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MIDDLE AND LATE HOLOCENE HUNTING IN THE GREAT BASIN: A CRITICAL REVIEW OF THE DEBATE AND FUTURE PROSPECTS

Bryan Hockett

Recent papers published in American Antiquity and elsewhere have debated whether there were more artiodactyls available to human foragers during the relatively cool and moist Late Holocene compared to the relatively warm and dry Middle Holocene in the Great Basin. If so, how did human foragers respond to changes in artiodactyl abundance, and what explanations may be offered to account for any changes in human behavior across the Middle Holocene-Late Holocene boundary? A critical examination of the data used in this debate does not support the interpretation that human foragers across the Great Basin intensified artiodactyl hunting during the Late Holocene relative to Middle Holocene levels. Depending on location and setting, individual sites occupied during the Middle Holocene may show decidedly more intensive artiodactyl hunting at this time. At other sites, artiodactyl hunting remained consistent throughout the Middle and Late Holocene, while small game hunting and gathering significantly varied. New data presented below suggest that a change from encounter or ambush hunting involving small family groups to the communal hunting of pronghorn by larger numbers of people occurred near the Middle Holocene-Late Holocene boundary. I suggest that changes in social organization and technology also occurred at this time.

En artículos recientes publicados en American Antiquity y otra partes, ha surgido una discusión con respecto a si había más artiodáctilos disponibles para los forrajeros humanos durante el último periodo Holoceno relativamente fresco y húmedo, comparado con el clima relativamente caliente y seco en el Holoceno Medio en el Cuenca Grande. Si es así ¿cómo los forrajeros humanos respondieron a los cambios en abundancia de los artiodáctilos, y qué explicaciones se pueden ofrecer para a los cambios del comportamiento humano a través del Holoceno Medio-Holoceno Tardío. Todo parece coincidir en que los climas frescos y húmedos del Holoceno Tardío fomentaron mayores densidades demográficas de artiodáctilos. Un punto de vista es que los cazadores respondieron intensificando la caza de artiodáctilos, privilegiándolos sobre presas de caza más pequeñas tal como los leporinos. Según esta visión, estos datos apoyan modelos tales como "opción de la presa" diseñada para probar si los forrajeros eligen los alimentos sin tomar en cuenta valores calóricos. Desde otro punto de vista, los cazadores intensificaron la caza de los artiodáctilos durante el Holoceno Tardío porque les dio mayor acceso a las hembras, de tal manera aumentando su aptitud selectiva. Un examen crítico de estos datos, sin embargo, no apoya la interpretación de que los forrajeros humanos de la Cuenca Grande intensificaron la caza de los artiodáctilos durante el Holoceno Tardío y el Holoceno Medio. Dependiendo de la localización, los sitios ocupados durante el Holoceno Medio demuestran una caza decididamente más intensiva de los artiodáctilos, siendo constante a través del periodo, mientras que la caza de presas pequeñas varió perceptiblemente. Los datos presentados aquí de 31 trampas aborígenes de antilope y 15 puntos de "proyectiles de matanza" situados en el norte-centro de la Cuenca Grande sugiere que un cambio de estrategia en la caza, variando del encuentro ó la emboscada de la presa, lo que implicaba a grupos pequeños de la familia, hacia la caza comunal del antilope, por mayor número de gente, ocurrió cerca del Holoceno Medio-Holoceno Terminal. Basado sobre estos datos, sugiero que los cambios en la organización y la tecnología social también ocurrieron en este tiempo. Discuto que se deben desarrollar nuevos modelos para describir y explicar adecuadamente los cambios en preferencias humanas de caza durante el Holoceno Medio y el Holoceno Tardío de la Cuenca Grande. Estos nuevos modelos requieren la evaluación y la incorporación del récord arqueológico regional y deben incluir el conocimiento actual sobre las relaciones sociales de las maneras, el comportamiento humano, la influencia de la tecnología y de la nutrición y las tendencias demográficas.

Why do changes occur in the nature and timing of prehistoric hunting patterns through time? In the Great Basin and elsewhere, there are at least four factors commonly cited to account for such changes, each of which

is not necessarily mutually exclusive of one another. The four factors I am referring to are (1) paleoclimatic patterns that impact the abundance, density, and distribution of resources (e.g., Broughton and Bayhem 2003; Haynes 2002; Hockett and Haws

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2002); (2) selection acting on the demographic consequences of dietary choice, either from the perspective of nutritional ecology (e.g., Hockett and Haws 2003, 2005; Schwarcz and Schoeninger 1991) or optimal foraging theory (e.g., Winterhalder and Smith 2000); (3) social customs that influence the types of food people choose to eat and where they eat it (e.g., Crabtree 1990; Hockett 1998; Hildebrandt and McGuire 2002); and (4) technological changes that result in, or are a consequence of, increasing intensification of certain foods (e.g., Bettinger 1999).

In a number of recent papers, the first three factors have been discussed in one form or another to help explain the apparent increase in the number of artiodactyl bones found in many California and Great Basin sites that postdate ca. 5000 B.P. (Broughton and Bayhem 2003; Broughton and O'Connell 1999; Byers and Broughton 2004; Byers et al. 2005; Hildebrandt and McGuire 2002; McGuire et al. 2004; Schmitt et al. 2004; Ugan 2005; Zeanah 2000, 2004). The main questions here are threefold: (1) were there more artiodactyls available to human foragers in the Great Basin and California during the relatively cool and moist Late Holocene (LH) compared to the relatively warm and dry Middle Holocene (MH)?; (2) How do human foragers respond to changes in artiodactyl abundance?; (3) What explanations can be offered to account for changes in human behavior across the MH-LH boundary in response to differences in the abundance of artiodactyls?

On one side of this debate are the optimal foraging theorists who have developed models such as "prey choice" and "patch choice" to test whether human foraging behavior has been molded by selective forces to extract calories from the environment in the most efficient manner possible (Broughton and O'Connell 1999, and references therein). This philosophical position within archaeology is now often referred to simply as "foraging theory" (for a review of the origin of this general philosophy in experimental psychology, see Zipf 1949; for the biological sciences, see Winterhalder and Smith 2000). In these models, resources are ranked on an ordinal scale from most efficient to least efficient based on the net caloric return rates of individual food items. According to these rankings, artiodactyls outrank smaller game and plant resources (but see Madsen and

Kirkman 1988; Madsen and Schmitt 1998). As a result, artiodactyls are always included in the diet when encountered. Small game and plant foods are only eaten when large game is not encountered frequently enough to fulfill caloric requirements. Admittedly, human foragers rarely find enough large game to eat, so other resources are added to the diet based on their caloric return rankings. Importantly, if artiodactyls are encountered with increasing frequency through time, then they will constitute a greater proportion of the diet. Lower-ranked small game and plant foods will be consumed less frequently depending on their net caloric return rates in order for hunter-gatherers to maintain the most energy-efficient foraging strategy.

Broughton and Bayhem (2003), Byers and Broughton (2004), and Byers et al. (2005) suggested that MH climate in the Great Basin depressed the numbers of artiodactyls on the landscape, while LH climate fostered greater population densities of large game. Human encounter rates with artiodactyls would have dropped during the MH; conversely, human foragers would have encountered artiodactyls more frequently during the LH. Utilizing the "artiodactyl index," which tracks the ratio of artiodactyls (high-ranked prey) to leporids (lower-ranked prey), Byers and Broughton (2004) cited two examples (Hogup Cave and Camels Back Cave) in which more leporids were eaten relative to artiodactyls during the MH; conversely, more artiodactyls were eaten relative to leporids during the LH at these sites.

Byers et al. (2005) then listed artiodactyl indices for eight Great Basin sites (including Hogup and Camels Back caves), each of which apparently shows that artiodactyls were more abundant than leporids during the LH compared to the MH. They did not state that human hunters took proportionately more artiodactyls during the LH at the six sites not mentioned in the Byers and Broughton (2004) article (Danger Cave, Dirty Shame Rockshelter, Gatecliff Shelter, Last Supper Cave, O'Malley Shelter, and Pie Creek Shelter), only that artiodactyl bones were recovered in larger numbers relative to leporid bones in the LH at all eight sites. Thus, without a single MH Great Basin site in which artiodactyls were either present or eaten in greater relative proportion to leporids, these data corroborate the predictions of the prey choice

model derived from optimal foraging theory. Artiodactyl populations were depressed during the MH relative to the LH, and prehistoric human foragers chose which animals to pursue and eat based on body size, which itself directly correlates with caloric return rates.

On the other side of this debate are those who believe that social factors may have played a role in driving prehistoric dietary choice across the MH-LH boundary. Hildebrandt and McGuire (2002) took a different tact to explain the apparent increasing focus on artiodactyl hunting during the LH in California. They noted that some evolutionary ecologists have found that foragers make decisions about which animals to hunt for reasons other than energy maximization and family provisioning. In particular, the "showing-off" hypothesis (e.g., Hawkes 1991; Hawkes et al. 2001) argues that men may hunt unpredictable large-game resources that become public goods rather than provisions for their immediate families because of increased social benefits that ultimately increases the individual fitness levels of hunters (e.g., see discussions between Hawkes 1993 and Hill and Kaplan 1993). Interestingly, contrary to the prey choice model, the hunting of large game by show-offing males is a rather inefficient strategy in terms of caloric return rate. Nevertheless, show-offing results in social prestige that matches the mating of better hunters with better mothers, so selection favors the development of this pattern in some foragers. Hildebrandt and McGuire (2002) suggested that increases in artiodactyl hunting during the LH in California was related to a change to prestige or to a "showing-off" hunting strategy that was not present in the social customs of the MH foragers. They suggested that male-female relationships, including sexual division of labor, changed during the LH to include "prestige" hunting of large game by men. Part of these changes were in response to the increasing availability of artiodactyls on the landscape. This large mammal hunting strategy, while relatively calorie inefficient, matched better hunters with better mothers, and so became a selectively more fit strategy compared to the subsistence and settlement patterning practiced by MH foragers.

More recently, McGuire et al. (2004) tested the prey choice model outlined above at the newly excavated Pie Creek Shelter site located in north-eastern Nevada. Pie Creek Shelter contains a wealth

of well-preserved ecofacts dating to 4800 B.P., including a variety of burned plant seeds and small-game resources such as leporids and fish, together with abundant artiodactyl remains. Examining the diachronic patterning in diversity and quantity of charred plant seeds in relation to animal resources, Wohlgemuth (2004:105) concluded that, "Trends in the Pie Creek data also suggest that resource ranking schemes may be seriously flawed and need to be reworked." This conclusion was based on the fact that the diversity and quantity of so-called low-ranked plant foods did not follow trends in the intensity of artiodactyl hunting, as the prey choice model would predict. These and other similar conclusions based on examinations of the faunal data led McGuire et al. (2004) to conclude that either the prey rankings developed by optimal foraging theorists are in error, human foragers near Pie Creek Shelter did not center their subsistence and settlement patterns around the efficient extraction of calories, or both. As a result, McGuire et al. (2004) suggested that the relatively intensive LH hunting of artiodactyls documented at Pie Creek Shelter may provide further evidence that social customs changed to a prestige or show-off strategy in the central Great Basin as well.

Recent data have come to light in the north-central Great Basin in the form of a rather remarkable concentration of aboriginal pronghorn corrals and projectile point "kill spots" that may have relevance to the debate summarized above. Specifically, these data suggest that foragers began to communally hunt artiodactyls within the transitional time period that marks the end of the MH and the beginning of the LH. One result of these changes in both technology and social organization would have been the deposition of more artiodactyl bones to individual sites. These data support Hildebrandt and McGuire's (2002) general suggestion that a change in social organization occurred near the MH-LH boundary. Whether the change to communal hunting occurred partly because there were more artiodactyls on the landscape during the LH is a proposition not easily substantiated, as I detail below.

Before presenting the new data on corrals and kill spots, a number of issues surrounding the presentation of the Great Basin data related to MH and LH paleoclimates and faunas need to be addressed. These issues focus on four arenas: (1) taphonomic circumstances and site integrity; (2) the manner in

Table 1. Great Basin Sites Used in Byers et al. (2005) and the Degree of Taphonomic Analysis Completed at Each Site.

Site	Taphonomy completed: large fauna	Taphonomy completed: small fauna
Camels Back Cave	Yes	Yes
Danger Cave	Partially	Partially
Dirty Shame Rockshelter	No	No
Gatecliff Shelter	Yes	No
Hogup Cave	No	Yes
Last Supper Cave	Yes	No
O'Malley Shelter	No	No
Pie Creek Shelter	Yes	Yes

which assemblages that date between 4000 and 5000 B.P. are pigeonholed as representing either strictly MH or LH occupations; (3) the relevance of chronological scale for evaluating the relative intensity of large and small-game hunting at individual sites; and (4) the availability of artiodactyls such as pronghorn (*Antilocapra americana*), mountain sheep (*Ovis canadensis*), and deer (*Odocoileus hemionus*) to human foragers based on differences in site location and elevation. I begin with an examination of these four issues before proceeding with new data on the chronological patterning of encounter and communal pronghorn hunting in the north-central Great Basin.

Middle and Late Holocene Hunting of Large and Small Game in the Great Basin

Taphonomic Circumstances and Site Integrity

Zooarchaeologists always need to be mindful that the majority of faunal remains recovered from Great Basin caves and rockshelters with long stratigraphic sequences have not been subjected to complete taphonomic analysis (Table 1). Unfortunately, only two of the eight Great Basin sites listed in Byers et al. (2005) have had taphonomic analysis completed on both the large and small faunal remains recovered. Those sites that have had taphonomic analysis on parts of their assemblages, including Danger Cave (Grayson 1988), Hogup Cave (Hockett 1994), and Gatecliff Shelter (Grayson 1983; Thomas and Mayer 1983) have revealed that nonhuman agents such as owls played significant roles in the deposition of bones to these sites, particularly the leporids and rodents. For example, at Danger Cave, Grayson (1988) noted that burned bones cannot be used as unequivocal

evidence that humans deposited leporid bones to the cave because massive regions of the cave sediments burned in situ, and in the process randomly burned both human and nonhuman deposited bone. At Hogup Cave, I revealed that owls had deposited thousands of the leporid bones into the cave; further, I found owl-deposited leporid bones that had been thoroughly charred by the in situ burning of the Hogup Cave sediments as well (Hockett 1993, 1994). At Gatecliff Shelter, Grayson (1983) concluded that the deposition of small faunal remains probably would have been the same whether humans occupied the site or not. If Grayson is correct, then an artiodactyl index at Gatecliff Shelter tracks the ratio of artiodactyls hunted by humans to leporids deposited by nonhuman agents.

Byers and Broughton (2004) argued that humans did indeed take relatively more artiodactyls in relation to leporids during the LH at Camels Back and Hogup caves. At Hogup Cave, however, the data specifically show that the intensity of artiodactyl hunting did not change between the MH and the LH, but the numbers of leporid bones deposited inside the cave varied through time (see Table 2; for a more detailed discussion of issues related to time scale at Sudden and Pie Creek shelters, see below). The Hogup Cave MH occupations are represented by strata 1–7. These occupations date between about 8100 and 6200 B.P., so they took approximately 1,900 years to accumulate. The LH occupations are represented by strata 8–16, they date between roughly 3900 and 850 B.P., and they took approximately 3,050 years to accumulate. According to Durrant (1970:242), a total of 1,318 leporids and 63 artiodactyls were deposited in the cave during the MH, while 668 leporids and 102 artiodactyls were accumulated during the LH (based on MNI). If scaled to length of time that the

Table 2. Artiodactyls and Leporids Recovered from Middle Holocene and Late Holocene Occupations in Hogup Cave, Utah. Data from Durrant (1970).

	Strata 1-7 Middle Holocene 8,100--6,200 B.P. Duration: 1,900 years	Strata 8-16 Late Holocene 3,900--850 B.P. Duration: 3,050 years
Artiodactyls	MNI: 63 #/year: .033	MNI: 102 #/year: .033
Leporids	MNI: 1,318 #/year: .694	MNI: 668 #/year: .219

MH and LH deposits took to accumulate, artiodactyl hunting remained constant throughout the depositional history of Hogup Cave (Table 2). An average of .033 artiodactyl bones per year were deposited in Hogup Cave in both the MH and LH layers. If there were more artiodactyls available to human foragers during the LH, then this fact apparently had no impact on the intensity of artiodactyl hunting. Alternatively, there may have been minimal differences in the numbers of artiodactyls available near Hogup Cave throughout the MH and LH.

Within this context of continuity in artiodactyl bone deposition, however, greater numbers of leporids were deposited inside the cave during the MH (.69 bones per year) than during the LH (.22 bones per year). Whether this was caused by humans conducting more intensive "rabbit drives" during the MH similar to nearby Camels Back Cave, or whether it simply indicates that great-horned owls (*Bubo virginianus*) occupied the site more frequently during the MH compared to the LH, is uncertain, as I documented over a decade ago (Hockett 1993, 1994). The answer may be that both humans and great-horned owls deposited large numbers of leporid bones into the cave during the MH, which in combination greatly inflated these values over those of the LH. Whatever the case, it is an interesting phenomenon nevertheless that small mammal bone deposition varied while the intensity of large mammal bone deposition remained constant through the MH-LH transition.

What was happening in the MH in the remainder of the Great Basin and northern Colorado Plateau in terms of large and small-game hunting?

What's in a Name? Or, When Did the Middle Holocene Begin and End in the Great Basin?

When did the MH end and the LH begin? And

equally important, should archaeologists make such a rigid distinction at all? Briefly, the paleoenvironmental record suggests that a relatively cool and moist Early Holocene (EH) climate persisted in the central and northern Great Basin until ca. 8300 B.P. (e.g., Grayson 2000; Madsen et al. 2001; Rhode and Madsen 1995), while the period 10,000 to 8300 B.P. was relatively warm and moist in the southern Basin (e.g., Hockett 2000). By 8300 B.P., xeric-adapted species had either replaced or become more abundant than mesic-adapted species in many Great Basin settings, particularly in lowland habitats. This restructuring in plant and animal distributions signals the beginning of the MH, or the warm Altithermal originally defined by Ernst Antevs (1948). The MH warm period persisted for several millennia. The timing of the end of the MH and the beginning of the LH, however, is a matter of debate. By 4000 B.P., the central and northern Great Basin subregions experienced an increase in effective precipitation (e.g., Thompson 1990:222). This "Neoglacial" or "Medithermal" phase that is traditionally set between about 4000 and 2000 B.P. saw the return of marshlands that had essentially laid dormant for four millennia. Sites such as Lovelock Cave (Loud and Harrington 1929), Hidden Cave (Thomas 1985), and the Stillwater marsh open-air locales (Raven and Elston 1988) all attest to an overall cooler and wetter climate. Thus, there is probably general agreement that archaeological sites that date between approximately 8500 and 5000 B.P. represent adaptations to the warm MH, while those that date after ca. 4000 B.P. represent adaptations to LH environments. Sites that date between 4000 and 5000 B.P. are transitional between these two more extreme paleoclimatic periods. In fact, this transitional period is marked by the initial occupation of a number of sites across the central Great Basin, including Hidden Cave (Thomas 1985), Gatecliff Shelter (Thomas 1983), Lower South Fork Shelter (Heizer et al. 1968), and Pie Creek Shelter (McGuire et al. 2004).

Pie Creek Shelter exemplifies this issue rather well. Pie Creek Shelter contains faunal remains and lithic artifacts dating back about 4800 BP. If 4500 B.P. is chosen as the date that separates the MH from the LH, then the site has a MH horizon that totals three centuries. If 5000 B.P. is chosen for the MH-LH transition, then the site was occupied entirely during the LH. But at Pie Creek Shel-

Table 3. Large and Small Fauna Recovered from Middle Holocene Cave and Rockshelter Sites in the Great Basin and Northern Colorado Plateau. Data from Lucius and Colville (1980), Hockett (2005), Spencer et al. (1987), Durrant (1970), and Schmitt et al. (2004).

Site	¹⁴ C (B.P.)	Potential Human Deposited Fauna	Elevation (Feet)	Setting
Sudden Shelter Strata 1-10	8300-5300	Leporids: 29 (MNI) Artiodactyls: 104 (MNI)	7,500	Upland - Forest
Bonneville Estates Rockshelter Strata 9, 16	7300-5200	Leporids: 58 (NISP) Artiodactyls: 387 (NISP)	5,200	Mid-slope - Xeric Brush & Juniper Trees
U. South Fork Shelter Levels 22-23	7000-5700	Small Fauna: (7g) Large Fauna: (87g)	5,100	Valley - Riverine
Hogup Cave Strata 1-7	8100-6200	Leporids: 1318 (MNI) Artiodactyls: 63 (MNI)	4,700	Lowland - Playa
Camel's Back Cave Stratum V	7100-6400	Hare: 697 (NISP) Artiodactyls: 10 (NISP)	4,550	Lowland - Playa

ter this situation is even more fuzzy. Byers and Broughton (2004), Byers et al. (2005), and McGuire et al. (2004) separated Component IV from the shelter into a MH occupation, while Components III-I represented LH occupations. Yet the ¹⁴C dates for Component IV span the period between 4800 and 4300 B.P. Using a separation date of 4500 B.P. for the MH-LH split, part of Component IV lies in the MH by three centuries and part lies in the LH by two centuries. Similar kinds of situations apply to other important sites such as Swallow Shelter in northwestern Utah with a basal date of 5400 B.P. (Dalley 1976), Gatecliff Shelter with a basal date around 5500 B.P. (Thomas 1983), lower South Fork Shelter with a basal date of 4000-5000 B.P. (Heizer et al. 1968), and so forth. The point here is that these sites are poor examples to compare differences in human hunting strategies between the MH and LH in the Great Basin. Great Basin archaeologists are on safer ground to argue that sites that date between 8500 and 5000 B.P. represent MH occupations, and sites that date younger than 4000 B.P. represent LH occupations in order to make the kinds of comparisons in human hunting strategies that are being discussed here. It would then be interesting to see how the data from all of these transitional sites that were first occupied between 4000 and 5000 B.P. compare to the latter two data frames.

Elevation and Location Matter

Considering the climatic concerns above, there are few sites in the Great Basin and surrounding region that preserve a faunal record of human adaptation

to MH climate. Sites with relatively reliable ¹⁴C dates, stratigraphic integrity, and that unequivocally date to the MH include Bonneville Estates Rockshelter (Graf et al. 2004; Hockett 2005), Camel's Back Cave (Schmitt et al. 2004), Sudden Shelter (Jennings et al. 1980), and Upper South Fork Shelter (Spencer et al. 1987). While Hogup Cave has stratigraphic and taphonomic problems, it clearly contains MH occupations that can be separated from LH occupations. Danger Cave has taphonomic problems that will not be dealt with here (Grayson 1988). These five sites may be particularly telling about subsistence patterns in the MH of the Great Basin and nearby regions because they represent adaptations to at least three general ecotones. Camel's Back Cave and Hogup Cave are lowland sites, resting at 1,380 m and 1,425 m (4,550 and 4,700 feet) asl, respectively; Upper South Fork Shelter and Bonneville Estates are mid-elevation sites, resting at 1,545 m and 1,575 m (5100 and 5200 feet) asl, respectively; and Sudden Shelter is an upland site, resting at almost 2,275 m (7,500 feet) asl (Table 3).

Interestingly, in the mid-to-upper elevation sites (Upper South Fork Shelter, Bonneville Estates Rockshelter, and Sudden Shelter) artiodactyls outnumber leporids during the MH (Table 3). Sudden Shelter also shows a rather dramatic drop in artiodactyl bone deposition between the MH (.052 bones per year) and the LH (.026 bones per year) (Table 4). There is, however, an increase in artiodactyl bone deposition from the transitional period of 4000-5000 B.P. (.021 bones per year) to the LH period after 4000 B.P. (.035 bones per year). If the

Table 4. Number of Artiodactyls and Leporids Recovered from the 22 Strata in Sudden Shelter, Scaled to the Average Number of Bones of Each Animal Type Deposited per Year. Data from Lucius and Colville (1980:160, Table 26).

	Strata 1-10 Middle Holocene 8400-5,300 B.P. Duration: 2,100 years	Strata 11-15 Transitional 5000-4100 B.P. Duration: 900 years	Strata 16-22 Late Holocene 3800-3350 B.P. Duration: 450 years
Artiodactyls	MNI: 104 #/year: .050	MNI: 19 #/year: .021	MNI: 16 #/year: .035
Leporids	MNI: 29 #/year: .014	MNI: 9 #/year: .010	MNI: 7 #/year: .012

majority of these bones were deposited by human hunters, then artiodactyl hunting was significantly more important to MH foragers. As might be expected from a relatively high altitude site, leporid bone deposition remains consistent throughout the MH (.014 bones per year) and the LH (.012 bones per year). This patterning, therefore, is opposite of that from Hogup Cave where leporid bone deposition varied while artiodactyl bone deposition remained constant (Table 2). In contrast, within a context of consistency of small mammal bone deposition, large mammal bone deposition varied through time at Sudden Shelter.

These data suggest that the patterns that Byers and Broughton (2004) and Byers et al. (2005) documented for the MH also do not extend to several important sites that lie in middle-to-upper settings. Camels Back Cave, however, may show that leporids were more abundant than artiodactyls in the MH at this low-elevation site. These data may suggest a hunting strategy increasingly based on leporids in some lowland settings and on artiodactyls in middle-to-upland settings during the warm MH. If that is the case, then MH climate may have had a more dramatic impact on artiodactyl populations in some lower elevation settings compared to

upland habitats, even though data from lowland sites such as Hogup Cave do not suggest that this pattern is universal at low elevation settings.

Does the Consumption of "Low-Ranked" Animal Foods Correlate with the Intensity of Large-Game Hunting? The Case of Pie Creek Shelter

According to the prey choice model, human foragers consume low-ranked food items less frequently as higher-ranked food items are encountered with increasing frequency. Pie Creek Shelter is an excellent site to test this hypothesis because it contains abundant artiodactyl bones, as well as a host of "lower-ranked" animal foods such as leporids and fish. At this site, the intensity of artiodactyl hunting was unchanged throughout the depositional history of the site; what varied was the intensity of small game use through time (Table 5).

Table 5 shows the four occupation Components for Pie Creek Shelter, along with their associated ¹⁴C dates and the length of time that each Component represents. Additionally, the numbers of artiodactyls, leporids, and fish are shown for each Component, together with the average number of bones deposited per year in each Component. As noted, there is no change in the intensity of artio-

Table 5. Number of Artiodactyls, Leporids, and Fish Recovered from the Four Components in Pie Creek Shelter, Scaled to the Average Number of Bones of Each Animal Type Deposited per Year. Data from Carpenter (2004:108, Table 35) and Butler (2004:118, Table 39).

	Component IV 4800-4300 B.P. Duration: 500 years	Component III 4000-2750 B.P. Duration: 1,250 years	Components II-I 2500-250 B.P. Duration: 2,250 years
Artiodactyls	NISP: 25 #/year: .05	NISP: 71 #/year: .06	NISP: 116 #/year: .05
Leporids	NISP: 45 #/year: .09	NISP: 100 #/year: .08	NISP: 441 #/year: .20
Fish	NISP: 55 #/year: .11	NISP: 156 #/year: .12	NISP: 686 #/year: .30

dactyl hunting throughout the depositional history of the site. In addition, Components IV and III display the same intensity of artiodactyl, leporid, and fish exploitation. In contrast, there is a two-fold increase in the exploitation of leporids and a three-fold increase in the exploitation of fish in the latter two components, dated to after 2500 B.P. At Pie Creek Shelter, then, there was a tendency to increase the exploitation of small fauna while maintaining a consistency in the intensity of artiodactyl hunting. Add these data to the fact that the patterns of plant exploitation through time at Pie Creek Shelter do not conform to the predictions of the prey choice model either, and it is apparent that other models are necessary to explain the patterning of faunal and plant exploitation at this site.

Seeking Additional Data: Open-Air Sites and the Regional Archaeological Record

The data presented above all derive from a single site type: caves and rockshelters. These sites suggest that large and small bone deposition varied considerably throughout the MH and LH depending on location and setting. But are there other sources of information that may relate to these issues, and in particular to Hildebrandt and McGuire's (2002) general suggestion that there was a change in social organization that coincided with the MH-LH transition? To further broaden the discussion, I now turn to the new data that has come to light regarding the EH, MH, and LH hunting patterns in the north-central Great Basin. These data derive not from caves and rockshelters, but from open-air lithic scatters and aboriginal pronghorn traps or corrals. I begin with a discussion of the ethnographic evidence concerning the social organization related to communal pronghorn hunting, and then present the new archaeological data suggesting that a change from encounter to communal hunting occurred in the north-central Great Basin between 5000–3500 B.P.

Social Organization of Communal Pronghorn Hunts—The Ethnographic Evidence

Ethnographic accounts of communal pronghorn hunting in the Great Basin are all similar, and generally involve multiple families, a so-called "antelope shaman," and the construction of a large corral

and associated wings. The following passages in Steward (1938:34) are typical:

Living in the open and being the fleetest American mammal prevented effective chases on foot. But the herding tendency coupled with excessive curiosity made them easy to take by wiles, such as disguises, and to drive into corrals.

Communal antelope drives were among the few economic activities not restricted to family groups. As the animals are wary and fleet of foot, they were taken with considerable difficulty by lone hunters. Large numbers of Indians on foot, however, could manage to drive them into a corral. Throughout most of the Shoshoni area these drives were managed by a shaman who received special supernatural power in a vision to charm antelope. During one to several nights of singing and shamanizing prior to the drive this man was believed to capture the antelopes' souls, rendering them docile and stupid. The next day a large number of men spread out over miles of country and slowly drove the animals toward the corral.

While pronghorn can be taken singly using encounter or intercept methods by lone hunters or small groups of hunters, they tend to congregate into herds numbering in the hundreds to migrate between winter and summer pastures. This makes them especially vulnerable to communal hunts involving large numbers of men, women, and children (Arkush 1986; Lubinski 1997, 1999). Given enough people, however, the construction of corrals were not necessary for a successful communal hunt. As summarized by Lubinski (1997), two types of communal pronghorn hunting involved surrounds and corrals. Surrounds simply involved encircling the animals at a distance and slowly concentrating them into a tight cluster. The animals could then be dispatched with spears or arrows. Corrals often required substantial effort to build, as these structures generally consisted of interlocked juniper (*Juniperus osteospermota*) or pinyon pine (*Pinus monophylla*) limbs, and occasionally were made of stone in the north-central Great Basin. These corrals measured up to 500 m

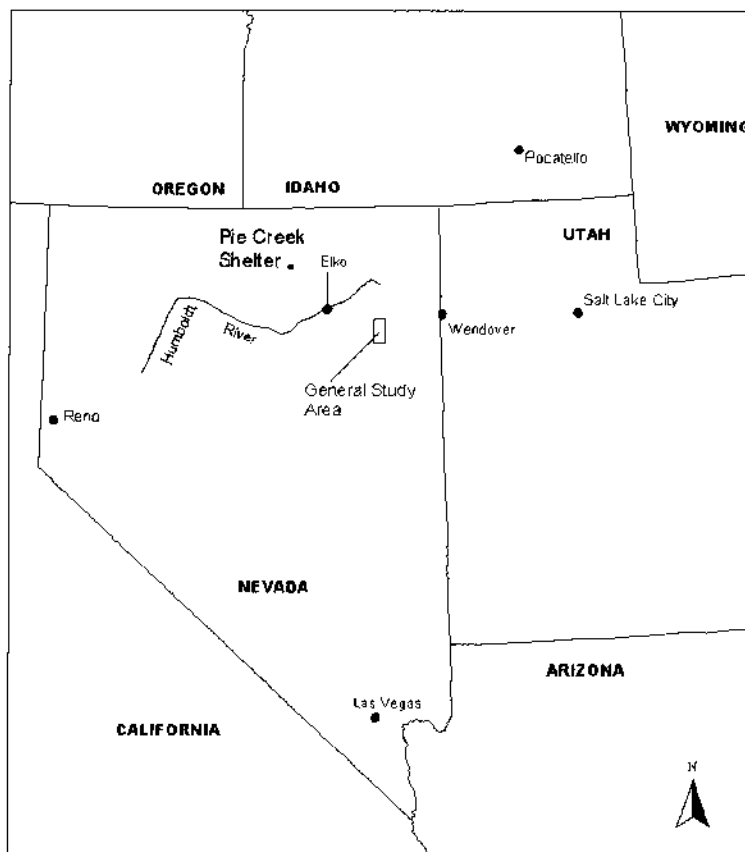


Figure 1. The study area.

across and 600–700 m in length (see descriptions below). Foragers in the north-central Great Basin also used standing trees that became part of the corral wall. From the opening of the corral, v-shaped or expanding juniper and sagebrush (*Artemisia tridentata*) wings up to 5,000 m (three miles) in length were constructed to funnel animals into the structure. Both surrounding and corralling methods may have been used in the north-central Great Basin in the past, but evidence suggests that neither occurred on a consistent basis until the MH-LH transitional period.

Communal Hunting of Pronghorn in the North-Central Great Basin: The Archaeological Evidence

For this study, I use two different sets of data from the north-central Great Basin: (1) a sample of 31 aboriginal corrals representing one of the largest

concentrations known in North America, and (2) a sample of nearly 2,000 projectile points, almost 1,200 of which are distributed in small, concentrated zones within or near the existing corrals. These latter sites likely represent “kill spots,” or places where pronghorn were shot either inside an older, now-decayed corral or within the boundary of a surround.

The Study Area. The corrals and projectile points are located in the central subregion of the Great Basin (see Grayson 1993). They lie within a north-south rectangular-shaped swath that measures only about 170 km (100 miles) in length and 85 km (50 miles) in width. About 40 percent of the known corrals and almost all known kill spots are located within a smaller, 250,000-acre parcel within this general zone, referred to below as the “study area” (Figure 1). To date, approximately 6 percent of this 250,000-acre study area has been surveyed in 30 m transects.

Table 6. Projectile Point Styles from the North-Central Great Basin together with their Associated Phase Designations and General Chronology. Data from Elston and Katzer (1980), Hockett and Morgenstein (2003), and McGuire et al. (2004).

Point Style(s)	Phase	Chronology	Period
^a Desert Side-Notched & Cottonwood	Eagle Rock	550–150 B.P.	Late Archaic
^b Elko, Eastgate & Rose Spring	Maggie Creek	1300–550 B.P.	
^b Elko	James Creek	3500–1300 B.P.	Middle Archaic
Gatecliff, Gypsum & Humboldt	South Fork	5000–3500 B.P.	
Large Side-Notched & Humboldt	Pie Creek	7500–5000 B.P.	Early Archaic
^c ?Great Basin Stemmed	No Name	8500–7500 B.P.	
^d Great Basin Stemmed	Dry Gulch	10,800–8500 B.P.	Paleoarchaic
^e Clovis	Izzenhood	> 10,800 B.P.	Paleoindian

^aThe Late Archaic is sometimes broken into two Periods: (1) Late Archaic represented by the Maggie Creek Phase; and (2) Protohistoric represented by the Eagle Rock Phase.

^bThe bow-and-arrow, represented by Eastgate and Rose Spring points, enter the archaeological record of the north-central Great Basin about 1300 B.P. However, Elko dart points continued to be manufactured after this date, and are commonly found in Fremont (Maggie Creek Phase) sites together with arrow points.

^cThere are no 14C dated assemblages from this time period in the immediate region (see also Beck and Jones 1997). This time frame represents the first millennium of Antev's (1948) "Altihermal," the longest sustained period of hot and dry climate recorded during the Holocene (see Grayson 2000; Hockett 2000). Occupations dating to this time are likely to be represented by either Large Side-Notched and/or stemmed points, and possibly by Pinto-like points.

^dIncludes several varieties of stemmed points originally defined from the Plains region, including Hasket and Scottsbluff. Recent work at Bonneville Estates Rockshelter and other regions (e.g., Goebel et al. 2003; Graf et al. 2004) suggest that foragers manufacturing Great Basin Stemmed points may have consumed a broad-based diet. Hence the term "Paleoarchaic" (after Willig and Aikens 1988).

^eClovis points represented by isolated surface finds are present in the north-central Great Basin, but none have been dated. One Folsom point is known from the region. I suggest the Phase designation "Izzenhood" here to represent this period of time characterized by fluted points. "Paleoindian" is suggested here based on Haynes's (2002) assessment that suggests that pre-Younger Dryas groups were tracking large mammals across this region. As there are no actual "campsites" recorded to date in the north-central Great Basin from this time period, his interpretation is upheld here.

The study area is typical of central Great Basin topography and vegetation. Valley floors sit about 1,725 m (5,700 feet) asl, with nearby ranges extending between about 2,100 m and 2,600 m (approximately 7,000 to 8,500 feet) asl. These north-south trending ranges are separated by narrow, flat valleys. Vegetation growing on the valley floors is dominated by big sagebrush. Draining the higher ranges are numerous east-west trending ephemeral washes separated by ridges that are dotted with juniper trees on their lower slopes. Trees become more dense with elevation, with pinyon pine joining the juniper-sage contingent at about 2,000 m (6,500 feet) asl. This creates the classic pinyon-juniper zone with a sagebrush understory growing atop limestone bedrock that is the hallmark characteristic of the central Great Basin.

Given the large number of aboriginal corrals recorded to date, this area must have been an active corridor of pronghorn migration in the past. Pronghorn still inhabit the area, albeit in small numbers. A century-and-a-half of sheep and cattle grazing and stock fencing, coupled with a paved highway that runs the entire length of the primary valley floor, undoubtedly keep pronghorn numbers well

below their prehistoric levels.

Projectile Point Chronology. Before discussing the corrals and point scatters in more detail, a quick summary of projectile point chronology of this region of the Great Basin is necessary. The common projectile points and their associated chronologies and archaeologically defined phases are summarized in Table 6 and Figure 2. The projectile point sequences can be summarized this way: (1) fluted (Clovis and Folsom) points are present but very rare (four Clovis points and a single Folsom point have been recorded in 25 years of survey in northeastern Nevada), none of which have been found in a datable context; (2) a variety of large stemmed points are found in the region, and they are assumed here to post-date about 10,800 B.P.; the only stemmed points found in a datable context from the region are from Bonneville Estates Rockshelter at ca. 10,500–9500 B.P. (Goebel et al. 2003; Graf et al. 2004); (3) the negative effects of the first millennium of the MH (ca. 8500–7500 B.P. [see Grayson 2000; Hockett 2000; Schmitt et al. 2004]) seems widespread throughout the region, as there are no datable occupations yet recovered; this climate-induced impact seems to have faded some-

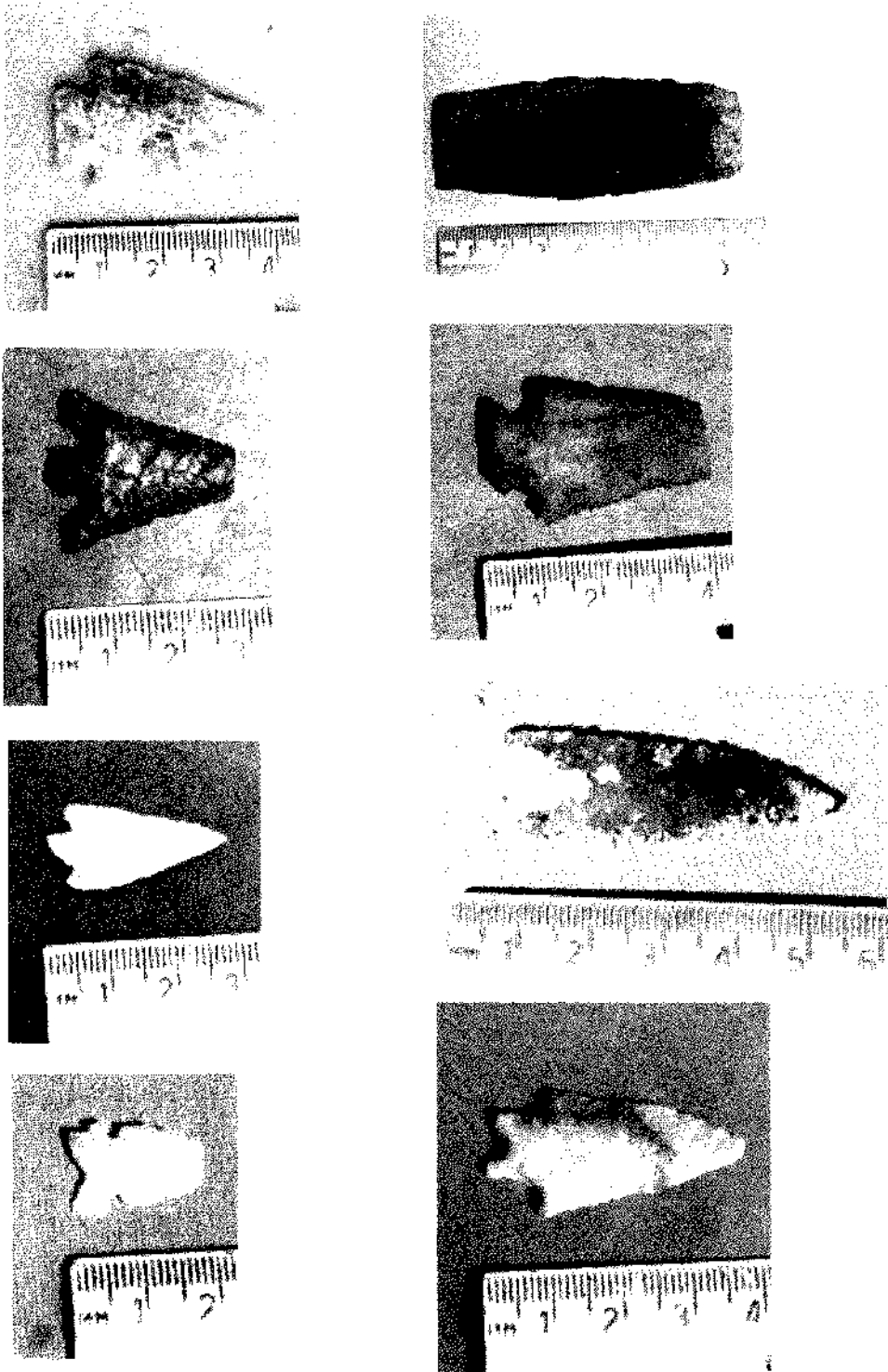


Figure 2. Common projectile points recorded from the study area. Left column, top to bottom: Western Stemmed, Large Side-Notched, Humboldt, Gatecliff. Right column, top to bottom: Elko Corner-Notched, Eastgate, Rose Spring, Desert Side-Notched.

Table 7. Aboriginal Pronghorn Traps Recorded to Date in the North-Central Great Basin.

Trap	Width (diameter)	Number of Points [Identifiable Points]
South Spruce	375 m	none
Pygmy Rabbit	275 m	none
Spruce Knoll	250 m	11 [10 DSN]
Gallegos	310 m	2 [1 DSN; 1 Elko]
Spruce Well	450 m	none
Sprucemont	120 m	1 [Elko]
Valley Mountain	400 m	188 [34 Elko; 62 Humboldt; 1 Gatecliff; 3 LSN]
Hill	300 m	43 [3 DSN; 21 Elko; 2 Humboldt; 7 LSN]
Storey	200 m	1 [Elko]
Spruce Pond	140 m	21 [11 DSN; 1 Eastgate; 5 Elko]
Spruce Ridge	175 m	16 [14 DSN]
Mizpah	240 m	1 [1 DSN]
Ruby Wash	240 m	none
Currie Hills	240 m	none
Tobar	340 m	none
South Dry Lake Flat	420 m	none
North Dry Lake Flat	280 m	none
Clover Valley	400 m	2 [2 DSN]
Cobre	320 m	63 [27 DSN; 4 Rose Spring; 3 Elko; 1 LSN]
Maverick	500 m	none
Wendover	250 m	52 [28 DSN; 3 Elko; 1 Humboldt; 1 Gatecliff]
Toano Draw	260 m	none
Butte Valley	220 m	none
North Five Mile Draw	360 m	none
South Five Mile Draw	320 m	4 [2 DSN; 1 Great Basin Stemmed]
East Five Mile Draw	320 m	none
Liza Jane North	220 m	38 [12 DSN; 2 Eastgate; 13 Elko; 1 LSN]
Thorpe	260 m	none
South White Horse Pass	220 m	none
West White Horse Pass	200 m	none
Silver Zone Pass	450 m	none

Note: Desert Side-Notched and Cottonwood Points Have Been Combined into a Single Category (DSN) Below. Large Side-Notched Points Are Labeled LSN.

what by 7500 B.P. in the eastern Great Basin, but may have lingered longer in much of the central Great Basin. In any case, the first Large Side-Notched points reach the region by at least 7500 B.P. Large Side-Notched points were manufactured until at least the MH-LH transitional period. Humboldt points are poorly dated in the region. Pie Creek Shelter contained a concentration of Humboldt points that dated to about 4900 B.P., so it is possible that these points were manufactured during the MH; (4) the MH-LH transitional period (ca. 5000-4000 B.P.) is marked by a rather sudden appearance of corner-notched points with bifurcate or split-stemmed bases known as Gatecliff; as mentioned, Humboldt points likely date to this time period as well; (5) Elko Series projectile points replace Gatecliff points about 3500 B.P.; these points occur in assemblages dating as late as 1100 B.P. in the region; (6) the bow-and-arrow reached

the central Great Basin by about 1300 B.P., and is marked by the appearance of Eastgate and Rose Spring projectile points; and (7) the immediate ancestors of the modern Western Shoshone and Goshute began manufacturing Desert Side-Notched and Cottonwood points by ca. 550 B.P., and these were the points fashioned at historic contact.

The Corrals and Kill Spots: Introduction and Working Hypotheses. A total of 31 aboriginal corrals has been documented in the north-central Great Basin (Table 7). A dozen corrals have been recorded in the smaller study area outlined in Figure 1; the majority of remaining corrals are located within 50 km (30 miles) in any direction of this centralized zone. Of the 31 traps, 14 contain projectile points within the confines of their corrals (Table 7). These are typically smaller traps that measure less than 320 m in diameter. Some corrals, such as Spruce

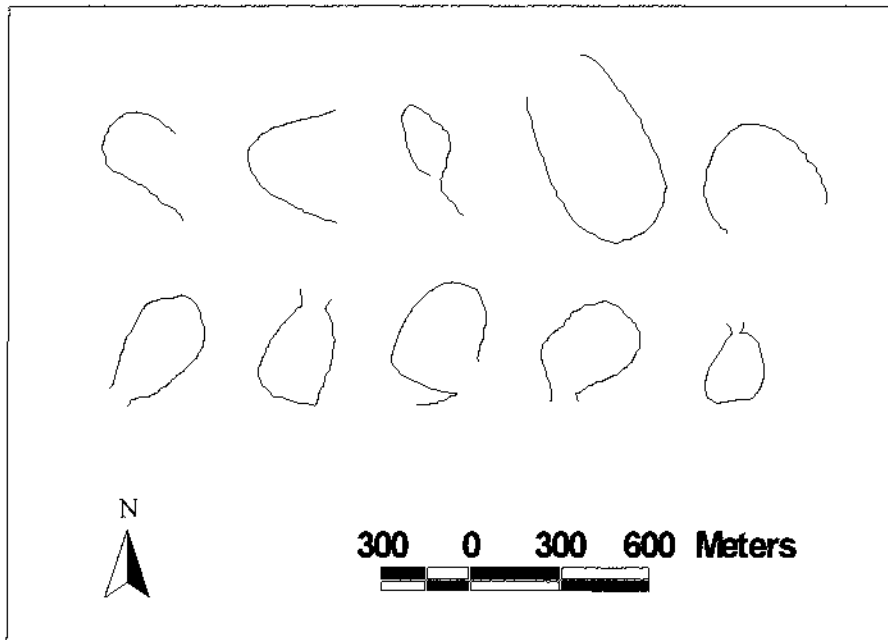


Figure 3. Size, shape, and orientation of 10 aboriginal pronghorn corrals recorded from the study area. Top row, left to right: Spruce Ridge, Pygmy Rabbit, Spruce Pond, Valley Mountain, Wiseman. Bottom row, left to right: Gallegos, Hill, South Spruce, Spruce Knoll, Liza Jane North. See Table 6 for additional details.

Knoll, contain only Desert Side-Notched projectile points, so the corrals and points probably are both physically and behaviorally associated with one another. Others, such as Valley Mountain, contain predominantly or exclusively older point styles that probably were not used during the final phases of corral construction. These time-averaged sites probably represent cases in which corrals were repeatedly constructed on the same ridgetop over a long period of time, or places where some combination of corral construction and surrounding took place. However, the majority of projectile points found within the confines of the corrals consist of the Desert Side-Notched variety that would have been manufactured during final use of the structures. When present, the majority of Desert Side-Notched points were found near the entrances to the corrals, which suggests the pronghorn were shot as they entered the enclosures. Those corrals without associated point scatters may have been unsuccessful traps, or perhaps the animals were dispatched by other means such as clubbing.

The size and shape of 10 of the corrals located in the study area are illustrated in Figure 3. All of the corrals within the study area are made of juniper limbs; sagebrush would have been used as filler

between the tree limbs that formed the corral walls and to make the v-shaped wings. The corrals vary in preservation from single juniper limbs now evenly spaced about every 3–5 m to continuous and thick lines of juniper branches stretched from limb-to-limb. These limbs would not be expected to survive complete decay for longer than a few centuries, so all of them must have been built or refurbished within 100–200 years of historic contact between A.D. 1750–1850. Although some of the 31 corrals contain axe-cut juniper branches indicating that they were built after historic contact and after the native populations acquired metal tools, none of the 12 corrals within the smaller study area were built with the aid of metal tools such as axes. Therefore, they can be considered “prehistoric” features.

In addition to the 12 corrals, more than 100 open-air sites (lithic scatters) have been recorded in the small study area shown in Figure 1. All styles of projectile points listed in Table 6 have been found in the study area except fluted points, suggesting that hunting was an important activity since the Late Pleistocene or EH. Individual sites contain between 0 and more than 250 points. Regardless of style or age, most sites within the study area contain less than 10 projectile points. This suggests that

hunting methods other than communal hunting occurred during all cultural phases. However, some sites contain large numbers of points that are concentrated close to one another, typically no more than a few centimeters apart. These are interpreted as ancient kill spots related to communal hunting (see also Petersen and Stearns 1992).

The abundance and spatial distribution of the various projectile point styles within the study area can be examined in order to interpret some basic elements of social organization such as group size during hunting episodes. The assumptions guiding my interpretations are as follows: (1) Short-term hunting or foraging locales created by small family groups would be expected to contain relatively few projectile points at any one site. As mentioned, more than 100 of these sites have been recorded to date in the study area, and these are interpreted as encounter/ambush locales or short-term retooling stations created by small, family groups. In contrast, kill sites created by multiple family groups working cooperatively to surround or corral large numbers of animals may contain large numbers of concentrated projectile points if the animals were shot rather than clubbed. Thus, just as the corrals represent an architectural manifestation of communal hunting by multiple family groups, so, too, do the ancient kill spots now represented only by concentrated projectile points. (2) The kill spots or point scatters that represent places where animals were shot inside a corral or surround should show some combination of the following six features: (a) projectile points that are tightly clustered (e.g., points are found that lie on top of one another or only several cm from one another); (b) a relatively large number of complete points (20 or more) or points with impact fractures are present; (c) point tips are present, suggesting that the projectiles were broken in situ; (d) uniformity in point style or type; (e) similarity in raw material used to manufacture the points; and (f) there is a relatively high tool to flake ratio with little debitage present.

The following caveats are acknowledged: (1) Small family groups repeatedly camping on the same ridge over a long period of time could have cumulatively created a palimpsest assemblage of large numbers of lithic artifacts. However, these sites are generally characterized by diffuse scatters with small clusters of relatively few projectile points within larger scatters of artifacts. (2) A ques-

tion may be raised regarding the number of points that should be present at a single site in order for that site to represent the ancient remains of a surround or corral rather than an encounter or ambush hunting episode. Some of the aboriginal corrals with Desert Side-Notched points, for example, contain as few as six points on the surface. However, most of these sites are located within depositional zones that consist of loose, aeolian silts. Six Desert Side-Notched points on the surface in this context will represent only those visible at the time of site recordation. A complete excavation of the sediments associated with these corrals would undoubtedly reveal many more points. Most of the pre-Desert Side-Notched kill spots reported here were found on deflated surfaces, which enhanced their archaeological visibility. Other ancient kill spots were found within depositional microenvironments, so for some of these sites the number of points listed are minimum figures. A cut-off of 20 points, together with the other features noted above, seems conservative and reasonable to interpret a site as representing an early surround or corral created by communal hunting. (3) Sites containing large numbers of points can also be created outside of the actual kill spot if large numbers of foreshafts with broken points were retrieved and collectively dropped at a repair/retooling station. In these cases, sites should consist of broken bases with few or no tips or complete points. This situation was discussed by Petersen and Stearns (1992), who found the first two large concentrations of projectile points in the region during highway and gravel pit surveys. However, all of the sites interpreted here as kill spots consist of large numbers of complete points, point tips, and point midsections except the Town Creek Site (see Table 8).

The Chronological Distribution of Communal Hunting

The projectile point data presented here are based on nearly 2,000 specimens recorded from over 100 individual sites within the study area. Of these, 1,406 (70 percent) were recovered from the 15 sites interpreted as kill spots, and listed in Table 8. The remaining 600 points were recorded from dozens of smaller sites within the study area representing all phases of the EH, MH, and LH. Table 9 shows the total number of points identified to style (1,167) from all sites in the study area, with the raw num-

Table 8. Pre-Desert Side-Notched Kill Spots in the Study Area. Includes Only Those Sites with 20 or More Projectile Points.

Site	Total Number of Points	Identifiable Points
11-5014	256	72 Humboldt; 7 Elko; 5 Rose Spring; 1 Gatecliff
11-12602	188	62 Humboldt; 34 Elko; 3 LSN; 1 Gatecliff
11-5336 ^a	150	94 Gatecliff
11-8030	149	55 Humboldt; 45 Elko; 3 Rose Spring; 1 Gatecliff; 1 LSN
11-13086	128	21 Gatecliff; 2 Humboldt
11-12575	86	46 Eastgate/Rose Spring; 7 Elko; 3 Cottonwood; 1 Humboldt; 1 LSN
11-13074	85	51 Gatecliff; 1 Humboldt
11-12576	81	54 Elko; 1 Gatecliff; 1 Rose Spring
11-12195	70	35 Elko; 11 Gatecliff/Gypsum; 8 Humboldt
11-8832	52	42 Elko; 3 Rose Spring
11-12603	43	21 Elko; 7 LSN; 2 Humboldt
11-13390	38	13 Elko; 2 Eastgate; 1 LSN
11-8833	32	26 Elko
11-12604	28	13 Eastgate; 5 Elko; 3 Humboldt
11-12191	20	19 Elko

^aPetersen and Stearns (1992) argued that the Town Creek site represents a place where foreshafts were retrieved from a nearby kill spot, with the broken points unbound and dropped here. This interpretation seems correct because few complete points or tips were found at the site. However, the kill spot, which undoubtedly contains a large number of point tips along with other points not retrieved, was likely located very close to the site, and thus this site is used as a representative of a Gatecliff-era killing event.

bers also scaled to the number of years each point style was manufactured.

The data in Table 8 suggest that foragers who manufactured Humboldt, Gatecliff, Elko, and Eastgate projectile points engaged in the communal hunting of pronghorn. Conspicuously absent are large concentrations of EH and MH-aged points (Great Basin Stemmed and Large Side-Notched). As noted above, Humboldt points date to at least the transitional period of 5000–4000 B.P. between the MH and the LH, so they were placed within that timeframe in Table 9. If some of these Humboldt kill spots are older than 5000 B.P., then MH communal pronghorn hunting is represented as well. Unfortunately, this possibility remains uncertain until firmer dates are obtained on this point style.

Gatecliff (and probably Humboldt) points date

between about 5000 and 3500 B.P., so it appears that this time frame represents the beginning of communal pronghorn hunting in the study area. Based on the large number of aboriginal corrals recorded, foragers were also actively engaged in communal pronghorn hunting as recently as 200–300 years ago. Thus, there is no evidence for communal pronghorn hunting prior to ca. 5000–3500 B.P., but there is ample evidence for this activity after this time until historic contact.

Discussion and Future Prospects

Prior to 5000–3500 B.P., foragers in the study area who manufactured Great Basin Stemmed and Large Side-Notched projectile points probably were organized into small family units during hunting episodes. Small, mobile groups apparently were

Table 9. Identifiable Projectile Points Recorded in the Study Area.

Point Style(s)	Time Span	Years	Number of Points	Points Per Century	Period
Desert Side-Notched & Cottonwood	550 B.P. –Present	550	124	23	Late
Eastgate & Rose Spring	1300–550 B.P.	750	115	15	Archaic
Elko	3500–1300 B.P.	2200	428	20	Middle
Gatecliff, Gypsum & Humboldt	5000–3500 B.P.	1500	437	29	Archaic
Large Side-Notched	7500–5000 B.P.	2500	34	1	Early Archaic
Great Basin Stemmed	10800–7500 B.P.	3300	29	1	Paleoarchaic
Total			1167		

moving in and out of the region relatively quickly, probably encounter hunting and foraging for plant resources along the way. Ambushing pronghorn or "charming" individual animals during migrations are possibilities. These activities associated with small family groups continued after 5000 B.P. as well. However, sometime between 5000 B.P. and 3500 B.P., social relations between small bands of foragers who now manufactured Gatecliff and Humboldt points changed—they were at times cooperating in multiple family units to communally hunt pronghorn. They spent longer periods of time in the study area during these episodes, sometimes investing rather substantial labor in the construction of corrals, and at other times surrounding pronghorn and killing large numbers of animals trapped on ridgetops. These large get-togethers probably served other purposes such as match-making and alliance-building. This general pattern continued until historic contact within groups who manufactured Elko, Eastgate, and Desert Side-Notched projectile points.

Interestingly, the cultural continuity of communal pronghorn hunting since the MH-LH transitional period cross-cuts the development and spread of four culture phases (South Fork, James Creek, Maggie Creek, and Eagle Rock; see Table 6) and two periods (Middle and Late Archaic), the latter of which included the switch from the atlatl and dart to the bow-and-arrow as the primary hunting weapon, as well as the introduction of ceramics by 1100–1200 B.P. (Hockett and Morgenstein 2003). In any case, these communal hunting efforts probably would have resulted in the deposition of large numbers of artiodactyl bones to individual sites within a short span of time, signaling the mass collecting of artiodactyls.

In general, these data support Hildebrandt and McGuire's (2002) and McGuire et al.'s (2004) argument that a change in social organization coincided with the transition to LH climates in California and the Great Basin. However, the interpretation that LH climates fostered increasing numbers of artiodactyls and that human foragers responded in kind by intensifying large-game hunting currently finds little support as a general pattern from the faunal record of the Great Basin, although it likely occurred at specific locales. For example, the projectile point and corral data suggest that foragers did indeed intensify pronghorn hunting in certain

regions during the MH-LH transitional period through communal hunting efforts. Yet caves and rockshelters from the Great Basin and northern Colorado Plateau suggest that the intensity of artiodactyl and leporid bone deposition at individual sites varied based on factors such as location and elevation.

The faunal and corral/projectile point data are contradictory only in the context of sweeping models that propose that foragers responded in essentially the same manner to changes in environmental and social conditions across the Great Basin and beyond. Unfortunately, there is no mathematical formula that accounts for the variability in the archaeological record of the Great Basin, nor for its continuities. Instead, the faunal and lithic records suggest that foragers responded to local situations in uniquely human ways that are not always predictable (e.g., Binford 2001). And yet that is what makes the study of human behavior so fascinating.

Overall, then, the intensity of small game use seems to have varied between the MH and LH within a context of relative stability in large-game hunting throughout this period in the Great Basin and northern Colorado Plateau. It therefore appears that any increases in small game procurement in the latter LH of the north-central Great Basin likely came about as an addition to, rather than a substitution for, other resources such as artiodactyls. This general pattern is not restricted to the Great Basin: it is characteristic of the European Upper Paleolithic in regions such as north-central and eastern Europe, as well as much of the Iberian Peninsula (Hockett and Haws 2003, 2005).

From a demographic perspective, if foragers were consuming more artiodactyls during the LH, we might expect them to drop their previous levels of consumption of small game taxa only if population densities were remaining constant or declining. Given that human population densities were likely increasing during the transitional period between the MH and LH, there simply is no reason to expect a reduction in small-game hunting through time regardless of the intensity of large-game hunting. Models such as nutritional ecology (e.g., Haws 2004; Hockett and Haws 2003, 2005) would predict that resource diversity should be either maintained or increased during periods of human population pulses because diverse diets increase the probability that females will consume

the essential nutrients necessary for proper fetal development. Such a pattern of maintaining or increasing resource diversity in the context of increases in the intensity of site use is precisely the pattern documented at sites such as Pie Creek Shelter. Nutritional ecology-based approaches within archaeology have the advantage of being based on current knowledge about the impacts of nutritional factors on human fertility and mortality rates, so these types of models should prove useful in the future.

The idea of mass collecting small animals such as hares with nets began at least two or three millennia before the advent of the LH in nearby regions (e.g., Schmitt et al. 2004). It is possible that the LH changes to mass collecting pronghorn partially occurred as a result of growing human populations who began utilizing similar hunting methods (surrounding), as well as new technologies (corral construction) in order to intensify the taking of large- and small-game resources. In fact, pronghorn are known for their high rate of survival in a variety of environments and climatic situations due to a combination of behaviors, food preference, and physiological design, and their populations can rebound relatively quickly following declines (Sundstrom et al. 1973).

Finally, although Bettinger (1999) has generally applied his model of culture change to post-2000 B.P. sites in the Great Basin, his emphasis on the relationships between how people relate to their environment, technology, and population growth may have relevance to the sociocultural changes that occurred between 4000 and 5000 B.P. in the Great Basin. For example, Bettinger (1978, 1999) argued that a change in thinking about resources as private rather than public goods resulted in the intensified use of plant resources, which in turn sparked changes in technology and, ultimately, led to a continuation of population growth in the Great Basin. In a similar vein, a change in the way foragers thought about their environment and their relationships to one another appear to be manifested in a change to communal pronghorn hunting between 5000 and 3500 B.P. in the north-central Great Basin. Both cave/rockshelter and open-air sites have relevance to testing such propositions.

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