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ZOOARCHAEOLOGICAL ANALYSIS OF SUBSISTENCE PRACTICES AT THE LAKE ROBERTS VISTA SITE (LA71877) GILA NATIONAL FOREST, NEW MEXICO

By

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Zooarchaeological Analysis of Subsistence Practices at the Lake Roberts Vista Site (LA71877) Gila National Forest, New Mexico

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Abstract

This work examines the faunal subsistence practices at Lake Roberts Vista, a small Mimbres pueblo with a pithouse component occupied during the Late Pithouse to Classic Mimbres periods (A.D. 550-1130). It is in the Sapillo Valley, a tributary to the Gila River in southwestern New Mexico. Inhabitants consumed mostly deer and rabbits throughout their occupation. Evidence suggests a decline in Artiodactyla resource abundance in later years based on a declining Artiodactyl Index and an increasing fragmentation rate of Artiodactyla bones. Inhabitants captured more cottontails than jackrabbits throughout their occupation.

Acknowledgments

Virginia L. Lucas was instrumental throughout my education at UNLV. Without her guidance and friendship, I would not be where I am today. She provided uncounted hours of instruction and assistance toward the proper identification and analysis of the faunal material discussed herein. I am eternally in her debt for this and many other reasons. I could not have asked for a better mentor.

Dr. Barbara J. Roth allowed me access to the faunal material and excavation notes. Our ongoing discussions concerning Lake Roberts Vista assisted in my analysis and conclusions. As my committee chairperson, she provided helpful advice after every draft for improving the next.

As committee members, Dr. Levent Atıcı, Dr. Karen G. Harry, and Dr. Gabriel Judkins answered questions, provided reference material, and assisted my writing of this thesis with their insights and expertise.

Thank you all for your assistance.

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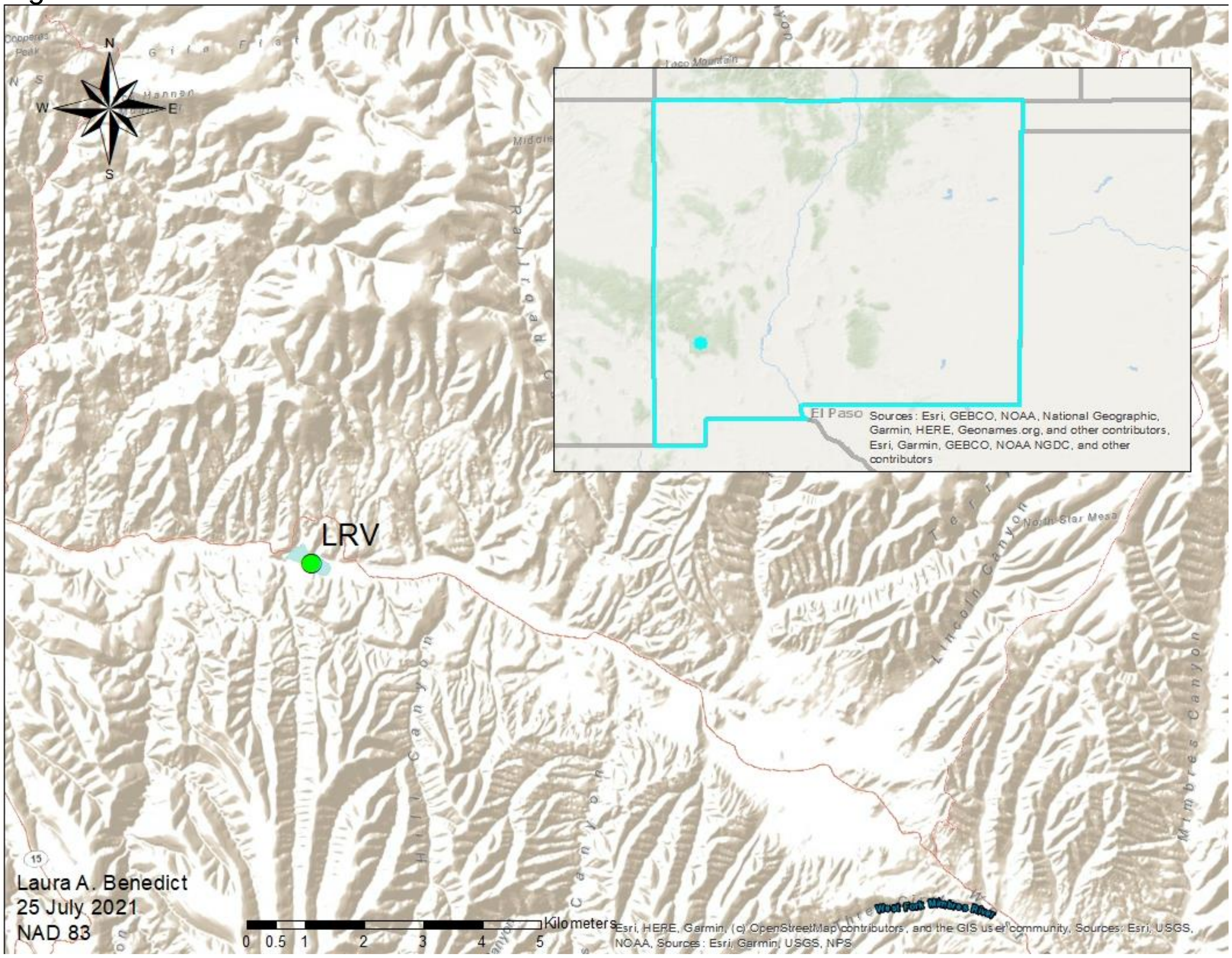
Chapter 1: Introduction

An archaeologist makes a meaningful statement about a dynamic past based on static, contemporary facts (Binford and Bertram 1977). They do this to illuminate human behavior based on archaeological remains (Binford 1978). A zooarchaeologist reconstructs lifeways to the extent allowed by faunal remains (Klein and Cruz-Uribe 1984). To be more precise, zooarchaeologists study human interactions with animals and the consequences on both the animals and the humans (Reitz and Wing 2008). By analyzing faunal remains, zooarchaeologists can answer many questions concerning the environment surrounding a site, the diet of the people within a site, and the way people used certain animal products. This work examines the faunal subsistence practices of Lake Roberts Vista (LRV; Figure 1), a small site in the Sapillo Valley, which connects the Mimbres Valley with the upper Gila area of the Mimbres Region. Inhabitants occupied LRV from the Late Pithouse to the Classic Mimbres periods (A.D. 550 – 1130).

LRV is distinct among Mimbres sites because it is along the Sapillo Creek, a tributary of the Gila River, rather than along the Mimbres River. It is a small, 15-20 room pueblo site with a pithouse component. Its Late Pithouse great kiva is larger than expected for the site size (56.25 m^2). It is at a higher elevation (6180 ft.) and is in a more mesic environment than many of the sites in the lower portion of the Mimbres Valley. As well, the inhabitants remained seasonally mobile for longer than did most occupants of the Mimbres Valley (Roth 2007).

Figure 1: Lake Roberts Vista Location



The purpose of this research is to document the faunal subsistence practices of the inhabitants of LRV during the Late Pithouse to Classic Mimbres periods (A.D. 550 – 1000), to document the changes over time, and to compare the practices to contemporaneous sites in the Mimbres region. To facilitate this goal, I will address three research questions.

1. **What faunal subsistence practices did inhabitants of LRV use during the Late Pithouse to Classic Mimbres periods?** Specifically, what species did they consume at LRV?
2. **What changes in faunal subsistence practices, if any, occurred through time?** Specifically, what species did they use in one period but not another, and how were species used differently between periods?
3. **How did faunal subsistence practices at LRV compare with contemporaneous sites in the Mimbres region?** For comparison, I chose five sites to span the diversity of elevations throughout the Mimbres region and faunal assemblages representing the Late Pithouse period through the Classic Mimbres period.

Overview of the Following Chapters

Before I present my findings, I provide a background to the region and the theories upon which I base my analysis. In Chapter 2, I describe and briefly summarize the history of archaeology in the Mimbres region, defining the chronological terms used throughout this work and describing the archaeological characteristics typical for each period. I then discuss previous zooarchaeological research.

In Chapter 3, I summarize the Human Behavioral Ecology Theory (HBE) and some of its subsets used to predict human behavior concerning the hunting of wild animals: the *patch choice model,* the *marginal value theory,* and the *prey choice model*. I use these subsets as a basis for my analysis.

In Chapter 4, I describe LRV and the five contemporaneous comparative sites: La Gila Encantada, Harris, Mattocks, Galaz, and NAN Ranch.

In Chapter 5, I present my research questions and describe what evidence I will use to address them. I then describe my methodologies for analyzing the data gathered and for calculating analysis tools.

I present my results and address my research questions in Chapter 6, using the foundation of the theories summarized in Chapter 3 and the methods presented in Chapter 5.

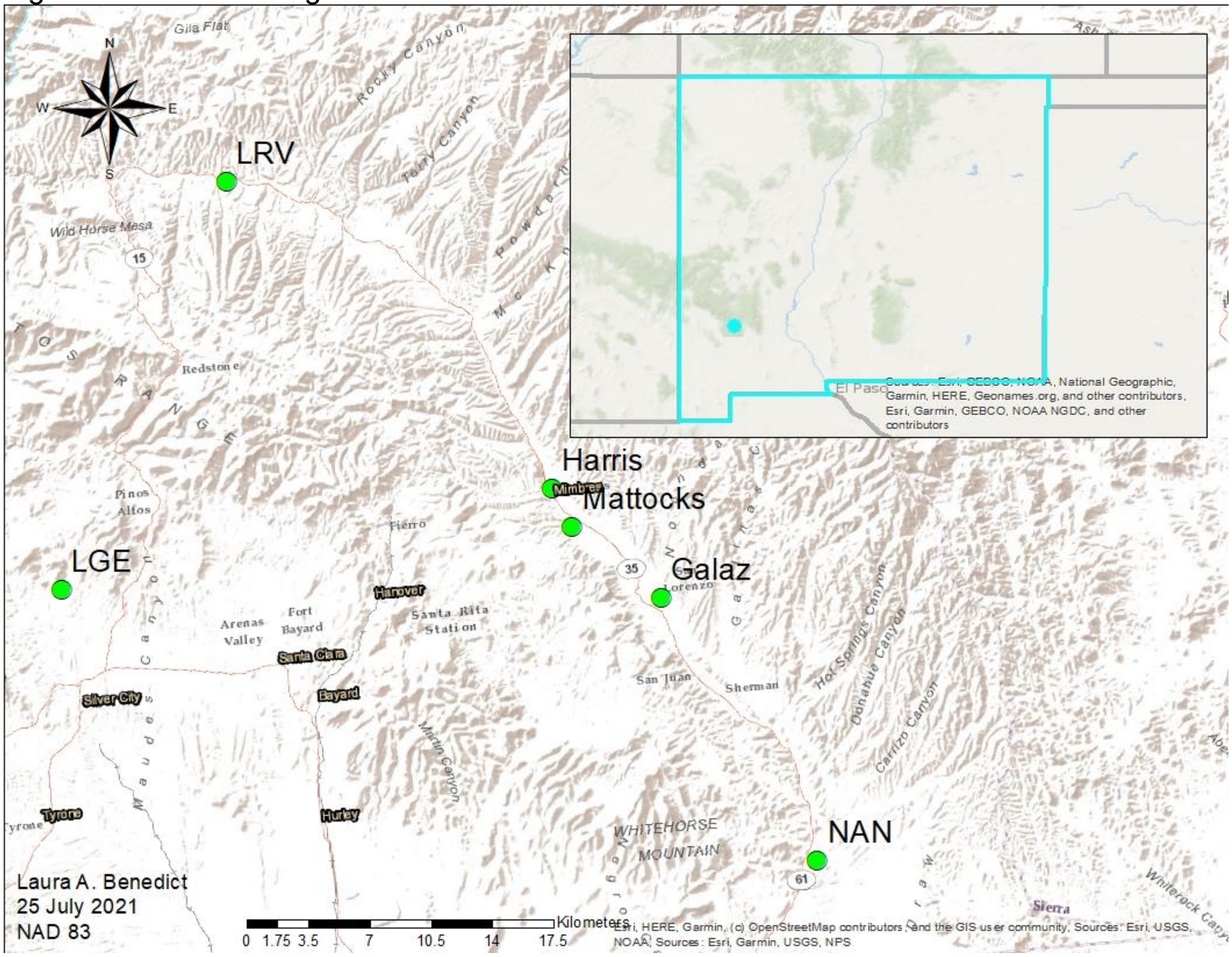
I summarize my findings and discuss their significance in Chapter 7.

Chapter 2: Mimbres Region Description

Mimbres Region Archaeology

The Mimbres region (Figure 2) encompasses the southwestern corner of New Mexico with peripheries extending into Arizona, Mexico, and Texas (Hegmon 2002; Roth, Gilman, and Anyon 2018). The topography is basin-and-range with two major rivers: the Gila River and the Mimbres River (Roth, Gilman, and Anyon 2018).

Figure 2: Mimbres Region with Sites Mentioned in this Work



The Black Range and Mimbres Mountains form the eastern edge of the region with the western edge at about 109° W latitude (Graybill 1975). All large Mimbres communities are in the agriculturally productive area between the Mogollon Plateau and the grasslands (Shafer 2003). In the 1880s, Bandelier and Webster mapped the Mimbres region, but archaeologists only began paying attention when Fewkes (of the Smithsonian Institution) published observations about the distinctive Black-on-white pottery he obtained from a local pothunter (Anyon and LeBlanc 1984; Shafer 2003). The designs found on Classic Mimbres ceramics are unique in their time and place in that no other United States Southwestern culture created the distinct imagery and designs (Gilman and LeBlanc 2017; Shafer 2003). Hogan (2004) called the quality of Mimbres ceramics far superior to later Southwestern ceramics.

By the end of the nineteenth century, local people already knew of the existence of the ceramics and how to find them. However, when Osborne sold a collection of pottery to Fewkes in 1914, they inadvertently began the private and commercial looting and collecting trade that continues to flourish and destroy sites in the area today (Shafer 2003). The trade has since decimated Mimbres archaeological sites so that future excavation opportunities are severely limited (Shafer and Taylor 1986). Professional archaeological work began with the excavations of the Swarts Ruin, the Galaz Ruin, and the Mattocks site in the 1920s (Anyon and LeBlanc 1984). Emil Haury developed the first chronology for the Mimbres region (Table 1) using changes in the ceramic styles and architecture found at pithouse sites (Haury 1936; Anyon and Roth, 2018; Roth, Gilman, and Anyon 2018).

In the 1970s, the Mimbres Foundation conducted a region-wide survey of the Mimbres Valley and excavated several pithouse and pueblo sites (Anyon and LeBlanc 1984). They focused on documenting changes through time within and between sites (Anyon and LeBlanc 1984). They then synthesized analyses of ceramic style progression with dendrochronological data to confirm Haury's original broad chronology, making it more accurate while increasing their understanding of the Classic Mimbres period (Anyon et al. 1981). Shafer and Taylor (1986) documented the evolution of pueblo architecture at NAN Ranch Ruin, coordinating it with the evolution of ceramic styles and dendrochronology. Shafer (2003) helped refine the pueblo sequence with dendrochronology and archaeomagnetic dating techniques.

Archaeologists continue to refine the Mimbres chronology, improving the accuracy with more data (Anyon et al. 2017; Anyon and Roth 2018). In the chronological lexicon of the Mimbres region, a major adaptive shift heralds a change in the period while stylistic changes indicate a phase shift (Anyon et al. 1981; Anyon et al. 2017; Anyon and Roth 2018). The movement of communities from the tops of knolls to the first terrace above the river, tied to an increase in agricultural dependence, signaled the transition from the Early Pithouse to the Late Pithouse periods (Anyon et al. 1981). Similarly, the transition from separate pithouses to connected surface pueblos signaled the end of the Late Pithouse period and the beginning of the Classic Mimbres period (Anyon et al. 1981). Within each period, major changes in style signal phase changes (Anyon et al. 1981; Cannon 2001). In ceramics, archaeologists see style changes in the addition of painted decorations beginning in the San Francisco phase and the change of designs through time (Anyon et al. 1981).

With pithouses, archaeologists see style changes in the straightening of the sides, seen in the San Francisco phase, and the squaring of the corners, seen in the Three Circle phase (Anyon et al. 1981).

Table 1: Mimbres Region Chronology

Period	**Phase**	**Date Range**	**Archaeological Characteristics**
Late Pithouse	Georgetown	550-650	Circular pithouses; plain and San Francisco Red pottery
	San Francisco	650-750	Rectangular pithouses with rounded sides; Mogollon Red-on-brown pottery; increase in communal structure size
	Three Circle	750-1000	Rectangular pithouses with squared corners; Three Circle Red-on-white; Mimbres Style I (Boldface) Black-on-white pottery; increase in the size of communal structures A.D. 900-1000: rooms with shallow floors and thin adobe walls; Mimbres Style II (transitional) Black-on-white pottery.
Classic Mimbres		1000-1130	Aboveground masonry pueblos; Mimbres Style III (Classic) Black-on-white and corrugated pottery; large, aggregated sites.

(Adapted from Anyon et al. 2017: 324; Roth, Gilman, and Anyon 2018:10)

Late Pithouse Period

The Late Pithouse period (A.D. 550-1000) encompasses three phases: the Georgetown phase (A.D. 550-650), the San Francisco phase (A.D. 650-750), and the Three Circle phase (A.D. 750-1000). The Late Pithouse period ended with the transition to above-ground pueblos (Anyon et al. 2017; Anyon and Roth 2018).

Georgetown phase. Archaeologists define the Georgetown phase by the advent of San Francisco Red, a red-slipped ceramic style (Anyon et al. 1981; Anyon et al. 2017; Roth, Gilman, and Anyon 2018). Pithouses were frequently circular or D-shaped and were deeper and larger than earlier examples (Anyon et al. 2017; Roth, Gilman, and Anyon 2018). At the onset of the Georgetown phase in the Mimbres Valley, sites typically moved from hilltops to the first terrace above the river. Georgetown phase sites normally remained small with fewer than fifteen houses (Cannon 2001; Roth, Gilman, and Anyon 2018), and with inhabitants remaining seasonally mobile at least through the early years (Anyon and Roth 2018). Kivas are pit structures that are larger than domestic pithouses that inhabitants used for communal events. In this phase, kivas frequently exhibited lobes in the shape of the construction, giving them a kidney-shaped outline (Anyon, LeBlanc 1980). In the Georgetown phase, many kivas display evidence of use as domestic structures as well as ritual spaces, and few features besides size distinguish them from domestic pithouses (Anyon and LeBlanc 1980). At around the transition to the San Francisco phase, populations increased, and communities exhibited a greater commitment to year-round sedentism and agricultural production (Anyon and Roth 2018; Roth 2016; Roth, Gilman, and Anyon 2018).

San Francisco phase. The Mimbres people created Mogollon Red-on-brown ceramics in the San Francisco phase and built rectangular pithouses with rounded corners (Anyon et al. 2017; Roth, Gilman, and Anyon 2018). During this phase, great kivas were significantly larger than domestic pithouses and inhabitants used them exclusively as ritual spaces (Anyon and LeBlanc 1980; Roth, Gilman, and Anyon 2018). Many sites experienced population growth and inhabitants increased dependence on agricultural products during the San Francisco phase (Anyon et al. 2017; Anyon and Roth 2018).

Three Circle phase. The Three Circle phase was a time of rapid changes throughout the Mimbres region, likely because of increased reliance on agricultural products and a continued increase in population (Roth, Gilman, and Anyon 2018; Schollmeyer 2009). Inhabitants built large rectangular kivas, some with masonry interior walls, possibly indicative of more formal rituals (Roth, Gilman, and Anyon 2018). They also built rectangular pithouses in clusters, possibly indicative of extended family groups working together in shared courtyards (Anyon and Roth 2018; Roth and Baustian 2015). In some cases, remodeled pithouses included blocked ramp entryways, converting them to ventilator shafts in the late Three Circle phase (Shafer 1995). At larger sites, the kiva opened to a communal plaza, possibly indicative of utilizing the kiva for more private rituals and using the plaza for more public, community-wide ceremonies (Creel and Shafer 2015). Ceramic styles progressed from Three Circle Red-on-white in the early years of this phase to Style I Black-on-white, and then Style II Black-on-white (Roth, Gilman, and Anyon 2018).

By the end of the Three Circle phase, basin-lined hearths became slab lined and inhabitants began to bury certain family members under the floor of pithouses with ritually killed bowls added to some of the graves (Roth, Gilman, and Anyon 2018; Shafer 1995; Shafer and Taylor 1986). The transition from pithouses to pueblos happened relatively quickly, leaving little archaeological evidence that an excavation team could easily miss (Anyon et al. 1981; Sedig et al. 2018). At some sites, excavations revealed a few pueblo rooms with Style II Black-on-white ceramics indicating an early adoption of pueblo architectural styles (Sedig et al. 2018). At the Woodrow Site, in the Gila River Valley, archaeologists found three houses using the same footprint, providing a clear example of architectural changes during the transition (Sedig et al. 2018:68). At NAN Ranch, cobble-adobe constructions with sunken floors preceded surface pueblo rooms on the same footprint displaying the transition through time (Shafer 1995, 2003).

Classic Mimbres

Regionally, the largest number of occupied sites and the highest population density occurred during the Classic Mimbres period (Gilman et al. 2018). By the early Classic Mimbres period, most homes were surface pueblos in room blocks (Anyon et al. 2017; Roth, Gilman, and Anyon 2018). Extensive remodeling indicates continued use over time while building more rooms as needed (Gilman et al. 2018; Shafer 2003). The use of room blocks indicates that people organized sites around extended family households (Shafer 2003). Inhabitants stopped using great kivas by the end of the Three Circle phase or during the transitional phase in favor of communal plazas (Roth, Gilman, and Anyon 2018).

Instead, corporate kin groups constructed kivas and granaries into their room blocks (Shafer 2003). The only painted style of ceramics made locally during the Classic Mimbres period was Style III Black-on-white, and this was not widely traded outside the Mimbres region (Creel and Speakman 2018; Gilman et al. 2018).

Mimbres Region Environment

Inter-site ecological differences depend on elevation, annual precipitation, and other factors (Diehl and LeBlanc 2001). In Southwestern New Mexico, the primary foliage of the region is juniper and piñon between 5,000 and 8,000 feet in elevation (Bailey 1913). The arid climate provides enough annual rainfall to support the sufficient growth of grasses and edible plants but is not sufficient for dry farming (Bailey 1913). Higher elevations have more juniper and piñon trees because of more annual rainfall (Bailey 1913). In contrast, the lower elevations have more grasses, low shrubs, and cacti with the defining juniper and piñon trees only along waterways such as streams and rivers (Bailey 1913). Because of climate and population variability, both spatial and temporal differences explain changes in faunal subsistence between sites.

Mimbres Faunal Subsistence Patterns

At most sites in the Mimbres region, the most common animal remains found in the assemblage are from the family Leporidae, such as jackrabbits (*Lepus* spp.) and cottontails (*Sylvilagus* spp.; Anyon and LeBlanc 1984; Cannon 2001; Sanchez 1996; Schollmeyer 2009). However, the most economically important animals are in the Order Artiodactyla, such as deer (*Odocoileus* spp.), pronghorn (*Antilocapra americana*), and elk (*Cervus canadensis*; Bayham 1979; Cannon 2001; Orians and Pearson 1979).

Other animals possibly used as food include Aves (such as turkey, quail, and ducks) and Rodentia (such as badger and ground squirrel; Graybill 1973; Schollmeyer and MacDonald 2020). In the Mimbres region, faunal subsistence practices remain understudied, although several zooarchaeologists have researched hunting and faunal use changes during the Early Pithouse period (A.D. 200-550) through the Black Mountain phase (A.D. 1200-1300; Cannon 2001; Schollmeyer 2009, 2018). As large mammal resource reduction in the Mimbres region is evident, a major theme among zooarchaeological studies is the question of when that reduction first occurred (Cannon 2001; Schollmeyer 2009, 2018). Human hunting patterns are a major determining factor for densities of desirable species, which can lead to resource depression (Alvard 1993; Freese et al. 1982; Kay 1994). Evidence suggests a reduction of access to large mammals occurred sometime between the Early Pithouse period and the Three Circle phase as humans became more sedentary, as site populations increased, and as the number of communities increased (Cannon 2001; Schollmeyer 2009, 2018).

Sanchez (1992) re-examined conclusions presented in unpublished theses and compared those to new data from NAN Ranch and Old Town. She compared several faunal studies throughout the Mimbres region, noting that the differences in species found at each site were due, at least in part, to environmental factors such as elevation, annual rainfall, and local floral abundance. For instance, cottontails were more abundant in the upper valley with a more wooded environment while jackrabbits were more abundant in the middle (grassy) and lower (scrubby) valley. Sanchez found no significant difference in Artiodactyla use throughout the region between the Late Pithouse and Classic Mimbres periods.

Schollmeyer (1999) studied how site size affected the environment in the Mimbres Valley during the Classic Mimbres period and in the eastern Mimbres region during the Black Mountain phase. She found more evidence for anthropogenic changes in the local flora than in the local fauna in both areas in that larger sites caused a greater reduction of riparian wood than did smaller sites. She wrote that the riparian wood population significantly recovered during the period of non-occupation between the Classic Mimbres period and the Black Mountain phase, but she found no significant differences in the Artiodactyla population between those same periods (Schollmeyer 1999). She later focused on the eastern Mimbres area to assess environmental changes in the Classic Mimbres period and the Reorganization phase (A.D. 1130-1250). Even though she found no significant decrease in resources to explain the rapid depopulation of the area during the Reorganization phase, she wrote that perceptions of significant changes might have precipitated a desire to move elsewhere (Schollmeyer 2009). While prime agricultural land was slightly less available, there remained sufficient land near villages to support the population (Schollmeyer 2009). While large mammals were not overly abundant in the area, there were no significant changes in the relevant abundances of Artiodactyla remains between the Classic Mimbres period and the Reorganization phase in the eastern Mimbres area (Schollmeyer 2009). However, the faunal remains were heavily processed (e.g., fragmented to access marrow), indicating hunters may have needed to travel farther to capture them (Schollmeyer 2009). Expanding her study to include the four geographical areas (Reserve, upper Gila, Mimbres Valley, and eastern Mimbres) within the Mimbres region, Schollmeyer (2018) tracked changes in Lagomorpha and Artiodactyla use coincident with population and agricultural intensification changes. By incorporating data throughout the length of occupation (A.D. 200-1450) for all four geographical areas, she effectively documented the broad pattern of subsistence the Mimbres people followed in all environments. In the Mimbres Valley area, Schollmeyer (2018) found Artiodactyl and Lagomorph Index values lower than those of the upper Gila area and no significant changes between the Late Pithouse and Classic Mimbres periods. In the upper Gila area, Schollmeyer found no significant changes in the Lagomorph Index between the Late Pithouse and Classic Mimbres periods. In addition, she found a larger relative number of Artiodactyla remains in the Late Pithouse period than in the Early Pithouse period, with a significant decrease in the Classic Mimbres period. This surprising pattern of fewer Artiodactyla remains in the Early Pithouse period might be because of a difference in site occupation patterns between periods. During the Early Pithouse period, people occupied pithouses for a shorter duration (seasonally rather than year-round) and for fewer years than they did pithouses in the Late Pithouse period (Schollmeyer 2018).

Cannon (2000, 2001) analyzed faunal material from McAnally, Mattocks, Galaz, and Old Town in the Mimbres River Valley. He found a significant decrease in the relative abundance of Artiodactyla from the McAnally sample dated to the Early Pithouse period to the Galaz sample dated to either the Georgetown or San Francisco period. From this decrease, he found support for his hypothesis that the Early Pithouse period had more Artiodactyla because of fewer hunters and other anthropogenic stresses. He found another decline from Galaz and Mattocks between the Three Circle period and the Classic Mimbres phase.

However, he found no significant differences in Artiodactyla use between periods at Old Town, and no significant differences at any site after the Three Circle period. Evidence from the Mattocks site suggests selectivity in body parts returned to the community, possibly indicating that hunters needed to travel farther to capture Artiodactyla in a pattern like that found in the eastern Mimbres area (Cannon 2001; Schollmeyer 2009).

Each of these researchers compared sites throughout the Mimbres region and found a similar pattern of Artiodactyla resource reduction, that relative numbers decreased from the Early Pithouse to the Classic Mimbres periods. Cannon (2001) concluded the large mammal resource reduction happened sometime during the Early Pithouse period or early in the Late Pithouse period to account for this pattern in the Mimbres Valley, but Schollmeyer (2018) found no significant differences in the Mimbres Valley between the Early Pithouse and Late Pithouse periods. This lack of significant changes might be because of the low values found throughout all periods (Schollmeyer 2018). However, in the upper Gila area, she found an increase in the Artiodactyla Index from the Early Pithouse to the Late Pithouse periods, followed by a decline in the Classic Mimbres period.

Chapter 3: Theoretical Background

The foundation of Human Behavioral Ecology theory (HBE) is evolutionary in that it assumes that the goal of all people is to produce as many offspring as possible that survive long enough to procreate (Barlow 1997; Lupo 2006). Behavioral ecologists define human behavior as adaptive if that behavior generally increases longevity and procreative ability, and maladaptive if it does not (Ferguson 2016). To accomplish this goal, HBE assumes people always strive to maximize their nutrient intake per unit of energy spent to obtain it (Bettinger 1991; Bird et al. 2009) and that more efficient foraging strategies will always be favored over less efficient strategies (Hawkes et al. 1982). Another assumption is that people know exactly what resources are currently available, the energy required to obtain them, and the energy available from them (Barlow 1997). As well, HBE assumes that all behavioral variations affect the survival rate of individuals (Gremillion 1996).

One of the most frequent uses of HBE is to identify resource depression: the reduction of the rate of capture of a prey species in a predator’s range (Charnov et al. 1976). Resource depression happens because of over-hunting, because prey adjusts behavior, or because prey moves locations to avoid capture (Charnov et al. 1976; Shaffer and Schick 1995). The optimal diet in the Mimbres region during the Late Pithouse to Classic Mimbres periods ranked Artiodactyla as highest in profitability and desirability (Cannon 2010; Schollmeyer 2018). To measure foraging efficiency, the *patch choice model* predicts the most efficient place to find food, the *marginal value theory* predicts the most efficient foraging time in one patch, and the *prey choice model* predicts in what order hunters will seek available prey.

Patch Choice Model

A patch is a foraging area, separated from other patches by non-foraging areas (Bettinger and Grote 2016; Stephens and Krebs 1986). Hunters rank patches in order of expected gains per unit of time spent in the patch and then utilize the patch with the highest expected gain first (Stephens and Krebs 1986). The expected gain per patch can vary depending on the target prey, which usually corresponds with the density of that prey within the patch (Bettinger 1991; Broughton et al. 2010; Hawkes et al. 1982). Hunters are usually aware of what species they are likely to encounter in a patch and they prepare appropriately to capture those species (Lupo 2007). One problem with this model is that an archaeologist can rarely claim a faunal assemblage originated from a single patch (Cannon 2010). However, for addressing research questions one and two, I view small mammals as coming from the agricultural field for reasons explained in Chapter 5 while large mammals are hunted at long distances, far away from the community. While I am unable to determine which (if any) faunal remains were a direct result of inhabitants hunting in the agricultural field they probably did so regularly (Badenhorst and Driver 2009).

Marginal Value Theory

The marginal value theory predicts the point in time when searching for another unit of resource in the same place is less productive than moving to another patch to continue the search (Bird et al. 2009; Cannon 2010). If over-used, hunters will eventually eliminate all prey from a given patch (Bettinger and Grote 2016; Charnov 1976).

However, as hunters remove a patch from use, they increase travel time to other patches, the time spent within the new patch, and the intensity with which they use the patch (Bettinger and Grote 2016; Winterhalder and Kennett 2006). One problem with this model is that archaeologists cannot empirically evaluate where patches existed or how hunters ranked them (Bird et al. 2009). However, in addressing research question two, I utilized the rates of highly fragmented faunal remains (discussed in Chapter 5) to illustrate that inhabitants probably hunted Artiodactyla at farther distances in later years.

Prey Choice Model

The prey choice model predicts the rank order of prey by profitability and desirability, which reflects the optimal order in which to obtain them to provide the greatest nutrient value per unit of energy used (Barlow 1997; Bettinger 1991; Bird et al. 2009; Broughton et al. 2010; Cannon 2010; Winterhalder and Kennet 2006). Hunters do not pursue a prey species on its own merits, but only in comparison with other prey they are likely to encounter (Stephens and Krebs 1986). The prey choice model assumes a hunter will always attempt to capture the highest-ranked prey species and will only include a lower-ranked species in the absence of the higher (Stephens and Krebs 1986). As the preferred prey declines within a patch, hunters will capture more of the less preferred species (Broughton et al. 2010; Stephens and Krebs 1986). One problem with this model is that it assumes that individual hunters search for all available prey whenever hunting, while those in the Mimbres Region hunted communally (Lupo 2007). In addressing research questions one and two, I treat Artiodactyla as the highest-ranked prey species and assume hunters capture them whenever they encounter them (Bayham 1979; Pianka 1970; Schollmeyer 2018; Stephens and Krebs 1986).

Putting It All Together

When hunters focus on Artiodactyla, they track them at long distances from the community, often on multi-day hunts (Dean 2007a). Hunters only add smaller, less desirable game (such as Lagomorpha) to their diet when they capture fewer larger, more desirable game (such as Artiodactyla) than they would prefer (Dean 2007b; Engen and Saether 2016; Shaffer and Schick 1995). When they do capture small game, hunters are much less likely to transport them over long distances (Dean 2007a). Therefore, small game are much more likely to reflect hunting activities centered around the community and their agricultural fields while large game are much more likely to reflect hunting activities at long distances from the community and their fields (Dean 2007a, 2007b).

Conclusion

In addressing research questions one and two, I treat Artiodactyla as the highest-ranked prey and assume hunters capture them whenever they encounter them (*prey choice model*). The hunters likely captured most Artiodactyla away from the site but captured Lagomorpha near the site (*patch choice model*). I use the increasing rate of highly fragmented Artiodactyla remains to illustrate that hunters probably went farther afield to capture Artiodactyla in later years (*marginal value theory*).

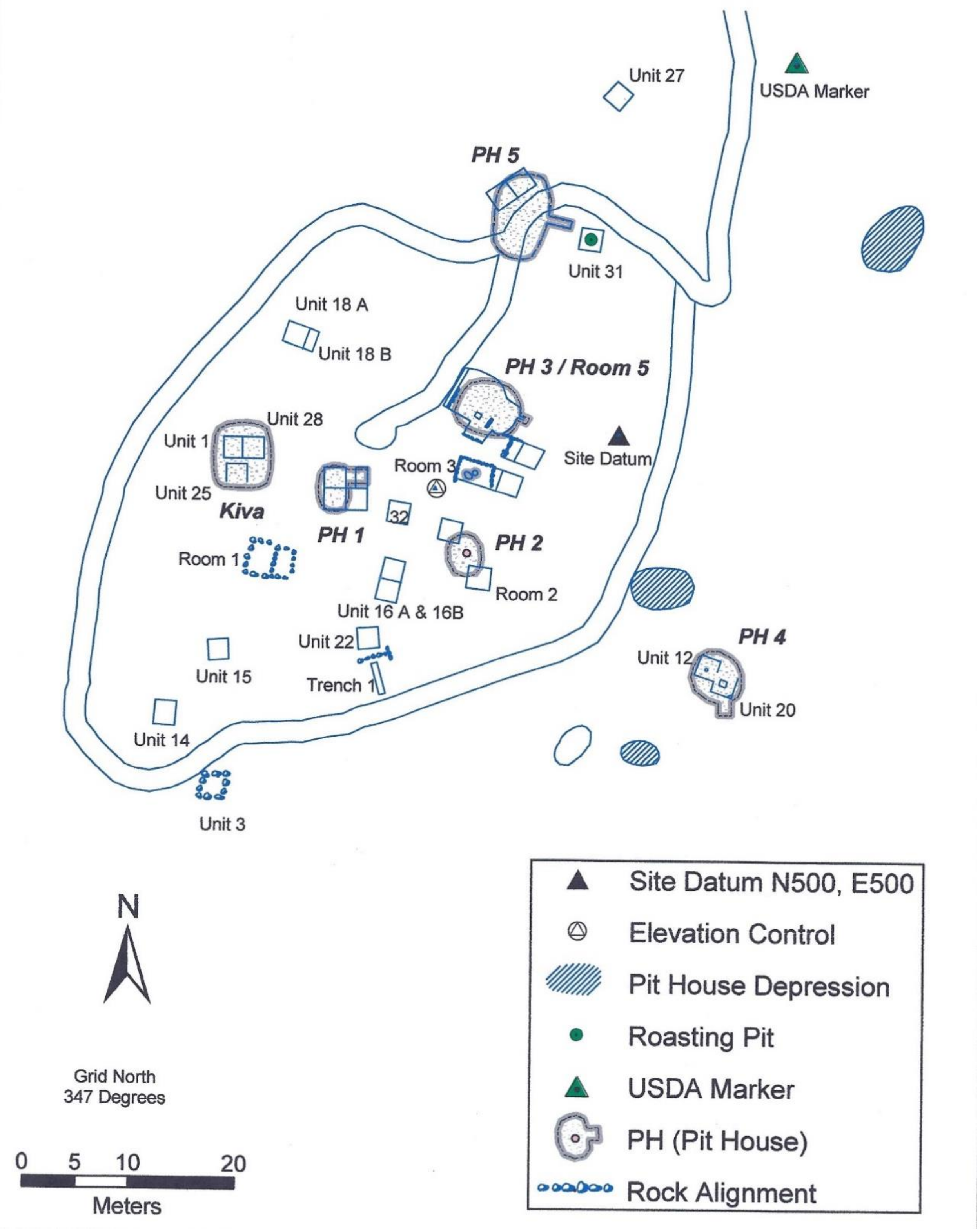
Chapter 4: Site Descriptions

Within the Mimbres region, there are four geographical areas: the Reserve, the upper Gila, the Mimbres Valley, and the eastern Mimbres areas (Schollmeyer 2018). This research focuses on the Mimbres Valley area, and the Sapillo Valley (where LRV is), which connects the Mimbres Valley and the upper Gila area. The Sapillo Valley is higher in elevation and enjoys more annual precipitation than do the sites in the lower Mimbres Valley.

Lake Roberts Vista

Lake Roberts Vista (LA71877; Figure 3) is a small, 15-20 room Mimbres pueblo site with a pithouse component within the Gila National Forest in southwestern New Mexico (Roth 2007). It is on a finger knoll about 30 meters above the Sapillo Creek, a tributary of the Gila River, which runs year-round because of several active springs (Stokes and Roth 1999). It is at an elevation of 1883 m. (6180 ft.) and is in the middle portion of the Sapillo Valley, surrounded by abundant natural resources including game, arable land, wild vegetation, and lithic material (Roth 2007). Roth and Bettison co-directed the excavation of LRV in anticipation of the Forest Service interpreting it for the public, including a sidewalk path, shown on the site map (Figure 3; Bettison and Roth 1995).

Figure 3: Lake Roberts Vista Site Map



From 14 surface collection units, the team collected diverse artifacts including turquoise, shell bracelet fragments, and ground stone, noting numerous potholes and depressions, which indicated significant pot hunting at the site (Roth 1996). Over the three field seasons, the team excavated 32 units, unearthing a great kiva, five pueblo rooms, and portions of six pithouses. Bettison and Roth planned excavation units to maximize the data gathered while preserving the site for future research (Roth 1996). The team excavated each unit in quadrants and screened all material through ¼” mesh with artifacts bagged by classification (lithics, ceramics, bone, etc.) and archaeological unit (Roth 1996). The team screened feature fill from hearths, storage pits, floor fill, and control units through 1/8” mesh (Roth 1996). On average, 20 cm. of “Cultural Fill” covered pueblo rooms while 50-80 cm. of “Cultural Fill” covered pithouses (Bettison and Roth 1995). Excavation followed natural levels where available (or arbitrary 20 cm. levels) and continued until they reached sterile soil, including below pueblo floors to search for pithouses (Roth 1996).

Evidence for occupation began in the Georgetown phase (A.D. 550-650; Table 3) of the Late Pithouse period (Roth 2007). The one Georgetown phase pithouse excavated at this site was round, had a floor plastered with tan clay, a ramp facing east, a basin hearth lined with clay, and a central post to support the roof (Roth 2007). Inhabitants utilized Alma Plain, Alma Black Burnished, and San Francisco Red ceramics (Roth 2007). Roth (2007) reported finding portions of six ceramic vessels from the floor of this pithouse as well as lithic tools, bone tools, and ground stone. The preservation of the contents of this pithouse is likely because of a fire that collapsed the roof (Roth 2007).

Inhabitants during the Georgetown phase likely practiced agriculture in the form of maize, beans, and squash. However, they relied mostly on wild resources during this phase, including by gathering local vegetation such as piñon nuts and hunting wild animals such as deer in the surrounding areas (Roth 1996; Roth 2007).

In the San Francisco phase (A.D. 650-750) of the Late Pithouse period, LRV pithouses were rectangular with rounded corners (Roth 2007). The inhabitants utilized Alma Plain, San Francisco Red, and Mogollon Red-on-brown ceramics (Roth 2007). Excavation of Pithouse 4 revealed three distinct floors. Inhabitants lived on the first floor during the San Francisco phase (Roth 2007). It was plastered with red-orange clay and had a clay-lined basin hearth (Roth 2007). Later in the San Francisco phase, inhabitants created the second floor, a layer of ash with certain materials placed there, including the left mandible of a now extinct grizzly bear (*Ursus arctus*). Roth (forthcoming) interprets this floor as a ritual closure of the lower house before building the upper house in the Three Circle period. Several occupations, a remodeling of the floor, and a large storage pit indicate seasonal mobility, at least through the early years of the San Francisco phase (Roth 2007).

The Three Circle phase (A.D. 750-1000) of the Late Pithouse period ceramic styles are Three Circle Red-on-white and Mimbres Style I Black-on-white (Anyon et al. 2017; Roth 2007; Roth, Gilman, and Anyon 2018). Inhabitants blocked the east-facing ramp entryway to Pithouse 3, making it into a ventilation shaft, and remodeled it into a subterranean Classic Mimbres pueblo room kiva (Roth 2007). In Pithouse 5, the entryway faced east, and plaster covered the rectangular floor and the walls, indicating an increase in sedentism (Roth 2007).

While earlier structures at LRV indicated seasonal use of the site, the Three Circle phase introduced a rapid shift to sedentism, an increase in population, and an increase in dependence on agricultural products (Stokes and Roth 1999). In addition to the pithouses, LRV inhabitants built a great kiva in the Three Circle phase (Roth 2007). The great kiva doorway faced east, had cobble and adobe walls, a tan clay plastered floor, an adobe bench, a clay-lined basin hearth in front of the entryway, a shallow, clay-lined pit, and a central post-hole (Roth 2007). Because it is larger than expected for the estimated population during the Three Circle phase, it likely served surrounding communities in addition to LRV (Roth 2007; Stokes and Roth 1999). Inhabitants ritually retired the great kiva by removing the central post and then later filled it with 1.5 meters of Classic Mimbres period trash (Roth 2007).

The Classic Mimbres period (A.D. 1000-1130) component at LRV consists of four small room blocks separated by open plazas, where inhabitants completed work in a communal atmosphere (Roth 2007). The ceramic style of this period is Classic Mimbres style Black-on-white and corrugated pottery. The inhabitants used the remodeled Pithouse 3 during the Classic Mimbres period as a kiva.

Table 2: Lake Roberts Vista Chronology

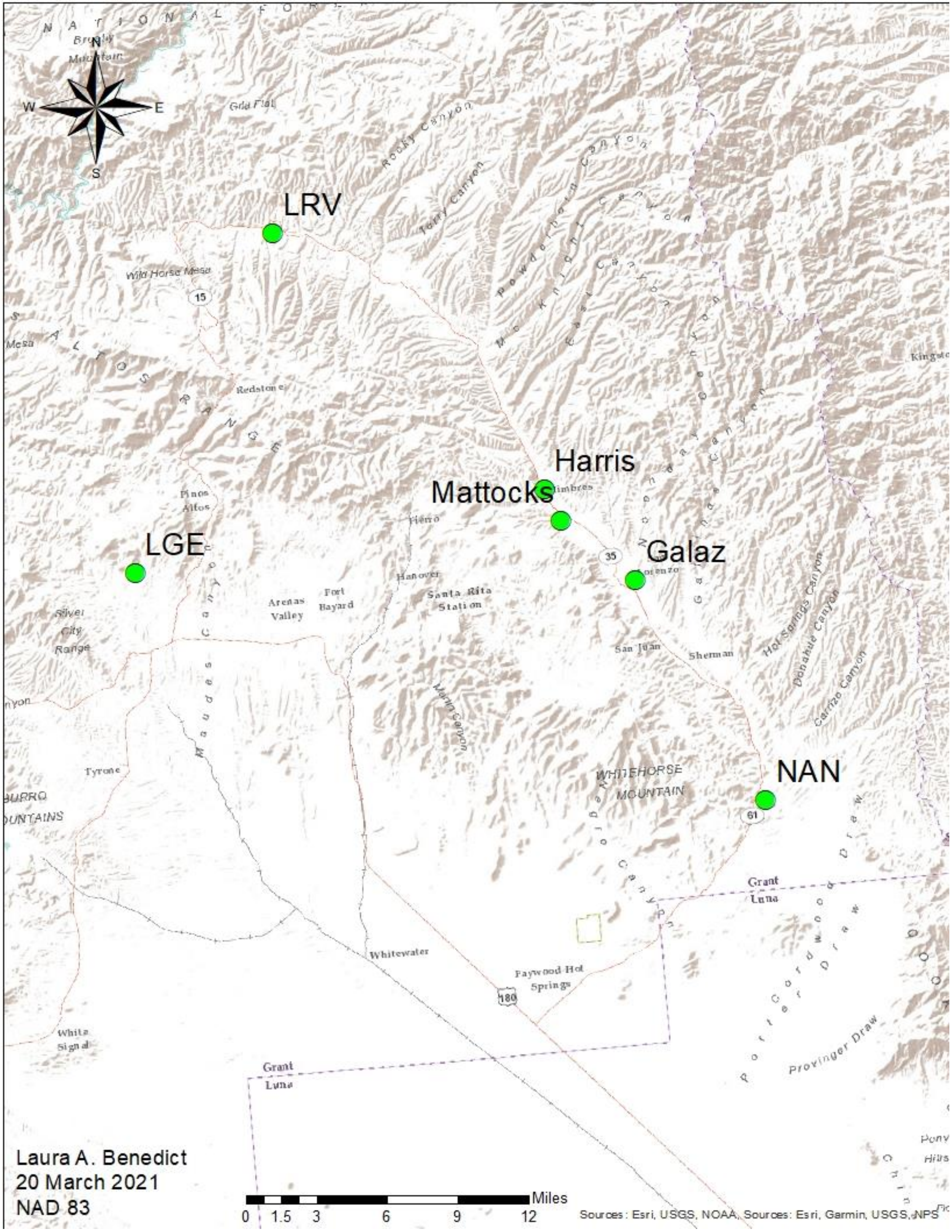
Period	**Phase (years)**	**Domestic Architecture**	**Communal Architecture**	**Ceramics**	**Social Structure**
Late Pithouse	Georgetown (A.D. 550-650)	Circular pithouses	N/A	Plain, San Francisco Red	Individual Pithouses
	San Francisco (A.D. 650-750)	Rectangular Pithouses with rounded corners	N/A	Mogollon Red-on-brown	Individual Pithouses
	Three Circle (A.D. 750-1000)	Rectangular Pithouses with square corners	Pithouse Great Kiva	Three Circle Red-on-white, Mimbres Style I Black-on-white	Individual Pithouses
Classic Mimbres	(A.D. 1000-1130)	Adobe pueblos	Plazas, pueblo kivas	Classic Mimbres styles Black-on-white	Corporate family, courtyard groups of pueblo room blocks

(Adapted from Anyon et al. 2017; Roth 2007; Roth, Gilman, and Anyon 2018)

Comparison Sites

To ascertain possible differences between LRV and other sites in the Mimbres Region, I compare the LRV faunal assemblage with those of five contemporaneous sites (Figure 4).

Figure 4: Contemporaneous Mimbres Sites



La Gila Encantada. La Gila Encantada is a Late Pithouse period site excavated by Roth (Roth 2010). It is at an elevation of 6500 ft. (1981 m.) on an isolated ridge in Little Walnut Canyon, north of Silver City, New Mexico in an open juniper woodland with easy access to natural resources (Roth 2010). Occupation of the site began in the Georgetown phase and continued through the Three Circle phase with the highest population during the Three Circle phase (Roth 2010). Schmidt (2010) used the faunal material recovered from seven pithouses spanning the Late Pithouse period. I use this site as a comparison because the faunal material encompasses the Late Pithouse period.

Harris. The Harris site was one of two sites Haury (1936) used to differentiate the Mogollon from the Anasazi (Ancestral Puebloan) culture group. It is a Late Pithouse period site on an alluvial terrace above the Mimbres River (Roth 2015, 2019). It is in the north-central Mimbres Valley, at an elevation of 6000 ft. (1828 m.; Roth 2015, 2019). It is above an alluvial floodplain, providing access to agricultural field land, and adjacent to an open piñon-juniper woodland where inhabitants had easy access to many natural resources (Roth 2015, 2019). Habitation began in the Georgetown phase and continued through the late Three Circle phase (Roth 2015, 2019). During the San Francisco phase, inhabitants built pithouses in clusters with shared workspaces and storage areas distinct from other clusters (Roth 2015, 2019). Roth (2015) interprets this configuration as the beginning of extended family households. The communal organization was probably a result of increased population and the resultant increased reliance on agricultural products, and possibly on irrigation agriculture (Roth 2015, 2019).

The site and population grew in the Three Circle phase, culminating in the largest population of the occupation (Roth 2015, 2019). People left the site by the late A.D. 900s (Roth et al. 2018). The faunal material used in this study came from seven pithouses from the Three Circle phase (Powell 2015). I use this site as a comparison because it encompasses the Three Circle phase within the Mimbres Valley area of the Mimbres region.

Mattocks. The Mattocks site is a large Classic Period Mimbres pueblo site at an elevation of 5900 ft. (1800 m.). It is on the first terrace above the Mimbres River and was heavily looted (Gilman and LeBlanc 2017). It is about a mile south of Harris with easy access to juniper and piñon pine trees as well as riparian flora and agricultural land (Gilman and LeBlanc 2017). The faunal material used in this study came from four Classic Mimbres room blocks (Cannon 2001, 2003). I use this site as a comparison because it encompasses the Three Circle phase through the Classic Mimbres Period within the Mimbres Valley area of the Mimbres region.

Galaz. The Galaz Ruin is one of the best-known and most extensively excavated sites in the Mimbres region (Anyon and LeBlanc 1984). A 100-200+ room pueblo before its destruction in the service of commercial looters, it was one of the largest and most influential sites in the Mimbres Valley (Anyon and LeBlanc 1984). It is on the first terrace above the Mimbres River in the central Mimbres Valley (Anyon and LeBlanc 1984). It is at an elevation of 5700 ft. (1737 m.) with easy access to agricultural land (Anyon and LeBlanc 1984). Occupation of the site began in the Georgetown phase and continued through the Classic Mimbres period. The faunal material used in this study comes from four pithouses, a communal structure, and an extramural pit fill (Cannon 2001).

I use this site as a comparison because it encompasses the Late Pithouse through the Classic Mimbres periods in the Mimbres Valley of the Mimbres region.

NAN Ranch Ruin. NAN Ranch Ruin is a large Classic Mimbres pueblo site with at least five room blocks and at least 100 rooms (Shafer 2003). It is on the first terrace above the Mimbres River in the southern portion of the Mimbres Valley at an elevation of 5300 ft. (1615 m.; Shafer 2003). Occupation of the site began in the Georgetown phase and continued through the Classic Mimbres period (Shafer 2003; Shaffer 1991). The faunal material used in this study came from two middens, encompassing the Three Circle phase and the Classic Mimbres period (Shaffer 1991).

Conclusion

LRV is a small, 15-20 room Mimbres pueblo site with a pithouse component above the Sapillo Creek. It differs from the core Mimbres Valley sites by its location, elevation, annual precipitation, site size, population, and timing for sedentism. It is also unique because the great kiva is larger than expected for the estimated population. For these reasons, it is possible that the faunal subsistence practices also differ from those of other Mimbres sites. To ascertain if differences exist and if they do, to what extent, I compare the faunal subsistence practices of LRV to five contemporaneous sites throughout the Mimbres region. I chose the sites to represent a variety of ecosystems (riverine and non-riverine), elevations (5300-6500 ft.), and periods of occupation represented by the faunal material (Late Pithouse to Classic Mimbres periods).

Chapter 5: Research Design and Methodology

In the Mimbres Region, faunal subsistence practices remain understudied. This research documents the faunal subsistence practices of the inhabitants of LRV during the Late Pithouse to Classic Mimbres periods and compares them with contemporaneous sites in the Mimbres region. LRV is a small Mimbres site, which makes this research that much more important as faunal research is rare among small Mimbres sites. This research compares sites of varying sizes, elevations, and occupations to gather a comprehensive view of the range of faunal choices available to the Mimbres people in the Late Pithouse and Classic Mimbres periods.

Research Design

To document and compare the faunal subsistence practices of the inhabitants of LRV, I address the following research questions.

Research question one. **What faunal subsistence practices did inhabitants at Lake Roberts Vista use during the Late Pithouse to Classic Mimbres periods?** To address this question, I document the faunal subsistence practices used by LRV during each period. I describe what species inhabitants procured, what elements remain in the archaeological record in connection with each period, and the secondary use of animal remains such as the creation of tools and decorations. I utilize the faunal assemblage from LRV as described below. I report on the relative abundance of the represented Orders to show that inhabitants captured mostly rabbits and deer. I show the context of the faunal remains to illustrate that the inhabitants completed the final processing at home before cooking or other food preparation activities.

I show the survivorship of select species to indicate that they utilized all parts of Artiodactyla and Lagomorpha and that the density of the bones did not factor in their utilization decisions. Inhabitants made tools from Artiodactyla bones, such as awls from metapodials and flintknapping tools from antlers.

Research question two. **What changes in the faunal subsistence practices occurred through time at Lake Roberts Vista?** To address this question, I document changes through time regarding what species hunters procured. I describe differences in the relative abundance of species associated with each period. I compare data gathered while addressing research question one. I present a pattern of decreasing Artiodactyl Index values to show that the abundance of Artiodactyla in the area probably decreased through time. I show the survivability of elements of *Odocoileus* spp. to assess if hunters selectively transported elements (the results are inconclusive). I show an increase over time in the fragmentation rate of Artiodactyla remains, which indicates greater processing of Artiodactyla bones in later periods. This is another indication that the relative abundance of Artiodactyla probably declined in later periods. I show that inhabitants capture more cottontails than jackrabbits throughout their occupation.

Research question three. **How did faunal subsistence practices at Lake Roberts Vista correlate with contemporaneous sites in the Mimbres region?** To address this question, I compare the faunal subsistence practices of LRV to five contemporaneous sites in the Mimbres Region. For this comparison, I use published taxonomic lists. I compare the representative Orders to show differences in capture rates. LRV captured a comparatively high percentage of Artiodactyla fragments and a comparatively low percentage of Lagomorpha fragments.

I compare the Artiodactyl Index values by site and period to show a pattern of higher Artiodactyl Index values at sites with higher elevations and lower Artiodactyl Index values at sites with lower elevations during the same period. I compare the Lagomorph Index values by site and period to show a pattern of higher Lagomorph Index values at sites with higher elevations and lower Lagomorph Index values at sites with lower elevations during the same period

Methodology

From a subsistence perspective, one of the most influential changes the people of LRV made during their occupation was a gradual shift from forager-farmers in the Georgetown phase to agriculturalists who supplemented their diet with wild resources by the end of the Three Circle phase. As a seasonally mobile, forager-farming group in the Georgetown phase, they acted more like ancillary cultivators, relying somewhat on wild food procurement, while supplementing their diet with agricultural foods such as maize, beans, and squash (Freeman 2012; Roth 2007). By the end of the Three Circle phase, they acted more like surplus cultivators by obtaining more of their diet from their fields (Freeman 2012; Roth 2007; Schollmeyer et al. 2018). They also supplemented their diet with wild foods, such as deer and rabbits (Freeman 2012; Roth 2007; Schollmeyer et al. 2018). In addressing research questions one and two, I will describe this transition in greater detail.

Garden hunting. Agricultural practices inherently modify the environment, which adjusts the selective pressures for humans, animals, and plants (Neusius 2008; Shafer 2003). Additionally, the longer a group stays in one place, the more they change their surrounding environment (Neusius 2008; Shafer 2003).

Because of this, an agricultural field changes the dynamics between humans and animals as the food grown in the field attracts some animals and repels others (Badenhorst and Driver 2009; Cannon 2000; Schollmeyer and Spielmann 2018). Animals attracted to agricultural fields are easier to catch than those animals hunted afield, they consist of high-quality protein and other important nutrients, and culling them somewhat secures the food from consumption loss (Clinton and Peres 2011; Fiedler 1990; Neusius 2008; Szuter 1989). Animals hunted in and around agricultural fields are more likely to be those that travel in smaller numbers, are more passive, can better withstand heavy predation, and will recover quicker (Clinton and Peres 2011; Smith 2005). In short, they are more likely to be r-selected taxa, discussed below.

Additionally, field cultivation requires a time commitment that interferes with hunting more desirable species away from the community, and so hunting animals close to the field would somewhat compensate for that loss (Clinton and Peres 2011). Because of the time constraints provided by cultivation and because several species are attracted to the cultivated plot, hunters likely captured whatever species was in the area, rather than selecting for a favorite species (Neusius 2008; Schollmeyer and Spielmann 2017). For this reason, garden hunting can sometimes be seen in the archaeological record by a relatively high number of species in the assemblage that would be attracted to agricultural land as compared to those species that would not, and by a relatively highly diverse assemblage of faunal material, though this is not easily conclusive (Clinton and Peres 2011; Dean 2005; Neusius 2008; Schollmeyer and Spielmann 2017). In addition, Dean (2005) argues that the relative numbers of species attracted to agricultural fields would increase as agricultural intensification increases.

It is not possible to be certain which (if any) of the LRV faunal assemblage were captured in the field, but inhabitants probably employed this method regularly (Badenhorst and Driver 2009). Therefore, in addressing research questions one and two, I treat the agricultural fields as the patch from which hunters captured small game, such as Lagomorpha (*patch choice model*) as explained in Chapter 3. The following section discusses in greater detail why garden hunting is more likely to incorporate Lagomorpha rather than Artiodactyla (Schollmeyer and Spielmann 2018).

K-selected and r-selected taxa. The r- and K-selection category is a continuum based on body size and reproduction rate that helps identify species-specific desirability by human predators (Hayden et al. 1981; Schollmeyer 2018). The K-selected taxa (such as Artiodactyla) are large-bodied, produce one or two offspring per reproductive cycle, and have one or fewer reproductive cycles annually (Schollmeyer 2018; Shaffer and Schick 1995). The K-endpoint of the continuum represents high-quality offspring in small numbers with a low resistance to environmental changes (Pianka 1970). While agricultural fields attract Artiodactyla, the presence of hunters detracts them, ensuring the demographics around communities and fields remain low (Schollmeyer and Spielmann 2017). On the other end of the spectrum, r-selected taxa (such as Lagomorpha) are small to medium-bodied, have more than one offspring per reproductive cycle, and have more than one reproductive cycle per year (Schollmeyer 2018; Shaffer and Schick 1995). These taxa are attracted to sites by fields, discarded food, stored grains, and plentiful shelter, and are therefore abundant even when they are intensively hunted (Dean 2005).

Because of the reproductive habits of the various prey, predators easily over-hunt K-selected taxa while they rarely over-hunt r-selected taxa (Pianka 1970; Shaffer and Schick 1995). In addition, K-selected taxa are frequently highly desired while hunters usually only capture r-selected taxa when K-selected taxa are unavailable or are available in fewer numbers than the hunters would prefer (Dean 2007b; Engen and Saether 2016; Shaffer and Schick 1995). In some cultures, humans only hunt and consume r-selected taxa when they perceive a scarcity of more desirable species (Fiedler 1990; Schollmeyer and Spielmann 2017; Shaffer and Schick 1995).

Schollmeyer (2018) analyzed four attributes relevant to categorizing taxa by resilience: body size, gestation, diet, and population density (Table 2). Her taxonomic ranking is a rough estimate for the selection continuum as well as their resilience to anthropogenic environmental changes. She categorized rodents as the most resilient and the least desirable taxa (Bayham 1979; Pianka 1970; Schollmeyer 2018). Rabbits are more desirable than rodents for food and skins, shown by the number of faunal remains found at Mimbres region sites (Table 20). Skunks and badgers are somewhere in the middle of the continuum and are moderately resilient (Schollmeyer 2018). Small mammals, such as rabbits and rodents, provide a lot of edible meat per gram of body weight (Simonetti and Cornejo 1991). Given their abundance, predictability on the landscape, and relative ease of capture, they can be a reliable food source (Analia 2015; Simonetti and Cornejo 1991). For instance, women with children will frequently hunt prey young hunters can easily manage, such as rabbits and rodents (Lupo and Schmitt 2005).

Artiodactyla are among the least resilient prey species and are generally the most desirable, highest-ranked prey species by human predators (Bayham 1979; Pianka 1970; Schollmeyer 2018). In addressing research questions one and two, I assume hunters will capture Artiodactyla whenever they encounter them (*prey choice model*; Bayham 1979; Pianka 1970; Schollmeyer 2018).

Table 3: Ranked Taxon Relevant to Study Area

Family	**Common Name**	**Example Species (Common Name)**	**Ranking**
Cricetidae	Hamsters, voles, lemmings	*Onychomys* spp. (Grasshopper mice)	1
Heteromyidae	Kangaroo and Pocket mice	*Perognathus* spp. (Pocket mice)	1
Geomyidae	Pocket gophers	*Thomomys* spp. (Pocket gophers)	1
Sciuridae	Squirrels	*Spermophilus* spp. (Rock squirrels)	1
Leporidae	Rabbits and Hares	*Lepus* spp. (Jackrabbits)	1
Mephitidae	Skunks and stink badgers	*Mephitis* spp. (Skunks)	2
Mustelidae	Weasels, badgers, and otters	*Taxidea taxus* (American badger)	2
Procyonidae	Raccoons and ringtails	*Bassariscus* spp. (Ringtailed cat)	2
Canidae	Wolves, dogs, and coyotes	*Canis latrans* (Coyote)	3
Felidae	Cats	*Felis concolor* (Mountain lion)	3
Ursidae	Bears	*Ursus arctos* (Grizzly bear)	3
Antilocapridae	Pronghorns	*Antilocapra americana* (Pronghorn)	3
Cervidae	Deer	*Odocoileus* spp. (Deer)	3

(Adapted from Schollmeyer 2018)

Identification. To document the faunal subsistence practices of the inhabitants, I identified all faunal material to the most precise taxonomic level possible using standard methodology (Driver 2011; Meadow 1980; Reitz and Wing 2008). I used the comparative collection in the Zooarchaeology Lab on the campus of the University of Nevada, Las Vegas as my primary identification source and published osteological guides as needed (France 2009; Gilbert et al 1996; Olsen 1990). When more than one species of a Genus was present in the region during the occupation period, I identified relevant fragments to the Genus level with the abbreviation “spp.” to indicate that the fragment could have belonged to multiple species within that Genus (Reitz and Wing 2008). For example, the identification *Odocoileus* spp. indicates that the element could belong to a mule deer (*Odocoileus hemionus*) or a white-tailed deer (*O. virginianus*; Cannon 2001; Driver 2011; Schollmeyer 2009; Schollmeyer and MacDonald 2020). In the case of the Order Lagomorpha, two species of each Genus lived in the area during the occupation period: desert cottontail (*Sylvilagus audubonii*), eastern cottontail (*S. floridanus*), black-tailed jackrabbit (*Lepus californicus*), and possibly white-sided jackrabbit *(L. callotis*; Cannon 2001; Schmidt 2010; Schollmeyer and MacDonald 2020). Where appropriate, I identified elements as *Lepus* spp. or *Sylvilagus* spp. I identified elements to the Family “Leporidae” when I was unable to identify them as either *Lepus* spp. or *Sylvilagus* spp. When I was unable to identify a fragment beyond Class, when possible, I separated it by size. I categorized the Class Mammalia as small (smaller than a cottontail), medium (cottontail-sized through coyote-sized), and large (larger than a coyote). I categorized the Class Aves as small (smaller than a chicken), medium (chicken-sized through goose-sized), and large (larger than a goose).

I identified a fragment as intermediate (e.g., Mammalia, Small-Medium) to indicate that the fragment could be either category. I identified and analyzed all faunal material found in direct context. In an archaeological setting, the word “context” conveys an array of information concerning each artifact, ecofact, feature, etc. The context describes where in the site the faunal material was found (in a domestic structure, a communal structure, or a trash midden), what period it is correlated with (Late Pithouse or Classic Mimbres periods), and what other items were in the same area (Johnson 2010). The identified faunal material included whole bones, bone fragments, teeth, and antlers. I considered all material labeled “Roof Fall and Wall Fall”, “Floor Fill”, “Floor”, and “Feature Fill” as direct context and treated them as part of the relevant period for analysis. “Roof Fall and Wall Fall” materials were within 10 cm. of a roof or wall stratum. “Floor Fill” materials were within 10 cm. of the floor of a structure. “Floor” materials were directly on the floor of a structure. “Feature Fill” materials were within the confines of a feature, such as a hearth or a posthole.

Sample. When people moved out of an old pithouse, and when they did not build another using the same footprint, inhabitants of LRV filled the depression with trash, labeled “Cultural Fill” by the excavation team. I identified all faunal material in direct context because I wanted to preserve as much information as possible about what the inhabitants left and how they utilized it. However, I sampled the “Cultural Fill” material for expediency in addressing the research questions. A sample of 10 percent is sufficient for addressing certain questions, and there are no fixed rules concerning what fraction of the assemblage constitutes an appropriate sample (Gamble 1978; Payne 1972).

Therefore, under the guidance and direction of Dr. Roth and Dr. Atıcı, I decided on a sample of 20 percent for the “Cultural Fill” context. I randomly sampled the “Cultural Fill” using a structured, multi-stage cluster sampling strategy (Gamble 1978; Orton 2000). I separated all “Cultural Fill” faunal material by archaeological unit, removed surface collections, and then randomly sampled 20 percent of the levels within each unit with a minimum of one level. Using this method, I ensured a random sample of all units and levels with faunal material in a “Cultural Fill” context across the site.

Quantification. The most basic unit of quantification for faunal material is the number of identified specimens (NISP) as this measure is not likely to change based on arbitrary decisions such as unit placement or stratigraphy (Grayson 1984; Schollmeyer 2018). In this work, a taxonomically identified specimen is one I identified to at least the Order level and an anatomically identified specimen is one where I identified the element (Grayson 1984; Lyman 1984). While identifying each specimen, I calculated the minimum number of elements (MNE) each set of fragments represents. For example, if two fragments fit together, I noted that they represent one element. I calculated MNE because this number assists in finding the minimum number of individuals (MNI), and it is essential when calculating the survivorship of elements. I calculated the MNI for each Genus based on the largest number of an element by side, by period, and by context (Grayson 1984).

Survivorship of elements. As hunters choose hunting grounds farther away from the community (*patch choice model*), they make choices concerning what aspects of the prey they will transport back to the community, using MUI concepts standardized by Binford (1978), discussed below.

I utilized the survivorship of elements as a proxy to determine if hunters selectively transported elements or if inhabitants differentially utilized the carcass (Binford 1978; Grayson 1989). To calculate the survivorship of the elements of a species, I multiplied the number of elements expected for the species with the MNI for that species and then divided the observed number of elements by that number (Analia 2015; Atıcı 2007). For example, for each *Odocoileus* spp., I expect two proximal femora. I calculated an MNI of 20 *Odocoileus* spp.: 2 x 20 = 40 expected proximal femora. I observed 3 *Odocoileus* spp. proximal femora. Therefore, the survivorship for *Odocoileus* spp. proximal femora is 7.5 percent ((3 / 40) x 100). Because the femur is one of the most valuable elements for meat, marrow, and grease, hunters will not likely leave it behind when selectively transporting elements (Binford 1978; Grayson 1989; Madrigal and Capaldo 1999; Madrigal and Zimmermann Holt 2002; Wolverton et al. 2008). This helps address research question one because it illuminates how inhabitants utilized Artiodactyla.

Meat utility index. Binford (1978) created the meat utility index (MUI) to quantify the perceived economic value of each skeletal element found at archaeological sites. To compare usable meat from an element in the assemblage, he assigned relative utility values as an objective reference (Binford 1978). While cultural practices dictate the most desirable parts, this method is useful for intra-site comparisons (Lyman 1979). When faced with the need to choose what to transport back to camp, the MUI predicts that people will choose the meatiest skeletal elements (and thus the most economic value) over the elements with the least meat (and thus the least value; Binford 1978; Grayson 1989).

However, it does not address how hunters will decide concerning items of cultural significance (such as antlers) with little to no utility value. Because meat is not the only useful nutrient bank in and around bones, Binford (1978) created the marrow index to standardize the amount of marrow calculated for each element and the grease index to quantify the grease rendered through boiling the bones. One notable and contrasting aspect of grease and marrow extraction is that it is easiest from the least dense elements (Binford 1978). The Nunamiut reported that they ignored bones such as phalanges for grease and marrow because phalanges are too dense and have too little grease and marrow for it to be worth their time and effort (Binford 1978). However, the access of phalangeal marrow can also be a decision based on taste because phalangeal marrow has a soft, pleasant texture (Jin and Mills 2011). Jin and Mills (2011) report that the extra time and effort required to obtain marrow from the phalanges is not significant and would not deter people who desire it. One white-tailed deer can yield as much as 552, 479 Kcal. from the meat (Madrigal and Zimmermann Holt 2002), 951 Kcal. from the marrow (Madrigal and Capaldo 1999), and a grease value of 1703 from the bones (Wolverton et al. 2008). In addressing research questions one and two, I use the concept of MUI to assess if inhabitants selectively transported elements and if they increasingly processed bones to access marrow and grease.

Fragmentation Rate. The level of fragmentation helps identify when people want to extract as many nutrients as possible from an element, including grease and marrow (Binford 1978; Grayson 1989; Madrigal and Capaldo 1999; Madrigal and Zimmermann Holt 2002; Potter 1995; Schollmeyer 2009; Wolverton et al. 2008).

When extracting grease from bones, smaller fragments require less water, less time boiling, and allow for a more complete extraction in less time (Church and Lyman 2003; Janzen et al. 2014). I identified fragments as “highly fragmented” if I estimated 50 percent or less of the element present (Schollmeyer 2009). In addressing research question two, I use the fragmentation rate as a proxy for showing that LRV hunters likely traveled farther in later years to capture Artiodactyla (*patch choice model* and *marginal value theory*).

Artiodactyl resource abundance. The Artiodactyl Index is the total number of Artiodactyl fragments divided by the combined total of Artiodactyla and Lagomorpha fragments (Broughton 1994; Spielmann and Angstadt-Leto 1996; Szuter and Bayham 1989). This calculation provides the ratio of Artiodactyla fragments in a faunal assemblage as compared to Lagomorpha fragments (Broughton 1994; Spielmann and Angstadt-Leto 1996; Szuter and Bayham 1989). This ratio is important toward addressing research question two because I use it as a proxy to assess the presence and intensity of Artiodactyl resource reduction through time at LRV. Hunters in the Mimbres Region prefer to capture species in the Order Artiodactyla (*prey choice model*; Cannon 2001; Schollmeyer 2009, 2018) and easily overhunt them in the immediate surroundings of a settlement because they are K-selected taxa (Pianka 1970; Schollmeyer 2018; Shaffer and Schick 1995). Lagomorpha reproduce quickly and remain abundant in sites and fields even when intensively hunted (Broughton 1994; Spielmann and Angstadt-Leto 1996; Szuter and Bayham 1989). Therefore, any change in the Artiodactyl Index is a change in the abundance of Artiodactyla in the hunting range (Broughton 1994; Spielmann and Angstadt-Leto 1996; Szuter and Bayham 1989).

Another way to see artiodactyl resource reduction in the archaeological record is a pattern of greater processing through time, as seen in higher fragmentation rates (Cannon 2001; Schollmeyer 2009, 2018). This is because as the amount of time increases that a hunter must search for an artiodactyl before capturing it, the amount of processing of the carcass also increases (Cannon 2001; Schollmeyer 2009, 2018).

Lagomorpha resource abundance. The Lagomorph Index is the number of cottontail (*Sylvilagus* spp.) fragments divided by the total number of Lagomorpha fragments (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). A higher Lagomorph Index value indicates the inhabitants captured more cottontails, which might indicate a lower population, that they cleared less land for agricultural and other domestic purposes, that the agricultural land was farther away from the domestic structures, or some combination of the options (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). Jackrabbits and cottontails often overlap in their home range, but they have different preferences for cover (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). Cottontails prefer higher elevations and thicker vegetation because when faced with a threat, they freeze in place (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). On the other hand, jackrabbits prefer lower elevations and thinner vegetation because when faced with a threat, they prefer to run (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). Because of their behavior when threatened, hunters utilize different strategies to capture them. In smaller communities, individuals hunt cottontails while in larger communities, groups hunt jackrabbits (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989).

Therefore, differences in the Lagomorph Index, do not necessarily identify changes in the surrounding environment, but it might also identify changes in the population, though the two frequently mirror each other to suggest a lower Lagomorph Index value as the community grows larger (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). However, because of the way the Lagomorph Index is calculated, when bones are too fragmented to identify as *Sylvilagus* spp., (and are instead identified as Leporidae) they increase the Lagomorph Index. Therefore, a decrease in the Lagomorph Index does not inherently indicate an increase in jackrabbit fragments in the assemblage. In addressing research question two, I use the Lagomorph Index as a proxy to indicate changes in the population size of LRV and changes in their Lagomorph hunting patterns.

Contemporaneous site comparison. Because LRV differs from many sites in the Mimbres Valley in several ways, they might also differ in their faunal subsistence strategy. To ascertain if faunal subsistence strategy differences exist, I compare that of LRV to those of five contemporaneous sites. To make this comparison, I use faunal analysis information and taxonomic lists from published sources. In order of descending elevation, I compare the faunal assemblages of La Gila Encantada (Schmidt 2010), Harris (Powell 2015), Mattocks (Gilman and LeBlanc 2017), Galaz (Anyon and LeBlanc 1984), and NAN Ranch Ruin (Shaffer 1991). I chose these sites to represent the extent of ecosystems, elevations, site occupations, and site sizes in the Mimbres region during the Late Pithouse to Classic Mimbres periods. With this comparison, I address research question three.

Chapter 6: Results

This chapter presents the results of the analysis of the LRV faunal remains and discusses them in relation to the research questions posed in Chapter 5. The LRV site is located at a high elevation (6180 ft.), in the Sapillo Valley. It is in an area of the Gila National Forest with yearlong access to running water and a rich environment filled with resources, including wild plants and agricultural land (Roth 2007). This area was home to a variety of aerial, terrestrial, and freshwater fauna during the occupation period (Schollmeyer and MacDonald 2020).

Lake Roberts Vista Faunal Subsistence Practices

This section addresses the first research question, **"What faunal subsistence practices did inhabitants at Lake Roberts Vista use during the Late Pithouse to Classic Mimbres periods?"** The faunal diet consisted of mostly Artiodactyla and Lagomorpha. Table 20 presents the list of species inhabitants captured by period while Table 4 displays the Orders represented at LRV. Of the 1503 total fragments in the faunal sample, I identified 32 percent (n = 474) at least to the Order level, including 201 Artiodactyla fragments (13%) and 84 Lagomorpha fragments (6%). In addition, I identified 131 Rodentia fragments (9%) and 36 Carnivora fragments (2%). All other Orders represent less than one percent of the assemblage. This helps address research question one by confirming that inhabitants consumed mostly deer and rabbits.

When I organized the NISP by context and Order, Table 5 shows that the excavation team found 221 fragments (15%) in the "Floor Fill", "Floor", and "Sub Floor" contexts, followed by 184 fragments (12%) in the "Roof Fall and Wall Fall" contexts.

This pattern suggests that inhabitants completed some of the faunal processing work in their homes. The excavation team saw evidence of a processing site with groundstones (Dr. Barbara Roth, personal communication, 2021). However, because it was outside their excavation area, they were unable to explore it further. Inhabitants likely completed the main tasks associated with faunal processing, such as butchering, at this processing site and the final processing before cooking in their homes. This helps address research question one because it illuminates how inhabitants utilized animal remains.

As stated in Chapter 5, I sampled the “Cultural Fill” (trash midden) material using a structured, multi-stage cluster sampling strategy. The sample includes only 35 fragments (2%) that the excavation team found in the “Cultural Fill” context. However, as this sample is only 20 percent of the “Cultural Fill” aspect of the assemblage, sampling bias may have left this group of faunal remains underrepresented (Binford 1964).

Survivorship. One person can transport an adult white-tailed deer (*Odocoileus virginianus*) for up to a mile (Madrigal and Zimmermann Holt 2002). When there is more meat than people to carry it or when the distance is too far, the concept of MUI indicates that people will transport the elements with the most utility (meat, marrow, and grease values) before transporting the elements with the least utility (Binford 1978; Grayson 1989). I use the survivorship of elements as a proxy for assessing if inhabitants selectively transported elements. I calculated the survivorship of elements based on the number of expected elements per individual for each species calculated (Figure 5; Table 6).

In Figure 5, the bar chart shows the percent survivorship for *Odocoileus* spp. elements while the line graph shows the density value for each element. This combination chart visually indicates that density plays no apparent role in processing and utilization decisions per element. For *Odocoileus* spp., *Lepus* spp., and *Sylvilagus* spp., the mandible is the element with the highest survivability rate (*Odocoileus* spp.: 15%; *Lepus* spp.: 17%; *Sylvilagus* spp.: 27%; Table 6). For *Cervus canadensis*, the element with the highest survivability rate is the cranium (25%). That crania and mandibles have the highest survivability rate is unsurprising because they are among the least useful for meat, grease, and marrow. Binford (1978) rated mandibles and crania low for MUI. Madrigal and Capaldo (1999) listed mandibles just above phalanges for the ideal kcal marrow yield and did not report on crania. Wolverton et al. (2008) report a low grease value for mandibles but do not report a grease value for crania.

For *Cervus canadensis*, the survivorship of the distal radius was 19%, and the proximal ulna, pelvis, distal tibia, astragalus, and calcaneus were all 6%. For *Odocoileus* spp., the survivorship of the cranium was 10%; the scapula, proximal femur, and proximal tibia were all 8%; the atlas, distal humerus, and metapodials were all 5%; the proximal humerus, distal radius, proximal ulna, distal tibia, astragalus, calcaneus, and first phalanx were all 3%; the cervical vertebra was 2%; the second and third phalanges were 1%; and the thoracic vertebra, rib, and carpals were all less than 1%. For *Lepus* spp., the survivorship of the pelvis was 13%; the femur was 10%; the cranium, atlas, distal humerus, and distal radius were all 7%; the scapula, proximal radius, and tibia were all 3%; and the metatarsals were 1%.

For *Sylvilagus* spp., the survivorship of the cranium was 14%; the scapula and pelvis were 13%; the humerus, tibia, and calcaneus were all 10%; the atlas was 7%; the proximal ulna and femur were 3%; the proximal metatarsal was 2%; and the distal metatarsal was 1%.

Because the femur is one of the most valuable elements for meat, marrow, and grease, hunters will not likely leave it behind when selectively transporting elements (Binford 1978; Madrigal and Capaldo 1999; Madrigal and Zimmerman Holt 2002; Wolverton et al. 2008). For *Odocoileus* spp., the survivorship of the proximal femur was 8% and I did not identify any distal femur fragments. I identified neither proximal nor distal femur fragments for *Cervus canadensis*. Therefore, these low survivorship numbers suggest that the inhabitants processed the elements beyond my ability to identify them.

No element of those species within the Orders Artiodactyla or Lagomorpha survived at a rate higher than 27 percent, suggesting that bone density did not play a factor in utilization decisions. Inhabitants processed elements with high density (proximal metatarsal) and low density (transverse process, lumbar vertebra; Lyman 1984) as well as high utility (femur) and low utility (metapodials) with no obvious distinction between the extremes (Binford 1978). Inhabitants processed the bones of Artiodactyla and Lagomorpha in a way that did not encourage their preservation, including highly fragmenting them for easier processing for marrow and grease (Atıcı 2007). Inhabitants utilized all parts of Artiodactyla and Lagomorpha for consumption, the creation of tools, or other modifications.

Modification. I identified 48 fragments with one or more modifications (Table 7). The largest category of modification included 20 fragments (42%) split, pounded, or otherwise opened to access the marrow. Taxon included in this category are Mammalia, Medium; Mammalia, Large; *Taxidea taxus*; *Canis* spp.; Artiodactyla; *Odocoileus* spp.; and *Cervus canadensis*. I identified 15 polished fragments (31%), which included Mammalia, Small; Mammalia, Medium; Mammalia, Medium-Large; Leporidae; Artiodactyla; *Odocoileus* spp.; and *Meleagris gallopavo*. I identified 14 fragments (29%) with cutmarks, which included Mammalia, Small; Mammalia, Medium; Mammalia, Medium-Large; Mammalia, Large; Leporidae; Carnivora; Artiodactyla; *Odocoileus* spp.; *Cervus canadensis*; and *Meleagris gallopavo*. The cutmarks on the Carnivora rib fragment are a pattern along the top, suggesting the inhabitants intended to create a decoration, such as a bracelet. I identified 9 fragments (19%) that made 7 tools. One Mammalia, Medium-Large fragment made one awl, one Artiodactyla fragment made one awl, 4 *Odocoileus* spp. fragments made 3 awls, and 3 *Odocoileus* spp. fragments made 2 flintknapping tools. Two fragments (4%) made 2 beads, which included: Mammalia, Medium and Mammalia, Medium-Large.

Table 8 shows the composition of the bone tools and the beads. Inhabitants made 5 tools from *Odocoileus* spp. elements, including metacarpals, metatarsals, and antlers. Inhabitants made 5 awls from metapodials, including 3 from *Odocoileus* spp., one from Artiodactyla, and one from Mammalia, Medium-Large. Inhabitants made one bead from an unidentified fragment from Mammalia, Medium-Large, and one bead from a diaphysis fragment from Mammalia, Medium. I identified 4 awls and 2 beads in the "Floor Fill" context, one awl from the "Cultural Fill" context, one flintknapping tool in the

“Roof Fall and Wall Fall” context, and 1 flintknapping tool in the “Floor” context. This assessment of the modification of faunal remains helps address research question one because it helps identify how inhabitants utilized animals beyond meat consumption. Inhabitants used animal bones and antlers to create awls, beads, and flintknapping tools.

Burned fragments. I identified 320 burned fragments (21%), of which, 151 (47%) were calcined (bluish-white or grey; Shipman et al. 1984; Yravedra and Uzquiano 2013). Burned animal bones can provide direct evidence that humans used animals for food, but this is not always the case because buried bones can also display evidence of burning (Nicholson 1993; Stiner and Kuhn 1995). Table 9 shows the composition of the burned fragments. I identified less than one percent from the Georgetown phase, 10 percent from the San Francisco phase, 84 percent from the Three Circle phase, and 7 percent from the Classic Mimbres period. I identified 84 percent at the Class level or less specific. However, I identified 2 percent as Lagomorpha and 12 percent as Artiodactyla. I also identified one Squamata (lizard) femur fragment in the Three Circle phase and two *Apalone spinifera emoryi* (Texas spiny softshell) tibia fragments in the San Francisco phase. However, the turtle femur in the same context remained unburned, which may indicate an accidental burning of the tibia fragments.

Table 4: Representative Orders at Lake Roberts Vista

Order	**Representative Species**	**NISP**	**Percent of Total**
Lagomorpha	Hares and rabbits	84	6%
Rodentia	Mice and rats	131	9%
Carnivora	Bears and canines	36	2%
Artiodactyla	Deer and elk	201	13%
Galliformes	Turkeys	7	<1%
Accipitriformes	Eagles and hawks	3	<1%
Falconiformes	Falcons	1	<1%
Gruiformes	Coots and cranes	1	<1%
Testudines	Tortoises and turtles	3	<1%
Squamata	Lizards and snakes	2	<1%
Cypriniformes	Carps, loaches, and minnows	5	<1%

Table 5: Number of Identified Species by Context, Order, and Period

Context	**Period**	**Lagomorpha**	**Rodentia**	**Carnivora**	**Artiodactyla**	**Galliformes**	**Accipitriformes**	**Falconiformes**	**Gruiformes**	**Testudines**	**Squamata**	**Cypriniformes**
Cultural Fill	GT	0	0	0	2	0	0	0	0	0	0	0
	TC	5	8	3	9	0	0	0	0	0	0	0
	CM	2	0	0	6	0	0	0	0	0	0	0
Entry Fill	TC	0	2	0	1	0	0	0	0	0	0	0
Feature Fill	TC	3	5	0	9	1	0	0	0	0	0	0
Floor	TC	1	2	8	1	0	0	0	0	0	0	0
	CM	4	4	1	2	0	0	0	0	0	0	0
Floor Fill	SF	8	39	9	43	1	0	0	0	3	1	1
	TC	21	22	3	41	1	3	0	0	0	1	4
Plaza Fill	GT	0	0	0	2	0	0	0	0	0	0	0
	TC	1	0	1	1	0	0	0	0	0	0	0
RF/ WF	SF	6	4	3	15	0	0	0	1	0	0	0
	TC	27	38	5	59	4	1	1	0	0	1	0
	CM	6	6	3	10	0	0	0	0	0	0	0
Sub Floor	TC	0	1	0	0	0	0	0	0	0	0	0

(GT = Georgetown phase; SF = San Francisco phase; TC = Three Circle phase; CM = Classic Mimbres Period)

Figure 5: *Odocoileus* spp. Percent Survivorship and Bone Density

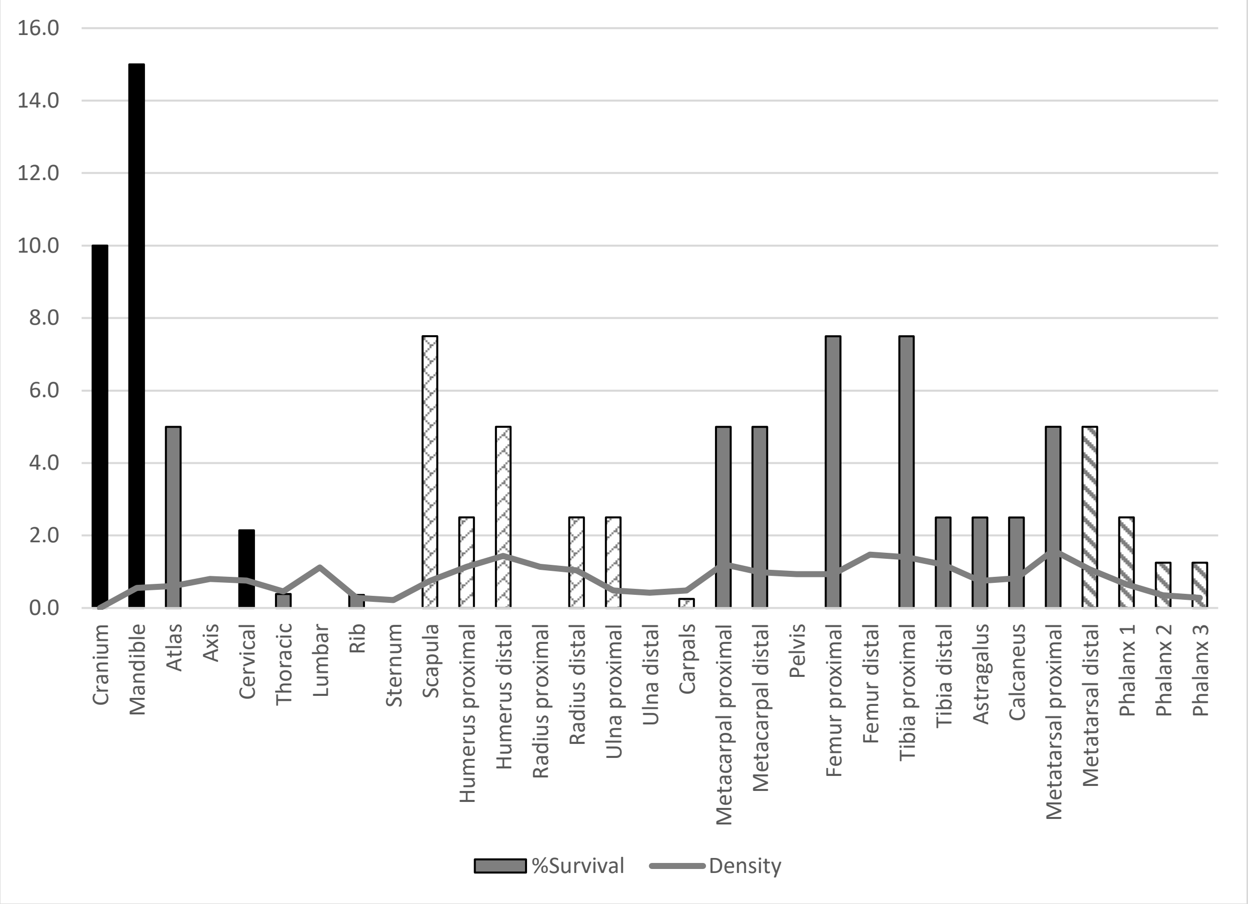


Table 6: Percent Survivorship of Elements for Certain Taxa

Element	***Cervus canadensis***	***Odocoileus* spp.**	***Lepus* spp.**	***Sylvilagus* spp.**
Cranium	25%	10%	7%	14%
Mandible	0%	15%	17%	27%
Atlas	0%	5%	7%	7%
Axis	0%	0%	0%	0%
Cervical	0%	2%	0%	0%
Thoracic	0%	<1%	0%	0%
Lumbar	0%	0%	0%	0%
Rib	0%	<1%	0%	0%
Sternum	0%	0%	0%	0%
Scapula	0%	8%	3%	13
Humerus, proximal	0%	3%	0%	10%
Humerus, distal	0%	5%	7%	10%
Radius, proximal	0%	0%	3%	0%
Radius, distal	19%	3%	7%	0%
Ulna, proximal	6%	3%	0%	3%
Ulna, distal	0%	0%	0%	0%
Carpals	0%	<1%	0%	0%
Metacarpal, proximal	0%	5%	0%	0%
Metacarpal, distal	0%	5%	0%	0%
Pelvis	6%	0%	13%	13%
Femur, proximal	0%	8%	10%	3%
Femur, distal	0%	0%	10%	3%
Tibia, proximal	0%	8%	3%	10%
Tibia, distal	6%	3%	3%	10%
Astragalus	6%	3%	0%	0%
Calcaneus	6%	3%	0%	10%
Metatarsal, proximal	0%	5%	1%	2%
Metatarsal, distal	0%	5%	1%	1%
Phalanx 1	0%	3%	0%	0%
Phalanx 2	0%	1%	0%	0%
Phalanx 3	0%	1%	0%	0%

(Elements listed in anatomical order)

Table 7: Modification Types by Taxon

Taxon	Marrow Access	Polish	Cutmark	Awl	Flintknapping Tool	Bead
Mammalia, Small	0	1	1	0	0	0
Mammalia, Medium	0	2	1	0	0	1
Mammalia, Medium-Large	2	3	1	1	0	1
Mammalia, Large	4	0	1	0	0	0
Leporidae	0	1	1	0	0	0
Carnivora	0	0	2	0	0	0
Taxidea taxus	1	0	0	0	0	0
Canis spp.	1	0	0	0	0	0
Artiodactyla	4	2	1	1	0	0
Odocoileus spp.	6	5	3	4	3	0
Cervus canadensis	2	0	2	0	0	0
Meleagris gallopavo	0	1	1	0	0	0
Total	20	15	14	6	3	2

Table 8: Bone Tool and Bead Composition

Phase	Context	Taxon	Element	NISP	Products	Product Description
GT	Cultural Fill	*Odocoileus* spp.	Metacarpal	2	1	Awl
SF	Floor Fill	Artiodactyla	Metacarpal	1	1	Awl
SF	Floor Fill	Mammalia, Md.-Lg.	Metapodial	1	1	Awl
TC	Floor Fill	*Odocoileus* spp.	Metatarsal	1	1	Awl
TC	Floor Fill	*Odocoileus* spp.	Metacarpal	1	1	Awl
TC	Floor Fill	Mammalia, Md.-Lg.	Unidentified fragment	1	1	Bead
TC	Floor Fill	Mammalia, Medium	Diaphysis	1	1	Bead
TC	Floor	*Odocoileus* spp.	Antler	1	1	Flintknapping tool
TC	RF/ WF	*Odocoileus* spp.	Antler	2	1	Flintknapping tool

(GT = Georgetown phase; SF = San Francisco phase; TC = Three Circle phase)

Table 9: Burned Fragment Composition

Period	**Taxon**	**Burned**	**Calcined**
Georgetown	*Odocoileus* spp.	1	0
San Francisco	Mammalia, Small-Medium	2	1
San Francisco	Mammalia, Medium	1	1
San Francisco	Mammalia, Medium-Large	14	5
San Francisco	Mammalia, Large	5	0
San Francisco	*Sylvilagus* spp.	1	0
San Francisco	Carnivora	1	0
San Francisco	Artiodactyla	4	0
San Francisco	*Odocoileus* spp.	1	0
San Francisco	*Apalone spinifera emoryi*	2	0
Three Circle	Vertebrata	29	1
Three Circle	Mammalia, Small	5	3
Three Circle	Mammalia, Small-Medium	19	11
Three Circle	Mammalia, Medium	33	21
Three Circle	Mammalia, Medium-Large	108	74
Three Circle	Mammalia, Large	14	1
Three Circle	Mammalia	20	15
Three Circle	Leporidae	1	1
Three Circle	*Sylvilagus* spp.	3	0
Three Circle	*Lepus* spp.	2	0
Three Circle	Carnivora	1	1
Three Circle	*Vulpes macrotis*	1	0
Three Circle	Artiodactyla	22	8
Three Circle	*Odocoileus* spp.	5	0
Three Circle	*Cervus canadensis*	1	1
Three Circle	Aves, Small-Medium	1	0
Three Circle	Aves, Medium	1	0
Three Circle	Squamata	1	0
Classic Mimbres	Mammalia, Small	2	0
Classic Mimbres	Mammalia, Medium	12	7
Classic Mimbres	Mammalia, Medium-Large	3	0
Classic Mimbres	Mammalia, Large	1	0
Classic Mimbres	Artiodactyla	2	0
Classic Mimbres	*Odocoileus* spp.	1	0

Lake Roberts Vista Changes Through Time

This section addresses the second research question, **“What changes in the faunal subsistence practices occurred through time at Lake Roberts Vista?”** The evidence suggests that the inhabitants experienced an Artiodactyla resource reduction through time.

Artiodactyla resource abundance. The Artiodactyl Index is the number of Artiodactyla fragments divided by the combined total of Artiodactyla and Lagomorpha fragments. At LRV, the most numerous Artiodactyla are deer (*Odocoileus* spp.), with a few examples of elk (*Cervus canadensis*). I did not identify any pronghorn (*Antilocapra americana*) fragments, though they were likely in the area during the occupation period (Schollmeyer and MacDonald 2020). Upland sites typically have Artiodactyl Index values of 0.19-0.75 (Szuter and Bayham 1989). The total Artiodactyl Index for LRV is 0.71, which is within the typical range and is consistent with expectations given the elevation and proximity with woodland habitats (Szuter and Bayham 1989).

Following Cannon (2001), I removed from analysis categories of elements that remain identifiable after extensive fragmentation, potentially inflating NISP values. In addressing research question two, I removed from calculation all fragments in the following categories: alveolar process (n = 8), antler (n = 6), articular surface (n = 23), cancellous bone (n = 11), and loose teeth or tooth fragments (n = 93). In addition, I removed fragments not identified to at least the Order level in the following categories: diaphysis (n = 297), rib (n = 18), and unidentified fragments (n = 556). All further reported analyses in this section eliminate these categories unless otherwise specified.

After removing the specimens listed above, the updated NISP is 490, of which, 165 (34%) are Artiodactyla, and 82 (17%) are Lagomorpha. The adjusted Artiodactyl Index is 0.67 (Table 10), which is still within the expected range and is consistent with expectations given the elevation and proximity with woodland habitats (Szuter and Bayham 1989). As explained in Chapter 3, I expect to see a decline in the Artiodactyl Index over time. There is insufficient data to calculate the Artiodactyl Index for the Georgetown phase, but there is a definite declining trend from 0.78 in the San Francisco phase to 0.64 in the Three Circle phase, and 0.50 in the Classic Mimbres period. This trend suggests a reduction over time in the availability of Artiodactyla in the surrounding environment.

Additionally, I expect to see evidence of inhabitants selectively transporting elements from the capture location to the habitation area. Binford (1978) assigned the femur the highest utility and the metapodials among the lowest utility. Madrigal and Capaldo (1999) stated that the tibia and the femur provide the highest marrow yield and the phalanges among the lowest marrow yield. Wolverton et al. (2008) found the proximal humerus and proximal tibia to provide the highest grease yields while the ribs and the distal humerus provide the lowest grease yields. For these reasons, when faced with the need to choose what aspects of an animal to transport back to the community, I expect hunters to transport more long bones and fewer metapodials, carpals, tarsals, and phalanges. Table 11 shows the observed MNE of *Odocoileus* spp. by period to illustrate the pattern found at LRV. The results are inconclusive for assessing if hunters selectively returned higher utility elements.

No element of *Odocoileus* spp. survived at a rate higher than 15 percent (Table 6). This confounds the interpretation of Table 11 because I am unable to analyze whether the inhabitants selected higher utility elements with which to return to LRV, if they brought everything back and highly processed certain elements beyond my ability to identify them, or some combination of the two options.

I also expect an increase through time in the rate of highly fragmented remains. Of the 1503 total fragments in the assemblage, I estimated 1304 (87%) to be highly fragmented (50 percent complete or less; Schollmeyer 2009). Table 12 shows the consistency through time of highly fragmented, non-Artiodactyla remains. This indicates a disregard for species when fragmenting the remains. This is somewhat confirmed by Table 7, which shows evidence of marrow access in 1 *Canis* spp. fragment, and 1 *Taxidea taxus* fragment. The inhabitants may have accessed marrow from all prey, regardless of species, which possibly indicates a perception of scarcity of meat or other nutrients in their diet. Importantly, Table 13 shows a pattern of increased fragmentation through time for Artiodactyla fragments. This suggests that inhabitants processed Artiodactyla bones more in later periods, suggesting a decline in their availability in later years. The decreasing Artiodactyl Index and the increasing rate of highly fragmented bones through time both suggest a decreased availability of Artiodactyla in later years. Because of the high fragmentation rate in all periods, it is unclear if hunters selectively returned with higher utility elements at any time during the occupation. In addressing research question two, the reduction of Artiodactyla availability indicates that inhabitants probably traveled farther in later years to acquire their preferred prey (*patch choice model*, *prey choice model,* and *marginal value theory*).

Lagomorpha resource abundance. The Lagomorph Index is the number of *Sylvilagus* spp. fragments divided by the total number of Lagomorpha fragments (Table 14). While there is not enough data to calculate for the Georgetown phase, in each period for which I have data, I identified more *Sylvilagus* spp. fragments than *Lepus* spp. fragments. The Lagomorph Index in the San Francisco phase is high (0.64) with a decrease in the Three Circle phase (0.41), followed by an increase in the Classic Mimbres period (0.92). As discussed in Chapter 5, the Lagomorph Index value decrease in the Three Circle period is because of the 11 fragments identified as "Leporidae". Because of how the Lagomorph Index is calculated, these fragments are calculated as if I identified them as *Lepus* spp. and therefore skews the value. Inhabitants captured comparatively more *Sylvilagus* spp. than *Lepus* spp. during the Classic Mimbres period than during any other period. This might be because of sample bias, sample size differences between periods, or for some other reason. At LRV, the Lagomorph Index values during all periods are higher than expected (0.08-0.30) by Szuter and Bayham (1989). This is because cottontails prefer areas of higher elevation and denser vegetation, which usually corresponds to smaller agricultural fields because of smaller populations (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989).

Table 10: Lake Roberts Vista Artiodactyl Index by Period

Period	**Artiodactyla**	**Lagomorpha**	**Total**	**Artiodactyl Index**
Georgetown	4	0	4	0
San Francisco	50	14	64	0.78
Three Circle	99	56	155	0.64
Classic Mimbres	12	12	24	0.50
Total	165	82	247	0.67

Table 11: Minimum Number of Elements of *Odocoileus* spp. by Period

Element	**Georgetown**	**San Francisco**	**Three Circle**	**Classic Mimbres**
Mandible	0	3	2	1
Cervical Vertebra	0	1	3	0
Thoracic Vertebra	0	0	1	0
Rib	0	0	1	0
Lumbar Vertebra	0	0	0	0
Pelvis/ Sacrum	0	0	1	0
Scapula	0	2	1	0
Humerus	0	1	2	0
Radio-ulna	0	1	1	0
Metacarpal	1	0	1	0
Carpal	0	0	1	0
Femur	0	0	2	1
Tibia	0	0	2	1
Metatarsal	0	0	3	0
Astragalus	0	1	0	0
Calcaneus	0	0	1	0
Proximal phalanx	0	1	2	1
Medial phalanx	0	1	1	0

Table 12: Lake Roberts Vista Non-Artiodactyla Fragmentation Rate by Period

Period	**High Fragmentation**	**Low Fragmentation**	**Total per Period**	**High Fragmentation Percent per Period**
Georgetown	13	0	13	100%
San Francisco	225	45	270	83%
Three Circle	801	118	919	87%
Classic Mimbres	87	13	100	87%
Totals	1126	176	1302	86%

Table 13: Lake Roberts Vista Artiodactyla Fragmentation Rate by Period

Period	**High Fragmentation**	**Low Fragmentation**	**Total per Period**	**High Fragmentation Percent per Period**
Georgetown	4	0	4	100%
San Francisco	49	9	58	84%
Three Circle	107	14	121	88%
Classic Mimbres	18	0	18	100%
Totals	178	23	201	89%

Table 14: Lagomorph Index by Period

Period	***Sylvilagus* spp.**	***Lepus* spp.**	**Leporidae**	**Total**	**Lagomorph Index**
Georgetown	0	0	0	0	0
San Francisco	9	5	0	14	0.64
Three Circle	24	22	11	58	0.41
Classic Mimbres	11	1	0	12	0.92
Total	44	28	11	84	0.52

Site Comparison

This section addresses the third research question, **“How did faunal subsistence practices at Lake Roberts Vista correlate with contemporaneous sites in the Mimbres region?”** The Mimbres diet mainly consisted of Lagomorpha and Artiodactyla (Table 20).

At La Gila Encantada, 10 percent of the assemblage is Lagomorpha, 5 percent is Artiodactyla, 3 percent is Rodentia, and 1 percent is Galliformes; all other Orders make up less than 1 percent of the assemblage (Table 15). At Harris, 11 percent of the assemblage is Lagomorpha, 9 percent is Rodentia, and 3 percent is Artiodactyla; all other Orders make up less than 1 percent of the assemblage. At Mattocks, 23 percent of the assemblage is Lagomorpha, 5 percent is Rodentia, and 4 percent is Artiodactyla; all other Orders make up less than 1 percent of the assemblage. At Galaz, 22 percent of the assemblage is Lagomorpha, 6 percent is Rodentia, 5 percent is Artiodactyla, and 1 percent is Carnivora; all other Orders make up less than 1 percent of the assemblage. At NAN Ranch, 28 percent of the assemblage is Lagomorpha, 7 percent is Rodentia, and 2 percent is Artiodactyla; all other Orders make up less than 1 percent of the assemblage. This suggests that at all reported sites, inhabitants ate Lagomorpha and Artiodactyla. At all sites except LRV, the Order with the highest percentage of fragments is Lagomorpha. This is understandable because, in terms of protein yield, one pronghorn is equivalent to 28 cottontails or 17 jackrabbits (Table 16), one deer is equivalent to 51 cottontails or 30 jackrabbits, and one elk is equivalent to 188 cottontails or 113 jackrabbits (Nelson and Schollmeyer 2003).

However, at no site in this report are there at least 17 times more Artiodactyl fragments than Lagomorpha. This might be due to sampling bias, a high fragmentation rate of Lagomorpha fragments, or some other factor. LRV is the only site where the Artiodactyla fragments and the Rodentia fragments outnumber the Lagomorpha fragments. This might be due to sampling bias as I only identified 20 percent of the fragments in the "Cultural Fill" context. At La Gila Encantada, the Artiodactyla fragments outnumber the Rodentia fragments, but at all other sites, the reverse is true.

Artiodactyl resource reduction. Because the Artiodactyl Index is an important proxy for measuring the presence and extent of large mammal resource reduction, I calculated it for each site. Using published fragment counts for each site, I divided the total NISP for Artiodactyla fragments per period by the sum of NISP for Artiodactyla and Lagomorpha per period (Table 17). Based on previous research, I expect to see a decline in the Artiodactyl Index from the sites at the highest elevations (La Gila Encantada and LRV) to the sites at the lowest elevations (Galaz and NAN Ranch). During each period, LRV has a higher Artiodactyl Index than any other site, followed by La Gila Encantada. For the remainder of the sites, for each period, the site at the higher elevation has the higher Artiodactyl Index, following the expectation. As upland sites, the Artiodactyl Index values during each period at La Gila Encantada, Harris, and Mattocks are consistent with the expectation of 0.19-0.75 (Szuter and Bayham 1989). As lowland sites, the Artiodactyl Index values during the Classic Mimbres period at Galaz and all periods at NAN Ranch are consistent with the expectation of 0-0.16 (Szuter and Bayham 1989).

During the San Francisco and Three Circle phases at Galaz, the Artiodactyl Index is higher than expected for a lowland site (Szuter and Bayham 1989). As discussed in Chapter 3, Artiodactyls are large-bodied mammals that are slow to reproduce and are therefore easily over-hunted in an area. Because of this, I expect to see a decline in the Artiodactyl Index at each site through time. At La Gila Encantada, the Artiodactyl Index is high in the Georgetown phase (0.36), decreases in the San Francisco phase (0.20), but then increases in the Three circle phase (0.33), and so does not follow the expectation. At Harris, the only period for which I have data is the Three Circle phase (0.23). At Mattocks, the Artiodactyl Index in the Three Circle phase (0.22) is low but increases slightly in the Classic Mimbres Period (0.24), and so does not follow the expectation. At Galaz, the Artiodactyl Index is high in the San Francisco period (0.50), decreases in the Three Circle phase (0.22), and decreases again in the Classic Mimbres Period (0.13), and so does follow the expectation. At NAN Ranch, the Artiodactyl Index is low in the Three Circle period (0.09) and decreases in the Classic Mimbres Period (0.06), and so does follow the expectation. While LRV does follow the expectation, and there is insufficient evidence to conclude concerning Harris, the remainder of the upland sites in this work (La Gila Encantada and Mattocks) do not follow the expectation. At the upland sites, the deviations from the expectation might be explained by a variation in sample sizes between periods, changes in the environment, or variations in the availability of Artiodactyls. The lowland sites reported in this work (Galaz and NAN Ranch) do follow the expectation of a decreased Artiodactyl Index in later periods, possibly because the Artiodactyl Index is so low at these sites during the Three Circle phase and the Classic Mimbres Period.

Even with the deviations from the expectation, the pattern suggests a decrease in Artiodactyla availability in the last period for which I have data at each site except Mattocks as compared to the first period.

Lagomorpha resource reduction. Because the Lagomorph Index is an important proxy for environmental and demographic changes, I calculated it for each site. Using published taxonomic counts for each site, I divided the NISP for *Sylvilagus* spp. per period by the total NISP for Lagomorpha fragments (Table 18). As discussed in Chapter 3, Lagomorpha are small to medium-bodied mammals that reproduce quickly and remain abundant at archaeological sites even when hunted intensively (Schollmeyer 2018; Shaffer and Schick 1995). I expect to see a decline in the Lagomorph Index from the sites at the highest elevations to the sites at the lowest elevations because cottontails prefer higher elevations while jackrabbits prefer lower elevations (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989).

In the Georgetown phase, the Lagomorph Index for La Gila Encantada is 0.53. In the San Francisco phase, the Lagomorph Index for La Gila Encantada (0.73) is the highest, followed by LRV (0.64), and Galaz (0.60), so the expectation is met. In the Three Circle phase, the Lagomorph Index for Harris (0.67) is the highest, but the expectation is met for the remainder of the sites with La Gila Encantada (0.57), LRV (0.41), Mattocks (0.40), Galaz (0.28), and NAN Ranch (0.25). In the Classic Mimbres period, the expectation is mostly met with the Lagomorph Index for LRV (0.92) being the highest, followed by Mattocks (0.47), NAN Ranch (0.22), and Galaz (0.15). This pattern indicates that in lower elevations, inhabitants hunted more jackrabbits than cottontails.

In addition to jackrabbits preferring lower elevations, this pattern might indicate that the sites lower in elevation are associated with more land cleared for agriculture or larger population sizes where people hunt in groups rather than individually (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). The longer people inhabit a site, the more they change their surrounding environment (Neusius 2008; Shafer 2003). As people create larger or more fields for agricultural uses, and as the footprint of the site grows, the more cottontails leave the area, and the more jackrabbits are attracted to the region (Badenhorst and Driver 2009; Cannon 2000; Schollmeyer and Spielmann 2018). In addition, individuals tend to hunt cottontails while groups tend to hunt jackrabbits (Dean 2007b; Schollmeyer and Spielmann 2017; Szuter and Bayham 1989). For these reasons, I expect to see a decline in the Lagomorph Index at each site through time, indicating fewer cottontails and more jackrabbits acquired.

At La Gila Encantada, the Lagomorph Index is high in the Georgetown phase (0.53), increases in the San Francisco phase (0.73), and then decreases in the Three Circle phase (0.57), but remains higher than that in the Georgetown phase, and thus does not follow the expectation. This pattern might be explained by a sampling bias or by a small sample size in the Georgetown phase. At Harris, the Three Circle phase (0.67) is the only period for which I have data. At Mattocks, the Lagomorph Index is high in the Three Circle phase (0.40) and increases in the Classic Mimbres Period (0.47), and so does not follow the expectation. This might be because the agricultural fields were farther away in the Classic Mimbres period, because more individuals (rather than groups) hunted Lagomorphs, or for some other reason.

At Galaz, the Lagomorph Index is high in the San Francisco phase (0.60), decreases in the Three Circle phase (0.28), and decreases again in the Classic Mimbres Period (0.15), and so it does follow the expectation. At NAN Ranch, the Lagomorph Index is moderate in the Three Circle phase (0.25) and decreases in the Classic Mimbres Period (0.22), and so it does follow the expectation. During all periods, La Gila Encantada, LRV, Harris, and Mattocks exceed the expected Lagomorph Index values for village sites, as does Galaz during the San Francisco phase (0.08-0.30; Szuter and Bayham 1989). During the Three Circle phase and Classic Mimbres period, the Lagomorph Index values at Galaz and NAN Ranch are within the expected range for village sites.

Synopsis. At all contemporaneous sites included in this research, Lagomorpha is the Order with the most fragments in each assemblage with an average 23 percent (Table 15). Rodentia makes up an average of 6 percent of the assemblages, and Artiodactyla is an average of 3 percent of the assemblages. However, at LRV, Artiodactyla is the Order with the most fragments in the assemblage with 13 percent. Rodentia is 9 percent and Lagomorpha is 6 percent of the assemblage. These differences might be because of sample biases because the environment at LRV (elevation, access to resources, and annual precipitation) is like those of La Gila Encantada and Harris. When compared to each other, the contemporaneous sites mostly follow the expected pattern of a higher Artiodactyl Index value in higher elevations and a lower Artiodactyl Index value in lower elevations during the same period.

LRV breaks this pattern by having the highest Artiodactyl Index value of all the reported sites in any given period, even though it is the second-highest in elevation. Galaz and NAN Ranch follow the expected pattern of earlier periods having a higher Artiodactyl Index value at the same site than later periods. At Mattocks, there is only a minor difference between the San Francisco and the Three Circle periods in terms of Artiodactyl Index values. At La Gila Encantada, there is a small difference in the Artiodactyl Index values between the Georgetown and the Three Circle phases, but there is a large decrease in the intervening San Francisco phase. At LRV, the pattern is as expected: that the Artiodactyl Index values are higher in the earlier periods and smaller in the later periods. While individual site histories vary, when compared across all reported sites, the Artiodactyl Index pattern is clear. Inhabitants in lower elevations during the same period, and in later periods at the same site, had less access to Artiodactyla than their counterparts in higher elevations in the same period or earlier periods in the same site.

Because *Sylvilagus* spp. prefers higher elevations and *Lepus* spp. prefers lower elevations, I expect the Lagomorph Index values to decrease as elevation decreases during the same period. When comparing all reported sites, the Lagomorph Index values follow the expected pattern except at Harris. In the Three Circle phase, the Lagomorph Index is higher at Harris than at any other site. Because *Sylvilagus* spp. prefers thicker vegetation while *Lepus* spp. prefers thinner vegetation, I expect a lower Lagomorph Index value in later periods at the same site. Of the reported sites in this project, only Galaz and NAN Ranch follow the expected pattern.

At Mattocks, the Lagomorph Index increased from the Three Circle phase to the Classic Mimbres period. At LRV, the Lagomorph Index value increased from the San Francisco phase to the Classic Mimbres period with a large decrease in the intervening Three Circle phase. At La Gila Encantada, the Lagomorph Index value increased from the Georgetown to the Three Circle phases with a substantial increase in the intervening San Francisco phase. When comparing all reported sites, the pattern of the Lagomorph Index values indicates that *Sylvilagus* spp. is more abundant in the higher elevations while *Lepus* spp. is more abundant in the lower elevations. However, increased time at a site does not inherently signify that the inhabitants will capture more *Lepus* spp. This might mean that the inhabitants continued to hunt individually rather than in groups in later periods, that their fields were farther away from the domestic village and thus did not attract *Lepus* spp. as much as if the fields were closer, or for some other reason.

Table 15: Percent of Site Assemblage by Representative Order

Order	**LGE**	**LRV**	**Harris**	**Mattocks**	**Galaz**	**NAN Ranch**
Lagomorpha	10%	6%	11%	23%	22%	28%
Rodentia	3%	9%	9%	5%	6%	7%
Chiroptera	0%	0%	0%	0%	0%	<1%
Carnivora	<1%	2%	<1%	<1%	1%	<1%
Artiodactyla	5%	13%	3%	4%	5%	2%
Cathartiformes	<1%	0%	0%	0%	0%	0%
Galliformes	1%	<1%	<1%	<1%	<1%	<1%
Strigiformes	0%	0%	0%	0%	0%	<1%
Anseriformes	0%	0%	0%	0%	<1%	<1%
Accipitriformes	0%	<1%	0%	<1%	<1%	<1%
Falconiformes	0%	<1%	0%	0%	0%	<1%
Gruiformes	0%	<1%	0%	0%	0%	0%
Passeriformes	<1%	0%	<1%	<1%	0%	<1%
Piciformes	0%	0%	0%	0%	0%	<1%
Columbiformes	0%	0%	<1%	0%	0%	0%
Testudines	0%	<1%	0%	0%	<1%	<1%
Squamata	0%	<1%	0%	<1%	<1%	<1%
Cypriniformes	0%	<1%	<1%	<1%	<1%	<1%
Higher classifications	81%	68 %	75%	67%	65%	61%

Table 16: Lagomorph to Artiodactyl Equivalent Protein Values

	Lagomorph Species	*Sylvilagus* spp.	*Lepus* spp.
Artiodactyl Species	Protein per individual	425 g.	709 g.
Antilocapra americana	12000 g.	28	17
Odocoileus spp.	21499 g.	51	30
Cervus canadensis	79855 g.	188	113

(Adapted from Nelson and Schollmeyer 2003)

Table 17: Mimbres Region Artiodactyl Index by Period

Site	Georgetown	San Francisco	Three Circle	Classic
La Gila Encantada	0.36	0.20	0.33	0
Lake Roberts Vista	0	0.78	0.64	0.50
Harris	0	0	0.23	0
Mattocks	0	0	0.22	0.24
Galaz	0	0.50	0.22	0.13
NAN Ranch	0	0	0.09	0.06

Table 18: Mimbres Region Lagomorph Index by Period

Site	Georgetown	San Francisco	Three Circle	Classic
La Gila Encantada	0.53	0.73	0.57	0
Lake Roberts Vista	0	0.64	0.41	0.92
Harris	0	0	0.67	0
Mattocks	0	0	0.40	0.47
Galaz	0	0.60	0.28	0.15
NAN Ranch	0	0	0.25	0.22

Conclusion

In this chapter, I addressed the three research questions with which I started this project. In addressing research question one, I found that during the Late Pithouse to Classic Mimbres periods, inhabitants of LRV consumed Artiodactyla such as deer and elk and Lagomorpha in the form of cottontails and jackrabbits. The excavation team saw a processing space with ground stones just outside their excavation area, where inhabitants completed at least some of the butchering of large animals. Inhabitants completed the final processing of animals before cooking and preparing the meat inside their homes. The low survivability rate of post-cranial elements of Artiodactyla indicate that inhabitants utilized all parts of the animals and that the density of the bones did not affect their decisions concerning what parts to use. In addition to filling dietary needs, the inhabitants of LRV utilized animal remains for tools and decorations including 5 awls, 2 flintknapping tools, and 2 beads.

In addressing research question two, I found evidence that the inhabitants of LRV experienced a decline through time in the availability of Artiodactyla. The Artiodactyl Index decreased and the rate of highly fragmented remains of Artiodactyla increased through time. In addition, inhabitants captured more *Sylvilagus* spp. than *Lepus* spp. in all periods.

In addressing the third research question, I found that the faunal assemblage at LRV has a comparatively high percentage of Artiodactyla fragments and a comparatively low percentage of Lagomorpha fragments. As a result, LRV has a higher Artiodactyl Index value than any other reported site during all periods.

For all other sites, I found the expected pattern of a higher Artiodactyl Index value during the same period for sites at higher elevations while sites at lower elevations had a lower Artiodactyl Index value, except at La Gila Encantada during the San Francisco phase. At LRV, Galaz, and NAN Ranch, I found the expected pattern of a consistently lower Artiodactyl Index in later periods than in earlier periods. At La Gila Encantada, I found a lower Artiodactyl Index value in the Three Circle phase as compared to the Georgetown phase, but an even lower Artiodactyl Index in the San Francisco phase. At Mattocks, I found a higher Artiodactyl Index value in the Classic Mimbres period than in the Three Circle phase.

Except at Harris, I found the expected pattern of a higher Lagomorph Index value at sites higher in elevation during the same period while sites lower in elevation had lower Lagomorph Index values. I also expected a higher Lagomorph Index value during earlier periods as compared to later periods at the same site. I found this pattern only at Galaz and NAN Ranch, sites lower in elevation, and thus more likely to always have more *Lepus* spp. than *Sylvilagus* spp.

Chapter 7: Discussion and Conclusion

LRV is a small, 15-20 room Mimbres pueblo site with a pithouse component in the northwest area of the Mimbres region. It is in the middle of the Sapillo valley, just above the Sapillo Creek, a tributary to the Gila River. It is at a higher elevation and gets more annual precipitation than many sites in the Mimbres Valley, and the Sapillo Creek runs year-round. I identified elk at LRV, which is not identified at any other reported site in this work, but I did not identify pronghorn, which is identified at all other sites reported in this work. Occupation of LRV began in the Georgetown phase of the Late Pithouse period and continued through the Classic Mimbres period. Inhabitants remained seasonally mobile into the Three Circle phase, inhabiting the site year-round by the end of the Three Circle phase. Population, site size, and dependence on agricultural products increased throughout the occupation, culminating in a peak of all three during the Classic Mimbres period.

Faunal subsistence practices remain understudied in the Mimbres region, and those of small sites are even less represented in archaeological studies of the area. This research documented the faunal subsistence practices of the inhabitants of LRV during the Late Pithouse to Classic Mimbres periods and compared them to five contemporaneous sites in the Mimbres region. I chose the comparative sites to represent the variety of sites occupied during the Late Pithouse to Classic Mimbres periods. The sites represent both ecosystems (riverine and non-riverine), elevations ranging from 6500 ft. to 5300 ft., and faunal assemblages throughout the Late Pithouse and Classic Mimbres periods.

I utilized Human Behavioral Ecology theory and three of its subsets as a foundation for my analysis of the faunal assemblage. Using the *patch choice model*, I addressed research questions one and two by identifying the agricultural field as one hunting patch for small game while a large game hunting patch must have been at a considerable distance from the community. Hunters chose the patch in which to hunt based on the prey they intended to pursue (*prey choice model*) and the expected efficacy of the patch (*marginal value theory*).

Using the *marginal value theory*, I addressed research question two. I compared the Artiodactyl Index values and the rate of highly fragmented Artiodactyla bones as proxies for showing probable Artiodactyla resource reduction over time. As the availability of Artiodactyla reduced, hunters would have traveled farther (*patch choice model* and *marginal value theory*) to capture their preferred prey (*prey choice model*).

Using the *prey choice model*, I addressed research questions one and two by treating Artiodactyla as the highest-ranked prey species in the hunting range and assuming hunters captured them whenever they encountered them.

Lake Roberts Vista Faunal Subsistence Practices

To address research question one, "**What faunal subsistence practices did inhabitants at Lake Roberts Vista use during the Late Pithouse to Classic Mimbres periods?**", I analyzed the faunal assemblage from LRV. Using the faunal comparative collection in the zooarchaeology lab on the campus of the University of Nevada, Las Vegas, I identified all faunal fragments in direct context to the most precise taxonomic level possible.

Utilizing a random, structured, multi-stage cluster strategy, I sampled 20 percent of the fragments in the “Cultural Fill” context (trash midden), and then identified those fragments to the same level of precision as those in direct context. Although the sample size was small (NISP = 474), and I introduced some sample bias because of the “Cultural Fill” sample, some patterns remain clear. Inhabitants ate mostly Artiodactyla (deer and elk) and Lagomorpha (cottontail and jackrabbit). The remains found in the domestic structures represent the final processing of faunal material before cooking or otherwise preparing for consumption. The inhabitants utilized all parts of the deer and rabbits, heavily processing the bones for marrow and grease. Neither the density nor the utility of the bones appears to have affected utilization decisions. They used mammal diaphyses to make two bone beads, Artiodactyla metapodials to make awls, and Artiodactyla antlers to make flintknapping tools.

Lake Roberts Vista Changes Through Time

To address research question two, “**What changes in the faunal subsistence practices occurred through time at Lake Roberts Vista?**”, I compared data gathered while addressing research question one. Two of the three lines of evidence support the hypothesis that LRV experienced Artiodactyl resource reduction through time. The Artiodactyl Index decreased and the rate of highly fragmented Artiodactyla bones increased through time. The test of whether hunters selectively returned with higher utility elements over lower utility elements was inconclusive, possibly because of the increasing rate of highly fragmented Artiodactyla remains.

Inhabitants captured more *Sylvilagus* spp. than *Lepus* spp. throughout the occupation. They captured comparatively more *Sylvilagus* spp. during the Classic Mimbres period than during any other period.

Site Comparison

To address research question three, “**How did faunal subsistence practices at Lake Roberts Vista correlate with contemporaneous sites in the Mimbres region?**”, I utilized published taxonomic lists for five contemporaneous sites. The diet at the comparative sites consisted of mostly of Artiodactyla and Lagomorpha. At LRV, the Artiodactyl Index value was higher than at any comparative site during all periods, likely because of sample bias. At all other sites reported in this work, sites at a higher elevation had a higher Artiodactyl Index value than sites at a lower elevation during the same period. As well, the Artiodactyl Index value at most sites, including LRV, was higher in the earliest period than in the latest period for which I have data.

At all sites except Harris, the site at the higher elevation had a higher Lagomorph Index value than the site at the lower elevation during the same period. However, later periods did not necessarily have lower Lagomorph Index values at the same site, as I expected to see.

Appendix: Tables

Table 19: Lake Roberts Vista Numbers of Identified Specimens by Period

Taxon	**Total**	**GT**	**SF**	**TC**	**CM**
Vertebrata	71	0	12	59	0
Mammalia	65	0	0	65	0
Mammalia, Small	52	0	6	42	4
Mammalia, Small-Medium	95	0	14	74	7
Mammalia, Medium	83	0	4	59	20
Mammalia, Medium-Large	484	4	119	354	7
Mammalia, Large	137	9	35	58	35
Leporidae	12	0	0	12	0
Sylvilagus spp.	44	0	9	24	11
Lepus spp.	28	0	5	22	1
Rodentia	107	0	39	62	6
Onychomys spp.	1	0	0	1	0
Peromyscus spp.	3	0	1	0	2
Sigmodon spp.	1	0	0	1	0
Neotoma spp.	12	0	2	10	0
Otospermophilus spp./ *Xerospermophilus* spp.	4	0	0	3	1
Sciurus spp.	1	0	0	1	0
Sciuridae	2	0	1	0	1
Carnivora	18	0	5	11	2
Mephitis spp.	1	0	0	0	1
Taxidea taxus	1	0	0	0	1
Canis spp.	3	0	3	0	0
Vulpes macrotis	1	0	0	1	0
Lynx rufus	2	0	2	0	0
Puma concolor	2	0	2	0	0
Ursus arctus	8	0	0	8	0
Artiodactyla	114	2	30	73	9
Odocoileus hemionus	4	0	2	2	0
Odocoileus virginianus	2	0	0	2	0
Odocoileus spp.	61	2	20	35	4
Cervus canadensis	20	0	6	9	5

Table 19: Lake Roberts Vista Numbers of Identified Specimens by Period (continued)

Taxon	**Total**	**GT**	**SF**	**TC**	**CM**
Aves	1	0	1	0	0
Aves, Small	5	0	0	5	0
Aves, Small-Medium	5	0	2	3	0
Aves, Medium	21	0	1	20	0
Aves, Medium-Large	2	0	0	2	0
Aves, Large	3	0	0	2	1
Meleagris gallopavo	7	0	1	6	0
Accipitridae	3	0	0	3	0
Buteo spp.	1	0	0	1	0
Falconiformes	1	0	0	1	0
Gruiformes	1	0	1	0	0
Apalone spinifera emoryi	3	0	3	0	0
Squamata	2	0	0	2	0
Phrynosoma spp.	1	0	1	0	0
Amphibia	3	0	0	3	0
Cypriniformes	5	0	1	4	0
Period Totals	1503	17	318	1049	119

(GT = Georgetown phase; SF = San Francisco phase; TC = Three Circle phase; CM = Classic Mimbres period)

Table 20: Mimbres Region Numbers of Identified Specimens by Site

Taxon	**LGE**	**LRV**	**Harris**	**Mattocks**	**Galaz**	**NAN Ranch**
Vertebrata	529	71	619	2936	391	2045
Mammalia	0	65	0	617	1710	1071
Mammalia, Micro	0	0	0	0	0	2
Mammalia, Small	6	52	145	0	0	443
Mammalia, Small-Medium	84	95	199	0	0	2
Mammalia, Medium	12	83	15	0	0	2
Mammalia, Medium-Large	133	484	553	0	0	1190
Mammalia, Large	0	137	0	0	0	0
Leporidae	1	12	2	181	59	128
Sylvilagus spp.	57	44	153	450	268	528
Lepus spp.	35	28	72	593	387	1565
Rodentia	1	107	65	35	42	50
Onychomys spp.	0	1	0	0	0	2
Reithrodontomys spp.	0	0	0	0	1	0
Peromyscus spp.	0	3	37	9	3	9
Sigmodon spp.	0	1	0	0	0	8
Neotoma spp.	18	12	62	17	34	99
Microtus spp.	0	0	0	0	1	0
Ondatra zibethicus	0	0	0	1	0	5
Cricetidae	0	0	0	2	0	44
Chaetodipus spp./ *Perognathus* spp.	0	0	0	2	1	4
Dipodomys spp.	1	0	0	2	6	5
Thomomys spp.	0	0	18	0	89	118
Geomys spp.	6	0	0	143	0	142
Otospermophilus spp./ *Xerospermophilus* spp.	0	4	0	4	2	28
Sciurus spp.	0	1	0	3	0	10
Cynomys spp.	0	0	0	10	4	16
Sciuridae	0	2	11	23	6	4
Vespertilionidae	0	0	0	0	0	1
Carnivora	0	18	2	1	4	2
Mephitis spp.	0	1	0	1	8	0

Table 20: Mimbres Region Numbers of Identified Specimens by Site (continued)

Taxon	**LGE**	**LRV**	**Harris**	**Mattocks**	**Galaz**	**NAN Ranch**
Taxidea taxus	0	1	0	3	2	0
Bassariscus sp.	0	0	0	0	6	0
Canis spp.	0	3	0	21	7	7
Urocyon cinereoargenteus	0	0	1	0	9	0
Vulpes macrotis	0	1	0	0	0	0
Lynx rufous	0	2	0	0	0	0
Puma concolor	2	2	0	0	0	0
Felidae	0	0	0	1	0	0
Ursus arctus	0	8	0	6	0	0
Artiodactyla	1	114	8	178	77	125
Antilocapra americana	1	0	1	11	10	25
Ovis canadensis	0	0	0	0	0	3
Odocoileus hemionus	42	4	26	0	5	0
Odocoileus virginianus	0	2	0	0	0	0
Odocoileus spp.	0	61	34	38	71	22
Cervus canadensis	0	20	0	0	0	0
Bovidae	0	0	0	0	0	2
Aves	0	1	5	12	20	10
Aves, Small	0	5	0	0	0	19
Aves, Small-Medium	0	5	0	0	0	9
Aves, Medium	0	21	0	0	0	22
Aves, Medium-Large	0	2	0	0	0	19
Aves, Large	0	3	0	0	0	6
Cathartes aura	1	0	0	0	0	0
Callipepla gambelii	1	0	4	1	1	0
Meleagris gallopavo	11	7	0	21	0	0
Phasianidae	0	0	0	0	0	39
Strigiformes	0	0	0	0	0	1
Anatidae	0	0	0	0	1	2
Accipitridae	0	3	0	5	11	4
Buteo spp.	0	1	0	0	0	0

Table 20: Mimbres Region Numbers of Identified Specimens by Site (continued)

Taxon	**LGE**	**LRV**	**Harris**	**Mattocks**	**Galaz**	**NAN Ranch**
Falconiformes	0	1	0	0	0	5
Gruiformes	0	1	0	0	0	0
Passeriformes	2	0	6	1	0	9
Emberizidae	0	0	0	0	0	1
Molothrus spp.	0	0	0	0	0	1
Corvidae	0	0	0	0	0	6
Corvus corax	3	0	0	0	0	0
Picidae	0	0	0	0	0	2
Columbidae	0	0	1	0	0	0
Reptilia	0	0	0	12	0	0
Apalone spinifera emoryi	0	3	0	0	0	0
Testudines	0	0	0	0	26	3
Squamata	0	2	0	0	0	0
Phrynosoma spp.	0	1	0	0	0	0
Serpentes	0	0	0	1	0	7
Viperidae	0	0	0	0	1	1
Colubridae	0	0	0	0	1	13
Amphibia	0	3	0	0	1	1
Cypriniformes	0	5	0	0	7	1
Osteichthyes	0	0	2	1	0	2
Site Totals	947	1503	2041	5342	3272	7890

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2013 Burnt Bone Assemblages from El Esquilleu Cave (Cantabria, Northern Spain): Deliberate Use for Fuel or Systematic disposal of Organic Waste? *Quaternary Science Reviews,* 68: 175-190.

Curriculum Vitae

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EDUCATION:

M.A. in Anthropology, University of Nevada, Las Vegas: **In Progress**
Concentration: Archaeology
M.L.S. in Organizational Leadership, Fort Hays State University: **2015**
Concentration: Business Ethics
B.A. in Anthropology, University of Nevada, Las Vegas: **2018**
B.A. in Sociology, Fort Hays State University: **2013**
A.G.S. in Psychology, Rio Salado Community College: **2014**

PROFESSIONAL EXPERIENCE:

2018-Present Cultural History Collections Manager, Las Vegas Natural History Museum; Curator, Southern Nevada Federal Repository
Managed and preserved collections according to the professional museum and archival practices: utilized PastPerfect, managed volunteers, managed acquisitions and deaccessions, cleaned, inventoried, labeled, documented, analyzed, identified, and digitized collections and associated records.
2019-2020 Faunal Material Analyst, Springs Preserve
Identified and analyzed faunal material assemblage.

FIELD EXPERIENCE:

2020 September 19, 26: Site Documentation at Jumbo Wash
Assisted in documentation of archaeological site including rock writing panels and graffiti
PI: Staffan Peterson, NPS
2020 March 16: Artifact recovery at Dreamweaver Cave.
Assisted in the recovery of artifacts at a highly sensitive site including surface collection, minor excavation, and documentation.
PI: Bryan Hockett, BLM.
2020 March 17: Artifact recovery at King Solomon Cave.
Assisted in the recovery of artifacts at a highly sensitive site including surface collection, minor excavation, and documentation.
PI: Bryan Hockett, BLM.

LAB EXPERIENCE:

2019-Present Zooarchaeology Lab, UNLV
Lab Manager: supervised and recruited volunteers, organized lab projects for volunteers, maintained lab inventory, facilitated Open House.
Supervisor: Dr. Levent Atıcı.
2018-Present Southwest Archaeology Lab, UNLV
Volunteer: cleaned, organized, and analyzed artifacts.
Supervisors: Danielle Romero, Barbara Roth.
2017-2018 Archaeology Collections Lab, UNLV
Volunteer: organized, labeled, curated artifacts.
Supervisor: Virginia L. Lucas.
2017-2019 Zooarchaeology Lab, UNLV
Volunteer: organized, labeled, analyzed, identified, curated skeletal material.
Supervisors: Virginia L. Lucas, Dr. Levent Atıcı.

INTERNSHIPS:

2018 Las Vegas Natural History Museum’s Southern Nevada Federal Repository.
Organized, analyzed, curated artifacts, utilized PastPerfect.
Supervisor: Virginia L. Lucas.
2018 Nevada State Historic Preservation Office, Las Vegas Field Office.
Created maps, edited pdf documents, edited videos, created educational and outreach materials, edited the archaeological site database, worked with the Nevada Cultural Resource Information System (NVCRIS), created activity flyers.
Supervisor: Dr. Samantha Rubinson.

RELATED TRAINING:

2020 October 26-28: Association on American Indian Affairs 6th Annual Repatriation Conference: Growing Community & Moving Forward after 30 Years of **NAGPRA**.
Workshops about completing NAGPRA related tasks in real-life situations including notification, consultation, and repatriation.
2018 September 6: **Pedestrian survey** training by Erin Eichenberg, Tule Springs National Monument.
2018 July 17-18: “NHPA, **Section 106** Review and Compliance Process”, Nellis Air Force Base, taught by Katherine Kerr.
Introduction to the Section 106 process and memoranda of agreement.

PROFESSIONAL MEMBERSHIPS:

2019- American Institute for Conservation
2019- Southern Nevada Agency Partnership Cultural Resource Team
2018- Archaeo-Nevada Society
2018- Nevada Museum Association
2018- Archaeological Institute of America

2017- Society for American Archaeology
2017- Lambda Alpha Honor Society
2017- Anthropology Society

NON-PEER REVIEWED PUBLICATIONS:

Benedict, Laura A.
2017 Polyandry Around the World http://digitalscholarship.unlv.edu/award/28
A definition of the six types of polyandry with examples as practiced historically by people around the world.