POINTS IN TIME: DIRECT RADIOCARBON DATES ON GREAT BASIN PROJECTILE POINTS

Geoffrey M. Smith, Pat Barker, Eugene M. Hattori, Anan Raymond, and Ted Goebel

Typological cross-dating is the primary means by which archaeological sites are placed into chronological frameworks. This approach relies on the assumption that artifacts at undated sites—usually projectile points—are coeval with similar artifacts found at other, dated sites. While typological cross-dating is necessary in regions dominated by open-air lithic scatters, the approach can be problematic when undated and dated sites are separated by significant distances. Here, we present radiocarbon dates on projectile points with organic hafting material still attached or found within organic storage bags. Our results provide unequivocal ages for various morphological projectile point types at several Great Basin locales and should be useful to researchers seeking local age estimates for those point types, which often involves relying on chronological data from more distant sites. The results also highlight potential issues with uncritically applying typological cross-dating using typologies based on metric attributes, and in two cases, suggest the need to revise the age ranges for certain point styles in the western Great Basin.

Fechado por comparación tipológica es el medio primario a través del cual sitios arqueológicos son ubicados en marcos cronológicos. Esta aproximación asume que los artefactos de un sitio no fechado—generalmente puntas de proyectil—son contemporáneas con artefactos similares encontrados en otros sitios ya fechados. Aunque esta metodología es necesaria es regiones dominadas por dispersiones líticas al aire libre, esta aproximación puede resultar problemática cuando aquellos sitios que han sido fechados y aquellos que no se encuentran a grandes distancias. Aquí presentamos fechados radiocarbónicos en puntas de proyectil con residuos de enmangamiento orgánico o las bolsas en las que se hallaron. Nuestros resultados proveen fechas inequívocas para varios tipos morfológicos de puntas de proyectil en varias localidades de la Gran Cuenca y deberían ser útiles para los investigadores que buscan edades estimadas para dichos tipos, lo cual a veces involucra depender en datos cronológicos de sitios más lejanos. Los resultados también resaltan potenciales problemas con la aplicación acrítica del fechado por comparación usando tipologías basadas en atributos métricos y, en dos casos, sugiere la necesidad de revisas los rangos de fechas para ciertos estilos de puntas en el oeste de la Gran Cuenca.

Projectile points rank perhaps behind only ceramics and textiles in their utility to provide age estimates for prehistoric occupations in North America, and, given their greater spatial and temporal distribution, points are the most common index fossils employed by archaeologists. Borrowed from the biological sciences, the index fossil concept is a relative dating technique that allows multiple sites to be assigned to the same time period if they contain similar fossils—in this case, projectiles. With the advent of radiometric dating in the mid-twentieth century and the excavation of stratified archaeological sites containing points associated with dated features and strata, the relative index fossil concept evolved into an absolute dating technique known as typological cross-dating. Typological cross-dating rests on the assumption that diagnostic points found at undated sites are roughly the same age as similar diagnostic points found at other dated sites. In much of North America, typological cross-dating is the primary means of assign-

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Table 1. Select Local Great Basin Projectile Point Chronologies.

Region	Reference	Point Type	Age Range (cal B.P.)
Central Great Basin	Thomas (1981)	Large Side-notched	Pre-650
		Humboldt Series	4950–1250
		Gatecliff Series	4950–3250
		Elko Series	3250–1250
		Rosegate Series	1250–650
		Desert Series	Post-650
Sierra-Cascade Front	Hildebrandt and King (2002)	Large Side-notched	7000–4000
		Gatecliff Series	5000–2000
		Humboldt Series	3500–1300
		Elko Series	4500–1300
		Rose Spring Series	1900–200
		Desert Series	Post-200
Bonneville Basin	Schmitt and Madsen (2005)	Elko Series	8800–700
		Large Side-notched	8300–4500
		Humboldt Series	6300–2900
		Gatecliff Series	5100–2850
		Rose Spring Series	2000–500
		Desert Series	Post-900
Chewaucan Marsh, OR	Oetting (1994)	Northern Side-notched	7000–5000
		Humboldt Series	6000–1300
		Gatecliff Series	5000–2000
		Elko Series	5000–1000[a]
		Rosegate Series	Post-2000
		Desert Series	Post-1000
North-Central Great Basin	Hockett and Murphy (2009)	Northern Side-notched	-
		Humboldt Series	5700–3700
		Gatecliff Series	5700–3700
		Elko Series	3700–1300
		Rosegate Series	1300–600
		Desert Series	Post-600

Note: In cases where the authors presented age ranges in radiocarbon years, we converted them to calendar years using Appendix A in Grayson (2011).

[a]Oetting (1994) acknowledges that a minority of Elko points are associated with pre-5,000 cal B.P. dates in the northern Great Basin but argues that most postdate 5,000 cal B.P.

ing ages to sites, and it is especially useful in the Great Basin where replicable typologies based on metric attributes (e.g., Thomas 1981) offset a lack of stratified open-air sites.

Despite the utility of cross-dating using point typologies in the Great Basin, as the number of radiocarbon dates associated with projectiles has grown, it has become clear that substantial spatiotemporal variation exists among point types. An early recognition of such variability involved the "long" versus "short" chronologies of the eastern and western Great Basin, where in the 1970s it became clear that morphologically similar points had dissimilar temporal spans (Thomas 1981). This recognition of spatiotemporal variability fostered numerous local chronologies using morphologically distinct point types (e.g., Hildebrandt and King 2002; Holmer 1986; O'Connell and Inoway 1994; Oetting 1994) and helped refine our understanding of the age ranges of point types in different parts of the Great Basin (Table 1). However, despite this increased resolution, typological cross-dating—even when employed locally—has two shortcomings. First, the temporal estimates used in typological cross-dating are generally derived from a handful of sites where points were found associated with dated features and then applied at numerous undated sites. Thomas (1981:37) cautioned that temporal and morphological ranges developed for points in particular areas become "fuzzy" the farther removed one works from those areas—a warning recently echoed by Beck (1995). Second, radiocarbon dates from directly dated sites are usually obtained on features or isolated organic material within different strata, not on points themselves. Archaeol-

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ogists generally assume that the points are the same age as the dated material found nearby—an assumption that may be violated due to post-depositional processes (Schiffer 1987). The recent discovery of a fluted point in the historic stratum at Bonneville Estates Rockshelter (Goebel 2007) illustrates this point. Despite these issues, many archaeologists uncritically apply Thomas' (1981) Monitor Valley Key or similar classification schemes based on morphological attributes to estimate the ages of most sites, probably because most open-air sites cannot be directly dated.

In this paper, we present radiocarbon dates obtained on organic hafting material (e.g., sinew) on morphologically diagnostic points from sites across the Great Basin. Our goals are to increase confidence in existing typologies by providing unequivocal dates for morphological point types in different regions, and in a few cases, suggest minor revisions. Our sample of directly dated points is small, but we hope that researchers using existing typological cross-dating schemes will incorporate our results into their estimates of point ages, especially when working in areas far removed from those dated sites used to established local chronologies. Our results are generally not unexpected, but a few points revealed surprises. They highlight the danger of uncritically applying typological cross-dating approaches to sites that are spatially disparate and the need to continually refine local chronologies.

Materials and Methods

We sought points from contexts for which we could obtain radiocarbon dates that unequivocally provide age estimates for those specimens. Points met two criteria: (1) they possess intact bases with metric attributes that could be used to classify them; and (2) they have organic material (e.g., sinew) still attached, or come from within an organic container (e.g., a fiber or hide bag). We compiled our sample by reviewing the Nevada State Museum's records for specimens in collections excavated by professional archaeologists (e.g., Last Supper Cave, Kramer Cave, Shinners Site C, and Desiccation Cave) or recovered during unauthorized excavations (e.g., Elephant Mountain Cave, Bob's Cave, and the Nicholarsen Site). We also contacted colleagues working at sites that have produced points containing hafting materials (e.g., Bonneville Estates Rockshelter, Siblings Shelter, and Lower Lead Mine Hills Cave). These efforts produced a sample of 83 points comprised of isolated specimens and collections of closely associated points from nine Great Basin sites (Table 2, Figure 1).

Points in our sample were recovered from proveniences of varying resolution. Possessing the least amount of contextual information are specimens with attached binding material from Elephant Mountain Cave in the Black Rock Desert and Bob's Cave in Elko County; both samples were recovered during separate Archaeological Resource Protection Act (ARPA) cases (see Barker et al. [2011] for an overview of Elephant Mountain Cave and Ross [2000] for a review of Bob's Cave). Given the context of their recovery, we know only that the points came from those sites. The points with organic binding from Last Supper Cave possess slightly better contextual data; they were found in packrat middens along cave's walls (see Layton and Davis [1978] and Grayson [1988] for overviews of Last Supper Cave). Other specimens, like those recovered from Desiccation Cave, Shinners Site C (Hattori 1982), and the Nicholarsen Site (Barnes 2000; Hester 1974; Raymond 1989) were found as part of caches by professional archaeologists or artifact collectors. Finally, possessing the best provenience are points containing organic binding (or in one case attached to a foreshaft) found *in situ* during professional excavations at Kramer Cave (Hattori 1982), Bonneville Estates Rockshelter and Siblings Shelter (Ted Goebel, personal communication 2012), and Lower Lead Mine Hills Cave (Arkush 1998). The significance of points containing organic hafting materials, despite the varying resolution of provenience outlined above, is that we can be confident that the radiocarbon dates returned on them accurately represent the time periods when they were discarded, rather than having to rely on less firm associations between morphologically diagnostic points and dated features/strata, or typological cross-dating using other dated sites.

Eighty-three points were included in our study. For points with organic binding attached to their bases ($n = 16$), we removed small pieces for AMS dating. For the point from Kramer Cave attached

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Table 2. Great Basin Archaeological Sites with Directly Dated Projectile Points.

Archaeological Site	Material Dated	Point Type(s)	N	Reference(s)
Last Supper Cave, NV	Sinew Attached to Individual Points	Elko Eared	3	Grayson (1988); Layton and Davis (1978)
		Elko Corner-notched	1	
		Humboldt	1	
		Rosegate	1	
Elephant Mountain Cave, NV	Sinew Attached to Individual Points	Elko Eared	2	Barker et al. (2011)
		Humboldt	1	
		Rosegate	1	
Desiccation Cave, NV	Fiber Bag Containing Points	Rosegate	2	Unpublished Data, Nevada State Museum
Shinners Site C, NV	Cordage on Fiber Bag Containing Points	Humboldt	7	Hattori (1982)
Kramer Cave, NV	Wooden Atlatl Foreshaft	Gatecliff Split Stem	1	Hattori (1982)
The Nicholarsen Site, NV	Hide Bag Containing Points	Rosegate	36	Barnes (2000); Hester (1974); Raymond (1989, 2008)
		Elko Corner-notched	21	
Bob's Cave, NV	Sinew Attached to Individual Points	Large Side-notched	2	Ross (2000)
		Elko Eared	1	
Bonneville Estates Rockshelter, NV	Sinew Attached to Point	Rosegate	1	Unpublished Data, Ted Goebel
Siblings Shelter, NV	Sinew Attached to Point	Humboldt	1	Unpublished Data, Ted Goebel
Lower Lead Mine Hills Cave, UT	Sinew Attached to Point	Rosegate	1	Arkush (1998)
Total			83	

to a wooden foreshaft, Hattori (1982) dated the foreshaft via conventional radiocarbon dating. Finally, for the diagnostic points ($n = 66$) recovered from inside fiber or hide bags at three sites, we dated a portion of each bag using conventional or AMS radiocarbon dating. Most specimens were sent to Beta Analytic, Inc. or the University of Arizona for dating; specimens dated in earlier studies were sent to the University of California, Los Angeles, or to Gakushuin University in Tokyo. Points were classified using Thomas' (1981) Monitor Valley Key.[1] In cases where we could not record key metric attributes because they were obscured by hafting material, we x-rayed them with the help of Dr. Michael Day, a dentist in Sparks, Nevada, to reveal their basal morphologies. Figure 2 shows select specimens from our sample.

Results

Table 3 provides the results of radiocarbon dated points and the metric attributes used to classify them. Figure 3 graphically represents our findings by region as compared to local chronologies for the western (Hildebrandt and King 2002), northern (Oetting 1994), and eastern Great Basin (Schmitt and Madsen 2005). We discuss our results by geographic sub-region below.

The Northern Area

Our sample from the northern area includes six points from Last Supper Cave. The mean calibrated dates for the Humboldt point (4035 cal B.P.), Rosegate point (590 cal B.P.), and four Elko points (1745, 1790, 1830, and 2545 cal B.P.) are consistent with the age ranges provided by Oetting (1994) for the Chewaucan Basin to the north (see Figure 3). Additionally, with the exception of the Humboldt point, which predates Hildebrandt and King's (2002) age estimate for Humboldt points along the Sierra-Cascade Front by ~500 years, the ages of the Last Supper Cave points generally correspond to that nearby region as well. When calibrated at two sigma, the age ranges of three of the four Elko points overlap, suggesting that they may be contemporaneous and could have been discarded during a single maintenance episode.

The Eastern Area

Six points from four sites—Bob's Cave, Bonneville Estates Rockshelter, Siblings Shelter, and

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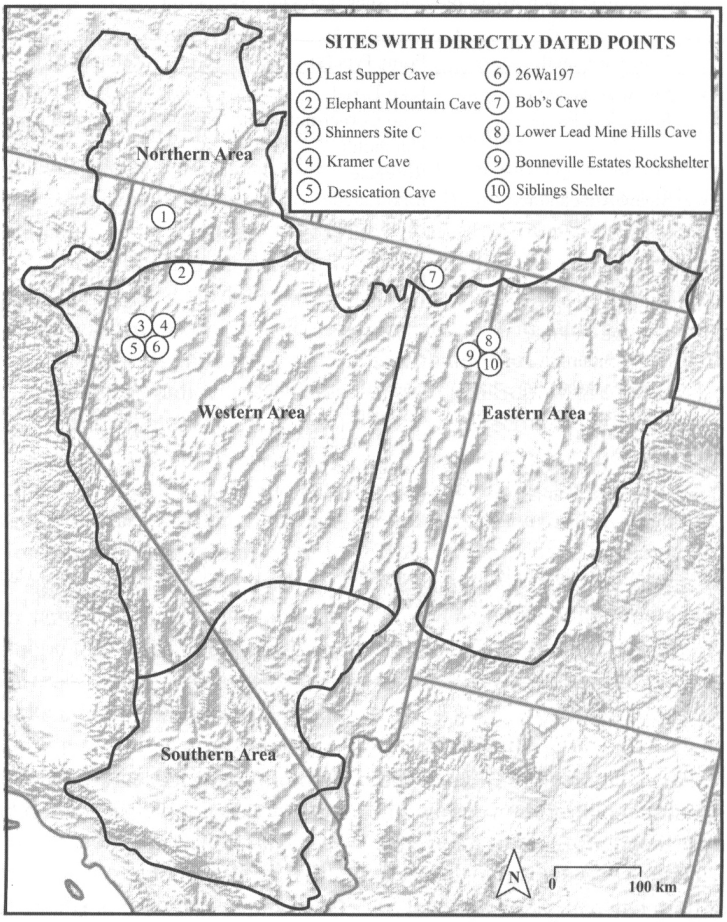


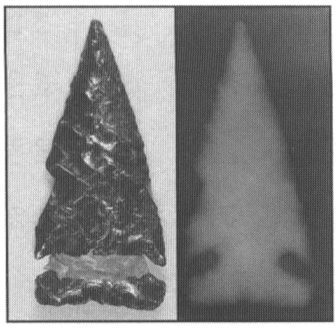
Figure 1. Map of the hydrographic Great Basin with locations of sites containing directly dated projectile points. Geographic subdivisions of Great Basin adapted from Jennings (1986).

Lower Led Mine Hills Cave—comprise our eastern area sample. As is the case for our results from the northern area, dates for the Rosegate (n = 2), Humboldt (n = 1), Elko (n = 1), and Large Side-notched (n = 2) points fall within current chronological estimates for those types provided by Schmitt and Madsen (2005). The early emergence of Elko points in the eastern Great Basin, which Aikens (1970) and Holmer (1986) have long argued for based on stratigraphic associations with dated features/strata, is reflected by the single Elko Eared specimen from Bob's Cave possessing a mean calibrated age of 7684 cal B.P.[2] The age of this specimen predates the estimated range of 3700-1300 cal B.P. for Elko points provided by Hockett and Murphy (2009) for the north-central Great Basin by ~4000 years (see Table 1). The two Large Side-notched points with mean dates exceeding 7000 cal B.P. also reflect the early emergence of that point type in the eastern Great Basin.

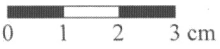
The Western Area

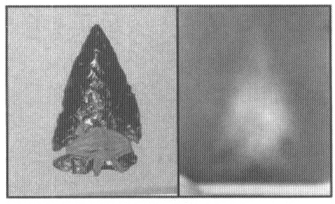
The western area contains eight of our 20 dated points/associated groups of points, and we found several notable surprises in those results. First, the two Rosegate points from Desiccation Cave found in a bag with a mean date of 1965 cal B.P. are substantially older than traditional age estimates (e.g., O'Connell 1975; Thomas 1981) for Rosegate points in the western Great Basin. Instead, their age corresponds more with Hildebrandt and King's (2002) revised estimate (1900–200 cal B.P.) derived from both radiocarbon and obsidian

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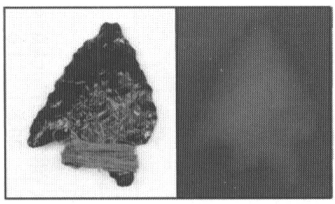


26Ek6892-242: Large Side-notched point from Bob's Cave

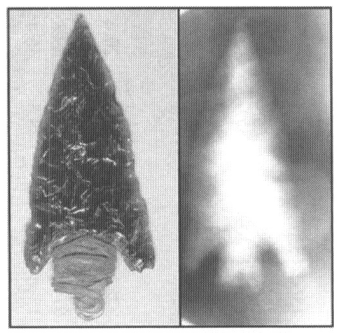




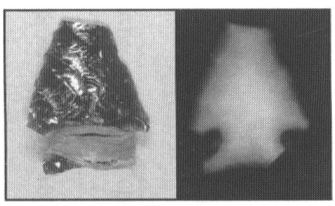
26Ek6892-243: Elko Eared point from Bob's Cave



26Hu3557-49: Elko Eared point from Elephant Mountain Cave



26Hu3557-88: Rosegate Corner-notched point from Elephant Mountain Cave



26Hu3557-58: Elko Eared point from Elephant Mountain Cave

Figure 2. Select x-rayed projectile points with hafting material from our sample.

hydration data along the Sierra-Cascade Front. The early age of Rosegate points at Desiccation Cave also corresponds with Oetting's (1994) expanded age range (post-2000 cal B.P.) for Rosegate points in the northern Great Basin.

Second, because Humboldt points are widely regarded as poor index fossils in the western Great Basin due to their morphological and temporal variability, it is difficult to characterize dates associated with them as "unexpected." However, we note that the Humboldt specimen from Elephant Mountain Cave (6707 cal B.P.) and seven specimens found together in a dated fiber bag (4565 cal B.P.) at Shinners Site C substantially predate both Hildebrandt and King's (2002) and Thomas's (1981) age estimates for Humboldt points in the western Great Basin by a millennium or more. Instead, our results more closely align with Delacorte's (1997) view of an earlier emergence of Humboldt points in the western Great Basin.

Third, the collection of 57 projectile points found in a hide bag (together with 10 unclassified points and 34 point preforms not discussed here) at the Nicholarsen Site includes 21 large corner-notched specimens that type as Elko points when

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Table 3. Radiocarbon Dates and Metric Attributes for Directly Dated Projectile Points.

Catalog Number	Point Type	Radiocarbon Sample ID	^{14}C BP Date	2σ cal BP Range	Metric Attributes[a]									
					L_T	L_A	BIR	W_B	W_M	W_N	THI	DSA	PSA	WT
Last Supper Cave														
31-2191	Rosegate	Beta-248288	580 ± 40	660-520	23.0	-	-	8.5	11.0	6.0	4.0	200	120	0.8
31-5220	Elko Corner-notched	Beta-248292	1820 ± 40	1860-1630	20.5	-	-	11.0	14.0	-	4.0	180	130	0.8
31-5047	Elko Eared	Beta-248290	1850 ± 40	1880-1700	30.0	28	0.93	14.5	18.0	11.0	5.0	150	130	1.7
31-2972	Elko Eared	Beta-248289	1900 ± 40	1930-1730	35.0	-	-	15.0	17.0	13.0	3.5	160	140	2.0
31-5142	Elko Eared	Beta-248291	2480 ± 40	2730-2360	28.0	-	-	22.0	23.0	16.0	4.0	140	130	2.6
31-1542	Humboldt	Beta-248287	3700 ± 40	4150-3920	33.5	-	-	14.0	18.0	n/a	6.0	n/a	n/a	3.5
Elephant Mountain Cave														
26Hu3557-37	Elko Eared	AA-86303	6879 ± 58	7785-7669	28.2	20.4	0.72	17.5	22.3	11.0	5.5	150	130	2.9
26Hu3557-49	Elko Eared	AA-86304	1866 ± 37	1857-1751	29.1	26.8	0.92	12.0	-	9.0	4.8	140	110	2.2
26Hu3557-58	Humboldt	AA-86305	5879 ± 55	6766-6648	49.8	49.8	1.0	11.2	11.6	n/a	5.8	n/a	n/a	5.8
26Hu3557-88	Rosegate	AA-86306	1333 ± 36	1294-1212	48.5	46.4	0.96	9.0	22.0	7.0	4.0	115	100	3.5
Lower Lead Mine Hills Cave														
11-19-01	Rosegate	Beta-303191	1010 ± 30	960-910	22.2	-	-	6.6	13.4	5.0	2.9	135	105	0.6
Bob's Cave														
09-242	Large Side-notched	AA-92079	6273 ± 58	7317-7007	53.3	45.6	0.86	22.0	22.0	11.0	6.3	145	155	6.1
09-243	Elko Eared[b]	AA-92080	6831 ± 57	7786-7581	26.9	23.8	0.88	15.0	15.8	11.0	3.4	145	150	1.3
09-244	Large Side-notched	AA-92081	6586 ± 49	7566-7428	20.4	13.5	0.66	23.7	24.0	3.0	5.0	150	160	6.0
Bonneville Estates Rockshelter														
11-4895-2531	Rosegate	Beta-297411	1400 ± 30	1340-1280	29.5	29.5	1.0	5.8	16.6	5.0	2.6	120	100	0.9
Siblings Shelter														
E-203	Humboldt	Beta-297413	4350 ± 40	5040-4840	43.4	42.2	.97	7.5	13.7	n/a	5.0	n/a	n/a	3.7
Desiccation Cave[c]														
3998C	Rosegate	GaK-2804	1950 ± 100	2160-1750	22.1	22.1	1.0	15.5	16.1	9.0	3.4	130	105	1.4
3988O	Rosegate				20.2	20.2	1.0	-	16.1	-	2.9	130	120	1.2
Kramer Cave[d]														
196-2269	Gatecliff Contracting Stem	GaK-2387	3830 ± 110	4389-4077	52.0e	47.0[e]	.90[f]	12[e]	29.9[f]	16.0[e]	6.8[f]	180[e]	75[e]	9.1[f]

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Table 3 (continued). Radiocarbon Dates and Metric Attributes for Directly Dated Projectile Points.

Catalog Number	Point Type	Radiocarbon Sample ID	^{14}C BP Date	2σ cal BP Range	Metric Attributes[a]									
					L_T	L_A	BIR	W_B	W_M	W_N	THI	DSA	PSA	WT
Shinners Site C[g]														
492-2	Humboldt				52.0	-	-	-	16.5	n/a	5.0	n/a	n/a	4.2
492-3	Humboldt				53.0	-	-	-	16.5	n/a	5.0	n/a	n/a	4.2
492-4	Humboldt				48.4	-	-	-	15.0	n/a	5.1	n/a	n/a	3.8
492-5	Humboldt	UCLA-978	4030 ± 85	4698-4431	48.0	-	-	-	14.4	n/a	5.3	n/a	n/a	3.1
492-6	Humboldt				44.4	-	-	-	13.9	n/a	5.3	n/a	n/a	3.2
498-7	Humboldt[h]				44.3	42.4	.96	-	11.8	n/a	3.8	n/a	n/a	1.5
498-8	Humboldt[h]				43.3	41.7	.96	-	11.5	n/a	3.3	n/a	n/a	1.5
Nicholarsen Site[i]														
-	Rosegate (n=36)	Beta-101411	1330 ± 50	1310-1160	See Table 4 for basic metric data for individual specimens.									
-	Elko Corner-notched (n=21)													

[a]L_T = Total Length; L_A = Axial Length; BIR = Basal Indentation Ratio; W_B = Basal Width; W_M = Maximum Width; W_N = Neck Width; THI = Thickness; DSA = Distal Shoulder Angle; PSA = Proximal Shoulder Angle; W = Weight (g).

[b]Using the Monitor Valley Key, this specimen types out as a Desert Side-notched point due to its low weight (<1.5 g) and PSA (150); however, given the early date we think that it is more likely a small Elko Eared point.

[c]Date on Catlow Twine fiber bag containing both points.

[d]Date on wooden foreshaft to which the point was attached.

[e]Measurements obtained by senior author using photograph of artifact in Hattori (1982).

[f]Data from Hattori (1982).

[g]Date on cordage from fiber bag containing seven points.

[h]Using the Monitor Valley Key, these specimens type out as Cottonwood Triangular Points based on weight (≤ 1.5 g) and thickness (< 4 mm), but not length. Given their context – found within a directly dated bag containing five other points that clearly type as Humboldts – we argue that both 498-7 and 498-8 are also Humboldt points.

[i]Date on marmot hide bag containing 57 diagnostic points.

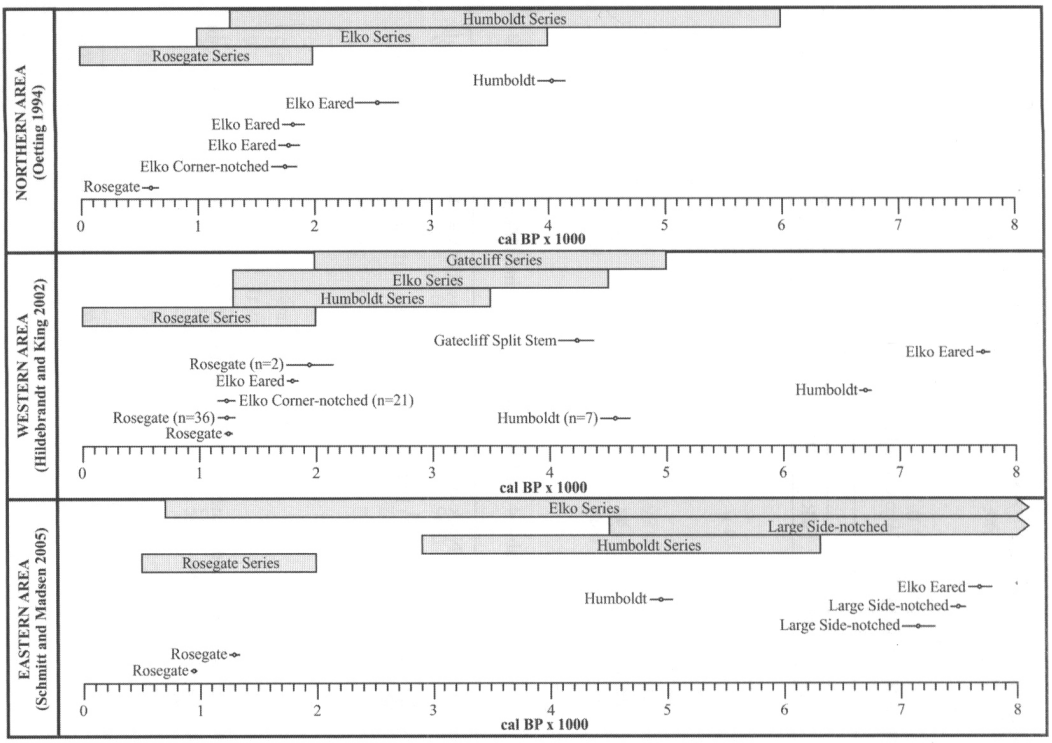


Figure 3. Chronological distribution of dated points by region, as compared to northern (Oetting 1994), western (Hildebrandt and King 2002), and eastern (Schmitt and Madsen 2005) projectile point chronologies.

using the Monitor Valley Key (Table 4; Figure 4). The bag was directly dated to 1235 cal B.P. (Raymond 2008), which represents the latest end of most estimated age ranges for Elko points in the western Great Basin (Hildebrandt and King 2002; O'Connell 1975; Thomas 1981). This finding is not problematic by itself; however, those 21 Elko points co-occur with 36 smaller corner-notched points that type as Rosegate points when using the Monitor Valley Key. Finding Rosegate points associated with a date of 1235 cal B.P. is also not problematic by itself, as that date corresponds well with the earliest end of established temporal ranges for Rosegate points in the western Great Basin (O'Connell 1975; Thomas 1981, but see Hildebrandt and King 2002). What is problematic, however, is the co-occurrence of a substantial number of *both* Elko and Rosegate points together in a cache presumably representing a single moment in time. When Barnes (2000) applied Shott's (1997) single variable discriminate analysis to classify the 57 points, most (~93 percent) but not all were classified as dart points (see Table 4). Regardless of the classification scheme used, multiple morphological types are recognized, which many researchers, in turn, accept as valid temporal (e.g., pre- and post-1300 cal B.P.) and/or technological (dart and arrow) types. This is problematic, since all of the points in the cache were presumably deposited at the same time, suggesting that (1) two hunting technologies (the dart and atlatl and bow and arrow) were used simultaneously in the western Great Basin ~1300 cal B.P.; and/or (2) classification schemes create arbitrary morphological distinctions that lack temporal and/or technological significance within contemporaneous corner-notched point assemblages (see Hildebrandt and King [2012] for an alternative method of classifying projectile points).

Finally, our most noteworthy finding is that of an early (~7700 cal B.P.) Elko Eared point from Elephant Mountain Cave (Figure 5). Although Elko points possess considerable antiquity in the northern and eastern Great Basin (Aikens 1970; Holmer 1986), we are unaware of specimens in the

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Table 4. Metric Attributes for Projectile Points from the Nicholarsen Site.

Specimen Number	Thomas (1981)	Shott (1997)	Metric Attribute[a]					
			L_T	W_B	W_M	THI	PSA	WT
2	Rosegate	Dart	37.0	8.2	28.2	4.2	92	2.9
4	Rosegate	Arrow	28.3	7.7	16.6	3.3	115	1.2
7	Rosegate	Dart	46.4	9.5	22.0	3.8	103	2.5
9	Rosegate	Dart	49.7	9.3	24.5	4.4	99	3.6
10	Rosegate	Dart	49.5	8.4	22.1	3.9	90	3.8
11	Rosegate	Dart	44.2	10.0	24.5	3.4	115	3.3
14	Rosegate	Dart	35.0	10.0	19.3	3.4	115	1.5
16	Rosegate	Dart	39.2	9.5	20.7	3.4	106	2.2
18	Rosegate	Dart	46.9	9.7	22.0	3.9	105	3.7
19	Rosegate	Dart	37.0	8.4	19.0	3.1	101	2.0
20	Rosegate	Arrow	38.3	8.2	18.3	3.8	110	1.9
23	Rosegate	Dart	32.5	9.5	23.5	3.5	118	1.8
25	Rosegate	Dart	40.5	9.3	20.7	2.9	108	1.8
26	Rosegate	Dart	37.9	9.8	23.3	3.7	110	2.7
27	Rosegate	Dart	39.4	8.0	19.2	4.0	100	2.0
28	Rosegate	Dart	41.5	6.6	20.8	3.1	95	1.9
29	Rosegate	Dart	36.8	9.4	24.8	3.6	105	2.3
31	Rosegate	Dart	42.3	9.5	25.7	3.5	115	2.9
32	Rosegate	Dart	51.1	9.5	22.8	3.6	100	3.3
37	Rosegate	Dart	44.2	10.0	19.4	4.0	108	2.6
49	Rosegate	Dart	50.3	8.4	22.9	3.2	113	2.6
50	Rosegate	Dart	59.3	7.9	22.2		118	3.0
51	Rosegate	Dart	42.1	9.4	23.3	3.9	110	2.5
52	Rosegate	Dart	37.8	9.6	26.1	3.5	110	2.7
53	Rosegate	Dart	39.6	9.4	19.4	3.8	109	2.4
57	Rosegate	Dart	33.1	8.2	23.2	3.4	110	2.3
59	Rosegate	Dart	36.9	9.2	26.9	3.5	109	2.2
62	Rosegate	Dart	34.8	9.1	21.4	3.3	105	2.2
63	Rosegate	Dart	39.7	9.8	21.0	3.2	100	2.6
66	Rosegate	Dart	36.2	8.6	18.6	3.5	115	1.8
67	Rosegate	Dart	39.3	8.1	19.2	4.4	107	2.3
71	Rosegate	Dart	34.3	8.6	23.8	3.5	101	2.2
74	Rosegate	Dart	46.3	8.6	20.7	3.7	108	2.7
75	Rosegate	Arrow	44.8	9.2	18.5	4.0	111	2.6
76	Rosegate	Dart	62.2	9.8	21.5	3.2	108	3.5
77	Rosegate	Arrow	64.5	9.4	18.4	3.8	115	4.3
3	Elko Corner-notched	Dart	37.4	10.8	27.6	3.3	115	2.3
12	Elko Corner-notched	Dart	37.4	11.2	21.8	4.1	109	2.2
13	Elko Corner-notched	Dart	35.7	10.5	20.0	4.2	115	2.4
15	Elko Corner-notched	Dart	31.4	11.6	20.0	3.2	108	1.7
17	Elko Corner-notched	Dart	28.2	11.0	21.4	3.7	113	1.6
21	Elko Corner-notched	Dart	31.5	10.8	23.6	3.5	110	1.8
22	Elko Corner-notched	Dart	34.3	12.6	25.2	4.2	116	2.2
24	Elko Corner-notched	Dart	36.3	10.2	20.8	3.2	115	2.0
30	Elko Corner-notched	Dart	45.4	11.3	23.3	3.8	110	3.0
34	Elko Corner-notched	Dart	40.8	10.8	26.8	3.7	115	3.4
54	Elko Corner-notched	Dart	42.7	12.5	23.5	4.0	115	3.1
55	Elko Corner-notched	Dart	40.3	11.1	20.7	4.4	112	2.7
56	Elko Corner-notched	Dart	38.9	11.0	29.5	3.1	110	3.3
58	Elko Corner-notched	Dart	32.1	10.8	32.1	3.4	120	2.2
61	Elko Corner-notched	Dart	36.6	10.6	24.1	3.5	110	2.2
64	Elko Corner-notched	Dart	36.5	11.2	24.1	3.5	111	2.7
68	Elko Corner-notched	Dart	42.1	10.6	22.8	3.3	111	2.9
69	Elko Corner-notched	Dart	40.3	11.0	22.2	3.4	125	2.4
70	Elko Corner-notched	Dart	35.1	11.4	23.7	3.8	125	2.1

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Table 4 (continued). Metric Attributes for Projectile Points from the Nicholarsen Site.

Specimen Number	Thomas (1981)	Shott (1997)	Metric Attribute[a]					
			L_T	W_B	W_M	THI	PSA	WT
72	Elko Corner-notched	Dart	37.9	10.8	24.0	3.4	120	2.2
73	Elko Corner-notched	Dart	36.5	10.4	23.7	3.7	110	2.4
1	Indeterminate	Dart	37.5	10.9	27.8	4.0	105	2.6
5	Indeterminate	Dart	41.2	11.8	27.5	4.0	107	3.1
6	Indeterminate	Dart	47.8	12.8	22.5	4.8	107	3.4
8	Indeterminate	Dart	52.0	10.8	23.4	4.8	100	3.8
33	Indeterminate	Dart	51.3	10.1	23.4	3.2	100	3.1
35	Indeterminate	Dart	41.8	10.8	24.3	3.6	107	2.7
36	Indeterminate	Dart	42.2	10.4	23.8	4.2	100	2.8
60	Indeterminate	Dart	33.9	13.0	23.3	3.5	130	2.3
65	Indeterminate	Dart	35.6	11.7	27.1	3.9	110	3.0
103	Indeterminate	Dart	54.7	11.1	30.9	6.0	90	6.9

Note: Data compiled by Raymond (1989) and presented by Barnes (2000).
[a]L_T = Total Length; W_B = Basal Width; W_M = Maximum Width; THI = Thickness; PSA = Proximal Shoulder Angle; W = Weight (g).

western Great Basin as old as that from Elephant Mountain Cave. If the point's age was estimated using a less secure means (e.g., stratigraphic position), we might consider rejecting the date as many researchers do when index fossils do not correspond well with absolute dates (*sensu* Thomas 1976). However, *because the date was obtained on sinew still attached to the point*, we have no reason to reject it. Elko points found in middle Holocene contexts at Dirty Shame Rockshelter (Aikens et al. 1977) and Skull Creek Dunes (Wilde 1985) indicate that they are older in the northern Great Basin than in the western Great Basin, and although we placed Elephant Mountain Cave in the latter, it lies close to the border between the two areas. As such, the early specimen from Elephant Mountain Cave is not completely without analogue. Researchers should consider the possibility that some Elko points in the western Great Basin may predate even Milliken and Hildebrandt's (1997) early range (~5000–3500 cal B.P.) for their emergence in that region.

Discussion

While our study produced some notable results, it cannot provide comprehensive age ranges for the various point types for several reasons. First, our sample is small in terms of number of directly dated points and sites containing such points. They were recovered from dry caves and rockshelters, which are rare relative to other site types. Additionally, only a handful of excavated caves and rockshelters have yielded points with hafting material still attached, thereby further limiting how well our sample represents the populations from which they were drawn. Nonetheless, these contexts are not unusual relative to the contexts in which point ages from typological cross-dating are derived (i.e., buried layers in a few dry caves and rockshelters). Second, the projectiles included in our sample really do represent "points in time"—that is, they are the products of particular events (e.g., caching, gear maintenance, discard). Thus, they do not represent the full time ranges during which the point styles were used. The Elko points from Last Supper Cave illustrate this point; because the calibrated age ranges of three of the specimens overlap, it is conceivable that they were removed and discarded during a single event and not during multiple events spanning the entire duration of that point style in the region. Third, as outlined above, given that point types, like many classes of material culture, waxed and waned in popularity over time, basic statistical theory suggests that the specimens that we have dated were likely used during periods of widespread use (the mode[s]), rather than very early or very late in their periods of use (the tails). In other words, it is statistically improbable that our sample reflects those times when particular types were initially adopted or finally abandoned. Rather, our dates most likely, but not absolutely, reflect times when the point types were widely used.

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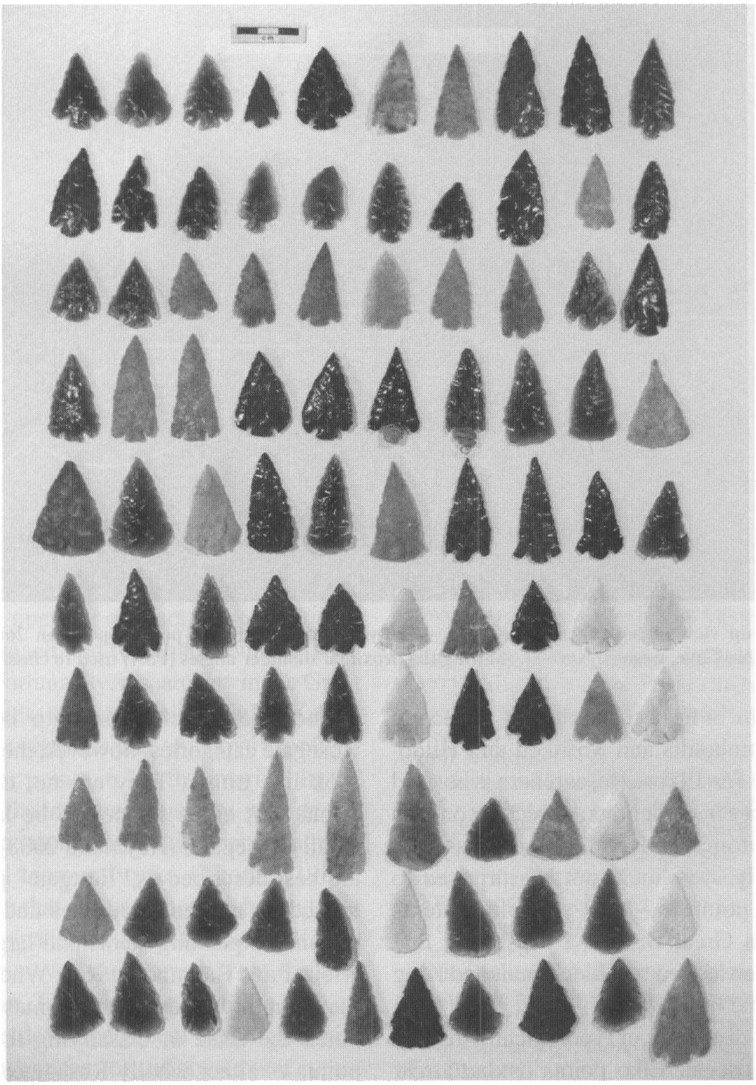


Figure 4. The Nicholarsen cache of 67 corner-notched points and 34 preforms (courtesy of Anan Raymond).

Despite these issues, our results have merit. First, they provide additional unequivocal ages for diagnostic point types in different areas of the Great Basin. Given that open-air lithic scatters dominate the region's archaeological record and we must rely heavily on typological cross-dating, putting new "points on the map" representing places with firmly dated diagnostic points is important. Researchers may want to use these new data to refine their chronologies when working close to the sites included here.

Second, a few of our directly dated specimens do not correspond well with current age estimates provided by regional point chronologies. The 7,700-year-old Elko point from Elephant Mountain Cave is the best example of this issue. We have no clear reason to dismiss the date, as we might be tempted to do if it were less securely associated with the artifact. Instead, like all of the dates presented here, we believe that it accurately reflects the period when the artifact was used and discarded. As such, in a few cases, we need to revise the temporal ranges that we assign to morphologically distinct point forms. Both Humboldt and Elko points appear to have been used earlier than commonly believed in the west-

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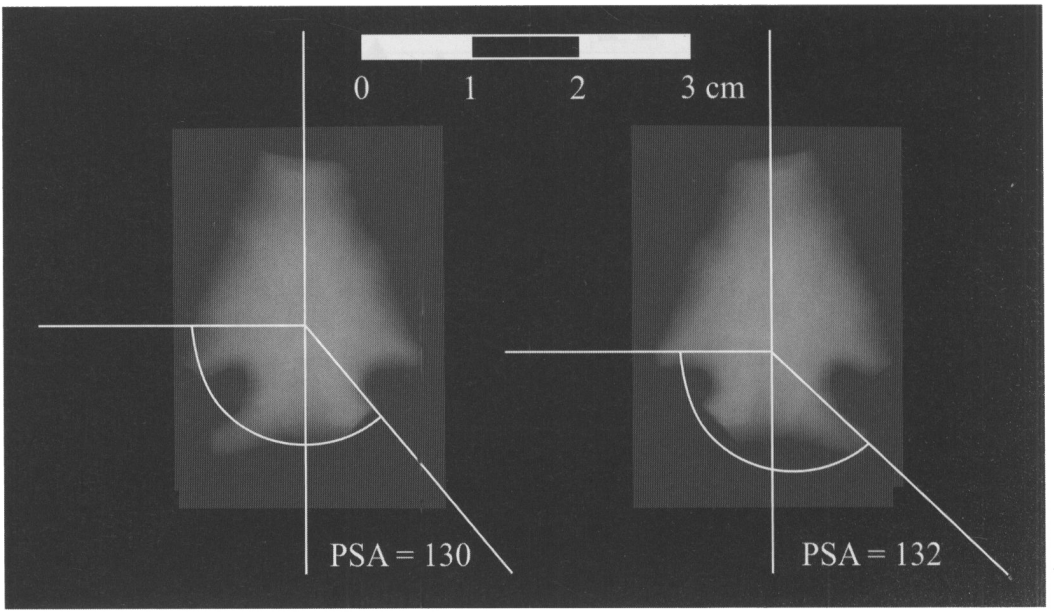


Figure 5. Close-up view of both faces of x-rayed ~7700-year-old Elko Eared point (Specimen 26Hu3557-37) from Elephant Mountain Cave, western Nevada, showing the proximal shoulder angles (PSA) used to classify the specimen.

ern Great Basin, as has been argued by Delacorte (1997) for Humboldts and Milliken and Hildebrandt (1997) for Elkos. Researchers who find these point types in earlier than expected contexts should not automatically reject those associations. Similarly, we should not be surprised to find Rosegate points in ~2000-year-old contexts in the western Great Basin—a possibility that has been acknowledged by Hildebrandt and King (2002) for some time now.

Finally, the discovery of typologically distinct forms (e.g., Rosegate/Elko points or dart/arrow points) together in a directly dated cache bag at the Nicholarsen Site raises some important issues with how we classify projectiles. If viewed from a technological perspective, the points in the Nicholarsen Cache type as dart *and* arrow points. While the transition from the atlatl and dart to the bow and arrow was probably a gradual process, the homogenous lithic technology and morphology exhibited by points in the cache—deposited at a single moment in time—suggest that one weapon system, but not both, is represented (Raymond 2008). The fact that some of the points fall on one side of the arrow-dart line while some fall on the other probably means that the line is misplaced.

If instead viewed from a morphological/chronological perspective, the points in the Nicholarsen Cache sort into both Elko and Rosegate categories; however, they do not really look like either. They are not corner-notched points that either happen to be large (Elko) or small (Rosegate) (Raymond 2008). Instead, they are best described as "Eastgate" points, characterized by triangular outlines and basal notches forming expanding stems and large, wide barbs (Heizer and Baumhoff 1961). When constructing the Monitor Valley Key, Thomas (1981:31–32) noted the issue of classifying the Nicholarsen points as either wholly Rosegates or Elkos, and ultimately opted for the latter. The difficulty of easily classifying those points likely stems from the fact that typologies necessarily conflate and sort hundreds of specimens made by multiple individuals using varied techniques across large swaths of time and space. The Nicholarsen points defy prevailing typologies because most of them were unused and made in a technologically consistent manner by a single individual within a short period of time (Raymond 2008).

The primary implication of the issues associated with classifying the Nicholarsen Cache points relates to the widespread use of typological cross-dating to estimate the age of otherwise undatable sites. Clearly, assigning such sites to two cultural periods (e.g., the Middle and Late Ar-

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chaic) based solely on the presence of both point styles (whether classified as Elkos/Rosegates or darts/arrows), or conjuring up artifact reuse (e.g., Thomas' [1976] Heirloom Hypothesis) to explain their co-occurrence can be problematic. As evidenced by the Nicholarsen Cache, sites containing both point types might represent single occupations and not palimpsests of repeated occupations. While we recognize that this final implication represents little more than a cautionary tale, we nevertheless urge researchers to consider that possibility before uncritically assigning undated sites containing both Elko/dart and Rosegate/arrow points to two cultural periods.

Conclusion

Despite the shortcomings of typological cross-dating highlighted here, in regions whose records are dominated by open-air artifact scatters, it is a necessary approach, but one that should be used with caution. Fortunately, researchers in the Great Basin have access to the Monitor Valley Key—one of the most rigorous and objective typological schemes for points in North America. In the central Great Basin, where the key was developed, there is a strong association between morphological and temporal types (Thomas 1981). However, given that points varied in shape across both time and space, the Monitor Valley Key is less applicable as you move away from the central Great Basin. To compensate for this fact, researchers have developed local typologies with adjusted age estimates for different point types.

Our study of directly dated points from various Great Basin locales indicates that while our results generally support those local chronologies, a few changes are in order. Elko and Humboldt points may have been used in the western Great Basin earlier than most researchers have suspected. Additionally, Rosegate and Elko points were likely used coevally in the western Great Basin, suggesting either the presence of two overlapping technologies (the dart and atlatl and bow and arrow) ~1235 cal B.P. or, more likely, issues with prevailing typologies. While our sample is small, we hope that researchers working near our sites will adopt our revised estimates for different point types and continue to seek directly dated specimens to further refine local chronologies, and that researchers working in other regions will consider the implications of our findings to their own applications of morphological and temporal typologies.

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Notes

1. In a few cases, points typed out as one morphological type when considering one attribute (e.g., proximal shoulder angle), but another type when considering another attribute (e.g., weight). In such cases, we considered the sum of the metric data, the age of the sinew attached to the point, and the context from which the point was recovered when making our final decisions.

2. Using the Monitor Valley Key, Specimen 09-243 types out as a Desert Side-notched point due to its low weight (< 1.5 g) and proximal shoulder angle (150°); however, it possesses a basal width of 15 mm, which is more consistent with larger Elko or Large Side-notched points. We opted to classify it as the former, but recognize that it is an unusual specimen. When the dart-arrow index is used (neck width + maximum thickness; < 11.8 mm = arrow and > 11.8 mm = dart) (Hildebrandt and King 2012), the specimen falls within the arrow category (neck width of 8.0 mm and maximum thickness of 3.4 mm = dart-arrow index value of 11.4).

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