ANALYSIS AND INTERPRETATION OF THE FAUNA FROM THE BLUFF GREAT HOUSE

by

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ABSTRACT

This thesis describes the analysis and interpretation of the animal remains from the Bluff Great House, a Chacoan outlier in southeastern Utah. Faunal resources utilised at the Bluff Great House are generally analogous to those from other sites in the region. The temporal changes in the Bluff assemblage show a decrease in the percentage of artiodactyls and an increase in the percentage of turkeys, a pattern which is paralleled at other sites from the same time period. This pattern may have been influenced by a form of resource depression and shaped by the domestication of the turkey. A comparison of regional assemblages revealed that the material from Great Houses and unit pueblos were similar. All pathological conditions present in the faunal material from Bluff were briefly reviewed and discussed. Some of the pathological specimens resemble pathologies from other Chacoan sites in the Northern San Juan region.

Keywords: Faunal analysis; zooarchaeology; palaeopathology; American Southwest; Chaco

Subject Terms:
Animal remains (Archaeology)—Utah—Bluff Great House
Excavations (Archaeology)—Southwest
Pueblo Indians—Antiquities
Palaeopathology
DEDICATION

To my Uncle Garry, for questioning and rebelling; to my Grandfather Fothergill, for thinking and analysing; and to Dr. Linda Cordell, for the perfect gift: a push in the right direction.
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CHAPTER 1: AN INTRODUCTION

I. Statement of Research Objectives

My thesis is motivated by an idea belonging to Wolf-Rüdiger Teegen: animal remains can function as a mirror of human behaviour (Teegen 2005). The research described herein is part of an attempt to gaze into that mirror and ascertain what, if anything, can be seen of human behaviour in the remains of the fauna from the Bluff Great House. This involves discussing and attempting to interpret the results of the analysis and investigation of the faunal remains recovered from the Bluff Great House, which was occupied by Ancestral Puebloan horticulturalists from 1075 through 1150 A.D. There are definite inspirations behind the research undertaken for this thesis. One motivation is the desire to make an intellectual contribution to the extant body of knowledge on the Chaco Phenomenon. Another is to clearly present faunal analyses and comparisons in order make available the data gleaned from them for the purpose of future study. This chapter is a brief introduction to the research objectives and areas of discussion that will be more thoroughly examined in the following chapters.

Focal to the investigation of these faunal remains and their analysis is the fact that the Bluff Great House is a Chacoan outlier. The idea of "Chaco" concerns a Pueblo II (900 through 1150 A.D.) period development initially concentrated in and around Chaco Canyon, New Mexico. Great Houses,
monumental structures built within and outside of the canyon, are a hallmark of the concept of Chaco. These structures are classified using a number of characteristics, which will be discussed further in later chapters. As John Kantner (2005) notes, a number of critical questions about Chaco remain unanswered after many decades of research. There are two primary reasons why Chaco has been and continues to be the subject of archaeological investigation in the American Southwest. One is the fact that we still cannot answer many of the more simple enquiries concerning the origin and collapse of the system itself. The other is that the Chacoan archaeological record itself challenges many entrenched assumptions about the emergence of social hierarchies (Kantner and Mahoney 2000).

Material culture recovered from outlying great houses such as Bluff are one practical source of information on the Chacoan system. The study of Chacoan outliers specifically is still rather new; larger, more architecturally impressive structures within the canyon have received the bulk of scholarly consideration. Though they have not received a great amount of attention, these outliers have the potential to inform upon whatever it is that Chaco was. Many outliers appear to have possessed a large amount of autonomy, and many of these great houses contain architectural and material patterns which diverge (often significantly) from the Chacoan signature. Some were clearly more deeply involved in the Chacoan system. For example, the Chimney Rock Great House in southern Colorado comes close to cloning the architectural style used in the canyon. On the other hand, many outlying great houses possess few Chacoan
characteristics. The vast majority of these outlying sites are not well understood in general, nor are their connexions to and relationships with the central Chaco Canyon area.

Faunal remains have the potential to reflect local subsistence history, differences in status between communities, and belief systems. I will describe the cultural context of the Bluff Great House, both in terms of the connexion to the Chaco Phenomenon as well as on the smaller sub-regional scale of the Northern San Juan Basin. I will identify aspects of the Bluff Great House and the associated faunal assemblage which resemble other local great house assemblages and those which may reflect Chacoan attributes. I will detail the analyses I have performed on the faunal remains excavated from the Bluff site and describe the methodology which I employed during analysis. Finally, I will describe the three specific areas of emphasis I investigated in addition to performing a standard zooarchaeological analysis, and draw conclusions concerning these areas. The overarching theme of this research is to contribute to an understanding of the function of Great Houses as part of local communities as well as elements of the Chaco system.

My primary research goals are as follows:

1.) Ascertain what animal resources were utilised by the inhabitants of the Bluff Great House.

2.) Evaluate change in the faunal assemblage through time and explain any changes identified.
3.) Determine how the Bluff Great House compares to non-great house sites in the Northern San Juan Basin in the same time period.
4.) Determine how the Bluff Great House compares to other great house sites in the Northern San Juan Basin in the same time period.
5.) Note and investigate all pathological conditions present in the faunal material.

II. The Chaco Phenomenon and the Bluff Great House

I will be focussing on the Bluff faunal assemblage within a very specific framework: that appropriate to a Chacoan Great House. There are some patterns which emerge from the faunal assemblages at various great houses that seem to hint at the possibility of a "Chacoan" faunal assemblage. Some animals, macaws for instance, are associated with the canyon itself and with the more prominent great houses, while others (such as turkeys) are ubiquitous throughout the northern American Southwest during certain time periods. Occasionally, at outlying sites the remains of avian and terrestrial predators are recovered in certain contexts (Durand and Durand 2006), while other creatures are more typically recovered from middens.

The expression "Chaco Phenomenon" is one that I will use to describe whatever it is that Chaco was. (Please see Chapter 2 for a fuller description of the phrase "Chaco Phenomenon" and its origin.) This remarkable development encompassed a political, ceremonial, and trade network in the American Southwest. At its greatest extent, the far reaches of Chacoan architectural traits spanned an area roughly the size of Portugal and included sites in New Mexico,
Arizona, Utah, and Colorado; some items traded into this area originated as far away as western Mexico. The heart of Chaco as an architectural development was Chaco Canyon in northwestern New Mexico, which accommodated twelve massive great houses and a great number of smaller structures. The flagship Great House in Chaco Canyon is Pueblo Bonito. This masonry behemoth was built in several phases starting in approximately 850 A.D., and may have had over 700 rooms. Pueblo Bonito may have been as much as five stories high, and was in some way (at least with respect to architecture) clearly central to the purpose and function of the Chaco core area. Figure 1 shows the Chaco region and some of the Chacoan roads.
Figure 1: The Chaco Region

Figure 1 adapted from Kantner 1997.
The degree to which outlying Great Houses such as Bluff were involved in the Chaco Phenomenon, and in what aspects they participated, if at all, is still debated. The value of investigating these outlying sites to our understanding of the Chaco Phenomenon on the whole, however, is enormous. While the core often defines the periphery in geographical relationships (Fellmann et al. 1996), it is possible that information gleaned from the periphery could clarify certain aspects of the core. One of the more striking hallmarks of Chaco Canyon is the presence of various exotic goods that were brought there from distant locales (Lekson 2000). While there appears to be little evidence of exotic good re-distribution throughout the network of outlying sites (Frazier 2005, Judge 1993, Kantner 2004a), some items (chipped stone and ceramics) were traded throughout the American Southwest and have been associated with a connexion to the Chaco core area (Lekson 1999). The concept of a Chacoan re-distributive network is discussed more fully in Chapter 2.

The Bluff Great House has been classified as a Chacoan outlier; it is located in southeastern Utah (Figure 2). The term “outlier” is conferred upon the structure because of architectural resemblances to the Great Houses in Chaco Canyon itself. Great houses, which are planned structures with a severe, geometric layout, differ from unit pueblos, the typical residential structures of the American Southwest. For Bluff, the relevant factors include the presence of core-and veneer walls and other architectural traits, the association of a Great Kiva, roadways and berms, the suite of architectural traits present in one of the embedded kivas and the non-local chipped stone and ceramics which were
recovered during excavation. Bluff shares situational landscape attributes with several other Chacoan outliers, which tend to be located on high points with broad views of the surrounding area (Lekson 1999). The orientation of the Bluff site with respect to the cardinal directions is also similar to a great many Chacoan structures. The Bluff site is one of few outlying Great Houses which are located within a few kilometres of a major river. This characteristic is reflected in the faunal remains recovered from the site and I will discuss this topic further in following chapters. Bluff is unusual in another respect; it is commonly assumed that there was an abandonment period following the decline of Chaco. Not only was Bluff occupied after the collapse of the Chacoan core late in the Pueblo II period, but there is possible evidence for a continuous occupation (Blinman 2007). The continued occupation of great houses such as Bluff would have the potential to reveal information lacking in the current literature about life in the American Southwest after Chaco.
III. Investigations of the Bluff Faunal Material

I have performed a detailed zooarchaeological analysis of all faunal material excavated from the Bluff Great House. An attempt was made to identify all bones in the Bluff assemblage whenever feasible and assign as specific a taxonomic designation to the specimens as possible. The element and side of the specimen, its length, and the state of epiphyseal fusion were recorded. I also noted whether a pathological condition was present. The description of the
pathologies identified, their probable aetiologies, and further discussion of zooarchaeological palaeopathology can be found in Chapter 7. In addition, I recorded any alterations made to the bone. When recording burn marks, their location and whether the burn was white or black was noted. I also recorded the presence of rootlet etching, carnivore gnawing, and cut marks resulting from stone tools. Also noted were breaks which occurred prior to and during excavation, identifiable residue present (i.e. charcoal or manganese traces), and any evidence of working or manufacture. If a specimen fit the description of a specific type of artifact such as a scraper or an awl, that would also be noted. I did undertake a basic taphonomic analysis of the identifiable Bluff fauna, and a discussion of the results can be found in Chapter 5.

I utilised the comparative collection of faunal bone housed at Simon Fraser University in order to make most taxonomic designations. In addition, I used a comparative collection at the Burke Museum in Seattle for the taxonomic designation of passeriformes and other fauna not available in the SFU comparative collection.

Resource Depression

One of the goals of this research is to investigate subsistence practices. As the Bluff locale was occupied for centuries, it is entirely probable that the inhabitants affected the local environment. In order to examine this possibility, I applied the concept of resource depression to changes over time in the Bluff faunal assemblage. Resource depression is a concept borrowed from ecology which relies on a number of different premises found in optimal foraging theory.
and predator behaviour models as well as r and K selection theory (MacArthur and Wilson 1967). Resource depression is defined specifically as a negative change in prey availability from the perspective of the predator (Charnov et al. 1976). In this case (as in most archaeological applications of the concept), the predators modelled are human hunters. There are three different types of resource depression: behavioural, microhabitat, and exploitative. These will be discussed further in Chapter 6. The range of possible interpretations resulting from evidence of resource depression in archaeological assemblages is quite broad, and resource depression has been used as an indicator of a number of different social or behavioural changes. Among these are technological changes, changes in territoriality, increases in violence and warfare, possible reduced health and stature in humans, and the emergence of social hierarchies (Broughton and O’Connell 1995; Hildebrandt and Jones 1992; Raab et al. 1995). Given the environmental circumstances prevalent in the Northern San Juan Basin at the time of the occupation of Bluff, the probability of a type of resource depression occurring is relatively high. The degree of certainty with which one might assign a specific type of resource depression to an archaeological assemblage, however, is not likely to be high. Despite this, there are various correlates in the material record which can be used to validate the possibility of a certain type of resource depression. This concept will be discussed more fully in Chapter 5 with reference to the Bluff Great House faunal assemblage.
Regional Comparison

Chacoan Great Houses are architecturally distinct from neighboring structures. One can therefore ask whether faunal assemblages from great houses differ from those at contemporaneous sites that lack great house architecture. The theme of regional comparisons results from questions regarding these differences. Furthermore, did Great Houses across the region share similar traits?

In an attempt to answer questions regarding the role of outlying Great Houses in the Chaco Phenomenon and to learn more about life at the Bluff Great House specifically, I have compared the data from the Bluff Great House faunal assemblage to that from other sites in the Northern San Juan region. One comparison has contrasted the Bluff assemblage with nearby sites in order to see if the great house fauna differs from that in neighboring sites. Another compares the Bluff material to that from other Chacoan great houses to ascertain whether there is a common pattern in Northern San Juan sites. Specifically, I have researched the faunal collections from the following sites: North McElmo #8, Wallace Ruin, Escalante Great House, the Nancy Patterson Site, Chimney Rock Great House, Salmon Great House, and the Mitchell Springs site. In Chapter Six I will be comparing those assemblages to the results from the Bluff collection. I intend to look not only at the presence of certain species, but also at the change in species proportions over time.
Palaeopathology

As part of this analysis of the faunal remains from the Bluff Great House, I made plain my intent to identify and research any pathological lesions or alterations evident osteologically in the Bluff assemblage. Palaeopathology is a source of information on the health of animals in the past and therefore an indirect source of knowledge regarding the lives of humans. Pathologies can indicate nutritional deficits that may have affected humans, reflect human behaviour directly, and elucidate a number of different interconnected relationships between humans and animals. Animal palaeopathology has been somewhat neglected in archaeology until recently, for various reasons. Analysts have preferred to depend upon information gleaned from human remains to inform upon human lifeways. Animal remains are rarely fully articulated, making some pathologies difficult to identify and designation of a systemic pathological condition impossible. Also, there has been little standardisation in zooarchaeology regarding the treatment of animal palaeopathology. Often, a pathological specimen was highlighted because it was unusual, but no interpretations were offered (O'Connor 2000). It is often the case that no statement regarding pathologies is made whatsoever; one has no idea if the remains were examined for pathologies or not. Terry O'Connor highlights the need for a systematic evaluation of pathologies in animal bones as they have potential as a valuable resource for the study of palaeoecology, ancient diseases, and human-animal relationships (O'Connor 2000). I have followed his recommendations in explicitly searching for and noting pathological specimens.
Eight specimens from the assemblage have pathological lesions; all but two of them are present on *Meleagris gallopavo* specimens. I will further discuss the pathologies and their implications in Chapter 7.

IV. Summary

My intent is to evaluate the faunal material from Bluff within the framework of animal remains as a mirror of human behaviour. I interpret and present the resulting data in hopes of contributing to the understanding of human behaviour at outlying Great Houses and as part of the Chaco Phenomenon. The taxon present at Bluff, changes over time in the structure of the faunal assemblage, comparisons of the data to sites in the Northern San Juan basin and a description of pathological specimens are discussed in the following chapters.
CHAPTER 2: THE CHACO PHENOMENON

An Introduction

Chaco Culture National Historical Monument is located in the northwestern corner of the state of New Mexico in the American Southwest (Figure 2). The monument encloses 13,675 hectares and the canyon itself, which runs for over thirty kilometres. Chaco Canyon alone contains approximately 3,600 identified archaeological sites with dates ranging from 10,000 BC to the historic period. In this chapter, I focus on the archaeological sites and materials in Chaco Canyon from the end of the Basketmaker III time period (approximately 700 A.D.) to the Pueblo III period, which ended at approximately 1350 A.D.. With the intention of contextualising the Bluff Great House, I will also be focussing on what happened during these time periods in the Northern San Juan Region.

The term “Chaco Phenomenon” was initially coined by Cynthia Irwin-Williams in a paper she presented at the 1975 Pecos Conference. It is used here to describe not only the Pueblo II Great Houses of the Chaco Canyon, but also the idea and conceptualisation of Chaco as a regional social system, involving hundreds of smaller outlying Great House communities and likely affecting a number of other cultural groups. There are many hypotheses regarding the Chaco Phenomenon, and most of them can be discussed in the context of the following queries:
How and why did the Chaco Core develop as the centre of a regional system?

What was the function of Chacoan great houses?

How did Chaco function?

What are the theories on social organisation in Chaco Canyon?

Why and how did the Chaco Phenomenon collapse?

What aspects of the Chaco Phenomenon remained after 1150 A.D. or post-collapse?

Zooarchaeological data can contribute to the understanding of some of these questions. The function of Great Houses might be reflected in the faunal assemblage, particularly if unusual species are abundant or there is an obvious spatial patterning to the deposition of the fauna. Hunting behaviour and feasting behaviour, both of which could reflect aspects of social organisation, can be interpreted from faunal remains. Changes over time in the structure of faunal assemblages can be applied to questions of behaviour and ecology. For example, resource depression of artiodactyls as a result of overhunting or other factors could have been motivation for increased turkey husbandry. Also, one of the hypotheses on the collapse of Chaco discussed later in this chapter relies upon environmental and ecological factors such as resource depression.

Before I examine the main questions about Chaco and various hypotheses that have evolved in response, I provide a brief description of the
Chaco Phenomenon in Chaco Canyon and in the Northern San Juan region (in which the Bluff Great House is located).

Ia. Prior to Pueblo I in the Chacoan Core (La Plata Phase)

The earliest beginnings of a distinctive Chaco Phenomenon occurred at approximately 800 A.D., possibly with the movement of people south from the northern part of the San Juan Basin. Prior to that, the canyon was inhabited in various locales, but sites were indistinguishable from other sites in the San Juan Basin.

Much of the Basketmaker III material culture from the Chaco Core resembles that from other areas of the northern Southwest (see below). The primary faunal resources utilised within Chaco Canyon between 600 A.D. and 925 A.D. were *Sylvilagus* sp. (cottontail rabbit) and pronghorn antelope (Sebastian 2006). The relative proportion of small mammals (as compared to large) decreases at approximately 700 A.D. The ceramic assemblages from this time period include La Plata Black-on-White as well as Lino and Obelisk graywares (Windes 2004). Architecture consisted primarily of dispersed pithouse structures with storage cists, and horticulture of maize took place. Within the Chaco core were two large aggregated pithouse villages dating to the Basketmaker III era (Shabikeschee and 29SJ423) which had accompanying Great Kivas (Windes 2004, Wilshusen and Van Dyke 2006).
Ib. Prior to Pueblo I in the Northern San Juan

A great deal of technological change took place during the Basketmaker III era in the American Southwest, and the Northern San Juan region was no exception. Bisque and black-on-white ceramic wares with mineral paint were developed. Bow and arrow technology replaced the atlatl. Maize is common, and beans also occur in botanical assemblages. In addition, the domestication of the turkey most likely took place during this period.

Most of the population lived in deep pithouses which often were part of a small hamlet. These pithouses sometimes had above-ground rooms, and sometime during Basketmaker III, the "proto-kiva" made the transition to a rounded shape (Wilshusen and Van Dyke 2006).

One unusual feature of the Northern San Juan basin during the Basketmaker III period is the prevalence of burned, stockaded hamlets (Hurley 2000). Many of these sites are on the northern periphery of the San Juan region; some argue that the most likely reason for the presence of stockades is warfare, despite other possible explanations such as turkey penning (Chenault and Motsinger 1995). At the end of the Basketmaker III period, there was a significant population increase; this probably led to the later construction of large, aggregated village sites (Windes 2004, Wilshusen and Van Dyke 2006).

Ilia. The Pueblo I Period in the Chacoan Core (White Mound Phase)

The architecture in the Chaco Core area from later periods (1020-1120 A.D.) has drawn so much scholarly attention that there has been a rather limited
focus on earlier occupations within the canyon. The seeming neglect of the Pueblo I sites may result partially from the lack of resemblance to the later Great Houses. The primary site type within Chaco Canyon during the Pueblo I period was the small, aggregated pithouse village, with a few exceptions. These shallow pithouses gradually became a bit deeper late in the PI period (approximately 800-850 A.D.), and some above-ground rooms with stone slab wall bases were also built (Wilshusen and Van Dyke 2006).

The first great houses within Chaco Canyon were essentially continued expansions upon earlier masonry structures. Pueblo Bonito, for instance, was constructed in at least three phases (possibly four) over the course of its occupation. At the same time that major expansions of these structures occurred, major storage facilities were also constructed (Windes 2004). The masonry structures that would later expand to become the now-famous Chacoan Great Houses were initially unremarkable (Lekson 1999). At 875 A.D., only Pueblo Bonito or Una Vida were close to the size of the smaller Pueblo I villages in the Northern San Juan. Not until 1040 through 1100 A.D. did the Chacoan structures reach the size of the largest Pueblo I villages in the Northern San Juan such as McPhee Pueblo (Wilshusen and Van Dyke 2006). There were two rather large Pueblo I hamlets in Chaco Canyon, 29SJ724 and 29SJ627. These were constructed in Chaco Canyon during or just after the depopulation of the Northern San Juan, and were not unique. Similar structures were built just prior to or at approximately 925 A.D. in the Red Mesa Valley, on the Dutton Plateau, and along the Chuskan slope (Wilshusen and Van Dyke 2006). This pattern
suggests that perhaps the development and origin of Chaco Canyon may have been more tied to regional phenomena. The vast majority of fauna recovered from Chaco Canyon sites during the Pueblo I period continue to be deer and small mammals (Sebastian 2006). There is an increase in the relative proportion of small mammals to large at about 800 A.D. The proportion of small mammals peaks at approximately 900 A.D. A slight decline follows, and it remains stable throughout the rest of the occupations at Chaco prior to collapse. Ceramic assemblages from this time period are dominated by Lino Gray ware and White Mound Black-on-White.

Ilb. The Pueblo I Period in the Northern San Juan

The Northern San Juan region is known for being a prime place to study the pithouse-to-pueblo transition (Wilshusen and Van Dyke 2006). No other area in the northern Southwest had such villages, and within the San Juan basin, large PI villages are present mostly in the northern half of the watershed.

The Dolores Archaeological Project in southwestern Colorado resulted in the excavation of 101 archaeological sites. Vast amounts of material culture were unearthed; these revealed a large amount of information regarding the Pueblo I period in the Northern San Juan region. On average, Pueblo I villages were much larger and more prevalent than initially thought; the smaller villages commonly contained about 35 rooms, and represent approximately 15 households (Wilshusen and Van Dyke 2006). The earliest large PI villages (770-830 A.D.) occur along the Utah-Colorado border, and by 840-880 A.D., they
were present from the northern Montezuma valley to Mesa Verde. These later villages had average populations of about 48 households.

During the beginning of the Pueblo I period, a large population increase occurred (Wilshusen and Ortman 1999:377-382). The scale of expansion suggests that immigrants were joining the populace and that the local population was independently increasing concurrently (Windes 2004, Wilshusen and Van Dyke 2006). Wilshusen and Van Dyke (2006) argue that the origin of these immigrants was the Southern San Juan region. They estimate that by 860 A.D. half to two-thirds of the entire Ancestral Pueblo population lived in the Northern San Juan region.

As a result of information from the DAP and other projects, social organisation and possible evidence for ranked or ritual leadership during the Pueblo I era in the Northern San Juan has been investigated (Kane 1989, Wilshusen 1986, Wilshusen 1991). Despite the general consensus that the Dolores villages were basically egalitarian, some evidence to the contrary does exist. This includes the presence of large habitation structures such as those found at the McPhee site, the deliberate killing and burial of adult couples (male and female) in ritual contexts at the time of the abandonment of one of the more organised villages, and the consistent presence of paired burials in structures with ritual features (Wilshusen 1986). Wilshusen suggests that the structures with ritual features were controlled by specific corporate groups (Wilshusen 1989:103).
Local and regional population movement also proved to be a much more important aspect of life in the Pueblo I time period in the Northern San Juan. In the Dolores Archaeological Program database, there are 243 occurrences of ornaments, the majority of which were formed from non-local shell and rare stones (an “occurrence” in the DAP database can represent anything from a fragment of a pendant to a large cache of beads). Exotic goods in the Northern San Juan region prior to 925 A.D. may be more common than or as common as they are in contemporaneous Chacoan sites.

By 925 A.D., people begin to abandon these Pueblo I villages, and only a handful of archaeological sites in the Northern San Juan region appear to be occupied. There was likely a significant depopulation event, and communities resembling the Northern San Juan villages were built close to the San Juan River (Windes 2004, Wilshusen and Van Dyke 2006). These “Piedra Phase” sites were burned and not re-occupied. It has been suggested that they may have been “half-way stations” between Pueblo I villages in the Northern San Juan and locales in the Southern San Juan basin (Wilshusen and Van Dyke 2006).

Neck-banded pottery is common throughout the Northern San Juan region during the Pueblo I period; it becomes popular during Pueblo II in the Chaco Core area (Wilshusen and Van Dyke 2006). Also, at McPhee Pueblo (the largest room block at McPhee Village, a Pueblo I Dolores village) one of the full masonry walls was built using Type I “Chacoan” masonry (Wilshusen and Van Dyke 2006).
Illa. Early Pueblo II in the Chacoan Core (Early Bonito Phase)

Pueblo Bonito was constructed in several phases, beginning in the late 800s. The bulk of Old Bonito was constructed between 920 and 935 A.D. (Lekson 1984a:127-132). According to Lekson et al. (2006) Pueblo Bonito was probably built and expanded in four phases; one phase of construction took place in the late 800s to early 900s A.D., one occurred at 1020-1050 A.D., another between 1050 and 1075 A.D., and the last prior to 1115 A.D. Other Great Houses within the canyon also were built in phases, including Peñasco Blanco, Pueblo Alto, Chetro Ketl, and Pueblo del Arroyo (Lekson, et al 2006). Incipient great houses looked much like aggregated pueblos, only with thicker walls and more stories. These budding Great Houses were not the only structures built and occupied in Chaco Canyon in the early Pueblo II period; small unit pueblos were also constructed on the south side of the canyon (Lekson 1999). The vast majority of large great houses in Chaco Canyon were constructed on the north side of the canyon. The predominant faunal species recovered from all sites within Chaco Canyon between 900 and 1125 A.D. was Odocoileus sp. (deer) with small amounts of small mammals and avians. At the beginning of PII, ceramic assemblages include Kiatuthlanna and Red Mesa Black-on-White, Lino Gray, and Kana’a Neck-banded wares (Windes 2004). The number of above-ground slab houses increased and they appear to have become aggregated more frequently between 900 and 1040 A.D. A major population increase occurred during this time period, and may have been the result of an influx of
residents from the Northern San Juan region (Windes 2004, Wilshusen and Van Dyke 2006).

IIIb. Early Pueblo II in the Northern San Juan

After 900 A.D. in the Northern San Juan, very little data are present with which to judge local developments. Speaking of the region at 925 A.D., Wilshusen and Van Dyke state:

“...its role was so diminished that, at this point, archaeologists have difficulty defining what was occurring within the Northern San Juan.” (Wilshusen and Van Dyke 2006:242)

IVa. Late Pueblo II in the Chacoan Core (Classic Bonito Phase)

The “climax” of Chaco is thought to have occurred at approximately 1035-1135 A.D. A distinct decline followed by 1150 A.D. From the initial construction of Pueblo Bonito to the collapse of the Chaco Phenomenon, 250 years passed. This may not seem an impressive time span. However, that comprises nearly five lifetimes or ten generations and is longer than Canada or the United States have been nations.

By 1030 Pueblo Bonito, Una Vida, and Peñasco Blanco had been built; following this were the constructions of four new Great Houses: Hungo Pavi, Chetro Ketl, Pueblo Alto, and Pueblo del Arroyo. Two stand-alone Great Kivas (Casa Rinconada and Kin Nahasbas) were constructed, along with roads, ramps, and staircases. (Lekson 2004). Three major periods of labour investment in the construction of great houses within the canyon occurred at approximately 1050,
During the late PII period, kivas within and outside of great houses become commonplace. Chacoan architecture is unique; it is monumental, the masonry techniques utilised follow specific canons, and special traits such as T-shaped doorways and core-and-veneer walls distinguish Chacoan buildings from other masonry dwellings (Lekson 2004). In the words of Steve Lekson: “Chaco was architecture or it was nothing” (Lekson 1999:48). The labour required to construct these massive buildings was significant, particularly when the hours necessary to retrieve lumber from the Chuska Mountains up to 100km away are calculated in (Lekson 2004).

The contemporaneous small sites within Chaco Canyon along the south side of the Canyon would have required much less labour, and were constructed in an entirely different architectural style than the massive great houses across the canyon (Lekson 1999). These sites generally lack the “Chacoan” building traits, and bear a resemblance in size and structure to the unit pueblos which tend to dot the landscape surrounding outlying Chacoan great houses. Unit pueblos are small masonry structures which are typically one story in height and consist of a few rooms in an L shape or end to end formation. A small kiva is sometimes associated with the structure.

After 1150 A.D., avian remains begin to make up a significant proportion of faunal assemblages from Chaco Canyon and Meleagris gallopavo becomes more common. Prior to this, the avian remains in faunal assemblages from Chaco Canyon made up less than 10% of the total NISP (Sebastian 2006). The proportion of large mammals such as deer and pronghorn antelope decreases
sharply after 1175 A.D. Gallup Black-on-White as well as indented corrugated
wares (with sand and trachyte temper) dominate the ceramic assemblages
recovered from this period.

Many unusual items have been recovered from various locales in Chaco
Canyon, particularly from the late Pueblo II period, and one of the hallmarks of a
Chacoan outlier is the presence of imported goods. The exchange of goods
cements social relationships; having friends, trading partners, or other houses in
another place may not only have been fortunate, but also lifesaving (Toll 2004).
Regional goods which came into Chaco include massive quantities of trachyte-
tempered pottery from the Chuska mountains (the peak period of Chuskan
imports to Chaco was approximately 1050-1125 A.D.). Also imported prior to
1150 A.D. were Narbona pass chert, red and brown wares from the Mogollon
region of east-central Arizona and west New Mexico, red wares from
southeastern Utah, obsidian from the Jemez and Mount Taylor areas, yellow
chert from the Zuni area, and green chert from the Four Corners area. More
exotic materials include turquoise from the Cerillos Hills in New Mexico (190km
southeast of Chaco), which was placed in burials, kiva pilasters, wall niches, and
under foundation slabs (Toll 2004). Approximately 50 copper bells from western
Mexico were recovered from Great Houses in Chaco Canyon; over thirty of these
were found in Pueblo Bonito. Scarlet macaws were also imported from far to the
south. It is likely that animals other than macaws were brought into the canyon.
However, “animals have the analytically inconvenient ability to move among
environments and ecological zones” (Toll 2004:37). Toll’s (2004) hypothesis on
the non-regional exotic materials is that these items were not for exchange; they were emblems of Chaco’s connexions to important and powerful people.

Abundant small chert drills and other possible tools as well as plentiful turquoise fragments present in some of the unit pueblos on the south side of Chaco Canyon may indicate the processing of imported turquoise (Toll 2004). Some of these sites have been interpreted as workshops for tethered lapidary specialists, though this is still debated (Mathien 2001).

**IVb. Late Pueblo II in the Northern San Juan**

Other than the documentation of a few outlying Great Houses which were occupied after the de-population of Chaco Canyon, there is a distinct paucity of information regarding major developments in the Northern San Juan connected to any trace of the Chacoan regional system remaining after 1150 A.D. According to dendrochronological data, the Northern San Juan region was struck by a severe drought during the period between 1130 and 1180 A.D. This period coincides neatly with the end of large, planned construction events that followed the Chacoan style—the last large-scale construction event at Aztec West occurred sometime between 1118 and 1130 A.D. Lipe (2006) suggests that this type of construction ceased due to drought-induced crop failures which may have undercut any belief in the power of Chacoan authority. Cutting dates from the Northern San Juan all but disappear during the end of Pueblo II, and only increase significantly in the 1200s A.D. Population estimates based upon ceramic dating from a number of sites in the Mesa Verde region indicate a decline for the period 1140-1180 A.D. (Ortman, Varien, and Spitzer 2003).
Based upon the appearance of Northern San Juan traits on ceramics and the presence of Northern San Juan style architecture, ritual focus in the Chaco Canyon region appears to shift northward after 1120 A.D. The sites of Salmon and Aztec, which were the largest great houses outside of Chaco Canyon, were constructed during the late Pueblo II period. The Salmon Great House was constructed in between 1090 and 1094 A.D.; it included between 275 and 325 rooms (Lipe 2006). Aztec West, the largest building of several built at the Aztec locale, was constructed in two episodes at 1112 and 1125 A.D. Additions to Aztec West continued into Pueblo III times in the very late 1100s and 1200s A.D. (Lipe 2006). Aztec North (another large Great House at the Aztec locale) has not been excavated; however, due to the ceramics present at the surface level, it was likely constructed prior to Aztec West (Lipe 2006).

Va. Chacoan Collapse: Within the Canyon (Late Bonito-McElmo Phases)

At the beginning of the Pueblo III period, there was a minor population increase followed by a large decrease and what is popularly considered to be a nearly complete abandonment of the area. Faunal remains recovered shift from primarily deer to cottontail, avians, and prairie dogs. Ceramics present include Chaco-McElmo and Gallup Black-on-White, and indented corrugated wares with sand temper only. The last two Great Houses built within the canyon were Kin Kletso and Wijiji, both constructed after 1100 A.D. in the McElmo style, which differs from former Chacoan Great Houses. The McElmo style of construction uses large loaf-shaped sandstone bricks as compared to the thinner bricks used
in the banded masonry at earlier great houses within Chaco Canyon. At Wijiji, there is no great kiva in the plaza nor is there an arc of rooms around the plaza. There is a major great house construction episode north along the San Juan river (Windes 2004), and around 1130 A.D. the core ritual leadership of Chaco Canyon may have left the canyon and moved north to the sites of Salmon and Aztec (Lekson 1999). Although Pueblo Bonito, Pueblo del Arroyo and other great houses within the canyon were burned and presumably abandoned, outlying great houses continue to be constructed. A period of severe drought from 1130-1180 A.D. may have contributed to the abandonment of the region; however, many great houses within the canyon experienced re-occupation and architectural modification up to 1300 (Lekson, Windes, and McKenna 2006; Lekson and Cameron 2005).

Vb. Chacoan Collapse: In the Northern San Juan

The only related evidence for the collapse of Chaco in the Northern San Juan region is the distinct lack of any connexion to the Chaco Core post 1150 A.D. The drought in the Northern San Juan during the mid 1100s A.D. probably contributed to a decrease in overall population levels. Also, lumber from distant locales was utilised to build Aztec West and probably Aztec North, but this activity ceased by (or before) 1150 A.D. and local lumber resources were used after this point (Lipe 2006). Also, at approximately this time (1180 A.D.), it appears that any evidence of the presence of non-local goods and exotica ceases at the Aztec locale (Lipe 2006). According to Lipe (2006) the population
levels in the Northern San Juan did not begin to recover until the mid-to-late 1100s, when a gradual increase began.

**Vla. Post-Collapse in the Chacoan Core (Mesa Verde Phase)**

From approximately 1200 to 1300 A.D., there was a major re-population of the Chaco Core area; the great houses were re-occupied, and several great kivas were re-roofed and re-floored (Lekson, Windes, and McKenna 2006). Though there is not an abundance of faunal data from this phase, the use of avians appears to increase (Sebastian 2006). Ceramic assemblages include Mesa Verde Black-on-White, White Mountain redware, and indented corrugated wares tempered with both sand and grog (Sebastian 2006). New construction within the canyon as well as modification of existing Chacoan buildings resemble the “Mesa Verde” style architecture (Lipe 2004).

**Vlb. Post-Collapse in the Northern San Juan**

The site of Aztec West was occupied through the 1200s; however, it is highly unlikely that the occupants retained any connexion to any remnants of the Chacoan system due to the use of local building materials and the seeming lack of Chacoan prestige goods (Lipe 2006). After the drought of the mid-1100s A.D., the population of the Northern San Juan region continue to recover and increase, reaching a peak in the 1270s A.D. (Lipe 2006). By 1280 A.D., population levels in the northern San Juan Basin were on the decline and Chaco Canyon was depopulated.
During the later stages of the Pueblo III period and the beginning of Pueblo IV, populations throughout most of the northern American Southwest appear to have aggregated (Adler 1996, Rautman 2000). In what is now New Mexico, aggregated sites from this period were constructed according to a rough formula. Typically, the site was built in a defensible locale with four linear room-blocks which defined a central plaza (Rautman 2000). The Northern San Juan region also experienced aggregation in the form of large aggregated sites from Pueblo III "canyon-head" sites such as Shields Pueblo and Sand Canyon Pueblo. While these were also defensible, different architectural canons were followed. Plazas were present in the Northern San Juan basin, but tri-wall structures and D-shaped structures were also constructed. Based upon zooarchaeological investigation, these structures may have served a socially integrative or ritual function (Muir and Driver 2002). Though there is debate concerning the "purpose" of the plaza form, most argue that it resulted from a specific need for maintaining social relationships (McGuire and Saitta 1996) or creating a more defensible site and retaining social integration in the face of inter-group hostility (LeBlanc 1999).

VII. Other Chacoan Phenomena

Earthworks, Roads, and Landscapes

Various earthworks accompanied the construction of Chacoan Great Houses both within and outside of the canyon. The common form of earthwork was the berm, a built mound of earth which sometimes partially surrounded or encircled a great house. Berms and other earthworks were common in the
Chaco core; Pueblo Bonito boasts two large capped platform mounds which were ascendable by staircases (Lekson 1999, Cameron 2002). Most berms are present at Chacoan great houses south and west of Chaco Canyon; very few are present in the Northern San Juan Region (Cameron 2002). Despite its northern location, the Bluff Great House has a berm, which is divided by two ancient roads entering the site.

A significant aspect of the Chacoan system was the road and signal tower system that was constructed throughout the Pueblo II period (Lekson 1999, Mathien 2005), though little in the way of precise dating has been available for the roads and signal stations, and the signal network has not been well-discussed in the current literature. One of the primary locales for signal towers was Huerfano Mesa, which could be viewed from distant outliers such as Chimney Rock as well as higher elevation locales close to Chaco Canyon (Lekson 1999).

Many ancient roadways are present in the Chaco Core area, and are also in association with outlying Great Houses such as Bluff. According to Kendrick Frazier (2005) Chacoan roads were broad, straight, well-engineered roadways. There are approximately 650 kilometres of identified Chacoan roads; 160 kilometres of these are in the immediate Chaco Canyon area. Pierre Morenon performed walking exercises with a respirometer using different weights and varied slopes on a sampling of Chacoan road segments (Frazier 2005). His results showed that using them to reach an objective on the landscape resulted in up to a 38% savings of energy expended, particularly when an individual was
burdened. Fred Nials compared the efficiency of the North Road, a major Chacoan road, to the modern road between the Blanco Trading Post and Chaco Canyon. He found that the Chacoan road, centuries after construction, was functionally better than the modern road in terms of elevation gain and ground distance to an objective. Many of these roads are still detectable from aerial photographs and from sites at ground level. According to John Kantner, those who built Chacoan Roads were not concerned with efficiency, but directionality and linearity (Kantner 2004b). This idea seems sound, as it appears that the Chacoan road-builders proceeded in reasonably straight lines; they often raised beds, stairways, and ramps in order to preserve the linearity of the road (Kantner 2004b).

**Exotica**

While architectural and built attributes are the central identifying characteristics of Chacoan Great Houses, these structures are also distinguished by the exotic items found within them. In the literature, exotica from these Great Houses (such as macaws, copper bells, turquoise, and shell goods) are sometimes overlooked in favour of discussion over ceramics, chipped stone, and corn. The ideas of prestige, exotic goods, and the Chacoan economy have been examined in great detail (Doyel 1991, Mathien 1993, Toll 1991). Some authors suppose that the exotics indicate a political prestige economy while others minimize their importance. Lekson (1999) points out that “bells, birds, and baubles” are typically seen as less important “tagalongs” on bulk goods such as maize. While the import of maize, lumber, and ceramics to Chaco is
unquestionably important, other goods seem to have received less attention.

One possible reason for the downplay of the importance of these exotics in the Chacoan system is as part of a reaction against DiPeso's (1974) *pochteca* model (Lekson 1999). His theory on the development of Chaco highlighted the Mesoamerican influence in the form of travelling merchants peddling trinkets and macaws (DiPeso 1974). The general interpretation of the presence of unusual and exotic items is that special goods signify special activities (Lekson 1999, Windes 1992). Despite the fact that the outliers more distant from Chaco Canyon rarely contain large quantities of exotic or imported items (compared to Great Houses inside Chaco Canyon), a small amount of unusual items such as turquoise beads and shell goods have been recovered from larger outliers such as Aztec and Salmon. It is also not uncommon to find a small number of ceramics originating in the Chaco core area at outlying Great Houses (Lekson 1999). The fact that even a small amount of these goods occurs could indicate that these outlying Great Houses held a special purpose or significance.

Astronomy

Another facet of Chaco emphasized in the literature is astronomical observation. There are a few obvious indications of astronomical observation at Chaco Canyon. The most famous of these is the "Sun Dagger" at Fajada Butte which indicates winter and summer solstices (Sofaer and Sinclair 1987). Beneath Peñasco Blanco is a pictograph believed to represent the Crab Nebula supernova, which occurred on July 4th in 1054 A.D. (Malville and Putnam 1993, Marshall and Sofaer 1986). Some sources argue for the presence of similarly
functioning astronomical indicators at outlying great houses such as Chimney Rock (Malville and Putnam 1993). In addition, Jim Judge supposes that the built figures in the Great Kiva at Lowry may indicate dates of solstice and lunar standstills (Judge, pers. comm. 2005). Again, the presence of these astronomical markers at outlying sites might indicate that they served a special purpose.

Zooarchaeology

Animal remains are a mirror of human behaviour (Teegen 2005). The discipline of zooarchaeology is wholly concerned with the interpretation of human behaviour by analysing faunal remains and a great deal of this type of research has been done in the American Southwest. However, a great deal of faunal remains from prominent sites such as Pueblo Bonito and Chetro Ketl were entirely discarded by the excavators. At the time when excavations of major sites began, faunal remains were not viewed as a useful or important tool for understanding human behaviour. Therefore, most of the faunal assemblages available for study originate from smaller, less monumental sites or are rather incomplete as only exotic fauna such as the Scarlet Macaw were identified or kept. The faunal assemblage from Chaco Canyon that was recovered and kept has an NISP (number of identified specimens) of 6,752 bones; these identifications were performed by N. Akins, S. Emslie, and J. Applegarth (Akins 1985).

Kovacik (2000) considered two types of Chaco-era structures: pit structure/kiva (and does not distinguish between these categories) and above-
ground pueblos/ramadas. He argues that species present in these assemblages represent group and individual choice and agency, manipulation of power, and social relations, not simply meat weight. He sees rabbit, deer, and sheep (distributed widely in a spatial sense) as representative of a “harmless domestic” sphere, while carnivores and raptors (with a much narrower spatial distribution) represent a “detrimental non-domestic” or wild sphere. Using these definitions, Kovacik attempts to construct a dichotomous framework consisting of the concept of “inside/human” as opposed to “outside/animal.” He wishes to apply this framework and the accompanying inferences (outside or animal behaviour as detrimental to humans, and inside activities inside being the converse) to the 29SJ627 site in Chaco Canyon, and cautiously predicts that his approach will be a success. While no such distinctive spatial distribution has been identified at the Bluff Great House, Muir’s work on the fauna from a later site, Sand Canyon, has revealed distinct spatial patterning with regard to taxa (Muir and Driver 2004) which may be indicative of specialised activities or social frameworks.

VIII. Hypotheses on Chaco

The Rise of Chaco

Out of Mesoamerica?

Many explanations for the rise of Chaco as a regional centre exist; what type of centre it was is still debated. In late Pueblo I and early Pueblo II, the displaced population from the Northern San Juan may have found the basin attractive. Some authors argue that Chaco was a good place for agriculture at the time (Vivian 1990) and that it may have even produced large surpluses
(Sebastian 1992). However, the dendroclimatic data do not necessarily justify these claims (Lekson 1999). Wilshusen and VanDyke (2006) note the possible presence of a large amount of ponded water that may have made the canyon a desirable place to live. The first Great Houses are indeed located at favourable places: three confluences where agricultural potential was unmatched locally. Peñasco Blanco was constructed directly above the juncture of the Chaco and Escavada Washes, Pueblo Bonito was built opposite the South Gap (the major side drainage for the canyon), and Una Vida was located at the confluence of Gallo Canyon, the Chaco Wash, and the Fajada Gap.

In addition to explanations involving local development, a number of authors have tackled the subject of Mesoamerican influence upon the Chaco Phenomenon (DiPeso 1974, Frisbie 1980, Kelley 1986, Mathien 1986, Nelson 2005 and others) and for the last few decades there has been a divide in the archaeological community as to what exactly these traces mean. Some older sources argue that there must have been a direct influence upon the developments at Chaco (DiPeso 1974), while other often newer sources tend to downplay the intensity of any possible influence (Lekson 2004, Windes 2004). Some Mesoamerican traits seen in Chaco Canyon include the following: square masonry columns used to front galleries or plazas such as those at Chetro Ketl; circular stone discs placed at the bottoms of holes to serve as a foundation for roof posts; water and plumed serpent motifs on pottery; the presence of cast copper bells at Pueblo Bonito, Pueblo del Arroyo, and Pueblo Alto; in addition, 29 macaw skeletons were recovered from Pueblo Bonito alone (more were found at
Kin Kletso and Pueblo del Arroyo) and these creatures are native to Mesoamerica. Other aspects of Chaco have been used as indicators of Mesoamerican connexions; however, in comparison to the previous evidence, they seem less probable for a variety of reasons. These items include shell beads, the treatment of turkey remains, the manufacture of bone pins, the use and storage of ceremonial canes, and the existence of conical objects bearing incised designs which Lister referred to as “stamps” or “seals” (Frazier 2005). It is my opinion that the developments in Chaco Canyon were primarily the result of local innovation, which was (directly or indirectly) influenced by Mesoamerican peoples.

**The Function of Outliers**

The function of outlying great houses has been (and likely will continue to be) a much-debated topic in the literature of the American Southwest. For a time, there were many denials of outlier connexion with Chaco in any respect; local archaeologists may have felt that their toes were stepped on in the matter of cultural association with Chaco (Lekson 1999). The clear architectural association of some great houses on the very fringes of Chacoan influence (i.e., Chimney Rock) might have been what made the existence of 200+ outliers in four states more palatable to the archaeological community at large (Lekson 1999). The question which followed from association with Chaco was, inevitably, “What purpose did such a connexion serve?”

There are two primary explanations for the origin of Chacoan outliers. The first suggests that members of the Chacoan leadership from the Canyon forced
individual settlements to construct great houses in the Chacoan style as bastions or representations of Chacoan power, or even as homes for high-ranking Chacoan officials. The second argues that outlying sites inevitably noted the wealth and grandeur of Chaco, and out of a desire to be associated with such power, imitated the striking architecture of the centre and built their own Great Houses.

Jim Judge initially proposed a redistributive system that encompassed the Chacoan region (Judge 1979). His idea was based on the presence of vast empty storage facilities at Chaco Canyon Great Houses, the fact that rainfall in the San Juan basin was sparse and unpredictable, and that “downtown Chaco” was central to the population of the region. Outlying great houses would have produced goods that were appropriate for their environment and setting, and their surpluses would have been routed to Chaco Canyon. Supplies such as corn and other goods could have been distributed as needed to the surrounding Chacoan sites (Judge 1979, 1984, 1989). Theories underpinning this proposal came under attack (Drennan 1984, Lightfoot 1979), and Judge has withdrawn it (Judge 1993). At the time Judge published his hypothesis, the Chacoan region was thought to be much smaller than it is currently; some authors (Lekson 1999, Schelburg 1992) still believe that his hypothesis may have been correct on a smaller scale. Lekson (1999) uses the definition of “Chaco Halo” as provided by Doyel et al. (1984) to describe the area within a 5km radius of Chaco Canyon, and the term “Chaco Basin” as defined by Vivian (1990) to describe the area within a 100km radius of Chaco to construct a framework of integrative tiers.
within which some sort of re-distributive system may have been possible (Lekson 1999). Lekson considers sites associated with Chaco outside of the Chaco Basin to be part of what he calls the “Chaco Hegemony” and suggests that these farthest sites took part in the Chacoan system on a less-intensive basis (Lekson 1999).

The Function of the Regional System

At the heart of the Chacoan regional system were the Great Houses within the canyon, the goods and people that they housed, and the ritual and social meaning that the buildings and the landscape they were part of represented. As to why the great houses were built and what their function was, most recent sources agree that they were not primarily residential structures due to the lack of architectural features typically associated with dwellings (Lekson 1999). The most popular explanations for their construction include ritual or ceremony in at least one facet, for example: a destination for pilgrimages (Malville and Malville 2001), monumental expressions of Chacoan ritual (Judge 2004), or palaces for the elite priesthood (Lekson 1999). Colin Renfrew argues that Chaco Canyon was a pilgrimage destination; a “location of high devotional expression” due to the presence of directionally aligned roads as well as the monumental scale and symbolic aspects of the architecture and landscape involved (Renfrew 2004). He believes that Chaco Canyon resembles other ancient pilgrimage destinations such as the image ahu of Easter Island, the temples of prehistoric Malta, the Stones of Stenness in the Orkney Islands, and others (Renfrew 2004). John Kantner appears to be in general agreement with Renfrew, stating that a large
quantity of interesting and exotic goods came in to Chaco, and were rarely (if ever) re-distributed (Kantner 2004a). Also embracing this perspective is William Lipe (2006) who argues that the pilgrims would have received benefaction and status, while the Chacoans would have received labour, materials, and participants in various activities (Lipe 2006).

Goods came from various locales both relatively near to and quite far from Chaco Canyon; however, very few of these goods seem to be re-distributed throughout the regional system (Frazier 2005). As detailed above, some argue that the outliers closest to the canyon may have participated in a system of re-distribution of food and other goods (Judge 1979, 1984, 1989, Lekson 1999). There appears to be little evidence that this was carried much farther than the core canyon area, however.

Hypotheses on Social Organisation in the Canyon

A primary question regarding the initial construction of the Chaco Canyon Great Houses has been "Where did the labour force come from?" a query that has embedded implications for the interpretation of societal frameworks, ritual organisation, and the overall function of the regional system itself. There are number of other explanations, some of which involve a formal hierarchy and others that invoke pure egalitarianism. Jim Judge has a theory that makes concessions to both sides. He suggests that ritual sodalities based on a common belief system emerged to integrate kin groups; these social constructs are the sorts which drive the construction of most major community structures in other cultures, i.e. mosques, cathedrals, and so on (Judge 2004). From the
creation of these ritual sodalities, a formal chiefdom emerged, perhaps based on social status or rank and not necessarily only ritual knowledge. These individuals may have acquired status, wealth, and power through various types of social competition such as feasting (Judge 2004, Hayden 2001).

The Collapse of Chaco

The collapse of the Chacoan regional system is lately seen more as a gradual development rather than a sudden breakdown (Judge 2004). Most theories on the migration from Chaco Canyon include ecological factors such as drought or population pressure exceeding the carrying capacity of the arid desert environment. By 1100, the sites of Salmon and Aztec were under construction, and some experts theorise that the elite of Chaco Canyon re-located to one or both of these sites, eventually leading to the complete de-population of the canyon itself (Lekson 1999). Aside from the possibility of warfare, the re-location of a local elite, and changes in the local environment, there is another possible development that might have factored into the de-population of Chaco Canyon. Rib lesions indicative of pulmonary tuberculosis have been identified in individuals from Pueblo Bonito (Lambert 2002). Kent (1988) has argued that the level of dietary stress in Ancestral Pueblo peoples from Chaco Canyon was insufficient to justify the amount of porotic hyperostosis as an indicator of anaemia in the population. She concludes that the stress necessary to bring on the level of osteological change present most probably came from infectious disease brought on in part by increased sedentism (Kent 1988). Lynne Sebastian (2004) points out that the individuals buried within Chacoan Great
Houses were in notably better health than those buried outside Great Houses, which has implications for who may have been more vulnerable to disease. Also, the origin myth of Acoma Pueblo includes a description of the abandonment of Chaco Canyon. The reason for leaving the canyon given in the narrative was the outbreak of a disease characterised by blisters and sores on the body which the local healers were unable to cure (Stirling 1942).

**Potential of Zooarchaeological Data**

Physical evidence is quite complex, and the material culture of Chaco is no exception. A broad range of hypotheses about the Chaco Phenomenon exist, and will doubtless be debated for decades to come. While analysis of fauna at major Chacoan Great Houses is uncommon, faunal remains are found at all Chacoan sites. These animal remains from outlying Great Houses such as Bluff therefore have the potential to elucidate Chacoan behavioural variability. Assessment of spatial and temporal patterning of faunal remains, pathological specimens, change in the structure of assemblages over time, and variation in taxa can contribute not only to an understanding on the level of the archaeological site, but also to knowledge about Chaco on a larger scale.

As faunal data from Chaco Canyon proper are limited, the assemblages from Great Houses like Bluff are the primary zooarchaeological resource for questions about the Chaco Phenomenon. Together with information from other types of material culture, faunal data from these sites, the periphery of Chaco, can clarify the present understanding of the core.
CHAPTER 3: THE BLUFF GREAT HOUSE

I. Introduction

The Bluff Great House is a Chacoan Great House on the north edge of the town of Bluff in southeastern Utah, which is in the northwestern part of the American Southwest. Commonly associated features include massive masonry walls, Great Kivas, multiple stories, berms, and road features. Figure 3 shows the site and associated features.

Figure 3: The Bluff Great House Site

Figure 3 is used courtesy of Dr. Catherine Cameron.
Unlike in Canada, where an archaeological site is automatically considered to be the property of the Crown, under U.S law these cultural and historical resources are owned by whomever owns the land upon which they are situated. The Bluff site is currently owned by the Southwest Heritage Foundation, an educational organisation initially developed by local archaeologists (Abajo Archaeology) to protect and study the Bluff Great House after it was purchased and donated to the people of the city of Bluff.

The Bluff Great House site is one of approximately 40 other Chacoan Great Houses in the Northern San Juan Basin (formally, the Middle San Juan River Valley). More specifically, Bluff is located in the Blanding Basin, a subdivision of the Paradox Basin of the Colorado Plateau. This part of the San Juan River is the only significant segment with good agricultural potential as other portions are composed of deep canyon terrain. The Bluff Great House site is situated on a high terrace overlooking the San Juan River, which runs approximately a kilometre to the south. Incised washes drain into the river valley from the north and the south. As the northern washes in the area have large alluvial outwash fans and would have been closer to hunted and gathered resources located at higher elevations, they may have been favoured for settlement. The four major topographical features that define the local landscape are the Bluff sandstone cliffs to the north with three canyons that cut through these cliffs (Cow Canyon, Calf Canyon, and Cottonwood Canyon), the Bluff Bench, and Tank Mesa, which extend from the cliffs to the north and northwest, and the San Juan River to the south. Cow and Calf Canyons are short “box
canyons” which drain the Bluff Bench; the Bluff Bench and Tank Mesa are to the east and west of Cottonwood Canyon respectively. Bordering the San Juan River to the south is the Casa del Eco mesa, a lengthy, continuous cliff face.

The geology of this portion of the San Juan River Basin is dominated by exposed beds of the Jurassic Morrison formation and Quaternary silts, sands, and gravels (Stokes 1977). Table 1 below describes the Bluff area geology.

<table>
<thead>
<tr>
<th>Exposed bedrock units</th>
<th>Character of deposit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluff Sandstone</td>
<td>Solid sandstone; primary cliff-former</td>
</tr>
<tr>
<td>Summerville Formation</td>
<td>Alternating sandstone and shale deposits</td>
</tr>
<tr>
<td>Entrada Sandstone</td>
<td>Dark red sandstone and shale units</td>
</tr>
<tr>
<td>Carmel Formation</td>
<td>Thin-bedded fossiliferous grey limestone</td>
</tr>
</tbody>
</table>

The erosion and subsequent spalling of Bluff Sandstone has produced significant talus deposits along the exposed portions of the Summerville Formation and Entrada units; it seems likely that these deposits could have been a primary source of building material for the Ancestral Puebloan population that constructed the Bluff Great House.

The local cemetery, created by Mormon pioneers, is located on the same prominence as the Great House and the road that was cut through the site in historic times to reach the cemetery was recently paved. It is probable that quantities of sandstone masonry from the Great House site were removed
historically and used as construction material by the Mormon pioneers who settled in the area.

II. Environment and Ecology

In the Bluff region, precipitation is generally below 200mm per year and originates from a phenomenon termed “the Mexican Monsoon.” Mexican Monsoon rainfall is the result of air from the Gulf of Mexico circulating over the American Southwest and cumulating in high energy thunderstorms in the late summer (from July through September). This is the primary source of precipitation for the Bluff region, which lies in the “Summer Dominant” rainfall area of the American Southwest (Stensrud et al. 1995). Another peak in precipitation occurs later in the year, generally in November, a product of Pacific cyclonic storms (Sellers and Hill 1974). The current number of yearly frost-free days in the Bluff area is between 160 and 180 (Rupp and Libbey 1996), more than sufficient for maize cultivation.

At an elevation of approximately 1,350 metres above sea level, the Bluff Great House lies between the Sagebrush and Piñon-Juniper Woodland ecozone types, and is located in the Upper Sonoran Lifezone. The present vegetation community is classified as part of the Shadscale Zone (Cronquist et al. 1972:111). Bluff’s ecological landscape includes a diversity of habitats within a small area: riparian, canyon, and mesa top. Several vegetation communities grade into one another in varying responses to micro-ecological influences. Trees such as cottonwood and willow grow only along riparian waterways, in addition to threleaf sumac, chokecherry, buffaloberry, and other grasses and
wildflowers. To the west and east of the Bluff site are sand dune field microhabitats which support Indian ricegrass (*Oryzopsis hymenoides*), sand dropseed grass (*Sporobolus contractus*), sand muhly grass (*Muhlenbergia pungens*), purple sage (*Poliomitha incana*), sand sagebrush (*Artemisia filifolia*), and four-wing saltbush (*Atriplex canescens*). Despite the fact that non-native invasive species such as the Russian olive and tamarisk now dominate floodplain areas, native coyote willow (*Salix exigua*) and cottonwood trees (*Populus deltoides*) are still present.

Cottonwood Wash and other small tributaries of the San Juan River are characterised by the presence of alluvial fans which could have been exploited for their agricultural potential.

The exact methods and techniques involved in Ancestral Puebloan agriculture in the Bluff region have not been identified with complete certainty. However, water infiltration may have supported crops in floodplain micro-environments (perhaps also along terraces). If irrigation was used, it may have consisted of minor diversion features such as check dams similar to those at the Chimney Rock Great House (Mobley-Tanaka and Eddy 1995) Given the nature of *Zea mays* as a grass, it may well have thrived in sandy alluvial soil available in the Cow and Calf Canyons. On alluvial fans, a variety of differing soil options are available within a relatively small area; perhaps these pockets of land allowed for farming the ‘triad’ of corn, beans and squash in one conveniently accessible place. Oviatt (1981) discusses the exploitation of river-edge wetland micro-habitats and the role of these in retaining sediment, preventing erosion, and
retaining a fruitful horticultural environment. Destructive floods likely had an impact on Bluff’s ancient riparian zone. Despite this, there has been some speculation that they were probably less destructive than recent floods and that modern technologies are more disruptive than ancient ones (Oviatt 1981).

Regional fauna from nearby habitats include a wide range of mouse and rat species, squirrels, beavers, prairie dogs and various species of Geomyidae. Other common local mammals consist of lagomorphs (both Sylvilagus and Lepus), and several species of Chiroptera. Local carnivores include the skunk, badger, bobcat, coyote, and fox (Vulpes vulpes as well as Urocyon cinereargenteus). Various species of snakes and lizards also inhabit the region. Regularly occurring avians include a vast assortment of passeriformes, ducks, falconiformes, and galliformes. Most of the species present in the region today tend to be quite wide-ranging and occur in a variety of habitats. Bighorn sheep, a species found fairly commonly in Ancestral Pueblo sites, is no longer present in the Bluff region. Today elk and deer are still regularly encountered in the area, but elk is rarely encountered archaeologically. Species domesticated by the Ancestral Puebloan people include both the turkey (Meleagris gallopavo) and the dog (Canis familiaris); however, the overwhelming majority of domestic remains recovered from Ancestral Puebloan sites are turkey.

III. Summary of Excavations

The Bluff Great House Project began in 1995 when the Southwest Heritage Foundation invited Dr. Cathy Cameron and Dr. Stephen Lekson of the University of Colorado to bring an archaeological field school to the site. In the
spring of 1995, Drs. Cameron and Lekson conducted a series of test excavations at the site with the aid of staff from Abajo Archaeology (a local contract archaeology firm), members of the Southwest Heritage Foundation, and various volunteers. Drs. Cameron and Lekson returned with the University of Colorado Field School in the summer of 1996 and full-scale excavations continued through 1998. A second set of excavations (also performed by the University of Colorado Field School, members of the Southwest Heritage Foundation, and volunteers under the direction of Drs. Cameron and Lekson) were held during the 2002 through 2004 field seasons.

IV. Timeline and Occupations

The Bluff Great House was located near prime farmland in the nearby Cottonwood Wash and on the San Juan River floodplain. According to Jalbert (1998) the majority of sites (7 of 8) on the San Juan floodplain and up the Cottonwood Wash have been dated to periods which overlap with the occupation of the Bluff Great House. It is possible that there were a great many unit pueblo sites on the San Juan floodplain with a potential connexion to the Bluff Great House which have been destroyed by flooding and other processes. Population reconstructions by Matson et al. (1988) suggest that the Great Houses of the Northern San Juan region were built by people who were new to the region, some of whom Cameron surmises may have come directly from the core Chaco Canyon region (Cameron 2005).

The terrace that the Bluff Great House was built upon was occupied as early as Basketmaker III, though Cameron argues that people were not living
there just prior to the construction of the Bluff Great House (Cameron 2007). According to Blinman (2007), there is a pattern of uninterrupted surface sherd deposition between 920 and 1075 A.D., however, this interpretation is uncertain due to overlapping ceramic dates. This suggests an earlier Pueblo II occupation which may have been obscured by the construction of the Bluff Great House. Both dendrochronological and ceramic dates place the construction and occupation of the Bluff Great House at 1075-1150 A.D., which seems to correspond to the construction dates of other great houses in the Northern San Juan Basin. These dates indicate that the Bluff Great House was constructed at around the time the Chacoan system reached its greatest extent. Figure 4 shows a site plan of the Great House portion of the Bluff Great house.

Figure 4: Bluff Great House Site Plan
The Great House itself, the Great Kiva, and the berm were all built during the peak of Chacoan expansion, and the first embedded kiva within the Great House itself was constructed in the Chacoan style. The Bluff Great House was constructed in two phases and built from West to East. The Western portion resembles Pueblo II construction from the Kayenta region, which typically exhibits single-coursed edge-flaked masonry. The Eastern portion contains the Chacoan-style core-and-veneer masonry and also includes the row of rooms along the rear (North) side of the Great House, which may have been as much as four stories in height. Both sections were built upon the same artificially levelled surface. Therefore not only was some plan in effect with regard to the construction of the Great House, but there was also probably not a large gap between building phases (Cameron 2007). In the early 1100s, some parts of the Great House were torn down and those materials were used to construct portions of the southeastern part of the berm and a flat (shady) use-surface north of the Great House. Ceramics do not indicate a definitive hiatus of occupation during this period, but Blinman notes that the ceramic types used to define this period can overlap with temporally adjacent periods, and this may mask a break in the occupation of the Bluff Great House (Blinman 2007). There is some stratigraphic indication of a hiatus in the use of particular spaces. In the Feature 58 room, level 7 (which is sterile) separates the Chacoan deposits from Post-Chacoan. Only four excavation units exposed unambiguously superimposed Chacoan and Post-Chacoan strata (Cameron 2007).
Sometime during the Pueblo III period, the Bluff Great House was remodelled and debris was added to the berm. After 1175, residents began to deposit trash in the rooms containing Feature 56 and Feature 58 (located in the rear row of rooms along the North side of the Great House). The river cobble walls at the southeastern corner of the site (Features 71B and 71I) were likely built at approximately the same time. After this, trash was deposited into the Feature 2 room (also located in the rear row of rooms) and these deposits may very well extend temporally beyond 1200 A.D.; they do cease at about the same time trash is being deposited into the 71B/71I area of the site (Cameron 2007). After this, occupations seem to be concentrated in the intramural kivas: the last construction event is a rebuilding of the East Kiva. Multiple layers of plaster on the walls suggest that it had a relatively long use-life after remodelling. The Great Kiva also underwent reconstruction; however, the exact time at which this occurred during Post-Chacoan times is uncertain. In the opinion of Winston Hurst, the Bluff Great House architecture from Pueblo III resembles Tsegi Phase (1250-1300 A.D.) sites like Kiet Siel, Scaffold House, Long House, Bat Woman, and others in the Four Corners region. However, Bluff does have some core-and-veneer masonry, and of the Tsegi phase sites only Long House (situated on Wetherill Mesa in southwestern Colorado) has any core-and-veneer masonry (Cameron 2007).

When attempting to determine activities that may have occurred at the Bluff Great House, the primary source of information gleaned is the material culture, specifically chipped stone and ceramics. Very few grinding implements
were recovered from the site: out of 400 cubic metres of sediment removed from
the site, only 3 manos, 18 mano fragments, and 9 metate fragments were
unearthed. That proportion is similar to other Great Houses (Lowry, for instance)
and may indicate that either there was a very low population at the Bluff Great
House or that grinding and perhaps other plant-processing activity occurred off-
site. In terms of ceramics, Blinman sees a decrease in the diversity of utility ware
types, whereas white ware form diversity does not change. In the Post-Chacoan
era, mugs become a recognisable component of ceramic assemblages at Bluff,
which may indicate “pot luck” style feasting as opposed to “hosting” style
feasting. Large ceramic serving vessels are only present in the deposits from the
time of construction of the Great House (Blinman 2007). Ceramic trash was also
deposited differentially in a few areas of the site. The Feature 58 room contained
a sizeable proportion of large bowls compared to other proveniences within the
site. The Feature 56 room contained much larger sherds then other areas of the
site, whereas the Feature 2 room had only very small sherds present (Blinman
2007). Perhaps this dissimilar distribution indicates something about activities at
the Great House, i.e. ceramics were used in a specific area of the site and when
they broke, the most convenient place at hand to throw them away was Feature
56; perhaps sherds were only transported to the Feature 2 area later or as part of
a different process. The clay recovered from the Bluff Great House site was not
considered good pottery clay (Blinman 2007) and there is otherwise very little
evidence for ceramic production; only two sherds were modified to be pot
scrapers. Vessels from the Cibola region indicate probable interaction between
the people at Bluff and the Chaco Canyon region; whiteware commodity exchange ceases at about the time of Chacoan collapse (Sebastian 2006).

Despite the fact that there is not an abundance of evidence to indicate maize processing, *Zea mays* was the most common botanical remain identified. Cotton (*Gossypium hirsutum*) was also recovered from two locales within the site: from just above the floor in the Northeast kiva (from a Chacoan level) and from the north antechamber of the Great Kiva (this provenience may or may not be Chacoan). In the Chacoan era, most cotton was produced in the Salt/Gila basin region, however, it was also grown at Glen Canyon and Canyon De Chelly. Perhaps the cotton from the Great House was local in origin, much like the vast majority of the fauna.

Chacoan wealth is typically defined by the unusual and the exotic: turquoise, copper bells, marine shell from the Pacific, pink chipped stone from the Chuska Mountains, and other rare goods. Although the excavations at Bluff did not recover any copper bells, turquoise, azurite or other favoured exotic materials, non-local chipped stone and debitage was found. Six pieces of Narbona Pass Chert (a common import to Chaco), two pieces of Yellow-Brown Spotted Chert, and two pieces of obsidian from the Jemez Mountains were recovered; nearly half of the projectile points from Bluff are made of non-local stone (Cameron 2007). According to Jennings (2005) some of the whole projectile points were likely non-functional and may have served a symbolic purpose.
Of the 55 ornaments recovered from Bluff, two-thirds of them were created from local materials, and the other third were made from marine shell. Two of these were from Chaco-era deposits, and another 6 were from mixed deposits that could have originated in either the Chacoan or Post-Chaco time periods (Cameron 2007).

Given the two most popular methods of estimating population (number of rooms times the average household size vs. one kiva per family) the number of people who may have lived at the Bluff Great House varies widely. With the first method (depending upon how many rooms a family is assumed to use), 33-120 people from 15 or 16 households may have lived at Bluff. With the second, only 1-4 families would have lived at the site. According to Cameron (2007), the quantity of goods recovered correlates more closely with a lower population estimate.

V. Summary

The Bluff Great House, constructed at the time of the Chacoan system’s greatest extent (1075-1150 A.D.), is a Chacoan outlier with characteristics fitting such a structure: a berm, roads, a Great Kiva, core-and-veneer walls, multiple stories, and a Chaco-style embedded kiva. The great house was constructed from West to East in two phases, both of which took place upon the same artificially levelled surface; this indicates that there was likely not a large temporal gap between construction phases. There had been an occupation of the locale during Basketmaker III times, though there is no indication of activity just prior to the construction of the great house. The local environment would have been
suitable for floodplain farming and possibly also dry farming; a number of archaeologically and ethnographically important faunal and botanical resources thrived in the area. The Bluff site is situated perfectly with regard to the availability of alluvial fans and floodplain deposits, particularly considering that the majority of the length of the San Juan River flows through deep canyons which are unsuitable for most farming. The variety of differing soil options obtainable within a relatively small area may have allowed for farming corn, beans and squash in one conveniently accessible place. The presence of cotton from a Chacoan context may indicate local cultivation or interaction with the populations of Canyon de Chelly or another source of the plant. From Jalbert’s (1998) examination of sites in close proximity to the Bluff Great House on the San Juan floodplain and given the temporal overlap with the Bluff site, it also seems probable that the local population formed a small social network in which the residents of Bluff took part. Based upon the material culture recovered from the site and a conservative population estimate, the Bluff site was probably occupied by only a few families, and at times only a very limited portion of the great house was in use. It is possible that (given the occurrence of mugs in the Post-Chacoan deposits from parts of the site) the inhabitants of Bluff did take part in community events and there may have been feasting events held at the Bluff Great House. The associated great kiva may well have been an integrative community structure. Very little in the way of Chacoan wealth (exotic goods, ornaments) was recovered, aside from a small quantity of chipped stone. The presence of Cibola whiteware signifies definite interaction with the core Chaco
area; indicators of whiteware commodity exchange cease after Chacoan collapse.
CHAPTER 4: IDENTIFICATION OF SPECIMENS

I. Methodology

Identification and designation

Faunal specimens were coded in an Excel spreadsheet using the Crow Canyon Archaeological Center Manual for Description of Vertebrate Remains, authored by Jonathan Driver (2005). Faunal specimens from the Bluff Great House assemblage were only considered identifiable if I could designate the skeletal element. Thus, categories such as “long bone” were not necessary. Bone artefacts were included in this analysis in addition to analysing the unmodified faunal remains. Designations of element and taxon were made using comparative collections from Simon Fraser University and the Burke Museum at the University of Washington. Identifications were made to the most precise taxonomic level possible, which was often not to species level. I was responsible for the zooarchaeological analysis of the material from the 2002-2004 field seasons. My data were incorporated into a previously existing faunal database from earlier excavations at the Bluff Great House. In addition to the standard zoological nomenclature, some general categories were used in order to identify a specimen by size or biological grouping. Those utilized in the Bluff database are listed in Table 2.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIS</td>
<td>All Osteoichtyes</td>
</tr>
<tr>
<td>SBI</td>
<td>Avian of Robin size and smaller</td>
</tr>
<tr>
<td>MBI</td>
<td>Avian of mallard size or smaller</td>
</tr>
<tr>
<td>LBI</td>
<td>Avian larger than a mallard</td>
</tr>
<tr>
<td>ATE</td>
<td>Teal ducks</td>
</tr>
<tr>
<td>LGF</td>
<td>Falconiformes of vulture size or larger</td>
</tr>
<tr>
<td>MFA</td>
<td>Falconiformes larger than a prairie falcon</td>
</tr>
<tr>
<td>SMF</td>
<td>Falconiformes of prairie falcon size or smaller</td>
</tr>
<tr>
<td>SMA</td>
<td>Mammal of jackrabbit size or smaller</td>
</tr>
<tr>
<td>MMA</td>
<td>Mammal of deer size or smaller</td>
</tr>
<tr>
<td>LMA</td>
<td>Mammal larger than a deer</td>
</tr>
<tr>
<td>SMR</td>
<td>Rodent of wood rat size or smaller</td>
</tr>
<tr>
<td>LGR</td>
<td>Rodent larger than a wood rat</td>
</tr>
<tr>
<td>SMC</td>
<td>Carnivore smaller than a fox</td>
</tr>
<tr>
<td>MCA</td>
<td>Carnivore of fox size and larger</td>
</tr>
<tr>
<td>LGC</td>
<td>Carnivore larger than a wolf</td>
</tr>
<tr>
<td>FOX</td>
<td>Any fox of Urocyon or Vulpes genus</td>
</tr>
<tr>
<td>MDA</td>
<td>Medium artiodactyl</td>
</tr>
</tbody>
</table>

There were a few issues with identification of some specimens. Passerines (small perching birds) are notoriously difficult to differentiate, as are many elements from medium artiodactyls. Taphonomic processes such as
rootlet etching or rodent gnawing can make identification of small elements difficult; they can also obscure various osteological landmarks used by analysts to identify fragmentary elements. These taphonomic processes can also obscure pathological conditions present and in turn, pathological lesions can make identification of fragmentary elements difficult.

**Analysis and data entry**

Unidentifiable fragments were counted and the number of modified (burned or worked) fragments recorded. During analysis of the faunal assemblage, I recorded various metric and non-metric attributes of each identifiable specimen in an Excel spreadsheet. The Field Specimen Number (which connects the specimen with a specific provenience) was recorded before any specific analysis took place. The specimen was identified to the most precise taxonomic level feasible and sided if possible. The percentage of completeness and state of epiphyseal fusion were assessed. All of these attributes were coded in the database in addition to the length of the specimen, breakage types and patterns if applicable, and the cortical thickness of long bone fragments if apparent. In addition, modifications to the bones were also noted, including human alterations such as working, burning, and cut marks. The presence of any residue such as manganese, caliche (calcium carbonate) or ochre was documented; pigment traces may indicate human activity, while substances such as caliche result from natural taphonomic processes. Natural influences such as carnivore or rodent gnawing and rootlet etching were also recorded. Other alterations such as pathological conditions and wear as a result
of carnivore digestion were also noted. As there are no standard methodological procedures for analysing pathological specimens from faunal assemblages, Chapter 7 provides a description and brief discussion on all pathological specimens identified in the Bluff assemblage. Data from this analysis exists in electronic form and will be accessible as part of the site archives and report; it may also be available online in the future.

**Storage of Specimens**

After the completion of this analysis, the faunal remains from the Bluff Great House will be housed in an archival unit at the University of Colorado Museum of Natural History.

**II. Description of Faunal Remains and NISP**

Table 3 summarizes all specimens from the Bluff Great House assemblage. A brief discussion of each taxonomic group present follows.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Common Name</th>
<th>Code</th>
<th>NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superclass: Osteichthyes</td>
<td>Bony fish</td>
<td>PIS</td>
<td>67</td>
</tr>
<tr>
<td>Class: Reptilia</td>
<td>Reptiles</td>
<td>REP</td>
<td>1</td>
</tr>
<tr>
<td>Suborder: Lacertilia</td>
<td>Lizards</td>
<td>LIZ</td>
<td>2</td>
</tr>
<tr>
<td>Suborder: Serpentes</td>
<td>Snakes</td>
<td>SNA</td>
<td>4</td>
</tr>
<tr>
<td>Class: Aves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Branta canadensis</em></td>
<td>Canada Goose</td>
<td>BRC</td>
<td>1</td>
</tr>
<tr>
<td>Genus: <em>Anas</em></td>
<td>Teals only</td>
<td>ATE</td>
<td>6</td>
</tr>
<tr>
<td>Order: Falconiformes</td>
<td>Birds of prey</td>
<td>FAL</td>
<td>4</td>
</tr>
<tr>
<td>Medium Falconiformes</td>
<td>Birds of prey</td>
<td>MFA</td>
<td>1</td>
</tr>
<tr>
<td>Large Falconiformes</td>
<td>Birds of prey</td>
<td>LGF</td>
<td>2</td>
</tr>
<tr>
<td>Genus: <em>Buteo</em></td>
<td>Hawks</td>
<td>BUT</td>
<td>5</td>
</tr>
<tr>
<td>Taxa</td>
<td>Common Name</td>
<td>Code</td>
<td>NISP</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Order: Galliformes</td>
<td>Ground fowl</td>
<td>GAL</td>
<td>2</td>
</tr>
<tr>
<td>Meleagris gallopavo</td>
<td>Turkey</td>
<td>MEG</td>
<td>1523</td>
</tr>
<tr>
<td>Family: Phasianidae</td>
<td>Quail</td>
<td>QUA</td>
<td>1</td>
</tr>
<tr>
<td>Grus canadensis</td>
<td>Sandhill Crane</td>
<td>GRC</td>
<td>5</td>
</tr>
<tr>
<td>Zenaida macroura</td>
<td>Mourning dove</td>
<td>ZNM</td>
<td>3</td>
</tr>
<tr>
<td>Order: Strigiformes</td>
<td>Owls</td>
<td>STI</td>
<td>1</td>
</tr>
<tr>
<td>Asio otus</td>
<td>Long-eared owl</td>
<td>ASO</td>
<td>1</td>
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<td>Dog, wolf, or coyote</td>
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<td>Fox</td>
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<td>Code</td>
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<td>Pronghorn</td>
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<td>14</td>
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<td><em>Ovis canadensis</em></td>
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<td>Small mammal</td>
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<td>Medium mammal</td>
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<td>Large mammal</td>
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<tr>
<td>Medium artiodactyl</td>
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<td>798</td>
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</tr>
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</table>

Total Identified: 5273
Total Unidentified: 8451

**Superclass: Osteichthyes**

**Fish:** (PIS)

Ecology: Species native to the San Juan River include the Razorback Sucker (*Ptychocheilus lucius*) and Colorado Pikeminnow (*Xyrauchen texanus*) both of which are endangered, as well as Roundtail Chub (*Gila robusta*), Speckled Dace (*Rhinichthys osculus*), Bluehead Sucker (*Catostomus discobolus*), Flannelmouth Sucker (*Catostomus latipinnis*), and Mottled Sculpin (*Cottus baridi*). All catfish, bass, sunfish, and trout species are considered non-native; they did not occur in various collection events prior to 1959 (Miller and Rees 2000).

**Class: Reptilia**

Reptiles: (REP)

*Non-standard Reptilia descriptions:*
All Lizards: Lacertilia (LIZ)
All Snakes: Serpentes (SNA)

**Class: Aves**

Note: There appears to be a prevalence of avian species that prefer a watery or marshland habitat; it is likely that this reflects the proximity of the Bluff Great House site to the San Juan River.

Canada Goose: *Branta canadensis* (BRC)

Ecology: Naturally migratory, and winters in most of the US. Breeds in Canada and the northern United States in a variety of habitats, but prefers marshy settings. Feed mainly on plant material, and typically are found in flocks very near water.
Anas sp.: (ATE)
Ecology: This genus normally includes all mallards, wigeons, teals, and other dabbling ducks. These creatures are found mainly on smaller ponds and marshes. They feed primarily on plant material, but also consume insect larvae, various invertebrates, fish and frogs.

Teals: (TEA)
Ecology: Teals live in a variety of habitats but tend to favor wetlands with some taller vegetation. They typically feed by dabbling for plant food or grazing. Teals nest on the ground, often near water.

Vultures, hawks, and eagles: Falconiformes (FAL)
Ecology: Falconiformes are predatory, diurnal, carnivorous birds whose diet and hunting habits vary greatly by species.

Medium Falconiformes (MFA)
Buteo sp.: (BUT)
Ecology: Members of the Buteo genus are medium-sized raptors; many species occupy a variety of habitats throughout North America.

Large Falconiformes (LGF)
Ecology: Falconiformes are predatory, diurnal, carnivorous birds whose diet and hunting habits vary greatly by species.

Galliformes (GAL)
Ecology: Ground dwelling birds which forage on seeds, buds, other plant material and some insects. Species are quite wide-ranging.

Turkey: Meleagris gallopavo (MEG)
Ecology: Common to the four corners area, the turkey prefers open woodland or open field habitats. M. gallopavo tends to group in flocks as small as five up to as large as forty, and roosts nightly in trees, which is unusual for galliformes. This species was domesticated in the American Southwest, and the turkey identified in the Bluff assemblage is considered domestic.

Quail: Phasianidae (QUA)
Ecology: All quail seem to prefer arid, shrubby deserts or grassland. They tend to live in small coveys and roost on the ground.

Sandhill crane: Grus canadensis (GRC)
Ecology: The sandhill crane inhabits marshy wetlands and feeds on plant material as well as small animals. They tend to forage and fly in flocks, much like geese, and may have habitual gathering places. Grus canadensis nests in open meadows and prefers to winter in marshland habitat. These creatures are not considered native to the four corners area nor does their migration pattern carry
them near the Bluff site. This pattern may have changed over the years or this specimen may be an "exotic."

Mourning dove: *Zenaida macroura* (ZNM)
Ecology: The mourning dove thrives in various open and semi-open environments, including most agricultural areas. The species has adapted well to areas altered by humans, and tends to migrate south during the winter months. The mourning dove eats mainly seeds, and is hunted as a game bird for sport in some parts of North America today.

**Owls:** Strigiformes (STI)
Ecology: Owls are nocturnal predators, and are largely inactive during the day. They generally roost in dense vegetation or a concealing structure, such as a tree cavity. (Large species feed on mammals; the smaller are insectivores.)

Long-Eared Owl: *Asio otus* (ASO)
Ecology: The long-eared owl is a medium-sized owl with large ear tufts. It is nocturnal, and tends to nest in trees, often conifers, many times using nesting materials which have been left behind by corvids. The long-eared owl eats mainly rodents and small avians.

**Woodpeckers:** Piciformes (PIC)
Ecology: Nest in tree cavities and excavate wood in search of wood-boring insects; mostly solitary.

**Perching birds:** Passeriformes (PAS)
Ecology: Varies highly by species.

Raven: *Corvus corax* (COC)
Ecology: Omnivorous; feeds on everything from insects to fruit to carrion, seeds and nuts. *Corvus corax* lives in a wide variety of habitats from tundras to coniferous forest and arid brushland.

Magpie: *Pica pica* (PIP)
Ecology: Common in the prairies and brushland with scattered trees. Feeds on both seeds and animal prey, foraging mostly on the ground.

**Blackbirds and Orioles:** Icteridae (ICT)
Ecology: Varies greatly by species.

**Class: Mammalia**
**Rabbits and hares:** Lagomorpha (LAG)
Ecology: Lagomorphs occupy an extremely wide variety of habitats; however, most species are adapted for foraging in open environments. Most are nocturnal or crepuscular and are strictly vegetarian, feeding on grasses and forbs. These creatures are famous agricultural pests.
Cottontail rabbit: *Sylvilagus sp.* (SYL)
Ecology: The range of most *Sylvilagus* species includes woodland, grassland, and desert. They are typically found in diverse habitats and often associated with riparian brush. These rabbits feed on grasses, shrubs, and forbs. The modern species which currently inhabit the Four Corners area are *Sylvilagus audobonii* and *Sylvilagus nuttallii.

Jackrabbit or hare: *Lepus sp.* (LEP)
Ecology: The species encountered at the Bluff Great House is most likely *Lepus californicus*, which has an enormous range historically and prefers arid to semi-arid environments (along with any agricultural land). *Lepus* commonly feed in open rangeland on a variety of vegetable resources, including those which are considered to be undesirable forage.

**Rodents: Rodentia (ROD)**
Ecology: Species range over a wide variety of habitats and possess a wide range of features and habits.

**Squirrels: Sciuridae (SCI)**
Ecology: Species range over a wide variety of habitats and possess a wide range of features and habits.

**Antelope Squirrel: Ammospermophilus leucurus** (AML)
Ecology: White-tailed antelope squirrels are a type of ground squirrel which burrows, are diurnal and do not hibernate. They have a somewhat flattened tail compared to other sciurids, and have a single white stripe on the body. They feed on a variety of plants and insects. This species is adapted to more arid regions of North America.

**Ground squirrels: Spermophilus sp.** (SPE)
Ecology: Consume a wide variety of plant forage and occasionally insects. These creatures typically burrow, are generally diurnal, and thrive in a wide variety of habitats.

**Rock squirrel: Spermophilus variegatus** (SPV)
Ecology: The rock squirrel has an extensive geographical range. Most commonly found in and among rocky canyons and cliffs and only rarely in trees or brushy areas. Feeds on buds, nuts, and fruits (juniper berries, acorns, etc.) and have been documented consuming insects, young turkeys and other birds, as well as kangaroo rats. While this species is generally considered vegetarian, it will select for meat whenever possible.

**Prairie Dog: Cynomys sp.** (CYN)
Ecology: There are several species which range in the Four Corners area of the American Southwest. These creatures are generally diurnal and burrow. Prairie dogs are quite social, and feed on a diet of grasses, seeds, and roots.
Gunnison’s Prairie Dog: *Cynomys gunnisoni* (CYG)
Ecology: This species is the smallest and least specialised prairie dog. They are entirely limited to the Four Corners region, and are primarily herbivorous. *Cynomys gunnisoni* burrows, hibernates, and is diurnal.

Pocket gophers: *Geomyidae* (GEO) and *Thomomys sp.* (THO)
Ecology: These creatures are distinguished by fur-lined cheek pouches which they use for food storage and transport. They burrow, and prefer open foraging areas; their diet consists of roots and tubers, though sometimes they also consume forbs, grasses and agricultural products. Many are widely known to be agricultural pests. Some *Thomomys* live in a group, while others seem to prefer a solitary existence.

Kangaroo rats, kangaroo mice and rock pocket mice: *Heteromyidae*

*Perognathus sp.* (PEG)
Ecology: These burrowing rodents feed primarily on seeds and vegetation, but have been known to consume insects and invertebrates as well. Like the *Geomyidae*, they possess fur-lined cheek pouches. *Perognathus* are nocturnal and prefer arid to semi-arid environments.

Ord’s kangaroo rat: *Dipodomys ordii* (DPO)
Ecology: Though these creatures have an enormous range (from Canada to central Mexico and from Oregon to Oklahoma) they have a distinct preference for habitats with finely textured sandy soils, which they use for grooming purposes. Thus, they mainly inhabit arid to semi-arid grasslands and feed on seeds and green vegetation. They burrow, are nocturnal, and do not hibernate. They are supposedly sympatric with Merriam’s kangaroo rat and the silky pocket mouse, though this seems to vary somewhat by locale.

Mice: *Peromyscus sp.* (PER) and *Peromyscus maniculatus* (PEM)
Ecology: *Peromyscus* are nocturnal, omnivorous, and reside in a wide variety of habitats.

Wood rat: *Neotoma sp.* (NEO)
Ecology: *Neotoma* species do not hibernate, are nocturnal, and den in caves, cliff crevices, abandoned buildings, and so forth; they eat mainly plant foods and produce substantial middens, some of which are useful for archaeological purposes.

Beavers: *Castoridae*

Beaver: *Castor canadensis* (CAC)
Ecology: This large rodent is adapted for an aquatic existence; some burrow, but many build dams and the species has a preference for dwelling near
water. Beavers consume mostly herbaceous vegetation, though they do eat some woody material. They do not hibernate and are nocturnal.

**Canidae (CAN)**

This category includes probable wolf, coyote, fox, or dog species.

Dog, Wolf, or Coyote: *Canis sp.* (CNS)

Ecology: Members of genus *Canis* are carnivorous and omnivorous, occupy a variety of habitats, and are widespread throughout North America.

Domestic Dog: *Canis familiaris* (CAF)

Ecology: The domestic dog is one of two animal species domesticated by the Ancestral Pueblo people of the American Southwest. Some experts subdivide these ancient domestic dogs into various categories based on size. The domestic dog is formally listed by the Smithsonian Institution as a subspecies of the Gray Wolf, *Canis lupus familiaris*, although it was originally classified as *Canis familiaris* by Linnaeus, and some authorities still use the latter form.

Fox: Urocyon or Vulpes (FOX)

Ecology: Foxes are carnivores and live in a variety of biomes; they are typically crepuscular (though in areas of human interference they tend to become nocturnal). The Red Fox, *Vulpes vulpes* is the most widely distributed terrestrial carnivore.

**Ursidae (URS)**

Ecology: Bears are mainly omnivorous, and live in a variety of habitats from the tropics to the arctic, and from forested woodland areas to arid grassland. Many bear species hibernate.

Badger: *Taxidea taxus* (TXT)

Ecology: Possesses a third eyelid and partially webbed toes; both are likely adaptations for digging. The badger has a very large range which covers much of North America. These creatures live in dens and hibernate; they eat carrion, insects, and rodents.

**Felidae:**

Lynx or bobcat: *Lynx sp.* (LYN)

Note: This category includes specimens which may be from *Lynx canadensis* or *Lynx rufus*; however, they are most likely representative of *Lynx rufus*.

Ecology: Both the Lynx and the Bobcat tend to favour high-altitude forests with dense cover, however, they also range over most of North America and live in a variety of habitats. Lynx and Bobcats are carnivorous predators and are typically solitary.
Artiodactyls (ART)
   Ecology: Even-toed ungulates with various specializations which live in a wide variety of habitats.

Deer: Odocoileus sp. (ODO)
   Ecology: Both Odocoileus virginianus and Odocoileus hemionus range over the Four Corners area of North America. While deer are typically associated with a forested environment, they have been described as an “ecotone” species which inhabits a transitional zone between true forest or thicket and open grassland. Deer are entirely herbivorous.

Pronghorn: Antilocapra americana (ANT)
   Ecology: Antelope prefer flat, expansive grassland habitats (this includes deserts and alpine plateaus). They feed on a variety of plants such as forbs and shrubs and are also known to consume plants that are poisonous to livestock.

Bighorn sheep: Ovis canadensis (OVC)
   Ecology: This species dwells in most mountainous areas of North America and is quite widespread, though the availability of water limits habitation in some regions. Bighorn sheep are migratory, and graze on grasses and forbs (they are also known to eat cacti in the American Southwest). This species no longer lives in the Bluff area.

Temporal and Spatial Context
   Faunal remains were assigned to the appropriate spatial context within the Bluff site based upon information noted in the field and recorded on the bag labels which were correlated with excavation maps and stratigraphic profiles. I assigned a two-letter code representing general locales (for instance, GK is Great Kiva) to every item in the database. Figure 5 shows a site plan of the Bluff Great House with all Test Units excavated during the project and Table 4 lists all locale codes and the associated Test Units.

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As for assigning specimens to time periods, Dr. Cameron provided me with stratigraphic dates resulting from the ceramic analysis performed by Dr. Eric Blinman. These dates were also recorded on the primary data spreadsheet. Not all faunal remains had associated datable material. When the ceramic analyst (Blinman 2007) noted that a layer was deposited during the late portion of a period (for instance, "Late PII") or the date was weak, I recorded those notes in the spreadsheet. In addition, I created a date category for faunal bone from contexts with both Pueblo II and Pueblo III ceramics which were either the result of mixed deposits from different periods or from a transitional phase.
Table 4: Locale codes and associated Test Units

<table>
<thead>
<tr>
<th>Code</th>
<th>Locale</th>
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<tbody>
<tr>
<td>PR</td>
<td>“potted room” (Feature 2)</td>
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<td>BE</td>
<td>SE berm (TU 1)</td>
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<tr>
<td>BT</td>
<td>Berm trench (TUs 10, 25, 26, 43, 44 ?)</td>
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<tr>
<td>GK</td>
<td>Great Kiva (TUs 8, 23, 29, 42, 46, 49, 50, 51, 55, 56, 57, 58, 59, 63, 67, 74, 76, 77, 81 and associated sub units)</td>
</tr>
<tr>
<td>WC</td>
<td>Wall clearing</td>
</tr>
<tr>
<td>WK</td>
<td>West Kiva (TUs 24, 30, 33, 34, 37 and associated subunits)</td>
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<tr>
<td>EK</td>
<td>East Kiva (TUs 18, 45, 47, 68 and associated subunits)</td>
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<tr>
<td>NE</td>
<td>Northeast Kiva (TU 68 and associated subunits)</td>
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<tr>
<td>CK</td>
<td>Central Kiva (TUs 60 and 64 and associated subunits)</td>
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<tr>
<td>NB</td>
<td>North berm (TUs 19, 62, 66 and associated subunits)</td>
</tr>
<tr>
<td>SR</td>
<td>TU 71, all associated units</td>
</tr>
<tr>
<td>ER</td>
<td>TU 72, all associate units</td>
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<td>NR</td>
<td>TU 75, all associated units</td>
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<tr>
<td>SL</td>
<td>TU 7</td>
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<tr>
<td>PZ</td>
<td>Plaza (TUs 69 and 70 all associated units)</td>
</tr>
<tr>
<td>GH</td>
<td>Great House (test units from 2002)</td>
</tr>
<tr>
<td>NN</td>
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III. Random Re-Analysis of Selected Field Specimen Bags

After analysis of the faunal material from the Bluff Great House, I independently re-analyzed 30 Field Specimen bags of faunal remains selected at
random from the assemblage. I did this in order to assess the accuracy of my analysis. I felt that in order for my identifications to be considered reliable, my results should be duplicable (within a margin of error).

There were 104 faunal Field Specimen numbers from the 2003-2004 field seasons, and those re-analyzed totalled approximately 29% of the total Field Specimen numbers. The process of re-analysis involved re-combining all remains I had previously identified with those I did not, and re-analyzing the remains as though they were un-analyzed. I was in error approximately 2% of the time with regard to specific designations. I identified 599 specimens during re-analysis compared to the 586 identified during initial analysis. 1,214 specimens went unidentified during my initial analysis while 1201 were unidentifiable after re-analysis. I specifically examined the number of *Sylvilagus* and *Meleagris* remains identified during each analysis. During the re-analysis, I identified 94% of the previously identified *Sylvilagus* specimens, and 104% of the previously identified *Meleagris* specimens. The variation in identification of these taxa is partially due to the use of less precise codes such as LBI (large bird) for fragments of possible turkey elements, and LAG (lagomorph) for rabbit. The overall increase in number of identifications may be due to my increased familiarity with the regional fauna or the specimens themselves. Overall, I was reasonably consistent in my identifications over the course of assemblage analysis. Table 5 compares the results of the two analyses.
Table 5: Comparison of first and second analyses

<table>
<thead>
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<th></th>
<th>First analysis</th>
<th>Second Analysis</th>
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<tr>
<td>Identified Specimens</td>
<td>586</td>
<td>599</td>
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<tr>
<td>Unidentified Specimens</td>
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<td>1,201</td>
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<td><em>Lepus sp.</em></td>
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<tr>
<td><em>Sylvilagus sp.</em></td>
<td>99</td>
<td>94</td>
</tr>
<tr>
<td>Lagomorpha</td>
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<td>25</td>
</tr>
<tr>
<td>Total Lagomorphs:</td>
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<td>160</td>
</tr>
<tr>
<td><em>Meleagris gallopavo</em></td>
<td>262</td>
<td>273</td>
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<tr>
<td>Large Aves</td>
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<td>7</td>
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<tr>
<td>Total Large Aves and <em>Meleagris gallopavo</em></td>
<td>267</td>
<td>280</td>
</tr>
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</table>

IV. Summary

I conducted a standardised zooarchaeological analysis of the faunal remains from the 2002-2004 field seasons at the Bluff Great House and recorded metric and non-metric attributes of each specimen. These data were added to a faunal data spreadsheet from previous zooarchaeological analyses of animal bones from previous field seasons at Bluff. The fauna recovered during the excavation of the Bluff Great House are consistent with the ecology of the surrounding area, though some species identified, such as the Bighorn Sheep, are no longer present in southeastern Utah. The temporal and spatial contexts of faunas were based upon stratigraphic profiles and a ceramic chronology provided to me by Dr. Cathy Cameron. The process of re-analysis of selected Field Specimen bags demonstrated that I was reasonably consistent in my taxonomic designations and my identifications may be duplicated with little variation.
CHAPTER 5: TAPHONOMY AND THE BLUFF GREAT HOUSE ASSEMBLAGE

I. Introduction

Human behaviour can affect a faunal assemblage in a wide range of ways (Binford 1978, Brain 1967, Lyman 1982, 1987a, 1991, 2005). Human hunters may have preferentially transported only those portions of an animal with a high economic utility back to a living site (Binford 1978). The "schlepp effect," as defined by Perkins and Daly (1968) is the concept that describes the idea of certain bones from large animals being left at the kill site while other elements might be relocated to processing or consumption sites. Due to sheer size and weight, artiodactyls at Bluff may have been affected more by the "schlepp effect" than a lagomorph. This framework, especially in concert with Binford's body part utility indices (1978), was used to interpret various faunal assemblages (Binford 1981, 1984; Jackson and Scott 2003, Speth 1983; Thomas and Mayer 1983). Studies of this nature utilised Binford's modified general utility index (MGUI), though his methods for deriving them were criticised (Metcalfe and Jones 1988). The MGUI was created to predict what body parts and therefore what skeletal elements would be left at a kill site, or conversely, transported elsewhere for eventual consumption. This general index is based on four different component utility indices on meat utility, marrow, white grease, and general utility (Binford 1978:12).
Humans may have also made a preferential selection for elements used in toolmaking and ritual. Driver (1984) analysed the selection of raw material by a Saxon bone-worker and found that strong preferences for certain types of bones were demonstrated. Not only did the artisan select for certain elements from a specific species, but they also selected for mature bone from older, larger animals (Driver 1984). Kristine Bovy (2002) investigated the phenomenon of proportionately high numbers of wing elements occurring in faunal assemblages, a pattern which has been noted elsewhere (Crockford et al. 1997). The most common explanation for the overabundance of wing elements is based upon conjectures involving high bone densities for these elements. Bovy used data from northwest coast archaeological sites to test this hypothesis, and concluded that bone density values were not sufficient to support it (Bovy 2002). Instead, it is probable that behavioural processes such as differential transport and scavenging of carcasses, processing techniques, consumption practises, or curation of wings could have been responsible for the trend.

Some butchery practises could also have affected the number and types of elements left in the assemblage. For instance, smashing bones for grease and discard of elements away from an archaeological site would reduce the number of identifiable elements (Brink 1997; Lyman 1992; Marshall and Pilgram 1991). The burning of faunal bones through cooking and other processes would also decrease potential survivability.

Natural processes also affect faunal assemblages in various ways. Root etching can obscure bone features and mimic cut marks (Andrews and Cook
Fluvial and alluvial activity can transport bone within, away from, or onto an archaeological site (Hofman 1986; Waters 1991). Burrowing rodents leave their skeletal remains behind and sometimes relocate smaller bones within a site, though the degree to which they disturb stratigraphy is debated (Bocek 1986; Hofman 1986). These rodents also modify skeletal material by gnawing it (Lyman 1987b, Schiffer 1983) as do carnivores. Such effects differentially affect certain elements. For instance, carnivores preferentially chew elements such as the proximal humerus and femur which have easily accessible deposits of fat (Binford 1981, Binford et al. 1988, Blumenschine 1988, Marean et al. 1990). Carnivores often select for the ends of elements, which may have resulted in the obliteration of an element's most diagnostic features (Marean and Spencer 1991). A likely consequence of this destruction is a reduction in the number of identifiable elements. In Tables 6 and 7, I list some of the taphonomic processes which modify or destroy faunal bone in the context of an archaeological site.

### Table 6: Natural and behavioural taphonomic processes

<table>
<thead>
<tr>
<th>Natural</th>
<th>References</th>
<th>Behavioural</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rootlet etching</td>
<td>Andrews and Cook 1985; Shipman and Rose 1984</td>
<td>Burning</td>
<td>Lyman 2002</td>
</tr>
</tbody>
</table>
Table 7: Transport-related taphonomic processes

<table>
<thead>
<tr>
<th>Action</th>
<th>Natural</th>
<th>References</th>
<th>Human</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add bones to site</td>
<td>Predator discard of prey; on-site deaths; fluvial and alluvial transport</td>
<td>Hofman 1986; Waters 1991</td>
<td>Transportation of prey</td>
<td>Binford 1978; Perkins and Daly 1968</td>
</tr>
<tr>
<td>Remove bones from site</td>
<td>Weathering; carnivore chewing, digestion, and transport; rodent gnawing</td>
<td>Lyman 1987, Schiffer 1983</td>
<td>Butchery practises; waste disposal; burning</td>
<td>Binford 1978; Bunn and Kroll 1986; Stahl and Zeidler 1990</td>
</tr>
<tr>
<td>Move bones within site</td>
<td>Cycle of freezing and thawing; root activity; rodent burrowing</td>
<td>Bocek 1986; Hofman 1986</td>
<td>Construction and renovation</td>
<td>Schiffer 1983</td>
</tr>
</tbody>
</table>

II. Detection of Taphonomic Processes

The detection of taphonomic processes is generally based upon identifying modifications of specimens; different processes will alter skeletal elements in a distinguishing and sometimes predictable pattern. Taphonomic processes can also be detected when the overall structure of an assemblage is affected. For instance, high or low frequencies of specific elements and the size of bone fragments can also function as indicators of taphonomic processes.

Major problems with detection of taphonomic processes:

An important issue with the detection of taphonomic processes is the problem of equifinality, i.e., different processes can lead to the same element appearances or patterns in the assemblage. As an example, Lyman (1985) argued that the transport of bones with high food values and the density-related attrition of bones from archaeological sites should not be treated as mutually
exclusive explanations for assemblage formation. He demonstrates that many elements of high food value have a low bone mineral density and some bones of low food value have a high density (Lyman 1985). Therefore, the two processes may produce similar results in terms of faunal assemblage structure.

Another problem with detecting taphonomic processes involves the possibility of various taphonomic agents acting in a series or together. One taphonomic agent might be obscured by another. For instance, an element may have been made into a tool and then digested by carnivores once disposed of. Taphonomic agents might also act in tandem to produce a different effect than that expected. Human selection for, transport, and disposal of elements could mimic other, natural taphonomic processes.

III. Element Representation

Any archaeological assemblage of faunal remains is the result of both human behaviour and natural processes. Although distinguishing between these processes can be difficult, taphonomic factors acting upon the assemblage can be identified using various measurements. Identification of processes dominant in the formation of the excavated assemblage may commence with an examination of the relative frequencies of different parts of the skeleton with reference to their expected natural frequency. Should the numbers of surviving elements from an animal skeleton differ from what would be expected of a complete skeleton, it is entirely probable that natural processes or human behaviour in one form or another could be responsible for these differences. Natural processes (i.e., those that may be expected or predicted due to element
size or density) should be fully assessed before assuming that a pattern evident in a faunal assemblage is due to human behaviour.

Though there is not always agreement between analysts on NISP values for any given assemblage, I have chosen to base all quantified data on NISP. In Chapter 4, I described the NISP values for the fauna of the Bluff Great House. While NISP is a measure of taxa that were recovered from an archaeological site, it is not necessarily an indicator of those taxa which were removed from the ecological landscape, nor of those taxa which were killed by human hunters. NISP (number of identified specimens) is an observational unit, as distinguished from derived or interpretive units such as MNI (minimum number of individuals) which are defined by some mathematical relation between fundamental measurements (Lyman 1994). In order to grasp at the answers to questions of a taphonomic nature, both derived and interpretive measurements are necessary. While different measurements are often necessary in order to answer differing research questions, derived measurements do have certain weaknesses. According to Lyman (1994:37), derived measurements such as MNI can have “non-explicit, unclear, or only weakly established relations to theoretical or interpretive concepts.”

There are many quantitative units of varying types and different authors calculate measurements of the same name in inconsistent ways (Lyman 1994). Therefore, it is absolutely necessary to make explicit the measurements used in any study of faunal remains as well as how these measurements are derived. In
this chapter, the units MNE, MAU, and %MAU are utilised; definitions and calculations of these units follows.

MNE is defined most commonly as minimum number of elements; it is a derived unit consisting of the "minimum number of skeletal elements; determined from the most common portion of each skeletal element and summing right and left sides [for paired elements]" (Stiner 1991:459).

MAU refers to "minimum animal units." It is calculated separately for each class of elements (all femurs, all humeri, and so on) by taking the MNE of each element type and dividing it by the number of times that element occurs in one skeleton of the appropriate taxon (Binford 1984:51).

\[
\text{MNE in assemblage} = \frac{\text{MNE in skeleton}}{\text{MNE in skeleton}}
\]

%MAU is a percentage value of MAU; it is calculated by taking the MAU of an element, multiplying it by 100, and dividing it by the highest MAU observed of that taxon (Binford 1984).

\[
\frac{(\text{MAU of element})100}{\text{maximum MAU observed}}
\]

In taphonomic analysis, these measurements are intended to determine relative abundances of elements within a taxon. They have the potential to quantify and compare the survivability of particular elements of specific taxa. For instance, the innominate in mammals tends to survive taphonomic processes more successfully than an avian innominate, which is rather delicate. The foot bones of artiodactyls tend to be well-represented, while those of lagomorphs and turkeys are smaller and can be lost during excavation. (Note in Tables 10 and 11
that the third phalanx is not present in the case of both *Sylvilagus* and *Lepus*. Also, despite the fact that lumbar vertebra are not necessarily the most numerous of the vertebra types, they tend to be more prevalent in assemblages, perhaps due to their density).

I now present the data from the faunal assemblage of the Bluff Great House based upon the measurements described previously in this chapter. I chose to focus on the data from four taxa which were likely obtained for food. I chose these taxa because they are present in the faunal assemblages from many other Chaco-era sites in the Northern San Juan region. Artiodactyls may not have made up the bulk of dietary protein, but they are often represented in Great House assemblages. Turkeys were one of the domesticated species of the peoples of the American Southwest, and their remains dominate the Bluff faunal assemblage from the Pueblo III period. Lagomorphs are a ubiquitous utility species and they seem to be present at nearly every site in the Northern San Juan region with an analysed faunal assemblage.

The first table displays the data for artiodactyls, which includes all *Odocoileus, Antilocapra, Ovis*, and all specimens identified as any size of artiodactyl. The second presents the data for all *Meleagris gallopavo* specifically. The third and fourth give data for *Sylvilagus sp.* and *Lepus sp.*, respectively.

Selected artiodactyl elements are ordered by %MAU, with MNE and MAU values also shown. Based on actualistic studies, Brain (1981) divided artiodactyl elements into three categories of survivability: high, medium, and low. These categories are also listed in Table 8. There have been attempts by researchers
to refine Brain's categories by measuring bone densities directly and then plotting
%MAU against bone density. I chose to use Brain's categories for artiodactyls
instead of a bone density study due to criticisms of bone density studies (Lam et
al. 2003; Lam and Pearson 2004, 2005). The diversity of methods utilised to
acquire bone density data combined with shortcomings of specific techniques
has led to a great deal of confusion and incompatibility between studies (Lam et
al 2003). While Lam and Pearson (2004) allow that bone density studies have
been of benefit, the assessment of "a bone's ability to survive destruction... as
represented by a single number" may be an oversimplification of a set of
destructive processes. Lack of adequate documentation of bone density
rankings by species and the deficiency of attention to some preservational biases
has also contributed to the discord. Lam and Pearson (2005) suggest that if a
consensus was reached within the zooarchaeological community to standardise
techniques, bone density studies would be of far more value and I agree with
them wholeheartedly. Table 8 shows the derived MNE, MAU, and %MAU values
for selected artiodactyl elements.

Table 8: Bluff Great House artiodactyl element values

<table>
<thead>
<tr>
<th>Element</th>
<th>MNE</th>
<th>MAU</th>
<th>%MAU</th>
<th>Brain 1981</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innominate (acetabulum)</td>
<td>15</td>
<td>7.5</td>
<td>100</td>
<td>Medium</td>
</tr>
<tr>
<td>Calcaneum</td>
<td>14</td>
<td>7</td>
<td>93</td>
<td>Medium</td>
</tr>
<tr>
<td>Tibia</td>
<td>13</td>
<td>6.5</td>
<td>87</td>
<td>High</td>
</tr>
<tr>
<td>Scapula</td>
<td>12</td>
<td>6</td>
<td>80</td>
<td>High</td>
</tr>
<tr>
<td>Metapodials</td>
<td>24</td>
<td>6</td>
<td>80</td>
<td>High</td>
</tr>
<tr>
<td>First Phalanx</td>
<td>51</td>
<td>6</td>
<td>80</td>
<td>Low</td>
</tr>
<tr>
<td>Femur</td>
<td>11</td>
<td>5.5</td>
<td>73</td>
<td>Medium</td>
</tr>
<tr>
<td>Second Phalanx</td>
<td>41</td>
<td>5</td>
<td>67</td>
<td>Low</td>
</tr>
<tr>
<td>Radius</td>
<td>9</td>
<td>4.5</td>
<td>60</td>
<td>High</td>
</tr>
</tbody>
</table>
In a broad sense, the %MAU values shown here from the artiodactyl elements correlates to Brain's categories. Most elements in the "high" category are clustered toward the top, and most elements in the "low" category appear at the bottom, though there is a great deal of overlap. Immediately obvious is that the innominate is the best-preserved element from Artiodactyla in the Bluff assemblage. Following it are the calcaneum, tibia, metapodials, scapula, femur, and various other bones of the feet. These elements may have been better preserved simply due to their higher density while elements such as vertebrae and ribs are a bit less dense. The low number of carpals is a bit surprising, though these are not large bones and may have been swallowed by carnivores or missed by inexperienced excavators.

**Meleagris gallopavo**

In order to assess whether the turkey remains recovered from the Bluff Great House were primarily affected by natural or cultural taphonomic processes, it is important to note the effect that bone density has on survivorship of elements. Rankings of density for each element based on Dirrigl's (2001) wild turkey bone density study are provided as well as MNE, MAU, and %MAU. I
chose to use the data for BMDv or "True Physical Density" (Blake and Fogelman 1996) or Lyman's "bulk bone mineral density" (Lyman 1982, 1984) because the measurement allows for variation in bone thickness within a region of interest, as compared to BMDa or "Linear Density", which has a tendency to underestimate bone mineral density (Kreutzer 1992). Kreutzer describes Linear Density as "misleading," "at best ambiguous and at worst invalid" and "of dubious value" (1992). As Dirrigl used multiple scan sites for most elements, all estimations of density in Table 9 below are based on an average of BMDv rank with the exception of phalanges, which had only one scan site. Unfortunately, many of the elements selected for comparison were not analysed in Dirrigl's investigation. Although foot bones were included in the study, individual phalanges are not distinguished, thus I give no ranking for the P4.

Table 9 below displays data from selected Meleagris gallopavo elements in order of descending %MAU. Please note that Dirrigl (2001) uses a reverse scale of density for the Meleagris gallopavo specimens. This means that a rank of 1 indicates the lowest recorded density for the study, while a rank of 28 would indicate the highest density observed.

Table 9: MNE of selected Meleagris gallopavo elements

<table>
<thead>
<tr>
<th>Element</th>
<th>MNE</th>
<th>MAU</th>
<th>%MAU</th>
<th>Density Rank(s)</th>
<th>Avg. Density Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humerus</td>
<td>76</td>
<td>38</td>
<td>100</td>
<td>1, 8, 17</td>
<td>8.66</td>
</tr>
<tr>
<td>Ulna</td>
<td>72</td>
<td>36</td>
<td>95</td>
<td>4, 11, 21</td>
<td>12</td>
</tr>
<tr>
<td>Tibiotarsus</td>
<td>71</td>
<td>35.5</td>
<td>93</td>
<td>2, 12, 23</td>
<td>12.33</td>
</tr>
<tr>
<td>Coracoid</td>
<td>53</td>
<td>26.5</td>
<td>80</td>
<td>7, 13, 14</td>
<td>11.33</td>
</tr>
<tr>
<td>Femur</td>
<td>50</td>
<td>25</td>
<td>66</td>
<td>3, 5, 20</td>
<td>9.33</td>
</tr>
<tr>
<td>Innominate</td>
<td>44</td>
<td>22</td>
<td>58</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
The most abundant turkey element recovered and identified in the Bluff assemblage is the humerus, followed by the ulna and other longbones. These are mostly bones of high to medium density, which may be expected to survive well. However, the lowest density bone in this comparison is the humerus, which has the lowest average density and the highest %MAU. This may be due to human selection for wing elements, a pattern that has been observed in other archaeological assemblages (Bovy 2002). There is a gap in element occurrence following the coracoid and femur. Thinner, more fragile bones (the innominate at the acetabulum), scapulae and vertebrae as well as smaller bones such as carpals and phalanges are far less frequent. The lack of smaller bones could be due in part to recovery techniques and screen size. Despite the fact that not all elements I selected for comparison were involved in the study, there is not a strong correlation between elements of higher density on average with higher survivorship. This does differ depending on the location of the scan site. See Table 13 for a comparison of turkey long bone ends with density rank.
Sylvilagus sp.

For the density levels in Tables 10 and 11 which follow, leporid mean ranks for multiple scan sites on the same element using VDsa or "Shape-Adjusted Volume Density" (Pavao and Stahl 1999) have been provided. Pavao and Stahl completed structural density assays of bone scan sites from four leporid taxa, though they were prevented from using areal determinations by the small size of many scan sites (Pavao and Stahl 1999). Leporid mean was utilised instead of distinct ranks for each species as the sample size was small, some juveniles were present, and the exact species hunted in the region of the Bluff Great House were not represented in Pavao and Stahl’s study. Elements were ranked based upon the density of specific scan sites; in the case of elements for which there were multiple scan sites, I list all ranks given for that element and provide the average rank. There were no scans on any part of a thoracic vertebra; only the third phalanx was scanned, and the ranks for that phalanx are associated with all three phalanx types. A rank of 1 indicates the highest density used in the study.

Table 10: MNE of selected Sylvilagus elements

<table>
<thead>
<tr>
<th>Element</th>
<th>MNE</th>
<th>MAU</th>
<th>%MAU</th>
<th>Density Rank(s)</th>
<th>Avg. Density Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cranium (mandible)</td>
<td>83</td>
<td>41.5</td>
<td>100</td>
<td>7, 1, 24, 37</td>
<td>17.25</td>
</tr>
<tr>
<td>Innominate (acetabulum)</td>
<td>80</td>
<td>40</td>
<td>96</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Humerus</td>
<td>65</td>
<td>32.5</td>
<td>78</td>
<td>4, 28, 29, 23, 9</td>
<td>18.6</td>
</tr>
<tr>
<td>Tibia</td>
<td>64</td>
<td>32</td>
<td>77</td>
<td>3, 15, 18, 25, 5</td>
<td>13.2</td>
</tr>
<tr>
<td>Femur</td>
<td>63</td>
<td>31.5</td>
<td>76</td>
<td>19, 20, 10, 14, 21, 2</td>
<td>14.33</td>
</tr>
<tr>
<td>Radius</td>
<td>52</td>
<td>26</td>
<td>63</td>
<td>35, 44, 41, 38, 36</td>
<td>38.8</td>
</tr>
</tbody>
</table>
Cranial elements are the most abundant in the *Sylvilagus* assemblage from Bluff; this correlates well with the density ranks, though portions of other elements are more dense and might be expected to preserve better. Closely following the cranium is the innominate and then long bones, a pattern present in the other faunal groups discussed in this chapter. Again, the least-represented bones seem to be either fragile or small for the most part.

*Lepus sp.*

As with the *Sylvilagus* table, *Lepus* element density ranks are those derived by Pavao and Stahl (1999) based upon Shape-Adjusted Volume Density.

<table>
<thead>
<tr>
<th>Element</th>
<th>MNE</th>
<th>MAU</th>
<th>%MAU</th>
<th>Density Rank(s)</th>
<th>Avg. Density Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scapula</td>
<td>50</td>
<td>25</td>
<td>60</td>
<td>26, 45, 51</td>
<td>40.66</td>
</tr>
<tr>
<td>Calcaneum</td>
<td>30</td>
<td>15</td>
<td>36</td>
<td>27, 8</td>
<td>17.5</td>
</tr>
<tr>
<td>Lumbar vertebra</td>
<td>47</td>
<td>6.7</td>
<td>16</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Metapodials</td>
<td>94</td>
<td>5.9</td>
<td>14</td>
<td>47, 42, 39, 49, 40</td>
<td>43.4</td>
</tr>
<tr>
<td>Astragalus</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Thoracic vertebra</td>
<td>29</td>
<td>2.2</td>
<td>5</td>
<td>No Data</td>
<td>No Data</td>
</tr>
<tr>
<td>Ribs</td>
<td>57</td>
<td>2.2</td>
<td>5</td>
<td>57, 50, 58, 56, 60</td>
<td>56.2</td>
</tr>
<tr>
<td>Cervical vertebra</td>
<td>10</td>
<td>1.4</td>
<td>3</td>
<td>31, 12 (Atlas and Axis)</td>
<td>21.5</td>
</tr>
<tr>
<td>First Phalanx</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>59, 55</td>
<td>57</td>
</tr>
<tr>
<td>Second Phalanx</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>59, 55</td>
<td>57</td>
</tr>
<tr>
<td>Third Phalanx</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>59, 55</td>
<td>57</td>
</tr>
</tbody>
</table>

Table 11: MNE of selected *Lepus* elements
<table>
<thead>
<tr>
<th>Element</th>
<th>MNE</th>
<th>MAU</th>
<th>%MAU</th>
<th>Density Rank(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>19</td>
<td>9.5</td>
<td>45</td>
<td>19, 20, 10, 14, 21, 2</td>
</tr>
<tr>
<td>Scapula</td>
<td>18</td>
<td>9</td>
<td>43</td>
<td>26, 45, 51</td>
</tr>
<tr>
<td>Astragalus</td>
<td>13</td>
<td>6.5</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>Calcaneum</td>
<td>8</td>
<td>4</td>
<td>19</td>
<td>27, 8</td>
</tr>
<tr>
<td>Metapodials</td>
<td>57</td>
<td>3.5</td>
<td>17</td>
<td>47, 42, 39, 49, 40</td>
</tr>
<tr>
<td>Lumbar vertebra</td>
<td>19</td>
<td>2.7</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Ribs</td>
<td>58</td>
<td>2.23</td>
<td>11</td>
<td>57, 50, 58, 56, 60</td>
</tr>
<tr>
<td>Cervical vertebra</td>
<td>12</td>
<td>1.7</td>
<td>8</td>
<td>31, 12 (Atlas and Axis)</td>
</tr>
<tr>
<td>Second Phalanx</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>59, 55</td>
</tr>
<tr>
<td>Thoracic vertebra</td>
<td>9</td>
<td>0.7</td>
<td>3</td>
<td>No Data</td>
</tr>
<tr>
<td>First Phalanx</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>59, 55</td>
</tr>
<tr>
<td>Third Phalanx</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>59, 55</td>
</tr>
</tbody>
</table>

The *Lepus* assemblage follows a pattern slightly different from that of the *Sylvilagus* assemblage. The dominant element recovered was the tibia, and while other long bones were relatively abundant, the frequency of crania was second only to that of tibias and humeri. Vertebrae, phalanges, and other small bones were among the least-represented elements.

In order to demonstrate clearly how much element dimensions affect preservation with respect to lagomorph remains, the length and breadth of every relevant element from a *Sylvilagus sp.* skeleton has been measured and plotted on Figure 6. This demonstrates the relationship between the size of *Sylvilagus* elements and % MAU. Elements from the Bluff faunal assemblage with a %MAU greater than 50% are represented as circles, and those with a %MAU below 50% are represented as squares.
Figure 6: Length vs. breadth of *Sylvilagus* sp. elements

The square points in Figure 6 represent elements with a %MAU value below 50 and the circles represent elements with a %MAU above 50. While many taphonomic processes may have had an effect on the lagomorph assemblage, it is clear that element size is a defining factor in terms of the survival of the given elements. This pattern could be due to a number of processes including not only those natural and cultural, but also those involved in excavation, such as screen size.

Density Comparison

Thus far, I have used entire elements for the purposes of comparing frequencies and survivorship. Many bone density studies scan several sites on any given element for the purposes of clarifying the variable physical characteristics of any one bone. This results in various ranks for a single element, particularly with respect to proximal and distal ends of long bones. In
order to make comparisons of %MAU and density, it was necessary in Tables 9, 10, and 11 to list all density ranks generated for that single element. Tables 12 and 13 list NISP for the proximal and distal ends of selected long bones of *Sylvilagus* sp., *Lepus* sp., and *Meleagris gallopavo*. Corresponding density ranks follow the NISP in parentheses. Both lagomorphs have the same density rank as I used the Pavao and Stahl’s leporid mean for comparative purposes (Pavao and Stahl 1999). Artiodactyls were not included in this comparison for two reasons: the number of long bone ends is low, and I did not use a density study for comparison of their element frequencies (though Brain does distinguish between proximal and distal ends).
Table 12: Comparison of cottontail and jackrabbit long bone ends with corresponding density rank

<table>
<thead>
<tr>
<th>Mammals</th>
<th>Proximal Humerus NISP</th>
<th>Distal Humerus NISP</th>
<th>Proximal Radius NISP</th>
<th>Distal Radius NISP</th>
<th>Proximal Tibia NISP</th>
<th>Distal Tibia NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sylvilagus sp.</td>
<td>22 (4)</td>
<td>62 (9)</td>
<td>46 (35)</td>
<td>33 (36)</td>
<td>22 (3)</td>
<td>46 (5)</td>
</tr>
<tr>
<td>Lepus sp.</td>
<td>1 (4)</td>
<td>25 (9)</td>
<td>15 (35)</td>
<td>13 (36)</td>
<td>12 (3)</td>
<td>19 (5)</td>
</tr>
</tbody>
</table>

Table 13: Comparison of turkey long bone ends with corresponding density rank*

<table>
<thead>
<tr>
<th>Turkey</th>
<th>Proximal Humerus NISP</th>
<th>Distal Humerus NISP</th>
<th>Proximal Ulna NISP</th>
<th>Distal Ulna NISP</th>
<th>Proximal Tibiotarsus NISP</th>
<th>Distal Tibiotarsus NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meleagris gallopavo</td>
<td>51 (1)</td>
<td>53 (8)</td>
<td>39 (4)</td>
<td>35 (11)</td>
<td>11 (2)</td>
<td>34 (12)</td>
</tr>
</tbody>
</table>

*Please note that Dirrigl (2001) uses a reverse scale of density for the Meleagris gallopavo specimens. This means that a rank of 1 indicates the lowest recorded density for the study, while a rank of 28 would indicate the highest density observed.

Some of the lagomorph long bone density values do not make intuitive sense as they do not correlate with the results of carnivore ravaging as examined by Binford (1981:279). Binford argued that when an assemblage of large mammal remains is thoroughly ravaged by carnivores, there would be an over-representation of the distal ends of the humerus and tibia while the proximal ends were under-represented. This pattern was thought to be due in part to the desirability of the interior fat of these proximal ends as well as the fragility thereof. The density ranks and NISP values of these elements do not seem to correlate with the concept of “denser bones have a higher survivability,” and
instead follow Binford's model. As mammal skeletal morphology is somewhat consistent, it is probable that Binford's pattern does more closely fit the data from the Bluff lagomorphs. Pavao and Stahl, it should be mentioned, do state that there is not always a good correlation between density and representation (Pavao and Stahl 1999).

IV. Conclusions

Taphonomic processes, both behavioural and natural, modify or destroy faunal bone in the context of an archaeological site. Detection of these processes involves both examination of individual specimens as well as the assessment of the overall assemblage structure. There are some problems with the detection of taphonomic processes in any faunal assemblage. For instance, different processes can lead to the same pattern in the assemblage, and there is also the possibility of taphonomic agents acting in a series or together to produce a complex pattern. Though distinguishing between these processes can be difficult, it is possible to use various measurements to identify which factors most likely acted upon the assemblage and which were probably dominant. The data which resulted from my study of taphonomic factors acting on the Bluff faunal assemblage (density rank, survivorship probability, element size), have led me to conclude that the effects of natural processes prevail. One exception, perhaps, is the Turkey. The comparative abundance of *Meleagris gallopavo* wing bones as contrasted with leg and axial elements may be due to human selection for wings on the part of the Bluff Great House inhabitants, a pattern that has been observed elsewhere (Bovy 2002, Crockford et al. 1997). Whatever decisions
humans may have made, it appears as though natural processes dominated the taphonomic changes present in the Bluff faunal assemblage.
I. Defining Resource Depression

Resource depression is defined as a negative change in prey availability from the perspective of a predator. The concept is loosely based on various models from Foraging Theory (Charnov et al. 1976), and will be the basis for the chapter that follows. There are three types of resource depression: behavioural, microhabitat, and exploitation. Behavioural resource depression occurs when the prey species in question alters certain behavioural or social strategies in order to avoid or deter predators. For instance, schooling tendencies in fish and increased alertness in other species are examples of this type of resource depression. Microhabitat resource depression occurs when prey species abandon a certain niche or "resource patch" in favour of another location less popular with predators. Exploitation resource depression is the type that archaeologists are primarily concerned with, and it is indicated by the removal of an entire species from a significant area, or (in the case of a confined locale such as an island) the extinction of a prey species. This type of resource depression results from humans killing off a desirable species within a certain physiographic range, or perhaps completely (Charnov et al. 1976).

Some prey are more susceptible to exploitation resource depression. Often, r/K selection theory is utilised to define which species in a region are more
likely to be depressed. Species of the “r” type reproduce rapidly and invest little energy in creating offspring (for example, lagomorphs) while “K” species invest a large amount of time and energy in producing fewer offspring (i.e., artiodactyls). These "K-adapted" species are less likely to be successful when an increase in predation or other disruption occurs as they cannot recover population numbers quickly.

There are various examples in the literature where resource depression is identified and then used to infer the conservation and structuring of environments as well as a number of social and technological transformations in a particular culture group (Alvard 1994; Butler 2001; Redman 1999). The usual projection is one of decline over time in the occurrence of the prey species along with a decrease in age of prey. From an interpretation of the decline in foraging efficiency, various consequences have been postulated. More specifically, the emergence of social hierarchies, declining health and reduced stature, increases in human violence and warfare, and technological changes have all been linked to exploitation resource depression (Broughton and O'Connell 1995; Hildebrandt and Jones 1992; Raab et al. 1995). In addition, faunal resource depression has been linked to larger, broad trends in human antiquity such as the origins and adoption of agriculture (Hawkes and O'Connell 1992; Madsen and Simms 1998).

Anticipated developments that might be expected to accompany exploitation resource depression could include intensification of plant production, an increase in storage facilities, a switch to procurement of different species, increased levels of domestic species, and an increase in herding or other types of animal
husbandry. An alternative to these strategies may have been abandonment of a living site and movement to a different resource patch.

Identification of resource depression as a trend over time in a faunal assemblage would necessarily include various lines of evidence. For instance, intensification of the production of horticultural goods might be reflected in an assemblage as an increase in the occurrence of specialised processing tools. An increase in the percentage of domesticated species or smaller, less preferred wild prey would result in an increase in the number of faunal remains from those species. An increase in the number of storage cists could also indicate the use of alternative strategies for survival. A change in the type of technologies and strategies employed to more effectively exploit prey could also be interpreted as evidence for resource depression.

II. Artiodactyls in the Bluff Assemblage

As can be seen from Table 14, the number of artiodactyls present in the Bluff assemblage decreases over time from the Pueblo II period to the Pueblo III period, though less severely when compared to other great house assemblages in the region. (The following chapter compares the Bluff faunas from Pueblo II and Pueblo III with those from the other great house sites). At Bluff, the percentage of artiodactyls as part of the entire assemblage decreases. Also, there is a decrease in the Artiodactyl Index between Pueblo II and Pueblo III. My conclusions regarding a decrease in the number of artiodactyls over time in the faunal assemblage are based upon the use of dated deposits resulting from a ceramic analysis performed by Blinman (2007). During analysis of the faunal
remains, specimens from a dated locale were noted in the database. Specimens that were from weakly dated strata or mixed deposits were not used to examine the possibility of resource depression at the Bluff.

Table 14: Core Fauna Indices and NISP from Pueblo II to Pueblo III

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Turkey NISP</th>
<th>Turkey Index</th>
<th>Sylvilagus NISP</th>
<th>Lepus NISP</th>
<th>Lagomorph total NISP</th>
<th>Lagomorph Index</th>
<th>Artiodactyl NISP</th>
<th>Artiodactyl Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluff PII</td>
<td>38</td>
<td>.11</td>
<td>337</td>
<td>183</td>
<td>427</td>
<td>.65</td>
<td>423</td>
<td>.45</td>
</tr>
<tr>
<td>Bluff PIII</td>
<td>1372</td>
<td>.66</td>
<td>480</td>
<td>213</td>
<td>723</td>
<td>.69</td>
<td>276</td>
<td>.27</td>
</tr>
</tbody>
</table>

Based on fusion data from phalanges and vertebrae, it was determined that approximately half of the artiodactyls in the Bluff assemblage died before reaching skeletal maturity (Driver et al. 2007). This phenomenon correlates with an explanation of exploitation resource depression since larger, adult animals were routinely targeted by human hunters due to higher meat values (Stiner 1994:302-303). Instead of targeting older, juvenile, or weak animals (which is a tendency of other predators) humans preferentially select for larger, prime animals which would have been part of the breeding population for that species.

Change in Lagomorph use over time

In the Bluff assemblage, the use of lagomorphs also appears to change over time, though the differences between the Pueblo II and Pueblo III periods are not as drastic as those apparent from the turkey or artiodactyl remains (Table 14).
A small but notable increase in the Lagomorph index in Pueblo III indicates that \textit{Sylvilagus} became more prevalent. As cottontail rabbits thrive in disturbed environments (Driver and Woiderski in press), it is possible that their dominance of the lagomorph assemblage hints at disturbance of local habitats by agricultural activity.

\textbf{Possible Complications}

There is a degree of difficulty in distinguishing between the three types of resource depression. Often, behavioural and natural taphonomic processes can mimic the signals of exploitative resource depression, and it is important to use multiple lines of evidence in order to determine what cause is most likely responsible for the trends observed. Cultural taboos, climate change and a host of other factors can influence the number of a given prey species available to human hunters. In the case of Bluff, the most commonly identified artiodactyl was \textit{Ovis canadensis}, a species which is no longer present in the area. This may be the result of human activity in the region over the last centuries, which has changed the character of the landscape in a variety of ways and contributed to increasing aridity. The consideration of environmental change coupled with the use of rank models derived from cultural preferences and other contributing factors such as ease of hunting, transporting and processing the animal in question in addition to energy expenditure compared to energy gained from the hunt may bolster arguments for exploitation resource depression (Butler 2001).
III. Conclusions

In the case of the artiodactyl assemblage from the Bluff Great House, there is some evidence for exploitative resource depression. While the number of artiodactyls decreases over time, the number of turkeys increases drastically between Pueblo II and Pueblo III, indicating probable husbandry and a much more intensive exploitation of a different food resource. An increase in the presence of a domestic species at the same time a decrease in the number of artiodactyls occurs could indicate possible resource depression. There is an increase in the number of lagomorphs from Pueblo II to Pueblo III. Also, the ratio of *Lepus* sp. to *Sylvilagus* sp. decreases over time, which could indicate a change in hunting strategy or the local habitat. In addition, the young age at which most of the artiodactyls present in the assemblage were killed indicates a change in the expected hunting strategy, one which may have resulted from a lack of preferred targets. This pattern is mirrored at other great houses in the region; all great houses compared in Chapter 7 show a decrease in artiodactyl frequency. Bluff does have more artiodactyls present, which may be due to resource control and privileged access to artiodactyls (Driver 1996), or the operation of specialised hunting societies (Muir and Driver 2002). The faunal assemblages from small sites in the immediate area surrounding the Bluff site have not been analysed and it is therefore not possible to make a more complete evaluation of the artiodactyls present in the Bluff assemblage. The changes in the assemblage over time correlate well with the ceramic data and suggest a continuous occupation.
It is possible that the trends observed in the data derived from the artiodactyl remains from the Bluff assemblage are due to a combination of different types of resource depression. In addition, other factors that cannot be detected during faunal analysis may have contributed to the pattern observed. These factors may include various taphonomic processes and the products of human behaviour.
CHAPTER 7: COMPARISON OF REGIONAL FAUNA TO THE BLUFF ASSEMBLAGE

I. Introduction

In order to place the Bluff Great House fauna within the greater physiographical context of the San Juan Basin, comparisons between excavated fauna from a number of Great House and Unit Pueblo Sites will be made on various levels. I will first compare the fauna from the Bluff Great House with other sites in the immediate region (the western part of the Montezuma drainage). I will then contrast the fauna from other Chacoan Great Houses in the Northern San Juan Basin with those from Bluff. The primary purpose of these comparisons is to ascertain what assemblages Bluff most resembles and to what extent it diverges from a regional pattern. The importance of this assessment lies in the framework which has been constructed to describe archaeological sites connected in any way to the Chacoan system: Unit Pueblo and Great House. This framework is in no way intended to illustrate a dichotomous relationship between the two types of sites, but as a way of understanding activities and behaviour which are expected to leave behind different faunal traces. Should the Bluff faunal assemblage bear more of a resemblance to small unit pueblos in the neighboring region, different conclusions about life at Bluff could be drawn than if the Bluff assemblage had more similarities to a large Great House at a great distance. The following questions are of concern with reference to the comparisons of this chapter:
a) Did the inhabitants of the Bluff Great House subsist off the same diet with regard to animal species as inhabitants in the unit pueblos?

b) Did the inhabitants of the Bluff Great House use more exotic species, perhaps for ritual purposes?

c) With regard to changes in faunal assemblages over time, are the changes in indexes similar? Is change in Great House fauna over time different from change at small sites?

II. Methodological Considerations

When making comparisons between different sites and the associated assemblages, several factors have the potential to cause methodological concern. Identification of fauna varies significantly between analysts. At the species level, there may be only slight concurrence, resulting in large disparities in the NISP of a given taxonomic category (Gobalet 2001). Also, there are issues with inaccurate identifications and the use of overly broad or excessively specific categorisations. Quantification is often not standardised, and the sample size (and sampling strategy) is not consistent across assemblages. There are also potential issues with clear chronological resolution and the fact that mixing between assemblages of different time periods can and does occur, and is not always easily detected. In addition, excavation methods and techniques vary by time and circumstance, and often there is only selective sampling of sites for an entire region. In light of these potential difficulties, I will be making broad comparisons and looking at large patterns of faunal use. I will use a variety of
methods to compare faunas, including faunal indices, species lists, and rank-order tables in order to best evaluate differences in assemblages for which I have MNI data instead of NISP. Sites for which NISP data were available will be compared using NISP.

There are some standard indices for zooarchaeological analyses in the American Southwest, and these are used to evaluate reliance on different faunas. These indices are calculated in the following manner:

**Artiodactyl** (Szuter and Bayham 1989):
(NISP of Artiodactyls) + (NISP of Artiodactyls + Lagomorphs)

**Lagomorph** (Driver and Woiderski, in press):
(NISP of *Sylvilagus*) + (NISP of *Sylvilagus* + *Lepus*)

**Turkey** (Spielmann and Angstadt-Leto 1996):
(NISP of *Meleagris gallopavo* + Large Birds) + (M. gallopavo + Large Birds + Lagomorphs)

The comparisons made do not include fauna in less specific categories such as "Large Mammal" if those categories were not clarified by the analyst or were not compatible with those used in the Crow Canyon Archaeological Center Manual for Description of Vertebrate Remains. Some assemblages represented in this chapter included human remains; I will not be incorporating these data into the comparative tables (no human remains were recovered during the excavation of the Bluff Great House). In addition, for the purposes of these comparisons, I utilize assemblages as a whole and do not delineate spatial categories such as "ceremonial context" or "midden." The exception to this is when site assemblages can be sub-divided by time period. Only three Great House sites in the northern San Juan region had reports which clarified any sort of temporal
resolution: the Nancy Patterson site (42Sa2110), Wallace Ruin (5MT6970) and Salmon Ruin. Faunal material from these sites will be divided into the appropriate periods and compared to the Bluff Great House fauna using NISP.

The Bluff assemblage will be presented here for the most part as two assemblages divided by time periods: Pueblo II and Pueblo III. These two sets of fauna do not account for the entirety of the fauna recovered from the Bluff site as there were many specimens which could not be assigned to a specific time period with any degree of confidence. I will note when all fauna is lumped together to represent all identified specimens from Bluff for the purposes of comparing complete assemblages.

Comparisons of fauna commonly interpreted as “food fauna” are made separately from comparisons of exotic or unusual fauna; this delineation is made in an attempt to clarify the presence of amounts of species as well make plain the presence or absence of potential ritual fauna across many sites.

IIIa. Bluff as Compared to Regional Great House Assemblages

The Bluff Great House is situated in the western part of the Montezuma drainage in southeastern Utah; the following comparisons are to Great Houses and other sites in that part of the drainage which shares similar regional and environmental characteristics with Bluff. Table 15 lists the three excavated Great houses in southeastern Utah that I use for comparison.
Table 15: Great House sites in the Bluff locale

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Reference</th>
<th>Location</th>
<th>Total NISP</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluff</td>
<td>This Thesis</td>
<td>SE Utah</td>
<td>5273</td>
<td>Northern San Juan Basin</td>
</tr>
<tr>
<td>Nancy Patterson</td>
<td>Thompson 1990</td>
<td>SE Utah</td>
<td>398</td>
<td>Montezuma Basin</td>
</tr>
<tr>
<td>Comb Wash</td>
<td>Driver and Badenhorst 2007</td>
<td>SE Utah</td>
<td>881</td>
<td>Comb Wash</td>
</tr>
</tbody>
</table>

Nancy Patterson

The Nancy Patterson site (42Sa2110) is composed of two sites, one of which is a Chacoan Great House. It is situated in the Montezuma drainage of Southeastern Utah (Thompson 1990). It appears that the artefacts and fauna resulting from the excavations span the Pueblo I through Pueblo III time periods (Thompson 1990). The material from “Period 1” dates to Pueblo I and early Pueblo II. Fauna from “Period 2” are from the mid to late Pueblo III period. Though the assemblage is not large, it is one of few analyses from the same portion of the Montezuma basin as Bluff and is therefore valuable for comparative purposes.

Comb Wash

Five sites in Comb Wash (approximately 40 km north of Bluff) were excavated; four were smaller unit pueblos and the fifth was a Great House (42Sa24756) (Driver and Badenhorst 2007). Badenhorst analysed the resulting faunal assemblage using the protocols constructed by Driver as described in the Crow Canyon Archaeological Center Manual for Description of Vertebrate
Remains. As these are precisely the same categories utilised in the analysis of the Bluff fauna, all faunal categories are completely compatible.

Table 16 compares faunal indices for the Bluff site to those from the Comb Wash Great House (42Sa24756) and from the Nancy Patterson site.

Table 16: Comparison of regional Great House faunal indices

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Period</th>
<th>Artiodactyl</th>
<th>Lagomorph</th>
<th>Turkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluff</td>
<td>PII</td>
<td>.45</td>
<td>.65</td>
<td>.11</td>
</tr>
<tr>
<td>Bluff</td>
<td>PIII</td>
<td>.27</td>
<td>.69</td>
<td>.66</td>
</tr>
<tr>
<td>Nancy Patterson</td>
<td>PI-PII</td>
<td>.54</td>
<td>.71</td>
<td>.26</td>
</tr>
<tr>
<td>Nancy Patterson</td>
<td>PIII</td>
<td>.14</td>
<td>.90</td>
<td>.94</td>
</tr>
<tr>
<td>Comb Wash</td>
<td>PIII</td>
<td>.08</td>
<td>.99</td>
<td>.83</td>
</tr>
</tbody>
</table>

Table 16 shows that the Bluff and Nancy Patterson assemblages from the earlier periods (Pueblo II and Pueblo I-II respectively) are quite similar. Both assemblages have artiodactyl indices near .5, fairly high lagomorph indices, and low turkey indices. Between Pueblo II and Pueblo III, the indices for Bluff and Nancy Patterson change in similar ways. Both sites have a drop in artiodactyl indices (markedly in the case of Nancy Patterson), both lagomorph indices increase slightly, and turkey indices increase significantly. The Pueblo III assemblage from the Comb Wash Great House appears to reflect similar trends. The artiodactyl index from Comb Wash is quite low, the lagomorph index shows a strong pattern of cottontail presence over jackrabbit, and the turkey index is quite high.
Other than the presence of similar species, there are a few patterns which are obvious from an evaluation of the indices from these three sites. One commonality is the rank of the lagomorph index (though in the Pueblo III period, Bluff lags behind somewhat); this indicates a prevalence of cottontail as opposed to jackrabbits in all three locales. As discussed by Driver and Woiderski (in press), that prevalence may simply be a reflection of the habitat present in the western Montezuma basin as opposed to specific prey selection. The differences in the lagomorph indices from the three sites may also be due to variations in habitat. The Nancy Patterson site has the highest Artiodactyl index of the three sites, and the percentage by NISP of Artiodactyls as compared to the rest of the assemblage is considerably higher. In addition, during the Pueblo III period Nancy Patterson had the highest turkey index of the three sites; this may be due to small-scale environmental differences, differing times of occupation, and sampling decisions. Overall, the patterns from Nancy Patterson mirror those at Bluff: the Artiodactyl index decreased significantly, while the Lagomorph index increases slightly and the Turkey index increased considerably.

Table 17 compares the core fauna of great houses in the Bluff area, and Table 18 compares taxa that may have had special cultural significance. These tables are discussed subsequently.
Table 17: Core fauna from great houses in southeastern Utah

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Meleagris gallopavo</th>
<th>Lagomorpha</th>
<th>Lepus sp.</th>
<th>Sylvilagus sp.</th>
<th>Artiodactyla</th>
<th>Odocoileus sp.</th>
<th>Antilocapra americana</th>
<th>Ovis canadensis</th>
</tr>
</thead>
<tbody>
<tr>
<td>42Sa24756</td>
<td>212</td>
<td>55</td>
<td>1</td>
<td>67</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nancy Patterson (PI-II)</td>
<td>1</td>
<td>15</td>
<td>37</td>
<td>90</td>
<td>109</td>
<td>59</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nancy Patterson (PIII)</td>
<td>278</td>
<td>12</td>
<td>9</td>
<td>82</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Bluff PII</td>
<td>38</td>
<td>1</td>
<td>183</td>
<td>337</td>
<td>367</td>
<td>2</td>
<td>2</td>
<td>51</td>
</tr>
<tr>
<td>Bluff PIII</td>
<td>1372</td>
<td>30</td>
<td>213</td>
<td>480</td>
<td>247</td>
<td>6</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Bluff Complete</td>
<td>1523</td>
<td>32</td>
<td>553</td>
<td>1196</td>
<td>804</td>
<td>10</td>
<td>14</td>
<td>94</td>
</tr>
</tbody>
</table>
Table 18: Special fauna from the Bluff locale

<table>
<thead>
<tr>
<th>Taxa</th>
<th>42Sa24756</th>
<th>Nancy Patterson (PI-PII)</th>
<th>Nancy Patterson (PIII)</th>
<th>BIPII</th>
<th>BIPIII</th>
<th>Bluff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passeriformes</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Falconiformes</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Accipiter sp.</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Buteo sp.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Anas sp.</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Grus sp.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Branta canadensis</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Strigiformes</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Asio otus</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Bubo sp.</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Corvus corax</td>
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<td>0</td>
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<td>4</td>
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<td>Piciformes</td>
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<td>0</td>
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<td>1</td>
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<tr>
<td>Pica pica</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Icteridae</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Zenaida macroura</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Canis sp.</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>16</td>
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<tr>
<td>Canis latrans</td>
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<td>2</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>Ursidae</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Taxa</td>
<td>42Sa24756</td>
<td>Nancy Patterson (PI- PII)</td>
<td>Nancy Patterson (PIII)</td>
<td>BIPII</td>
<td>BIPIII</td>
<td>Bluff</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>------------------------</td>
<td>-------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td><em>Vulpes sp. or Urocyon sp.</em></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>2</td>
<td>14</td>
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<tr>
<td><em>Lynx sp.</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td><em>Lynx rufus</em></td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
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</tr>
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</table>
Overall, the Nancy Patterson site assemblage bears the closest resemblance to the Bluff Great House assemblage; for the most part, food fauna seem to be comparable by time period. The decrease in the number of artiodactyls and concurrent increase in NISP of turkey parallel the pattern observed in the Bluff assemblage. Neither the Comb Wash Great House (42Sa24756) nor the Nancy Patterson Great House seem to have the number of unusual or exotic fauna that Bluff does. However, as discussed later (see Figure 7), the sample sizes involved have an obvious effect on the representation of rarer species. Smaller assemblages (from unit pueblos) only represent a few species and the larger an assemblage is, the larger the number of species identified. Few large assemblages do not have rare fauna, and the converse is also true: few small assemblages have unusual fauna.

IlIb. Bluff as Compared to Regional Unit Pueblo Assemblages

The tables that follow show first the faunal indices (when possible) of assemblages from small sites in the northern San Juan Region west of the Montezuma Basin. I then compare the NISP of fauna typically exploited for food, and then the NISP of unusual or what I term “special” fauna. Unfortunately, some sites had sample sizes too small to calculate any reasonable indices. Such sites were excluded from Tables 19 and 20 below if they had no lagomorphs, artiodactyls, or turkeys or if the total site NISP was less than 10. However, all sites in the region are included in Table 21 as parts of physiographic groups, regardless of sample size.
Table 19: Comparison of Bluff region small site faunal indices

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Period</th>
<th>Artiodactyl</th>
<th>Lagomorph</th>
<th>Turkey</th>
<th>Location</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>42Sa6396</td>
<td>BIII-PII</td>
<td>.06</td>
<td>.73</td>
<td>.14</td>
<td>White Mesa, UT</td>
<td>Davis 1985</td>
</tr>
<tr>
<td>42Sa12209</td>
<td>PI</td>
<td>.95</td>
<td>1.0</td>
<td>N/A</td>
<td>Cottonwood Canyon, UT</td>
<td>Fetterman, Honeycutt and Kuckelman 1988</td>
</tr>
<tr>
<td>42Sa9937</td>
<td>PI-PII</td>
<td>.08</td>
<td>.51</td>
<td>N/A</td>
<td>White Mesa, UT</td>
<td>Talbot, Bingham, and Nielson 1982</td>
</tr>
<tr>
<td>42Sa3725</td>
<td>PI-PII</td>
<td>.05</td>
<td>.97</td>
<td>0.1</td>
<td>Verdure Canyon, UT</td>
<td>Fetterman and Honeycutt 1990</td>
</tr>
<tr>
<td>Bluff</td>
<td>PII</td>
<td>.45</td>
<td>.65</td>
<td>.11</td>
<td>Bluff, UT</td>
<td>This Thesis</td>
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<tr>
<td>42Sa24625</td>
<td>PII</td>
<td>.50</td>
<td>.83</td>
<td>.52</td>
<td>Comb Wash, UT</td>
<td>Driver and Badenhorst 2007</td>
</tr>
<tr>
<td>42Sa24611</td>
<td>PII</td>
<td>.17</td>
<td>.75</td>
<td>.17</td>
<td>Comb Wash, UT</td>
<td>Driver and Badenhorst 2007</td>
</tr>
<tr>
<td>42Sa7659</td>
<td>PII</td>
<td>.51</td>
<td>.75</td>
<td>.79</td>
<td>White Mesa, UT</td>
<td>Firor, Greubel, and Reed 1998</td>
</tr>
<tr>
<td>Engineer's Ltd.</td>
<td>PII</td>
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<td>.60</td>
<td>.43</td>
<td>Montezuma Creek, UT</td>
<td>Mohr and Sample n.d.</td>
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<tr>
<td>42Sa8908</td>
<td>PII</td>
<td>.37</td>
<td>.82</td>
<td>.19</td>
<td>Recapture Wash, UT</td>
<td>Nielson, Janetski, and Wilde 1985</td>
</tr>
<tr>
<td>42Sa8887</td>
<td>PII</td>
<td>.26</td>
<td>.84</td>
<td>.03</td>
<td>Recapture Wash, UT</td>
<td>Nielson, Janetski, and Wilde 1985</td>
</tr>
<tr>
<td>Tall Pine</td>
<td>PII-PIII</td>
<td>.87</td>
<td>1.0</td>
<td>N/A</td>
<td>Comb Wash, UT</td>
<td>Wilson 1974</td>
</tr>
<tr>
<td>Big Westwater</td>
<td>PII-PIII</td>
<td>.09</td>
<td>.85</td>
<td>.13</td>
<td>White Mesa, UT</td>
<td>Ray 1981 and Emslie</td>
</tr>
<tr>
<td>Bluff</td>
<td>PIII</td>
<td>.27</td>
<td>.69</td>
<td>.66</td>
<td>Bluff, UT</td>
<td>This Thesis</td>
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<td>------</td>
<td>-----------</td>
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</tr>
<tr>
<td>42Sa24626</td>
<td>PIII</td>
<td>.11</td>
<td>.95</td>
<td>.35</td>
<td>Comb Wash, UT</td>
<td>Driver and Badenhorst 2007</td>
</tr>
<tr>
<td>42Sa10986</td>
<td>PIII</td>
<td>.06</td>
<td>.57</td>
<td>.03</td>
<td>Verdure Canyon, UT</td>
<td>Fetterman and Honeycutt 1990</td>
</tr>
<tr>
<td>42Sa7660</td>
<td>PIII</td>
<td>.02</td>
<td>.96</td>
<td>.28</td>
<td>White Mesa, UT</td>
<td>Firor, Greubel, and Reed 1998</td>
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</table>

Table 20 compares the "core" or probable food fauna from local small sites.
Table 20: NISP values of core fauna from small sites in southeastern Utah

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Meleagris gallopavo</th>
<th>Lagomorpha</th>
<th>Lepus sp.</th>
<th>Sylvilagus sp.</th>
<th>Artiodactyla</th>
<th>Odocoileus americana</th>
<th>Antilocapra canadensis</th>
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</thead>
<tbody>
<tr>
<td>42Sa9937 (PI-PII)</td>
<td>0</td>
<td>2</td>
<td>21</td>
<td>22</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>42Sa3725 (PI-PIII)</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>35</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>42Sa10986 (PIII)</td>
<td>4</td>
<td>0</td>
<td>64</td>
<td>85</td>
<td>0</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Big Westwater (PIII-PII)</td>
<td>42</td>
<td>0</td>
<td>41</td>
<td>229</td>
<td>0</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>42Sa8014 (BIII-PII)</td>
<td>0</td>
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<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>42Sa6396 (BIII-PII)</td>
<td>59</td>
<td>1</td>
<td>95</td>
<td>260</td>
<td>12</td>
<td>2</td>
<td>0</td>
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<tr>
<td>42Sa12209 (PI)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>29</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>42Sa8876 (BIII-PII)</td>
<td>0</td>
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<td>2</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>42Sa8887 (PII)</td>
<td>13</td>
<td>6</td>
<td>63</td>
<td>332</td>
<td>0</td>
<td>130</td>
<td>0</td>
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115
<table>
<thead>
<tr>
<th>Engineers Ltd. (PII)</th>
<th>5</th>
<th>0</th>
<th>4</th>
<th>18</th>
<th>0</th>
<th>10</th>
<th>0</th>
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<tr>
<td>Willey Springs (PII)</td>
<td>26</td>
<td>0</td>
<td>14</td>
<td>21</td>
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<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Harvey (PII)</td>
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<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Skizziar (PII)</td>
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<td>0</td>
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<td>4</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Tall Pine (PII-PIII)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>42Sa7659 (PII)</td>
<td>319</td>
<td>1</td>
<td>25</td>
<td>76</td>
<td>58</td>
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<td>44</td>
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<tr>
<td>42Sa7660 (PII-PIII)</td>
<td>34</td>
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<td>4</td>
<td>87</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>42Sa24626 (PII-PIII)</td>
<td>4</td>
<td>11</td>
<td>1</td>
<td>20</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>42Sa25064 (PII-PIII)</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>42Sa24625 (PII)</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>42Sa24611 (PII)</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>
Table 21 compares groups of fauna from the Bluff region comprised of multiple assemblages from the same geographic locale; for instance, the four Comb Wash unit pueblos are considered together, regardless of time period.
<table>
<thead>
<tr>
<th>Site Name</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PII-PII</td>
</tr>
<tr>
<td></td>
<td>0  2  21  22  1  3  0  0</td>
</tr>
<tr>
<td></td>
<td>8  0  65  120  0  11  0  0</td>
</tr>
<tr>
<td></td>
<td>42  0  41  229  0  26  0  0</td>
</tr>
<tr>
<td></td>
<td>59  1  96  263  12  2  0  8</td>
</tr>
<tr>
<td>Big Westwater</td>
<td>PII-PIII</td>
</tr>
<tr>
<td>42Sa8014, 42Sa6396</td>
<td>0  0  0  2  29  4  0  9</td>
</tr>
<tr>
<td>42Sa8876, 42Sa8887, 42Sa8908</td>
<td>BMIII-PII</td>
</tr>
<tr>
<td></td>
<td>18  8  69  350  0  146  0  10</td>
</tr>
<tr>
<td>Engineers Ltd., Willey Springs, Harvey, Skizziar</td>
<td>PII</td>
</tr>
<tr>
<td></td>
<td>27  0  16  28  0  2  2  0</td>
</tr>
<tr>
<td>Tall Pine</td>
<td>PII-PIII</td>
</tr>
<tr>
<td>42Sa7659, 42Sa7660</td>
<td>0  0  0  5  0  2  7  25</td>
</tr>
<tr>
<td>42Sa24626,</td>
<td>PII-PIII</td>
</tr>
<tr>
<td></td>
<td>353  1  29  163  59  3  0  45</td>
</tr>
<tr>
<td></td>
<td>7  18  4  31  10  0  0  1</td>
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</table>

Table 21: Core fauna grouped into local clusters
<table>
<thead>
<tr>
<th></th>
<th>PII</th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
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<td>Bluff PII</td>
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<td>183</td>
<td>337</td>
<td>367</td>
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<td>2</td>
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<td>Bluff PIII</td>
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<td>30</td>
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<td>247</td>
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<td>11</td>
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<td>Bluff Complete</td>
<td>1523</td>
<td>32</td>
<td>553</td>
<td>1196</td>
<td>804</td>
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<td></td>
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<td>51</td>
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</table>
Table 22 compares special fauna from unit pueblo assemblages, when there are any present.

### Table 22: Special fauna from small sites in southeastern Utah

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Big Westwater (Pll-Plll)</th>
<th>Willey Spgs</th>
<th>42Sa6396 (Blll-Plll)</th>
<th>42Sa8887 (Plll)</th>
<th>42Sa7659 (Pll)</th>
<th>42Sa24626 (Plll)</th>
<th>42Sa25064 (Pll)</th>
<th>42Sa24625 (Pll)</th>
<th>42Sa24611 (Pll)</th>
<th>BIPII</th>
<th>BIPIII</th>
<th>Bluff</th>
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</thead>
<tbody>
<tr>
<td>Passeriformes</td>
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<td>3</td>
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<td>0</td>
<td>0</td>
<td>2</td>
<td>13</td>
<td>17</td>
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<td>Falconiformes</td>
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<td>Grus sp.</td>
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<td>2</td>
<td>5</td>
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<tr>
<td>Branta canadensis</td>
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Clearly, very few of the smaller sites had unusual or exotic fauna present, and with the exception of the Willey Springs site, which had a NISP of 30 for *Canis sp.*, the numbers of these fauna are quite low. It is possible that these low numbers are at least partially the result of low sample sizes; again, this could be connected to the size of the assemblage (see Figure 7).
IV. Great House Assemblages of the Northern San Juan Region

In order to evaluate how the Bluff fauna fit in with assemblages from Chacoan Great Houses on a larger spatial scale, the comparisons which follow are made to contemporaneous sites which were occupied during Pueblo II and Pueblo III in the Northern San Juan basin. Though the environmental circumstances (and therefore the presence/absence of species) differ between these sites, they were all commonly connected to the Chaco Phenomenon in some respect, and that may be reflected (to a degree) in the presence of certain fauna. The first few sites are compared using rank-order tables and indices as data were only available for them in MNI format; following these are comparisons by NISP as well as by indices.

Chimney Rock (MNI only)

The Chimney Rock site (SAA83) is a Chacoan Great House in Southwestern Colorado (Eddy 1977). As only data in the form of MNI was available for the Chimney Rock site, gleaning nuanced information from assemblage comparisons is unlikely. A rank-order comparison (MNI vs. NISP) for the Chimney Rock site and the Bluff Great House follows. In addition, this site is included in the comparison of indices. Despite the fact that MNI values were used for the Chimney Rock index and therefore two different types of data are being compared, MNI and NISP have a demonstrated relationship (Grayson 1984). This relationship makes such a comparison useful, if only in a rather broad sense.
North McElmo #8 (MNI only)

The North McElmo #8 site appears to be a small Chacoan outlier in Southwestern Colorado (Brisbin and Brisbin 1973) near the Wallace site, and the only available faunal data were recorded as MNI. Rank-order comparison (MNI vs. NISP) for the North McElmo #8 (Ida Jean) site and the Bluff Great House follows. This site data are included in the table of index comparisons.

Escalante

The Escalante site is a Chacoan Great House in Southwestern Colorado which was occupied during Pueblo II and Pueblo III (Hallasi 1979). No time resolution for the faunal remains from this site was available. As the data are in the form of NISP, they are compared to the same at the Bluff Great House in Tables 23 and 24.

Mitchell Springs

The fauna from the Mitchell Springs ruin, a Chacoan Great House in Southwestern Colorado (Dove et al. 1997) are compared to the same at the Bluff Great House by NISP below. There was no time resolution within the faunal assemblage available in the report, thus these fauna may be from both the Pueblo II and Pueblo III periods. Note: Although the number of Antilocapridae in this assemblage is rather high (NISP 141) the vast majority of those bones (NISP 139) were from a discrete (and likely intrusive) articulated juvenile antelope (Dove et al. 1997). Table 25 gives two artiodactyl indices for this site; the first is
based on the total NISP from the site report, and the second is calculated without the possibly intrusive antelope bones.

**Salmon**

The Salmon site is a large Chacoan outlier in Northwestern New Mexico with occupations dating to both Pueblo II and Pueblo III. Taxa present at Salmon as reported by Durand and Durand (2006) are compared to those at the Bluff Great House by NISP in Tables 23 and 24.

**Wallace**

Fauna from the Wallace site were divided into time periods based upon a ceramic chronology of the stratigraphy (Shelley 1993). These were as follows: "Early Chaco," which is listed as 900 A.D. through approximately 1100 A.D.; "Late Chaco," which dated from 1050 A.D. through 1150 A.D.; and "Mesa Verde," which included material from 1200 through 1300 A.D. For the purposes of my comparison, I included both faunal remains from the "Early Chaco" and "Late Chaco" categories in my "Pueblo II" group. The "Mesa Verde" material correlated enough with the Pueblo III time period that I use it as my "Pueblo III" category. Had finer temporal resolution of the Bluff material been available, it would have been possible to utilize all three of Shelley's categories.

Table 23 compares core fauna from great houses in the Northern San Juan region. Please note that the majority of *Antilocapra americana* from the Mitchell Springs site are considered to be intrusive. Table 24 provides data on special taxa from great houses in the Northern San Juan region.
<table>
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<tr>
<th>Site Name</th>
<th>Meleagris gallopavo</th>
<th>Lagomorpha</th>
<th>Lepus sp.</th>
<th>Sylvilagus sp.</th>
<th>Artiodactyla</th>
<th>Odocoileus sp.</th>
<th>Antilocapra americana</th>
<th>Ovis canadensis</th>
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127
Faunal indices and time periods from sites compared previously in this chapter, including Bluff, are presented Table 25 below. The indices from the Chimney Rock site and North McElmo #8 are based on MNI as the data were not available in NISP. Also, the “Bluff Complete” row includes undated material.

Table 25: Faunal indices for Great Houses in the Northern San Juan Basin

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Period</th>
<th>Artiodactyl Index</th>
<th>Lagomorph Index</th>
<th>Turkey Index</th>
</tr>
</thead>
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<tr>
<td>Chimney Rock (MNI)</td>
<td>PII</td>
<td>.97</td>
<td>1 (MNI 1)</td>
<td>.50</td>
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<tr>
<td>North McElmo #8 (MNI)</td>
<td>Late PII-PIII</td>
<td>.13</td>
<td>.79</td>
<td>.13</td>
</tr>
<tr>
<td>Escalante</td>
<td>PII-Early PIII</td>
<td>.45</td>
<td>.93</td>
<td>.13</td>
</tr>
<tr>
<td>Mitchell Springs</td>
<td>PII-PIII</td>
<td>.39 (.05)</td>
<td>.73</td>
<td>.46</td>
</tr>
<tr>
<td>Salmon PII</td>
<td>PII</td>
<td>.47</td>
<td>.83</td>
<td>.14</td>
</tr>
<tr>
<td>Salmon PIII</td>
<td>PIII</td>
<td>.08</td>
<td>.67</td>
<td>.46</td>
</tr>
<tr>
<td>Wallace PII</td>
<td>PII</td>
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<td>.90</td>
<td>.18</td>
</tr>
<tr>
<td>Wallace PIII</td>
<td>PIII</td>
<td>.08</td>
<td>.86</td>
<td>.14</td>
</tr>
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<td>.65</td>
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</tr>
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<td>.27</td>
<td>.69</td>
<td>.66</td>
</tr>
<tr>
<td>Bluff Complete</td>
<td>PII-PIII</td>
<td>.34</td>
<td>.68</td>
<td>.57</td>
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</table>

A few broad patterns in the above table are immediately obvious. For the most part, high Turkey indices are associated with later sites and the high Artiodactyl with earlier. The Lagomorph indices do not fluctuate as much over time as the Turkey or Artiodactyl indices. Somewhat more subtle patterns are also present. The Turkey indices all fall rather neatly into two groups. They are
either below .19, or above .45; in two cases this represents a change over time in
the utilization of fauna (at the Bluff and Salmon sites). At the Wallace site,
however, the Turkey index decreases over time which is rather unusual and does
not fit the regional pattern presented by Driver (2002). The Lagomorph indices
are all above .5; they also do not change a great deal between PII and PIII at any
of the sites for which we have temporal resolution. The highest Artiodactyl index
by far is that from Chimney Rock, and while this index is based upon MNI as
opposed to NISP, 30 of the 45 total MNI from that site are artiodactyls. Though
this percentage may represent a dependence upon artiodactyls prior to an
increased popularity of turkey in the Pueblo III period, it may also have been
affected by ecological circumstances such as increasing aridity or the pressure of
human hunting on the breeding population.
V. Comparisons of Complete Assemblages and by Period

Table 26 combines Great House site assemblages which had been split into time periods and compares the complete assemblages. Table 27 presents all Pueblo II material across assemblages, and Table 28 provides data on all Pueblo III material.

Table 26: Total assemblages from multi-component Great House sites: core fauna

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Meleagris gallopavo</th>
<th>Lagomorpha</th>
<th>Lepus sp.</th>
<th>Sylvilagus sp.</th>
<th>Artiodactyla</th>
<th>Odocoileus sp.</th>
<th>Antilocapra americana</th>
<th>Ovis canadensis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluff</td>
<td>1523</td>
<td>32</td>
<td>553</td>
<td>1196</td>
<td>804</td>
<td>10</td>
<td>14</td>
<td>94</td>
</tr>
<tr>
<td>Nancy</td>
<td>279</td>
<td>27</td>
<td>46</td>
<td>172</td>
<td>122</td>
<td>59</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Salmon</td>
<td>56</td>
<td>0</td>
<td>172</td>
<td>510</td>
<td>259</td>
<td>17</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>Wallace</td>
<td>542</td>
<td>0</td>
<td>719</td>
<td>5027</td>
<td>260</td>
<td>351</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>
### Table 27: Comparison of Pueblo II core faunas

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Meleagris gallopavo</th>
<th>Lagomorpha</th>
<th>Lepus sp.</th>
<th>Sylvilagus sp.</th>
<th>Artiodactyla</th>
<th>Odocoileus sp.</th>
<th>Antilocapra americana</th>
<th>Ovis canadensis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluff</td>
<td>38</td>
<td>1</td>
<td>183</td>
<td>337</td>
<td>367</td>
<td>2</td>
<td>2</td>
<td>51</td>
</tr>
<tr>
<td>Nancy</td>
<td>1</td>
<td>15</td>
<td>37</td>
<td>90</td>
<td>109</td>
<td>59</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Patterson</td>
<td>10</td>
<td>0</td>
<td>54</td>
<td>265</td>
<td>243</td>
<td>17</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Salmon</td>
<td>160</td>
<td>0</td>
<td>199</td>
<td>1784</td>
<td>156</td>
<td>155</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 28: Comparison of Pueblo III core faunas

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Meleagris gallopavo</th>
<th>Lagomorpha</th>
<th>Lepus sp.</th>
<th>Sylvilagus sp.</th>
<th>Artiodactyla</th>
<th>Odocoileus sp.</th>
<th>Antilocapra americana</th>
<th>Ovis canadensis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluff</td>
<td>1372</td>
<td>30</td>
<td>213</td>
<td>480</td>
<td>247</td>
<td>6</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Nancy</td>
<td>278</td>
<td>12</td>
<td>9</td>
<td>82</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Patterson</td>
<td>46</td>
<td>0</td>
<td>118</td>
<td>245</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Salmon</td>
<td>382</td>
<td>0</td>
<td>520</td>
<td>3243</td>
<td>104</td>
<td>196</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

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The broad patterns already identified previously in this chapter are evident when comparing these data: Pueblo II assemblages have a lower percentage of turkey remains than the Pueblo III counterparts; at no site in any time period is the percentage of *Lepus* greater than the percentage of *Sylvilagus*; at all sites the percentage of artiodactyl remains decreases between Pueblo II and Pueblo III.

Other patterns not previously discussed are also apparent. Salmon has a low percentage of turkeys in general, and the percentage of artiodactyls from Salmon dating to the Pueblo III period is also quite small. This may be due in part to the fact that the site was probably not occupied intensively during the Pueblo III period. A possible issue with this explanation is that the percentage of lagomorph remains recovered from the site increases from Pueblo II to Pueblo III. Of the four sites, Bluff has the most *Meleagris gallopavo* identified. The Bluff assemblage also has the highest percentage of artiodactyls of any site compared, despite the fact that the overall assemblage size is approximately a third of the size of the Wallace assemblage. The vast majority of probable food faunas recovered from the Wallace site are lagomorphs. When considering the complete Bluff assemblage, artiodactyls identified to genus or species were most commonly *Ovis canadensis*; this is also true for Pueblo II and Pueblo III sub-assemblages. Salmon follows a similar pattern to Bluff; *Ovis canadensis* is the most common artiodactyl identified to species in the assemblage. The Nancy Patterson assemblage as a whole had more *Odocoileus* identified than any other genus or species of artiodactyl. This pattern also holds true for the Wallace assemblage, with *Odocoileus sp.* as the most commonly identified artiodactyl by
These differences in artiodactyl presence may be due to the location of the sites; though none of them are particularly distant from water, disparities in altitude, soil chemistry, vegetation, and other environmental variables are likely responsible.

**VI. Conclusions on Comparisons**

The Escalante faunal material looks quite like that from Bluff, with the exception of the turkey index, while the Salmon and Wallace assemblages also bear some similarities to the Bluff assemblage. In terms of faunal indices, the patterns in the assemblage from the Nancy Patterson site most closely resemble those from the Bluff Great House, particularly with reference to change over time. With reference to Salmon and Wallace, the similarities to the Bluff assemblage occur in both the Pueblo II and Pueblo III sub-assemblages.

It is generally assumed that the number of exotic or unusual species present in an assemblage increases with the number of specimens identified. In order to determine if the number of unusual and exotic fauna identified at the Bluff Great House is abnormal, the NISP of every assemblage considered for comparison in this chapter has been plotted by number of taxa identified in Figure 7. As the data were only available in MNI from the sites of Chimney Rock and North McElmo #8, they have been excluded from this plot.
Bluff has the second largest assemblage present, and sixty-two taxa identified. The Wallace site data stretch the graph a great deal and sets the plateau with 15,095 specimens identified, representing 111 taxa. Were it not for the number from Wallace, the number of unusual species at Bluff would seem a bit atypical, especially compared to the smaller sites in the northern San Juan Basin. It should be noted that a number of exactlying precise designations were used at the Wallace site—a great deal more than was used in the identification of species from any other site used for comparison. This is an ideal illustration of
how analysts of faunal material differ in their methodological processes and precision of identification. Unfortunately, there is no data available from assemblages near the size of those from Bluff or Wallace in order to highlight the curve more accurately. Also, great houses are generally excavated more frequently and thoroughly, which results in larger sample sizes. Figure 8 plots the same data, but Wallace is excluded.

Figure 8: NISP vs. Taxa Sans Wallace

Figure 7 and Figure 8 do appear to demonstrate that as the number of specimens identified increases, the number of taxa identified increases (Meltzer
et al. 1992). When the data from Wallace are excluded, Bluff becomes the “outlier” that sets the plateau for the graph. Also, in the case of both scales, there seems to be little difference between small great house assemblages and larger unit pueblo assemblages. In fact, the collective NISP from all of the unit pueblos considered in this chapter has also been plotted in Figure 8, and fits the curve set by the other assemblages. This pattern may imply that there is little overall difference between smaller sites and great houses in terms of the composition of faunal assemblages.
CHAPTER 8: PALAEOPATHOLOGICAL EXAMINATIONS

Introduction

One of the primary goals of this research was to make explicit analysis, description, and discussion of any pathologies present on the faunal remains from the Bluff Great House collection. In the last few decades, description of palaeopathological specimens from zooarchaeological assemblages has become more common (Udrescu and Van Neer 2005). However, the data are generally limited to a description of the pathology and a diagnosis. Only quite recently have inferences about human behaviour become more commonplace.

I. Zooarchaeological Palaeopathology

Zooarchaeological palaeopathology has lagged behind human palaeopathology in study and application despite the potential of animal pathologies to reveal information about various facets of human behaviour. The intellectual occupation with human palaeopathology has followed in the footsteps of medicine and is of seemingly more direct importance to society, thus socially justifying its importance (Baker and Brothwell 1980), while the efforts of animal palaeopathology might seem less relevant. Not only can zooarchaeological palaeopathology inform upon direct human-animal relationships and elucidate such interactions (for instance, husbandry practices) but it also has the potential to illuminate more subtle relationships such as the transfer of zoonotic diseases.
Zooarchaeologists have approached palaeopathology in a number of different ways; at one time it was common to ignore pathologies unless they fit into the category of “we have an interesting case of x” (Thomas and Mainland 2005). Often, a pathological bone was merely an interesting specimen (Stein 1963). Horton and Samuel’s (1978) study of an assemblage of macropod remains was one of the first to assess multiple types of skeletal lesions. Later, studies on less obvious pathological conditions such as the effects of bitting on horses (Anthony and Brown 1989) and bone development abnormalities in turkeys (Duff 1984) were published. Techniques that have potential to further elucidate the past are presently being developed and applied to faunal assemblages. One example is the proposed use of PCR techniques on tubercular lesions to determine which exact strain of tuberculosis affected the individual (Mays 2005). Another is the potential of stable isotope analysis to reveal facets of animal diet that might not be explained by osteological conditions (such as linear enamel hypoplasias or Harris lines) or botanical remnants (Thomas and Mainland 2005).

Terry O’Connor suggests that animal pathologies from archaeological sites should be investigated as systematically as possible (O’Connor 2000). This is vital; from the experience of the author, when one confronts the archaeological literature on the subject of faunal remains, it is difficult to tell if the population described was completely normal and healthy or if pathologies went entirely unexamined. O’Connor also proposes that the prevalence of a pathological condition should be stated in reports, which makes sense; the presence of
tuberculous lesions in a population is interesting, but knowing whether the pathological creature was an isolate or one of 29% of that species with the condition is much more informative. Another recommendation concerns the description of pathological conditions; considering how little descriptive information exists concerning animal palaeopathology, it is doubtful that a consensus on the diagnostic traits of most major pathologies could be reached (O'Connor 2000). Given that such methodological suggestions are followed, it seems probable that palaeopathology has the potential to contribute a great deal to zooarchaeology specifically and archaeological knowledge in general.

In the case of the Bluff Great House, the majority of pathological specimens are from a domesticated species and therefore could potentially carry some importance with regard to human and animal interactions.

The overall pattern of disease and survivorship was completely altered by domestication. While the process of domestication probably exposed animals to physical stresses and pathogens related to husbandry practices, factors such as predation and winter malnutrition may have been reduced. Systems of turkey management probably varied (penning, tethering, etc.) and had differential impacts upon disease transmission and the probability of injury. Trading animals would have resulted in exposure to new environmental circumstances (and therefore pathological agents) in addition to the stress of moving long distances.

Meat hygiene knowledge was probably well-developed long before the Pleistocene (Baker and Brothwell 1980) and it is probable that fleshy lesions were discarded; any correspondingly pathological osseous material was likely not
deemed fit for consumption. Treatment of pathological domesticates may have been a different matter. In the case of a relatively minor injury, it is possible that humans aided in the recovery process, though perhaps only in ways such as keeping the injured animal away from predators or ensuring it had a supply of water and food. More severe illnesses, particularly those which may have been known to be contagious, probably resulted in the slaughter of the afflicted animal.

II. Pathological Faunal Material from the American Southwest

Though very few pathologies are noted in site reports from Chacoan archaeological sites, there are some which are appropriate to note here, particularly because of their similarity to pathological turkey specimens from the Bluff Great House. From the Salmon Great House two pathological *Meleagris gallopavo* bones were recovered, both with healed fractures. These were a right ulna and a left humerus (Durand and Durand 2006). The assemblage from Eleanor Ruin contained a right and left tibiotarsus and a right scapula from *Meleagris gallopavo*, all of which had healed fractures (Durand and Durand 2002). Also, according to Gillespie (1991:292), site 29SJ633 in Chaco Canyon yielded a *Meleagris gallopavo* right ulna and left tibiotarsus which had been broken. In the case of the bones from Salmon and Eleanor, the fractures were complete and did heal entirely. Durand and Durand (2006) interpret this as evidence for the raising of turkeys at these sites, given that the healing of such fractures in the wild would have been unlikely.
III. Pathologies Present in the Bluff Assemblage

The entire faunal assemblage contained eight pathological specimens, six of which were *Meleagris gallopavo*. The remaining two pathologies were both present on *Sylvilagus* specimens. Approximately two-fifths of a percent of all designated *Meleagris gallopavo* remains (NISP of 1523) were identifiably pathological, while about one-seventh of a percent of *Sylvilagus* remains (NISP of 1196) were affected.

Due to the fact that *Sylvilagus sp.* is a wild species, it is less likely that the pathologies present bear or clarify much information about human behaviour. The *Sylvilagus* pathologies include a complete metatarsal with a healed fracture (FS 3672). The anatomical axis of the element was preserved, it suffered no shortening, and the callus has a smooth appearance. The metatarsal would have been aided in healing by the presence of other metatarsals which would have acted as anatomical splints. The other pathological *Sylvilagus* specimen (FS 1413) is a mostly complete lumbar vertebra with possible osteoarthritic modifications; these include exostoses (pronounced lipping) and bone loss at the centrum. Osteoarthritis is considered an age-related condition, and thus unusual in a short-lived prey species such as *Sylvilagus*. Other pathological conditions can result in similar osteological modification; however, it would be quite difficult to make a diagnosis based upon a single element. In addition, pathological specimens from wild species are not commonly identified from archaeological sites (O’Connor 2000). Most frequently, any debilitating injury or disease with osteological effects severe enough to be detected by a zooarchaeologist would
probably (either directly or indirectly) result in the death of the creature in the wild. These two specific pathologies probably did not contribute in any major way to the death of the individuals affected.

The majority of pathologies (75%) identified in the Bluff assemblage were present in the remains of the domestic turkey, and it is upon these pathologies that I will primarily focus my discussion. These include an interesting array of pathologies, all of which I will identify as specifically as possible, and many of which can be broadly diagnosed. Some of these pathologies carry definite implications for human behaviour, while others are general and could have resulted from varied aetiologies. All photographs were taken by the author.

Figure 9: Field Specimen Number 3679
The pathological specimen from FS 3679 (Figure 9) is the distal portion of a left *Meleagris gallopavo* humerus; it is large, heavily root-etched, and the proximal end was broken off in antiquity in an irregular fashion. The distal end is not entirely complete as portions of it have eroded away. This specimen bears lytic lesions (an area where removal or destruction of osseous material has occurred due to a disease process) of an unknown aetiology as well as unusual modification of the bone near the condyles.

**Figure 10:** Field Specimen Number 3843

![Field Specimen Number 3843](image)

Figure 10 shows a right distal tibiotarsus from a *Meleagris gallopavo* which terminates in a spiral fracture at the proximal end bears a well-healed spiral fracture with a smooth callus. Exostoses have formed at lateral and medial ends of the callus, but there is no evidence for osteomyelitis, thus the fracture was
probably not compound, the wound was not exposed to bacteria, or the host had a solid resistance to infection. Shortening of the element is not apparent, and little deviation from the anatomical axis of the element occurred. While the fibula does technically qualify as an anatomical splint, in *Meleagris gallopavo* the distal portion of the tibiotarsus would have received very little support from it. Some investigation of human intervention in the healing of longbone fractures in domestic animals has been carried out, but much of it has been inconclusive and dealt with livestock. To the best of my knowledge, no such studies have been carried out on avian remains, thus, any tentative conclusions regarding human intervention with regards to this specimen remain speculative. However, it is my opinion that it would be very unlikely for this individual to survive long enough for this lesion to heal without some sort of human assistance. In the case that such assistance occurred, the individual may have been protected from predation and provided with food and water. Though there is no evidence for direct medical intervention in the case of injured turkeys, it is possible that basic care such as splinting limbs or tending wounds took place. Any direct evidence for such action on the part of the inhabitants of the Bluff Great House to care for their turkeys would certainly highlight the importance of the species.
One Field Specimen bag contained two *Meleagris gallopavo* ulnas with similar pathologies present, as shown above in Figure 11. The ulnas are missing their epiphyses and bear splintering along with rodent gnaw marks. Both specimens were fractured in a compound fashion mid-diaphysis. While the left ulna retained appropriate form, the right was displaced from the anatomical axis. The calluses are roughly formed and osteomyelitis is present on both specimens. Baker and Brothwell (1980) would classify these infections as osteoperiostitis due to the fact that an infection of the periosteum would have taken place first, at the time of trauma. From the presence of fistulae (sinuses formed by the infectious agent), it is apparent that the infections were active at the time of death in the case of both individuals. The agent responsible for the infection was probably not extremely virulent as the individuals lived long enough for obvious osteological modification to take place. It is possible that the infection of the
osseous material led to septicaemia and contributed to the deaths of these turkeys. Such compound fractures are unlikely to have occurred in the wild or in competition with other turkeys, and the fractures do not resemble those resulting from a carnivore attack. There is a possibility that humans intentionally fractured the ulnas of turkeys as a method of control; however, there is little evidence for that as described in the archaeological literature of the American Southwest.

Figure 12: Field Specimen Number 4271

The specimen shown above in Figure 12 is a well-preserved and complete right *Meleagris gallopavo* humerus. A neoplastic lesion is present on the dorsal portion of the element, mid-diaphysis. This type of lesion is characterized by an unusual proliferation of cells, which, in this case form a distinct mass. Neoplasms are not synonymous with cancer as they can be benign as well as
malignant; it is unlikely that this neoplasm contributed to the death of the affected individual. As the cell growth was preserved, it is probable that the mass was not malignant; malignancies tend to metastasize and spread quickly and typically involve poorly-structured masses which do not preserve well (Baker and Brothwell 1980). Given the excellent state of preservation of the element, it is possible that the individual died at an early stage of cancerous development.

Figure 13: Field Specimen Number 4442

Figure 13 above shows a nearly complete *Meleagris gallopavo* sternal rib with a healed fracture mid-shaft. The essential structure of the element, while slightly malformed, has been preserved, and the callus appears to be relatively well-formed, probably due in part to the presence of nearby ribs which acted as
anatomical splints. The fracture had healed completely prior to the death of the

IV. Conclusions

In summary, some of the pathologies in *Meleagris gallopavo* present in the

Bluff assemblage do resemble (at least in terms of description) those reported at

Salmon, Eleanor Ruin, and 29SJ633. While I am in agreement with Durand and

Durand (2006) that these pathologies are broadly indicative of a domestic turkey

population, other more complex conclusions would be difficult to draw from the

limited sample available. A large-scale comparison of pathological *Meleagris gallopavo* specimens from the Chaco region as a whole would have the potential
to reveal more about turkey husbandry and domestication in the American

Southwest.
CHAPTER 9: CONCLUSION AND SUMMARY

Introduction

In the previous chapters, I have addressed various research questions with respect to the faunal assemblage from the Bluff Great House. In this chapter, I will summarise the analysis and interpretations presented in the preceding portions of this thesis.

I. The Faunas of the Bluff Great House

Faunal Species Present at Bluff

Identifications of the faunas from the Bluff Great House assemblage were made using comparative collections housed at Simon Fraser University and the Burke Museum at the University of Washington. Metric and non-metric aspects of the bones were recorded in an Excel spreadsheet using the format outlined in the Crow Canyon Archaeological Center Manual for Description of Vertebrate Remains (Driver 2005). For a complete list of taxa identified, please see Table 3 in Chapter 4. The dominant taxa present in the faunal assemblage from the Bluff Great House were *Meleagris gallopavo*, *Sylvilagus sp.*, *Lepus sp.*, and members of the order Artiodactyla. Identification of lagomorphs was not to species level due to the similarities in osteological morphology between species. *Sylvilagus sp.* is almost universally more common than *Lepus sp.* in sites from the Four Corners region due to the prevalence of the preferred habitat of *Sylvilagus sp.*
(Driver and Woiderski, in press). Of the artiodactyls at Bluff, the most commonly identified to species level was *Ovis canadensis*. Bluff had the highest NISP of this species, and it is also the most commonly identified artiodactyl at Salmon. Salmon and Bluff are both located within the San Juan Valley, and share that set of ecological characteristics. It is possible that the valley was home to a population of bighorn sheep during the occupation of both sites. As that species no longer ranges into the Bluff area, it is possible that either overhunting during the last century or environmental changes over time caused the disappearance of *Ovis canadensis* from the region.

Fauna that may have been acquired for other purposes are also present at the Bluff Great House, though not in large numbers. Most common among these unusual fauna are the Aves class, including passerines, falconiformes, water birds such as teals and *Grus canadensis*, ravens (*Corvus corax*), the Mourning Dove (*Zenaida macroura*) and Strigiformes. Among the carnivores recovered from the site are specimens identified as belonging to *Lynx sp.*, family Ursidae, and the tribe Vulpini. Coyote (*Canis latrans*) was not specifically identified at the Bluff Great House, though several specimens belonging to *Canis sp.* were. Bony fish, lizard and snake were identified in the assemblage, though not specifically.

**Taphonomy and Survivability**

From the data collected from the analysis of faunal remains from the Bluff Great House, I calculated MNE, MAU, and % MAU for selected elements from artiodactyls, *Meleagris gallopavo*, *Sylvilagus sp.*, and *Lepus sp.* I compared these numbers to survivability categories in the case of artiodactyls, and bone
density studies in the case of the lagomorphs and turkeys (please see Tables 8, 9, 10, and 11). For the most part, the %MAU generated paralleled the ranks given for those animals in the studies I used for comparison, with the exception of the *Meleagris gallopavo* data. These results can be interpreted as an indication that natural taphonomic processes affected the formation of the Bluff Great House faunal assemblage, at least with respect to three of the food faunas. Possible reasons for the lack of correlation with the *Meleagris gallopavo* data are the fact that elements selected in Dirrigl’s (2001) study were not equivalent, and also the possibility that human behaviour affected the outcome, i.e., there may have been selection for wing elements (Bovy 2002). Another indicator of the dominance of natural processes is the relationship between the size of an element and survivorship. In Figure 6 of Chapter 5, I plotted *Sylvilagus sp.* element length versus breadth, and demonstrated the correlation between increasing element size and higher %MAU. Correlation does not imply causality, but a relationship between these two factors is clear. While this indicates a probable prevalence of natural processes over behavioural, factors such as screen size used during excavation are likely to have had an effect.

**Change in the Faunal Assemblage Over Time**

The broad patterns present in the faunal assemblages that change over time between the Pueblo II and Pueblo III time periods have been mentioned previously in this chapter. However, a specific comparison of assemblages by NISP from which fauna from both time periods are represented is made in Chapter 7 (please see Tables 26, 27 and 28) and more particular trends may be
isolated. The sites with material from both Pueblo II and Pueblo III are Bluff, Nancy Patterson, Salmon, and Wallace. These four sites all demonstrated the expected patterns present in most assemblages considered (the turkey index increases at three of the sites, at no time does the number of *Lepus sp.* exceed the number of *Sylvilagus sp.*, and the artiodactyl index decreases). In addition, other observations made are as follows. While the turkey index increases between Pueblo II and Pueblo III at both Salmon and Bluff, the Bluff turkey index shows the highest increase. Although the NISP of turkey at the Wallace site increases over time, there is a decrease in the turkey index over time (please see Table 25) which is entirely contrary to the pattern observed elsewhere. The Bluff assemblage also has the highest NISP of artiodactyl of any site compared, despite the fact that the overall assemblage size is approximately a third of the size of the Wallace assemblage. There is some variation in the species of artiodactyl identified between the sites, though this is likely due to environmental variability.

**Bluff as part of the Chaco Phenomenon**

While the faunas identified in the Bluff assemblage are similar to those recovered from both unit pueblos and Great Houses in the Northern San Juan, the assemblage does resemble faunal collections from other Chacoan Great Houses in some respects. In the western portion of the Montezuma basin, faunal assemblages from two other Great Houses have been analysed. These are from the Nancy Patterson Great House and the Comb Wash Great House. Times of occupation do differ somewhat between the three sites, and the Comb Wash
assemblage contained only Pueblo III material. Overall, the Bluff assemblage and the Nancy Patterson assemblage are quite similar, not only with regard to the fauna present, but also in terms of change in the use of fauna over time. The material from the Comb Wash site also parallels the general Pueblo III pattern shown in the indices from Nancy Patterson and Bluff: a low artiodactyl index, a high lagomorph index, and a high turkey index. The reader is referred to Table 16 in Chapter 7 for a comparison of faunal indices from the three sites.

When comparing the Bluff fauna to those fauna from Chacoan Great Houses from a larger region, some of the same patterns are repeated. Earlier assemblages have higher artiodactyl indices, later assemblages have higher turkey indices, and the lagomorph indices don't change as much over time as the other indices, though there are some exceptions. Bluff, along with most of the other Great Houses compared, has unusual fauna present which are generally not identified in assemblages from the unit pueblos in the region (please see Tables 18, 22, and 24 for tables of non-food faunas from assemblages compared). The larger numbers of what I term "special fauna" at Chacoan Great Houses is probably due almost entirely to the relationship between NISP and number of taxa identified. Figure 7 and Figure 8 in Chapter 7 demonstrate a strong correlation between NISP and the number of taxa identified from a site: it is apparent that the higher the number of identified bones from a site, the higher the number of taxa that will be identified. This concept somewhat undermines the expectation that unusual fauna are more likely found at Great Houses due to ritual practises or other behavioural influences. Variation between analysts,
sampling strategy, and excavation techniques can alter this correlation. In addition, assemblage size has a great effect.

**Non-Great House Faunal Assemblages**

The assemblages from unit pueblos had much the same core fauna present as the Bluff Great House, but fewer of the unusual species. This is at least in part the result of the relationship between NISP and the number of identified taxa. Smaller sites such as unit pueblos produce small assemblages, which limits the potential amount of interpretation with respect to human behaviour. Until a large non-Great House assemblage can be compared to a Great House assemblage of similar size, it will be difficult to ascertain the relationship between Chacoan Great Houses and the concurrent presence of unusual fauna.

**Palaeopathological Observations**

There were eight pathological specimens identified in the faunal remains from the Bluff Great House. Two of the pathologies were present in *Sylvilagus* sp. and include a complete metatarsal with a healed fracture and a nearly complete lumbar vertebra with bone loss at the centrum and pronounced exostoses. Both of these pathologies seem unlikely to develop in a lagomorph. First, the fracture would render the creature more vulnerable to predation, and secondly, the life span of *Sylvilagus* sp. is short and the length of time necessary for morphological changes in bone to occur is comparatively long. The vertebral lesion is also unusual, as the most likely diagnosis of the pathology is
osteoarthritis, which tends to be an age-related disease. Six of the pathological specimens from the Bluff assemblage were *Meleagris gallopavo*, and as that species is considered to be a domesticate, implications for human behaviour may be made. Domestication necessitates a large degree of interaction between people and the species in question. Perhaps a degree of human control over domesticated species can be interpreted from evidence of penning, tethering, or other husbandry practises. Certainly the marks of this control could be evident in the skeletal remains of the domesticate. The *Meleagris gallopavo* pathologies vary in type and include lytic lesions of undetermined aetiology, healed and unhealed fractures, and a neoplasm (unlikely to be malignant). One of the healed fractures was present on a right tibiotarsus at the distal portion of the diaphysis. There was little deviation from the anatomical axis of the element; and as this element does not have a true anatomical splint, the level of healing present is remarkable. Human intervention in the process is plausible, especially considering the vulnerability of the individual, but that idea is speculative. Two of the unhealed fractures (probably compound, due to the presence of osteoperiostitis) were on left and right ulnas; both were broken mid-diaphysis. A fracture in this region of the anatomy is not likely to occur in the wild, nor in the throes of competition with other turkeys. Though the pathologies described above do resemble (in description) those from other sites in the Southwest such as Salmon, 29SJ633, and Eleanor Ruin (Durand and Durand 2006), no in-depth examinations of the effect of human behaviour on avian skeletal remains have
been published. Any suggestions as to the involvement of humans in the aetiologies of these pathologies are therefore tentative.

II. Conclusions

With reference to the idea of interpreting animal remains as a mirror of human behaviour, we have yet to see a completely clear reflection. Despite this, my analysis of the faunal material from the Bluff Great House has revealed a number of thought-provoking patterns.

The Bluff Great House assemblage was primarily composed of local faunas, some of which do not inhabit the region today. Identifications of taxa and descriptions of specimens were made using published guidelines and skeletal comparative collections. I conducted a re-analysis of randomly selected field specimen numbers which made up roughly 29% of the total field specimen numbers. As there was a 2% variation in identification, the results of my analysis are most likely duplicable (see Chapter 4).

For part of the analyses, I divided the faunal material into two categories: "Core" and "Special." The "Core" faunas are probable food faunas which are identified in most assemblages from Chacoan sites from the Pueblo II and Pueblo III time periods. "Special" faunas are those which may not be considered food faunas, and may have held specific meaning to the inhabitants of the Bluff Great House. This division allowed me to examine great house and non-great house assemblages in the Northern San Juan region for the purpose of determining whether there was an abundance of probable non-food faunas at
great houses (see Chapter 7). With reference to these regional comparisons, the animal bones from Bluff fit neatly into the known spectrum of assemblages from northern Chacoan outliers. The fauna present resemble those recovered from other Great Houses and unit pueblos in the immediate region. Changes in the structure of the fauna from Pueblo II to Pueblo III follow an anticipated pattern; and natural taphonomic processes appear to have dominated the formation of the assemblage with the exception of *Meleagris gallopavo* element abundance.

The pathologies present in the Bluff assemblage offer glimpses of what zooarchaeological palaeopathology might contribute to a more discernable picture of past human behaviour. The Bluff assemblage has several remarkable pathological specimens, some of which are similar to those detailed in the archaeological literature. These specimens are especially interesting as some of them resemble identified pathologies described from other sites in the greater San Juan region (see Chapter 8).

The most unexpected result from this analysis was certainly the relationship between the number of taxa and NISP in the assemblages I used for comparison (please see Figures 7 and 8 in Chapter 7). I anticipated that Bluff, along with other Chacoan Great Houses compared, would have proportionately more taxa as compared to overall NISP than the unit pueblos compared. My expectation in this case sprang from the apparent differences between Chacoan Great Houses and unit pueblos. In terms of appearances, they seem to be different expressions of human behaviour. The two types of sites look different on an architectural level and the Great Houses often possess a specific set of
physical traits which distinguish them from unit pueblos. Therefore, I had some expectation that the faunal assemblage from Bluff would be distinct from assemblages from unit pueblos with regard to the number of taxa identified versus overall NISP. The fact that the faunal assemblages from unit pueblos resemble those from Great Houses could be interpreted in two ways. First, it is entirely feasible that any special activities occurring at the Great Houses are not reflected in the faunal assemblage. There may be different uses for and practices associated with the fauna present at Great Houses, but we cannot detect them. It is entirely probable that there are some species associated only with Great Houses. For instance, when macaws occur in Chaco-period assemblages in the San Juan region, they are present at Great Houses. Members of Ursidae are represented at only two sites used in my comparisons: Bluff and Wallace. Both of these sites are Great Houses with very large faunal assemblages. As the presence of these rarely occurring taxa would still be considered a function of the number of specimens identified, it seems unexceptional. Second, the data on NISP versus number of taxa identified may reflect a standard subsistence structure driven primarily by the local environment.

Recommendations

Faunal data from the American Southwest are rather inaccessible. It is difficult to obtain data because it entirely unpublished or essential details are not provided. The use of online databases for such information could be of great benefit in this case. Also, it is my opinion that more intensive regional comparisons of faunal assemblages from the American Southwest could
contribute a great deal to the extant body of southwestern archaeological knowledge, particularly if that data were more reachable.

There is abundant room for refinement of methodology and implementation of a standard procedure for identification, documentation, and analysis of zooarchaeological pathologies in general (O'Connor 2000). The American Southwest has ideal preservational circumstances for a comprehensive study of all *Meleagris gallopavo* pathologies. Turkeys were raised as domestic animals, but in contrast to the research of Old World domesticates, there have been no studies using pathologies to investigate how turkeys were raised. Such an analysis could make an intellectual contribution not only to the development of a standard method for handling faunal pathologies, but also to the extant knowledge of human-animal relationships in the American Southwest.
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