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Gifts from the Pueblo Valley: An Analysis of a Donated Collection from Far Southeastern Oregon

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Lithic analysis of a large artifact collection from the Grove Ranch in Pueblo Valley, Oregon, contributes new insights involving a relatively understudied area of the northern Great Basin. The diversity and density of artifacts from the Grove Ranch indicate a consistent use of the site throughout the Holocene, and source provenance analysis elucidates diachronic conveyance patterns. The overall suite of raw materials suggests a localized conveyance zone that included the southern Alvord Basin and areas to the southwest. Late Holocene arrow points from Grove Ranch were made from more diverse sources than middle Holocene dart points. A single Desert Side-notched point is made from Bear Gulch obsidian from 600 km. away in eastern Idaho, and may be related to an influx of people from the Snake River Plain during the latest Holocene. This research demonstrates the value of donated collections and the impact they can have on areas where little previous archaeological research has been conducted.

In 2011, John and Darlene Grove donated a collection of lithic artifacts to the University of Oregon Museum of Natural and Cultural History that came from their former ranch property in the Pueblo Valley of southeastern Oregon. John Grove's grandparents homesteaded the Grove Ranch in 1913, and had collected many of the artifacts as they were uncovered during ranching activities on their ~160-acre property (John and Darlene Grove, personal communication 2013). The 410 stone artifacts in this collection provide new data that suggest that the Grove Ranch locale was consistently used throughout the entire Holocene (and perhaps even earlier). Although these artifacts were not collected by professional archaeologists, they come from a known location, offer valuable information about the prehistory of a relatively understudied area of the northern Great Basin, and illustrate the merit of collections-based research. In this paper, we present the results of a projectile point classification, a reconstruction of biface reduction strategies, and geochemical analyses that support previously identified toolstone conveyance patterns and provide new data related to the long history of human occupation in the northwestern Great Basin.

BACKGROUND

Environmental Setting

The Grove Ranch is situated on the basin floor of the Pueblo Valley at an elevation of ~1,271 m. (Fig. 1). The valley is bounded on the east by the Trout Creek Mountains, on the west by the Pueblo Mountains, and on the north by the Alvord Desert; all of these are part of the Alvord Basin drainage system. Pluvial Lake Alvord covered much of the Pueblo Valley during the late Pleistocene (Carter et al. 2006; Hemphill-Haley 1986). The age of the highest shoreline (1,294 m.) of the Alvord terraces is constrained by a 17,800 ± 100 years B.P. luminescence date in Bog Hot Valley (Personius et al. 2006); a minimum age of 12,000 to 10,000 cal B.P. for the lowest shoreline (1,280 m.) is indicated by the archaeological record (Pettigrew 1984). At present, perennial water sources, diverse vegetation, and variable topography are immediately accessible from the Grove Ranch. The larger Alvord Basin contains shallow lakes and playas, seasonal and perennial streams, small marshes, and several flowing springs. The nearest source of water is perennial Trout Creek, located ~3 km. north of the ranch.

Desert shrubs and salt desert species characterize the valley ground cover. The foothills of the Trout Creek Mountains are blanketed by steppe and shrub-steppe communities, dominated by sagebrush (*Artemisia*), rabbitbrush (*Chrysothamnus*), and various grasses. Cottonwood (*Populus*) and alder (*Alnus*) trees grow along Trout Creek and along its tributaries draining from the west side of the mountains. Alder, black cottonwood (*Populus trichocarpa*), willow (*Salix*), chokecherry (*Prunus virginiana*), and red osier dogwood (*Cornus sericea*) are found at elevations between 1,200 and

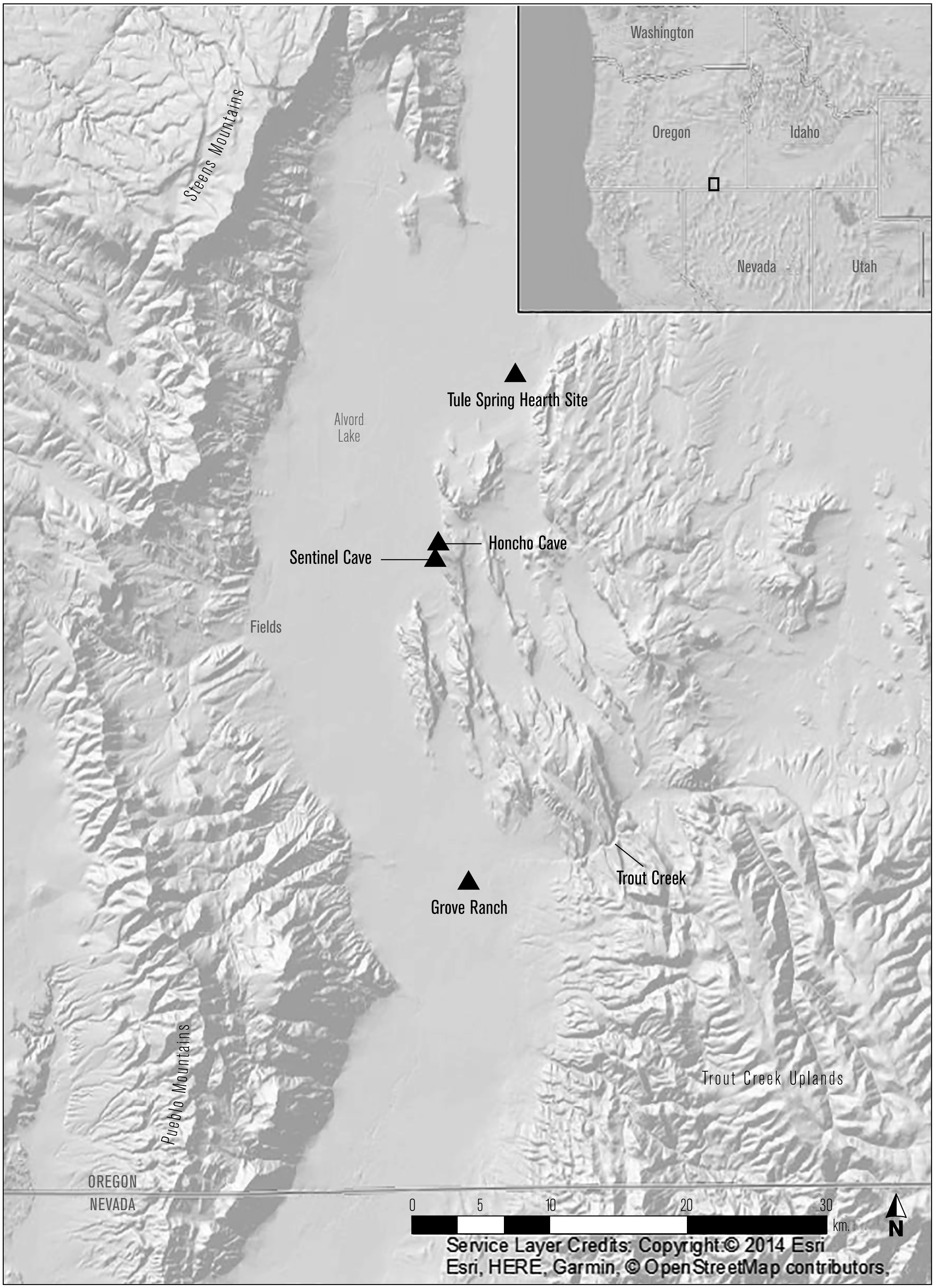

Figure 1. Map of the Pueblo Valley indicating the Grove Ranch and other sites discussed in text.

1,800 m. The neighboring Pueblo and Trout Creek ranges offer a variety of floral and faunal resources that would have been important for human subsistence. Groves of mountain mahogany (*Cercocarpus ledifolius*) and riparian greenways with quaking aspen (*Populus tremuloides*) and willow occur above 1,800 m. Other culturally significant plants found on the neighboring mountain slopes include yarrow (*Achillea millefolium*), various sedges (*Carex aurea* and *C. filifolia*), serviceberry (*Amelanchier utahensis*), and balsamroot (*Balsamorhiza sagittata* and *B. serrate*) (Pettigrew and Lebow 1989). Pollen data from Steens Mountain sediment cores suggest that current tree and shrub communities have been in the region for the past 14,000 years, with some altitudinal shifts associated with changes in surface water and climatic conditions (Mehringer 1985; Wigand 1987).

Pronghorn (*Antilocapra americana*), mule deer (*Odocoileus* sp.), coyotes (*Canis latrans*), rabbits (*Leporidae*), and rodents (Rodentia) inhabit the expanses of sagebrush and grasslands throughout the Pueblo Valley. Nearby Tum Tum and Alvord lakes host migratory waterfowl. Bison (*Bison bison*) and bighorn sheep (*Ovis canadensis*) were once present in the region but disappeared following Euro-American contact and the early 1900s, respectively (Bailey 1936; Grayson 2006; Stutte 2004). Various species of fish swim in the drainages of the Trout Creek and Pueblo mountains, including the now rare Whitehorse cutthroat trout (*Oncorhynchus clarkii*) that is still present in the permanent stretches of both Whitehorse and Willow creeks (Pettigrew and Lebow 1989:8). Water availability, diverse vegetative species, and a range of faunal resources accessible across the topographically-varied landscape would have made the Pueblo Valley an appealing locality for human habitation.

Archaeological Context

There has been a paucity of professional archaeological research in the Pueblo Valley; a few pedestrian surveys in adjacent areas constitute the bulk of the previous work. Subsurface excavations in the immediate region are rare but provide an important context for the extensive surface record.

Paleoindian surface artifacts are found throughout the majority of the Alvord Basin, and indicate that groups occupied the region during the terminal Pleistocene and early Holocene (Jew et al. 2015; O'Grady et al. 2008, 2009; Plew 2012). East of the Pueblo Valley, Pettigrew and Lebow (1989) found evidence for the first use of the Trout Creek uplands beginning in the middle Holocene and persisting until the contact period. Based on the spatial distribution of diagnostic projectile points throughout the Alvord Basin, Pettigrew (1984) proposed four "adaptive modes" to characterize shifts in settlement-subsistence patterns throughout the last 12,000 years: *Paleoindian* (ca. 12,000 to 11,000 cal B.P.); *Western Pluvial Lakes Tradition* (ca. 11,000 to 7,000 cal B.P.); *Transitional Archaic* (ca. 7,000 to 5,000 cal B.P.); and *Full Archaic* (5,000 to contact) (Pettigrew 1984:83). Each mode is characterized by a unique economic system with distinct technological, subsistence, and settlement strategies. While Pettigrew's work marked an important step in our understanding of the Alvord Basin at the time, his model was based primarily on a surface record, and 35 years of research in the northern Great Basin have significantly changed our understanding of prehistory. Consequently, we do not evaluate the Grove Ranch collection in light of his model. Extensive surface surveys, coupled with paleoenvironmental reconstruction during the Steens Mountain Prehistory Project (SMPP), documented a continual use of the area throughout the Holocene, with Beck (1984) arguing that the distribution of projectile points on the landscape was related to shifting population aggregation, as well as the types of resources and habitats being used at a particular time.

Few subsurface excavations have been undertaken in the Alvord Basin, and to our knowledge none have been conducted in the Steens Mountains or Trout Creek uplands. The SMPP carried out excavations at the Tule Spring Hearth site, Honcho Cave, and Sentinel Cave, all located north of Grove Ranch (see Fig. 1). The Tule Spring Hearth site is situated in a stabilized dune adjacent to a small spring-fed marsh. Wilde (1989) obtained a radiocarbon date from an exposed hearth that registered as modern. Excavations recovered four Rose Spring points subsurface, suggesting a late Holocene occupation. Surface collection recovered a suite of diagnostic projectile points, including one crescent, suggesting mixture and secondary context for at least part of the site (Wilde 1985, 1989). Sentinel Cave provided evidence for human use dating back to the early Holocene. The site contained four hearth features, three of which dated to post-3,500 ^{14}C B.P. and one that dated to 8,310 ± 105 ^{14}C

B.P. (9,495–9,030 cal B.P.) (Wilde 1985:189). The Sentinel Cave excavations did not recover any diagnostic artifacts. Honcho Cave contained two hearth features that dated to 3,425±85 ^{14}C B.P. (3,890–3,470 cal B.P.) and 5,840±100 ^{14}C B.P. (6,890–6,515 cal B.P.) (Wilde 1985:189). The only diagnostic artifact Wilde (1985) recovered in situ was an Elko Series point associated with the younger hearth at Honcho Cave. He recovered unifacially worked flakes and biface fragments throughout the deposits of both caves.

While the Pueblo Valley was not included in any of the studies described above, they nevertheless demonstrate that a rich archaeological record exists in the immediate vicinity of the Grove Ranch. Notably, the Grove Ranch provides temporally diagnostic artifacts spanning the entire Great Basin sequence, and our analysis provides one of the few systematic studies of artifacts from the Pueblo Valley.

GROVE RANCH ARTIFACTS

The Grove Ranch collection contains 350 flaked stone tools, 46 pieces of lithic debitage, and 14 items of ground, battered, or fire-cracked stone. All artifacts are in good condition and are now curated at the University of Oregon Museum of Natural and Cultural History. The Groves indicated that the donated materials are all that remain of the artifacts collected from the ranch property. John's relatives collected many of the artifacts as they were uncovered during ranching activities, and John recalled additional artifacts that were not kept in the family. Therefore, the extent to which the donated artifacts represent the entire original collection is uncertain. The Groves included with their donation a history of the ranch and a map indicating areas of the property where they believe many of the artifacts were found. These areas include a roughly 40-meter-long rise near the edge of a modern pond (~15 m. diameter) and two garden beds. Such information is helpful for understanding the general provenance of the collection; however, the exact location of the artifacts and whether some of them were collected from elsewhere on the property remains unknown. Due to the lack of precise provenience data, we treat the analyzed collection as a palimpsest. Our analysis primarily focuses on the temporally-diagnostic projectile points and biface reduction sequences to address questions of chronology and tool manufacturing activities.

Projectile Point Types

The diagnostic Great Basin projectile point styles from the Grove Ranch suggest a long period of human activity, potentially spanning ~13,000 years (Davis et al. 2019; Jenkins et al. 2012). Temporally-diagnostic types identified in the collection include Western Stemmed Tradition, Northern Side-notched, Gatecliff Split Stem, Humboldt Concave Base, Elko Corner-notched, Elko Eared, Rose Spring, Eastgate, and Desert Side-notched (Table 1). We identified all middle and late Holocene points using the Monitor Valley Key (Thomas 1981), but we chose to assign points as Northern Side-notched instead of Large Side-notched and delineate Rose Spring and Eastgate points within the Rosegate Series. The full dataset of metrics from the projectile points can be found in Appendix A.

The oldest identifiable points in the collection belong to the Western Stemmed Tradition (n=9), which locally dates to between ~13,000 and ~9,000 cal B.P. (Jenkins et al. 2012; Rosencrance 2019; Smith and Barker 2017; Fig. 2). Three specimens are complete (Fig. 2: p and q), two of them are shouldered (Fig. 2: p and q), and five are basal fragments that exhibit grinding and/or polishing (Fig. 2: q, s, and t). The two shouldered specimens are most consistent with the Parman type (Layton 1970), dating to post ~11,500 cal B.P. in the northwestern Great Basin (Rosencrance 2019).

There are twenty-two Northern Side-notched points present in the collection (e.g., Fig. 2: l and m). They display a range of variability characteristic of the Northern Side-notched type, with seven exhibiting sharp, elongated tangs and a deep concave base, and the remaining ten exhibiting flat or slightly concave bases. Northern Side-notched points date from ~7,000 to 4,500 cal B.P. in the northern Great Basin (Heizer and Hester 1978; Oetting 1994; Smith et al. 2013). The collection includes 25 Humboldt Series points—a type that persists for ~2,700 years in the northern Great Basin, from 4,000 cal B.P. to ~1,300 cal B.P. (Oetting 1994; Smith et al. 2013). Elko Series points include 10 Elko Corner-notched and 10 Elko Eared (Fig. 2: h–k). The age of Elko points varies by region in the Great Basin; they generally date between 5,000 and 1,250 cal B.P. in the northwestern Great Basin (Heizer and Hester 1978; Oetting 1994; Pettigrew and Lebow 1989), but are perhaps as much as 1,500 years older (Hoskins 2016; Keene 2018; Smith et al. 2013). As local chronological markers, there is an Elko

Table 1

COUNTS OF ALL ARTIFACTS FROM THE GROVE RANCH COLLECTION

	Obsidian	CCS	FGV	Total
Projectile Points				
Desert Side-notched	1	0	0	1
Rose Spring	13	0	0	13
Eastgate	12	3	0	15
Elko Eared	10	0	0	10
Elko Corner-notched	10	0	0	10
Gatecliff Split Stem	4	0	0	4
Humboldt Series	24	1	0	25
Northern Side-notched	22	0	0	22
Western Stemmed Tradition	4	2	3	9
Small notched fragment	9	0	0	9
Large notched fragment	5	0	0	5
Indeterminate projectiles	68	0	0	68
Biface Stage				
1/2	1	0	0	1
2/2	45	2	4	51
2/3	30	5	1	36
2/4	3	1	0	4
3/3	8	3	0	11
3/4	10	0	0	10
4/4	10	0	0	10
4/5	1	0	0	1
5/5	3	0	0	3
Other Formed Tools				
Drill	3	2	0	5
Uniface	10	4	0	14
Scraper	1	1	0	2
Chopper	0	0	1	1
Core	0	1	0	1
Groundstone[a]				
Handstone	0	0	0	9
Grinding Slab	0	0	0	2
Debitage				
	32	14	0	46

[a]Groundstone artifacts are made on a variety of unknown coarse-grained volcanic material.

Series point associated with a hearth at Honcho Cave dated to 3,425±85 ^{14}C B.P. (3,890–3,470 cal B.P.), and Wilde (1985) reports Elko points beneath Mazama tephra (~7,630 cal B.P.) at Skull Creek Dunes in Catlow Valley, ~30 km. northwest of Pueblo Valley. Four Gatecliff Split Stem points are part of the Grove Ranch collection. Nearby, this style is associated with an occupation zone dated by two radiocarbon dates of 3,315±85 ^{14}C B.P. (3,820–3,370 cal B.P.) and 3,170±270 ^{14}C B.P. (4,085–2,760 cal B.P.) at Skull Creek Dunes (Wilde 1985:265).

The appearance of Rose Spring and Eastgate (Rosegate Series) projectile points marks the transition from the atlatl to the bow-and-arrow, which occurred ~2,000 cal B.P. in the Great Basin (Bettinger and Eerkens 1999). Thirteen Eastgate points and 15 Rose Spring points are part of the collection (Fig. 2: d–e, b–c, a, respectively). A single Desert Side-notched point was also recovered at Grove Ranch. Desert Side-notched points are thought to be a very late arrival (<300 cal B.P.) in Oregon, as indicated by the use of Rose Spring and Eastgate arrow points in the Fort Rock Basin as late as ~400–300 cal B.P. and the overall low frequency of Desert Side-notched in the region (Delacorte 2008; Jenkins and Brashear 1994).

Bifacial Reduction Stages

We assigned bifaces to reduction stages to determine the technological activities that occurred at the Grove Ranch. Many of the 126 bifaces have ventral and dorsal faces that are in differing stages of reduction. To more accurately describe the bifaces, we classified the ventral and dorsal faces of each independently (e.g., 2/3) using the stages of Callahan (1979). Table 1 displays the results of our biface stage classifications. While there is a lack of Stage 1 bifaces and only one core, most (72%) of the bifaces displayed at least one face in Stage 2 of reduction, suggesting early-stages of bifacial reduction. Lack of cores at Grove Ranch might reflect collector bias. Overall, the presence of bifaces in various stages of reduction in conjunction with debitage and formed tools indicates that knappers performed various degrees of tool manufacturing at this locality. Such a variety of bifaces and projectile points provides an opportunity to investigate lithic technological organization via toolstone conveyance trends, which we explore below.

Groundstone and Other Artifacts

The Grove family collected eight handstones and two pestles at the ranch, suggesting that lengthy occupations and plant processing occurred there at times (Fig. 3). Metric data for the groundstone are available in Appendix B. John Grove indicated that the family found many additional groundstone "plates" (probably milling stones) on the property but they were not collected (John Grove, personal communication 2013). The earliest groundstone

Figure 2. Representative projectile points in the Grove Ranch collection. (a) Desert Side-notched; (b–c) Rose Spring; (d–e) Eastgate; (f–g) Humboldt Concave Base; (h–i) Elko Corner-notched; (j–k) Elko Eared; (l–m) Northern Side-notched; (n–o) Gatecliff Split Stem; (p–t) Western Stemmed Tradition (* indicates geochemical sourcing).

in the Great Basin appears after 8,500 cal B.P., and the technology was used by foragers into the ethnographic present (Herzog and Lawlor 2016; Rhode et al. 2006). Therefore, these artifacts provide little chronological information regarding the Grove Ranch collection. Additional non-temporally diagnostic tool types in the collection include five drills, three scrapers, eight blades, and one chopper (see Table 1; Fig. 4). We interpret the variety of tool types in the collection as suggesting that the Grove Ranch served as a multifunctional site.

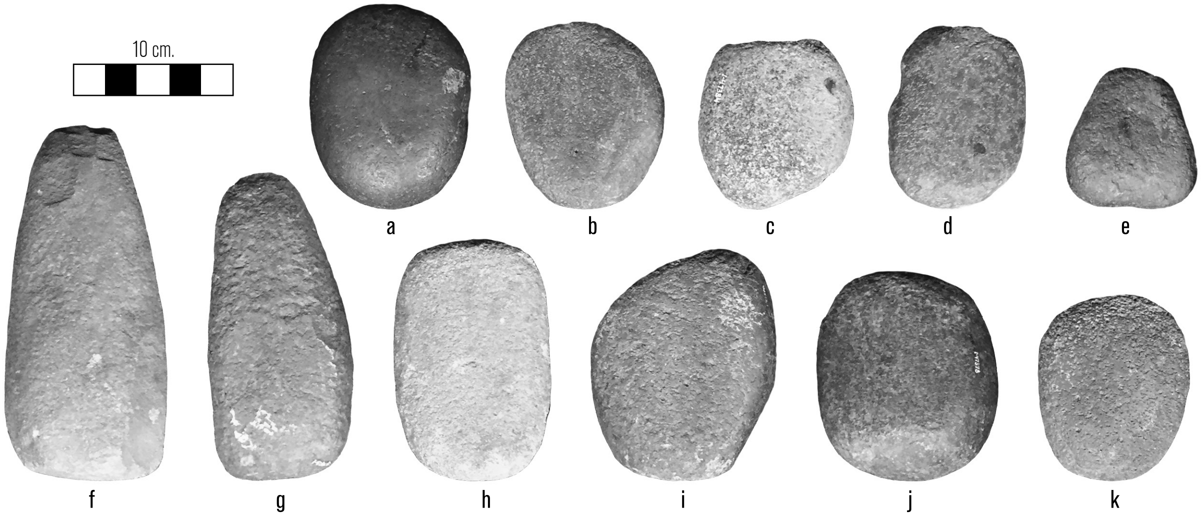

Figure 3. Groundstone artifacts from the Grove Ranch collection. (a–e) and (h–k) are handstones. (f) and (g) are pestles. All but c are made of some type of basalt or similar volcanic. (c) is made from granite. (a) 47377; (b) 47380; (c) 47384; (d) 47381; (e) 47382; (f) 47386; (g) 1- 47385; (h) 47383; (i) 47376; (j) 47378; (k) 47379.

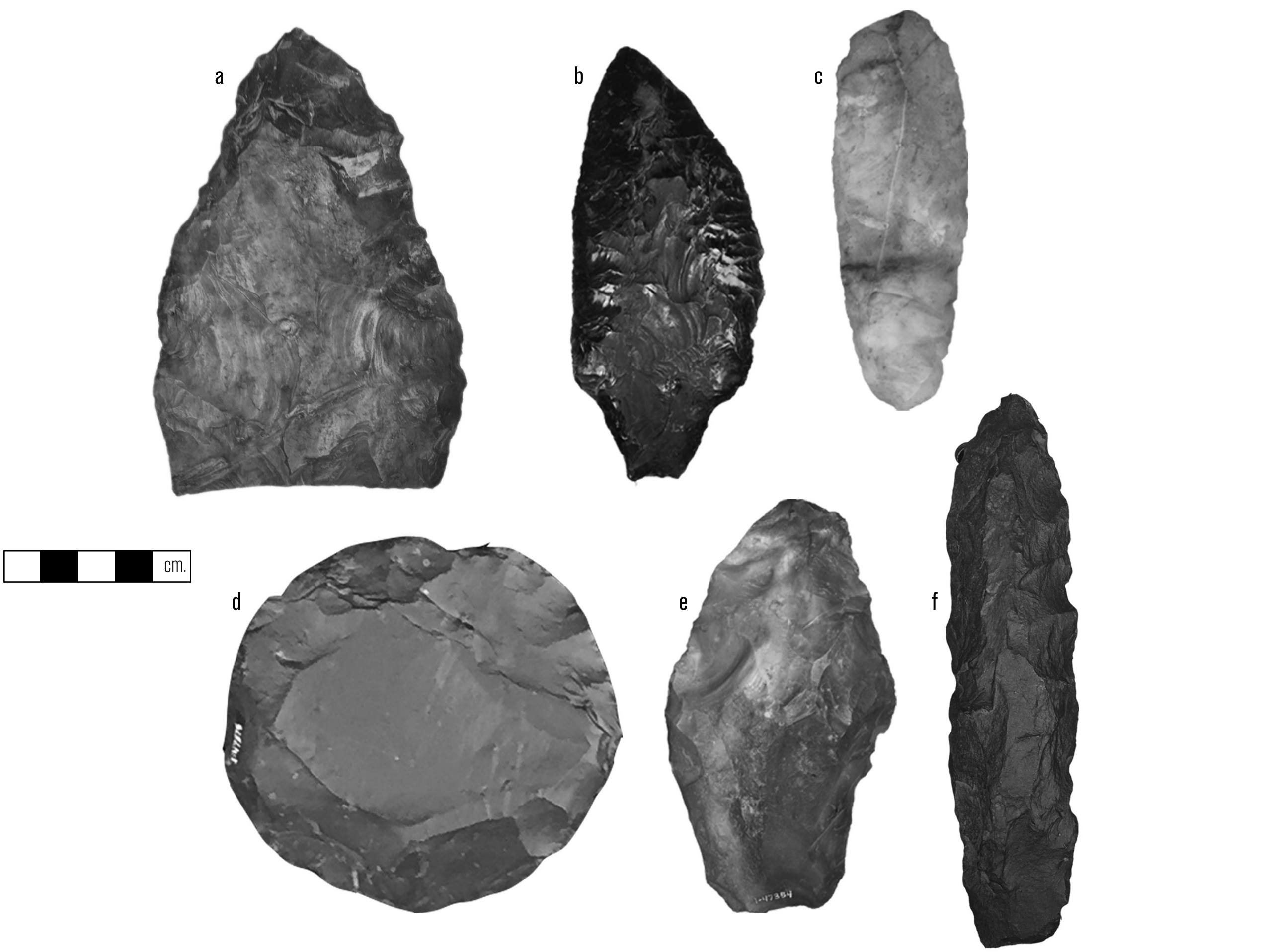

Figure 4. Large bifaces and blades from the Grove Ranch collection. (a) Stage 3/3 Cryptocrystaline silicate (CCS) biface, 47356; (b) Asymmetrical obsidian stemmed blade, 47338. (c) Stage 2/2 fine-grained volcanic (FGV) biface, 47362. (d) FGV chopper 47375; (e) Stage 2/2 CCS biface, 47354. (f) CCS blade, 47355.

Geochemical Sourcing

Twenty-six artifacts, including 17 projectile points, eight bifaces, and one drill (Table 2), were analyzed by the Northwest Research Obsidian Studies Laboratory using X-ray fluorescence spectroscopy. To examine potential diachronic toolstone conveyance patterns, we submitted a sample of projectile points for analysis spanning the terminal Pleistocene to the late Holocene. We included bifaces in various stages of reduction to further investigate tool manufacturing and toolstone procurement strategies. Geochemical analysis identified 11 distinct geochemical sources, including nine known obsidian types, one known fine-grained volcanic (FGV) type, and one unknown FGV type among these artifacts. The sources ranged from 20 to 595 km. away (see Table 2).

We identify local toolstone as sources within 20 km. of the Grove Ranch—a feasible distance to travel in a day (*sensu* Smith et al. 2012; Surovell 2003). Locally available sources include Massacre Lake/Guano Valley (ML/GV) and Hawks Valley obsidian. Non-local sources include Double H/Whitehorse (DH/WH), Willow Butte FGV, Beatys Butte, Craine Creek/Bog Hot Springs (CC/BHS), Spodue Mountain, Riley, Chickahominy, and Bear Gulch obsidian (see Table 2). Thus, five (19%) of the sourced

Table 2

GEOCHEMICAL PARTS PER MILLION VALUES OF ARTIFACTS SOURCED FROM THE GROVE RANCH ADAPTED FROM NWROSL REPORT

		Measured Trace Element Concentrations						
Catalog #	Type	Rb	Sr	Y	Zr	Nb	BA	Geochemical Source
47169	Western Stemmed Tradition	109 ± 2	310 ± 3	54 ± 2	361 ± 3	19 ± 2	1909 ± 38	Willow Butte FGV
47059	Western Stemmed Tradition	124 ± 2	434 ± 4	40 ± 2	340 ± 3	20 ± 2	1213 ± 33	Unknown FGV
47335	Western Stemmed Tradition	107 ± 2	8 ± 1	64 ± 2	473 ± 3	25 ± 2	1066 ± 31	Riley
47190	Northern Side-notched	214 ± 3	3 ± 1	89 ± 2	596 ± 4	30 ± 2	0 ± 26	Massacre Lake/Guano Valley
47078	Northern Side-notched	193 ± 3	4 ± 1	69 ± 2	500 ± 3	33 ± 2	0 ± 24	Double H/Whitehorse
47136	Northern Side-notched	198±3	5 ± 1	85 ± 2	495 ± 3	24 ± 2	0 ± 25	Double H/Whitehorse
47063	Gatecliff Split Stem	189 ± 3	5 ± 1	80 ± 2	469 ± 3	23 ± 2	0 ± 24	Double H/Whitehorse
47055	Humboldt Series	128 ± 2	176±2	14 ± 2	165 ± 2	9 ± 1	895 ± 31	Beatys Butte
47028	Elko Corner-notched	182 ± 3	3 ± 1	77 ± 2	445 ± 3	24 ± 2	0 ± 24	Double H/Whitehorse
47106	Elko Eared	207 ± 3	3 ± 1	92 ±	550 ± 3	30 ± 2	0	Massacre Lake/Guano Valley
47084	Rose Spring	223 ± 3	3 ± 1	90 ± 2	607 ± 4	31 ± 2	0 ± 25	Massacre Lake/Guano Valley[a]
47104	Rose Spring	225 ± 3	25 ± 1	41 ± 2	148 ± 2	28 ± 1	NM	Hawks Valley[a]
47075	Rose Spring	187 ± 3	1 ± 1	66 ± 2	494 ± 3	36 ± 2	NM	Double H/Whitehorse[a]
47073	Rose Spring	198 ± 3	5 ± 1	81 ± 2	480 ± 3	25 ± 2	NM	Double H/Whitehorse[a]
47026	Eastgate	123 ± 2	166 ± 2	14 ± 1	164 ± 2	8 ± 1	NM	Beatys Butte[a]
47105	Eastgate	199 ± 3	4 ± 1	83 ± 2	498 ± 4	27± 2	NM	Double H/Whitehorse[a]
47033	Eastgate	128 ± 2	149 ± 2	20 ± 1	155 ± 2	13 ± 1	NM	Bog Hog Springs/Craine Creek[a]
47138	Desert Side-notched	185 ± 3	48 ± 1	49 ± 1	325 ± 3	58 ± 2	NM	Bear Gulch[a]
47251	Stage 2 Biface	203 ± 3	3 ± 1	88 ± 2	500 ± 3	27 ± 2	0 ± 23	Double H/Whitehorse
47255	Stage 2 Biface	216 ± 3	0 ± 1	88 ± 2	599 ± 4	30 ± 2	0	Massacre Lake/Guano Valley
47292	Stage 2 Biface	200 ± 3	3 ± 1	70 ± 2	509 ± 3	32 ± ±2	0	Double H/Whitehorse
47336	Stage 2/3 Biface	197 ± 3	5 ± 1	82 ± 2	474 ± 3	25 ± 2	0 ± 22	Double H/Whitehorse
47295	Stage 2/3 Biface	186 ± 3	5 ± 1	80 ± 2	475 ± 4	24 ± 2	0 ± 24	Double H/Whitehorse
47338	Asymmetrical Stemmed Blade	126 ± 2	57 ± 1	33 ± 1	131 ± 2	11 ± 1	983 ± 30	Spodue Mountain
47220	Stage 4 Biface	124 ± 2	186 ± 2	14 ± 1	171 ± 2	9 ±	954 ± 21	Beatys Butte
47367	Drill	106 ± 2	25 ± 1	53 ± 2	308 ± 3	21 ± 1	1280 ± 32	Chicahominy
RGM-1	RGM-1	149 ± 2	107± 2	25 ± 1	223 ± 2	7± 1	744 ± 31	RGM-1 Reference Standard

All trace element values reported in parts per million (ppm). NM = not measured.

[a]Small sample.

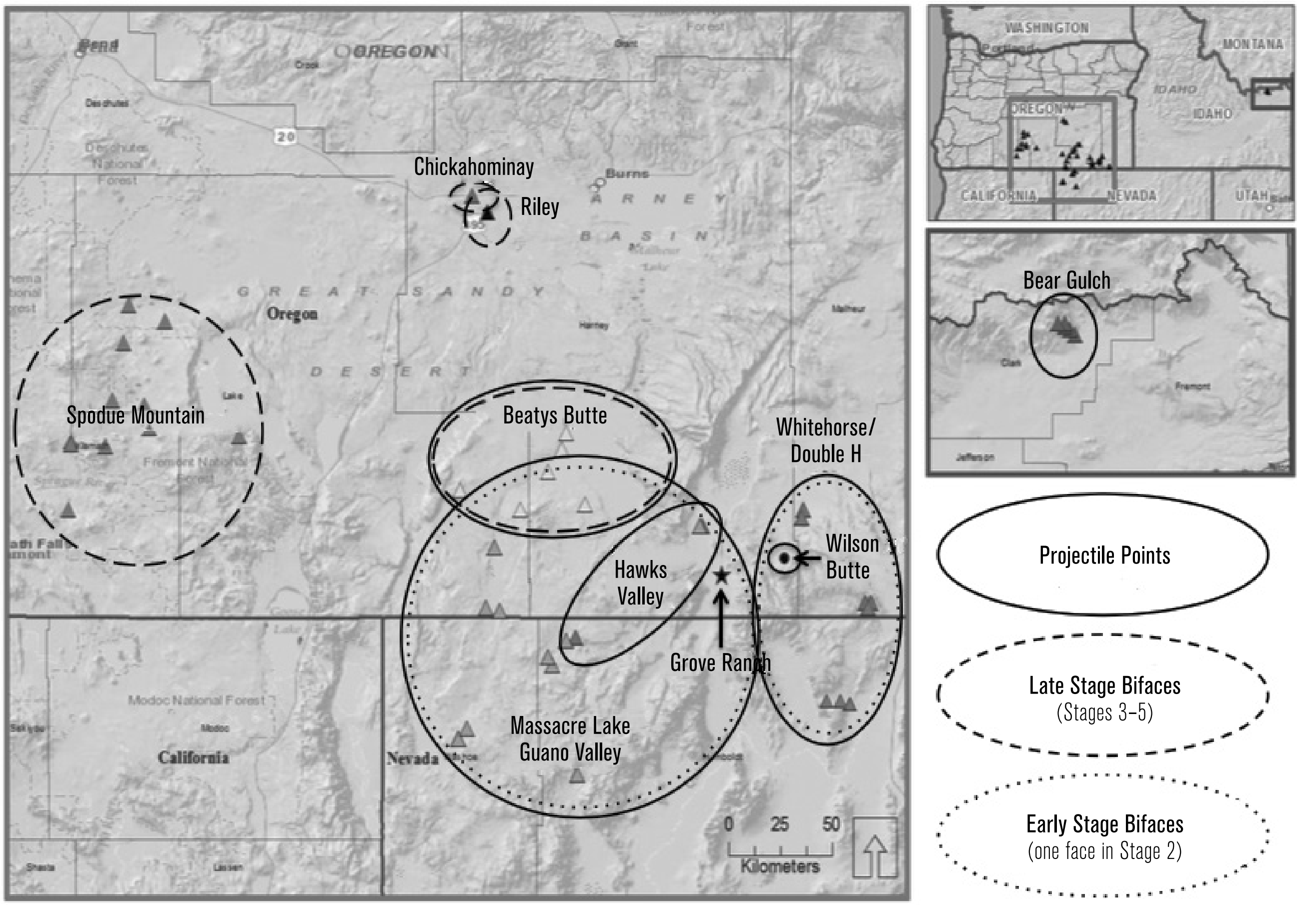

Figure 5. Toolstone source locations in relation to the Grove Ranch and the differential use by artifact type. Projectile points and late stage bifaces were made from more distant sources than early stage bifaces.

artifacts are derived from locally available sources and 20 artifacts (77%) originated from non-local sources.

Results show eight sources, ranging in distance from 20 to 595 km., among the 17 projectile points, while only two sources, ranging in distance from 20 to 37 km., are among the five early bifaces (Stages 2/2 and 2/3). This contrast may be due to sample size or it may indicate the use of local raw materials for tool manufacturing. These data also show that the projectile points at Grove Ranch tended to be transported farther and come from more variable sources than the bifaces (Fig. 5). This is consistent with previous studies in the Great Basin which have found that projectile point source profiles involve greater transport distances and source diversity than other tool types (Page and Duke 2015; Smith and Kielhofer 2011).

Changes in source diversity and distance were also found across time. The Western Stemmed Tradition points analyzed (n=3) involved three sources, ranging from 24 to 58 km. away. The middle Holocene points (Northern Side-notched, Gatecliff Split Stem, Humboldt, and Elko; n=7) involved only three sources, ranging from 20 to 27 km. in distance. The eight late Holocene arrow points (Eastgate, Rose Spring, and Desert Side-notched; n=8) involved six sources between 20 and 595 km. from Grove Ranch.

DISSCUSION

The analysis of the Grove Ranch collection suggests that the location was a multifunctional site repeatedly visited by Holocene foragers (and perhaps by others even earlier). Artifacts associated with hunting, tool production, and plant processing are present at the site. A somewhat regular or permanent use (at certain points in time) of this site is supported by evidence of multiple activities, including the presence of large flaked and groundstone tools (handstones and pestles), and the apparent concentration of many of the artifacts in one or two locations. During a visit to the Grove Ranch in 2013, McDonough observed two notched projectile points and lithic scatters involving over 75 obsidian, basalt, and cryptocrystaline silicate (CCS) flakes on the property. This observation lends support to the general provenience of the artifacts in the donated collection.

Our modest source provenance analysis of 26 artifacts indicates several things. First, the comparison between the unfinished bifaces and the projectile points shows that early-stage bifaces were produced from more proximate and less diverse sources than the projectile points, suggesting tool users were choosing locally available toolstone to replenish a curated toolkit. Source diversity and transport distances varied between the early, middle, and late Holocene, showing that trends in diachronic toolstone use could be examined in future studies of the Pueblo Valley. Interestingly, late Holocene arrow points involved more diverse sources than middle Holocene dart points. The sources represented suggest a southwest directional trend of toolstone conveyance that includes the southern Alvord Basin and adjacent uplands.

Our data are strikingly similar to those from a number of extensive source provenance studies from the northwestern Great Basin which elucidate diachronic patterns of obsidian conveyance in the region. Southwest of the Pueblo Valley in northwestern Nevada, Smith (2010) examined 250 terminal Pleistocene/early Holocene points (TP/EH) and 1,085 middle and late Holocene projectile points to evaluate existing TP/EH toolstone conveyance models (Jones et al. 2003) and the relative degrees of mobility of foragers through time. Smith and colleagues (2012) used a sample of 53 diagnostic projectile points and 92 pieces of debitage from late Holocene deposits at Paiute Creek Rockshelter in the northern Black Rock Desert, Nevada to evaluate toolstone conveyance before and after ~1,500 cal B.P., and Hildebrandt et al. (2016) used a large dataset of diagnostic projectile points recovered during the Ruby Pipeline survey along the entire northern border of Nevada.

In all of these cases, with a total sample size numbering in the thousands, obsidian transport distances and diversity were greatest during the earlier period (TP/EH), significantly decreased in middle Holocene assemblages, and then significantly rose in the latter ~2,500 years of the Holocene. Hildebrandt and colleagues (2016), as well as Lyons et al. (2001; see below), found evidence for an even more drastic increase in transport distances and diversity in the late prehistoric period (<500 cal B.P.). While the Grove Ranch sample is very small in comparison to these other studies, our data provide support for this diachronic change in obsidian conveyance in the Pueblo Valley.

Changing Degrees of Mobility in the Middle and Late Holocene

The stark decrease in toolstone conveyance (i.e., mobility) occurring with the onset of the middle Holocene has been attributed to increasing aridity and thus a decreased reliability of water, plant, and animal resources (Connolly 1999; Grayson 2011; Smith 2010). Within this changing environment, foragers had to reorganize their settlement subsistence patterns, focusing on more localized resource patches and the most proximate (local) toolstone sources. The Grove Ranch obsidian source data suggest this pattern holds true in the Pueblo Valley.

Another considerable reorganization of settlement patterns and toolstone procurement occurred in the northwestern Great Basin ~1,500 cal B.P. involving more dispersed residential sites (Jenkins 1994), directional shifts in toolstone conveyance (Skinner et al. 2004), and increased projectile point transport (Smith 2010), among other things (Smith et al. 2012:416). Other researchers have suggested technological change was a primary driver of this shift—specifically, the introduction of the bow and arrow (Hughes 2015). In the eastern Great Basin, Hughes (2015) examined a large assemblage of middle and late Holocene projectile points and found a marked increase in toolstone diversity and transport distance after ~1,500 cal B.P. Citing Bettinger's (2013) hypothesis, he posited that the introduction of the bow and arrow may have promoted smaller band sizes and undermined the need for cooperative hunting strategies that were more successful when employed by larger groups of foragers. In turn, this created more diverse social networks across the landscape and thus increased the interaction between groups and the nonlocal resources that each possessed. The Grove Ranch collection also exhibits a more diversified and more curated use of obsidian among the arrow points relative to dart points, providing support at least for the underlying conveyance pattern.

Desert Side-notched Anomalies

Lyons and colleagues (2001) found a stark change in obsidian source use occurring ~500 cal B.P. in the Harney Basin that may have an analogue in the Grove Ranch collection. The lone Desert Side-notched point from Grove Ranch is made from Bear Gulch obsidian, a source located in eastern Idaho nearly 600 km. away. This was the first artifact from the Bear Gulch source to be identified in Oregon (Craig Skinner, personal communication 2012). Lyons and colleagues (2001) found that ~500 years ago, the majority of the Desert Side-notched points were made from eastern sources, towards the Owyhee River, rather than from the many obsidian sources within the Harney Basin. Accompanying these same Desert Side-notched components was Shoshoni brownware pottery, a rarity in the northwestern Great Basin (Endzweig 1989; Lyons et al. 2001), causing Lyons to hypothesize that the data represent an incursion into the Harney Basin of peoples from the east using brownware pottery and different obsidian.

Similarly, Hildebrandt et al. (2016) found pottery along with Desert Side-notched and Cottonwood points made of obsidian from 300 km. north of northeastern Nevada. They suggest, as did Lyons et al. (2001), that this may represent the incursion of Western Shoshoni groups into the northwestern Great Basin after the introduction of the horse ca. 350 cal B.P.

Artifacts made from obsidian from southern Oregon and northern Nevada (Beatys Butte and DH/WH) have been found in eastern Idaho and western Wyoming, providing a reciprocal view of this obsidian transport (Scheiber and Finley 2011). Scheiber and Finley identified the most diverse use of obsidian sources from the Greater Yellowstone area (including eastern and southeastern Idaho) between 1,500 cal B.P. and the time of European contact. This aligns with the high diversity of sources in our own and others' samples of arrow points (Hildebrandt et al. 2016; Lyons et al. 2001; Scheiber and Finley 2011). In short, the Desert Side-notched point from the Grove Ranch collection provides support and context to a growing body of evidence suggesting a Western Shoshoni use of eastern Oregon, and a widespread, diverse conveyance of toolstone after 500 cal B.P. in the Great Basin and central Rocky Mountains.

Despite the limited sample size, the source provenance data from Grove Ranch can inform future studies of the region. Furthermore, research projects in the Alvord Basin or Pueblo Valley could include the large number of diagnostic projectile points not geochemically characterized in our study.

CONCLUSIONS

In light of previous archaeological work in adjacent areas, the Grove Ranch is a unique archaeological location. Insofar as the extant literature shows, few if any localities in the Alvord Basin exhibit such a diverse suite in one location of diagnostic projectile points, bifaces of all stages, and groundstone. Data from this research suggest that the Grove Ranch was repeatedly visited and used for a variety of activities over the course of many millennia. Our source provenance analysis of Grove Ranch artifacts provides preliminary data on emerging patterns of diachronic toolstone conveyance, the possibility of a localized conveyance zone in far southeastern Oregon, the effects that the introduction of the bow and arrow had on social interaction in the area, and supports previous hypotheses concerning the latest Holocene anomalies of Desert Side-notched points in Oregon. As such, the Grove Ranch assemblage demonstrates that the Pueblo Valley holds great potential for future archaeological research.

Donated private collections are not ideal datasets, but their potential to contribute to the archaeological record should not be dismissed. The Grove Ranch analysis serves as one example of how donated collections with only general provenience data can provide valuable information, and how museum-based research can be especially useful in understudied areas (Connolly et al. 2016; Kallenbach 2013). Data from this collection can and should be incorporated into future studies investigating the Alvord Basin, the Pueblo Valley, and adjacent areas. We hope that the generosity of the Grove family and the stewardship of the University of Oregon Museum of Natural and Culture History can be appreciated and seen as an example of community and archaeological collaboration.

Appendix A

MEASUREMENTS OF PROJECTILE POINTS USING THE MONITOR VALLEY KEY (THOMAS 1981)*

Cat #	C/I	WT	LT	LA	WM	TH	WB	NW	PSA	DSA	NOI	LM	BIR	LT/WM	100 LM/LT	WB/WM	MVK
47138	C	0.4	16	15.8	12	2	12.0	5.9	180	180	10	6	1	1.3	40.0	1.0	DSN
47028	I	1.7	27	27.6	21	4	13.8	10.6	130	180	20	4	1	1.3	13.3	0.7	ECN
47079	I		36	35.1	22	4	15.5	11.6	125	145	40	5	1	1.6	14.7	0.7	ECN
47087	I	3.3	29	29.1	24	5		12.5	125	160	50	5	1	1.2	16.9		ECN
47088	I	2.4	19	18.1	22	4	15.6	13.1	120	135	25	3	1	0.9	16.3	0.7	ECN
47095	Is	1.9	34	33.0	20	3	13.0	9.2	120	135	25	6	1	1.7	16.8	0.7	ECN
47103	I	2.2	21	22.8	12	3	15.3	9.7	120	135	25	9	1.1	1.8	41.0	1.3	ECN
47107	I	2.4	35	29.4	19	4		12.3	130	190	25	7	0.8	1.8	20.3		ECN
47126	I	1.9	26	25.8	18	5	16.2	8.9	135	160	30	9	1	1.4	34.2	0.9	ECN
47130	I	2.0	28	28.1	14	5	12.6	8.4	120			9	1	2.0	30.2	0.9	ECN
47160	I	3.7	27	26.6	25	5		13.1	120	160	40	5	1	1.1	18.5		ECN
47062	I	2.2	28	25.5	21	4	16.6	10.5	130	140	100	14	0.9	1.3	51.4	0.8	EE
47065	I	3.6	34	31.3	21	7	18.1	13.7	125	170	40	11	0.9	1.6	32.1	0.9	EE
47068	I	2.6	25	19.9	21	7	14.4	12.8	120	170	45	5	0.8	1.2	20.0	0.7	EE
47069	I	3.1	37	33.0	21	5	17.3	11.4	135	130	70	94	0.9	1.8	254.1	0.8	EE
47070	C	2.7	31	26.6	17	6	14.3	11.0	115	220	100	9	0.9	1.8	30.0	0.8	EE
47071	I	2.2	25	20.9	19	4	19.4	14.6	130	200	80	12	0.8	1.3	48.0	1.0	EE
47072	I	3.0	30	26.0	20	5	17.3	13.5	125	115	95	12	0.9	1.5	39.7	0.9	EE
47074	I	1.2	17	15.0	14	4	11.4	11.0	115	190	90	9	0.9	1.2	51.8	0.8	EE
47076	I	2.3	21	17.8	20	5	17.7	14.3	130	125	70	11	0.8	1.1	50.5	0.9	EE
47106	I	2.6	30	27.3	24	4	19.5	12.8	140	135	40	7	0.9	1.3	22.0	0.8	EE
47063	C	6.7	46	43.0	28	5	12.8	12.2	110	180	75	8	0.9	1.6	17.4	0.5	GSS
47064	C	7.1	46	40.4	32	5	17.5	16.8	100	190	90	10	0.9	1.4	21.7	0.5	GSS
47067	Is	5.4	30	28.8	29	6	13.8	15.2	95	175	105	9	1.0	1.0	30.0	0.5	GSS
47300	I	5.3	31	30.6	22	6		13.0	100	220	125	6	1.0	1.4	20.3		GSS
47040	I	2.5	19	14.3	23	5	21.0						0.8	0.8		0.9	HUM
47041	C	1.1	22	19.1	13	4	12.3						0.9	1.7		0.9	HUM
47042	I	2.0	31	28.0	13	4	13						0.9	2.4		1.0	HUM
47043	I	1.4	26	21.0	16	4	15.6						0.8	1.6		1.0	HUM
47044	C	2.0	27	22.7	15	5	14.9						0.8	1.8		1.0	HUM
47045	I	3.4	40	38.5	13	6	13.1						1.0	3.1		1.0	HUM
47046	I	3.7	30	26.6	17	7	14.2						0.9	1.8		0.8	HUM
47047	I	4.6	30	28.5	19	6	8.3						1	1.6		0.4	HUM
47048	I	3.9	29	26.6	20	7	13.1						0.9	1.5		0.7	HUM
47050	C	5.9	38	34.6	20	7	11.5						0.9	1.9		0.6	HUM
47051	I	3.8	37	31.5	17	6	13.8						0.9	2.2		0.8	HUM
47052	I	1.6	25	16.7	18	5	13.8						0.7	1.4		0.8	HUM
47053	I	4	32	27.5	20	7	17.0						0.9	1.6		0.8	HUM
47054	I	0.9	14	11.6	15	4	10.2						0.8	0.9		0.7	HUM
47055	I	2.5	28		16	4								1.8			HUM
47058	I	1.7	17	16.1	15	5	11.5						0.9	1.1		0.8	HUM
47061	I	1.5	17		16	4								1.1			HUM

Appendix A (*Continued*)

MEASUREMENTS OF PROJECTILE POINTS USING THE MONITOR VALLEY KEY (THOMAS 1981)*

Cat #	C/I	WT	LT	LA	WM	TH	WB	NW	PSA	DSA	NOI	LM	BIR	LT/WM	100 LM/LT	WB/WM	MVK
47127	I	0.7	19		11	3						2		1.7	8.4		HUM
47141	C	4.2	43	43.0	15	7	7.3						1.0	2.9		0.5	HUM
47143	C	1.2	31	31.0	10	4	6.1						1.0	3.1		0.6	HUM
47144	C	1.6	26	26.1	11	5	8.6						1.0	2.4		0.8	HUM
47145	C	1.7	32	31.0	10	5	9.9						1.0	3.2		1.0	HUM
47146	C	1.9	35	34.6	11	5	9.5						1.0	3.2		0.9	HUM
47147	C	4.3	36	33.8	16	7	11.1						0.9	2.3		0.7	HUM
47148	C	2.1	30	30.0	14	5	8.1						1.0	2.1		0.6	HUM
47149	I	1.5	24		13	4								1.8			HUM
47151	C	2.2	25	23.7	15	5	8.8						0.9	1.7		0.6	HUM
47152	I	1.8	27		14	4							0.0	1.9			HUM
47153	I	1.6	34	34.0	12	4	6.4						1.0	2.8		0.5	HUM
47154	C	1.6	28	27.6	14	4	6.2						1.0	2.0		0.4	HUM
47155	C	2.9	35	33.7	16	6	7.3						1.0	2.2		0.5	HUM
47156	I	6.3	48	48.0	15	6	8.8						1.0	3.2		0.6	HUM
47174	C	1.1	21	19.4	13	4	11.0						0.9	1.6		0.8	HUM
47196	C	1.4	25	25.0	13	4	11.6						1.0	1.9		0.9	HUM
47037	I	1.1	14	10.0	23	3	22.9		180	180		17	0.7	0.6	122.9	1.0	NSN
47038	I	1.2	15	9.2	24	4	24.9	9.6	180	180		17	0.6	0.6	114.0	1.0	NSN
47039	I	0.6	12	7.3	19	3	17.6		180	180		14	0.6	0.6	116.7	0.9	NSN
47060	I	0.7	18	7.6	21	3			180	180		16	0.4	0.9	90.6		NSN
47077	I	1.8	22	17.0	17	4		14.8	180	180	85	16	0.8	1.3	73.6		NSN
47078	I	2.6	38	32.5	26	4	23.8	9.4	180	180	30	14	0.9	1.5	36.1	0.9	NSN
47122	I	4.0	32	33.5	22	6	21.1	11.5	155	175	55	8	1.0	1.5	25.0	1.0	NSN
47123	I	2.5	28	28.0	16	5		10.2	180	180	40	7	1.0	1.8	24.6		NSN
47124	I	1.6	28	28.2	19	4		8.3	180	180	20	9	1.0	1.5	32.1		NSN
47125	I	1.8	27	27.0	14	4		9.7	180	180	30	7	1.0	1.9	25.2		NSN
47128	I	1.1	20	18.7	14	3		8.7	180	180	30	13	0.9	1.4	63.0		NSN
47131	I	3.7	31	31.3	23	6		11.2	180	180	25	14	1.0	1.3	44.8		NSN
47132	I	3.5	32	29.1	22	5		13.9	180	180	30	10	0.9	1.5	32.2		NSN
47133	I	2.3	25	25.0	18	4		11.7	155	195	40	9	1.0	1.4	35.6		NSN
47134	I	1.3	23	23.0	16	4		8.4	180	180	25	9	1.0	1.4	37.0		NSN
47135	I	2.4	32	32.4	22	4		9.1	180	180	25	13	1.0	1.5	40.6		NSN
47136	I	1.8	32	32.7	16	4		7.8	165	175	30	8	1.0	2	25.6		NSN
47137	I	1.4	22	21.2	17	4		9.1	155	170	35		1.0	1.3			NSN
47139	I	3.4	28	27.3	27	6	27.5	14.6	155	165	30	13	1.0	1.0	45.4	1.0	NSN
47140	I	1.7	22	15.6	20	4		11.3	180	180	25	17	0.7	1.1	75		NSN
47190	I	2.0	30	13.8	18	5		11.1	180	180		30	0.5	1.7	100		NSN
47209	I	3.8	38		21	6							0.0	1.8	0.0		NSN
47026	I	0.7	19	18.9	17	3		6.9	100	115	20	0	1.0	1.1	0.0	0.0	RS
47027	I	1.5	31	30.2	18	3	6.6	6.5	100	115	15	2	1.0	1.7	7.4	0.4	RS
47029	I	0.9	20	20.9	17	3	5.8	5.5	105	120	25	1	1.0	1.2	7.0	0.3	RS

Appendix A (*Continued*)

MEASUREMENTS OF PROJECTILE POINTS USING THE MONITOR VALLEY KEY (THOMAS 1981)*

Cat #	C/I	WT	LT	LA	WM	TH	WB	NW	PSA	DSA	NOI	LM	BIR	LT/WM	100 LM/LT	WB/WM	MVK
47030	I	2.4	22	21.6	21	4	7.4	8.4	105	110	10	0	1.0	1.0	0.0	0.4	RS
47031	I	0.7	25	24.1	12	2	5.3	5.0	100	110	15	1	1.0	2.1	3.2	0.4	RS
47032	I	1.6	20	1.9	21	4	7.7	7.4	110	125	20	2	0.1	1.0	7.5	0.4	RS
47033	I	0.7	12	12.3	18	3	6.9	6.8	100	125	35	1	1.0	0.7	11.7	0.4	RS
47034	C	1.5	30	28.4	20	3	7.0	5.8	105	120	20	2	0.9	1.5	6.0	0.3	RS
47035	I	2.0	30	30.0	17	3	5.9	6.8	100	120	30	2	1.0	1.8	8.0	0.3	RS
47066	I	0.9	20	17.8	12	3		7.8	125	215	85	7	0.9	1.7	35.0		RS
47073	I	0.7	25	24.5	10	2		6.5	115	205	70	8	1.0	2.5	32.8		RS
47075	C	0.7	22	21.7	10	4	9.9	7.4	115	195	60	7	1.0	2.2	31.8	1.0	RS
47081	C	1.4	26	25.8	19	3	8.5	7.3	105	115	10	2	1.0	1.4	7.3	0.4	RS
47084	C	1.2	25	25.0	16	4	9.0	6.5	130	140	20	4	1.0	1.6	14.4	0.6	RS
47089	I	1.5	26	23.7	20	4	9.6	8.2	120	135	40	1	0.9	1.3	5.4	0.5	RS
47090	I	0.6	15	15.5	18	2	4.9	5.5	105	120	40	0	1.0	0.8	0.0	0.3	RS
47092	I	0.8	18	18.0	13	4	6.8	6.7	125	210	95	2	1.0	1.4	11.1	0.5	RS
47093	I	0.9	27	27.0	15	4	6.8	6.8	110	135	25	3	1.0	1.8	9.3	0.5	RS
47094	I	0.9	23	19.5	12	3	8.6	5.6	120	170	55	3	0.8	1.9	13.5	0.7	RS
47096	I	0.9	21	17.6	14	3		6.7	115	120	25	2	0.8	1.5	11.4		RS
47097	I	1.1	18	16.3	18	3	9.8	8.6	125	145	15	2	0.9	1.0	12.8	0.5	RS
47098	I	1.0	17	15.7	19	3	8.0	7.0	105	120	20	1	0.9	0.9	6.5	0.4	RS
47101	I	0.7	12	11.8	16	3	8.3	6.5	120	140	30	2	1.0	0.8	15.0	0.5	RS
47104	I	0.7	24	20.8	23	4	5.4	5.4	95	140	60	2	0.9	1.0	8.8	0.2	RS
47105	I	0.5	17	16.8	14	2	7.1	5.6	105	120	25	1	1.0	1.2	7.1	0.5	RS
47110	I	0.8	21	21.0	12	3	9.0	7.0	115	145	50	2	1.0	1.8	9.5	0.8	RS
47117	I	0.6	17	15.1	12	2	5.3	6.1	100	125	30	1	0.9	1.4	7.6	0.4	RS
47129	I	1.1	12	24.1	24	4	6.5	5.8	100	120	125	2	2.0	0.5	12.5	0.3	RS
47036	I	1.3	26		13	4		6.7						2.0			SNF
47083	I	1.5	24		18	4	7.6	7.1						1.3			SNF
47099	I	1.3	20		20	4	9.3	7.9						1.0			SNF
47100	I	0.9	16		16	3		6.1						1.0			SNF
47109	I	1.4	26		14	4		7.8						1.9			SNF
47111	I	0.9	21		14	3		8.4						1.5			SNF
47112	I	1.4	20		17	4		8.3						1.2			SNF
47113	I	1.3	19		18	3								1.1			SNF
47118	I	1.0	22		16	3		7.8						1.4			SNF
47080	I	3.5	33		20	6			115	130	35			1.7			LNF
47082	I	1.8	33		19	3								1.7			LNF
47091	I	2.9	34		21	6			110	140	45			1.6			LNF
47102	I	2.7	31	31.0	24	5		11.0	145	165	35	8	1	1.3	26.8		LNF
47121	I	1.5	27		19	3		11.8	125	170	35			1.4			LNF

*Weight is in grams (g.) and other measurements are in millimeters (mm.). Blank entries could not be measured on that specimen or were not relevant to the projectile point type.

Key to abbreviations: C/I=Complete/Incomplete; WT=weight; LT=Maximum length; LA=Longitudinal axis; WM=Maximum width; TH=Maximum thickness; WB=Basal width; NW=Neck width; PSA=Proximal shoulder angle; DSA= Distal shoulder angle; NOI=Notch opening index; LM=length maximum width; BIR=Basal indention Ratio; LT/WM=Length to width ratio; LM/LT=Maximum width position; WB/WM=Basal width-Maximum width ratio. DSN=Desert Side-notched; ECN=Elko Corner-notched; EE=Elko Eared; GSS=Gatecliff Split-stem; HUM=Humboldt Series; NSN=Northern Side-notched;RS=Rosegate Series; SNF=Small notched fragment; LNF=Large notched fragment.

Appendix B

MEASUREMENTS OF GROUNDSTONE ARTIFACTS

Cat #	Material	Type	Length (cm.)	Width (cm.)	Thickness (cm.)	Width-Thickness Ratio	Figure 3 Key
47376	Basalt	Handstone	12.8	9.6	4.7	2.04	I
47377	Basalt	Handstone	14.2	10.6	5.9	1.80	A
47378	Basalt	Handstone	12.9	10.3	6.8	1.51	J
47379	Basalt	Handstone	11.5	9.0	3.5	2.57	K
47380	Basalt	Handstone	11.8	9.4	4.1	2.29	B
47381	Basalt	Handstone	11.1	7.9	4.5	1.76	D
47382	Basalt	Handstone	8.6	8.2	3.8	2.16	E
47383	Basalt	Handstone	14.5	9.2	3.3	2.79	H
47384	Granite	Handstone	10.0	9.3	5.5	1.69	C
47385	Basalt	Pestle	18.0	7.6	6.9	1.10	G
47386	Basalt	Pestle	21.0	8.6	6.3	1.37	F

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