A Case for Paleoindian Use of
Pinto Projectile Points in the Great Basin:
Morphological Analysis from the Old River Bed, Utah

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Arts in Anthropology

by
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August 2012
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entitled

A Case for Paleoindian Use of Pinto Projectile Points in The Great Basin: Morphological Analysis from the Old River Bed, Utah

be accepted in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

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August, 2012
ABSTRACT

The chronology and morphology of Pinto series projectile points in the Great Basin and the Mojave Desert have been the subject of much debate. Split-stemmed points have been found in both early and late contexts associated with dates spanning the late Paleoindian and Archaic Periods. This lack of temporal specificity may relate to differences in regional morphology through time coupled with misidentification of other point types as Pinto series. These issues are discussed using a collection of 170 Pinto series points from the distal portion of the Old River Bed delta of northwestern Utah. The research presented here examines the distributional, chronological, and quantitative differences between the Pinto series and other split-stemmed projectile points of the Great Basin. The results indicate the comparatively robust Pinto form is primarily found on the southern and eastern fringes of the Great Basin in earlier contexts than that of the more northerly and gracile Gatecliff Split stem point.
I’d like to thank my committee, Dr. Gary Haynes, Dr. Peter Wigand, and Dr. Donald Hardesty, for sticking with me as I dragged the writing process out and for providing guidance along the way. Thanks to the Sundance Archaeological Research Fund for providing financial assistance. Also, a special thanks to Dr. Daron Duke for all his insight, gentle direction, and consistent prodding. Much thanks to Jeff Rust for being my sounding board and for threatening future unemployment if I didn’t finish. Thanks are due to Fred Frampton and Alyce Branigan for taking a chance on me and giving me much-needed institutional advice.

My friends and family were also instrumental in my grad school experience. I appreciate all my friends who helped me through tests and papers with study sessions and happy hour. Thanks to Mom, Dick, Dad, and Julie for helping me get to grad school in the first place, helping me move back, and the multi-faceted support in between. Thanks to Marjorie Langdon and her quirky family for being my support system in Reno, and persistently nagging me to finish. I could not have done this without any of them.

And most importantly, I thank my son, Ricky, for putting up with me all those times I said no because I had to study. I’ll be saying yes a lot more often now.
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CHAPTER 1: INTRODUCTION

This thesis explores the history and current thought regarding Pinto style projectile points using a collection of 170 points from the southern Great Salt Lake Desert. I address the following questions: What technical attributes characterize the Pinto series of projectile points, and what is the age range of this type of point. I look at research in various areas of the Great Basin and Mojave Desert to gain insight about the chronology of Pinto points, and then examine the Pinto points recorded from the Old River Bed (ORB) area of Utah. My goals are to establish the frequency and distribution of Pinto point occurrence on the ORB and to see how the distal ORB Pinto points fit in the Great Basin temporal scheme.

Pinto series projectile points are examples of some of the more ambiguously defined diagnostic artifacts, presenting researchers with both typological and chronological problems. Archaeologists’ understanding of the cultural chronology of the Great Basin is in an evolving state as new information refines and sometimes contradicts established paradigms. Diagnostic artifacts such as projectile point styles provide an easily recognizable yet sometimes controversial means of placing sites within a cultural context.

Pinto Point Chronology and the Long/Short Debate

The Pinto style was initially described by Amsden (1935) in the Pinto Basin Site report (Campbell and Campbell 1935). Pinto points are characteristic of the Pinto Complex, the name given to the artifact assemblage frequently associated with the Pinto style. As used here, “complex” refers to the material remains characteristic of a prehistoric culture, “period” refers to a chronological timeframe associated with a culture or complex, and “series” refers to the morphological subtypes of projectile points collectively referred to as one style of point.
Projectile point series are often indicative of a complex, which is assigned a period based on available chronometric and contextual evidence.

Almost immediately after the Pinto discovery, dissent arose in the archaeological community of southern California regarding period assignment for the Pinto Complex and a definition of the series. Rogers (1939) organized the series into five morphological types largely based on the notch and stem. Harrington’s (1957) more widely-employed classification reorganized the series, separating it into five classes based on shoulder morphology. Harrington’s subtypes won out, probably because of literature access issues (Rogers was out of print). Rogers and Harrington both suggested that the Pinto complex dated to the Little Pluvial, as opposed to the estimated age of 12,000 BP originally proposed by Campbell and Campbell (1935) for the Pinto Basin site.

Pinto-like points were subsequently identified in many parts of the western United States, from Texas north to Montana and west to California and Oregon. Many of these early discoveries, such as those in New Mexico (Hurt and McKnight 1949), were associated with more well-known local cultural complexes. Some researchers gave the Pinto Basin site a requisite nod in their artifact descriptions (e.g. Steward 1939), while others did not (e.g., Bryan and Toulhouse 1943). Lister (1953) assembled a list of such sites, noting that split-stemmed projectile points were found in California, Nevada, Arizona, New Mexico, Texas, Utah, Montana, and Colorado. Sites with Pinto-like points were soon announced in Oregon, Wyoming, and Idaho as well. In addition to Pinto, shouldered bifurcate-stemmed projectile points in the Great Basin have been called Little Lake (Lanning 1963; Bettinger and Taylor 1974), Silent Snake (Layton 1970), Bare Creek (O'Connell 1971, 1975), McKean (Mulloy 1954; but see Green 1975), and Gatecliff series (Thomas 1981).

Temporal designations, which ranged from Upper Paleolithic (Campbell and Campbell 1935) to Late Prehistoric (Kelley 1947), relied on geological interpretations. For example,
Botelho (1955) noted that most of the Pinto-like points found on the surface near San Juan River in the Four Corners region of Utah were located along the cliff and mesa tops, well above the current level of the river. Campbell and Campbell (1935) observed that the Pinto Basin site was situated along an extinct riverbed, which they speculated was a result of post-glacial precipitation.

The advent of radiometric dating methods further divided the archaeological community concerned with the Pinto Complex into two camps. Warren (1980) termed these diametric viewpoints the long and short chronologies. Both positions observed the frequent association of Pinto sites with a wet period, but differed in interpreting this period as subsequent to the Great Pluvial or Little Pluvial, respectively. Warren originally applied this terminology to Mojave Desert archaeology, but the appellation spread as archaeologists in other parts of the Great Basin ascertained the same type of problems related to the Pinto style.

Proponents of the short chronology accept the few available radiocarbon assays, most of which came from sites in the northern Great Basin, as applicable to the Mojave Desert. The short chronology viewpoint suggests the Pinto Period in the Mojave Desert lasted from approximately 5800 to 2000 cal BP and was separated from the previous cultural tradition (variously referred to as Lake Mojave, Playa, or San Dieguito Complex) by a complete or partial millennia-long occupational hiatus. Advocates of the long chronology interpret the Pinto Period as directly succeeding the Lake Mojave Period, with some cultural overlap but no hiatus (but see Jenkins 1991). Most of the estimations for the long chronology span the period from ca. 7800 to 4500 cal BP, though some are considerably earlier.

Research of the past thirty years is increasingly in favor of two projectile point series, separated morphologically, chronologically, and geographically (Basgall and Hall 2000, Holmer 1986, Thomas 1981). These studies indicate that the true Pinto point is robust, generally crude, and older than the more gracile Gatecliff Split Stem point proposed by Thomas (1981). The
geographic boundaries are not yet tightly delimited, but generally Pinto is found more in the south and Gatecliff in the north.

**Research Questions**

The “Pinto Problem,” named such by Warren (1980), has been addressed in several studies, but none of these have centered exclusively on the eastern Great Basin. Holmer (1986) suggested that split-stemmed points in the eastern Great Basin belong to the Pinto series, while those in the western and northern Great Basin belong to the Gatecliff series, with both occurring in the northeastern reaches. Basgall and Hall (2000) hypothesized that such points from the eastern Great Basin are morphologically and temporally more similar to the Pinto series from the southwestern Great Basin than the Gatecliff series of the northwestern Great Basin. Both studies suggested Pinto series are older than Gatecliff series.

This early Pinto/late Gatecliff differentiation forms the underlying assumption of my analysis. Issues related to chronology and morphology are explored here using a collection of 170 split-stemmed projectile points from the southern Great Salt Lake Desert. The points were recovered from the surface along the distal portion of the Old River Bed (ORB) delta, hereafter referred to as the distal ORB. The ORB is an extinct river that dates to the Pleistocene-Holocene transition. In this region, Pinto points are often associated with Great Basin Stemmed (GBS) projectile points, a point type associated with Great Basin Paleoindian groups\(^1\). This context necessarily supports the long chronology for split-stemmed points. Given this association, the split-stemmed points from the distal ORB should be morphologically more similar to the Pinto series of the southwest than to the Gatecliff series of the northwest. The first issue my analysis

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\(^1\) Many researchers favor “Paleoarchaic” or “Pre-Archaic” when discussing the Pleistocene/Holocene transition archaeology of the Great Basin. On the distal ORB, Pinto and GBS are part of the same technological tradition, herein referred to as Paleoindian.
addresses is simple but fundamental: Are the split-stemmed points from the distal ORB in fact Pinto series, or do they more closely resemble Gatecliff series? My research indicates that morphologically the distal ORB split-stemmed points fit quite comfortably in with the Pinto series of the southwestern Great Basin. This question is explored thoroughly in chapter three, and going forward the split-stemmed projectile points in the distal ORB collection are referred to as Pinto.

Empirically establishing typological affinity allows the following questions to be framed more simplistically: What technical attributes characterize the Pinto series and what types are found on the distal ORB? What does research in other areas of the Great Basin and Mojave Desert suggest about the chronology of Pinto points and where do the distal ORB Pinto points fit in the Great Basin temporal scheme?

**Study Area**

The study area is situated in the Great Salt Lake Desert (GSLD) of western Utah. The GSLD formed when the pluvial Lake Bonneville, which comprised much of the eastern Great Basin, receded at the Pleistocene-Holocene transition. The receding lake left remnant stands in the Great Salt Lake, Goshen, and Sevier Basins. From approximately 13,400 to 9900 cal BP, Lake Gunnison in the Sevier basin overflowed north, forming the Old River Bed, which emptied the waters of the Sevier basin into the Great Salt Lake (now the Great Salt Lake Desert), where it disembogued in a delta across the basin floor (Oviatt et al. 2003). During the approximately 4,000 years this river existed, it supported a marsh/wetland and riverine environment along its shores, around which hundreds of Paleoindian sites have been found (Young 2008). Evidence indicates occupation began around 12,100 cal BP (Duke 2011), but after the desiccation of the wetlands around 9900 cal BP or possibly as late as 9300 cal BP (Daron Duke, personal
communication 2012), the area no longer had a resource base attractive to prehistoric residents. Thus, the Paleoindian archaeology is contextually separated from later-period sites. The chronology of the distal ORB is further discussed in chapter four.

The area of focus covers 825 km² (200,000 acres) of the distal portion of the ORB delta, in the south-central GSLD. It is located within the Utah Test and Training Range (UTTR) managed by the U.S. Air Force (Figure 1).

Figure 1. Location of the study area and notable split-stemmed sites in and near the Great Basin.
Field Methods

A series of archaeological investigations in the Great Salt Lake Desert over the past two decades has resulted in a rich record of known Paleoindian sites. Project data used in my study were generated between 1991 and 2011. Archaeological reconnaissance of the project area began in earnest in 1991 with a series of surveys directed by Brooke Arkush of Weber State University. Collecting during these early surveys was limited to projectile points and other formal tools. From 1998 through 2011, Daron Duke and D. Craig Young of Far Western Anthropological Research and Jim Carter of Historical Research Associates directed several cultural resource surveys and excavations in the study area (Figure 2, Table 1). Surveys during this period were intensive-level, with 30m transect intervals. Crews conducting the field work during the 1998 and 2000 seasons collected most formal tools, and from 2001 forward, field crews collected every flaked-stone tool. These surveys represent approximately 15 percent of the total distal ORB defined by Duke (2011).

Figure 2. Archaeological surveys conducted in the distal Old River Bed study area since 1998 (Duke 2011:133, Figure 26).
To the south, the Desert Research Institute has focused archaeological investigations on the proximal ORB delta, which lies within the Dugway Proving Grounds managed by the U.S. Army. Collaborative efforts between archaeologists working in the two areas have led to a suite of radiocarbon dates and geomorphological information (e.g., Madsen et al. 2011; Oviatt et al. 2003, 2005), as well as studies of obsidian and fine-grained volcanic toolstone (Duke 2011; Page 2008). The dataset analyzed here is a subset of the data used in Duke’s (2011) study and includes 170 Pinto series points recovered from the distal ORB. Of these, 126 came from 60 sites, while the remaining 44 were isolated finds. Duke’s technical analysis included 95 Paleoindian sites with five or more GBS and/or Pinto projectile points, but the 60 sites accounted for here are not

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Type</th>
<th>Year</th>
<th>Principal Investigator</th>
<th>Acres</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various Previous Projects</td>
<td>Survey</td>
<td>1991-1997</td>
<td>B. Arkush</td>
<td>-</td>
<td>Survey by Weber State University in the 1990s</td>
</tr>
<tr>
<td>TS-5 Inventory</td>
<td>Survey</td>
<td>1998</td>
<td>J. Carter</td>
<td>9,755</td>
<td>Primary Wild Isle survey encompassing north, south, east, and west portions</td>
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<tr>
<td>TS-5 Central Area</td>
<td>Survey</td>
<td>2000</td>
<td>J. Carter</td>
<td>3,900</td>
<td>Central area of Wild Isle</td>
</tr>
<tr>
<td>South Route Inventory</td>
<td>Survey</td>
<td>2001</td>
<td>D. Duke</td>
<td>920</td>
<td>Road survey from along south study area boundary to west Wild Isle</td>
</tr>
<tr>
<td>Wild Isle 22-Site Testing</td>
<td>Excavation</td>
<td>2003</td>
<td>J. Carter</td>
<td>-</td>
<td>Test excavations at 22 sites on Wild Isle Dunes</td>
</tr>
<tr>
<td>Wildcat 04 Inventory</td>
<td>Survey</td>
<td>2004</td>
<td>J. Carter</td>
<td>5,037</td>
<td>Survey in eastern Wildcat Dunes and on Wildcat Mountain</td>
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<tr>
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<td>Survey</td>
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<td>Survey on western margins of Wildcat Dunes and at Lone Dunes</td>
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<td>D. Duke</td>
<td>-</td>
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<tr>
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<td>Survey</td>
<td>2010</td>
<td>D. Duke</td>
<td>2,563</td>
<td>Survey in northern Knolls Dunes</td>
</tr>
</tbody>
</table>

Table 1. Archaeological projects in the study area. Modified from Duke (2011:134, Table 6).
necessarily a subset of Duke’s selected 95 sites. Twenty of the 60 sites did not meet the requirements for Duke’s technical analysis. The data presented here are not analyzed at the site level, so this was not a factor.

**Thesis Organization**

Chapter two provides an overview of the project area, a reconstruction of the paleoenvironment of the eastern Great Basin, including a discussion of proxy data used in such reconstructions, and an overview of current theories regarding cultural response to environmental change. Chapter three presents the history of archaeological thought regarding the morphology of the Pinto style. A discussion of classification techniques employed in identification of Pinto points throughout the Great Basin, the statistical analysis of technical attributes of the distal ORB Pinto collection, and a discussion of Pinto variation are presented in chapter four. Chapter five discusses previous chronologic interpretation of Great Basin split-stemmed points and the chronology of the Pinto series on the distal ORB. My conclusions and a discussion of the chronological implications make up chapter six.

Dates in this study are presented in calibrated years (cal BP) prior to AD 1950. General age estimates of radiocarbon data were calculated by assuming an 80-year $^{14}$C standard deviation and rounding the result to the nearest 100 years. Reported radiocarbon dates were calibrated with CALPAL (Danzeglocke et al. 2007) using their true standard deviations.

Using calibrated dates allows comparison of data sets requiring radiometric dating methods to those with differing temporal resolutions, such as the time-dependent techniques necessitated by obsidian hydration and dendrochronology. Young (2008) points out that human behavior is adapted to a calendrical cycle, and as archaeology professes to study that behavior, it should be discussed within the same framework in which it occurs.
CHAPTER 2: ENVIRONMENT

Natural Setting

Geology and Physiography

The study area is comprised entirely of the Great Salt Lake Desert physiographic subdivision of the Basin and Range Physiographic Province as defined by Stokes (1986). The physical pattern of the region is north-south trending and is comprised of flat valley bottoms to fault-block mountains, the highest of which is Wildcat Mountain (1594 m [5230 ft] asl) (Automated Geographic Reference Center [AGRC] 2009). When present, runoff from the surrounding mountains drains to the Great Salt Lake Desert (1280 m [4200 ft] asl), which in turn drains northeast to the Great Salt Lake (UDWR 2001).

The geology of the GSLD is predominantly comprised of Quaternary-age surficial mud and salt flat deposits, Lake Bonneville deposits, and eolian deposits. The mountain blocks are comprised of Precambrian-, Paleozoic-, and Mesozoic-age sedimentary, metamorphic, and intrusive volcanic rocks, while the foothills are comprised of Quaternary surficial alluvium and colluvium (Giraud and Shaw 2007; Raines et al. 1996; UDWR 2001). While the composition of the mountain blocks and alluvial slopes is favorable for groundwater aquifers, most of the groundwater underlying the basins exceeds drinking water standards for salinity and other concentrations of dissolved solids (UDWR 2001).

Soils and Vegetation Communities

Soils in the study area are predominantly loam- and silt loam-type Playas and silt loam-type Playas-Saltair Complex, 0-1% Slopes (Natural Resources Conservation Service 2009). The
Playas are flat, undrained plains that undergo an annual flood/evaporation cycle, which results in highly saline soils and impedes vegetation growth. Soil materials are strongly calcareous, comprised of stratified lacustrine sediments of silt loam, silty clay loam, and sandy loam. The dominant soils type includes long, linear slopes with playas in depressed basins and limited vegetation dominated by pickleweed (*Salicornia virginica*) and inland saltgrass (*Distichlis spicata*). Soil materials include Playa soils and Saltair soils comprised of brown silt loam, silty clay, or sandy loam on the surface, overlying very deep deposits of white silt loam and silty clay loam (Trickler 2001).

The major ecosystems in the study area include Salt Desert and Shadscale-Dominated Saline Basins (U.S. Environmental Protection Agency 2010). The sparse vegetation is interspersed with playas, salt flats, and active and stabilized dunes. Vegetation, where present, is characterized by an open-canopied salt desert shrubland consisting predominantly of greasewood (*Sarcobatus vermiculatus*) and pickleweed flats, with shadscale (*Atriplex confertifolia*), horsebrush (*Tetradymia* spp.), halogeton (*Halogeton glomeratus*) and other halophytic plants present in lesser quantities. The sparse understory of grasses and forbs is composed of saltgrass, cheatgrass (*Bromus tectorum* [a Eurasian invader species]), Indian ricegrass (*Achnatherum hymenoides*), galleta (*Hilaria jamesii*), seepweed (*Suaeda* spp.), and Salicornia (AGRC 2001; Griffith et al. 2009).

**Climate**

The average annual precipitation in the GSLD is approximately 279 mm and fluctuates between 127 mm in the basins and 1249 mm in the surrounding mountains. Maximum precipitation occurs in the winter months in the form of snow. Most of the runoff occurs between April and July; however, much of the water is absorbed by the arid soil, with less than 8 percent of annual precipitation persisting as runoff. The eastern portion of the GSLD generally
receives more precipitation than does the western portion (Sims 1997; Utah Division of Water Resources [UDWR] 2001).

High elevation regions experience long, cool winters and short, cool summers. The lower elevations experience greater seasonal fluctuations, with winter lows in excess of -40º C at Ibapah (1609 m [5280 ft] asl; approximately 20 kilometers west of the southern boundary of the GSLD) and summer extremes higher than 43º C. Both the mountains and the valleys regularly experience daily fluctuations of 22º C in all seasons. Frost-free days in the area range from 67 (Ibapah) to 196 (Mid-lake) (UDWR 2001).

**Paleoenvironmental Reconstruction**

The vegetation of the late Pleistocene and early to middle Holocene differed significantly from that found in the Great Basin today. Analysis of packrat middens, sediment cores, animal remains, and geomorphology has allowed researchers to establish a detailed knowledge of Late Quaternary vegetation history in the Great Basin, though some periods have more surviving proxy data than others.

This section discusses how proxy data serve researchers in their attempts to recreate the paleoenvironment, summarizes the current models of the climate of the Bonneville Basin, and discusses how these climatic changes may correlate to changes in the archaeological record.

**Proxy Data**

Packrat midden analyses are frequently cited as data sources in paleoenvironmental reconstructions. The eastern Great Basin is home to two types of packrats, also commonly called woodrats. The desert packrat (*Neotoma lepida*) lives in the valleys in and adjacent to the Great Basin, and dens under boulders and at the base of trees and shrubs. The bushy-tailed packrat
*(Neotoma cinera)* prefers caves and crevices of higher elevations. The collecting behavior of the packrat is what makes a midden so valuable to science. The packrat amasses bits of bone, vegetation such as leaves or seeds, soil, rock, and anything else that is small enough to be carried in its mouth, then deposits the material in a midden and urinates and defecates on the mass, sealing it into a hard substance.

The preservation of a midden depends on long-term shelter from moisture, and for this reason the middens of the bushy-tailed packrat are more suitable for preservation. Older middens in the Bonneville Basin are biased toward the western margins, possibly because the isostatic rebound from the decline of Lake Bonneville fractured the abundant rockshelters in the center of the basin, letting in moisture that consequently destroyed the middens. Similarly, the mountains in the eastern Bonneville Basin have a greater amount of moisture and are thus less suited to midden preservation (Madsen et al. 2001). Packrats typically collect within 50 to 100 m of their middens, so they are excellent sources for plant macrofossil information at a point location, and the rodents typically nest in the same place for generations, which can produce a midden that spans the entire length of radiocarbon dating (up to 55,500 cal BP) (Grayson 1993; Madsen 1996).

Climate change can also be inferred from the geomorphology of an area. Both landforms and the sediments they contain provide abundant information regarding surficial process in the area through time and therefore of the climate as well. In the study area, aeolian, fluvial, and glacial deposits can be found. In the Mojave River system, fluvial sediments mark episodes of temporary lakes and increased precipitation during the Holocene, followed by aeolian deposition as the fluvial sediments were modified by the wind. A middle Holocene increase in aeolian stability is indicative of an increase in regional precipitation and vegetation growth. Drier Late Holocene conditions led to a resurgence of aeolian activity as the previously stable sediments were reworked by the wind (Lancaster and Tchakerian 2003). Analyses of sediment size, organic
and trace elements, degree of weathering, and depositional processes have been used to elucidate specific soil-forming periods and indicate variation in available soil components, slope stability, and rainfall intensity (Mehringer 1986).

Sediments from stratified cave deposits are especially valuable sources of environmental data because caves provide excellent preservation conditions in spatially restricted areas which, like packrat middens, offer the advantage of data from point locations with enhanced temporal specificity. According to Madsen et al. (2001), data from middens combined with sediments from stratified cave deposits around the margin of the Great Salt Lake Desert have recently become sufficient to visualize the change in the vegetation of the Bonneville Basin from the late Pleistocene through much of the Holocene.

The best conditions for preserving pollen are found in deep, stratified deposits in areas that have been continually wet, which provides optimal anaerobic conditions. The pollen found in sediment cores of lakes provides vegetal information on a small-scale regional basis, as the pollen in a lake is derived from both wind and the tributaries that feed the lake. This means that sediment cores are likely to provide information on the valley bottom that holds the lake as well as the higher elevations that surround the basin (Grayson 1993). Studies of sediment cores in the Bonneville Basin have typically involved deposits from or near the shore of the Great Salt Lake. These cores have provided detailed micropaleontological, mineralogical, and geochemical information, and have been used to reconstruct the lake level history of the Bonneville Basin (Thompson et al. 1990).

Given that most plants thrive in specific climates, plant macrofossils from packrat middens combined with pollen microfossils from lake and cave sediments can create a relatively reliable picture of regional vegetation over time and, by extension, regional climate change. Analysis of animal remains adds to climatic reconstruction in a similar way. Ecological data indicate that the amount of precipitation in arid areas is positively correlated to mammalian
taxonomic richness (Lyman and O'Brien 2005). Thus, when the paleontological record of the Late Pleistocene demonstrates a higher diversity of mammals relative to the early Holocene (Grayson 1993), it agrees with vegetation and lake level research that indicates a general warming and drying trend between the Last Glacial Maximum (LGM) and the Holocene.

Similarly, Lyman and O'Brien (2005) used two species of packrat from Homestead Cave to demonstrate that as humidity in an arid area increased, so did within-species morphological variation. Their study, which revealed more variation in the size of packrats in the moist early Holocene and less variation in the drier middle Holocene, supports vegetation studies that show the same drying trend (e.g., Wigand and Rhode 2002). This research is further validated by Livingston's (2000) analysis of avifauna from Homestead Cave, which documents a decline in waterfowl and an increase in terrestrial birds at the end of the early Holocene, indicating a drop in the lake level. This diversity is likely a result of climate change. Diversity is greatest when a regional climate is in transition because species from both climate regimes are represented. Transitional floral and faunal assemblages include members of the previous climate regime as well as the invading regime.

The geomorphology of a region can help elucidate the paleoenvironment as well. For example, ongoing research of the Wild Isle Delta and Old River Bed indicates that landforms that can be seen today as channels rising .5 to 4 m above the surrounding mudflats formed as a distributary system connecting two basins. Recent trench excavation revealed a direct association between these channels and the wetland system they are assumed to have supported. The archaeological implications for this connection are immense, given that it provides a direct temporal connection between several archaeological sites and the wetlands (Young 2008). The channels are discussed in more detail later.
Paleoenviroment

Interdisciplinary research within the Great Basin indicates that, as elsewhere, environmental change through time has affected the locations and methods of human survival for thousands of years. Many environmental studies have been conducted in the Bonneville Basin, which, combined with studies of other regions in the Great Basin, provide a general description of the past environment of the eastern Great Basin. This section summarizes information assembled from significant Great Basin environmental research on the Late Pleistocene and the Holocene.

Late Pleistocene

Late Wisconsin (ca. 44,000 to 17,300 cal BP). The Late Pleistocene in the hydrographic Great Basin is distinguished from today's environment by lower temperatures and a higher rate of average annual precipitation. The increased precipitation and decreased evaporation that occurred in the Great Basin during the Pleistocene resulted in greater effective precipitation. This in turn resulted in the formation of large pluvial lakes and mountain glaciers. Estimates indicate that Great Basin average temperatures for this time period were between 5° - 7° C less than modern temperatures. As temperatures warmed and the glaciers receded, jet streams moved further north, bringing increased precipitation to the Great Basin and resulting in the Pleistocene pluvial lakes (Grayson 1993; Oviatt 1997; Wigand and Rhode 2002).

Pleistocene Lake Bonneville was the largest lake in the Great Basin, covering over 50,000 square kilometers of Utah, Nevada, and Idaho at its highstand (Grayson 1993). Research indicates that the Bonneville Basin has had lakes intermittently for at least the last two million years (most of the Pleistocene), but because succeeding lakes destroy the surface manifestation of previous lakes, exposed shorelines are primarily associated with the last lake cycle, which began sometime between 36,000 and 34,300 cal BP.
At 17,600 cal BP, Lake Bonneville broke the threshold near Zenda, Idaho, and unleashed 4750 km$^3$ of water into the Snake River. The flood probably continued for two months to one year, generating large channels down-stream of the sill, and depositing large foreset beds as far down stream at Lewiston, Idaho, where they were buried by Lake Missoula flood deposits about 900 years later. The flood stabilized due to resistant rock at Red Rock Pass, forming the Provo shoreline, where it remained for approximately 300 years (Grayson 1993; Rhode et al. 2005).

**Late Glacial (17,300 – 11,500 cal BP)** Estimates of the lake level variation of Bonneville is an ongoing debate, but sometime after 17,400 cal BP the lake began a steady decline from the Provo shoreline and reached its historic level between 13,900 and 13,100 cal BP. Oviatt (1997; Oviatt et al. 1992) has suggested that Bonneville's decline started around 17,300 cal BP, but recently he revised his hypothesis, suggesting that the decline took place gradually between 15,600 and 13,900 cal BP, and then more rapidly until it reached the level of the Great Salt Lake at 13,100 cal BP (Oviatt et al. 2005). Godsey et al. (2005) suggested that the lake existed at the Provo level as late as 13,900 cal BP. Broughton (2000; Broughton et al. 2000) analyzed remains of fish from Homestead Cave to draw inferences about regional climate and paleohydrography by documenting hydrographic connections from the geographic distributions of fishes and deducing the levels of ancient lake systems that would have allowed for such connections. Remains of 11 species of freshwater fish deposited by scavenging owls in Homestead Cave, Utah, suggest that native coldwater fish had died off and rebounded multiple times during the terminal Pleistocene, but were gone from Lake Bonneville by 12,300 cal BP, around the time the lake receded from the Gilbert level. These catastrophic die-offs, the first of which occurred at 13,200 – 13,100 cal BP, were associated with declining lake levels as the lake became warmer or more saline. This evidence suggests that Lake Bonneville was deep and cold enough to support species which were adapted to low salinity and low temperatures prior to its decline at 13,200 cal BP, supporting
Oviatt et al.'s (2005) latest theory of a rapid decline between 13,900 and 13,100 cal BP. The
decline at 13,100 cal BP signals the end of the Bonneville cycle and the beginning of the Great
Salt Lake cycle.

A short-term increase in the lake level occurred sometime between 12,800 and 12,100 cal
BP. This increase, known as the Gilbert level, is significant because by this time the Great Basin
was inhabited by human populations who would have been affected by the climatic change that
facilitated the lake's rise to the Gilbert level. Elsewhere, this time period corresponds to the
Younger Dryas, the millennial-scale cold snap that interrupted the general warming trend of the
Pleistocene after the LGM (Grayson 1993:88-92; Oviatt et al. 2005).

The onset of the ORB between 13,400 and 12,900 cal BP is evident in the pre-
‐Gilbert
lake channels and slack-water deposits seen in trenches, but these preliminary channels were only
a precursor to the extensive marshlands supported after about 12,100 cal BP (Duke 2011).
Evidence of Utah chub in the ORB sand channels, which formed between 12,900 and 9900 cal
BP, indicates that very shallow, warm, and possibly saline water flowed continuously until at
least 9900 cal BP (Oviatt et al. 2003; Schmitt et al. 2007).

Packrat middens dating from 17,300 to 11,500 cal BP are relatively more common than
from the preceding period. These samples indicate substantial vegetation change in the eastern
Great Basin as the floral regime adjusted to the warmer and drier climate of the Holocene.
Evidence dating from 17,300 to 15,600 cal BP suggests a montane shrubland dominated altitudes
up to 2000 m (6561 ft) in the western Bonneville Basin, but pollen and wood remains from the
Wasatch Front on the eastern side of the basin indicate a coniferous forest. The same is true of
the northern Bonneville Basin where limber Pine extended from the shore of Lake Bonneville to
almost 2519 m (8,264 ft) in the Albion Range (Davis et al. 1986). This difference could have
occurred due to more mesic conditions resulting from lake effect caused by the Great Salt Lake,
and/or orographic forcing of rainfall along the Wasatch Mountains (Rhode and Madsen 1995).
Middens from the northeast Bonneville Basin indicate that limber pine woodland began spreading at 15,600 cal BP and was dominant in low montane settings and plains adjacent to the lake by 14,600 cal BP. At the same time, sagebrush, prostrate juniper, and mesophili shrubs were dominant in the northwest, and the southern Bonneville Basin saw bristlecone pine woodlands and the beginning of thermophilus shrubs (Thompson 1984; Rhode and Madsen 1995; Wigand and Rhode 2002). The paleomammalogical data from Danger Cave near the Nevada border and the southwest edge of the Silver Island Mountains in western Utah agree with packrat data, suggesting the eastern Great Basin was colder and more humid than present during the Pleistocene/Holocene transition, with a change from closed to more open vegetation (Grayson 1988).

The presence of fewer faunal species today and a decrease in fossil deposition indicate that the terminal Pleistocene Great Basin supported a much larger biomass than it is capable of today. This is probably because the climatic transition sustained species of the old and new climate regimes. The end of the Pleistocene in the Great Basin is characterized by mass range reductions and extinctions, which have resulted in several dozen sites containing Pleistocene vertebrate fossils. These fossils reveal that the landscape supported a great diversity of now-extinct mammals; in fact, the Great Basin has yielded 16 of the 35 genera of mammals known to have become extinct in North America toward the end of the Pleistocene. Extinct late Pleistocene mammals that have been unearthed in and around the eastern Great Basin include several species of horse, giant ground sloth, short-faced skunk, giant short-faced bear, saber-tooth cat, yesterday's camel, large-headed llama, Harrington's mountain goat, Harlan's muskox, American mastodon, and Columbian mammoth (Grayson 1993; Heaton 1990).

Extensive paleontological excavations at Homestead Cave in the Silver Island Mountains on the western margin of the Great Salt Lake Desert yielded 183,798 mammal bones and teeth that were identified to the genus level (Grayson 2000a; Madsen et al. 2001), 14,866 fish
specimens (Broughton 2000), and avifaunal bones representing at least 6000 individuals from 75 species (Livingston 2000). The resulting analysis has established the presence of hundreds of species of animals living in the eastern Great Basin at the Pleistocene-Holocene transition. See Madsen (2000) for a complete report of the paleoecological aspects of the "Silver Island Expedition."

**Holocene (11,500 cal BP to Present)**

**Early Holocene (11,500 to 8300 cal BP)** Climatic changes leading to the establishment of modern climate occurred in a series of steps, as opposed to smooth, gradual changes. Madsen (1999) suggests a climate averaging 2° - 3° C cooler and moister than present is supported by paleovegetation records (e.g., Mehringer 1985; Wigand and Rhode 2002) and paleomammalian records (e.g., Grayson 2000a). Evidence from paleoenvironmental studies indicates that while most Great Basin pluvial lakes collapsed at the end of the Pleistocene, many basins that are dry today continued to hold shallow pluvial lakes and marshes intermittently into the early Holocene. The pervasiveness of these wetlands indicates a relatively humid climate, and their intermittent nature is suggestive of numerous climatic shifts (Madsen 1999). Marsh deposits near the ORB dating to 11,500 to 10,100 cal BP indicate a higher water table in the region. Hackberry shrub, which is indicative of spring activity or high water table, was plentiful around Homestead Cave prior to 8900 cal BP, but its presence could also be a due to a cooler and moister climate (Hunt et al. 2000). Evidence for a lake level below the Gilbert shoreline most likely dates to the early Holocene, which also argues for a more mesic climate (Wigand and Rhode 2002). Between 11,500 and 10,100 cal BP, the surface area of the lake was much larger and the geographic center was west of where it is currently located due to isostatic rebound occurring in response to the reduction of Lake Bonneville to the Great Salt Lake (Oviatt et al. 2003).
Ice cores from Greenland, which have shown an analogous relationship with Great Basin lake history, indicate that a trend of increased seasonality began about 11,500 cal BP and continued throughout the Holocene (Madsen 2000b). Packrat middens and pollen cores in Bonneville Basin document xerophytic sagebrush and shadscale scrubs in valley bottoms and basin margins by 10,800 cal BP. In montane settings, limber and bristlecone pine declined (but remained at lower elevations than they are found today), and toward the end of the early Holocene more temperate conifer woodlands arrived, bringing Rocky Mountain juniper and Utah juniper. Throughout the early Holocene, mesophilic shrubs declined, while thermophilous plants increased (Wigand and Rhode 2002). The high occurrence of a variety of small mammals such as voles and sage voles, pygmy rabbits, bushy-tailed packrats, mice, marmots, and other animals suited to cool and moist climates at Homestead Cave agrees with the vegetation record (Grayson 2000a; Madsen 2000b; Madsen et al. 2001).

**Middle Holocene (8300 to 5100 cal BP)** Environmental records for the middle Holocene are relatively sparse throughout the Great Basin and Mojave Desert, but available proxy data indicate that the middle Holocene in the Great Basin was the hottest and driest period in the Holocene. Conditions became so arid that the Great Salt Lake may have dried up completely, although it had been restored by 6700 cal BP (Madsen 2000b). The greatest climatic changes documented at Homestead Cave occurred between the early and middle Holocene.

During this time, mammal and probably plant diversity decreased significantly, driven by a series of extinctions and near-extinctions, but avifauna show an opposite trend, with terrestrial species increasing in diversity and waterfowl diversity decreasing. The taxa that survived desiccation were well-adapted to xeric conditions and therefore increased significantly as the climate grew more arid (Grayson 2000a, 2000b; Madsen 2000b).
A possible increase in summer precipitation around 7800 cal BP probably aided the northern migration of piñon pine, ponderosa pine, douglas fir, and other temperate conifers. Utah juniper and piñon pine expanded their limits but remained sparse, and limber pine disappeared from low elevations. Mammalian and isotope records suggest that at 7800 cal BP, lowlands were dominated by shrublands with open vegetation, and shadscale replaced sagebrush in some areas until about 6100 cal BP (Wigand and Rhode 2002). The near disappearance of hackberry from Homestead Cave around 6900 cal BP probably reflects increased drought or a drop in the water table (Hunt 2000). The arrival of singleleaf piñon to the floristic Great Basin denotes one of the most culturally significant vegetation events. Only one site, Danger Cave in the Silver Island Range along the Utah-Nevada border, yields any indication of singleleaf piñon in the Great Basin prior to 7500 cal BP. However, packrat middens in the area do not contain piñon, suggesting it may have been imported from further south by native populations (Grayson 1993; Thompson 1984; Wigand and Rhode 2002). Pollen records from the eastern Great Basin indicate that around 6300 cal BP, the climate shifted to cooler temperatures with wetter winters than before, although overall relatively arid conditions remained. This episode was brief but dramatic and can be traced from the Plateau of eastern Washington to the northern Mojave Desert. Around this time, sagebrush and conifers increased and shadscale and saltbush decreased. Montane woodlands were dominated by Rocky Mountain juniper, Utah juniper, and piñon pine (Wigand and Rhode 2002).

**Late Holocene (5100 cal BP to present)** Climate conditions of the last 5100 cal BP have been cooler and moister than the middle Holocene, but not as cool and moist as the early Holocene (Rhode 2000a). Pollen records from all over the Bonneville Basin indicate an increase in effective moisture (Madsen et al. 2001; Thomas 1984). At 3800 cal BP, the neopluvial period reached a climax, characterized by conditions cooler and more winter-wet than today. This climax coincided with an increase in lake levels, as well as an increase in sagebrush, grass, and
conifers. Rocky Mountain juniper apparently moved into some montane settings. Utah juniper characterized elevations lower than current distribution, and Utah juniper and piñon pine dominated lower-montane settings (Wigand and Rhode 2002).

About 1700 cal BP, annual precipitation began to decrease and what did remain shifted to late spring or summer months. The climax of the late Holocene warm-wet conditions occurred 1400 cal BP, as evidenced by an increase in grass pollens. By this time, modern plant communities were established, and as Wigand and Rhode (2002) point out, the increase in summer precipitation may have facilitated the spread of small-scale horticulture in the eastern Great Basin. This period was also characterized by dramatic variability on the decadal scale in the amount of annual precipitation. Drought began about 900 cal BP and continued with brief respites until about 400 cal BP with the advent of the Little Ice Age, which led to the expansion of the juniper woodland and the recharge of some water bodies. This resulted from an increase in winter precipitation as summer precipitation waned. Variability characterizes the Great Basin during this time, with some areas more mesic than they had been since the early Holocene, and others more xeric and warmer than any time in the Holocene (Wigand and Rhode 2002).

**Climate Change and Human Adaptation**

Early models of the environment of the Great Basin from the Late Wisconsin to the late Holocene painted a picture of slow millennial-scale climatic fluctuations to which human populations adjusted over scores of generations. According to Madsen (1999), these early ideas of gradual change have persisted, but in all likelihood many of the environment changes that the Great Basin has seen since the colonization of people were decadal rather than millennial. Working on the assumption that the Greenland ice cores documenting the Younger Dryas are globally applicable, Madsen (1999) suggests that the advent of nearly full-glacial conditions
happened within the span of an individual lifetime, and was marked throughout by decadal climatic variations that were extreme in nature. As a result, individuals had to adapt to frequent climatic fluctuations that dramatically modified environmental conditions. The extremity of change is accentuated in a semi-arid region such as the Great Basin.

For Great Basin hunter-gatherers, the instability of the Younger Dryas climate probably resulted in lower populations of game animals that could not recover fast enough between climate changes. The availability of provisional ephemeral plants probably fluctuated widely, and the ability of non-ephemeral plants to effectively mature probably decreased. Madsen (1999) suggests that direct climatic stress combined with indirect stress associated with these proxy factors probably resulted in low human population densities, though the reduced seasonality probably prolonged the availability of food resources and reduced the need for winter storage.

The Younger Dryas ended as quickly and dramatically as it began, warming approximately 8°C in just 15 years. At the dawn of the Holocene, decadal fluctuations apparently decreased dramatically, providing environmental stability that allowed new adaptive strategies to gain a foothold (Madsen 1999). Madsen suggests that increased seasonality caused people to become less mobile during the winter months, preferring instead to winter in a fixed location.

Paleoindian people living in the Great Basin likely employed broad-spectrum foraging rather than big-game hunting strategies, but with a narrower diet breadth than later people. Great Basin Paleoindian sites include the remains of small mammals, birds, fish, and the same types of large game found in Archaic sites (Madsen 2007; Pinson 2007). By the time the Holocene had fully arrived, diet-breadth had increased and included plant-based foraging and use of groundstone (Jones and Beck 1999), though seed-processing technologies did not become abundant until the wetlands of the early Holocene had dessicated (Madsen 2007). Madsen (1999) posits that if broad-spectrum foraging is the result of increased diet breadth associated with the
loss of high-ranked food resources, then strategies such as extensive seed processing appeared where changes associated with the transition to the warmer conditions of the Holocene were most extreme. This threshold occurred where floral and faunal distributional changes were more pronounced, along the basin margins where valley bottom elevations are lower. According to Rhode and Louderback (2007), Danger Cave and Bonneville Estates Rockshelter, both in the western Bonneville Basin near the Utah-Nevada border, show evidence of limited plant use in the Paleoindian diet. Prehistoric peoples did not emphasize plant foods such as seeds, roots, and tubers in their diets until after about 9600 cal BP at Danger Cave and 8300 cal BP at Bonneville Estates.

As the wetlands dried and the early Holocene came to a close, Archaic foragers fully adopted seeds into their diet and became even more broad-spectrum, moving upland into areas that held previously low-ranking resources (Madsen 2007). Seeds are among the lowest-ranking foods in terms of cost and benefits and are thus the first to be dropped when a higher-ranking item becomes available. Archaic foragers of the middle Holocene dramatically intensified their seed processing as their previously preferred resources disappeared with wetland drying (Grayson 1993).

Some suggest that the arid climate of the middle Holocene caused a depopulation as the people who inhabited the area followed their game animals and plant foods elsewhere (Price and Johnston 1988). Others maintain that depopulation did not occur and the lack of sites that date to the middle Holocene is due to site deflation during drier times or a sampling error in the sites or dates. Elston (1997), however, asserts that the pattern reflects a general population decline. Most of the small sample of Great Basin sites outside the Bonneville Basin that date to the middle Holocene are caves, and Grayson (1993) suggests that people made less use of caves outside the Bonneville Basin during this time due to the drying of permanent water sources near caves. Instead, people preferred camping in open sites near permanent springs and rivers, locations that
are not as conducive to preservation. The Bonneville Basin, which appears to have been occupied throughout this period and has both surface and cave sites, provided inhabitants with permanent sources of water.

The archaeological record of the late Holocene in the Great Basin shows an increase in population density and expansion as the lakes and marshes that had desiccated during the middle Holocene re-expanded. An increase in cultural diversity and resource abundance is evidenced by the use of textiles, baskets, bone and horn tools, incised stones, and stone sculptures. The beginning of this period shows an expansion in both number of sites and diversity of habitats in which sites are found (Grayson 1993). House structures in this period indicate a proliferation in residential bases, but the house structures are not as substantial as earlier structures and the remains are often saucer-shaped depressions (Bettinger 1999). According to Grayson (1993), the difference in residential structures is a response to environmental change: large, substantial houses of the middle Holocene were likely winter residences, and the smaller structures of the late Holocene were for summer use.

The broadening of the collection area to upper elevations may have occurred because of the actual arrival of piñon, and processing and caching behaviors are most pronounced during this time period. Grayson (1993) suggests that although piñon use was undoubtedly important in many areas, the most important factor in the change of the archaeological record at this time is the end of the middle Holocene aridity. He points out that at the time of Euro-American arrival, population density was highly correlated with the availability of shallow water resources. Thus, human populations were low in the middle Holocene because water was scarce, but populations increased in the late Holocene because of the return of water, and accommodating the subsistence needs of more people meant broadening the resource base. The use of wetland resources appears to have been a focus of specialization after 2600 cal BP, but use did not peak until later (Bettinger
1999). Many behaviors that began in the late Holocene persisted into historic times (Grayson 1993).

Bettinger (1999) points out that many Great Basin archaeologists have a tendency to overemphasize the importance of environmental conditions when explaining patterns in the archaeological record. The image that has been painted is that of rational humans responding to material stimuli such as climate and population by modifying behaviors and technology. He suggests that changes noted in the archaeological record (specifically the late Holocene record) reflect social transformations—people began relating to each other and the environment differently than they had before, thus they responded differently to environmental stress.

Bettinger makes a strong point in that while environmental factors and resulting population densities undoubtedly shape human experience to a degree, we cannot forget about the very adaptation that makes us human—culture. That said, environmental stimuli should not be understressed either, and any holistic account of past behaviors must take both into account.
CHAPTER 3: PINTO MORPHOLOGY

Since the initial characterization of the Pinto series, the type has been divided and renamed several times. Split-stemmed and indented base points of the Great Basin have been variously referred to as the Little Lake series (Lanning 1963; Bettinger and Taylor 1974), Silent Snake Bifurcate-stem (Layton 1970), Bare Creek Eared (O'Connell 1971, 1975), Sierra Pinto (Davis 1963), McKean (Mulloy 1954; Green 1975), and Gatecliff Split Stem (Thomas 1981). They have been described as shouldered and unshouldered, thick and thin, pressure and percussion flaked, serrated and straight-edged, contracting and expanding stemmed, and straight-to bifurcated-stemmed. This chapter presents the history of archaeologists’ construals of the Pinto style and its variants.

Early Pinto Discoveries

The Pinto style was initially described by Amsden (1935) in the Pinto Basin Site report (Campbell and Campbell 1935) as thick, with a narrow shoulder, an incurving base, frequently serrated, and formed by percussion flaking. Amsden estimated the average size to be approximately 40.0 mm long, 18.8 mm wide, and 8.8 mm thick.

A few years later, Rogers (1939) analyzed a collection of 562 Pinto points found in association with Gypsum series points from the Lower Colorado River basin, an area which includes Pinto Basin. Dividing the Pinto series into five variants based on notch and stem morphology, he suggested that Gypsum Cave contracting-stems were included in the Pinto industry, giving rise to the Pinto-Gypsum complex. Hurt and McKnight (1949), however, suggested that Pinto and Gypsum are two complexes that occasionally overlapped geographically, citing evidence from the Lower Colorado basin and in the San Augustin Plains. Gypsum points
were later assigned to the Elko Contracting-stem type (Clewlow 1967; Thomas 1971), and eventually to the Gatecliff Contracting Stem type (Thomas 1983b).

Rogers described his Pinto Type 1 as weakly shouldered to unshouldered with a concave base, and occasional (and perhaps unintentional) blade serration. Type 2 was marked by weak shoulders and a broad, thick stem with a slight basal indentation. Type 3 had definite shoulders and clear basal indentation. This type had more serrated edges and was often thinner than the other four types. Type 4 was side-notched with a straight or slightly concave base, thin, and well flaked. Type 5 was small, leaf-shaped, and more uniform in size than the other types. The Gypsum point was described as triangular, wide at the shoulders with a short, tapered stem, and thickest at about the midpoint of the length.

Rogers’ descriptions were qualitative and compared types in terms of quality of workmanship. Based on his evaluations of form refinement, he suggested Types 1 and 2 were the oldest, and Gypsum was coeval with Types 3, 4, and 5. Rogers’ classification was never widely recognized, perhaps because his *Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas* (1939) was out of print for several years.

Early reports of the Pinto form occurred all over the western United States. Lister (1953) compiled data from 17 sites in Texas, New Mexico, Arizona, California, Nevada, Utah, Colorado, and Montana with purported Pinto-like points. He noted that stemmed indented-base points exhibited a wide geographic range, but exhibited some variation such as serrated/straight blade edges and percussion/pressure flaking. The first single-shouldered Pinto-like points were reported from Borax Lake, California, approximately 160 kilometers north of San Francisco. Lister (1953) noticed the similarity between these points and those of the Pinto series. Harrington (1948) described the collection as containing wide, concave base points, some of which only had one shoulder.
Hurt and McKnight (1949) found several points on the surface of the San Augustin Plains of western New Mexico which corresponded to Roger’s Pinto typology. Like Rogers (1939), they avoided problematic nomenclature by using an alphanumeric classification. Of their 97 types, they determined that 15 types were similar to the Pinto series of the Mojave Desert. These points varied widely in terms of shoulder definition, placement of side- or corner-notching, degree of basal indentation, and stem length. As with their predecessors, the authors primarily provided qualitative descriptions of each artifact class.

Reports of Pinto points outside the Great Basin and Mojave Desert continued to crop up into the 1950s. Botelho (1955) reported at least 85 Pinto-type points found on the surface in the Four Corners region in the 1950s. The points were identified as Pinto Series by Dr. H. Marie Wormington of the Denver Museum, but the morphological characteristics that were used for classification are not discussed in the report. Wallace (1958, 1962) reported a collection of surface Pinto sites in Death Valley, California, in which the Pinto points generally possessed weak, narrow shoulders and concave bases. He conjectured that they were too thick and heavy to have been arrowheads and therefore must have been dart heads used with atlatls (Wallace 1962).

Harrington’s Typology

Just west of Wallace’s study area in Death Valley, Harrington (1957) unearthed 497 Pinto points at the Stahl site at Little Lake, located approximately 300 kilometers northeast of Pinto Basin. He asserted that every Pinto style found in the Pinto Basin report (Campbell and Campbell 1935) could also be found at the Stahl site, with the exception of deeper basal notching and more reworking in the Stahl site points. He attributed these differences to toolstone quality, as the Pinto Basin points were predominantly quartzite and the Stahl site points were
predominantly obsidian. Harrington organized the series into five morphological classes based on shoulder variation, which became the most widely-used Pinto typology.

Harrington’s types include Shoulderless, which is characterized by straight edges with no shoulders and frequent evidence of resharpening; Sloping Shoulder, characterized by weak to well-developed shoulders with a rounded form; Square Shoulder, characterized by shallow basal-notches and distinctly straight shoulders, thin cross-sections, and pressure rather than percussion flaking (possibly an antecedent of the other types in reduction sequence); Barbed Shoulder, characterized by barbs and sharp shoulders pointed downward; and One-Shoulder, characterized by a single shoulder, setting it well apart from any of the other shouldered types. Harrington followed Rogers (1939) in suggesting that different forms were the result of chronological progression, with Shoulderless as the oldest, and noted the effect of blade resharpening on overall form. After 25 years of typological confusion, Meighan (1981) analyzed a sample of 65 of these points but avoided labeling them as Harrington did. He grouped them according to location/degree of shoulder and basal notching, blade shape, stem shape. His categories that apply to the Pinto points included: corner-notched with visible tangs and a notched base; notched stem with open sides; side-notched with a slightly concave base and no basal notch; basal-notched with straight sides in lower portions; and notched base with flaring sides.

Holmer (1978) later statistically analyzed the morphology of published illustrations of Great Basin projectile point type sites. His analysis of Pinto points from the Stahl site reflected a continuum of shoulder types, rather than clusters, and he condensed them into three sub types: shouldered, single-shouldered, and shoulderless. Interestingly, his test was unable to ascertain a clear difference between the Elko Split-stem and the Pinto series.
Pinto and the Little Lake Series

Lanning (1963) reported obsidian Pinto points from the Rose Spring site, located south of Owens Valley in eastern California, as large, crude, thick, and asymmetrical, and exhibiting percussion flaking with occasional pressure retouch. Following Harrington (1957), Lanning classified the points as Pinto shoulderless, Pinto Sloping-shoulders, Broad-leaf, and Willow-leaf. Square and barbed shoulder points were absent from the assemblage. Discerning a difference between the Stahl Pinto points and those of Pinto Basin, Lanning grouped the points from the Stahl and Rose Spring sites into the Little Lake series.

Lanning did not indicate a clear difference between the two series; however, Bettinger and Taylor (1974) suggested points in the Little Lake series were long, thin, and showed extensive pressure retouch, while Pinto Basin points were thick and percussion flaked, and restricted to the eastern Mojave and Colorado deserts. Later, Yohe (1992) suggested that only three of the points in question from Rose Spring were Pinto types, one of which was discovered in Yohe’s re-excavation of the site.

Schroth’s (1994) typological comparison of Pinto-style points from the Stahl site and Pinto Basin found no significant difference between the two areas in terms of types. T-tests revealed three measurements (thickness, distance to the maximum width from the base, and the ratio of the distance of the maximum width from the base divided by the maximum length) as the only affinities between the two populations. Similarly, Basgall and Hall (2000) found Pinto points from the Stahl site were larger on average with more defined notches and shoulders than those from Pinto Basin. However, both studies ultimately concluded that points from both sites were of the same technology (Pinto series), attributing the differences to proximity to a good toolstone source (the Stahl site is closer to its dominant source than is Pinto Basin). Despite some archaeologists’ continuing consensus of the separation of the two series, Basgall and Hall discounted the validity of the Little Lake series, stating that “the concept of a Little Lake series
(Lanning 1963; Bettinger and Taylor 1974) can now be abandoned to eliminate continuing confusion” (Basgall and Hall 2000:240).

**Sierra Pinto**

Davis (1963) also suggested a new Pinto type, based on her study of cultural sequences along the Sierra piedmont. Pinto points from this area exhibited a wide range of blade forms but were all obsidian, unstemmed with a pronounced and ground basal notch, manufactured with initial percussion flakes, and completed with indirect percussion or pressure retouch. The form is similar in outline to Harrington’s (1957) Shoulderless subtype. Davis dubbed these “Sierra Pinto” due to her observation of their widespread occurrence in the southern Sierras, but the moniker did not stick in archaeological terminology. She noted that they were associated with the Pinto series through the Stahl site, but considered them closer to Clovis and Folsom in design, suggesting they “present an interesting possibility of a late hybridization of Paleoeastern and Paleowestern point traditions” (Davis 1963:207).

**Pinto, Silent Snake Bifurcate-stem, and Bare Creek Eared**

Layton (1970) discerned significant morphological differences between the Pinto points from Pinto Basin and Little Lake and the widespread geographic range attributed to the series. Frustrated with the dissonance, he noted in *High Rock Archaeology: An Interpretation of the Prehistory of the Northwestern Great Basin* (1970:240):

> Archaeologists have, however, expanded the Pinto categories to include so much variation and to cover such a broad geographical area that the type designation has lost most of its utility. Any student naïve enough to think that the Pinto type designation retains any precise descriptive function should compare the original type illustrations
from the Pinto Basin report with Harrington’s (1957:50) illustrations of Pinto series from the Stahl site.

Asserting that the bifurcate-stemmed points from Silent Snake Springs were more similar to each other than to comparable points from the Stahl site, over 800 kilometers away, Layton designated such points Silent Snake Bifurcate-stem type. The Silent Snake Bifurcate-stem had deep corner notches, barbed shoulders, a slightly expanding to parallel stem, and a stem split up to 3.5 mm in length.

Layton designated other bifurcate-stemmed points from the High Rock area in northwestern Nevada to the Bare Creek series proposed for Surprise Valley by O’Connell and Ambro (1968; O’Connell 1971, 1975). He described the average Bare Creek Eared point as having a stem that is 1 cm long, slightly contracting to parallel sides, barbed, square, or sloping shoulders, and a basal notch up to 8 mm deep. The Bare Creek series included sloping shoulder, square shoulder, and barbed variants, and the Silent Snake Spring assemblage contained a single-shouldered form, similar to Harrington’s (1957) One-Shoulder type. Basal notch depth was the defining difference between the two types described here: points with basal concavity greater than or equal to 3.5 mm were considered Bare Creek Eared, and those with concavity less than 3.5 mm were designated Silent Snake Bifurcate-stem.

**Pinto, Humboldt, and McKean**

Further clouding the typological conundrum of the Pinto series, Clewlow (1967) suggested Humboldt Concave Base A points as a variation of the Pinto series, and Thomas (1971) agreed that the two were contemporaneous. The two styles were never integrated into one complex; however, Green (1975) agreed that except for the outline morphology, the two series exhibit identical technology.
Building on Clelowlw’s (1967) suggestion, Butler (1970) proposed a McKean-Humboldt Concave Base A-Pinto Series. His analysis demonstrated that the only technological difference between Humboldt-Pinto and McKean types is edge grinding modification—the former are edge-ground or dulled, while McKeans are not (see Mulloy 1954); they are otherwise identical.

Green (1975) compared McKean lanceolate and stemmed points from the McKean type site in northeastern Wyoming to points ascribed to the McKean and Little Lake series from sites in Idaho, Wyoming, Utah, Nevada, California, and Oregon. He found that in every site he studied (except the McKean site), the points assigned to the McKean series were technologically equivalent to the Little Lake series, though he ultimately concluded that the two series are technologically, spatially, and chronologically separate. His dataset only included points from the northern Great Basin and Wyoming, a large portion of which are now considered Gatecliff Split Stem (see below).

Green treated Humboldt and Pinto types as “members of the Little Lake series” (1975:165), calling attention to the common parallel oblique pressure retouch technique and shared antiquity, which he placed at 9500 to 2200 years ago. Green was the first to publish a detailed description of the technological attributes of Pinto points, though he did not work directly with the points from Pinto Basin or the Stahl site. Warren (1980) commented that the flaking technique described by Green (1975) for the Pinto points in the northern Great Basin varies significantly from the descriptions of Pinto points from the Mojave Desert provided by Amsden (1935), Rogers (1939), and Harrington (1957).

**Pinto and the Gatecliff Series**

Prior to proposing the Gatecliff series, Thomas (1971; Layton and Thomas 1979) reluctantly used the term “Pinto” until the series could be revised, stressing that his terminology
referred explicitly to the Pinto points of Nevada rather than those of the Mojave Desert. His revisions appeared in his 1983 publication, “How to classify the Projectile Points from Monitor Valley,” in which he combined Elko Contracting-stem points and Gypsum points into Gatecliff Contracting Stem and the Pinto variants of the Great Basin into the Gatecliff Split Stem type. The Gatecliff Split Stem was defined as weighing greater than one gram, having a basal indentation ratio of less than or equal to 0.97, and either a notch opening index of greater than 60° or a proximal shoulder angle of less than or equal to 100°. Thomas acknowledged the presence of an older series of bifurcate stemmed points in the Mojave Desert and elsewhere in the Great Basin, but maintained that the younger Gatecliff series solved “the Pinto problem” because Gatecliff points are a chronologically and regionally separate technology.

Holmer’s (1986) discriminant analysis of Pinto points recovered from Sudden Shelter (Jennings 1980), Danger Cave (Jennings 1957), and Hogup Cave (Aikens 1970) in Bonneville Basin dated before 6000 B.P. and the Gatecliff Split Stem points recovered from Gatecliff Shelter demonstrated a significant morphological difference between the two types ($F = 20.53; df = 5, 69$). His tests revealed Gatecliff Split Stem points have a deeper and wider basal notch, more pointed basal projections, and usually parallel or contracting stems with broad corner-notching. Pinto points have more subtle basal notching, bulbous basal projections, and an expanding stem with narrow corner-notching. Likewise, Vaughan and Warren (1987) discerned statistically significant differences between Pinto points from the Awl site in Fort Irwin and Gatecliff points from Monitor Valley. They found Pinto points were thicker, with narrow sloping shoulders, while Gatecliff points are much thinner with squared, wide shoulders.

In an overview of technological and temporal data of split-stemmed points, Basgall and Hall (2000) agreed with Thomas (1981), Holmer (1986), and Vaughan and Warren (1987) that Pinto points were separated chronologically, morphologically, and geographically from the Gatecliff series. Their conclusions were based on an analysis of 700 bifurcate-stemmed or
indented-base points from eight localities in the western Great Basin and Mojave Desert. Basgall and Hall determined that such points from the central and northwestern Great Basin were morphologically more similar to the Gatecliff type defined by Thomas (1981), while indented-base points from the southwestern Great Basin and Mojave Desert were more similar to Pinto points as defined by Harris (1957). According to Basgall and Hall (2000:248), the defining morphological difference resides in the gracile Gatecliff Split Stem points having “shorter, narrower, contracting stems and more abrupt distal shoulders” than the more robust Pinto points.

A suitable collection of artifacts from the eastern Great Basin was unavailable for Basgall and Hall’s (2000) analysis; however, based on the comparison of collections from Sudden Shelter, Danger Cave, and Hogup Cave (the same collections Holmer [1986] used for his discriminant analysis) with artifacts from the Stahl site and Monitor Valley, they hypothesized that bifurcate-based dart points from the eastern Great Basin are morphologically and temporally more similar to those from the southwestern Great Basin.
CHAPTER 4: ANALYSIS OF TECHNICAL ATTRIBUTES

This chapter presents the framework and results for the technical analysis of the distal ORB Pinto collection. A discussion of variation between the Pinto and the Gatecliff and Humboldt series, as well as the variation manifest within the Pinto series in the study area, is included.

Pinto Taxonomy

Thomas’s (1981) Monitor Valley key represents the first attempt to classify split-stemmed points in a taxonomic system. His key, made specifically for the projectile points of central Nevada, combined Elko Contracting-stem points and Gypsum points into Gatecliff Contracting Stem and the Pinto variants of the Great Basin into the Gatecliff Split Stem type. Warren (Vaughan and Warren 1987; Warren 1991, 2002) revised the Monitor Valley key and Harrington’s typology, assigning subtypes based on shoulder and stem morphology to classify Lake Mojave, Silver Lake, and Pinto series points from Fort Irwin in the Mojave Desert.

Warren’s first revision (Vaughan and Warren 1987) was produced to characterize 21 Pinto points from the Awl site. The points were not segregated into named groups such as Harrington’s (1957). Instead, Vaughan and Warren chose an approach similar to Rogers (1939) and Hurt and McKnight (1949), grouping them alphanumerically. The points were separated into Types I, II, and III, and the first two were further partitioned into subgroups, ending with a total of six factions. As Schroth (1994) points out, a division of such a small sample into six groups should not necessarily be considered a reliable analog for other assemblages. Nevertheless, the key has obtained as much credibility as the Monitor Valley Key and researchers continue to rely on it as an alternate to the Monitor Valley Key when the Pinto series must be accounted for. Vaughan and Warren ascertained
thickness and distal shoulder angle as the vital differences between the Pinto points of the Mojave Desert and the Gatecliff Split Stem points of central Nevada.

Warren’s (2002) most recent key again revised the Monitor Valley key, this time to account for Pinto points from the whole Mojave Desert. It divides the series into subtypes including Pinto sloping shoulder with expanding stem, Pinto square shoulder with expanding stem, Pinto sloping shoulder with straight stem, Pinto square shoulder with straight stem, and an ambiguous subtype called “Pinto series” which was labeled Pinto Shoulderless in an earlier rendering (Warren 1991). Unlike Thomas’s key, which leaves no room for both Pinto and Gatecliff series, Warren’s keys account for both series, though Gatecliff points are grouped with Elko series.

Likewise, Basgall and Hall (2000) revised the Monitor Valley key to more accurately represent Pinto and Elko series points from Fort Irwin, California. The proximal shoulder angle of Pinto points from Fort Irwin average 12 degrees greater than the Gatecliff points from Monitor Valley. Basgall and Hall’s modification therefore emphasized notch opening angle, which increased Pinto classification success by almost 20 percent over the Monitor Valley Key.

**Methods**

One hundred eighty-six Pinto-style tools were recovered as a result of archaeological reconnaissance on the distal ORB. Sixteen of these were classified as “Pinto tools” rather than projectile points because two or more of their attributes measured greater than two sigma from the mean. The final dataset includes 170 Pinto projectile points.

I examined several attributes in my sample for comparison with data published in Basgall and Hall (2000), Schroth (1994), Thomas (1981), Vaughan and Warren (1987), and Warren (2002). These attributes include maximum length, axial length, stem length, basal indentation,
basal indentation ratio (calculated as axial length divided by maximum length), maximum width, basal width, neck width, maximum width at shoulder, shoulder width (calculated as maximum width at shoulder minus neck width), shoulder width-maximum width at shoulder index (calculated as shoulder width divided by maximum width at shoulder multiplied by 100), maximum thickness, weight, distal shoulder angle (DSA), proximal shoulder angle (PSA), and notch opening angle (NOA, also known as notch opening index). The NOA was calculated as DSA - PSA = NOA. I also used this equation to assign a mean NOA to the Surprise Valley collection to better facilitate comparison in the cluster analysis. Though Basgall and Hall (2000) used the larger angle in cases of uneven PSAs and DSAs, I followed Thomas (1981) and used the smaller angle, on the assumption that shoulders become less pronounced (i.e. greater DSA) as a consequence of resharpening. Values are reported in millimeters (mm), grams (g), degrees, or percentages.

Using these attributes, I performed various statistical tests and taxonomic checks to see how the points compare to each other and to other collections. Statistical tests were performed using Minitab 16 and include paired and two-sample t-tests and cluster analysis using Euclidean distance and McQuitty and single linkage. Descriptive statistics of all the Pinto points analyzed are summarized by type in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>ML</th>
<th>AL</th>
<th>SL</th>
<th>BI</th>
<th>MW</th>
<th>BW</th>
<th>NW</th>
<th>MT</th>
<th>WT</th>
<th>DSA</th>
<th>PSA</th>
<th>NOA</th>
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<tbody>
<tr>
<td>Num</td>
<td>134</td>
<td>131</td>
<td>120</td>
<td>164</td>
<td>125</td>
<td>133</td>
<td>135</td>
<td>154</td>
<td>105</td>
<td>122</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>Avg</td>
<td>36.3</td>
<td>33.5</td>
<td>10.2</td>
<td>2.7</td>
<td>18.8</td>
<td>16.0</td>
<td>14.7</td>
<td>6.2</td>
<td>4.0</td>
<td>222.5</td>
<td>108.5</td>
<td>114.0</td>
</tr>
<tr>
<td>Std</td>
<td>9.0</td>
<td>9.1</td>
<td>3.0</td>
<td>1.5</td>
<td>3.5</td>
<td>3.2</td>
<td>3.2</td>
<td>1.3</td>
<td>2.2</td>
<td>23.7</td>
<td>13.7</td>
<td>25.7</td>
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<tr>
<td>Max</td>
<td>64.0</td>
<td>60.0</td>
<td>19.9</td>
<td>7.5</td>
<td>28.7</td>
<td>26.4</td>
<td>24.3</td>
<td>9.8</td>
<td>10.9</td>
<td>265.0</td>
<td>142.0</td>
<td>163.0</td>
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<tr>
<td>Min</td>
<td>18.8</td>
<td>14.9</td>
<td>5.1</td>
<td>0.2</td>
<td>11.2</td>
<td>7.7</td>
<td>7.6</td>
<td>3.5</td>
<td>0.9</td>
<td>154.0</td>
<td>84.0</td>
<td>39.0</td>
</tr>
</tbody>
</table>

Table 2. Descriptive statistics for distal ORB Pinto points.

Num = number of measurements; Avg = average; Std = standard deviation; Max = maximum; Min = minimum; ML = maximum length; AL = axial length; SL = stem length; BI = basal indentation; MW = maximum width; BW = basal width; NW = neck width; MT = maximum thickness; WT = weight; DSA = distal shoulder angle; PSA = proximal shoulder angle; NOA = notch opening angle.
Typology of the Pinto Points of the Distal Old River Bed

Each point was typed out according to the Monitor Valley key (Thomas 1981) and revisions of the Monitor Valley key published in Vaughan and Warren (1987), Basgall and Hall (2000), and Warren (2002). All of these keys treated shouldered Pinto points only, tossing out unshouldered points in the first step, and the following results reflect only those points having shoulders and complete enough to have the required attributes for each key. As a result, each key was able to classify a different number of points. Table 3 summarizes results of these tests.

The Monitor Valley key (Thomas 1981) classified 69 percent as Gatecliff Split Stem (Pinto is not included) and 30 percent as Elko series. Under this key, points with PSAs between 110º and 150º are considered Elko series, while Gatecliff series points have PSAs less than 100º. The mean PSA of the distal ORB collection is 108.5º, well above Monitor Valley’s mean PSA of 92º (Basgall and Hall 2000). To combat the over-classification of Elko series in the Mojave Desert, Basgall and Hall (2000) modified this definition so points must meet either Thomas’s PSA requirements or have an NOA of less than 80º to be considered an Elko. Pinto points, on the other hand, must have a PSA less than 100º or an NOA greater than 80º (Table 4). This modification allows for a point with a PSA over 100º but an NOA over 80º, which describes the majority of the shouldered split-stem points on the distal ORB, to still be considered a Pinto.

This classification problem is paralleled at North Creek Shelter in south-central Utah on the northern Colorado Plateau (Bodily 2009). Early Archaic strata contained Pinto points that have slightly flared bases similar to Elko Eared points, but they occur too early to be Elko series. At 112.4º, the mean PSA is slightly too high to be Gatecliff Split Stem on the Monitor Valley key, rendering the points Elko Eared. The mean NOA, however, is 114º, classifying them as Pinto series under Basgall and Hall’s definition.
### Table 3. Classification results of shouldered split-stem points (Pinto, Gatecliff and Elko series results only)

<table>
<thead>
<tr>
<th>Key</th>
<th>Pinto</th>
<th>Gatecliff</th>
<th>Gatecliff/Elko</th>
<th>Elko</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas (1981)</td>
<td>88</td>
<td>38</td>
<td>1</td>
<td></td>
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<td>127</td>
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<tr>
<td>Vaughn and Warren (1987)</td>
<td>21</td>
<td>48</td>
<td>13</td>
<td></td>
<td></td>
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<td>Warren (2002)</td>
<td>20</td>
<td>46</td>
<td>17</td>
<td></td>
<td></td>
<td>83</td>
</tr>
<tr>
<td>Basgall and Hall (2000) key</td>
<td>110</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>122</td>
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<tr>
<td>Basgall and Hall (2000)</td>
<td>85</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td>93</td>
</tr>
</tbody>
</table>

### Table 4. Differentiation of Pinto, Gatecliff, and Elko series points by Thomas (1981) and Basgall and Hall 2000.

<table>
<thead>
<tr>
<th>Pinto</th>
<th>Gatecliff</th>
<th>Elko</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas</td>
<td>WT &gt; 1g; PSA \leq 100° or NOA \geq 60°</td>
<td>BW &gt; 10 mm; 110° &lt; PSA &lt; 150°</td>
</tr>
<tr>
<td>Basgall and Hall</td>
<td>BW &gt; 10.0 mm; PSA \leq 100° or NOA \geq 80°</td>
<td>BW &gt; 10 mm; 110° \leq PSA \leq 150° or NOA &lt; 80°</td>
</tr>
</tbody>
</table>

Of the four keys used to type the distal ORB collection, Basgall and Hall’s key was the most successful for Pinto classification, identifying 90 percent of the shouldered split-stem points in the distal ORB collection as Pinto. They also provided the following formula derived from discriminant analysis to segregate the Pinto series from Elko series:

\[
\text{type} = (\text{SL} \times 0.1817) + (\text{NOA} \times 0.0347) - (\text{BW} \times 0.0941) - 3.6756
\]

\(< -1.0 = \text{Elko}, > -1.0 = \text{Pinto}\)

where SL is stem length, NOA is notch opening angle, and BW is basal width. This formula classified 85 of the 93 points with the required attributes as Pinto, and the remaining eight as Elko. Interestingly, these eight were classified as Pinto in their key.

Warren’s (2002; Vaughn and Warren 1987) keys identified about a quarter of the shouldered split-stem points as Pinto series and about half as Elko/Gatecliff series. According to
the keys, the maximum thickness for Elko and Gatecliff points is 6.4 mm, while a point must be
thicker than that to be a Pinto. With a mean maximum thickness of 6.2 mm, the Pinto points from
the distal ORB tend to be thinner than those from the Mojave Desert. The pattern is again
mirrored at North Creek Shelter, where the mean thickness is 4.8 mm. Bodily (2009) attributes
this difference to material type: the majority of the North Creek Shelter Pinto points are made of
local cryptocrystalline silicate (CCS), while the Fort Irwin Pinto points that Vaughn and Warren’s
key is based on are primarily made of fine-grained volcanic rock (FGV). However, the mean
thickness of CCS Pinto points at Fort Irwin is 8.0 mm, while the mean for all Pinto points
regardless of material type is 7.4 mm (Basgall and Hall 2000). Additionally, the distal ORB
points are dominated by obsidian and FGV. This suggests that the regional variability exhibited
in the thickness of Pinto points in the eastern Great Basin is not a result of raw material
constraint.

**Variation among Split-stemmed Points in the Great Basin**

Basgall and Hall (2000) found that overall the bifurcated-stem points in the northwestern
localities were more similar to each other than to those in the southwestern group, and those in
the southwestern group were more similar to each other than to those in the northwestern group.
Using two-sample t-tests and cluster analysis, I compared the distal ORB attributes to the
attributes of the eleven localities published by Basgall and Hall. T-tests between distal ORB and
these localities used only summarized data (mean, standard deviation, quantity), while the tests
they published are based on raw data. The sites within the Fort Irwin locality had enough
differences between them that Basgall and Hall found it more useful to analyze them separately
than as a group, and I have followed their lead. Results for t-tests between the distal ORB and the
Fort Irwin sites (Awl, Rogers Ridge, Goldstone, and Floodpond) are discussed here rather than
the tests between the distal ORB and Fort Irwin as a whole. Statistical analysis of the distal ORB Pinto points indicates that shouldered split-stem points from the eastern Great Basin are more similar to those from the southwestern Great Basin than those from the northwestern Great Basin. Results of two-sample t-tests ($a = 0.05$), formatted after Basgall and Hall for comparison, are summarized in Table 5.

The data indicate that distal ORB points are quite different from the northwestern split-stemmed points and similar in many ways to the southwestern points. This is consistent with Basgall and Hall’s conclusion that Gatecliff Split Stem occurs in the northwestern Great Basin and is technologically distinct from the Pinto series of the southwestern Great Basin. Examples of shouldered Pinto points from the distal ORB and Gatecliff Split Stem points from Gatecliff Shelter (Thomas 1983b) are shown in Figures 3 and 4, respectively. Cluster analysis corroborates this, indicating the Pinto points of the distal ORB appear to be the same technology as those of the southwestern Great Basin (Figure 5).

Not surprisingly, the defining characteristic of a split-stemmed point, the basal indentation, is the most likely attribute to produce converging results in every paired comparison. Interestingly, the only locality that has a mean basal indentation significantly different from the distal ORB is the type site, Pinto Basin. With the exception of tests with Pinto Basin, t-tests between all pairs returned convergences. This pattern is also evident in the NW/NW, NW/SW, and SW/SW paired tests published by Basgall and Hall (2000, Table 4), wherein the basal indentation of Pinto points from Pinto Basin differed significantly every time. The Pinto Basin assemblage is dominated by quartzitic toolstone and comes closest to converging with the quartzitic points from Fort Irwin. Basgall and Hall suggest that quartzite is a more difficult material with which to produce a well-notched point.
Northwest localities

<table>
<thead>
<tr>
<th></th>
<th>DORB/SSS</th>
<th>DORB/SVL</th>
<th>DORB/MVL</th>
<th>DORB/HCV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t-value</td>
<td>df</td>
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<td>df</td>
</tr>
<tr>
<td>ML</td>
<td>-2.13</td>
<td>12</td>
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<td>79</td>
</tr>
<tr>
<td>AL</td>
<td>-1.93</td>
<td>15</td>
<td>-0.51</td>
<td>16</td>
</tr>
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</tr>
<tr>
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<td>33</td>
</tr>
<tr>
<td>MW</td>
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</tr>
<tr>
<td>BW</td>
<td>3.53</td>
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<td>NW</td>
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Southwest localities

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Table 5 (continued on next page). T-test results of distal ORB Pinto points compared to localities published in Basgall and Hall (2000). Formatted after Basgall and Hall for comparison purposes.
Fort Irwin sites

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Table 5, continued. T-test results of distal ORB Pinto points compared to localities published in Basgall and Hall (2000). Formatted after Basgall and Hall for comparison purposes.

* denotes statistically indistinguishable samples (alpha = 0.05); Sites: DORB = distal Old River Bed; SVL = Surprise Valley; SSS = Silent Snake Springs; HCV = Hidden Cave; MVL = Monitor Valley (including Gatecliff Shelter); PBS = Pinto Basin; AGT = Alabama Gates (INY-328/H, INY-3766, INY-3767); STL = Stahl site; GLD = Goldstone; AWL = Awl; RRG = Rogers Ridge; FLP = Floodpond. Statistics: ML = maximum length; AL = axial length; SL = stem length; BI = basal indentation; MW = maximum width; BW = basal width; NW = neck width; MT = maximum thickness; WT = weight; DSA = distal shoulder angle; PSA = proximal shoulder angle; NOA = notch opening angle.

For the most part, the only attributes other than basal indentation in which the distal ORB Pinto points and the northwestern localities converge are maximum length and axial length. This appears to be a common pattern between NW/SW pairs. For instance, these three are the only attributes split-stemmed points from Monitor Valley have in common with those from Fort Irwin, Stahl, and the distal ORB (see Basgall and Hall 2000, Table 4). The distal ORB points are most similar to the collections from Alabama Gates and Floodpond. The distal ORB only differs significantly from Alabama Gates in length and base width, and from Floodpond in width measurements. Similarly, Alabama Gates and Floodpond only differ from each other with respect to base and neck width.
Figure 3a. Shouldered Pinto projectile points from the distal ORB
Figure 3b. Shouldered Pinto projectile points from the distal ORB.
Figure 3c. Shouldered Pinto projectile points from the distal ORB.
Figure 3d. Shouldered Pinto projectile points from the distal ORB.
Figure 3e. Shouldered Pinto projectile points from the distal ORB.
At first glance, it seems these are the only two localities with which the distal ORB has any noteworthy convergences. However, a study of the attributes most characteristic of shouldered split-stem points gives a more informative view. The distal ORB measurements having to do with the shoulder/neck configuration (stem length, distal shoulder angle, proximal shoulder angle, and notch opening angle) differ significantly from all the northwestern collections. The t-tests for these attributes between the distal ORB and the southwestern localities revealed several statistically indistinguishable results, suggesting they are likely to have come from the same population.
Figure 5. Cluster analysis of split-stemmed points of the Great Basin using all twelve attributes. Gatecliff cluster in red, Pinto cluster in green. Euclidian distance, McQuitty linkage.

Figure 6. Cluster analysis of split-stemmed points of the Great Basin using five basal quadrant attributes. Gatecliff cluster in red, Pinto cluster in green. Euclidian distance, McQuitty linkage.

Sites: HCV = Hidden Cave; MVL = Monitor Valley (including Gatecliff Shelter); SVL = Surprise Valley; SSS = Silent Snake Springs; AGT = Alabama Gates (INY-328/H, INY-3766, INY-3767); PBS = Pinto Basin; RRG = Rogers Ridge; DORB = distal Old River Bed; FLP = Floodpond; STL = Stahl site; AWL = Awl; GLD = Goldstone.
The shoulder/stem configuration are the most likely elements to remain at the end of a projectile point’s use-life and are therefore the most likely to be available for measurement (though the presence of shoulderless Pinto points indicates that the distal shoulder angle is subject to substantial modification in the Pinto series). This is demonstrated in the distal ORB collection, where the stem length, basal indentation, distal shoulder angle, proximal shoulder angle, and notch opening angle are the attributes that are the most useful for categorizing the distal ORB Pinto points. All five attributes can be obtained from one of the lower (basal) quadrants of the point. Cluster analysis indicates these five attributes separate the two series just as well as all twelve attributes (Figure 6). The results suggest that typological determination from a fragment is possible with some degree of confidence (Figure 7).

When the other measurements (ML, AL, MW, BW, NW, MT, WT), most of which are more subject to breakage or use-life modification, are removed from consideration, the dichotomy in the t-test results becomes much more clear (Table 6). The tests between the distal ORB and the northwest localities reveal significant differences in all attributes except basal indentation, the same pattern observed in the study by Basgall and Hall.

Figure 7. Illustration of four of the five measurements most useful for identifying shouldered Pinto points from the distal ORB. The fifth measurement, notch opening angle, is calculated as DSA - PSA.

SL = stem length; BI = basal indentation; DSA = distal shoulder angle; PSA = proximal shoulder angle
## Northwest localities

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## Southwest localities

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## Fort Irwin sites

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### Table 6. T-test results of five basal quadrant attributes of distal ORB Pinto points compared to localities published in Basgall and Hall (2000). Formatted after Basgall and Hall for comparison purposes.

* denotes statistically indistinguishable samples (alpha = 0.05); Sites: DORB = distal Old River Bed; SVL = Surprise Valley; SSS = Silent Snake Springs; HCV = Hidden Cave; MVL = Monitor Valley (including Gatecliff Shelter); PBS = Pinto Basin; AGT = Alabama Gates (INY-328/H, INY-3766, INY-3767); STL = Stahl site; GLD = Goldstone; AWL = Awl; RRG = Rogers Ridge; FLP = Floodpond. Statistics: SL = stem length; BI = basal indentation; DSA = distal shoulder angle; PSA = proximal shoulder angle; NOA = notch opening angle.
Variation within the Pinto series

The distal ORB collection does not converge with all southwestern Pinto sites all the time. As many have pointed out, the Pinto style does display some variation. For instance, Pinto Basin has a smaller proximal shoulder angle than most and a significantly smaller basal indendation, meaning it has a comparatively straighter stem and base than the other Pinto sites. The Stahl site has a significantly smaller mean distal shoulder angle and notch opening angle than all other Pinto sites, indicating relatively straight shoulders. Based on these parameters, the Stahl Pinto collection comes closest to Schroth’s description of a “perfect” Pinto (Schroth 1994). The distal ORB collection fits in especially well with the Fort Irwin sites, differing most significantly from the Goldstone site. However, Goldstone also varies from the rest of the group, particularly in stem length. The Goldstone collection has a significantly longer mean stem length and the smallest mean proximal shoulder angle of all the Pinto sites, giving it a comparatively long, straight stem.

Basgall and Hall noted that the Pinto group, while still one technological series, clusters into two smaller groups based on size. The larger mode includes the Stahl, Awl, and Goldstone sites, while the smaller mode includes Rogers Ridge, Floodpond, Alabama Gates, and Pinto Basin. They attribute these differences to proximity to the dominant toolstone source. The sites in the large mode are closer to a good source than sites in the small mode.

The Pinto assemblage from the distal ORB is comprised of non-local lithic material, with the closest known toolstone source located approximately 60 km away, and cluster analysis using all twelve measurements indicates that the distal ORB collection fits quite comfortably in the smaller mode (Figure 5). The distal ORB Pinto points show a slight predominance for fine-grained volcanic rock (FGV) at 52 percent, followed by obsidian at 43 percent. Fewer than 5 percent of the points are made from cryptocrystalline silicate and quartzite. Acquisition of obsidian and FGV for the ORB has been discussed extensively (Duke 2011; Page 2008).
(2008) found that FGV points from Pinto assemblages found on the distal ORB had traveled an average of 64.1 km. Toolmakers of the distal ORB preferred the nearest source, Topaz Mountain at 90 km to the south, for obsidian Pinto points, but Duke (2011) emphasizes that toolstone in distal ORB assemblages with Pinto points came from as far away as 400 km.

Comparison of the means of the twelve localities showed an interesting pattern in five attributes: base width, neck width, maximum thickness, distal shoulder angle, and notch opening angle (Table 7). The mean values of the Gatecliff localities are smaller for all of these attributes. The Pinto group displays a little more variation. For the first three measurements, all small-mode sites have smaller means than all large-mode sites, demonstrating smaller mass for smaller points. The pattern is reversed for the last two measurements, the shoulder angles, with the large-mode group having consistently smaller means than the small-mode group. This indicates that the smaller points have less pronounced shoulders, consistent with increased resharpening of a tool to extend its use-life when farther from a toolstone source. Cluster analysis of these five attributes highlights the distinction between these modes and their northwestern counterparts, segregating the Pinto series as much from each other as from the Gatecliff series (Figure 8). Though these modes differ in overall size, they still converge strongly in the five attributes that separate Pinto from Gatecliff.

Variation within the Distal Old River Bed Assemblage

As outlined at the beginning of this chapter, many researchers have found several subtypes of Pinto series, five being the favored number. However, the distal ORB collection does not seem to exhibit the same level of variation seen in other Pinto collections. Cluster analysis on several combinations of attributes did not detect more than one cluster of shouldered Pinto points. The data indicate a simple continuum of shoulder reduction rather than five discreet clusters,
Table 7. Localities ranked by attribute, smallest mean to largest.

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Figure 8. Cluster analysis of split-stemmed points of the Great Basin using stem length, base width, neck width, thickness, and weight. Gatecliff cluster in red, small-mode Pinto cluster in green, large-mode Pinto in blue. Euclidian distance, single linkage.

Sites: HCV = Hidden Cave; MVL = Monitor Valley (including Gatecliff Shelter); SVL = Surprise Valley; SSS = Silent Snake Springs; AGT = Alabama Gates (INY-328/H, INY-3766, INY-3767); DORB = distal Old River Bed; PBS = Pinto Basin; RRG = Rogers Ridge; FLP = Floodpond; STL = Stahl site; AWL = Awl; GLD = Goldstone. Statistics: BW = basal width; NW = neck width; MT = maximum thickness; DSA = distal shoulder angle; NOA = notch opening angle.
similar to Holmer’s (1978) findings. Moreover, various researchers have shown little consistency in assigning subtypes, defining them with regard to morphology of the notch and stem (Rogers 1939), shoulders (Harrington 1957), stem and shoulders (Warren 1991, 2002), and resemblance to a leaf (Lanning 1963). The distal ORB collection does contain Pinto specimens with a single shoulder, but because they appear to be an intermediate stage between shouldered and shoulderless, and because they have shoulder angles available for analysis, they were treated as shouldered in this study.

The collection can be described as medium length, generally 30 – 40 mm, thin and narrow relative to Pinto points in other parts of the Great Basin, with a variable basal indentation, sloping shoulders or shoulderless, straight to expanding stem, frequently asymmetrical, and manufactured from volcanic rock.

Despite the lack of morphological variation in the shouldered points, the collection does exhibit variation, specifically regarding material characteristics and differences between shouldered and unshouldered variants. Basgall and Hall (2000) found that obsidian points from Fort Irwin tend to be smaller than tools made from other lithic material because volcanic glass is brittle and more subject to attrition through use. They also found that tools deposited far from good toolstone sources are smaller than those located near a good source. The closest FGV toolstone source is 30 km closer to the distal ORB than the closest obsidian source. If these observations hold true for the distal ORB, the obsidian points will be smaller than the FGV points based on material type and proximity to source, and this is in fact the case. The points manufactured from FGV are larger in all measurements except shoulder angles (Table 8). The obsidian points have significantly larger average shoulder angles, consistent with the pattern of increased resharpening in the small Pinto mode mentioned above.

Pinto shoulderless points have been described by many as the result of reworking the shoulders off the points. As is expected by this retooling strategy, unshouldered Pinto points at
the distal ORB are significantly smaller than shouldered points in length, width, thickness, and weight. The points display no difference in base width, length to maximum width, or the width/thickness ratio, suggesting the hafting element remains intact while the rest of the point decreases in all over size. Two measurements, the basal indentation and the neck width, are unexpectedly significantly larger on the unshouldered points. The neck width on unshouldered points is the narrowest position between the base width and the maximum width, and is available on all but the most reworked shoulderless tools.

Variability such as this could be a result of raw material. If the unshouldered points are dominated by FGV while the shouldered points are obsidian, these stem characteristics could be bigger because of the closer proximity to the FGV source. The neck width of FGV Pinto points in the distal ORB assemblage as a whole is indeed significantly larger than the neck width of obsidian Pinto points (there is no significant difference in basal indentation between toolstone materials).

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<td>* 111</td>
</tr>
<tr>
<td>PSA</td>
<td>0.21</td>
<td>* 97</td>
</tr>
<tr>
<td>NOA</td>
<td>0.83</td>
<td>* 111</td>
</tr>
</tbody>
</table>

Table 8. T-test results between obsidian and fine-grained volcanic rock (FGV) Pinto points from the distal ORB assemblage. Formatted after Basgall and Hall (2000) for comparison purposes.

* denotes statistically indistinguishable samples (alpha = 0.05); Statistics: ML = maximum length; AL = axial length; SL = stem length; BI = basal indentation; MW = maximum width; BW = basal width; NW = neck width; MT = maximum thickness; WT = weight; DSA = distal shoulder angle; PSA = proximal shoulder angle; NOA = notch opening angle.
Based on the closer proximity to the dominant toolstone source, the more robust characteristics of FGV, and the expectation that shouldered points have not been reworked as much as unshouldered points, the shouldered tools should have a larger neck width than the unshouldered tools. However, this is not the case. The unshouldered points are divided approximately equally between FGV and obsidian, while the shouldered points are 42 percent obsidian and 53 percent FGV.

**Segregating Pinto Shoulderless from Humboldt**

Many researchers have considered the separation of the Pinto series from the Elko series. Elko and Pinto points were not found on the distal ORB in the same archaeological context, so this topic was not considered here. However, Humboldt points occur alongside Pinto points in the distal ORB. The congruence of Pinto points and Humboldt Concave Base A points was treated by Butler (1967), Clewlow (1967), and Green (1975). Butler and Clewlow suggested that the two were part of the same series, and Green agreed that they are technologically identical, though maintained that they are not of the same series. However, the purported Pinto points in Green’s study were restricted to sites in the northern Great Basin, and most of them are now deemed Gatecliff series.

The distal ORB collection has 43 Pinto Shoulderless points and 33 Humboldt points. Though the dataset is somewhat small, it is large enough to ascertain a few differences between the two series. The most striking difference between the two point types across the Great Basin is flaking technique. The Humboldt series is known for its easily-identifiable parallel oblique pressure flaked pattern. However, points found on the surface of the distal ORB have been
subject to sandblasting to the extent that flake pattern is not always readily distinguishable. In these cases, morphology was a better indicator of type.

The blade of shoulderless Pinto points ranges from parallel-ovate with acute tip to deltoid in outline. Humboldt points are lanceolate with a parallel-ovate to expanding-ovate blades. The sand-blasted parallel-ovate bladed points provided the most classification difficulties. T-tests between the two styles indicate that they converge in length, length to maximum width, and weight (Table 9). However, the mean maximum length of unshouldered Pinto is longer than that of Humboldt, while the axial length is longer in Humboldt. As expected from this difference, the basal indentation is significantly larger in the Pinto Shoulderless and the basal indentation ratio (axial length/max length) is smaller in Humboldt. The data indicate that while the two are similar in length, the basal concavity is more pronounced in Pinto. The Pinto Shoulderless points are also significantly wider and thicker than the Humboldt points. Selected Pinto Shoulderless and Humboldt points are shown in Figures 9 and 10, respectively.

<table>
<thead>
<tr>
<th>Shoulderless/Humboldt</th>
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<tr>
<td>ML</td>
<td>0.99</td>
<td>* 42</td>
</tr>
<tr>
<td>AL</td>
<td>-0.18</td>
<td>* 18</td>
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<tr>
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<td>* 44</td>
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<tr>
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<td>* 73</td>
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<tr>
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<tr>
<td>w/th</td>
<td>0.89</td>
<td>* 60</td>
</tr>
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</table>

Table 9. T-test results between Pinto Shoulderless and Humboldt points from the distal ORB assemblage. Formatted after Basgall and Hall (2000) for comparison purposes.

* denotes statistically indistinguishable samples (alpha = 0.05); Statistics: ML = maximum length; AL = axial length; SL = stem length; BI = basal indentation; MW = maximum width; BW = basal width; NW = neck width; MT = maximum thickness; WT = weight; LM = length to maximum width; BLW = blade width; W/TH = width divided by thickness.
Figure 9a. Pinto Shoulderless projectile points from the distal Old River Bed.
Figure 9b. Pinto Shoulderless projectile points from the distal Old River Bed.
Figure 10. Humboldt series projectile points from the distal Old River Bed.
Summary

The prevalent range of bifurcate-stem points across the Mojave Desert has historically led to extensive confusion regarding the definition of the Pinto series. Several studies have reached similar conclusions that the types are segregated geographically and temporally. Basgall and Hall (2000) found that the Gatecliff series is located in the northwestern Great Basin and the Pinto series in the southwestern Great Basin. The data presented here indicate that the split-stemmed points found on the surface of the distal ORB are part of the same technology as the Pinto series in the southwestern Great Basin. The Pinto series can effectively be segregated from Gatecliff Split Stem points with five key attributes which can be found on most basal fragments of split-stemmed points. These attributes include stem length, basal indentation, distal shoulder angle, proximal shoulder angle, and notch opening angle. Gatecliff points tend to have short, straight to contracting stems and straight to downward-pointing shoulders relative to Pinto points, which have weaker shoulders or no shoulders at all, straight to expanding stems, and a less pronounced basal indentation. Pinto points are generally thicker and have wider bases and necks.

Within the Pinto series, points that are found near a toolstone source tend to be larger than those made from non-local lithic material. On the distal ORB, where the nearest preferred sources are 60 and 90 km away, Pinto points are much smaller than they are elsewhere in the Great Basin. Within the distal ORB assemblage, Pinto points made from obsidian sources ranging from 90 to 300 km away are significantly smaller than the points made from closer FGV sources. This is probably a result of both proximity to the toolstone source and differential flaking characteristics. However, the five diagnostic attributes that identify a Pinto point as such do not differ significantly regardless of lithic material. This corroborates Basgall and Hall’s (2000:257) assertion that, “…stem characteristics remain mostly stable across both local and
exotic toolstone classes [which] not only reflects the effects of reworking, but implies that all artifacts derived from the same initial population.”

The distal ORB assemblage has two types of Pinto points, the shouldered and the unshouldered. Unshouldered points tend to be smaller than shouldered points in all characteristics except basal morphology. This supports the notion that they are a reworked version of the shouldered points, the reduction in size a result of the reclamation of a tool in an area with no direct access to new toolstone. The unshouldered points can be difficult to separate from Humboldt Concave-base points because of their sand-blasted surface and similar shape. However, where the flake scars are no longer visible the two can be differentiated based on morphology. Humboldt points are more slender and gracile than Pinto points, and the latter have a deeper basal concavity.
CHAPTER 5: CHRONOLOGY

Thomas (1979, 1981) has stated that the ultimate goal of archaeology, explaining cultural processes, is accomplished through reconstructing past lifeways within an established framework of temporal variability. This variability is observable in the shared aspects of culture, cultural modes or commonalities that are expressed in the archaeological record and can be grouped into temporal types. Focusing on these modes of behavior allows archaeologists to explore cultural change though time. A fine-grained cultural chronological framework enables researchers to extrapolate absolute data of cultural modes from well-controlled chronostratigraphic relationships onto temporally uncontrolled modes, such as the surface scatter (Thomas 1983b, 1988).

Traditionally, cultural chronologies for prehistory have been established by the presence of temporally diagnostic artifacts. Establishing the temporal depth of sites permits the examination of cultural change via the nature of subsistence and settlement systems, resource procurement strategies, mobility patterns, exchange and population interaction, and adaptation to climatic change. Projectile points are among the most useful time-sensitive artifacts. Thomas (1981:14) describes diagnostic projectile points as “morphological types that are found consistently to be associated with a particular span of time in a given area,” although the fundamental tenet of using an artifact with unstable morphological qualities as a temporal control is debated (Flenniken and Raymond 1986; Flenniken and Wilke 1989; Schroth 1994).

Projectile points can be useful for determining chronological placement of a site and extrapolating adaptive strategies, but morphological variation, such as notch position, could vary due to either stylistic or functional reasons. Although archaeologists often equate form with function when classifying tools, we do not really know if the variation is an effect of function. Regionally and chronologically contemporaneous yet stylistically distinct points could indicate the differentiation of one human group from another (social patterning), or simply the personal
preference of the knapper. Function could be responsible for some of the variation, such as the
dart/arrow dichotomy. Also, certain features are open to differing interpretations; for example,
some researchers argue that bifaces with notches were used as hafted and propelled projectile
points, while bifaces without notches were hafted for use as thrusting lances (Whittaker 1994).

Caution must be taken when assigning a function to a tool class. For example, resource
procurement locations tend to be visible based on the type of procurement that occurs and the
types of tools needed to accomplish the task (Thomas 1983a). This can make tasks typically
attributed to men seem more prominent in the archaeological record simply because stone tools
are more durable over time than tools made from organic materials such as basketry and digging
sticks. However, Gero (1991) points out that stone tools are useful for a variety of purposes,
including tasks attributed to women, and it is likely that women would have made and used their
own stone tools, rather than waiting for men to make them. Further, flakes are useful as
expedient tools, but utilized flakes are often misidentified on-site or under emphasized when
evaluating site function and division of labor. Elston and Zeanah (2002) have suggested that
Paleoindian sites are located near wetland resources that women utilized and the formal tools
found there are likely women’s tools, while evidence of men's high-variance foraging behavior
remains in valley piedmonts and passes, buried or not identified as Paleoindian.

Projectile points are often found fragmented or reduced from their original size due to
rejuvenation, attrition, or use wear, but the hafting element is less susceptible to these processes
(Thomas 1981). For instance, Basgall and Hall (2000) demonstrate that using the proximal
shoulder angle and notch opening angle to differentiate between Elko series and Pinto series
incorrectly assigned just nine of 310 points from Fort Irwin. When based on the hafting portion
of a point, metric attributes can be quite effective. For this reason, elements on the proximal end
are considered diagnostic, and these measurements are frequently the basis of typology keys.
However, when an archaeologist encounters a site with projectile points in the field, it is much more practical to subjectively use categorical attributes to determine the type rather than run through a series of measurements and compare them to the numerous keys published on the subject. Subjectively classifying the point types and the artifacts with which they occur allows a site to be tentatively assigned a temporal range. A drawback of visually identifying types is lack of uniformity: the same types may be identified differently by different researchers (Thomas 1981).

Great Basin archaeologists of the 1970s and 1980s theorized linear Great Basin projectile point sequences that can be helpful in temporal placement of sites; however, these researchers (Heizer and Hester 1978; Thomas 1981) did not intend for their projectile point typologies to become rigid frameworks encompassing the entire Great Basin.

With these considerations in mind, this chapter summarizes the history of discourse of Pinto chronological interpretations and presents the chronological placement of the Pinto points from the distal ORB.

**Early Chronological Interpretations**

Archaeologists have disagreed on the age of the Pinto projectile point series since the style was first defined in the 1930s. The Pinto points at the type locality, the Pinto Basin, were found surficially associated with Pleistocene camel and horse remains which appeared to be culturally broken and left in campsites (Campbell and Campbell 1935). No behavioral association could be proven, but the juxtaposition of the artifacts and Pleistocene bones suggested to the authors a very ancient date. The Campbells worked closely with Ernst Antevs to relatively date the Pinto Basin site based on the geology. They tentatively submitted that, “Very possibly our group is upper paleolithic [sic] in the full sense of the term, with all its time implications”
More specifically, they suggested the extinct Pinto river bed that would have been the main water source for the occupants of Pinto Basin derived its waters from the post-glacial climatic rainfall and drainage, around 12,000 BP, and dried up soon after.

Malcolm Rogers also followed Antevs’ geologic scheme; however, he interpreted it quite differently for sites in the Lower Colorado River Basin. He suggested an age of 2800 to 1800 BP for his Pinto-Gypsum Complex, at the “anticlimax” of Antev’s moist period (the Little Pluvial) (Antevs 1948; Rogers 1939:73 and Plate 21).

M. R. Harrington’s (1948) estimation for the age of Pinto-like points at Borax Lake, California, was similar to the Campbell’s for Pinto Basin. He assigned the site to the end of the Great Pluvial, at the transition from the Folsom culture. Meighan and Haynes (1970) later analyzed the obsidian hydration rates, which suggested the middle Archaic (ca. 5000 to 3000 BP) for the concave base points at Borax Lake. At the Stahl site, however, Harrington (1957) followed Rogers in assigning the short chronology. He noted that Silver Lake and Lake Mojave points were found in stratigraphic association with Pinto points and accordingly dated the Pinto occupation to the Little Pluvial, 4000 to 3000 BP.

While it was clear to early Great Basin archaeologists that the Pinto culture was much earlier than other, better-known cultures, assigning a date was much more difficult for archaeologists working prior to the advent of radiocarbon dating. Hurt and McKnight (1949) accepted both Rogers and the Campbell’s interpretations as possibilities. They found several points on the surface of the San Augustin Plains of western New Mexico which were similar to the points Rogers (1939) reported. The Pinto-type points from the San Augustin Plains seemed to overlap the Folsom horizon, and the authors suggested a possible early age of 10,000 BP or a later occupation, the Little Pluvial of 4000 to 3000 BP, in which case they conjectured the Folsom complex lasted much longer than previously thought. Noting the surficial association of Pinto points and extinct animal remains at Pinto Basin, they proposed a Gypsum-Manzano-Pinto
complex to fill the gap between Folsom and recent horizons. Lister (1955), in his overview of 17 localities in the west with Pinto-like points, agreed, suggesting the type marks a horizon between Folsom and recent horizons.

Working near Hurt and McKnight in the Four Corners Region, Botelho (1955) noted the spatial distribution of several surficial Pinto-like points. With the exception of two points found out of context in a wash and in a trail, all the identified Pinto points were located along the cliffs and mesa tops, hundreds of feet above the present level of the San Juan River, with Basketmaker and Pueblo materials located at lower elevations. To Botelho, the spatial data indicated that the Pinto occupation occurred much earlier than the Basketmaker occupation, when water levels were much higher, but he did not hazard a guess on an actual age. Based on this data, Botelho conjectured that the Pinto-makers traveled from the Pinto Basin in California toward the Colorado River, and branched off along the Little Colorado and the San Juan rivers.

Shortly after Harrington (1957) published his analysis of the Stahl site with his widely-accepted subtypes, Wallace (1958) published *Archaeological Investigations in Death Valley National Monument 1952-1957*, in which he reported a collection of surface Pinto sites. He placed the Pinto period between the Lake Mojave and Armagosa periods during the Little Pluvial, ca. 5000 to 2000 BP and introduced the debatable concept of an Altithermal hiatus between the Lake Mojave and Pinto complexes. Regarding the timing of the Pinto complex, he stated, “First a date of 15,000 years was accepted. Current opinion, however, favors a placement in a later wet cycle, the start of which is set at 3000 or 2500 B.C., and which lasted until around the beginning of the Christian Era” (Wallace 1962:175).

Modern dating techniques have added to the confusion surrounding the competing chronologies. For instance, Harrington’s (1957) estimate of 4000 to 3000 BP was initially corroborated by Meighan’s (1981) hydration analysis of the Coso obsidian Pinto points from the Stahl site. He used a rate of 340 years/micron, from which the hydration readings return an age
of ca. 6700 to 2200 cal BP. Using 220 years/micron, the estimated age is ca. 4200 to 1300 cal BP, which is likely much too late. Warren (1991) recalculated Meighan’s reported mean hydration reading using a rate of 712 years/micron (derived by correlating hydration measurements from subsurface obsidian with associated radiocarbon dates) and arrived at a mean date of 8351 ± 1971 cal BP for the Pinto points at the Stahl site, substantially earlier than Harrington’s initial estimate. Gilreath (1987) and Hildebrandt and Gilreath (1988) used a similar approach to assign an approximate age of ca. 6800 to 3400 cal BP and a micron range of 7.8 to 11.5 microns for Little Lake series points manufactured from Coso obsidian.

In a separate obsidian hydration study of the Stahl and Awl sites, Jenkins and Warren (1984) placed the series at ca 6900 to 4500 cal BP, or possibly even 7800 to 3800 cal BP. Using a rate of 344 years/micron to derive age estimates of 65 Coso obsidian specimens from the Awl site, they placed the earliest Pinto occupation at ca. 8200 cal BP, or 7100 cal BP if the three earliest specimens were discounted. At the same site, the series was associated with a hearth that returned dates of 10,812 ± 115 cal BP (Beta-16313) and 10,727 ± 115 cal BP (Beta-16100) (Gilreath et al. 1987). Basgall and Hall (1993) discounted these dates and their association with the Great Basin Stemmed points in close proximity to the hearth.

*Olivella* Type A1 beads from Pinto deposits at Awl, Rogers Ridge, Floodpond, and Goldstone in Fort Irwin returned accelerator mass spectrometry (AMS) assays ranging between 11,600 and 10,000 cal BP (Basgall and Hall 2000). Basgall and Hall (2000) report that the paired charcoal and shell samples from the Goldstone and Floodpond sites are inconsistent, with discrepancies as high as 3,600 years. Similar dates were obtained from three *Olivella biplicata* shell beads from the Pinto component at the Stahl site. These returned assays so close together that a t-test determined them to be statistically indistinguishable. The mean date for the beads is 9927 ± 112 cal BP (Schroth 1994). Haynes (2004) acknowledged that these dates would indicate more ancient occupation of the Stahl site than Pinto Basin, but ultimately discounted their validity.
based on unsubstantiated comparability to charcoal dates. Fitzgerald et al. (2005) report that marine shells provide assays comparable to those from charcoal when properly corrected and calibrated using regional marine reservoir correction rates. The authors maintain the accuracy of all three of the assays reported for the *Olivella* beads associated with Pinto points at Stahl and at least two from Fort Irwin: 11,667 ± 85 cal BP (AA-12405) from Rogers Ridge and 10,032 cal BP (AA-12406) from Floodpond. Until the comparability of radiocarbon assays between shell, bone, and other organic substances is better understood, the dates probably will not be widely accepted.

Radiocarbon assays attained by Schroth (1994) indicated Pinto occupation at the Stahl site lasted from 10,000 to 5000 cal BP, an extension of the dates obtained for Pinto Basin. Two of the 22 sites in Pinto Basin dated from 10,000 to 7000 cal BP, but Schroth emphasized that these dates do not necessarily encompass the entire range of occupation at the locale.

**Little Lake, Bare Creek Eared, and Silent Snake Bifurcate-stem variants**

Lanning (1963) estimated age of the Pinto and Little Lake series at ca. 5800 to 3800 cal BP. Based on radiocarbon dates from Rose Spring, Surprise Valley, and Spooner Lake, Bettinger and Taylor (1974) widened the perceived duration of the Little Lake series, suggesting it spanned from ca. 6100 to 3200 cal BP, while Yohe (1992) narrowed it, placing the series at ca. 6300 to 5100 cal BP, based on new radiocarbon data from Rose Springs. Layton’s (1970) range for the more northerly expressions, the Bare Creek series and the Silent Snake Bifurcate-stem points, are comparable to Lanning’s at ca. 6500 to 3800 cal BP, though he suggested the Bare Creek series began slightly later.

Green (1975) grouped Pinto types with Humboldt Concave Base A as members of the Little Lake series, which he gave an inclusive span of 10,800 to 2200 cal BP. He suggested they started earlier in the northeastern Great Basin and exhibited a temporal cline toward the western
side. This is a logical conclusion given that his data came from sites located in the northern Great Basin where the oldest dates are on the east side and associated with forms more similar to the robust Pinto points of the Mojave Desert. He did not discern a morphological difference between the points located in the east and west portions of the northern Great Basin.

At Falcon Hill in the Winnemucca Lake Basin, Nevada, 15 points variously identified as Pinto, Bare Creek Eared, and Gatecliff temporally clustered around 4100 cal BP (Hattori 1982). One of these points, found in Kramer Cave, was obsidian and still attached to a dart foreshaft. The foreshaft assayed at 4233 ± 156 cal BP (GaK-2387), and the point itself had an obsidian hydration reading of 3.2 microns, which converts to approximately 3500 cal BP using the conversion rate of one micron per 1,000 years (Meighan and Haynes 1968). Thomas (1983) later unequivocally pronounced this point a Gatecliff Split Stem, a conclusion corroborated by Basgall and Hall (2000) in their analysis of Pinto variants from the northwestern and southwestern Great Basin.

**Gatecliff Split Stem and the Geographic Division**

Based on his excavations in Monitor Valley in central Nevada, Thomas (1981) suggested that the Gatecliff series dated from approximately 5800 to 3500 cal BP in the central and western Great Basin, and conjectured a different, undefined relationship for the eastern Great Basin. Holmer (1978) noted the geographic difference in dates even before Thomas (1981) established the Gatecliff moniker. Holmer observed that the Pinto series occurred the earliest at sites in the eastern Great Basin located along the edge of the Holocene Lake Bonneville shoreline (Danger and Hogup Caves) and in the northern Colorado Plateau (Joes Valley Alcove and Sudden Shelter). The Pinto occupations at these sites date from 9300 to 7200 cal BP. These were followed in time by eastern Great Basin sites not on the shoreline (O’Malley and Swallow...
Shelters), where the Pinto occupation dates from 7400 to 3200 cal BP. Holmer placed the initial
Pinto occupation in the central and western Great Basin latest, from 5100 to 3500 cal BP.

Holmer (1986) later accepted Thomas’ (1981) proposal that the two series are entirely
separate from each other in both form and time. He visualized an east/west partition between the
younger, gracile Gatecliff Split Stem points and the older, robust Pinto series (Figure 11).
Through his research, in which he used discriminant analysis to statistically evaluate the
coordinates of projectile point attributes on an X-Y axis, he determined that the Pinto series did
not occur at all in the western Great Basin, but occurred quite early in the eastern Great Basin. In
the dated sites in the east, the Pinto style initially appeared alone or with Lake Mojave points at
about 8900 cal BP, after which they were joined by Elko series and Northern Side-notched points
and continued until approximately 7400 cal BP. He determined that Gatecliff Split Stem, on the
other hand, did not occur in the Bonneville Basin, but originated in the west at approximately
4500 cal BP. He theorized that sometime before 3200 cal BP the type was introduced northward
where it persisted until 1800 BP or so.

Basgall and Hall’s (2000) analysis of 700 bifurcate-stemmed or indented-base points
from eight sites in the western Great Basin and Mojave Desert supported Holmer’s conclusions
that Pinto points were separated chronologically, morphologically, and geographically from the
Gatecliff series, but they posited a southwest/northwest divide rather than Holmer’s east/west
division. Lacking comparative data from the eastern Great Basin, they focused on the western
Great Basin. They determined that Gatecliff Split Stem points occurred in the central and
northwestern Great Basin from approximately 5800 to 3200 cal BP, while the Pinto series of the
southwestern Great Basin is older, in the range of 8300 to 4500 cal BP, and perhaps even earlier.
Based on the comparison of collections from Sudden Shelter, Danger Cave, and Hogup Cave with
artifacts from the Stahl site and Monitor Valley (the same collections used in Holmer’s [1986]
study), they hypothesized that bifurcate-based dart points from the eastern Great Basin are more
similar to the Pinto series of the southwestern Great Basin in both form and time.

When Holmer placed his east/west partition, he noted the presence of projectile points morphologically and temporally similar to the Pinto series in west Texas and western Colorado, but did not consider such points from the Mojave Desert, except to say that they are morphologically similar to the dated points in the eastern Great Basin. At the time, the Mojave Desert did not have any firm radiocarbon dates associated with the Pinto series. Thus, his overview included western Colorado but not the Mojave Desert.

Schroth’s (1994) broad study of Pinto points in the Great Basin included a reassessment of the original assemblages from Pinto Basin and the Stahl site (Campbell and Campbell 1935; Harrington 1957), additional excavation of both sites, and an extensive overview of radiocarbon
dates associated with Pinto forms all over the Great Basin. The analysis indicated that the Pinto series was used from 10,000 to 2,000 cal BP and is not a good chronological indicator. However, as comprehensive as the study was, the author did not make any geographic divisions. As a result, her dataset covers what many consider to be two separate series, the Pinto and the Gatecliff, integrating their associated dates into an amalgamation spanning the entire Archaic.

Schroth’s study amassed an expansive suite of radiocarbon assays, which I analyzed for geographic patterning. The dataset is comprised of 124 assays from 34 sites. It is limited to radiocarbon dates published prior to the 1994 publication of her study and does not include data from grey literature. Schroth restricted her study to radiocarbon dates associated with what she calls the “classic” Pinto, which is square-shouldered and stemmed with an indented base (Schroth 1994:348). The dataset includes assays from bone and shell, which some authors take issue with (Basgall and Hall 1993, 2000; Haynes 2004; but see Fitzgerald et al. 2005). Analysis of the quality of the dates and security of Pinto association is not within the scope of this study; however, Schroth analyzed the validity of the assays by grading them on a 21 point scale.

Frequency distributions of the dates divided into northwest, southwest, and eastern Great Basin zones (following Basgall and Hall 2000) reveal a pattern for the northwest zone, with dates generally starting later and lasting longer than most researchers’ estimates of 5800 to 3200 cal BP (Figure 12). The southwest zone contains dates spanning the range of most estimates. Regional overviews of the Pinto occupation in the southwestern Great Basin have dated it from 7800 to 4500 cal BP (Warren and Crabtree 1986), 8300 to 4500 BP (Basgall and Hall 2000), and 10,800 to after 7400 cal BP (Haynes 2004). It is worth noting that all dates in the southwest zone on Figure 12 were published between 1987 and 1994.

The eastern zone is a little more perplexing. In his study of Pinto and Gatecliff floruits, Holmer (1986) attributed the early occurrences of large bifurcate-stemmed points in the northeastern Great Basin to the Pinto series and the late occurrences to the Gatecliff series, with
both occasionally occurring in the same site. For instance, at the Wasden site in the Snake River Plains (Butler 1978) he labeled the points in question dated at 8600 cal BP as Pinto and those dated at 3800 cal BP as Gatecliff, with no discussion of their morphology. This view accounts for the distribution of both early and late dates as depicted in the histogram of the eastern zone.

Further differentiation of Schroth’s dataset following Holmer’s (1978) observations reveals an interesting pattern. All but one of the dates in the eastern zone older than ca. 5800 cal BP are in and east of the Bonneville Basin, while the majority (70 percent) of the dates later than this are generally farther west. A cursory look at some of the shouldered points associated with the latter group from O’Malley Shelter (Fowler et al. 1973) and Swallow Shelter (Dalley 1976) show that they are finely-flaked and have the straight shoulders and straight to contracting stems that are more characteristic of the Gatecliff series. I have referenced these sites as the central zone, though most of them are traditionally considered part of the eastern Great Basin.

Separating the east zone into two smaller sectors better explains the earlier dates found along the western margins of the Bonneville Basin, resulting in a timeline that satisfactorily fits with previous interpretations of Gatecliff and Pinto duration (Figures 13, 14). The late Pinto and early Gatecliff dates may be partly due to outliers or loosely associated dating,
Figure 13. Frequency of Schroth’s (1994) synthesis of radiocarbon dates associated with Pinto points, with original east zone separated into central and east zones. Calibrated with http://www.calpal-online.de and rounded to the nearest 100 years.

Figure 14. Frequency of radiocarbon dates of Pinto and Gatecliff series in the Great Basin. Pinto category includes southwest and eastern zones, Gatecliff includes northwest and central zones (refer to Figure 13). Data from Schroth (1994).
An in-depth analysis of all reported Pinto points in the eastern Great Basin is out of the scope of this study, but if this observation holds true for the other eastern Great Basin sites west of Bonneville Basin (i.e., central zone), the spatial pattern indicates that the true Pinto style with early dates is located on the eastern and southwestern peripheries of the Great Basin (Figure 15). A study of their elevations may reveal an affinity of Pinto for the lower basins, such as the Bonneville Basin and Mojave Desert, and Gatecliff with higher elevations, such as Gatecliff Shelter. Further research is required to better characterize the split-stemmed projectile point pattern in the eastern/central Great Basin.

Figure 15. Map of sites with radiocarbon dates associated with Pinto points and possible geographic division for Pinto (east and southwest zones) and Gatecliff (northwest and central zones) distribution. Adapted from Schroth (1994:7 [Figure 3]; 1994:349 [Figure 80]).
Schroth’s compilation of dates supports a combination of Holmer’s (1978, 1986) and Basgall and Hall’s (2000) conclusions. According to these dates and this strategy for separating the two series geographically, the Pinto series occurs earliest in the far eastern Great Basin and Colorado Plateau and somewhat later in the southwestern Great Basin. The Gatecliff series occurs concomitantly in the central and northwestern Great Basin, primarily between 5000 and 2000 cal BP. Further research may indicate that they both occur at some sites in the northeastern Great Basin, as Holmer (1986) suggested.

**Pinto and Great Basin Stemmed in the Mojave Desert**

The debate surrounding the timing of the Pinto series has been fueled by the reported synchronism of Pinto series with Great Basin Stemmed (GBS) series in the Mojave Desert and eastern Great Basin. In the Mojave Desert, the Pinto period is generally understood to fill the interval between the Lake Mojave (characterized by GBS) and Gypsum (aka Newberry) periods, with a disputed hiatus after the Lake Mojave period.

Haynes (2004) synthesized published radiocarbon assays from Mojave Desert sites and analyzed obsidian hydration data from southwest Nevada to characterize the transition from the Lake Mojave Period to the Pinto Period. His analysis included assays from two sites in Pinto Basin (CA-RIV-521, CA-RIV-522), the Stahl site (CA-INY-182), and five sites at Fort Irwin in the north-central Mojave Desert (the Henwood Site [CA-SBR-4966], Rogers Ridge [CA-SBR-5250], the Awl Site [CA-SBR-4562], Goldstone [CA-SBR-2348], and Flood Pond [CA-SBR-5251]). He determined that in the Mojave Desert, Pinto points joined GBS-dominated assemblages in limited quantities between 10,800 to 10,100 cal BP and continued in similar proportions until ca. 9500 cal BP, when the two series became co-dominant. This trend persisted until 8900 cal BP, when Pinto points became dominant. GBS became rare around 7800 cal BP.
and nonexistent in Mojave Desert assemblages by 7400 cal BP, while Pinto points continued for some time (not defined by Haynes). His analysis of obsidian hydration readings of 110 GBS and Pinto points recovered from the Nevada Test Range in southwest Nevada supported the radiocarbon data. Thus, Haynes concluded the transition from GBS to Pinto dominance was gradual and overlapping from ca. 10,800 to 7800 cal BP.

These dates are a bit earlier than the similar pattern Jenkins (1987, 1991) detected for the Rogers Ridge and Henwood sites at Fort Irwin, which were included in Haynes’ study. Jenkins concluded that Pinto points joined assemblages containing Lake Mojave and leaf-shaped points between 9200 and 8900 cal BP and the three styles coexisted until ca. 8300 cal BP. From 8300 to 5800 cal BP, Lake Mojave and leaf-shaped points gradually declined in number, and Pinto series points became dominant from 5800 to 4500 cal BP.

Warren (1991) drew a similar conclusion from radiocarbon assays, obsidian hydration data, and analysis of assemblage composition from seven sites (including the Henwood site) in Nelson Wash in Fort Irwin. The data from Fort Irwin indicated Lake Mojave-Pinto occupation of the area from approximately 9500 to 6900 cal BP. However, Jenkins discerned a cultural hiatus between 7800 and 5800 cal BP where Warren saw none.

**Pinto and Great Basin Stemmed on the Distal Old River Bed**

In the Great Salt Lake Desert, Pinto series points have been found in context with projectile points from the Great Basin Stemmed series (GBS), which are Pleistocene-Holocene transition time markers for the region. At the time of primary occupation of the study area, the landscape was a productive wetland associated with the ORB delta. The Old River system formed as Lake Gunnison in the Sevier basin overflowed north into the Great Salt Lake, resulting in a meandering, narrow riverbed that eroded into the fine-grained lake deposits of the Bonneville
Basin. The geomorphology of the ORB has been extensively studied in recent years (e.g. Oviatt et al. 2003; Young 2008). Research is ongoing, but geomorphological evidence indicates that flows from surface and groundwater sources of the Old River system created a broad distributary delta across the southern GSLD. The wetland environment surrounding the ORB combined with the effective spring systems on the west side of the basin (e.g. Blue Lakes, Salt Springs) to provide a rich resource base for human inhabitants (Duke, 2011; Young 2008).

Most of the archaeological sites are associated with gravel or sand channels that meander through the ORB valley. Gravel channels are older than sand channels. They are geomorphically distinct, produced by rapidly flowing water which deposited coarse sand and gravel during overflow episodes of Lake Gunnison. They are topographically inverted, standing one to four meters above the surrounding mudflats. Sand channels are in the same area as gravel channels, but are less topographically inverted (0.5-1.2 m above mudflats). They were formed between 12,900 and 9900 cal BP (Oviatt et al. 2003).

Radiocarbon dates from the proximal delta and the distal reaches of the ORB distributary system have ascertained the chronological constraints of the associated wetlands. Assays derived from organic-rich marsh deposits and freshwater gastropods that thrived in the wetland ecosystem indicate that the distal deltaic environment was available for human occupancy from 13,400 to 12,900 cal BP, and again from 12,100 to 9900 cal BP. New data from the study area suggests the terminal date for the latter wetland period may be as late as 9300 cal BP (Daron Duke, personal communication 2012). The intervening period likely represents the Gilbert phase lake, the duration of which is unknown. During this time, only the proximal ORB delta would have been available for human use. The lake may not have persisted at the Gilbert level for the entire 800 year span, and fluctuations in lake level may have exposed the surface of the distal ORB intermittently prior to 12,100 cal BP. However, channel assays and the geomorphological characteristics of the distal ORB suggest occupancy post-dating 12,100 cal BP (Duke 2011).
Duke (2011) used cluster analysis of Pinto and GBS varieties from the same dataset presented here to determine typological associations among sites. He found eight of the 47 sites with five or more diagnostic artifacts clustered based on the presence of Parman and Lake Mojave types, while the other 39 sites in the sample were dominated by other GBS subtypes and Pinto types. He then divided the study area into east and west sides based on paleochannel groups of the ORB, which revealed statistically significant differences between the two sides: Parman and Lake Mojave types are more common on the west side, which is associated with the oldest distributary channels in the study area, while other GBS subtypes and Pinto types dominate the east side, where the wetlands are interpreted to have existed longer.

Every site in the sample that has Pinto points also has GBS points. Duke suggested the occupation of the west side of the study area was restricted to approximately 12,100 to 11,200 cal BP, and the east side occupation was closer to the range of approximately 11,300 to 9900 cal BP. As mentioned above, Haynes (2004) placed the period encompassing the initial appearance of Pinto to Pinto dominance in Pinto/GBS assemblages in the Mojave Desert at ca. 10,800 to 8900 cal BP.

Of particular importance on the distal ORB is the position of middle to late Archaic assemblages on the dunes, which formed after the desiccation of the ORB. This further asserts the co-occurrence of Pinto and GBS, both contextually and technologically (Duke 2011).

At North Creek Shelter in south-central Utah on the northern Colorado Plateau, North Creek Stemmed points (similar to Silver Lake and other GBS points) were found in the Paleoindian component dating from about 11,500 to 10,800 cal BP. This range is very similar to the occupation of the east side of the distal ORB, but no Pinto points were associated with the early occupation at North Creek Shelter. Early Archaic strata dating between 10,100 and 8900 cal BP contained Pinto points but no stemmed types (Bodily 2009). Haynes (2004) placed the interval when GBS became rare to nonexistent in the Mojave Desert between 8600 and 8200 cal BP, later than that at North Creek Shelter.
The data from the distal ORB and North Creek Shelter suggest the advent of Pinto and replacement of GBS occurred slightly earlier in the eastern Great Basin than in the Mojave Desert. Obsidian hydration data from the ORB and northeastern Nevada support the GBS/Pinto overlap, though no dates are available for comparison. Obsidian hydration analysis of projectile points from the entire ORB delta indicates Pinto/GBS contemporaneity (Duke 2011; Duke et al. 2007). The study, which includes 59 Pinto and 335 GBS points from both the proximal and distal portions of the delta, found that the mean rim values of Pinto and GBS points made from Topaz Mountain obsidian do not differ significantly ($t= -1.19, df=51, p=.24$). The micron range of Pinto and GBS points from the Browns Bench source do not overlap, but the sample size for Pinto ($n=7$) is too small to draw defensible inferences from (Table 10).

<table>
<thead>
<tr>
<th>Projectile Point Type and Obsidian Source</th>
<th>n</th>
<th>Mean (μ)</th>
<th>SD</th>
<th>CV</th>
<th>Min</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Max</th>
<th>No. of Outliers</th>
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<td>198</td>
<td>8.92</td>
<td>1.08</td>
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<td>6.36</td>
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<td>8.92</td>
<td>9.70</td>
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<tr>
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<td>0.12</td>
<td>8.50</td>
<td>11.48</td>
<td>12.10</td>
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<td>0.10</td>
<td>7.15</td>
<td>7.28</td>
<td>8.16</td>
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<tr>
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<td>-</td>
<td>-</td>
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<td>-</td>
<td>9.10</td>
<td>-</td>
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</tr>
<tr>
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<td>7.29</td>
<td>-</td>
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Table 10. Descriptive statistics for obsidian hydration rim values of Pinto and Great Basin Stemmed projectile points from the ORB delta (Duke 2011:48).
*SD=standard deviation, CV=coefficient of variation
Similarly, Hockett’s (1995) analysis of hydration rinds of split-stemmed points from several sites in northeastern Nevada indicated that most of the Browns Bench obsidian points were manufactured during the middle Holocene, though some dated to the Late Pleistocene/Early Holocene. The micron range for split-stemmed points overlapped that of GBS, with the latter being somewhat older, and subsumed that of Large Side-notched and Humboldt points.

**Summary**

Differentiating the Gatecliff series from the Pinto series has helped clear some of the confusion surrounding the chronological placement that has plagued the Pinto series of projectile points (Basgall and Hall 2000; Holmer 1986; Thomas 1981). Analysis of Schrotth’s (1994) compilation of radiocarbon assays associated with split-stemmed points in the Great Basin suggests that the Gatecliff series is distributed throughout the east-central and northwestern Great Basin and occurs in dated contexts from approximately 5000 to 2000 cal BP. The Pinto series occurs earliest in the eastern margins of the Great Basin and the northern Colorado Plateau. Pinto points occur with Great Basin Stemmed points on the distal ORB in contexts dating from 11,300 to 9900 cal BP, and possibly as late as 9300 cal BP. They persist in the archaeological record of the eastern Great Basin until at least 5000 cal BP and perhaps longer. These dates are somewhat earlier than accepted dates of Pinto occurrence in the southwestern Great Basin where, according to Haynes (2004), Pinto points are securely associated with Great Basin Stemmed points from 10,800 to about 7800 cal BP, though GBS points decrease in frequency after 8900 cal BP. Several AMS assays on hearths and *Olivella* shell beads associated with the Pinto series in the Mojave Desert hint at similar antiquity, though at present such assays are not widely accepted (Basgall and Hall 1993, 2000; Haynes 2004; but see Fitzgerald et al. 2005; Schrotth 1994).
CHAPTER 6: CONCLUSION

The Pinto series has been redefined and renamed several times in the eighty years since Amsden (1935) first described it. Analysis of 170 Pinto projectile points from the distal ORB corroborates recent findings that the original designator applies to older, robust, split-stemmed points from the southwestern Great Basin, while similar but more gracile split-stemmed points from the northwestern Great Basin generally belong to the younger Gatecliff series (see Basgall and Hall 2000). Such points from the northeastern Great Basin likely represent both series, but further research is needed to accurately determine the relationship of the two series in this region.

My research indicates that the Pinto series can be successfully segregated from the Gatecliff series using five basal attributes: stem length, basal indentation, proximal shoulder angle, distal shoulder angle, and notch opening angle. These elements are present on most projectile point fragments large enough to be considered diagnostic. Pinto points generally have larger distal and proximal shoulder angles than Gatecliff points, signifying shoulders that are less defined and stems that expand more. Pinto points are also thicker and have longer stems, wider bases and necks, and relatively shallow basal indentations.

On the distal ORB, Pinto series projectile points are surficially associated with GBS projectile points, suggesting possibly greater time depth than is often ascribed to the Pinto series. In the Mojave Desert, the synchronic occurrence of the two point styles is well-documented, and Haynes (2004) estimated the period of initial Pinto occurrence to Pinto predominance in Mojave Desert Pinto/GBS assemblages at approximately 10,800 to 8900 cal BP. The distal ORB was occupied by Pinto/GBS tool users from 11,300 to 9900 cal BP, though sites that contain only GBS projectile points are associated with older gravel channels dating to 12,100 cal BP.
**Pinto as a Paleoindian Tool**

On the distal ORB, Pinto and GBS appear to be part of the same technological tradition. Pinto points are not traditionally considered part of the Paleoindian toolkit. In their overview of southwestern Great Basin prehistory, Warren and Crabtree (1986) dichotomized the periods associated with GBS and Pinto point styles by designating GBS points as Paleoindian and Pinto points as Archaic, and many subsequent researchers have followed suit.

In the Mojave Desert, Pinto points have been found in sites dating to the Lake Mojave Period, the late Paleoindian period characterized by GBS points, as well as the Pinto Period. Toolkits from the Lake Mojave and Pinto Periods are identical except for the dominant projectile point styles and the presence of crescents in the former and groundstone in the latter. However, not all Lake Mojave sites have crescents, and some have groundstone (Jenkins 1987). Additionally, GBS and Pinto are part of both traditions, but in differing proportions. Preponderance of GBS relative to Pinto is a characteristic of the Lake Mojave Period that reverses with the onset of the Pinto Period.

Beck and Jones (1997) report that while groundstone is occasionally associated with GBS sites, it does not become prevalent until after 8300 cal BP. Groundstone occurs frequently in the artifact assemblages of Pinto sites, and many suggest the intensification of groundstone use at ca. 9500 cal BP marks the beginning of a more diverse subsistence strategy that differentiates the Archaic from the preceding period (e.g., Madsen 2007). At North Creek Shelter on the Colorado Plateau (Bodily 2009) and Bonneville Estates Rockshelter on the western fringe of Bonneville Basin (Goebel 2007), groundstone first appears in the early Archaic components. At North Creek Shelter, the onset of the Archaic component is accompanied by a distinct shift from GBS points to Pinto points.
The distal ORB lacks both groundstone and formal crescents, but other known tools from the Great Basin Paleoindian toolkit, such as bifacial cores, scrapers, gravers, and choppers, are present on Pinto/GBS sites. This is consistent with the subsistence technology usually attributed to Paleoindian foragers (Madsen 2007) and suggests that on the distal ORB, Pinto projectile points were used in the same subsistence strategies as GBS points, although they were probably used for different activities.

Groundstone is not present in the Pinto/GBS assemblages of the distal ORB, and across the entire ORB delta, GBS points outnumber Pinto points five to one. The intensification of groundstone use and notched-point technology provides material culture evidence of the shift from the Paleoindian to Archaic phase (Haynes 2007). If groundstone, accompanied by the gradual replacement of GBS by Pinto, hallmarks the beginning of the Archaic, the surface record of the distal ORB is considered wholly Paleoindian and thus represents one of the earliest Pinto occupations documented to date. Inferences drawn from surface sites must be regarded with prudence; however, assays attained from buried wetland organic material associated with the geomorphology of the study area indicate a limited window for the wetland system that supported Pinto/GBS users. Future research on the distal ORB may reveal sites containing Pinto points in datable deposits to corroborate the surface pattern.

**Further Research**

Previous research has suggested that among split-stemmed projectile points, Gatecliff is primarily in the central and northern Great Basin and Pinto is primarily in the eastern and southern Great Basin. However, the boundary of the Gatecliff range may extend further to the east, encompassing areas usually considered eastern Great Basin. The main geographic boundary of Gatecliff may be closer to the western margin of the Bonneville Basin, and Gatecliff series
points have even been found further east. For instance, excavations in Camels Back Cave in the southeastern Bonneville Basin revealed projectile points belonging to the Gatecliff series but not the Pinto series (Schmitt and Madsen 2005).

Further north, Pinto and Gatecliff are likely both present. Because of early typological confusion concerning split-stemmed points, such points in the northeastern reaches of the Great Basin have been referred to as Pinto, Gatecliff, and even McKean. Holmer (1986) suggested that split-stemmed points occurring in early contexts are Pinto and those in late contexts are Gatecliff, and a systematic analysis is needed to test this postulation. A thorough re-evaluation of split-stemmed points north of and along the western margin of the Bonneville Basin will enable archaeologists to better assess their geographic and chronological extent.
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