

Hohokam Core Area Sociocultural Dynamics:
Cooperation and Conflict along the Middle Gila River in
Southern Arizona during the Classic and Historic Periods

by

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ABSTRACT

Patterns of social conflict and cooperation among irrigation communities in southern Arizona from the Classic Hohokam through the Historic period (c. 1150 to c. 1900 CE) are analyzed. Archaeological survey of the Gila River Indian Community has yielded data that allow study of populations within the Hohokam core area (the lower Salt and middle Gila valleys). An etic design approach is adopted that analyzes tasks artifacts were intended to perform. This research is predicated on three hypotheses. It is suggested that (1) projectile point mass and performance exhibit directional change over time, and weight can therefore be used as a proxy for relative age within types, (2) stone points were designed differently for hunting and warfare, and (3) obsidian data can be employed to analyze socioeconomic interactions. This research identifies variation in the distribution of points that provides evidence for aspects of warfare, hunting, and the social mechanisms involved in procuring raw materials. Ethnographic observations and archaeological data suggest that flaked-stone points were designed (1) for hunting ungulates, or (2) for use against people. The distribution of points through time and space consequently provides evidence for conflict, and those aspects of subsistence in which they played a role. Points were commonly made from obsidian, a volcanic glass with properties that allow sources to be identified with precision. Patterns in obsidian procurement can therefore be employed to address socioeconomic interactions. By the 18th century, horticulturalists were present in only a few southern Arizona locations. Irrigation

communities were more widely distributed during the Classic Period; the causes of the collapse of these communities and relationships between prehistoric and historic indigenes have been debated for centuries. Data presented here suggest that while changes in material culture occurred, multiple lines of evidence for cultural continuity from the prehistoric to Historic periods are present. The O'Odham creation story suggests that the population fluctuated over time, and archaeological evidence supports this observation. It appears that alterations in cultural practices and migrations occurred during intervals of low population density, and these fluctuations forced changes in political, economic, and social relationships along the middle Gila River.

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CHAPTER 1: INTRODUCTION

This investigation examines conflict and cooperation among Native American communities along the middle Gila River in southern Arizona (Figure 1.1). The emphasis here is on analysis of the terminal portion of the flaked-stone projectile point record, between roughly A.D. 1150 and A.D. 1880. Dramatic changes in material culture, social organization, and settlement patterns occurred during this time. Analyzing diachronic patterns in conflict and cooperation provides insight into broader issues regarding relationships between Prehistoric and Historic populations, as well as understanding the nature and meaning of episodic changes that occurred in the material cultural traditions of southern Arizona.

An *etic* design approach is employed in which analyses of tasks stone projectile points were intended to perform are emphasized, and the role of performance in the reproduction of designs is considered (Nelson 1997; Odell 2003:192–193). Historical records for the study area and Native American traditions are also examined. People who lived along the middle Gila River possessed few firearms until near the end of the nineteenth century, and stone points continued to be employed until the late 1800s (Ezell 1961:66, 1994:346; Hall 1907:420; Russell 1908:111). Thus, the situation along the middle Gila offers an important opportunity to compare patterning among stone projectile points with historically documented settlement patterns, socioeconomic interactions, societal conflicts, subsistence practices, and other observations.

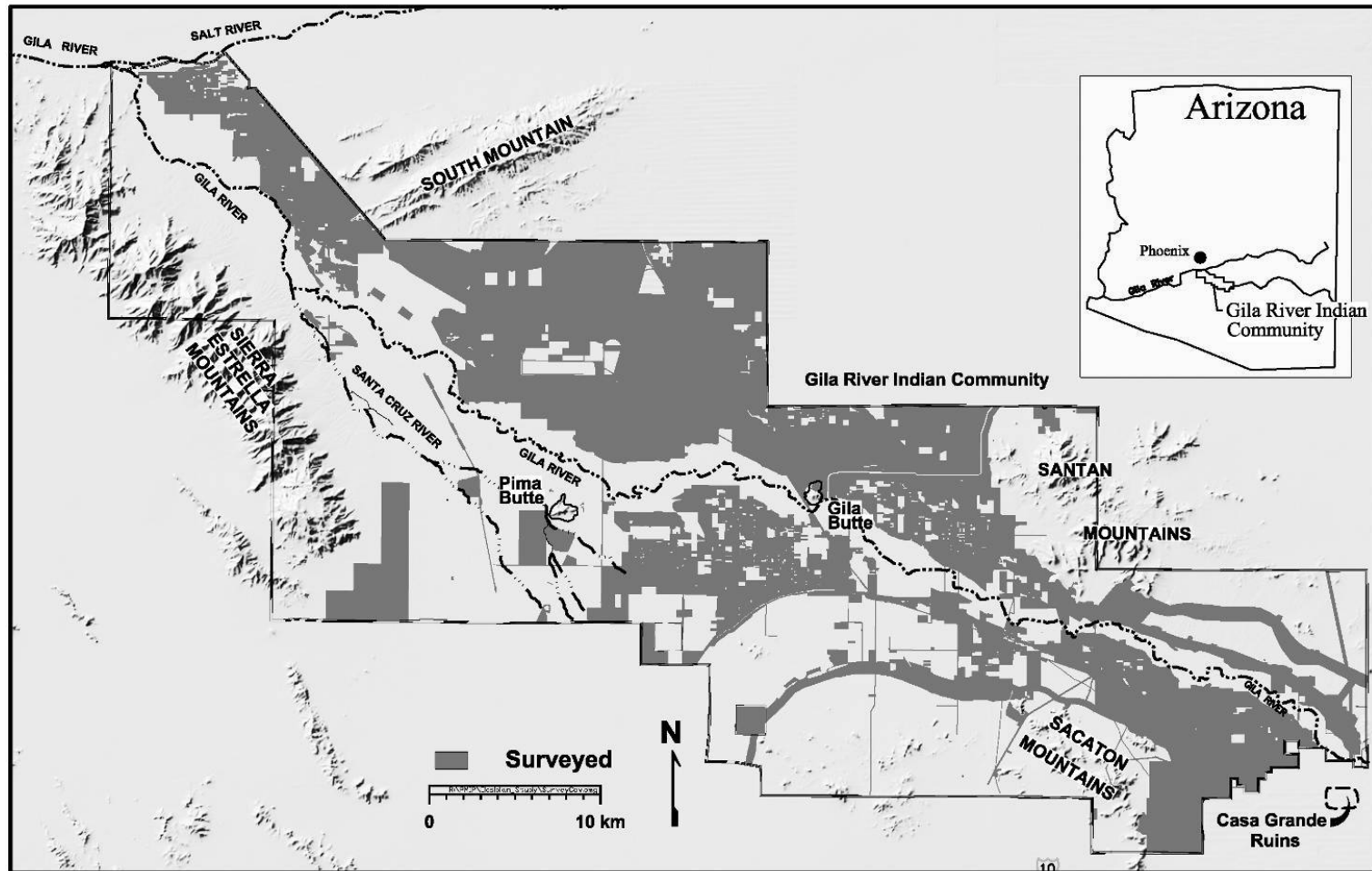


Figure 1.1. P-MIP survey coverage, place names mentioned in the text, and GRIC study area.

This research further analyzes projectile point data that were recovered by the Gila River Indian Community Cultural Resource Management Program (GRIC-CRMP) as part of the Pima-Maricopa Irrigation Project (P-MIP), which is partially funded by the Department of the Interior, U.S. Bureau of Reclamation. With the prominent exception of the Pre-Classic Hohokam site of Snaketown (Haury 1976), archaeological data from the heart of the Akimel O’odham (i.e., Pima) historic period settlement area were comparatively unknown until these investigations (Ravesloot 2007:93). In particular, early Historic period Akimel O’odham data are critical for assessing issues related to the Hohokam collapse as well as the possible continuum of populations within the Phoenix Basin, and these remains largely occur within the boundaries of the modern community. GRIC-CRMP has conducted full coverage survey of over 525 square kilometers of the GRIC, and this large and spatially expansive dataset allows the investigation of a wide range of research issues (Darling et al. 2004; Wells 2006; Wells et al. 2004b; Ravesloot 2007).

Projectile points from the Sonoran Desert have previously received comparatively little attention from prehistorians; however, these data are ideally suited for analyzing warfare and socioeconomic interactions among social groups. First, lithics are common and durable artifacts that are one of the most likely remains to be preserved, particularly in surface contexts, which form the primary dataset for most regional analyses (Cotterell and Kamminga 1992:126). Second, stone tools were employed throughout the archaeological sequence from the

Paleoindian through the Late Historic period. Third, projectile points in the Hohokam core area are commonly made from obsidian, which has properties that allow source locations to be objectively defined with a high degree of precision. Consequently, diachronic and synchronic obsidian acquisition patterns can be employed to address socioeconomic interactions at different scales from the local to the regional. Fourth, ethnographic research suggests stone points were designed for use against other people or for hunting large game animals and this research differentiates points designed for killing large quadrupeds from those made for warfare. Analyzing the density and distribution of points through both time and space thus provides evidence regarding conflict as well as subsistence data.

Although stone projectile points may seem to be small and insignificant pieces of material culture, their successful design has important consequences. Large game hunting requires considerable energy investment, but offers substantial economic rewards (Dean 2003:26-27; Shott 1996). Successful performance is of an even greater concern during human conflict when point designs are directly competing with one another. The selection of effective designs, and more importantly the negative consequences for ineffectual design, combine to produce comparatively strict limits on variation (cf. Vanpool 2003).

Any analyses of these data, however, are complicated by the fact that morphologically similar projectile points were produced over a long period of time in southern Arizona. Artifacts with similar shapes have been found in Archaic through Historic period archaeological contexts (Figure 1.2). Some

Hohokam archaeologists have even suggested it is impossible to seriate projectile points that post-date the Archaic period (e.g., Peterson 1994). This investigation employs the hypothesis that flaked-stone projectile points generally decreased in size over time, and point weights are therefore used to approximate age (cf. Mason 1894:653; Shott 1996).

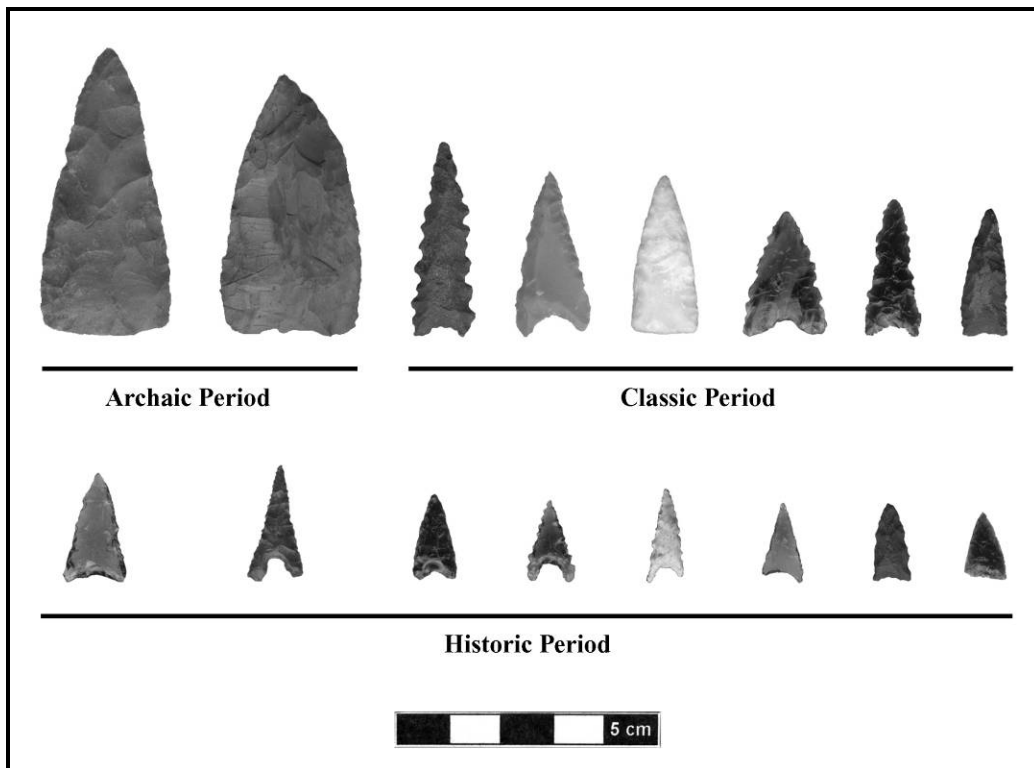


Figure 1.2. Unnotched triangular flaked-stone points and period assignments, P-MIP collection. Archaic and Classic period assignments are following the Sliva 1997 typology. Historic period assignments are according to Loendorf and Rice 2004. The point on the bottom left is man-made glass.

As Shott concluded (1996:304), “[I]f theory is developed more fully to link performance requirements to point size and form on the one hand, and economic and sociopolitical properties of aboriginal cultures on the other, then

points can serve as more than simple time markers.” The research presented here develops the former theory, and in part employs obsidian data to address the latter. While assigning age estimates to artifacts is not anthropologically interesting in and of itself, improving chronological associations for common remains such as flaked-stone points allows investigation of a wide range of issues that are of importance to archaeologists.

Research questions that are considered here include; (1) is there temporal variation in point design that is associated with patterns of hunting and/or warfare, (2) what does the spatial distribution of Classic and Historic period projectile points suggest regarding settlement patterns, (3) did settlement locations change over time and if so what is the nature of this variation, (4) is there continuity in projectile point data (i.e., design, size, and obsidian utilization) between the Classic and Historic periods or are there discontinuities in these data associated with cultural tradition disruptions, (5) is there patterning in point data that suggests some types were introduced by immigrants, (6) how do projectile points compare and contrast with other lines of evidence including ceramics and architecture, and (7) what do local and regional patterns of obsidian procurement suggest regarding synchronic and diachronic trends in economic cooperation and integration?

Studying materials that were transported to the Hohokam core area such as obsidian provides a complimentary perspective with products that were produced locally (e.g., ceramics). In the past 30 years, obsidian analyses have become

increasingly comprehensive, and consequently broad regional and temporal patterns have become apparent in these data (Shackley 1988, 1990, 1995, 2005). For Central Arizona populations, direction of the source has a greater affect than absolute distance on raw material utilization (Rice et al. 1998). If people traveled directly to sources to obtain obsidian, then distance should be the primary barrier for acquisition; however, proportions for the most commonly utilized sources are only weakly correlated with distance. These observations suggest that Classic period people along the lower Salt River, the middle Gila River, Casa Grande, and the two arms of the Tonto Basin maintained different trade relationships. Patterning in obsidian acquisition suggests that the strongest socioeconomic ties among communities were those between sites that were dependent on the same water sources. At the same time, variation in artifact data among geographical areas suggests that the Classic period Hohokam were not a politically centralized or economically integrated entity (Simon and Gosser 2001).

By the Late Classic, communities of sites received most of their obsidian from distant areas in different directions. Use of the closest source, Superior, decreased from the Pre-Classic to the Classic periods. While Saucedo obsidian, which is located to the southwest of the core area, became the main supply by the Late Classic and this pattern continued into the Historic period. This continuity of trends between the Classic and Historic periods is one example of the link between the Hohokam and the Akimel O'Odham (i.e., Pima), who live in the area today.

The Historic period appears as the culmination of this long trend toward greater reliance on obsidian sources located to the southwest of the middle Gila. The well-documented relocation of Akimel O’Odham populations to the south bank of the Gila River for protection from Apache raiding during the seventeenth century offers one explanation. Access to northern, western, and eastern sources including the San Francisco Volcanics, Vulture, and Superior was cut-off by intervening Apache and Yavapai populations. Meanwhile, continued alliances between the Tohono O’Odham (i.e., Papago) and the Pee Posh (i.e., Maricopa) allowed access to raw materials in the direction of the Gulf of California. The observation that the decline in the use of obsidian from northern, western, and eastern sources begins during the Classic period suggests that hunter-gatherers such as the Apache and Yavapai may have been in southern Arizona earlier than has traditionally been assumed (Baldwin 1997; Doyel 1978:201; Hodge 1895; Whittlesey et al. 1997:185).

Ethnographic descriptions and physical performance constraints both indicate that warfare and hunting points may have been designed differently. This research suggests that stone points were employed to tip projectiles because they made the weapon more lethal than points made of organic materials (Figure 1.3). This, however, came at an expense in durability, accuracy, raw materials, and manufacturing costs. For these and other reasons, stone points were designed for hunting large animals and/or warfare.

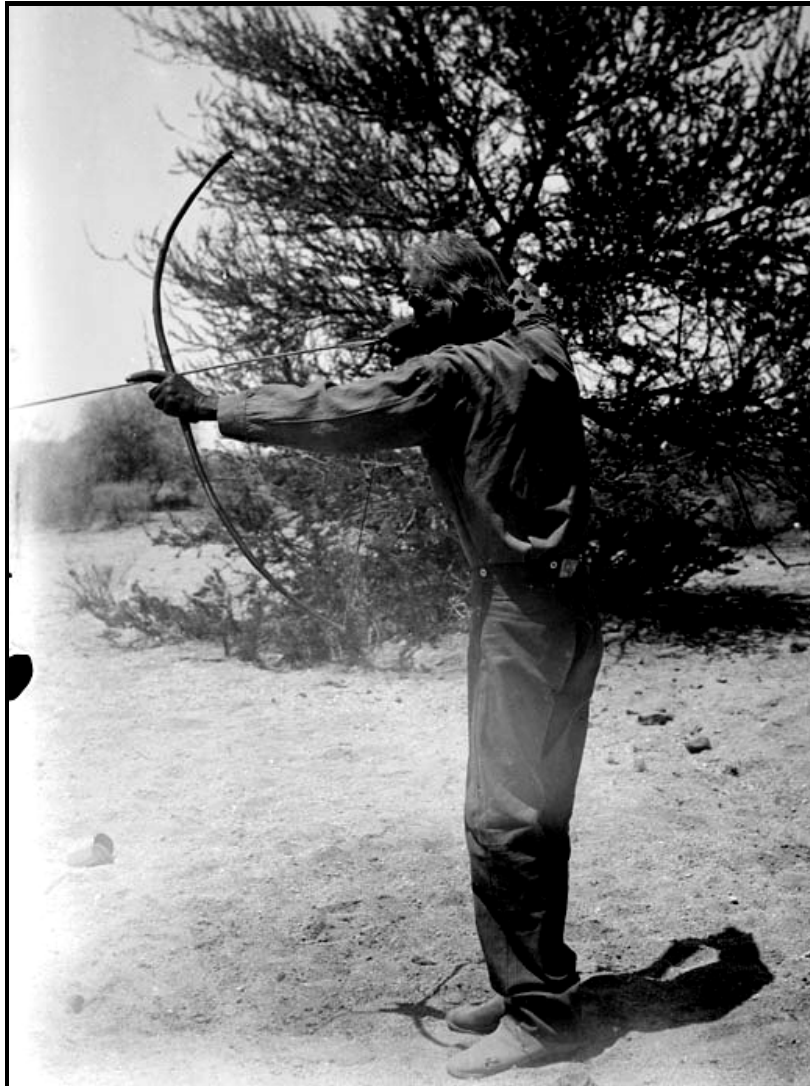


Figure 1.3. Akimel O'odham man using a self-bow for hunting small game with a wooden tipped arrow, Smithsonian collections, unknown photographer. Self-bows consist of a piece of straight wood with an attached string.

This investigation defines point designs more precisely than previous analyses, and patterning in the collection considered here is consistent with expectations that are derived from this line of argument. Distinguishing projectile points that were associated with specific aspects of behavior (i.e., big game

hunting or warfare) provides additional evidence for assessing subsistence practices, as well as data regarding conflict among social groups.

The relationship between the late prehistoric inhabitants of the middle Gila River (i.e., Classic Hohokam) and the Akimel O’Odham has been debated since Spanish missionaries first arrived in the late 1600s (Fewkes 1912:33; Russell 1908). Despite centuries of speculation and argument, this issue remains unresolved (Ezell 1983:149–150; Gilpin and Phillips 1998:28–43; Wells 2006), and some researchers continue to argue that the Akimel O’Odham are recent migrants to the middle Gila (e.g., Rea 2007). One of the main limitations for understanding the relationship between the Hohokam and Akimel O’Odham is that indigenously produced artifacts that are diagnostic of the Protohistoric and early Historic periods have remained poorly understood, and most absolute dating techniques are of insufficient resolution to discriminate materials from this time (Dean 1991; Wells 2006). Consequently, the identification of any distinctive artifacts associated with this period is of considerable importance for understanding the past along the middle Gila River, which is an issue that has modern socio-political ramifications in a region where highly contested water rights are based on prior usage.

Recent research regarding the Classic Period Hohokam collapse has focused on assessing the roles of socioeconomic interactions, conflict, and changes in subsistence practices over time (e.g., Abbott 2003; Clark 2001; Hegmon et al. 2008; Raveslout et al. 2009; Redman 1999; Tainter 1988). It is

possible to address each of these issues with projectile point data; however, comparatively little attention has been paid to this line of evidence. This investigation employs point data to assess settlement patterns and material cultural evidence in an analysis of the Hohokam-Akimel O’Odham continuum. Although this research does not resolve this issue, it does introduce a previously underutilized line of evidence to the debate.

Data presented here indicate that the area between Gila and Pima Buttes on the south side of the Gila River referred to hereafter as Casa Blanca was a focal point for the coalescence of Protohistoric and Historic period groups that were decimated by intense conflict, repeated epidemics, and other changes visited upon them by external pressures. As populations declined, people who formerly lived throughout much of the Hohokam region in southern Arizona assembled along this short stretch of the Gila River. The population of the area then increased as the people gathered and large areas of former occupation were left to others. Ethnohistorical and archaeological data both suggest that rather than “abandoning” areas such as the San Pedro River, sedentary agriculturalists were pushed from these regions by more mobile hunter-gatherer populations that are difficult to identify in the archaeological record (Ferg and Tessman 1997; Herr et al. 2009, Seymour 2009:435–437; Vint 2005:3).

Small projectile points that lack notches or serration were employed by the people living in the Casa Blanca area during the Historic period, while groups coming from other locations tended to settle on the immediate margins of this

area. Projectile points described here suggest corroborating evidence that one of these immigrations involved the San Pedro Sobaipuri. This pattern of population decline and subsequent aggregation appears to be part of longer-term processes (Hill et al. 2004). The archaeologically and ethnohistorically documented coalescence of communities that happened during the Historic period began before the close of the Classic period sometime around A.D. 1450, prior to the arrival of Europeans in the region (Hill et al. 2004). Akimel O'Odham creation stories and episodic changes in archaeological data within southern Arizona both suggest that similar periods of collapse, aggregation, and reorganization occurred on a periodic basis in the region. These transitions appear to have resulted in substantial alterations to socioeconomic relationships and political organization in the Hohokam region.

While the precise causes of these periodic fluctuations may have varied, it appears that climatic oscillations between warmer and colder periods may have alternately favored conditions for irrigation along the Salt and Gila Rivers in the Phoenix Basin, which in turn affected variation in ideological, economic, and political relationships. The *corporate-network* conceptual model provides essential insight for understanding the political responses that people developed to ameliorate these climatic oscillations (Feinman et al. 2000:453). The network strategy is associated with more personalized forms of leadership. Wealth is concentrated in the hands of certain individuals, who use their network of connections to expand their personal power and authority. In contrast, within

corporate organizations, economic resources are more dispersed, leadership is less personalized, and individual aggrandizement is uncommon.

It appears that Pre-Classic Hohokam social organization was characterized by an emphasis on corporate organizational strategies, which is reflected by communal architecture designed for public gatherings, socioeconomic relationships that linked communities, and little differentiation in wealth. Reorganization in response to a down-cutting episode around A.D. 1070 (Waters and Ravesloot 2001) appears to have resulted in the emergence of more network orientated political strategies with greater emphasis on individual aggrandizement, wealth accumulation, and differentiation in residential architecture. By the Late Historic period the inhabitants of the Hohokam core area (i.e., Akimel O'Odham and Pee Posh) appear to have returned to a greater emphasis on corporate strategies, though vestiges of more network focused roles still persisted.

This investigation begins with a description of the study area and dataset (Chapter 2). Next, previous research in the Hohokam region of southern Arizona is presented in Chapter 3. Chapter 4 subsequently discusses the methodological approach employed in this investigation, and offers three middle-range hypotheses that are employed to link material culture and human behavior. Chapter 5 summarizes ethnohistorical data for the study area, which are used to generate expectations for patterning in the archaeological record. Chapter 6 presents analyses of projectile point data. The penultimate chapter explores

broader implications of this research. Finally, conclusions are offered in Chapter 8.

CHAPTER 2: STUDY REGION AND DATASET

This chapter summarizes the geological setting of the study area and the archaeological data that are employed in this research. The GRIC is located in the Basin and Range physiographic province of southern Arizona, which is characterized by highly dissected mountainous terrain. The focus here is on surface remains from the middle Gila River (Figure 2.1). This region is conventionally described as encompassing a 120 kilometer (72 mile) segment of the Gila River that begins at North and South Buttes (collectively known as “the Buttes”), approximately 26 kilometers east of Florence, Arizona, and continues downstream to the confluence of the Gila and Salt Rivers (Doyel et al. 1995; Gregory and Huckleberry 1994; Waters and Ravesloot 2001). Data from the Salt, Tonto, and Tucson Basins of the Hohokam area are also employed for comparison.

Study Region

Survey data employed in this research are from a physiographic region known as the middle Gila Valley, which includes the southern portion of the Phoenix (Salt–Gila) Basin. The middle Gila River has ideal geomorphological conditions for irrigation agriculture. The valley is broad, ranging from 5 kilometers (3.2 miles) to over 20 kilometers (12.5 miles), and has a low gradient, descending only 176 kilometers (579 feet) from the Buttes to the Gila-Salt confluence, an average of 1.4 meters (4.6 feet) per kilometer. The Sierra Estrella, South, Sacaton, and Santan Mountains are the most prominent topographic

features in the area, along with smaller bedrock extrusions such as Pima, Gila, Cholla, and Poston Buttes (Woodson 2000).

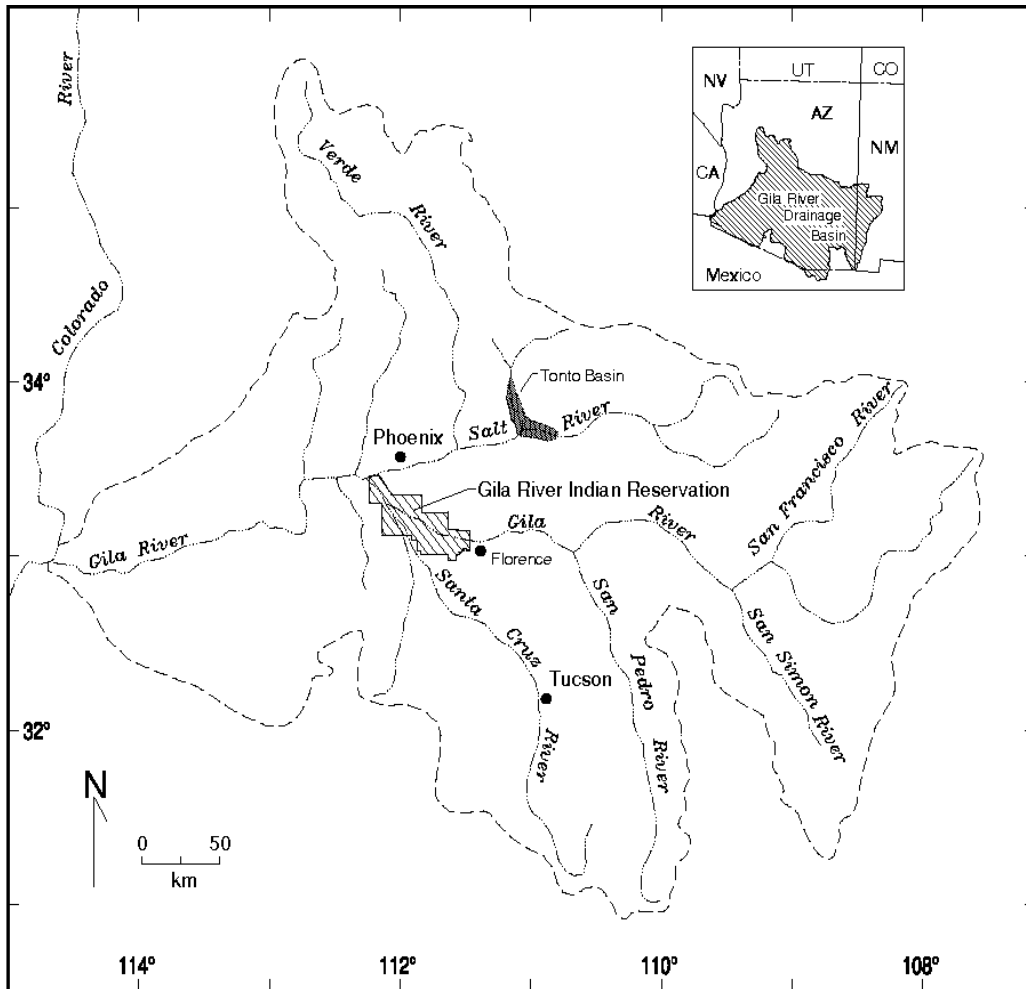


Figure 2.1. Map showing the GRIC study area and the Gila River Watershed (adopted from Waters and Ravesloot 2001).

The climate of the region is arid and hot (Sellars and Hill 1974; Sellars et al. 1985). The mean annual temperature is 21°C (70°F), with average July highs of 41°C (106°F), and 1°C (34°F) January minimum averages (Camp 1986). The wettest months are typically July and August, when afternoon thunderstorms

produce localized, but generally heavy rainfall. A second period of precipitation occurs in the winter when large storm systems from the Pacific Ocean enter the region. Rainfall associated with these storms is typically gentle and widespread. The spring months of April, May, and June are the driest. Occasionally, late summer or early autumn tropical storms pass through Arizona, which may contribute considerable rainfall (Smith 1986). Generally, however, the middle Gila is a water-deficient region, with evapo-transpiration usually exceeding precipitation (Waters 1996).

The valley contains three major landforms: the river channel, terraces, and bajadas (Waters 1996). An eolian sand sheet covers much of the upper (T-3) terrace, where prehistoric and Historic cultural remains are concentrated. Major tributaries to the middle Gila River include the Salt River, the Santa Cruz River, and McClellan Wash.

The area falls in the Sonoran Desert subprovince of the Basin and Range physiographic zone. Vegetation in the middle Gila Valley is classified as part of both the Lower Colorado River Valley and Arizona Upland subdivisions of the Sonoran Desert scrub biotic community. Local natural vegetation is generally sparse and includes creosote, mesquite, saltbush, palo verde, cholla, prickly pear, saguaro, ocotillo, yucca, as well as various desert grasses. (Brown 1994; Brown and Lowe 1980).

The Gila River Indian Community and the P-MIP Dataset

The Gila River Indian Community borders Phoenix, Arizona, which is now one of the largest metropolitan areas in the United States. In contrast with many other Native Americans who lived close to major centers of Euroamerican settlement, the Akimel O’Odham retained a comparatively large portion of the core area of their Historic territory. Consequently, this location encompasses a wealth of the archaeological data that are their heritage. Despite their location adjacent to affluent suburbs, community members continue to suffer from poverty that began as a result of the diversion of Gila River water by upstream settlers in the late 1860s (Dejong 2009; Dobyys 1989:49). Previously, people living in the area enjoyed considerable economic prosperity (Dejong 2009; Ezell 1994:359–366). Compared with the surrounding urban sprawl, the economic underdevelopment of the GRIC has kept its archaeological remains relatively untouched. Furthermore, because of community members’ respect for their past, little intentional disturbance to cultural resources has occurred. This pattern differs with the surrounding state, federal, and private lands where looters and development have extensively impacted archaeological sites.

As part of long-awaited economic redevelopment, the Bureau of Reclamation funded Pima-Maricopa Irrigation Project (P-MIP) is being designed to bring water to the many long dormant agricultural fields in the community. In 1993, planning was initiated for an irrigation system that is designed to serve 146,000 acres of land. “This project incorporates tribal social memory in the

design and construction of a gravity-fed water-delivery system” (Ravesloot et al. 2009:235). The GRIC established a Cultural Resource Management Program (GRIC-CRMP) as part of this project. In advance of construction, GRIC-CRMP conducted full-coverage survey of over 525 square kilometers of the community, where archaeological remains were identified in a range of geophysical settings from the uplands to the lower river terraces (Figure 2.2, Ravesloot and Waters 2004; Waters and Ravesloot 2000; Wells et al. 2004; Ravesloot 2007).

This investigation further analyzes P-MIP survey data, which encompass much of the middle Gila portion of the Hohokam core area (Loendorf and Rice 2004).

Nearly 1,000 projectile points, which date from the Early Archaic (ca. 8000 B.P.) through the late A.D. 1800s have been collected. All metric data employed in this research and images of the points in the P-MIP survey collection are available in Loendorf and Rice 2004. Excavation data from on-going mitigation projects in the GRIC are also considered where possible.

The surface collection also includes nearly 10,000 pieces of obsidian (Darling 2000). To date, roughly 600 obsidian artifacts from the GRIC have been sourced, including both P-MIP survey data as well as artifacts from recent mitigation projects within the GRIC (Loendorf 2008b). Obsidian data for over 1,000 additional artifacts are employed for comparison with the study area (Marshall 2002, Peterson et al. 1997; Shackley & Bayman 2006; Shackley 2005; Rice et al. 1998). These latter data are from sites in the Salt, Tonto, and Tucson Basins of the Hohokam area.

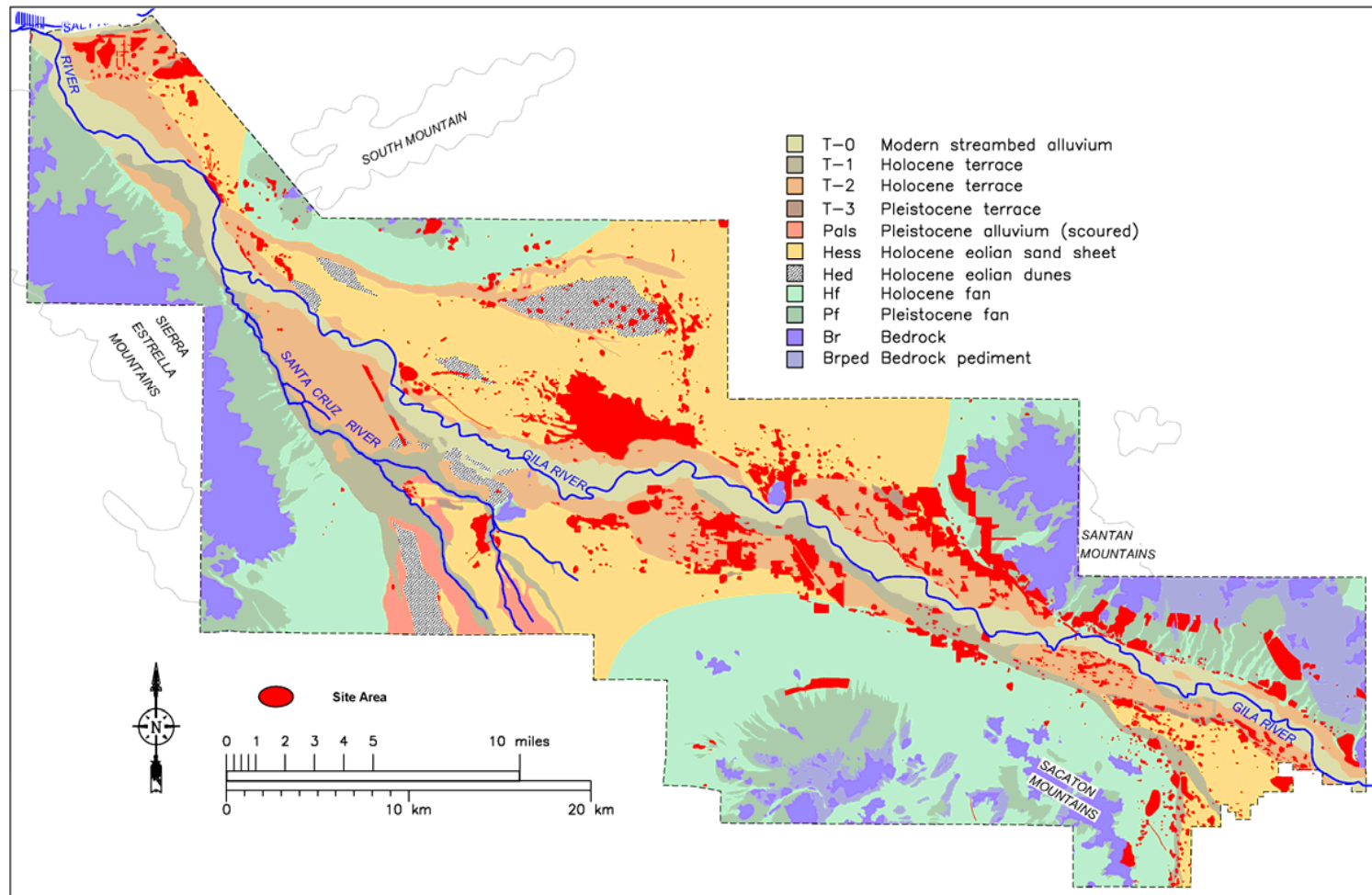


Figure 2.2. Map showing geomorphology and site areas within the GRIC.

Surface Data

When considering the projectile point sample used in this study, it is important to emphasize that the collection was derived almost exclusively (97%) from surface contexts. This has probably affected the sample in several ways (Barton et al. 1999:614–617; Redman and Watson 1970). First, because they are generally covered by deposition, artifacts in contexts such as pit house floors or burial features are less likely to be exposed on the modern ground surface. Consequently, the sample may be skewed toward artifacts from middens or other contexts that are less likely to be buried. Second, geomorphologic factors may affect the apparent frequency of artifacts of different ages. For example, recent artifacts are more likely to be exposed on the modern ground surface, because they have experienced a shorter period in which they may have been buried by substantial deposition or redeposited by erosion (Loendorf and Rice 2004:8–10). Third, during the survey no artifacts were collected from areas with human bone; consequently, any points potentially associated with human remains were not sampled. Fourth, most of the archaeological sites in the study area have been occupied for considerable periods of time, and surface contexts include mixed deposits from different time periods. Consequently, temporal associations for non-diagnostic artifacts are generally unclear. Fifth, extensive agricultural fields are present in the community, and both Prehistoric as well as Historic period farming may have disturbed cultural remains (Barton et al. 1999).

Geomorphology

Because the collection was recovered from surface contexts, which include landforms of differing ages, consideration of geomorphological processes that may alter the apparent distribution of projectile points is especially important. The effects of erosion and deposition condition the apparent spatial distributions of projectile points dating to different periods. Old landforms may have recent points, but younger landforms are less likely to have older points on the modern ground surface. Consequently, the apparent frequency and distribution of points with differing ages are affected (Loendorf and Rice 2004).

The main landforms within the study area include alluvial terraces along the Gila River and its tributaries, an extensive area of Holocene eolian sand sheet and dune fields, and piedmonts (bajadas) that are either Holocene or Pleistocene in age. Ages for the terraces along the Gila River were estimated using the radiocarbon method, and other landforms that have not been dated are assigned only to general geological periods, such as early Holocene or Pleistocene, based on soil development and other factors (Waters 1996). The eolian sand sheet and dune fields may have been deposited during the early Holocene, possibly ending around roughly 5000 B.C. The Pleistocene fans are more than 40,000 years old and predate human occupation of the New World. The greatest temporal range of projectile points will occur on the surface of the oldest geomorphic landforms. The younger landforms will generally have only more recent archaeological remains. The current, active surface of the Gila River channel (T-0) will not

contain projectile points except possibly as secondary deposits derived from erosion of the upper terraces.

This investigation focuses on recent projectile points that post-date roughly A.D. 1150 and does not include remains from the modern floodplain. Consequently, geomorphological processes are less likely to have substantially altered the apparent distribution of the projectile points that are analyzed in the following research. The next section summarizes materials that were employed for projectile points manufacture in the study area, and the effects of raw material constraints on stone points.

Middle Gila River Lithic Raw Materials

The study area is located in the Basin and Range physiographic province of south-central Arizona, where northwest-southeast trending mountain ranges rise abruptly from broad and flat basins filled with deep deposits of eroded sediments (Pierce 1985). These sedimentary basins contain thousands of feet of alluvial gravels, sands, and silts eroded from nearby mountain ranges. The mountains were formed by both the erosion of uplifted fault blocks and volcanic activity (Hendricks 1985). Although some ranges primarily consist of silicic to basaltic composition rocks (e.g., basalt, andesite, rhyolite), most of the mountains are Precambrian granites, schists, and gneiss (Anderson 1992; Reynolds 1985; Wilson 1969).

The size, shape, and fracture toughness of available lithic raw materials constrain both the reduction techniques that can be employed and the character of

the resulting artifacts (Andrefsky 1994; Binford 1979; Cotterell and Kamminga 1992:125-151; Parry and Kelly 1997). Consequently, it is necessary to consider the effects of raw material constraints in any lithic analysis.

Fracture toughness is defined as the stress-intensity factor necessary to begin the propagation of a crack in the stone, and this factor is a fundamental characteristic of flaked-stone raw materials (Cotterell and Kamminga 1987:678). Although oversimplified, a dichotomy can be drawn between fine- and coarse-grained stones. Fine-grained materials have a shiny or glass-like surface luster, whereas coarse-grained materials have a dull luster and visible grain. Coarse-grained materials usually have a higher fracture toughness than fine-grained materials (Andrefsky 1994; Whittaker 1994). Consequently, prehistoric flint knappers appear generally to have employed fine-grained and coarse-grained materials for different tasks (Cotterell and Kamminga 1992:127-130).

Because of their lower fracture toughness, fine-grained materials are well suited for thinning and shaping into patterned tool types. In contrast, the high fracture toughness of most coarse-grained materials makes them extremely difficult (if not impossible) to retouch by pressure flaking into patterned tools. At the same time, high fracture toughness would have been advantageous for their use as expedient tools, because the working edges would have dulled less quickly than more brittle, fine-grained materials. As a result, fine-grained materials are closely associated with the production of patterned tools, whereas coarse-grained

materials were generally used for the production of expedient flake tools (Cotterell and Kamminga 1992:129).

In general, fine-grained materials rarely naturally occur in the study area; most locally available materials are coarse-grained stones that have high fracture toughness. Consequently, the majority of the projectile points in the collection were made from non-local raw materials. These materials had to be obtained through trade or other means, and as a result, it is possible to consider socioeconomic interactions through analyses of projectile point raw material utilization (Shackley 2005).

Fine-grained lithic resources have limited distributions throughout the Sonoran Desert (Anderson 1992; Shackley 1988). The few cryptocrystalline lithic materials that are present occur in two forms: as primary, concentrated deposits of lithic materials, and as mixed, secondary geological deposits spread more diffusely across the landscape (Anderson 1992). Primary, concentrated deposits of fine-grained lithic materials are not common along the middle Gila River. Larger deposits of low-fracture-toughness materials do occur in relatively nearby areas. Some of these resources include obsidian deposits associated with the Superior, Vulture, and Saucedo mountains volcanic fields in south-central Arizona (Peterson 1994; Shackley 1988), as well as chert deposits in several nearby regions, including at Windy Hill in Tonto Basin (Rice et al. 1998). Extensive chert deposits also occur in the Payson area, however, these materials have numerous flaws and are of generally low quality for projectile point manufacture.

Course-grained materials that are better suited for ground-stone artifacts and expedient lithic tools are more abundant locally. For example, primary, concentrated deposits of vesicular basalt were available at Lone Butte, the Santan Mountains, Picture Rocks, the Vaiva Hills, the McDowell Mountains, the Gila Bend Mountains, and at several locations in the New River drainage (Anderson 1992; Hoffman and Doyel 1985; Wilson 1969; Wilson et al. 1969).

The most widespread local source of lithic raw materials was provided by secondary geological deposits, such as Pleistocene river gravels, bajada surfaces, and alluvial fans. These deposits contain a variety of igneous, metamorphic, and sedimentary gravels. Fine-grained cherts and chalcedonies occasionally occur in these deposits, but higher fracture-toughness materials such as quartzites, rhyolites, basalts, dacites, and other siliceous volcanics are more common (Anderson 1992). These lithic materials are generally small and randomly dispersed at a low density across extensive areas.

P-MIP Projectile Point Raw Materials

Chert is the most common material in the P-MIP projectile point collection (Table 2.1). Nearly 40 percent of the recovered artifacts were identified as chert. Although obsidian does not naturally occur in the project area (Bayman and Shackley 1999), obsidian is the next most common type, accounting for almost one-third of all projectile points. Basalt is the next most frequent material, with 19 percent of the survey collection. Finally, six percent of the artifacts are

rhyolite. All other materials are uncommon, occurring in frequencies less than five percent.

Table 2.1. Material type by point size for projectile points and preforms (adopted from Loendorf and Rice 2004).

Material	Point Size						TOTAL	
	Indet.		Large		Small		N	%
	N	%	N	%	N	%		
Chert	13	54	83	31	273	40	369	38
Obsidian	4	17	7	3	248	36	259	26
Basalt	3	12	97	36	88	13	188	19
Rhyolite	2	8	44	16	10	1	56	6
Chalcedony	1	4	3	1	45	7	49	5
Quartzite	0	0	13	5	4	1	17	2
Quartzite	1	4	4	2	12	2	17	2
Meta-Basalt	0	0	9	3	2	0	11	2
Glass	0	0	0	0	8	1	8	2
Siltstone	0	0	4	2	0	0	4	0
Welded Tuff	0	0	2	1	0	0	2	0
Dacite	0	0	1	0	0	0	1	0
Tuff	0	0	1	0	0	0	2	0
TOTAL	24		268		690		982	

Note: Percentages are for column totals.

The points are separated by size. Large points are generally Archaic period atl-atl tips, while small points are more likely to be arrow tips (Thomas 1978; Patterson 1985; Shott 1996:286-288). For example, Shott (1996:286-288), found that shoulder width was the most reliable discriminator between atl-atl and arrow points. In the typological classification system, a shoulder width of 14 mm was used to separate these two types (Loendorf and Rice 2004). Raw material choices differ for large and small projectile points. In general, fine-grained materials were preferred for the manufacture of small points. For example, less than 3 percent of the large points are made from obsidian, whereas this material is one of the most

commonly identified for small points (36% of the collection). Basalt is substantially more common for large points, and these artifacts tend to be made of coarser-grained materials. Raw material types also tend to vary among different types of projectile points (Table 2.2).

Table 2.2 Projectile point raw material by period (adopted from Loendorf and Rice 2002)

Period		Basalt	Chalcedony	Chert	Obsidian	Rhyolite
Middle	Archaic (n=95)	55.8%	1.1%	29.5%	2.1%	11.6%
Late	Archaic (n=57)	29.8%	0%	35.1%	3.5%	31.6%
Pre-Classic	(n=91)	0%	9.9%	47.3%	38.5%	4.4%
Classic	(n=132)	11.4%	4.5%	34.8%	49.2%	0%
Historic	(n=196)	24.0%	5.6%	35.7%	33.2%	1.5%

In general, varieties that were made at a given time generally were produced from similar raw material types, and variation in material use is consequently apparent among time periods. First, basalt is the most common material for Middle Archaic projectile points. The use of basalt then declined until after the Classic period, when it accounts for nearly one quarter of the collection. Chert was popular throughout the sequence. Chert use peaked during the pre-Classic period, comprising nearly half of all the points from this time. Rhyolite was not commonly employed, but its use peaked during the Late Archaic period. Obsidian use was greatest during the Classic period in the study area, and other

researchers have also suggested that obsidian use peaked during the Classic period (Bayman and Shackley 1999; Peterson 1994:103; Rice et al. 1998:110).

CHAPTER 3: PREVIOUS RESEARCH IN SOUTHERN ARIZONA

Since the time Spaniards first came to the middle Gila River in A.D. 1694, foreigners have questioned the relationship between the prehistoric (i.e., Hohokam) and Akimel O’Odham populations (Fewkes 1912). Largely based on architectural differences between the Classic (ca. A.D. 1150–1450) and Historic periods (A.D. 1694–1950), early observers simply assumed the Akimel O’Odham must be recent migrants from elsewhere (Russell 1908:26–29). Similarly, material culture and settlement pattern shifts that occurred between the Pre-Classic (ca. A.D. 600–1150) and Classic periods were seen as evidence for the migration of an ethnic group termed the “Salado” (Gladwin and Gladwin 1930). Once again, material cultural changes between the Archaic and Pre-Classic periods were argued to result from the migration of external ethnic populations (Haury 1976:351).

However, beginning with salvage archaeology in the 1960s and intensifying in the 1970s with the advent of contract archaeology, more data became available and archaeologists began to increasingly dispute each of these migration models. Based on similarities between the archaeological record and ethnographic observations, researchers such as Ezell (1963) argued for cultural continuity from the Classic to the Historic periods. By the 1990s, the “Salado” were no longer regarded as an ethnic group that lived alongside the Hohokam, and ceramics that had been attributed to them were instead thought to be associated with a regional belief system (Crown 1994). Archaeologists have also

increasingly developed a consensus favoring *in situ* development of the Pre-Classic Hohokam from an Archaic base (e.g., Wallace 1997).

Although each of the migration models has been questioned, agreement does not exist regarding explanations for why these episodic changes in material culture occurred. This investigation compares projectile point patterning with other lines of evidence (e.g., ceramics and architecture) to improve our understanding of changing sociocultural dynamics between the Classic and Historic periods. This chapter begins with an overview of what is currently known regarding the culture history of the middle Gila River region.

Culture History Summary

This section briefly summarizes the culture history of the middle Gila Valley, and follows the background discussion that was developed to guide P-MIP research (e.g., Loendorf 2008a). More detailed overviews can be found in Bayman 2001; Berry and Marmaduke (1982), Bronitsky and Merritt (1986), Crown and Judge (1991), Fish 1989; Fish and Fish 2007, and Gumerman (1991).

Paleo-Indian and Archaic Periods

Human utilization of Southern Arizona spans the last 11,500 years. Nine main chronological periods are recognized, and each is characterized by different social and cultural attributes (Figure 3.1). Occupation during the Paleo-Indian period (ca. 10,000–8,500 B.C.) and Early Archaic periods (ca. 8,500–5000 B.C.) remains poorly defined in the study area (Huckell 1984a, 1984b). The first definitive evidence of human habitation along the middle Gila dates to the Middle Archaic period. Recent work on the GRIC (Bubemyre et al. 1998; Neily et al.

YEAR	PERIOD	PHASE
A.D. 1900	HISTORIC	-
A.D. 1800		-
A.D. 1700	PROTOHISTORIC	-
A.D. 1600		-
A.D. 1500	CLASSIC	Polovorón?
A.D. 1400		Civano
A.D. 1300		Soho
A.D. 1200	SEDENTARY	Sacaton
A.D. 1100		Sacaton
A.D. 1000	COLONIAL	Santa Cruz
A.D. 900		Gila Butte
A.D. 800	PIONEER	Snaketown
A.D. 700		Estrella/Sweetwater
A.D. 600	EARLY FORMATIVE	Vahki
A.D. 500		Vahki
A.D. 400		Vahki
A.D. 300		Vahki
A.D. 200		Red Mountain
A.D. 100	Red Mountain	Red Mountain
<<<<<<	<i>undefined</i>	<i>boundary</i>
100 B.C.	ARCHAIC	Late Archaic
500 B.C.		Early Agricultural
1000 B.C.		Early Agricultural
2000 B.C.		Early Agricultural
3000 B.C.	Middle	-
5000 B.C.		-
7000 B.C.	Early	-
9000 B.C.	PALEO-INDIAN	-
10,000 B.C.		-

Figure 3.1 Chronological periods and phases defined for the study area.

1999; Woodson and Davis 2001) has documented Middle Archaic period sites, and surface finds of projectile points suggest the widespread use of the Phoenix Basin during this time period (Loendorf and Rice 2004).

Beginning around 1500 B.C., the first agricultural villages appeared in the Sonoran Desert (Huckell 1995; Mabry 1998; Matson 1991; Diehl 2003; Sliva 2003). Similar pre-ceramic semi-sedentary horticultural settlements have not as yet been identified in the middle Gila Valley. It is likely, however, that any Early Agricultural period settlements within the study area were located along Holocene terraces with potential for floodwater agriculture, and these remains are therefore deeply buried in alluvium. The succeeding Early Ceramic period (roughly A.D. 1 – A.D. 550) is characterized by small seasonally occupied hamlets, and the initial production of plain ware (around A.D. 1), and red ware (around A.D. 450) ceramics (Doyel 1993; Mabry 1998; Wallace et al. 1995; Whittlesey and Ciolek-Torrello 1996). However, ceramics were not as widely used as they were at later Hohokam sites, and the range of types produced was comparatively limited (Whittlesey and Ciolek-Torrello 1996). Specialization in ceramic production began around A.D. 450 when potters in the eastern South Mountain vicinity fabricated most of the vessels used along the lower Salt River (Abbott 2009).

Hohokam Pre-Classic

Based on the many antecedents that have been identified, researchers have developed a consensus favoring *in situ* development of the Hohokam from Archaic populations (Bayman 2001; Cable and Doyel 1987; Doyel 1991; Wallace

1997; Wallace et al. 1995; Wilcox 1979). The Pioneer period of the Hohokam sequence traditionally included the Vahki, Estrella, Sweetwater, and Snaketown phases (Gladwin et al. 1937; Haury 1976). However, researchers now agree that the Vahki phase is more consistent with Early Formative developments in southern Arizona, and they place the beginning of the Pioneer period around A.D. 550/650 with the introduction of decorated ceramics in the Estrella phase (Ciolek-Torrello 1995; Mabry 1998; Wallace et al. 1995; Whittlesey 1995). For the next five centuries, residents of the lower Salt River appear to have received most of their decorated ceramics from the middle Gila River (Abbott 2009:552). The Hohokam tradition initially appeared in the Phoenix Basin and was characterized by the development of large-scale irrigation agriculture, red-on-buff pottery, a distinctive iconography, exotic ornaments and artifacts, a cremation mortuary complex, and larger as well as more complex settlements (Fish 1989; Howard 2006).

During the Colonial period (ca. A.D. 700 – 900), village structure became more formalized and groups of houses were arranged around central courtyards where a variety of extramural activities were undertaken (Howard 2000; Wilcox et al. 1981). Villages were comprised of several courtyard groups that were organized around a large central plaza, which was a place for communal gatherings and frequently included a cemetery (Abbott and Foster 2003:25; Fish 1989:20; Howard 2006; Wilcox et al. 1981). The geographic range of the Hohokam expanded during this period, and ballcourts appeared (Bayman 2001;

Wilcox and Sternberg 1983). Agricultural intensification occurred in the subsequent Sedentary period, a time when marketplaces may have emerged and the ballcourt system reached its maximum extent with over 230 courts spread across much of central and southern Arizona (Abbott et al. 2007; Abbott 2009; Bayman 2001; Dean 2003; Howard 2006; Marshall 2001a).

Hohokam Classic Period

The transition between the Pre-Classic and Classic periods was marked by many dramatic changes in Hohokam society (Bayman 2001; Doyel et al. 2000:222). During this interval, between roughly A.D. 1100 and 1200, the Hohokam regional system appears to have weakened (Abbott et al. 2007). Transitions in Hohokam cultural traditions that occurred at this time include a shift in burial practices from cremation to inhumation, semi-subterranean pit-houses were replaced with surface structures, courtyard groups were enclosed with compound walls, a reduction occurred in red-on-buff manufacture while red ware pottery production increased, and extensive alterations occurred in regional exchange networks (Abbott 2009; Abbott et al. 2007; Bayman 2001; Crown 1991; Doyel 1980, 1991). The Classic period has been divided into the Soho (around A.D. 1150/1200–1300) and Civano (around A.D. 1300–1450) phases. The Soho phase saw the construction of platform mounds, a type of communal architecture that replaced the ballcourt system, which fell from use near the end of the Sedentary period (Abbott 2003; Abbott et al. 2007; Bayman 2001; Elson 1998).

The end of the Classic period around A.D. 1450 was marked by the collapse of the platform mound system and the abandonment of Hohokam sites along the lower Salt River and in the Tonto Basin (Hegmon et al. 2008; Ravesloot et al. 2009). Considerable debate exists regarding the cause or causes of this population decline, as well as the relationship between the Hohokam and subsequent people (i.e., Akimel O’Odham) who lived in the area (Bayman 2001; Reid and Whittlesey 1997; Hegmon et al. 2008; Ravesloot et al. 2009). Researchers generally agree that Hohokam populations along the lower Salt began to decline in the 1300s, and have offered many explanations for why this occurred including salinization of fields, the introduction of European diseases, overpopulation with resulting environmental impacts, conflict with the Apache, warfare within Hohokam society, rigidity traps, and various aspects of climatic conditions such as flooding or drought (Abbott 2003; Bayman 2001; Dean 2000; Ezell 1983; Haury 1976; Graybill et al. 2006; Grebinger 1976; Hegmon et al. 2008; Meegan 2009; Mindeleff 1897:13; Ravesloot et al. 2009; Redman 1999; Reid and Whittlesey 1997; Tainter 1988:46-47; Weaver 1972; Wilcox 1989). These explanations are not mutually exclusive, and as will be further explored in the following research, it appears that a combination of factors lead to the dramatic changes that occurred between the Classic and early Historic periods.

Hohokam-Akimel O’Odham Continuum

The relationship between the Classic period Hohokam and the Akimel O’Odham has been contested since the first written descriptions of the middle

Gila River area were completed in the late 1600s (Fewkes 1912). Based on the assumption that Classic period adobe structures such as Casa Grande were superior to the brush houses that the Akimel O'Odham built, the early Spanish observers concluded that the Akimel O'Odham were recent migrants. They argued instead that the Aztecs, who abandoned the area and moved south, built Casa Grande.

The subject of who constructed Casa Grande has continued to interest travelers since these first descriptions. For example, Cozzens (1874:194-195), who visited in 1859 said:

What race of people dwelt here? By whom were these decaying walls erected? Who constructed the many thousand miles of acequias [canals]? How did they live, and where are they now? are [sic] questions that suggest themselves at every step; and as yet they have never been satisfactorily answered. It seems to me that our government ought to take some measures towards solving this great mystery, as well as preserving these monuments of an extinct people.

Until recently, almost all outside observers who speculated on the relationship between the builders of Casa Grande and the Akimel O'Odham have focused on the differences between Historic period construction techniques and Classic period architectural styles, which are themselves a departure from the long-standing structural forms of the Hohokam Pre-Classic period. Similar changes in construction styles, settlement patterns, subsistence techniques, and

material culture also occurred earlier in time along the middle Gila River, and few researchers have considered the possibility that these periodic fluctuations are part of broader patterns of cultural change.

Most early observers also focused almost exclusively on the differences in architecture, and they ignored the many other similarities in material culture between the Classic and Historic periods. However, Emory (1847:133-134), who was one of the first people from the United States to visit the O'Odham villages along the middle Gila, is an exception. He said:

Wherever the mountains did not impinge too close to the river and shut out the valley, they [ruins] were seen in great abundance, enough, I should think, to indicate a former population of at least one hundred thousand...

Based on what he observed along the Middle Gila, Emory (1847:133) goes on to say:

My own impression, and it is stated so in my journal, is that the many ruins we saw on the Gila might well be attributed to Indians of the races we saw in New Mexico, and on the Gila itself. I mean by the last, the Pimos [Akimel O'Odham], who might easily have lost the art of building adobe and mud houses. In all respects, except their dwellings, they appeared to be of the same race as the builders of the numberless houses now level with the ground of the Gila River.

At the time this conclusion was almost universally rejected, and it wasn't until the 1960s that the possibility of a Hohokam and Akimel O'Odham continuum gained favor. Ezell (1963, 1983) examined material cultural traits and found both similarities and differences between the prehistoric and Historic period people who lived along the middle Gila. For example, he argued that while Akimel O'Odham architecture and settlement patterns differed from those of the Classic period, the Historic period patterns were more similar to those of the Pre-Classic period (Ezell 1963:62). Based on his analysis of the data available at the time, Ezell (1963:65) concluded that Akimel O'Odham could provisionally be considered to be related to the Hohokam.

By the 1990s, a measure of consensus among archaeologists was reached that the Akimel O'Odham are related to the Hohokam. For example, Gilpin and Phillips (1998:117) suggested:

The Hohokam and Saladoan archaeological cultures were transformed into historic Piman culture, involving a shift from irrigation-based, centralized communities [snip] to dispersed rancheria settlements, with concomitant changes in subsistence, social organization, architecture, and other aspects of material culture, although the timing, causes, and specifics of these changes are poorly understood.

However, some researchers continue to argue that the Akimel O'Odham are recent migrants to the middle Gila that completely or partially replaced the Hohokam populations. Rea (2007), for example, maintains that older members of

the GRIC do not believe they are related to the Hohokam; however, Rea did not begin his work until the 1960s, and many other observers have argued that the Akimel O’Odham recognize descent from the Hohokam. For example, George Webb (1959:53) an Akimel O’Odham from Gila Crossing who was born in 1893 said, “I think, as all Papagos and Pimas, that we are their [the Hohokam] descendents”. Furthermore, prehistoric sites play a prominent role in Akimel O’Odham traditions and close similarities between the prehistoric record and these stories are unlikely to have occurred by coincidence (Lewis and Rice 2009; Teague 1993). The following research further explores this debate and introduces previously under-utilized lines of evidence to this discussion.

The Protohistoric

The Protohistoric period (ca. A.D. 1500 – A.D. 1700) is generally defined as the time between the end of the Hohokam Classic period and Spanish contact (Wells 2006; Whittlesey et al. 1997:185). In contrast to the prehistoric periods and phases, the Protohistoric is defined based on an external event (the arrival of Europeans in the New World) rather than changes in material culture of the region. As a result, the Protohistoric period remains poorly defined throughout southern Arizona. There is a small sample of excavated material, poor chronometric control, and a cohesive interpretive framework does not exist for these remains (Ravesloot and Whittlesey 1987; Wilson 1999; Wells 2006). Therefore, the Protohistoric is not separated as a distinct period in the following research.

Akimel O’Odham Historic Period

The Historic period is traditionally defined to encompass the time between A.D.1694 to 1950 for which written records exist. The first definitive European contact occurred in A.D. 1694 when Father Kino visited the Akimel O’Odham villages along the middle Gila River (Ezell 1961, 1983; Russell 1908; Wilson 1999; Darling et al. 2004). The Akimel O’Odham did not experience intensive colonial contact during the Hispanic era (A.D.1694–1853), and exchanges instead were limited to parties traveling through the territory or community members visiting settlements to the south. Nevertheless, the Akimel O’Odham were affected by introduced European elements such as new cultigens (e.g., wheat), religious practices, livestock, metal, and especially disease (Ezell 1961, 1983; Shaw 1994; Wells 2006).

The American era (A.D. 1853–1950), began in 1853 with the Gadsden Purchase, when southern Arizona became part of the United States (cf. Ezell 1983). Euroamerican contacts with the Akimel O’Odham in the middle Gila Valley increased after 1846 as a result of the Mexican-American War (Dejong 2009). New markets were developed to supply grain to the military as well as to immigrants heading for California, and the Akimel O’Odham experienced a period of prosperity (Dejong 2009; Doelle 1981; Ezell 1983; Hackenberg 1983; Russell 1908). Thereafter, interaction between Native American groups and Euroamerican settlers became increasingly tense, and the U.S. Government adopted a policy of

pacification and reservation confinement of Native Americans (Spicer 1962). The GRIC was established in 1859.

The following years saw the arrival of large numbers of Euroamerican migrants to upstream locations along the Gila as well as along the lower Salt River (Dejong 2009). Uncertainty and variable crop yields led to major settlement reorganizations, including the movement of some Akimel O’Odham and Pee Posh to the lower Salt River (Webb 1959:45-46). The establishment of agency headquarters, churches and schools, and trading posts at Casa Blanca and Sacaton during the 1870s and 1880s led to the growth of these towns as administrative and commercial centers at the expense of others (Wilson 1999; Webb 1959:49-52). By 1898 agriculture had nearly ceased within the GRIC, and although some Akimel O’Odham drew rations, woodcutting was the principal livelihood (Shaw 1994:122). The first allotments within the GRIC were established in 1914. Each male who was the head of a household was assigned a 10-acre parcel of potentially irrigable land located within districts watered by the Santan, Agency, Blackwater, or Casa Blanca projects on the eastern half of the reservation. In 1917, the allotment size was doubled to include a secondary usually non-contiguous ten-acre tract of grazing land.

The most ambitious attempt to rectify the economic plight of the Akimel O’Odham in the early 1900s was the San Carlos Project Act, which authorized the construction of a water storage dam on the Gila River (Pfaff 1994, 1996). However, the San Carlos Project failed to revitalize the O’Odham farming

economy and never provided sufficient water to the community (Hackenberg 1983). Over the years, the U.S. Government placed severe acculturative pressures on the Akimel O’Odham that caused changes in nearly every aspect of their lives. Since World War II, however, the Akimel O’Odham have experienced a resurgence of interest in tribal sovereignty and economic development. The community has now become a self-governing entity, developed several profitable enterprises in fields such as telecommunications and has built several casinos. The tribe has also worked to revitalize their farming economy by constructing a water delivery system across the reservation (Ravesloot et al. 2009).

The researchers who have developed this culture history have paid comparatively little attention to projectile points from the Sonoran Desert, especially those made after the appearance of decorated ceramics sometime around A.D. 600. Stone projectile point data, however, provide essential insight for reconstructing patterns of social conflict and cooperation in the study area during late prehistory. The following discussion considers analytical approaches that have been previously applied to projectile points.

Projectile Point Analysis

Archaeologists have offered many explanations for why flaked-stone projectile points varied over time and space (Shott 1996). Suggested sources of apparent synchronic or diachronic variation include: differences among cultural or social groups; raw material constraints; use-wear or reworking after breakage; variation in motor skills of the makers; low standards of conformity to ideals;

random drift as a function of time or space; measurement or classification error by researchers; variation in propulsion technology (e.g., atl-atl to bow); toy point variants (Bonnichsen and Keyser 1982); pragmatic modifications to facilitate hafting (Flenniken and Raymond 1986:606); change in mechanical stress factors (Shott 1996:281); point types made for ritual or mundane purposes (Haury 1976:297); durability concerns (Cheshier and Kelly 2006); variation in cultural transmission modes (Mesoudi and O'Brien 2008); differences related to functional requirements such as hunting or warfare (Ahler 1992); and change in ballistic performance requirements (Shott 1996).

These mechanisms for differentiation and change are not mutually exclusive. Instead, more than one of them must have affected variation among stone points. Until recently, however, archaeologists largely analyzed points with the often tacit assumption that patterns they could measure were essentially a direct reflection of cultural differences (Mason 1894:655; Whittaker 1994:260-268). Comparatively little attention was paid to the functional aspects of projectile technology and the role that performance played in technological change.

Style and Function

Researchers have long debated the meaning of the term “style,” and most lithic analysts now recognize style as something that is conceptually separate from “function” (Brantingham 2007; Carr 1995; Clark 1989; Hoffman 1997:42-65; Kooyman 2000:7; Whittaker 1994:270). “Style can be conceptualized as an axis of variability (or causal vector) free to vary independently of function, raw

material and other factors” (Clark 1989:32). Further, lithic artifact style can be a passive and unintentional reflection of culture, or it can be a deliberate expression that has an invested symbolic component (Kooyman 2000:96).

There are also two main aspects to how function has been implicitly or explicitly defined. First, the “function” of a tool can be operationalized as the task or tasks that the tool was designed to perform. This definition emphasizes the intent of the maker rather than realized uses of the object, whereas the second characterization focuses on the task or tasks for which a specific tool was actually employed. Design theory is focused on understanding function in the former sense, whereas usewear and residue analyses are generally employed to address lithic use in the latter sense (Odell 2003:135–173).

In general, archaeologists have concentrated their research on cultural aspects other than functional variation, and as a consequence, they have tended to focus on the identification of style rather than facets perceived to be functional traits. In practice, however, it may be impossible to separate stylistic and functional aspects of artifacts, and understanding diachronic morphological variation requires consideration of both function and style (Brantingham 2007; Carr 1995). For example, changes through time in the appearance of projectile points may have occurred as a result of variation in the frequency of the tasks points were designed to perform. Stone projectile points were often designed differently for hunting and warfare (Ellis 1997:45; Justice 2002:38–44). Those intended for the former activity have aspects of design that facilitated secure

hafting (e.g., notches), whereas those designed for the latter activity lacked notches or had thick stems that were intended to split the shaft on impact (Keeley 1996:52). Thus, diachronic patterns in the frequency of unnotched projectile points could be related to temporal variation in the intensity of conflict. Seen from this perspective, the increasing incidence of unnotched projectile points over time at Ventana Cave (Haury 1950:268), would suggest a general diachronic trend in the intensity of warfare in southern Arizona.

At the same time, other aspects of projectile point morphology that may change over time are more closely related to stylistic variation in the sense that these differences are unrelated to variation in function (either intended or actual). Unintentional flake scar patterns on points caused by habits of manufacture, for example, have been shown to be effective for distinguishing the work of individual knappers, and these differences are less likely to have functional aspects (Whittaker 1994:292–298). Synchronic variation in serration data among points from the Hohokam region also suggests this practice may have been more closely related to stylistic expressions rather than functional aspects (Hoffman 1997).

Sackett (1982, 1985, 1986, 1990) used the terms *isochrestic* and *iconological* to distinguish respectively between such unintentional and intentional expressions of style. He defined isochrestic style as choice among functionally equivalent alternatives, which is generally an unintentional expression of cultural identity that results primarily from passive enculturation

and interaction among groups of artisans. He argued that isochrestic style is embedded within functional variation, because this type of style is created by specific production strategies and manufacturing techniques for achieving functional ends. Sackett (1982, 1985, 1986, 1990) used the term iconological style for referring to intentional expressions of cultural identity, and he argued that media such as lithic artifacts are unlikely to generally be used to convey such messages.

Following the work of Wobst (1977), Wiessner (1983, 1985, 1990) defined two different types of style where artifacts are consciously employed to communicate information (i.e., iconological style). She used the term *emblemic style* to refer to intentionally codified cultural information, and *assertive style* to refer to personal expressions of identity created by the artisan who made the artifact. Wiessner (1983) studied San arrows from the Kalahari and argued this media was well suited for communicating cultural information because arrows had social, economic, and symbolic importance in San society. Emblemic and assertive stylistic expressions most commonly occurred on the shaft of the arrow, which is the most visible portion.

Projectile Point Use-Life

Constraints imposed by raw material characteristics, manufacturing techniques, projectile use, and the reworking of broken points may all affect the morphology of Hohokam stone points (Hoffman 1997:91). As a result, in order to analyze the style and function of projectile points it is also necessary to consider

other variables that affect the appearance of stone tips. Every projectile point goes through a production and use process that defines its history of manufacture and employment as a tool (Geneste and Maury 1997). This includes procurement of the raw material, making the tool, use of the artifact, maintenance strategies that are designed to prolong life, and finally the intentional discard or loss of the projectile point (Hoffman 1997:83–93). Recognizing the potential effects of these stages is essential for understanding projectile point morphological variation. In this research, raw material procurement strategies and constraints are addressed through the analysis of obsidian sources that were used to make projectile points. The discussion below considers the morphological stages a point goes through during the manufacturing process, and describes how unfinished points were recognized and classified as such during analysis of the collection.

As will be discussed further in Chapter 4, the reworking or maintenance of fragmented arrow points is unlikely to have occurred for several reasons. First, the highly brittle nature of the stone that was preferred to make projectile points (e.g., obsidian) and the fact that these artifacts were designed to be fired at high velocities is likely to have resulted in catastrophic breakage, rather than incremental wear or slow dulling of the point edges from repeated use. Studies have shown that “[w]hen a stone point is bound to a shaft with a ligature tightly enough to prevent recoil, it often breaks into several fragments” when used (Knecht 1997:203). “These fragments usually are not suitable for reworking” (Knecht 1997:203). Second, the stone points considered here are generally small

(usually less than 20 mm in length), which limits the extent to which broken fragments can be reworked into useful tools of any type. Third, reworking broken points will negatively impact the performance characteristics of the weapon. Fourth, manufacturing a stone arrow point can be completed in a short period of time, and reworking broken points will result in a minor energy savings (Mason 1894:670). Fifth, some point styles were designed to detach from shafts and it is therefore probable that use of the arrow will result in disassociation of the point, which consequently is unlikely to have been recovered for reworking or reuse (see Chapters 4 and 6).

At the same time, reworking of projectile points occasionally occurred, and there is evidence for this practice in the P-MIP collection. It is argued here, however, that when reworking did occur it was generally at a substantially later date. Evidence for reworking and reuse in the P-MIP point collection was recorded in several ways. First, every point was examined for use-wear. The nature of the wear, worn locations, as well as the intensity of wear were recorded. Second, characteristics that suggest the point was reworked were coded for each artifact. These include abrupt changes in the angle of the blade margins, differential patination on flake scars, evidence for previous haft elements (e.g., partial notches at the base of a point that was re-notched higher up the blade), systematic differences in the reduction technique or the edge angle of retouch, and variation in flake scar patterns.

Table 3.1 presents use-wear and reworking frequencies by point size. Projectile points with macroscopic evidence of use are rare in the collection, and less than two percent of all points have wear. Although the sample sizes are small, large points more commonly have use-wear (5.3 %) than small points (.4 %), Yates corrected *Chi-Square* = 23.2, $p < .001$. Reworking was more common, but less than seven percent of all points have evidence of this practice. Large points were significantly more commonly reworked (12.8%) than small points (3.9%), and the Yates corrected *Chi-Square* is 23.3, $p < .001$. These data suggest that large points were more commonly reused for other tasks, and small arrow points were only rarely reworked.

Table 3.1 Use-wear and Reworking by Point Size

Point Size	Use-Wear				Reworking			
	Present		Absent		Present		Absent	
	Count	%	Count	%	Count	%	Count	%
Small Point (Arrow Tip)	3	0.4%	683	99.6%	27	3.9%	658	96.1%
Large Point (Atlatl Tip)	14	5.3%	248	94.7%	33	12.8%	224	87.2%
TOTAL	17	1.8%	931	98.2%	60	6.4%	882	93.6%

*Excludes artifacts of indeterminate size, use-wear, and/or reworking.

While it is possible that some reworked points do not have macroscopic evidence of this process, if broken points were commonly reworked unless they were too small, then nearly complete points that are only missing small fragments and could therefore have been readily reworked should rarely occur in the sample.

Table 3.2 shows, however, that 17.4 percent of the collection consists of projectile points that are only missing small fragments, and could have theoretically been easily reworked. Small points are not significantly more likely to be whole than large points (Yates corrected *Chi-Square* = 2.7, $p = 0.1$), and slightly more small points are complete (50.7 percent) than large points (44 percent). As will be discussed further below in Chapter 4 and tested in Chapter 6, breakage patterns appear to be more closely associated with point design variations.

Table 3.2 Point Completeness by Size

Point Portion	Small Point (Arrow Tip)		Large Point (Atlatl Tip)		TOTAL	
	Count	%	Count	%	Count	%
Whole	349	50.7%	117	44.5%	466	48.9%
Nearly Whole	118	17.1%	48	18.3%	166	17.4%
Base	122	17.7%	39	14.8%	161	16.9%
Midsection	42	6.1%	22	8.4%	64	6.7%
Tip	45	6.5%	30	11.4%	75	7.9%
Longitudinal Fragment	7	1.0%	4	1.5%	11	1.2%
Small Fragment	6	0.9%	3	1.1%	9	0.9%
TOTAL (row percents)	689	72.4%	263	27.6%	952	100%

*Excludes artifacts of indeterminate size and/or fragment portion.

Production Sequence

Before discussing projectile point design theory in the following chapter it is important to consider the potential effects of including point preforms in analyses with completed artifacts. The fact that most of the materials archaeologists analyze consist of discarded trash is often not considered, and

previous lithic analyses in the Hohokam region frequently have not distinguished between finished points and those where manufacturing was stopped prior to completion. Failure to differentiate production stages results in the misclassification of point preforms as other tool types, and the inclusion of artifacts that were not fully formed as types in classification schemes. These misclassifications alter the apparent variation in point data, as well as interpretations of stone tool use.

To make a projectile point it is necessary to go through a reduction process that can be classified into a series of steps. Whittaker (1994:153–159) defined four stages in this process, which were simplified to three categories (early, nearly completed, and finished) for the current analysis. In addition, Whittaker defines Stage 0 as selecting a suitable blank for the desired point. This blank must be larger than the intended size of the point and should be relatively flat. This step is referred to as “Stage 0 because it is not possible to recognize an unworked blank in archaeological sites” (Whittaker 1994:153).

In this analysis, several characteristics were employed to distinguish point preforms from completed points, including the presence of step fractures and/or steep edge angles that would preclude further thinning, symmetry, as well as the presence or absence of use-wear. Preforms were classified as either early stage or nearly completed (late stage). Early stage preforms were defined as relatively flat artifacts with invasive retouch on one or more margins. These artifacts lack macroscopically visible use-wear and are more irregular than late stage preforms

or completed points. It is often difficult to distinguish early stage preforms from a variety of different artifact classifications including unifaces, scrapers, and bifacial knives.

Nearly completed points were defined as relatively small artifacts with invasive bifacial retouch on more than two margins. These artifacts also lack use-wear. Because notches are generally added in the final manufacturing stages (Whittaker 1994:159), it is frequently difficult to separate completed points that lack notches from late stage preforms that were discarded prior to notching. Step fractures and/or edge angles were in part used to differentiate discarded late stage preforms from completed points. Irregular edges and an overall lack of symmetry were also employed to separate late stage preforms from completed points.

Hohokam Region Lithic Analyses

Archaic period point styles in southern Arizona are comparatively well established (Sliva 1997; Justice 2002). However, there is not a similarly agreed upon classification scheme for points from the Ceramic period. Instead, Hohokam collections are generally typed based on *ad hoc* criteria, on a project-by-project basis. Consequently, little consistency exists among previous typologies for Hohokam projectile tips.

Most studies of stone points from the study region have tended to focus on only a few attributes (e.g., the presence or absence of notching) within collections. Sayles (Gladwin et al. 1937) was one of the first researchers to classify Hohokam points recovered from initial excavations at Snaketown. His system defined seven

classes that were based on differences in morphology as well as perceived temporal associations. Subsequent researchers did not systematically employ the types he suggested. Crabtree (1973) completed the first detailed technological analysis of Hohokam points. The intent of his research was the identification of specific manufacturing techniques and consideration of the craftsmanship quality. He argued that the skill necessary to produce certain styles suggests specialization by individuals in the production of projectile points. Following researchers also failed to adopt the classification system proposed by Crabtree.

Subsequent typologies of Hohokam projectile points have been largely descriptive (e.g., Bernard-Shaw 1988; Hoffman 1988; Montero 1993; Peterson 1994; Rozen 1984), and the functional as well as temporal systematics of Hohokam points have received less attention (although see, Craig 1992; Justice 2002; Sliva 1997; Marshall 2001b). For example, Bernard-Shaw (1988) employed a taxonomic system to classify Sedentary to Classic period points from Las Colinas. This system employed the presence or absence of serration, notches, tangs, and basal concavity to differentiate the points. In addition, a separate style was employed for points that were thought to have been reworked.

Peterson (1994:103) observed, "...many studies have dealt with relatively small collections from single-component sites." This factor when combined with the availability of better age estimates from other lines of evidence (particularly ceramics), probably accounts for the general lack of emphasis placed on the temporal sequencing of Hohokam points. Furthermore, the Hohokam produced

more than one point shape at a given time, which also complicates the identification of temporally relevant types.

The typology developed by Hoffman (1997) was designed for the classification of Pre-Classic Hohokam points, and thus is of limited relevance for the present analysis. He was primarily concerned with synchronic rather than diachronic variation among Hohokam projectile points. His intent was to “address questions about the ethnic and/or linguistic diversity of regional Hohokam populations, and their potential organization into one or more alliances” (Hoffman 1997:iii). His analysis employed collections from three geographical areas, including the middle Gila River (i.e., Snaketown collections), the lower Salt River, and the Gila Bend area. “Most of the points were recovered in mortuary contexts, although a few points associated with domestic and trash contexts are also included” (Hoffman 1997:162). His focus on points from mortuary features creates additional incompatibilities with the current study, which does not include points from these contexts. Hoffman identified quantitative variation among these three geographical areas that he interpreted as evidence for social variation among them.

More recently, Justice (2002) reviewed Southwestern archaeological research and defined projectile point styles based on both regional and temporal variation. He identified three style “clusters” that occur on the middle Gila during the Ceramic period, including the “Western Triangular Cluster,” the “Snaketown Cluster,” and “Pueblo Side Notched Cluster” (Justice 2002). However, examples

of many small point styles he defines for the Southwestern region are present among the collection considered here, while at the same time several styles he suggests typify the Hohokam are rare in the P-MIP survey data (Loendorf and Rice 2004). In addition, styles in his typology are not systematically differentiated and he did not employ a taxonomic classification system, which complicates comparison of these types.

A further factor complicating comparisons with the various samples considered by previous Hohokam researchers is that these collections are generally derived from a variety of archaeological contexts, whereas the present study is focused on surface data. In particular, previous analyses of large Hohokam collections include substantial numbers of points from mortuary assemblages, whereas these contexts are under-represented in the collection considered here. Points associated with burials frequently differ markedly from those recovered in other contexts, and individual interments may be associated with large numbers of highly similar projectile points (e.g., Loendorf 1997; McGregor 1943; Peterson 1994; Vint 2005; Whittaker 1987). This variation has been variously interpreted (e.g., the points from mortuary contexts are sometimes assumed to be too large or fragile for use), but whatever its source, failure to control for recovery context affects comparisons across time and space to the extent that sampled contexts are not uniformly distributed across these dimensions.

Most recently, Sliva (2006) attempted to define temporal variation in a projectile point collection from Northern Arizona, and concluded "...the primary differences in projectile point style appear to be related more to culture than to temporal variation...". She examined data from Anasazi, Hohokam, Mogollon, Cohonina, and Sinagua sites in order to better define both regional and temporal variation in projectile point styles. She found that simultaneous shifts occur in projectile point style across much of Arizona during the ceramic era (Sliva 2006:63). She found greater variability existed in point styles from A.D. 950-1150, while increased stylistic homogeneity occurs across Arizona during the A.D. 1150 – 1350 interval. She suggested this patterning "may be related to increasing levels of population movement and conflict that have been postulated for the region during this time" (Sliva 2006:63).

Lithic Raw Material Studies

Identification of source locations for materials at archaeological sites provides data that allow evaluation of many aspects of prehistoric societies. Lithic material studies have been employed to infer mobility patterns, inter-regional contacts including migration, and trade or exchange networks (Kooyman 2000:136–149; Odell 2003:89–90). Much of the work on lithic diversity has been directed toward research questions associated with settlement strategies, especially the degree of sedentism. "[S]ome researchers believe that non-local raw materials are more likely to be found on shorter-duration sites than on longer

duration sites” (Andrefsky 1998:219–220), and lithic raw material diversity is also similarly suggested to be associated with occupation length.

Colin Renfrew (1977:72–78) suggested the “Law of Monotonic Decrement” to describe the negative correlation he observed between distance from the source and the quantity of material, and lithic researchers generally expect that stone abundance should decrease with distance from the source. In addition to decreasing in quantity, studies have demonstrated a relationship between source distance and cortex percentages on artifacts, and a general tendency for greater reduction of stone from distant locations (Odell 2003:196). Some researches have used perceived distance decay relationship deviations to infer territorial areas for mobile groups. For example, Goodyear (1989) observed that many Paleo-Indian sites have substantial quantities of non-local lithic material from up to 200 km away, and he argued that the distance to these sources indicated the size of the band territory. Variations from expected distance relationships are also sometimes argued to indicate a raw material had a special ritual or social significance (Kooyman 2000:147).

For many reasons, much of the lithic analysis literature has focused on research issues associated with mobile hunter-gatherers, and lithic studies of sedentary agricultural societies have received less attention (Odell 2003:202; Whittaker 1994:291). The “neutral model” for lithic acquisition developed by Brantingham (2003), for example, is based on assumptions that are not applicable to sedentary populations. The model assumes random and complete mobility with

a limited amount of material that can be transported. Sedentary populations in contrast have a fixed location in space where materials can be accumulated and logistical forays or other mechanisms are required to bring items to that location (Binford 1979). Research by Barton (1998) suggests that the effective local lithic abundance is controlled as much by human land-use patterns as it is by absolute raw material distributions, and mobility patterns consequently affect both the density of artifact accumulations and the intensity of lithic reduction. Patterning observed by Riel-Salvatore and Barton (2004), suggests the importance of controlling for raw material variation in order to better distinguish technological patterns.

In situations where a fully sedentary settlement pattern is apparent from additional lines of evidence (e.g., substantial and persistent architecture), archaeologists have often simply assumed that raw materials from distant sources (e.g., those further than a days travel) arrived at sites as the result of trade relationships. In order to demonstrate that trade or exchange occurred, however, researchers must address three primary issues (Odell 2003:209). First, it is necessary to reliably establish the source of raw materials. Second, the manufacturing location for the product must be identified. Third, the mechanism for material displacement must be established.

While analyses of the first two factors have often produced widely agreed upon results, demonstrating the third aspect has proven more difficult and controversial. For example, some researchers have argued that the presence of

unworked exotic raw materials indicates direct access, whereas finished goods of non-local materials at a site that lacks manufacturing debris are taken as evidence for trade (Bayman and Shackley 1999:842). While the latter may be possible evidence for trade, the former does not necessarily indicate direct access to sources because raw materials as well as finished products can be exchanged (Peterson et al. 1997:236).

Examination of distance decay relationships is one method archaeologists have employed to suggest different mechanisms for material transport (Kooyman 2000:136–140). Within the supply zone, for example, “direct access should result in a slightly curved, almost linear, decline in quantity with distance” (Kooyman 2000:139). In contrast, “[d]own-the-line reciprocal exchange should be similar in shape, since distance and number of exchanges in the chain are really the only factors effecting the exchange, but the decline with distance from the source should be much more rapid and so the slope of the line will be steeper” (Kooyman 2000:139). While the slopes of the lines are expected to vary, exchange relations should distribute materials over a larger area, whereas with direct access material densities rapidly fall to zero after the limit of the supply zone.

Analytical problems exist when comparing archaeological data with hypothetical distance decay relationships; some major issues include the following. First, this approach requires data from many sites, but archeologists rarely have information from contemporaneous components that are also spread uniformly across the landscape at evenly varying distances from a given source.

More often, data from just a few or even one site are available, site data may cluster in groups at similar distances, and/or sites at varying distances are from different time periods. Second, different raw material acquisition mechanisms are not necessarily mutually exclusive, and multiple approaches may have been taken even at a given moment in time. Third, the slopes of distance decay correlation lines are related to many variables, including such things as transport costs (i.e., transporting goods over land versus water or with human porters versus pack animals), in addition to the nature of trade or exchange interactions.

Another factor demonstrated by Brantingham's (2003) simulation, is the effect of raw material density and distribution in the environment on both material diversity at sites as well as distance decay relationships. Despite these limitations, examination of the relationship between material quantities and distance to the source provides useful information regarding the movement of goods on the prehistoric landscape. The following discussion explores obsidian source characterizations, tool manufacturing locations, and transport mechanisms in the Hohokam region of southern Arizona.

Socioeconomic Interactions and Obsidian Procurement

Study of the intersocietal movement of goods is one of the primary methods archaeologists have employed to identify prehistoric interaction systems at different scales from the local to the regional (Shortman and Urban 1992:236). Exchange patterns reflect community and regional economic, ideological, and political interrelationships (Simon and Gosser 2001:220). In order to understand

the nature of exchange relationships it is necessary to consider a number of factors including, value of the item, the number and type of transactions between the source and the consumer, size of the distribution area, the effects of competition, and “the social and cultural meaning of the goods” (Kooyman 2000:140). Archaeologists have developed ways to measure facets of exchange relationships in part by analyzing goods such as obsidian, which has properties that are ideal for the study of socioeconomic interaction patterns in Arizona.

Southwestern Obsidian Source Identification

Obsidian is well suited for the study of socioeconomic interaction patterns in central Arizona because: 1) obsidian is a desirable, but not ubiquitous, material for small point manufacture (Figure 3.2); 2) obsidian sources are generally localized deposits that are also abundant; 3) obsidian does not naturally occur in the study area, but sources are present to the north, south, east, and west; 4) obsidian has physical properties that allow source areas to be objectively defined with a high degree of precision. Because of these characteristics, diachronic and synchronic patterning in obsidian acquisition has been employed to address economic, political, and ideological aspects of Hohokam society.

Source geochemical characterization is the initial step in the reconstruction of human exploitation patterns for obsidian. In the last three decades, Shackley (1988, 1990, 1995, 2005) has identified sources of both calc-alkaline and peralkaline obsidian in western New Mexico, Arizona, Nevada, California, Baja California, and Sonora (Figure 3.3). These relate to silicic

volcanism that occurred during two periods, the middle to late Tertiary and the Quaternary. Both the geologic age and location of sources are important factors in raw material utilization for projectile point manufacture.



Figure 3.2. Examples of obsidian flakes, marekanites, and projectile points.

In general, older sources tend to be composed of small remnant obsidian nodules known as *marekanites* or “Apache Tears” located in primary and secondary deposits mixed with devitrified, perlitic obsidian that appears mainly at the primary deposit or in volcanoclastic sediments. Perlite is unsuitable for tool production. Marekanites, however, are a common source of volcanic glass. Marekanites are small residual obsidian fragments that occur both at the source and in streambeds or alluvial deposits away from the flow zone. Obsidian in this form

typically has low-fracture toughness, but due to the small nodule size, tool size is limited and reduction is generally bipolar (Shackley 1990; 1992; 2005).

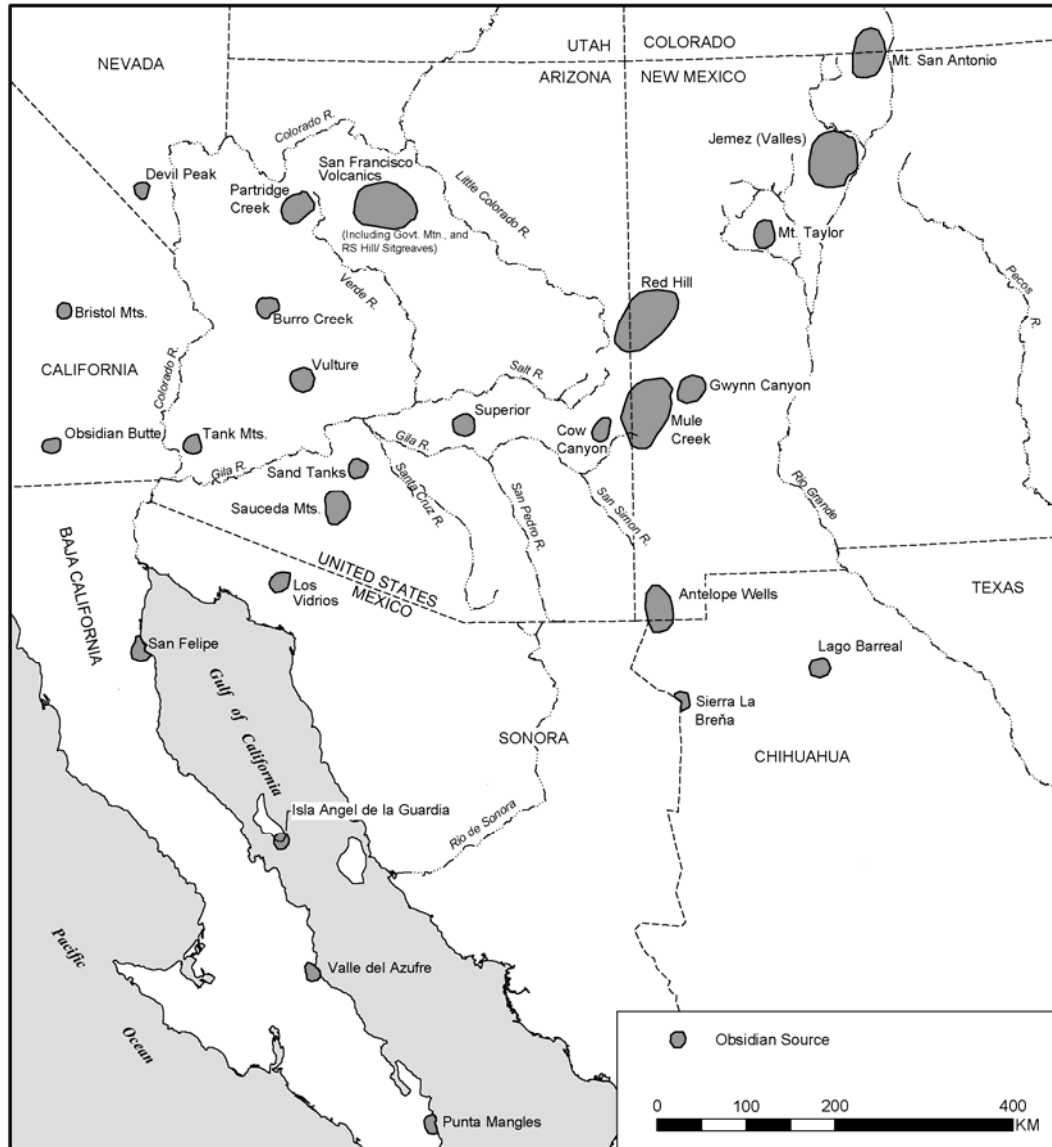


Figure 3.3. Southwestern obsidian sources (adopted from Shackley 2005).

Middle to Late Tertiary sources in Arizona include Antelope Wells, Burro Creek, Bull Creek, Cow Canyon, Vulture, Saucedo Mountain, Superior, Los

Vidrios, and Tank Mountain. Somewhat more recent marekanite sources further to the east include Mule Creek and Red Hill in western New Mexico. Secondary sources or alluvial deposits of obsidian gravels may occur many kilometers from the primary deposit in major drainage systems flowing away from primary deposits located at higher elevations.

More recent Quaternary sources include nodules as much as 30 cm in diameter, which allows larger tools to be produced (Shackley 1990). Obsidian sources of this period include the San Francisco Volcanic Fields in northern Arizona (Government Mountain), and the Río Grande Rift zone including Jemez (including Valles Caldera) and Taos Plateau Volcanic Field in central and northern New Mexico.

Exchange, Social Interaction, and Material Transport

While it is a relatively straightforward process to identify source locations for obsidian found at archaeological sites, understanding how that material arrived is more complicated. “Identifying the precise behavioral mechanisms behind Hohokam, indeed any form of obsidian circulation, is extremely difficult given that multiple processes could account for its movement” (Bayman and Shackley 1999:842). Although obsidian acquisition may have been a complicated process that lacks a single universal explanation, it is still possible to evaluate different explanations for obsidian movement. Moreover, analyses of multiple lines of evidence for prehistoric interactions (e.g., ceramic manufacturing locations and

distribution) provides a way to more rigorously assess different models for transport (Simon and Gosser 2001:220).

Models proposed by Hohokam researchers for obsidian acquisition during the Classic period can be grouped into three general categories, which are *direct access*, *elite control*, and *social exchange* models. Ceramic studies add a fourth context for Pre-Classic remains; the exchange of commodities in *markets* associated with activities at ballcourts (Abbott et al. 2007; Shackley 2005:169). By the Classic period, however, the ballcourt system was no longer in use, and associated market place transactions are thought to have ended (Abbott et al. 2007). Recent research demonstrates that the elite redistribution models do not apply either to obsidian (Peterson et al. 1997; Rice et al. 1998) or ceramic exchange (Abbott 2000), and most researchers now argue for direct access or social exchange. The following discussion considers each of these models through an examination of previous archaeological research.

Direct Access Models

Models in this category assume that the end user of the obsidian personally traveled to the source to collect the material. This acquisition pattern is generally assumed to have been the primary or exclusive means of obsidian transport during the Archaic period in the Southwest. Peterson et al. (1997:237-238) refer to this category as the *Opportunistic Model*, in part, because some researchers argue that obsidian procurement strategies were embedded within the acquisition of other goods. For example, researchers suggest that the Hohokam

obtained Saucedá obsidian during shell collection trips to the Gulf of California (Bayman and Shackley 1999). It is assumed that obsidian was a comparatively low value item that was obtained when possible in the context of other activities. This model holds that distance to the source should be a primary factor that determines obsidian frequencies at sites, and deviations from this patterning are generally thought to be related to the embedded acquisition of other goods, variation in raw material quality, or sampling errors.

While direct obsidian procurement must have occurred in some regions and time periods, a number of observations suggest it is not the most parsimonious explanation for Classic period obsidian acquisition patterns in the Hohokam core area. First, the incidence of obsidian at sites increases throughout the region during the Classic period (Loendorf et al. 2004; Marshall 2002:127-132; Peterson et al. 1997:234-235; Rice et al. 1998:109), indicating that greater effort was expended to acquire obsidian and suggesting that the material was more highly valued at this time. Second, Classic period obsidian frequencies are generally only weakly correlated with distance to the source (Marshall 2002; Bayman and Shackley 1999; Rice et al. 1998). This contrasts with Pre-Classic obsidian procurement patterns where stronger distance decay relationships appear to be present (Loendorf et al. 2004; Marshall 2002:129; Bayman and Shackley 1999). During the Classic period, direction to the source has a much greater effect on obsidian frequencies than distance, and separate groups of sites that are in close proximity relative to the distances of sources have divergent obsidian

assemblages (Rice et al. 1998:122). Third, steep falloff curves for lithic raw materials are inconsistent with direct procurement (Kooyman 2000:139).

Windy Hill chert, which is the one of the few substantial and localized sources of fine-grained materials in the Hohokam region, provides an example of rapid raw material falloff during the Classic period (Rice et al. 1998). Sites in close proximity to Windy Hill had comparatively high proportions of chert, while sites only slightly further away were nearly devoid of chert and instead had higher proportions of other fine-grained materials (including obsidian) that could not have been from the source. Rice and others (1998:129) concluded:

All settlements in the excavated sample could have satisfied their requirements for fine-grained lithic materials by directly procuring chert from the Windy Hill quarry. However, even settlements that lay 20 kilometers from Windy Hill had sufficient difficulty in procuring Windy Hill chert that they found it feasible to make up the balance by substituting fine-grained lithics from sources that lay hundreds of kilometers away.

These observations and others presented in the following research suggest that direct procurement was not the primary mechanism for obtaining obsidian within the core area during the Classic period. Historic period data also are not consistent with direct procurement, and sources located in close proximity to the core area were no longer extensively used at this time (Loendorf et al. 2004).

Elite Control Models

These models posit that Classic period obsidian acquisition was part of complex organizational networks, which controlled raw material distribution (e.g., Teague 1984). These researchers suggest platform mounds were centers for managing economic interactions, and they argue that elite members of society controlled access to exotic materials such as obsidian. Teague (1984), for example, argued that obsidian was a highly valued resource that was exchanged in a prestige sphere of interaction. Other researchers have posited that the elite members of societies who resided at the mounds were responsible for controlling redistribution of exotic materials, including obsidian. As another example, Bayman (1995) argued that elites provided obsidian to residents during “give-away” ceremonies at mound events. This material was then further distributed throughout the wider community through reciprocal exchange (Bayman 1995).

In one of the most detailed and comprehensive studies to date, Rice (1998) evaluated the elite redistribution model through analyses of multiple exotic items, including obsidian. Rice (1998a:141) found that while platform mounds did have greater quantities of some goods including obsidian, the levels of exotic materials were well below that expected for centralized managerial control systems. Further, materials that were more abundant at mounds consisted of items associated with ceremony and ritual, while other exotic items had roughly similar distributions within communities.

Throughout the Hohokam core area, debitage and finished tool source proportions for most types are similar, suggesting that obsidian was not usually transported as completed tools and that core reduction commonly occurred at sites (Bayman and Shackley 1999; Marshall 2002; Peterson et al. 1997:243; Loendorf et al. 2004). Rather than stockpiles of cores or large flakes as would be expected with redistribution, obsidian at Tonto Basin platform mounds occurred largely as manufacturing debris and other sites in the community had similar evidence for on-site obsidian tool manufacture. Based on his analyses, Rice (1998a:150) concluded that elites at platform mounds “did not exercise managerial control over long-distance exchange or the production of craft items”. Peterson et al. (1997) examined raw material diversity, tool manufacturing locations, and intra as well as inter-site variation in obsidian at Classic period sites in the Salt Basin and along the Middle Gila. They similarly concluded that there is little evidence to support elite distribution models for obsidian (Peterson et al. 1997:255).

Social Exchange Models

This class includes models that suggest the Classic period populations in southern Arizona predominately acquired obsidian through exchange networks. Researchers differ in their characterizations of the basis for these networks, but these differences are largely a matter of emphasis and the explanations are not mutually exclusive. Peterson et al. (1997), for example, suggest that exchange networks were “based on family and simple reciprocal ties”. Other researchers argue that trade networks were established by the arrival of immigrants from

different regions (Simon et al.1998). Based on the distribution of imported goods, Rice et al. (1998) argued that the ability to produce agricultural surpluses was an important factor that determined involvement in trade networks.

Diachronic and synchronic patterning in obsidian acquisition provides evidence for Classic period socioeconomic interaction networks. For example, in their analyses of Tonto Basin materials including obsidian, Simon and Gosser (2001:236) found evidence that the sites on the Tonto and Salt arms were integrated into distinct polities, which maintained separate trade relationships. They also found that the division among communities within the basin started in the Early Classic, and the two polities became increasingly polarized over time.

In some respects, Tonto Basin is a microcosm of the Hohokam core area, and similar economic distinctions developed and intensified throughout the area during the Classic period. For example, sites in the Salt and Tonto Basins both generally have higher proportions of obsidian from the sources in Northern Arizona, than the Middle Gila where this obsidian comprises only four percent of the collection (Shackley and Daehnke 2004). Northern Arizona obsidian accounts for 49 percent of the Pre-Classic collection and 24 percent of the Classic period collection from the Salt Basin (Marshall 2002:132-133). This diachronic trend is reversed in the Tonto Basin, where Government Mountain obsidian is less than 10 percent of Early Classic assemblages, but is the most common obsidian at roughly 35 percent for both the Salt and Tonto Arms in the late Classic (Simon and Gosser 2001:227). The Northern Arizona sources are approximately 265 kilometers from

the Middle Gila, a distance that far exceeds the roughly 30 kilometers between Salt and the Gila sites. Diachronic patterning in the Salt Basin suggests ties to the north decreased over time, while interaction to the north increased in the Tonto Basin and at Casa Grande (Bayman and Shackley 1999: 841; Rice et al. 1998:120).

Vulture obsidian, which is located to the west, is rare in Classic contexts in the Tonto Basin (Rice et al. 1998:120) and at Casa Grande (Bayman and Shackley 1999), but use of this material peaked during the Classic within the GRIC, when it comprises 18 percent of the sample (Loendorf et al. 2004). Sites in the Salt basin show a slight increase in the use of Vulture obsidian during the Classic period, when this material comprises 34 percent of collections (Marshall 2002:131). The western portion of the study area is closer to Vulture than are sites in the center of the lower Salt, but only seven percent of the obsidian from the western portion was from Vulture (Loendorf et al. 2004).

Superior obsidian, which is close to the core area, was one of the most commonly used materials during the Pre-Classic, but this obsidian dropped in frequency at all Classic period sites sampled to date including, Casa Grande (Bayman and Shackley 1999), the Tonto Basin (Rice et al. 1998:122), along the Middle Gila (Shackley and Daehnke 2004), and in the Salt Basin (Marshall 2002). Another pattern that holds for these areas is that the proportion of Saucedá obsidian (located to the southwest) increased over time. Although information is not available for other areas, data from the Middle Gila suggest this pattern

continued into the Historic period. Data suggest that Saucedo obsidian may have become nearly the exclusive source brought to the Middle Gila at this time (Loendorf et al. 2004).

Chapter Summary

This chapter has provided background information for the investigations that follow, including a summary of current knowledge concerning the culture history of the study area. While consensus exists regarding the general outline of events that occurred during prehistory, there is not similar agreement regarding why changes in material culture traditions occurred over time. Although such alterations have long been recognized and are still used to define periods and phases in the archaeological record, until comparatively recently, most seemingly abrupt changes in material culture were simply assumed to have resulted from the migration of outside groups.

Compared to ceramics, projectile point data have previously received little attention in debates regarding cultural variation in the study area. It is suggested here that stone point data can be employed to provide a different perspective on cultural historical events, which may help elucidate issues such as the Hohokam continuum debate.

Much of the previous research regarding projectile point variation has revolved around debating the meaning of the term “style,” which is now generally agreed to be something separate from function. Style can be a passive and

unintentional expression that results from habits of manufacture, or it can be consciously communicated information regarding social identity. In addition, there are two different ways that function can be defined: 1) as the use or uses an artifact was designed to perform; or 2) as the use or uses that the artifact was actually employed to perform. The failure to explicitly recognize these and other distinctions has been the source of considerable disagreement over the meaning of the terms “style” and “function”. As will be presented in the next chapter, this study focuses on point function rather than style, and a design approach is employed that attempts to define tasks points were intended to perform.

Addressing the use-life of projectile points is essential for any analysis of variation in point shape and size. While some previous researchers have argued that wear and subsequent reworking commonly resulted in substantial alterations to the size and appearance of projectile points, P-MIP survey collection data suggest this practice only rarely occurred in the study area, especially for the small arrow points that are considered in this analysis. As will be discussed further in the following research, it appears that performance characteristics and differences in the intended use of the weapon had a more substantial affect on the size and shape of stone points.

Little consensus exists among previously proposed classification schemes for arrow points from the Hohokam region. Instead, most researchers employ *ad hoc* types on a project-by-project basis. Rather than following this pattern, types employed in this study were developed following those defined by Sliva (1997).

Type classifications, metric data, and images of all P-MIP survey points that are employed in the following analyses are available in Loendorf and Rice 2004.

Fine-grained raw materials that were preferred for the manufacture of stone points rarely occur in the study area. Consequently, most of this material had to be brought in from elsewhere, and projectile point raw material source studies are therefore well suited for the consideration of regional socioeconomic interaction patterns. After nearly 30 years of research, regional patterns in obsidian procurement have become apparent. Three models have been proposed for obsidian transport in the Hohokam region. The first of these models (elite control) has been rejected because extensive excavation projects completed during the 1990s failed to identify supporting evidence. Most Hohokam researchers now argue for direct access or social exchange models. Both synchronic and diachronic patterns in obsidian acquisition are inconsistent with direct access, and it appears that the most parsimonious explanation is that the Hohokam of central Arizona obtained most of their obsidian through social mechanisms. This suggestion is stated as a hypothesis in the following chapter, and subsequently tested using P-MIP survey and excavation data in Chapter 6.

CHAPTER 4: RESEARCH METHODS

The following discussion considers point variation from an *etic* design perspective, which holds that highly-shaped artifacts such as projectile points were produced with the intent of performing one or more specific tasks. The design process is limited by available materials and known manufacturing techniques, while the performance of projectiles is constrained by the laws of physics (Cotterell and Kamminga 1992; Klopsteg 1993; Kooi 1983). These laws are employed in the subsequent discussion to suggest cross-cultural constraints on the point design process.

This research employs both an attribute-based approach and analyses of projectile points based on previously defined types (Loendorf and Rice 2004, Sliva 1997). Quantitative variation in Classic and Historic period projectile point metric attributes, including weight and notching characteristics, are evaluated through the use of Exploratory Data Analysis (EDA). The EDA approach emphasizes visual displays of the data rather than summary statistics derived from the assemblage (Shennan 1990:22). This technique is well suited for archaeological data that may not conform to assumptions that underlie many summary statistics. Bivariate analyses are subsequently employed to test the statistical significance of distributions identified in the EDA. Multivariate cluster analysis is used to examine variation in obsidian data. Obsidian source areas were determined through XRF elemental analyses.

This chapter presents three middle-range hypotheses that are employed to link patterning in archaeological data to past human behavior. The first hypothesis is employed to seriate point collections. The second hypothesis defines the tasks that stone points were designed to perform. The third hypothesis is based on considerable previous research, and it postulates that obsidian distribution patterns can be used as a proxy measure for socioeconomic interactions among communities. Survey methodological issues are addressed prior to discussion of the hypotheses.

Survey Methods

During the Pima Maricopa Irrigation Project (P-MIP) survey, crewmembers walked parallel transects spaced 20 m apart. The Arizona State Museum (ASM) definition of an archaeological site, provided in the ASM Site Recording Manual (Fish and Fish 1993) and subsequent update (Fish and Fish 1994), was used to determine those areas that have a site-level artifact density. These guidelines define a site as: 30 or more artifacts of a single artifact type within a 15 m area; 20 or more artifacts of at least two artifact types within a 15 m area; one or more features in temporal association with artifacts; or two or more temporally associated features with no artifacts. Areas that met these criteria and were separated by 100 m or more were recorded as separate sites. Locations that met this definition and were less than 100 m apart were recorded as separate loci of the same site.

Each site was assigned a Gila River (GR) site number, and a datum with an identification tag was established. All datum locations were recorded using a

real-time differential GPS unit. Sites were delineated by marking artifacts and features with pin flags. This enabled visual determination of the site boundaries and any internal fluctuations in artifact density. AutoCAD mapping software was employed to calculate site and survey areas based on the recorded boundaries.

An ASM site form was completed for each site, and photographs were taken. Artifact collections included at least one quantitative unit and a sample of diagnostic artifacts. Quantitative units consisted of 2 m diameter circles, in which all artifacts were collected. A sample of diagnostic artifacts (including obsidian, decorated ceramics, undecorated non-body sherds, and projectile points) was collected. Rough estimates for the total counts of nondiagnostic artifacts were noted in the ASM Site Description form. In addition, a GRIC-CRMP Artifact Diversity Form was completed. This form includes estimates for the counts of non-diagnostic artifacts of different materials, and presence/absence data for various artifact types.

Isolated occurrences (IOs) were defined as individual artifacts or features and dispersed non-site scatters that did not meet the definition for sites stipulated by ASM guidelines (Fish and Fish 1994). IOs were numbered consecutively by township, range, and section. Each isolated occurrence was described and plotted on the appropriate USGS 7.5' topographic map. These artifacts were not generally collected for analysis.

Discussion

For several reasons, site size varies widely within the study area. First, dispersed rancheria-style habitations are common in the area, and the location of these settlements has tended to drift over time (Darling et al. 2004; Ezell 1961:110; Spier 1933:22). “Because of this, practically every inch of the valley from Sacate to Gila Crossing had at one time or another been the site of dwellings” (Spier 1933:22). As a result, essentially continuous scatters of artifacts occur in some locations, and following the ASM guidelines leads to the creation of expansive sites. Second, comparatively little topographic relief exists in many locations, and few natural features are present to delineate site boundaries. Consequently, site and loci limits were generally arbitrarily based on modern features such as roads or agricultural field boundaries. In areas with little modern development, site boundaries were extended until roads or other recent features were reached, in some instances for many kilometers. Third, because of the arid environment, comparatively little deposition and erosion has occurred in most locations. Pleistocene deposits are exposed on the ground surface in some places, and less than 50 cm of sediment has accumulated during the Holocene in many areas. Consequently, the entire Holocene record is exposed at or near the surface throughout much of the study area (Wells et al. 2004b:632). Rather than being covered by deposition or eroded and thus dispersed at a lower density, very high surface artifact concentrations occur in some areas (Wells et al. 2004b). Fourth,

vegetation is sparse, and ground visibility is generally high in the study area, which facilitates the identification of surface artifacts.

Sites recorded during P-MIP survey range from small scatters of less than 1000 m² to extensive and dense deposits that cover more than 15,000,000 m². In areas with few modern features, even the loci defined at sites range to over 700,000 m². Surface artifact densities at sites also have a large range of variation, from lower than two artifacts per m² to over 200 (Wells et al. 2004b:635).

Because provenience control for most artifacts was defined based on archaeological site and locus, the exponential variation in site and loci size creates sampling issues. First, the sampling fraction of collection units differs by many orders of magnitude. This is complicated by the fact that artifacts are unlikely to be evenly distributed across sites or loci. Second, the generally low depositional rates and spatially expansive habitation areas that tended to drift result in a situation where cultural remains from a long timeframe are mixed together on modern ground surface. This problem is exacerbated by the large size of the sites and even loci within sites, which are the only level of provenience control available for most of the projectile points that were collected. Thus, dating non-diagnostic artifacts based on nearby diagnostic artifacts is problematic. Third, the extensive prehistoric and historic agricultural fields in the community have mixed and dispersed remains in some locations, whereas other expansive areas have not been similarly disturbed.

One solution to address some of these analytical limitations is to only consider data that were collected from the small quantitative units (Wells et al. 2004b). More precise provenience information is available for these units, and all artifacts were collected rather than just a sample of diagnostic remains. However, each quantitative unit encompassed just 3.14 m², which represents a minor fraction of site areas. As a result of the small sampling area, projectile points were never found in them and the only provenience data for points are at the site and sometimes locus level.

In this analysis, artifact provenience and temporal control limitations are addressed in several ways. First, instead of comparing site data, much larger areas of roughly comparable size are employed as sampling units. Second, the total survey area was used to standardize the data (i.e., densities were calculated by dividing point counts by the area surveyed in each unit). Third, temporal estimates for the points themselves were used rather than ages for other diagnostic artifacts in the sampled context.

P-MIP Survey Data

Figure 4.1 shows the 12 units used as sampling areas in the analysis of point data. Unit boundaries are based on the location of topographic features and streams. Due to the provenience limitations, it is necessary to jog unit boundaries around site borders in some locations (e.g., between units four and seven on the map). All units are separated by the Gila River, and adjacent boundaries are divided along the modern floodplain.

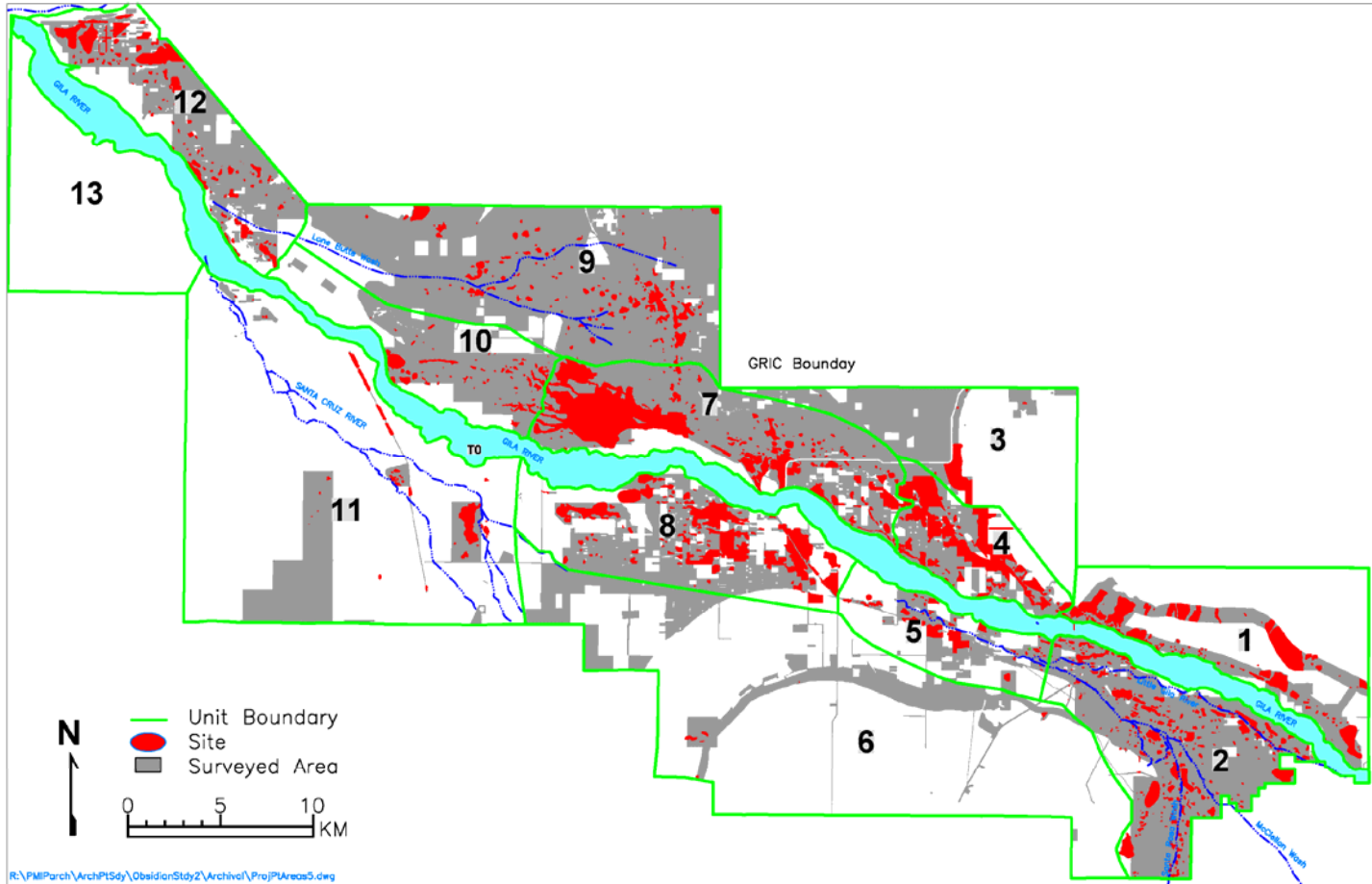


Figure 4.1. Survey coverage, site areas, and study units employed in the analyses.

Table 4.1 shows sampling unit hectares, survey hectares, and site area hectares for the P-MIP survey data in 2002. Data are available for relatively large proportions of most areas except Blackwater, the Sacaton Mountains, and the Santa Cruz where sampling error is a concern. Site densities are also reported.

Table 4.1. Survey coverage and site size by study unit within the GRIC.

Site Group	Map Num.	Unit Area Hectares	Survey Hectares	Survey Proportion	Site Hectares	Site Proportion
Maricopa	12	7,273	5,223	71.8%	791	15.1%
Santan Mnts	3	7,990	3,096	38.7%	224	7.2%
Borderlands	9	15,109	13,752	91.0%	582	4.2%
Blackwater	1	9,748	1,778	18.2%	1,036	58.3%
Santan	4	3,989	3,052	76.5%	1,238	40.6%
Lone Butte	10	5,752	3,432	59.7%	245	7.1%
Snaketown	7	9,434	8,267	87.6%	2,327	28.1%
NORTH SIDE		59,294	38,600	65.1%	6,443	16.7%
Sacaton	5	4,083	1,535	37.6%	267	17.4%
Santa Rosa	2	8,883	5,449	61.3%	931	17.1%
Sacaton Mnts	6	25,592	4,404	17.2%	167	3.8%
Santa Cruz	11	25,107	3,047	12.1%	250	8.2%
Casa Blanca	8	8,651	5,325	61.5%	1,448	27.2%
SOUTH SIDE		72,317	19,760	27.3%	3,062	15.5%
GRAND TOTAL		131,611	58,360	44.3%	9,505	16.3%

The high site densities in the Blackwater and Santan units are due to the presence of extensive non-irrigation agricultural fields along the Santan Mountain bajada, where site areas were defined on the basis of features rather than artifact densities. With the exception of these two areas, site density is the highest in the Snaketown and Casa Blanca areas, and the overall site densities on the north and south sides of the river are similar. No projectile points were collected from the

Santan or Sacaton Mountain units, and these areas are therefore not included in the following analyses of point data. No survey data are available for Unit 13 on the map, which therefore is also not included in this study.

Historic and Classic Period Projectile Point Types

This section summarizes metric data that were collected and a typological classification system that was designed to seriate Classic and Historic points from the study area (Loendorf and Rice 2004). Although the term “style” is commonly employed to refer to the categories in point classification schemes, the use of this word introduces confusion because both stylistic and functional variation appear to be associated with the morphological traits on which the types are based.

Therefore, the following discussion eschews the use of the term “style” in favor of “type” or “variety” when referring to categories in the classification system.

Previous research in southern Arizona has attributed small unnotched points to the Historic period (Figure 4.2k–m). Two types have been recognized, one is associated with O’Odham (Pima or Papago), while the other has been suggested to have been made by the “Sobaipuri,” a designation derived from early Spanish sources for people who lived along the San Pedro and Gila Rivers (Brew and Huckell 1987; Bronitsky 1985; Canouts et al. 1972; Di Peso 1953; Doyel 1977; Haury 1950; Gilpin and Phillips 1998; Loendorf and Rice 2004; Masse 1981; Justice 2002; Ravesloot and Whittlesey 1987; Rosenthal et al. 1978; Seymour 1993, 2009; Vint 2005).

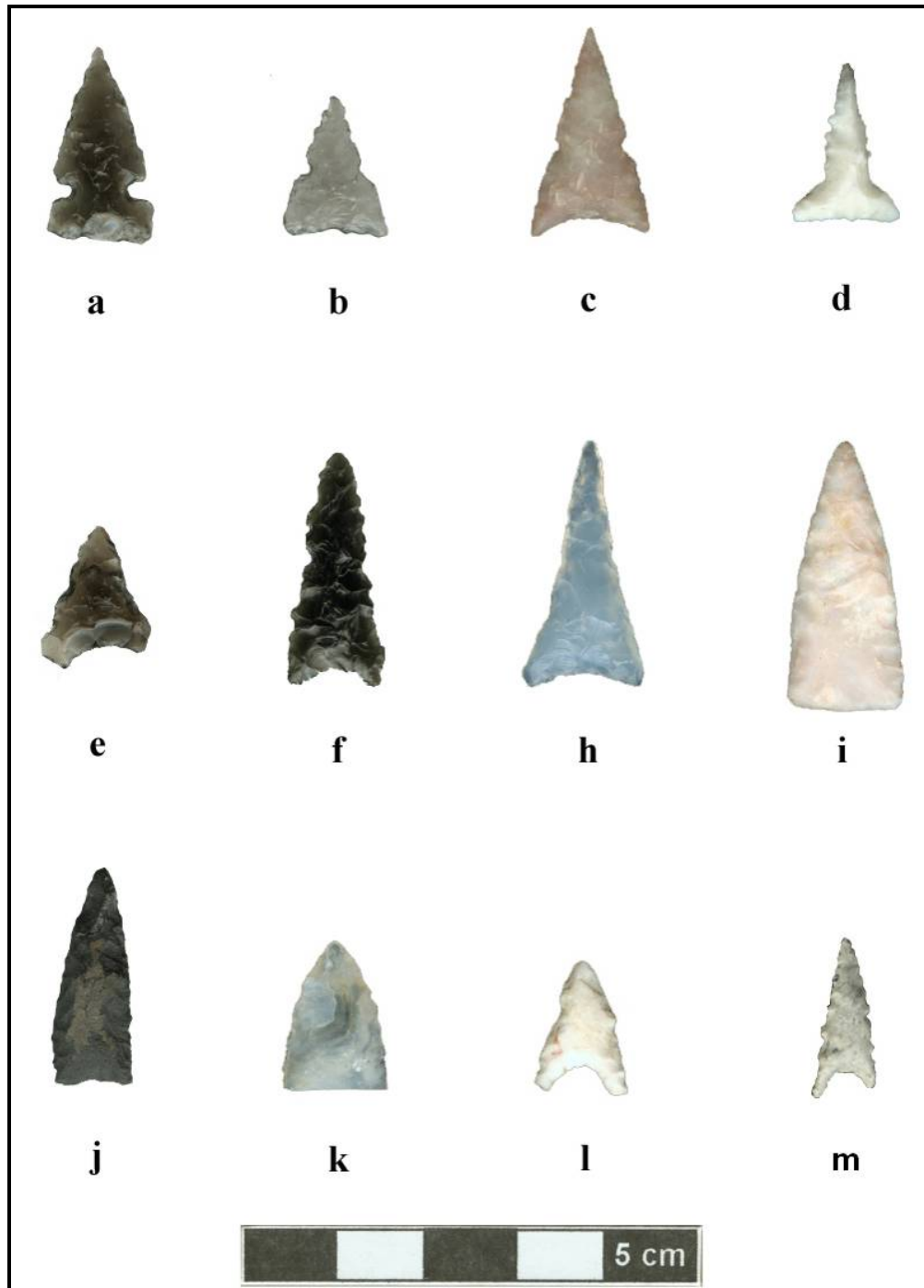


Figure 4.2. Examples of point types from the Classic and Historic Periods: a) Intermediate Side-Notched; b) Upper Side-Notched; c) Middle Side-Notched; d) Flanged; e) Bulbous Base; f) Straight Blade Serrated; h) Concave Base Triangular; i) Thin Triangular; j) Long Triangular; k) Straight Base Triangular; l) U-shaped Base Triangular; m) Sobaipuri (adopted from Loendorf and Rice 2004).

Points that fit these two categories are common in surface contexts in the study area, and a total of 205 examples are present in the P-MIP collection (Loendorf and Rice 2004). It appears, however, that this dichotomy is an oversimplification of variation present among Historic period projectile points. Morphologically similar points were produced during the Classic period, and attribution of individual artifacts to either type or even to the Historic period itself remains uncertain (Justice 2002:273; Ravesloot and Whittlesey 1987:96; Vint 2005:41).

Stone projectile points made by the O’Odham have been suggested to be small triangular forms that lack notches or serration (Figure 4.2k, Brew and Huckell 1987:171; Haury 1950; Gilpin and Phillips 1998; Rosenthal et al. 1978). Haury (1950:268), for example, suggests a pattern at Ventana Cave where unnotched points occurred only sporadically prior to the appearance of ceramics, but were common afterward until intensive use of the cave stopped. He describes point collections from several “known historic Papago village sites,” and concludes that small generally unnotched points typify these sites and the most recent material from Ventana Cave (Haury 1950:274). These points were classified as “Straight Base Triangular” in Loendorf and Rice 2004.

The second variety that has been associated with recent assemblages from southern Arizona includes unnotched points with U-shaped concave bases that are usually serrated (Figure 4.2l, Gilpin and Phillips 1998:89–91; Justice 2002:272–274; Vint 2005; Seymour 2009). These points were classified as “U-shaped Base

Triangular” in Loendorf and Rice 2004. Previous researchers have classified these artifacts as the “Sobaipuri” points based, in part, on Pfefferkorn’s (1989) description of points from southern Arizona. When describing “Sonoran” points in the mid-1700s, Pfefferkorn states (1989:202): “this [a triangular pointed flint] is about one inch long, not quite an inch wide, and as thick in the middle as the back of a strong knife. The edges, however, are filed as thin as a single card and are armed all along with sharp saw teeth.”

Serrated points with deeply concave bases also appear to be common at late sites along the San Pedro River (Di Peso 1951, 1953; Masse 1981; Justice 2002:272-274; Vint 2005:40; Seymour 2009). As will be discussed further in Chapter 5, this is the location generally associated with the “Sobaipuri.” These definitions of “Sobaipuri” points, however, are different than that employed for U-shaped Base Triangular points, and are restricted to serrated points with U-shaped concave bases and straight blade margins that lack notches. Points judged to be most similar to this definition of the “Sobaipuri” type were therefore reclassified here as a subcategory of the U-shaped Base Triangular, hereafter referred to as the *Sobaipuri* variety (Figure 4.2m).

Based on a recent analysis of Historic period projectile points from southern Arizona, Vint (2005:41) concluded:

Throughout this paper, I have referred to the points from sites discussed as “Sobaipuri” or “Piman” points. In part this is forced by convention to clarify the social contexts of the sites:

the Spanish clearly identified the people living along the San Pedro River and in the Santa Cruz Valley as Sobaipuri, and so sites known to date to the early historical period (as identified by sites with Spanish artifacts), and sites that share similar material culture (architecture, tool types), are defined as Sobaipuri. This is done even though in the discussion above I assert that assigning ethnic significance to variation in point shape is tenuous at best. However, in contrast to the very murky definition of “Soto” points, the association of triangular, concaved-based points with Piman people—specifically Sobaipuri—in southern Arizona seems legitimate.

Sliva (1997) defined nine projectile point types that have been recovered from Classic period archaeological contexts in the Sonoran Desert (Figure 4.2a–j). These include both side-notched and unnotched forms. Sliva (1997) defined three types of side-notched points based on the placement of notches along the blade margins. One variety consists of points with notches in the lower 1/3 of the blade (Figure 4.2a). The taxonomic definition of this style overlaps with a pre-Classic category she defined, and the two types were therefore combined in Loendorf and Rice 2004. The second side-notched point type has notches near the middle of the blade (Figure 4.2c), and the final type has notches closer to the upper 1/3 of the blade (Figure 4.2b).

While notched points have not previously been associated with the Historic period in southern Arizona, highly similar unnotched flaked-stone points occur in both Classic and Historic period contexts, which has complicated the identification of temporally relevant point shapes (Justice 2002:273; Ravesloot and Whittlesey 1987:96; Vint 2005:41). Sliva (1997) defined six Classic period varieties that lack notches. One category (Classic Flanged) has wide flaring bases and long parallel-sided blades (Figure 4.2d). Classic Long Triangular points are narrow bifacially retouched artifacts with length-to-width ratios of 3:1 or more (Figure 4.2j). Another type is based on the presence of serration and straight blade margins (Figure 4.2f). The fourth type is defined based on the presence of crescent-shaped concave bases (Figure 4.2h). She defined the fifth type “on the basis of their uniform thinness” (Figure 4.1i, Sliva 1997:54). The sixth and final unnotched type is rare in the P-MIP collection, and these points have irregular bulbous bases (Figure 4.2e).

Figure 4.3 shows measurement locations and the terms used to refer to aspects of the points in the following research. Table 4.2 lists attributes that were recorded for each artifact. Where possible, these data were collected for all projectile points or point preforms in the collection.

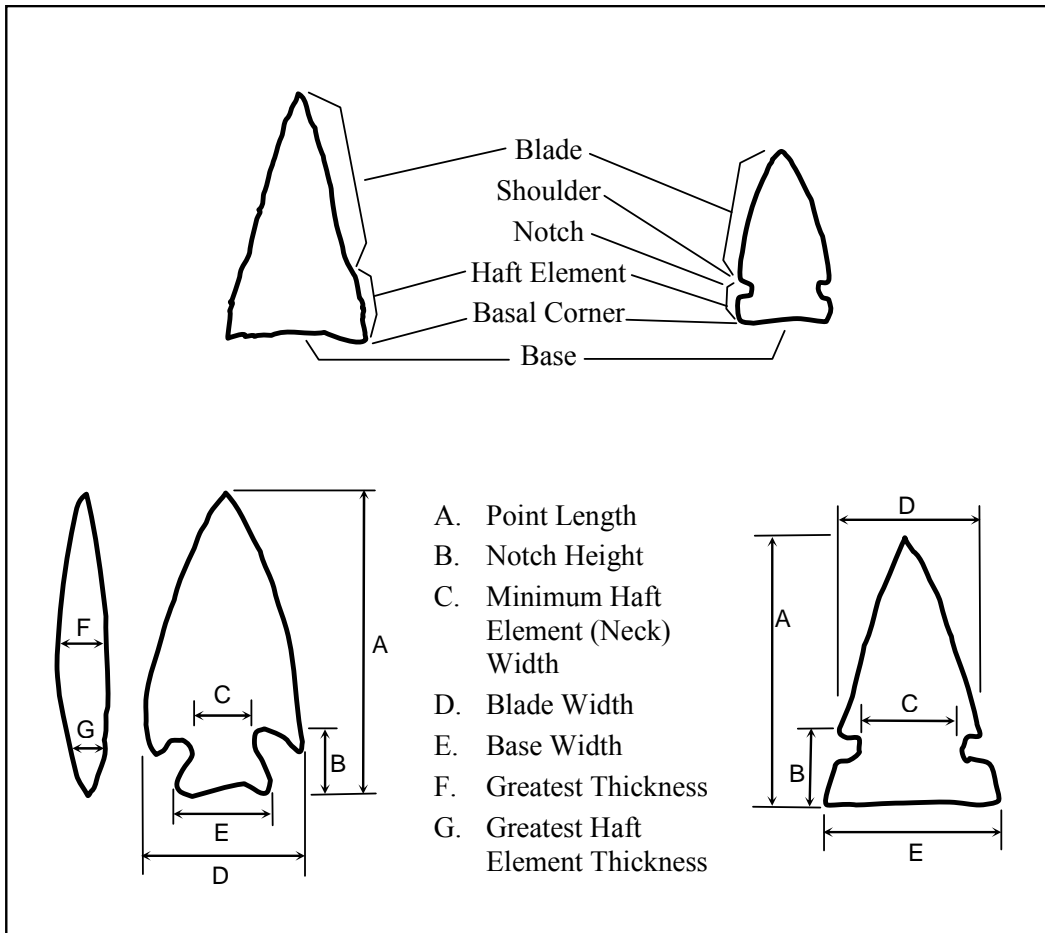


Figure 4.3 Measurement locations and point terminology employed in the analysis.

Table 4.2. Attribute definitions employed in the projectile point analysis.

Diagnostic Criteria and Associated Attributes

Point Shape

Teardrop: convex blade margins that taper asymmetrically from the base to the tip.

Lanceolate: lower blade margins are parallel and taper in a curve to the tip.

Triangular: straight blade margins with the maximum width at the base.

Diamond: trapezoidal shape with shoulders (maximum blade width) near the midpoint of the blade.

Haft Treatment

Notch: depressions in the blade margin that are at least as deep as wide (Holmer 1986).

Side-notched: notches are approximately perpendicular to the long axis of the point, and the base width is equal to or greater than the shoulder width.

Corner-notched: notches are at an angle of less than 90 degrees to the long axis of the point and the base width is less than the shoulder width.

Corner/Side-notched: notches are perpendicular to the long axis of the point, and the base width is less than the shoulder width.

Stemmed: the hafted portion is separated from the blade by a shoulder.

Unnotched: lacks notching or a stem; the haft element is not differentiated from the blade by either a shoulder or notch.

Stem Shape

Expanding: base width is greater than the minimum haft element width.

Straight: base width is approximately equal to the minimum haft element width.

Contracting: base width is the minimum haft element width.

Base Shape

Concave: the basal corners are lower than the center of the base.

Convex: the basal corners are higher than the center of the base.

Straight: the basal corners and central portion of the base form an approximately straight line (as straight as possible given irregularities of flake scars).

Pointed: the basal corners meet.

Shoulder Shape

Obtuse Angle: the junction of the blade and haft element is greater than a right angle.

Abrupt: the junction of the blade and haft element forms a right angle.

Barbed: the junction of the blade and haft element form an acute angle.

Proportionate Criteria

Haft Element Width: See Figure 2 for location of measurement

Shoulder Width: See Figure 2 for location of measurement

Base Width: See Figure 2 for location of measurement

Serrated Edge

Present: Blade has adjacent small notches forming teeth along the edge.

Absent: Edge of blade is not serrated.

Blade Margin Shape

Straight: The blade margins define a straight line between the basal corners and the tip.

Concave: The blade margins define concave lines between the basal corners and the tip.

Convex: The margins of the blade define convex lines between basal corners and the tip.

Projectile Point Design Theory

Performance constraints do not determine the appearance of points, but merely set limits for effective design within which there is room for cultural expression and individual variation (Nelson 1997:372). Deviations beyond theoretically optimal design parameters also certainly occurred for myriad reasons, but if these are indeed exceptions they can not invalidate generalizations regarding projectile performance design constraints. Most importantly, designs are subject to modification through chance, trial-and-error, emulation, and inspired innovation. Simply put, while humans are constrained by this world, our practices are not determined by these limits.

Flaked-stone projectile points are small portions of composite weapons, the remainders of which are rarely preserved in archaeological contexts. Although points are seemingly small elements, their design is constrained by forces involved in successfully launching an elongated projectile and having it penetrate an intended target at range (Cotterell and Kamminga 1992; Klopsteg 1993; Kooi 1983; Vanpool 2003). No single ideal design exists for projectiles because these weapons were used for a variety of purposes, and optimization of one design aspect usually results in compromising others (Knecht 1997:200). Effective projectile design is therefore the result of compromise, the exact nature of which is largely dependent on the intended use of the weapon (Knecht 1997).

Projectile performance requirements are not static and instead vary based on a number of variables (Knecht 1997). A partial list of these factors includes:

target size, target range, target type (human or other animal), target location (air, land, water), if the intent is to wound or kill, and general vegetation density and type in the environment. Some of the factors that affect the performance of the projectile itself include kinetic energy, momentum, spine (resistance to bending), durability, maintainability, sectional density, and point geometry including edge sharpness and haft design (Vanpool 2003:116-165). In order to consider design constraints of projectiles, it is therefore necessary to address the range of uses for which these artifacts may have been intended, and the technological responses that were possible.

Contrary to a common assumption, a stone projectile tip is not necessary to “balance” the shaft. Ethnographic observations and unusually well-preserved prehistoric artifacts suggest that projectiles commonly lacked stone points (Figure 4.4). Instead, organic tips such as bone, antler, or wood were frequently employed. In a cross-cultural study of over 100 preindustrial societies, Ellis (1997) observed that different types of projectile tips were employed for separate purposes. Stone points were closely associated with hunting large game animals (>40 kg) and/or warfare, while organic tips were far more commonly employed in small game (<40 kg) hunting. “In fact, this pattern is so strong that in prehistoric cases one can almost always assume that stone points were used in large animal hunting [or warfare]” (Ellis 1997:63). The main reason stone points were employed was to make the projectiles more lethal, and contrary to a common assumption, almost no indications were found that stone point size was correlated

with the size of the animal hunted (Ellis 1997:45-46). These data suggest that stone points were used for a subset of all projectile tasks (i.e., large game hunting or warfare), and the following discussion focuses on physical constraints that are common to both practices.



Figure 4.4. Small game hunting arrows with wooden points collected from the GRIC, Smithsonian collections, unknown photographer.

Many reasons exist why stone points were not designed for small game hunting. First, it is possible to have a larger blunt striking area using organic materials (Ellis 1997:47). These large tips made it easier to hit a target, and were less likely to damage the thin skin of small animals. Second, stone points would too easily pass through a small animal so the game could run away unimpeded. Third, stone points were seen as a liability in waterfowl and small aquatic mammal hunting because the weight of the stone would cause rapid sinking of the arrow (Ellis 1997:47). Fourth, the weight of the point would decrease the speed of the projectile (Cotterell and Kamminga 1992; Klopsteg 1993); benefits of higher projectile velocities are discussed further below. Fifth, the broad flat surface of the point affects the aerodynamic performance of the arrow, making it less accurate (Klopsteg 1993; Vanpool 2003:162). Sixth, the additional manufacturing costs of procuring raw materials, producing and attaching a stone point (which is likely to break with use) would not be warranted given the limited return from small game (Dean 2003). Finally, stone points are simply not necessary to effectively kill small animals (Ellis 1997).

Christenson (1997) argues that penetration (i.e., depth) and wound size (i.e., diameter) are the two most critical aspects of stone projectile point performance (see also Klopsteg 1993; Kooi 1983:24; Vanpool 2003:123). He maintains that wound size is principally related to point width. Penetration, however, is more important than wound width because the victim of a large but shallow wound is more likely to survive than one who receives even a minute

wound to a critical internal organ, especially the heart (Bill 1862:385). The most efficient and rapid way to kill any large animal with a projectile is to completely penetrate both lungs and the heart; even a puncture to a single lung may cause death through suffocation, this area is a larger target than the head or neck, and is encased by less bone (Stevens 1870). This vital area, however, is still protected by the rib cage, a potentially effective barrier, and the shot requires passing through or between the ribs (Stevens 1870:564). Flaked points must necessarily be made from brittle stone that readily fractures on impact (this is how points are shaped), and wider points are more likely to hit the ribs and shatter, resulting in a wide but shallow and non-life threatening wound on the exterior of the rib cage (Bill 1882:104).

These two performance characteristics (wound width and penetration depth) are also inversely related such that all else being equal, projectiles with larger cutting diameters will not penetrate as deeply (Nelson 1997:377; Pope 2000:43). Because of the greater importance of penetration, it is likely that the cutting diameter was compromised in favor of penetration for stone projectile tips. The nature of this relationship, however, differs for projectile points made from metal, which has different performance characteristics than stone.

Penetration is the product of kinetic energy and momentum (i.e., impact force), sectional-density (i.e., projectile cross-section), and projectile geometry including point edge sharpness (cf. Christenson 1997:137; Kooi 1983:24; Vanpool 2003). Impact force is a fundamental factor because without sufficient

energy a projectile will not penetrate regardless of how sharp it is or the nature of the cross-section. The impact force of a projectile is a function of its mass and velocity, and the lighter arrows have higher velocity than the heavier arrows (Klopsteg 1993; Cotterell and Kamminga 1992:33-35).

Increasing the velocity of projectiles has important performance advantages. First, higher velocities allow greater range (Klopsteg 1993; Vanpool 2003:119; Ratzat 1999). Excluding friction, this is because projectiles begin to fall accelerated by gravity at the same rate, as soon as they leave the launching mechanism, regardless of their speed. Consequently, the greater the velocity the longer the forward distance a projectile will travel before hitting the ground. Second, higher velocities allow greater accuracy because it is possible to aim more directly at targets, this is colloquially referred to as “flat-shooting”(Cotterell and Kamminga 1992; Klopsteg 1993:14; Kooi 1983:24). The lower the velocity the greater the necessity to aim above a target at a given range (the maximum distance occurs at approximately 45 degree angle above the target; Cotterell and Kamminga 1992:162-163). For the same reason, low velocity projectiles also require greater accuracy in the target distance estimation and control over projectile speed in order to determine precisely how far above the target to aim (Klopsteg 1993:24). Third, the higher the velocity the less time will elapse between launching the projectile and its impact with the target. This makes hitting moving targets easier, and allows less time for an intended target to avoid the projectile. Fourth, higher velocities allow the use of smaller projectiles while

maintaining the same impact force; therefore it is possible to carry more individual projectiles, which allows more shots without having to retrieve fired projectiles.

At the same time, the mass of stone tips attached to elongated projectiles is also constrained by the acceleration method employed to launch the missile. Hand thrown spears are held closer to the center of mass (i.e., balance point) during launch, while both atlatl darts and arrows are launched by accelerating the distal end, which creates different constraints on the distribution of mass for these projectiles. For example, when an arrow is launched from a bow, the nock (i.e., notch for the bowstring) is accelerated before the tip. The greater velocity of the nock when combined with the inertia of a tip of higher density than the shaft and on its opposite end, tends to spin the distal portion of the projectile forward (Ratzat 1999:201). A heavy point also increases stresses that occur in the shaft when rapidly accelerated from the opposite end, which can result in “porpoising” of the projectile or even shatter the shaft if severe (Blyth 1980; Klopsteg 1993:22; Ratzat 1999:200). Fletching (e.g., feathers) near the nock slows this end of the shaft and helps counteract these forces (Ratzat 1999:201). Fletching, however, is the primary source of drag that slows the projectile after launch (Klopsteg 1993:23; Rheingans 2002:3), which would result in unacceptable performance even if large fletching and a massive shaft were used in an attempt to compensate for a heavy arrow or atlatl tip (Klopsteg 1993:22; Ratzat 1999).

Diachronic changes in launching technology also suggest that the range of acceptable variation among projectile tips became increasingly constrained through time. The thrower receives feedback during launching both spears and atl-atl darts that within certain limits allows compensation for differences in the mass of individual projectiles. In contrast, once an arrow is released it is not possible to alter the rate of acceleration, and projectiles of varying mass will have different points of impact (Klopsteg 1993:11-22; Mason 1894:660).

Consequently, reworking broken points is less likely to have occurred for arrow tips, but may more commonly have happened with atl-atl dart and especially spear points (Flenniken and Raymond 1986; Hoffman 1985). In addition, the comparatively small size of the arrow points considered here limits the extent to which fragmented portions could be maintained or reused for other tasks.

Furthermore, any energy savings accrued by reworking arrow points would be offset by variance in the performance of projectile tips of different sizes. Instead, other explanations, including reworking at a later date when smaller points were produced, may generally account for the reworked points in the collection. Creating an arrow point requires less than 10 minutes (Chushing 1895:318-319), while reworking might take perhaps 5 minutes, resulting in a savings of no more than 5 minutes. In contrast, successfully stalking within range of a deer or other large game animal can require hours or even days of effort and it is unlikely that any hunter would commonly use less than optimal designs for such a minor energy savings.

Finally, the suggestion that arrow weight was a carefully controlled variable is supported by ethnographic observation (Mason 1894:660):

The same tribe used arrows of about one length and weight, as correct shooting, like good penmanship, is a balancing of a hundred sensibilities. Every good archer drew his bow to the arrow-head every shot, for near or for far. If one's bow be drawn always to arrow-head, and one's arrows be always of the same length, whether from his own quiver or from another's, the elements of variability are much reduced. It must be from some such cause that the arrows of each tribe agree so nearly in length. [snip] It is not here affirmed that the arrows of a tribe are exactly of a length. The variations are within certain narrow limits. The author has measured a large number of quiver contents. The arrows of one quiver agree absolutely. The arrows of a tribe agree within a narrow margin.

Similarly, Coues (1866:351) suggested that Apache stone points were “quite uniform in size and shape. I think I never saw one much over the dimensions stated.”

Temporal Variation in Stone Point Weight: Why Size Matters

Because of the performance advantages of velocity, it is expected that projectile mass was minimized in order to maximize velocity within the performance limits of a given propulsive design. Developments in the technology

for launching projectiles (e.g., spear, atl-atl, bow, and firearms) that occurred over time, and alterations within mechanism designs (e.g., atl-atl length, weight, and flexibility) can increase the maximum attainable projectile velocity (Cotterell and Kamminga 1992:166-175; Cushing 1895:329-349; Ratzat 1999). Such technological changes are expected to be associated with decreases in projectile point weight (Mason 1894:653; Shott 1996; Vanpool 2003:162-163).

Developments of the latter type should result in incremental modification to points while changes in the former must be associated with substantial alterations. Hypothetically, these changes may produce a kind of “punctuated equilibrium” in point design, where long periods of gradual weight decrease are interspersed by comparatively short periods of more dramatic change (cf. Shott 1996:295).

While the appearance of the atl-atl is poorly dated in the region, Sliva (1999) argues that experimentation with the bow and arrow occurred in the southern Southwest as early as 800 B.C., while Justice (2002:44-46) suggests a date of A.D. 500 based on an extensive literature review. A more rapid decrease in stone point weight is expected to be associated with the advent of bow technology. Similarly, Shott (1996:295) in his analysis of points from the American Bottom, identified a gap in the distribution of metric attributes that was possibly associated with the introduction of the bow-and-arrow.

Modifications within technologies can also increase the maximum attainable projectile velocity (Cotterell and Kamminga 1992:185; Klopsteg 1993; Kooi 1983:56; Vanpool 2003). For example, many aspects of bow design can be

altered to incrementally or more substantially increase potential arrow velocity (Cotterell and Kamminga 1992:180-186; Baker 2001; Hamn 1991; Heath 2001; Laubin and Laubin 1980; LeBlanc 1999; Klopsteg 1993; Kooi 1983; Vanpool 2003:151-162). Such changes in bow design are expected to be associated with concurrent decreases in flaked-stone projectile point weight (Vanpool 2003:162-163). The more rapidly a bow springs back to shape when the string is released, the faster the arrow will be propelled (Baker 2001; Klopsteg 1993). The speed that the bow snaps back is related to draw weight (i.e., how much energy is required to deform the bow from its resting state), characteristics of the bow limbs, the nature of the string, and other factors (Heath 2001; Klopsteg 1993).

Bow design changes that will increase recovery speed can occur within bow types, as well as between types (e.g., self-bow, recurved bow, composite bow). For example, the limbs of self-bows can be tapered to decrease the mass at the tips and thereby reduce their inertia and increase bow performance (Baker 2001:109). The species of wood and/or other materials the bow is made from (e.g., bone, horn, sinew), portion of tree used (e.g., heartwood and/or sapwood), the diameter of the tree the bow is cut from, length to width ratio of the bow, cross-section shape of the bow stave, string material (e.g., plant fiber or sinew), and additional factors can all be modified to increase recovery speeds (Baker 2001; Cotterell and Kamminga 1992:185-187; Heath 2001; Klopsteg 1993). More dramatic changes to bow design include recurving the limbs such that the handle is “set-back”, which thereby raises arrow velocities by increasing the draw length of the weapon (Baker 2001; Hamn

1991:37). Consequently, as will be discussed further in Chapter 6, the advent of the recurved bow (Figure 4.5) in the Southwest, is one example of a change in bow construction that is expected to have resulted in a more substantial decrease in arrow point weight.

To summarize, changes in the technology for launching projectiles, from spear to atlatl to self-bow to recurved bow, are expected to select against larger projectile tips over time. These transitions in technology may or may not be associated with point form changes in addition to size. As will be considered further in the following section, differences in shape are more likely to be related to variation in the intensity of tasks that stone points were designed to perform (i.e., big game hunting and warfare), or with societal changes. These observations lead to the formulation of the first hypothesis that is employed in this research. Hypothesis 1: The average size of stone projectile points declined progressively over time.

Implication 1.1: Because technological changes (the introduction of recurved bow designs) increased the recovery speed of bows and thereby the velocity of arrows, there should be a general decline in the weight of stone projectile points from A.D. 1150 (Hohokam Classic Period) to A.D. 1880 (Akimel O'Odham Historic Period).

Implication 1.2: Projectile point weight patterns among large artifact assemblages are such that relative age assessments can be made with these data.

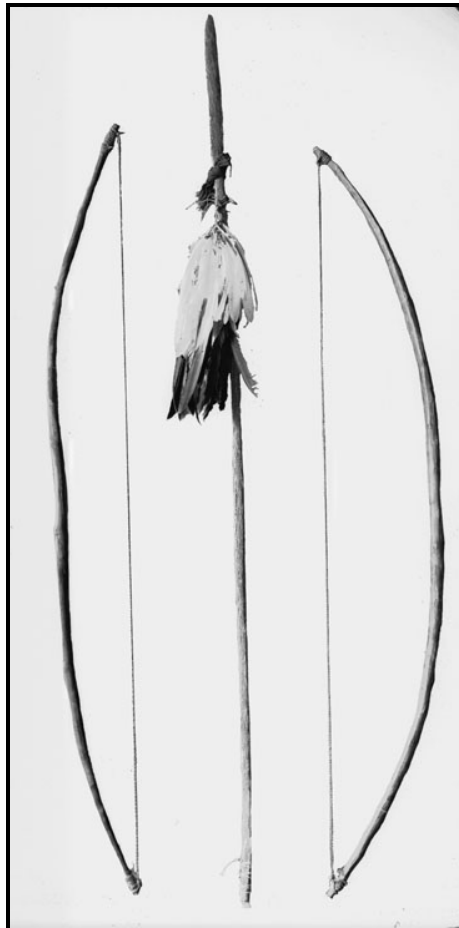


Figure 4.5. Akimel O'Odham recurved bow designed for warfare (left), and self-bow used for hunting small game (right), Smithsonian collections, photographer unknown. Recurved bows consist of a piece of wood that has been reshaped so it forms a double arch.

Warfare and Big Game Projectile Point Designs

The terms “warfare” and “hunting” points are used for convenience in this discussion; however, the suggestion here is only that certain projectile point designs may have been intended for use against humans, whereas other point types may have been designed for killing other animals. In practice, points designed for “warfare” may actually have been used in altercations between

individuals, raiding, small-scale inter-group conflict, and/or larger scale organized battles. Differentiating among these possibilities is not relevant to this discussion and is therefore not attempted. This section begins with a review of ethnographic research that indicates projectile points were often designed differently for hunting and warfare.

Ethnographic Descriptions of Warfare and Hunting Point Designs

The following discussion summarizes ethnographic research that describes cross-cultural variation among warfare and hunting projectiles; observations regarding O’Odham practices and those concerning other Historic period groups from the middle Gila River region are presented in the following chapter. This body of research shows that warfare projectile points from around the world were commonly designed differently than points that were intended for big game hunting. These descriptions suggest characteristics that may be used to distinguish warfare and large game hunting projectile points.

The extensive review of the North American ethnographic literature by Ellis (1997) found that stone points were by far the most common tip type for warfare arrows. Stone points were employed on warfare projectiles in 57 instances (83 percent) of the 69 cases he considered. In 10 examples (14 percent) other materials (horn, bone, or wood) were sometimes employed to tip war arrows in addition to stone. In only two cases (three percent) were materials other than stone exclusively employed. “It is of some interest that the stone points used for warfare could differ in size and shape, and often in the presence or absence of

barbs, from those used on large game” (Ellis 1997:45). When discussing pre-industrial warfare around the world, Keeley (1996:52) also observed that “[p]oints of war projectiles were commonly weakened or hafted in such a way that when the shaft was extracted, the point or some part of it would remain in the wound”.

The description of Plains arrow technology given by Catlin (1975:109) in 1832 is an example of the most common distinction described for warfare and hunting arrows recorded in the literature:

The one [arrow type] to be drawn upon an enemy is generally poisoned, with long flukes or barbs. They are designed to hang in the wound after the shaft is withdrawn. The other [arrow type] is used for their game, with the blade firmly fastened to the shaft and the flukes inverted so that it may easily be drawn from the wound and used on a future occasion.

This distinction and other morphological characteristics of warfare projectile points are describing by Mails (1995:425) for Plains arrow technology in general:

The war arrowhead can easily distinguished from the hunting point. If one looks at the design of the head and sees that it would resist being pulled back out of the wound, it's a war point. [snip] A war arrowhead could not be extracted by pulling it back out. To remove the war

arrowhead, the victim had to suffer the excruciating pain of having the head either cut out or pushed on through his body.

When summarizing North American bows and arrows in general, Stevens (1870:564) said the following:

The Indians of the West [Western North America] use two kinds of arrows, the one for hunting and the other for war. The hunting arrow is armed with a leaf-shaped or triangular head, sometimes with a stemmed head, but never with one possessing barbs. The war arrow has invariably a barbed head; this is very slightly attached to the shaft, so that, if the arrow enters the body of the enemy, it cannot be withdrawn without the head being left in the wound.

Pfefferkorn (1989) also made similar observations regarding hunting and warfare arrow points of “Sonoran” arrows in the mid-1750s:

...the arrow is divided into two pieces. If one tries to pull out the arrow, the front shorter part inevitably remains stuck and cannot be removed except by horribly cutting and enlarging the wound and thus placing the wounded person in danger of becoming a cripple or of losing his life (Pfefferkorn 1989:202-203).

Pfefferkorn (1989:203) also said that hunting arrows differed from war arrows in that they were made from a single piece of wood and lacked stone points.

Figure 4.6 shows examples of hunting and warfare points from California. In this instance the stem of the warfare points is designed to split the arrow shaft, and the wide shoulders (with barbs for one point) and intended to complicate backing the point out of the wound.

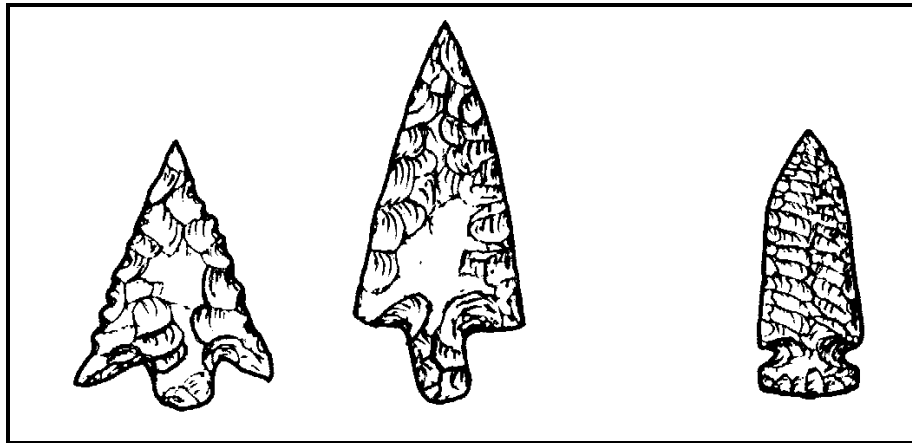


Figure 4.6. Stemmed warfare points (center and left), and side-notched hunting point (right); Wintu, northern California. (Redrawn after Dubois 1940:124 by the author).

Similarly, in regard to Comanche points, Mason (1894) said:

There is more authority and reason for the assertion that the barbed arrowheads among these Indians were for war and the leaf-shaped and rhomboidal heads were for hunting, because they could be easily withdrawn from the wound and used again...

Parker (1912:67) suggested that warfare and hunting point designs differed in their orientation relative to the nock:

The head of the war arrow is shorter and broader than that of the hunting arrow, and is attached to the shaft at right angles with the slot which fits the bowstring, the object of this being to allow the arrow in flight more readily to pass between the human ribs, while the head of the hunting arrow, which is long and narrow, is attached perpendicularly to the slot, to allow it to pass readily between the ribs of a running buffalo.

While it is unclear if point position at launch affects the penetration orientation, these observations do suggest that projectiles were designed based on perceived differences in the anatomy of people and quadrupeds (Mails 1995:429).

These ethnographic descriptions suggest two characteristics that can be used to distinguish points designed for warfare from those intended for hunting large game. First, hunting points may more commonly have rounded basal corners, whereas warfare points may more frequently have pointed tangs. Second, warfare points may more commonly have highly concave bases creating barbs that resist backing out of wounds (Mason 1894:654).

To summarize, certain types of both thick stemmed and unnotched points may have been more commonly designed for use in warfare, whereas points made for hunting were more frequently corner-notched or have side notches in the lower 1/3 of the blade. Points with side-notches in middle of the blade or above are possibly a hybrid type that was a compromise between these two designs. The

notch placement on these points suggests they were deeply set into shafts, which may have tended to splinter them thus loosening the point.

Discussion

Human targets differ from other large animals in ways that suggest why the design of projectile points intended for warfare or hunting may vary (Cotterell and Kamminga 1992:181). First, the upright posture of people alters effective shot placement areas for projectiles. Second, humans can employ defensive armor such as shields (Figure 4.7). Third, people are capable of firing projectiles in return. Fourth, the conditions of conflict between humans are likely to vary substantially from hunting. Fifth, people are considerably more adept than other animals at removing a projectile from their body, either by themselves or with help from others, and in order to create a more serious wound warfare projectiles were designed such that the stone tips detached on impact.

On quadruped large game animals the most effective shot placement is at the animal's side where at least one lung and the heart can be penetrated (Stevens 1870:564). Because of our upright posture, however, humans present a smaller target in profile, complicating the heart and lung rapid kill shot. More importantly, the heavy bone and muscle of the upper arm may cover this vital area, whereas it is possible to more readily shoot behind the front leg of quadrupeds. Humans present the largest target in a frontal position. In this stance, however, the dense bone of the sternum protects the heart and narrower gaps exist

between the ribs—it is also not possible to penetrate both lungs and the heart with a single projectile. Furthermore, humans may employ shields (see Figure 4.7) or other armor that stops or sufficiently slows projectiles.

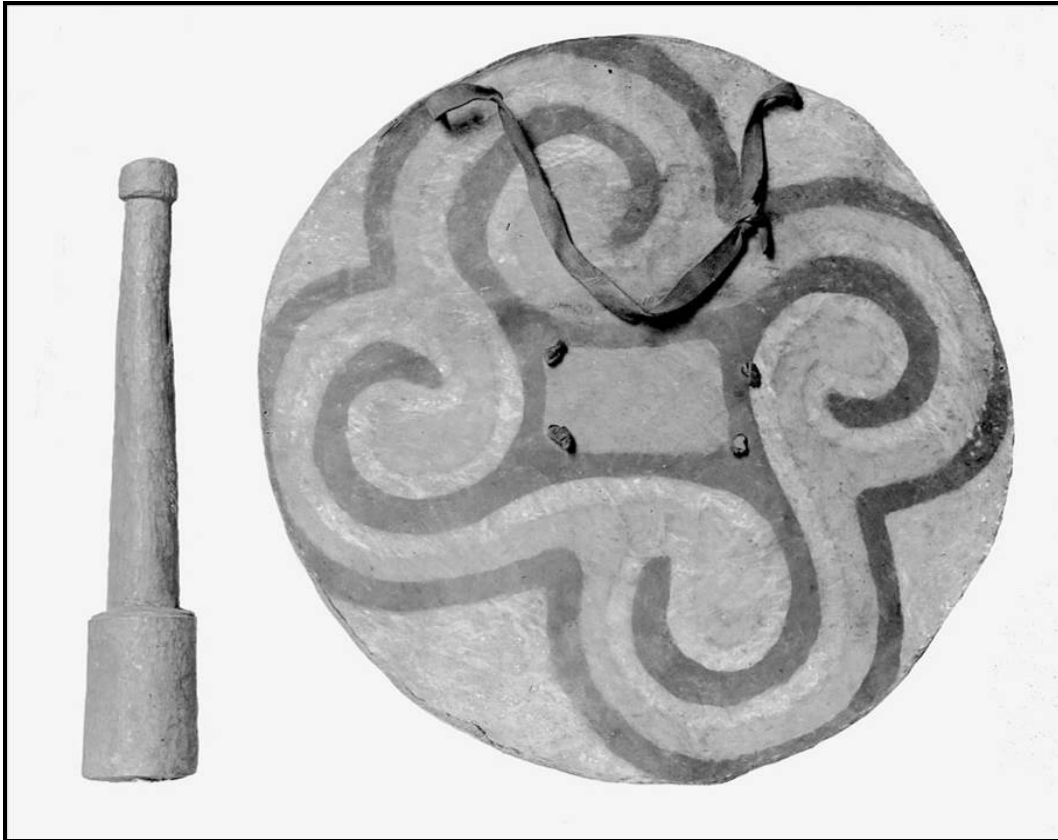


Figure 4.7. Akimel O'Odham war club and shield collected from the GRIC, Smithsonian collections.

If defensive armor is present, then projectile points designed for warfare are expected to be narrow, deep penetrating designs that are intended to pierce this protection (Cotterell and Kamminga 1992:181). If shielding is not employed, then a point with a larger cutting area would be more important than a deep penetrating point design. Based on this reasoning it is expected that warfare points are unlikely to exhibit the same widths as contemporaneous hunting point designs,

and depending on the type of shielding employed, warfare points may be wider or narrower than hunting designs, which are expected to be optimized for lateral penetrations on quadrupeds.

These observations are supported by data collected by US Army surgeons who treated arrow wounds, which unarmored US soldiers received. Although most of the examples involved metal points (which have different performance characteristics than stone), Bill (1862, 1882) provided information regarding the location of injuries and survival rates for 154 soldiers who were shot with Native American arrows in the Southwest and elsewhere (Table 4.3). See Coues (1866) for descriptions of stone point effects.

Table 4.3. Arrow Wound Locations and Fatality Rates (adapted from Bill 1882:107).

Wound Location	Severe Injuries	Percent of all Wounds	Died from Wounds	Percent Fatal
Arms	46	30%	2	4%
Legs	18	12%	1	6%
Neck	13	8%	1	8%
Head or Spinal Column	13	8%	7	54%
Chest	30	19%	15	50%
Abdomen	34	22%	21	62%
TOTAL	154	100%	47	31%

While only 1/3 of all arrow wounds were fatal, impacts to the chest and abdomen were most dangerous. Injuries to the arms were most common, and 42 percent of all wounds were to the extremities. Only half of the chest injuries were fatal, and in 10 of these cases the lungs and heart were not injured; all of these

patients survived their wounds. “An arrow sometimes goes through the chest and passes out. It would always do so if it were not that it can scarcely miss hitting a bone” (Bill 1862:376). The patient, however, died in both cases where the heart was injured, instantly in one case and within 5 minutes in the second (Bill 1862).

These data also suggest that arrow injuries to the abdomen were most likely to be fatal. As a result, Bill (1862) says “Mexicans” generally wore several layers of blankets around their stomachs for protection. Ninety percent of the instances where the intestines were wounded resulted in death, but this generally took several days or even weeks (Bill 1862:385-386). In the instance of impacts to unprotected abdomens, wider points that are more likely to cut the intestines and vessels would be more damaging than deep penetrating narrow point designs.

The case described by Calvin Dewitt (1871) is a typical example of an arrow wound to the abdomen:

Private Courad Tragesor, Troop I, 8th Cavalry, was wounded in an engagement with Apache Indians, at Sunflower Valley, Arizona Territory, March 9, 1870, by an arrow, which entered the left-side, about four inches from the spine, and above the crest of the ileum, from below upward. The kidney evidently was injured, as the patient passed bloody urine in small quantities, and frequently. His face was pale, anxious, and expressive of great pain-; pulse weak. He was conveyed in an ambulance to Camp McDowell, Arizona Territory, a distance

of thirty miles, over a rough, stony, and hilly road. He died the next day. At the autopsy, it was found that the arrow had transfixed the kidney, entering it on the external border, at the juncture of middle and lower thirds emerging from the posterior surface near the internal border, a few lines below the pelvis. A large irregular piece, about one inch long, and half an inch thick, was torn from the posterior border of the kidney at the place of entrance, evidently by the traction made in extracting the arrow, leaving the head behind.

Bill (1862:366-367) described the tendency for arrow points used in warfare to detach from the shaft and the effects of this as follows:

An arrow is shot at a man at a distance of fifty yards. It penetrates his abdomen, and without wounding an intestine or a great vessel, lodges in the body of one of the vertebrae. The arrow is grasped by the shaft by some officious friend, and after a little tugging is pulled out. We said the arrow is pulled out. This was a mistake; it is the shaft only of the arrow that is pulled out. The angular and jagged head has been left buried in the bone to kill—for so it surely will—the victim.

Similarly, regarding Apache stone points Coues (1866:352) observed:

So frail is the connection between the head and the shaft, that in all my little experience, I never saw or heard of an instance in which the former was removed on pulling out the latter. I do not see very well how it can occur, provided the head be buried beyond its barbs. For the matter of that, as the shaft produces ordinarily next to nothing of the sum total of injury, we may regard the missile as practically consisting of the head alone.

Bill also suggested that Native Americans intentionally targeted the chest and abdomen with points that were designed to detach on impact (Bill 1862:386).

Experience has abundantly shown, and none know the fact better than the Indians themselves, that any arrow wound of chest or abdomen, in which the arrow-head is detached from the shaft and lodged, is mortal. From this we concluded that the danger peculiar to all arrow wounds is, *that the shaft becoming detached from the head of an implanted arrow, leaves this so deeply imbedded in a bone that it cannot be withdrawn, and that, it kills* [italics in original].

One of the main differences between the US Calvary and Native Americans is that the US troops did not employ defensive armor. Bill (1862:386) concluded with this recommendation:

We wish in conclusion to recommend to those in authority the plan of protecting soldiers and others exposed to arrow

wounds with a light cuirass. The Indians have a method of dressing bulls' hide for shields for themselves, which renders it arrow proof.

In addition to the effects on point design, the circumstances of warfare may have resulted in a lower recovery rate for arrows, whereas hunting arrows (with broken points securely attached) may have been more commonly retrieved. Even if the warfare arrows were recovered, the points are more likely to have become disassociated from the arrow shaft because they were intentionally loosely attached (Coues 1866:351). In contrast, the basal portions of side-notched points (which were removed and discarded on habitation sites) would be more readily retrieved because they were firmly attached to shafts that were collected for reuse. This suggests that hunting points recovered from archaeological sites may more commonly be fragmentary than warfare points.

Summary

A considerable body of ethnographic evidence, including observations of Akimel O'Odham practices (see next chapter), suggests that projectile tips were designed differently for hunting and warfare (Ellis 1997:45; Justice 2002:38-44; Russell 1908). Human targets differ from other animals in ways that suggest the design of projectiles intended for warfare or hunting will vary. In order to create a more serious wound, warfare projectiles were frequently made so that the tips detached on impact (Bill 1862, 1882; Coues 1866; Ellis 1997:45; Justice 2002:38-44). In contrast, hunting points designed for large game animals were securely

fixed such that they would stay on the shaft and create more damage as the projectile moved in the wound.

When attempting to tightly bind a triangular point several problems occur if the stem is wider than the shaft (Christenson 1997:134-135). First, it is difficult to firmly fasten the point because the binding material is cut by the sharp edges of the point (Geneste and Maury 1997:183). Second, the bindings necessarily extend over a larger area that is perpendicular to the cutting edges of the point. This perpendicular wedge is an impediment to effective penetration of the projectile (Knecht 1997:201-202). Notching is one solution for reducing the width of the stem. Notching also recesses the binding from the cutting edges of the point, which further decreases the chance that the material will be cut during penetration (Redding 1879). These observations suggest that triangular points designed for use against people may lack notches near the base. Triangular arrow points designed for hunting are expected to have notches for the bindings in the lower 1/3 of the blade.

Research presented above suggests additional characteristics that may distinguish warfare from hunting points. First, hunting points may more commonly have rounded tangs to facilitate removal, whereas warfare points may more frequently have pointed tangs. Second, warfare points may have wider or narrower bases than hunting arrow points, depending on the absence or presence of defensive armor respectively (Cotterell and Kamminga 1992:181). Third, hunting points should more commonly be fragmentary, whereas warfare points

should be more commonly whole. Observations presented in this section provide the basis for the formulation of the second hypothesis that is used to guide the following analyses:

Hypothesis 2: Stone projectile points were designed differently for warfare and large game hunting.

Implication 2.1 Points made for hunting will have design features that facilitated secure hafting, whereas points intended for warfare will be designed to detach from the shaft.

Obsidian Analysis Methods

The third hypothesis concerns socioeconomic interactions involved in procuring the raw materials used to make points. This hypothesis is based on considerable previous research that was summarized in Chapter 3. As a result, it is possible to more succinctly summarize the final hypothesis that is employed to guide this investigation. Trace element analyses were performed in the Archaeological XRF Laboratory, Department of Earth and Planetary Sciences, University of California, Berkeley, under the supervision of M. Steven Shackley. Trace element data were collected from each sample for a total of 9 elements (titanium (Ti), manganese (Mn), iron (as Fe^T), thorium (Th), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb)). Elemental intensities were converted to concentration estimates in parts per million by employing a least-squares calibration line established for each element from the analysis of international rock standards certified by the National Institute of

Standards and Technology (NIST), the US. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994).

Further details concerning the petrological choice of these elements in Southwest obsidians are available in Shackley (1995, 2005). These quantitative determinations were then compared to known samples. The source comparative database has been compiled as part of a long-term project to characterize obsidian sources in the Southwest (Shackley 1988, 1990, 1992, 2005).

P-MIP Obsidian Data Sampling Methods

A sample of 142 of the obsidian artifacts from the P-MIP survey collection was selected for XRF analysis. In order to obtain a spatially and temporally representative sample, the obsidian artifacts were stratified geographically and by time period. The 13 units depicted in Figure 4.1 were employed to stratify the sample spatially. Because too few pieces of obsidian are available from units 3, 6, and 13 these areas were not included in the sample. Between 7 and 28 artifacts were selected for XRF analysis from each of the areas. Both diagnostic projectile points and obsidian flakes were selected for analysis from each area. Temporal stratification was achieved by selecting roughly equal numbers of artifacts from the Hohokam Pre-Classic, Classic, and O'Odham Historic periods for each of the units.

In addition to the survey data, obsidian artifacts from two recent Data Recovery projects conducted in the GRIC are also considered. One project

includes excavations at sites along the Santa Cruz River in the GRIC (Loendorf 2007). The second excavated sample is from the north side of the Gila River and includes both Pre-Classic and Classic period obsidian from the Lower Santan Platform mound village (Loendorf 2008b). The third hypothesis employed to guide this research is as follows:

Hypothesis 3: Obsidian distribution patterns can be used as a proxy measure for socioeconomic interactions among communities.

Implication 3.1: Classic and Historic populations of the middle Gila and lower Salt Rivers procured obsidian, an important material for the production of small projectile points, through social mechanisms.

Implication 3.2: significant differences in obsidian frequencies at neighboring communities suggest they maintained separate trade contacts.

Chapter Summary

The nature of middle Gila River archaeological data, the topography of the region, and the survey methods employed during P-MIP investigations result in a situation where sites vary in size by many orders of magnitude. Therefore, it is necessary to control for site area and other sampling issues in any analyses of these data. In the research presented in Chapter 6, sampling fraction is standardized based on survey coverage, and instead of sites, large areas of roughly equal size are employed as units of analysis.

This chapter presented three hypotheses that are used to link material cultural patterns with past human behavior. The first hypothesis is employed in

conjunction with point shape to suggest temporal associations for projectile point assemblages. It is posited that flaked-stone projectile tips generally became smaller over time as a response to developments in the technology for launching these weapons. Technological changes increased the maximum attainable projectile velocity, and lighter projectiles will be launched at higher velocities than heavier projectiles. Concurrently, heavy projectiles tips can result in catastrophic shaft failures, which creates upper and lower optimal design limits for points employed with a given launching technology (Cotterell and Kamminga 1992:168).

Because projectile points generally became smaller, weight can be employed in conjunction with shape to suggest the relative age of assemblages. Applying taxonomic classification systems without including size as a variable would result in the creation of some types that span thousands of years. The ability to more precisely control for differences in temporal association is essential when considering synchronic issues, which include most questions associated with social complexity. The suggestion that stone points generally decreased in weight over time is readily testable using archaeological data, and Chapter 6 considers regional, site, and feature level variation in projectile tip weight.

The second hypothesis posits that flaked-stone points were designed differently for large game hunting and warfare. Therefore, analyses presented below of temporal and spatial variation in point design provide data regarding

both subsistence practices and conflict among humans. This hypothesis is based on a large body of ethnographic research, which was summarized in this chapter. Expectations for projectile point patterning based on this research include: 1) hunting points should generally have rounded tangs, while warfare points will more frequently have pointed tangs that resist backing out of wounds; 2) in cases where defensive armor was employed, warfare points are expected to have narrower bases than hunting arrow points; 3) points designed for hunting are expected to have higher fragmentation rates, while warfare points are anticipated to more commonly be whole. The following chapter presents ethnohistorical and ethnographic information from the study area itself. These expectations and are then tested in Chapter 6.

The third and final hypothesis used in this analysis is based on extensive previous research, and it provides a means to consider socioeconomic interaction patterns. Because XRF analyses of obsidian have been conducted for 30 years, comparative data from across the Hohokam region are available. Chapter 6 employs these data to consider patterns of cooperation among Classic and Historic period sedentary agriculturalists in the Sonoran Desert of central Arizona.

CHAPTER 5: STUDY AREA ETHNOHISTORICAL OBSERVATIONS

The relations of the Pimas to their neighbors had a profound influence upon their social organization and general cultural development. They held possession of the best agricultural lands in their section of the Southwest, and were compelled to fight for the privilege (Russell 1908:200).

Despite the intense conflict they faced and repeated requests for firearms, the Akimel O’Odham living along the middle Gila River possessed few guns until near the end of the nineteenth century, and flaked-stone points continued to be used until the late 1800s (Ezell 1961:66, 1994:346; Hall 1907:420; Russell 1908:111). Written descriptions of Akimel O’Odham cultural practices and settlement locations began in the late 1600s and continued throughout the Historic period (Darling et al. 2004:284). Thus, the situation along the middle Gila offers an important opportunity to compare spatial and temporal patterning among stone points with historically documented trading partners, migrations, settlement patterns, and subsistence practices.

Historic Period Projectile Technology and Hunting Practices

No one would think that a small straight stick would hurt anything or kill anybody, or that a small flat white stone would be harmful (Burns 1916:313).

In contrast to many Eastern and Plains tribes, Native Americans along the middle Gila only rarely employed metal points, and they continued to make stone points until the late 1800s (Ferg and Tessman 1997:259-261; Mason 1894;

Russell 1908). This is probably the result of several factors, but because the Akimel O'Odham did make projectile points from man-made glass containers, it is unlikely that this difference results exclusively from a lack of access to Euroamerican goods (Loendorf and Rice 2004).

Russell (1908:95-96), one the only anthropologists who visited the Akimel O'Odham while they were still regularly using bows, provided several observations regarding stone point use. However, changes in cultural practices occurred prior to his visit and much of the information he collected was from community elders (Roffler 2006). As Fontana (1975: xi-xv) observed in his introduction to the 1975 reprinting of Russell's work:

...*The Pima Indians* provides us with a valuable, if distorted view, of what parts of Pima life may have been in, let us say, the 1860s or 1870s. Read and understood in that context, the book is a classic of its kind. [snip] The reader should know, however, that he is reading a particular kind of history and that much of the information was already history in 1901-02. It is by no means a balanced picture of Pima life in any period; it certainly is not a depiction of Pima life today. [italics in original]

Although it is essential to recognize the limitations of his research, his record is the most comprehensive study available regarding the Historic period Akimel O'odham and it is therefore extensively cited in the following discussion (Roffler 2006).

At the time of his visit in 1902 and 1903, the Akimel O’Odham only rarely practiced large game hunting: “Perhaps one [deer] in two or three years would be an excessive estimate of the number killed by the men of the Gila River reservation” (Russell 1908:81). Instead, they primarily hunted locally available small game, and the arrows they used for this purpose lacked stone tips. Because use of the design had largely stopped, he was only able to collect one example of an arrow intended for use in warfare. This arrow was unusually long and has a stone point attached, which suggests stone tips were used in warfare (Ezell 1961:65). This conclusion is supported by the observations of Bancroft (1886:520) who stated: “The Pimas wing their war arrows with three feathers and point them with flint, while for hunting purposes they have only two feathers and wooden points.” Similarly, Mason (1894: Plate XLII) illustrates both wooden tipped and stone pointed Akimel O’Odham arrows.

Grossman (1873:416) also described similar differences between O’Odham arrows designed for small game hunting and those intended for warfare, as well as the effectiveness of shields for defensive purposes:

The only weapons used by the Pimas before the introduction of fire-arms [sic] were the bow and arrow and war-club. For defensive purposes they carried a round shield, about two feet in diameter, made of rawhide, which, when thoroughly dry, becomes so hard that an arrow, even if sent by a powerful enemy at a short distance, cannot penetrate it. These weapons are still

used by them to a great extent, and, like all Indians, they are good marksmen with the bow, shooting birds on the wing and fishes while swimming in the shallow waters of the Gila River. For hunting fishes and small game they use arrows without hard points, but the arrows used in battle have sharp, two-edged points made of flint, glass, or iron.

Webb (1959:25) described the use of these shields as follows:

If you shot an arrow at him [a Pima warrior] he merely side-stepped, holding the shield at an angle in the path of the arrow. When it hit the shield, it only glanced off to one side.

In addition to differences in arrows, the Akimel O'Odham used separate bow designs for small game hunting and warfare. Self-bows were used with arrows that lacked stone points for small game hunting (Figure 5.1). As will be discussed further in the next chapter, recurved bows that are capable of higher arrow velocities were employed with stone tipped arrows for warfare (Figure 5.2).

Russell (1908:82) related an anecdote that is consistent with his suggestion that the Akimel O'Odham only rarely hunted big game:

When climbing in the Sierra Estrella, in March, 1902, the writer saw a flock of five [mountain sheep] which did not manifest any such fear at the sight of man as do the mountain sheep of British Columbia and the more northern Rockies. Indeed, the Pima chief at the foot of the mountains explained the reason for their indifference very adequately when he declared the sheep were game fit only for the Papagos, who had no fields to look after.

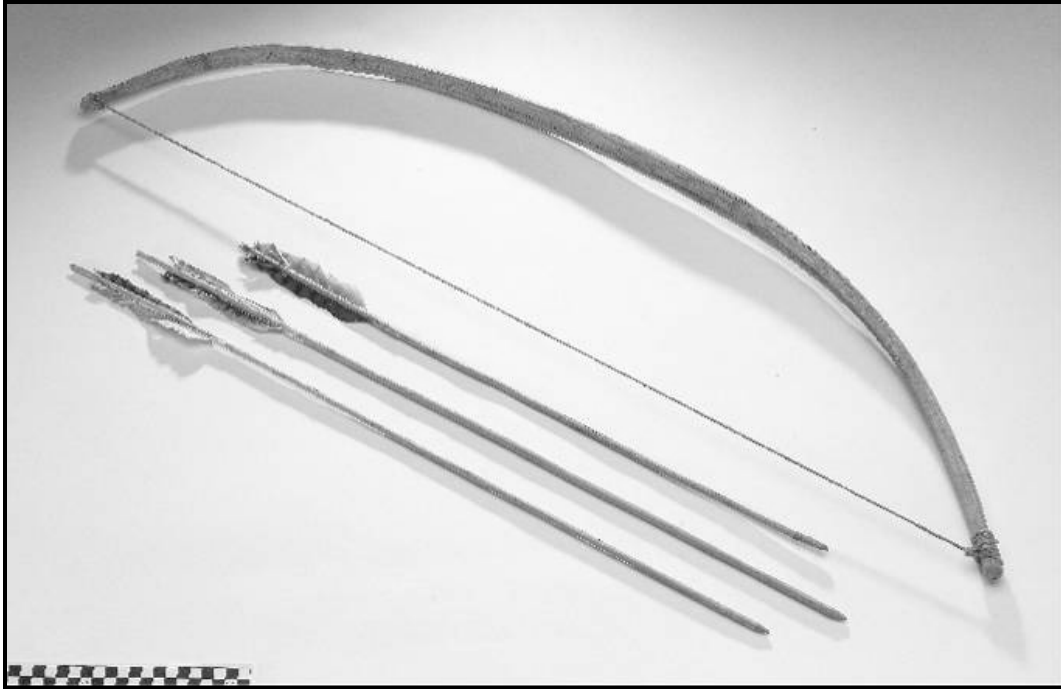


Figure 5.1. Tohono O'Odham bow and small game hunting arrows, collected by Edward H. Davis (Courtesy, National Museum of the American Indian, Smithsonian Institution [8/9793]).



Figure 5.2 Depiction of two O'Odham men, drawn by Kino on his 1696-1697 manuscript. The men are using recurved bows to shoot arrows at a Jesuit Missionary.

Almost 100 years later, regarding this statement Rea (1997:60) said:

It was not a flippant remark that the Pima leader at the foot of the Sierra Estrella made in 1902... [snip] Even when I arrived and took up residence at the base of the Estrella in 1963, only several men were known to be big-game hunters in the four local villages, and individual hunters were remembered by name.

Cremony (1868:90-91) related a Pee Posh [Maricopa] story regarding their migration to the middle Gila River, which says that the Akimel O'Odham made the cessation of large game hunting part of the agreement that allowed the Pee Posh to move next to their villages. It also provides an explanation for why these people didn't regularly practice large game hunting:

...it was agreed that the Maricopas should inhabit certain lands of the Pimos [Akimel O'Odham]; but it was made a *sine qua non* that the new-comers must forever renounce their warlike and hunting propensities, and dedicate themselves to tillage—for, said the Pimos, we have no hunting grounds; we do not wish to incur the vengeance of the Tontos, the Chimehuevis, the Apaches, and others, by making useless raids against them; they have nothing to lose, and we have, and you must confine yourselves solely to revenging any warlike incursions made either upon us or upon yourselves.

Whittemore (1898:56) also suggested that large game hunting could cause conflicts to arise with the Apache:

Formerly, there were some deer and mountain sheep in the vicinity, but the latter are nearly extinct, and in hunting them there was danger of trespassing on the hunting-ground of the war like Apache.

He also relates an anecdote that suggests the Akimel O'Odham hunted big-game in some circumstances, but it was a dangerous activity that required traveling from the GRIC:

Once the Pimas, being hungry, went to the San Pedro to hunt deer. They took their wives with them and a few ponies. They left the women in the morning and on their return in the evening, all had been taken captive by the Apaches.

Ezell (1961:42) found little evidence in Hispanic sources that the Akimel O'Odham practiced large game hunting. The only reference he cites is a large pile of mountain sheep horns that was reported at one village, and he goes on to say:

The American accounts contain many more references to game, but they are chiefly to small game such as quail. Emory's party was the only one to report large game... [snip] This, however, occurred at the western edge of Maricopa territory near the Mohawk Mountains, and no other American diarist reported either seeing or taking any large game while traveling through Pima territory...

Spier (1933:134) stated that Pee Posh “war and hunting arrows did not differ in length, but in their heads and feathering. War arrows were infrequently provided with stone heads...”. However, Spier made these observations roughly 50 years after the manufacture of flaked points ceased, and his description of stone points was based on a single wooden model that was made for him by an informant. The model was “...triangular but with convex edges, straight base, and notched in the edges near the base” (Spier 1933:134). These observations suggest that side-notched points were used for large game hunting.

Bourke (1891:71), who lived among the Apache while they were still making stone projectile points, provided more detailed observations regarding manufacturing techniques and shape:

Mr. Edwin A. Barber, in the *American Naturalist*, described nine different kinds of arrow-tips. Each of these various shapes could be seen among the Apaches to-day [sic], and often in the same quiver several shapes would be found.

This observation suggests that considerable morphological variation existed in Apache points at a given time, and point shape (i.e., style) alone may be a poor indicator of the cultural association for points made by the Apache in general.

Bill (1882:104) described the use of loosely attached stem-less points on Apache arrows used in warfare, as well as the tendency for stone or glass points to fragment within wounds:

These [stone or glass] arrow heads have no neck; they are about an inch long, and a third of an inch wide. They are fastened by gum into a notch, which is cut in a rod of wood eight inches long, and this again is fastened by gum into a reed thirty inches long; but so frail is the connection between head and shaft, that the Indian is obliged to take extraordinary care that they do not become separated in the quiver. These heads are of course brittle, and if they strike a bone, they are sure to break. Mr. V., a paymaster and clerk, was thus wounded in the arm by an Apache arrow. The glass head struck the humerus, and broke into many fragments...

Similarly, Coues (1866:353) made the following observations regarding Apache arrow wounds he treated:

The extreme friability of the head produces results which must be taken into consideration, as one of the most common and troublesome features of the wound. When the head impacts on bone—and it generally traverses soft tissue till halted in this way—the chances of its shivering [sic] into bits vastly preponderate over the probability of its becoming fixed or glancing.

Mike Burns, an “Apache-Mohave Indian” who was born in Arizona around 1864 and lived in the vicinity of the GRIC, described the Apache arrow

manufacturing process including the use of heat-treatment for making stone points (Farish 1916:289). “The arrows were made of sticks, with a little sharp stone in the end...” (Burns 1916:311). “The arrow heads were made of a hard flint, which would be put close to a fire to make it chip easy, and then it would be worked down to the shape and size desired.” (Burns 1916:314).

In contrast to the Akimel O’Odham, some mobile populations who lived close to the middle Gila River did practice big game hunting on a regular basis and meat was a more substantial portion of their diet (Hrdlička 1908:22; Burns 1916:291). As is the case for nearly all ethnographic examples, Apache arrows designed for hunting large game or warfare were tipped with stone points, but arrows intended for killing birds or other small game did not have stone points attached (Basso 2004:227; Bourke 1890:56; Coues 1866; Mason 1894:668-669). Similarly, the Yavapai also hunted large game with stone-tipped arrows that were generally side-notched, and they used arrows without stone points for small game hunting (Khera and Mariella 1983:50).

Hoffman (1878:467-468) argued that triangular shaped side-notched points were characteristic of one Apache group:

The manufacture of stone arrow-heads is still carried on by the Coyoterò Apachès. Various species of siliceous materials are employed. The triangular shape is characteristic of this tribe. The dart is fastened to the shaft by means of dark reddish-brown vegetable gum and sinew threads, which are brought

forward over the two basal apices, above which there are usually two slight notches for their reception. Fragments of so-called porter-bottles are frequently utilized in the manufacture of arrow-heads, making an effectual but brittle weapon.

Coues (1866:351), who was a surgeon, described Apache stone projectile points used in warfare as follows:

The head is apparently a small and trifling affair, compared with the results it is capable of producing. It is made from some species of quartz, chalcedony, obsidion [sic], etc., and is always either white or black in color. It is an inch or somewhat less in length, by about a-third of an inch in greatest width; in shape a narrow isosceles triangle. [snip] There is no projecting handle for insertion into the wood. No thongs or wrapping of any sort are used; and so frail is the connection between the head and shaft, that the Indians themselves are obliged to carry their arrows with great care.

He goes on to observe (Coues 1866:353):

The characteristics of the Apaché arrow-head are essentially these: 1, its minute size; 2, its jagged edges and angles; 3, its extreme friability; 4, its very ready separation from the shaft...

Bourke (1890:57) described the preferred materials and manufacturing techniques for Apache points as follows:

Stone arrow-heads were preferably made of obsidian (*dolguini*), next of chalcedony, lastly of pieces of beer bottles, but the process of manufacture was in each case the same, and consisted in chipping small fragments from the edges of suitable pieces of material, the chipping implement being a portion of hardened deer or elk horn, held in the right hand, the silicious stone being held in the left over a flap of buckskin to protect the fingers.

Bourke (1890:57-58), who was a Calvary officer, was concerned with how long it would take “Apache Indians, whose village had been captured and destroyed by troops, to provide themselves anew with weapons...”. Consequently, he also recorded how long it took to make stone points:

I made it my business to determine exactly how many minutes were requisite for making a serviceable arrow-head. I singled out an Apache at random and stipulated that he should employ no tools of iron, but only allowed him to gather from the ground such pieces of chalcedony as he pleased. He made a number of barbs [stone points], the time as recorded in my note-book being five, six, seven, and eight minutes. An expert would have completed the barbs in less time...

One of the main documented differences between Apache, Pee Posh, and Akimel O’Odham arrows is the materials employed to make the shafts. Pee Posh and Akimel O’Odham arrows generally had solid shafts made from arrow-weed

(Figure 5.3), whereas the Apache usually employed cane shafts (Bourke 1890; Coues 1866:351; Mason 1894:668-669; Russell 1908:96; Spier 1933). Bourke (1890) suggested the Apache design was superior:

The Apaches have a myth which states that they overcame all of the tribes in their path because the god, *To-va-dis-chinni* (“The Mist Rising from the Water), placed them in a reed swamp and gave them pieces of obsidian as tips for their arrows. When read between the lines this myth relates an important truth: The Apaches did subdue or drive the other tribes before them on account of having better arrows...



Figure 5.3. Akimel O’Odham woman collecting arrow weed, photograph by Edward Curtis.

In addition to arrows, the Pee Posh also sometimes employed spears (Spier 1933), and Russell (1908) describes similar weapons for the Akimel O’Odham, as do Bourke (1890:56), Cozzens (1874:119), and Hoffman (1878:468) for the Apache (Figure 5.4). The use of spears in warfare is also described in the calendar stick records Russell (1908:40-41) reported. Charlie Redbird, one of Spier’s (1933) informants, told him stone points were sometimes used on these spears.

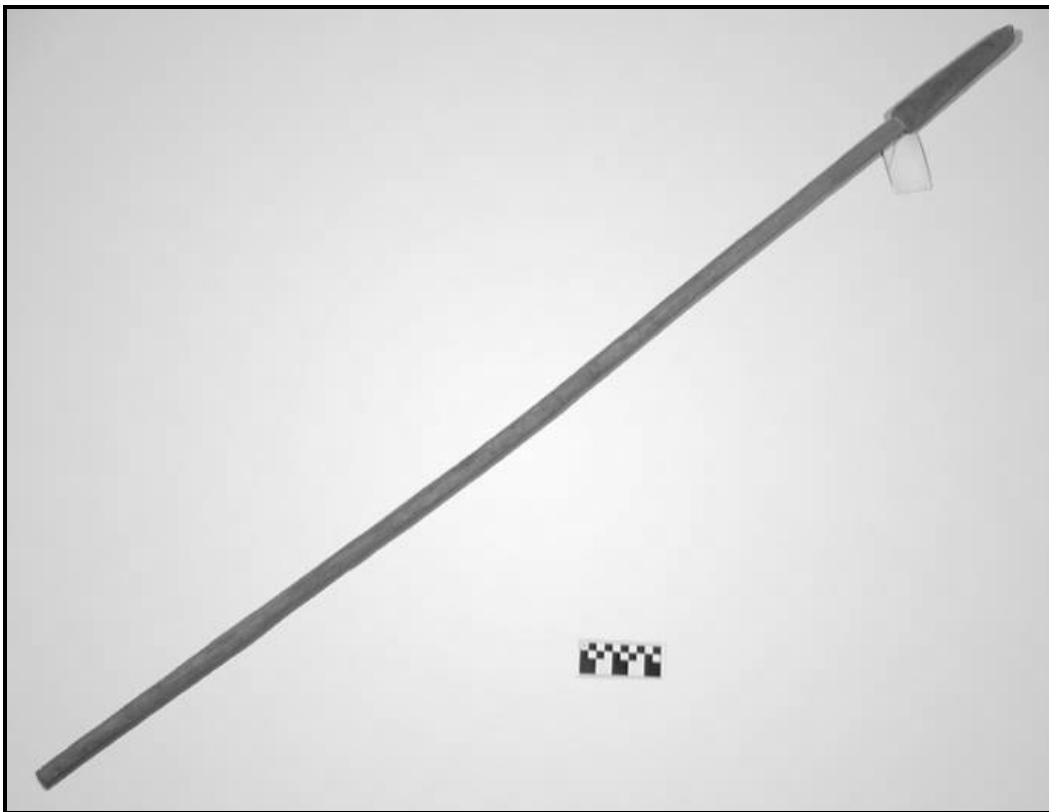


Figure 5.4. Tohono O’Odham spear with metal point, collected in 1919 by Edward H. Davis (Courtesy, National Museum of the American Indian, Smithsonian Institution [8/9845]).

Bourke (1890:56) reported that Apache spears were sometimes “tipped with a flint barb, two or three inches in length by an inch in breadth, sometimes

with serrated, sometimes with plain edges, fasted to the staff with sinew and gum”. “[A good lance-head] could be made in a very short time, but in exactly how many minutes I am unable to say” (Bourke 1890:58). These observations suggest that in addition to small arrow points, substantially larger spear points should also occur in Historic period projectile point collections from the middle Gila Region. The next section considers socioeconomic interactions of Historic period populations within the study area.

Historic Period Socioeconomic Interactions

This discussion considers Historic period exchange relationships, which are used to suggest expectations for Historic period obsidian acquisition patterns. The Akimel O’Odham exchanged goods largely with the Pee Posh and Tohono O’Odham, and were in conflict with other surrounding groups (Ezell 1961:28-31; Russell 1908:93). They also bartered or sold goods to Hispanic populations to the south, and by the 1850s they also extensively traded with settlers who traveled through the area. Prior to 1833, Pee Posh from Gila Bend came at harvest time to trade with the Akimel O’odham (Russell 1908:93). After the Pee Posh moved to the area adjacent to the Akimel O’Odham communities in the early 1800s, the Tohono O’Odham were their primary external trading partners. Although the Tohono O’Odham lived in more arid desert environments to the south, they brought both food and other items for exchange (Webb 1959:65).

Russell (1908:93) observed that in addition to salt the Tohono O’Odham also brought a wide variety of other items:

“[T]he trade which they carried on with the Pimas was by no means one-sided, as may be seen from the following list of products that were formerly brought to the Gila at the time of the June harvest. Of vegetable products there were saguaro seeds, the dried fruit and sirup [sic]; tci’aldi, a small hard cactus fruit; agave fruit in flat roasted cakes; agave sirup [sic]; rsat, an unidentified plant that grows at Santa Rosa; prickly pear sirup [sic]; wild gourd seeds; a small pepper, called tcil’tipin; acorns of *Quercus oblongifolia*; baskets of agave leaf; sleeping mats; kiâhâs and fiber to make them; maguey fiber for picket lines. [snip] Of mineral products they brought red and yellow ochers [sic] for face and body paint, and the buff beloved by Pima weavers. [snip] In exchange for the objects of barter brought to them the Pimas gave wheat, which was also given the Papagos for aid in harvesting it; corn; beans; mesquite beans; mesquite meal, roasted in mud-lined pits; cotton blankets and cotton fiber, with the seed; dried squash, pumpkin, and melon; rings of willow splints and of devil's claw for baskets; besides articles of lesser consequence. In recent years there has been some trade carried on in colored earths and salt with the once hostile Yumas and Mohaves.

Few of the items Russell listed are likely to be preserved in archaeological sites, and only the ochre and possibly the colored earths would remain unless they were charred. It is interesting that the exchanged items were largely foodstuffs

(Webb 1959:65). However, Russell (1908:92) also listed exchange rates as follows:

For purposes of trade or in gambling the following values were recognized: A gourd was equivalent to a basket; a metate, a small shell necklace, or the combination of a basket and a blanket and a strand of blue glass beads was equivalent to a horse; a string of blue glass beads 4 yards long was equivalent to a bag of paint; and a basket full of beans or corn to a cooking pot.

This list suggests that baskets full of food were exchanged for cooking pots, and decorated ceramics were also obtained as containers through exchange interactions (Russell 1908:124):

Furthermore, many of the smaller decorated [ceramic] pieces are traded from both the Kwahadk's and the Papagos, the latter bringing them filled with cactus sirup [sic] to exchange for grain.

These observations suggest that by the Late Historic period, exchange relationships among the Akimel O'Odham and other surrounding groups were predominately with people who lived to the south and east of the study area. The next section develops expectations for the spatial distribution of Historic period projectile points within the GRIC.

Historic Period Settlement Pattern Descriptions

The Akimel O'Odham did not experience intensive colonial contact during most of the Historic period (Ezell 1994:319; Eiselt 2002:10). Initial historical documentation of the middle Gila River area was not until 1694, and written records after this time are sporadic and limited in scope until the arrival of Americans in the mid-1800s. Sufficient references exist, however, to make a number of inferences regarding Akimel O'Odham settlement patterns and population movements between roughly 1700 and the time stone point manufacture largely ceased sometime in the late 19th century (cf. Russell 1908:111).

The Spanish missionary Father Kino was the first European to visit the Akimel O'Odham communities along the middle Gila (Wilson 1999). Figure 5.5 shows a detail from one of the maps he drew based on his visits. He made four trips through the area, spending a maximum of 10 days over the course of these encounters (Wilson 1999:9). Of this time Ezell (1983:150) writes:

...it can be argued that disease did not wait upon Spanish explorers but preceded them by being spread by fugitives from infected communities and that one or more epidemics had struck Pimeria by 1524. Proceeding on that assumption, it is argued that the Spaniards met in 1694 a society reeling under the onslaughts of repeated epidemics over a period of approximately 170 years.

Distances were given relative to one another and it is unclear exactly when the Spaniards would decide they were arriving and leaving at a given community as their descriptions suggest houses were scattered in loose clusters that varied in size and density (Ezell 1961:110).

Neither Kino nor Manje provided population estimates for all of the middle Gila communities, and at the time of their visits people were still living in the Gila Bend area further to the west along the river (Wilson 1999). Despite the epidemics that spread through the area, there are indications that the population along the middle Gila was rapidly growing over the course of Kino's visits (Wilson 1999):

In his 1694 entry, Father Kino mentioned only two settlements.

In 1697 and in the context of Casa Grande he said "...There are nearby six or seven rancherías of Pimas Sobaipuris..."

During the seventeenth century the Spanish applied the name "Sobaipuri" indiscriminately to people residing along the San Pedro, Santa Cruz, and Gila Rivers in southern Arizona, which has created considerable confusion regarding the use of this designation (Hackenberg 1974:63; Vint 2005). It appears that the San Pedro and Santa Cruz populations were culturally similar to the ancestors of the Akimel O'Odham living along the middle Gila River, but the people along the San Pedro experienced more intensive contact with the Spanish and suffered greater conflict with the Apache during the first part of the 18th century.

Hackenberg (1974) found few reasons to differentiate among these peoples. “All of these Pimas, or Pimas Sobaipuris, spoke a mutually intelligible language, were riverine agriculturalists, and were settled in scattered villages...” (Hackenberg 1974:70). Hackenberg goes on to conclude that the main differentiation between the people along the Gila and those on the San Pedro river is based on the:

...divergent courses of events which befell the two groups in the Eighteenth Century. During this time, the Gila Pimas consolidated their settlements to a range of less than twenty miles, and formed a united defense perimeter against Apaches which permitted them to survive. The San Pedro Sobaipuri, on the other hand, quarreled among themselves, failed to unite even in the face of large scale Apache attacks, [and] remained in sprawling settlements scattered for 90 miles along the San Pedro River... (Hackenberg 1974:70).

When discussing relationships among the Akimel O’Odham and other Native American groups, Ezell (1961:21) states:

...the Sobaipuris of the San Pedro and Santa Cruz valleys, were most like the Gila Pimas, since the Spaniards, visiting the latter for the first time after having known the Sobaipuris, at first identified the Gila Pimas as Sobaipuris also. By 1762 Nentvig (Rudo Ensayo 1951:79) reported that the Sobaipuris

had abandoned the San Pedro Valley, some joining the Gila Pimas and some moving to the Santa Cruz Valley, although some of these later left to join the Gila Pimas...

Population estimates for the Akimel O'Odham given by the Spanish missionaries also suggest that a portion of the San Pedro populations and surrounding areas moved to the Gila River (Ezell 1961:116). Father Garces in 1768 reported a population of approximately 4,000 people along the middle Gila River, which Wilson (1999) suggests is "several fold from the numbers in Kino's time". He goes on to say:

...it appears that the population of the middle Gila was increasing by the 1740s if not before and that this increase continued until at least the 1770's. The new people were initially refugee Sobaipuris who came directly or indirectly (or both) from the San Pedro valley.

Between 1744 and 1775, the occupied area along the middle Gila River contracted by at least half. By the time Anza and Garcés visited the middle Gila in 1775, the first village was not encountered until the vicinity of Gila Butte, but locations to the east in the Santa Rosa area appear to have been occupied during a visit just a year earlier (Wilson 1999). The last settlement was encountered near Pima Butte (Wilson 1999).

Akimel O'Odham settlements had become the target of more frequent raiding during this time (Ezell 1983; Russell 1908; Wilson 1999). To defend

against these constant threats, the Akimel O’Odham adopted this denser settlement pattern, introduced mandatory military service for all males, and conducted punitive campaigns. Village locations provided by Bringas in 1795, suggest the locations of the settlements remained stable from 1775 until that time (Wilson 1999).

The next written record of settlement patterns along the middle Gila came during the Romero expedition in 1823. He reported four villages that appear to have been along the same stretch of the river between Gila and Pima Buttes where Garcés and Anza reported O’Odham settlements approximately forty-eight years earlier (Wilson 1999). Romero also made the earliest reference to the Pee Posh village of “Standing Bone”, which apparently was located along the Santa Cruz River immediately west of the O’Odham villages (Wilson 1999). It is unclear when this area was first occupied by the Pee Posh, though Spier (1933:26) suggests it occurred at the beginning of the 19th century.

Hackenburg (1974:38) states that by 1846 the Akimel O’Odham and Pee Posh were living in a short stretch of land south of the Gila River in the vicinity of Casa Blanca, extending no farther west than the Gila-Salt confluence. He goes on to observe, “Pimas were afraid to venture any farther than five or six miles east of Casa Blanca...”, because the Apache posed a constant threat (Hackenburg 1974:39). Though the number of reported villages increased suggesting possible population expansion, the Akimel O’Odham appear to have occupied the same stretch of the river from Gila to Pima Buttes in 1846-1849 as they had in 1775,

and the limited expansion in settlement outside the core area consisted of Pee Posh communities (Wilson 1999).

As late as 1850, all "...Pima Indian villages were still on the south side of the Gila River..." (Hackenberg 1974:100). Bartlett (1856:232) described the area in 1852 as follows:

The valley or bottom-land occupied by the Pimos [Akimel O'Odham] and Coco-Maricopas [Pee Posh] extends about fifteen miles along the south side of the Gila, and is from two to four miles in width, nearly the whole being occupied by their villages and cultivated fields. The Pimos occupy the eastern portion. There is no dividing line between them, nor anything to distinguish the villages of one from the other. The whole of this plain is intersected by irrigating canals from the Gila, by which they are enabled to control the waters, and raise the most luxuriant crops.

After this time, however, Apache raiding began to abate and as a consequence of external pressures exerted by Euroamerican settlers, the Akimel O'Odham returned to a more dispersed settlement pattern (Dejong 2009; Webb 1959:38; Shaw 1994:58-65). John Reid, a traveler from Texas, reported settlements on both sides of the Gila in 1857 (Wilson 1999). The Pee Posh established a settlement at Sacaton perhaps in 1848-49 (Spier 1933). By this time,

the O’Odham core area appears to have been bordered on the east, west, and north by Pee Posh settlements.

The most devastating effect of the migration of Euroamerican settlers into the region was the construction of upstream canals in the 1870s that diverted much of the water to non-Native American farmers along the Gila River (Ezell 1983; Dejong 2009). As a result, during subsequent periods of drought the lack of water led to the further dispersal of the Akimel O’Odham, including the relocation of some settlements to areas of former occupation in the Salt River Valley (Ezell 1983; Webb 1959:45). Russell (1908:33) concluded:

...no effective efforts were made to prevent the water from being diverted from the reservation, and the result was nearly as predicted—a result that should bring a blush of shame to every true American. A thrifty, industrious, and peaceful people that had been in effect a friendly nation rendering succor and assistance to emigrants and troops for many years when they sorely needed it was deprived of the rights inhering from centuries of residence. The marvel is that the starvation, despair, and dissipation that resulted did not overwhelm the tribe.

Middle Gila River Historic Period Conflict

Although the nature and intensity of warfare varied substantially over time and space, conflict was endemic among Southwestern Historic period populations (Basso 2004; Ezell 1961; Jacoby 2008; Kroeber and Fontana 1986; Rice 2001; Russell 1908; Shaw 1994:10-14; Spier 1933; Webb 1959:22-25). During the 19th century the Akimel O’Odham experienced two primary forms of violence, which are generally classified as raiding and warfare. The Pee Posh, for example, distinguished between “formally arranged pitched battles” and small raiding attacks, where the intent was brief assault and rapid disengagement (Kroeber and Fontana 1986; Spier 1933).

The Western Apache also differentiated between raids where the primary objective was to obtain property, and vengeance attacks where the intent was to kill enemies (Basso 2004). Apache raiding parties tended to be small groups of five to fifteen men who moved stealthily and tried to avoid combat (Kroeber and Fontana 1986:36). Warfare expeditions, on the other hand, could include 200 or more men who attempted to kill adversaries and even destroy entire settlements (Kroeber and Fontana 1986). These attacks were generally organized in retaliation for their own losses.

Both Yavapai and Apache groups raided the Akimel O’Odham villages along the middle Gila. “Every three or four days small parties of five or ten would come steal live stock or to kill any individual that might have gone some little distance from the villages” (Russell 1908:201). As discussed in the previous

section, although the individual attacks were generally minor, conflict with these groups impacted Akimel O’Odham settlement patterns along the middle Gila, and lead to the abandonment of large areas of former habitation (Russell 1908:201).

In response to these raids and larger attacks, the Akimel O’Odham organized punitive campaigns against the Apache on a periodic basis (Webb 1959:30). Many facets of these campaigns were highly ritualized. For example, prescribed and detailed speeches were made each evening while they traveled. These raids usually ended with the death of one or two O’Odham, and the destruction of an Apache camp, with “perhaps half a dozen of the enemy killed and a child taken prisoner” (Russell 1908:202).

In contrast to the Apache, the Akimel O’Odham did not conduct raids in order to acquire goods, and their intent was usually instead to inflict deaths and injuries. Bourke (1890:59), who lived with the Apache, described Akimel O’Odham and Pee Posh tactics as follows:

Having located a *rancheria*, or village, of their enemies, they would surround it at night and when first light appeared in the east would raise a yell, shrill and unmistakable in its blood-curdling significance. The terror-stricken foe, rushing out pell-mell from their frail *jacales* were obliged to go down on their hands and knees to get out of the low openings. Crouched in this defenseless position, they would hardly have protruded their heads, when crack ! would come the *macan* or war-club

of the blood-thirsty assailants. The Pimas and Maricopas used to be greatly addicted to plundering, in which they rivaled the Prussians.

After describing similar depredations inflicted by the O'Odham against the Apache, Burns (1916:311) said:

Treatment like this will, of course, make any human being feel like getting even in some way. The Apaches, however, did not have many weapons to protect themselves; they only had bows and arrows.

The Akimel O'Odham, who had a different perspective, recorded details of these conflicts in the calendar stick records they kept (Russell 1908:34-66, Figure 5.6). For example, the record written by McClatchie for the year 1837 describes a raid in which the assailants used armor to defend themselves (Hall 1907:416):

In the summer a Pima woman went out to gather some cactus fruit and Apaches chased her back. In trying to jump a ditch she fell in and they killed her. Our men who were in the field pulling white-head weeds out of the corn, saw the woman running toward them and wondered why she ran. Then they saw the Apaches and ran to the homes and got more men and went after the Apaches. On the south side of where Mesa now is, they overtook the Apaches and killed five. The rest escaped. None of the Pimas were killed. As soon as the fight was over they sent back a man to



ḃ TCO'KŪT NAK, HOLDING A CALENDAR STICK
Figure 5.6 Pima calendar stick, from Russell 1908.

tell the women how many Apaches they had killed. This was a very hard fight. The Pima Chief See-o-Ke kept telling his men not to run away, to stand and fight. But the Apaches did run, and got mixed up with the Pimas, and the dust was so thick it was hard to tell which was Apaches and which was Pimas. The Apaches fought with bows and arrows, and the Pimas with sharp sticks, very few of them having a bow or arrow. Some Pimas living near where the fight was, saw the dust and came to see what was the matter. The fight was at its thickest, so they joined in and helped the other Pimas. The Apaches wore cowhides for shirts and

blankets on top, so the sharp sticks would not go into their bodies, but the Pimas killed five by hitting them on their faces.

Russell (1908:203) summarized Historic period conflict among the Native Americans from the middle Gila River region as follows:

These raids [by the Akimel O'Odham] were not infrequent, but they could hope to reap no better reward for their efforts than revenge for past injuries, whereas the Apaches were spurred on to constantly renewed attacks for the sake of plunder that they might secure. Thus the feral pauper preyed upon the sedentary toiler, but paid dearly in blood for his occasional prize of grain or live stock. The effect upon the two tribes of so strenuous a life was beginning to manifest itself in an interesting manner at the time of the intervention of the Americans. The Spaniards and Mexicans had shown utter incapacity to cope with the Apaches, and their presence in Sonora was rather an aid to the enemy than otherwise. The Pimas were compelled to fight their own battles. In doing so they learned the advantage of concentrating their fields. They perfected a system of attack, appointed runners for bringing in assistance, and organized a fairly satisfactory method of defense. They never used smoke signals except to announce the victory of an incoming war party. They kept themselves constantly in fit condition by their

campaigns, and even engaged in sham battles for practice.

These have been held within the last decade at the lower villages on the reservation. Their daily duties were ordered with reference to the possibility of attack. Their arts were modified by the perpetual menace. Their myths were developed and their religion tinged by the same stress.

Settlement Patterns and Archaeological Visibility

The ongoing conflict among Historic period populations in the middle Gila region had substantial effects on the settlement patterns of different groups, which in turn, variously affect the archaeological visibility of these people. In short, warfare between sedentary agriculturalists (e.g., Akimel O'Odham and Pee Posh) and people who practiced raiding (e.g., Apache and Yavapai) resulted in the concentration of the former populations for defense, while the latter groups instead practiced a dispersed and mobile settlement pattern as a defensive mechanism (Nabokov and Easton 1989:338; Jacoby 2008:143-188). This observation is supported by the fact that although extensive historical records exist regarding the results of conflict between them, no archaeological sites attributed to the Apache have been recorded in the study area, while Akimel O'Odham sites are common.

For many reasons sedentary populations are more readily visible in the archaeological record than are highly dispersed mobile populations (Herr et al. 2009; Seymour 2009; Upham 1988). First, concentrated populations leave behind

much denser accumulations of cultural material (e.g., large middens) that are more readily identifiable on the modern ground surface than are diffuse low-density remains left behind by scattered populations. Second, in order to travel efficiently, populations that frequently move are restricted in the materials they can carry. In contrast, sedentary populations are not similarly constrained, and it is therefore possible to accumulate more possessions (Andrefsky 1994). Third, year-round habitations are more likely to be built in geomorphological settings that facilitate their preservation (Loendorf and Rice 2004:8-10). Fourth, Seymour (2009) argues that the archaeological remains from Historic period mobile people tend to co-occur with the remains of Archaic period populations. Archaeologists have generally assumed all of these materials are from the Archaic period, and have therefore failed to recognize data from mobile Historic period peoples (Seymour 2009).

Most importantly, because the Akimel O'Odham and US Government troops regularly organized military campaigns against hunters-gatherers who raided sedentary populations, these seasonally transhumant populations went to considerable lengths to conceal their presence on the landscape (Basso 2004; Herr et al. 2009:39). One of the ways they hid their activities and obtained materials for tools in the process was to intentionally reoccupy prehistoric sites, which further complicates identification of the remains they did leave behind (Ferg and Tessman 1997; Herr 2009:45; Whittlesey et al. 1997:212).

The Apache were so successful at hiding it was difficult to find any evidence whatsoever of their existence even at the time they were occupying much of southern Arizona (Shaw 1994:39-42). A contemporary observer, John C. Cremony (1868:138), put it this way:

Remember that a well appointed and careful party may travel through Arizona from one year's end to the other, without ever seeing an Apache, or any trace of his existence, and from this cause travelers frequently become careless and fall an easy prey to their sleepless watchfulness. Indeed, it is not difficult to point out many who have no faith in their apparent ubiquity, but believe they must be sought in their strongholds. There are others again who will not be convinced that the eyes of these Indians are always upon them, because they see nothing to indicate that fact; but the truth is, every move you make, every step you advance, every camp you visit, is seen and noted by them, with the strictest scrutiny.

Cremony (1868:142) went on to argue:

Casual observers have, unintentionally, done serious evil by underrating their [the Apache] real strength, to an extent almost inconceivable among those who are better informed. I have been in company with a body of fifteen hundred at the very time that intelligence was received that half a dozen other

parties, numbering from twenty to three hundred each, were actively engaged on committing depredations at other points embraced in a radius of five hundred miles, and yet I have seen the number of Apaches estimated as low as fifteen hundred and two thousand. Nearly eight years of personal experiences have satisfied me that the Apache race, collectively, will number fully twenty-five thousand souls.

Burns (1916:325) provided an anecdote regarding difficulties that the US troops had when attempting to find Apache camps (Figure 5.7):

Once in the winter of 1872, the soldiers passed right by a camp of Indians on a thick flat of cedar; it was snowing and the wind was blowing right in the soldiers' faces. They never looked down on the ground to see if there were any tracks of the Indians, and went right on by.

Because the Apache went to considerable lengths to conceal their presence on the landscape, they left behind comparatively little evidence of their existence in the archaeological record. Furthermore and for the same reason, their existence is also under-represented in the Historical records written by Euroamericans who traveled through the region.



Figure 5.7. Apache village, photograph by Edward Curtis.

In addition to the effects of settlement patterns on archaeological visibility, differences in material culture (especially architecture and ceramics) between sedentary people and groups with high residential mobility also differentially affect archaeological visibility (Upham 1988). For example, Apache groups were generally small and they built ephemeral brush structures (Figure 5.8) that are less likely to leave evidence in the archaeological record than are adobe and especially masonry structures (Nabokov and Easton 1989:338).



Figure 5.8. Apache brush structure, photograph by Edward Curtis.

Indeed, one current database that is designed to track populations between 1200 to 1700 only includes archaeological sites with more than 12 rooms (Clark et al. 2008:2). Therefore, people such as the Apache who usually traveled in small groups and built structures that do not commonly leave evidence in the archaeological record are excluded from this database by definition, and they are consequently archaeologically invisible.

Furthermore, the Apache less commonly used ceramic vessels, which are fragile and difficult to transport (Baugh and Eddy 1987; Herr 2009:41). The few ceramics that were made by the Apache were plainwares, which are more difficult to identify and may not be recognized as Apache wares (Baugh and Eddy 1987;

Herr 2009:41). Decorated ceramics play a central role in chronological control within southern Arizona, and sites that lack diagnostic ceramics and surface evidence of architecture are almost invariably designated as “artifact scatters” of unknown age (Wells et al. 2004b). Therefore even if Apache sites are identified during archaeological survey, they are unlikely to be recorded as such. As a result, mobile populations that did not regularly use decorated ceramics and who lived in ephemeral structures are quite literally archaeologically invisible.

Discussion

Although people such as the Apache are difficult to identify in the archaeological and even the Historical record, their raiding had thoroughly documented and dramatic effects on sedentary populations. As a consequence, in order to examine conflict and cooperation among the people who lived along the middle Gila River, it is necessary to consider the role that highly mobile populations (e.g., the Yavapai and Apache) played.

In spite of what appeared to be an inconsequentially small population to many observers, the Apache forced the Sobaipuri to abandon the San Pedro River, and the Akimel O’Odham found it necessary to concentrate their habitations in a small area for defense. The Apache and other archaeologically invisible peoples successfully stopped and then reversed Euroamerican expansion into Southern Arizona for hundreds of years and were not subdued until the late 1800s, despite concerted and prolonged efforts by Euroamericans (e.g., placing large bounties on Apache scalps) as well as other Native Americans (Cozzens 1874:38-39; Kozak

and Lopez 1999:42-43). Although these dramatic effects of Apache raiding are clearly documented in the Historical record; until recently, the methodology Southwestern archaeologists have employed has meant these people and other mobile groups have previously remained archaeologically invisible (Herr et al. 2009; Seymour 2009).

Chapter Summary

This chapter has presented ethnographic and ethnohistorical descriptions of projectile technology, socioeconomic interactions, settlement patterns, conflict, and subsistence practices of Historic period people who lived within or in the immediate vicinity of the middle Gila River study area. Although relatively few Euroamericans visited the region until the 1850s and initial contact was not until A.D. 1694, it is possible to infer numerous expectations for patterning in the archaeological record that are based on written documentation. Table 5.1 summarizes expectations for Historic period arrow point technology that are based on the observations of people who visited the middle Gila during the Historic period.

Historic period exchange consisted largely of foodstuffs, though decorated ceramics and cooking vessels were also exchanged. Prior to their relocation to the GRIC, trade was carried out with the Pee Posh in the Gila Bend area. Conflict between the Akimel O'Odham and surrounding populations limited trade interactions, and the Tohono O'Odham who were located to the south of the study area were their primary trading partners.

Table 5.1 Warfare and hunting expectations based on ethnohistorical observations.

Group	Large Game Hunting	Hunting Point Types	Warfare	Warfare Point Types
Apache/ Yavapai	Common	Wooden arrow tips for small game, and side-notched stone points for large game.	Raiding, skirmishes, and large battles only rarely.	Small stone arrow points with a wide variety of shapes. Stone tipped spears.
Akimel O'Odham	Very rarely	Wooden arrow tips for small game only.	Skirmishes and large battles regularly.	Small stone arrow points. Sobaipuri points were serrated. Stone tipped spears.
Pee Posh	Only before immigrating to the middle Gila River.	Wooden arrow tips for small game, and side-notched stone points for large game.	Skirmishes and large battles regularly.	Wooden tipped arrows? Stone tipped spears.

Settlement pattern expectations based on historical documentation include the following observations. (1) Historic period settlement was largely on the south side of the Gila River until 1850, suggesting that projectile points from this time should be concentrated on that side of the river. (2) The dispersal of Akimel O'Odham settlements that occurred after the arrival of Euroamericans in the mid-1800s suggests that Historic points found on the north side of the river should generally be most recent and therefore by inference lighter than older Historic points from the south side. (3) The contraction of Akimel O'Odham settlement to a small stretch of the Gila River from Gila to Pima Buttes that occurred by 1775 and continued until the 1850s, suggests that Historic projectile points should be most highly concentrated in the Casa Blanca area. (4) Pee Posh migrants to the middle Gila River settled on the margins of the Historic settlement core area, suggesting point styles associated with people moving into the area may be more

common on the immediate peripheries of Casa Blanca. (5) Some San Pedro Sobaipuri moved to the middle Gila during the mid-1700s, suggesting they might have introduced point types at this time.

Until recently, the methodological approach of Southwestern researchers has meant that highly mobile hunter-gatherer populations have been archaeologically invisible. Conflict among hunter-gatherers and sedentary agriculturalists had profound effects on both groups, which were extensively documented in the historical record. Because mobile populations actively concealed their location on the landscape these people are hard to recognize in the archaeological record. Although these people are difficult to identify, diachronic trends in obsidian utilization presented in the next chapter suggest evidence that hunter-gatherers may have moved into the Sonoran Desert before the Historic period and they may therefore have played a role in the changes in settlement patterns and cultural practices that occurred between the Classic and Historic periods.

CHAPTER 6: MIDDLE GILA RIVER PROJECTILE POINT DATA

After considering the overall distribution of projectile points within the study area, this chapter begins with an analysis of projectile points that have been suggested to be Historic period types based on previous research in the region (Brew and Huckell 1987; Bronitsky 1985; Canouts et al. 1972; Di Peso 1953; Doyel 1977; Haury 1950; Gilpin and Phillips 1998; Loendorf and Rice 2004; Masse 1981; Justice 2002; Ravesloot and Whittlesey 1987; Rosenthal et al. 1978; Seymour 1993, 2009; Vint 2005). Patterns in these data are compared to ethnohistorical and ethnographic descriptions of Akimel O'Odham settlement locations (Bolton 1948; Ezell 1961, 1983; Hackenberg 1974; Russell 1908; Spier 1933; Upham 1983; Wells 2006; Wilson 1999). Following these investigations, the distribution of Historic period ceramic types is compared to patterning in the point collection. Classic period ceramic data and platform mound locations are then used to generate exceptions for the distribution of stone projectile points that were made at this time.

The following sections present attribute based analyses of the P-MIP projectile point collection that further explore both temporal and spatial variability in these remains. This research attempts to better define and understand the underlying characteristics that were employed to define categories in the typological system (Loendorf and Rice 2004). The hypothesis that points generally became smaller over time as a result of improvements in delivery systems is tested through analyses of point size data at a range of spatial

scales, beginning with study area wide analyses, continuing through intra-site patterning, and finally considering variation among individual features. Both survey and excavation data are considered, however, the available sample of excavated Historic period features is small.

The following discussion tests several expectations for warfare and hunting point designs. The distribution of these two different point types is then considered. Next, temporal and spatial patterning in serration data is examined. These analyses suggest that some point attributes that are generally employed to define “styles” in classification schemes are actually more closely associated with differences in the intended function of the projectile points. At the same time, evidence is identified that suggests other attributes, especially those associated with the blade margins, may be more closely associated with style in the sense that they appear to be intentional expressions of cultural associations. The final portion of this chapter employs obsidian source data to examine synchronic and diachronic variation in socioeconomic cooperation among social groups within the study area as well as those in surrounding locations.

GRIC Projectile Point Densities

Projectile points were rarely collected as IOs, and more than 95 percent of the collection was recovered from contexts that had site-level artifact densities. Projectile points collected from the surface of these sites probably entered the archaeological record as a result of many different processes. First, points may have been accidentally disassociated from shafts in habitation areas.

Ethnohistorical documentation summarized in Chapter 5 suggests that warfare points readily detached from arrows and the small size of the points would have complicated recovery of separated projectile tips. Second, some points were intentionally discarded after breakage. Third, projectile points were sometimes included as intentional or unintentional (e.g., because they were lodged in the body of the deceased) burial accompaniments. Fourth, some projectile points may have been lost during use when the arrow was fired at a target. Fifth, points may have been in contexts such as structures that burned or otherwise collapsed and were therefore not recovered. For example, flooding and resultant deposition may have buried functional cultural artifacts. Sixth, points may have been buried in caches for later use. Seventh, projectile points may have been used as offerings in ritual contexts. These explanations are not mutually exclusive, and these as well as other factors resulted in the deposition of artifacts in the archaeological record.

Table 6.1 presents projectile point counts by portion of the study area, and Figure 6.1 shows the overall point density within the study area. This table does not include 28 small indeterminate biface fragments in the study collection that were too incomplete to determine the point size. Point densities are low throughout the community, and areas with the highest concentrations still have less than 50 points per 1000 hectares of survey. This in part probably results from the limited large game hunting opportunities in the lowland desert environment of the study area (James 2003:76). Furthermore, faunal analyses suggest that there was less reliance on large game after the Middle Archaic, while the importance of

small game hunting, which did not require the use of stone points, increased in the Hohokam region (Dean 2003, 2005; James 2003; Greenspan 2001:14). Although point densities are low throughout the GRIC, because over 50,000 hectares were surveyed as part of P-MIP investigations, a total of nearly 1,000 projectile points or point preforms was collected from the community.

Table 6.1. Projectile point size by study unit within the GRIC.

Site Group	Map Unit	Survey Hectares	Large Point or Preform		Small Point or Preform		TOTAL	
			Count	Points/1000H	Count	Points/1000H	Count	Points/1000H
Maricopa	12	5223	4	0.8	27	5.2	31	5.9
Borderlands	9	13752	88	6.4	27	2.0	115	8.4
Blackwater	1	1778	0	0.0	3	1.7	3	1.7
Santan	4	3052	5	1.6	28	9.2	33	10.8
Lone Butte	10	3432	8	2.3	26	7.6	34	9.9
Snaketown	7	8267	45	5.4	214	25.9	259	31.3
NORTH SIDE		35504	150	4.2	325	9.2	475	13.4
Sacaton	5	1535	10	6.5	13	8.5	23	15.0
Santa Rosa	2	5449	43	7.9	50	9.2	93	17.1
Santa Cruz	11	3047	31	10.2	108	35.4	139	45.6
Casa Blanca	8	5325	24	4.5	198	37.2	222	41.7
SOUTH SIDE		15356	108.0	7.0	369.0	24.0	477.0	31.1
South/North Ratio		0.4	0.7	1.7	1.1	2.6	1.0	2.3

*Excludes Indeterminate Size Points. H = Hectares

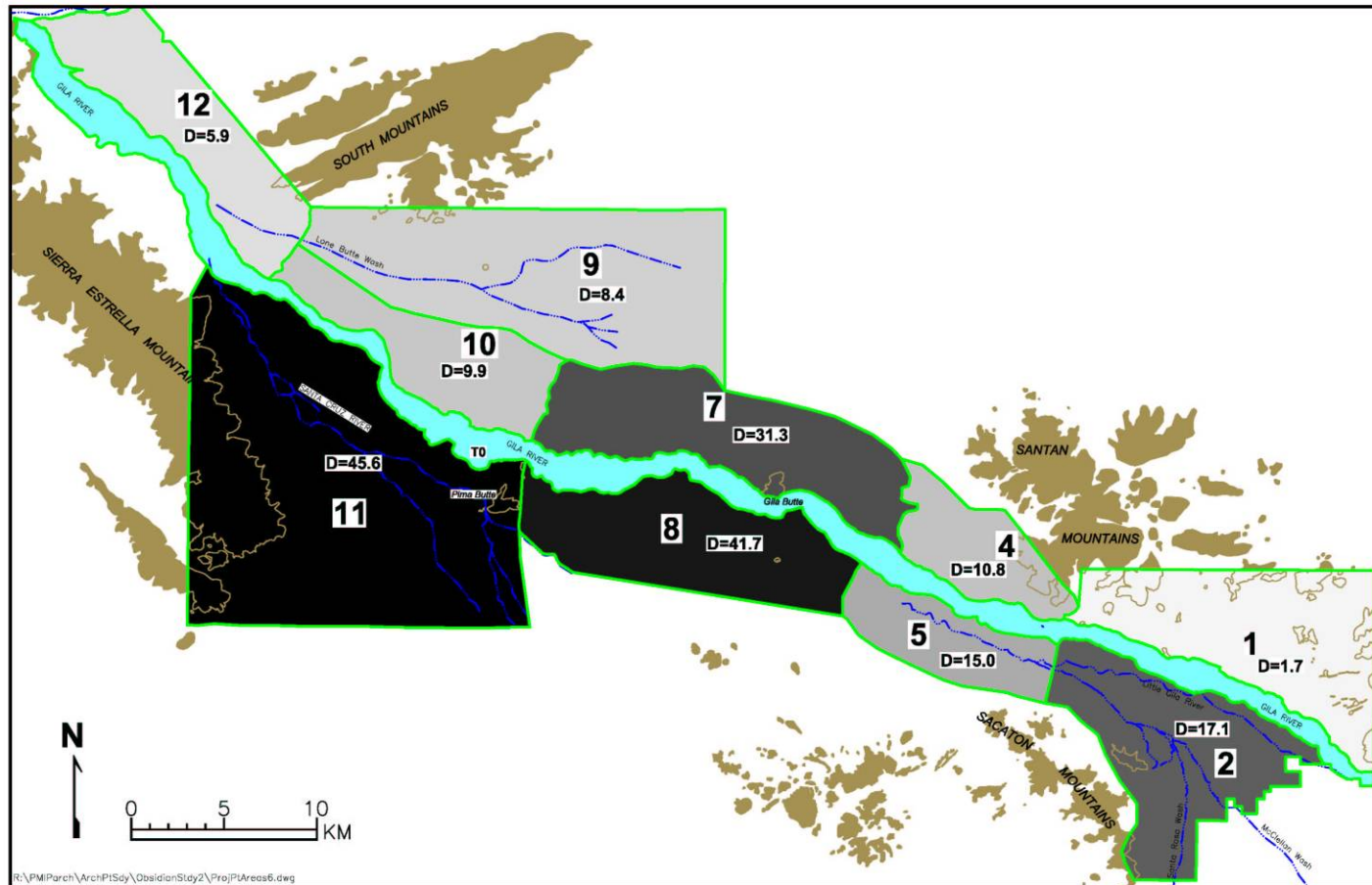


Figure 6.1. Map of overall point densities, P-MIP collection. Units are shaded based on point density, with black being the greatest. D = projectile point density, in points per 1000 hectares of survey in the unit.

All projectile points in the surface collection are more concentrated on the south side of the river than the north, and the south side density of all projectile points is over two times higher than the density on the north side of the river. The Snaketown area (Unit 7) has the highest small point density on the north side of the river, while Borderlands area (Unit 9) has the highest large point density. Similarly, Casa Blanca (Unit 8) has the highest small point density on the south side of the river, while large points are most dense in the Santa Cruz river area. (Unit 11), which has the highest density of large points found in the study area.

Several factors may account for the tendency for overall point densities to be higher on the south side of the river. Because the Akimel O'Odham collected points from earlier occupations (Russell 1908:95), this practice may have depleted surface artifacts in areas outside their habitations. As will be discussed further below, the Historic population was concentrated on the south side of the river, and their collecting activities may consequently have lowered point counts elsewhere while increasing densities in their habitation areas.

As will be considered further below, it also appears that some parts of the community afforded better access to big game hunting opportunities or were peripheral areas that were more exposed to attack, and the people in these areas may therefore have made more stone points per capita than other locations. The Santa Cruz River area in particular has the highest density of Archaic points and the second highest density of small points, with the highest overall point density. In addition to riparian area access along the Santa Cruz and Gila Rivers, this area

is adjacent to upland locations in the Sierra Estrella mountains that currently support large game animals including bighorn sheep (Rea 1997; Webb 1959:76). This possibility is supported by recent excavation data from the Santa Cruz unit. Clark (2007:18.15) found “[l]arge game animals (order *Artiodactyla*) are the third most abundant mammalian order...”. This is also the portion of the community where Rea (1997) found a small number of big-game hunters within the GRIC, a practice that continues to this day (Barnaby Lewis 2010, personal communication).

Typological Classification Analyses

This section analyzes the spatial distribution of projectile points that have been suggested to be from the Historic and Classic periods based on a classification system that was developed to seriate points from the study area (see Chapter 4 for descriptions and illustrations of the types). Table 6.2 lists densities across the GRIC for the types thought to be Historic points based on previous research. For this analysis, a subset of the U-shaped Based Triangular points that most closely match the previous definitions of the Sobaipuri points are reclassified. These small triangular points have straight blade margins, serration, and highly concave bases. The combined density of all other classified projectile points is also included. Survey coverage is available for relatively large portions of each area, but few points were collected from the Blackwater area (Unit 1).

Table 6.2 Historic period point type densities by study unit within the GRIC.

Site Group	Map Unit	Survey Hectares	Straight Base		U-Shaped Base		Sobaipuri		Total Historic		Other Points		TOTAL	
			Count	Points/ 1000H	Count	Points/ 1000H	Count	Points/ 1000H	Count	Points/ 1000H	Count	Points/ 1000H.	Count	Points/ 1000H
Maricopa	12	5223	0	0.0	0	0.0	0	0.0	0	0.0	26	5.0	26	5.0
Borderlands	9	13752	0	0.0	2	0.1	0	0.0	2	0.1	23	1.7	25	1.8
Blackwater	1	1778	1	0.6	0	0.0	0	0.0	1	0.6	1	0.6	2	1.1
Santan	4	3052	3	1.0	0	0.0	0	0.0	3	1.0	23	7.5	26	8.5
Lone Butte	10	3432	1	0.3	1	0.3	1	0.3	3	0.9	25	7.3	28	8.2
Snaketown	7	8267	9	1.1	13	1.6	10	1.2	32	3.9	176	21.3	208	25.2
NORTH TOTAL		35,504	14	0.4	16	0.5	11	0.3	41	1.2	274	7.7	315	8.9
Sacaton	5	1535	1	0.7	2	1.3	1	0.7	4	2.6	9	5.9	13	8.5
Santa Rosa	2	5449	0	0.0	12	2.2	7	1.3	19	3.5	32	5.9	51	9.4
Santa Cruz	11	3047	6	2.0	13	4.3	18	5.9	37	12.1	76	24.9	113	37.1
Casa Blanca	8	5325	41	7.7	54	10.1	5	0.9	100	18.8	105	19.7	205	38.5
SOUTH TOTAL		15356	48	3.1	81	5.3	31	2.0	160	10.4	222	14.5	382	24.9
South/North Ratio		0.4	3.4	7.9	5.1	11.7	2.8	6.5	3.9	9.0	0.8	1.9	1.2	2.8

*Excludes isolated occurrences. Other points includes all additional points that were assigned styles. H = Hectares

Historic period settlement was largely on the south side of the Gila River until at least 1850 (Bolton 1948; Eiselt 2002; Ezell 1983:151; Hackenberg 1974:236; Russell 1908; Wells 2006:22-25; Wilson 1999), suggesting that projectile points from this time should be concentrated on that side of the river. The density of the three Historic types on the south side of the Gila River is nine times higher than the north, whereas the density of all other classified points is more similar for the two sides of the river. Historic types account for over 40 percent of all points collected on the south side. In contrast, these points comprise just 10 percent of the collection from the north side of the river. These observations are consistent with the historically documented tendency for settlements to be located on the south side of the Gila until roughly 1850.

Akimel O'Odham settlements contracted to a short stretch of the Gila River between Gila and Pima Buttes before 1775, and this continued until the 1850s (Ezell 1961:115; Russell 1908:29-30; Upham 1983:56-57; Wells 2006:25; Wilson 1999), suggesting that Historic projectile points should be most highly concentrated in this location known today as Casa Blanca. As expected, the highest Historic point density occurs in this area, where Spanish sources suggest people were concentrated from at least the middle 1700s until the 1850s (Figure 6.2). Furthermore, the highest Historic point density on the north side is the Snaketown area, opposite Casa Blanca.

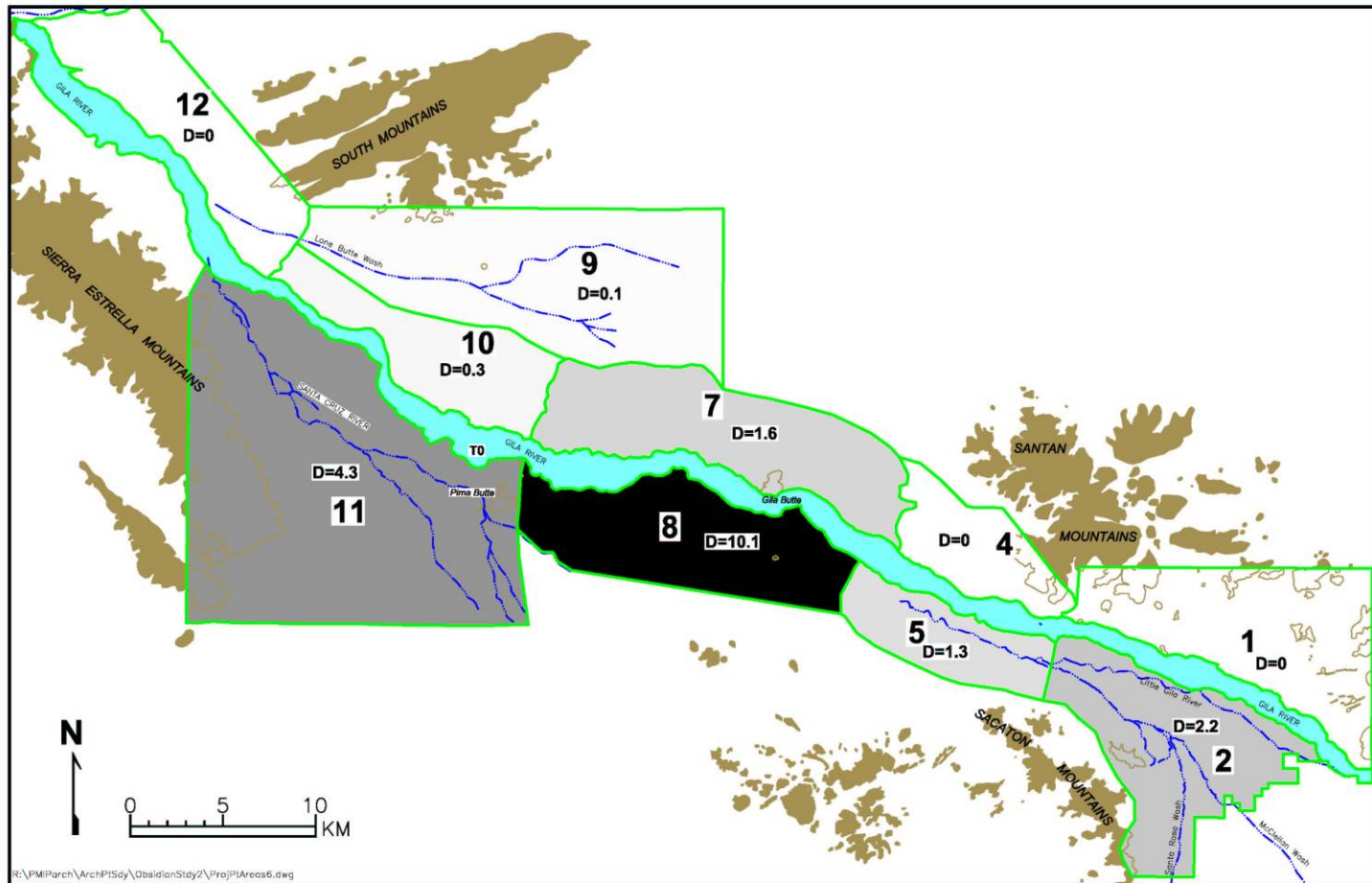


Figure 6.2. Map of U-Shaped Base point densities, P-MIP collection. Units are shaded based on point density, with black being the greatest. D = projectile point density, in points per 1000 hectares of survey in the unit.

Pee Posh [Maricopa] migrants to the middle Gila River in the early 1800s settled on the margins of the Casa Blanca area (Hackenberg 1974:113; Spier 1933:26; Wilson 1999), suggesting point types associated with people who moved into the area may be more common on the immediate peripheries of the core area for Historic occupation. In contrast to the other two Historic point types, Sobaipuri points occur at higher densities in locations surrounding Casa Blanca (see Table 6.2); areas to the north, west, and east have both higher densities and proportions of Sobaipuri points (Figure 6.3).

The concentration of these points on the margins of the Casa Blanca area suggests that Sobaipuri points were introduced by people who immigrated to the middle Gila to join existing populations. In part, because similar points have been found at sites on the San Pedro and further southeast along the Santa Cruz Rivers (Di Peso 1951; Justice 2002; Ravesloot and Whittlesey 1987; Vint 2005), it appears these artifacts may have been associated with Sobaipuri immigrants from those areas. Spanish sources document the movement of people, as a result of disease and warfare, from these areas to the middle Gila River (Ezell 1961:116; Hackenberg 1974:116-126; Russell 1908:23; Wilson 1999).

Ceramic Data

Another way to consider settlement patterns is to compare other lines of evidence with the point distributions presented in the previous section. Table 6.3 shows survey data for Historic period sherd counts and densities by portion of the GRIC (see Simon 2003 for a discussion of the types). All of the Historic ceramic densities are substantially higher on the south side of the river, and every type is most concentrated within the Casa Blanca area (Figure 6.4).

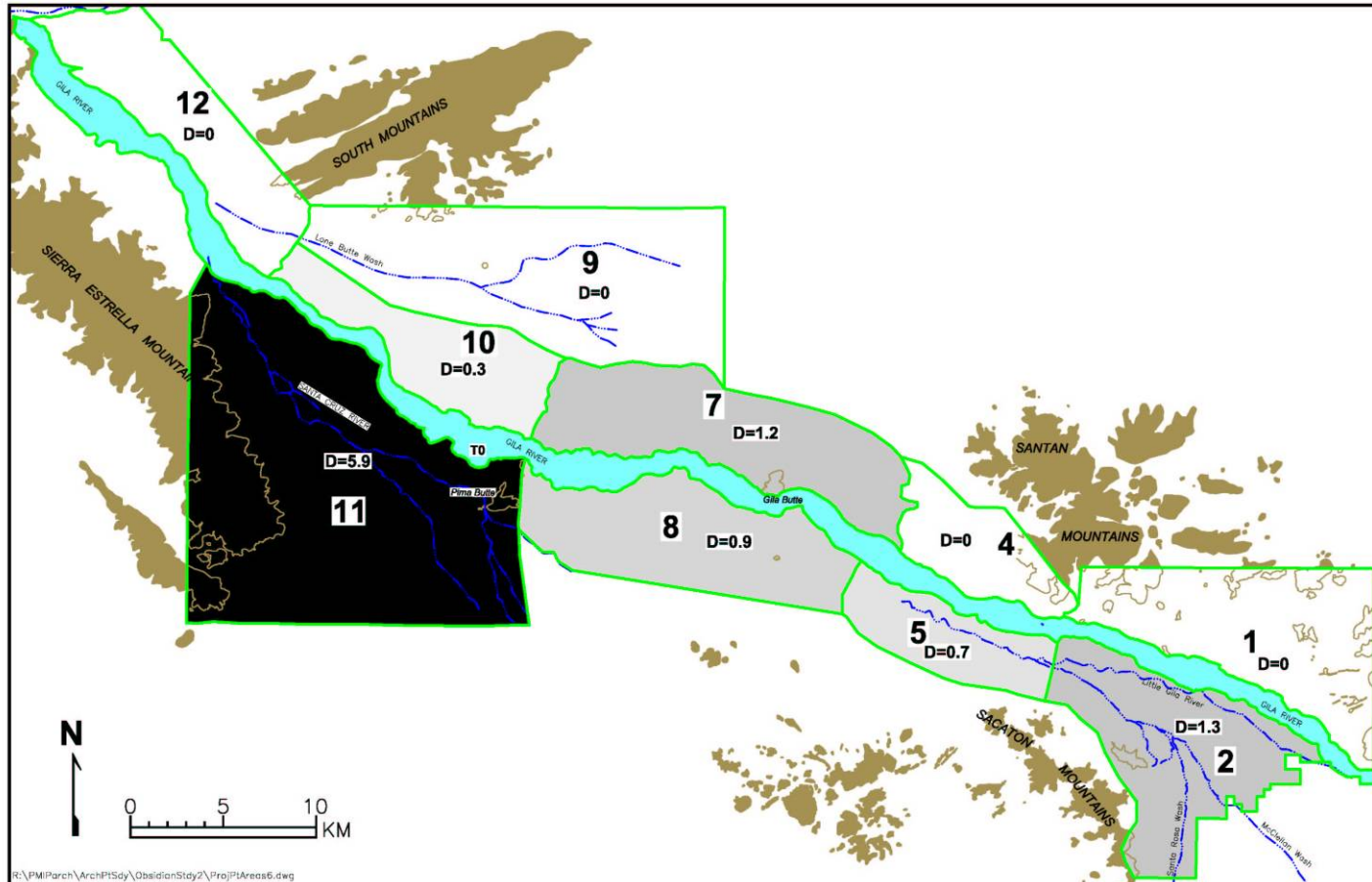


Figure 6.3. Map of Sobaipuri point densities, P-MIP collection. Units are shaded based on point density, with black being the greatest. D = projectile point density, in points per 1000 hectares of survey in the unit.

Black-on-red and Red-on-buff sherds are the most equally distributed by side of the river, but these ceramics are still over 10 times more common on the south side than the north. Because these Historic types were not made during the Classic period, it appears that these varieties may have been more common during the late Historic period when populations began to disperse across the GRIC. Red-on-brown and plain ceramics are more concentrated on the south side of the river, suggesting the possibility that these types were more common when the population was highly concentrated in the Casa Blanca area during the 18th and early 19th centuries. These possibilities are generally consistent with site-based multivariate analyses of Historic period artifacts (Wells 2006; Wells et. al. 2004a).

Figure 6.4 shows the total density of Historic sherds by site group. Ceramics from this time are concentrated in the Casa Blanca area, and densities tend to drop with distance from this location. The highest density on the north side is in the Snaketown area, which is opposite Casa Blanca. This patterning is similar to that observed for Historic period projectile point types presented in the preceding section (compare Figures 6.2 and 6.4). Figure 6.5 depicts this tendency graphically. Because of the difference in sample size, ceramic counts were log transformed for the graph. The Pearson correlation coefficient for the untransformed sherd and point counts is .94, Significance < .01, which suggests that Historic period point types and ceramics tend to be concentrated in the same locations.

Table 6.3. Historic period ceramic counts by study unit within the GRIC.

Site Group	Map Unit	Survey Hectarces	Black-on-Red		Red-on-Buff		Red		Plain		Red-on-Brown		TOTAL	
			Count	Sherd/ 1000H	Count	Sherd/ 1000H	Count	Sherd/ 1000H	Count	Sherd/ 1000H	Count	Sherd/ 1000H	Count	Sherd/ 1000H
Borderlands	9	13752	73	5	1113	81	21	2	203	15	65	5	1475	107
Maricopa	12	5223	40	8	710	136	243	47	176	34	172	33	1341	257
Blackwater	1	1778	3	2	5	3	3	2	42	24	0	0	53	30
Lone Butte	40	3432	3	1	305	89	206	60	77	22	3	1	594	173
Santan	4	3052	78	26	308	101	356	117	164	54	29	10	935	306
Snaketown	7	8267	73	9	1817	220	204	25	411	50	733	89	3238	392
NORTH TOTAL		35,504	270	8	4258	120	1,033	29	1,073	30	1002	28	7636	215
Santa Cruz	11	3047	30	10	1405	461	1652	542	1586	521	267	88	4940	1621
Santa Rosa	2	5449	254	47	715	131	389	71	499	92	226	41	2083	382
Sacaton	5	1535	129	84	889	579	52	34	180	117	143	93	1393	907
Casa Blanca	8	5325	856	161	20904	3926	4266	801	7638	1434	9681	1818	43345	8141
SOUTH TOTAL		15356	1269	82.6	23913	1557	6359	414	9903	645	10317	672	51761	3371
GRAND TOTAL		50860	1539	30.3	28171	554	7392	145.3	10976	215.8	11319	700	59397	3586
South/North Ratio		0.4	4.7	10.9	5.6	13.0	6.2	14.2	9.2	21.3	10.3	23.8	6.8	15.7

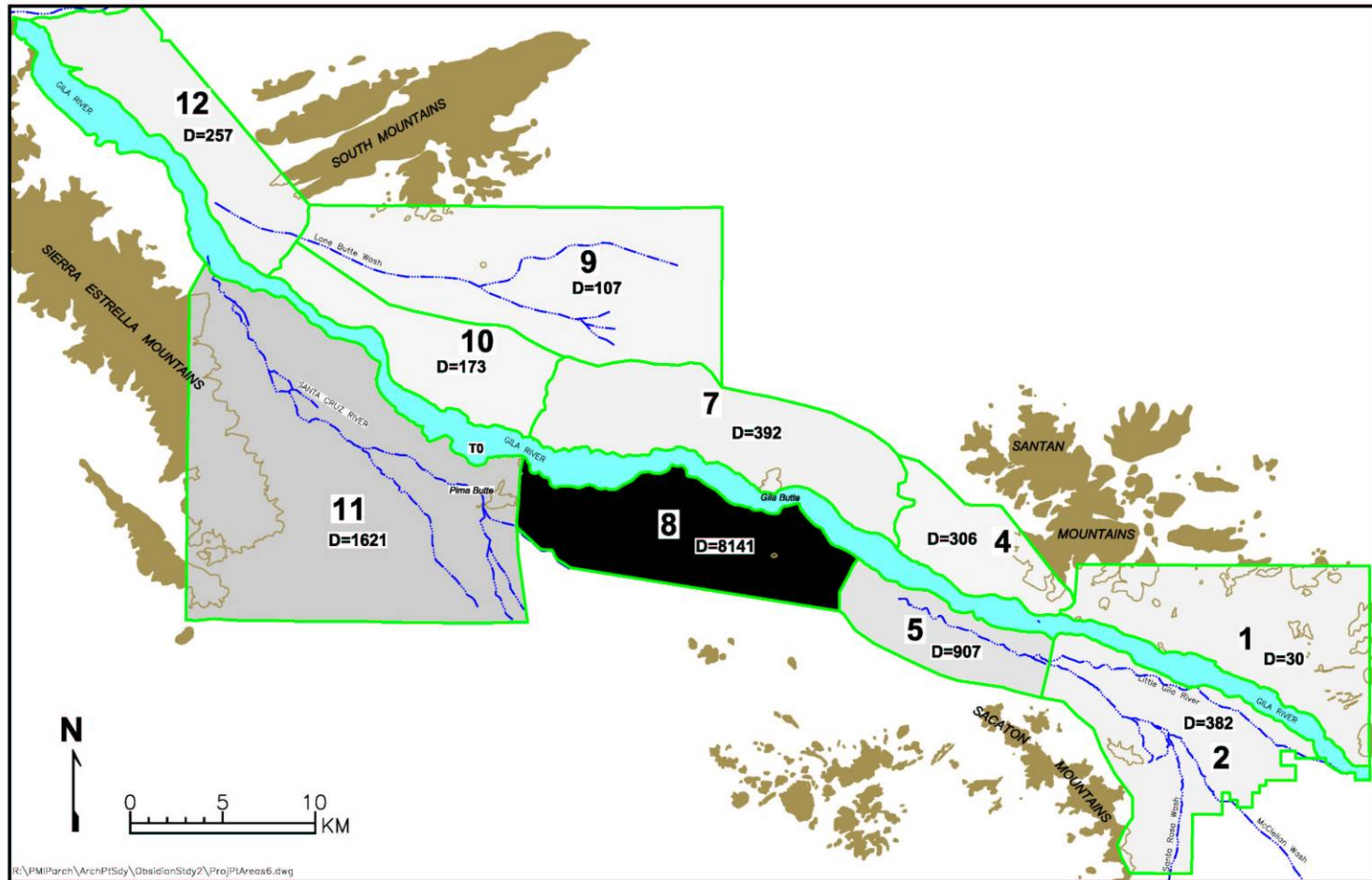


Figure 6.4. Map of Historic period ceramic densities, P-MIP collection. Units are shaded based on ceramic density, with black being the greatest. D = ceramic density, in sherds per 1000 hectares of survey in the unit.

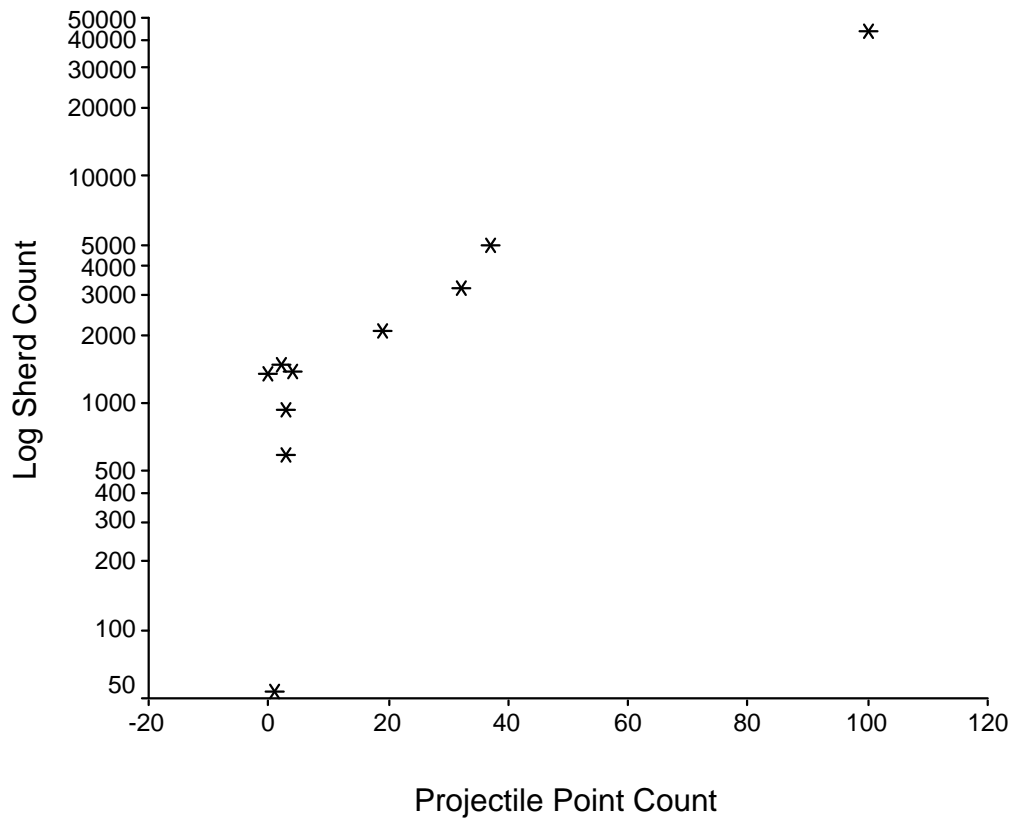


Figure 6.5. Scatter plot of log 10 transformed Historic period ceramic count and Historic type point counts by study unit, P-MIP Collection.

Classic Period Diagnostic Ceramic Data

Classic period ceramics have different distributional patterns than the Historic period artifacts, which are consistent with other lines of evidence regarding settlement locations during this period (Table 6.4). In contrast to Historic ceramic densities, Classic sherds are more concentrated on the north side of the river (Figure 6.6).

Table 6.4. Classic period ceramic counts and densities by study unit, P-MIP Collection.

Site Group	Map Unit	Survey Hectares	Casa Grande		Gila Poly		Tonto Poly		TOTAL		Mound Area
			Count	Sherd/ 1000H	Count	Sherd/ 1000H	Count	Sherd/ 1000H	Count	Sherd/ 1000H	Sq. M
Borderlands	9	13752	17	1.2	19	1.4	1	0.1	37	2.7	0
Maricopa	12	5223	6	1.1	53	10.1	4	0.8	63	12.1	625
Blackwater	1	1778	7	3.9	105	59.0	4	2.2	116	65.2	0
Lone Butte	10	3432	113	32.9	392	114.2	37	10.8	542	157.9	1225
Santan	4	3052	1005	329.3	909	297.9	71	23.3	1985	650.5	1720
Snaketown	7	8267	1911	231.2	3315	401.0	322	39.0	5548	671.1	0
NORTH TOTAL		35,504	3,059	86.2	4,793	135.0	439	12.4	8,291	233.5	3570
Santa Cruz	11	3047	5	1.6	98	32.2	8	2.6	111	36.4	0
Santa Rosa	2	5449	55	10.1	339	62.2	34	6.2	428	78.5	0
Sacaton	5	1535	136	88.6	213	138.7	15	9.8	364	237.1	0
Casa Blanca	8	5325	482	90.5	828	155.5	55	10.3	1365	256.4	1400
SOUTH TOTAL		15356	678	44.2	1478	96.2	112	7.3	2268	147.7	1400
GRAND TOTAL		50860	3,737	73.5	6,271	123.3	551	10.8	10,559	207.6	4970
South/North Ratio		0.4	0.2	0.5	0.3	0.7	0.3	0.6	0.3	0.6	0.4

H = Hectares

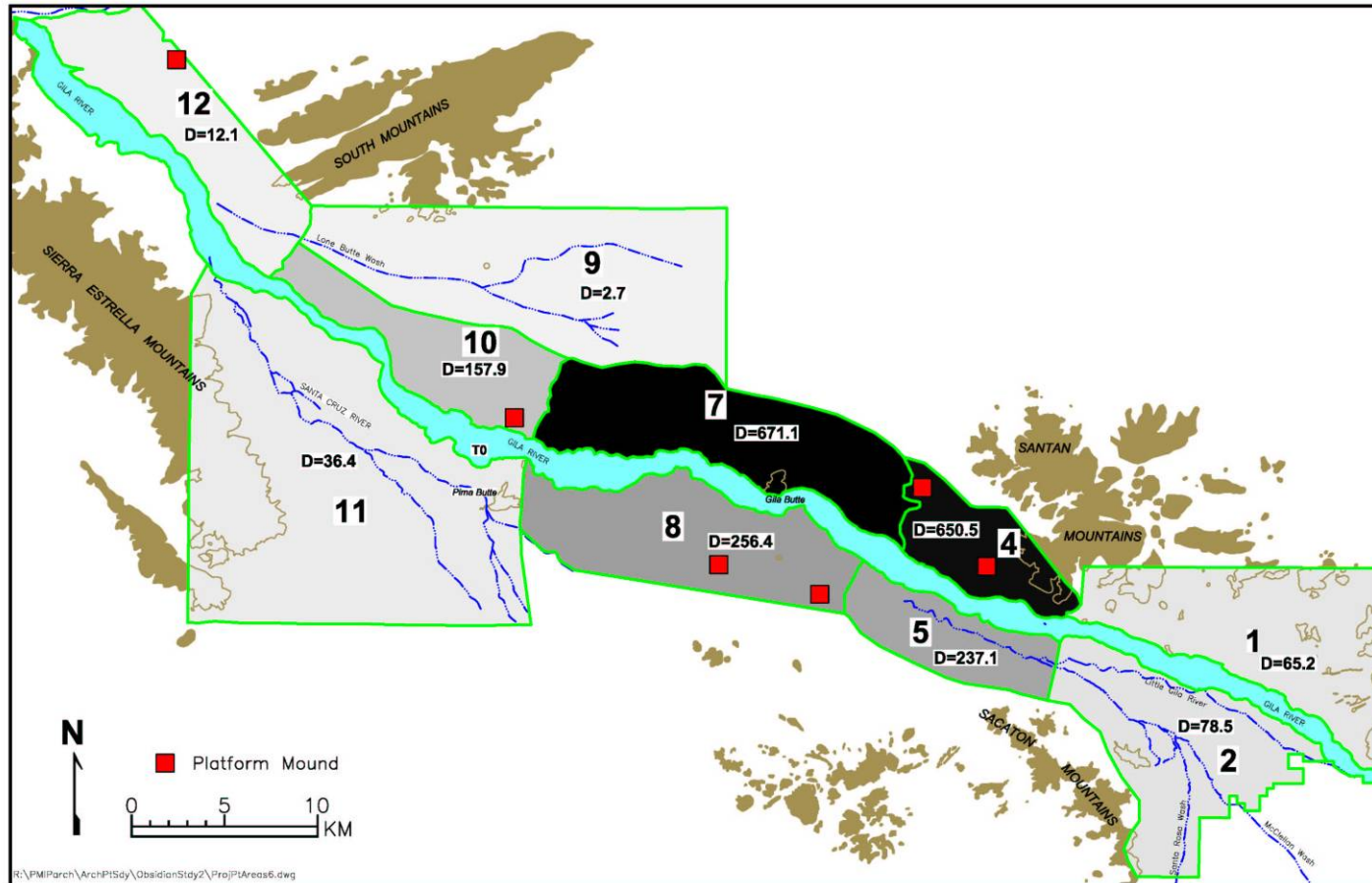


Figure 6.6. Map of Classic period ceramic densities and platform mound locations, P-MIP collection. Units are shaded based on ceramic density, with black being the greatest. D = ceramic density, in sherds per 1000 hectares of survey in the unit.

The densest areas on this side occur in the Santan and Snaketown units, while the highest density for all three types on the south side occurs in the Casa Blanca area, which lies opposite these units. Five of the six platform mounds in the area occur within or immediately adjacent to these locations.

Public architecture size has been employed as a proxy measure of Classic period settlement complex size (Rice and Ravesloot 2003:18), and these data are consistent with the ceramic data. Four platform mounds were built on the north side of the river, while only two mounds occur on the south side of the river in the study area (Ravesloot and Rice 2004; Rice and Ravesloot 2003:24). The platform mound sizes are indicated on Table 6.5, and their locations are shown on Figure 6.6. The total volume of the mounds on the north side of the river is roughly 2.5 times greater than the south side volume, which also suggests the population on the north side of the river was higher than the south during the Classic period and this ratio is similar to that observed for the ceramic data.

Classic Period Projectile Point Distribution

Table 6.5 shows Classic period projectile point densities by portion of the study area. While the overall south/north ratio for points suggested to be from the Classic period is almost 3 times lower than the Historic period ratio, it appears probable that some of the Classic types may be misclassified. Ceramic and architectural data both suggest that Classic period habitation was denser on the north side of the river. Unnotched Classic period point types, in particular, are substantially more concentrated on the south side of the river.

Table 6.5. Classic period projectile point counts and densities by study unit within the GRIC, P-MIP Collection. Classic period types were defined following Sliva 1997.

Site Group	Map Unit	Survey Hectarces	Classic Period Sliva Styles								Historic Period		TOTAL	
			Mid-Side		Low-Side		Un-Notched		TOTAL		TOTAL		TOTAL	
			Count	Points/ 1000H	Count	Points/ 1000H	Count	Points/ 1000H	Count	Points/ 1000H	Count	Points/ 1000H	Count	Points/ 1000H
Maricopa	12	5223	1	0.2	1	0.2	3	0.6	5	1.0	0	0.0	5	1.0
Borderlands	9	13752	1	0.1	1	0.1	1	0.1	3	0.2	2	0.1	5	0.4
Blackwater	1	1778	0	0.0	0	0.0	2	1.1	2	1.1	1	0.6	3	1.7
Santan	4	3052	2	0.7	2	0.7	5	1.6	9	2.9	3	1.0	12	3.9
Lone Butte	10	3432	1	0.3	1	0.3	7	2.0	9	2.6	3	0.9	12	3.5
Snaketown	7	8267	14	1.7	19	2.3	29	3.5	62	7.5	32	3.9	94	11.4
NORTH TOTAL		35,504	18	0.5	23	0.6	47	1.3	90	2.5	41	1.1	131	3.7
Sacaton	5	1535	1	0.7	1	0.7	1	0.7	3	2.0	4	2.6	7	4.6
Santa Rosa	2	5449	0	0.0	0	0.0	4	0.7	4	0.7	19	3.5	23	4.2
Santa Cruz	11	3047	0	0.0	13	4.3	13	4.3	26	8.5	37	12.1	63	20.7
Casa Blanca	8	5325	1	0.2	9	1.7	60	11.3	70	13.1	100	18.8	170	31.9
SOUTH TOTAL		15356	2	0.1	23	1.5	78	5.1	103	6.7	160	8.1	263	17.1
South/North Ratio		0.43	0.11	0.26	1.00	2.31	1.66	3.84	1.14	2.65	3.90	7.62	2.01	4.6

*Excludes points collected as isolated occurrences.

Raveslout and Whittlesey (1987:96) argued that “small, triangular, concave-based points with serrated edges were being produced in the Classic Period.” These points are highly similar to the types that have been suggested to be associated with the Historic period. Indeed, it is this lack of differentiation in shape that has complicated the identification of early Historic period points. At the same time, this strong continuity in projectile point forms from the Classic to the Historic periods is one example of the close links between the Hohokam and the Akimel O’Odham.

Middle side-notched points are the only type that has a higher density on the north side of the river, suggesting that points with notches in the middle of the blade margins may be a distinctive Classic period type. Sliva (1997:54) argued that these points were made between A.D. 1050 through roughly 1350 in southern Arizona. Justice (2002) illustrates four categories that include middle-side notched examples, but he did not use notch placement along the blade margin to distinguish types. Interestingly, all four of these varieties are from the Pueblo area of the southwest, which is also the location where ceramic and architectural influences have been suggested to originate during this time. Sliva (2006:59) suggests this distinctive variety is one of the most widely distributed point types in Arizona, which is similar to the widespread distribution of Classic period Salado polychromes at this time (Crown 1994).

Diachronic Variation in Projectile Point Size

This section tests the point size hypothesis through analyses of both survey and excavation data. Research presented in this section does not prove that projectile points generally decreased in size over time, and instead merely suggests the hypothesis requires further testing. These following analyses also suggest the resolution of the size weight data is limited, however, diachronic variation among points from the Hohokam core area is currently poorly understood and it appears possible that employing size may improve our understanding of the temporal systematics of points from the region. Figure 6.7 shows box plots of projectile point weight for all complete projectile points that were assigned to Classic or Historic categories in the typology (see Chapter 4 for a description of the types). The Historic period artifacts are significantly lighter than Classic period types (T-test $p = .02$, equal variances not assumed).

Although the Historic types are all unnotched, the difference in size does not appear to be the result of notching patterns because unnotched small projectile points are not significantly different in weight than are notched small projectile points (Figure 6.8; T-test $p = .74$, equal variances not assumed). Furthermore, if only unnotched points are considered, the Historic period types are significantly different from the Classic period unnotched points (Figure 6.9; T-test $p < .001$, equal variances not assumed).

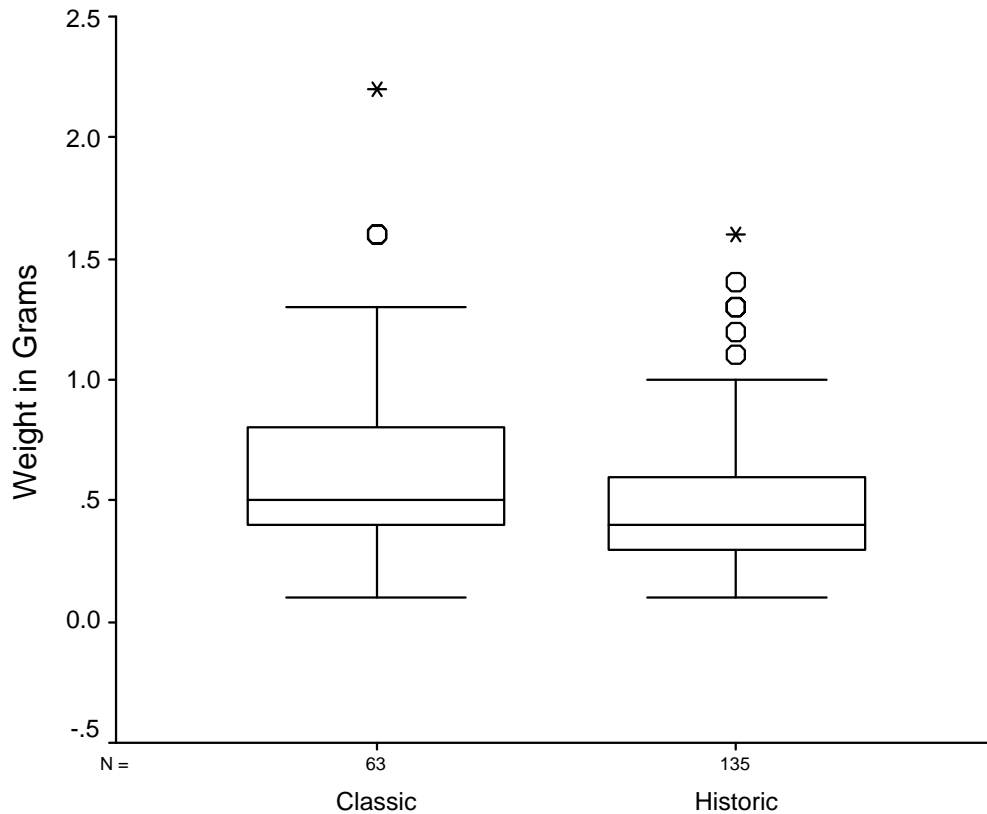


Figure 6.7 Box plots of projectile point weight for all finished and complete projectile points in the collection that were assigned to Classic or Historic period types.

Previous researchers have also noticed the tendency for projectile points from the Sonoran Desert to decline in weight over time (Craig 1992; Marshall 2001b:503-505). For example, Craig (1992:231) found that the Classic period projectile points were lighter than earlier types, and they also generally have a lower size index (Length x Width/Thickness), which he suggested was the result of "...increased standardization or specialization during that time period". This analysis has considered the possibility that this general decrease in weight is the result of diachronic technological changes.

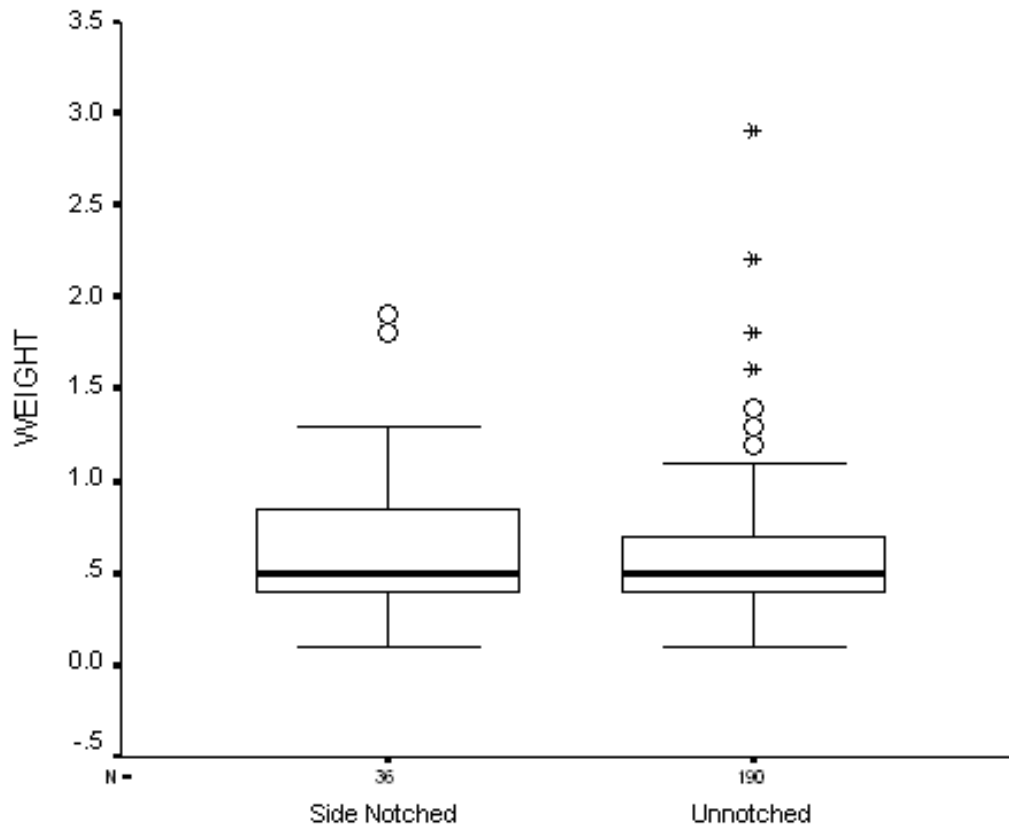


Figure 6.8 Box plots of projectile point weight for small finished and complete projectile points by presence or absence of notching (exclude atl-atl dart size points).

The possibility that points from the Historic period are generally smaller than Classic period artifacts is consistent with evidence that a new bow technology, which increased potential arrow velocities, was introduced during the Classic period. LeBlanc (1999:99-100) argued that arrows shot from recurved bows are 25 to 50 percent faster than arrows shot from self-bows. Empirical data provided by Baker (2001:108) shows a nearly 20 percent increase in arrow velocity for a recurved bow design, and Cotterell and Kamminga (1992:185)

suggest these bows can “store 50% more energy than a simple longbow [i.e., self-bow] of the same weight”.

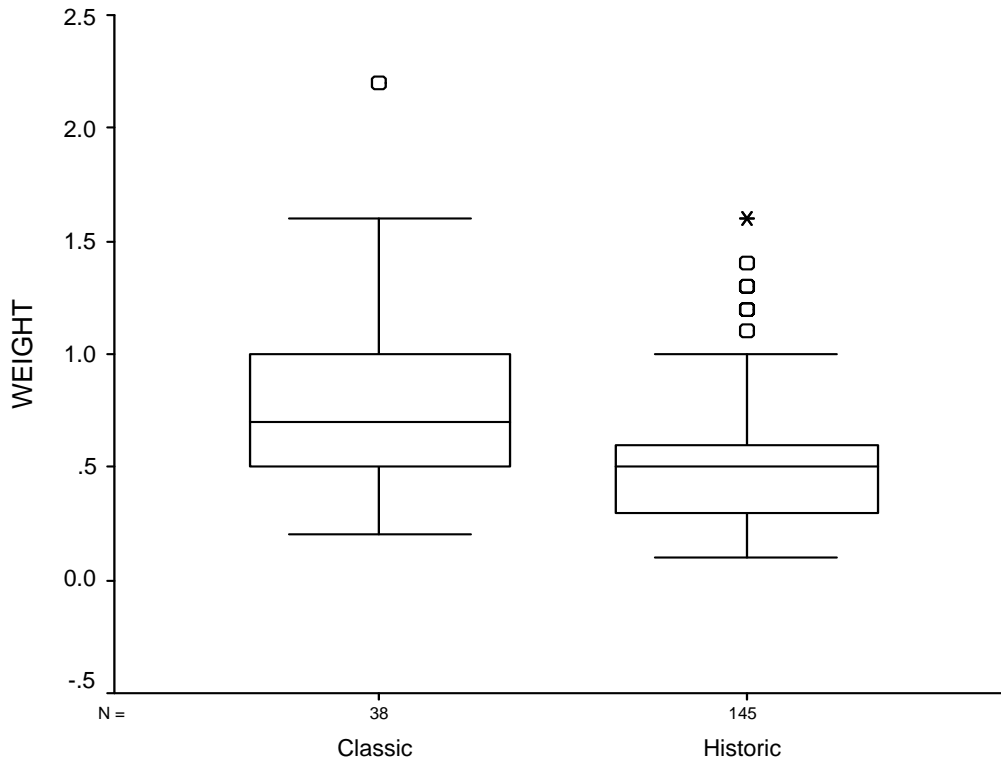


Figure 6.9. Box plots of projectile point weight for unnotched projectile points assigned to Classic or Historic period types.

LeBlanc (1999) reviewed bows recovered from dry caves, depictions on pottery, as well as Kiva mural images, and he concluded that the recurved bow was introduced to the Southwest somewhere between A.D. 1200 and A.D. 1450. However, according to Schaafsma (2000:48) “[t]he recurved bow, which may have been sinew backed, does not appear in the art before the fourteenth century...” Although LeBlanc suggested that sinew-backing and recurving almost

always co-occur in the Southwest, Schaafsma (2000:48) maintained that Pubeloan recurved bow are not sinew backed, nor are those made by the Akimel O'odham (Russell 1908:95; Rea 1997:74-76).

Baldwin (1997:4), who reviewed data for bows recovered from dry caves, depictions on pottery, kiva murals, and in petroglyphs concluded: “[a]rchaeological evidence documents the presence of only the self-bow in the Southwest before A.D. 1300.” Counter to Schaafsma (2000:48), Baldwin (1997:3) suggested that “ethnographic data show the sinew-backed bow to be limited in production and use to the Pueblo Indians, the Navaho, and the various Apache groups [snip], and lacking among the Yuman-speakers and the Pimas and other Uto-Aztecan-speakers of southern Arizona and northern Mexico”. Based on his analysis of the data, Baldwin (1997) suggested “that the appearance of ‘double-curved’ bow forms [i.e., recurved] in the depictions dating after A.D. 1300 is a symptom of the arrival of the sinew-backed bow technology”. Baldwin associated the introduction of this technology with the arrival of Apacheans, which he places at around A.D. 1400 based on analyses of several lines of evidence. LeBlanc (1999:102) argued that “the arrival of the Athapaskans appears to have been too late for them to have been vectors” for the introduction of the technology. However, LeBlanc does not cite any evidence regarding when Athapaskans first appeared in the region, and the date range he suggests for the introduction of the recurved bow technology overlaps Baldwin’s interpretation of the data. There is also some ethnographic support for the possibility that the Apache introduced the

recurved bow to the southern Southwest (Baldwin 1997:8). For example, one of Goodwin's Apache informants told him, "[t]he double arc bow we had before the single arc bow" (Basso 2004:224).

The A.D. 1400 date suggested by Baldwin (1997) corresponds with Schaafsma's (2000:48) argument, and places the introduction of this technology in the Southwest at or near the end of the Classic period Hohokam sequence. Baldwin (1997:7) observed "[i]t should also be noted that D-shaped [i.e., self-bows] continue to appear in kiva murals and rock art, frequently side-by-side with the 'double-curved bows [i.e., recurved bows]". This suggests that recurved designs did not rapidly replace earlier bow technology, which is supported by the observation that both types continued to be employed by the Akimel O'Odham in the late nineteenth century (Russell 1908).

If the technology was introduced sometime during the Late Classic, it suggests that subsequent decline in point weights may have occurred during the Historic period. Because the design did not immediately replace earlier technologies, a period of transition is expected when both larger points designed for self-bows were replaced by smaller points intended for recurved bows. Therefore, transitional assemblages with a mixture of sizes are expected, and as recurved designs became more common because of their superior performance, the average weights for point assemblages are expected to have declined gradually over time.

Support for the possibility that the Akimel O’Odham were emulating introduced designs is provided by differences in construction techniques among recurved bows in the Southwest, including the lack of sinew backing on the Akimel O’Odham bows. If the Akimel O’Odham copied the Apache design, then they may have gone through a period of experimentation during which they improved the performance of their design. The effects of the lack of sinew backing on recurved bow performance are unclear: Spier (1933:132) suggested that the Pee Posh used both sinew-backed and self-bows, and his informants said that sinew-backed bows did not draw harder or give more penetration. Similarly, experiments done by Pope (2000:68-69) suggested that sinew-backing had little effect on arrow cast and instead primarily prevented the bow from breaking (see also Baugh 2001:117; Heath 2001:106; Laubin and Laubin 1980:53-72).

Hamm (1991:49-51), however, argues that sinew-backing makes the bow faster and the high tensile strength of the material prevents breakage of recurved bow due to the increased stress caused by recurving of the tips (see also Bergman and McEwen 1997). “The sinew will cure almost any problem on the back of the bow, such as knots, cutting through the grain, or cracks” (Hamm 1991:49). Without the sinew backing, it would have been necessary for the Akimel O’Odham to carefully shape and cut bows such that the grain structure of the wood provided greater strength (Baugh 2001:117; Burch 2004:89-122; Eagle 1988; Hamm 1991:22-49; Heath 2001; Pope 2000:55-80), and this also may have slowed adoption of the technology. Furthermore, Akimel O’Odham recurved

bows were made with mulberry wood that was not locally available (Russell 1908; Rea 1997:75), which also may have complicated and therefore slowed adoption of the design.

Rea (1997:75) quoted an O'Odham story recorded by Densmore (1929) regarding the construction techniques for recurved bows that describes an interesting juxtaposition of roles:

[Coyote] went east, cut two [mulberry] saplings for the children and one for himself and brought them home. He threw down the two for the children and their mother pulled off the bark, curved them by the heat of the fire, and put strings on them, doing this at once. Coyote cleaned the wood of his tree nicely and bent his bow by leaning the tree against another tree so that when dry it would be in the proper form. The mother had used the whole tree except the rough outer bark but Coyote scraped off part of the wood on each side of his bow. He told the woman she was doing something that no one ever did and that his way was right.

Rea (1997:76) observed, “[w]hile Coyote is usually the paradigm of the bungler, in this case he is making the bow correctly, in contrast to the mother”.

GRIC Surface Data by Weight

Because Historic period settlement was largely on the south side of the Gila, it is expected that points from this time should be concentrated on that side of the river. Figure 6.10 compares weight by side of the Gila River for all finished and unbroken projectile points in the GRIC collection, regardless of morphology.

Projectile points from the south side are significantly lighter on average than projectile points from the north side, which is consistent with the expectation that small points should be concentrated on the south side of the Gila (T-test $p < .001$, equal variances not assumed). This analysis involves the fewest assumptions and includes all points from throughout the archaeological sequence. Therefore, it is possible that variation in earlier settlement locations accounts for part of the patterning observed in the point distribution. Different patterning, however, is apparent if only points that were assigned Historic period types are considered, and all of the following analyses in this section exclude large atl-atl tips.

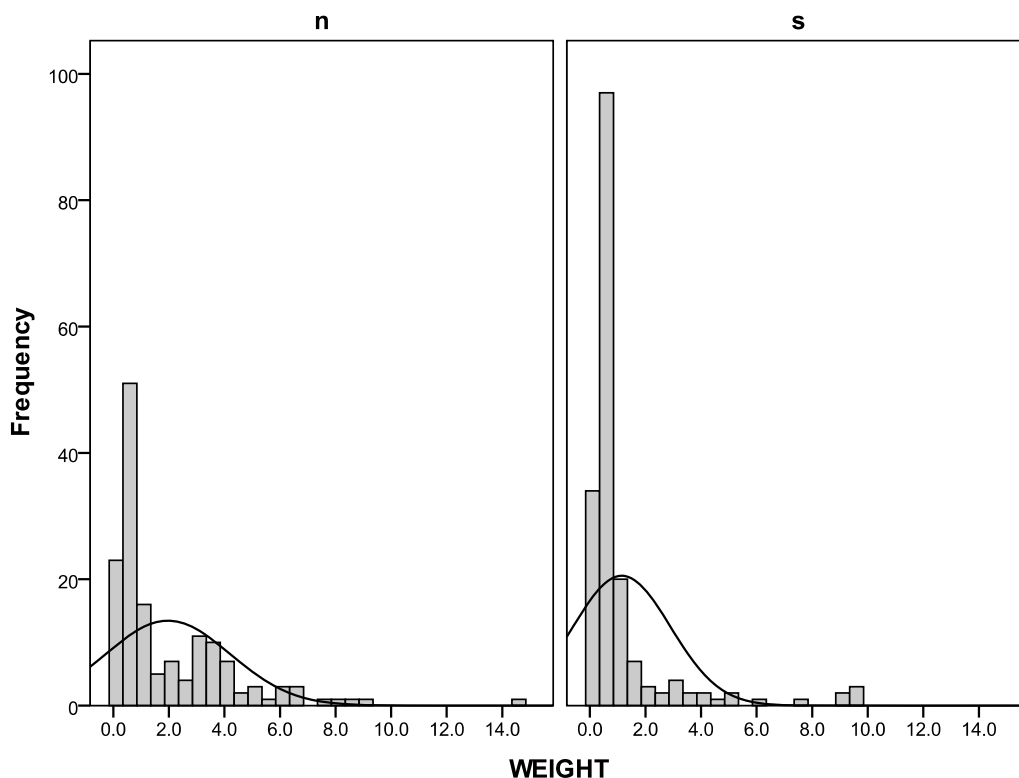


Figure 6.10. Histograms for all complete projectile point weights ($n=311$) by side of the middle Gila River, P-MIP collection. n = north side of river. s = south side of river (excludes IOs, preforms, and broken points).

The Akimel O’Odham returned to a more dispersed settlement pattern after the arrival of Euroamericans in the mid-1800s (Ezell 1983; Hackenburg 1974:236; Wells 2006:24; Wilson 1999), suggesting that Historic points found on the north side of the river should generally be most recent and therefore lighter than points from the south side. Within the artifacts classified as Historic points based on the typological classification system, the data are consistent with the expectation that Historic points from the north side should generally be smaller because they are more recent than those from the south side (Figure 6.11; T-test $p < .001$, equal variances not assumed).

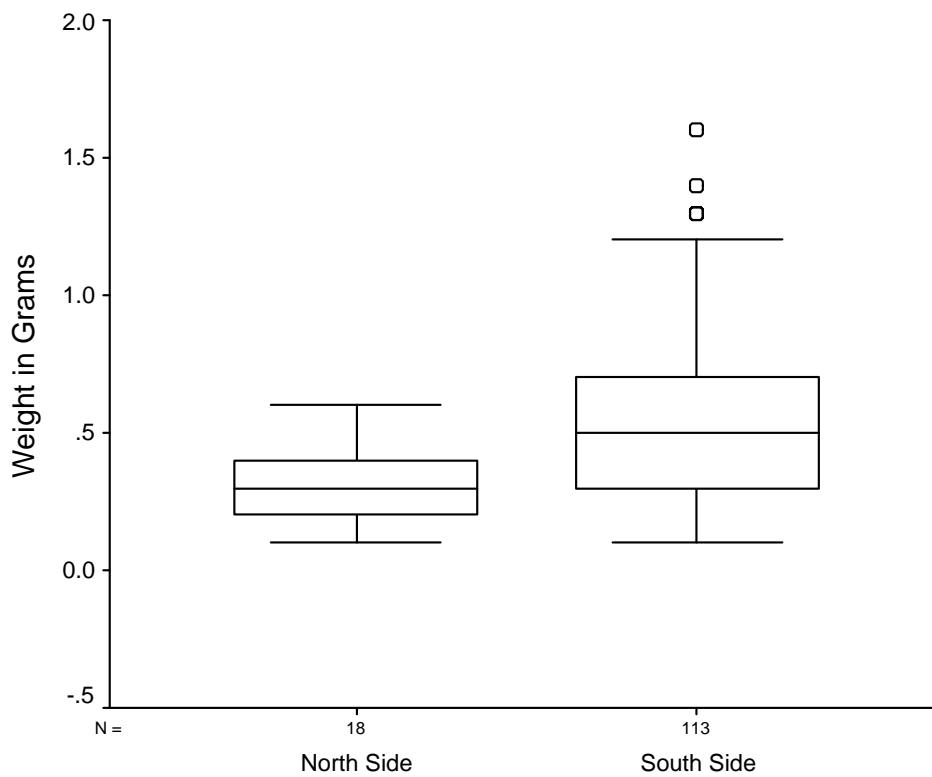


Figure 6.11. Historic point weights by side of the Gila River, P-MIP Collection (Excludes Isolated Occurrences, preforms, and broken points).

Sacate Site Data

Another way to examine variability in Historic period projectile points is to examine patterning in surface collection data from a single site. The Sacate site (GR-909) is a roughly 3 km long and 0.8 km wide Historic period Akimel O’Odham village that is located near the center of the modern GRIC, on the south side of the Gila River in the Casa Blanca area (Figure 6.12). Two hundred and four features, including 103 *ki* depressions (i.e., traditional round houses), three cemeteries, numerous middens, and other areas with structural remains were identified on the surface.

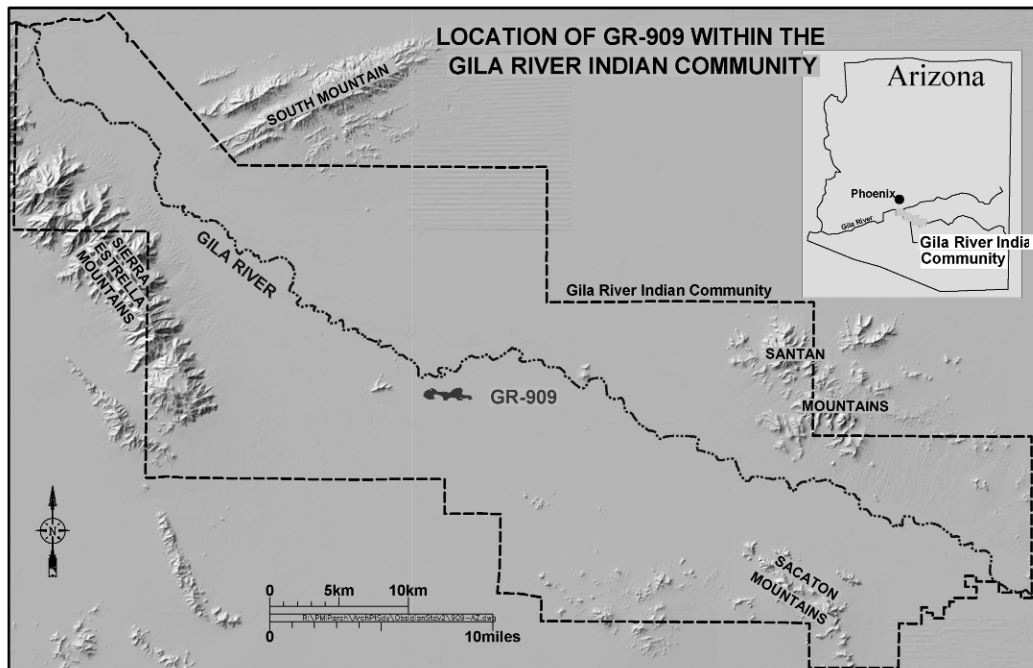


Figure 6.12. Map showing the location of the Sacate Site (GR-909), GRIC.

Diagnostic artifacts from the site were largely from the Historic period (Randolph et al. 2002). The site therefore provides an opportunity to consider diachronic variation during the Historic period, in a context where earlier remains are largely not intermixed. Nearly 120 projectile points and preforms were recovered from GR-909. Projectile points from the site are almost exclusively small triangular forms that lack notching or serration (Figure 6.13). In fact, no side-notched points were recovered from the site, which suggests by inference that these people did commonly not practice big game hunting. This possibility is consistent with ethnographic documentation (see Chapter 5), and with analyses presented below.

Darling et al. (2004) identified a process whereby village locations drift over time, resulting in horizontal stratigraphy, and analyses of non-indigenous artifacts from the Sacate site support this model (Randolph et al. 2002:13). Preliminary examination of indigenously produced artifacts, however, failed to identify spatial patterning in these data (Randolph et al. 2002). Non-indigenous artifact data suggest that the initial area of habitation at the Sacate site occurred in the central section of the site, and this portion of the site was occupied for the longest period of time (Figure 6.14). The area of occupation then extended to the east and west, in the locations designated as the expansion area on Figure 6.14. The most recent habitation occurred in the western portion of the site.

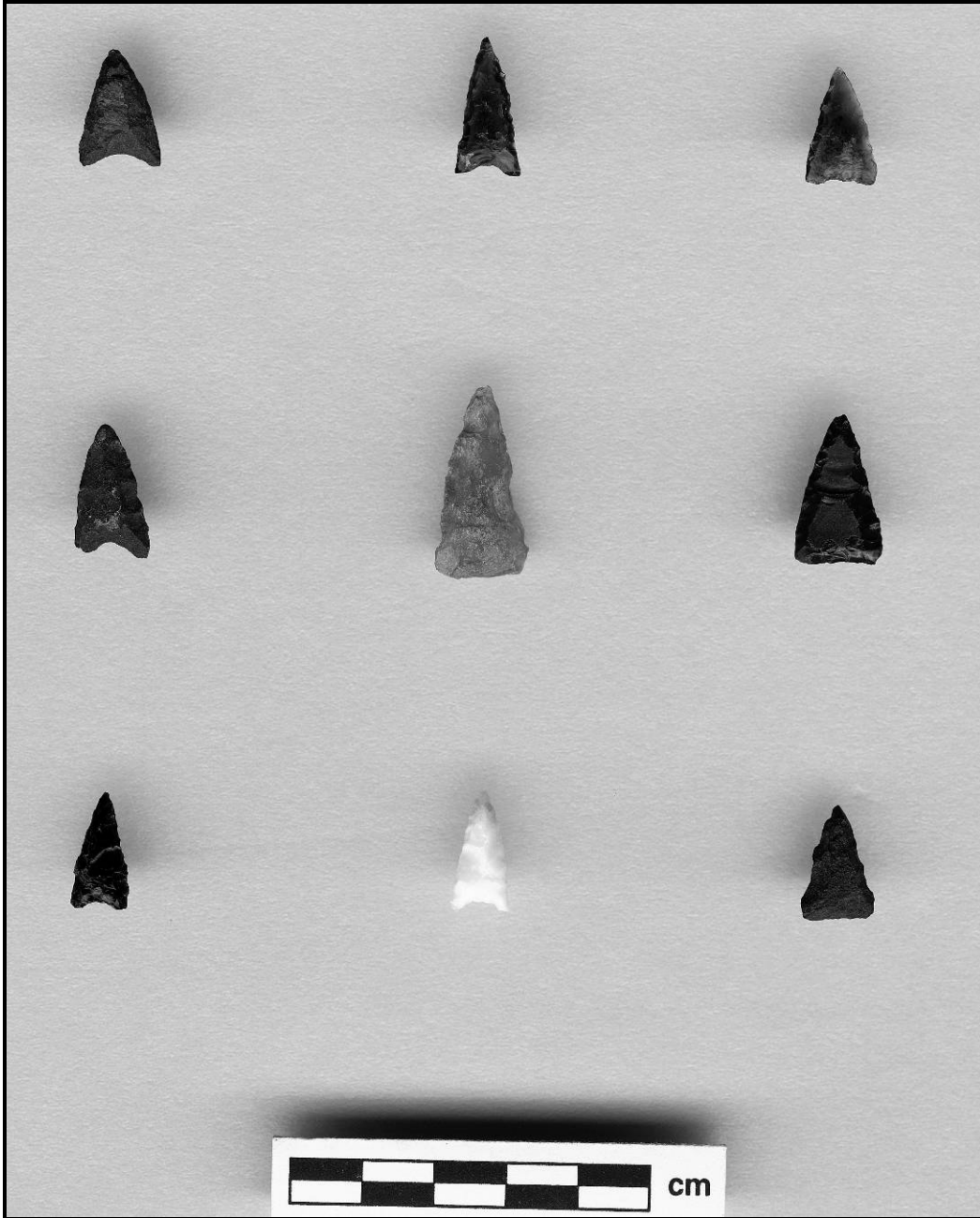


Figure 6.13. Historic period projectile points collected from the Sacate site (GR-909), GRIC. The point in the center is man-made glass.

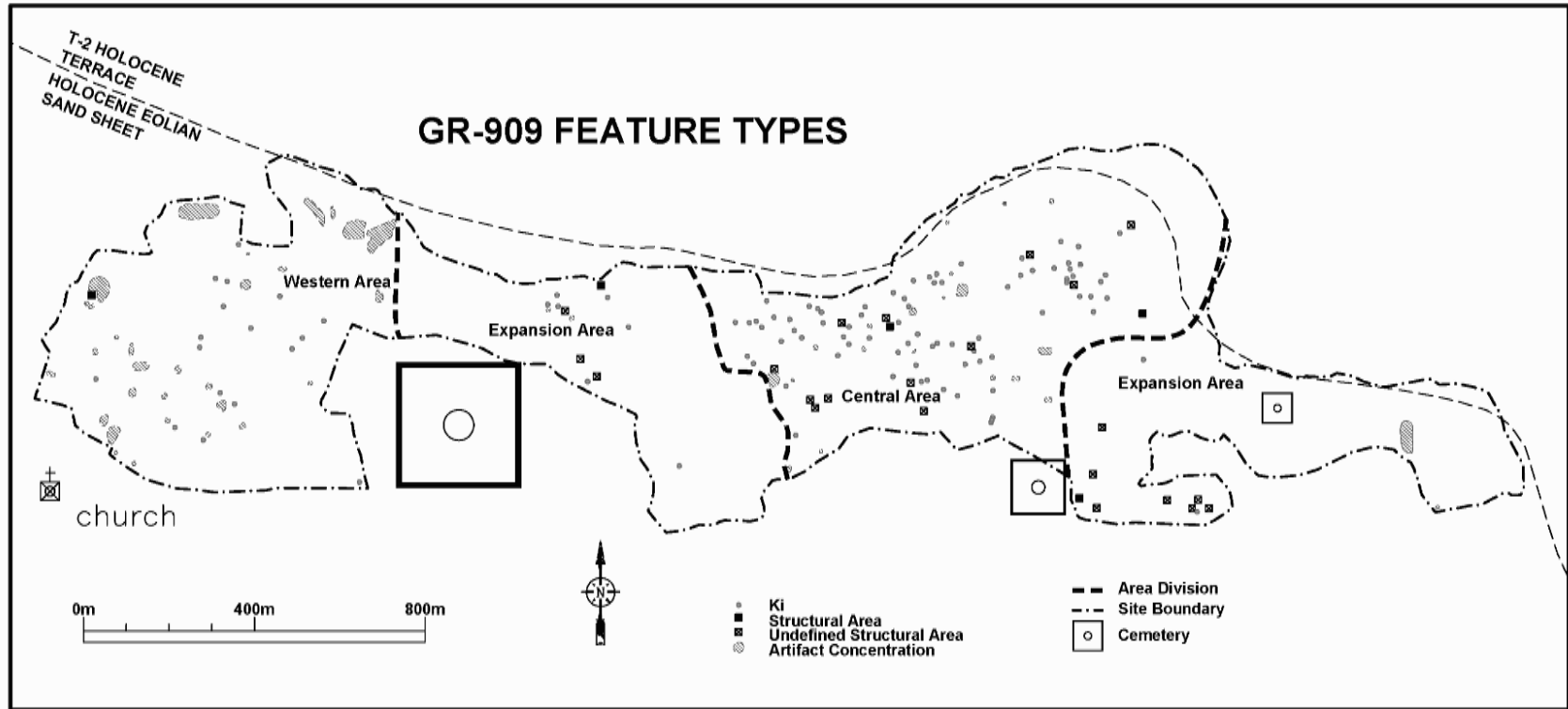


Figure 6.14. Map showing the location architectural features, cemeteries, and site areas at GR-909, GRIC.

Because Euroamerican goods were rare in the area until the mid-1800s, it is difficult to establish when the site was first occupied based on this evidence alone (Figure 6.15), and Wilson (1999:12) suggests Sacate was visited by Kino in the late 1600s. It is unlikely that the village was settled immediately before his visit, and Classic Period Salado Polychromes were collected. The oldest non-indigenous artifacts were recovered from the central area, and consist of one-piece metal buttons that were manufactured between 1750-1812. Other non-indigenous artifacts suggest the area was occupied through at least the late 1800s. In contrast to the central area, *ki* depressions are less common in the expansion area. A shift in structure types occurred the late 1800s, but there is evidence *kiik* were used until at least 1910. The low incidence of *kiik* in the expansion area site suggests it was first inhabited more recently than the central portion of the site. Non-indigenous artifacts from the expansion area include military buttons and black glass, including one example with an “improved” pontil scar, suggesting the area was used prior to the 1880s. The non-indigenous assemblage from the western area differs substantially from the assemblages collected from the rest of the site, and the percentage of glass, ceramics, as well as metal items is higher suggesting this area has the most recent occupation (Randolph et al. 2002). Shifts in the occupied area at the site were argued to have resulted from historical and environmental events including Apache raiding, movement of the Gila River channel, flooding episodes, Euroamerican interaction, and the construction of the railroad and other transportation routes (Randolph et al. 2002).



Figure 6.15. Non-indigenous goods collected from the Sacate site. Including glass container fragments (top left and right), ceramic pipe (top center), metal buttons (bottom two on left), metal crucifixes (bottom two in center), and center fire cartridge casing (bottom right).

Figure 6.16 shows boxplots of weights for complete small projectile points by area of the site. The smallest points on average are from the western portion of the site where the most recent occupation appears to have occurred based on the non-indigenous artifact assemblage. Statistically significant differences exist between the western and central areas (T-test $p = .002$, equal variances not assumed), and the western and expansion portions (T-test $p = .003$, equal variances not assumed), but greater similarity exists between the central and expansion area point weights. These data are consistent with a general drift of the settlement location over time as modeled by Darling et al. (2004), and with

patterning in the non-indigenous artifact assemblage from the site (Randolph et al. 2002).

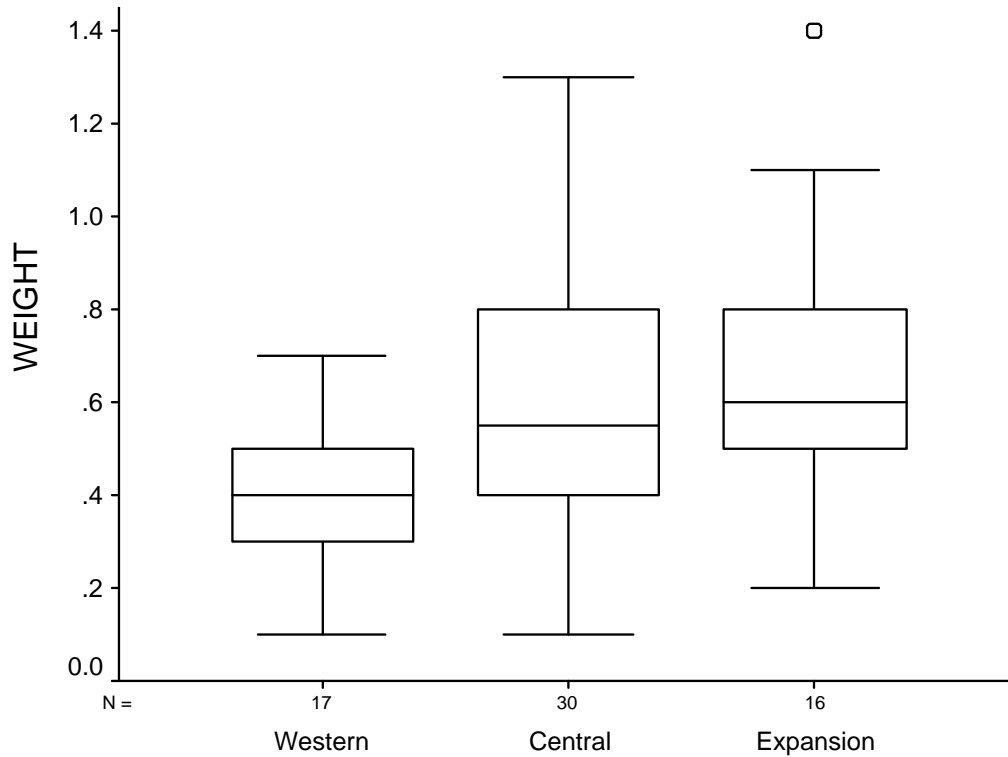


Figure 6.16. Boxplots of point weight by site area at the Sacate site (excludes broken points, preforms, and Large projectile points).

Cienega Creek Burial Data

A range of variation in point design is expected at any moment in time, and one way to assess this variance is to consider large assemblages of artifacts recovered from contexts that suggest they are contemporaneous, for example, points from burial facilities. Historic period interments associated with large numbers of projectile points have not as yet been reported for the GRIC, but weight data are available for two inhumations recently excavated along Cienega

Creek, which is located between the Santa Cruz and San Pedro Rivers to the southeast of the GRIC (Vint 2005). Over 150 Sobaipuri style projectile points (Figure 6.17) were recovered from the body cavities of two old adult males, who were covered with rocks and at least one of which was partially dismembered (Vint 2005). All of these points were unnotched, which is consistent with test expectations for points designed for use against people. Nearly half of the points were serrated, and all of the points had irregular edge margins that were to some extent uneven (Vint 2005:17).

Although the precise temporal association of the burials is uncertain, a domestic cow vertebra was found with Feature 1, and this interment must have occurred after the arrival of European livestock in the area. The earliest mention of cattle in the region occurred in 1696, when Father Kino took livestock to San Xavier del Bac near modern Tucson, Arizona (Wilson 1999). This suggests the burials post-date the late 1600s (Vint 2005:11); however, cattle were rare in the region until after the gold discoveries in 1849, when large stock drives were undertaken along the Gila River (Wilson 1999). “One drover estimated that in 1854 alone some 3,000 head of cattle were lost along the trails south of the Gila, mostly to Indians” (Wilson 1999).

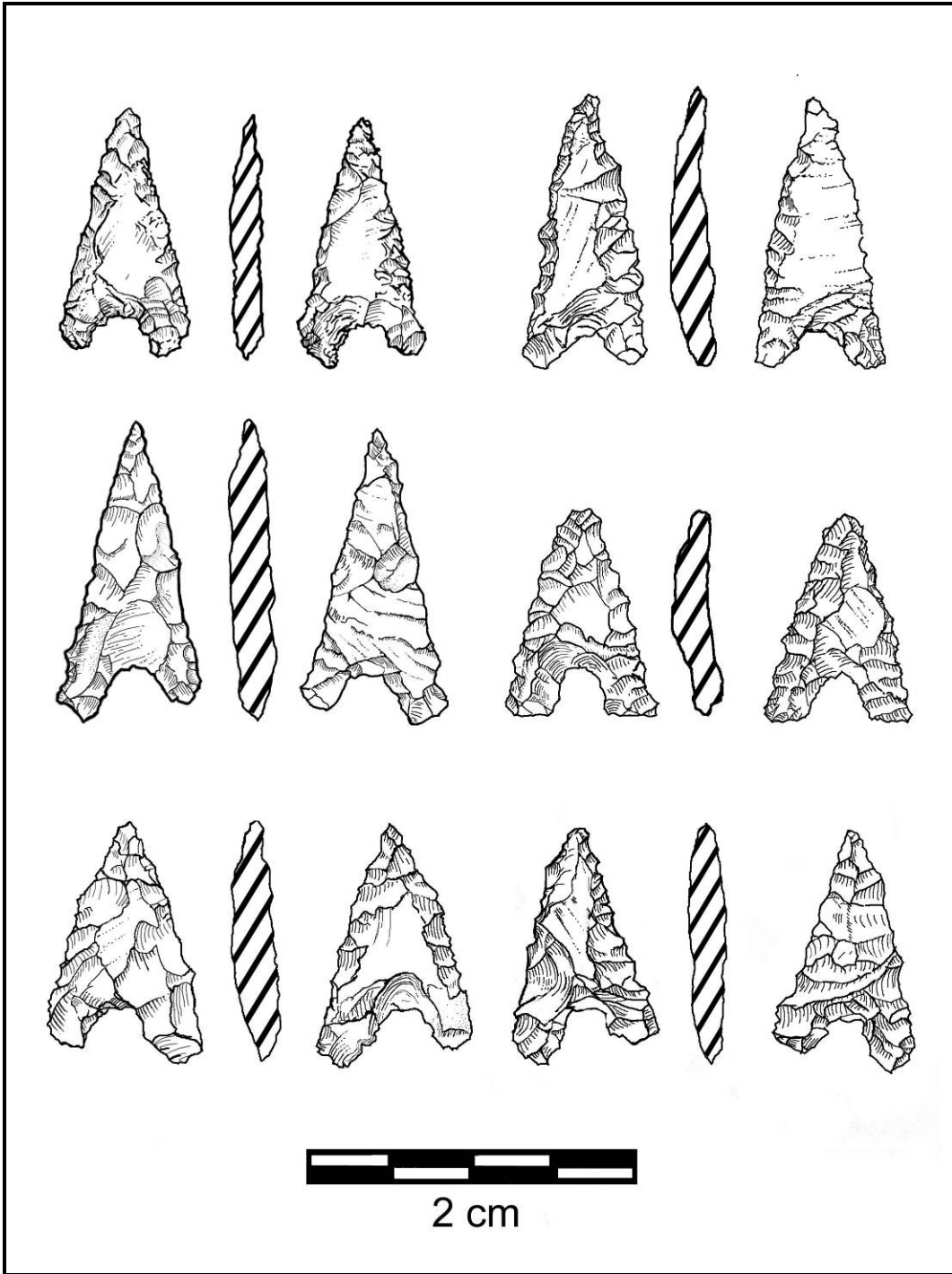


Figure 6.17. Projectile point examples from the Cienega Creek burials (Redrawn by Rob Ciaccio after Vint 2005).

Figure 6.18 is a histogram of weights for complete or nearly complete projectile points recovered from the two bodies. The mean, median, and mode for the assemblage are all .3 grams. The distribution is non-normal, with a skewness of 1.3 and a kurtosis of 3.1, indicating the weight values are more clustered than a normal distribution and skewed right. Over 75 percent of the points weigh within just .1 grams of the mean/median/mode of .3 grams, which is consistent with the suggestion that Historic period points were generally small. In addition, over half of the points were broken, which supports the observation that points are likely to catastrophically break when used. At the same time, the large number of projectile points found within the two bodies is consistent with the suggestion that warfare points were not generally recovered for reuse or reworking.

Interestingly, comparison of the point assemblages from the two burials suggests it is possible that they were not precisely contemporaneous, which has implications for understanding the cultural practices that resulted in the interment of the individuals. Figure 6.19 shows box plots of point weights for the two burials. Point weights associated with Features 1 and 2 are significantly different (T-test $p = .04$, equal variances not assumed). Other observations also support the possibility that the two burials may not have been interred together.

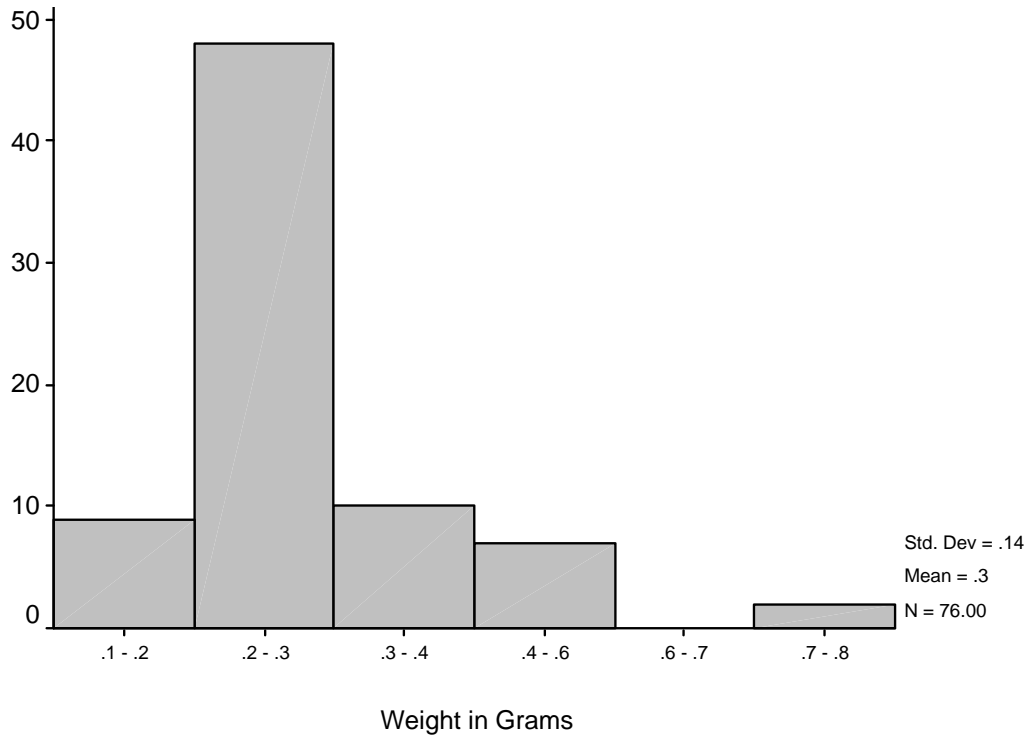


Figure 6.18. Histogram of weights for 76 complete or nearly complete projectile points from the Cienega Creek burials.

First, breakage patterns vary significantly at the 90 percent confidence interval between the two burials (Yates corrected *Chi-square* = 3.6, $p = .06$); points associated with Feature 2 are more likely to be broken suggesting the exact conditions under which the points were shot into the bodies varied. Second, raw material frequencies vary between the two assemblages. Although the proportion of jasper points is roughly similar, a significant difference at the 90 percent confidence level exists between the proportions of chert and chalcedony in the two assemblages (Yates corrected *Chi-square* = 3.0, $p = .08$).

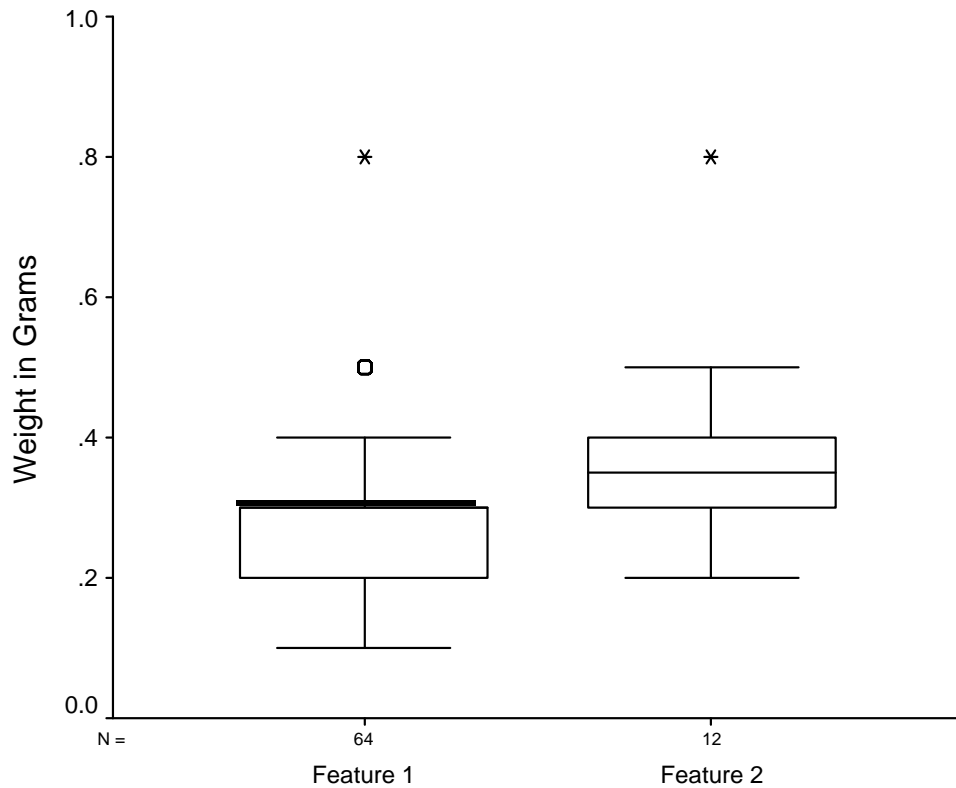


Figure 6.19. Boxplots of weight for complete and nearly complete projectile points from the Cienega Creek burials by feature.

Independent Age Estimates

The most rigorous way to test the point size hypothesis is to examine projectile points from controlled contexts with independent age estimates. Although he does not appear to have considered weight, Shott (1996) compared radiocarbon age estimates for occupational levels at seven Woodland and later sites in the American Bottom. These components ranged in age from 1620 B.P. to 883 B.P. When ordered by site, the correlations between metric attributes and age ranged between .50 and .97. Ordered by component, correlations between projectile point attributes and radiocarbon age estimates ranged between .62 and .85. Shott (1996:294-297) identified a gap in the distribution he suggested was

possibly associated with the introduction of the bow-and-arrow, but he also found that probable arrow tips decreased in size over time. Furthermore, he observed that “time-dependant trends in the size of probable arrows are found in other areas”. For example, “base or maximum width declined steadily by about 9.3%, and maximum thickness by about 16.7%, over the roughly six-century span” for an occupation in southwestern Indiana (Shott 1996:297). Shott (1996) used Optimal Foraging Theory to explain this continuous variation. He (Shott 1996:301) suggested “[i]f projectile length and shaft diameter must decline to achieve improvements in accuracy and range, then projectile point width, especially neck and base width, also should decline”. This investigation suggests that weight is the best single measurement of this relationship, and has further explored the association between point size and performance.

Historic period Akimel O’odham habitation within the Phoenix Basin was largely restricted to the location of the modern GRIC, and until recently little research has been done in the area. As a result, the only Historic period projectile point from a controlled excavation context within the study area consists of an artifact from a feature at the Sweetwater site (Woodson 2003). This projectile point was found in a non-thermal pit (Feature 58), and a Thermal Luminance (TL) age estimate of 1808 ± 21 was obtained for a sherd in a deeper portion of the feature. One of the two coins found at the site was minted between 1832-1838, and was recovered from another pit (Feature 51) located eight meters south of Feature 58. A TL estimate of 1836 ± 49 was obtained for this feature, which falls

within the range of manufacture for the coin. The point is a Straight Base type, and the age estimates from the site support the association of this variety with the late Historic period. The weight of the point is .4 grams, which is close to the mean/median/mode of .3 grams for the Cienega Creek Historic period points.

Although Historic period burial data from excavation contexts within the study area are not available, it is possible to compare points from Classic period contexts to the assemblages from Cienega Creek. Figure 6.20 graphs the Cienega Creek Historic period point data and all of the complete or nearly complete projectile points from Classic period room floors or pits at GR-140 and GR-522 in the GRIC (Fertelmes 2010). Both sites are located at the edge of the Santan Mountains bajada, and these habitation areas both have surface structures with enclosing compound walls. GR-140 is predominately Early Classic while GR-522 includes both Early Classic and Late Classic rooms. The Classic period points are significantly heavier than the Historic points (T-test $p = .01$, equal variances not assumed), which supports the possibility that Historic period points are on average smaller than Classic period artifacts.

In order to increase the Classic period sample size it is necessary to include additional excavation data from outside the study area. Figure 6.21 shows box plots for Classic period inhumation data from the Roosevelt Platform Mound Study (RPMS). The box plot labeled “Feature 22” includes all complete projectile points from an Early Classic period inhumation at AZ U:4:75 (ASM). This individual had the largest assemblage of projectile points that was identified

during the RPMS (Loendorf 1997). The “All RPMS” plot includes all complete projectile points recovered from all Classic period inhumations that were excavated during the project. The Classic period Feature 22 assemblage from Tonto Basin is significantly heavier than the Cienega Creek Historic points (T-test $p < .001$, equal variances not assumed), as are all of the RPMS inhumation data (T-test $p < .001$, equal variances not assumed).

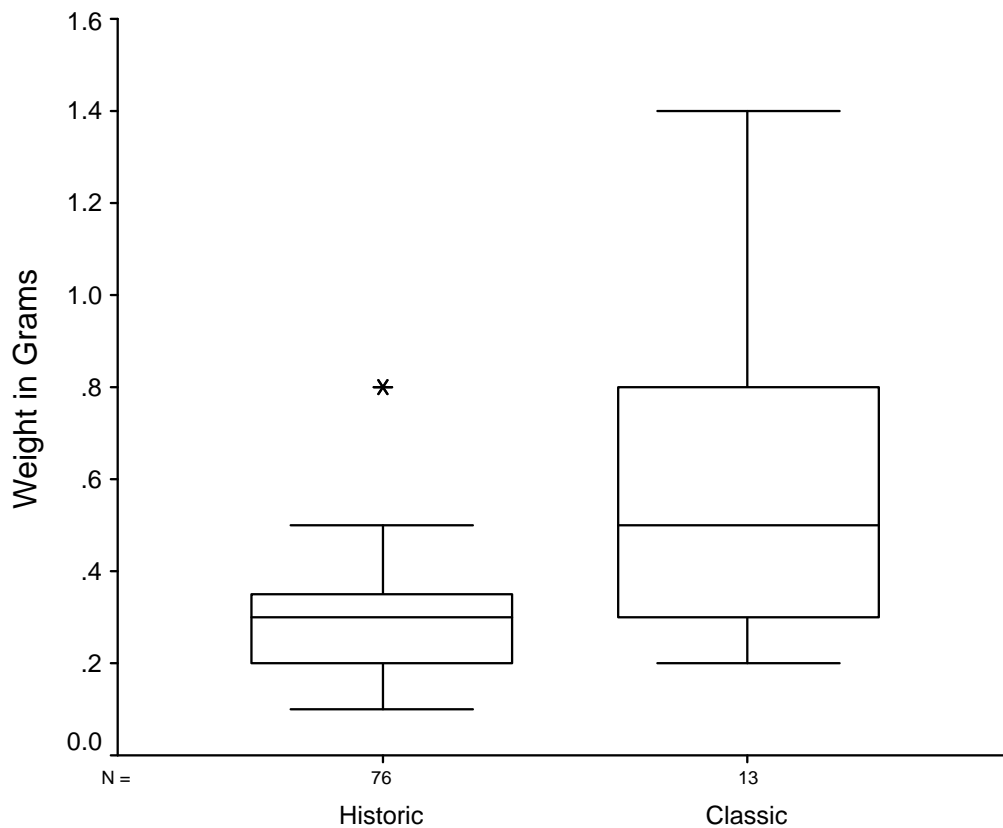


Figure 6.20. Boxplots of Historic Period Cienega Creek Burial data and Classic period projectile point from the GRIC.

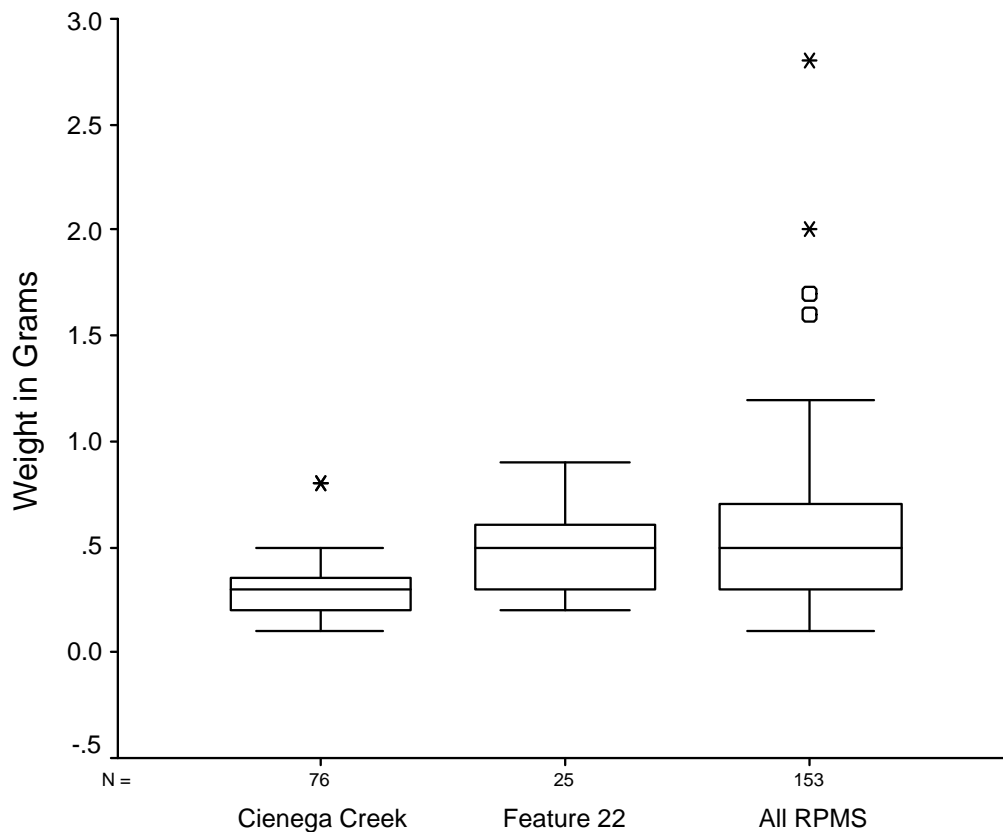


Figure 6.21. Boxplots of Historic Period Cienega Creek Burial data and Classic period projectile points from inhumations excavated during the RPMS.

Discussion

Analyses presented here support the suggestion that points generally decreased in size over time within the study. This does not mean that points can be used to date sites, and these data appear to have a limited resolution. However, in at least some cases it is possible to identify significant temporal patterning with sufficiently large projectile point assemblages. At the same time, considerable overlap occurs among different contexts, and the weights for individual artifacts can not be used alone to suggest temporal estimates. Furthermore, because

culturally contingent technological factors are suggested to have driven the change in size over time, points are not expected to have decreased uniformly in size among different regions, and any comparisons across technological traditions may produce spurious results. For example, if the Apache did indeed introduce recurved bow technology, it is expected that they made smaller points earlier in time than existing Southwestern populations. As a result, smaller points are expected to occur earlier in time within the areas they occupied. The rate of adoption for recurved bow technology (e.g., because some groups lacked access to the wood and manufacturing techniques that are necessary) may also have varied among cultural traditions, and some people therefore may have continued to produce large points later in time than others.

Although the exact ages of the Cienega Creek and Sacate loci remain unclear, these data suggest that it may be impossible to separate Late Classic period points from Early Historic period artifacts from the study area based on weight alone, and it is necessary to also consider shape. It is also probable that at a given time, hunting points were smaller than warfare points and it may also be necessary to control for point design factors (Cotterell and Kamminga 1992:181; Ellis 1997:45). While the resolution of the size data may be limited, previous researchers have had little success in seriating points from the ceramic period and there is consequently considerable room for improvement. Furthermore, lithic analysts have long used point size to separate atl-atl darts from arrow points, and

the design theory presented here attempts to more clearly define the underlying performance factors associated with this change.

Analyses in this section do not prove the projectile point size hypothesis is correct, but they do suggest it merits further investigation and may have heuristic value. Although other lines of evidence (largely ceramics) can be used in some instances to suggest temporal associations for non-diagnostic artifacts, this is not the case for assemblages produced by late prehistoric and Historic period populations who did not commonly make temporally diagnostic decorated ceramics (e.g., the Apache). Ethnohistorical observations presented in Chapter 6 suggest these highly mobile peoples had considerable effects on the Historic period sedentary agriculturalists who lived in the Southwest, and the identification of any temporally diagnostic artifacts they may have produced is therefore of importance. The next section examines the relationship between notching and the performance of triangular projectile points.

Warfare and Hunting Point Designs

The following analyses test expectations for warfare and hunting points designs that are based on ethnographic descriptions and performance requirements: 1) hunting points should generally have rounded tangs, while warfare points may more frequently have pointed tangs that resist backing out of wounds; 2) when defensive armor is present as was the case along the middle Gila in the Historic period (Shaw 1994:35-46; Webb 1959:25), warfare points are expected to have narrower bases than hunting arrow points (Bergman and

McEwen 1997:153; Cotterell and Kamminga 1992:181); 3) points designed for hunting are expected to have higher fragmentation rates, while warfare points are anticipated to more commonly be whole.

Table 6.6 presents basal corner (i.e., tang) shape for side-notched and unnotched points. Expectations based on ethnographic research presented in Chapter 4 suggest that rounded tangs should be more common on hunting style points, whereas pointed tangs should be more common for points designed for use in warfare. As hypothesized, pointed tangs are the most common design for unnotched specimens, and side-notched points are more likely to have rounded tangs. A significant difference exists in basal corner treatment for notched and unnotched points, supporting the postulated expectation for variation between these designs (Yates Corrected *Chi-Square* = 91.8, $p < .001$).

Table 6.6. Tang treatment by notch design for small projectile points.

Basal Corners (Tang)	Unnotched Points		Low-Side Notched Points	
	Count	%	Count	%
Rounded	10	3.4%	40	41.7%
Pointed	285	96.6%	56	58.3%
TOTAL	295	100.0%	96	100.0%

Similarly, side-notched arrow points are also significantly more likely to have straight bases while unnotched points more commonly have concave bases (Table 6.7; Yates Corrected *Chi-Square* = 6.41, $p = .01$). Highly concave bases

create two basal points (i.e., barbs) at different angles from each other that would resist backing out of wounds.

Table 6.7. Base treatment by notch design for small projectile points.

Base Shape	Unnotched Points		Low-Side Notched Points	
	Count	%	Count	%
Straight	88	28.8%	43	38.4%
Concave	205	67.0%	53	47.3%
TOTAL	293	100.0%	96	100.0%

Because shielding was employed in the study area, it is expected that warfare point designs should be narrow types that are intended to pierce these defenses (Bergman and McEwen 1997:153; Cotterell and Kamminga 1992:181). Narrow armor penetrating designs have been referred to as “bodkin” points, while wider hunting points are termed “broadheads” based on analogy with Medieval European metal point designs (Harlan 2009). Similarly, Rice and Simon (1994) identified a tendency for points from the Tonto Basin to be long and narrow or short and wide. Figure 6.22 shows boxplots of basal widths for unnotched and side-notched points from the study area (see Figure 4.3 for measurement locations). Although considerable overlap occurs, a significant difference exists in the basal widths of these designs as postulated (T-test $p < .001$, equal variances not assumed).

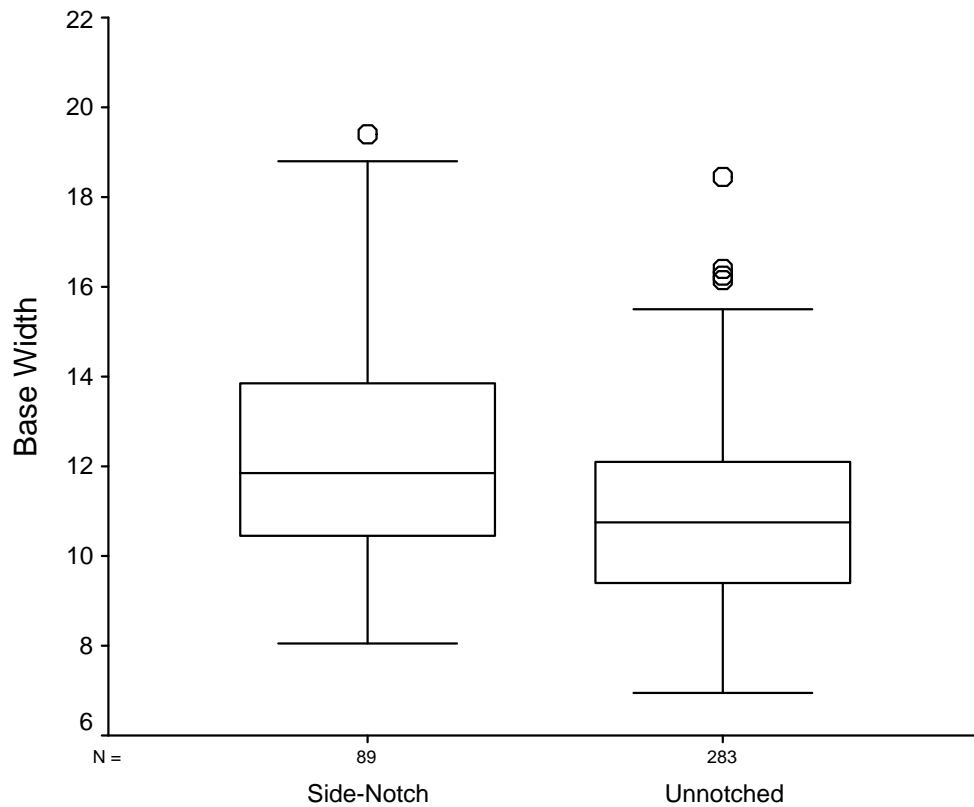


Figure 6.22. Base widths for side-notched and unnotched small projectile points.

In order to haft a projectile point, the width of the neck (i.e., stem) is constrained by the shaft diameter. When attempting to securely fasten a point several problems occur if the stem is wider than the shaft (Christenson 1997:134-135; Geneste and Maury 1997:183). As shown in Figure 6.23, it does not appear to be the case, however, that narrow points were left unnotched because the points were already narrower than the shaft diameter. In fact, the neck (i.e., stem or haft element) widths for unnotched projectile points are significantly wider than the widths of side-notched points (T-test $p < .001$, equal variances not assumed).

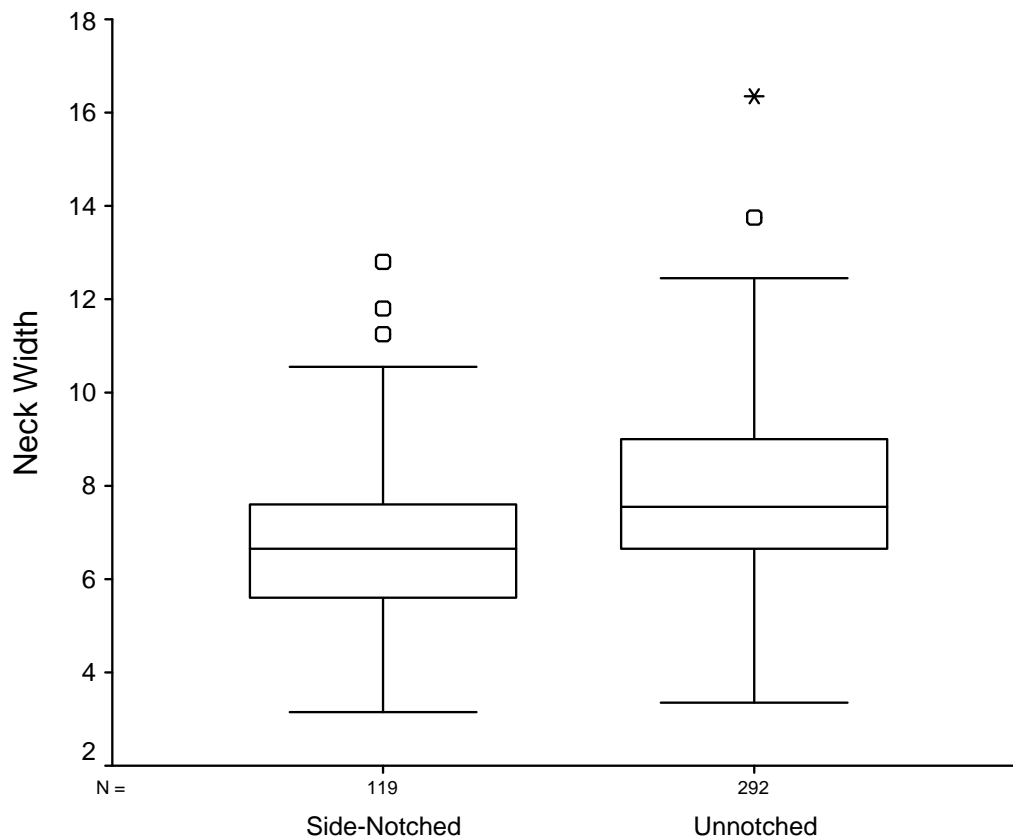


Figure 6.23. Neck widths for side-notched and unnotched small projectile points.

Comparison of breakage patterns for unnotched and side-notched points also suggests that these point types were used differently. Points that lack notches are significantly more likely to be whole than are side-notched points (Table 6.8; Yates corrected *Chi-Square* = 59.1, $p < .001$). The circumstances of warfare are expected to result in a lower recovery rate for these arrows, whereas hunting arrows (with broken points securely attached) were more commonly retrieved for reuse of the shaft. Even if the warfare arrows were recovered after use, the points are likely to have been detached because they were intentionally loosely secured. In contrast, the bases of side-notched points would be more readily retrieved

because they were firmly attached to shafts. These points were then removed and discarded at habitation sites.

Table 6.8. Point completeness by notch design for all projectile points.

Point Portion	Unnotched Points		Low-Side Notched Points	
	Count	%	Count	%
Nearly Complete	69	14.3%	42	27.8%
Mid-Section	5	1.0%	14	9.3%
Base	83	17.3%	33	21.9%
Longitudinal Fragment	2	0.4%	15	9.9%
Small Fragment	3	0.6%	1	0.7%
Broken Total	162	33.7%	105	69.5%
Complete	319	66.3%	46	30.5%
TOTAL	481	100.0%	151	100.0%

Finally, variation in the material types used to make the points also supports the suggestion that notching patterns are related to differences in the intended function of projectile points (Table 6.9). While chert is the most common material for both types, the incidence of basalt and obsidian vary significantly by notch type, and side-notched points were only rarely made from basalt (Yates corrected *Chi-Square* = 27.1, $p < .001$). Obsidian has the lowest fracture toughness of all flaked-stone materials, while basalt has a higher fracture-toughness and is therefore less likely to shatter on impact (Whittaker 1994). One possibility is that less brittle basalt points were employed on war arrows in an attempt to more effectively penetrate shielding employed by opponents.

Table 6.9. Material type by notch design for projectile points.

Material	Unnotched Points		Low-Side Notched Points	
	Count	%	Count	%
Chert	197	41.0%	42	27.8%
Obsidian	132	27.4%	82	54.3%
Basalt	83	17.3%	7	4.6%
Chalcedony	33	6.9%	8	5.3%
Rhyolite	11	2.3%	8	5.3%
Glass	8	1.7%	0	0.0%
Other	17	3.5%	4	2.6%
TOTAL	481	100.0%	151	100.0%

In summary, patterning in base width and shape, point completeness, and basal corner design are all consistent with expectations for variation between warfare and hunting point design features. These data support the hypothesis that triangular projectile points with side-notches in the lower 1/3 of the blade were designed for big-game hunting, while unnotched triangular points were designed for use against other people. The following section explores patterning in the spatial and temporal distribution of warfare and hunting design projectile points. These data are consistent with independent lines of evidence including faunal remains, and ethnohistoric as well as ethnographic descriptions of cultural practices in the study area. These correspondences further support the hypothesis that projectile points in the study area were designed differently for hunting and warfare.

Projectile Point Functional Attributes

The first portion of this section examines the spatial and temporal distribution of projectile points that may have been designed for hunting. Next, synchronic and diachronic patterning in the distribution of points with features that suggest they were designed for warfare is presented. Finally, temporal variation in these two types is considered.

Hunting Design Projectile Points

Table 6.10 lists the counts and densities for projectile points with design attributes that suggest they were intended to be securely attached to arrow shafts (i.e., points designed for big-game hunting), and Figure 6.24 shows the overall densities of these points by portion of the study area. This category includes all side-notched, corner-notched, and stemmed points. Although the ethnographic literature presented in Chapter 4 suggests that some warfare point designs may have had thick narrow stems that were designed to split the shaft, points with this design feature are rare in the collection (Loendorf and Rice 2004), and all stemmed points are included as possible hunting designs. The point data are organized based on temporal estimates for the types, and Archaic as well as Pre-Classic artifacts are included for comparison with the Classic and Historic period distributions.

Table 6.10. Hunting design projectile points by study unit within the GRIC, P-MIP Collection.

Site Group	Map Unit	Survey Hectares	Archaic		Pre-Classic		Classic		Historic		TOTAL	
			Count	Points/1000H.	Count	Points/1000H.	Count	Points/1000H.	Count	Points/1000H.	Count	Points/1000H.
Maricopa	12	5223	2	0.4	6	1.1	1	0.2	0	0.0	9	1.7
Borderlands	9	13752	45	3.3	3	0.2	1	0.1	0	0.0	49	3.6
Blackwater	1	1778	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Santan	4	3052	3	1.0	1	0.3	2	0.7	0	0.0	6	2.0
Lone Butte	10	3432	5	1.5	1	0.3	1	0.3	0	0.0	7	2.0
Snaketown	7	8267	26	3.1	32	3.9	19	2.3	0	0.0	77	9.3
NORTH TOTAL		35,504	81	2.3	43	1.2	24	0.7	0	0.0	148	4.2
Sacaton	5	1535	0	0.0	2	1.3	1	0.7	0	0.0	3	2.0
Santa Rosa	2	5449	15	2.8	1	0.2	0	0.0	0	0.0	16	2.9
Santa Cruz	11	3047	14	4.6	2	0.7	13	4.3	0	0.0	29	9.5
Casa Blanca	8	5325	7	1.3	5	0.9	9	1.7	0	0.0	21	3.9
SOUTH TOTAL		15356	36	2.3	10	0.7	23	1.5	0	0.0	69	4.5
GRAND TOTAL		50860	117	2.3	53	1.0	47	0.9	0	0.0	217	4.3
South/North Ratio		<i>0.4</i>	<i>0.4</i>	1.0	<i>0.2</i>	0.5	<i>1.0</i>	2.2	<i>0.0</i>	<i>0.0</i>	<i>0.5</i>	1.1

*Excludes points collected as isolated occurrences. H. = Hectares

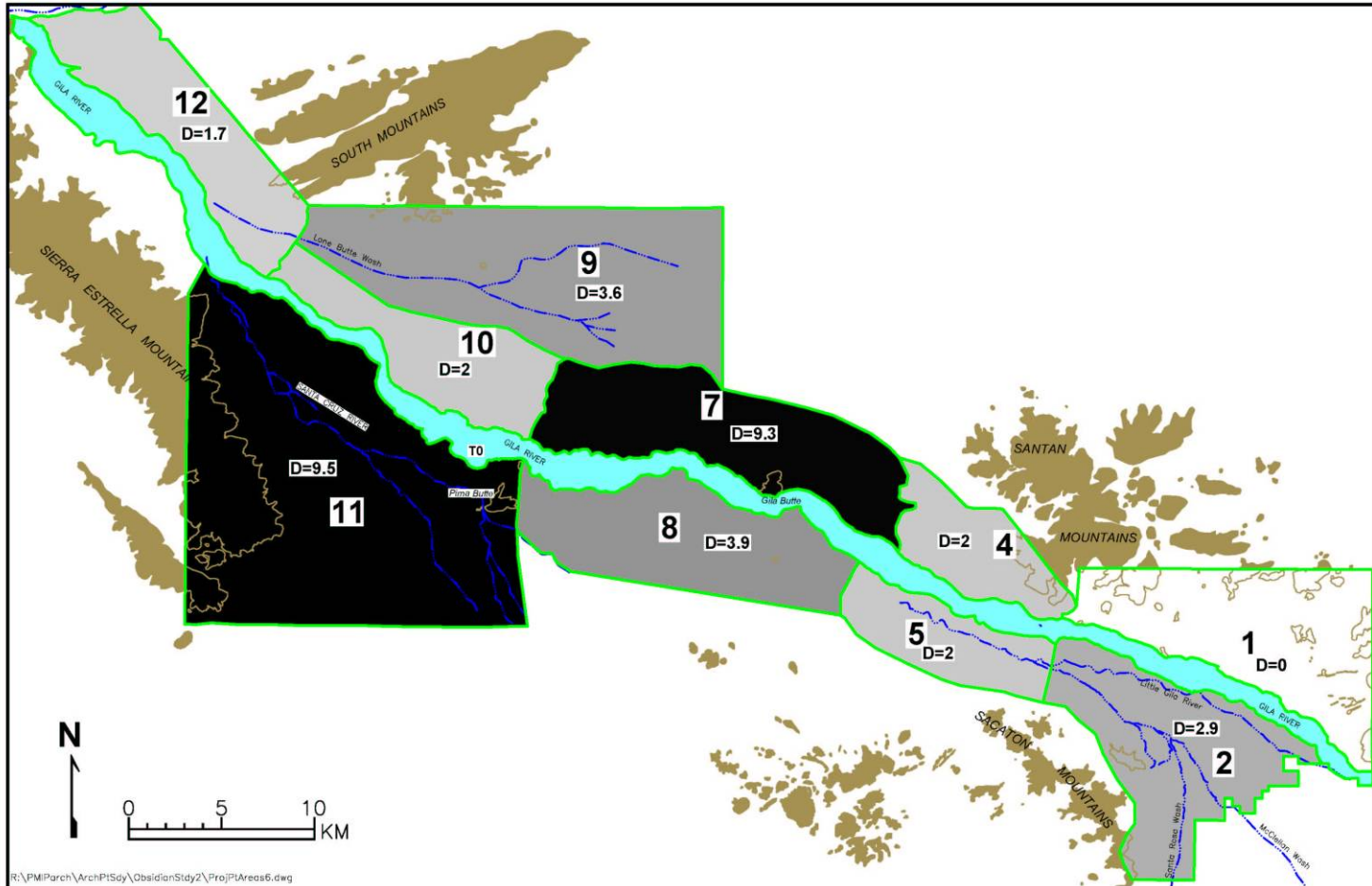


Figure 6.24. Proportions of hunting design projectile points by study unit within the GRIC, P-MIP collection. Units are shaded based on density, with black being the greatest. D = point density for the unit.

Overall, points that may have been designed for hunting are most concentrated in the Snaketown and Santa Cruz areas. The densities for these two areas are over twice as high as the next highest overall density. Points from different periods are most concentrated in these areas, suggesting hunting was more important for people in these areas through time. This patterning by type suggests long-term continuity in practices within the study area. Although 7,500 hectares were surveyed in the Santan and Sacaton mountains as part of P-MIP investigations, no projectile points were collected from either of these locations (see Table 4.1 and Figure 4.1). These observations are consistent with diachronic and synchronic patterns of big-game hunting practices within the Southwest that are based on faunal remains.

Dean (2003:179) in an analysis of faunal data from throughout the American Southwest, argued that large “prey species, including mule deer (*Odocoileus hemionus*), bighorn sheep (*Ovis canadensis*), pronghorn antelope (*Antilocapra americana*), and white-tail deer (*Odocoileus virginianus*), were only a minor part of most prehistoric diets.” She argues “it is clear that ungulate hunting was not sufficient to meet protein needs of populations in southern Arizona from at least the Middle Archaic” through the Classic period (Dean 2003:179). Szuter (1991) developed the Artiodactyl Index (the NISP of artiodactyls divided by the sum of the NISP of lagamorphs and artiodactyls), and used it to compare Archaic and Hohokam sites. She observed that big-game acquisition was primarily related to elevation and site size.

Similarly, Dean (2003) found that sites below 800 m usually have low Artiodactyl Indexes, and found similar patterning based on site type. For low elevation sites, villages have higher values than farmsteads, field houses, or camps. She argued that low elevation villages probably had more artiodactyls remains because hunting groups were bringing resources from upland environments down to the community for redistribution, and “this distribution would have taken place in villages, rather than small farmsteads, and the logistic camps associated with floodplain and river terrace occupations would have focused on plant resource extraction, rather than large game hunting (Dean 2003:198). Dean (2003:211) also argued that faunal analysts may be underestimating the importance of large mammals in the diet of villagers because many of the bones were left in upland logistic camps. One way to examine this possibility is to consider projectile point data.

Hunting design points are concentrated in the areas where Hohokam and Akimel O’odham villages were located rather than peripheral areas such as the Santan and Sacaton mountains where low-land specialized activity sites and logistical camps were located (Wells et al. 2004b). Figure 6.25 shows areas that are above 800 meters in the vicinity of the study area. All P-MIP survey data are from below 800 meters (including the survey areas in the Santan and Sacaton Mountains), and with the exception of a single peak in the South Mountains, only the Sacaton and Estrella Mountains have areas above 800 meters.

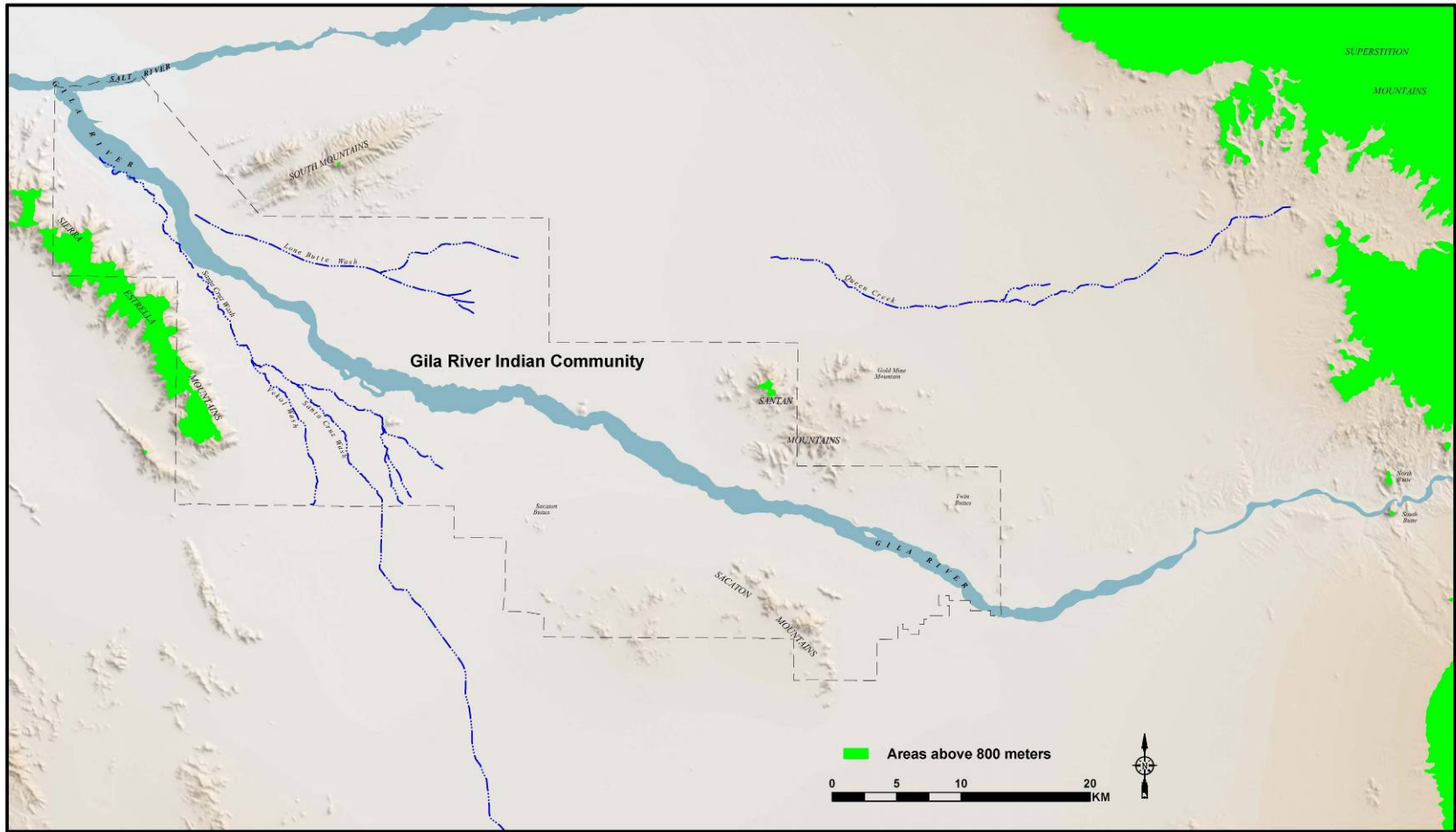


Figure 6.25. Upland areas above 800 meters in elevation in the vicinity of the study area.

The nearest extensive upland areas are roughly 30 km away in the Superstition mountains to the east and north, locations that were occupied by the hunter-gatherers during the Historic period, which may have limited access to these areas at that time. This would have reduced big-game hunting opportunities during the Historic period. These data suggest that hunting points were collected from habitation areas, and locations where big game hunting actually occurred are not present in the surveyed area. The greater importance of hunting in the Estrella communities is consistent with the observation that Anna Shaw's (1994:95) father, who lived at the base of the Estrella Mountains, hunted big-game animals. These arguments are also supported by ethnographic data assembled by Rea (1998:61-63), who argued that Historic period big-game hunters who lived in the GRIC traveled between 30 to 160 km in order to hunt. The only areas he identifies as Historic period large game hunting locations are to the south and east of the community in the direction that allied Tohono O'Odham groups lived. He also suggests that Desert Bighorn, Mule Deer, and White-tailed deer were hunted in the Estrella mountains, where hunting design points are most concentrated.

Warfare Design Projectile Points

Table 6.11 shows the distribution of projectile points that may have been designed for warfare by portion of the GRIC and temporal assignment for the artifacts. Figure 6.26 shows the overall density for these points. This category includes all completed projectile points that lack notches. The highest densities of this design occur in the areas along the river where villages were concentrated,

which is consistent with patterning observed for big-game hunting points. There are a number of differences, however, in the distribution of these two designs. In general, warfare points occur at higher overall densities than hunting point designs, which is consistent with the limited opportunities for large game hunting in the study area.

Although projectile point densities are low throughout the GRIC, nearly 400 warfare points were collected because 50,860 hectares were surveyed. All of the points considered here were recovered from locations with extensive evidence for habitation, and it appears that warfare points were rarely if ever recovered from contexts of use away from habitation areas (e.g., battlefields). In contrast to hunting designs, the overall density of all warfare design points is three times higher on the south side of the river than the north, a ratio which includes Middle Archaic through Late Historic period artifacts. The highest densities for Pre-Classic and Classic period types, however, occur in the Snaketown area on the north side where the population was concentrated at this time. During the Historic period, people aggregated on the south side of the river for protection from hunter-gatherers who regularly raided the Akimel O'odham villages, and all points from this time period are therefore expected to be concentrated in this area. The following section further explores temporal variation in the incidence of warfare and hunting point designs.

Table 6.11. Warfare design projectile points by study unit within the GRIC, P-MIP Collection.

Site Group	Map Unit	Survey Hectares	Archaic		Pre-Classic		Classic		Historic		TOTAL	
			Count	Points/1000H.	Count	Points/1000H.	Count	Points/1000H.	Count	Points/1000H.	Count	Points/1000H.
Maricopa	12	5223	0	0.0	8	1.5	4	0.8	0	0.0	12	2.3
Borderlands	9	13752	18	1.3	3	0.2	4	0.3	4	0.3	29	2.1
Blackwater	1	1778	0	0.0	0	0.0	1	0.6	1	0.6	2	1.1
Santan	4	3052	1	0.3	4	1.3	4	1.3	3	1.0	12	3.9
Lone Butte	10	3432	0	0.0	3	0.9	7	2.0	3	0.9	13	3.8
Snaketown	7	8267	6	0.7	25	3.0	34	4.1	32	3.9	97	11.7
NORTH TOTAL		35,504	25	0.7	43	1.2	54	1.5	43	1.2	165	4.6
Sacaton	5	1535	5	3.3	1	0.7	1	0.7	4	2.6	11	7.2
Santa Rosa	2	5449	9	1.7	1	0.2	4	0.7	20	3.7	34	6.2
Santa Cruz	11	3047	5	1.6	3	1.0	7	2.3	37	12.1	52	17.1
Casa Blanca	8	5325	3	0.6	5	0.9	20	3.8	100	18.8	128	24.0
SOUTH TOTAL		15356	22	1.4	10	0.7	32	2.1	161	10.5	225	14.7
GRAND TOTAL		50860	47	0.9	53	1.0	86	1.7	204	4.0	390	7.7
South/North Ratio		<i>0.4</i>	<i>0.9</i>	2.0	<i>0.2</i>	0.5	<i>0.6</i>	1.4	<i>3.7</i>	8.7	<i>1.4</i>	3.2

*Excludes points collected as isolated occurrences. H. = Hectares

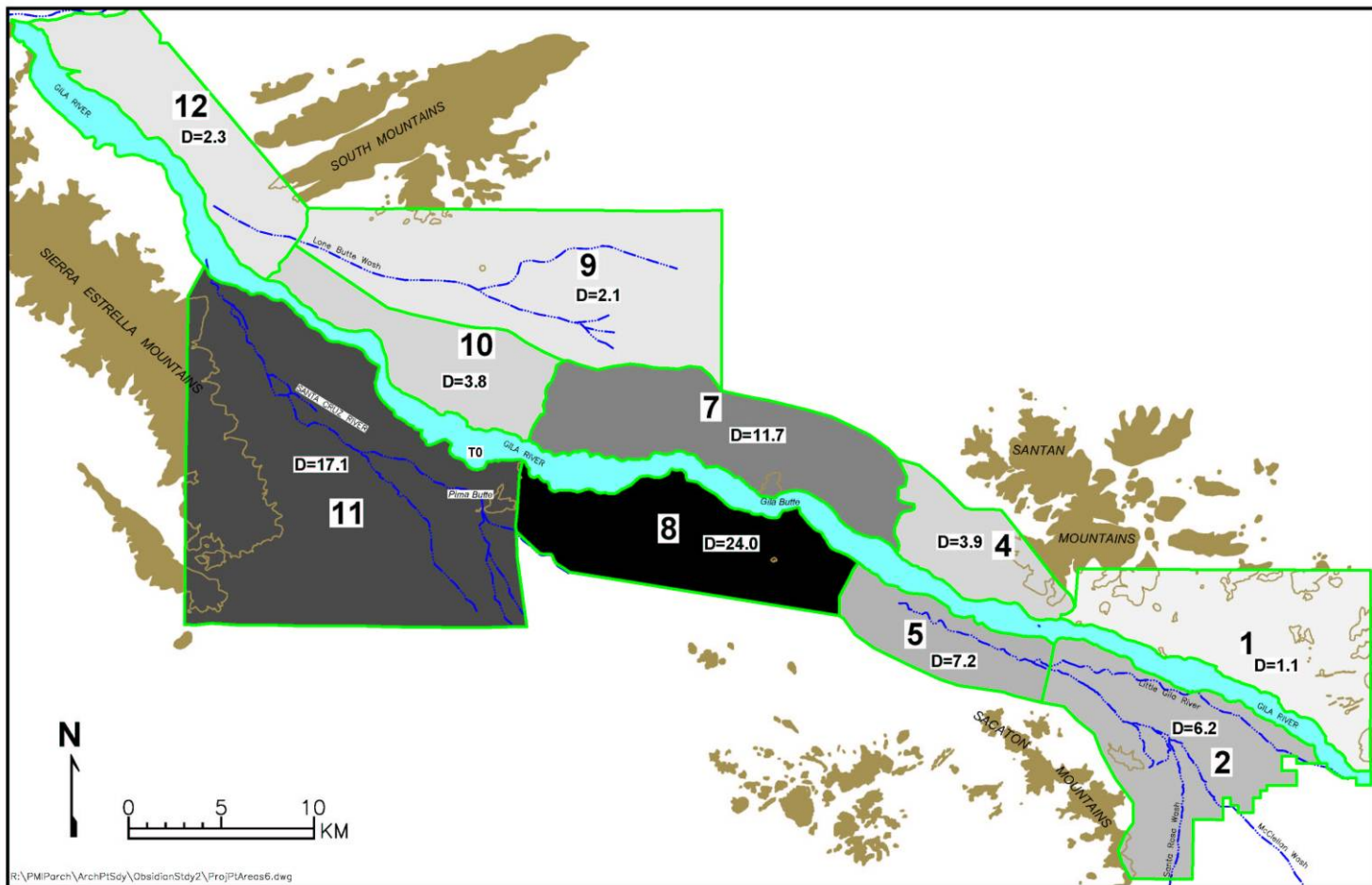


Figure 6.26. Proportions of warfare design projectile points by study unit within the GRIC, P-MIP collection. Units are shaded based on serration proportion, with black being the greatest. D = point density for the unit.

Diachronic Variation in Warfare and Hunting Point Designs

All three of the Historic period types that have been previously defined for the study area have warfare design features, whereas both hunting and warfare types are present in the Archaic, Pre-Classic, and Classic period point categories (Loendorf and Rice 2004; Sliva 1997, 2006). This suggests that big-game hunting was only rarely practiced during the Historic period, a possibility that is supported by extensive ethnographic research (see Chapter 5).

Figure 6.27 shows bar charts of the incidence of projectile points with hunting and warfare design features by time period for the types. While the incidence of warfare points tends to increase over time, the frequency of hunting design points tends to decrease over time. Because large-game hunting areas do not occur in the survey area, increased conflict may have resulted in limiting access to suitable hunting locations in higher elevations away from the villages along the middle Gila. The diachronic patterning in point design is also supported by faunal data from the study area. Based on faunal remains from the Santa Cruz area, Clark (2007:18.23) argued that the incidence of large game hunting decreased over time from the Pre-Classic to the Classic periods. Similarly, James (2003:76-77) argued that the Pueblo Grande Artiodactyl Index values suggest there was a general decrease in the incidence of large game over time from the Pre-Classic to the Classic period.

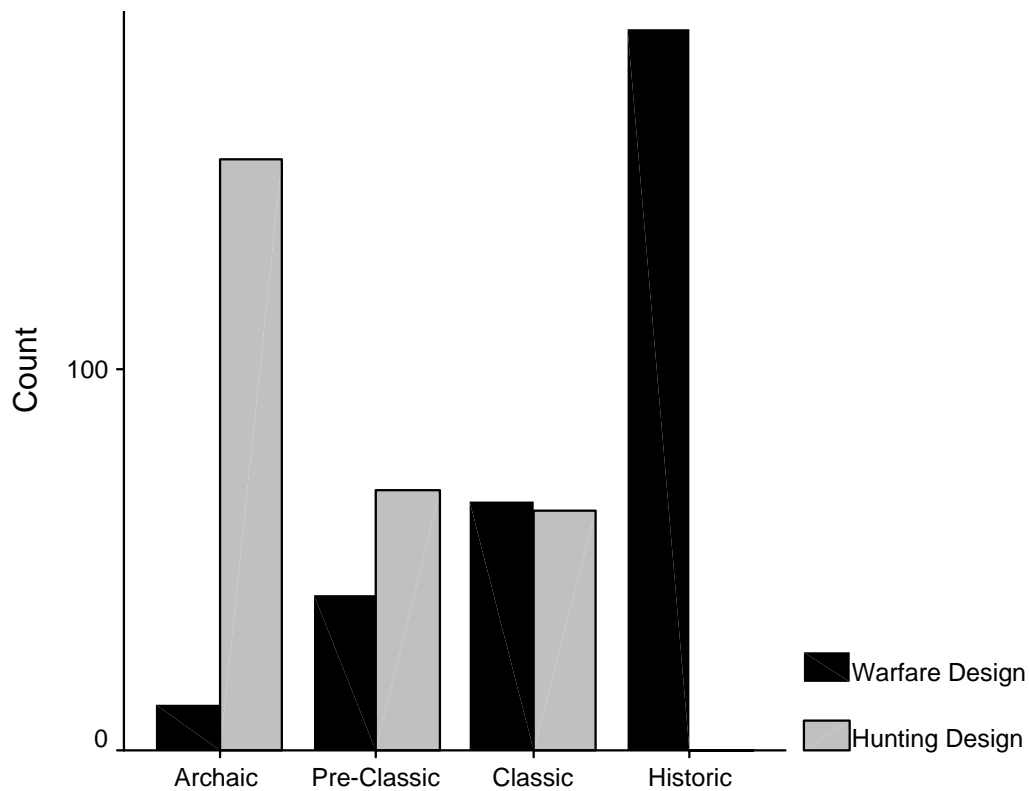


Figure 6.27. Bar chart of all classified projectile points in the collection by time period and point design.

Projectile Point Stylistic Attributes

Points with serrated blades are unequally distributed across the study area (Table 6.12, Figure 6.28). The data are organized based on the time period assigned to the artifacts based on the typological classification. Only 6 percent of all points from the Casa Blanca area were serrated, while over a third of points from other locations had this form of edge treatment (Yates corrected *Chi-Square* = 45.4, $p < .001$). This total includes artifacts that were classified as Middle Archaic through Historic period remains.

Table 6.12. Serrated projectile points by study unit within the GRIC, P-MIP Collection.

Site Group	Map Unit	Serration Absence/Presence by Time Period												TOTAL		
		Archaic			Preclassic			Classic			Historic			-	+	%
		-	+	%	-	+	%	-	+	%	-	+	%			
Maricopa	12	2	1	33%	6	8	57%	3	2	40%	0	0	0%	11	11	50%
Borderlands	9	55	25	31%	2	2	50%	3	2	40%	4	0	0%	64	29	31%
Blackwater	1	0	0	0%	0	0	0%	0	1	100%	0	1	100%	0	2	100%
Santan	4	2	3	60%	1	4	80%	6	0	0%	3	0	0%	12	7	37%
Lone Butte	10	4	2	33%	2	3	60%	5	3	38%	2	1	33%	13	9	41%
Snaketown	7	28	12	30%	35	25	42%	43	9	17%	12	20	63%	118	66	36%
Sacaton	5	8	0	0%	2	1	0%	2	0	0%	1	3	75%	13	4	24%
Santa Rosa	2	33	7	18%	1	0	0%	2	2	50%	12	8	40%	48	17	26%
Santa Cruz	11	27	2	7%	4	4	50%	17	3	15%	19	17	47%	67	26	28%
TOTAL		44	23	34%	18	9	33%	44	33	43%	106	65	38%	346	171	36%
Casa Blanca	8	20	2	9%	7	2	22%	25	3	11%	98	2	2%	150	9	6%
TOTAL		64	25	28%	25	11	31%	69	36	34%	204	67	25%	496	180	27%

*Excludes isolated occurrences and small indeterminate biface fragments.

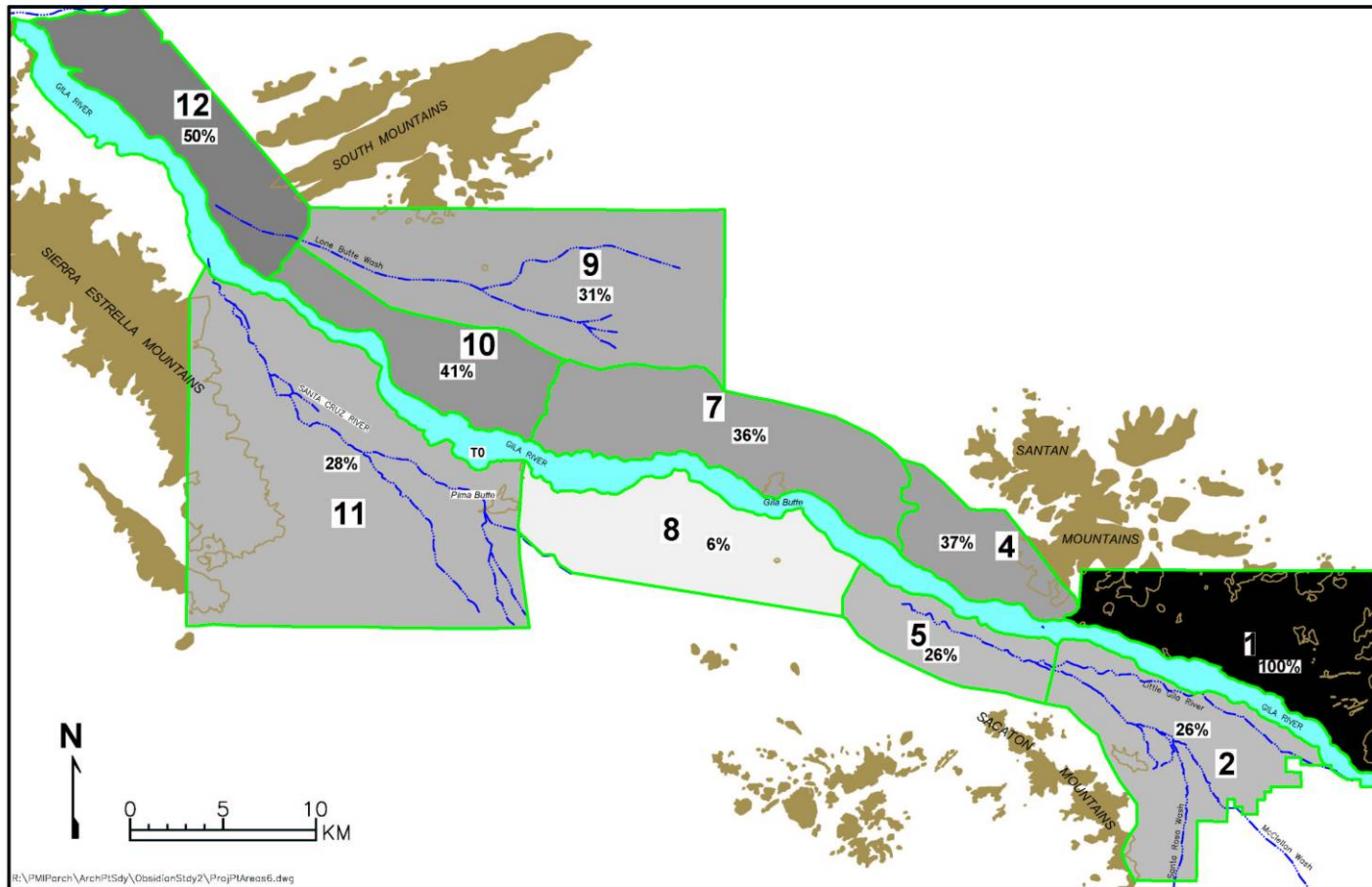


Figure 6.28. Proportions of complete serrated projectile points by study unit within the GRIC, P-MIP collection. Units are shaded based on serration proportion, with black being the greatest. Percentages are the serrated proportion in the collection.

Other researchers have also noted regional and temporal variation in projectile point serration data from the Southwest. For example, in her overview of stone points from Arizona, Sliva (2006:60) argued that while serrated points were common during the pre-Classic Hohokam sequence, “serrated Puebloan points are rare in any time period”. Marshall (2001b:502) argued that serration was most frequent during the Santa Cruz and Sacaton phases, and was less common for earlier and later points from Grewe.

Based on an analysis that employed the Unified Theory of Stylistic Design (Carr 1995), Hoffman (1997) argued that the Hohokam used projectile point blade margin treatment including serration to signal group affiliations. Hoffman (1997:95) recognized that the shaft and fletching were the most visible portions of arrows, and therefore these elements “were commonly decorated or designed to reflect individual ownership or tribal affiliation” (see also Mason 1894:662). He, however, focused on points because data from the shafts are not available. He argued that because the haft element was not visible when the points were used (i.e., when they were attached to arrows), the blade margins were the most visible aspect of the points and therefore are the most likely to exhibit intentional expressions of cultural affiliation.

Characteristics employed as active symbols of social group membership are generally associated with highly visible artifacts used in public contexts (Carr 1995; Hodder 1982; Wobst 1977). Small stone points would seem to fit this definition poorly; however, these artifacts were designed for use in warfare,

which is a public setting that is possibly the primary context of interaction for some social groups. Although small points may not have been visible from a distance, they were shot at the enemy thereby increasing the proximity of observation for other groups. Furthermore, stone points were designed to detach within wounds, leaving behind a potent symbol of the maker's cultural affiliation.

Discussion

Patterning by point type suggests that serration was rarely practiced in the Casa Blanca area throughout the archaeological sequence, while more substantial percentages of points from other locations were serrated. The lowest incidence of serration in the Casa Blanca area occurs during the Historic period, a time when almost 40% of the points from elsewhere in the community were serrated (Yates corrected *Chi-Square* = 40.06, $p < .001$). As shown in Figure 6.28, the overall density of serrated complete points tends to increase with distance from the Casa Blanca area. Furthermore, serration occurs on only 2 of the 22 Archaic period points from Casa Blanca, while 34 percent of the Archaic types from elsewhere in the community have serrated blade margins (Fishers Exact Test $p = .03$). These data therefore suggest that long-term prehistoric cultural traditions in the Casa Blanca area were maintained through time into the Historic period.

This continuation of practices over time provides another example of cultural continuity in this location. The temporal and spatial variability in serration data also suggest that different social segments lived within the study area, and it appears that these people were not politically integrated. The

following discussion analyzes obsidian data in order to further explore synchronic and diachronic variation among these social groups as well as those in surrounding locations.

Socioeconomic Interaction Patterns

Archaeologists have inferred aspects of prehistoric interaction systems through analyzing distributional patterns for economic goods (Shortman and Urban 1992:236). Exchange patterns reflect economic, ideological, and political interrelationships among communities (Simon and Gosser 2001:220). Within the study area, obsidian data have ideal properties for the studying socioeconomic interactions. Table 6.13 presents obsidian source proportions for collections with more than 40 artifacts from the Hohokam area in southern Arizona (the data are derived from Loendorf et al. 2004; Marshall 2002, Mitchell and Shackley 1995; Peterson et al. 1997; Shackley & Bayman 2006; Rice et al. 1998.). As a geographical reference point, the sites are ordered based on distance from Snaketown, which is also located near the center of the study area. The source locations are arranged from west to east with respect to the study area (Figure 6.29). The results of a non-hierarchical K-means cluster analysis are also reported. Examination of the cluster assignments and the underlying obsidian proportions suggests that site proximity to sources alone is a poor predictor of assemblages. For example, although Loci A and D from GR-522 are adjacent to each other, they have different cluster assignments. Instead, temporal and regional differences are apparent within these data.

Table 6.13. Obsidian source proportions for collections with more than 40 sourced artifacts.

Collection	Period	Obsidian Source													K-Means Cluster	Sample Size
		(West)								(East)						
		Tank Mountains	Burro Creek	Partridge Creek	Los Vidrios	Vulture	Government Mtn	RS Hill/Sitgreaves	Sauceda Mts	Sand Tanks	Superior	Cow Canyon	Mule/Antelope Creek	Unknown/Other		
Snaketown	Pre-Classic	0%	0%	0%	0%	5%	2%	2%	22%	1%	60%	2%	1%	0%	3	299
GR-522 Locus D	Pre-Classic	0%	0%	0%	0%	3%	13%	0%	15%	0%	51%	0%	0%	18%	3	39
GR-522 Locus A	Classic	0%	0%	0%	2%	0%	4%	0%	61%	0%	20%	0%	2%	12%	1	51
ELXP	Classic?	0%	1%	0%	7%	5%	3%	4%	63%	5%	8%	0%	0%	1%	1	76
Rowley	Classic	0%	0%	0%	0%	47%	0%	0%	30%	0%	23%	0%	0%	0%	5	43
Pueblo Grande	Classic	1%	0%	4%	4%	27%	22%	0%	30%	0%	10%	0%	0%	3%	5	220
Los Colinas	Pre-Classic	4%	0%	2%	4%	26%	38%	10%	10%	0%	2%	0%	0%	4%	2	50
Casa Grande	Classic	0%	0%	0%	0%	1%	29%	0%	46%	0%	7%	0%	14%	2%	4	137
Grewe	Pre-Classic	0%	0%	0%	0%	1%	0%	0%	1%	0%	95%	0%	1%	2%	3	137
Palo Verde	Pre-Classic	0%	0%	2%	0%	55%	31%	11%	0%	0%	0%	1%	0%	0%	2	122
Gatlin	Pre-Classic	0%	3%	0%	1%	4%	0%	0%	85%	0%	0%	0%	0%	7%	1	75
Brady Wash	Classic	0%	0%	0%	3%	7%	4%	0%	79%	0%	3%	0%	1%	1%	1	67
Tonto Arm Early	Classic	0%	0%	0%	0%	0%	5%	0%	0%	0%	90%	2%	0%	3%	3	11
Tonto Arm Late	Classic	0%	0%	0%	0%	0%	38%	0%	20%	0%	6%	4%	32%	0%	4	80
Salt Arm Early	Classic	0%	0%	0%	0%	0%	13%	13%	13%	0%	64%	0%	0%	0%	3	54
Salt Arm Late	Classic	0%	0%	0%	0%	3%	33%	0%	11%	0%	15%	9%	26%	3%	4	45
Marana	Classic	0%	0%	0%	0%	6%	0%	0%	85%	0%	4%	1%	3%	1%	1	152
P-MIP Survey Data																
Pre-Classic GRIC	Pre-Classic	0%	0%	0%	0%	0%	11%	0%	55%	0%	33%	0%	0%	0%	N/A	9
Classic GRIC	Classic	0%	0%	0%	0%	8%	0%	0%	67%	0%	8%	0%	8%	8%	N/A	12
Historic GRIC	Historic	0%	0%	0%	5%	9%	0%	0%	76%	0%	9%	0%	0%	0%	N/A	21

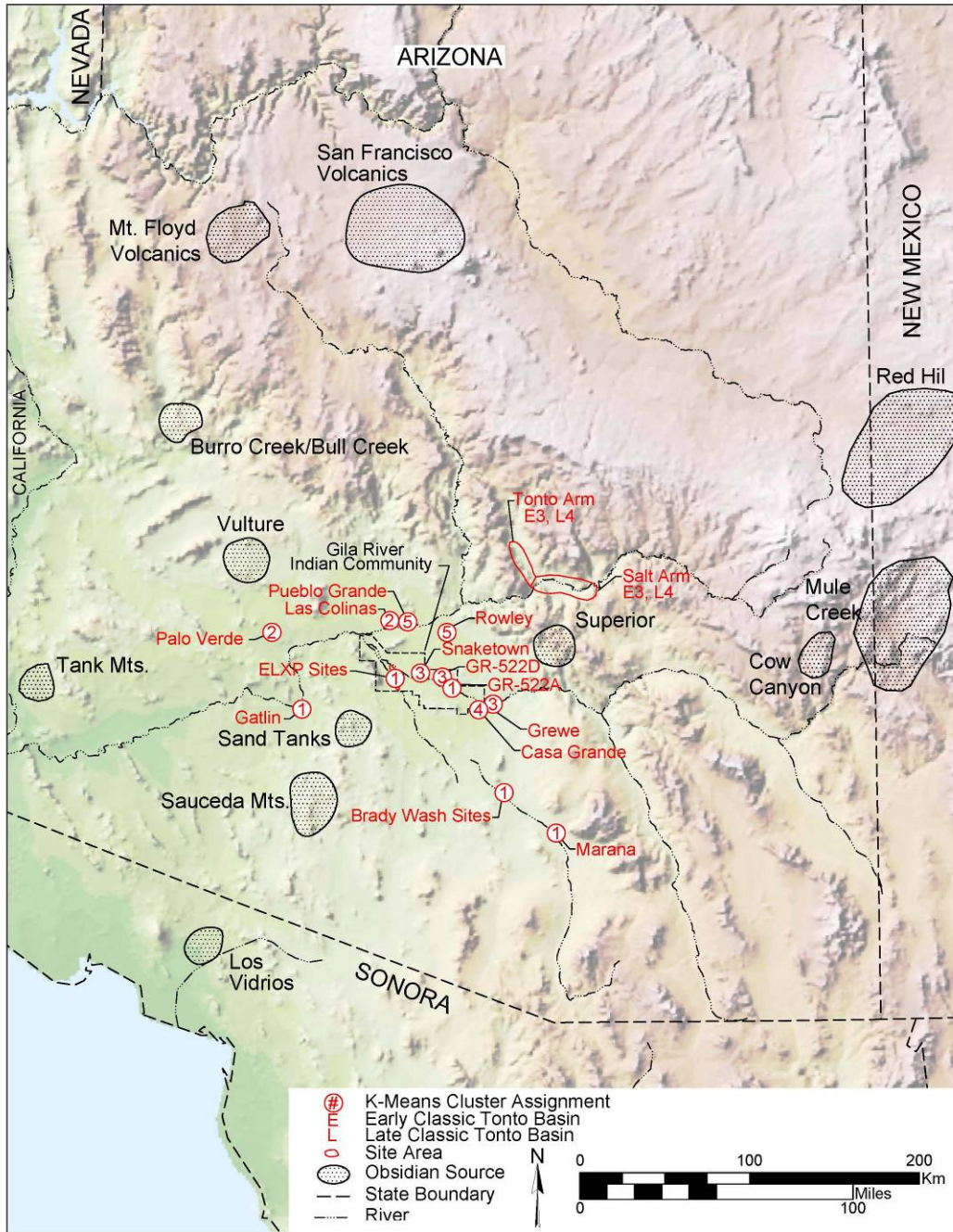


Figure 6.29. Archaeological site locations within Southern Arizona and obsidian sources identified at these sites.

Cooperation within the Hohokam Core Area

With the exception of Sand Tanks, the closest obsidian sources to the core were the most commonly used by the Hohokam (Shackley 2005). These include the Saucedo, Superior, and Vulture (Figure 6.30). The use of these source materials, however, varies substantially over time and space. Although Sand Tanks is geographically closest, this material rarely occurs. This obsidian source does not appear to have been extensively utilized throughout the Hohokam region, but the reasons for this remain unclear (Shackley and Tucker 2001).

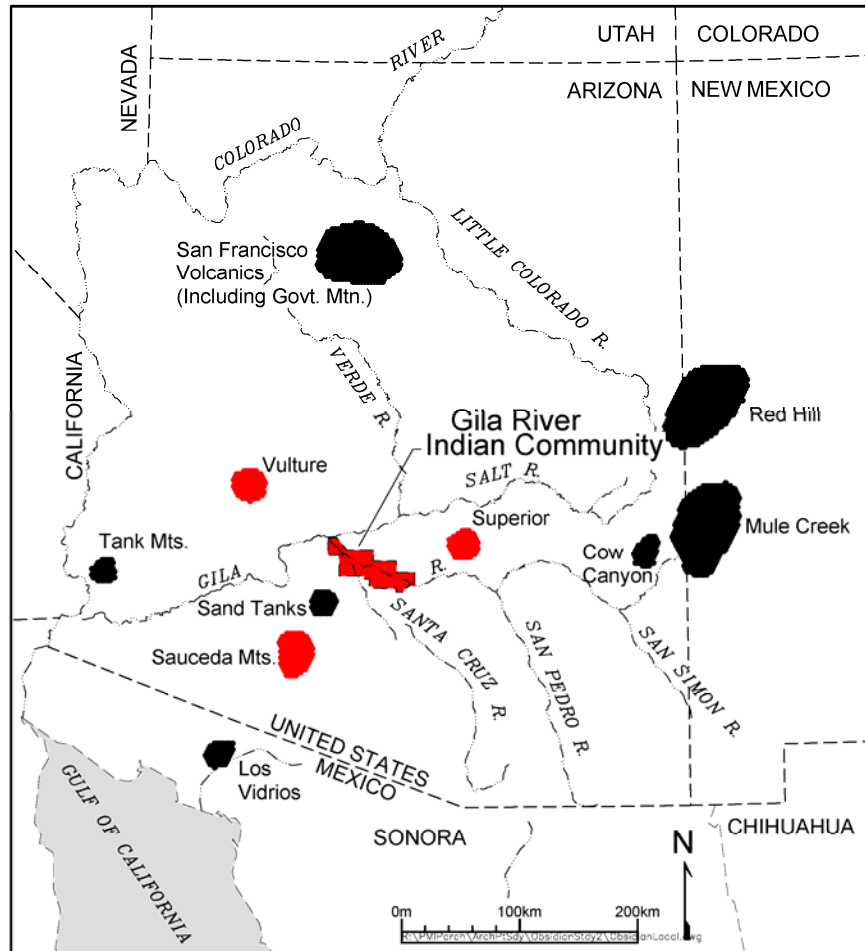


Figure 6.30. Obsidian sources identified in the P-MIP survey collection. The most common sources are shown in red.

Sauceda obsidian was one of the most common sources used by the Hohokam throughout the archaeological sequence, and its proportion in assemblages is not correlated (Pearson Correlation = -0.03) with distance from the source (Figure 6.31). These data are not consistent with *Direct Access* models for obsidian acquisition that assume the end user of the obsidian personally traveled to the source to collect the material.

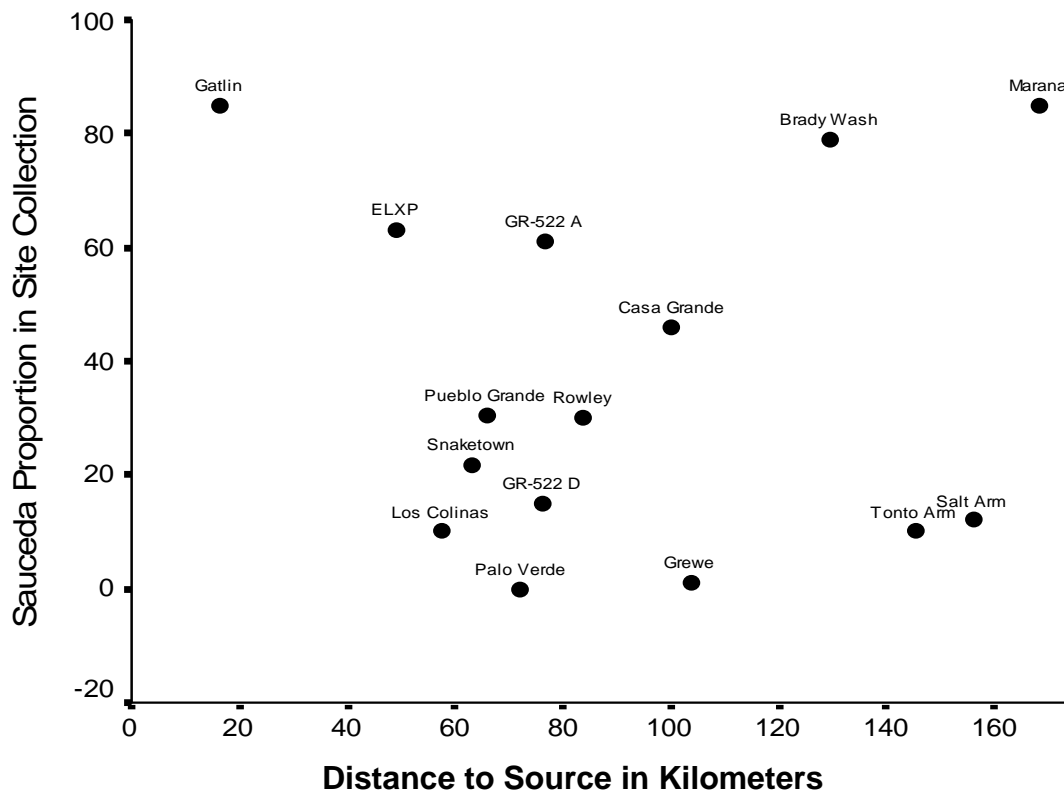


Figure 6.31. Scatterplot of Sauceda obsidian proportions by straight-line distance in kilometers from the source location.

Peterson and others (1997) referred to this category as the *Opportunistic Model*, in part, because some researchers argue that obsidian procurement strategies were embedded within the acquisition of other goods. It is assumed that obsidian was a comparatively low value item that was obtained when possible in the context of other activities. This model holds that distance to the source should be a primary factor that determines obsidian frequencies at sites, but temporal variation in obsidian utilization as well as the lack of distance decay relationships for common types suggests this model is not the most parsimonious explanation for obsidian acquisition in the Hohokam region.

Nonetheless, distance decay relationships are apparent in the obsidian frequencies for the P-MIP survey data. Figure 6.32 graphs obsidian proportions for the three most common source areas within different portions of the community by distance to the sources. A rapid falloff with distance is apparent for the proportions of Superior and Vulture obsidians; however, the two types have opposite falloff patterns. Superior obsidian, which is located to the east, proportions falloff from east to west. In contrast, Vulture obsidian, which is located to the west, proportions falloff from west to east. Excluding the Saucedá source, a negative linear relationship exists between the log transformations of source proportion and distance. The Pearson Correlation coefficient for this relationship is -0.87 with a significance of 0.02. Distance to the source appears to be the primary barrier for the movement of these two obsidian types within the study area, and the steep fall-off curve is consistent with down-the-line exchange

within the community (Kooyman 2000:139). These data provide evidence for socioeconomic cooperation within the study area.

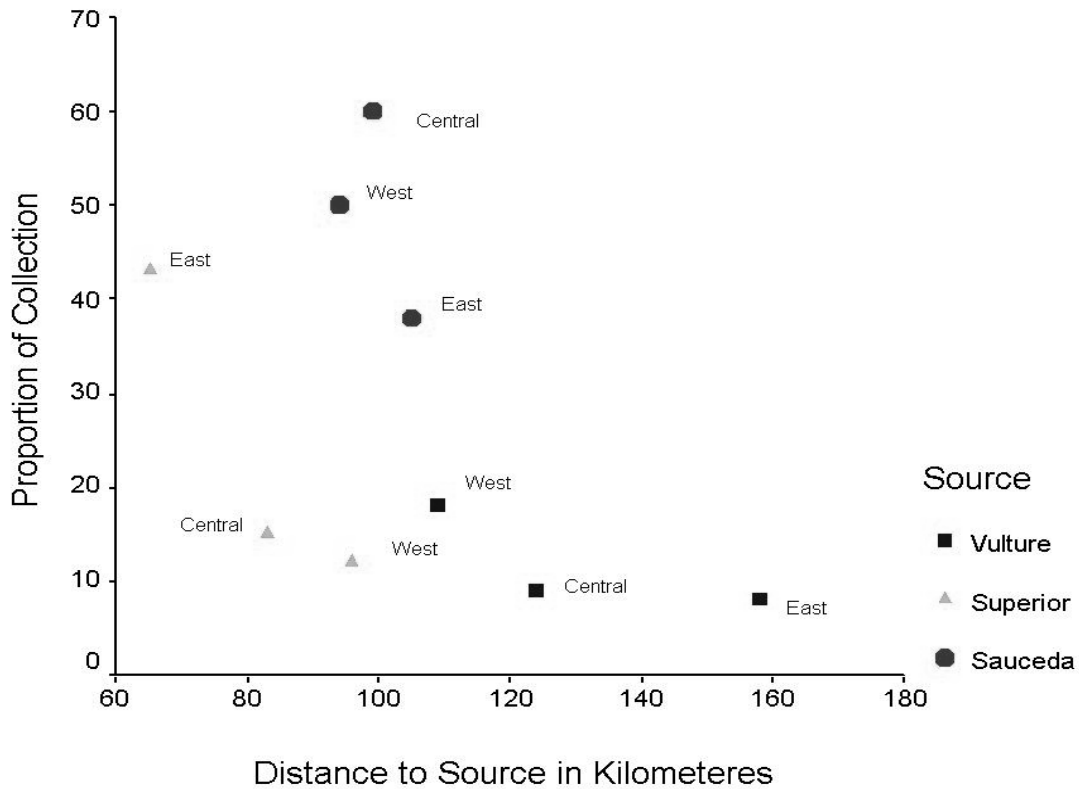


Figure 6.32. Obsidian proportion by geographical area in the GRIC (East, Central, and West) and distance to the source, P-MIP Survey Collection, Gila River Indian Community.

Several temporal trends are also apparent in these data. P-MIP survey artifacts suggest that the dependence on Saucedada obsidian increased over time, with the highest incidence occurring in the Historic period (Loendorf et al. 2004). This possibility is also supported by the observation that obsidian artifacts in the sample from the Historic period Sacate site are almost exclusively from the Saucedada source: 13 of the 14 analyzed samples are Saucedada obsidian, and the

remaining artifact is from Los Vidrios, which is located further to the south in Mexico. The proportion of Saucedá obsidian along the lower Salt River also increased over time, and this trend toward greater reliance on southern sources appears to have occurred throughout the Hohokam area (Marshall 2002:132-133).

At the same time, use of obsidian from the Superior source declined after the Pre-Classic period. For example, data from Grewe (a large Pre-Classic period village) and Casa Grande (a nearby Classic period site) show that a dramatic decline occurred in the use of Superior obsidian during the Classic period (Bayman and Shackley 1999). At 60 percent Superior obsidian was also the most common material identified at the Pre-Classic period, Snaketown site located within the GRIC (Shackley and Bayman 2006). A similar pattern occurs in the Tonto Basin, where the use of Superior obsidian also declined between the Early and Late Classic period (Rice et al. 1998).

Vulture obsidian utilization may have peaked during the Classic period in the GRIC, when it comprises 18 percent of the survey sample. Previous examination of sites along the lower Salt River shows a slight increase in the use of Vulture obsidian during the Classic period; however, this material is substantially more common during both the Pre-Classic and Classic periods along the lower Salt River than it appears to be in the study area (Marshall 2002; Mitchell and Shackley 1995; Peterson et al. 1997). The western portion of the P-MIP survey area is closer to the Vulture obsidian source than are sites in the core of the lower Salt area, but only 7 percent of the obsidian from the western part of

the GRIC was derived from the Vulture source, whereas this material constitutes roughly 30 percent of the overall lower Salt collection (Marshall 2002). These observations suggest that proximity to the source alone does not fully account for differences in the utilization of Vulture obsidian; it appears that people along the Salt and Gila Rivers maintained different trade relationships during the Classic period.

Classic Period Regional Obsidian Source Patterns

This section uses Classic period obsidian data to examine patterning in social interactions. Periods of low stream flows may cause conflicts to arise among upstream and downstream users of water (Rice 1998b). One way to avoid disagreements that result from disputes over limited resources is to develop social institutions that mitigate these stresses. For example, regular social activities such as ballgames can be used to bring people from different communities together and relieve stress through non-violent competition (Wilcox and Sternberg 1983:184). These social events also create opportunities for social and economic interactions among communities (Abbott et al. 2003:13; Abbott et al. 2007). Exchanging food for other items provides a mechanism for redistributing water dependent resources, which further ameliorates stresses caused by water shortages.

Figure 6.33 is a cluster analysis dendrogram for Classic period obsidian frequencies. The analysis employed a Squared-Euclidian distance measure and Ward's method. At the two-cluster solution level, all Salt River Basin sites are in one cluster, whereas all sites in the Gila River Basin are in the second. Although

some GRIC sites occur in close proximity to the Lower Salt sites, obsidian proportions differ substantially between sites along the two rivers (Loendorf 2008b). At the same time, the Tonto Basin is more than 80 km away from the lower Salt over difficult terrain, yet it has similar obsidian proportions. These data suggest that socioeconomic ties among communities were strongest among people who were dependent on the same water sources.

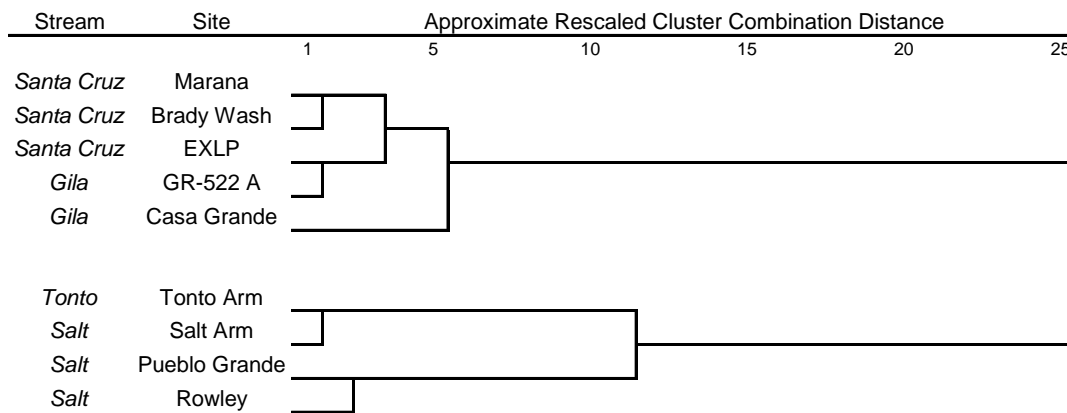


Figure 6.33. Cluster analysis dendrogram (Squared-Euclidean distance measure and Ward's method) for Classic period obsidian data.

In summary, within the study area direction of the source has a substantially greater effect than absolute distance on raw material utilization. If people traveled to sources themselves in order to obtain obsidian, then distance should be the primary barrier for the acquisition of the material; however, obsidian proportions for the most common source are very weakly correlated with distance. Observations also suggest that prehistoric people in the lower Salt Basin, Middle Gila, Casa Grande, and the two arms of the Tonto Basin maintained

different trade contacts. Data suggest that by the Late Classic, little obsidian was transferred between adjacent subregions. Instead communities of sites received most of this raw material from distant areas in different directions.

Patterning in obsidian acquisition suggests that the strongest socioeconomic ties among communities were those between sites located on the same rivers. Variation in source utilization patterns among these locations supports the argument that the Classic period Hohokam were not a politically centralized or economically integrated entity. Use of the closest source, Superior, decreased dramatically over time from the Pre-Classic to the Classic period. While Saucedá obsidian, which is located to the southwest of the core area, became the main supply of obsidian by the Late Classic and this trend appears to have continued into the Historic period. This continuity of trends between the Classic and Historic periods provides another example of the link between the Hohokam and the Akimel O'odham.

This tendency for greater reliance on obsidian sources located to the southwest of the middle Gila culminated in the Historic period, and Saucedá obsidian may have become nearly the exclusive source. The movement of Apache and Yavapai populations would have cut off access to northern, western, and eastern sources including the San Francisco Volcanics, Vulture, and Superior obsidian. Meanwhile, alliances between the Tohono O'odham (i.e., Papago), and the Pee Posh (i.e., Maricopa) allowed continuing access to raw materials to the

southwest of the GRIC. These observations are consistent socioeconomic interaction patterns described in ethnographic research presented in Chapter 5. Figure 6.34 shows Historic period Native American territories and obsidian locations. Saucedá is the only obsidian source located within an area occupied by speakers of the same language as the Akimel O'odham. The observation that the decline in the use of obsidian from northern, western, and eastern sources began during the Classic period, suggests the possibility that foragers such as the Apache and Yavapai moved into southern Arizona earlier than has traditionally been assumed. Most researchers have argued that the Apache did not arrive in southern Arizona until after the end of the Classic period around roughly A.D. 1450. For example, Hodge (1895) analyzed ethnohistorical population descriptions, Historic period settlement patterns, as well as Navajo and Akimel O'odham creation stories and concluded that the Apache were not in southern Arizona before the late 1600s. More recently, Doyel (1978:201) said the "feeling is that the Apache were probably not in the area [in the vicinity of the Superior obsidian source] before A.D. 1500". Whittlesey et al. (1997:185) completed an extensive review of the archaeological data and concluded that Athapaskan, Yuman, and Numic speakers established themselves in the Southwest after A.D. 1450. Based on analyses of several cultural traits suggested to be associated with the Athapaskan populations, Baldwin (1997) argued that Apache moved into the Pueblo area of the Southwest after A.D. 1400, which is one of the earliest dates previously suggested for the arrival of Apache populations in Arizona.

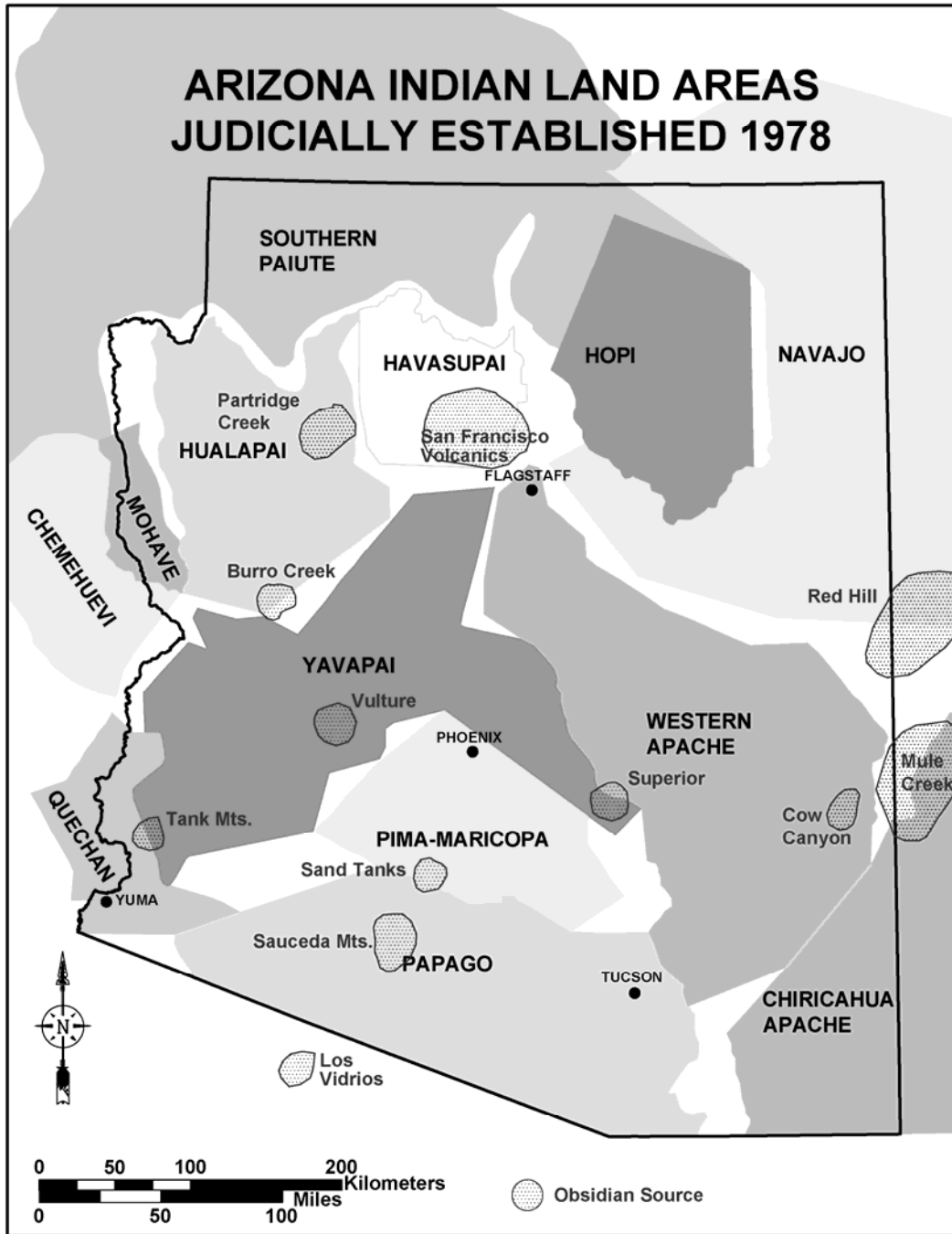


Figure 6.34. Obsidian source locations and judicially established tribal territories.

Chapter Summary

The spatial distribution of Historic period projectile point types closely corresponds with independent lines of evidence for settlement patterns at this time, including ceramics and ethnohistorical descriptions of Akimel O'odham village locations. These data indicate that Casa Blanca area was a focal point for the coalescence of populations that formerly lived throughout much of the Sonoran Desert. Casa Blanca is located on the south side of the middle Gila River at the center of the study area, a location that is immediately opposite Snaketown, which is one of the largest Pre-Classic sites in the region. These data also suggest that Sobaipuri groups, probably from the San Pedro and Santa Cruz Rivers, were one of the peoples who immigrated to the study area during the Historic period.

Classic period platform mound and ceramic data suggest that habitation was most densely concentrated on the north side of the river at this time. Highly similar point types were made during the Classic and Historic periods, and as Ravesloot and Whittlesey recognized in 1987, this has complicated the identification of distinctive Historic period types. At the same time, this continuity in point design is also an example of the continuation of material cultural traditions from the prehistoric to the Historic periods.

Point data patterning at a range of scales from study region wide patterns, intra-site differences, and variation within individual features are consistent with the hypothesis that stone points generally became smaller over time (Shott 1996). These data suggest that in addition to shape, point size may be a useful indicator

of age for these artifacts. This hypothesis is of particular importance in regions such as the study area where some point shapes were produced for thousands of years. Furthermore, the ability to recognize any remains left behind by highly-mobile hunter-gather groups who only rarely produced diagnostic ceramics is of considerable importance. These analyses suggest that while it is not possible to precisely suggest ages for individual artifacts using size alone, significant variation in point weight is present between the Classic and Historic period assemblages considered here. Although these investigations do not prove that the projectile point size hypothesis is correct, they do suggest it warrants further testing.

Projectile point metric data from the study area are consistent with expectations for warfare and hunting point designs that were presented in Chapters 4 and 5. Furthermore, the spatial and temporal distribution of warfare and hunting point designs is coherent with other lines of evidence including faunal data, and ethnohistorical descriptions of conflict along the middle Gila that were presented in Chapter 5. These data suggest that the intensity of conflict generally increased over time along the middle Gila, and rather than reflecting population migrations, the complete disappearance of side-notched points at some Historic period sites such as Sacate is the result of a decrease in big-game hunting opportunities at this time.

These diachronic changes in projectile point design suggest that the incidence of big-game hunting generally decreased over time in the study area,

and that by the end of the Historic period, people only occasionally hunted large animals. This is consistent with the observation that Classic period side-notched projectile point types are present within the classification scheme, while the types thought to be from the Historic period are all unnotched. Both the decline in points designed for hunting (suggesting greater circumscription of populations with less access to favorable big game habitats away from villages; Kozak and Lopez 1999:43), as well as the increased incidence of warfare point designs suggest that the intensity in conflict increased over time from the Classic to the Historic periods along the middle Gila River.

Projectile points from the Casa Blanca area that were made throughout the archaeological sequence were rarely serrated. In contrast, projectile points from the north, east, and west of Casa Blanca more commonly had this form of edge treatment. This variation also suggests that different social groups existed in the study area, and these people were not a politically centralized entity. Because Casa Blanca area projectile points regardless of type or size have a lower incidence of serration, these data suggest long-term continuity in the cultural traditions of people who lived in the area, which is another example of the link between Hohokam and Historic period populations.

Obsidian data suggest that interaction pattern trends that began during the Classic period continued into the Historic period, which also suggests continuity in cultural practices over time in the study area. Obsidian data suggest that socioeconomic ties were strongest among people who were dependent on the

same water sources, and exchanging food for items such as obsidian may have provided a mechanism for redistributing water dependent resources. Decline in the use of obsidian from sources located in Yavapai and Apache Historic period territories began during the Classic period, which suggests these people may have moved into these areas beginning in the Late Classic period. The next chapter explores broader implications of this possibility as well as other patterns identified in this chapter.

CHAPTER 7: CORPORATE-NETWORK POLITICAL STRATEGIES

The previous chapters presented several lines of ethnohistorical and archaeological data that suggest cultural continuity existed between the Classic and Historic periods along the middle Gila River. At the same time, substantial alterations in material culture occurred between these two periods, and similar episodic transitions in archaeological remains have been documented earlier in time. Indeed, it is these punctuated differences in material culture that researchers have long used to define “periods” (i.e., Paleo-Indian, Archaic, Pre-Classic, and Classic) in the prehistoric archaeological record. However, why these episodic alterations occurred remains less understood.

This chapter explores the possibility that these periodic changes reflect human economic, political, social, religious, and technological responses to constraints that resulted from climatic oscillations between warmer and colder regimes. The focus of this discussion is on political changes, which are described using the concept of *corporate-network* strategies developed by Blanton et al. (1996). This model provides insight to dimensions of social organization that depart in fundamental ways from the traditional anthropological classifications of egalitarian versus hierarchical. After summarizing the Blanton et al. (1996) model, this theory is applied to Pre-Classic, Classic, and Historic period material culture records from the Phoenix and Tonto Basins of Central Arizona.

Corporate-Network Conceptual Model

Social complexity remains one of the most acrimoniously contested topics among Southwestern archaeologists. Until the 1980s, most of the dispute revolved around the existence of complexity, with one group arguing that Southwestern societies were egalitarian and another that they were hierarchical. “This debate regrettably became adversarial and was characterized by arguments that presumed a polar dichotomy between hierarchical and nonhierarchical political formations” (Feinman et al. 2000:450).

After this time archaeologists recognized that social organization is a multi-dimensional phenomenon, with multiple aspects that do not necessarily vary in concert (Nelson 1995). By the late 1990s, a certain measure of consensus was reached that status and ranking were largely related to ceremonial authority; however, like most things in archaeology, the argument was never fully resolved (Kintigh 1998).

Feinman et al. (2000) introduced the concept of *corporate-network* strategies to this debate. Blanton et al. (1996) developed this conceptual model through the study of Mesoamerican societies. According to Feinman et al. (2000:453), “[t]he network strategy of political action is associated with heavily personalized or centralized forms of leadership. Wealth is concentrated in the hands of a few, who use their network of personal connections to enhance and expand their individualized power and authority”. In contrast, the corporate conception shares similarities with Johnson’s (1989) characterization of

sequential hierarchies, and “[i]n corporate organizations, economic resources are more dispersed, leadership is less personalized, and ostentatious displays and individual aggrandizement are less apt to be found” (Feinman et al. 2000:453).

These two forms of organization are not a replacement for the concepts of egalitarian and hierarchical, but instead are orthogonal to this dimension such that stratified societies can have network or corporate organizational strategies. Rather than being a binary variable, corporate and network forms are recognized to lie along a continuum, and it is unlikely that either of the two extremes would ever occur in societies. Feinman et al. (2000:465) concluded that Southwestern political formations varied through time along the two dimensions of *corporate-network* strategies and hierarchical differentiation. They also identified at least two major episodes of political change in the Puebloan Southwest.

Corporate-Network Strategies in Sonoran Desert

Discussing political organization in the Hohokam region of southern Arizona requires addressing a number of interrelated issues; however, the primary data that archaeologists have to analyze are nonperishable material culture, and furthermore most of these remains are items that were discarded. The relationship between material culture and social organization is a complicated one, in part because multiple factors in addition to the many facets of social complexity may condition diachronic or synchronic variation in the limited data preserved at sites. In the following discussion, I marshal as much of the ethnographic, ethnohistorical, and archaeological information as possible.

I begin with what the people who were living along the middle Gila at the time of Spanish contact say about themselves. The Akimel O'Odham worldview involves an inception, over-population and breakdown of traditional practices, then subsequent destruction; the cycle then repeats. This paradigm differs fundamentally from the assumption that prehistoric populations increased slowly and steadily over time. The Akimel O'Odham story instead says that the population fluctuated dramatically over time. This possibility has important implications for the interpretation of variation in material culture and social organization in Central Arizona.

The O'Odham conception is similar to Hopi traditions, which also describe a cycle of creation and destruction, but there are substantial differences. One fundamental distinction is that the cycle in Hopi reasoning involves the creation of different worlds with essentially the same creatures continuing through time, while the O'Odham beliefs emphasize the creation and destruction of people while essentially the same world continues through time. The Hopi believe this cycle involves the movement between "worlds" with people physically leaving one world and traveling to the next. In each cycle the creator of the world becomes unhappy with the transgressions of some people so he creates a new world for the few righteous beings from the previous land (e.g., Waters 1963). Basically, the continuity of place is emphasized in the O'Odham story, while the continuity of people and migration are more important in the Hopi traditions.

Akimel O'Odham Creation Story

Rather than a narrative that has historical meaning, the Akimel O'Odham creation story has been regarded as an invention or myth these people made up to explain the existence of the world (Russell 1908:206). For example, Curtis (1909:284) said:

The Pima claim to have lived always in the Gila valley, their lands stretching along some sixty miles of its length. They farm by irrigation and likely had canals larger and longer than other tribes. The very large prehistoric canals which formed a part of the development, with the building and occupancy of the Casa Grande and other like large prehistoric ruins, are in the country of the Pima. In their legends they account for these ruins and ditches and claim them as the work of Pima.

There is, however, little to encourage this claim.

Examination of this story, however, suggests it has close parallels with the archaeological record that are unlikely to have occurred by coincidence (Lewis and Rice 2009; Teague 1993). McIntosh (2000) introduced the term "social memory" to describe the communal, multigenerational knowledge of the environment and biocultural dynamics possessed by a society. McIntosh (2000) argued that deep-time motivations based on social memory are potentially verifiable by archaeologists. He maintained it is irrelevant whether social memory is correct in all particulars, and it is clear that this knowledge "is integral to an

ancient social construction, or social perception, of the dynamics of the physical environment” (McIntosh 2000:173).

The Akimel O’Odham social memory describes a cycle in which humans are created and destroyed by their paramount deity. While there are many recorded versions of the creation story, they all share the same basic structural elements (Bahr et al. 1994; Bahr ed. 2001; Bahr 2007; Baker 1973; Farish 1916; Fewkes 1912; Grossman 1873; Lloyd 1911; Russell 1908; Shaw 1995; Thomas 1917; Webb 1959:90-126). For this discussion, I refer to the version written by Russell (1908:206-230).

The story begins with *Earth Doctor* creating the world and humankind, but the people rapidly became too numerous and started eating each other, so *Earth Doctor* destroyed his creation. He then made different people, but in contrast to the previous cycle, a new supernatural being (*Elder Brother*) entered the picture at this time. “The people increased in numbers, but *Elder Brother* shortened their lives, and they did not overrun the earth as they had done before” (Russell 1908:209). This, however, did not satisfy *Elder Brother* and he decided to destroy the people *Earth Doctor* made. The story specifies this act of destruction was a flood. Before the flood, *Earth Doctor* helped some people escape through a hole in the earth, and he directed others to a high place above the floodwaters.

After traveling back from the distant locations where the water carried them, *Coyote*, *Earth Doctor*, and *Elder Brother* reunited. They agreed that *Elder*

Brother was first to emerge and he was therefore “the ruler of the world” (Russell 1908:213). They traveled again until they found the center of the world, and the three of them made new people and animals. *Coyote* created web-footed animals, snakes, and birds that *Elder Brother* said to throw into the water. *Earth Doctor* made creatures resembling human beings, but they were deformed. *Elder Brother* told *Earth Doctor* to put his creations in the west, after which *Earth Doctor* sank into the ground leaving sickness behind him. *Elder Brother* then made four groups of people, the second of which became the Apache.

After a series of more detailed events, the people decided to kill *Elder Brother* because he had become mischievous. After three attempts (he revived each time) they enlisted the help of *Vulture* for a fourth try, but *Elder Brother* still was not destroyed. In retaliation, he sank into the ground and resurrected the people who *Earth Doctor* had previously helped escape (i.e., people from before the flood), who proceeded to attack and defeat one by one the platform mound villages along the Salt and Gila Rivers.

Each village is associated with a specific named individual, such as *Morning-Blue* for Casa Grande, and *Elder Brother* himself is connected with a particular platform mound. During the conquest, the mound leaders tried to defend themselves by causing wind storms and other mostly weather related phenomena. After completing the destruction, the people from before the flood continued moving with *Elder Brother* and then eventually returned to the middle Gila River.

So what do we have? This version of the creation story (others have more or fewer cycles of creation and destruction) indicates: 1) A creation and vague destruction; 2) A re-creation and subsequent destruction by flood; 3) A third creation followed with a conquest by people who lived there before the flood; 4) The creation of the Apache and other non-O'Odham people after the flood, but before the conquest; 5) A story that associates named leaders with specific communally constructed architecture; 6) Leaders who lived at these platform mounds were believed to control the weather and other forces; 7) People moved across the landscape during episodes of destruction.

Prehistoric Climate

Some anthropologists reject the kind of arguments presented in the following discussion as “ecological determinism”. This is in part because human beings can (and are likely to) respond to the same natural events in different ways. For example, some people might react to a catastrophic flood by moving, others could change their social organization to facilitate the increased labor necessary to maintain previous agricultural practices (Waters and Ravesloot 2001:292), and many might simply die. I argue that all of these responses (and others) may have occurred, and I agree that environmental conditions do not *cause* cultural practices. Environmental factors, however, constrain human behavior and it is the responses of individuals to those changing limits that we can see in the archaeological record.

The study area lies at the junction of the Salt and Gila rivers. “Owing to differences in the topography and elevation of the two drainage basins, and thus to the manner in which climate affects precipitation and discharge, the Salt and Gila differ markedly in discharge volume” (Graybill et al. 2006:82). “Annual discharge of the Salt River is determined primarily by winter precipitation in the upper reaches of the watershed” (Graybill et al. 2006:83). “By contrast, Gila River discharge reflects a much more substantial contribution from summer convective rainfall (monsoonal) component than Salt River discharge” (Graybill et al. 2006:85). Based on differences in reconstructed stream flow patterns between the rivers, Graybill et al. (2006:107) argued, “...there may have been substantial long-term differences in the timing and magnitude of labor requirements and in the reliability of foodstuffs derived from irrigation farming” along these two rivers.

These stream-flow data are based on dendroclimatology records that are largely derived from trees growing in the upper portions of the watersheds for the streams, and consequently these reconstructions do not accurately reflect the contribution of flows from summer convective rainfall (Graybill et al. 2006). Another major weakness of the stream-flow data is that it is not possible to determine the configuration and discharge capacities of the river channels (Ravesloot et al. 2009:239). However, geoarchaeological investigations undertaken along the middle Gila River have reconstructed the alluvial history of the river (Waters and Ravesloot 2000, 2001). These investigations have provided

data that are critical for understanding the development and organization of irrigation communities that were dependent on the two rivers (Raveslout et al. 2009:238). The studies demonstrated “that after 750 years of floodplain stability and a predictable stream-flow regime, Hohokam farmers had to contend with a major environmental catastrophe” (Raveslout et al. 2009:238). This major sedimentological change (i.e., down-cutting event) occurred sometime between A.D. 1020 and 1160.

LeBlanc (1999:32-36, 2003:147-149) argued that a long-term worldwide climatic cycle between warmer and colder conditions over the last 2000 years affected Southwestern agricultural populations. Although the exact timing and local effects of these oscillations remain uncertain, LeBlanc (1999:33) suggested “...any change in temperature could have had major effects in Southwestern crop yields, not only in higher elevations but also in lower ones”. Dean (2000:97-101) synthesized paleoclimatic data that show low-frequency and high-frequency climatic change over the last 2000 years on the Colorado plateau in Arizona, and identified intervals of potential environmental stress. He (Dean 2000:101) argued that the period between A.D. 900-1130 was the most favorable interval for irrigation agriculture in the last 2,000 years. This long period of stability roughly coincides with the Hohokam Sedentary period. These extended favorable conditions may have resulted in population increases, which may have made groups more susceptible to subsequent climatic events. Following Dean (2000), Lekson (2002) examined dendroclimatology records for the Southwest and

identified patterns of “high temporal variability” in resource availability that he associated with cycles of conflict and variation in settlement patterns. Based on his analysis, Lekson (2002) concluded that war in pre-state societies is predicated by resource unpredictability and socialization for fear.

More recently, Mayewskia et al. (2004) examined nearly 50 globally distributed paleoclimate records and identified as many as six episodes of rapid climate change during the Holocene. Most of these climate change events were characterized by polar cooling, tropical aridity, and major atmospheric circulation changes. However, during the most recent interval (600–150 cal yr B.P.), polar cooling was accompanied by increased moisture in some parts of the tropics. They found that several of these intervals coincide with major cultural disruptions, and they argued that Holocene climate variability had substantial effects on human populations. Mayewskia et al. (2004) concluded that the periods of rapid climate change are generally characterized by bipolar cooling and an intensification of atmospheric circulation in the high latitudes and drying aridity at low latitudes. When the poles cool and polar atmospheric circulation intensifies, the low latitude band of atmospheric circulation may be compressed. This may dramatically alter the distribution of moisture bearing winds in the monsoon regions of the world and the carrying capacity for moisture in the atmosphere.

If these climatic oscillations suggested by Mayewskia et al. (2004) affected summer and winter precipitation patterns in southern Arizona, then given

the differences in the hydrology of the two streams, periods of good conditions for agriculture on the lower Salt River would alternate with more favorable conditions for irrigation along the middle Gila River. This possibility may have affected the cultural practices of the irrigation agriculturalists that lived along these streams in the Hohokam core area (Grebinger 1976).

Pre-Classic to Classic Transitional Period

The down-cutting event identified by Raveslout and Waters (2000, 2001) that occurred between A.D. 1020 and 1160 corresponds roughly with the Pre-Classic to Classic transition, and the “duration of this event was probably less than the 80-year error range of the associated radiocarbon dates” (Raveslout and Rice 2004). This event occurred close to when LeBlanc (1999:35, 2003:147-149), Dean (2000:102), and Lekson (2002) suggest a transition in climatic patterns occurred. Material cultural changes that happened at this time within the Hohokam core area include a shift in settlement patterns, pit houses were replaced by surface structures, red-on-buff ceramics became less common (Figure 7.1), Salado polychromes appeared (Figure 7.2), ballcourts were no longer built, platform mounds were constructed, and production stopped of some items (e.g., palettes and censers, Figures 7.3 and 7.4) that appear to be associated with religious activities (Haury 1976:286-289).



Figure 7.1. Pre-Classical red-on-buff bowl collected from GR-915 (Photograph by Melissa Altamirano).



Figure 7.2. Gila polychrome bowl collected from the Tonto Basin, Roosevelt Platform Mound Study, Arizona State University (Photograph by Brenda Shears).



Figure 7.3. Palettes from Pre-Classic components at GR-441, Locus A, GRIC (Photograph by Melissa Altamirano).



Figure 7.4. Greenstone effigy censer collected from GR-520, GRIC (Photograph by Melissa Altamirano).

The down-cutting event would have made irrigation more difficult (Waters and Ravesloot 2001), which when combined with a shift in regional precipitation patterns, may have made some people respond by moving to locations along the Salt River and possibly other areas. Few researchers have considered the possibility of migration away from the Hohokam core area, but the Zuni area is one possible location where people traveled. Based on linguistic research, Shaul and Hill (1998:377) argued "...that Zuni speakers may have been part of the Hohokam system during the Classic period in the fourteenth century". Similarly, Teague (1993) identified communalities in both the languages and ceremonial practices of the Zuni and the O'odham (see also Fewkes 1912:46 footnote).

Movement away from the Gila is considered likely because during the Pre-Classic period, conditions were less favorable along the Salt River and population densities would consequently have been lower providing a "pull". Furthermore, Waters and Ravesloot (2001) argued that aggregation occurred in response to the down-cutting event because of the increased labor necessary for irrigation (Ravesloot 2007; Ravesloot et al. 2009). Similarly, Ingram (2008:137) in his study of Canal System 2 along the lower Salt found that "population growth rates generally increased as the frequency, magnitude, and duration of inferred flooding, drought, and variability increased".

Haury (1976) argued that the largest Sedentary site (i.e., Snaketown) along the Middle Gila was abandoned at the end of the Pre-Classic. Wilcox and

Sternberg (1983:198-203) suggested that Snaketown was the paramount regional center within the Phoenix Basin during the Pre-Classic, and they thought that the population might have declined along the middle Gila during the Classic period, while it continued to increase along the lower Salt. While there are 28 Pre-Classic period ballcourts within the study area including sites with multiple ball courts, during the Classic period only six comparatively small platform mounds were built the same area (Ravesloot and Rice 2004; Rice and Ravesloot 2003, Figure 7.5). In contrast over 40 mounds (including by far the two largest examples) occur along the lower Salt River, and 26 mounds are present in the Tonto Basin, a location that has far less land that can potentially be irrigated than the middle Gila and also lacks any ball courts (Abbott et al. 2003:12; Elson 1998:102; Marshall 2001).

Ceramic and mound data presented in the previous chapter suggest that the Classic period population in the study area was most concentrated in Santan-Snaketown region, and there is evidence for population decline even within this portion of the GRIC. Based on the P-MIP survey data, Ravesloot (2007:95) reported both a decrease in the area that was potentially irrigated within Santan-Snaketown canal system during the Classic period, and at the same time the average irrigated acreage per settlement with public architecture more than doubled. Within this area there are seven Pre-Classic sites with ten ball courts, but just three settlements had platform mounds during the Classic period (Ravesloot 2007:95).

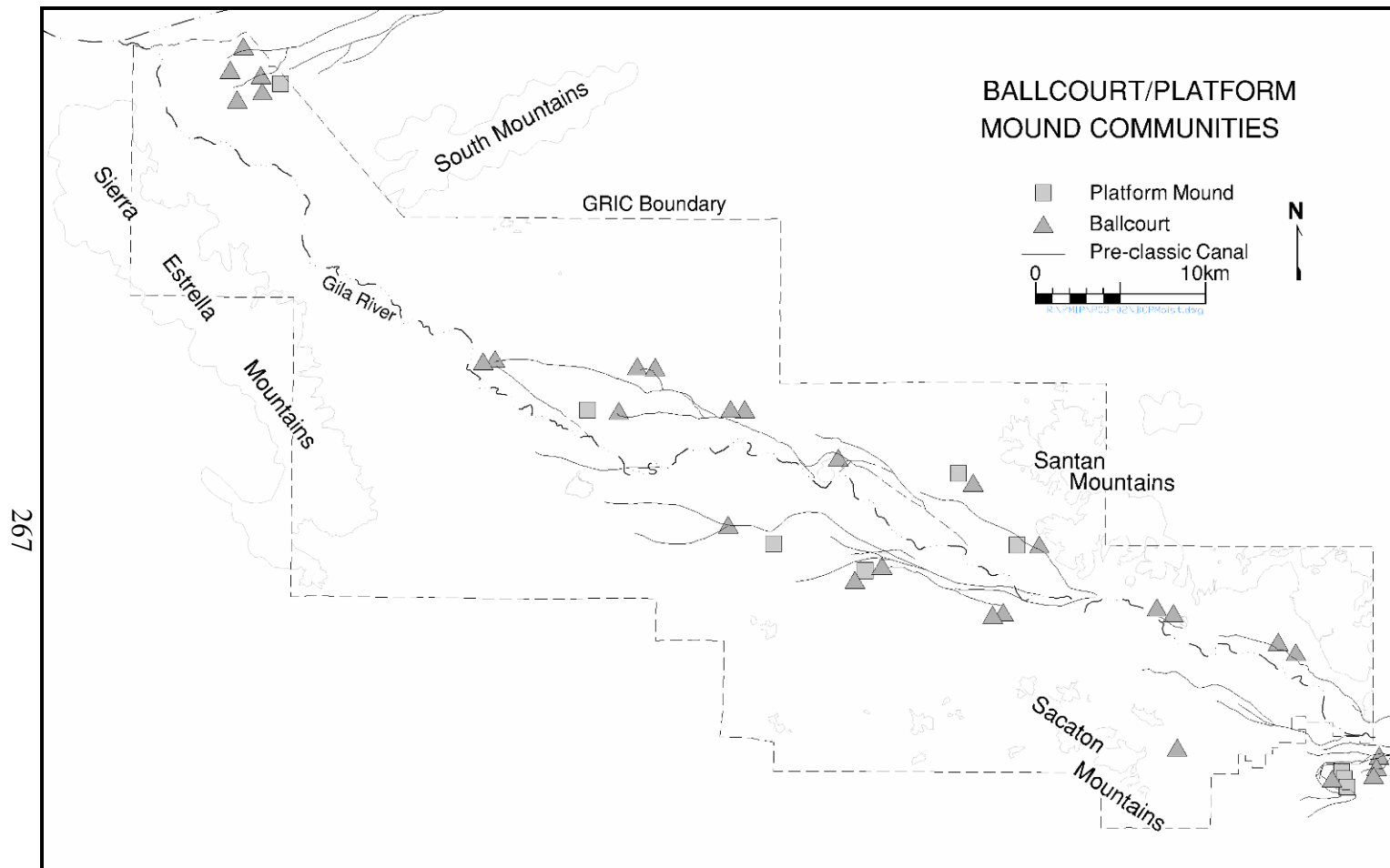


Figure 7.5. Ball court and platform mound locations within the study area (adopted from Raveslout and Rice 2004; Rice and Raveslout 2003).

At the same time, there is considerable evidence for population growth along the Salt River during the Classic period, including sites such as Pueblo Grande, which experienced a two- to threefold increase (Abbott and Foster 2003), and in the Tonto Basin (Doelle 1995, 2000; Oliver 1997:470). At Pueblo Grande, for example, Abbott and Foster (2003:46) identified a large influx of people at the start of the Classic period, “as entire residential groups newly rooted themselves at the margins of the village”. In a recent review of extensive excavation data, Ingram (2008) found evidence that immigration occurred in Canal System 2 along the lower Salt during the Classic period. Reconstructions for the entire Lower Salt River Valley have suggested that the overall population of the area increased from the Sedentary to the Classic periods (Doelle 2000; Hill et al. 2004; Meegan 2009). This population reorganization is expected to have altered economic, political, and ideological relationships within Hohokam society. Existing populations along the Salt would have been in a position to dictate conditions for allowing people from the Gila or elsewhere to settle near their homes. This is analogous to how the Hopi Bear clan achieved its position at the top of their hierarchy by maintaining access to the best lands and most “important” ceremonies for itself (Levy 1992).

Rather than resulting from the migration of outside ethnic groups, the architectural changes that occurred are consistent with responses to variation in the raw materials available for construction and a shift in performance requirements resulting from changed climatic conditions. Pre-Classic pit houses (Figures 7.6) were built largely of wood and frequently had multiple support

posts, whereas late Classic adobe structures (Figure 7.7) used no wood in the walls and commonly only had one main roof support post (Haury 1976:46-74; Rice 2003). The down-cutting event destroyed riparian habitats along the Gila and Salt Rivers, which eliminated many of the trees in the area (Waters and Ravesloot 2001:292). As the Hohokam concentrated in locations along the Salt River and Tonto Creek, they would have rapidly depleted remaining trees (Kwiatkowski 2003:67). In most areas house styles that used progressively less wood were built over the course of time (Abbott and Foster 2003:26-30; Craig et al. 1992:38-49; Ezell 1961:49; Rice 2003; Sayles 1938:79-80).

Pit houses and surface structures do not have equivalent thermal characteristics, and climatic conditions may also have also played a role in the construction of different house types (Gilman 1987). For example, Craig (1995) identified a tendency for the number of contiguous rooms to increase over time during the Classic period, a pattern also noted by Haury (1976:48). Building structures with shared walls both decreases the construction materials required, and also reduces the overall thermal energy loss for individual rooms. This would have facilitated the heating of structures with the limited fuels that were available.

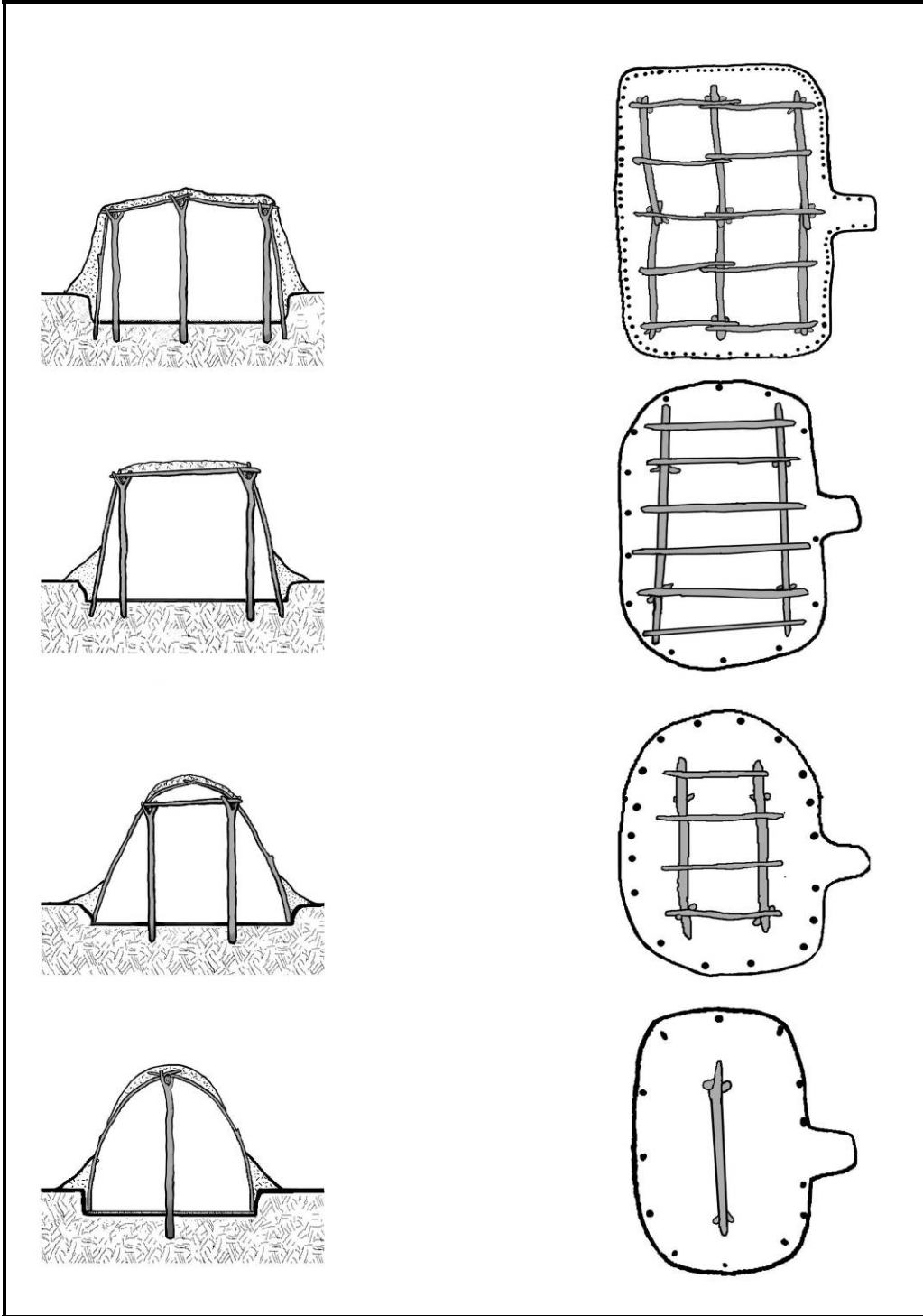


Figure 7.6. Possible techniques used in construction of Pre-Classic period Hohokam pit houses. Not to scale (adopted from Rice 2003 by Rob Ciaccio).

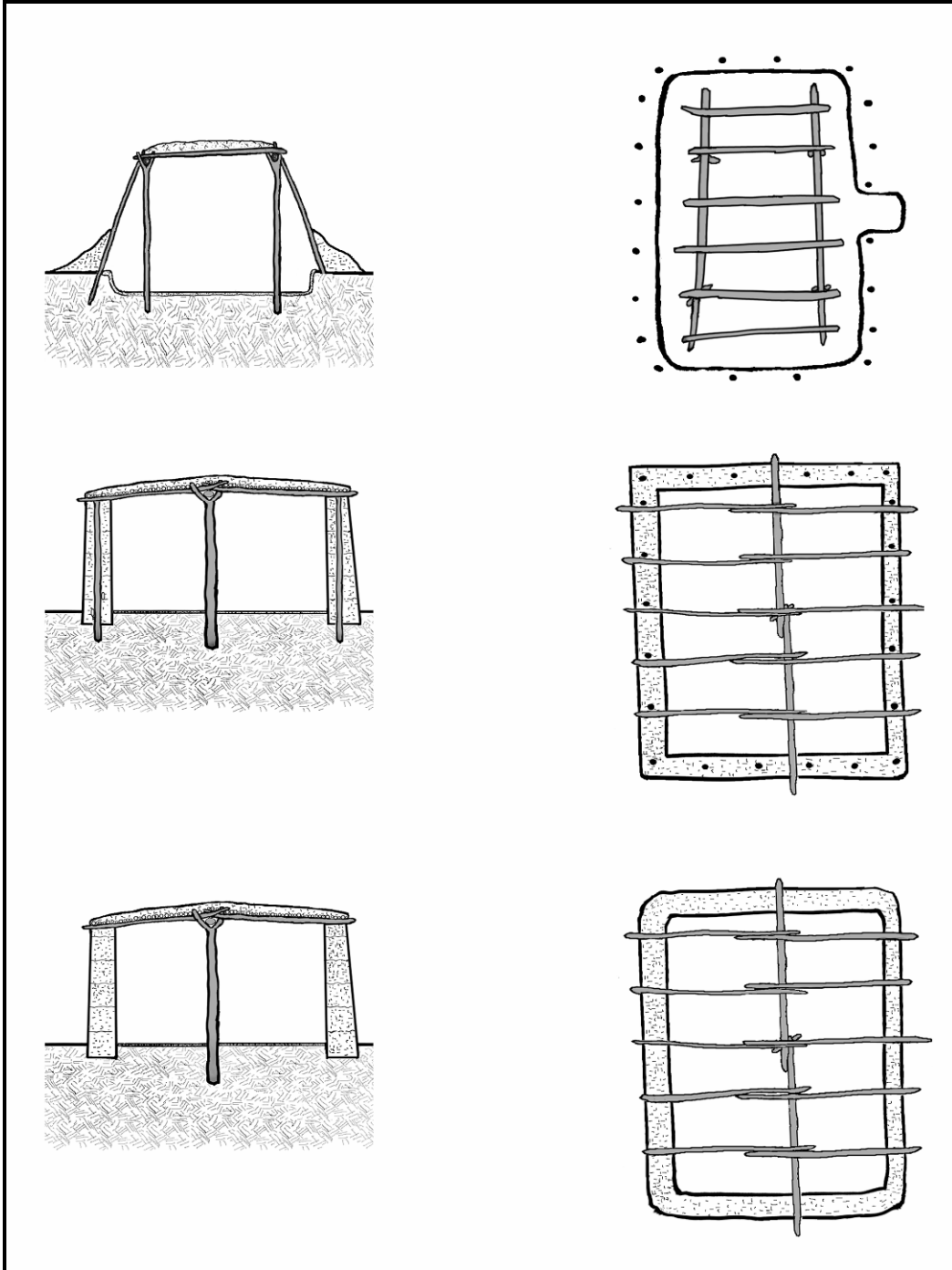


Figure 7.7. Possible techniques used in construction of Classic period Hohokam structures. Not to scale (adopted from Rice 2003 by Rob Ciaccio).

Furthermore, macrobotanical evidence suggests fewer trees were locally available along the lower Salt and in the Tonto Basin during the Classic period (Elson 1995:259; Kwiatkowski 2003:57). Faunal data including patterning in cottontail/jackrabbit ratios also suggests less cover existed in lower elevations during the Classic period (Bayham and Hatch 1985; James 2003). The shift from cremation to inhumation that occurred between the Pre-Classic and Classic periods is also consistent with a response to constraints imposed by the limited availability of fuels for cremation fires (Loendorf 1998:199-200). Although it is unlikely that the scarcity of cremation fuels alone would cause the alteration of mortuary traditions, it is possible that environmental constraints favored the adoption and/or development of beliefs that ameliorated stresses that resulted from an inability to complete previous ceremonies.

The disappearance of palettes and censers (Figure 7.8) also suggests changes in religious practices occurred at this time, which is reflected by the replacement of *Earth Doctor* by *Elder Brother* after the flood. The appearance of Salado polychromes during the Classic period (Figure 7.9), which Crown (1994) argued were part of a regional cult, also suggests a change in religious practices. Abbott (2000, 2009) argued that Pre-Classic red-on-buff ceramics were largely made along the middle Gila instead of the Salt River. The rapid decline of buffware proportions at Classic period sites is thus consistent with population loss along the middle Gila.

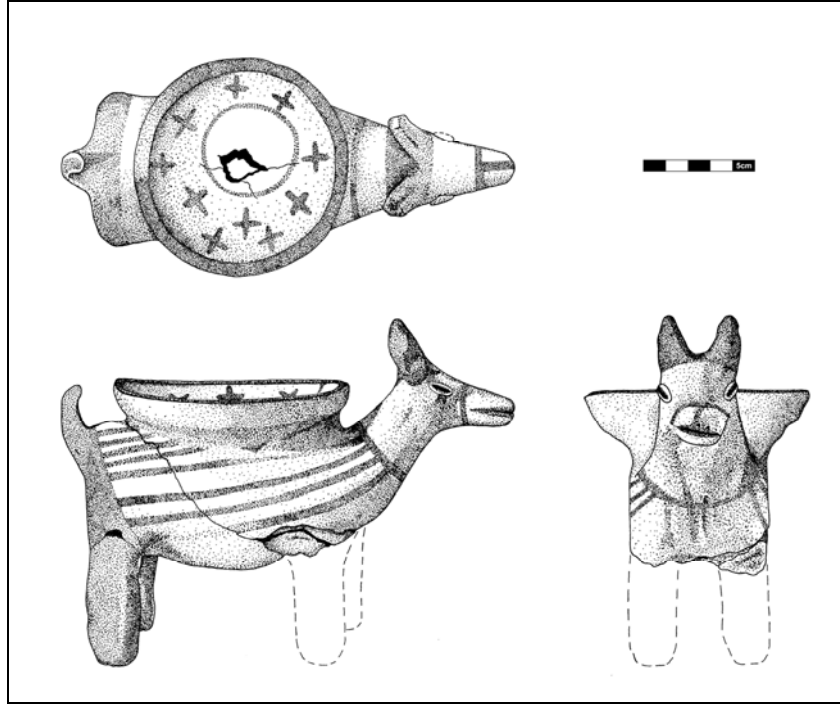


Figure 7.8. Ceramic red-on-buff effigy censer collected from a Pre-Classic period component at GR-522, Locus D, GRIC (illustration by John McCool).

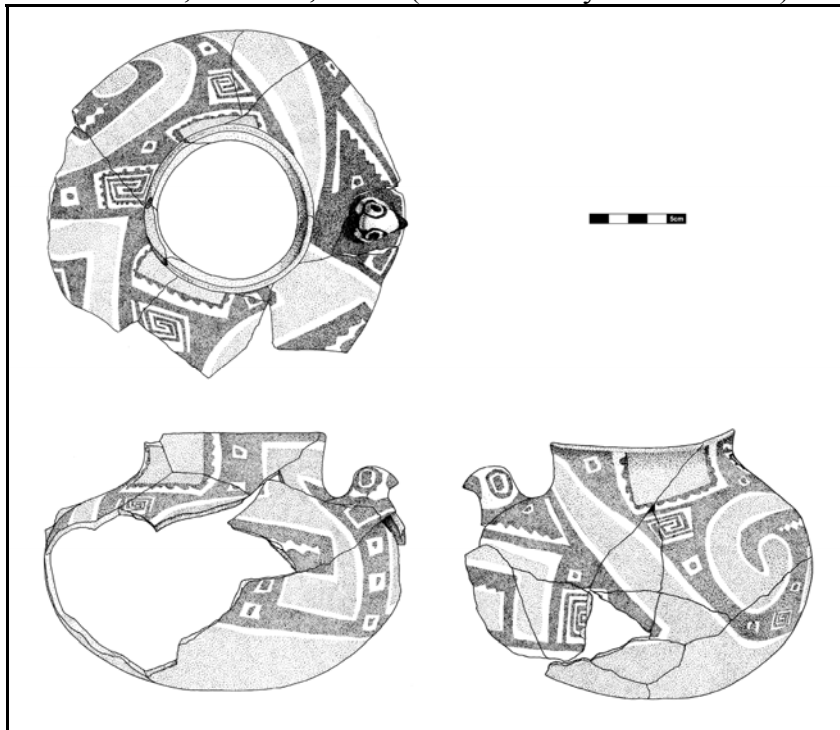


Figure 7.9. Ceramic Tonto Polychrome effigy jar collected from a Classic period component at GR-522, Locus A, GRIC (illustration by John McCool).

In contrast to the extensive Pre-Classic ceramic exchange relationships (Abbott 2000, 2009), patterning in Classic period obsidian data suggests that prehistoric people in the Salt Basin, Middle Gila, Casa Grande, and the two arms of the Tonto Basin maintained different exchange relationships. By the Late Classic little obsidian was transferred between adjacent subregions suggesting conflict intensified at this time (see Chapter 6). Variation in projectile point serration data also suggests that the Classic period Hohokam were not a politically integrated entity. The greater incidence of warfare style points over time also suggests conflict intensified, which is reflected by the O'odham story of conquest that resulted in the destruction of the platform mound villages. Because decline in the use of obsidian from northern, western, and eastern sources begin during the Classic period, it appears that hunter-gatherers such as the Apache and Yavapai may have moved into southern Arizona during the Classic period (see Chapter 6). This possibility is consistent with creation of the Apache and other non-O'odham people after the flood, but before the conquest (i.e., during the Classic period), as described in the O'odham traditions.

Pre-Classic and Classic Period Corporate-Network Strategies

A number of observations suggest that Pre-Classic social organization was based on a more corporate strategy, and that a shift to a system where network strategies had greater influence occurred during the Early Classic period (Elson 1998:105). Pre-Classic public architecture consisted of facilities including ballcourts (Figure 7.10) and big rooms that were designed for community

gatherings (Ravesloot and Rice 2004; Rice and Ravesloot 2003). These structures were not associated with specific households, suggesting they had a more corporate nature. “Some courtyards would be closer to or further from the public structures, but none were situated in such a way as to indicate a proprietary control of these edifices” (McGuire 1992:157).



Figure 7.10. Aerial photograph of the main Pre-Classic period ball court at Snaketown.

During the Pre-Classic extensive socioeconomic interaction networks appear to have operated within the Salt Basin and also linked it with the Middle Gila, as well as other areas (Abbott 2000, 2009; Harry 2005). “In contrast to the clustered and patchy spacing of the platform mounds, the ball courts had a continuous distribution, expressing uninterrupted connections among communities across a vast region” (Abbott et al. 2003). This patterning is

consistent with the expectations for cooperate organizations. The disruption to existing power relationships within Hohokam society along the Salt and Gila Rivers that resulted from changes in settlement patterns during the Classic period would have created opportunities that some groups may have exploited.

Classic period public architecture including platform mounds has more personalized and secluded characteristics (Abbott et al. 2003:12-13; McGuire 1992; Hegmon et al. 2008:319; Wilcox 1991). By the late Classic, a small segment of the population resided on the mounds (Abbott et al. 2003), suggesting more network-orientated strategies had emerged by this time (Figure 7.11). The named mound leaders in the Akimel O’Odham creation story are also consistent with an emphasis on individualized aggrandizement. The socioeconomic interaction networks of the Pre-Classic appear to have broken down, and it appears that there was comparatively little cooperation among sites during the late Classic (Abbott 2000, 2009; Abbott et al. 2007; Simon and Gosser 2001; Rice 2000; Rice et al. 1998).

Patterning in Early Classic burial data suggests that the greatest distinction among community segments occurred in measures of wealth, which is consistent with a more network orientated strategy (Loendorf 2001:139). These same burial data suggest that political authority was not highly stratified during the Early Classic (Loendorf 2001:141-142), and it appears hierarchical ranking may have been greater during the late Pre-Classic (i.e., Sedentary period) than it was in the Early Classic. “During the Colonial and Sedentary periods, the ballcourt system

became more centralized, with a decrease in the number of courts and an increased regularity in the spacing of courts” (Rice 2000:140).



Figure 7.11. Aerial photograph of the Cline Terrace platform mound in the Tonto Basin, Roosevelt Platform Mound Study, Arizona State University (Photograph by Brenda Shears).

The amalgamation of social segments into progressively larger units also appears to have occurred over the course of the Classic period. In the Tonto Basin, for example, the numerous small Early Classic platform mounds were replaced by only two (or possibly three) much larger mounds by the Late Classic (Rice 2000). Thus, by the end of the Classic period, the Hohokam social system may have become more hierarchical than the Early Classic (Hegmon et al. 2008),

and network leadership strategies were more important than they were in the Pre-Classic.

Classic to Historic Transitional Period

When the Spanish arrived in 1694, all or nearly all of the Akimel O'Odham within the Hohokam core area were living along the Gila River. Both ceramic and projectile data presented in Chapter 6 support this observation. Waters and Raveslout (2001:292), did not find evidence for a down-cutting episode at this time, and suggested that riparian habitats along the Gila River had recovered. No evidence exists that a down-cutting and channel widening episode occurred at this time along the lower Salt or in the Tonto Basin (Raveslout et al. 2009). As a consequence, more wood may have been locally available along these streams, and this material could have been used for construction and other purposes.

Based on stream flow patterns near the end of the Classic period, Graybill et al. (2006:114-120) argued that conditions for irrigation along the Salt were substantially worse than along the Gila River, and that Gila River communities may have endured longer than those on the Salt River. Graybill et al. (2006:118) suggested “[t]he collapse of Civano phase Salt River systems undoubtedly resulted in some attrition as well as out-migration, and one interesting possibility is that some portion of the Salt River population may have sought refuge in the Gila during the late 1380s and thereafter”.

Regarding this time, in an analysis that employed the concept of a “rigidity trap” from Resilience theory, Hegmon et al. (2008) argue: The end of the Hohokam Classic represents a virtual disappearance of the material culture that archaeologists associate with Hohokam, including pottery, formal architecture, and the irrigation system. Some people did remain in the region, and there are continuities with historic and contemporary populations, but these are difficult to trace archaeologically because of the lack of material continuity.

However, multiple lines of evidence for continuity in projectile point technology between the Classic and Historic periods have been presented in this research. These include strong similarities in projectile point shape and serration data, as well as the uninterrupted continuation of trends in obsidian acquisition patterns that began during the Classic period. Furthermore, during this interval people returned to building structures that are similar to Pre-Classic pit houses, which require substantially more wood for construction than adobe houses (Ezell 1963, 1983; Rice 2003:3; Sayles 1938; Whittemore 1898:56-57, Figure 7.12). These similarities lead Sayles (1938:83) to conclude: “Indications point strongly to the Pima as being the cultural descendants of the Hohokam. The analogy between the Pima type of single unit dwelling and that of the Hohokam is close”. Similarly, Haury (1976:72) said the “Pima house, in my opinion, represents the retention of the old Hohokam architectural idiom, a not insignificant argument in the favor of Hohokam-Pima continuity”

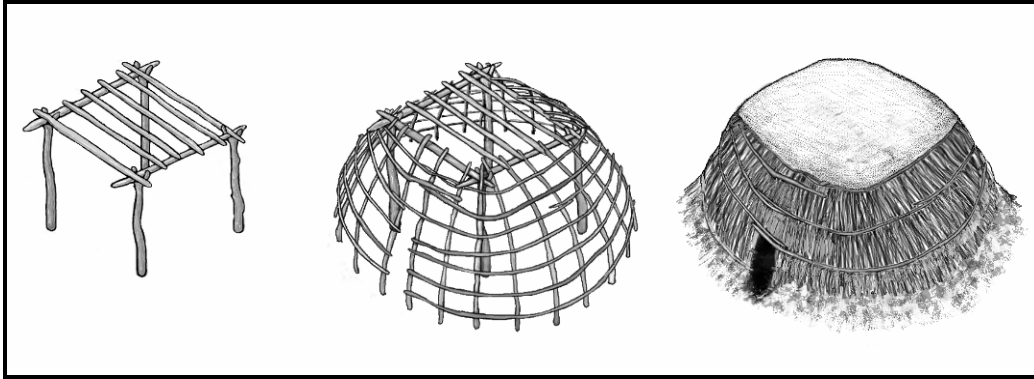


Figure 7.12. Construction technique for Akimel O'Odham *ki*. Not to scale. (adapted from Nabokov and Easton 1989 by Rob Ciaccio).

The Akimel O'Odham also practiced a dispersed rancheria settlement pattern that is similar to Pre-Classic settlement strategies (Ezell 1961:110-113; Fish 1989:21). They also returned to making red-on-buff pottery, which requires wood for firing. This pottery has close similarities in manufacturing technique, temper, clay, and design with Pre-Classic ceramics (Ezell 1963). The Akimel O'Odham were also dependent on irrigation agriculture, and their canal system shares close correspondences with both the Classic and Pre-Classic agricultural strategies and irrigation systems (Ravesloot et al. 2009; Webb 1959:121-126; Woodson 2004). After moving to the area, the Pee Posh continued to cremate deceased members of their community (Spier 1933), which was by far the most common burial treatment in the Pre-Classic period. Russell (1908:112) also collected two palettes from “medicine-men”, one of which is similar to Pre-Classic palettes and the other has a “horse scratched on one side” suggesting it was manufactured during the Historic period. This return of Pre-Classic period

cultural traditions is similar to the return of people from before the flood as described in the Akimel O'Odham creation story.

Recently, Ravesloot et al. (2009) offered a new model for the Hohokam collapse that supports continuity in cultural traditions within the Hohokam core area. They argue that the Hohokam entered a new adaptive cycle after the Classic period as the result of the declining availability of water in the region. They suggest that the prehistoric population levels could therefore not be maintained and the Historic Akimel O'Odham represent a reorganized society.

Classic and Historic Period Corporate-Network Strategies

The introduction of epidemic diseases by Europeans would have come at a devastating time for sedentary agriculturalists that recently experienced population losses and reorganization related to climatic cycles (cf. Ezell 1983:150). Akimel O'Odham perceptions of disease are different from Western ideas, and there is evidence that they believed diseases were a type of supernatural power that certain individuals could control (Hrdlička 1908:243-247; Shaw 1994:20). Russell (1908:256-258) described two types of religious specialists, which were both hereditary positions. The "Examining Physicians" treat disease. "Those who have power over the crops, the weather, and the wars are called Makai, Magicians" (Russell 1908:256). "They are ambitious, artful, and unscrupulous, and in this vicinity have done more to destroy the efforts of Indian agents..." (Whittemore 1898:62-64). Each village had approximately five of these ceremonial leaders, and they were paid for their services. "These two classes were

the true rulers of the tribe, as their influence was much greater than that of the chiefs” (Russell 1908:256).

It is generally argued that these people held little authority because they were sometimes executed (Bahr 1983:185); however, Russell (1908:262) states that when the patient of a specialist died, it was a rival practitioner who was sometimes diagnosed as the cause and killed. This suggests that competition among these specialists was a factor in these executions, and rather than being a sign of weakness, the killing of other specialists may have been a mechanism for some individuals to increase their own influence through the elimination of competitors (Grossman 1873:411-412). In any case, these specialists’ power was in part based upon the perception that they could cause and control disease. This power would have been fundamentally altered by their inability to stop repeated epidemics of European disease, which would have greatly weakened their authority in Akimel O’Odham society.

Although these observations suggest that more network orientated roles remained, social organization by the Late Historic period appears to have returned to a greater emphasis on corporate strategies. Akimel O’Odham political leaders could not compel group action, and instead decision-making was based on group consensus (Bahr 1983:185; Russell 1908:195-196; Whittemore 1898:59; though see Webb 1959:50-51). “The road to authority at nightly council meetings was gift giving. The headman ruled public life only in the sense of being in control of the agenda of the meetings” (Bahr 1983:185). Political leadership positions were

not hereditary, although in some cases sons followed their father in office (Russell 1908:196). These leaders were not compensated for their services, and use of their authority for personal economic benefit or favoritism of relatives was discouraged (Bahr 1983:185).

Chapter Summary

Data presented in this document suggest the following conclusions.

Climatic oscillations between warmer and colder periods alternately favored conditions for irrigation along the Salt and Gila Rivers. This in turn affected ideological, economic, and political relationships within the region. The *corporate-network* conceptual model provides a basis for understanding the political responses that people developed to ameliorate these constraints.

Pre-Classic Hohokam social organization was characterized by an emphasis on corporate organizational strategies, which is reflected by the following: communal architecture designed for public gatherings that individual households did not control; socioeconomic networks that linked communities; and little differentiation in wealth among individuals or households. Reorganization in response to a massive down-cutting episode around A.D. 1070, resulted in the emergence of more network orientated political strategies with the following properties: increased emphasis on individual aggrandizement, including associating platform mound sites with specific leaders; greater wealth accumulation by individuals and social segments; and increased differentiation in

residential architecture, with some households exercising control over publicly constructed facilities.

By the Late Historic period, the Akimel O’Odham and Pee Posh returned to emphasizing practices that are similar to those of the Pre-Classic period. These include the construction of similar architectural styles, the production of similar ceramic types with shared design elements, and the reoccurrence of the most common Pre-Classic period burial practice (i.e., cremation). At this time, greater importance was again placed on corporate strategies, though vestiges of more network-focused roles still persisted. The following observations suggest that corporate strategies were important: little differentiation occurred in wealth and no compensation was given to political leaders; specific individuals did not inhabit publicly constructed big rooms (i.e., council *ki*, Figure 7.13); and decision-making was based on group consensus.



Figure 7.13. Photograph of an Akimel O’Odham big room used for community gatherings, taken by Edward Curtis.

CHAPTER 8: CONCLUSIONS

Since the inception of historical documentation in the region, episodic alterations in human behavior along the middle Gila River have been suggested to be associated with the migration of external ethnic groups. Based on architectural differences, eighteenth century Spanish missionaries who visited the study area thought the Akimel O'Odham must be recent migrants from elsewhere, and they maintained that the builders of Casa Grande (i.e., the Classic Period Hohokam) were ancestors of the Aztecs who abandoned the middle Gila and migrated to Mesoamerica (Fewkes 1912:33). Over 200 years later, the Hohokam were still assumed to be migrants, but the direction of travel was reversed and the people were thought to have moved from Mesoamerica to the middle Gila River (Haury 1976). Similarly, material cultural and settlement pattern changes that occurred during the transition from the Pre-Classic to Classic periods were thought to have resulted from migration, but in this instance populations were argued to have come from the north (Gladwin and Gladwin 1930).

What the Akimel O'Odham, who have lived along the middle Gila since the first visit by Spanish missionaries, say about their past has been almost entirely ignored or misunderstood. For example, Father Pedro Font's party laughed when they were told the Akimel O'Odham creation story in 1775, and Font said this description was "history and tradition which the Pima of Gila River have preserved from their ancestors concerning said Casa Grande, which all reduces itself to fictions mingled confusedly with some catholic truths" (Fewkes

1912:59). Indeed, the terms “Pima” and “Hohokam” themselves are a result of misunderstanding (Lewis and Rice 2009). The archaeological term “Hohokam”, for example, has been translated and spelled differently than the O’Odham word “*Huhugam*” on which it is based. *Huhugam* more accurately means the spirits of O’Odham ancestors (Lewis and Rice 2009; Saxton et al. 1983:25). The term does not refer to a different tribe that is distinct from the modern O’Odham, and the O’Odham become *Huhugam* when they die.

Close similarities between the prehistoric record and the Akimel O’Odham social memory are unlikely to have occurred by coincidence (Lewis and Rice 2009; Teague 1993). This worldview suggests that people are created, subsequently they over-populate and traditional practices break down as a result, after which their destruction follows. This pattern then repeats. The O’Odham paradigm suggests that the number of people in the study area oscillated dramatically over time rather than steadily and slowly increasing from incipient populations. The possibility that the prehistoric population fluctuated over time as suggested by Akimel O’Odham traditions has fundamental implications for the interpretation of archaeological data. Periods of depopulation appear to have disrupted existing socioeconomic and political interaction patterns, and material culture change as well as population movements occurred during periodic intervals of low population density.

Research presented here suggests that people from throughout the Hohokam cultural area immigrated to the middle Gila River beginning sometime

around the end of the Classic period. The Akimel O'Odham are therefore the descendants of the prehistoric inhabitants of much of southern Arizona. At the same time, because many of these populations moved from elsewhere in the Hohokam region to the middle Gila, they have maintained traditions regarding migration, as well as distinctions among themselves (Webb 1959:22). This process of coalescence resulted in changes to social organization, as well as material culture. Because populations from as far away as the Colorado River moved to the GRIC, inter-marriage among these groups may also have resulted in genetic differences from the prehistoric populations who lived along the middle Gila River. All of these people are, however, the direct descendants of the Hohokam.

These conclusions were reached through analyses of projectile point data that previously have received comparatively little attention. Stone points are integral parts of weapon systems, but prior analyses of these data have largely focused on the identification of "styles". Because archaeologists have focused on cultural aspects, discussion of performance characteristics has commonly been directed toward the identification of variables that differ independently of function. Rather than eliminating factors thought to be associated with projectile use, this study instead has identified and analyzed tasks points were designed to perform. Ethnographic research, performance constraints, and archaeological data indicate that flaked-stone points were designed either for hunting large game or killing people.

The goals of hunting and warfare differ fundamentally in that the former cultural practice is undertaken to obtain food, while the primary intent of the latter activity is to kill or wound adversaries. As a result, different performance constraints exist for these two tasks. Because of the considerable effort required to track a wounded animal as well as the increased chance it will not be recovered for consumption, hunting points were designed to kill as rapidly and consistently as possible. Warfare points, on the other hand, were designed to maximize the probability that injury or death resulted, regardless of how long this might require.

Stone projectile points that were designed for hunting are rare in the surface collection data considered here, and unnotched points outnumber side-notched points by a factor of roughly three-to-one. Hunting point designs occur in Sedentary and Classic period assemblages, which suggests that big game hunting was more commonly practiced at these times, an observation that is supported by faunal data. In general, it appears the incidence of hunting designs decreased over time, while the incidence of warfare designs increased. The absence of points with hunting design features in the Historic point assemblage is consistent with the observation that big game hunting only rarely occurred at this time. Rather than reflecting the migration of outside ethnic groups, the disappearance of side-notched points at some Historic period sites was the result of changes in subsistence practices as well as an increase in the intensity of conflict over time.

Projectile points have long been shown to be useful indicators of chronological variation within archaeological assemblages. Indeed, pre-ceramic

cultural traditions (e.g., Clovis) are still defined largely on the basis of stone point morphology. However, points of identical shapes were made for extended periods of time, and this variable alone is a poor predictor of temporal associations. While previous research has concentrated on differences in shape, data presented here suggest that projectile point weight is also a good indicator of age. This hypothesis is of particular importance for regions such as the study area where some types such as triangular unnotched were made during much of the archaeological sequence between roughly 5000 B.C. and A.D. 1880.

Analyses presented here support the suggestion that points generally decreased in size over time within the study, and in at least some cases it is possible to identify significant temporal patterning with sufficiently large projectile point assemblages. At the same time, considerable overlap occurs among different contexts, and the weights for individual artifacts can not be used alone to suggest temporal estimates for sites. While the resolution of the size data is limited, previous researchers have had little success in seriating points from the ceramic period and there is consequently considerable room for improvement. Furthermore, lithic analysts have long used point size to separate atlatl darts from arrow points, and the design theory presented here attempts to more clearly define the underlying performance and technological factors, such as the introduction of the recurved bow, that are associated with this change.

Analyses presented here do not prove the projectile point size hypothesis is correct, but they do suggest it warrants further testing and may have heuristic

value. Although other lines of evidence (e.g., ceramics) are generally used to suggest temporal associations for artifact assemblages from the study area, diagnostic artifacts produced by highly-mobile populations (e.g., the Apache) remain poorly understood. Ethnohistorical observations presented in Chapter 6 suggest these peoples had considerable effects on the Historic period sedentary agriculturalists who lived in the Southwest, and the identification of any temporally diagnostic artifacts they produced is therefore of importance for understanding the past along the middle Gila River.

Projectile points in the study collection were largely made from non-local materials; therefore analyzing patterning in raw material source areas provides information regarding socioeconomic interactions. Almost 30 percent of the projectile points considered here were made from obsidian, and it is possible to objectively and precisely define source locations for this material. Further, Southwestern sources are generally localized deposits that are distributed in different directions from the Hohokam heartland. Thus, analyses of temporal and spatial variation in obsidian data compliment aspects of conflict that can be examined through consideration of projectile point design.

Archaeologists have generally focused on the study of diachronic variation in material culture, and have paid less attention to long-term traditions that did not change over time. Trends in obsidian acquisition patterns that began during the Classic period and continued into the Historic period suggest cultural continuity occurred. Close similarities between Classic and Historic period point styles also

suggest consistency in human behavior. Diachronic patterns in the projectile point blade margin treatment further suggest continuity between Hohokam practices and those of the Akimel O'Odham. Finally, the close parallels between the archaeological record and Akimel O'Odham social memory indicate these people have lived in the Hohokam core area for a considerable period of time.

The study area is located at the junction of the Salt and Gila Rivers. These two streams have major differences in the topography and elevation of their drainage basins, which create divergent discharge regimes. Data presented here suggest that climatic oscillations between warmer and colder periods alternately favored conditions for irrigation along the Salt and Gila Rivers. This in turn affected ideological, economic, and political relationships within the region. Pre-Classic Hohokam social organization was characterized by an emphasis on corporate organizational strategies. Evidence for the importance of these strategies includes the existence of exchange networks that linked communities, communal architecture designed for public gatherings that individual households did not control, and comparatively little differentiation in wealth.

Economic and social responses as well as changes in settlement patterns caused by a down-cutting episode around roughly A.D. 1070, resulted in the emergence of more network orientated political strategies during the Classic period. Evidence for this suggestion is provided by an increased emphasis on individual aggrandizement, the association of named individual leaders with specific sites, greater wealth accumulation, and increased differentiation in

residential architecture, with some households exercising greater control over publicly constructed buildings.

By the Late Historic period the Akimel O’Odham and Pee Posh returned to emphasizing practices that are more similar to those of the Pre-Classic period. Conditions for irrigation agriculture along the middle Gila River had improved, while they appear to have deteriorated along the Salt River. At this time, greater emphasis was again placed on corporate strategies, though remnants of more network-focused roles remained. The importance of corporate strategies is suggested by the observations that little differentiation occurred in wealth, no compensation was given to political leaders, specific individuals did not inhabit publicly constructed architecture, and decision-making was based on group consensus.

If the postulated effects of Holocene climatic oscillations on the discharge volumes of the Salt and Gila Rivers in the Hohokam core area are correct, then weather cycles that occurred prior to the Sedentary period may also have affected the settlement patterns of earlier populations who lived along these two streams. The Akimel O’Odham social memory supports the possibility that population fluctuations also occurred earlier in time. Although the effects of climatic oscillations are dependent on a number of different variables, it is possible that throughout much of the prehistoric sequence population densities along these two streams generally shifted over time such that periods of high population density

along one river correspond with comparatively low populations along the other stream.

This study has shown it is possible to use projectile point data to consider a much wider range of research issues using than has traditionally occurred in the study area. This research employed flaked-stone point data to analyze synchronic and diachronic variation in settlement patterns, subsistence practices, conflict, and socioeconomic cooperation. By employing projectile points to identify diachronic patterns in conflict and cooperation this research has elucidated relationships among Prehistoric and Historic people who lived along the middle Gila, as well as improved our understanding of the nature and meaning of episodic changes that occurred in the material cultural traditions of southern Arizona.

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