences in the directions from which toolstone was conveyed into the NWVSA across time. Both Paleoindian and Late Archaic points are made more often on obsidian/FGV found north of the NWVSA than expected due to chance alone. These trends reflect heavy use of the Horse Mountain/Horse Mountain B sources early in time and Glass Buttes later in time (see Table 7). Conversely, Middle Archaic points are more commonly made on obsidian/FGV found south of the NWVSA, which reflects the fact that almost half of the projectile points from that period are made on Beatys Butte obsidian. We excluded Early Archaic points from our statistical comparisons of transport directions due to their low numbers ($n = 7$) but they are also predominantly made on obsidian sources located south of the NWVSA.

Discussion

When considered together with the results of previous research in the area, the data presented here indicate that far northern Warner Valley was used throughout humans' tenure in the region, although the intensity of that use waxed and

Table 9. Source directions by cultural period.

Source direction	Period			Total
	Paleoindian	Middle Archaic	Late Archaic	
North	50 (+0.96)	10 (1.89)	12 (+0.51)	72
South	47 (0.87)	30 (+1.71)	11 (0.46)	88
Total	97	40	23	160

Note. $^2 = 8.62$, $df = 2$, $p = .0134$.
Numbers in parentheses represent standardized residuals.

waned across time. While the frequencies of time-sensitive projectile points in the NWVSA are likely biased towards Paleoindian types due to some non-random surveys of beach ridge parcels, they nevertheless provide a rough sense of diachronic variability in the degree to which the area was used. As we have discussed elsewhere (Smith et al., 2015), fluted- and WST-point users targeted areas along the 1390-m shoreline around the onset of the Younger Dryas (~12,900 cal BP). Although we recorded several "sites" containing fluted points for management purposes, most of the points were found within a 225 m 175 m area which could represent a single occupation (see Smith et al., 2015: Figure 6). Although fragmentary, those points are morphologically akin to Clovis points from other regions, suggesting that they are not post-Clovis variants recognized at other TP/EH sites in the region (Beck and Jones, 2010). The Clovis source profile reflects use of seven relatively close (<60 km) obsidian/FGV sources located in all directions from the NWVSA, which could reflect either logistical/exploratory forays from a residential camp in northern Warner Valley or repeated arrivals to the NWVSA by residentially mobile groups coming from the adjacent Alkali, Guano, and Harney basins where those obsidian sources are located (Smith et al., 2015). O'Grady et al. (2012) have noted a similar pattern of reduced transport distances and high source diversity among fluted point samples from other nearby sites, suggesting that the Warner Valley data may reflect an emerging regional pattern (also see Beck and Jones, 2013). Other aspects of Clovis lifeways in northern Warner Valley remain a mystery although the points' association with the 1390-m Lake Warner shoreline suggests that groups targeted nearshore resources.

WST points are far more abundant than Clovis points in the NWVSA and their source profile reflects significantly greater transport distances and significantly lower source diversity than the fluted points, suggesting that different conveyance systems (e.g., settlement-subsistence or exchange) are reflected in the two point types. Elsewhere, we have argued that such differences indicate that the two tool types were not simply components of the same toolkit (Smith et al., 2015). Instead, they may have been deposited by different ethnolinguistic populations (*sensu* Beck and Jones, 2010) or sequentially by related groups during the same general period when Lake Warner paused in its southward regression.

WST points are commonly associated with the 1390-m shoreline, which may mean they were deposited during the same general period as the fluted points. They also occur in high numbers on the valley floor, indicating that groups followed Lake Warner southward as it regressed. As noted earlier, Weide (1975, also see Young, 1998) suggests that the valley floor was dry by ~9650 cal BP, and later WST groups appear to have quickly shifted to targeting terrestrial resources there. At the nearby LSP-1 rockshelter, people using WST points first visited ~9650 cal BP and returned at least four times during the Early Holocene (Smith et al., 2016). Analyses of samples of faunal remains and flake tools from the pre-Mazama deposits suggest that leporids, which were probably collected on the valley floor below, were processed and consumed (Pellegrini, 2014; Van der Voort, 2016).

Despite intensive survey, we failed to locate evidence of a substantial Early Archaic presence in the NWVSA. Northern Side-notched points are exceptionally rare, suggesting that the area was abandoned during much of the Middle Holocene. LSP-1 also lacks Northern Side-notched points and a paucity of Middle Holocene radiocarbon dates from that site similarly suggests reduced use of far northern Warner Valley between ~8500 and 4500 cal BP (Kennedy and Smith, 2016). While the Middle Holocene is generally recognized as "hard times" (*sensu* Elston, 1982) for populations in the northern Great Basin (Jenkins et al., 2004; Louderback et al., 2010), northern Warner Valley may have been especially hard hit. As Table 4 shows, Northern Side-notched points are significantly underrepresented compared to each of the neighboring study areas. Some of those locations—for example, the Fort Rock Basin—contained wetlands that persisted during part of the Middle Holocene and Early Archaic groups may have refocused their settlement-subsistent patterns around those places (Jenkins et al., 2004). Alternatively, groups may have increasingly occupied upland springs adjacent to Warner Valley (Fagan, 1974; Weide, 1968). The territory encompassed by the NWVSA offers neither reliable wetlands nor upland springs and the nearest basins (e.g., Bluejoint Lake) are sensitive to hydrological changes and quickly become meadows and/or playas during dry intervals (Cannon et al., 1990; Young, 1998). While other parts of the northern Great Basin, including perhaps the adjacent uplands just outside of the NWVSA (e.g., Poker Jim Ridge, Hart Mountain), may have offered refuge during the worst parts of the Middle Holocene, the NWVSA itself likely did not, and we have no evidence that it was used to any great extent by Early Archaic groups.

As the Late Holocene ushered in generally cooler and wetter conditions, groups returned to the NWVSA. Middle Archaic points—in particular, Gatecliff points—are fairly abundant relative to those from other periods, although they are still less common than in adjacent study areas (see Table 4).

This may indicate that northern Warner Valley was reintegrated into larger settlement-subsistence strategies but remained peripheral to Steens Mountain, the Fort Rock, Chewaucan-Abert, and Massacre Lake basins. Radiocarbon dates from LSP-1 show that groups returned to the rockshelter ~4500 cal BP after a lengthy hiatus and with few exceptions repeatedly visited the shelter during the Middle Archaic period (Kennedy and Smith, 2016). The Middle Archaic point sample from the NWVSA shows decreased toolstone diversity relative to both earlier and later samples and a heavy reliance on nearby Beatys Butte obsidian. Elsewhere, reduced source diversity has been linked to an increased reliance on ‘‘go-to’’ obsidian sources and the development of regular and systematic procurement systems featuring either increased logistical trips or exchange networks (King, 2016; McGuire, 2002; Smith, 2010). While this may have been the case, the NWVSA lacks evidence of prolonged residential stays: we did not encounter any rock rings, middens, or fire-cracked rock scatters on survey. Instead, although the area appears to have been used more intensively than during the Early Archaic, use may have continued to be short-term in nature. Faunal data from LSP-1 show that leporids continued to be a primary focus of Middle Archaic groups in the area, and Pellegrini (2014) suggests that they may have been collected *en masse* by logistical parties operating from residential bases elsewhere. Those bases may have been located south of the NWVSA in the better watered portion of Warner Valley, where large residential sites postdating ~3500 cal BP were situated near Crump Lake and the terminus of Honey Creek (Aikens et al., 2011).

In many ways, Late Archaic use of the NWVSA was similar to the preceding period. Projectile point frequencies indicate that northern Warner Valley was used less intensively than neighboring areas but more so than during the Early Archaic period. The LSP-1 record suggests that visits were common between ~2000 and 1000 cal BP (Kennedy and Smith, 2016), during which time visitors continued to process leporids and plants (Kennedy and Smith, 2016; Pellegrini, 2014). Groups continued to rely heavily on Beatys Butte obsidian, but a wider range of raw material types is represented in the Late Archaic sample, which may signal a shift in mobility strategies or increased ad hoc exchange among neighboring groups (McGuire, 2002; Smith, 2010). The lack of residential, storage, and midden features suggests that visits to northern Warner Valley continued to be brief and, as was the case during the Middle Archaic period, longer-term Late Archaic occupations appear to have been located further south in Warner Valley. There, substantial winter village sites produced radiocarbon dates indicating intensive use after ~1000 cal BP and faunal assemblages dominated by jackrabbits (Aikens et al., 2011)—essentially the same settlement-subsistence pattern recorded by Kelly (1932) during ethnographic times. Young (1998) suggests that the Rabbit Basin, located northwest of those villages and immediately southwest of the NWVSA (see Figure 1), may have served as a destination for logistical parties. Based on similarities in the surface records of both areas, the NWVSA may have played a comparable role in Late Archaic land-use strategies.

Conclusion

Warner Valley has long been recognized for its rich record of cultural resources but prior to our survey of the NWVSA, little was known about the nature of prehistoric occupation in the far northern valley. Three years of survey have provided an understanding of how the valley was used across time, which may be augmented when the survey data are compared to information from the nearby LSP-1 rockshelter. Paleoindian groups appear to have frequented the NWVSA during the Terminal Pleistocene, when Lake Warner's southward regression was underway. During the Early Holocene, WST groups moved out onto the valley floor and, based on a roughly contemporary record from LSP-1, probably collected rabbits and hares. During the TP/EH, northern Warner Valley saw especially heavy use relative to surrounding areas; however, as conditions deteriorated during the Middle Holocene the NWVSA was all but abandoned. This trend contrasts with the records from adjacent areas, which continued to be occupied to a greater degree, perhaps due to the presence of more reliable water sources. During the Late Holocene, Middle and Late Archaic groups returned to northern Warner Valley and appear to have used it as a location from which to collect resources rather than as a residential hub. Those groups likely operated from residential sites located further south in Warner Valley closer to the more dependable creeks, marshes, and lakes that characterize that part of the valley.

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Notes

1. Aikens and Jenkins' (1994: iv) point frequencies for the Fort Rock Basin were compiled from "an immense unit of study, including mountain, hills, ridges, valleys, deserts, and woodlands; lakes, marshes, channels, dunes, and playas; and a multitude of micro-environments surrounding each." Oetting's (1995) point frequencies from the Chewaucan-Abert Basin were tabulated using data from the Rivers End Ranch Project, a large-scale CRM project. Jones' (1984) point frequencies were derived from a systematic, random survey of uplands and lowlands near Steens Mountain. Leach's (1988) point frequencies were compiled from her systematic random sample of 10 ecological zones in the Massacre Lake Basin.
2. Student's *t* tests or ANOVAs are often used to determine if two or more samples are significantly different but because the distributions of artifact transport distances are generally skewed towards local sources, they are often not normally distributed. As such, artifact transport distances often violate an assumption of those parametric tests. To compare transport distances between periods, we bootstrapped the means by pooling all the values for point types from two periods, drawing samples of sizes $n1$ and $n2$, and comparing the difference between the new means. The two-tailed probability is calculated as the relative frequency of bootstrapped mean absolute differences greater than the absolute observed difference. Based on our experiences, the p values obtained using t tests and bootstrapping are generally similar. We repeated this process to compare all time periods. Because traditional measures of richness (i.e., source diversity) may be influenced by sample size (Grayson, 1984; Kintigh, 1984), following Eerkens et al. (2007), we calculated it using a bootstrapping routine. We bootstrapped larger samples (using 1000 iterations) so that we could directly compare source diversity between point types. For example, to compare the 149 Paleoindian points to the seven Northern Side-notched points from the NWVSA, we drew 1000 samples of seven points each (with replacement) from the Paleoindian point sample and averaged the number of geochemical types represented in each sample.
3. Two-tailed p values for comparisons of projectile point transport distances are as follows: Paleoindian versus Early Archaic = .672; Paleoindian versus Middle Archaic = .329; Paleoindian versus Late Archaic = .499; Early Archaic versus Middle Archaic = .852; Early Archaic versus Late Archaic = .917; and Middle Archaic versus Late Archaic = .836.
4. Two-tailed p values for comparisons of source diversity between periods are as follows: Paleoindian versus Early Archaic = .404; Paleoindian versus Middle Archaic = .191; Paleoindian versus Late Archaic = <.001; Early Archaic versus Middle Archaic = <.001; Middle Archaic versus Late Archaic = <.001; and Early Archaic versus Late Archaic = .900.

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