# CRAFT, SUBSISTENCE, AND POLITICAL CHANGE: AN ARCHAEOLOGICAL INVESTIGATION OF POWER AND ECONOMY IN PREHISTORIC CHACO CANYON, NEW MEXICO, 850 TO 1200 CE

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**ABSTRACT**

Craft, Subsistence, and Political Change: An Archaeological Investigation of Power and Economy in Prehistoric Chaco Canyon, New Mexico, 850 to 1200 CE

by

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This research examines the development of sociopolitical and economic differentiation among the Ancestral Pueblo communities of Chaco Canyon, New Mexico by exploring trends in faunal procurement and craft production in relation to the sweeping political changes of the tenth, eleventh, and twelfth centuries CE. I hypothesize that with increasing political centralization, the animal remains from two Chacoan small sites will exhibit evidence of social differentiation, reflected in patterns of differential access and subsistence intensification. Further, I predict that intensification in the manufacture and use of bone tools and ornaments will covary with evidence for political centralization. By drawing on these separate and largely under-utilized data sets, this project moves beyond the dominant theoretical models that privilege the role of elites and great house-centered communal ritual in Chacoan political developments.

Study of the faunal remains from sites Bc 57 and Bc 58 revealed a temporal trend toward increasing dependence on large game, ultimately achieving levels well-beyond that of contemporaneous sites. Analysis of skeletal part frequencies indicated that large game procurement consistently entailed the transport of whole carcasses, rather than only high utility carcass parts. This strategy of subsistence intensification involving large game procurement implies redistribution and/or feasting behavior.

Study of Chacoan bone artifacts from fourteen sites throughout the canyon shed light on two temporal trends in the Chacoan worked bone industry. Species variation was characterized by a gradual increase in reliance on artiodactyls from Basketmaker III through the Early and Classic Bonito subphases, followed by a Late Bonito shift toward the use of bird elements in the manufacture of bone tubes. Raw material choice in awl manufacture became increasingly standardized during the Early and Classic Bonito subphases before a marked shift during Late Bonito wherein previous standards of awl manufacture were disregarded. Thus bone tool manufacture and use appears to have reached its apex during the Early and Classic Bonito subphases and was subsequently surpassed by a growing demand for bone tubes and ornaments during the Late Bonito period.

As an important test case in the study of societal complexity, this research illustrates that well-documented shifts in the Chacoan political landscape are reflected in changing subsistence and production strategies.

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# CHAPTER 1: INVESTIGATING POWER AND ECONOMY IN PREHISTORIC CHACO CANYON

During the 9th century CE, the southern Colorado Plateau comprised the Ancestral Pueblo world and was home to sedentary villages whose inhabitants practiced a combination of rain-fed maize agriculture and hunting and gathering. By the 10th century, Chaco Canyon communities in northwestern New Mexico had begun to form a regional network of unprecedented size and scope that was sustained for nearly 300 years (see Figure 1.1). While rooted in preexisting Pueblo patterns, Chaco stood out from its contemporaries in many ways. Large, multi-story, room-block structures or great houses, constructed with meticulous sandstone masonry and massive quantities of pine beams harvested from forests 80 km distant, required substantial planning, skill, and labor. Long-distance importation of exotic goods, such as turquoise, seashell, ceramics, chipped stone, cacao, and scarlet macaws demonstrate the presence of network ties to communities throughout the San Juan Basin and well beyond, and reflect the magnitude of Chacoan influence.

Following more than a century of archaeological excavation and survey, the material remains of the prehistoric Pueblo inhabitants of Chaco Canyon constitute one of the best-documented "cases for complexity" among prehistoric societies in North America. That Chaco at its peak exhibited some degree of political centralization is an assertion that few archaeologists would dispute. Evidence for the development of political centralization in Chaco may be found among a constellation of attributes including vast road networks, complex irrigation regimes, large-scale timber harvests, episodes of intensive great house construction, and iconographically-significant Chacoan 'hachure' ceramic designs, all of which bespeak varying degrees coordination, planning, and mobilization of labor.

**Project Focus and Central Problem**

This project investigates the development of sociopolitical complexity among the Ancestral Pueblo communities of Chaco Canyon, New Mexico during the Pueblo I through Pueblo III periods (AD 800-1200), by focusing on changes in political centralization, sociopolitical differentiation, and the organization of production. Over the past three decades of scholarship two principal and competing theoretical models have emerged that conceptualize Chacoan political evolution as driven to varying degrees by social, economic, and environmental change. Underlying these divergent narratives of Chaco's developmental trajectory are the shared assumptions that the canyon witnessed increasing political centralization predicated upon the formalization of local and regional exchange networks and deepening social differentiation within and between Chacoan communities. These models that privilege either the role of great house-centered communal ritual or elite aggrandizing efforts, however, afford only a partial understanding of how the organization of production might have changed in relation to the shifting political landscape. By focusing upon the political economy of small sites and great houses alike, my project builds on previous models, examining the complex interplay between political centralization and social differentiation as it is manifested in economic production, distribution, and consumption at multiple structural and spatial scales.

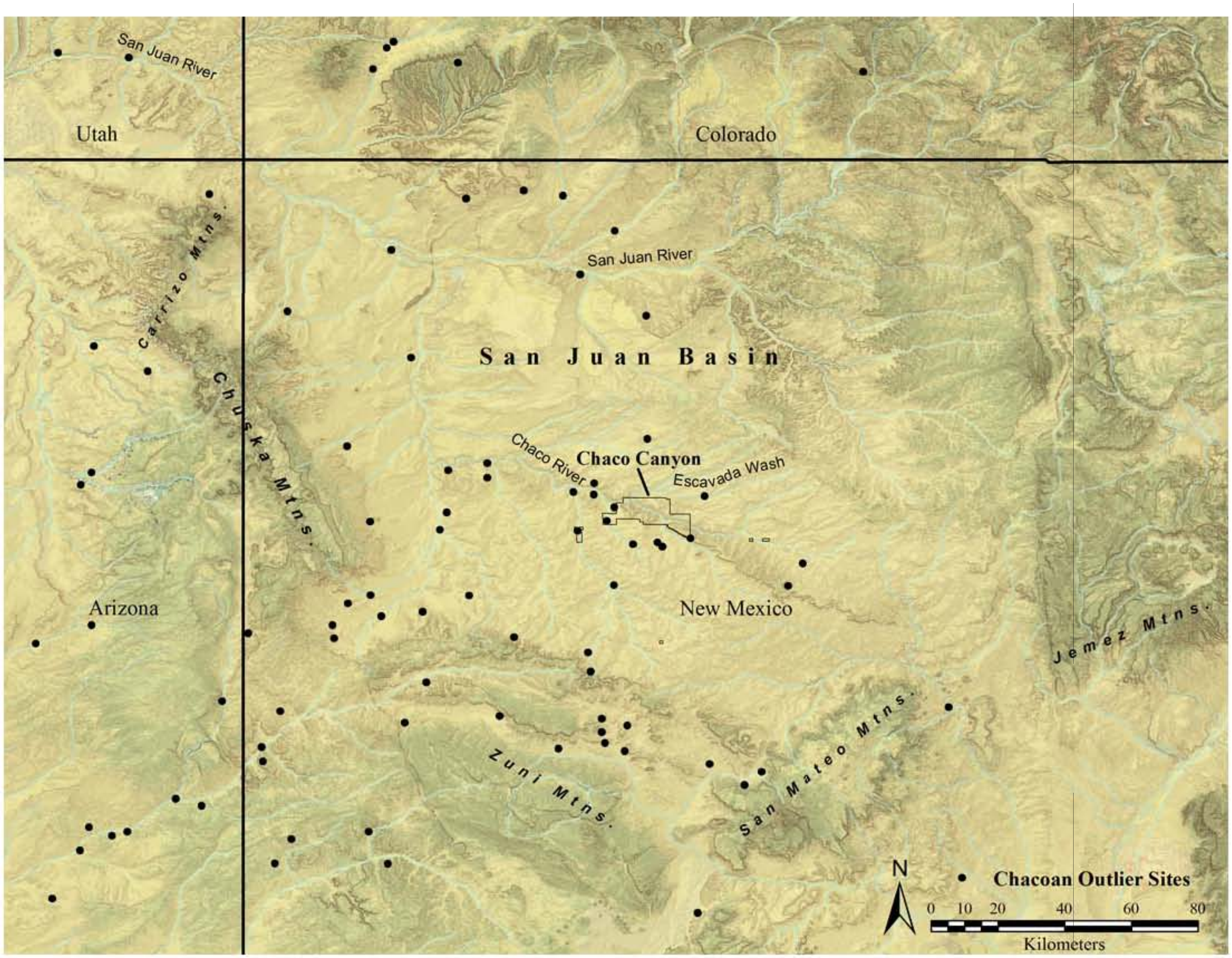


Figure 1.1: The Chaco World

This research employs two sources of data—relating to the faunal record and craft production—that directly address the development of hierarchy and specialization in the context of Chaco's evident political centralization. On the basis of this data, I hypothesize that the political centralization evinced by Chacoan expansion was paralleled by an elaboration of hierarchy and a reorganization of craft production.

The faunal record is a class of data common to nearly all Chacoan sites and patterns of procurement, consumption, and use directly reflect the ritual, economic, and political organization of Chacoan society. As will be discussed below, faunal remains may not only shed light on trends in differential access and feasting practices, but also may offer key insights into this significant but rarely preserved aspect of prehistoric craft production as these remains were frequently modified to serve as tools in the manufacture of basketry and hides. Despite the wealth of worked bone recovered from Chaco, this precious data source has been largely overlooked.

While anthropologists have long-questioned the relationships between political centralization and the elaboration of hierarchy and craft specialization, the coterminous nature of their development is widely accepted (Earle 1987a; Fried 1967; Helms 1998; Service 1962). The extent to which Chaco fits this model remains a matter of intense debate because, although there is compelling evidence for centralized leadership (Akins 1986; Kantner 1996; Lekson 1984; Nelson 1995; Saitta 1997; 1999; Schelberg 1982; 1992; Sebastian 1992; Vivian 1990; Wills 2000), the extent of specialization and hierarchy has not yet been resolved.

Explanation of the social, political, and economic developments in the rise and fall of the Chaco system is thus critical to understanding the long term cultural evolution of social formations in the prehistoric American Southwest, and has great potential for resolving questions of societal evolution globally. This region contains an exceptional archaeological record of the development of pre-state societal complexity and has long been treated as exemplary for processes of social evolution generally. Research on Chaco has the potential to address numerous questions concerning how social entities and networks are formed and transform over time, producing new developments in the evolutionary trajectory of human social organization. Specifically:

- What were the interrelations of religion, economy, and social organization during the critical Bonito phase in Chaco?
- How did these variables and relationships change from prior structures and contemporary Puebloan forms outside the Chacoan sphere, and how do they differ from subsequent social formations evident in the proximate archaeological record?
- How were social entities and networks, involving economic production, distribution, and regional exchange organized? How were these mobilized vis-a-vis an unpredictable environment and the evident pattern of increasing societal complexity both internally within the Canyon communities and in external neighboring groups?

Answering such questions is critical for the study of social complexity in societies of intermediate scale throughout the world. Although of longstanding interest among archaeologists in the Pueblo Southwest, debate regarding these questions remains vigorous and there has been no resolution.

My project will explore patterns of procurement, consumption, use, and discard of animal remains to address two related questions:

(Q1) To what extent are the increasing indications of political centralization in Chaco correlated with changes in the organization of craft production, specifically perishable technologies, at the intra- and inter-site levels and how might these patterns reflect social and economic affiliations?

(Q2) How are the effects of increasing political centralization in Chaco manifested among two adjacent and contemporaneous small sites, as reflected in patterns of faunal consumption and use?

The implications of this study are far-reaching – they extend beyond the ongoing regional debates with the potential to advance studies of political economy, hierarchy, craft specialization, and prehistoric bone tool industries.

# CHAPTER 2: CULTURE CHANGE IN CHACO CANYON

To better contextualize these research questions, I begin with an overview of the current consensus among archaeologists as to how patterns of subsistence, production, and exchange shifted over the course of Chacoan development. I then discuss in greater detail the origins and structure of the theoretical models developed to explain this change and that currently dominate the study of Chacoan complexity.

## Modeling Culture Change in Chaco

While correlates of the Chacoan cultural phenomenon are apparent throughout the San Juan Basin from as early as the eighth century CE, there is widespread agreement among scholars that by the ninth century the sites situated in and around Chaco Canyon had emerged as the core of a regional system (Vivian 1990:13). This area, often referred to as the Chaco Core, lies in the central San Juan Basin of northwest New Mexico, includes a swath of land 16 km wide and 65 km in length, and is characterized by numerous deep canyons and the confluences of several watercourses that drain the Chaco Plateau and Chaco Slope.

### *Archaic and Basketmaker (5500 BC – 700 CE)*

The cultural and technological changes of the Basketmaker II (500 BC-500 CE) and Basketmaker III (500-700 CE) periods are commonly attributed to a combination of favorable climatic fluctuations, the introduction of new food crops, and population growth. The time periods represent the formative stages of what was to become the general pattern observed throughout the southwest and laid the foundations for the Chaco culture (Cordell and Gumerman 1989:4-5). While BMII entailed a shift from Archaic mobile hunting-gathering strategies toward increased sedentism and reliance on horticulture, BMIII involved the emergence of the pithouse and slab-lined storage cists as the dominant architectural features, as well as a shift toward ceramic production (highly homogeneous in style) and use of the bow and arrow. Rainfall increases throughout much of the San Juan Basin likely stimulated continued dependence on cultivars and settlement expansion into under-utilized horticultural niches. The large Basketmaker site, Shabik'eshchee Village dates to the BMIII period and the worked bone assemblage from the site will be included in the present study to provide a comparison with those of several Bonito phase sites.

### *Pueblo I/Early Bonito Subphase (700-920 CE)*

Pueblo sites throughout the San Juan Basin exhibit many of the traits regarded as typical of the Pueblo I period, including a shared common spatial arrangement of pithouses, contiguous surface structures, and refuse deposits. During early Pueblo I, work-areas were often backed by storage rooms, only partially walled, and open on the plaza-facing side (Truell 1986:306-307). Pithouses tended to be larger and deeper than in earlier periods and, through the early tenth century, retained domestic floor features (Truell 1986:307). While some site variability existed within the San Juan Basin, Vivian (1990:153-154) characterized it as a difference of scale and to a lesser extent form, with curvilinear roomblock plans and adjacent "protokivas" more common in the northern basin and short linear blocks in the southern basin. Hayes et al. (1981) recorded a three-fold increase in the number of sites in Chaco Canyon from BMIII to PI as well as an apparent shift in settlement location from mesa tops to the knolls, ridges, and talus slopes along the canyon bottom.[1] In many cases, later architectural components obscure previous PI structures; in these cases, the presence of Piedra Black-on-white, Kiatuthlanna Black-on-white, and Kana'a Neck-banded are commonly accepted as indicative of a PI occupation.

One significant shift that occurred toward the end of PI was a marked divergence in architectural traditions in Chaco Canyon. While the small site spatial arrangement described above continued to dominate Chaco and the San Juan Basin more broadly, the canyon witnessed the earliest known great house construction, dated to the mid- to late-ninth century on the basis of tree ring dates drawn from roofing support beams (Gillespie 1984; Judd 1964; Lekson 1984; Windes and Ford 1996). The construction of these multi-storied and tiered buildings at Peñasco Blanco, Una Vida, and Pueblo Bonito (the best-documented), followed preconceived ground plans with "rear storage rooms rising two and three stories above and behind the fronting one-story living rooms and enclosed ramada work areas" (Vivian 1990:158). These initial structures differed from contemporaneous small sites not only in sheer size and multiple stories, but also in the use of copious amounts of mortar and sandstone masonry and the association of possible communal ceremonial structures or great kivas with multiple room suites.

The climatic amelioration that characterized the Basketmaker periods did not continue into the eighth century and many of the changes associated with the Pueblo I (700-920 CE) period have been interpreted as adaptational responses to a deteriorating environment (Vivian 1990:135). While the emergence of these great houses implies an

[1] Evidence exists that the BMIII-PI shift in site location may be more apparent than real. Many BMIII sites may remain buried under the 4 meters or more of alluvium that has accumulated in the canyon bottom since the BMIII period (Hayes 1981:24). At least 15 BasketmakerIII sites have been found exposed in arroyo cut-banks and Judd excavated one Pueblo I pithouse nearly 2 meters below the modern ground surface (Hayes 1981:24, 49; Judd 1924).

increase in population density, the well-documented climatic downturn suggests that subsistence systems may have undergone stress and, as some have argued, may have prompted the elaboration of exchange networks (Judge 1989; Vivian 1990). Studies of ceramics from all sites excavated by the Chaco Project indicate that more than 28 percent of pottery was imported from areas outside the canyon, including the Red Mesa and East Puerco valleys south of Chaco and the Chuska, La Plata, and San Juan valleys to the north and west (Toll 2006:120-121; Toll and McKenna 1997:130-135). Relative to other ceramic tempers (Chalcedonic sandstone and San Juan igneous) during this period, trachyte temper (diagnostic of manufacture in the Chuska valley) occurred in 12 percent of graywares, 7 percent of whitewares, and 30 percent of redwares. The distribution of lithics, however, does not support this conclusion since the majority was locally procured (Cameron 1984:142-143). Subsistence in Chaco during this period was similar to that of the surrounding San Juan Basin, consisting of a mix of maize, beans, and squash cultivation; gathering of wild plants such as amaranth and chenopodium; and hunting of rabbits, mule deer, bighorn sheep, and pronghorn antelope (Vivian et al. 2006:436-438). Akins' (1984:231-234) analysis of faunal assemblages from the Marcia's Rincon/Fajada Gap small house sites and the Alto and Una Vida great houses led her to posit that diminishing quantities of local fauna triggered an increased reliance on small fauna (prairie dogs and other smaller rodents) and imported non-local large fauna. In particular, Akins cited the drop in consumption of rabbits and pronghorn in favor of increased mule deer consumption as evidence of a decline in communal hunting strategies and the emergence of more specialized strategies in the tenth century.

While the developments of the periods outlined above are generally agreed upon, the spans known as the Early (850-1040 CE) and Classic Bonito (1040-1100 CE) subphases in Chaco Canyon that encompass the “initialization” and “formalization” stages of Chaco’s rise to prominence, remain the major sources of debate and it is upon these stages that the present study will focus. The Bonito phase provides us with some of the most compelling evidence for specialized production from the Chacoan periods.

***Pueblo II/Early Bonito Subphase cont. (920-1040 CE)***

The San Juan Basin witnessed a nearly forty percent increase in the number of sites from the preceding period, a shift that has been interpreted as evidence of population growth (Vivian 1990:168). Gillespie and Powers (1983) cautioned that brief occupations of habitation sites and inclusion of non-habitation sites may inflate these estimates. The ceramic design style known as Red Mesa, diagnostic of this period, exhibits a wide distribution suggesting the expansion of exchange networks. Despite ample evidence of continuing great house construction and occupation in Chaco, there remain no reliable indications of such communities in the surrounding Basin in this timeframe. Small sites during this period continue to exhibit the above-ground roomblock and associated pit structure configuration. Stacked sandstone masonry almost completely replaced upright slabs and puddled adobe as the construction method of choice for above-ground roomblocks and increasingly, plaza-facing rooms became fully walled. Although represented by only a small sample, excavated pit structures largely lack the domestic features seen in earlier periods indicating a shift in function (Truell 1986:307).

In Chaco more specifically, the initial boom of great house construction continued into the mid-tenth century but may then have declined during what Lekson (1984) has termed a "Hiatus" period. Chronometric controls for occupation of the canyon during the Early Bonito subphase is not as tight as for later periods, but the coterminous nature of both great houses and small sites has been conclusively demonstrated. As noted above, ceramics found in Chaco during the preceding phase may represent connections with sources to the south, west, and north. Toll and McKenna (1997:130-136) noted that the tenth and early eleventh centuries saw a slight decrease in imported ceramics (25 percent). While a decline in whitewares accounted for much of this apparent drop-off, graywares actually increased in frequency from 30 to 40 percent of the total imported assemblage. Among imported grayware vessels, the proportion exhibiting trachyte temper increased nearly three-fold, to 28 percent. Trachyte temper also increased slightly among whitewares (8.5 percent) but decreased sharply among redwares (9 percent), being largely supplanted by vessels of the San Juan variety (1997:130-136). Red Mesa Black-on-white continued to be the dominant style of decorated whitewares in the Chaco Core. Overall importation of lithic raw materials increased from multiple areas but without the regional emphasis apparent in ceramics.

Importation of "exotic" materials frequently utilized in the manufacture of ornaments such as turquoise, shell, and jet, rose substantially during this period prompting some scholars such as Judge (1989) to suggest that Chaco's emergent status was based on control and manufacture of turquoise. Mathien (2001:106) documented several, possibly specialized, jewelry workshops at both great houses and small sites dating to the Early Bonito subphase. High levels of consumption of these non-local exotics continued well into the twelfth century, but the importance and function of these materials remains a source of debate. More than 56,000 pieces of turquoise were recovered from two burials alone in Pueblo Bonito and while several scholars have argued that such richness coupled with the presence of distinctive ceramic forms constitutes clear evidence of social differentiation (Akins 2003; Akins and Schelberg 1984; Peregrine 2001; Van Dyke 2004:415-416) still others downplay the significance of such deposits, citing these as exceptions to the broader pattern (Mills 2002:66; Sebastian 1991:117; Toll 1991:101).

The period 900-1025 CE saw increased regional temporal variability in rainfall. Macrobotanical and pollen data actually indicate a decline in reliance on maize in favor of wild plant resources (Vivian et al. 2006:437-440). Water control systems may have been developed during the Early Bonito subphase but most were not in use until subsequent periods (Gillespie and Powers 1983; Vivian 1990:214; Vivian et al. 2006:438-439). Sebastian (1991:129; 1992) and Vivian (1990:214) have observed that a series of possible sharp environmental downturns may have occurred in the early tenth century and may have contributed to the need for water and erosion control as well as disparities in relative agricultural success.

Akins (1984; 1985) observed that after an initial decline in consumption of leporids and prairie dogs, their level of consumption remained fairly steady throughout the tenth century. The continued predominance of pronghorn antelope – likely numerous on the grasslands south of Chaco during the tenth and early eleventh centuries – correlates with the early trade in ceramics and chipped stone tied to the southern San Juan Basin. Likewise, the increasing importance of mule deer throughout the eleventh century, best suited to the well-watered uplands of the Chuska Mountains to the west and the San Juan River drainage to the north, may have accompanied the intensification of trade relations along the western and northern reaches of the Basin (Akins 1984:234). Akins found clear differences in faunal consumption patterns between several small sites, but concluded that the variation was secondary to the broader, cohesive temporal trend of the Early Bonito subphase.

McKenna (1984:386) contradicted Akins' findings and instead argued that differences, specifically inter-site differences in artiodactyl procurement, reflected differential access and task specialization. Greater abundance of pronghorn at one site, for instance, was interpreted as evidence of control over communal pronghorn hunts, a role traditionally associated with powerful individuals among the modern Pueblos (White 1962:129-130). Intentional stockpiling of raw material for bone tool production was seen as potential specialization in bone tool industry, hide-working, or basketry production (McKenna 1984:386). Moreover, McKenna (1984:385) asserted that the uneven representation of craft industries among small sites could reflect coordinated task specialization among small sites.

If sites were beginning to specialize in particular forms of production by the Early Bonito period as suggested by Mathien (2001:106) and McKenna (1984:386), one would expect to see greater standardization in addition to the uneven concentrations of tools and raw materials (Costin and Hagstrum 1995:620-621). In fact, Toll (1984:118; 1985) observed a striking consistency in the production of Chuskan graywares and surmised that it may well reflect site-level specialization. Vessels with trachyte temper consistently exhibit lower coefficients of variation for rim width and orifice diameter, suggesting greater standardization in ceramic manufacture (Toll 1984:118-120). Thus tantalizing evidence exists for early specialization within Chaco and potentially the

Chuska valley and the analysis undertaken in Chapter Eight explores this possibility in greater detail.

***Late Pueblo II-Early Pueblo III/Classic Bonito Subphase (1040-1100 CE)***

In contrast to the Early Bonito subphase, reliable chronometric data are available that establish the existence of Chacoan communities throughout the Basin. Although there is some degree of variability, the typical community is characterized by a core habitation zone of small sites surrounding a great house structure and great kiva. In the Chaco Core, the Classic Bonito subphase entailed repeated major construction programs at several great houses, many of which occurred simultaneously (Dean and Warren 1983; Lekson 1984). Since the nearest montane forests are some 60-80 km distant, timber harvests would have required substantial coordination and mobilization of manpower.

Lekson distinguished at least four broad construction episodes spanning this phase, involving both construction of new great houses and significant additions to existing great houses. Great house architecture evolved over the course of the eleventh century, departing in many instances from the curvilinear plans of Early Bonito great houses in favor of greater linearity, the construction of “wing” units appended to central roomblocks, and a reduction in plaza area with the addition of kiva clusters and wing structures (Vivian 1990:275). Among Classic Bonito small sites, including Bc 57 and Bc 58, pit structures were placed closer to the roomblock and in many cases contiguous or even situated within the roomblock itself. For the first time, small sites evince construction techniques previously reserved for great houses, specifically core-and-veneer masonry and larger room-sizes (Truell 1986:307-308). Truell (1986:308) also observed a greater diversity in small site construction and configuration compared to that of the preceding period.

The San Juan Basin saw above-average precipitation, albeit with significant variance in annual rainfall rates. In the mid-eleventh century, a consistent trend toward favorable summer rainfall led to increased dependence on cultivars and made colonization of previously marginal zones feasible. While the improved rainfall likely meant larger agricultural yields, longer periodicities also meant the need for considerable surplus stores. Vivian (1990:307) suggested that this would have meant diversification of subsistence resources as well as agricultural intensification. This intensification during the Classic Bonito subphase included increasing use of floodwater farming and water diversion and control features, particularly in areas on the north side of Chaco Canyon where the volume and velocity of rainfall runoff was much higher. Although difficult to date precisely, the extensive Chacoan road system, consisting of more than 640 km of remarkably straight and formally constructed roadways appears to have been a Classic Bonito development. These roadways may have served both utilitarian and ritual purposes, with at least four leading from Chacoan outliers and converging on Chaco Canyon.

From the beginning of the eleventh century, the overall proportion of artiodactyls in Chacoan faunal assemblages rose from 17 percent to around 30 percent by mid-century, finally declining to 14 percent by late century. Temporal variation in the relative frequency in artiodactyls is also apparent. While a roughly equal emphasis on deer, bighorn, and pronghorn is indicated during the early eleventh century, the procurement of the latter declined sharply after 1050 CE, being supplanted by deer. Consumption of small mammals (jackrabbit, cottontail, and prairie dog) exhibited a pattern parallel to that of artiodactyls, climbing from 66 percent to account for approximately 70 percent of faunal assemblages before dropping off slightly (to 68 percent) by about 1090 CE (Vivian et al. 2006:449, 455). The relatively heavy emphasis on artiodactyls, while common along the upland margins of the basin (Harris 1977; 1980; Pippin 1987; Roler 1999), is exceptional when compared with previous and subsequent patterns of faunal exploitation in the broader prehistoric Southwest (Adams 2002:46; Leonard 1989; Szuter and Gillespie 1994). Toward the end of the eleventh century another shift toward consumption of prairie dog and turkey with a reduction in deer and pronghorn is discernible.

The regional emphasis of exchange patterns appears to have mirrored trends in faunal exploitation. Just as procurement of mule deer, likely from the Chuska Range, increased in frequency, importation of Chuskan graywares continued to rise with trachyte-tempered vessels accounting for 50 percent of imported graywares, 20 percent of whitewares, and 31 percent of the overall imported assemblage (Toll and McKenna 1997:130-136). Although the majority of lithics utilized were still local, of the imported cherts and obsidian, Narbona Pass chert from the Chuska Range predominated, comprising nearly 20 percent of total lithics. Among decorated ceramics, Gallup and eventually Chaco Black-on-white, both with the iconographically significant hachure styles, and Escavada style pottery came to replace the dominant Red Mesa forms of the preceding period.

***Early-Late Pueblo III/Late Bonito Subphase (1100-1150 CE)***

This period marks a disintegration of the Chacoan system and an interregnum of sorts between two periods of population aggregation in the Pueblo Southwest. While small sites changed little, the "McElmo" architectural style that came to be characteristic of the period entailed a more compact, square construction with equal-sized rooms enclosing a kiva. The phase was characterized by a decrease in water table levels and precipitation across the Colorado Plateau creating conditions likely unfavorable for floodwater and dune farming systems. Patterns of faunal exploitation witnessed a dramatic shift toward consumption of turkey and small mammals during these waning years of the Chaco phenomenon, the former of which may have been imported from the region north of the San Juan River (Munro 1994). Further, artiodactyl consumption again increased from 14 to 19 percent of identified remains, reaching 25 percent among late deposits at Pueblo Alto (Vivian et al. 2006:455). The appearance of Chaco-McElmo Black-on-white ceramics, with tempers sourced to both the Chuska and now the San Juan River Valley suggested continued ties to these areas. Proportions of trachyte-tempered culinary graywares remained virtually unchanged at 50 percent while the occurrence of trachyte-tempered whitewares increased to 27 percent. Narbona Pass and Morrison cherts declined in favor of chert sources to the east and south (Cameron 1984; Vivian 1990:380-381; Windes 1985). Vivian (1990:333) observed that while many researchers regard the mid-twelfth century developments as indicative of system collapse at least partly in response to environmental degradation, the trend toward more specialized architecture and settlement patterns, as well as the establishment of outlier sites may bespeak an adaptive response of attempting to preserve the Chacoan system on a lesser scale. In other words, the evidence may indicate a scaling back rather than wholesale collapse.

The previous section presented the current consensus among scholars regarding the principal archaeological evidence for culture change in Chaco. I now turn to a review of evidence for political centralization in Chaco.

## Material Correlates of Political Centralization

As the independent variable in my analysis, a sound method for measuring political centralization is essential. If power can be understood as the transformative capacity of potential leaders (Giddens 1979:91-92) and political centralization, the growing concentration of power in the hands of increasingly few individuals (Roscoe et al. 1993:113), then the proliferation of activities requiring coordination and decision-making may be seen to reflect mounting political centralization. I therefore utilize the timing of Chacoan great house construction episodes and use of irrigation facilities as proxy measures of increased centralized decision-making. Other correlates not employed here but worth noting include the construction of the vast Chacoan road networks (Kincaid 1983; Nials et al. 1983) and the increasing prevalence of iconographically significant Chacoan "hachure" ceramic designs (Plog 2003; Toll et al. 1992; Washburn 2011) that further evidence heightened levels of planning and centralization within the broader Chacoan system.

Great house construction in Chaco entailed the quarrying of massive amounts of sandstone, production of mortar, and the use of more than 200,000 timbers harvested from high-elevation forests along the margins of the San Juan Basin, approximately 50-80 km distant from Chaco (Dean and Warren 1983; Windes and Ford 1996). At the

Chetro Ketl great house alone, as many as 20,000 trees were required for construction events during a thirty-year period (Dean and Warren 1983). As staggering as these figures are, Lekson (1984:262) estimated the amount of labor required for great house construction, positing that a thirty-person crew could harvest and transport the necessary timbers for about one month per year for six years and quarry stone and build for three to four months out of the year for four years and still produce a construction event that exceeds that of any in the Chacoan record. However, when one takes into account that these building efforts were interdigitated with many other Chacoan undertakings and subsistence activities, the scale of planning and coordination required is clear. As Sebastian stated:

> If we further consider that all of this was being done by people who were maintaining a widespread and highly active trade network, participating in a rich and potentially time-consuming ceremonial life, and, incidentally, making a living as agriculturalists and part-time hunter-gatherers in a very harsh and uncertain environment, it is difficult not to be impressed (Sebastian 1992:48).

Figure 2.1 depicts a timeline of great house construction events based on tree-ring cutting-dates (Lekson 1984; Windes 2003) and recent radiocarbon dates obtained from human burials in Room 33 at Pueblo Bonito that indicate occupation of the site pre-dates existing cutting-dates (Coltrain et al. 2007). The pace of great house construction can be seen to exhibit a low intensity, sporadic beginning and an apparent building hiatus 960-1020 CE. By 1040 CE, however, the Chacoan “big bang” had occurred and is visible in the surge in great house construction events that corresponds to the Classic Bonito subphase. After a slight decline in building efforts around 1070 CE, the intensity of great house construction again surged during the late eleventh century and continued to rise well into the early twelfth century/Late Bonito subphase.

The second correlate of centralized decision-making is Chacoan construction and use of irrigation facilities, which evolved in scale and complexity over the course of nearly three centuries. Chacoan irrigation facilities, designed to harness runoff and floodwaters for agricultural fields, have been documented throughout Chaco and the nearby great house communities of Kin Klizhin and Kin Bineola. Vivian noted that three methods of floodwater farming were utilized within the canyon: *akchin* (suitable for the south side of the canyon), terraced garden plots, and the more elaborate systems (diversion dams, canals, ditches, and headgates) feeding gridded gardens, designed to handle the larger volumes and velocity of run-off from side canyons. The latter included diversion dams, ditches, canals and associated headgates and were predominantly though not solely situated on the north side of the canyon, as evidenced by water control features in seventeen of the twenty-eight north-side drainage areas (Vivian 1974:97, 102).

To provide an indication of the scale of water control facilities employed in Chacoan agriculture, Figure 2.2 depicts an irrigation canal near the great house community of Kin Klizhin, 9 km southwest of Chaco Canyon. An example of one Chacoan gridded field system has been identified directly adjacent to the Chetro Ketl great house. The fields consisted of two rectangular, bordered plots separated by an irrigation canal. Masonry gates along the canal channeled water into individual gridded gardens, each of which averaged approximately 0.031 ha for a total of about 100 gardens/ha (Vivian 1990:312). Vivian stated that there are approximately 8 small drainages between each of the three large side tributaries, supporting an estimated 400 ha of arable land.  The south side of the canyon, though improved to a lesser extent through the construction of water control features, still supported 500 ha of cultivable land by Vivian's estimate (Vivian 1990:309).  There is no structural evidence for diversion of water from the Chaco Wash (Vivian 1990:309; cf. Loose and Lyons 1976).

Vivian (1974:103-104) posited that the water diversion systems utilized in Chaco, including the construction and maintenance of intake areas, canals, headgates, and fields would have required managerial control.  The spatial and temporal unpredictability of rainfall in Chaco would have required scheduling and coordination to ensure headgates were properly managed and water optimally utilized within a field system.  Given the force with which runoff often discharges from side canyons, damage to gate systems was probably a common occurrence and would have required swift repair.

Temporal control of irrigation facilities is less precise than for great house construction but Vivian et al. (2006:445, 453) has documented three general phases of water control  use in the canyon on the basis of associated ceramics and superposition of later facilities over earlier gates.  The earliest phase, likely dating to the period 900-1025 CE, is evidenced by masonry headgates and canals buried more than a meter below the present ground surface in the area west of Casa Rinconada (Vivian et al. 2006:438). Vivian et al. (2006:438, 442) posit that the use of large, well-constructed water control facilities was well-underway by the early eleventh century but describe the subsequent stage as, "a period of vigorous cultural development and agricultural intensification."

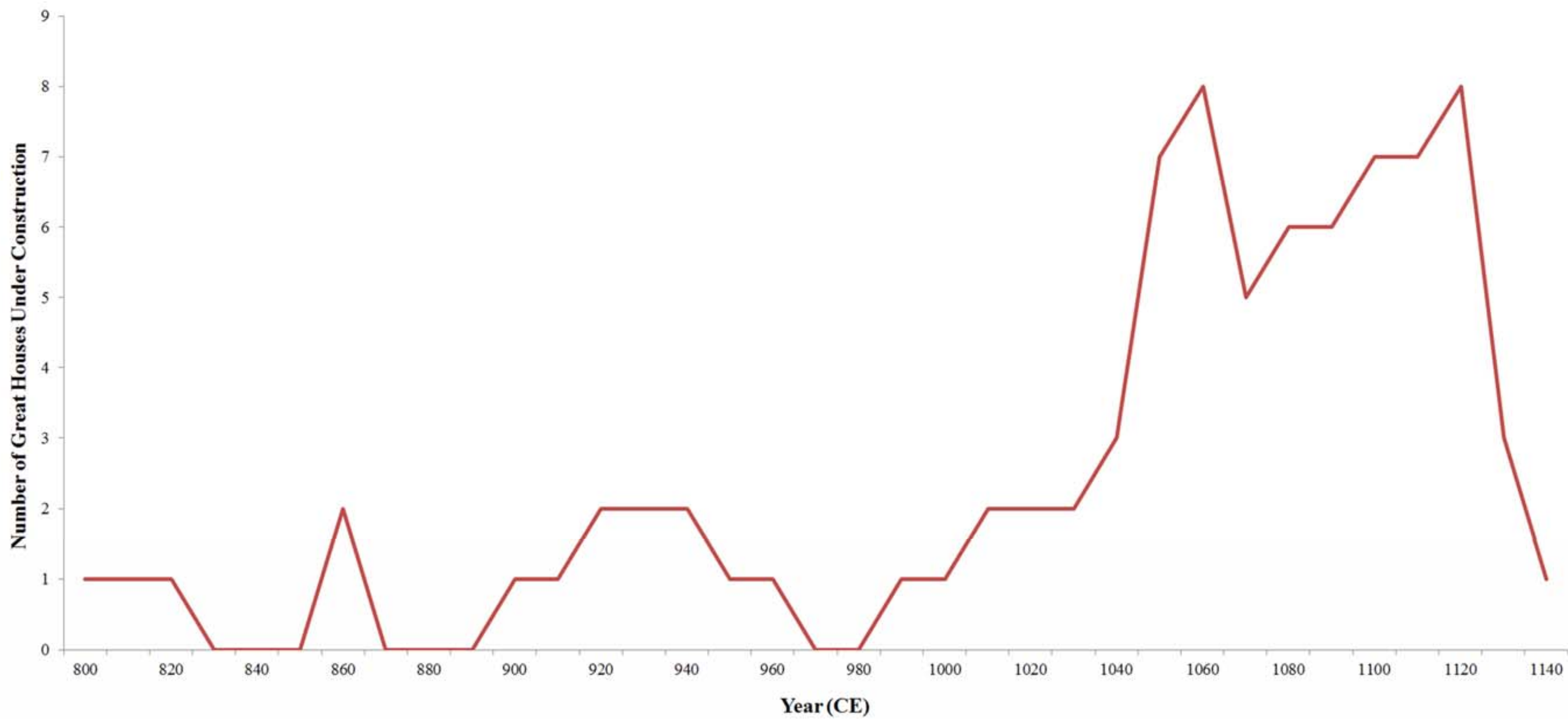


Figure 2.1: Great house construction events in Chaco through time; based on data from Lekson (1984), Windes (2003), and Coltrain (2007).

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Figure 2.2: Spillway of Chacoan irrigation canal near Kin Klizhin, looking east.  Photograph by author.

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Large masonry dams at the western end of the canyon and in one of the major side-canyon drainages and an expansion of canal systems are documented during this phase. Canals were re-oriented, channels shortened, and headgates increasingly included a large capstone, presumably to support greater quantities of water. Further, the Classic Bonito water control strategy implies a high degree of consistency throughout the canyon. Water control features likely dating to the Classic Bonito subphase have been identified in seventeen of twenty-eight side-canyons on the north side of the canyon and in two areas, near Rinconada and Peñasco Blanco, on the south side of the canyon (Vivian et al. 2006:442-445).

During the Late Bonito subphase (1100-1140 CE), water control features reflect additional structural changes. Canals become narrower and shallower during the final phase and headgates show both a reduction in size and decline in the quality of construction materials (Vivian et al. 2006:446, 452-453).

The apexes of both great house construction and use of complex irrigation strategies occur during the Classic Bonito subphase. While implementation of irrigation strategies may have declined during Late Bonito, great house continued, largely unabated through the first two decades of the twelfth century. Thus I conclude that the Classic Bonito and Late Bonito periods were the time spans most indicative of increasing centralization within Chaco. In order to situate my research project theoretically, I now turn to a brief discussion of the predominant models that attempt to account for these apparent Chacoan developments.

**Sociopolitical Organization in Chaco – A Precis of the Prevailing Models**

By contrast to the unanimity of opinion concerning Chaco's political centralization, the most contentious debates over Chacoan complexity stem from data that offer tantalizing but equivocal evidence for hierarchy and economic specialization. Like many Chacoan scholars, Mills (2002:66) observes that, "except for a few unusual burials…the construction of great houses was not accompanied by obvious signs of status and hierarchy, such as social ranking, palaces, limited access to long-distance goods, or a means of controlling the staple economy".

Beginning with Kluckhohn's (1939) pioneering attempt to offer alternative, testable hypotheses to account for archaeological variation in Chaco Canyon, researchers began to generate and test a range of explanatory models. At the conclusion of several seasons of excavation at three small sites (Bc 50, Bc 51, and Łeyit Kin) in Chaco Canyon, anthropologist Clyde Kluckhohn came to the conclusion that previous developmental models were insufficient to account for the observed variation in the archaeological record. His findings, based on ceramic evidence and tree-ring dates, that large sites and small sites may have been contemporaneously inhabited, were incongruous with the Pecos classification and ran counter to the then conventional interpretation of "House" sites as developmental precursors to "Great Pueblo" sites such as Pueblo Bonito and Chetro Ketl (1939:157). Having cast doubt upon the temporally-based theory, Kluckhohn presented two alternative hypotheses. First, he suggested that the large sites and small sites might represent separate autochthonous traditions, the latter of which constituted the "poor relations" or "conservatives who refused to adopt the progressive architectural styles of their congeners across the canyon" (1939:158).

Second, he offered the possibility that rather than "poor relations," the inhabitants of the small sites were "migrants from another region, representatives of a related but somewhat less advanced cultural heritage" (1939:159). The former "in situ development" hypothesis was to gain considerable momentum among several Chacoan archaeologists.

Following Kluckhohn and later Gordon Vivian and Thomas Matthews (1965), R. Gwinn Vivian (1970) espoused the notion that the large site – small site dichotomy described above, was best explained as the "culmination of a long in situ development of two cultural traditions whose differences could be attributed to contrasting organizational systems" (1990:399). Grebinger (1973:10) countered, asserting that the town vs. village dichotomy instead reflected a ranked society, wherein differential access to summer-dominant rainfall tipped the scales in favor of groups that exploited greater productive potential and assumed a leadership and redistributive role. For Grebinger, high status derived from differential access to arable land and status differentiation became ever-more pronounced with the population growth permitted by agricultural intensification (1973:7). The major shortcoming in Grebinger's model, however, lay in the perceived lack of evidence for the widespread status differentiation and full-time craft specialization he predicted.

While Vivian's use of systematic models was ground-breaking and innovative, it was Grebinger's formative study – attempting to address the range of observed variation in the archaeological record and to account for Chacoan complexity and the conditions and processes crucial to its development – that presaged the frameworks introduced by later researchers.

### *The Pilgrimage Fair Model*

One dominant framework developed by the Chaco Project and often termed the "pilgrimage fair model" evolved from the project's initial working hypothesis that Chaco functioned as a redistributive system, reallocating food throughout the San Juan Basin to offset environmentally induced inequities in agricultural success.

This classic redistribution model held that Chaco ostensibly located in a zone favorable to agriculture and in a central location that made administration more efficient, emerged as an adaptive response to environmental uncertainty. The canyon, so it went, would have served as a central "pooling-repository" where staples generated inside and outside Chaco could be imported, stored, and redistributed to other parts of the San Juan Basin to mitigate the effects of environmental inconsistencies (Judge 1979). Under this model, political leadership in Chaco was predicated on administration of this redistribution system and great houses were constructed to serve as watershed-specific pooling areas. A core assumption of the model was that raw materials or finished goods produced in Chaco would have been exported in exchange for subsistence goods flowing into the canyon. The model proposed by Schelberg (1982) similarly theorized Chaco as the nucleus of a complex and hierarchically organized three-tiered network formed as an adaptive response to an unpredictable environment. Implicit in Schelberg's framework was the canyon's inability to produce reliable agricultural surplus and he argued that eventually the system collapsed under the strain of an increasingly fragile redistributive economy.

The National Park Service excavations at Pueblo Alto confirmed the high rates of imported Chuskan ceramics previously documented by Shepard (Shepard 1939; 1954) –

the Chaco Project upper estimates suggested as many as 150,000 vessels disposed during the late eleventh century (Toll 1985:196). This finding, coupled with the concentrations of raw and finished turquoise among canyon small sites and great houses in vastly higher quantities than at contemporaneous sites elsewhere in the Southwest, led researchers to conclude that large quantities of materials were flowing into Chaco with little or no evidence of what might have been traded out as would be expected in the redistribution model (Kantner and Kintigh 2006:166). It should be noted that the potential importance of perishables such as hides and basketry as possible exports received little attention during Chaco Project investigations.

Beyond the sheer quantity of vessels deposited in the trash mound at Pueblo Alto, Toll (1985:396, 399) interpreted Akins' relatively high faunal consumption estimates as further evidence for periodic consumption events. Windes (1987b:608) asserted that clear boundaries were visible between layers in the Alto trash mound that were the result of discrete seasonal or annual depositional episodes.

As this evidence came to light over the course of the Chaco Project's research, alternative hypotheses were sought (Judge 1989; Mills 2002:78; Toll 1985; 1991:80). Windes' (1984; 1987b) case for equating hearths with households and Bernardini's (1999) attempts to identify distinct room suites within great houses resulted in drastic reductions in population estimates for the canyon. Both Windes' methods and Bernardini's reliance on Hopi analogues remain a subject of debate, but researchers have nonetheless widely accepted these lower population estimates. The reduced population estimates largely diffused the debate over whether the canyon would have been capable of provisioning a large perennial population given its potential marginality for agricultural. However, the possibility of a small population has left researchers at somewhat of a loss to explain the apparent scale and intensity of production, construction, and labor investment evident in Bonito Phase Chaco Canyon.

The conclusion many researchers reached was that Chaco could be understood as an empty ceremonial center that witnessed periodic population influxes from the surrounding region. Thus the "pilgrimage fair model" was born. These gatherings, argued to have occurred under the pretext of shared ritual observances, facilitated the exchange of raw materials, crafts, and subsistence goods (Judge 1989; Kantner 1996; Lekson et al. 1988; Nelson 1995; Saitta 1997; Toll 1985; 2001; 2006; Van Dyke 2007a; 2011; Van Dyke 1998; 1999; 2004). The tenets of this model, namely that the repeated communal events entailed large scale feasting and exchange, that maize agriculture in the canyon was unpredictable and unproductive (Schelberg 1992), and that as a consequence the population of Chaco remained relatively low throughout its florescence, are suppositions that remain largely untested (Breternitz et al. 1982; Cully et al. 1982; Lekson 1988; Toll 1985; Vivian 1990; Windes 1984). Judge distinguished five broad phases under this model: Initialization (early tenth century-CE 1020), Formalization (CE 1020-1050), Expansion (CE 1050-1115), Reorganization (CE 1115-1140), and Collapse (CE 1140-1200).

The Initialization and Formalization phases, corresponding to the Early and Classic Bonito subphases, are defined by environmental variability, increasingly formalized great house construction at the confluences of major drainages, and Chaco's rise to dominance predicated on its status as the primary source of finished turquoise in the San Juan Basin (Judge 1989:234-236). The Expansion phase, equated with the second half of the Classic Bonito period, was accompanied by a prolonged period of favorable environmental conditions and was marked by a shift in subsistence focus, overall population decline, the development of a vast road network, increasing frequency of central consumption events, and great houses increasingly functioning to accommodate “periodic influxes of people in substantial numbers” in a manner similar to the pilgrimage fairs of the lowland Maya. The Reorganization phase or Late Bonito period saw continued advantageous climatic conditions and further shifts in subsistence strategies and great house construction and function, as well as population increase. During the final period of collapse, correlated with the onset of a fifty-year drought, building came to a complete halt and the population appears to have entered into a gradual decline.

In sum, Chaco was an adaptive system adjusting to environmental stimuli, population dynamics, and historical contingency, and was at times a sparsely populated ceremonial center.

In more recent years, the pilgrimage fair model has gained momentum as researchers have increasingly attributed Chacoan florescence to the canyon’s status as a ritual center for the surrounding San Juan Basin, have emphasized the role of social memory and shared cosmography, and downplayed the significance of social differentiation (Judge 1989; Kantner 1996; 2003; Lekson et al. 1988; Nelson 1995; Stein and Lekson 1992; Toll 1985; 2001; 2006; Van Dyke 2007a; Van Dyke 1998; 1999; 2004; Yoffee 2001). Although these approaches rightly draw much needed attention to the role that ritual might have played in Chaco’s ascendancy, the case relies heavily on the still debatable occurrence of pilgrimage fairs and ultimately brings researchers no closer to grappling with the nature of production and the extent to which social differentiation corresponded with the “institutionalized social and political authority” of the Bonito Phase (Van Dyke 2004:415). In fact, a recent reevaluation of the evidence from Pueblo Alto (Plog and Watson 2012) failed to identify material signatures indicative of large population influxes, calling into question the validity of the pilgrimage fair model. Thus while feasts and communal ritual were almost certainly an important aspect of life at Pueblo Alto it seems the overarching pilgrimage fair model stands on shaky ground.

### *Staple Finance Model - Surplus as Power*

Sebastian’s (1992) theoretical model of Chacoan political evolution differs from the pilgrimage fair model primarily in that she regarded the development as an internal phenomenon generated in response to resource stress, rather than one driven by external impetuses.

Here Chaco is conceptualized as a staple finance system in which the mobilization of labor was based on the control of food production and the production and exchange of prestige goods was peripheral to the broader staple finance system (Earle 2001; Sebastian 1992). Based on correlations between environmental trends (both beneficial and detrimental) and great house construction episodes, Sebastian (1992) argued that political centralization in Chaco resulted from unbalanced reciprocal exchanges between groups having differential agricultural productivity, ultimately resulting in "patron-client" relationships. While Sebastian’s use of prehistoric rainfall data is invaluable, her study fails to adequately address either the relative productivity of the canyon’s agricultural land or economic productivity in general.

Sebastian (1992) was one of the first archaeologists to part with previous typological approaches to sociopolitical organization in Chaco, focusing her attention on the question of how leaders garnered and maintained support. Her groundbreaking study modeled climatic trends, their implications for agricultural production, and the timing and scale of building efforts. Interestingly, Sebastian found that the major Bonito Phase construction episodes did not simply correlate with favorable environmental conditions and she deduced that Chacoan leadership likely drew on factors beyond staple finance alone.

Based on climate-driven simulations of maize production and storage, she constructed a dynamic interpretation consisting of three main patterns. The first period (900-1040 CE) was characterized by an initial burst of building, correlated with periods of low agricultural productivity that Sebastian suggested was akin to competitive "Big Man" behavior where assertions of power were of limited extent and short-lived. During the second period (1040-1100 CE), the building efforts reached a crescendo, corresponding to high agricultural productivity, from which Sebastian inferred the availability and mobilization of large pools of labor on a consistent basis. The third and final period (1100-1130 CE), despite some of the best agricultural years, resulted in more limited building efforts, with a focus on smaller so-called "McElmo-type structures." The third and final period (CE 1100-1130), despite some of best agricultural years, resulted in more limited building efforts, with a focus on smaller so-called "McElmo-type structures." Sebastian subscribed to the notion that by the eleventh century great houses may have assumed a distinctly nonresidential purpose (1992:125) but acknowledged that the latter period remains less understood due to a lack of archaeological research on McElmo structures.

Sebastian's model is fundamentally similar to that of Grebinger in that she regarded sociopolitical differentiation in Chaco as resulting from unbalanced reciprocal exchanges between groups having differential agricultural success, ultimately resulting in "patron-client" relationships. She diverged however by focusing on the growth of complexity in terms of power relationships. Following Johnson (1978) and Haas (1982), she reduced the problem of leadership to: suppression of segmentation, legitimation, competition, and succession.

While her analysis stands as one of the most thorough, a major limitation lies in the model's reliance on apparent correlations between climatological fluctuations, differential quality of agricultural land, and sociopolitical developments with little or no empirical consideration of canyon hydrology, relative suitability of land for maize agricultural, and carrying capacity. Sebastian's case for developing complexity can be further tested by examining patterns of differential consumption of fauna as it relates to conditions of social differentiation and to distributions of bone tools indicative of changes in the types and relative importance of craft production.

A second model of Chacoan political economy can also be subsumed under the "staple finance" approach. Earle (2001) has proposed that Chaco Canyon functioned as a corporate chiefdom in which "faceless" leaders mobilized the labor of the broader canyon population through an as yet unidentified method of controlling surplus food production. Earle (2001:34) contends that while exchange of prestige goods, such as turquoise and shell, occurred within the Chacoan economy as part of a noncentralized reciprocal exchange network it was not involved in the system of finance.

Whether citing disparities in agricultural productivity on a regional scale (Judge 1989) or within Chaco Canyon itself (Sebastian 1992), the reliability of the canyon to provide a stable agricultural base is central to both of the dominant models. In the near absence of information on how craft production and exchange was structured, it has not been possible to evaluate the arguments regarding the organization of the craft economy set forth in these models. Thus my research focuses on the nature and organization of both subsistence and craft production in Chaco Canyon as it relates to changes in sociopolitical differentiation. The goal is to expand researchers' understanding of the role production and exchange played in the integration of settlements within the canyon and the greater San Juan Basin.

Having considered the dominant explanatory frameworks commonly utilized to explain culture change in Chaco Canyon, in the following chapter I present more general theoretical models and Pueblo ethnographic data that are helpful in drawing attention to certain shortcomings of the dominant models and from which my research hypotheses stem.

## Conclusion

The dominance and longevity of the two principal explanatory frameworks speaks to their viability as models of culture change in Chaco Canyon. That these models are empirically based has encouraged continued testing, e.g., Benson et al. (2003), Plog and Watson (2012), Wills (2001), essential if we are to continue expanding our knowledge of the complex archaeological record of the canyon. However, the models leave many questions unanswered.

For instance:

- To what extent is the political change observed by Sebastian reflected among small house sites?
- If agricultural intensification is linked to political change in the canyon, to what degree does the archaeological record reflect other forms of subsistence intensification?
- Where were the agricultural fields in Chaco located? How large were they and how might canyon-wide agricultural production have varied based on specific conditions such as soil, vegetation, field location, and catchment size?
- Does evidence for pilgrimage fairs extend beyond the Pueblo Alto case? What role might small site inhabitants have played in Chaco-as-ritual center?
- How might the organization of production be expected to vary under each explanatory model?

Specifically, this research addresses both the ritual-based pilgrimage fair model and the staple finance model by exploring the role of subsistence intensification and household production, by asking: 1) How is increasing political centralization in Chaco, either as a result of its position as a regional center or the functioning of a staple finance economy, materialized in the faunal record at two small sites?; and 2) To what extent do inter-site trends in the organization of bone and perishable craft industries covary with political change?

Thus, through an investigation of both ceremonial and quotidian contexts it becomes possible to examine the variables of political centralization, social differentiation, and economic intensification. The implications of this study are relevant in the broader scope of anthropological inquiry with the potential to advance the ongoing discourse on social change and societal complexity (Earle 1991; Paynter 1989; Sanders and Webster 1978; Spencer 1990; 1997).

# CHAPTER 3: COMPLEXITY AND THE CHACO CASE STUDY

Although modern humans have been in existence for more than two hundred millennia, only in relatively recent prehistory have societies undergone the social, political, and economic changes that gave rise to what we know today as complex societies. The emergence of state-level organization "has introduced the possibility of unparalleled material well-being while facilitating exploitation on a hitherto unimaginable scale and bringing life on earth to the brink of extinction" (Roscoe et al. 1993:111). However, political evolution as a process is neither linear nor inevitable and anthropologists continue to grapple with the socio-environmental conditions and catalysts that promote political change.

## Complexity, Power, and Hierarchy in Small and Intermediate Scale Societies

The nature and diversity of hierarchy and power, and complexity more broadly, remains at the heart of an ongoing debate among scholars about prehistoric Puebloan sociopolitical organization. The study of these themes, however, occurs within a wider theoretical and methodological discourse in anthropology.

### *Complexity*

In studying complexity – a pursuit firmly rooted in nineteenth century social evolutionary theory – archaeologists have more recently eschewed typological approaches and trait lists (cf. Carneiro 1970b) in favor of dissecting the concept into constituent variables. Flannery (1972) was one of the first archaeologists to attempt this, conceptualizing his systemic view of society in componential terms. He conceived of complexity as comprised of two variables: *segregation*, defined by the degree of differentiation and specialization, and *centralization* as the degree to which parts are interconnected and related to levels of social regulation.

Building on Flannery's framework, McGuire similarly regarded complexity as multidimensional, but added that it should be understood as forming a continuum. McGuire (1983:101-102) distilled complexity into two variables, *heterogeneity* or the number of distinct social personae as measured along both horizontal and vertical axes and *inequality* or the distribution of a population along a graduated vertical axis. Nevertheless, his somewhat narrow characterization of complexity in terms of only two variables fell short of providing researchers with a model readily applicable to archaeological study.

Following Easton (1959), de Montmollin (1989:16-17) proposed a useful conceptualization of complexity as composed of *bundled continua of variation*, akin to approaches adopted by several Mesoamerican scholars (Blanton et al. 1981; Kowalewski and Finsten 1983; Kowalewski et al. 1983; Steponaitis 1981). de Montmollin asserted that the theoretical utility of the *bundled continua* approach lies in its flexibility for both diachronic and synchronic contexts. For the former, a researcher may trace "movement through time along the various continua, testing for theoretically expected inter-relations among changing continua" and, for the latter, by examining specific attributes in relation to various continua, the analyst may test for the theoretically expected co-occurrences of several variable states (1989:19). de Montmollin's model draws on the contributions of Flannery and McGuire, providing a versatile and broadly applicable heuristic for the study of small scale and intermediate societies.

The major advantage of de Montmollin's and McGuire's approaches is that it highlights the need to decouple centralization and differentiation (Mills 2002:77). While these two dimensions of complexity are linked, the ethnographic and archaeological records attest to the complex and often indirect relationship between political centralization and hierarchy (Feinman 2001:172; Roscoe et al. 1993:113).

That this distinction is necessary stems from the common conflation of the terms political centralization, social differentiation, and economic differentiation[2] under the broader concept of political evolution (Roscoe et al. 1993:113). As Roscoe (1993:113) observed, "although political centralisation, socioeconomic differentiation, and social stratification often covary, they cannot be considered as merely facets of some single underlying state or process. They are products of quite different, albeit linked, processes." With this in mind, I turn now to a discussion of power as one variable of complexity.

### *Power*

Critical to any discussion of complexity, and its reflection in these various continua is a consideration of the "power base" upon which political formations are founded and through which political will is exercised. Drawing on earlier work by Adams (1975), Haas (1982:159) defined power as that "portion of the environment controlled by a power holder and of importance to a respondent." For heuristic purposes, he further separated "environment" into economic, ideological, and physical realms, of which each, he argued, may be utilized as a power base by individuals or groups aspiring to or attempting to maintain dominance.

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[2] The term political centralization as it used here refers to the increasing concentration of power and decision-making among fewer individuals; hierarchy, stratification, and social differentiation refer to differences in social status; economic differentiation is used to refer to economic specialization.

The relationship of economic power to increasing complexity as theorized by archaeologists has taken two general forms. Under so-called *managerial* models, activities requiring centralized direction included: (1) exchange and redistribution of subsistence and non-subsistence resources, themselves distributed unevenly across a landscape (Service 1962); (2) the construction and maintenance of irrigation complexes (Wittfogel 1957);[3] (3) warfare (Carneiro 1970b; Spencer 2003); and (4) subsistence risk management achieved through the stewardship of food stores (Flannery 1972:409; Fried 1967:183). Thus centralized decision-making structures emerged as a response to increasingly complex interactions. Alternatively, Earle's (1987a:294-297) theory of *control*, similar to that of staple finance, holds that political leadership emerged by virtue of circumstantial, differential access to and control over food production, mobilization of staple goods, exchange relationships, and the distribution of prestige goods.

Ideological power bases as described by Earle (1991:6) are those principles which "strengthen the legitimate position of leaders as necessary to maintain the 'natural' order of the world." They include the ability to exploit existing ideas of legitimacy such as ties or access to the past and the supernatural; the creation of new principles of legitimacy; control over internal production and distribution of wealth; and the ability to control the procurement of external wealth (Earle 1991:6). Indeed, as discussed in more detail below, Helms (1993; 1998) has argued convincingly for the importance of demonstrated access to cosmological origins, claims of first-principle charter, and ties to "geographically distant peoples and places that are situated in supernaturally defined cosmographical realms," for mediating relationships between competing groups and

[3] Often categorized by scholars as "managerial" in nature, Wittfogel (1957) also argues that oriental "despots" further exploited their positions of control to solidify their role as political elites. Thus, the "hydraulic society" model could as well be characterized as of the "control" variety.

between elites and non-elites (1998:148-149). While in Earle's (1987a:298) terms, religious ideology is largely epiphenomenal and a tool manipulated by an emergent elite to justify their rule and bind followers to them, several archaeologists (Hodder 1982; Miller and Tilley 1984; Pauketat 1994; Pauketat and Emerson 1991) have leveled critiques of this commonly-held perception, asserting that the relationship between cosmology and ritual on the one hand and economic base on the other, is of a dialectical and often mutually reinforcing nature (Miller and Tilley 1984:148).

Physical power, "derived from managerial control over the personnel in a military or police force" (Haas 1982:160) may have constituted a control strategy in Chaco (Wilcox 1993). Archaeological evidence of social conflict is not unusual in the Pueblo Southwest (Wilcox and Haas 1994) and the use of capital punishment is well-documented among Eastern Pueblos (Hill 1982:146-151, 187; Ortiz 1969:75). There is, as of yet, little compelling evidence to suggest the presence of standing armies or specialized warriors in Chacoan society. But as Upham (1982:95) notes, the expression of coercive power is not achieved solely through the existence of armed legions, but also through the exercise of control over "strategic social and natural resources" – an expression of power that lends itself well to the study of subsistence and production.

To reiterate, the separation of the concept of power into discrete categories is, in reality, a false distinction since the components are undeniably intertwined. However, the discussion emphasizes an important limitation of archaeological studies of political evolution. Political change is not solely reflected in material culture and only certain manifestations of power can be expected to produce correlates identifiable archaeologically. As noted by Feinman (2001:172), the existence of patterns consistent with centralization when lacking evidence of social differentiation and vice versa frequently confound archaeological inquiry. Shifting focus from power to the dimension of hierarchy, it will be shown that social differentiation is similarly expressed in both material and non-material ways.

### *Hierarchy*

Throughout much of the twentieth century, anthropologists studying social inequality predominantly regarded societies as either unequivocally *egalitarian* or *hierarchical*. As Flanagan observed, this tendency stemmed from the nineteenth century perspective that "treated egalitarianism as a sort of evolutionary starting point, with evolutionary social differentiation leading inevitably to hierarchy" (Flanagan 1989:260). The Western inclination to idealize, naturalize, and finally ignore the concept of egalitarianism, privileging inequality as the subject of inquiry, inadvertently masked the diversity inherent in "egalitarian" cultural systems. In fact, recent research (Wiessner 1998; 2002b) has shown that egalitarian subsystems may operate within rigidly hierarchical systems, while supposedly egalitarian systems may conceal entrenched hierarchies, and further, equality and inequality may articulate as contextually-dependent modalities within a single social system (Flanagan 1989:261-262). Sather clarifies this apparent contradiction by noting the distinction between ideology and practice, distinguishing an "egalitarian" ideology from the objective reality of "equality" and likewise "hierarchy" from "inequality" (1996:71-72). Bearing in mind this distinction, the following discussion focuses specifically on those circumstances in which both the ideological and economic reflections of hierarchy are institutionalized and coterminous, within what are traditionally termed "chiefdoms."

Before moving on to consider the utility of hierarchy as an analytical concept, discussion of its past relevance to archaeological models of sociopolitical complexity is warranted. Although its origins can be clearly traced to the neo-evolutionary paradigms of Leslie White (1949; 1959) and Julian Steward (1955), the concept of status differentiation or ranking became central to discussions of sociopolitical development with the introduction of Service's (1962) and Fried's (1967) typological sequences (Chapman 2003:34; Trigger 1989:289-290).

Service (1962:135-139) regarded the emergence of status differentiation as the direct result of increasing economic specialization and control of resource redistribution. As the redistributive system became more complex, the social standing associated with the office of redistributor grew concurrently. In other words, social standing grew out of economic and managerial power.

Like Service, Fried (1967:182-183) posited that the two overriding factors driving status differentiation were economic redistribution and the vagaries of demography. However, Fried also accepted that social ranking could stem from myriad other intersecting and overlapping circumstances that extended beyond the ecological and economic spheres. Presaging the work of Helms (1998), Fried maintained that status differentiation could and often did derive from structural relationships between neighboring groups such as those between original settlers and subsequent migrant groups.

Unlike Service, Fried (1967:185, 211-212) contended that social stratification preceded complex political institutions. Fried acknowledged that truly stratified societies lacking the controlling mechanisms of political institutions, while non-existent today, probably existed in prehistory (1967:185-186, 224). These societal types were, Fried argued, inherently unstable and ephemeral in nature because the unequal access to resources within a stratified society could not be maintained without the buttressing of a strong political structure.

With Flannery's (1972) and later Wright and Johnson's (1975) and Lightfoot's (1984) focus on decision-making hierarchies, the efficient control of information processing became a central concern in the study of state formation processes. Marxist (Gailey and Patterson 1987) and agent-based archaeological models (Clark and Blake 1994; Kantner 1996) have likewise depended heavily on the role of hierarchical organization in structuring patterns visible in the archaeological record. However, due to the difficulty of detecting the correlates of hierarchical organization in many archaeological contexts, a growing trend within the discipline has been toward the use of frameworks that either explore parallel, potentially coterminous non-hierarchical patterning (Crumley 1979; 1987; Ehrenreich 1995; Ehrenreich et al. 1994; Rautman 1998) or include models of sociopolitical organization that sidestep the question of hierarchy altogether in an effort to understand political strategies (Blanton et al. 1996; Earle 2001; Feinman et al. 2000). Having briefly reviewed the history of the anthropological discourse on hierarchy, I now examine the concept more closely before exploring its potential correlates in the archaeological record.

Helms (1998:97-98) defined hierarchy as the orderly ranking of units, accepted by a particular society as legitimate, and she distinguished between the quantitative and qualitative nature of this ranking. What she termed the "inclusive" type is based on a ranking of constituent units that are structurally "alike in kind" as with the clans of the

Hopi wherein ranking is established in terms of first-principle origins and those ceremonial possessions with which each clan arrived (Levy 1992:23-25). As for her "exclusive" type, hierarchy is the ordering of differences of a "type" that "ranks the house and its outside affinal groups" and derives from the hierarchy and inequality inherent in the very structure of the cosmos (Helms 1998:98). While it is this latter form that Helms regarded as diagnostic of the existence of chiefly elites, she also acknowledged the potential for both "types" to coexist (Helms 1998:96), and indeed this may have been the case in Chaco. This qualitative difference is often expressed through the aristocratic sector's ability to: 1) evince ties to cosmological origins, 2) control the supernatural, and 3) establish structurally superior status over commoner groups, i.e., through the formation of multiple affinal ties (Helms 1998:149).

For Helms, it follows that activities related to subsistence, artistry, trade, and warfare are consequently accorded political-ideological significance "because abundance, fertility, creativity, acquisition, and victory all signify the presence and support of the supernatural" (Helms 1998:101). Helms emphasized that the emergence of a qualitatively distinct hierarchy and inequality is tied to increasing political centralization and thus should not be regarded as a new cultural creation. Rather, "the principles of inequality and hierarchy" are already prefigured in the non-centralized conceptual "environment" and their formal expression in chiefdoms results from successful surmounting of efforts to contain them (Helms 1998:178). Cross-culturally in traditional societies, these hierarchical relations may be played out between social units, operating at the household, lineage, or community level, in a variety of contexts. It is my contention that these multi-scalar interactions are potentially discernible archaeologically in patterns of economic production and consumption.

**Social Differentiation and the Pueblo Southwest**

Thus although the relationship is subject to debate, there is wide agreement among scholars of preindustrial intermediate-scale societies that political complexity exhibits a strong positive correlation with degree of status differentiation (Carneiro 2010:157-158; Clark and Blake 1994; Cordy 1981; Feinman and Neitzel 1984; Hayden 1995; Maschner 1995; Sahlins 1958; Wright and Johnson 1975; Yoffee 2005:16-17).

While the basis for such differentiation may be diverse – whether by age, gender, kinship, ethnicity, or occupation – its expression often assumes a vertical or hierarchical structure. The staple finance model of Chacoan political development attributes the emergence of power and status differentials to differences in agricultural success. Advocates of the pilgrimage fair model see evidence of political inequality inherent in the periodic ritual gatherings in Chaco with leaders' "power legitimated through exclusive access to ritual knowledge" (Van Dyke 2011:15). Thus the dominant models of political evolution presented above allow that hierarchical sociopolitical differentiation, whether based in economic or ritual power, was a reality of Bonito phase Chaco but neither explicitly tests for the presence or absence of its archaeological correlates.

During the 1980's a contentious debate erupted over the relative degree of social differentiation evidenced by the archaeological remains of fourteenth century Western Pueblo communities. One group of archaeologists (Upham 1982; Upham et al. 1989; Upham and Plog 1986) maintained that the large ancestral Hopi site of Chavez Pass Pueblo reflected a society controlled by elites. Other scholars (Graves et al. 1982;

Longacre and Reid 1974; Reid and Whittlesey 1990) favored a more egalitarian model of ancestral Pueblo social organization, basing their conclusions on excavations at the site of Grasshopper Pueblo. Although the debate went largely unresolved, the dialogues directed much needed attention to the question of whether modern Pueblo groups are appropriate analogs for ancestral Pueblo social organization. The general consensus is that such comparisons while often useful must be approached with caution. For this reason, the present study also draws heavily on cross-cultural ethnographic and archaeological comparisons.

More recently, Southwestern archaeologists have begun constructing models that consider the potential coexistence of hierarchy and egalitarianism within prehistoric Puebloan societies. Plog (1995:192) called for the implementation of more realistic, "holistic," and flexible models that "admit the possibility of hierarchical dimensions and allow for variation in the extent to which hierarchy is present." McGuire and Saitta's (1996) "dialectical model" and Feinman et al.'s (2000) use of dual processual theory (Blanton et al. 1996; Earle 2001) move the discourse beyond the contentious debates over the presence or absence of inequality. Although both constitute useful approaches that enable the researcher to investigate *how* rather than *if* a society was complex, neither brings us closer to grappling with how the coexistence of hierarchy and egalitarian institutions might be recognized archaeologically.

Nevertheless, as Upham observed the Pueblo ethnographic record can be of considerable utility in identifying how organizational forms "manage and control the sociopolitical, economic, and religious activities for populations of different size and composition" (Upham 1989:101). He cautioned that when utilizing ethnographic sources, it is incumbent upon researchers to bear in mind the impact of centuries of Western influence, the importance of ceremonial "property" as a basis for political organization and control in Pueblo society, and that "social stratification based on ritual preeminence…confers to the elite stratum…sacred and secular authority, economic privilege, and coercive political power" (Upham 1989:101-102). Cordell (1989:52) agreed, but asserted that there exist "no tangible referents for such an elite, available to the archaeologist" since "those who control ritual knowledge live no differently from anyone else." This of course, is an important observation and may well be true of prehistoric Pueblos, but it is an assumption that requires testing.

As an invaluable source of information, the Pueblo ethnographic record attests to the existence of hierarchical differences in Pueblo society, manifested in ritual, economic, and political organization, and it is to this important comparative data that I now turn.

### *Hierarchy and Political Power in Pueblo Ethnography*

The anthropological study of the Pueblos is a tradition with roots extending back into the late nineteenth century. Consequently the ethnographic literature constitutes both an exceedingly rich source of information and one heavily influenced by the essentializing tendencies of early studies. The following section offers a brief overview of the theoretical trends in Pueblo ethnography as they relate to the sociopolitical, ceremonial, and economic organization of the Pueblos.

Several studies completed during the late nineteenth and first half of the twentieth centuries contributed to the commonly held view of the Pueblos as an egalitarian and largely homogeneous people. Benedict's (1934:79-80) broad characterization of the Pueblos as strictly "Apollonian"– that is, driven by an affinity for sobriety, peace, and the maintenance of the status quo, and a distrust individualism in any form – crystallized what Upham (1989:78) terms the "Composite Pueblo Model" echoed in the works of Bunzel (1932) and later Dozier (1970:187-189). In his seminal analysis of Puebloan social organization, Eggan (1950) followed Titiev (1944:67-68) in regarding the Hopi as politically acephalous beyond the village level. In this same work, however, Eggan took a critical step toward dispelling the notion of a homogeneous Pueblo culture, defining a typological distinction between the Western and Eastern Puebloan kinship systems that reflected a divergence of cultural trajectories.

Thus while some early twentieth century studies had indeed attempted to grapple with the hierarchical aspects of Pueblo politico-ceremonial life (Parsons 1939:158), the paradigm of the "egalitarian" Pueblos persisted until the late twentieth century when several scholars completed new fieldwork (Brandt 1977; Ford 1992; Hill 1982; Ortiz 1969; Whiteley 1988). The major contributions of these more recent "Revisionist" studies have been to detail the variability in Western and Eastern Puebloan social, politico-ceremonial, and economic organization; to reveal the importance of control over ritual knowledge and offices; and to demonstrate the hierarchic and (for Upham and Levy) oligarchic nature of Pueblo life (Brandt 1994; Fox 1967; Levy 1992; Schlegel 1992; Upham 1982, 1989; White 1932). A closer examination of the ethnographic record illustrates the many ways social hierarchy is reified and reinforced among Western Pueblos such as the Hopi and Eastern Pueblo groups like the Tewa.

*Hierarchy Among the Hopi*

Eggan's and Titiev's conclusion that Hopi society was generally acephalous can be largely traced to their theoretical perspective, that of descent theory which in turn structured their interpretation of Hopi kinship. At least two of the kinship units – phratry and lineage – identified by Eggan, and Titiev do not have direct referents in Hopi language. In addition, the fluid nature of the Hopi term for clan *(-ngyam* and -*wungwa*) has been a source of considerable confusion.

Eggan and Titiev, who conducted the bulk of their fieldwork at Oraibi from 1933-1934, conceptualized Hopi social structure as composed of discrete elements that crosscut one another horizontally and vertically and thus maintained the integrity of the whole (Eggan 1950; Titiev 1944). For them, the vertical structure consisted of matrilineal descent groups of increasingly inclusive levels: household, lineage, clan, and phratry (Whiteley 1998:57). Horizontally, religious sodalities and kiva groups interweave with the vertical structure at three different levels: First Order Societies (*Aa'alt, Kwaakwant, Wuwtsimt, Taatawkyam, Sosyalt, Mamrawt*), Second Order Societies (*Sakwalelent, Masilelent, Tsu'tsut, Tsöötsöpt, Lalqont, Owaqölt*), and Third Order Societies (*Powamuy, Katsina*) (Whiteley 1998:57). Between the ages of six and ten, all Hopis are initiated into either one of the Third Order Societies, at which point they become eligible to join a Second Order Society (the latter are differentiated along sexual divisions). Sometime between the age of sixteen and twenty, all Hopi males undergo *Wuwtsimt* or "Manhood" initiation (at which point *Sosyalt* initiation becomes possible) and females are initiated most often into the *Mamrawt* society. As discussed in more detail below, ceremonies are owned by a particular descent group which ideally provides the chief-priest while society members may be of any descent group. In Titiev's and Eggan's models, membership in societies and kiva groups (which are more fluid) provides the critical weft to the descent-based warp of Hopi society.

Households are the smallest distinct units of Hopi society, consisting of an exogamous kin group, related through a common ancestress, and sharing a common residence. Titiev acknowledged that it is possible for a household to represent an entire matrilineal lineage, but that most often, it is only a segment. For Titiev, households are not distinguished by name, do not possess a *wu'ya* or clan sacra, incorporate family through matrilocal residence and, especially in terms of ceremonial office inheritance, comprise the "most important social unit of all" (Titiev 1944:58).

Under Titiev's model, lineages are exogamic groups of matrilineal kin, descended from a single ancestress. Titiev argued that the lineage is the vaguest of all the categories because the descent line is not always demonstrable, it lacks both a name and a *wu'ya* (clan sacra), and because the unit may be distributed over multiple households. He maintains that its importance lies in the heritability of certain sacra and offices (Titiev 1944:58).

For Titiev, "the role of the matrilineal clan in the total kinship system is simple and clearly defined" (Titiev 1944:11). A clan is "a totemically named, exogamous, unilateral aggregation of matrilineal kindred, comprising one or more lineages all of which are supposedly descended from one ancestress" (Titiev 1944:58). Titiev noted that in addition to prescribed marriage rules, clans are also identifiable based on their connection to the *wu'ya* that form the nucleus of the clan's ritual. On this basis, Titiev asserts that because of its association with the *wu'ya*, the clan is the only unit of kinship defined in native terms and is thus the "cornerstone" of Hopi society. As noted below, the *wu'ya* is in fact maintained and passed down through a single lineage segment or household – thus the three preceding definitions would appear to be incorrect in stating that lineages and households do not have access to a *wu'ya*.

Finally, the phratry consisted of "a nameless division of kindred made up of two or more clans which share certain privileges, mainly ceremonial…the outstanding features…are that it delimits the greatest extension of kinship terms based on any given relationship, and that it marks the largest exogamic unit recognized by the Hopi" (Titiev 1944:58).

Parsons (1933:23) in contrast found that while membership in a ceremonial society had no bearing on one's clan affiliation, headship of societies or fetish custody rests not only within a particular clan, but a singular "maternal family or lineage in the clan". She suggested that it is this tendency of the Hopi to refer to maternal family and clan interchangeably in ceremonial contexts that had led to confusion over Hopi social organization. Parsons concluded that the maternal family or lineage is the "essential factor in the Hopi clan" with established control of ceremonial leadership (1933:39).

Whiteley offered an insightful critique of Eggan's and Titiev's categories, arguing that the theoretical principles underlying unilineal descent groups are inadequate for describing all aspects of Hopi social structure. He was careful to note that descent theory "provides a template for describing some elements of Hopi organization…however, its use is limited in scope, for Hopi society is more complex than the parameters of the theory allow" (Whiteley 1998:79). For one, Whiteley (1998:78-79) pointed out that the Hopi "clans," regarded by Titiev as the "cornerstone" of Hopi society, are not in actuality corporate groups as defined by descent theory that is, economically, ritually, or jurally. Clan affiliation was, in fact, more fluid than either Titiev or Eggan recognized. For instance, Whiteley (1998:75) observed that Hopi descent groups have "conceptual 'rights' over an ethnotaxonomic class of natural objects" and as such, a member of the Badger clan for instance, symbolically identified with Butterfly, Porcupine, and certain medicinal plants, could make a claim to be of the "Porcupine descent group." In the context of a social dispute, such a move could easily result in the founding of a new Porcupine descent group. By taking examples such as these into account, Whiteley demonstrated that it becomes impossible to definitively determine inclusion or exclusion of Hopi descent at the clan level.

Accepting Whiteley's critique and Parson's observation that the household or lineage segment is defined by ceremonial association, we may then distill Hopi kinship down to two discrete units – the household and clan-core lineage segment as it relates to an important manifestation of social hierarchy in Hopi society, that of ceremonial ownership. Moreover, these kinship categories are the only ones for which the Hopi have specific terms, the latter two having the same referent.

The only kinship units that the Hopi distinguish are household or *kiivit* and the descent-group denomination -*wungwa* for singular and -*ngyam* referring to the whole. Further, it is the household and core lineage segments that can be imbued with ritual primacy and can possess the attendant trappings of this status. But before proceeding to a discussion of the estates of these descent-groups, a brief discussion of how group membership is achieved, how groups get constituted, and how they fission is necessary.

Clans are very clearly defined in terms of estates. Parsons states that while not every clan has a ceremony, every clan has a *wu'ya,*[4] an ancient mask representing a being

[4] Totem, clan symbol

associated with their clan. These masks, also referred to as *tutuyqaw'i akamo*[5], are rarely exposed except during esoteric ritual (Parsons 1933:37). The "ancestral house of the clan is…the house or houses in which the sacred paraphernalia of the maternal family associated with the ceremony are kept" and "the maternal family which safeguards the clan mask or the *tiponi*,[6] the corn ear fetich of the ceremony…is thought of as the heart of the clan…and when it moves the clan is thought of as moving" (Parsons 1933:24, 36). Without its *tiponi,* a society is regarded as impoverished, weak, and unable to satisfactorily perform the ceremonial. The *tiponi* symbolizes the authority of the clan elder in possession and the individual is understood to have a special relationship with the rain-making Cloud Deities. Finally, it is believed to have first been obtained in the Underworld and it is not uncommon for the *tiponi* itself to be personified as the "mother" or "grandmother" of the people (Geertz 1987:17).

These all-important clan sacra are inherited matrilineally through eldest daughters, ostensibly extending as far back as the ancestral clan founders and thereby precluding any speculation as to the authenticity of ritual objects or their rightful ownership. As Weiner (1992:42) observed, "even the knowledge that an inalienable possession is hidden away, confirms the presence of difference in social identities." Thus it seems clear that this ritual basis for internal differentiation of clans – separating the *wu'ya*-wielding core lineage segments from those without – and the external differentiation of separate clans is also predicated upon genealogical ties to founding

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[5]Translates as "dominate/command/maintain control over "

[6] *Tiponi* is a fetish consisting of an ear of corn, feathers, and a variety of outer wrappings; it is referred to as the "mother" or "heart" of a ceremony; when not in use, it's stored in the clan house and the custody of the clan head woman ; Altar parts like netted gourds and other paraphernalia may be entrusted to secondary officials who may store these in own clan houses (Titiev 1944:103).

ancestors and the place of origin. Perhaps it is worth noting that in contrast to the enduring metal sacra observed by Traube among the Mambai, Hopi *tiponi* are comparatively fragile (Traube 1986:76). Although one can only speculate, I am inclined to believe that the relative fragility and potential impermanence of *tiponi* serves to highlight the precarious nature of Hopi existence and the fastidiousness and care with which they must tend to their relationships with ancestral sources of power and fertility throughout the ceremonial cycle.

Furthermore, these same core lineage segments in possession of *wu'ya* are invariably the same units in possession of ceremonial offices. *Pavansinom* or "most powerful people" and *sukavungsinom* or "grass roots people" as the Hopi distinguish them, are commonly differentiated on the basis of ceremony ownership, which in turn is internally ranked. For instance, the *Soyalangw* ceremony for which the Bear clan provides officers is superior to say, the *Lakon* owned by the Parrot clan or the *Marau* owned by the Lizard clan at Oraibi. Again the core lineage segment for each would be classed as *pavansinom* while other same-clan members would be *sukavungsinom* (Whiteley 1998:87).

Several other responsibilities and possessions qualify as aspects of a clan's estate: chief-priests can complete special rain-making pilgrimages to Kisuba during July droughts; clans possess a stock of clan names, i.e. names which may be given by women to their clansmen's offspring; and clans possess land, which is subject to redistribution within the clan, but not outside of it.

Although largely vestigial today, in earlier times the concept of clan lands was at least partially dictated by the ritual order. In fact, as Whiteley pointed out, the word for clan lands *wimvaavasa* translates as "ritual/ceremonial fields" (Whiteley 1998:62). As with the *wu'ya* and ceremonies, land allotment at Oraibi was predicated upon ancestral charter. Titiev recounted a rare opportunity to inspect the "sacred stone" of Oraibi, which visually related the assignment of clan-lands as prescribed by *Matcito*, the legendary founder of Oraibi, upon his arrival from the Underworld. The stone itself is said to have been brought from the Underworld by *Matcito* himself and given to the Bear clan for safe-keeping. During every *Soyalangw* ceremony, the stone was represented to officers of the various clans in order to ratify the existing distribution of arable lands (Titiev 1944:60). However, Whiteley (1998:64) noted that all land is not "clan land." In fact, of thirty clans listed by Eggan (1950:103) eleven owned no ceremonies and thus possessed no pre-ordained charter to farmland. At Oraibi, "those clans which had no legendary claims to particular plots were not left landless," rather any potential farmer could, with the chief's permission, lay out a plot in a zone designated as "free land" (Titiev 1944:63). Finally, while it was not unknown for a son to inherit land from his father, in theory only women could own title to or transfer land (Whiteley 1998:66).

Contemporary ethnography suggests that kiva ownership does not fall into the category of "estate." Since the beginning of the 20$^{th}$ century, kivas have been "owned" or maintained by "Kiva Chiefs" who serve in a lifelong capacity and upon death, vacancy is filled from within the ranks of the clan (Titiev 1944:48). However, Alexander Stephen noted that during an earlier period, kiva ownership could be achieved by a man who builds, repairs, or buys one that has fallen into disuse. Once owned it is then inherited within the "lineage" by brothers and/or nephews; failing that it will become inherited within the clan, "i.e. by another lineage within the larger group both lineages are affiliated in" (Parsons 1933:48). Thus it appears that one may add kiva ownership to the list of potential "estate holdings" of a clan. Parsons stated that kivas are mainly associated with clans through the powerful *Soyalangw* ceremony (Parsons 1933:51).

*Hierarchy among the Tewa*

Among the Tewa, Made People or *Patowa,* differentiated from common Dry Food People, "control and direct all group ritual activities and stand as the real powers behind the political officials" (Ortiz 1969:79). This segment of Tewa society is comprised of eight hierarchically ordered groups which in turn reflects the order in which these groups were "made" in the Tewa origin myth (1969: 81-81). At the top of this hierarchy are the chiefs of the two moieties (Summer and Winter) into which Tewa society is divided and these chiefs alternate their ritual and political control over the pueblo on a seasonal basis (1969:84). Unlike the Hopi, multiple pathways exist for recruitment into these groups including dedication (of one's self or by one's family at birth), trespass whereby an individual inadvertently intrudes upon a society in the midst of sacred activities and is therefore pressed to joined the society, and trapping whereby a society in need of members may draft individuals (1969:86-87).

In Tewa society, a second tripartite political structure serves at the behest of the Made People. Setting aside the "the Spanish Officials" and *Fiscales*, artifacts of Spanish colonization, the *Towa é* are appointed by and serve as protectors of the Made People. In addition, a principal role of the *Towa é* is to serve as political functionaries of the Made People, coordinating rituals and dances and ensuring that all participants fulfill their ritual obligations, by force if necessary (1969:72). Thus while hierarchy and power in Tewa society is clearly less confined to descent groups than at Hopi, politico-ritual leaders among the Tewa wield immense control over other members of society.

*Archaeological Correlates of Hierarchy*

In searching for potential archaeological markers of social differentiation, the rich Pueblo ethnographic record suggests several possible material correlates. Among the Hopi, ceremonial and political offices are not strictly separable and the transfer of power for each follows the same matrilineal rules (Lowie 1929:338). Town chieftaincy is centered on the maternal family with the office of Village Chief or *Kikmongwi* being passed from brother to brother or to maternal nephews and failing this, to a linked clan (Parsons 1933:56). For instance at Oraibi the same Bear clan core lineage segment that controls the *Soyalangw* ceremony also provides the *Kikmongwi*.

Hopi political leadership is not confined to the *Kikmongwi* alone but other leaders, collectively referred to as *Wimmomngwit* (heads of ritual sodalities) also include several lesser positions such as *Qaletaqmongwi* or "War Chief," provided by the heads of the *Momtsit* or warrior society (the *Kookop* clan at Oraibi) serving as a sort of "sergeant-at-arms" or enforcer of discipline within the village (Whiteley 1988:88-91). Again, it should be noted that possession of political positions besides *Kikmongwi* is also predicated upon ownership of ceremonial office and is thus restricted to those *pavansinom* lineage segments.

In addition to the less tangible benefits of being *Kikmongwi* are its potential economic benefits. Voth (1901) stated that the *Kikmongwi* are called this because they are understood to *own the village and the fields* and the inhabitants of the village are all said to be their children. As a result, it is not unusual for the Hopi to periodically work for their Town Chief, the men planting and harvesting his fields and bringing in wood, the women plastering his house or going there to cook for the men workers. The meal they traditionally provide is of beans, peaches, and meat and is highly ceremonial, "each tastes five times only: first of beans, then of peaches, then of meat, and then leaves the house" (Parsons 1933:56).

A similar relationship between lay people and chieftancy was documented by White (1962) at Zia Pueblo. Hunting parties were periodically organized expressly by the War Chief to provide for the *Tiamunyi* (cacique). Such hunts were known to last as long as a week or more depending on the success of the expedition (1962:302). Upon their return, deer carcasses were taken to the *hotcanitsa* (residence of the cacique) and divided between the cacique and the hunter. The head, skin, and upper torso were reserved for the hunter while most of the torso and hind quarters were given to the cacique. Returning home, the hunter's share of the kill was cooked and shared with family and other households (1962:303). Similar treatment of bear and turkey carcasses was also observed (1962:180).

Table 3.1: Archaeological correlates of feasting after Hayden (2001) and Twiss (2008).

| | **Traits** | ***Feasts*** | |
|---|---|---|---|
| | | **Solidarity** | **Distinctive** |
| Food | Concentrations of labor-intensive or communally-hunted species | X | X |
| | High frequency of meat bearing skeletal elements (e.g. limb bones) | | X |
| | Unusually large quantities of animal remains | | X |
| | Evidence of wastage (e.g. high frequency of minimally processed skeletal remains, evidence of roasting, articulated joints) | | X |
| | Animal remains cached or curated to commemorate event | X | X |
| Locations/Facilities | Spatial association of material remains with public/communal space | | X |
| | Special middens or unusually dense bone dumps | | X |
| | Food preparation facilities (e.g. large roasting pits) | | X |
| Associated Goods | Prestige goods (used and/or deliberately destroyed) | X | X |
| | Ritual equipment | X | X |
| | Unusual preparation/serving vessels (e.g. large or high-quality vessels) | | X |

## The Chacoan Test Case

In small- and intermediate-scale societies, communal ritual is a primary sphere of political interaction. Within these contexts leaders emerge, statuses are built, group identities are reproduced, and political and economic ties formed and solidified. Central to the successful performance of such commensal events is the intensification of subsistence and craft production (Spielmann 2002:196-197). Craft intensification may entail the heightened output of social valued goods (Eggan 1950:60; Spielmann 2002:197-198) while the material correlates of episodic subsistence intensification may include the presence of desirable food taxa (Damon 1989b:76, 79-80, 84; Hayden 1990:36) or skeletal part frequencies consistent with a preference for high utility carcass parts (Jackson and Scott 1995; Kelly 2001:347-348). This research will therefore address these two fundamental behavioral dimensions of Chacoan economy, faunal exploitation and craft production.

### *The Chacoan Test Case: Fauna and Feasting*

As seen at Hopi, Jemez, and Zia, the exchange or provisioning of food reifies existing political and ceremonial structures. However such exchanges when small in scale may be difficult to identify archaeologically. In contrast, feasts by nature often tend to be larger in scale. With visibility as an inherent goal, feasting events serve to overtly express social identities and relationships while simultaneously reinforcing boundaries and collective ideologies.

Feasts vary widely in form, purpose, and scale and it is these parameters that in turn influence the patterns visible in the archaeological record (Adams 2004; Hayden

2001; Mills 2007; Twiss 2008). Utilizing Hayden's useful typology of feasts, one class – hereafter referred to as *distinctive* – encompasses *competitive*, *tribute*, and *promotional/alliance/work* feasts, are frequently large in scale and entail visible departures from domestic patterns of consumption both in terms of the species consumed and the display of "prestige items." In contrast *solidarity* feasts that advance unity at the household, village, or inter-village scale are frequently "potluck" style. Provisioning of food is communal and consistent with domestic consumption, akin to a family meal (Adams 2004:61; Hayden 2001:55-58). *Distinctive* feasts may be more easily identified archaeologically while behavior associated with *solidarity* feasts may often be difficult to differentiate from accretions of daily household refuse. Outlining expectations associated with either form of feast is therefore a crucial step in this analysis (Table 3.1).

Due in part to the scale of *distinctive* feasts, preparation may require the use of public food preparation facilities and specialized structures such as roasting pits. Material remains may be spatially associated with communal rather than household space (Adams 1991; Hayden 2001:57-58; Lowell 1999; Muir 1999:113; Potter 2000:483). The abundance of large game, predominance of high utility carcass parts, and high rates of butchery waste such as unprocessed axial remains are all patterns that have been interpreted as indicative of feasting (Dean 2001; Grimstead and Bayham 2010:859; Jackson and Scott 1995:107; 2003; Kelly 2001; Potter 1997; 2000). If reductions in local food animal availability forced hunters to travel farther afield, greater field processing and more selective transport of elements back to the villages would be expected (Metcalfe and Barlow 1992).

Of course, small fauna procured in a large enough quantity is similarly capable of large scale provisioning (Madsen and Schmitt 1998) and the basis for linking large game to feasting stems from two possibilities: a) procurement of large game constitutes costly show-off behavior (Hildebrandt and McGuire 2002; 2003; McGuire and Hildebrandt 2005; McGuire et al. 2007); or b) large game is simply of high economic value (Broughton and Bayham 2003:784; Cannon 2000; 2003). Fisher (2010:14) cautions against the *a priori* assumption that the presence of large game is indicative of costly signaling. Grimstead (2010:75) attempted to resolve the debate by modeling net caloric returns for large and small game procurement at varying distances and determined that at shorter distances a single large deer carcass was of equal economic value as thirty-one large jackrabbits. However, when transport distance was taken into consideration, the net caloric gain on small game declines rapidly with distance traveled while the net return on large game remains high even in hunting forays in excess of 50 km. Thus it appears that artiodactyls would, in many cases, be considered a high value resource. Regardless, large game was likely an ideal resource for feasting, capable of feeding feast participants and conferring a certain cachet upon the feast-giver.

Faunal remains often exhibit evidence of roasting, less intensive breakage, an abundance of species conducive to communal procurement and consumption and greater representation of meat-bearing skeletal elements, particularly among large mammals (Jackson and Scott 2003; Kelly 2001; Potter 2000:483). Several species are well-suited for procurement through large scale collaborative hunting. According to ethnohistoric accounts, pronghorn were frequently hunted using cooperative corral drive tactics (Hill 1982; Parsons 1936:277-278). Communal hunting of local jackrabbit (*Lepus* *californicus*), cottontail (S*ylvilagus audubonii*), and coyote (*Canis latrans*) populations were often organized in conjunction with communal ritual and were observed at several pueblos including Hopi, Santa Clara, and Jemez (Hill 1982; Parsons 1925:94-95; 1936:277-278; Titiev 1944:144, 185, 188-192).

Since the material signature of solidarity feasts may closely resemble that of deposits generated through quotidian behavior, its presence or absence is unlikely to be established without converging lines of evidence. These feasts, likely to have occurred at regular intervals, would have been provisioned through the gradual accumulation of resources such as food staples and stored meat. Refuse generated by butchery and processing of animals would then be deposited along with other domestic refuse. However, subsistence intensification on an ad hoc basis in support of smaller-scale feasts is well-documented ethnohistorically, also may have taken the form of communal hunts, and may be recognizable on the basis of deposits with uncharacteristically homogeneous concentrations of particular species (Spielmann 2002:197). In the absence of feasting correlates, wholesale rejection of the occurrence of solidarity feasts seems imprudent given the frequency with which such behavior has been documented ethnohistorically. However, a dearth of such evidence should cast doubt on larger scale feasts for which there is no discernible signature.

As discussed above social differentiation is understood to covary with the degree of political centralization in nonstate societies and a primary goal of this study is to determine the extent to which Chaco was or was not an exception to the rule. I hypothesize that during periods of increasing political centralization in Chaco Canyon, patterns of faunal procurement, consumption, and use at neighboring, contemporaneous sites will exhibit increasing evidence of subsistence intensification such as feasting and differential access to high utility skeletal parts. The temporal and spatial intensity of great house construction will serve as a measure of the extent of political centralization.

These hypotheses assume that as political centralization increases, differences between neighboring sites are further elaborated as opportunities and incentives to establish social status become more common. The test cases for this hypothesis will be the adjacent and partially contemporaneous sites of Bc 57 and Bc 58, small sites in the vicinity of Casa Rinconada and directly across the canyon from Pueblo Bonito, Chetro Ketl, and Pueblo del Arroyo.

My choice of animal remains as a means by which to address this variation, derives from: 1) the near universal representation of the faunal remains within excavated Chaco assemblages; 2) the durability of bone, particularly in the arid environment of the Desert Southwest, that often allows for high rates of identifiability; 3) the direct relationship of faunal remains with procurement patterns, seasonal subsistence cycles, changes in subsistence strategies, differential consumption, and food sharing practices; 4) the association of fauna with depositional contexts that that may reflect differential discard pathways, e.g., domestic refuse and ritual interments; and 5) the widespread distributions of modified skeletal parts, often in unusually high frequencies and occasionally with turquoise and jade inlay, that reflect trends in the worked bone industry and the intensity of related forms of craft production such as basketry and hide-working.

In particular, this analysis will focus on variation in the species consumed, skeletal element abundance, and butchery and cooking practices to address the manner in which animals are processed and distributed. Fragmentation patterns provide an opportunity to differentiate human processing activities, such as the extraction of marrow and rendering of bone grease, from post-depositional taphonomic processes such as trampling, carnivore ravaging, and weathering. Since feasting frequently entails the roasting of whole animals or large cuts of meat, evidence such as bone exhibiting only partial heat exposure, exhibiting low levels of processing for meat or marrow, and overall low levels of fragmentation may be taken as evidence of potential feasting practices (Jackson and Scott 1995; Potter 2000; Rappaport 1984:129, 214). Such patterns would contrast with the more heavily fragmented and carbonized or calcined deposits typically generated by daily household activities.

The spatio-temporal distributions of assemblages produced by the hunting and consumption of fauna, in terms of relative abundance of game and processing techniques, often yield insight into the scale of provisioning, the manner of redistribution, and differential access to preferred or ritually important species. These in turn may reflect integration, centralization, and social ranking. For example, by considering the spatial distribution of taxa, skeletal elements, and by attempting to refit broken bones from separate contexts, Zeder and Arter (2008) were able to present compelling evidence for dichotomous processing and consumption of fauna, and thus potential social divisions within a single site.

In a recent archaeological study of Moundville and smaller surrounding hamlets, differential access to particular species and distinctive skeletal part distributions were cited in conjunction with distinctive ceramic distributions and patterns of plant processing as indicative of status-linked differences in overall consumption and in the labor of food procurement. The presence of rare species, higher frequencies of upper forelimbs and lower frequencies of large mammal backbone parts of deer were found to co-associate with high-status areas, while the pattern was reversed for commoner sites (Jackson and Scott 2003; Welch and Scarry 1995:405). Similar patterns of differential access to large game based on status-differences have also been documented among the prehistoric Maya (Emery 2003:505, 507; Masson 1999:95-96, 113).

Thus the detection of stages of butchery can aid in the identification of feasting episodes and when coupled with evidence of resource stress, is helpful in delimiting hierarchy evident at various scales. Monopolization of production and coercion may be implied by the co-association of disproportionate concentrations of hunted animals and skeletal part distributions diagnostic of centralized processing and distribution. References to the socially integrative and divisive nature of the act of hunting itself and the manner in which the community is provisioned are prevalent in the Pueblo ethnographic record (Eggan 1950:60; Hill 1982:51-52; Titiev 1944:228-229; White 1974:302-304).

The previously unanalyzed faunal collections from Bc 57 and Bc 58 represent the only animal remains from general refuse deposits from the University of New Mexico-School of American Research field school excavations of the mid-twentieth century. Located among the central canyon cluster of small sites commonly referred to as the "Bc sites," Bc 57 (Late PII-PIII) and Bc 58 (Late PII-PIII) lie within 30 m of each other on the south side of the canyon opposite the large, contemporaneous great houses of Pueblo Bonito, Pueblo del Arroyo, and Chetro Ketl and just north of the isolated great kiva of Casa Rinconada. The temporal placement of the two sites is based on radiocarbon assays, ceramic analyses, and architectural data. As will be explored in greater detail in

Chapter Four, although Bc 57 was likely constructed and occupied during the Classic Bonito subphase, deposits that pre-dated its construction ultimately came to be reside within the walls of the structure as post-occupational fill; thus the faunal record of Bc 57 offers a broad diachronic view of small site faunal consumption spanning the Early Bonito subphase through Late Bonito and McElmo phases. The neighboring site of Bc 58 affords a narrower glimpse of faunal subsistence during the Classic Bonito subphase and provides a rare opportunity to explore potential similarities and differences between two contemporaneous sites.

The Bc 57-Bc 58 site cluster constitutes an important comparison with the Chaco Project excavations in the 1970s of the sprawling PI-PII site of 1360 and the 627-629-633 site cluster (PI-PIII), both situated 4-6 km to the southeast in the Fajada Gap area of the canyon and south of the great house of Una Vida.

A multi-scalar study of patterns of differential access to higher-ranked subsistence species (deer, bighorn sheep, pronghorn antelope, and elk) and/or ritually important fauna (e.g., birds of prey, carnivores, and macaws) within and between sites will permit inferences of potential hierarchical relationships. Localized evidence of recurrent feasting episodes may further aid in the identification of asymmetric social relationships between sites. Fluctuations in behaviors such as intensified bone grease production or greater consumption of low-ranking food resources may signify changing strategies in food production and/or differential nutritional stress.

An absence of obvious patterns of differential consumption does not necessarily rule out the existence of hierarchy and of course hierarchy and egalitarian formations are not mutually exclusive. A dearth of evidence for such social differentiation may be taken to indicate that, at least among neighboring small sites, periods of political centralization may have led to a reduction in individual site autonomy. The supposed preeminence of great houses as loci of power, production, and ritual, may then have resulted in the downplaying of hierarchical relationships between non-great house sites, and the foregrounding of the distinction between great houses and non-great houses. Moreover, among loosely geographically dispersed communities existing hierarchies may not be evidenced in more quotidian behavior, but may become foregrounded in the context of ritual. To reiterate, a key to identifying similar such expressions of hierarchy archaeologically will be the ability to identify interactions between social units at both the inter- and intra-site levels. Likewise, the study of variation in craft industries is another approach with potential utility in evaluating social and economic differentiation among sites and it is to this subject that I now turn.

### *The Chacoan Test Case: Organization of Production and Craft Specialization*

Craft production, simply put, is the transformation of raw materials into usable objects. The process is shaped by environmental circumstance and occurs within the context of overarching economic, social, and political systems (D'Altroy and Earle 1985). Specialization, then, relates to the way production is organized and is defined by Costin (1991:3) as "the regular, repeated provision of some commodity or service in exchange for some other." For Earle (1987b:64), specialization is the "economic essence of complex society" in that it entails the development of economic interdependence, differentiation, and control and thus facilitates the support of a non-subsistence sector and increases the potential for population growth. Lest we become pre-occupied with the complexity implied by specialization Brumfiel (1995:129) reminds us that part-time or non-specialized production commonly complicates the daily lives of individual craftspeople far more than those participating in more *complex* economies.

*Framing the Study of Craft Production*

Costin (1991:7-18) offered a useful dimensional framework characterizing the organization of production, consisting of four parameters: *context* or the affiliation of producers with the sociopolitical structure, i.e., “attached” or “independent” specialists; *concentration* or the geographic organization of production; *scale* or the size and principles of labor recruitment for production units; and *intensity* or the amount of time dedicated by producers to their craft. Costin’s comprehensive methodology and thorough explication of its archaeological applications make her approach a valuable tool for the purposes of this investigation (1991:18-43).

A fundamental distinction exists between attached and independent specialization. The former is characterized by specialists who are contractually bound to and provide solely for elite patrons. The latter is comprised of specialists who produce goods or services for a broader, unspecified demand crowd. A third possibility introduced by Ames (1995), that of *embedded* specialists, includes those systems in which production to meet the needs of elites occurs under non-coercive circumstances and forms an essential part of the local economy.

Spielmann (2002) introduced the “ritual mode of production,” which I regard as particularly relevant to the Pueblo Southwest. Drawing on ethnographic sources from Melanesia and New Guinea (Damon 1989a; Firth 1950; Malinowski 1922; Rappaport 1984; Wagner 1989), Spielmann observed that in small-scale societies, “the scale of economic production necessary for ritual performance is critical to understanding economic intensification" (Spielmann 2002:196). With fulfillment of communal ritual as the driving force, craft production and feasting are supported by the population at large rather than elite sponsors and as a result the goal is not "profits" but "superlative performance and participation" (Spielmann 2002:197). It is under these circumstances that political centralization often emerges and otherwise latent hierarchy is foregrounded. An example, taken from the Mambai of East Timor provides a useful demonstrative case:

> Scattered house members reconvene at their origin places for ritual purposes, and dramatically re-present their ideal unity and wholeness. But the dispersal of house members in everyday life is as fundamental to the system as the ritually enacted idea of their original concentration, for it is the interplay of present separation and prior connection that creates the condition for hierarchy. (Traube 1986:66-67)

Materially, the hierarchy is reflected, if only briefly, in the asymmetry of ritual offerings that include the labor of house members in rebuilding or repairing the origin house, in the form of raw food, betal, and areca, the products "of the outside" that are subsequently returned by the origin house in cooked form. Finally, Traube observes that "claims to hierarchical status of a source are validated in practice by a house's ability to attract others to its seasonal rituals as junior dependents" (1986:74). I argue that by investigating both quotidian behavior as well as contexts of heightened communal integration in Chaco such as feasting episodes and periods of intense great house construction, the variables of political centralization, hierarchy, and craft production become accessible to archaeological inquiry.

Schortman and Urban (2004) write that "the pervasive distinction between elite industries used to fashion hierarchy and mundane crafts instrumental in the proliferation of heterarchical social distinctions probably simplifies complex ancient realities"

(Schortman and Urban 2004:207). Rather it is likely that both processes may have operated simultaneously, resulting in a complex "multi-centered political economy" in which power was dispersed and different crafts were undertaken in support of diverse political, corporate, and ritual endeavors (Schortman and Urban 2004:208-209). Wattenmaker (1998) observed that in many instances elite oversight of relatively simple manufacturing of readily available raw materials was limited or non-existent. It is thus important, she argues, to bear in mind that apparently mundane objects may well delineate social boundaries unrelated to social inequality (Wattenmaker 1998:202-203).

*Craft Production Among the Pueblos*

"Attached specialization" in Costin's terms is not generally regarded as an accurate characterization of productive strategies in the prehistoric southwest, but high levels of production and exchange, both in terms of scale and intensity, have been documented archaeologically as well as by modern ethnographers (Bayman 1999:252).

Ford (1972:40) observed that Tewa villages varied in size, relative "wealth," and level of participation in exchange systems, and that certain pueblos specialized in particular craft products such as blankets, baskets, and pottery while others specialized in particular services such as midwifery or ceremonials. Exchange networks within and between Pueblos tended to follow kinship relations or established friendships. The most common contexts for trade were those of informal individual exchanges, craft fairs, and goods bartered in exchange for ceremonial services (Ford 1972:36, 44). Still other ethnohistoric sources illustrate the diversity of craft goods including basketry, textiles, and hides that were commonly traded among Rio Grande Pueblos (Hammond and Rey 1953:624-626, 645; Hill 1982:91, 94, 99).

It should be noted that all of the above activities were regularly undertaken at the household scale for basic household consumption. Intensification could then, though not always, be distinguished by the presence of goods exceeding the needs of the immediate household.

Economic intensification at Hopi, which I take to include the mobilization of labor for spinning and weaving of wool (and likely cotton to a larger extent during prehistoric times), basketry production, hunting of rabbits and coyotes (and apparently deer and antelope in earlier periods), and the production of corn meal, primarily occurs in three contexts – dance-related feasts and marriage-based and general kin-related exchange (Eggan 1950:50-51, 55-56, 60; Titiev 1944:37-38, 228-229, 237). Eggan captured the nature of this relationship:

> On all important ritual occasions the father's sisters, whether own or ceremonial, play an important role in relation to ego and his lineage, and their efforts are repaid by the latter. The exchanges consequent upon initiations of various kinds furnish a goodly portion of the economic exchange of goods in Hopi society, and from each lineage and household there is a constant inflow and outgo of food, clothing, and other wealth (Eggan 1950:60).

From an archaeological perspective, the first scenario, the dance-related feast and surge in craft production might yield material signatures characterized by general increases in the number of implements needed for production and patterns of consumption indicative of a single hunting episode, i.e. catastrophic prey mortality profiles reflective of communal game drives, perhaps corroborated by narrow estimates of seasonality. Craft production would exceed "normal" household needs and would be reflected in bone tools required for the working of basketry and hides and in weaving and in the frequency of lapidary stones and drills required for the production of ornaments.

Diversity in raw material selection might be expected to decline as craft production intensifies and tool manufacture becomes more standardized.

The second and third scenarios – those of marriage-based and general kin-related exchange relationships – were probably the norm for prehistoric Pueblo society and represent the base-level of production and exchange. Such instances likely entailed levels of production only slightly above immediate domestic needs and presumably this pattern would be difficult to detect archaeologically.

While population growth would in all likelihood entail an overall increase in the frequency of such exchanges for the system it would not necessarily translate into increases at the level of individual households who, after all, have only so many potential initiates, grooms, or brides on behalf of which to engage in exchange. This is not to say that increasing elaboration and expansion of exchange might not be a side effect of population growth. Thus while population growth alone may not account directly for increases in production observed at the household level per se it would likely serve as a catalyst for the expansion and elaboration of exchange networks. In other words, intensification of production is a logical outcome of expanding exchange networks and increases in the scale of social participation in communal ritual. In the case of Chaco, evidence for similar such social, political, and economic expansion abounds in the form of great house construction, the existence of great kivas, potential pilgrimage fairs and road networks, the import of ceramics, lithics, and exotics, as well as overall population growth.

*Craft Production in Chaco Canyon*

To date, evidence from Chaco does not lend support to an interpretation of attached specialization but the existence of either independent or embedded specialists has been suggested by several scholars (Hagstrum 2001; Mathien and Windes 1987; Saitta 1999; Toll and McKenna 1997; Windes 1992). Toll and McKenna (1997:207-208) regard the ceramics produced in Chaco as destined for unspecified local and regional trade networks – a pattern more typical of independent specialization. The existence of part-time specialists in ornament production is indicated by the presence of at least one ornament workshop at a Chacoan small site (29SJ629). While finished ornaments of turquoise, shell, and other materials are rare at this and nearly all other small sites, they occur in astounding abundance in great house contexts (Mathien 1997:110; Plog and Heitman 2010:19622; Windes 1992:162). Great house demands for labor in the ornament industry thus appear well-defined and linked to ritual if not elite behavior, a seemingly clear case of embedded specialization. The high concentrations of rare ceramic forms at Pueblo Bonito also attest to the potential for embedded, if infrequent, specialized ceramic production. Thus the distinction between independent and embedded specialist while of heuristic utility was in practice probably fluid and contextually dependent.

The time-intensive production of basketry and textiles and the working of animal hides using bone implements are well-documented historically among the Pueblos and likely comprised a major component of craft production in the canyon (Cushing 1979:182; Hagstrum 2001:52; Hill 1982:51-52, 91, 103-108; White 1962:57). Certainly, the diversity of perishable artifacts recovered from Chaco (Judd 1954:159-173; Pepper

1920:94-96, 106-107, 164, 169, 174-175; Vivian et al. 1978; Webster 2006; 2008) is a testament to the breadth and intensity of Chacoan craft production. Although perishables such as baskets, sandals, and hides are preserved only in rare instances due to their organic composition, bone tools involved in their manufacture are common throughout most Chacoan assemblages.

My research will assess the consistency and pervasiveness of centralized production strategies over time and across multiple scales and contexts in the Chaco region. My investigation of craft production follows from two questions:

- First, how do the scale, intensity, and organization of craft production – as inferred from bone tool production and use – fluctuate relative to Chacoan political centralization?
- Second, since bone tool production and hide production may vary as functions of faunal procurement strategies, to what extent might these activities covary?

*Modeling the Intensification of Production*

To evaluate the questions outlined above, this analysis evaluates the hypothesis that evidence for intensification of production in Chaco correlates with the increasing political centralization of the Early, Classic, and Late Bonito subphases (850-1140 CE). I investigate the degree to which access to and selection of raw materials varies across time and space. Specifically, variation in raw material is assessed through an examination of the relationship between trends in species procurement and the frequency with which particular species and skeletal elements were selected for tool or ornament manufacture. Comparison of the frequency of formal bone implements relative to expedient ones and an examination of curation practices permits an assessment of the labor and care invested in the worked bone industry.

In examining the archaeological correlates of craft specialization, specifically standardization, Costin and Hagstrum (1995:622) differentiate between the *intentional* and *mechanical* attributes of objects produced. The former, they argue, include traits such as raw material choice and morphological differences that relate to the object's "economic, social or political" function and are less indicative of the organization of production. The latter consists of variations in raw material selection and minor size and style differences unrelated to the object's functional requirements that are unconsciously introduced to the manufacturing process by the craftsperson and are thus better indicators of the organization of production. Their underlying assumption is that the amount of variability in mechanical attributes directly relates to the number of independent producers or work units.

Although the organization of production in great house contexts is less clear at present and should be addressed in future research, production units dispersed among small house sites and consisting of members of one or more households is a plausible scenario. Therefore standardization in bone tool form is less likely to reflect the organization of production units than increasing intensification or task specialization at various sites. Awl length, for example, is probably a poor indication of standardization since tools are continually sharpened and often undergo modification throughout their use-lives. The diameter of the awl tip on the other hand represents a purely functional aspect of the tool's efficiency for a particular task whether related to hide perforation, coarse or fine basketry manufacture, or weaving. As an intentional attribute, such a measurement may be of little utility in distinguishing standardization in Costin and Hagstrum's terms, but it is a potential correlate of task specialization. Variation then would be expected to vary inversely as a function of the production intensity. Conversely, greater variation in awl tip sizes would reflect a wider range of craft activities. Bone tube beads are one osseous artifact class for which minor metrical differences may be expected to reflect differences in mechanical attributes.

Since bone tools were utilized in a range of tasks that included hide working, basketry production, pottery manufacture, among others, wear and stress degraded bone to varying degrees. It follows that durability should be a principal concern in raw material choice (Margaris 2009). As observed by Russell (2001a) in her study of worked bone from the Neolithic site of Çatalhöyuk, the degree of standardization of form can be understood as a proxy measure of the relative level of task specialization and the extent to which the maker expects to curate the tool. The amount of care taken in maximizing the number of tools produced from a single bone and the degree of reuse can also reflect the valuation of bone tools and potential uneven access to raw material (Russell 2001b). Further, the discard practices of still useable or easily resharpened tools could carry meaning beyond simply the end of the object's use-life (Russell 2001b:247). Thus the intensification in production and use of bone tools would be expected to result in a trend away from less durable and expedient types of bone tools toward durable raw materials and more standardized forms.

The next chapter explores in greater detail the chronology and depositional patterning at among sites examined in this study, including two sites in particular, Bc 57 and Bc 58, that have previously received little attention in the archaeological studies of Chaco Canyon.

# CHAPTER 4: THE SITES

The two small house sites Bc 57 and Bc 58 are located on the south side of Chaco Canyon, situated atop a narrow hill that stretches roughly one hundred-fifty meters northeast from Casa Rinconada (Figures 4.1 and 4.2). Of the two sites, Bc 58 is in closest proximity to Rinconada (a distance of 85 meters northeast) while Bc 57 is farther downslope (at approximately 125 meters).

Substantial deposits of faunal, ceramic, lithic, groundstone, and macrobotanical remains were recovered by the University of New Mexico-School of American Research Field School excavations of the 1940's and the collections now occupy nearly sixty linear feet of shelving at the Maxwell Museum of Anthropology in Albuquerque, New Mexico. Several sets of field notes and student papers relating to the excavations at these two sites are on file with the Chaco Culture National Historic Park Museum Collection. Despite the importance of understanding the organization and function of small sites in Chaco, study of these two sites and their neighbors (Bc 50 and Bc 51) has been limited in scope (Kluckhohn and Reiter 1939; McKenna and Truell 1986).

Only recently, the Chaco Research Archive (CRA) has begun compiling and interpreting these field notes, associating field specimens with pertinent provenience information where possible, and making this information available to the public through an online database. Prior to presenting the results of the Bc 57 and Bc 58 faunal analysis, a critical step was to synthesize the abundance of now accessible excavation records with recently obtained AMS radiocarbon dates and ceramic data in order to present an accurate temporal and spatial record of the sites.

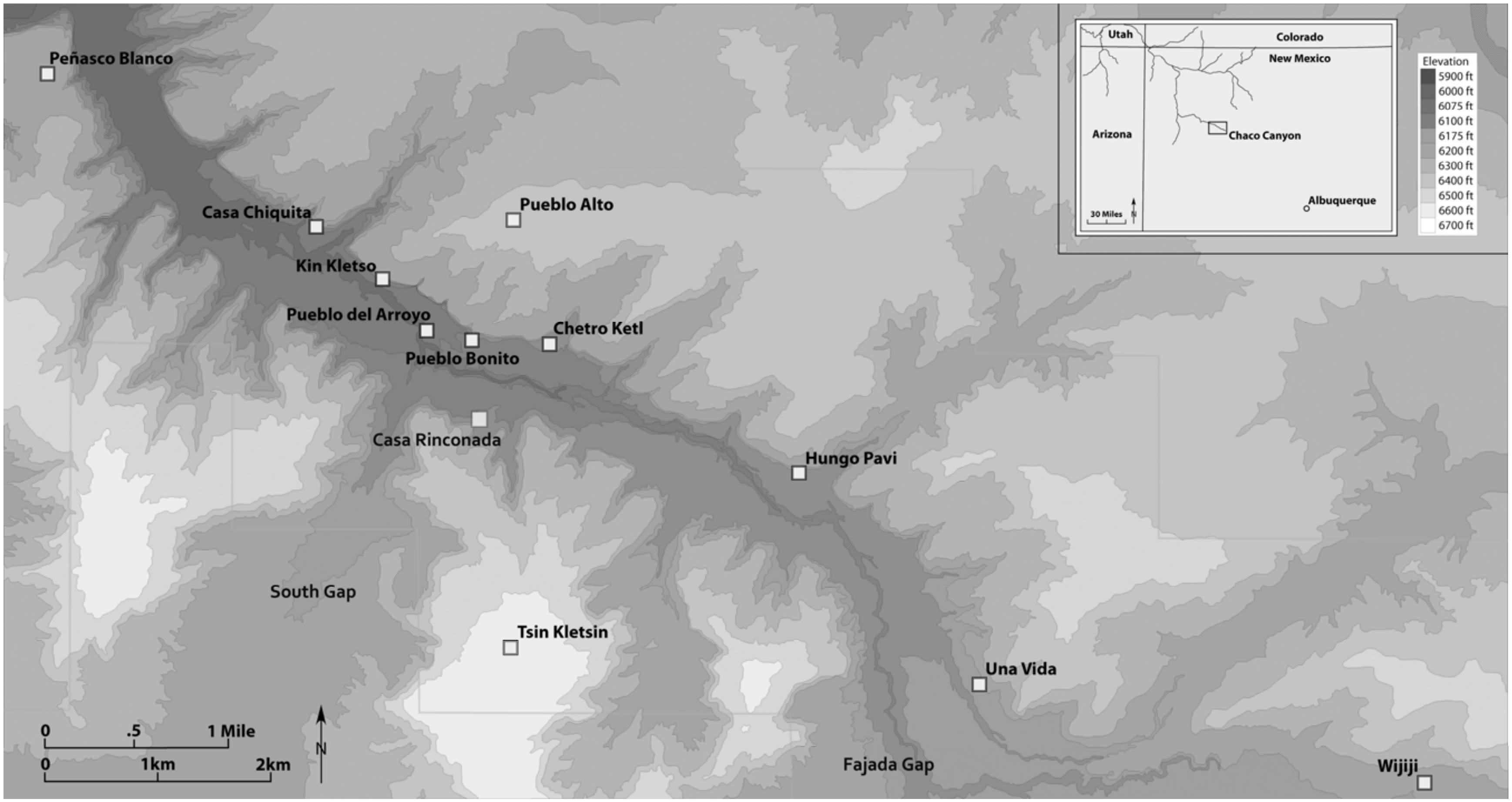



Figure 4.1: Chaco Canyon with locations of several great houses and the Casa Rinconada study area; *Inset* depicts the location of Chaco Canyon within the greater American Southwest (adapted from original map by Edward Triplett); http://www.chacoarchive.org/cra/chaco-sites/.


Figure 4.2: Aerial photograph of Casa Rinconada area indicating the locations Bc 57 and Bc 58. (Courtesy Chaco Culture NHP Museum Collection, University of New Mexico and the Chaco Research Archive, University of Virginia).

## Excavation and Depositional History of Bc 57, Bc 58, and Casa Rinconada

### *Bc 57 – Excavation History*

Bc 57 was excavated in the summer of 1942 by the University of New Mexico and School of American Research (hereafter UNM-SAR) field school under the direction of Paul Reiter and consists of nine single-story masonry rooms, three intramural kivas, one external kiva, and one unrelated pithouse that was investigated during the same field season (see Figure 4.3).

The discussion in Appendix A provides a detailed summary of the excavations at Bc 57 by integrating excavators' field notes, faunal and ceramic assemblages, and the archaeological database available through the CRA (http://www.chacoarchive.org/cra/). Field notes were not available for either Room 6 or Kiva D. Table A.1 in Appendix A illustrates the artifacts recorded by provenience.

As the account presented in Appendix A illustrates, when the field notes from the Bc 57 excavations are integrated to form a single narrative the level of detail in many instances equals, if not exceeds, that available for any other site excavated in Chaco prior to the Chaco Project of the 1970's. In many cases, excavators were careful to describe human burials and significant artifact finds and often noted stratigraphic patterns including the presence of ephemeral occupation surfaces and temporary hearths scattered throughout fill layers. Two archived photographs from the Bc 57 excavations, one of which is depicted in Figure 4.5, portray in dramatic fashion the abundance of groundstone recovered (Anthropology [1942]-b; [1942]-c). Prior to this investigation, these images of manos, metates, and hammerstones haphazardly stacked near the site were regarded as a testament to the site's important economic role and a sad token of the vast amounts of data lost or missing from the UNM-SAR excavations. In fact, the field notes provided a wellspring of information and most if not all of the groundstone artifacts recovered could be accurately linked with provenience records. Similarly, the excavators frequently recorded unusually dense concentrations of faunal, vegetal, and ceramic refuse and frequently noted when artifacts such as whole ceramic vessels were found in situ on floor surfaces. Subfloor architecture was reported in Room 2 and human burials, at least eleven in all, were mapped and recorded in Rooms 1, 2, 3, 5, and 9.

The design of Bc 57 suggests that the core roomblock was planned and likely constructed in a single building episode. As illustrated in Figure 4.3, the initial block exhibits a regular plan with three continuous walls running parallel between which abutting walls were then erected to divide the space into ten to twelve original rooms. The placement of abutting walls to form Room 1 indicates that it was a later addition to the structure. Likewise, the haphazard arrangement of the walls that enclose Kivas B and C points to their construction subsequent to the building of the main block of rooms.

***Bc 58 – Excavation History***

The excavation of Bc 58 was also conducted by the UNM-SAR field school under Paul Reiter's supervision during the 1947 season. Consisting of fourteen rooms and two intramural kivas, the single-story site appears to date to the late 1000s through early 1100s CE (see Figure 4.4). In contrast to Bc 57 that appears to have been initially constructed as a planned roomblock, the architecture of Bc 58 is less symmetrical and suggests that it was built and remodeled in numerous stages with the addition of walls and rooms occurring in an agglomerative fashion.

Although there are no indications that any masonry walls at Bc 58 were core-and-veneer in construction, Cornett (n.d.:4) reported that the majority of wall facing at Bc 58 corresponded closely to Hawley's Type 7 and 9, or Lekson's Type III and Type IV respectively, placing much of the construction within the interval 1050-1115 CE (Lekson 1984:17-19). Parts of the southwestern roomblock (Rooms 2, 3, 4, 5, 7, and 14) reportedly exhibit Hawley's Type 8 masonry style or McElmo suggesting that this portion of the site was a later addition (Cornett n.d.:4; Lekson 1984:19). Relative to those of Bc 57, the field notes available for Bc 58 are considerably less informative but the description in Appendix A provides a room-by-room account of the excavation history and what is known of the room contents. A list of artifacts recovered from Bc 58 is provided in Table A.2 in Appendix A.

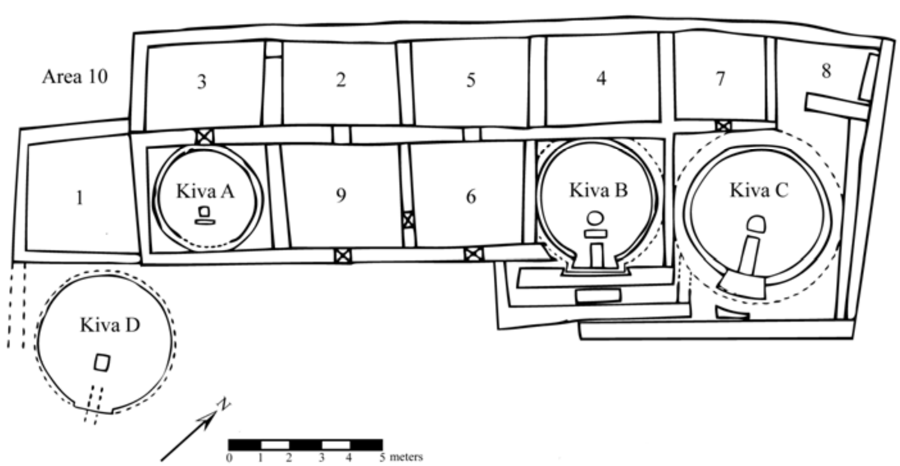



Figure 4.3: Plan view of Bc 57 (Courtesy Chaco Culture NHP Museum Collection, University of New Mexico and the Chaco Research Archive, University of Virginia).

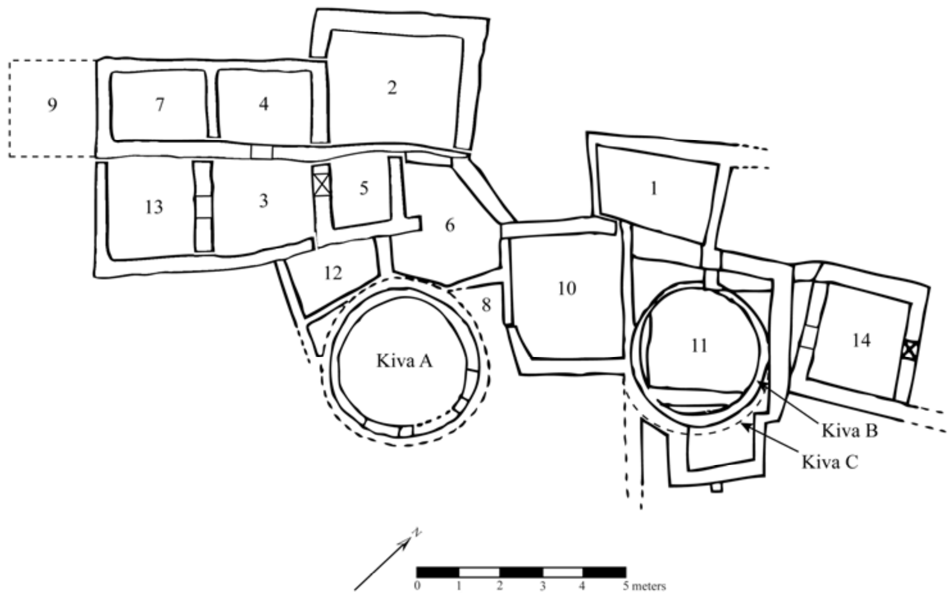



Figure 4.4: Plan view of Bc 58 (Courtesy Chaco Culture NHP Museum Collection, University of New Mexico and the Chaco Research Archive, University of Virginia).

Figure 4.5: Groundstone recovered from Bc 57, looking south (courtesy Maxwell Museum of Anthropology [1942]-a; http://www.chacoarchive.org/chaco_imgs/Maxwell/1/mid/88_43_234.jpg).

***Casa Rinconada – Excavation History***

The nearby site of Casa Rinconada is an isolated great kiva that was constructed atop an elevated landform situated among the South Gap small house site complex and appears to have been constructed and used during the Classic, Late Bonito, and McElmo subphases, 1050 - 1200 CE (McLellan 1969:179; Vivian 1948; Vivian and Reiter 1960:7, 24-26). The site was excavated by Gordon Vivian, Dick Vann, Janet Woods, and the UNM-SAR Field School in 1931. These excavations yielded a range of materials including ceramic sherds, ornaments (beads and pendants), and three copper bells from the structural fill and floor contexts (Vivian [1931]; Vivian and Reiter 1960:24; Woods 1931:8-9). Ceramics recovered during the excavation suggest use in the late-11th and early-12th centuries, while a single tree-ring date suggests construction may have begun in the mid-11th century. Vivian undertook restorations of portions of Casa Rinconada in 1933.

As with other isolated great kivas and those found within classic-style great houses, interior features of this semi-subterranean structure include a wide low bench, paired floor vaults, a roof supported by four masonry columns, and a stepped antechamber entryway (Vivian 1990:294). Despite the large number of great kivas that have been excavated across the Southwest, little is actually known about their use. Based on ethnographic parallels, prehistoric kivas are often interpreted as having served, at least partly, a ritual and integrative role at the corporate (lineage, clan, or kiva group) or community scale (Eggan 1950:299-300; Ortiz 1969:37). Several scholars have suggested that great kivas may have served as a community focal point for resource redistribution, feasting, ceremonial exchange, and ritual dances (Lightfoot 1984:73; Plog 1974:127).

Great kivas are often distinguished from the smaller and more common corporate group kiva on the basis of their immense size, a general lack of domestic features, and the presence of likely ritual features such as lateral floor vaults (Adler and Wilshusen 1990:141-142; Lekson et al. 2006:87-89; Van Dyke 2007b:112-114, 117-121; Wilshusen 1989:95-98). Although at 19.5 m in diameter, Casa Rinconada was a comparatively large ritual structure, Van Dyke (2007b:119) observes that no more than seventy-five spectators could have fit comfortably within the confines of the structure. With direct access to secretive ceremonies likely limited to some subset of the resident or visiting population, other activities such as exchange and feasting may have occurred in close proximity to the structure.

If great kivas were foci of communal ritual that may have entailed feasting, resource redistribution, and ceremonial exchange (Herr 2001:83; Lightfoot 1984:73; Plog 1974:127), the location of these two small sites adjacent to an isolated great kiva makes them ideal cases for an investigation of the roles feasting may have played in the eleventh and twelfth centuries in Chaco.

### *Excavation History and Chronology of Other Sites Sampled*

Table 4.1 lists the sites included in the faunal analysis and worked bone studies that follow. Łeyit Kin, located approximately 650 meters east of the Casa Rinconada rincon at the base of South Mesa, was excavated over the course of two field seasons in 1934 and 1936 by UNM-SAR field schools and later with the aid of the Works Progress Administration, exposing seventeen rooms and four kivas (Dutton 1938). Architectural evidence, tree-ring dates, and ceramics indicate at least three components at the site.

Table 4.1: Sites included in faunal and/or bone tool analyses in this study.

| Chaco Survey Number | Alternate Designation | Site Name | Location | Time Periods | Size | Faunal Analysis | Worked Bone Analysis |
|---|---|---|---|---|---|---|---|
| 29SJ 299 | - | Rich's Site | Mesa top north of Chaco Canyon | Basketmaker III; Pueblo I; Pueblo II kiva | 3-4 pit structures, 10 storage cists, 4 storage rooms, ramada, kiva | | X |
| 29SJ 386 | Bc 255 | Casa Rinconada | Casa Rinconada rincon | Late Pueblo II-Pueblo III | Great Kiva, 3-6 connected rooms, antechamber | | X |
| 29SJ 389 | - | Pueblo Alto | Mesa top north of Chaco Canyon | Pueblo II - Pueblo III | 120 rooms, 18 kivas, trash mound | X | X |
| 29SJ 396 | Bc 53 | Roberts' Site; Ignorance Hollow; Judd's Pithouse #1 | Casa Rinconada rincon | Pueblo I - Pueblo III | 20 rooms, 4 kivas, 1 pit structure | | X |
| 29SJ 397 | Bc 57 | - | Casa Rinconada rincon | Late Basketmaker II - Early Baskemaker III; Late Pueblo I; Pueblo II-Pueblo III | 9 rooms, 3 enclosed kivas, 1 exterior kiva, and 1 pit structure | X | X |
| 29SJ 398 | Bc 58 | - | Casa Rinconada rincon | Pueblo II | 14 rooms, 3 kivas | X | X |
| 29SJ 423 | - | - | West Mesa | Basketmaker III; Pueblo III | 3+ pit structures, 3 storage cists, Great Kiva, Pueblo III shrine | | X |
| 29SJ 519 | - | - | 750 meters southeast of Una Vida | Basketmaker III | 3 pit structures, 1 storage cist, 7 thermal features, ramada, midden | | X |
| 29SJ 627 | - | - | Marcia's Rincon/Fajada Gap | Pueblo I - Early Pueblo III | 25 rooms, 7 pit structures, trash mound | X | X |
| 29SJ 628 | | - | Marcia's Rincon/Fajada Gap | Basketmaker III - Pueblo I | 6 pit structures, 6 storage cists | X | X |
| 29SJ 629 | - | Spadefoot Toad Site | Marcia's Rincon/Fajada Gap | Pueblo I - Early Pueblo II; Early Pueblo III | 8 rooms, 2 pit structures, ramada | X | X |
| 29SJ 633 | Bc 187 | 11th Hour Site | Marcia's Rincon/Fajada Gap | Early and Late Pueblo III | 12-15 rooms, 3+ kivas | X | X |
| 29SJ 724 | | House Block 1; House Block 2 | Werito's Rincon | Pueblo I | 10 rooms, 1 pit structure, ramada | | X |
| 29SJ 750 | Bc 24 | Łeyit Kin | 650 meters southeast of Casa Rinconada Rincon | PI-early PIII | 27 rooms, 4 kivas, trash mound | | X |
| 29SJ 1360 | - | - | Fajada Gap | Pueblo I - Early Pueblo II | 18 rooms, 5 pit structures, ramada | X | X |
| 29SJ 1659 | Bc 256 | Shabik'eshchee Village | Chacra Mesa | Basketmaker III; Early Pueblo I (?) | 64+ pithouses, 48 storage cists, great kiva, 3 trash middens | | X |

The foundations of an earlier structure underlie the walls of the visible structure (Dutton 1938:25, 27, 34, 43). On the basis of tree-ring analysis the latter appear to have been constructed in the early- to mid-eleventh century CE (Dutton 1938:79). A third occupation is evinced by late-eleventh and early-twelfth century ceramics in upper depositional levels (Dutton 1938:84-89).

Excavated from 1940-1941 by Frank H. H. Roberts, Jr., Paul Reiter, William Mulloy, and the University of New Mexico/School of American Research field schools, Bc 53 is a small house site located in the same rincon as Casa Rinconada, Bc 57, and Bc 58 on the south side of the canyon, opposite Pueblo Bonito and Chetro Ketl. The excavations revealed 21 rooms and four kivas and although no report was ever published, copious field notes have enabled the Chaco Research Archive to provide a detailed account of the architecture and material remains recovered (http://www.chacoarchive.org/cra/chaco-sites/bc-53-roberts-site/). Wall bonding and abutment indicates that the site's growth was accretionary rather than being constructed in a single episode and ceramic tallies point to occupation during the late-eleventh century.

The Basketmaker III site of Shabik'eshchee Village, located 11 km east of Pueblo Bonito atop a northern promontory of Chacra Mesa, was first excavated from 1926-1927 by Frank H.H. Roberts for the Smithsonian's Bureau of American Ethnology (Roberts 1929). Roberts exposed 19 pithouses, 45 storage cists, and a great kiva. Additional survey and excavations by Alden Hayes and John Thrift for the National Park Service in 1973 identified at least 49 other structures and yielded the 36 worked bone specimens included in this study. Based on the high frequency of Lino Gray and La Plata Black-on-white ceramics and tree-ring dates that indicate great kiva construction in the mid-A.D.

500s, much of the site appears to date to the Basketmaker III period. However some portions of the site may represent an early-eighth century re-occupation.

The Pueblo Alto great house on the mesa top north of Pueblo Bonito, three Basketmaker III sites (29SJ 299, 29SJ 423, 29SJ 628), one Pueblo I period site near Werito's Rincon, and four small house sites in the Marcia's Rincon/Fajada Gap area (29SJ 627, 29SJ 629, 29SJ 633, and 29SJ 1360) were excavated by the Chaco Project from 1973-1978 and with the exception of sites 299, 423, 628, and 724 for which no reports were published, the excavations are well-documented (Mathien 1991; Mathien and Windes 1987; McKenna 1984; Truell 1992; Windes 1987a; 1987b; 1993).

Finally, the 29SJ 519 assemblage is the most recent, having been completed from June 2009 – May 2010 by Dabney Ford and Roger Moore of the National Park Service. Undertaken after maintenance work encountered the site, excavations exposed three pit structures, a storage cist, seven thermal features, a ramada, and associated midden dating to the Basketmaker III period as well as an isolated hearth dated to Pueblo I.

## Ceramic Dating of Bc 57 and Bc 58

The ceramic assemblages and radiocarbon dates from the site's refuse-filled rooms and subfloor deposits demonstrate that activity at and around the site spans Basketmaker III through Pueblo III periods. Temporal placement of the site on the basis of ceramic and radiocarbon evidence will be addressed in detail later in this chapter.

The Bc 57 and Bc 58 ceramic assemblages, housed at the Maxwell Museum of Anthropology at the University of New Mexico in Albuquerque, New Mexico, were analyzed by the author during research visits in September 2009 and November 2010. The goal of the ceramic analysis was two-fold: 1) to determine ceramic groups as a means of assigning sites to general chronological periods; and 2) to obtain mean ceramic dates for each context in an attempt to temporally place room assemblages and compare with radiocarbon dates where possible.

Ceramic groups represent “ideal assemblages” characterized by a series of types that predominate during a specific time period. Since the resulting temporal framework is based on ceramic production spans, the inference that production spans reflect occupation duration is a key assumption (Goetze and Mills 1993:87-88). The assignment of Bc 57 and Bc 58 ceramic assemblages to ceramic groups depicted in Tables 4.2 and 4.3 relies on the classification schemes outlined by Goetze and Mills (1993) and Windes (1987a).

Mean ceramic dating is a method pioneered by Stanley South (1972) for use with historic ceramics. Since then the technique has also seen widespread use in the dating of prehistoric sites in the Southwest (Christenson 1994; Goetze and Mills 1993; Mills 1988; Upham and Bockley 1989; Van Dyke 1997). The technique is based on several assumptions: (1) ceramic types have unimodal frequency curves; (2) at any given time, more than one ceramic type is in use and thus frequency curves overlap; (3) the date of a type can be represented by the midpoint of the type’s manufacturing span; and (4) the mean ceramic date (MCD) of an assemblage can be ascertained using the mean dates for each type weighted by its frequency. In the Southwest, production spans for many ceramic types have been estimated through correlation with tree-ring dates.

The approach is not without its flaws. Several variables affect relative frequencies of ceramic types including duration of site occupation, patterns of reoccupation in multi-component sites, differential access and use, reclamation/reuse, and use of heirloom vessels. The extent to which MCD's misrepresented site chronology at Nuvakwewtaqa even led Upham and Bockley (1989:489) to question the utility of the approach at the site. However, Christenson (1994) argued that mean ceramic dates have the potential to be just as accurate as other techniques (e.g. radiocarbon, archaeomagnetic, and tree-ring dating). Thus, the use of mean dates should be approached with caution but it constitutes a useful chronometric tool particularly when utilized in conjunction with other dating methods.

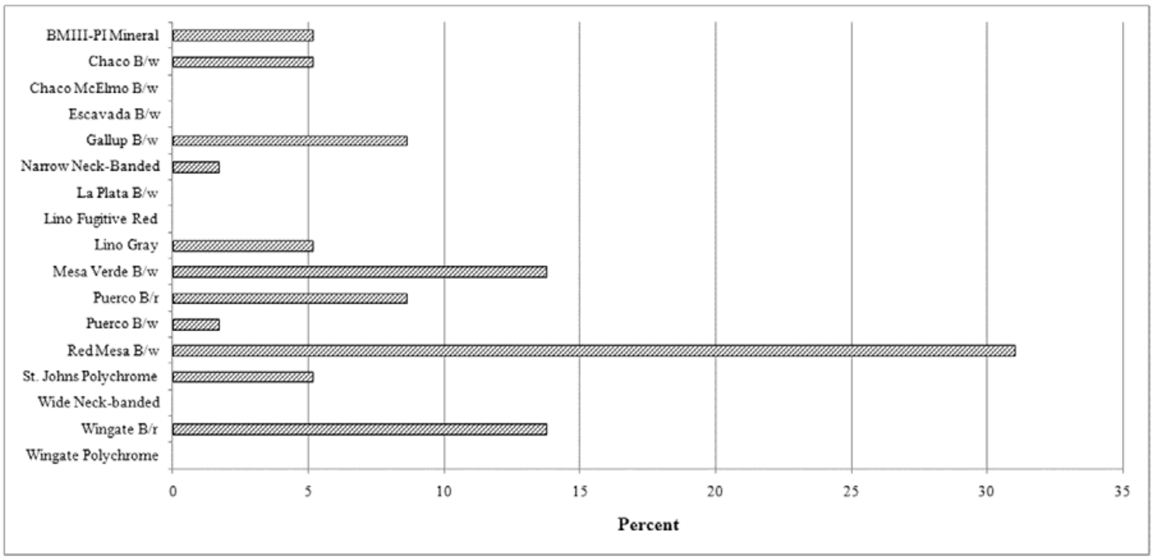



Figure 4.6: Early PII Ceramic Type Percentages at Bc 57.

Ceramic type ranges employed included those outlined by Van Dyke (1997:144); the incorporation of several additional types was necessary with date ranges based on Toll and McKenna (1997). A disadvantage of the South's (1972) method is that all ceramic types are weighted the same regardless of production span. Carlson (1983:8-9) has demonstrated that the accuracy of the results can be refined through inverse weighting of MCD's by their manufacturing dates. Following Van Dyke (1997) and

Christenson (1994:304), simple linear weighting was employed to allow types with narrower ranges to contribute more to the MCD calculation. This is accomplished by subtracting a manufacturing range from an arbitrarily selected large number (three hundred) and dividing by one hundred.  These weights are then multiplied by the number of sherds for the respective ceramic type and used to calculate the MCD.  For instance, a sherd with a production span of one hundred years would yield a weight of two and be counted twice.  Contexts with less than ten sherds were excluded from analysis.

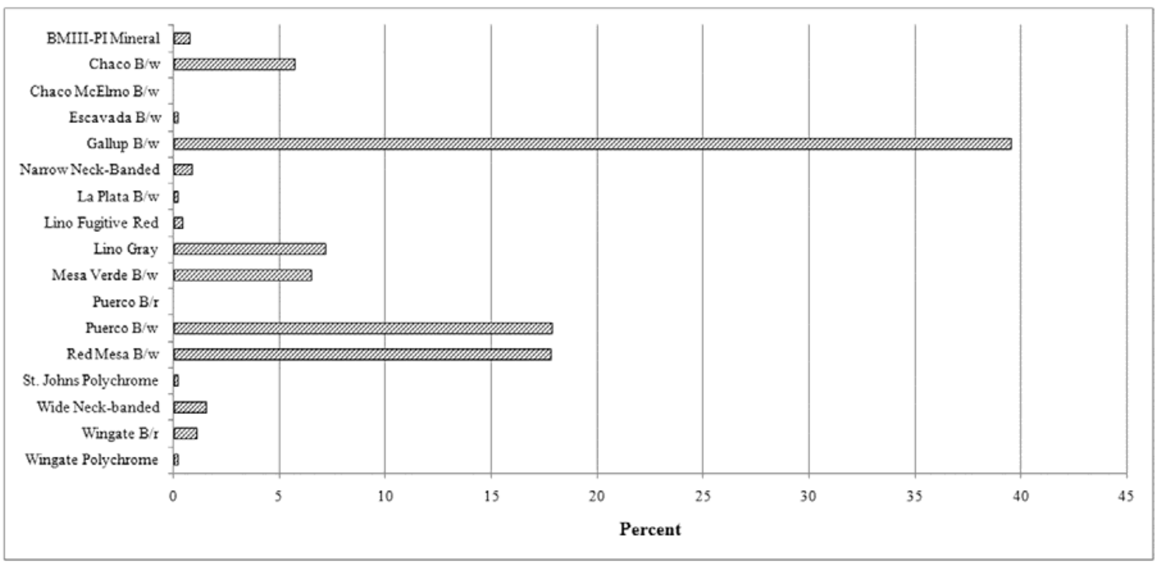



Figure 4.7: Late PII Ceramic Type Percentages at Bc 57.

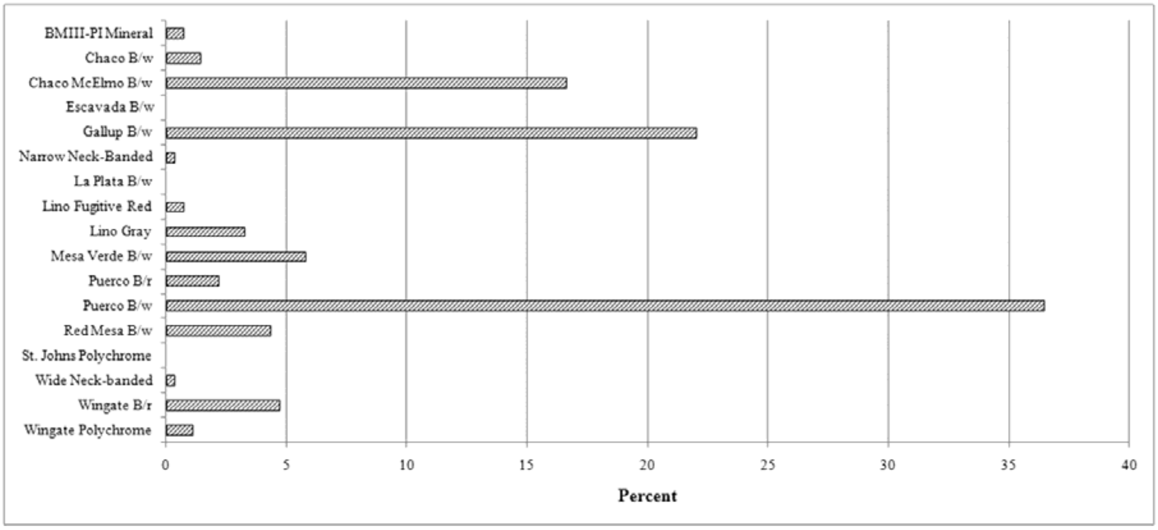



Figure 4.8: Early PIII Ceramic Type Percentages at Bc 57.

### *Bc 57 Ceramic Groups and Mean Ceramic Dates*

The assignment of ceramic groups and MCD's, shown in Table 4.2, permitted the identification of four distinct time periods represented by subfloor and above-floor deposits at Bc 57. Late Basketmaker III and Early Pueblo II ceramics predominate among subfloor assemblages and above-floor deposits could be assigned to the Early, Classic, or Late Bonito subphases. That the subfloor ceramics date to the Basketmaker III through Early Pueblo II is consistent with construction of the site some time during the late eleventh century. As depicted in Figure 4.6, Early Bonito assemblages at Bc 57 are characterized by the overwhelming frequency of Red Mesa black-on-white. Among Classic Bonito assemblages, Gallup black-on-white, Puerco black-on-white, and Chaco black-on-white are the predominant ceramic types (see Figure 4.7). Late Bonito assemblages in contrast tended to be dominated by Chaco-McElmo black-on-white, Chaco black-on-white, and White Mountain Redwares (see Figure 4.8).

The stem-and-leaf plot (Figure 4.9) illustrates the distribution of mean ceramic dates at Bc 57 and underscores that the majority of mean ceramic dates fall in the latter half of the eleventh century CE. Apparent temporal breaks occur between the eighth and tenth centuries and between the mid-tenth and early eleventh centuries CE. In a few cases (Room 5, Room 6, and Kiva A), mean dates postdate the ceramic group to which the assemblage was assigned. This can be accounted for by the apparent mixing of later ceramics, particularly Mesa Verde black-on-white, which in turn skews the mean dates. The relatively infrequent occurrence of Mesa Verde black-on-white ceramics, a type not manufactured until after 1200 CE, signifies a later occupation/use of the site.

### *Bc 58 Mean Ceramic Dates*

As shown in Table 4.3 and Figure 4.10, the majority of room fill assemblages at Bc 58 can be reliably attributed to the Classic Bonito subphase. Among these assemblages Gallup black-on-white and Red Mesa black-on-white were the predominant types with Chaco black-on-white and Chaco-McElmo black-on-white occurring in smaller numbers. The major exception was the Room 3 assemblage shown in Figure 4.11 that exhibits substantial mixing of ceramics from the Pueblo I through Pueblo III periods. In light of the mixed nature of the deposit the Room 3 faunal assemblage was excluded from analysis. The stem-and-leaf plot (Figure 4.12) reveals a mean date distribution evenly distributed throughout the eleventh century with no clear temporal breaks. However, Room 3, Room 7, and the Outside Kiva A context included high frequencies of Early Pueblo II ceramics (Red Mesa black-on-white and narrow neck-banded) in addition to Gallup and Chaco black-on-white and in these cases the mean dates appear to have been skewed somewhat earlier in the sequence.

This ceramic chronometric analysis appears to provide a fairly clear temporal sequence for both sites but the reliability of these results can be tested through comparison with radiocarbon dates.

Years (CE)

```
7   5
8
8
9   4
9
10  3
10M 5557788899
11  112
```

Figure 4.9: Stem-and-leaf diagram of mean dated assemblages with ten or more sherds at Bc 57; (50 year vertical scale; M = median).

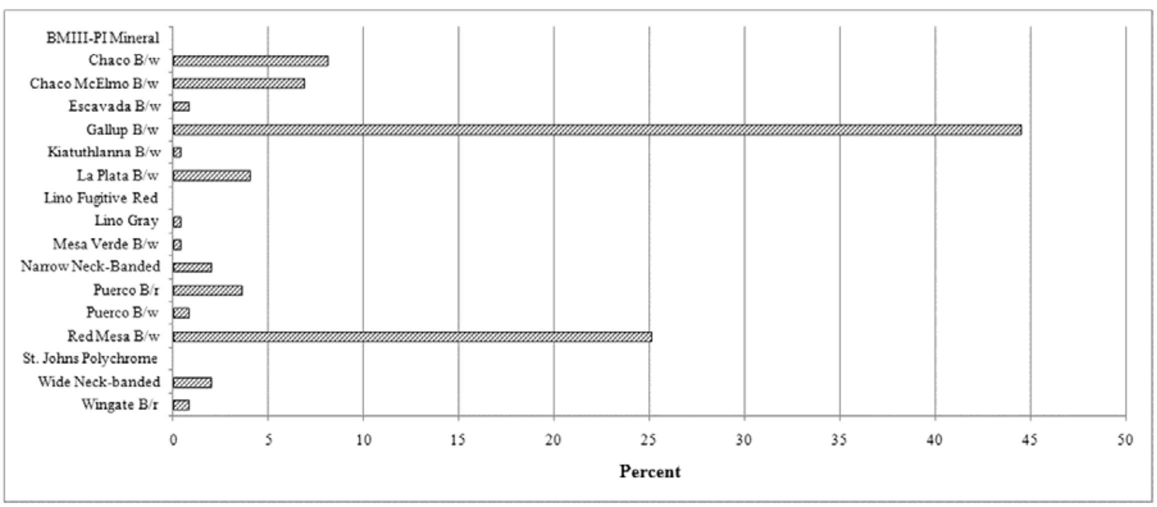



Figure 4.10: Late PII Ceramic Type Percentages at Bc 58.

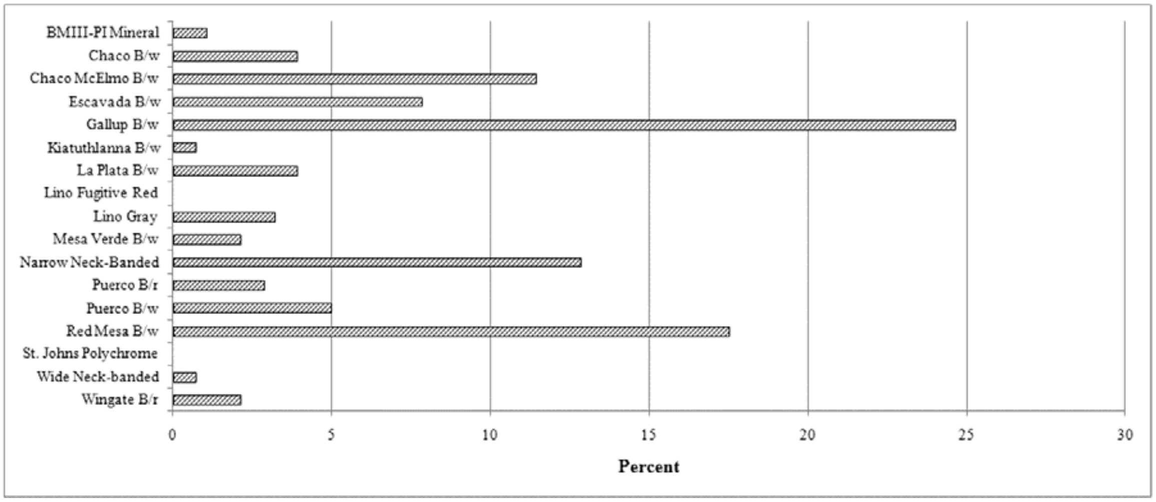



Figure 4.11: Late PII-Early PIII Ceramic Type Percentages at Bc 58 (Room 3).

Years (CE)

```
10  11
10  3
10M 5
10  6
10  89
```

Figure 4.12: Stem-and-leaf diagram of mean dated assemblages with ten or more sherds at Bc 58; (20 year vertical scale; M = median).

Table 4.2: Ceramic groups and mean ceramic dates by room at Bc 57.

| Provenience | Time Period | MCD (CE) | +/- | AMS Mean Date (CE) |
|---|---|---|---|---|
| Room 5 (subfloor) | Basketmaker III (500-700)-Early Bonito (900-975) | 752 | 158 | 414, 475 |
| Room 2 (subfloor) | Early Bonito (900-975)-Classic Bonito (1040/1050-1100) | 941 | 136 | - |
| Room 3 | Early Bonito (975-1040/1050) | 1051 | 133 | 955, 980 |
| Room 4 | Early Bonito (975-1040/1050) | 1052 | 119 | 943, 1009 |
| Room 2 | Early Bonito (975-1040/1050) | 1060 | 149 | - |
| Kiva A | Early Bonito (975-1040/1050) | 1084 | 118 | - |
| Kiva D | Classic Bonito (1040/1050-1100) | 1003 | 111 | - |
| Pithouse A | Classic Bonito (1040/1050-1100) | 1057 | 110 | - |
| Area 10 | Classic Bonito (1040/1050-1100) | 1077 | 61 | - |
| Room 1 | Classic Bonito (1040/1050-1100) | 1082 | 61 | - |
| Kiva B | Classic Bonito (1040/1050-1100) | 1090 | 153 | - |
| Room 7 | Classic Bonito (1040/1050-1100) | 1091 | 141 | 1096, 1163, 1213 |
| Room 6 | Classic Bonito (1040/1050-1100) | 1112 | 112 | - |
| Room 5 | Classic Bonito (1040/1050-1100) | 1119 | 86 | - |
| Room 8 | Classic Bonito (1040/1050-1100) | - | - | 1073, 1131 |
| Room 9 | Late Bonito (1100-1140) | 1089 | 102 | 1081, 1112, 1113, 1158, 1170 |
| Kiva C | Late Bonito (1100-1140) | 1125 | 85 | - |

Table 4.3: Ceramic groups and mean ceramic dates by room at Bc 58.

| **Provenience** | **Time Period** | **MCD (CE)** | **+/-** | **AMS Mean Date (CE)** |
|---|---|---|---|---|
| Room 4 | Classic Bonito (1040/1050-1100) | 1069 | 130 | 1064, 1106 |
| Room 5 | Classic Bonito (1040/1050-1100) | - | - | 1046 |
| Room 6 | Classic Bonito (1040/1050-1100) | 1098 | 51 | - |
| Room 7 | Classic Bonito (1040/1050-1100) | 1014 | 106 | - |
| Room 10 | Classic Bonito (1040/1050-1100) | 1051 | 152 | 1073, 1079, 1118 |
| Room 14 | Classic Bonito (1040/1050-1100) | - | - | 1006, 1092 |
| Outside Rm 2 | Classic Bonito (1040/1050-1100) | 1080 | 176 | - |
| Outside Kiva A | Classic Bonito (1040/1050-1100) | 1014 | 98 | - |
| Room 3 | Early Bonito (975-1040/1050)-Late Bonito (1100-1140) | 1031 | 91 | - |

## AMS Radiocarbon Dating of Bc 57 and Bc 58

### *Bc 57 and Bc 58 Radiocarbon Dates*

Absolute dates were obtained by direct-dating of faunal remains from both Bc 57 and Bc 58. Twenty-six samples from Bc 57 and nine samples from Bc 58 were selected and submitted to the NSF-University of Arizona AMS Laboratory for radiocarbon dating. Contexts were selected for sampling with three goals in mind: 1) sampling of subfloor, floor level, and fill contexts combined was intended to bracket construction and abandonment, thus improving our understanding of occupation spans; 2) sampling of room contexts targeted, where possible, floor level associations and specific stratigraphic fill levels with the hope of clarifying the breadth of time across which trash deposition occurred – a point of particular importance to the question of episodic feasting; and 3) sampling of spatial contexts distributed horizontally across the site has the further potential to shed light on questions of room abandonment.

The accelerated mass spectrometry (AMS) radiocarbon measurements for Bc 57 are shown in Table 4.4 and Figure 4.13; Table 4.5 and Figure 4.14 present the AMS results for Bc 58. Several pairs of radiocarbon assays (AA92498 and AA92505; AA92499 and AA92500; AA92504, AA92509, and AA92510) yielded duplicate radiocarbon ages and standard errors for separate room assemblages. Although these duplicate dates are attributable to rounding error (Richard Cruz pers. comm.), at the author's request the AMS laboratory reanalyzed those samples for which remaining graphite was sufficient. Remaining graphite was insufficient, however, for two samples (AA92509 and AA92510). The dates resulting from the first and second runs for each

Table 4.4: Bc 57 AMS samples.

| Sample | Room | Provenience Type | Taxon | Element | $\delta^{13}$C% | $\delta^{14}$C Age BP | +/- δ14C Age | $\delta^{14}$C Age cal CE 1σ | $\delta^{14}$C Age cal CE 2σ | mean |
|---|---|---|---|---|---|---|---|---|---|---|
| AA92498 (first run) | 3 | Floor Level | Artiodactyl | Rib | -15.2 | 1,091 | 37 | 896-991 | 885-1020 | 947 |
| AA92498 (second run) | 3 | Floor Level | Artiodactyl | Rib | -15.2 | 1,070 | 49 | 899-1018 | 827-1116 | 959 |
| AA92498 (pooled) | - | - | - | - | - | - | - | 898-994 | 894-1017 | 955 |
| AA92499 (first run) | 3 | Floor Level | *Lepus californicus* (black-tailed jackrabbit) | Femur | -14.9 | 1,073 | 37 | 900-1016 | 894-1021 | 960 |
| AA92499 (second run) | 3 | Floor Level | *Lepus californicus* (black-tailed jackrabbit) | Femur | -14.9 | 1,052 | 30 | 975-1020 | 898-1025 | 982 |
| AA92499 (pooled) | - | - | - | - | - | - | - | 975-1017 | 898-1023 | 980 |
| AA92500 (first run) | 4 | Room Fill | *Lepus californicus* (black-tailed jackrabbit) | Femur | -12.8 | 1,073 | 37 | 900-1016 | 894-1021 | 960 |
| AA92500 (second run) | 4 | Room Fill | *Lepus californicus* (black-tailed jackrabbit) | Femur | -12.8 | 981 | 33 | 1017-1149 | 992-1155 | 1073 |
| AA92500 (pooled) | - | - | - | - | - | - | - | 994-1023 | 906-1040 | 1009 |
| AA92505 (first run) | 4 | Room Fill | Artiodactyl | Femur (fragment) | -17.6 | 1,091 | 37 | 896-991 | 885-1020 | 947 |
| AA92505 (second run) | 4 | Room Fill | Artiodactyl | Femur (fragment) | -17.6 | 1,129 | 88 | 781-991 | 675-1040 | 889 |
| AA92505 (pooled) | - | - | - | - | - | - | - | 896-988 | 885-1018 | 943 |
| AA92502 | 5 | Subfloor | Artiodactyl | Femur | -17.3 | 1,643 | 39 | 344-527 | 263-536 | 414 |
| AA92501 | 5 | Subfloor | Artiodactyl | Long-Bone Fragment | -17.6 | 1,594 | 39 | 423-534 | 390-557 | 475 |
| AA92503 | 7 | Room Fill, Level, 2, Top of South Wall, 18-36" | Artiodactyl | Long-Bone Fragment | -19.0 | 817 | 42 | 1186-1264 | 1057-1279 | 1213 |
| AA92504 (first run) | 7 | Room Fill, Level 3, Top of South Wall, 36-54" | *Cynomys gunnisoni* (Gunnison's prairie dog) | Mandible w/teeth | -9.7 | 981 | 45 | 1014-1152 | 980-1164 | 1073 |
| AA92504 (second run) | 7 | Room Fill, Level 3, Top of South Wall, 36-54" | *Cynomys gunnisoni* (Gunnison's prairie dog) | Mandible w/teeth | -9.7 | 912 | 37 | 1043-1164 | 1031-1209 | 1113 |
| AA92504 (pooled) | - | - | - | - | - | - | - | 1035-1152 | 1025-1160 | 1096 |
| AA93202 | 7 | Room Fill, Level 3, Top of South Wall, 36-54" | Artiodactyl | Long-Bone Fragment | -17.8 | 861 | 45 | 1052-1225 | 1042-1262 | 1163 |
| AA92509 | 8 | Room Fill, E Side to 2' Deep | Artiodactyl | Long-Bone Fragment | -20.9 | 981 | 36 | 1016-1151 | 992-1155 | 1073 |
| AA92508 | 8 | Room Fill, E Side to 2' Deep | *Lepus californicus* (black-tailed jackrabbit) | Femur | -13.2 | 891 | 36 | 1050-1209 | 1039-1217 | 1131 |
| AA92507 | 9 | Room Fill, Stratigraphic Level 1 | *Cynomys gunnisoni* (Gunnison's prairie dog) | Mandible w/teeth | -12.1 | 972 | 45 | 1018-1152 | 986-1168 | 1081 |
| AA92506 | 9 | Floor Level +12" | Artiodactyl | Tibia (fragment) | -17.2 | 918 | 45 | 1040-1161 | 1026-1211 | 1112 |
| AA93203 | 9 | Room Fill, Stratigraphic Level 2 | Artiodactyl | Tibia (fragment) | -17.4 | 917 | 46 | 1040-1162 | 1026-1211 | 1113 |
| AA93204 | 9 | Room Fill, Stratigraphic Level 1 | *Lepus californicus* (black-tailed jackrabbit) | Femur | -12.6 | 865 | 45 | 1051-1224 | 1041-1260 | 1158 |
| AA93205 | 9 | Floor Level + 12" | Artiodactyl | Long-Bone Fragment | -18.3 | 855 | 45 | 1059-1254 | 1043-1265 | 1170 |

Table 4.5: Bc 58 AMS samples.

| Sample | Room | Provenience Type | Taxon | Element | $\delta^{13}C\%$ | $\delta^{14}C$ Age BP | +/- δ14C Age | $\delta^{14}C$ Age cal CE 1σ | $\delta^{14}C$ Age cal CE 2σ | mean |
|---|---|---|---|---|---|---|---|---|---|---|
| AA93206 | 5 | Room Fill, Associated with Bowl | *Lepus californicus* (black-tailed jackrabbit) | Innominate | -15.1 | 1,003 | 46 | 986-1148 | 900-1159 | 1046 |
| AA93209 | 4 | Room Fill | *Lepus californicus* (black-tailed jackrabbit) | Innominate | -16.7 | 930 | 46 | 1040-1155 | 1022-1208 | 1106 |
| AA93207 | 4 | Room Fill | *Odocoileus hemionus* (mule deer) | Thoracic (spinous process fragment) | -19.8 | 989 | 46 | 994-1150 | 972-1163 | 1064 |
| AA92511 | 14 | Room Fill | *Lepus californicus* (black-tailed jackrabbit) | Innominate | -15.2 | 954 | 36 | 1025-1152 | 1017-1163 | 1092 |
| AA92512 | 14 | Room Fill | *Odocoileus hemionus* (mule deer) | Thoracic | -20 | 1,027 | 37 | 979-1030 | 897-1149 | 1006 |
| AA93208 | 10 | Depth 39" | *Lepus californicus* (black-tailed jackrabbit) | Tibia | -14 | 909 | 46 | 1041-1171 | 1027-1215 | 1118 |
| AA92510 | 10 | Depth 39" | *Cynomys gunnisoni* (Gunnison's prairie dog) | Mandible w/teeth | -10.9 | 981 | 36 | 1016-1151 | 992-1155 | 1073 |
| AA92497 | 10 | Room Fill, Densest Concentration of Faunal Refuse | Artiodactyl | Thoracic | -20.4 | 974 | 43 | 1018-1152 | 990-1160 | 1079 |

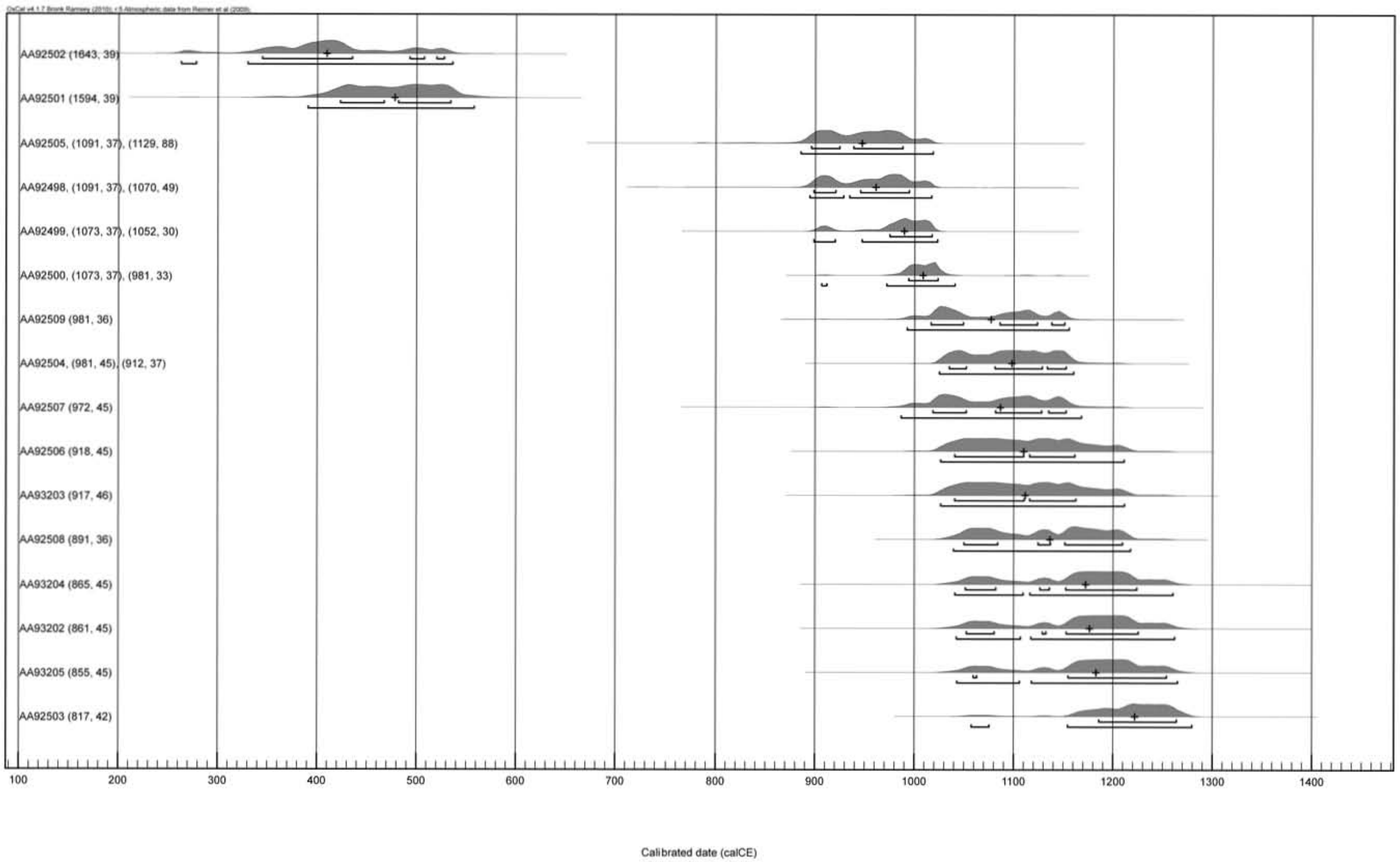



Figure 4.13: Radiocarbon dates of animal remains from Bc 57; δ14C Age BP and +/- δ14C Age are shown in parentheses; Brackets denote 1σ and 2σ range; + denotes median.

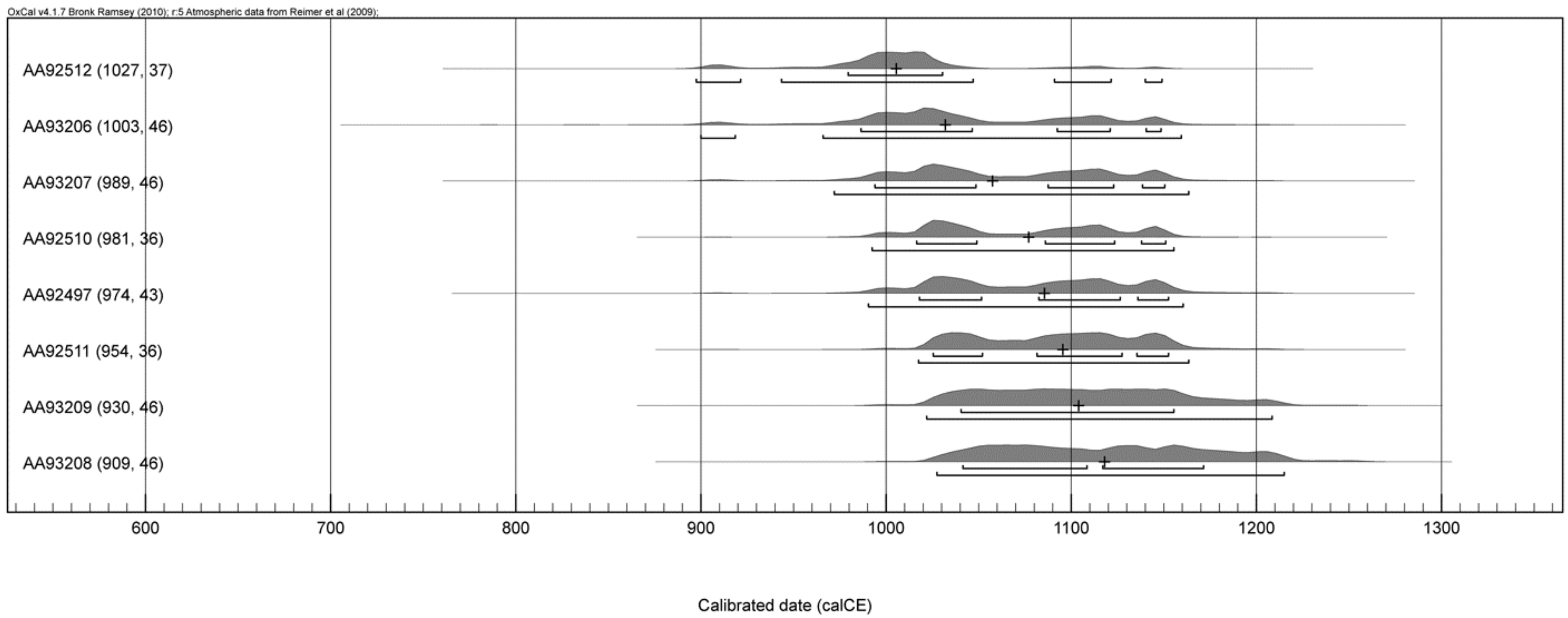



Figure 4.14: Radiocarbon dates of animal remains from Bc 58; δ14C Age BP and +/- δ14C Age shown in parentheses; Brackets denote 1σ and 2σ range; + denotes median.

sample were then pooled and a mean was computed using the R_Combine function embedded in the OxCal 4.1 software. Following Ward and Wilson (1978:28,30), the consistency of dates was evaluated using a $\chi^2$ test, yielding no statistical evidence to doubt the consistency of pooled radiocarbon dates. The dates depicted in Figure 4.13 include the pooled dates for Rooms 3, 4, and 7.

## Discussion of Bc 57 and Bc 58 Site Chronology

### *Bc 57 and Bc 58 – Temporal Analysis*

The incorporation of radiocarbon dates drastically improved temporal control of these assemblages. Direct dating of faunal remains suggests that the majority of the deposits date to the late tenth and early eleventh centuries. The radiocarbon dates pictured in Figures 4.13 and 4.14 reflect a late Basketmaker II/early Basketmaker III component, a tenth century component, and then a nearly continuous use of the two sites and their surroundings from the early eleventh century through the close of the twelfth century CE. Table 4.6 outlines the temporal designations determined on the basis of both ceramic evidence and radiocarbon dates.

In several cases at Bc 57, use of either ceramic data or radiocarbon dates alone produced ambiguous results. For instance, the Bc 57 Room 3 and Room 4 ceramics point to deposition during either the Early Bonito or Classic Bonito subphases but direct-dating of faunal remains places the assemblages securely in the Early Bonito period. Conversely, the AMS dates obtained for Rooms 7 and 9 were the source of uncertainty, suggesting that refuse deposits could be dated to either the Classic or Late Bonito periods. For the former room, the ceramics are overwhelmingly dominated by Gallup black-on-white, evidence that the assemblage largely derives from the Classic Bonito subphase. The Room 9 ceramic assemblage was dominated by Puerco black-on-white and Gallup black-on-white, the production of which spans the Classic and Late Bonito periods, but also included an abundance of Chaco-McElmo black-on-white and Wingate black-on-red, signifying that the deposits were more likely Late Bonito in origin.

As discussed in the review of the Bc 57 excavation records in Appendix A, Late Pueblo III ceramic types such as Mesa Verde black-on-white and St. Johns Polychrome were recovered at or near floor contact in Rooms 2 and Room 9. This, as well as the occurrence of small concentrations of Mesa Verde black-on-white in other room-fill contexts, attests to site-use as late as the early thirteenth century. Coupled with the relative paucity of radiocarbon dates placed firmly in the thirteenth century, the low frequency of Mesa Verde black-on-white ceramics recovered from room fill assemblages is strong evidence that the thirteenth century occupation of Bc 57 was relatively ephemeral and likely generated only a small fraction of the midden accumulation. Thus whole or partial room fill assemblages may represent secondary or tertiary deposition of eleventh and twelfth century midden material from adjacent areas by the site's latest inhabitants. In other words re-use and remodeling of the site during the Mesa Verdean period likely entailed removal and re-deposition of pre-existing refuse. However as will be discussed below, other evidence of secondary and tertiary depositional patterning such as extensive trampling, abrasion, or high fragmentation rates were not observed (LaMotta and Schiffer 1999:24-25; Scarborough 1989:415-416).

Table 4.6: Bc 57 and Bc 58 assemblage temporal assignments with mean ceramic dates and AMS radiocarbon mean dates.

| Bc 57 | | | | |
|---|---|---|---|---|
| **Provenience** | **Time Period** | **MCD (CE)** | **+/-** | **AMS Mean Date (CE)** |
| Room 5 (subfloor) | Basketmaker III (500-700)-Early Bonito (900-975) | 752 | 158 | 414, 475 |
| Room 2 (subfloor) | Early Bonito (900-975)-Classic Bonito (1040/1050-1100) | 941 | 136 | - |
| Room 3 | Early Bonito (975-1040/1050) | 1051 | 133 | 955, 980 |
| Room 4 | Early Bonito (975-1040/1050) | 1052 | 119 | 943, 1009 |
| Room 2 | Early Bonito (975-1040/1050) | 1060 | 149 | - |
| Kiva A | Early Bonito (975-1040/1050) | 1084 | 118 | - |
| Kiva D | Classic Bonito (1040/1050-1100) | 1003 | 111 | - |
| Pithouse A | Classic Bonito (1040/1050-1100) | 1057 | 110 | - |
| Area 10 | Classic Bonito (1040/1050-1100) | 1077 | 61 | - |
| Room 1 | Classic Bonito (1040/1050-1100) | 1082 | 61 | - |
| Kiva B | Classic Bonito (1040/1050-1100) | 1090 | 153 | - |
| Room 7 | Classic Bonito (1040/1050-1100) | 1091 | 141 | 1096, 1163, 1213 |
| Room 6 | Classic Bonito (1040/1050-1100) | 1112 | 112 | - |
| Room 5 | Classic Bonito (1040/1050-1100) | 1119 | 86 | - |
| Room 8 | Classic Bonito (1040/1050-1100) | - | - | 1073, 1131 |
| Room 9 | Late Bonito (1100-1140) | 1089 | 102 | 1081, 1112, 1113, 1158, 1170 |
| Kiva C | Late Bonito (1100-1140) | 1125 | 85 | - |

| Bc 58 | | | | |
|---|---|---|---|---|
| **Provenience** | **Time Period** | **MCD (CE)** | **+/-** | **AMS Mean Date (CE)** |
| Room 4 | Classic Bonito (1040/1050-1100) | 1069 | 130 | 1064, 1106 |
| Room 5 | Classic Bonito (1040/1050-1100) | - | - | 1046 |
| Room 6 | Classic Bonito (1040/1050-1100) | 1098 | 51 | - |
| Room 7 | Classic Bonito (1040/1050-1100) | 1014 | 106 | - |
| Room 10 | Classic Bonito (1040/1050-1100) | 1051 | 152 | 1073, 1079, 1118 |
| Room 14 | Classic Bonito (1040/1050-1100) | - | - | 1006, 1092 |
| Outside Rm 2 | Classic Bonito (1040/1050-1100) | 1080 | 176 | - |
| Outside Kiva A | Classic Bonito (1040/1050-1100) | 1014 | 98 | - |
| Room 3 | Early Bonito (975-1040/1050)-Late Bonito (1100-1140) | 1031 | 91 | - |

Thus the Bc 57 assemblages appear to represent three components. As the presence of subfloor features and architecture discovered underneath Rooms 1 and 2 and adjacent Pithouse A attest, Basketmaker III-Early Bonito use of the site area predates the construction of the main roomblock at Bc 57. This is congruent with previously documented evidence of Basketmaker III and Pueblo I occupation of the Casa Rinconada area (Hayes 1981:24-27). The earliest component is a late Basketmaker II/early Basketmaker III occupation of the area. The Early Bonito refuse deposits from fill deposits in Rooms 3 and 4 likely relate to a second tenth century component. The third component appears to reflect a more or less continuous use of the site spanning the Classic and Late Bonito subphases (1050-1150 CE) as well as the McElmo (1150-1200 CE) and Mesa Verde (1200-1300) phases.

Compared to Bc 57, the Bc 58 deposits reflect a simpler chronology. Based on both mean ceramic dates and radiocarbon dates, the majority of deposits can be traced to the Classic Bonito subphase. Only Room 3 reflected a more complex history, containing ceramics spanning the Early, Classic, and Late Bonito periods but this is yet to be corroborated by absolute dates. Room 3 also contained a substantial amount of Mesa Verde black-on-white sherds indicating that the site saw at least minimal use during the thirteenth century CE.

***Bc 57 and Bc 58 – Spatial Analysis***

How do we make sense of these complex depositional histories? The goal of this analysis of depositional patterning at Bc 57 and Bc 58 is to determine the extent to which the deposition of faunal, ceramic, and groundstone materials covary. Figures 4.15, 4.16, 4.17, 4.18, and 4.19 depict the distribution of faunal, ceramic, and groundstone densities at Bc 57 based on ordinary kriging analysis.

Kriging is a geostatistical method of interpolation, the goal of which is to “attempt to optimize interpolation by dividing spatial variation into three components: (a) deterministic variation (different levels or trends) that can be treated as useful, soft information, (b) spatially autocorrelated, but physically difficult to explain variations, and finally (c) uncorrelated noise” (Burrough and McDonnell 1998:132). In the realm of spatial analysis, *interpolation* includes any one of several procedures for predicting values at unsampled locations based on observations in the same region. Point data is converted into continuous surfaces that then permit analysis of broader spatial patterning (Burrough and McDonnell 1998:98). Surfaces commonly encountered in “real world” situations however, are often stochastic rather than regular and thus often defy modeling by simple, smooth, mathematical functions. Geostatistical interpolation methods like kriging comprise a particular set of interpolation procedures that incorporate observed spatial autocorrelation data derived from experimental variograms in order to optimize interpolation weights and search radii (Burrough and McDonnell 1998:132-133). They are thus appropriate for analysis of stochastic surfaces. Since archaeological data in general and the ceramic, groundstone, and faunal densities from Bc 57 in particular form similar stochastic surfaces, kriging is a potentially powerful analytical tool.

In addition to providing a predicted surface for unsampled regions or proveniences for which data is missing (e.g. the Room 8 ceramics or unexcavated subfloor contexts), kriging maps highlight broader site-wide spatial patterns. Distribution maps were constructed for above-floor/floor-contact ceramics (fourteen observations), above-floor/floor-contact faunal remains (fourteen observations), and total groundstone (eleven observations). Although limited by the number of observations, distribution maps of subfloor ceramics (two observations) and subfloor fauna (one observation) are also depicted. To account for varying sizes of excavation units interpolated surfaces were derived from artifact densities rather than absolute counts.

As is visible in Figures 4.15 and 4.17, predicted surfaces derived from above-floor faunal and ceramic densities are largely similar, emphasizing the parallels in overall refuse density. Both plots depict contoured surfaces that capture the dramatically higher concentrations within Room 4 and Room 9. The subfloor maps demonstrate that where subfloor deposits were excavated, densities of refuse were comparatively low.

The extent to which the above-floor maps of ceramics and fauna correspond suggests that spatial patterning of both types of refuse was shaped by the same depositional pathway(s). Secondary and tertiary refuse frequently exhibits substantial fragmentation and disturbance of deposits (LaMotta and Schiffer 1999:24).

However, the nearly complete raven skeleton recovered from Room 4 and multiple series of articulating artiodactyl vertebrae found in Rooms 2, 4, 8, and 9 defy these expectations. The high degree of cohesion observed within the faunal assemblage, that is the high frequency of articulating skeletal elements is strong evidence that whatever the mode of deposition, it was episodic, comprehensive, and not heavily impacted by secondary and tertiary deposition. One possibility is that periodic cleaning of living rooms resulted in the deposition of secondary refuse in abandoned adjacent rooms. An alternative explanation is that the refuse was introduced to Rooms 4 and 9 from adjacent rooms during the construction of the semi-subterranean Kivas A, B, and C.

If these kivas were later additions to the original Bc 57 footprint, construction would have required a substantial amount of earth-moving and it is conceivable if not likely that basket-loads of debris would have been re-deposited in adjacent abandoned rooms. The inordinately high density of fauna and ceramics in Rooms 4 and to a lesser extent Room 7 may well reflect secondary deposition of refuse during the Kiva B and Kiva C building episodes. However, as reflected in Table 4.6, the Room 9 and Room 6 deposits post-date those of Rooms 2, 4, and 7, and at least one, possibly two Mesa Verde black-on-white vessels were reportedly found at floor-level Room 9 suggesting that it may have remained in-use late in the occupation of the site. As noted above in the chronology discussion, late ceramics were also found at or near the floor surface of Room 2, perhaps indicating later utilization of this room as well. Finally, Room 5 contained at least two floor-level informal hearths against the north and south walls respectively, a pattern typical of the Mesa Verde period (Dutton 1938:93-94; McKenna 1991:132). An examination of the spatial patterning of a different material class, groundstone, sheds more light on the question.

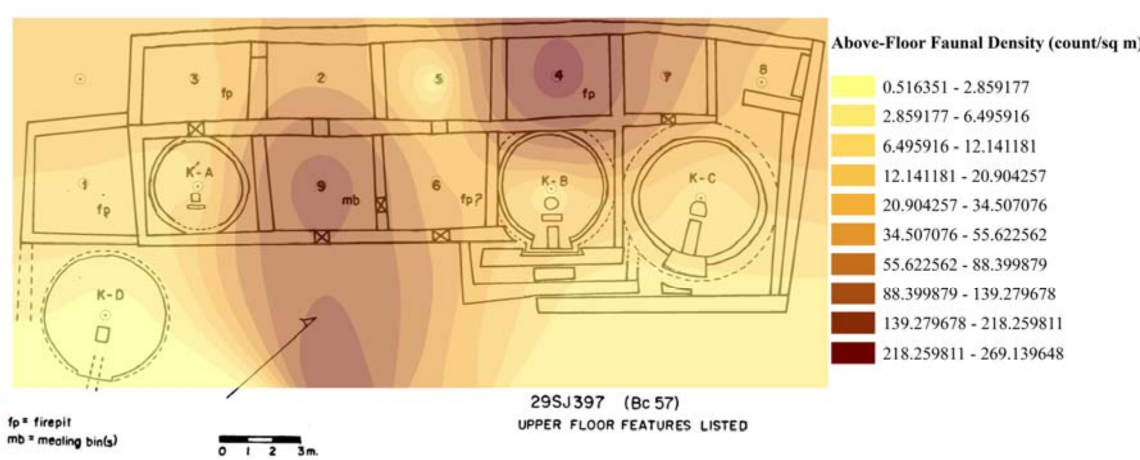



Figure 4.15: Above-floor faunal density (count per square meter), Lag=2, # of Lags=12, Spherical, Sill=6 m.

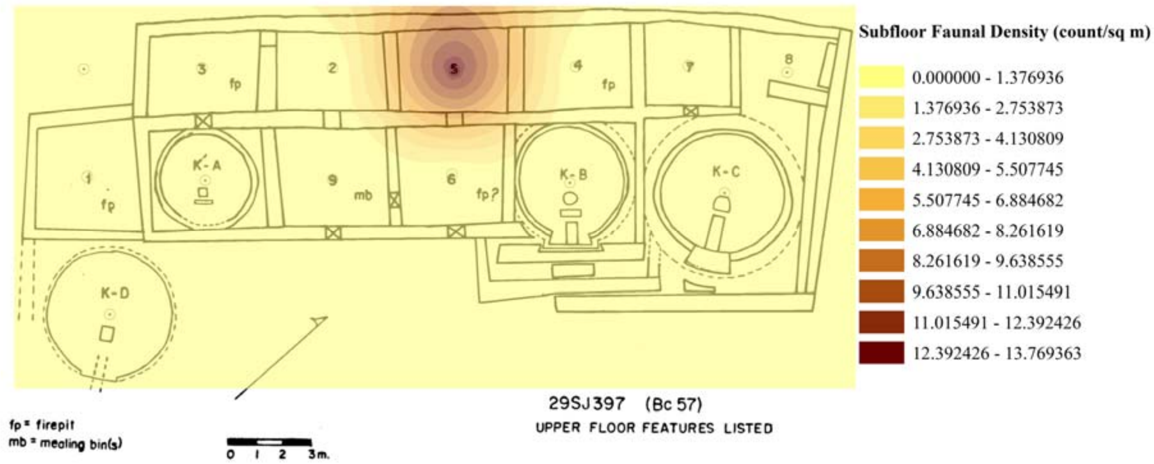



Figure 4.16: Subfloor faunal density (count per square meter), Lag=2, # of Lags=12, Spherical, Sill=6 m.


Figure 4.17: Above-floor sherd density (count per square meter), Lag=2, # of Lags=12, Spherical, Sill=6 m.

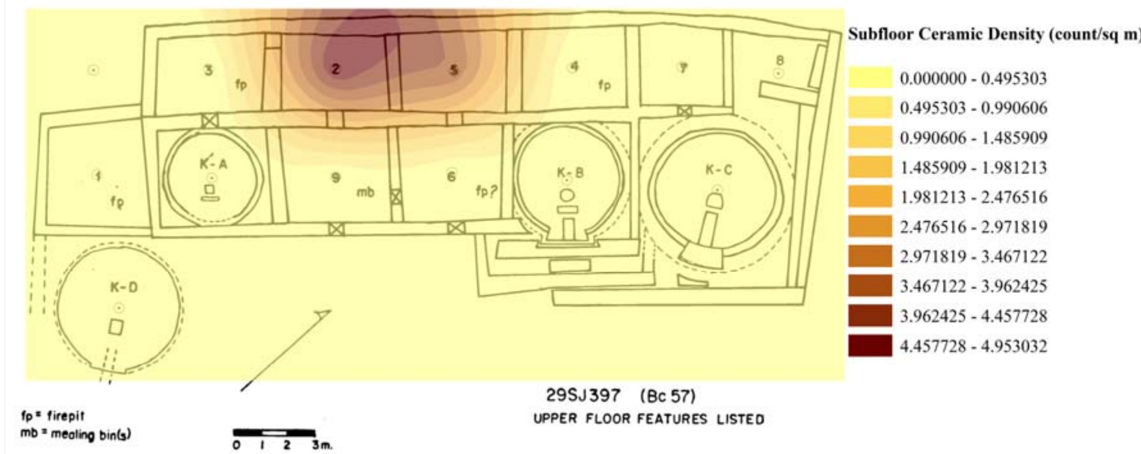



Figure 4.18: Subfloor sherd density (count per square meter), Lag=2, # of Lags=12, Spherical, Sill=6 m.

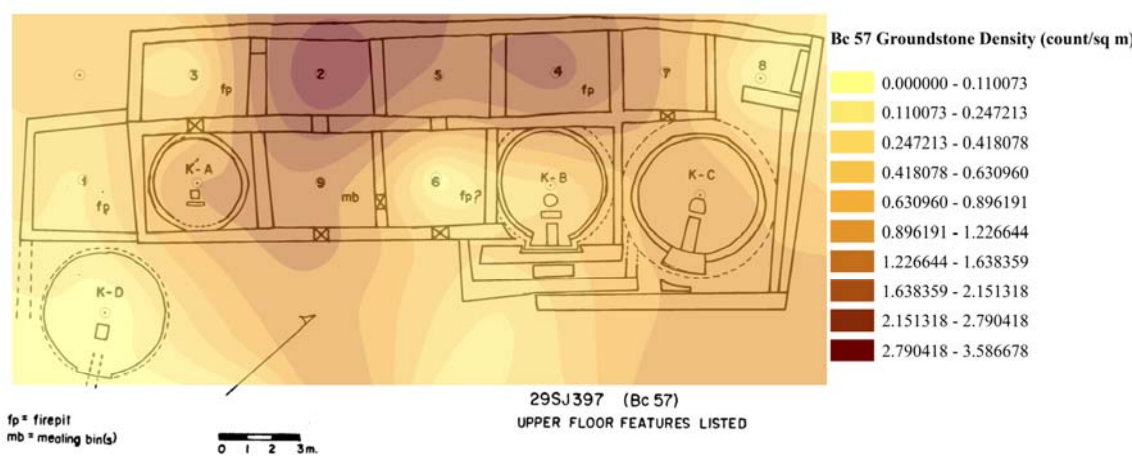



Figure 4.19: Bc 57 groundstone density (count per square meter), Lag=2.5, # of Lags=12, Spherical, Sill=6 m.

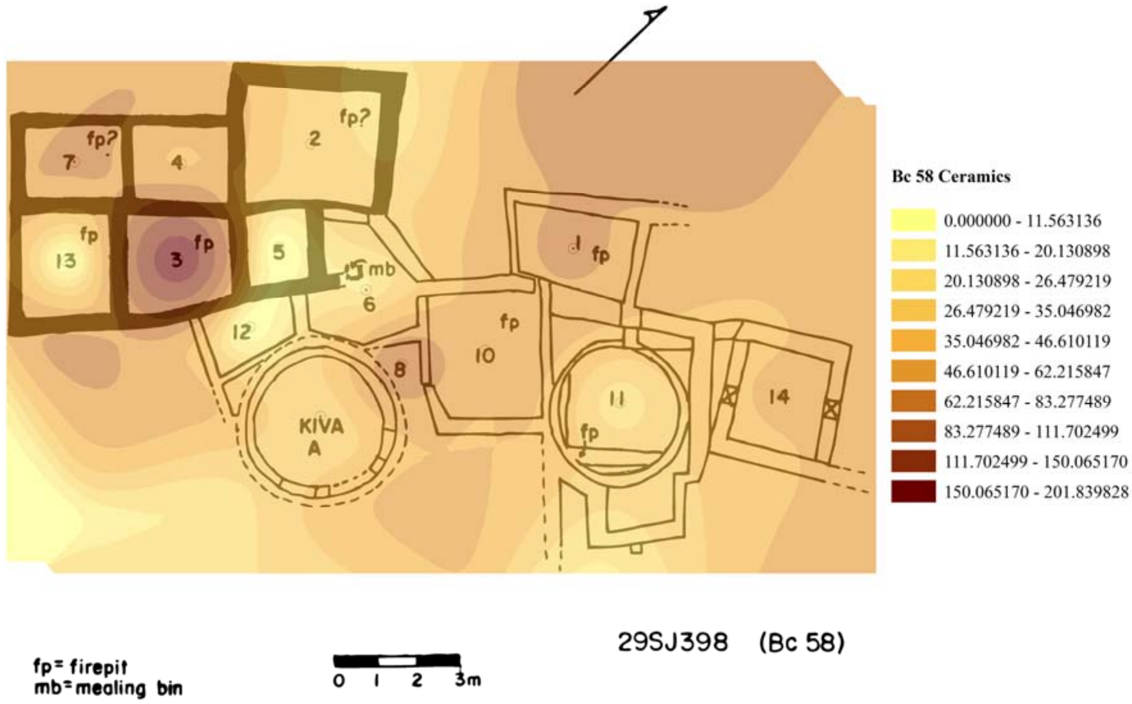



Figure 4.20: Bc 58 sherd density (count per square meter), Lag=1.5, # of Lags=12, Spherical, Sill=2.5 m.

The distribution of groundstone tools and hammerstones pictured in Figure 4.19 reveals a somewhat different spatial trend. In total, Bc 57 contained 195 pieces of groundstone and hammerstones. To put this figure in perspective, the multi-component Pueblo I-Pueblo II Fajada Gap site 29SJ 1360 yielded 463 pieces and the excavations at the Pueblo Alto great house recovered an estimated 3,021 artifacts identified as either a groundstone tool or hammerstone (Mathien and Windes 1987; McKenna 1984). As with faunal and ceramic refuse, groundstone exhibits elevated densities in both Rooms 4 and 9 but groundstone is also particularly high in Room 2. Overall the site exhibits a high concentration of groundstone among the back row of rooms (Rooms 2, 4, 5, and 7) and Rooms 2 and 4 account for 42 percent of all groundstone recovered.

Table 4.7: Groundstone frequency and density by provenience at Bc 57.

| Provenience | Count | Area ($m^2$) | Density ($count/m^2$) |
|---|---|---|---|
| Room 1 | 3 | 13.65 | 0.22 |
| Room 2 | 42 | 11.71 | 3.59 |
| Room 3 | 3 | 11.73 | 0.26 |
| Room 4 | 39 | 16.04 | 2.43 |
| Room 5 | 24 | 11.62 | 2.07 |
| Room 6 | 0 | 14.56 | 0.00 |
| Room 7 | 12 | 10.14 | 1.18 |
| Room 8 | 0 | 6.5 | 0.00 |
| Room 9 | 20 | 13.75 | 1.45 |
| Room 10 | 6 | 11.48 | 0.52 |
| Kiva A | 16 | 12.86 | 1.24 |
| Kiva B | 5 | 14.11 | 0.35 |
| Kiva C | 25 | 22.04 | 1.13 |
| Kiva D | 0 | 17.31 | 0.00 |

Why then do Rooms 2 and 4 diverge so drastically from other contexts in the density of groundstone? As shown in Table 4.6, the fill deposits from Room 2 are contemporaneous with those from Room 4 indicating that, like the latter, the Room 2 deposits were a byproduct of later kiva construction. In fact, groundstone frequency shown in Table 4.7 is nearly identical between Room 2 (forty-two pieces) and Room 4 (thirty-nine pieces). Room 9, which fronts Room 2, appears to have been a mealing room and perhaps served as a locus of other types of communal production and storage. Unfortunately, excavation records are unavailable for Room 6 and later remodeling of rooms adjacent to the northeast precludes much in the way of interpretation but one might speculate that these other front rooms were similarly utilized. In contrast to Room 4 where as much as a third of the groundstone was found in situ at floor level, all of the groundstone from Room 2 was recovered from above-floor fill contexts. If as posited above, Rooms 2, 9, and possibly 5 were in-use use during the latest Bc 57 occupation, exhausted groundstone may have been cleared from the front rooms and re-deposited in the abandoned back row of rooms. Such practices, along with the transfer of debris associated with kiva construction might explain the particularly high densities in Rooms 2 and 4. Thus, although the spatial patterning of groundstone differs slightly from that of other materials, the material signature is consistent with the broader depositional trend.

Turning to Bc 58, because of now known gaps in the faunal data (the recently discovered assemblages from Rooms 1, 8, 9, 11, and Kiva A) spatial analysis was conducted for ceramic densities only (eleven observations). Sherds from Rooms 5, 8, 11, 12, 13, 14 and Kiva A were not available for analysis but sherd tallies for some of these rooms were provided in excavator field notes (Chaco Culture NHP Museum Collection 1947). As illustrated in Figure 4.20, ceramics are fairly evenly distributed across Bc 58 with a major concentration in Room 3.

## Summary

Temporal and spatial analysis of Bc 57 reveals a complex history that can be viewed in two principal stages. The first stage consists of an early use of the area from Basketmaker III through the Early Bonito subphase as indicated by the presence of subfloor architecture and thermal features, Basketmaker III and Pueblo I ceramic styles, and absolute dates. The second stage represents an apparently continuous occupation spanning two centuries from the Classic through Late Bonito subphases into the McElmo and Mesa Verde phases and includes the initial construction, use, later remodeling, and finally abandonment of the site. Although Bc 57 may have been initially constructed for domestic use, the general absence of domestic hearths and storage features is perplexing.

The chance exists that such features were overlooked by the excavators but the care with which similar features were documented when encountered elsewhere at the site indicates otherwise. The extent to which a lack of domestic features at Bc 57 may have set the site apart from neighboring small sites Bc 50 and Bc 51 will be examined in more detail in Chapter Seven. Midway through the second stage one or more of the front row of rooms was remodeled to accommodate the addition of intramural kivas. The fill removed to make way for these semi-subterranean structures may have been re-deposited at least partially within the back row of rooms (Rooms 2, 4, 5, and 7). The remaining front rooms (Room 9 and possibly Room 6) may have remained in-use briefly but quickly began to accumulate refuse and eventually human burials during the late twelfth and early thirteenth centuries.

While the temporal placement of the majority of refuse contained within the rooms of Bc 58 relates to the Classic Bonito subphase, the architectural history of the site is somewhat more complex. Kivas B and C mark the earliest known construction at the site. Unfortunately little is known of the masonry style within the northeast roomblock, but it is likely that this was the next part of the site constructed. When later McElmo-style masonry does appear, it occurs among rooms of the southwestern roomblock. Thus much of the southwestern roomblock was probably erected during the final stage of construction at Bc 58. Further subfloor exploration of the site could reveal architecture associated with the earlier Kivas B and C. Like Bc 57, the infrequency of formal domestic features such as storage cists, bins, and formal hearths at Bc 58 is puzzling (Cornett n.d.:12-13). Rooms 3 and 10, roughly equidistant from Kiva A to the southwest and northeast respectively account for more than a third of the faunal assemblage and sixty percent of the ceramic assemblage. Although sampling bias may be to blame, the fact that two rooms accounted for such disproportionately large refuse concentrations suggests that major construction efforts, such as the later construction of Kiva A, may be responsible for significant displacement of earlier refuse deposits.

Given the proximity and partial contemporaneity of sites Bc 57 and Bc 58 to one another, the possibility exists that they represent a single extended household or closely related groups. However, the stark architectural contrasts provide some indication that the structures may have been constructed by separate groups. Whether the sites reflect a tightly related group such as kin or affines or late eleventh century migrants from disparate parts of the San Juan Basin, an examination of faunal patterning at the two sites provides a window onto fine grained inter- or intra-site differences in procurement and consumption.

# CHAPTER 5: VERTEBRATE FAUNA

The goal of the following analysis is to examine trends in procurement, use, and consumption of mammal, bird, and fish species at sites Bc 57 and Bc 58. Given the contemporaneity with and proximity to the dense cluster of great houses that includes Pueblo Bonito, Pueblo del Arroyo, and Chetro Ketl, and the adjacent isolated great kiva, Casa Rinconada, the animal remains from these two sites present an ideal test case for the research questions outlined above.

In this chapter, I provide a general overview of the Bc 57 and Bc 58 archaeofaunal assemblages by exploring the ecological and cultural implications of faunal patterning at these sites. I begin with a discussion of the recording procedures, zooarchaeological methods, and the rationale behind my approach to this analysis. I then address each species in turn, taking into consideration behavioral ecology and the conditions under which these species might have been procured prehistorically, as well as contextualizing the species' abundance relative to that of other Ancestral Pueblo sites in Chaco Canyon and the broader Southwest. In several cases, I present additional analyses that address spatial distribution, relative skeletal abundance, seasonality, and demographic (age and sex) representation.

Coupled with the taphonomic analysis in Chapter Six, which examines the factors that impacted the deposition and differential preservation of animal remains, these chapters lay the foundation for the analyses that follow in Chapters Seven and Eight.

## Methods

This section outlines the data collection methods employed in this analysis. From 2008 to 2010 I analyzed a total of 11,462 animal bones from sites Bc 57 and Bc 58 in Chaco Canyon, identifying thirty-two species including eighteen mammals, twelve species of bird, one fish, and one amphibian (Tables 5.2 and 5.3). The research was supported in part by a Smithsonian Institution National Museum of Natural History (NMNH) Predoctoral Fellowship and a National Science Foundation Graduate Research Fellowship.

Identification and analyses were conducted in the Archaeobiology Laboratory at the Smithsonian Institution's National Museum of Natural History employing modern comparative bird and mammal specimens available through museum's Department of Vertebrate Zoology. Data recorded included element, taxon, symmetry, sex, age, pathology, greatest length to the nearest 5mm and weight to the nearest 0.1g. Weathering stage, cause of fragmentation, and any modification attributed to human or animal activity were also noted. Taxonomic nomenclature used throughout this study is in accordance with several recognized authorities (Society 2006; Wilson and Reeder 2005). Specimens not identified to genus or species were sorted to lowest possible taxonomic class or by general size class (e.g., large mammal, medium carnivore, small bird, etc.). Metric data was recorded in accordance with von den Driesch (1976).

Accurate quantification of skeletal elements is critical to any faunal analysis. Analytical measures utilized here include: Number of Identified Specimens (NISP), Minimum Number of Individuals (MNI), Minimum Number of Elements (MNE), and Minimum Animal Units (MAU). MNI estimates the lowest number of individuals that could account for the number of skeletal elements observed in an assemblage and was calculated following Bokonyi (1970) and Chaplin (1971) where element duplication, developmental traits, and specimen size are taken into account. MNE is determined for each element regardless of side and was calculated for ruminants and jackrabbit. MAU is calculated by dividing the MNE for each skeletal element by the number of occurrences of that element in a single carcass. MAU for long bones was calculated using epiphyses as well as mid-shaft fragments in order to minimize the effects of density-mediated destruction (Blumenschine and Marean 1993; Bunn and Kroll 1986; Madrigal and Holt 2002; Marean and Frey 1997; Marean and Spencer 1991).

Although the accuracy of both MNI and MAU is based on MNE, this critical quantification step is a subject of debate among zooarchaeologists. As measures of skeletal completeness, the indices MNE and MAU are susceptible to influence by sample size and aggregation (Lyman 2008:248, 262). Further, NISP and MNE have been shown to frequently exhibit strong positive correlation (Grayson and Frey 2004).

There are multiple zooarchaeological recording systems each geared toward generating data in particular formats. Descriptive systems (Gifford and Crader 1977; Redding et al. 1975; Uerpmann 1978) are designed to provide complete and flexible records for each fragment. These systems are capable of providing NISP counts but none are designed to "readily generate an MNE, and none of the published descriptions provides a discussion of how to reach an MNE from a coded database of fragments" (Marean et al. 2001).

Table 5.1a: Bc 57 faunal remains by provenience.

| Bc 57 Site Fauna Totals | | | | | |
|---|---|---|---|---|---|
| **Room** | | **Features** | | **Unspecified Contexts** | |
| Room 1 | 160 | Pit A | 75 | *Subtotal* | 168 |
| Room 2 | 571 | Burial 1467 | 4 | | |
| Room 3 | 172 | | | | |
| Room 4 | 4,317 | *Subtotal* | 79 | | |
| Room 5 | 166 | | | | |
| Room 6 | 516 | | | | |
| Room 7 | 677 | | | | |
| Room 7 or 8 | 205 | | | | |
| Room 8 | 187 | | | | |
| Room 9 | 2,463 | | | | |
| Room 9 or 10 | 1 | | | | |
| Kiva A | 127 | | | | |
| Kiva B | 42 | | | | |
| Kiva C | 133 | | | | |
| Kiva D | 22 | | | | |
| Room/Kiva A | 7 | | | | |
| Area 10 | 183 | | | | |
| *Subtotal* | 9,949 | | | | |
| | | | | **Total** | **10,196** |

Table 5.1b: Bc 58 faunal remains by provenience.

| Bc 58 Site Fauna Totals | | | |
|---|---|---|---|
| **Room** | | **Features** | |
| Room 1 | 164 | Area 1 | 148 |
| Room 3 | 2 | Area 6 | 3 |
| Room 4 | 138 | | |
| Room 5 | 191 | *Subtotal* | 151 |
| Room 8 | 16 | | |
| Room 9 | 6 | | |
| Room 10 | 430 | | |
| Room 12 | 31 | | |
| Room 13 | 16 | | |
| Room 14 | 121 | | |
| *Subtotal* | 1,115 | | |
| | | **Total** | **1,266** |

Table 5.2: Faunal remains identified to genus or species recovered at site Bc 57.

| Taxon | | | | NISP | NISP % | MNI | MNI % |
|---|---|---|---|---|---|---|---|
| **Class** | **Order** | **Species** | **Common Name** | | | | |
| Actinopterygii (Ray-finned Fishes) | Cypriniformes | *Ptychocheilus lucius* | Colorado pikeminnow | 1 | 0.02 | 1 | 0.47 |
| Aves (Birds) | Falconiformes | *Accipiter cooperii* | Cooper's hawk | 1 | 0.02 | 1 | 0.47 |
| | | *Aquila chrysaetos* | golden eagle | 8 | 0.12 | 2 | 0.94 |
| | | *Buteo jamaicensis* | red-tailed hawk | 4 | 0.06 | 1 | 0.47 |
| | | *Buteo lagopus* | rough-legged hawk | 1 | 0.02 | 1 | 0.47 |
| | | *Buteo regalis* | ferruginous hawk | 3 | 0.05 | 1 | 0.47 |
| | | *Buteo* sp. | hawk | 6 | 0.09 | 2 | 0.94 |
| | | *Falco mexicanus* | prairie falcon | 1 | 0.02 | 1 | 0.47 |
| | Galliformes | *Callipepla squamata* | scaled quail | 2 | 0.03 | 1 | 0.47 |
| | | *Meleagris gallopavo* | turkey | 473 | 7.15 | 15 | 7.04 |
| | Passeriformes | *Corvus corax* | common raven | 70 | 1.06 | 3 | 1.41 |
| | Strigiformes | *Bubo virginianus* | great horned owl | 1 | 0.02 | 1 | 0.47 |
| | | *Megascops kennicottii* | western screech owl | 1 | 0.02 | 1 | 0.47 |
| Mammalia (Mammals) | Artiodactyla | *Antilocapra americana* | pronghorn antelope | 382 | 5.78 | 5 | 2.35 |
| | | Cervidae sp. | deer | 6 | 0.09 | - | - |
| | | *Odocoileus hemionus* | mule deer | 280 | 4.23 | 6 | 2.82 |
| | | *Ovis aries* | domestic sheep | 2 | 0.03 | 1 | 0.47 |
| | | *Ovis canadensis* | bighorn sheep | 48 | 0.73 | 3 | 1.41 |
| | Carnivora | *Canis latrans* | coyote | 1 | 0.02 | 1 | 0.47 |
| | | *Canis lupus* | grey wolf | 1 | 0.02 | 1 | 0.47 |
| | | *Canis* sp. | coyote, domestic dog, and wolf | 20 | 0.30 | 2 | 0.94 |
| | | *Lynx rufus* | bobcat | 27 | 0.41 | 1 | 0.47 |
| | | *Taxidea taxus* | American badger | 2 | 0.03 | 1 | 0.47 |
| | | *Urocyon cinereoargenteus* | gray fox | 1 | 0.02 | 1 | 0.47 |
| | | cf. *Urocyon cinereoargenteus* | probable gray fox | 1 | 0.02 | 1 | 0.47 |
| | Lagomorpha | Leporidae sp. | hares and rabbits | 291 | 4.40 | - | - |
| | | *Lepus californicus* | black-tailed jackrabbit | 1729 | 26.14 | 38 | 17.84 |
| | | *Sylvilagus audubonii* | desert cottontail | 29 | 0.44 | 22 | 10.33 |
| | | *Sylvilagus* sp. | cottontail | 2562 | 38.74 | 53 | 24.88 |
| | Rodentia | *Cynomys gunnisoni* | Gunnison's prairie dog | 116 | 1.75 | 37 | 17.37 |
| | | *Dipodomys ordii* | Ord's kangaroo rat | 8 | 0.12 | 2 | 0.94 |
| | | Geomyidae sp. | pocket gopher | 17 | 0.26 | - | - |
| | | *Neotoma cinerea* | bushy-tailed woodrat | 4 | 0.06 | 2 | 0.94 |
| | | *Neotoma* sp. | woodrat | 6 | 0.09 | 1 | 0.47 |
| | | *Perognathus flavus* | silky pocket mouse | 2 | 0.03 | 1 | 0.47 |
| | | *Peromyscus* sp. | mouse | 15 | 0.23 | 3 | 1.41 |
| | | Sciuridae sp. | squirrels, chipmunks, marmots and prairie dogs | 492 | 7.44 | - | - |
| | | | **TOTAL** | **6614** | **100.0** | **213** | **100.0** |

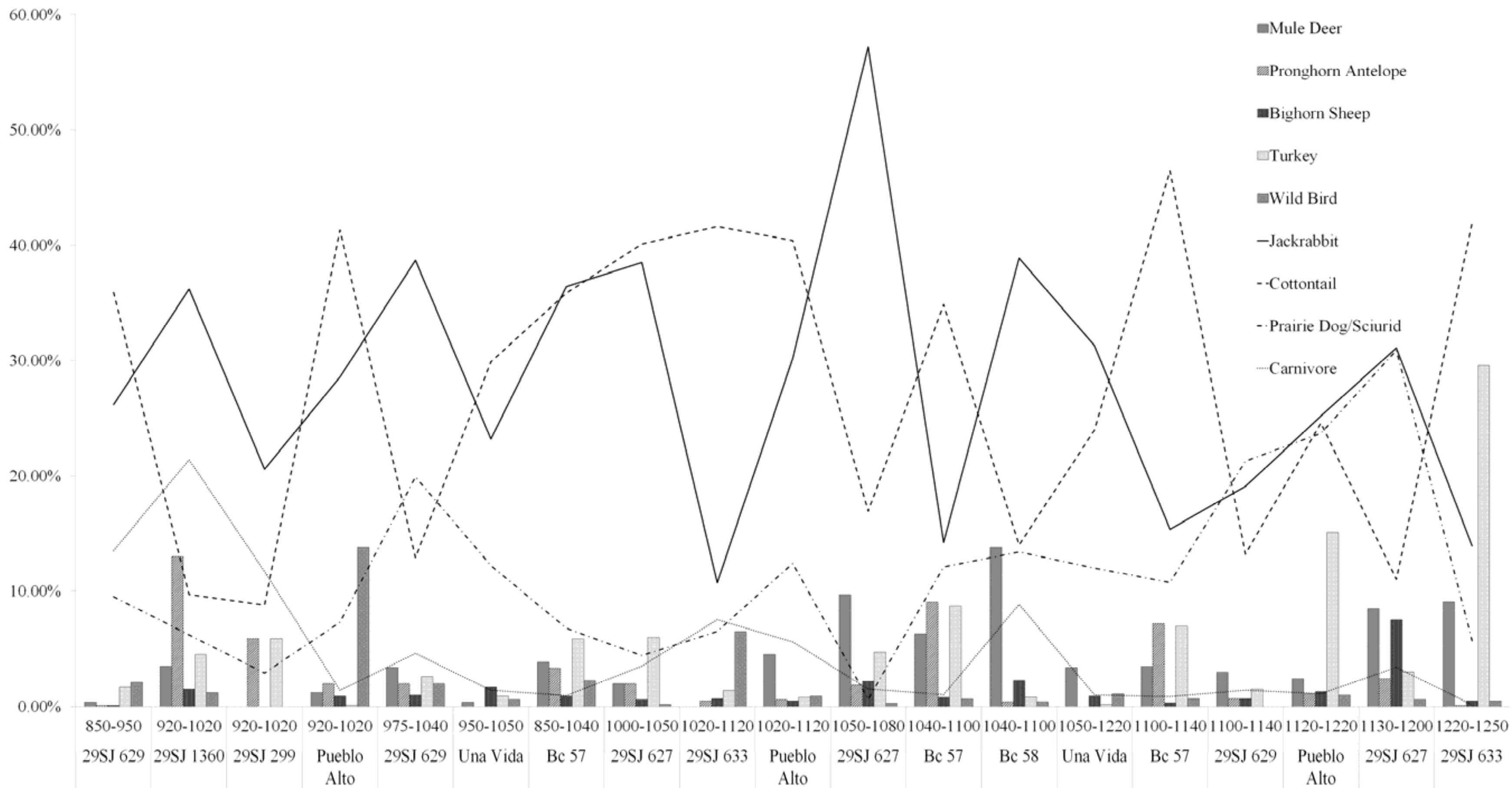
Table 5.3: Faunal remains identified to genus or species recovered at site Bc 58.

| Taxon | | | | NISP | NISP % | MNI | MNI % |
|---|---|---|---|---|---|---|---|
| **Class** | **Order** | **Species** | **Common Name** | | | | |
| Amphibia (Amphibians) | Anura | *Spea* sp. | western or plains spadefoot | 9 | 1.39 | 1 | 2.50 |
| Aves (Birds) | Falconiformes | *Aquila chrysaetos* | golden eagle | 1 | 0.15 | 1 | 2.50 |
| | | *Buteo jamaicensis* | red-tailed hawk | 2 | 0.31 | 1 | 2.50 |
| | Galliformes | *Meleagris gallopavo* | turkey | 10 | 1.55 | 1 | 2.50 |
| | Passeriformes | cf. *Gymnorhinus cyanocephalus* | pinyon jay | 1 | 0.15 | 1 | 2.50 |
| Mammalia (Mammals) | Artiodactyla | *Antilocapra americana* | pronghorn antelope | 6 | 0.93 | 1 | 2.50 |
| | | *Odocoileus hemionus* | mule deer | 79 | 12.21 | 2 | 5.00 |
| | | *Ovis canadensis* | bighorn sheep | 12 | 1.85 | 1 | 2.50 |
| | Lagomorpha | *Lepus californicus* | black-tailed jackrabbit | 279 | 43.12 | 11 | 27.50 |
| | | *Sylvilagus audubonii* | desert cottontail | 2 | 0.31 | 1 | 2.50 |
| | | *Sylvilagus* sp. | cottontail | 106 | 16.38 | 9 | 22.50 |
| | Carnivora | *Canis* sp. | domestic dog, wolf, or coyote | 48 | 7.42 | 2 | 5.00 |
| | | *Lynx rufus* | bobcat | 1 | 0.15 | 1 | 2.50 |
| | | *Vulpes macrotis* | kit fox | 1 | 0.15 | 1 | 2.50 |
| | | cf. *Vulpes macrotis* | probable kit fox | 1 | 0.15 | 1 | 2.50 |
| | Rodentia | *Cynomys gunnisoni* | Gunnison's prairie dog | 89 | 13.76 | 5 | 12.50 |
| | | | **TOTAL** | **647** | **100.0** | **40** | **100.0** |

Table 5.4: Faunal remains identified to genus or species recovered at sites in Chaco through time.

| | | NISP (%NISP) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **Time Period** | **Mule Deer** | **Pronghorn Antelope** | **Bighorn Sheep** | **Jackrabbit** | **Cottontail** | **Prairie Dog/Sciurid** | **Carnivore** | **Turkey** | **Wild Bird** |
| 29SJ 423 | 500-600 | 3 (0.4) | 11 (1.4) | 4 (0.5) | 97 (12.7) | 589 (77.1) | 6 (0.8) | 27 (3.6) | 0 (0.0) | 5 (0.6) |
| 29SJ 299 | 600-700 | 0 (0.0) | 2 (2.3) | 1 (1.2) | 27 (31.4) | 37 (43.0) | 6 (7.0) | 3 (3.6) | 0 (0.0) | 1 (1.2) |
| Shabik'eshchee | 600-750 | 5 (2.3) | 29 (13.2) | 4 (1.8) | 36 (16.4) | 103 (46.8) | 4 (1.8) | 9 (4.0) | 1 (0.4) | 2 (0.9) |
| 29SJ 721 | 650-850 | 0 (0.0) | 0 (0.0) | 0 (0.0) | 4 (30.8) | 8 (61.5) | 1 (7.7) | 1 (0.3) | 0 (0.0) | 0 (0.0) |
| 29SJ 628 | 700-820 | 16 (2.6) | 63 (1.4) | 30 (0.7) | 1717 (38.7) | 2042 (46.0) | 175 (3.9) | 154 (3.4) | 24 (0.5) | 143 (3.2) |
| 29SJ 299 | 780-820 | 0 (0.0) | 0 (0.0) | 0 (0.0) | 40 (39.2) | 36 (35.3) | 10 (9.8) | 1 (1.0) | 8 (7.8) | 0 |
| 29SJ 724 | 780-820 | 0 (0.0) | 2 (0.5) | 0 (0.0) | 178 (46.0) | 133 (34.4) | 18 (4.6) | 6 (1.6) | 1 (0.3) | 31 (8.0) |
| 29SJ 629 | 850-950 | 3 (0.4) | 1 (0.1) | 1 (0.1) | 199 (26.2) | 272 (35.9) | 72 (9.5) | 103 (13.5) | 13 (1.7) | 16 (2.1) |
| 29SJ 1360 | 920-1020 | 14 (3.5) | 52 (13.0) | 6 (1.5) | 145 (36.2) | 39 (9.7) | 25 (6.2) | 86 (21.4) | 18 (4.5) | 5 (1.2) |
| 29SJ 299 | 920-1020 | 0 (0.0) | 2 (5.9) | 0 (0.0) | 7 (20.6) | 3 (8.8) | 1 (2.9) | 4 (11.7) | 2 (5.9) | 0 (0.0) |
| Pueblo Alto | 920-1020 | 30 (1.2) | 50 (2.0) | 21 (0.9) | 697 (28.6) | 1006 (41.3) | 178 (7.3) | 34 (1.4) | 3 (0.1) | 337 (13.8) |
| 29SJ 629 | 975-1040 | 10 (3.4) | 6 (2.0) | 3 (1.0) | 117 (38.7) | 39 (12.9) | 60 (19.9) | 14 (4.6) | 8 (2.6) | 6 (2.0) |
| Una Vida | 950-1050 | 7 (0.4) | 0 (0.0) | 30 (1.7) | 405 (23.2) | 523 (29.9) | 213 (12.2) | 25 (1.4) | 16 (0.9) | 10 (0.6) |
| **Bc 57** | **850-1040** | **129 (3.9)** | **112 (3.3)** | **30 (0.9)** | **1220 (36.4)** | **1201 (35.9)** | **227 (6.8)** | **31 (0.9)** | **197 (5.9)** | **76 (2.3)** |
| 29SJ 627 | 1000-1050 | 22 (2.0) | 22 (2.0) | 7 (0.60) | 415 (38.5) | 432 (40.1) | 48 (4.4) | 37 (3.5) | 65 (6.0) | 2 (0.2) |
| 29SJ 633 | 1020-1120 | 0 (0.0) | 1 (0.5) | 1 (0.7) | 23 (10.7) | 89 (41.6) | 14 (6.5) | 13 (7.5) | 3 (1.4) | 14 (6.5) |
| Pueblo Alto | 1020-1120 | 361 (4.5) | 45 (0.6) | 40 (0.5) | 2418 (30.2) | 3235 (40.4) | 992 (12.4) | 276 (5.6) | 68 (0.8) | 75 (0.9) |
| 29SJ 627 | 1050-1080 | 31 (9.7) | 6 (1.9) | 7 (2.2) | 183 (57.2) | 54 (16.9) | 2 (0.6) | 5 (1.5) | 15 (4.7) | 1 (0.3) |
| **Bc 57** | **1040-1100** | **87 (6.3)** | **125 (9.1)** | **11 (0.8)** | **196 (14.2)** | **481 (34.9)** | **167 (12.1)** | **14 (1.0)** | **120 (8.7)** | **9 (0.65)** |
| **Bc 58** | **1040-1100** | **67 (13.8)** | **2 (0.4)** | **11 (2.3)** | **189 (38.9)** | **68 (14.0)** | **65 (13.4)** | **43 (8.9)** | **4 (0.8)** | **2 (0.41)** |
| Una Vida | 1050-1220 | 15 (3.4) | 0 (0.0) | 4 (0.9) | 138 (31.3) | 106 (24.0) | 53 (12.0) | 5 (1.0) | 1 (0.2) | 5 (1.1) |
| **Bc 57** | **1100-1140** | **62 (3.48)** | **128 (7.2)** | **6 (0.3)** | **273 (15.3)** | **827 (46.5)** | **191 (10.7)** | **15 (0.8)** | **124 (7.0)** | **12 (0.67)** |
| 29SJ 629 | 1100-1140 | 4 (3.0) | 1 (0.7) | 1 (0.7) | 26 (19.1) | 18 (13.2) | 29 (21.3) | 2 (1.4) | 2 (1.5) | 0 (0.0) |
| Pueblo Alto | 1120-1220 | 142 (2.4) | 63 (1.1) | 74 (1.3) | 1471 (25.2) | 1435 (24.6) | 1379 (23.7) | 29 (1.1) | 878 (15.1) | 56 (1.0) |
| 29SJ 627 | 1130-1200 | 42 (8.5) | 12 (2.4) | 37 (7.5) | 153 (31.1) | 54 (11.0) | 152 (30.9) | 17 (3.4) | 15 (3.0) | 3 (0.6) |
| 29SJ 633 | 1220-1250 | 1 (9.1) | 3 (0.1) | 1 (0.5) | 319 (13.9) | 963 (41.9) | 132 (5.7) | 3 (0.1) | 681 (29.6) | 11 (50.0) |

Figure 5.1: Relative abundance of taxa in Bonito Phase Chaco Canyon.



The "fraction summation approach" (Klein and Cruz-Uribe 1984:109), akin to Watson's (1979) "diagnostic zones," possesses several strengths, including the intuitive nature of individual zones and the simplicity of quantifying these zones; however, the tendency to underestimate MNE's and the inconsistencies among analyst's respective choices of diagnostic zones are both major weaknesses. To compensate for the shortcomings, Marean et al. (2001) applied Morlan's (1994) distinction of feature vs. zone to sample the entire length of skeletal elements. Features include anatomical landmarks such as nutrient foramina and zones representing larger featureless areas that can be recognized by shape or configuration such as proximal humeral shaft. Marean et al. (2001:336-338) further refined Morlan's approach by establishing zones for five long bone types and reducing the extent of zones on individual specimens to compensate for varying bone density (Lyman 1984; Marean and Spencer 1991).

Marean et al. (2001:347) observed that the "overlap approach" (Binford 1978; Bunn 1986; Bunn and Kroll 1986; Morlan 1994) is effective, but as they acknowledged, the method is labor intensive and often impractical for larger assemblages.

Through previous experience I have determined that while the descriptive systems are of great utility in generating mortality profiles, establishing butchery and processing techniques, and characterizing overall weathering stages, attempts to quantify skeletal elements beyond NISP and assess fragmentation patterns are often fraught with difficulty. The approach advocated by Marean et al. (2001) facilitates the straightforward calculation of MNE, MAU, and MNI but lacks the desired attention to indicators of age, processing, and weathering. For this reason and due to the impracticability of the overlap approach for large samples, Marean et al.'s (2001) adjusted fraction summation method was selected as the basis for the analysis of mammalian remains. Descriptive indicators such as epiphyseal fusion, stages of dental eruption and wear, and surface weathering observations are integrated with Marean et al.'s (2001) system and age classes were taken into consideration when calculating MNE, MNI, and MAU. For bird specimens, skeletal landmarks were recorded following Serjeanston (2009:412-418).

Age determination of mule deer (*Odocoileus hemionus*) specimens was accomplished through the analysis of tooth occlusal wear and eruption patterns following Robinette and Jensen (1950) and Robinette et al. (1957) and examination of fusion stages of long bone epiphyses following Lewall and Cowan (1963). Age classification for pronghorn antelope and bighorn sheep were based on criteria outlined by Taber (1969:397, 400) and Lubinski (2001). Age criteria for turkey were based on stages developed by Hargrave (1965) and subsequently modified by McKusick (1986:19-33) and Munro (1994:22-23); sex determination was based on metrical analysis. In the event that juvenile remains of smaller bird species could not be assigned to species, these specimens were assigned to a general "juvenile" age class.

## Taxonomic Representation

The Bc 57 faunal assemblage consists of 10,196 specimens (18.53 kg) of which 57 percent could be identified to genus (see Tables 5.1a and 5.2). The assemblage, listed in order of abundance is dominated by cottontail, jackrabbit, prairie dogs and other Sciurids, turkey and three species of artiodactyl (pronghorn, deer, and bighorn), represents the largest Chacoan small house site faunal assemblage analyzed to date. The Bc 58 faunal assemblage consists of 1,266 specimens (1.95 kg) of which 45 percent could be identified to genus (see Tables 5.1b and 5.3). Among the species identified in the Bc

58 assemblage, cottontail, jackrabbit, and prairie dog predominated, but unlike Bc 57 deer were by far the best represented artiodactyl species. Table 5.4 and Figure 5.1 depict the relative of species at Bc 57 and Bc 58 relative to assemblages from other sites in Chaco.

In the fall of 2010, subsequent to completion of the Bc 57 and Bc 58 faunal analysis, a follow-up research visit to the collections of the Maxwell Museum of Anthropology in Albuquerque, New Mexico resulted in the discovery of a box of faunal remains labeled, "941B/VIIA-D-15." Upon further investigation, the remains, numbering between 1000 and 2000 specimens, appear to have been recovered from Rooms 1, 8, 9, 11 and Kiva A at Bc 58 during the UNM-SAR field school excavations. Since this unanalyzed batch of remains would essentially double the size and spatial extent of the Bc 58 sample, its inclusion is unquestionably important to understanding faunal patterning at the site. Although it was not possible to include the analysis of these remains in the present study, I plan to analyze and incorporate the additional faunal data in the months that follow.

### *Aquatic Fauna*

*Class Actinopterygii (Ray-finned Fishes)*

*Order Cypriniformes*

A single right hyomandibula from Room 4 at Bc 57 was identified as *Ptychocheilus lucius* (Colorado pikeminnow). The Colorado pikeminnow is a large fish known to reach up to 1.5 meters in length and though their range is now limited to eastern Utah and western Colorado, the species at one time inhabited the San Juan and Animas Rivers as well as the Gila and Salt Rivers (Holden 1980b).

Although relatively common at prehistoric Pueblo sites of southern Arizona the Colorado pikeminnow has not previously been identified in Chaco Canyon (Gehlbach and Miller 1961; Miller 1955). The presence of fish remains in Chaco was recorded as early as the Hyde Exploring Expedition excavations at Pueblo Bonito but the species was not specified (Pepper 1920:136). Judd (1959:35, 127-128) reported finding the scales of *Lepisosteus* sp. (longnose gar) at Pueblo del Arroyo, Vivian and Mathews (1965:22-23) encountered a longnose gar mandible as well as scales in fill contexts at Kin Kletso, and Dutton (1938:65) reported the recovery of a single tooth from a mackerel shark at Łeyit Kin. A longnose gar dentary and a vertebra from either a bonetail (*Gila elegans*) or roundtail chub (*Gila robusta*) were also recovered from Pueblo Alto (Akins 1985:334; 1987b:486). According to Gehlbach and Miller (1961:2-3), longnose gar occurs in the lower Pecos River and may have inhabited the Rio Grande prehistorically. Like the Colorado pikeminnow, the bonetail and roundtail chub are large minnow species that have since been extirpated from the San Juan and possibly Animas Rivers (Holden 1980a; Holden and Minckley 1980). The latter two species were also recovered archaeologically from Aztec Ruin (Gehlbach and Miller 1961:3-4) while the former was identified at Salmon Ruins (Harris 2006:1066). Along with the roundtail/bonetail remains from Alto, the presence of Colorado pikeminnow at Bc 57 is further evidence of ties to the northern San Juan. Interestingly, the deposits from which the pikeminnow specimen derives yielded mean radiocarbon dates of 947 and 960 CE, well within the Early Bonito subphase.

### *Amphibians and Reptiles*

*Order Anura*

*Family Amphibia*

Two species of spadefoot toad inhabit Chaco Canyon today, *Spea hammondii* (western spadefoot) and *Spea bombifrons* (plains spadefoot) along with several species of lizard and snake. Nine specimens recovered from Room 1 at Bc 58 could be identified as *Spea* sp. Since the limb epiphyses were not present, as is often the case with buried amphibian remains (Olsen 1996:88), the specimens could not be identified further. Spadefoot remains have been recovered from several sites in Chaco including Bc 59, Una Vida, Pueblo Alto, 29SJ 299, 29SJ 627, 29SJ 628, 29SJ 629, 29SJ 633 (Akins 1985:332). Spadefoot species are more common today along the canyon bottom than on sandy mesas and as suggested by Akins (1985:330) their occurrence at Chacoan sites is probably non-cultural in nature.

***Avifauna***

Between the two sites Bc 57 and Bc 58, the former yielded the vast majority of bird remains (raptors in particular) that could be identified to genus or species. From Bc 57 (see Tables 5.5 and 5.6) wild birds (NISP = 98), that is birds other than turkey, accounted for 17 percent of the total avian assemblage making it the fourth largest such assemblage in Chaco behind Pueblo Alto (NISP = 472), Pueblo Bonito (NISP = 154), and 29SJ 628 (NISP = 143) (Akins 1985:383; Badenhorst 2008:130-131).

The long-standing ritual importance of birds as sacrificial offerings and as sources of feathers has been well-documented throughout the Pueblo Southwest through both archaeological and ethnohistoric evidence (McKusick 2001; Schroeder 1968:108-110). Chaco Canyon is no exception as forty-one different bird species, including fifteen species of raptor, have been recovered from Chacoan great house contexts and small sites over the years (Akins 1985:322-323). Ladd (2001:11-12) reported that the Zuni kept raptor species such as eagles and red-tailed hawks as pets as well as a source of feathers, while smaller birds including the mockingbird, steller's jay, sparrow hawk, and white-crowned sparrow were frequent pets (2001:12). Upon death, eagles and hawks were buried in fields, middens, and underneath floors (2001:11). Ladd (2001:12) underscored the heavy demand for feathers stating that, "depending on individual religious position, each Zuni must "plant" from 16 to 80 prayer sticks annually, using from 80 to 100 feathers of various kinds." Raven feathers, in particular, were important for making ceremonial masks and as many as 15 to 20 ravens were often involved in decorating a single mask (2001:12). Likewise, Bunzel's (1932:500) account of prayer stick assembly at Zuni includes a staggering list of no less than eight different bird species utilized. At Hopi, raptor species such as Cooper's hawk also play a prominent symbolic role in preparations for the hunt (Titiev 1944:189,191,193) and the sacrifice of captive eagles is a major component of the Niman ceremony (1944:235). Parsons (1925:68-69) recorded that eagle hunts at Jemez Pueblo were undertaken by one of two Eagle Watchers or Flute societies through extended month-long excursions into the mountains beginning in late November.

The importance of birds to ritual in Chaco Canyon is demonstrated by the substantial cache of wooden artifacts from Chetro Ketl depicting stylized bird forms (Vivian et al. 1978). The high diversity of bird species, numerous macaw burials, prayer sticks, and even feather bundles recovered from Pueblo Bonito provide further evidence (Judd 1954:262-274).

Table 5.5: Bc 57 bird species by provenience.

| Taxon | Provenience | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **R. 1** | **R. 2** | **R. 3** | **R. 4** | **R. 5** | **R. 6** | **R. 7** | **R. 8** | **R. 7/8** | **R. 9** | **Kiva A** | **Kiva B** | **Kiva C** | **Area 10** | **Pit A** | **General** | **TOTAL** |
| *Accipiter cooperii* (Cooper's hawk) | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 1 |
| *Aquila chrysaetos* (golden eagle) | - | - | - | 1 | - | - | 3 | - | - | 2 | - | - | 2 | - | - | - | 8 |
| *Bubo virginianus* (great horned owl) | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 1 |
| *Buteo jamaicensis* (red-tailed hawk) | - | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - | - | - | 4 |
| *Buteo lagopus* (rough-legged hawk) | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 1 |
| *Buteo regalis* (ferruginous hawk) | - | - | - | 2 | - | - | - | - | - | - | - | 1 | - | - | - | - | 3 |
| *Buteo* sp. | - | - | - | 5 | - | - | - | - | - | - | - | 1 | - | - | - | - | 6 |
| *Callipepla squamata* (scaled quail) | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 | - | - | - | 2 |
| *Corvus corax* (common raven) | - | - | 17 | 48 | - | - | - | - | - | 5 | - | - | - | - | - | - | 70 |
| *Falco mexicanus* (prairie falcon) | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| *Meleagris gallopavo* (turkey) | 20 | 49 | 26 | 118 | 25 | 4 | 71 | 10 | 10 | 111 | 4 | 4 | 13 | 1 | 1 | 6 | 473 |
| *Megascops kennicottii* (western screech owl) | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **TOTAL** | 21 | 49 | 43 | 177 | 26 | 4 | 74 | 10 | 10 | 120 | 4 | 9 | 16 | 1 | 1 | 6 | 571 |

Table 5.6: Bc 58 bird species by provenience.

| Taxon | Provenience | | | | | | |
|---|---|---|---|---|---|---|---|
| | **R. 1** | **R. 3** | **R. 4** | **R. 5** | **R. 10** | **R. 12** | **TOTAL** |
| *Aquila chrysaetos* (golden eagle) | - | 1 | - | - | - | - | 1 |
| *Buteo jamaicensis* (red-tailed hawk) | - | - | - | 1 | 1 | - | 2 |
| cf. *Gymnorhinus cyanocephalus* (pinyon jay) | - | - | - | - | - | 1 | 1 |
| *Meleagris gallopavo* (turkey) | 5 | - | 1 | 2 | 1 | 1 | 10 |
| **TOTAL** | 5 | 1 | 1 | 3 | 2 | 2 | 14 |

135

*Order Falconiformes*

*Family Accipitridae (eagles, hawks, and kites)*

*Accipiter cooperii* (Cooper's hawk) occurs year-round throughout much of New Mexico, primarily occupying wooded areas at a range of elevations (Cartron et al. 2010b:181). A single left femoral fragment identified as Cooper's hawk was recovered from Room 9 at Bc 57. The species was also reportedly found at Talus Unit (Akins 1985:324).

*Aquila chrysaetos (*golden eagle) is the most common raptor at Bc 57 – eight specimens (MNI = 2) were identified representing a range of skeletal elements related to the wing and pectoral girdle (humerus, scapula, coracoid, and sternum). These remains were recovered from Rooms 4, 7, 9, and Kiva C. A single golden eagle proximal ulna was identified from Room 3 at Bc 58. Although the lack of articulating elements and the scattered distribution of these remains is not consistent with interment of whole eagle carcasses the possibility that post-depositional disturbance or deficient recovery practices may have biased the sample should not be ruled out. The range of the golden eagle extends throughout much of New Mexico including desert grasslands and mountain meadows (Stahlecker et al. 2010:374). As noted above, historically the species has played a key role Pueblo ritual.

*Buteo jamaicensis* (red-tailed hawk) is a raptor whose distribution spans much of North and Central America and it is a year-round resident to New Mexico (Cartron et al. 2010a:321-322). Cartron et al. report that red-tailed hawk populations tend to swell with the arrival of winter migrants from northern latitudes (2010a:322). Red-tailed hawks are the second most common species at Bc 57 – two femora were identified from Kiva B and furculum and pelvis from Room 4. At Bc 58, two specimens were recovered, a radius from Room 10 and a partial tarsometatarsus from Room 5.

The rough-legged hawk (*Buteo lagopus*) is a resident of the taiga and tundra biomes of the northern latitudes, but in fall the species migrates south to it winter ranges. Although specific range and abundance vary, the species reaches New Mexico in most winters (Jones 2010:361-362). For this reason, its occurrence in Chaco is a good seasonal indicator. A single right femur was recovered from Kiva B at Bc 57 and indicates winter procurement.

*Buteo regalis* (ferruginous hawk) is another year-round resident of New Mexico with breeding grounds across the northern two-thirds of the state (Cartron et al. 2010c:340). In northwest New Mexico, ferruginous hawks tend to nest in badlands atop pinnacles and ledges (Cartron et al. 2010c:344). Such nests have been recorded in the Chaco region, specifically in the Bisti/De-Na-Zin Wilderness area (Cartron et al. 2010c:344-345). At Bc 57, right and left femora from Room 4 and a single left humerus from Kiva B represent ferruginous hawk.

Three cranial fragments from Room 4 and a partial right tibiotarsus from Kiva B (MNI = 2) could be identified to the genus *Buteo* and may represent any number of hawk species common to the region, including *Buteo swainsoni* (Swainson's hawk) a summer resident of the Chaco region and the species discussed above (Bednarz et al. 2010:282). Since hawks' diets include rabbits, mice, snakes, lizards, and insects, this species is a common visitor to man-made ecosystems such as agricultural fields (Emslie 1981a:320; 1981b:856-857). *Falco mexicanus* (prairie falcon) is a year-round resident of New Mexico that breeds throughout the state and nests have been documented in the Bisti/De-

Na-Zin Wilderness area near Chaco Canyon (Wolf et al. 2010:463-464,466). One prairie falcon right humerus was identified from Room 1 at Bc 57.

*Order Passeriformes*

*Family Corvidae (crows and jays)*

Common throughout northwest New Mexico including Chaco Canyon, ravens (*Corvus corax*) frequently nest along cliff-faces, feeding on carrion, rodents, and insects (Bailey 1927:279-280; 1928:487-488). They are one of the most numerous avian species recovered from sites in Chaco but their frequency at Bc 57 is nearly seven times greater than that of Pueblo Alto and 70 times greater than at any other Chacoan site (Akins 1985:329). It has been suggested that their capture by prehistoric Pueblo groups was frequently the result of "garden hunting" (Emslie 1981a:317; 1981b:857; Neusius 2008:306).

Next to turkey, the common raven was the most abundant bird species recovered from Bc 57 where 70 raven specimens representing at least three individuals were identified from Rooms 3, 4, and 9. The Room 3 remains comprise a set of hind limbs and the Room 9 remains including two ulnae, a radius, and carpometacarpus suggest deposition of whole wings. In contrast, the raven remains from Room 4 include at least one largely complete, articulating axial and appendicular skeleton (see Figure 5.2). Extensive cut marks on the mandible, humeri, ulna, and tibiotarsus indicate that the carcass was butchered and disarticulated prior to deposition rather than a complete interment. One raven ulna from Room 9 (specimen 2008.46.08713) exhibits a healed fracture – a good indicator that the individual had remained captive for some period of time prior to death (see Figure 5.3).

As noted above, at least one of the raven individuals represented displays numerous cut marks indicative of skinning and dismemberment. While this may reflect culinary processing, several points addressed in Chapter Five including the widespread ethnographic accounts of the importance of raven feathers and the potential evidence for captive ravens elsewhere at Bc 57 suggest that the species held substantial ritual importance.

In his analysis of the Grasshopper Pueblo fauna, Olsen (1990:69) reported that raven remains were clustered in and around ceremonial contexts, in particular the great kiva. Characterized by wing and leg elements, Olsen concluded that the remains were the likely byproducts of feather acquisition and ritual use (1990:70). At Pueblo Alto in Chaco Canyon, Akins (1987b:479,481,606-607) observed that wild bird remains, particularly wing and foot elements, including those of the common raven were most common during the Pueblo Alto Red Mesa component (1020-1050 CE). The Plaza 1, Grid 30 pit contained the majority of these remains and this, coupled with the presence of ornamental and potential ritual objects, led Akins to characterize the pit as a ceremonial deposit (1987b:606). The Bc 57 assemblage represents the densest concentration of raven skeletal remains yet documented in Chaco Canyon, is characterized by an abundance of wing and limb elements, and the site lies in proximity to the isolated great kiva Casa Rinconada.

The ritual importance of the raven is a common thread throughout a good deal of Old and New World mythology. The species' special status, it has been suggested, may stem from its frequent diet of carrion and by association the assumed ties to death and the afterlife (McKusick 2001:31-37; Serjeantson and Morris 2011).

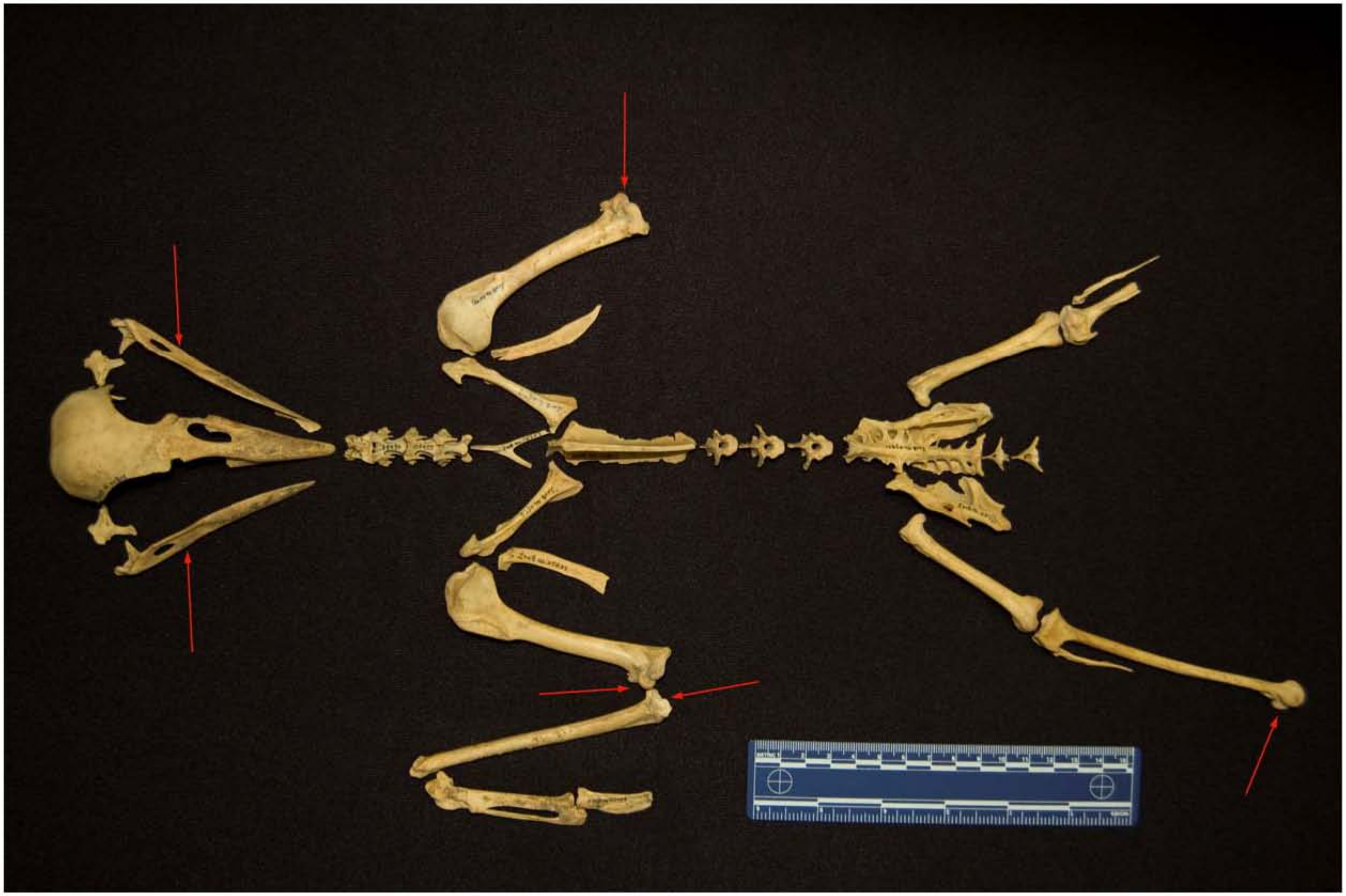


Figure 5.2: *Corvus corax* (common raven) articulating skeletal elements from Room 4 at Bc 57; arrows indicate location of butchery marks.


Figure 5.3: *Corvus corax* (common raven) left ulna (specimen 2008.46.08713) from Room 9 at Bc 57, exhibiting healed fracture.

Pinyon jays are more social than other Jays, particularly during nesting periods. The species' New Mexico range generally corresponds to that of pinyon-juniper woodlands (Lignon 1961:204-205) and in Chaco this would include the higher elevation portions of Chacra Mesa. A single probable pinyon jay (*Gymnorhinus cyanocephalus*) right ulna, representing a partial wing, was identified from Room 12 at Bc 58. The species has also been found at Pueblo Bonito, Pueblo Alto, and nearby Łeyit Kin (Akins 1985:323,328-329). Durand and Durand (2006:1099) observed that the occurrence of Steller's Jay (*Cyanocitta stelleri*) at Salmon Ruin along with other rare species such as bobcat, crane, and red fox signifies its use in ritual.

*Order Galliformes*

*Family Odontophoridae (New World quails)*

Two species of the genus *Callipepla, Callipepla squamata* (scaled quail) and *Callipepla gambelii* (Gambel's quail), have ranges that extend into and overlap in the Rio Grande, Mimbres, and Gila river drainages of western New Mexico and both are common year-round residents in these areas (Bailey 1928:216,220). In fact where ranges overlap, Gambel's quail has been known to hybridize with both the California quail and scaled quail (Society 2005:55). Thus the species are virtually indistinguishable on the basis of osteological remains. However, the scaled quail is native to Chaco Canyon and its surroundings and the northernmost extent of the Gambel's quail's natural range is still more than 250 km from Chaco Canyon. Thus it is likely that quail remains found in Chaco represent the former. Quail nest on the ground under low bushes or in agricultural fields and these species were commonly procured through garden hunting according to Pueblo ethnohistoric accounts (Bailey 1927:118; Emslie 1981a:320). Two scaled quail specimens (MNI = 1) were identified from Bc 57 – a left tibiotarsus from Kiva C and a partial sternum from subfloor deposits (dating to ca. 400-500 CE) in Room 5.

*Family Phasianidae (turkeys, grouse, pheasants, and partridges)*

As with many Old World animal domesticates the origins and history of domesticated turkey (*Meleagris gallopavo*) is complex with multiple centers of domestication. Until recently, debate existed over whether the domestic turkey was introduced to the Pueblo Southwest (Hargrave 1970; McKusick 1986:3) or had been domesticated by Ancestral Pueblo populations (Breitburg 1988). In fact, recent DNA evidence indicates that southwestern domestic turkeys were introduced into the region between 200 BCE and 450 CE from populations of either *Meleagris gallopavo silvestris* (Eastern) or *Meleagris gallopavo intermedia* (Rio Grande) to the east and southeast respectively (Speller et al. 2010:2810-2811). Complicating matters, Merriam's wild turkey (*Meleagris gallopavo merriami*) was present on the Colorado Plateau and Mogollon Rim areas as early as 6000 BCE. Archaeological and DNA evidence indicates that these wild turkeys were at times captured and penned during the Basketmaker II period (200 BCE – 450 CE) and that some degree of interbreeding between wild and domestic occurred after the latter's introduction to the region (Speller et al. 2010:2811).

The role of turkeys appears to have evolved through time, developing from one of ritual importance as a source of feathers into a principal food source and raw material for tool and ornament manufacture (Breitburg 1988; Hargrave 1965:161; Windes 1987; McKusick 1986). Many researchers including Windes, base this interpretation on the relatively low frequency of turkey skeletal remains prior to 1100 and the sharp increase in overall skeletal abundance as well as indicators of consumption such as burning and butchery (Windes 1987c:686). The latter development appears to have coincided with a general intensification of turkey exploitation throughout the Southwest during the twelfth and thirteenth centuries CE (Beacham and Durand 2007; Durand and Durand 2006:1096-1099; Munro 1994). Further, Webster (2006:989) documented an increase in the frequency of turkey feather blankets relative to rabbit fur blankets among post-1130 CE deposits at Salmon Ruin.


Figure 5.4: *Meleagris gallopavo* (turkey) sternum (specimen 2008.46.04444) displaying congenital anomaly or healed fracture.

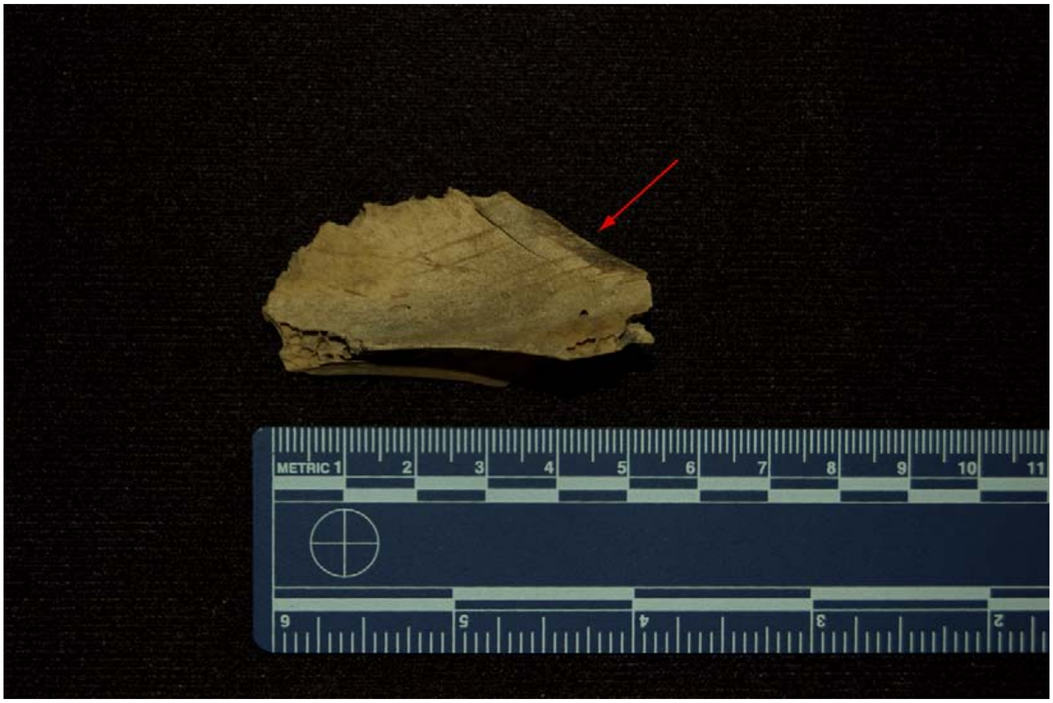



Figure 5.5: *Meleagris gallopavo* (turkey) sternum (specimen 2008.46.05891) from Room 4 at Bc 57; arrow indicates location of cut marks.


Figure 5.6: *Meleagris gallopavo* (turkey) left coracoid (specimen 2008.46.09341) from Room 1 at Bc 57; arrow indicates location of cut marks.

The distribution of turkey among contexts at Bc 57 and Bc 58 are outlined in Tables 5.5 and 5.6, respectively. Several criteria are often regarded as evidence of the raising and/or penning of turkeys including high numbers of immature individuals, the occurrence of pathologies such as healed fractures and osteoarthritis, and the presence of turkey eggshell (Beacham and Durand 2007; Durand and Durand 2006:1087).

Eggshell was recovered from fill contexts in Room 4 and Room 6 at Bc 57 although the species associated with these eggshell fragments has not yet been verified. A deformed, possibly healed fracture on the keel of a sternum (specimen 2008.46.04444) was observed on a turkey specimen from Room 4 (see Figure 5.4) and a turkey right coracoid (specimen 2008.46.09134) also from Room 4 deposits exhibited a pronounced exostosis possibly as a result of osteoarthritis. Juvenile or immature turkey remains (NISP = 21), including three small juvenile (<1 month old) specimens, account for 4 percent of NISP at Bc 57 while none were identified at Bc 58. Interestingly, of these immature individuals from Bc 57, 14 percent can be attributed to Early Bonito subphase contexts while the remaining 76 percent derive from Late Bonito deposits.

Taken together, this constitutes strong evidence that turkeys were being raised at or near Bc 57 and that it was a practice that underwent intensification through time, a pattern consistent with that seen elsewhere in Chaco Canyon at the Eleventh Hour Site (29SJ 633) (Gillespie 1991:291-292). However, unlike Eleventh Hour neither Bc 57 nor Bc 58 witnessed a dramatic overall increase in turkey through time. For instance, within the Room 4 (Early Bonito) assemblage turkey accounts for only 4 percent of NISP and the relative frequency increases to only 7 percent of the Room 9 NISP during the ensuing Classic and Late Bonito subphase.

The rate of cooking and butchery of turkey is low but indicates that turkey at least partially served an economic purpose at Bc 57 and Bc 58 during both the Early and Late Bonito subphases. Six turkey specimens (1 percent) from Bc 57 and a single element from Bc 58 displayed signs of roasting. Two turkey specimens from Bc 58 exhibited signs of butchery – a distal left coracoid (from Room 1) and the proximal end of a first phalanx (from Room 12). Evidence for turkey butchery is similarly low at Bc 57 (2 percent) and is again spread across Early and Late Bonito deposits although more common during the latter (Rooms 4, 7, and 9). At Bc 57, 80 percent of turkey butchery was located on the tibiotarsi, particularly at mid-shaft and toward the distal end and would have facilitated removal of the lower legs. One sternum (specimen 2008.46.05891) in particular from Room 4 at Bc 57 displayed numerous filleting cut marks on either side of the keel of the sternum (see Figure 5.5) and a coracoid from Room 1 exhibited cut marks at its proximal end (Figure 5.6).

Sex ratios for the Bc 57 and Bc 58 samples were estimated using metrics of the tarsometatarsus (Breitburg 1988:120-121; McKusick 1986:44-54; Munro 1994:87-93). As depicted in Figure 5.7, measurements of greatest length (GL) are distinctly bimodal, no doubt depicting sexual dimorphism. Based on this pattern one may infer a sex distribution at Bc 57 and Bc 58 of 45 percent female and 55 percent male. However, this is a relatively small sample size and although greatest length is the preferred measurement (von den Driesch 1976:129), in many cases it was not available due to fragmentation. As demonstrated by Munro (1994:89-91), distal breadth (Bd) of the tarsometatarsus is frequently measureable in such cases and is a strong predictor of GL. Figure 5.8 illustrates the distribution of distal breadth measurements for Bc 57 and Bc 58.

By plotting GL against Bd, the resulting regression equation can then be utilized to estimate GL values otherwise lost to fragmentation (Figure 5.9). The resulting $R^2 = 0.87$ is high and very nearly approximates the value reported by Munro ($R^2 = 0.84$). As demonstrated in Figure 5.10, upon incorporating the predicted GL values the clear boundary between male and female size ranges remains clear and yields a predicted sex distribution of 50 percent female and 50 percent male.

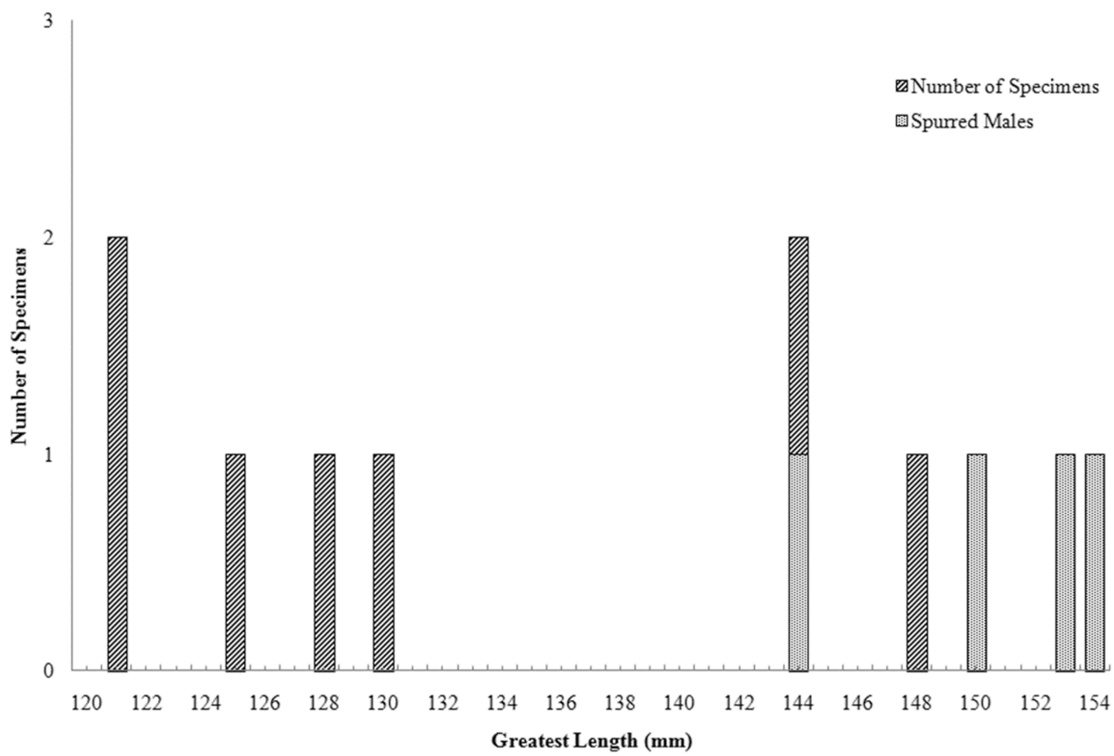



Figure 5.7: Measurements of turkey tarsometatarsus greatest length (GL) from Bc 57 and Bc 58.

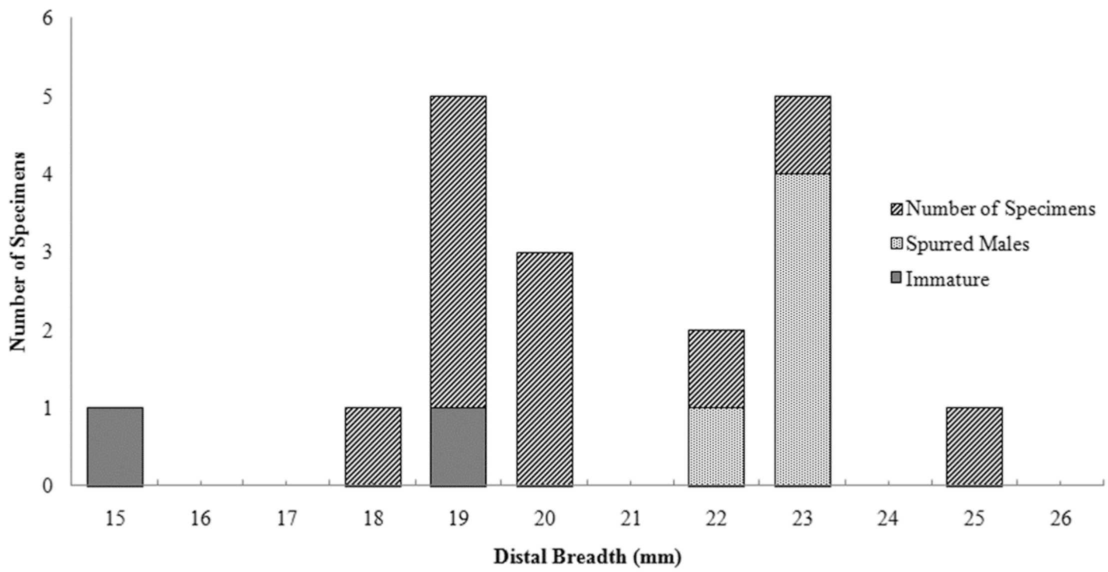



Figure 5.8: Measurements of turkey tarsometatarsus distal breadth (Bd) from Bc 57 and Bc 58.

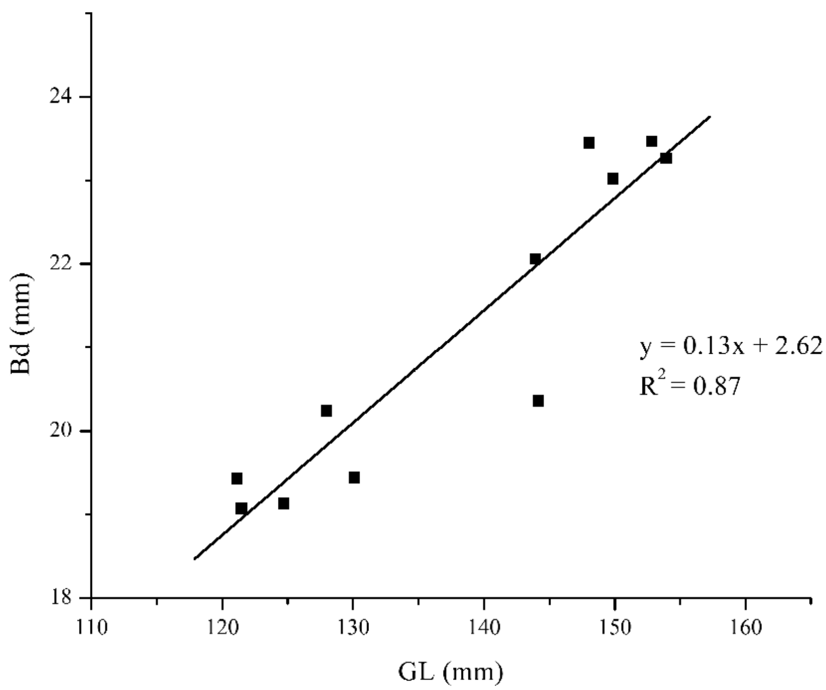



Figure 5.9: Plot of turkey tarsometatarsus Greatest Length vs. Distal Breadth for Bc 57 and Bc 58.

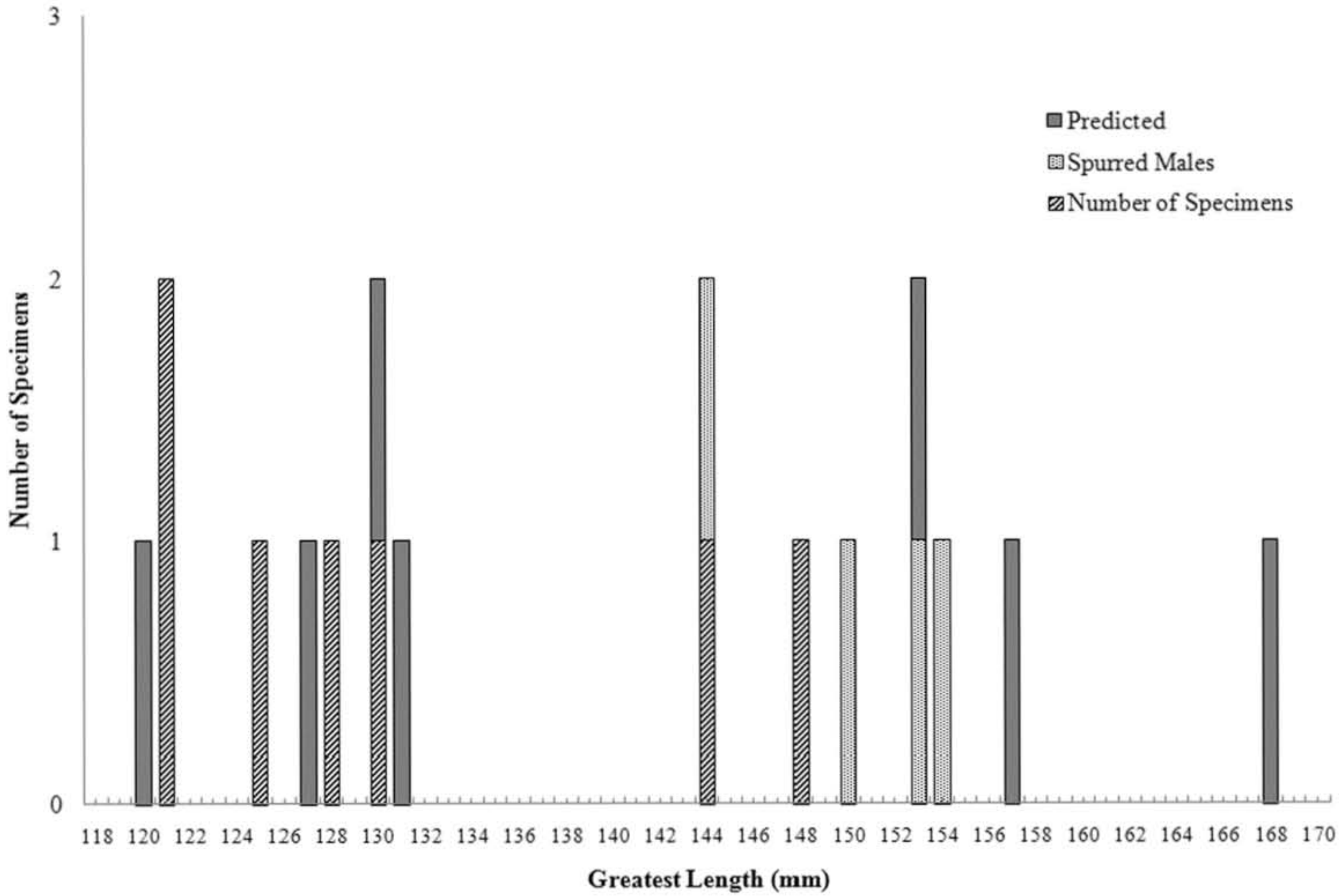



Figure 5.10: Plot of turkey tarsometatarsus Greatest Length vs. Distal Breadth for Bc 57 and Bc 58.

Finally, an examination of variation in relative frequency of turkey skeletal parts through time highlights a notable change in the Bc 57 assemblage. If the dietary importance of turkey increased through time as noted above, more extensive use of the turkeys as reflected by greater frequencies of axial skeletal parts (e.g. vertebrae, pelvis, and sternum) might be expected. Following Durand and Durand (2006:1087-1089) a chi-square test shows that the relationship between time period and skeletal part frequency is not statistically significant ($\chi^2 = 9.188$ ($p = 0.102$, $df = 5$). To account for the possibility that turkey burials and therefore more complete skeletons could bias the results, the only context where an intentional burial was reported (Room 3) was excluded from analysis.

As illustrated in Table 5.7, although the results were not significant, the adjusted residuals indicate that pelvis and neck parts are overrepresented during the Early Bonito subphase while body elements (coracoid, sternum, thoracic vertebrae, and ribs) were only slightly more frequent than expected during the Classic Bonito period. A chi-square comparison of turkey skeletal abundance in Classic and Late Bonito deposits (Table 5.8) also was not significant, $\chi^2 = 1.852$ ($p = 0.869$, $df = 5$). The results indicate that all turkey parts are represented throughout the three periods at Bc 57 and that there was no pronounced shift in skeletal abundance. The higher-than-expected frequency in pelvis elements suggests a slightly more extensive use of turkey during the Early Bonito period.

Such a drastic overrepresentation of pelvic fragments in the earlier assemblage may reflect greater onsite processing or more comprehensive use of turkey carcasses. The presence of the heavily butchered sternum from Room 4 would seem to support this interpretation. As discussed above, an overrepresentation of wings during the Classic-Late Bonito subphases may be linked to increasing use of wing elements and feathers for

Table 5.7: Chi-square table with adjusted residuals comparing turkey NISP by skeletal region and time period at Bc 57. Expected values are shown in parentheses; $\chi^2 = 9.188$ ($p = 0.102$, df = 5). For adjusted residuals, *denotes $p < 0.01$; analysis excludes worked bone.

| | | Time Period | | |
|---|---|---|---|---|
| **Skeletal Part** | **Early Bonito** | **Adjusted Residual** | **Classic Bonito** | **Adjusted Residual** |
| Skull | 3 (3.26) | -0.213 | 3 (2.74) | 0.213 |
| Neck | 22 (19.00) | 1.080 | 13 (16.00) | -1.080 |
| Body | 57 (62.43) | -1.275 | 58 (52.57) | 1.275 |
| Wing | 25 (26.60) | -0.499 | 24 (22.40) | 0.499 |
| Pelvis | 18 (11.94) | 2.688* | 4 (10.06) | -2.688* |
| Leg | 46 (47.77) | -0.447 | 42 (40.23) | 0.447 |

Table 5.8: Chi-square table with adjusted residuals comparing turkey NISP by skeletal region and time period at Bc 57. Expected values are shown in parentheses; $\chi^2 = 1.852$ ($p = 0.869$, df = 5); analysis excludes worked bone.

| | | Time Period | | |
|---|---|---|---|---|
| **Skeletal Part** | **Classic Bonito** | **Adjusted Residual** | **Late Bonito** | **Adjusted Residual** |
| Skull | 3 (3.85) | -0.653 | 4 (3.15) | 0.653 |
| Neck | 13 (12.09) | 0.407 | 9 (9.91) | -0.407 |
| Body | 58 (54.41) | 0.919 | 41 (44.59) | -0.919 |
| Wing | 24 (26.93) | -0.934 | 25 (22.07) | 0.934 |
| Pelvis | 4 (3.85) | 0.118 | 3 (3.15) | -0.118 |
| Leg | 42 (42.87) | -0.236 | 36 (35.13) | 0.236 |

ritual purposes. Moreover, the overall pattern contradicts the expected trend of increasing dietary use of turkey at Bc 57. Although, the possibility that taphonomic factors may be impacting these relative frequencies also cannot be ruled out, the greater frequency of fragile cranial fragments in the Classic-Late Bonito assemblages suggests otherwise.

*Order Strigiformes*

*Family Strigidae (typical owls)*

*Bubo virginianus* (great horned owl) is a year-round resident throughout northwest New Mexico inhabiting a wide range of habitat and vegetation types (Dickerman et al. 2010:540,542). Bailey (1928:321,323) reported that nesting pairs can be found in trees, along cliff faces, and in arroyo cutbanks. A juvenile or immature great horned owl partial right humerus was identified from Room 9 at Bc 57. *Megascops kennicottii* (western screech owl) can be found in a variety of habitats throughout the Four Corners region, nesting is strictly arboreal, and the species prefers wooded riparian areas not unlike parts of the modern day Chaco Wash (Bailey 1928:317; Gehlbach and Stoleson 2010:516-520). A single distal left ulna from Room 4 at Bc 57 was identified as western screech owl. Both of these owl species have diverse diets consisting of small mammals, birds, reptiles, and invertebrates, and are capable of hunting day and night (Dickerman et al. 2010:548-549). Accordingly, these species are often drawn toward man-made ecosystems like agricultural fields and the populations of small mammals and birds therein (Emslie 1981b:856-857; Neusius 2008:306).

### ***Mammalian Fauna***

*Order Artiodactyla*

As with the avian remains, Bc 57 yielded the larger sample of artiodactyl and large mammal remains (see Tables 5.9 and 5.10). Artiodactyls account for a slightly larger proportion of the total Bc 58 assemblage (26 percent) than that observed for Bc 57 (20 percent). At Bc 57, pronghorn antelope (*Antilocapra americana*) is the most common large mammal followed closely by mule deer (*Odocoileus hemionus*), but the latter species comprises a larger proportion of the artiodactyls identified at Bc 58. As will be discussed in a Chapter Seven, the relative abundance of artiodactyls at Bc 57 and Bc 58 are among the highest recorded for any site in Chaco Canyon.

*Family Antilocapridae (pronghorn antelope)*

Pronghorn antelope, a highly gregarious species, congregate in herds as large as 1,000 individuals, prefer open grassland basins and plateaus like those extending south and west of Chaco Canyon, and are highly dependent on sources of standing water (Nowak 1999:1134; O'Gara 1978:4). If Russell's (1964:8-9) map of historical pronghorn ranges is correct then Chaco was situated at the heart of a prime pronghorn range, stretching 50 km southward to the foot of the San Mateo mountains, 70 km west toward the Chuska and Lukachukai mountains, and 80 km northward toward San Juan and Animas River drainages. Although today North American pronghorn number in the tens of thousands, pre-contact estimates range as high as thirty-five million (O'Gara 1978:4). Herd size and composition varies seasonally. Large winter herds disperse in early spring, to form three separate herd structures, one consisting of does (and eventually fawns), dispersed territorial bucks, and bachelor males. The latter is comprised of yearlings, two year-olds, and older males without territories. During the rut, which lasts from roughly March to October, territorial bucks defend their small plots from challengers for the ability to mate with breeding females that wander through various territories (O'Gara 1978:4). Among southern pronghorn populations such as those of New Mexico, breeding usually occurs from late July to early October with a 250-day gestation (O'Gara 1978:3). Males and females of disparate age groups congregate to form large winter herds and although distances vary, documented winter ranges extend anywhere from 10 to 160 km in search of suitable graze and browse.

With observed bursts of speed approaching 90 km/hr and sustained speeds upwards of 70 km/hr, pronghorn were traditionally hunted by modern Pueblos using cooperative corral drive tactics of which Stephen (Parsons 1936:277-278) and Hill (1982) offer detailed descriptions. Hill (1982:51-52) recorded that antelope hunts were communal affairs, accomplished under the leadership of a war captain and where a successful hunt could yield anywhere from thirty to fifty antelope. The dressed carcasses were returned to the house of the war captain where meat and hides were apportioned to hunt participants and neighbors. Among the Tewa pronghorn hunting expeditions were undertaken during the fall months (Ford 1972:24). Pronghorn is a species common to Chacoan sites, particularly during Basketmaker III and Pueblo I periods, and likely roamed the open grasslands of the southern San Juan Basin (Akins 1985:321,358).

Table 5.9: Bc 57 artiodactyls and large mammals by provenience.

| Taxon | Provenience | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | R. 1 | R. 2 | R. 3 | R. 4 | R. 5 | R. 6 | R. 7 | R. 8 | R. 7/8 | R. 9 | R. 9/10 | Kiva A | Kiva B | Kiva C | Kiva D | Area 10 | Pit A | Burial 1467 | General | TOTAL |
| *Antilocapra americana* (pronghorn antelope) | 6 | 37 | - | 76 | - | 1 | 88 | 14 | 12 | 120 | - | - | - | 8 | 2 | 2 | 5 | - | 12 | 383 |
| *Odocoileus hemionus* (mule deer) | - | 18 | 2 | 109 | - | 7 | 35 | 18 | 21 | 62 | - | - | 1 | - | - | 5 | 1 | - | 1 | 280 |
| *Ovis aries* (domestic sheep) | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| *Ovis canadensis* (bighorn sheep) | - | 5 | 1 | 22 | - | - | 1 | 1 | 6 | 6 | - | 1 | - | - | - | 3 | - | - | 1 | 47 |
| Cervidae | 1 | 1 | - | - | - | - | - | - | - | 4 | - | - | - | - | - | - | - | - | - | 6 |
| Large Mammal | 21 | 117 | 12 | 404 | 9 | 21 | 94 | 44 | 69 | 365 | 1 | 1 | 1 | 1 | 4 | 59 | 30 | 2 | 44 | 1299 |
| **TOTAL** | 28 | 178 | 15 | 611 | 9 | 29 | 218 | 79 | 108 | 557 | 1 | 2 | 2 | 9 | 6 | 69 | 36 | 2 | 58 | 2017 |

Table 5.10: Bc 58 artiodactyls and large mammals by provenience.

| Taxon | Provenience | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | R. 1 | R. 3 | R. 4 | R. 5 | R. 8 | R. 9 | R. 10 | R. 12 | R. 13 | R. 14 | Area 1 | Area 6 | TOTAL |
| *Antilocapra americana* (pronghorn antelope) | 2 | - | - | - | 1 | - | 2 | 1 | - | - | - | - | 6 |
| *Odocoileus hemionus* (mule deer) | 8 | 1 | 9 | 4 | 3 | - | 27 | 1 | - | 50 | 1 | - | 104 |
| *Ovis canadensis* (bighorn sheep) | - | - | - | - | - | - | 11 | - | - | - | 1 | - | 12 |
| Cervidae | - | - | - | - | - | - | - | - | - | - | - | - | 0 |
| Large Mammal | 20 | - | 19 | 28 | 3 | 3 | 45 | 1 | 13 | 13 | 57 | 3 | 205 |
| **TOTAL** | 30 | 1 | 28 | 32 | 7 | 3 | 85 | 3 | 13 | 63 | 59 | 3 | 327 |

Pronghorn is the most common artiodactyl species at Bc 57, being found in eleven of fifteen room/kiva fill contexts and midden areas. In contrast, the species is relatively rare at Bc 58. Among Early Bonito deposits at Bc 57 pronghorn's relative abundance (%NISP = 1.3) is comparable to contemporaneous Chacoan, sites but the frequency in Classic/Late Bonito contexts (%NISP = 4.4) is markedly higher than any other coeval Chacoan site (Akins 1985:358). As will be addressed in later chapters, the skeletal element representation and butchery patterns provide strong evidence that nearly whole pronghorn carcasses were returned to the site where they were processed and consumed.

If pronghorn were procured through cooperative game drives one expectation is that mortality profiles would reflect a catastrophic kill-off pattern (Bar-Oz et al. 2011:7348; Lubinski and O'Brien 2001:838). Despite the presence of at least seven mandibles in the Bc 57 assemblage, only four possessed tooth rows suitable for age determination. Pronghorn mandibular dental eruption and wear was recorded in accordance with Taber (1969:400) and Lubinski (2001). Although histograms are generally not advisable for sample sizes less than 30-40 (Klein and Cruz-Uribe 1984:59; Steele 2005:417), Figure 5.11 illustrates those specimens for which age classes could be estimated. The graph demonstrates that juvenile, sub-adult, and adults were all targeted but unfortunately the small sample size precludes further interpretation. Epiphyseal fusion data was recorded but to date no reliable index of epiphyseal closure has been published for pronghorn antelope.

Although parturition dates vary from year to year for pronghorn populations (Fairbanks 1993:130), assuming a June 1 birthdate (Lubinski and O'Brien 2001:835), seasonality could be estimated for two specimens. The fore and hind limb remains of one neonatal or fetal individual were identified from Room 4 at Bc 57 (specimens 2008.46.9062-9064) based on cortical bone structure and epiphyseal fusion, suggesting a late spring-early summer death. Seasonality was estimated on the basis of tooth wear and eruption for two specimens, one from Room 9 (specimen 2008.46.06572) and another from an unknown provenience (2008.46.10020) at Bc 57. An approximate age of 12 months for the former indicates a late spring-early summer hunt while the latter, estimated at 4 months of age, represents a late summer-early fall kill. Bearing in mind the small sample size, it appears that Chacoan hunters at least partly exploited pronghorn during the spring, summer, and early fall when ranges were more limited, females were nursing young, and when territorial males were more or less stationary.

No age related information was available for the pronghorn remains from Bc 58.

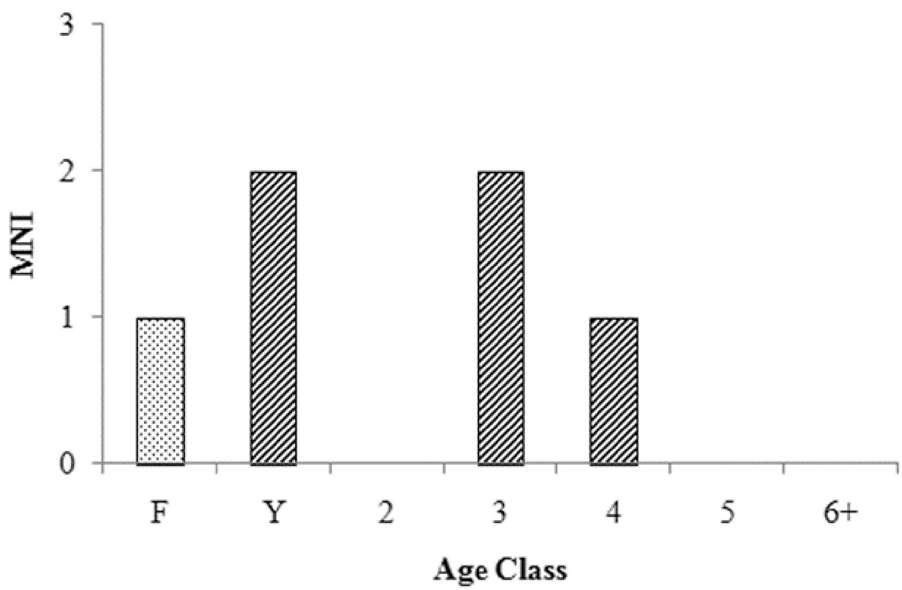



Figure 5.11: Pronghorn mortality profile for Bc 57 (based on tooth eruption/wear stages), n = 6; stippled value represents neonatal/fetal specimen identified on the basis of epiphyseal fusion and cortical bone condition.

Table 5.11: Elements and age classes employed in bighorn sheep age determination based on Walker (1987).

| Element | Fusion Age (months) | Age Class |
|---|---|---|
| Humerus (distal) | 5 | **A** |
| Radius (proximal) | 9 | **A** |
| Second Phalanx | 9 | **A** |
| First Phalanx | 17 | **B** |
| Tibia (distal) | 29 | **C** |
| Metapodial | 29 | **C** |
| Femur (distal) | 32 | **D** |
| Calcaneus | 42 | **E** |
| Femur (proximal) | 42 | **E** |
| Tibia (proximal) | 42 | **E** |
| Ulna (proximal) | 42 | **E** |
| Ulna (distal) | 42 | **E** |
| Radius (distal) | 42 | **E** |
| Humerus (proximal) | 42 | **E** |

Table 5.12: Percent survivorship of bighorn sheep by age class at Bc 57.

| Age Class | Bc 57<br>n = 9 |
|---|---|
| A | 100.0 |
| B | 75.0 |
| C | 50.0 |
| D | 100.0 |
| E | 75.0 |

*Family Bovidae (antelopes, cattle, gazelles, goats, sheep, and relatives)*

Although today *Ovis canadensis* (bighorn sheep) are generally found among the high elevation alpine meadows of the Rocky Mountains and lower elevation desert mountain ranges of the American Southwest, the pre-contact distribution of the species likely extended farther eastward into areas such as the San Juan Basin along major rivers and among stretches of badlands (Shackleton 1985:2). The species is migratory, inhabiting higher altitude biomes during spring and summer and descending to lower altitudes during fall and winter. The average home range is around 16 km but home ranges as great as 48 km have been recorded (Shackleton 1985:3). Bighorn are social animals forming groups of two to nine, segregated between breeding-age males and females with young although these groups temporarily coalesce during the rut in fall and early winter (Shackleton 1985:5).

No bighorn mandibles were recovered from either Bc 57 or Bc 58 thus assessment of the age structure of hunted animals was limited to the less precise use of epiphyseal fusion stages following Walker (1987). Although fusion rates (particularly those of early-fusing elements) vary somewhat by sex, fusion data is more complete for female bighorn than for male, so the former were employed in estimates of age at death (Walker 1987:10-11). In one case where fusion data was not available for an element (distal humerus) the male fusion age was utilized. Determination of sex following Gilbert (1993:63-65) was not possible for any bighorn sheep specimens.

The elements and ages of fusion shown in Table 5.11 were used in conjunction with the Fusion Score Formula: {[(f x 1) + (i x 0.5) + (u x 0)] x 100}/(f + i + u), where f = the number of fused elements, i = the number of fusing elements, and u = the number of unfused elements (Redding 1981; Zeder 1991:91; 2001:73). The score reflects the percentage of individuals surviving beyond a given age class. Due to the small sample size data from all time periods at Bc 57 was combined in the calculation of bighorn age structure (no data was available for Bc 58). The mortality profile depicted in Figure 5.12 reflects a heavy emphasis on prime-aged animals with a very gradual (50 percent) decline in survivorship over the first 2 years and a focus on adults in the three to four year age range (see Table 5.12). Although any interpretation of these data should be approached with caution due to the limited sample size and lack of seasonal indicators, the age structure hints at the existence of what is commonly referred to as an attritional or "U-shaped" mortality profile often associated with hunting of animals whose behavior is not conducive to mass procurement (Klein and Cruz-Uribe 1984:56).

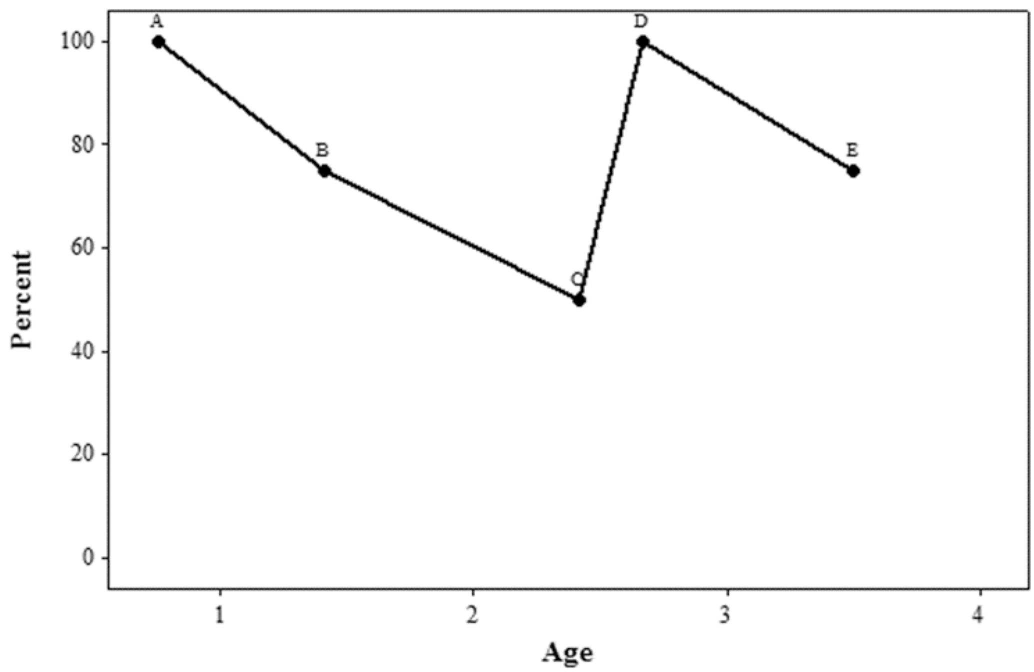



Figure 5.12: Bighorn sheep survivorship curve for overall Bc 57 assemblage, n = 9; letters denote age classes (after Zeder 1991:91).

Two specimens, a partial proximal radius and scapula from the surface or upper fill levels of Room 8 at Bc 57 were identified as *Ovis aries* (domestic sheep). The remains exhibited heavy carnivore gnawing and root etching. Domestic sheep/goat was also recovered from the surface or upper levels of structural fill at three sites excavated by the Chaco Project including Pueblo Alto (Akins 1985:321; 1987b:470-472). Although the Navajo undoubtedly acquired sheep and goats from Spanish colonists during the seventeenth century at the earliest, the extent of Navajo exploitation of sheep is poorly understood until the eighteenth century (Hill 1940:401). Given the presence of Navajo settlements in and around Chaco, sheep remains are not altogether surprising. Further, large-scale Hispano-owned sheep herding operations near Chaco were documented as early as the late nineteenth century and one such sheep camp was reportedly in close proximity to Pueblo Alto (Brugge 1980:112,156).

*Family Cervidae (deer)*

Mule deer (*Odocoileus hemionus*) are browsers found throughout the desert, lower elevation pinyon-juniper, and higher elevation biomes of northwestern New Mexico (Anderson and Wallmo 1984:1-3) and were primarily hunted by the Pueblos during fall and winter (Akins 1985:321; Ford 1972:24). They tend to herd in small family groups and while Hill observed at Santa Clara pueblo that deer were hunted by small hunting parties using blinds (Hill 1982), larger scale cooperative hunting was not unusual among the Hopi (Parsons 1936:277).

At Zia Pueblo, White (1962) reported that deer hunts consisted of at least one, sometimes two hunting parties and were frequently undertaken in the service of the *Tiamunyi* (cacique) at the behest of the War Chief. Once a quota of deer for the cacique had been reached, hunters were then permitted to hunt for their own families. These hunts generally lasted for six days but could be extended if initial efforts were unsuccessful (1962:302). After killing a deer, the hunter first skinned the animal leaving the skull and backbone attached to the hide and then meat was removed and packed for the return trip (1962:303). Upon return to the pueblo, the deer were brought to the *hotcanitsa* (residence of the cacique) where it was divided in two. The hunter received the head, skin, part of the backbone, the chest from the neck down to the fourth rib, and part of the abdomen while the rest (the majority of the torso and all of the hind quarters) were presented to the cacique. The meat was then piled at the *hotcanitsa* before being made into jerky for later use in stews. When the hunter returned home with his share of the hunt, his mother cooked the meat and boiled the lungs, heart, and entire head and the food was served with bread to the family and other households invited to partake in the meal (1962:303). Finally, the bones were discarded among the refuse dumps with special care to ensure that dogs were unable to gnaw on them (1962:303-304). Parsons (1925:70) and Titiev (1944:191) offer similar accounts from Jemez and Hopi respectively of rules dictating which carcass parts belonged to a successful hunter and those that were readily redistributed throughout the community.

Determination of age at death for deer has the potential to address two important questions: 1) During which seasons were deer hunts undertaken?; and 2) What age classes were targeted by prehistoric hunters? Poor preservation of key skeletal landmarks precluded attempts to distinguish male from female mule deer specimens following Taber (1956).

Of the mule deer mandibles identified, only two contained intact tooth rows from which age could be inferred. Based on tooth wear and eruption one individual (specimen 2008.46.03835) was taken as an older adult, aged approximately eight to nine years and another (specimen 2008.46.03836) was estimated at approximately one year and nine months of age (Robinette et al. 1957:145). Since more precise age estimates are not possible for specimens aged beyond twenty-eight months, inference of hunting seasonality was limited to the latter specimen (Robinette et al. 1957:135). Based on an estimated parturition date of June 20 (Anderson and Wallmo 1984:4), the specimen was likely procured in early fall.

Although mandibular tooth wear and eruption are preferable for the evaluation of kill-off patterns, in the absence of such data I again elected to utilize epiphyseal fusion stages following Zeder (1991:90-91, 141-142). Mule deer fusion rates vary by sex and are influenced by quality of forage, thus a degree of uncertainty is inherent in the formation of mortality profiles on the basis of epiphyseal fusion (Lewall and Cowan 1963). Moreover, the resolution of fusion-based age curves for deer becomes somewhat coarse for prime-aged and older individuals (sixty-plus months of age; see Table 5.13) (Klein and Cruz-Uribe 1984:43). The goal however is to identify variation in procurement strategies between sites and through time.

As with bighorn sheep, fusion scores were used to derive survivorship curves following Redding (1981) and Zeder (1991:91, 2001:73). Fusion rates for deer are variable as previously noted and this analysis relied on those recorded for female deer of good nutritive status (Lewall and Cowan 1963). Figure 5.13 compares the mule deer survivorship curves for the total Bc 57 assemblage, Bc 57 by time period, and the total Bc 58 assemblage (see Table 5.14). Again small sample size limits the degree of confidence that can be placed in these interpretations. The results for the overall Bc 57 assemblage appear to be heavily weighted by the Classic-Late Bonito subphase age distribution – both are characterized by a focus on prime-aged individuals. Deer survivorship during the Classic-Late Bonito subphase remains high through the middle of the second year, before declining 71 percent between the second and fourth years. The Classic-Late

Bonito age structure more closely reflects a "U-shaped" or attritional age-frequency curve. As noted above, the pattern is frequently associated with procurement of species for which ecology and behavior are not conducive to mass collection. Bc 58 exhibits a similar prime-dominated pattern but with an absence of older individuals as evidenced by a 100 percent decline in survivorship between the first and fourth years.

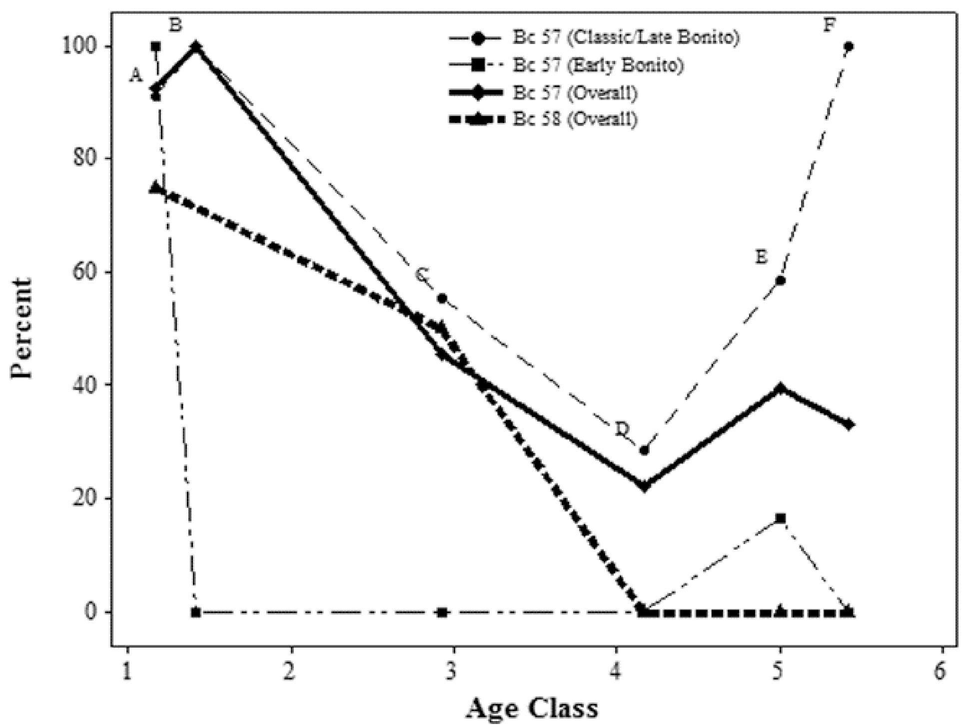



Figure 5.13: Mule deer survivorship curve for overall Bc 57 assemblage, n = 155; letters denote age classes (after Zeder 1991:91).

Table 5.13: Elements and age classes employed in mule deer age determination based on Lewall and Cowan (1963).

| Element | Fusion Age (months) | Age Class |
|---|---|---|
| Radius (proximal) | 14 | **A** |
| Phalanges | 14 | **A** |
| Humerus (distal) | 17 | **B** |
| Tibia (distal) | 35 | **C** |
| Femur (distal) | 50 | **D** |
| Calcaneus | 60 | **E** |
| Metapodial | 60 | **E** |
| Femur (proximal) | 60 | **E** |
| Tibia (proximal) | 60 | **E** |
| Ulna (proximal) | 60 | **E** |
| Ulna (distal) | 60 | **E** |
| Radius (distal) | 65 | **F** |
| Humerus (proximal) | 65 | **F** |

Table 5.14: Percent survivorship of mule deer by age class at Bc 57 and Bc 58.

| Age Class | Bc 57 - Early Bonito n = 18 | Bc 57 - Classic/Late Bonito n = 51 | Bc 57 (Overall) n = 69 | Bc 58 (Overall) n = 17 |
|---|---|---|---|---|
| A | 100.0 | 91.2 | 92.5 | 75.0 |
| B | 0.0 | 100.0 | 100.0 | - |
| C | 0.0 | 55.6 | 45.5 | 50.0 |
| D | 0.0 | 28.6 | 22.2 | 0.0 |
| E | 16.7 | 56.3 | 42.0 | 0.0 |
| F | 0.0 | 100.0 | 33.3 | 0.0 |

The Early Bonito subphase assemblage is the exception, displaying a steep decline in survivorship (100 percent decline) between the first and second years and only a slight increase apparent among older prime-aged individuals – reflecting a hunting strategy that targeted younger animals. The Early Bonito pattern approximates that of an "L-shaped" or catastrophic pattern commonly associated with mass kills such as drives or traps (Stiner 1990). However, such a pattern could also reflect resource depression in the form of anthropogenically-induced reductions in older animals within prey populations (Broughton 2002:64; Cannon 2000:323; Ugan 2005:231). Moreover, the increase in prime-aged animals during later periods at Bc 57 and Bc 58 could reflect hunting shifts toward less depleted territories (Broughton 2002:70).

*Large Mammals*

At Bc 57, six specimens (antler fragments) were identified as Cervid while another 1,299 specimens were classified as large mammal, presumably artiodactyl (see Table 5.9). At Bc 58, 205 specimens were identified as large mammal (see Table 5.10). Although these remains were relegated to the broader "large mammal" category due in large part to a higher degree of fragmentation and/or poor preservation that precluded identification of key diagnostic skeletal landmarks, in many cases these specimens could be assigned to a general skeletal region, i.e. skull, vertebra, rib, pelvis, or long bone.

*Order Carnivora*

*Family Canidae (coyotes, dogs, foxes, jackals, and wolves)*

Evidence for the presence of domestic dog is well-documented among early Holocene North American populations (Grayson 1988:22-23; Morey and Wiant 1992) as well as throughout the Pueblo Southwest (Allen 1920:456-457, 481-490; Colton 1970;

Douglas and Leslie 1981; Kidder and Guernsey 1919:99; Olsen 1990:109-118). The species served domestic and economic roles as a food resource and raw material for worked bone industries (Olsen 1990:110-113; Schwartz 1997:57; Sutton and Reinhard 1995:748). Ritual importance is often implied by the presence of intentional burials or deposition of isolated crania, often in conjunction with human burials (Allen 1920:456; Douglas and Leslie 1981:36-38; Fowles 2005; Hill 2000; Olsen 1990:110; Walker 1995:90-92). In Chaco, dog remains are more commonly associated with Pueblo II period small sites (Akins 1985:319; 1992:322-325; Gillespie 1993:368; McKenna 1984:313-321). At site 29SJ 1360, complete infant and adult dog skeletons were found amidst the human remains in Pithouse B, indicating that the domestic canids were living side-by-side with the site's inhabitants (McKenna 1984:352, 357).

Prior to European colonization, the North American distribution of the gray wolf was extensive and included a variety of habitats, desert and high mountain biomes being the exception (Mech 1974:1-2). Akins (1985:319) noted the rarity of the species among Chacoan assemblages in contrast to coyote, which is particularly common among Chacoan faunal assemblages dating to the Pueblo I and Pueblo II periods. That the sole coyote specimen derives from the Early Bonito assemblage from Room 4 is consistent with the trend observed by Akins. Although the modern distribution of coyotes has actually expanded, apparently in response to recent anthropogenic changes to habitats, the prehistoric distribution was widespread (Bekoff 1977:2-3).

Although the preferred biomes of the kit fox and gray fox differ - the former favor desert and semi-arid environments (McGrew 1979:1-2) while the latter inhabit rocky, wooded, and brushy habitats (Fritzell and Haroldson 1982:1-2) – Chaco appears favorable to both species (Cully 1985:291). Foxes are often enticed into anthropogenic habitats such as agricultural fields by the abundance of prey species (cottontail, prairie dog, and other rodents) and their presence archaeologically may be the result of garden hunting (Neusius 2008:306). Although coyotes are excluded from Neusius's (2008) list, it is likely that these species were similarly drawn to agricultural zones and potentially procured through garden hunting. The pelts of these species are commonly used among modern Pueblos for ritual purposes (Bradfield 1973:249).

Canids, represented by 24 specimens at Bc 57 and 48 specimens at Bc 58, comprised 0.4 percent and 7.5 percent of identifiable faunal remains respectively. Tables 5.15 and 5.16 depict the spatial distribution of carnivores at Bc 57 and Bc 58. Due to overlapping size and morphology, particularly between domestic dogs (*Canis familiaris*) and coyotes (*Canis latrans*), the majority of canid specimens were identified only as *Canis* sp. (domestic dog, wolf, or coyote). Although differentiation of dog and coyote on the basis of skeletal remains is often possible when intact crania are present (Colton 1970; Lawrence and Bossert 1967; Olsen 1980:42-43), such is rarely the case archaeologically. Further, nearly 30 percent of remains from Bc 57 are those of infant or young juveniles precluding metrical analysis.

At Bc 57, the majority of *Canis* sp. remains were recovered from Room 4 accounting for 41 percent of all canids at the site. While the whole range of *Canis* skeletal elements are represented in the Bc 57 assemblage, the fragmentary condition and lack of articulating elements is not consistent with intentional burial.

A single distal right humerus was identified as coyote (specimen 2008.46.02856) and was fully carbonized indicating that it may have found its way into a hearth or firepit during processing and prior to deposition in Room 4. A sizable left humeral shaft fragment (specimen 2008.46.06593) from Room 8 was identified as gray wolf (*Canis lupus*) and exhibited fine cut marks toward the distal end of the shaft, indicative of filleting. The maxillary region of a partial gray fox (*Urocyon cinereoargenteus*) cranium (specimen 2008.46.01713) displaying evidence of having been roasted was identified from Room 4 and one probable gray fox rib was identified from Room 2.

The pattern of canid remains at Bc 58 differs somewhat from that of Bc 57. As with the *Canis* sp. remains at Bc 57, the whole range of skeletal parts is represented but at Bc 58, axial remains (vertebrae, ribs, and pelvis) are particularly frequent. From the Room 4 assemblage the presence of a canid mandible, a string of articulating thoracic, lumbar, and caudal vertebrae, and several ribs provide the strongest evidence from either site of an intentional dog burial. Unfortunately, field notes are quite limited and make no mention of a dog burial encountered during excavation (Chaco Collection 1947:11). A single canid skull from Room 1 exhibited a clean chop through the left temporal and parietal (specimen 2008.47.00542). Room 14 contained an infant or young juvenile canid mandible (specimen 2008.47.00863) commingled with several adult canid vertebrae, ribs, and pelvis fragments. Compared with Bc 57, the frequency of infant or juvenile canids is very low, comprising only 2 percent and 6 percent of all canid specimens respectively. Finally, the partial right maxillary region (specimen 2008.47.01252) of a kit fox (*Vulpes macrotis*) and a second cranial fragment (specimen 2008.47.01232) that likely refits with the former were identified from Room 12.

*Family Mustelidae (badgers, otters, weasels, and relatives)*

The only mustelid identified in either assemblage was American badger (*Taxidea taxus*) represented by a right calcaneus from Room 4 and a left femur from Room 9 both at Bc 57. Known for its ferocity when cornered, the species tends to make its burrows in dry, open grasslands and fields and its principal prey species include small rodents such as ground squirrels and prairie dogs (Long 1973:3). One of the more frequent carnivores identified in Chaco Canyon assemblages, badgers appear across all time periods (Akins 1985:320, 348). This animal is also excluded from Neusius' (2008) list of garden-hunted species but the badger's behavior and ecology is certainly congruous with garden procurement.

*Family Felidae (cats)*

The natural range of *Lynx rufus* (bobcat) extends across much of North American and the species is versatile, inhabiting a variety of montane and lowland biomes (Larivière and Walton 1997:2-4). The author has, on several occasions, observed adult and juvenile bobcats in Chaco Canyon along mesa tops and in the canyon bottom. The ubiquity of the species, which occurs at most Chacoan sites albeit in low numbers, suggests that the species was probably available locally. Research indicates that an expansion of bobcat populations may coincide with clearance of land for placement of agricultural fields (Larivière and Walton 1997:3; Rollings 1945:134). This is not unexpected since their primary prey species include leporids, prairie dogs, and other rodents as well as a wide variety of birds.

Bobcat remains were identified in the Bc 57 assemblage and a single specimen was identified from Bc 58. The twenty-seven specimens classified as bobcat (0.4 percent of overall NISP) distinguishes Bc 57 as yielding one of the highest NISP values observed at sites in Chaco Canyon, exceeded only by the Basketmaker III period site 29SJ 519 (Watson 2011). However, the relative abundance of the species at Bc 57 is comparable to several other Chacoan sites including Pueblo Alto (0.4 percent NISP) and 29SJ 627 (Early Bonito – 0.4 percent NISP, Classic Bonito – 0.6 percent NISP) (Akins 1985:348). Relative abundance of bobcat is lower for the Early Bonito subphase at Bc 57 (0.2 percent NISP) than for Classic and Late Bonito deposits (0.8 percent).

Criteria employed in age determination of bobcat were drawn from Jackson et al. (1988) and Crowe (1975). However, all bobcat specimens for which age could be estimated were determined to be adult. No evidence of either butchery or exposure to heat was visible on any bobcat remains.

The dietary importance of bobcat was likely secondary to its value as a fur-bearer (Akins 1985:343; Hill 2000). Procurement and preparation of an animal for removal of its fur is often completed in stages and a preponderance of head, lower limbs, and toes can be indicative of the final stages of pelt processing (Fairnell and Barrett 2007:465; Trolle-Lassen 1987). Several articulating metacarpals (digits I-IV) representing a largely complete bobcat forepaw, as well as other isolated metacarpals and metatarsals, tarsals, and a distal tibia were recovered from Rooms 7 and 9. In other contexts bobcat phalanges (from Rooms 4 and 7) and mandibles (from Room 8 and Kiva D) were identified. Similarly, as previously noted the crania of a gray fox (Room 4, Bc 57) and kit fox (Room 12, Bc 58) were also identified. To evaluate the possibility that bobcat skeletal representation differs from that of other carnivores including dog, coyote, and gray wolf, a chi-square analysis was performed comparing bobcat skeletal abundance with that of *Canis* sp. at Bc 57 and Bc 58.

As demonstrated in Table 5.17, the results, $\chi^2 = 26.472$ ($p < 0.001$, df = 3), indicate that the difference in skeletal representation between bobcat and *Canis* sp. at Bc 57 is significant. Examination of the adjusted residuals reveals that bobcat lower limbs are indeed significantly overrepresented. Likewise, when comparing bobcat at Bc 57 with *Canis* sp. at Bc 58 (Table 5.18), the chi-square results are significant, $\chi^2 = 11.603$ ($p < 0.01$, df = 3). Once again, bobcat lower limbs are significantly overrepresented at Bc 57 and interestingly axial elements are significantly overrepresented among dogs at Bc 58. Figures 5.14, 5.15, and 5.16 illustrate graphically the observed relative frequency of skeletal elements for bobcat and *Canis* sp. at Bc 57 and Bc 58. These diagrams highlight the greater level of skeletal completeness recorded for *Canis* sp., and underscore the degree to which the representation of bobcat skeletal remains differs from that of other carnivores. One possible explanation is that if, by the Classic/Late Bonito subphase, bobcats had been overhunted in the Chaco area and were instead procured at longer distances, skeletal part representation may have been influenced by transport costs. In contrast if canids were obtained locally, a higher degree of skeletal completeness might be expected.

Alternatively, the gradual accumulation of ritual refuse has the potential to produce a material signature similar to that of a fur procurement strategy (Muir and Driver 2004:132; Walker 1995:90-92). As Muir observed, the repeated processing and handling of ritually important animals at certain loci may produce unintentional deposits associated with ritual (as opposed to those associated with deliberate burials). Thus

Table 5.15: Bc 57 carnivores by provenience.

| Taxon | Provenience | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **R. 1** | **R. 2** | **R. 3** | **R. 4** | **R. 6** | **R. 7** | **R. 8** | **R. 7/8** | **R. 9** | **Kiva D** | **General** | **TOTAL** |
| *Canis latrans* (coyote) | - | - | - | 1 | - | - | - | - | - | - | - | 1 |
| *Canis lupus* (gray wolf) | - | - | - | - | - | - | - | - | 1 | - | - | 1 |
| *Canis* sp. (domestic dog, wolf, or coyote) | 3 | 2 | 1 | 8 | 2 | - | 1 | 1 | 2 | - | - | 20 |
| *Lynx rufus* (bobcat) | - | 1 | 1 | 4 | 1 | 3 | 2 | - | 11 | 1 | 3 | 27 |
| *Taxidea taxus* (American badger) | - | - | - | 1 | - | - | - | - | 1 | - | - | 2 |
| *Urocyon cinereoargenteus* (gray fox) | - | - | - | 1 | - | - | - | - | - | - | - | 1 |
| cf. *Urocyon cinereoargenteus* (gray fox) | - | 1 | - | - | - | - | - | - | - | - | - | 1 |
| **TOTAL** | 3 | 4 | 2 | 15 | 3 | 3 | 3 | 1 | 15 | 1 | 3 | 52 |

Table 5.16: Bc 58 carnivores by provenience.

| Taxon | Provenience | | | | | | |
|---|---|---|---|---|---|---|---|
| | **R. 1** | **R. 4** | **R. 5** | **R. 10** | **R. 12** | **R. 14** | **TOTAL** |
| *Canis* sp. (domestic dog, wolf, or coyote) | 6 | 19 | 14 | - | - | 9 | 48 |
| *Lynx rufus* (bobcat) | - | - | - | 1 | - | - | 1 |
| *Vulpes macrotis* (kit fox) | - | - | - | - | 1 | - | 1 |
| cf. *Vulpes macrotis* (kit fox) | - | - | - | - | 1 | - | 1 |
| **TOTAL** | 6 | 19 | 14 | 1 | 2 | 9 | 51 |

Table 5.17: Chi-square comparison with adjusted residuals of bobcat and Canis sp. NISP by skeletal region at Bc 57. Expected values are shown in parentheses; $\chi^2 = 11.603$ ($p < 0.01$, df = 3). For adjusted residuals, *denotes $p < 0.001$.

| | Species | | | |
|---|---|---|---|---|
| **Skeletal Part** | **Bc 57 - *Lynx rufus* (bobcat)** | **Adjusted Residual** | **Bc 57 - *Canis* sp. (dog, coyote, or wolf)** | **Adjusted Residual** |
| Cranial | 2 (3.31) | -1.144 | 4 (2.69) | 1.144 |
| Axial | 8 (9.92) | -1.143 | 10 (8.08) | 1.143 |
| Upper Limb | 4 (6.06) | -1.419 | 7 (4.94) | 1.419 |
| Lower Limb | 13 (7.71) | 3.361* | 1 (6.29) | -3.361* |

Table 5.18: Chi-square comparison with adjusted residuals of bobcat and Canis sp. NISP by skeletal region at Bc 57. Expected values are shown in parentheses; $\chi^2 = 26.472$ ($p < 0.001$, df = 3). For adjusted residuals, *denotes $p < 0.01$; ** denotes $p < 0.001$.

| | Species/Site | | | |
|---|---|---|---|---|
| **Skeletal Part** | **Bc 57 - *Lynx rufus* (bobcat)** | **Adjusted Residual** | **Bc 58 - *Canis* sp. (dog, coyote, or wolf)** | **Adjusted Residual** |
| Cranial | 2 (5.04) | -1.877 | 12 (8.96) | 1.877 |
| Axial | 8 (13.68) | -2.733* | 30 (24.32) | 2.733* |
| Upper Limb | 4 (3.24) | 0.563 | 5 (5.76) | -0.563 |
| Lower Limb | 13 (5.04) | 4.914** | 1 (8.96) | -4.914** |

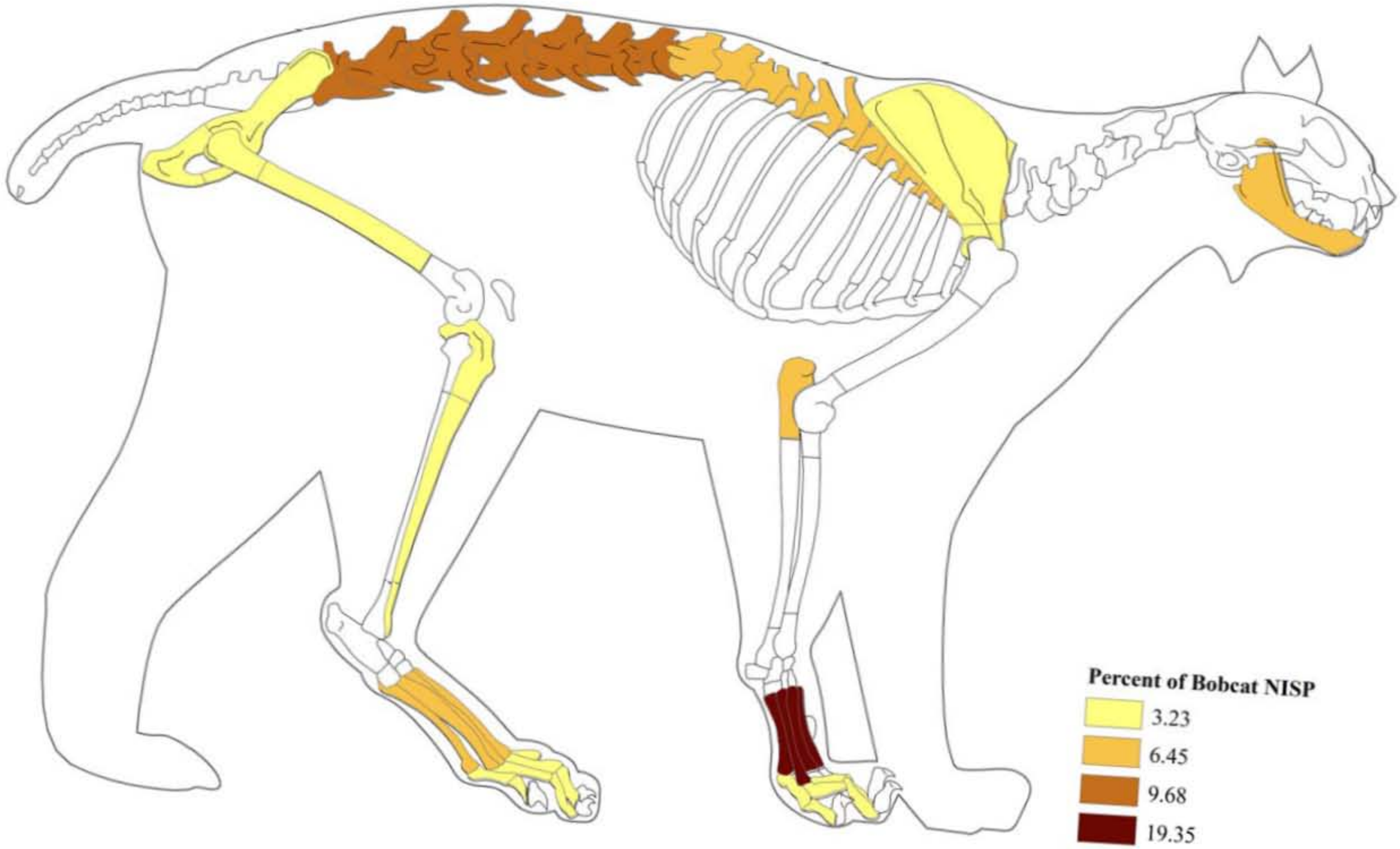



Figure 5.14: Relative abundance of *Lynx rufus* (bobcat) skeletal elements at Bc 57 (% of bobcat NISP); after Yvinec et al. (2007).

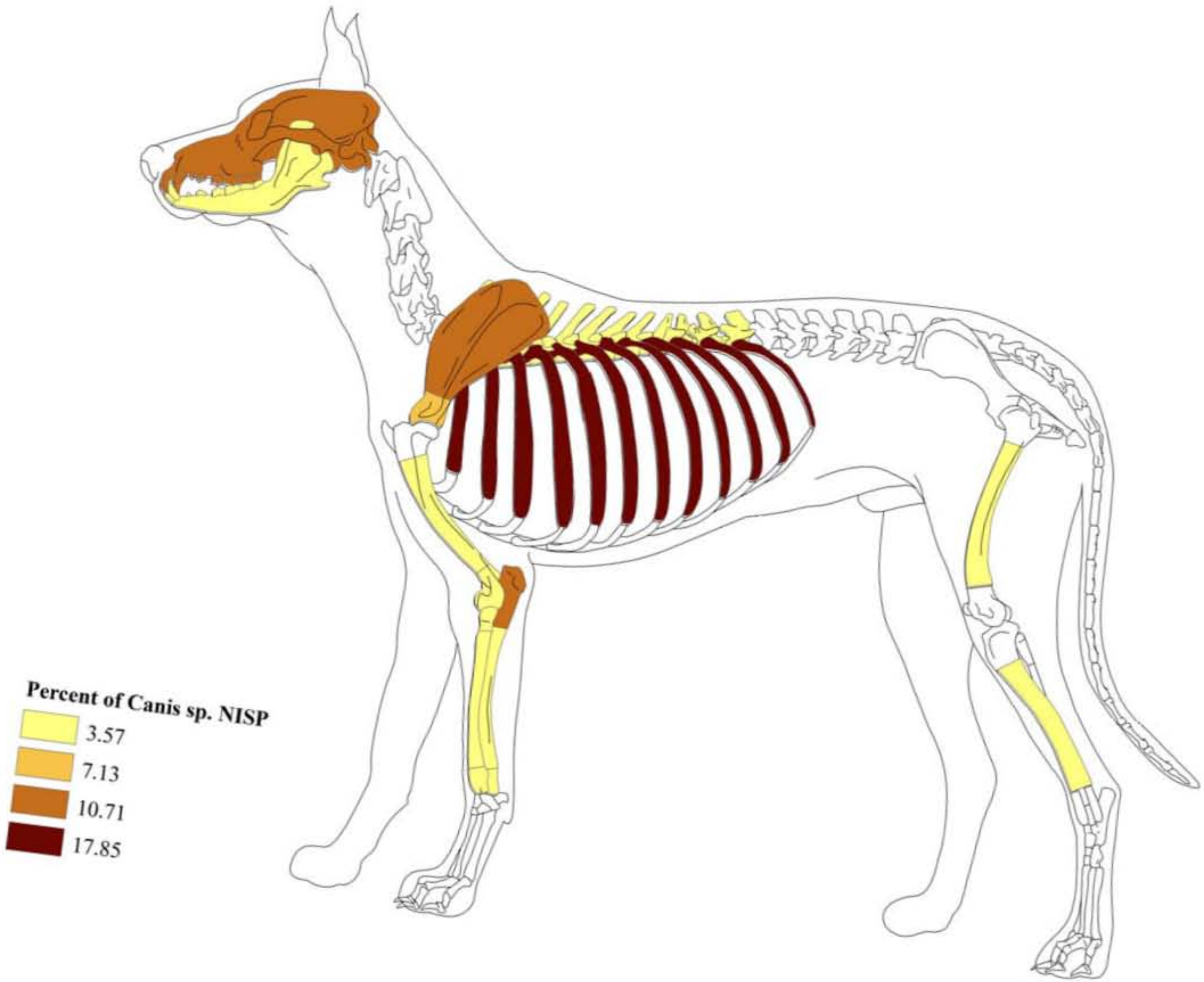



Figure 5.15: Relative abundance of *Canis* sp. (dog, coyote, or wolf) skeletal elements at Bc 57 (% of Canis sp. NISP); after Orton (2010) and Yvinec et al. (2007).

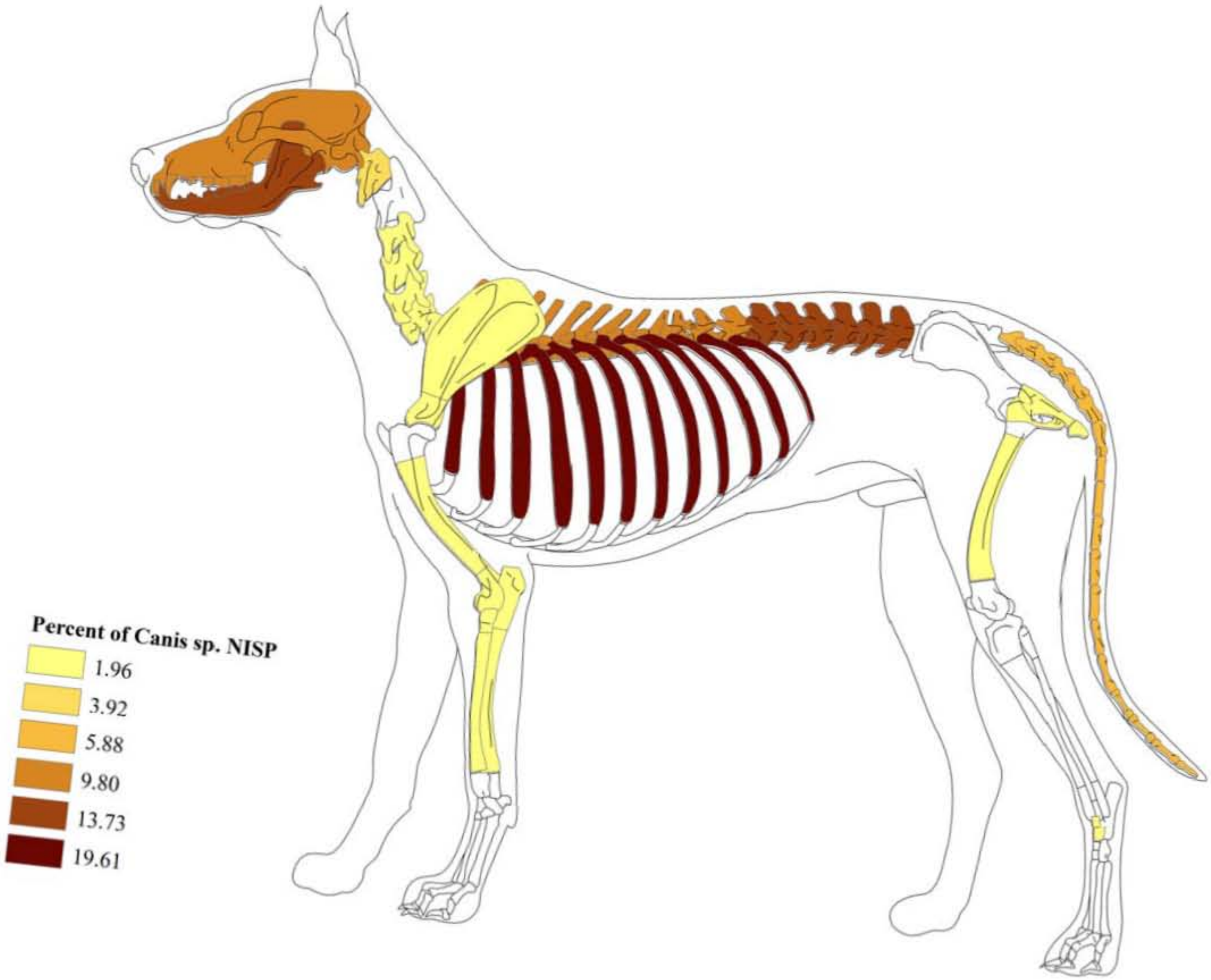



Figure 5.16: Relative abundance of *Canis* sp. (dog, coyote, or wolf) skeletal elements at Bc 58 (% of *Canis* sp. NISP); after Orton (2010) and Yvinec et al. (2007).

"a 'residue' of ritual refuse may gradually accumulate in certain areas, which are common places for storage, manufacturing, or use of ritual paraphernalia" (Muir and Driver 2004:132). Such deposits may contain rare taxa including a variety of carnivore species and wild bird taxa and in the case of the former, hides and claws were most heavily utilized (Hill 1982; Parsons 1925:62, 102). Moreover, such deposits might be expected to contain bone fragments from ritual paraphernalia as well as the discarded waste from bone artifact manufacturing (Muir and Driver 2004:132).

Analogous faunal signatures have been identified elsewhere in Chaco and throughout the broader Pueblo Southwest. Judd (1954:64-65) reported finding "a considerable number of grizzly claws and phalanges, 10 claws of the black bear (*Eurarctos americanus*), and 4 mountain-lion (*Felis concolor*) claws" in the north wall recess of Kiva Q at Pueblo Bonito as well as a grizzly claw from Room 330. Similarly, Pepper (1920:298) reported unearthing the jaw of a "cinnamon bear" and fragments of two claws in Room 92 at Pueblo Bonito. At Sand Canyon Pueblo, Muir (1999:122) interpreted the spatial association of bobcat remains with certain architectural forms as indicative of their ritual importance to the functioning of hunt societies. Finally, a largely similar pattern of bobcat skeletal representation was observed at Grasshopper Pueblo – an abundance of lower limb bones such as astragali and metapodials – that led Olsen (1990:128-129) to conclude that the species' principal value was as raw material for ceremonial and utilitarian objects.

*Order Rodentia*

*Family Cricetidae (New World rats and mice, voles, hamsters, and relatives)*

The remains of at least three bushy-tailed woodrats (*Neotoma cinerea*), also known as the bushy-tailed packrat, were identified at Bc 57 represented by ten specimens. The largest of the woodrat species, it was readily differentiated from other species of the genus on the basis of size. The species' geographic distribution extends across much of western North America, being found most frequently in rugged mountainous or canyon terrain and generally inhabits talus slopes, crevices in cliff faces, or even man-made structures such as mines or Pueblo cliff-dwellings (Smith 1997:4). Both the bushy-tailed woodrat and Stephens' woodrat (*Neotoma stephensi*) are modern residents of Chaco Canyon (Cully 1985:291). Along with the white-throated woodrat (*Neotoma albigula*), all three species have been documented archaeologically in Chaco but *N. cinerea* is by far the most common woodrat recovered in Chacoan assemblages (Akins 1985:318). Rea (1979:10) reported that white-throated packrats frequently nested in abandoned agricultural fields and, along with cotton rats, were trapped by the Pima.

The woodrat specimens include intact cranial elements and exhibit no evidence of butchery or cooking and it is also possible that the remains are non-cultural in origin. At least two specimens (2008.46.09886 and 2008.46.09887) were determined to be juvenile based on epiphyseal fusion stages but the species is known to produce two to three litters per year making it ineffective as a seasonal indicator (Smith 1997:3).

Several *Peromyscus* (mouse) species are canyon residents today, including *Peromyscus crinitus* (canyon mouse), *Peromyscus truei* (pinyon mouse), and *Peromyscus maniculatus* (deer mouse) (Cully 1985:291). Akins observed that numerous articulated skeletons of these species were recovered archaeologically at sites excavated by the Chaco Project (Akins 1985:318). Rather than a reflection of human dietary practices, Akins attributed the presence of mice to their commensal tendency to gravitate toward human habitation sites. No attempt was made to identify postcranial mouse remains beyond the genus level and no diagnostic cranial remains were recovered. At Bc 57, fifteen specimens representing three individuals were identified as *Peromyscus* sp. The unweathered, relatively complete condition of these remains and the absence of any sign of butchery, cooking, or gastric etching strongly suggest that the presence of this species is non-cultural.

*Family Geomyidae (pocket gophers)*

The Botta's pocket gopher (*Thomomys bottae*) is another species commonly included in the list of garden taxa (Neusius 2008:306). The pocket gopher's diet consists of a wide array of seeds, bulbs, tubers, and forage and is frequently encountered in and around cultivated fields (Jones and Baxter 2004:7-8; Moulton et al. 1983:57). Seventeen pocket gopher specimens were identified, representing at least five individuals. Weathering is very slight to non-existent and the remains exhibit no signs of butchery or digestion.

*Family Heteromyidae (kangaroo rats, pocket mice, and relatives)*

Seven specimens of *Dipodomys ordii* (Ord's kangaroo rat) were recovered at Bc 57, representing one at least one individual. The species favors open shrublands, grasslands, and sandy soils conducive to their shallow burrows (Garrison and Best 1990:4). Weathering on the remains is generally non-existent and there is no evidence of burning, cooking, or consumption. Since the kangaroo rat's preferred food includes seeds, along with forbs, grasses, and sedges, it is possible that, like the *Peromyscus* specimens, the species was drawn to seed stores in and around sites of human habitation (Garrison and Best 1990:5). Several limb elements are unfused but, like the woodrat, kangaroo rats have more than one litter per year, thus developmental stages are not useful as seasonal markers.

Two specimens representing at least one individual were identified as *Perognathus flavus* (silky pocket mouse) at Bc 57. This primarily granivorous species inhabits a variety of habitats, preferring loose sandy or loamy soils for burrows (Best and Skupski 1994:4-5). The silky pocket mouse tends to inhabitant grassy areas more frequently than kangaroo rats and has been known to feed on planted grains along the margins of agricultural fields in addition to *Curcurbita*, *Zea mays, Chenopodium*, and *Amaranthus* (Best and Skupski 1994:5-6). Thus it is possible that this species was trapped in agricultural fields or was drawn to prehistoric grain stores at Bc 57. The remains' unweathered condition and lack of evidence of cooking or digestion suggest that the remains are non-cultural in nature.

Overall, the complete lack of small rodents recovered from Bc 58 likely points to recovery bias. In contrast, the presence of such remains along with other remains small, fragile remains like eggshell indicate more careful excavation practices at Bc 57.

*Family Leporidae (hares and rabbits)*

*Sylvilagus audubonii* (desert cottontail) and *Sylvilagus nuttallii* (mountain cottontail) occupy overlapping ranges that include the San Juan Basin of northwest New Mexico while the western extent of *Sylvilagus floridanus* (Eastern cottontail) range includes parts of northwest New Mexico (Chapman 1975:2; Chapman et al. 1980:3;

Chapman and Willner 1978:2). With the exception of subtle differences in cranial morphology, these species are difficult to distinguish on the basis of osteological evidence. Barring the presence of this fragile palatal region, most specimens can seldom be reliably classified beyond genus (Hoffmeister and Lee 1963:508). Ecologically and behaviorally, the three species are quite similar, inhabiting brushy or wooded areas, feeding on a wide range of plants, and tending to stay motionless or quickly seek cover when confronted by a potential predator (Chapman 1975:2-3; Chapman et al. 1980:4-5; Chapman and Willner 1978:2-3).

Tables 5.19 and 5.20 show the spatial distribution of rodents at Bc 57 and Bc 58. At site Bc 57, *Sylvilagus* sp. was identified on the basis of 2,561 elements, representing at least 53 individuals. In addition, 29 specimens (MNI = 22) were identified as *Sylvilagus audubonii*. From the Bc 58 assemblage, 106 specimens (MNI = 9) could be identified as *Sylvilagus* sp. while another two specimens representing at least one individual were identified as *Sylvilagus audubonii*.

*Lepus californicus* (black-tailed jackrabbit) was identified based on 1,728 specimens (MNI = 37) at Bc 57 and 279 specimens (MNI = 11) at Bc 58. The western North American range of this species includes the San Juan Basin and its surrounding uplands (Best 1996:2-3). Like the cottontail, jackrabbits may remain motionless in response to danger, although flight is a common escape reaction (Best 1996:6). Though likely procured opportunistically on a year-round basis (Cushing 1979:310), Pueblos historically hunted local cottontail and jackrabbit populations through cooperative game drives organized in conjunction with communal ritual (Hill 1982; Parsons 1925:94-95; 1936:277-278; Titiev 1944:185, 191).

Table 5.19: Bc 57 rodents by provenience.

| Taxon | Provenience | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **R. 1** | **R. 2** | **R. 3** | **R. 4** | **R. 5** | **R. 6** | **R. 7** | **R. 8** | **R. 7/8** | **R. 9** | **Kiva A** | **Kiva B** | **Kiva C** | **Kiva D** | **Area 10** | **Pit A** | **Burial 1467** | **General** | **TOTAL** |
| *Cynomys gunnisoni* (prairie dog) | 9 | 22 | - | 206 | 5 | 110 | 22 | - | 1 | 191 | 11 | 6 | - | 3 | 16 | 4 | 1 | 1 | 608 |
| *Dipodomys ordii* (Ord's kangaroo rat) | - | - | - | 2 | 1 | - | - | - | - | - | - | - | 4 | - | - | - | - | - | 7 |
| Leporid | 1 | - | | 89 | 1 | 3 | 26 | 19 | 1 | 121 | - | - | 5 | - | 9 | 1 | - | 15 | 291 |
| *Lepus californicus* (black-tailed jackrabbit) | 18 | 44 | 17 | 1136 | 10 | 13 | 77 | 33 | 19 | 259 | 22 | 5 | 14 | 7 | 24 | 9 | - | 21 | 1728 |
| *Neotoma cinerea* (bushy-tailed woodrat) | - | 2 | 2 | - | - | - | - | - | - | 1 | - | - | 5 | - | - | - | - | - | 10 |
| *Perognathus flavus* (silky pocket mouse) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | 2 |
| *Peromyscus* sp. | - | 5 | - | 6 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | 15 |
| Sciuridae (squirrel) | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 2 |
| Small rodent | - | 8 | 2 | 9 | 2 | 2 | - | - | 1 | 14 | 8 | - | - | - | - | - | - | - | 46 |
| *Sylvilagus audubonii* (desert cottontail) | - | - | - | 10 | - | 3 | 3 | 1 | - | 12 | - | - | - | - | - | - | - | - | 29 |
| *Sylvilagus* sp. | 33 | 68 | 24 | 1057 | 52 | 222 | 141 | 12 | 29 | 756 | 41 | 10 | 59 | 2 | 25 | 6 | - | 24 | 2561 |
| *Thomomys bottae* (Botta's pocket gopher) | - | - | - | 12 | 1 | - | - | - | - | 2 | 2 | - | - | - | - | - | - | - | 17 |
| **TOTAL** | 61 | 149 | 45 | 2528 | 76 | 353 | 269 | 65 | 51 | 1356 | 84 | 21 | 87 | 12 | 76 | 21 | 1 | 61 | 5299 |

Table 5.20: Bc 58 rodents by provenience.

| Taxon | Provenience | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **R. 1** | **R. 4** | **R. 5** | **R. 8** | **R. 9** | **R. 10** | **R. 12** | **R. 13** | **R. 14** | **Area 1** | **TOTAL** |
| *Cynomys gunnisoni* (prairie dog) | 12 | 7 | 5 | 3 | - | 53 | 1 | - | - | 8 | 89 |
| Leporid | - | - | - | - | - | 12 | - | - | - | - | 12 |
| *Lepus californicus* (black-tailed jackrabbit) | 52 | 29 | 15 | 4 | 1 | 131 | 16 | - | 14 | 17 | 279 |
| *Sylvilagus audubonii* (desert cottontail) | - | - | - | - | - | - | - | - | - | 2 | 2 |
| *Sylvilagus* sp. | 28 | 3 | 8 | - | 2 | 45 | - | 1 | 12 | 7 | 106 |
| **TOTAL** | 92 | 39 | 28 | 7 | 3 | 241 | 17 | 1 | 26 | 34 | 488 |

*Family Sciuridae (squirrels)*

Gunnison's prairie dog's (*Cynomys gunnisoni*) natural range centers on the "Four Corners" region where Arizona, Utah, Colorado, and New Mexico intersect and are the third most common species recovered archaeologically in Chaco Canyon (Akins 1985:316; Pizzimenti and Hoffmann 1973:1-2). At Bc 57, the species was identified on the basis of 116 specimens, a minimum of thirty-seven individuals and at Bc 58, fifteen specimens (MNI = 6) were identified as *Cynomys*. Similar to the pocket gopher, it is a species commonly associated with garden hunting (Neusius 2008:306). One complete prairie dog skull from Room 2 at Bc 57 (specimen 2008.46.0127) exhibited very clear evidence of skinning cut marks on and around the nasal area.

Since prairie dogs produce only one litter per year and have a relatively brief (one-month) mating season with parturition in late April or early May (Hoogland 1997:174; Pizzimenti and Hoffmann 1973:2), tooth eruption and wear sequences can be utilized to infer season of death. Tooth eruption sequences for black-tailed prairie dogs (*Cynomys ludovicianus*) are better-documented (Cox and Franklin 1990:145; Stockrahm and Seabloom 1990).

Mating periods for both species vary by latitude but research indicates that the Gunnison's general breeding tendencies more closely approximate those of the northernmost populations of black-tailed prairie dogs (Hoogland 1996:3-4; 1997; Hoogland and Hutter 1987:394). Three prairie dog mandibles (two from Rooms 2 and 6 at Bc 57 and one from Room 10 at Bc 58) exhibited permanent fourth premolars erupting and the deciduous premolar nearly ejected. A lower third molar was observed in the tooth crypt for a fourth mandible. For northern populations of black-tailed prairie dog, the permanent mandibular fourth premolar erupts between July 1 and July 20 after which the deciduous tooth is lost and the third molar emerges between June 30 and July 20 (Stockrahm and Seabloom 1990:106). Thus the four prairie dog specimens in question were likely procured sometime between June and August.

Several species of ground squirrel are native to Chaco Canyon today, including *Ammospermophilus leucurus* (antelope ground squirrel) and *Spermophilus variegatus* (rock squirrel) and 492 specimens were attributed to the family Sciuridae. As noted by Akins (1985:315-317), due to overlapping size and morphology of postcranial skeletal elements between prairie dog, ground squirrels, and that of typical arboreal squirrels like *Tamiasciurus hudsonicus* (red squirrel) or *Sciurus aberti* (Abert's squirrel), identification beyond family often is not possible in the case of fragmentary remains (Oaks et al. 1987:1). Rock squirrel, antelope ground squirrel, and Abert's squirrel have all been identified at sites in Chaco and Akins has suggested that the former two species were likely drawn to agricultural fields and therefore possibly trapped opportunistically through garden hunting (Akins 1985:316).

## Summary

The Bc 57 and Bc 58 animal bone assemblages shed light on patterns of faunal procurement and use spanning the Basketmaker III through Pueblo periods within the Bc site cluster and provide an important perspective on trends in dietary and ritual practices in the area known as "Downtown Chaco." The overall frequency of wild bird species (98 specimens) is among the highest recorded for any site in Chaco, great house and small house included, second only to Pueblo Alto, Pueblo Bonito, and site 29SJ 628. Raven remains in particular are more common at Bc 57 than at any other site in Chaco Canyon.

Study of seasonal indicators such as pronghorn and deer mortality and the presence of the rough-legged hawk and juvenile prairie dogs indicate year-round hunting. Pronghorn were taken throughout the late spring, summer and early fall, mule deer in early fall, prairie dogs in summer and the lone rough-legged hawk specimen was likely procured in winter. Mortality profiles associated with hunting of bighorn sheep and mule deer, though limited by small sample size, suggest differing prey capture strategies or herd structures. Hunting of bighorn sheep appears to have emphasized sub-adult and adult individuals yielding a U-shaped age structure common to individually-hunted species and a similar pattern was observed for mule deer at both Bc 57 and Bc 58 during the Classic/Late Bonito subphases. Deer hunting during the Early Bonito subphase produced an L-shaped or catastrophic age structure – a pattern that can result from game drive tactics or may reflect the anthropogenic impact of over-hunting on prey populations.

This analysis identified significant temporal and inter-taxonomic trends that warrant mention. The lack of a discernible change in turkey skeletal part representation through time indicates that the use of turkeys in the vicinity of Bc 57 remained fairly stable through time. The analysis of carnivore remains revealed notable inter-species differences in skeletal part abundance. When compared with *Canis* sp. at both Bc 57 and Bc 58, bobcat remains at Bc 57 exhibit a statistically significant overrepresentation of lower limb bones while cranial and axial elements are underrepresented. In contrast, the dog remains exhibit a greater degree of skeletal completeness and cranial and axial parts actually exceed expected frequencies. The overall pattern may stem from variation in the ways certain carcasses were processed, utilized, and disposed. The bobcat signature is more consistent with the use of the species' pelage and claws, perhaps for ritual or economic purposes. Dogs, on the other hand, may have been more frequently utilized as a dietary resource. An alternative explanation that bobcats and canids were subjected to different transport considerations based on procurement distance cannot be ruled out.

The next chapter investigates taphonomic variation at Bc 57 and Bc 58, including differential fragmentation, carnivore activity, weathering, and the effects of human processing such as butchery, cooking, and consumption.

# CHAPTER 6: TAPHONOMY

This chapter addresses the taphonomy and fragmentation of remains at Bc 57 and Bc 58 and the implications for food production strategies. From the moment a creature dies to the time its skeletal remains arrive at a zooarchaeologist's laboratory, the bones may be exposed to a range of taphonomic agents that include weathering, trampling, fluvial effects, abrasion, human processing activities, carnivore ravaging, and deterioration of bone from soil acids, all of which impact skeletal completeness and level of preservation (Behrensmeyer 1975; 1978; Binford 1978; Brain 1981; Lyman 1994). For an analyst to accurately determine the degree to which human behavior affected a faunal assemblage, accurate evaluation of the non-human taphonomic factors is crucial.

As illustrated in Chapter Four, the patterns of material remains recovered from Bc 57 and Bc 58 were shaped by multiple, complex depositional pathways. The question of spatial and temporal variability in fragmentation, weathering, and human processing thus is central. For instance, consistency of taphonomic signatures across contexts may signal similar depositional patterns. By first ascertaining the impact of non-human taphonomic factors on fragmentation levels one may then begin to address variability in human processing. Human culinary decisions, that is cooking methods, butchery pattern, marrow extraction, and potential grease production may vary temporally and spatially by taxon or as a function of nutritional stresses and cultural preferences (Wandsnider 1997:13).

The use of bones by humans as raw material for tools and ornaments is another factor with the potential to bias the preservation and skeletal element frequencies. Chaco Canyon's prolific bone tool industry thrived from Basketmaker III through Pueblo III and as will be discussed in Chapter Seven, although raw material preferences and manufacturing methods fluctuated through time. In cases where it can be shown that particular elements were preferentially selected for use as raw material Lyman (1994:347-350) advised that the *entire* class of elements be excluded from analysis. As will be demonstrated in Chapter Eight some elements were indeed a favored raw material but exclusion of an entire class of elements was deemed an overly extreme solution, sacrificing important skeletal frequency data. Curation of tools by a site's inhabitants could also have the effect of inflating skeletal-part frequencies. Moreover, due to the vagaries of mid-twentieth century excavation and curation practices, bone tools and ornaments were separated from the bulk faunal collections and in some cases dissociated from specific provenience information. Therefore worked bone was excluded from analysis of skeletal part survivorship to avoid potential distortion of skeletal element counts.

## Methods

This section presents the methods employed to determine the impact of taphonomic forces on the Bc 57 and Bc 58 assemblages. The analysis will assess the effects of weathering, carnivore ravaging, fragmentation (human-induced or otherwise), as well as activities related to human culinary processing. The latter includes cooking techniques, bone breakage for the removal of marrow and/or grease extraction, and the various stages of butchery such as dismemberment, filleting, and skinning for hide removal. Following a review of the investigative approaches the results of the analysis will be discussed.

### *Weathering*

The extent to which specimens have been exposed to general forces of natural weathering provides valuable information regarding the depositional history of the contexts and the assemblage and was recorded on a six-point scale following Behrensmeyer (1978) and Johnson (1985); the criteria are outline in Table 6.1.

Table 6.1: Weathering stages after Behrensmeyer (1978) and Johnson (1985).

| Weathering Stage | | Description |
|---|---|---|
| 0 | Unweathered | Greasy, no cracking or flaking, perhaps with skin or ligament/soft tissue attached (marrow edible, bone still moist) |
| 1 | Very slight weathering | Cracking parallel to fiber structure (longitudinal); articular surfaces perhaps with mosaic cracking of covering tissue and bone (split lines begin to form, low moisture, marrow sours and is inedible) |
| 2 | Slight weathering | Flaking of outer surface (exfoliation), cracks are present, crack edge is angular |
| 3 | Moderate weathering | Rough homogeneously altered compact bone resulting in fibrous texture; weathering penetrates 1-1.5mm maximum; crack edges are rounded |
| 4 | Heavy weathering | Coarsely fibrous and rough surface with weathering penetrating inner cavities; open cracks |
| 5 | Very heavy weathering | Bone falling apart in situ, large splinters present, bone material very fragile |

### *Assessing Fragmentation*

Fragmentation patterns offer vital insight into the processing and depositional histories of faunal assemblages. Bones broken while fresh, display distinct traits such as curved or helical fracture outlines, oblique fracture angles relative to the cortical bone surface, and often display the effects of human culinary processing techniques like cut marks or percussion marks. Extraction of marrow by humans and carnivores has long been recognized as a source of pre-depositional fragmentation (Blumenschine and

Madrigal 1993; Outram and Rowley-Conwy 1998). Particularly severe pre-depositional fragmentation may also reflect attempts by humans to render grease from bone fragments.

Pre-depositional fragmentation cannot always be directly linked to human behavior (Kent 1981; Lyman 2002:364); scavenging of discarded faunal remains by carnivores is often a principal factor influencing fragmentation rates and skeletal part representation. Numerous studies have addressed the impact of carnivore scavenging on differential survivorship and transport of skeletal elements (Bunn et al. 1986; Grayson 1989; Sutcliffe 1970). Experiments by Marean and colleagues (Blumenschine and Marean 1993; Lyman 2002; Marean and Spencer 1991; Marean et al. 1992) have demonstrated that among assemblages exposed to carnivore ravaging, long bone shaft fragments preserve nearly 100 percent of the time, while axial elements and greasy long bone epiphyses are preferentially destroyed. As noted in Chapter Five, domestic dogs, coyote, and multiple species of fox lived among or near sites Bc 57 and Bc 58 and the possibility exists that the observed faunal patterning has been biased by carnivore ravaging. The extent of carnivore activity is measured by observing the frequency of carnivore gnawing.

Post-depositional bone breakage, due to trampling, exposure to wind, water, and sun, and even secondary and tertiary deposition patterns by humans, commonly results in notably different patterns such as longitudinal and transverse fractures (Fiorillo 1989; Outram 2001; 2002; Outram et al. 2005; Villa and Mahieu 1991).

One independent determinant of how individual skeletal elements weather the onslaught of attritional forces is its structural density measured here in $g/cm^3$. Since

Guthrie's (1967) seminal study, numerous researchers have addressed the relationship between bone density and differential survivorship (Behrensmeyer 1975; Binford and Bertram 1977; Lyman 1994:234-258; Voorhies 1969). As explained in more detail below, by exploring the relationship between bone survivorship and density, one can begin to understand the factors that shaped a faunal assemblage.

However, the problem is complicated by the possibility of differential transport. If human transport decisions resulted in only the denser parts being deposited at the site in question then one is faced with an instance of equifinality. How then is one to differentiate such a pattern from density-mediated destruction? The solution, discussed in greater detail below, is to examine the relationship between bone survivorship and both bone mineral density and the economic utility of the skeletal elements present.

Table 6.2: General fragmentation classification scheme.

| | |
|---|---|
| 1 | Whole |
| 2 | Pre-depositional |
| 3 | ?Pre-depositional |
| 4 | Postdepositional |
| 5 | ?Postdepositional |
| 6 | Modern |
| 7 | ?Modern |
| 8 | Mostly pre-depositional, some recent |
| 9 | Mostly recent, some pre-depositional |

Table 6.3: Fragmentation after (Villa and Mahieu 1991).

| Fracture Angle | Fracture Outline | Fresh Break |
|---|---|---|
| Oblique | Curved | Yes |
| Right | Transverse | No |
| Oblique/Right | V-Shaped | Indeterminate |
| Indeterminate | Transverse/Curved | |
| Unbroken | Indeterminate | |

Thus the nature of fragmentation, whether pre-depositional, post-depositional, or modern in origin, is a separate though not wholly unrelated question from differential survivorship and measurement of the each requires different approaches. The fragmentation of any skeletal element was first assigned to one of the nine fragmentation categories listed in Table 6.2. This subjective assessment was then quantified using the criteria set forth by Assefa (2002) and Villa and Mahieu (1991) outlined in Table 6.3. Focused on fracture outline, fracture angle, and shaft circumference, this approach was applied to all long bone fragments regardless of species to differentiate green (fresh) fractures from dry bone fractures. High rates of fresh bone breakage reflect human or carnivore activity while a high rate of dry bone fractures indicates post-depositional breakage from trampling and weathering.

Table 6.4: Relationship between NISP and MNE in assemblages Bc 57, Bc 58, and 29SJ 627.

| Assemblage | Relationship | $r^2$ | *p* |
|---|---|---|---|
| Bc 57 Early Bonito pronghorn | y = 0.468x + 0.120 | 0.43 | 0.0210 |
| Bc 57 Early Bonito deer | y = 0.295x + 0.223 | 0.26 | 0.0730 |
| Bc 57 Classic Bonito pronghorn | y = 0.453x + 0.261 | 0.39 | 0.0060 |
| Bc 57 Classic Bonito deer | y = 0.363x + 0.295 | 0.54 | 0.0110 |
| Bc 57 Late Bonito pronghorn | y = 0.453x + 0.261 | 0.39 | 0.0060 |
| Bc 57 Late Bonito deer | y = 0.363x + 0.295 | 0.36 | 0.0160 |
| Bc 58 Classic Bonito deer | y = 0.624x - 0.040 | 0.58 | 0.0800 |
| 29SJ 627 pronghorn | y = 0.724x + 0.090 | 0.54 | 0.0610 |
| 29SJ 627 deer | y = 0.768x + 0.047 | 0.44 | 0.0040 |

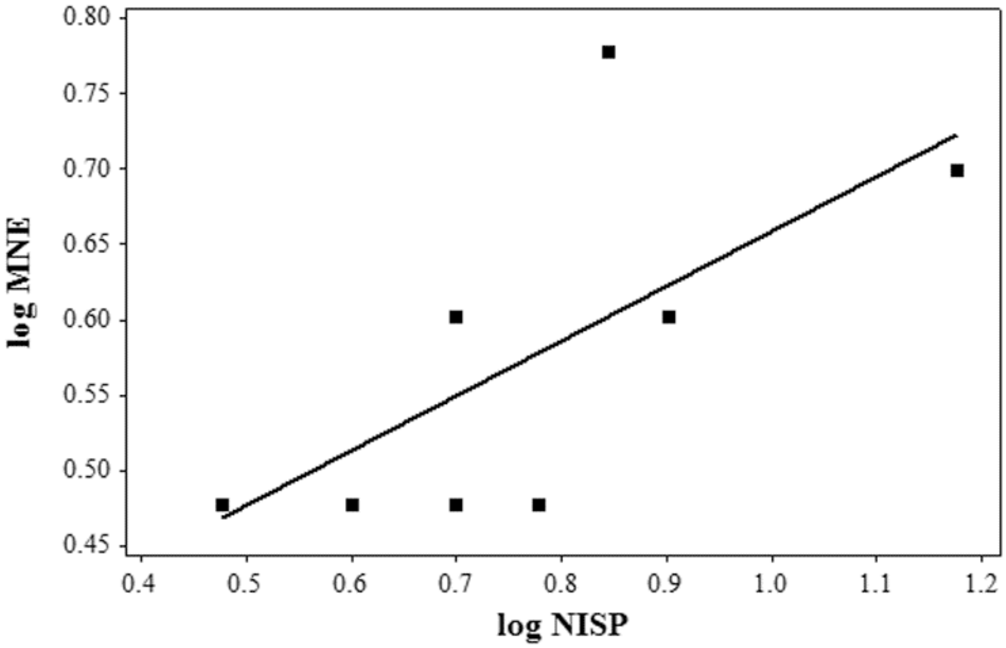



Figure 6.1: Relationship between NISP and MNE for deer remains in the Early Bonito assemblage from Bc 57.

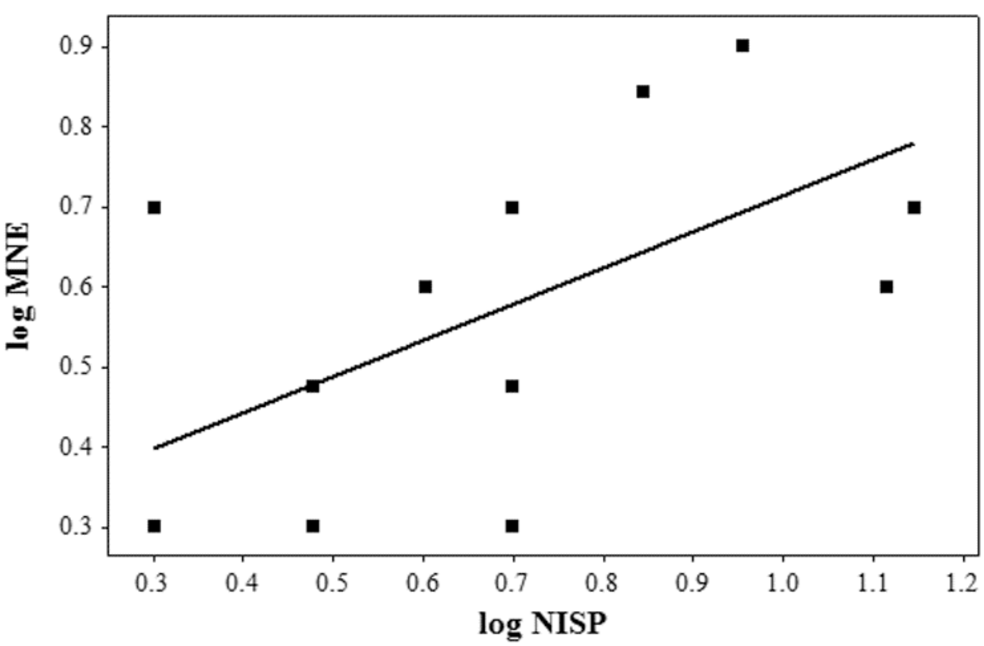



Figure 6.2: Relationship between NISP and MNE for pronghorn remains in the Classic Bonito assemblage from Bc 57.

$$\%Survivorship_i = \frac{MNE_i \times 100}{(MNI \times \text{number of times } i \text{ occurs in one skeleton})}$$

where:

*i* = skeletal portion at scan site
MNE = Minimum number of elements
MNI = Minimum number of individuals represented for a given a species in the assemblage

Equation 6.1: Calculation of %Survivorship after Brain (1969; 1976).

Variation in fragmentation by skeletal element is then assessed by examining the relationship between differential survivorship and bone density (Lam et al. 1999; Lam et al. 2003; Lyman 1994). MAU, %MAU and the measure from which they are derived (MNE) are commonly utilized to assess skeletal element abundance (Assefa 2002; Binford 1984b; Stiner 1994; Sunseri 2009). The utility of the indices lies in the ease of quantifying relative abundance of carcass parts that can then be compared with bone mineral density and relative nutritional values. While NISP and MNI can be heavily biased by differential fragmentation, MNE can also be employed to mitigate the potential influence of density-mediated destruction, especially when calculated on the basis of specific skeletal landmarks (Marean and Frey 1997:704). As derived indices, these measures have some inherent problems such as susceptibility to the effects of sample size and aggregation (Lyman 2008:248, 262). However, NISP and MNE often exhibit a strong positive correlation (Grayson and Frey 2004) and when it can be demonstrated that this is the case for a particular assemblage the former is preferable as a measure of skeletal abundance. As shown in Table 6.4 and Figures 6.1 and 6.2, in the assemblages from Bc 57, Bc 58, 29SJ 627, and 29SJ 629, NISP and MNE are positively and significantly correlated but in only three cases does the coefficient of determination exceed 0.5. Given the modest correspondence between the two measures in this case, I elected to utilize %MAU and the mathematically equivalent measure, %Survivorship, to assess the relationship between skeletal part survivorship, bone mineral density and utility indices while standardized number of identified specimens (NNISP) is employed to graphically evaluate skeletal part frequencies.

As noted above, variation in bone's intrinsic physical properties is one potential factor influencing survivorship. Bone mineral density (BMD) that varies not only by element but by taxon (Yeshurun et al. 2007) has the potential to bias the fragmentation rates within an assemblage. Therefore differential survivorship is examined for all three artiodactyl species encountered at Bc 57 and Bc 58 as well as jackrabbit. Bone density calculations were originally compiled for ungulate species by Lyman (1984) and Kreutzer (1992) and were obtained using photon densitometry at a series of scan sites for various skeletal elements across a range of taxa (Lyman 1994:240-248). Specific scan sites or the part of a bone measured by the photon were selected to provide an adequate assessment of structural variation within a given bone. Scan sites were associated with readily definable skeletal landmarks, and consisted of anatomical parts commonly found archaeologically (Lyman 1984:272-273). Subsequent research by Lam et al. (1998) determined that photon densitometry consistently overestimated cross-sectional area and thus tended to underestimate the density of long bones, especially mid-shaft shafts. Computed tomography (CT) was found to produce more accurate estimates of bone density and the calculations reported by Lam et al. (1999) are utilized here.

Tallies are recorded for each skeletal part for which density estimates are available. Since multiple individuals are often present within an assemblage and skeletal elements are represented in varying numbers in a given individual (e.g., one atlas, two humeri, thirteen thoracic vertebrae, twenty-six ribs, etc.), counts must be standardized accordingly. Following Brain (1969:18; 1976:109) and Lyman (1994:239) this standardization, often referred to as %Survivorship, is calculated as shown in Equation 6.1. The relationship between %Survivorship and bone mineral density is then evaluated. Even within species, structural density varies widely as a function of nutritive status, age, and sex and density values should be considered at best ordinal scale. Thus the relationship between these variables is assessed on the basis of Spearman's rank-order correlation (Lyman 1994:110, 252; 2008:222-229).

BMD values for caribou (*Rangifer tarandus*) were employed since, as demonstrated by Lam et al. (1999:355), BMD exhibits a high degree of correlation among all artiodactyl species. For jackrabbit, the shape-adjusted volume density estimates ($VD_{SA}$) provided by Pavao and Stahl (1999) were employed. Following Lam and Pearson (2004), null values were excluded from analysis due to the possibility that element absence could stem from either attrition or selective transport.

As an alternative means of evaluating the intensity of human processing, an assessment of relative completeness of compact bones (i.e. tarsals and first, second, and third phalanges) was employed following Munro and Bar-Oz (2005) and Bar-Oz and Munro (2007). The first and second phalanges as well as the calcaneus contain limited amounts of marrow while the astragalus and third phalanx contain no marrow (Bar-Oz and Munro 2007:952; Munro and Bar-Oz 2005:232). Since these compact elements require significant effort to extract marrow, a comparison of fragmentation rates illustrates the relative intensity of processing. Completeness (COMP) is measured as the frequency of whole bones relative to each element's MNE. Bones were considered complete when at least 90% of its original mass was intact.

As discussed above, correlation between survivorship and bone density alone is not sufficient to identify the likely factors shaping a faunal assemblage. An attempt must be made to determine the role of human behavior. In modeling human transport and utilization of carcasses, Binford (1978:72-81) introduced the general utility index (GUI) and modified general utility index (MGUI). GUI is an estimation of the relative usefulness of skeletal parts in terms of the meat, marrow, and grease associated. MGUI then takes into account that butchery is not always an exact reflection of utility but rather may include lower-utility skeletal parts or "riders" that remain attached to the high utility elements and as a result are transported from the kill-site. A measure of skeletal element frequency, referred to as %MAU, is essentially the same as %Survivorship and is plotted against the normed MGUI (%MGUI) to determine the extent to which skeletal part representation reflects human economic decisions. Again the relationship between these variables is measured by Spearman's rank-order correlation.

If indeed skeletal part frequencies are correlated with human dietary decisions, then it follows that archaeological patterning should reflect either an emphasis on meat-rich parts or preferential fragmentation of elements rich in marrow and/or grease. If carcass transport and processing was focused on meat procurement then element representation (%MAU) in the faunal assemblages from Bc 57 and Bc 58 should exhibit a significant positive correlation with Binford's (1978) estimated meat utility index (weight

Table 6.5: Criteria employed in assessment of burning after Buikstra and Swegel (1989).

| Surface Color | Cross-Section Color | Shallow web of cracks on head/neck | Transverse Splitting | Curved Cracks | Exfoliation | Concentric Rings on Popliteal Area | Longitudinal Shaft Fissures | Overall Burning Stage | Overall Color of Bone |
|---|---|---|---|---|---|---|---|---|---|
| Uniformly Smoked | Uniformly Smoked | Deep and More Common | Deep and More Common | Present but Very Rare | Less Common | Present | Deep/Long | Not Burned | Black |
| Heavily but Unevenly Smoked | Heavily but Unevenly Smoked | Deep and Less Common | Deep and Less Common | Present but Rare | More Common | Not Present | Shallow/Long | <0.5 Carbonized | Dark Brown |
| Sparsely Smoked | Sparsely Smoked | Shallow and Infrequent | Shallow and Infrequent | | Not present | | Not Present | >0.5 Carbonized | Brown |
| Heavily Smoked w/some Calcination | Heavily Smoked w/some Calcination | Not Present | Not Present | | | | | Fully Carbonized | Light Brown |
| Calcined (white) | Calcined (white) | | | | | | | <0.5 Calcined | Beige |
| Calcined (grey) | Calcined (grey) | | | | | | | >0.5 Calcined | Yellow |
| Calcined (blue) | Calcined (blue) | | | | | | | Fully Calcined (white/grey) | Grey |
| Light brown/tan | | | | | | | | Mostly Carbonized, some calcined | White |
| | | | | | | | | Mostly Calcined, some carbonized | Indeterminate |
| | | | | | | | | | Black/Grey |

of fat and muscle tissue). If differential processing of high marrow-yield carcass parts occurred, then the element distribution would be expected to exhibit significant positive correlation with marrow utility (marrow cavity volume multiplied by the percentage of fatty acids present in the marrow). Finally, if carcasses were heavily processed for bone grease, then skeletal frequencies are expected to exhibit a positive correlation with grease utility estimates (volume of skeletal part for cancellous parts multiplied by the percentage of fatty acids present in the marrow).

### ***Culinary Processing***

Wandsnider's (1997:13) survey of thermal processing techniques illustrates substantial cultural diversity in food preparation. Within a given culture, it is not unusual for a single species to be cooked using varied methods. The Tarahumara are known to prepare rabbit either by boiling or by roasting over coals. Among historic-period pueblos including Zia, Zuni, Jemez, and Hopi, rabbit and deer meat was commonly boiled, stewed, or roasted (Castetter 1935:16, 34, 38, 43; Parsons 1925:95), while deer was commonly roasted at Acoma and Laguna (Castetter 1935:31; White 1962:301-303). Removal of meat that was then dried and stored for later use was also likely a widespread practice (White 1962:303). Many of these culinary techniques such as roasting, butchery, marrow extraction, and grease rendering have readily identifiable archaeological signatures and a range of observations were recorded in an effort to detect such practices.

#### *Heat Exposure*

The level of exposure to heat sources, whether through cooking or incidental introduction of bone fragments to hearth deposits results in distinct patterns of coloration and changes in texture which in turn can yield insight into cooking and processing practices. For instance, during the process of roasting, meat attached to skeletal parts tends to shield underlying cortical bone from direct heat exposure while the exposed bone surface may be burned to varying degrees. The result is a mottled bone surface in which some areas altogether lack evidence of burning and other regions such as the articular ends may exhibit “smoking” or carbonization. Alternatively, if bone was dropped or discarded into a hearth, the expectation is that the specimen would exhibit carbonization or calcination (white, gray, or blue) over its entirety. An array of burning criteria, depicted in Table 6.5, was recorded following Buikstra and Swegel (1989).

Heat-altered bone fractures have been known to form clean, sharp-edged breaks not unlike that of fresh bone (Binford 1963; Spenneman 1989:53; Thurman and Willmore 1981:281). Thus the frequency of carbonized and calcined bone is taken into consideration when assessing fragmentation.

*Butchery*

During faunal procurement the degree to which a carcass is butchered is often though not always a function of transport costs. Typically small carcasses such as those of jackrabbits or cottontails are transported whole while those of large mammals such as deer, bighorn sheep, and pronghorn antelope are reduced to more manageable pieces. From this initial butchery stage, the carcass is processed in a series of subsequent steps that may include secondary butchery (i.e., additional dismemberment and filleting for redistributive purposes), cooking, and finally consumption. Dismemberment cut marks are often seen in the form of chops and deep cuts located around limb joints or along the vertebral column. Filleting cut marks for removal of meat tend to be more fine and are distinguishable from dismemberment cut marks (Binford 1984a:127). Cut marks associated with skinning might also be expected on the lower limbs (Fairnell and Barrett 2007; Lapham 2002; Trolle-Lassen 1987).

As an example, Guilday et al. (1962) in a pioneering study inferred a hypothetical sequence of butchery based on patterns observed at the historic period Susquehannock Eschelman site (1600-1625 CE). Their description offers a close parallel to the account of butchery practices at Zia pueblo discussed in Chapter Four (White 1962). Preparation began with the skinning of the carcass down to its dew claws, where the hide was then cut from the legs. The hide was also cut away from the head and around the antlers. Next, the body was dismembered, the limbs being removed from the shoulder and hip girdles. Forelimbs were separated at the elbow, followed by the wrist. The deer carcass was split down the breastbone facilitating the removal of major organs, at which point it was separated into three sections, the head and neck, the rib cage, and the loin. Brains were removed by splitting the skull into right and left halves, the antlers were hacked off, and all limb bones were broken for access to the marrow cavities (Guilday et al. 1962:77).

In an effort to quantify butchery, the location and frequency of cut marks were documented wherever possible. Discrete, non-adjacent (> 1 cm apart) cut marks were tallied while tightly grouped clusters of parallel cut marks were counted as a single instance of butchery.

*Marrow Extraction*

Mammals store fat subcutaneously, within muscle tissue and the kidneys, and in the medullary cavities of bones and they draw on these reserves during times of nutritional stress (Adams 2003; Bender et al. 2007; Mech 2007; Taillon et al. 2006). The marrow cavities tend to be last stores tapped by an animal during lean times and thus are a valuable and reliable resource for humans. The nutrient-rich marrow cavities of long bones, phalanges, and mandible are accessed by percussion. An intact limb is placed on an anvil and a hammerstone was then used to smash the diaphysis or long bone shaft, resulting in shattered shaft fragments, a percussion mark at the point of impact, and a characteristic "rebound scar" on the portion of the long bone shaft that lay directly atop the anvil. Archaeologically, marrow extraction can be identified by the presence of such shaft splinters and percussion marks (Villa and Mahieu 1991:43, 45). Again, the relative intensity of human-induced fragmentation can be measured through examination of the completeness of compact bones (Bar-Oz and Munro 2007; Lyman 1994:333-335; Munro and Bar-Oz 2005; Wolverton 2002). Finally, exploration of possible correlations between bone survivorship and marrow utility indices may reveal the presence or absence of a marrow-focused processing strategy (Madrigal and Holt 2002; Munro and Bar-Oz 2005).

*Grease Rendering*

Since Leechman (1951) first suggested bone grease production as a potential cause of heavy fragmentation, its reflection in the archaeological record has frequently been the subject of study (Binford 1978; Brink 1997; Church and Lyman 2003; Jordan and Watson 2005; Lupo and Schmitt 1997; Madrigal and Capaldo 1999; Madrigal and Holt 2002; Munro and Bar-Oz 2005; Outram 1999; 2001; Prince 2007; Speth and Spielmann 1983; Watson and Thomas n.d.; Zierhut 1967). Furthermore, many archaeologists commonly associate grease extraction with nutritional stress (Junker-Andersen 1986; Outram 2001; Socci 1995:203; Speth 1990; Spiess 1988; Vehik 1977).

Vehik (1977) stressed the importance of bone grease as a nutritional resource particularly during lean times, citing its durability since it may be stored for up to three years. During his time among the Nunamiut, Binford (1978) observed the process of bone grease production. Grease was extracted from cancellous or spongy parts of fractured long bones and through the comminution of axial elements and the articular ends of appendicular bones. When a suitable quantity of cancellous bone had been accumulated the material was simmered and the fat that floated to the surface was skimmed and stored (Binford 1978:153-155). Beyond its caloric value, the utility of bone fat has also been shown to contain trace amounts of essential vitamins and minerals (Church and Lyman 2003:1082; Vehik 1977:172). Archaeologically, the correlates of grease production often include deposits rich in long bone shaft splinters and comminuted cancellous bone coupled with high quantities of fire-cracked rock surrounding hearth areas (Binford 1978:153).

Although one criterion conventionally used to detect the production of bone grease is the presence of highly fragmented faunal assemblages, research has shown that reduction of bone fragments beyond 5 cm in length provides only a negligible increase in efficiency of extraction of within-bone nutrients (Church and Lyman 2003). A potential correlation between bone survivorship and grease utility indices may signal the relative importance of grease production.

While pot polish has been documented in assemblages where bone fragments have been subjected to prolonged boiling or simmering (Hurlbut 2000; Turner 1999; White 1992), no attempt was made during this analysis to determine its presence or absence.

## Results

### *Weathering*

Weathering at Bc 57 was low – 98 percent of faunal remains were classified as unweathered or very slightly weathered, approximately 2 percent exhibited slight weathering, and another 0.13 percent could be characterized has having moderate or heavy weathering (see Figure 6.3). Bc 58 exhibited somewhat higher levels of weathering with 80 percent of remains classified as unweathered or very slightly weathered, 15 percent with slight weathering, 5 percent with moderate weathering, and 0.5 percent with heavy weathering.

### *Carnivore Ravaging, Fragmentation, and Culinary Processing*

As noted in Chapter Five, the presence of small rodents along with other small, fragile remains such as eggshell suggests the careful excavation of Bc 57 while the complete lack of such remains from Bc 58 points to less thorough recovery practices. Therefore the possibility that smaller bone fragments are absent due to recovery bias indicates that interpretations of fragmentation patterns within the latter assemblage should be approached with caution.

Tables 6.6 and 6.7 depict the rate of carnivore gnawing and gastric etching by time period at Bc 57 and Bc 58. The overall rate of carnivore gnawing is relatively low in both the Bc 57 (1.95 percent) and Bc 58 (1.82 percent) assemblages, slightly higher than that observed at Pueblo Alto (0.2 percent) and Una Vida (0.3 percent), but comparable to that of 29SJ 627 (1.3 percent). By comparison the Basketmaker III site Shabik'eshchee Village exhibited a rather high rate of carnivore ravaging, at 5 percent

(Akins 1987b:507). Carnivore activity appears to have been somewhat greater among the Early Bonito assemblage at Bc 57 and gradually declined over the course of time.

Gastric etching was detected among 0.9 percent and 2.2 percent of specimens from Bc 57 and Bc 58 respectively. Of these, small mammals accounted for the majority (61 percent at Bc 57 and 57 percent at Bc 58) of remains exhibiting gastric etching. By comparison, evidence of gastric etching at Alto ranged from 0.9 to 17 percent of faunal remains depending on the spatial context and similarly tended to be most common among small mammal remains, which accounted for 85 percent of digested specimens (Akins 1987b:507-508). It is unclear whether the occurrence of digested remains reflects human or carnivore activity but the relative lack of carnivore gnawing and the domestic association of the remains points to consumption by humans. Evidence of rodent gnawing was very low at 0.3 percent within the Bc 57 assemblage and completely absent among the Bc 58 faunal remains.

Since carnivore ravaging can be ruled out as a major source of fragmentation at both Bc 57 and Bc 58, fragmentation can therefore be attributed to either human processing or other sources of post-depositional attrition. Figures 6.3 and 6.4 illustrate the remarkable consistency between the two assemblages in terms of the types of fragmentation. For both sites about 20 percent of fragmentation is pre-depositional in nature, that is exhibiting fracture characteristics consistent with the breakage of fresh, green bone at or near the time of deposition. Approximately 50 percent of the assemblage exhibits at least some evidence of modern breakage, the likely result of recovery processes and curation conditions. However, the degree of modern breakage is

Table 6.6: Percentage of remains from Bc 57 exhibiting signs of carnivore gnawing and gastric etching.

| Time Period | % Carnivore Gnawing | % Gastric Etching |
|---|---|---|
| Early Bonito | 1.00 | 0.56 |
| Classic Bonito | 0.62 | 0.22 |
| Late Bonito | 0.32 | 0.17 |
| Total | 1.95 | 0.94 |

Table 6.7: Percentage of remains from Bc 58 exhibiting signs of carnivore gnawing and gastric etching.

| Time Period | % Carnivore Gnawing | % Gastric Etching |
|---|---|---|
| Classic Bonito | 1.82 | 2.21 |

Table 6.8: Fracture angle and outline of large mammal limb bones at Bc 57 and Bc 58.

| Site | Time Period | **Fracture Angle** | | | | **Fracture Outline** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **(Fresh) Oblique** | | **(Dry) Right** | | **(Fresh) Curved** | | **V-Shaped** | | **(Dry) Transverse** | |
| | | N | % | n | % | n | % | n | % | n | % |
| Bc 57 | Early Bonito | 172 | 84.73 | 31 | 15.27 | 163 | 80.30 | 10 | 4.93 | 33 | 16.26 |
| | Classic Bonito | 125 | 62.50 | 75.00 | 37.50 | 127 | 63.50 | 0 | 0.00 | 71 | 35.50 |
| | Late Bonito | 105 | 73.43 | 38.00 | 26.57 | 106 | 74.13 | 1 | 0.70 | 25 | 17.48 |
| Bc 58 | Classic Bonito | 27 | 71.05 | 11.00 | 28.95 | 26 | 74.29 | 0 | 0.00 | 9 | 25.71 |

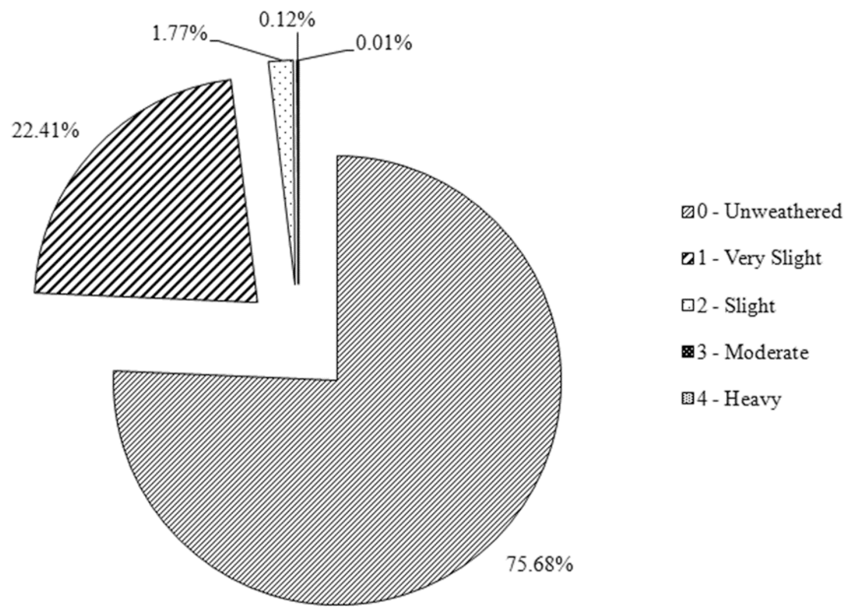



Figure 6.3: Weathering stages observed on faunal remains from Bc 57 (following (Behrensmeyer 1978).

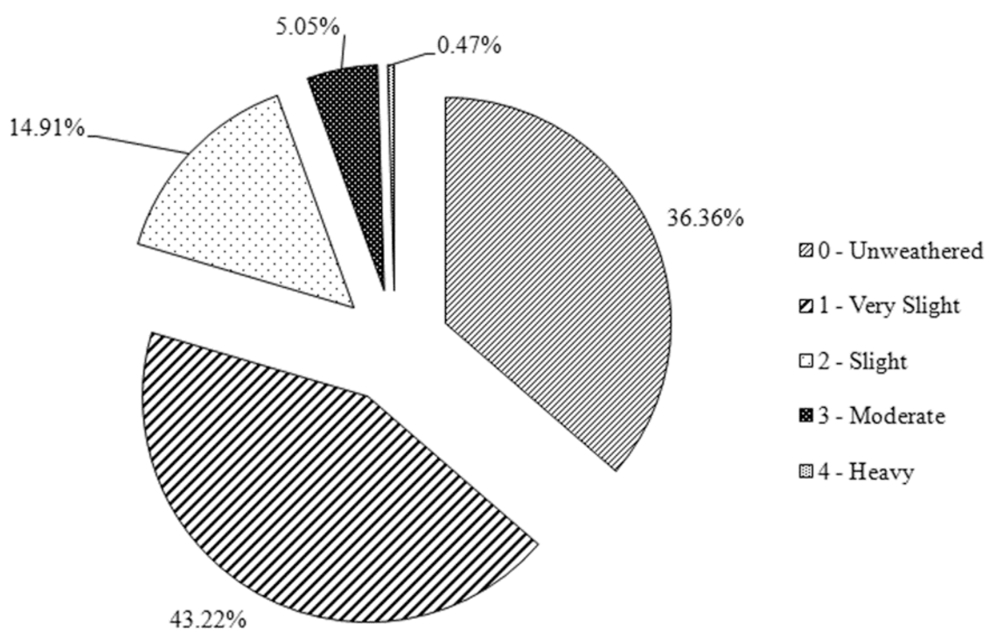



Figure 6.4: Weathering stages observed on faunal remains from Bc 58 (following (Behrensmeyer 1978).

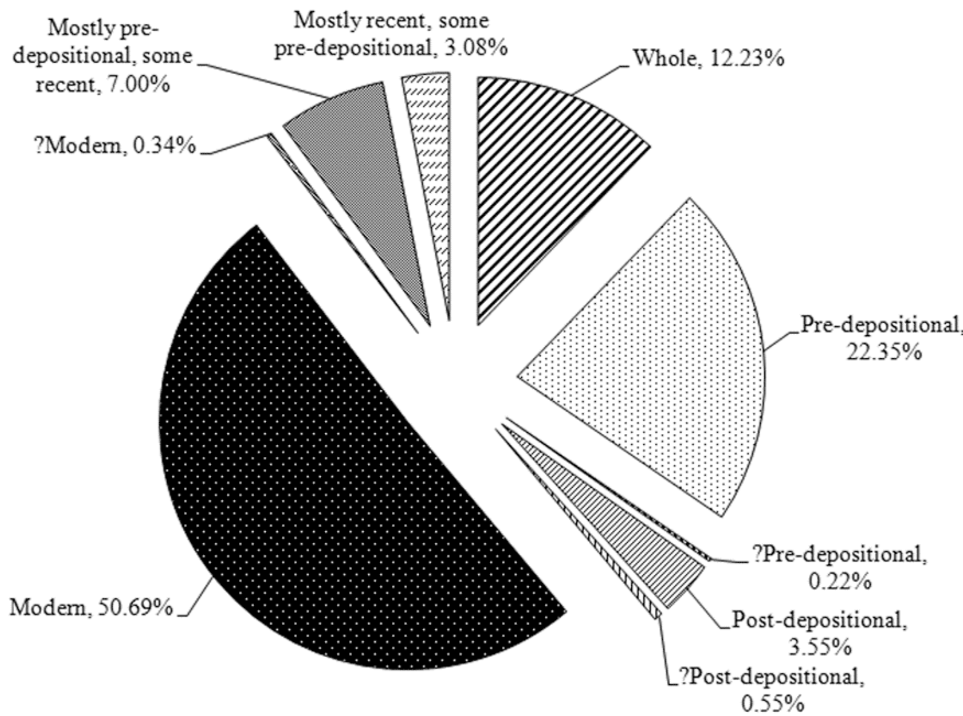



Figure 6.5: Fragmentation stages observed on faunal remains from Bc 57.

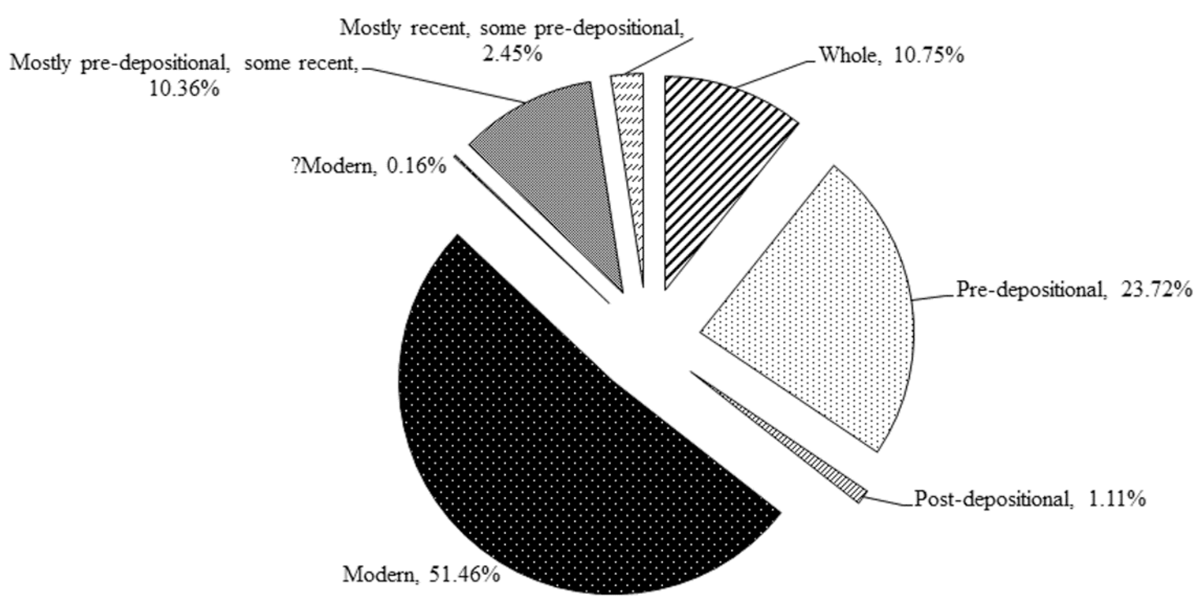



Figure 6.6: Fragmentation stages observed on faunal remains from Bc 58.

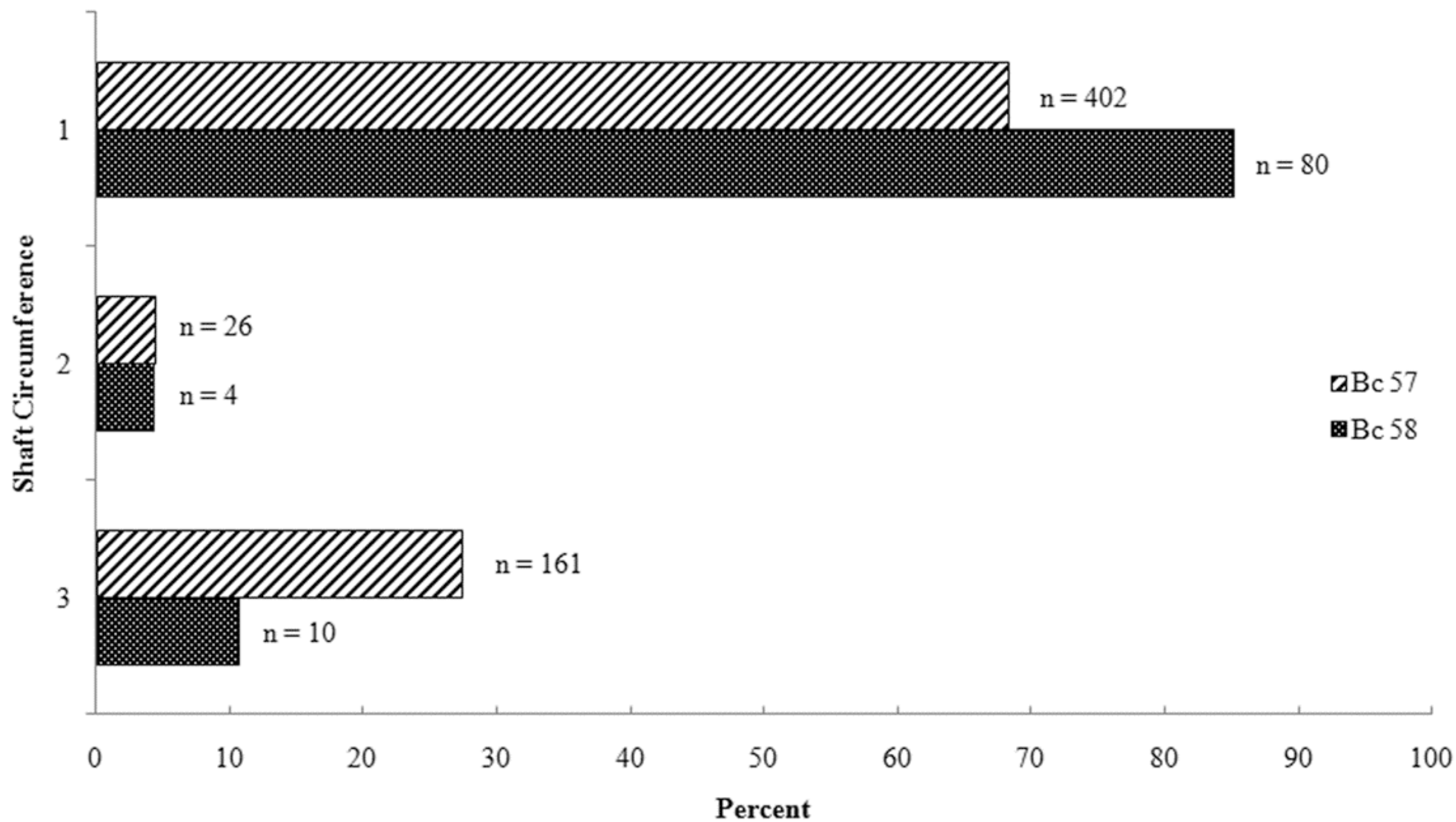



Figure 6.7: Shaft circumference of large mammal remains from Bc 57 and Bc 58; 1 = shaft circumference is < ½ of original; 2 = shaft circumference is > ½ of original; 3 = shaft circumference is complete.

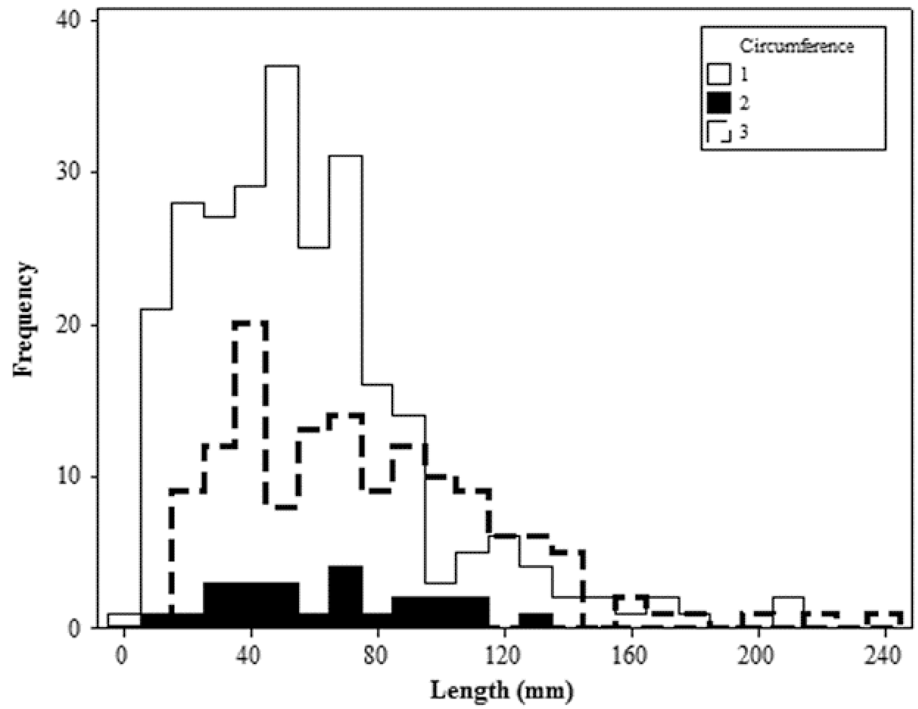



Figure 6.8: Large mammal long bone shaft length at Bc 57 grouped by circumference.

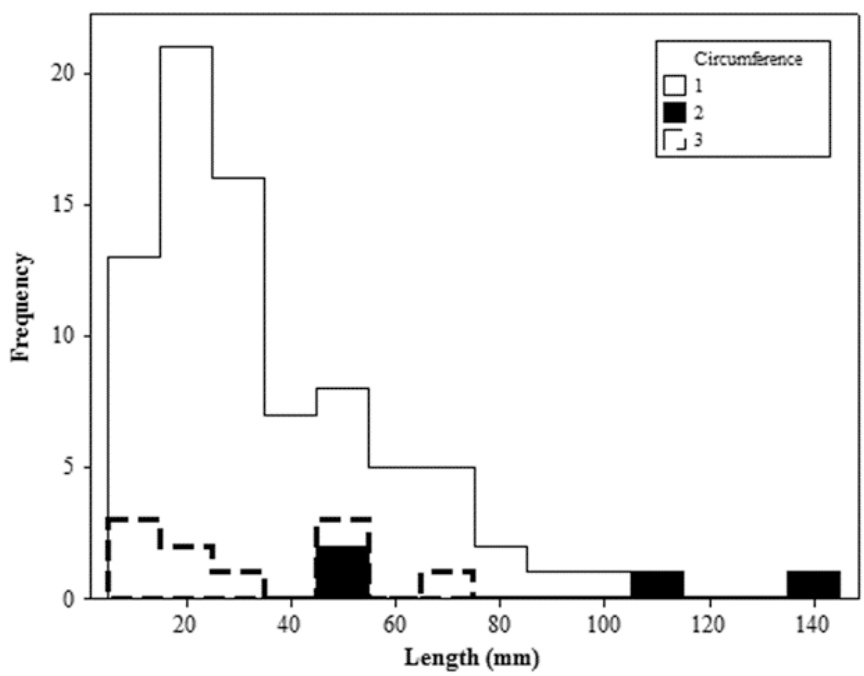



Figure 6.9: Large mammal long bone shaft length at Bc 58 grouped by circumference.

inflated substantially by inclusion of friable remains such as loose teeth and antler in the counts.

Employing criteria established by Villa and Mahieu (1991), Table 6.8 illustrates the relative frequency of fracture characteristics for large mammal long bones, providing a more accurate reflection of the nature of fragmentation at the two sites. Burned remains were excluded from consideration since, as noted above, heat exposure may produce fracture patterns similar to that of green bone but the frequency of fully carbonized or calcined shaft fragments was relatively low at Bc 57 (3.5 percent) and Bc 58 (1.2 percent). The fragmentation pattern is similar at both sites with 63 to 85 percent of fragmented remains exhibiting a fresh fracture angle and 64 to 80 percent displaying a curved fracture outline indicating the high rate of human processing.

Bunn (1983) introduced another criterion based on shaft circumference, (i.e. complete, more than half, or less than half), to differentiate faunal assemblages produced by hyena (where shafts tended to remain intact) from those generated by humans (where shaft splinters predominated). Figure 6.7 depicts the relative frequency of circumference measurements among large mammal remains from Bc 57 and Bc 58. From 70 to 85 percent of shaft fragments are represented by less than half of the original bone circumference, pointing to the prevalence of shaft splinters among both assemblages. Grouping length measurements of long bone shaft fragments by circumference reinforces this interpretation, demonstrating the high proportion of long narrow splinters 1-8 cm in length (Figure 6.8 and Figure 6.9). Overall fragment length varies somewhat between the two assemblages. As shown in Figures 6.10 and 6.11, fragment sizes indicate that large mammal remains are less fragmented at Bc 57 than at Bc 58.

Comparing the overall fragmentation patterns from Bc 57 and Bc 58 with those of the three sites examined by Villa and Mahieu, these Chacoan small sites more closely resemble the human-generated signature visible in the Fontbrégoua assemblage in terms of the frequency of fresh fracture characteristics and the preponderance of shaft splinters. Coupled with the low frequency of carnivore gnawing previously noted, the extent to which fragmentation patterns differ from that of Bezouce and Sarrians, both of which were attributed to carnivore behavior, supports the conclusion that carnivore ravaging was not a major source of fragmentation at Bc 57 and Bc 58.

*Differential Survivorship and Bone Mineral Density*

Turning to differential survivorship and bone mineral density, the results for Bc 57 and Bc 58 are outlined in Tables 6.9 and 6.10. As illustrated in Figures 6.12, 6.13, 6.14, and 6.15, bone survivorship and bone mineral density are generally uncorrelated for artiodactyls. In a few cases survivorship is negatively correlated with bone density. Use of Spearman's rank-order correlation indicates that relative skeletal abundance is not primarily a function of density mediated attrition. For artiodactyls, the only statistically significant positive correlation with bone density was encountered for pronghorn during the Classic Bonito subphase, but the correlation was still relatively low (0.27); the correlation thus accounts for only a small portion of the variation. Otherwise, correlations were low and insignificant or in the case of pronghorn and bighorn during the Late Bonito subphase, negatively correlated.

Conversely, %MAU is positively and significantly correlated with %MGUI for mule deer during the Early Bonito subphase and pronghorn antelope during the Late Bonito subphase. During the Classic Bonito subphase, both survivorship among deer and pronghorn are positively correlated with %MGUI and marginally insignificant. Comparing the Bc 57 results with Lyman's (1994:261-264) matrix of possible outcomes of correlation coefficients for %MAU:Bone Density and %MAU:%MGUI, deer during the Early and Classic Bonito subphases deer and pronghorn during the Classic and Late Bonito subphases fall into either Class 7 or Class 8, characterized by Lyman as "bulk or gourmet utility."

Thus the patterns of skeletal part representation seen at Bc 57 are largely consistent with economic utility rather than density-mediated attrition. The results suggest that skeletal part frequencies can therefore be interpreted as reflective of human transport and processing decisions.

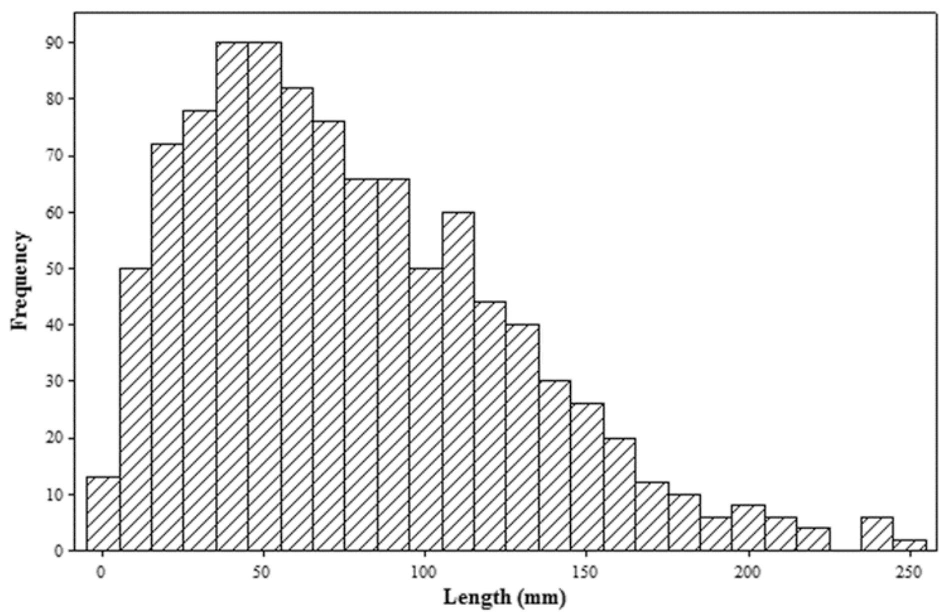



Figure 6.10: Length of bone fragments (large mammal and artiodactyl only) at Bc 57.

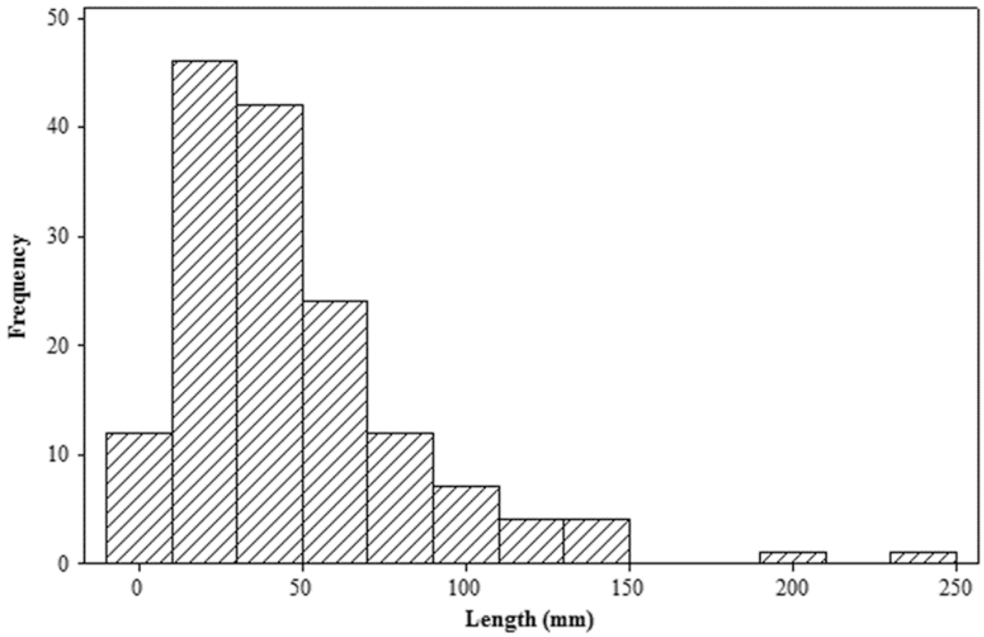



Figure 6.11: Length of bone fragments (large mammal and artiodactyl only) at Bc 58.

Table 6.9: %Survivorship vs. bone mineral density and %MAU vs. modified general utility by species and time period at Bc 57.

| | Early Bonito | | | | Classic Bonito | | | | Late Bonito | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mule Deer | Pronghorn Antelope | Bighorn Sheep | Jackrabbit | Mule Deer | Pronghorn Antelope | Bighorn Sheep | Jackrabbit | Mule Deer | Pronghorn Antelope | Jackrabbit |
| NISP | 127 | 111 | 30 | 1219 | 86 | 129 | 11 | 213 | 62 | 121 | 272 |
| MNI | 4 | 3 | 2 | 33 | 4 | 3 | 1 | 10 | 1 | 1 | 9 |
| Spearman's *r* density vs. survivorship | $r_s$ = 0.05; p = 0.73 | $r_s$ = 0.09; p = 0.61 | $r_s$ = -0.01; p = 0.94 | $r_s$ = 0.35; p < 0.01 | $r_s$ = 0.09; p = 0.47 | $r_s$ = 0.27; p = 0.02 | $r_s$ = 0.27; p = 0.33 | $r_s$ = 0.51; p < 0.001 | $r_s$ = -0.18; p = 0.21 | $r_s$ = -0.16; p = 0.19 | $r_s$ = 0.42; p < 0.01 |
| Spearman's *r* modified general utility index vs. %MAU | $r_s$ = 0.48; p = 0.03 | $r_s$ = 0.10; p = 0.63 | $r_s$ = 0.03; p = 0.93 | - | $r_s$ = 0.40; p = 0.06 | $r_s$ = 0.36; p = 0.09 | $r_s$ = 0.64; p = N/A | - | $r_s$ = 0.02; p = 0.94 | $r_s$ = 0.46; p = 0.02 | - |

Table 6.10: %Survivorship vs. bone mineral density and %MAU vs. modified general utility by species at Bc 58.

| | Classic Bonito | | |
|---|---|---|---|
| | Mule Deer | Bighorn Sheep | Jackrabbit |
| NISP | 59 | 17 | 17 |
| MNI | 3 | 1 | 9 |
| Spearman's *r* density vs. survivorship | $r_s$ = -0.20; p = 0..29 | $r_s$ = -0.02; p = 0.97 | $r_s$ = 0.56; p < 0.001 |
| Spearman's *r* modified general utility index vs. %MAU | $r_s$ = -0.24; p = 0.37 | $r_s$ = 0.31; p = N/A | - |

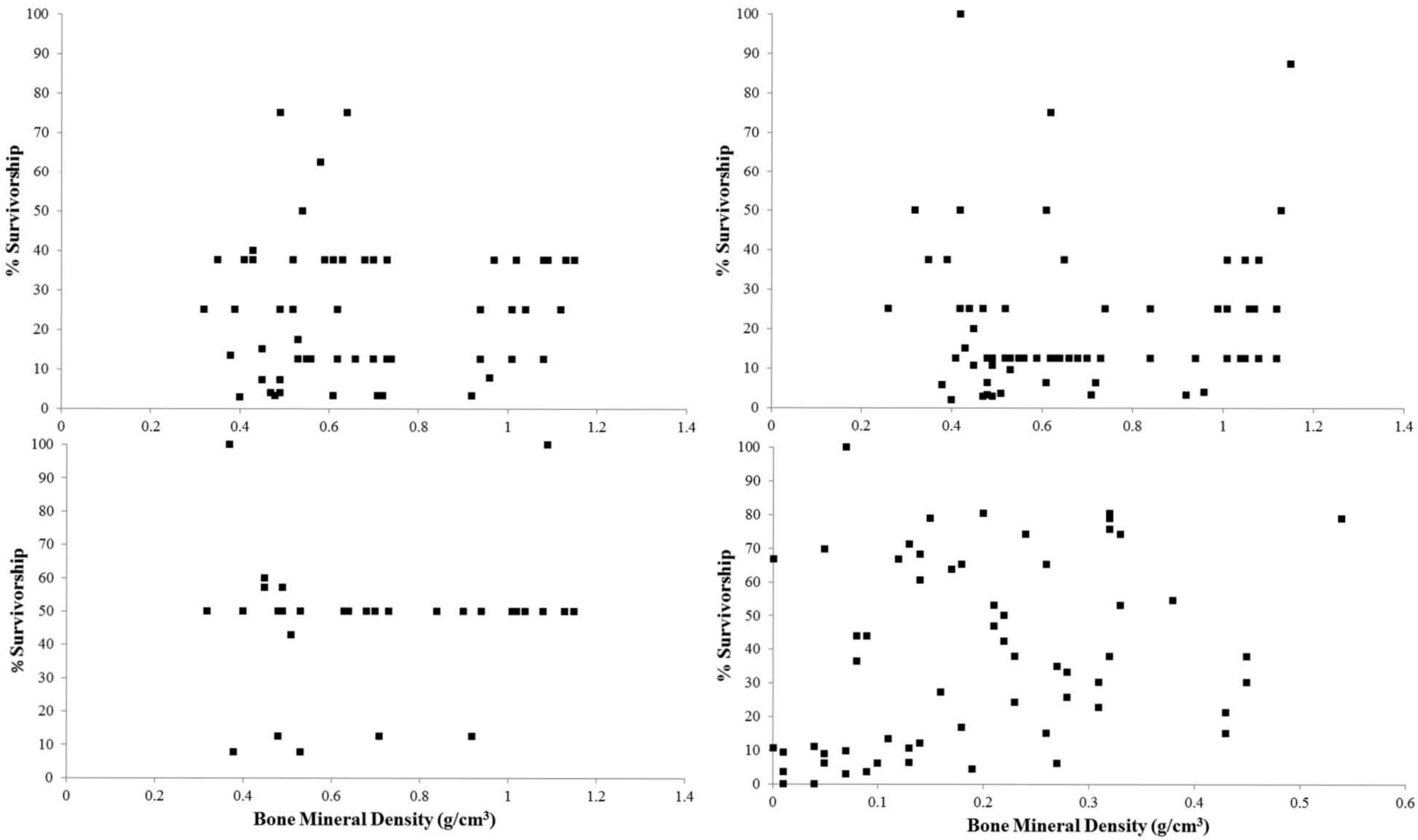



Figure 6.12: Scatterplots of BMD vs. % Survivorship for the Early Bonito subphase at Bc 57 by species; deer (upper left), pronghorn antelope (upper right), bighorn sheep (lower left), jackrabbit (lower right).

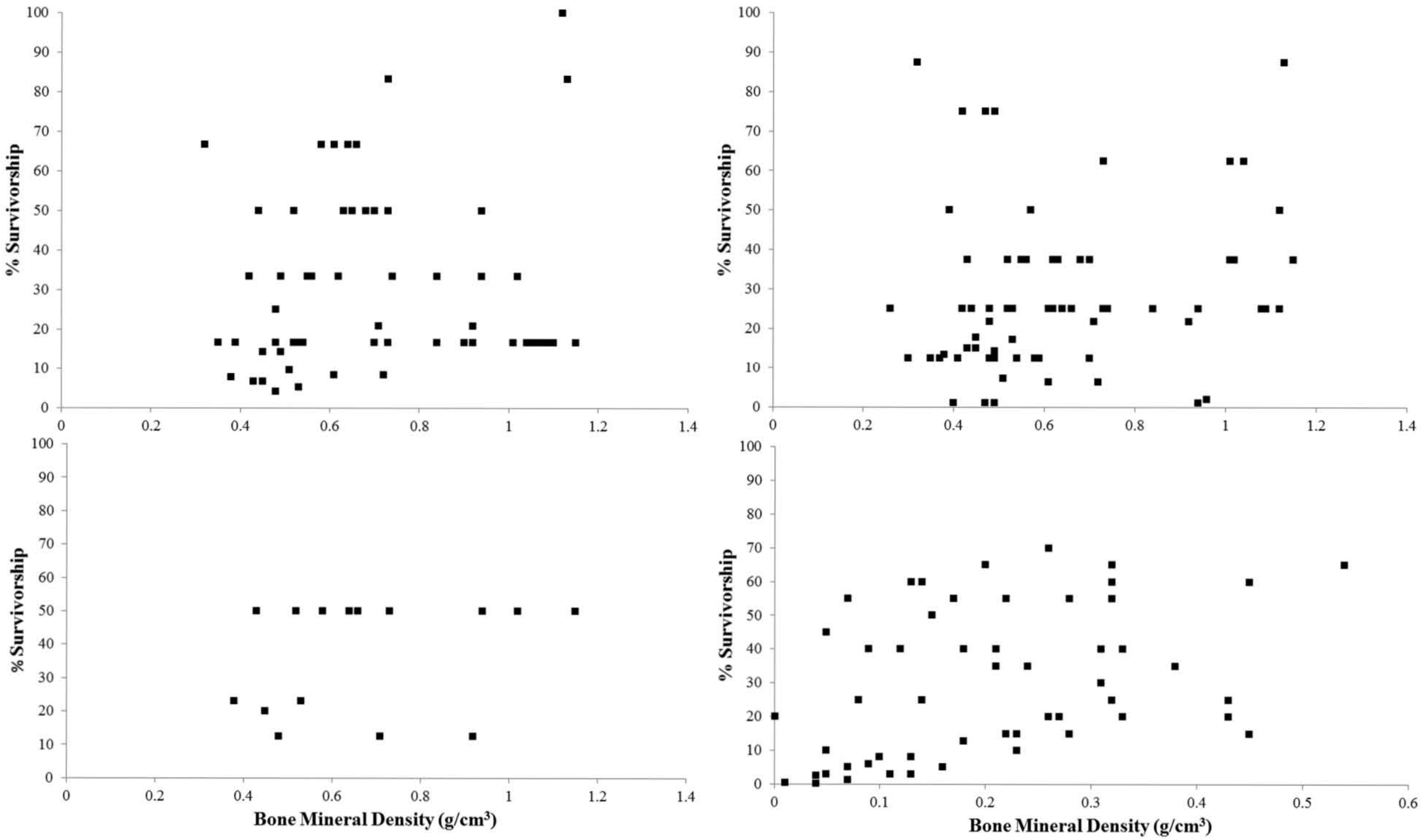



Figure 6.13: Scatterplots of BMD vs. % Survivorship for the Classic Bonito subphase at Bc 57 by species; deer (upper left), pronghorn antelope (upper right), bighorn sheep (lower left), jackrabbit (lower right).

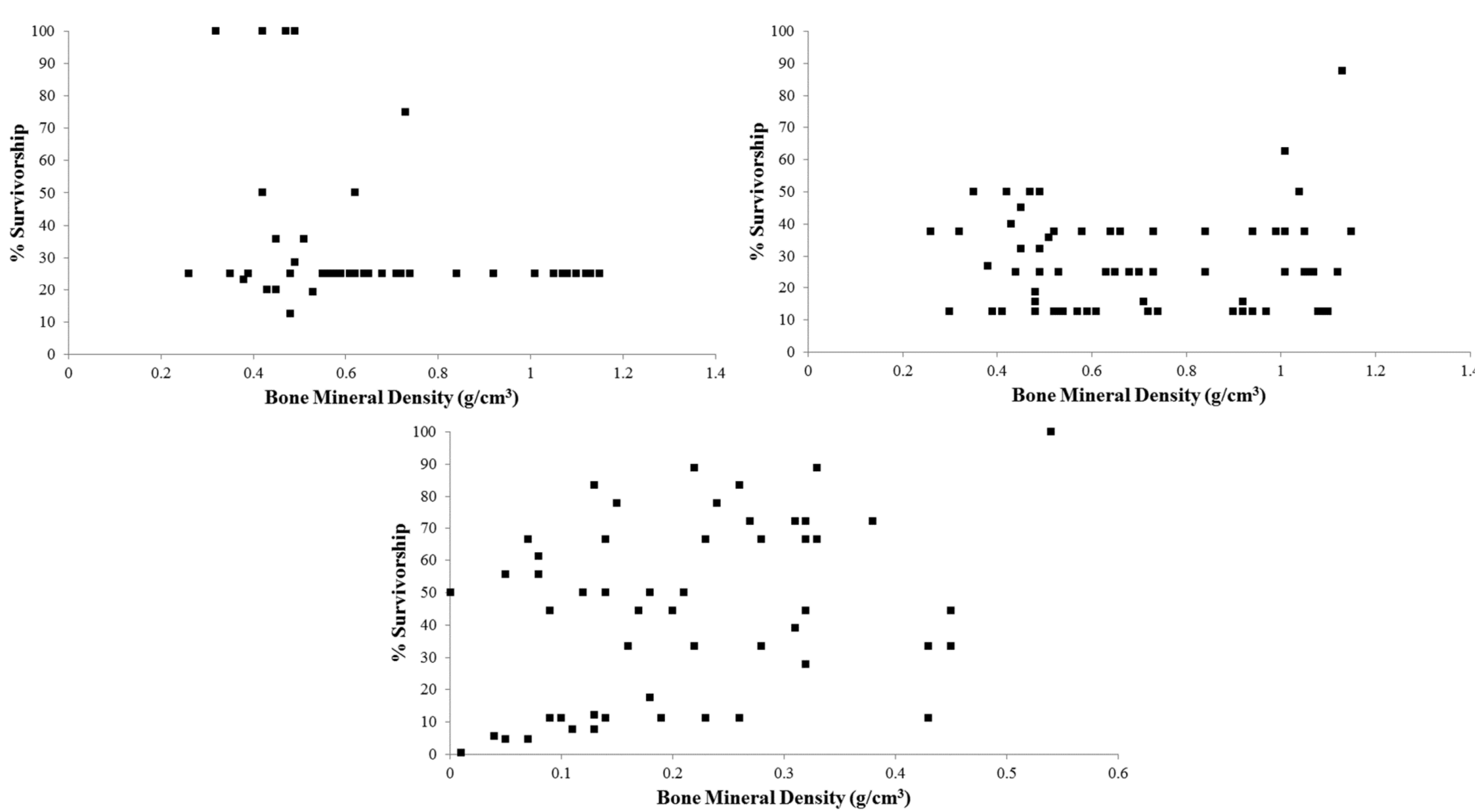



Figure 6.14: Scatterplots of BMD vs. % Survivorship for the Late Bonito subphase at Bc 57 by species; deer (upper left), pronghorn antelope (upper right), jackrabbit (bottom).

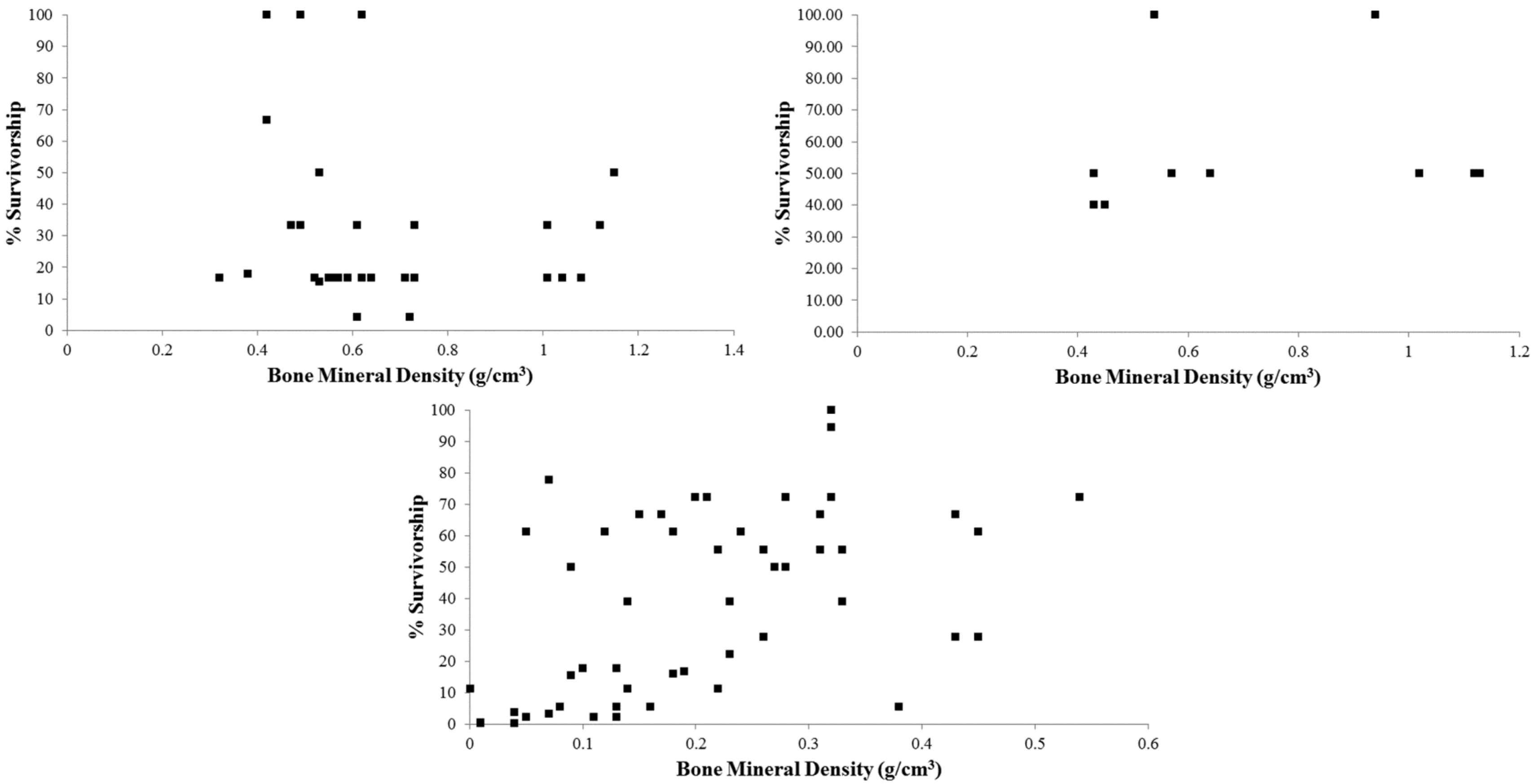



Figure 6.15: Scatterplots of BMD vs. % Survivorship for the Classic Bonito subphase at Bc 58 by species; deer (upper left), pronghorn antelope (upper right), jackrabbit (bottom).

Table 6.11: Percent completeness (COMP/MNE = number of elements at least 90% complete divided by MNE) of deer, pronghorn, and bighorn foot bones by time period.

| | | | Phalanx 1 | Phalanx 2 | Calcaneus | Phalanx 3 | Astragalus |
|---|---|---|---|---|---|---|---|
| Early Bonito | Mule Deer | COMP/MNE | 2/2 | 2/2 | 1/2 | - | 3/3 |
| | | % Completeness | 100.0 | 100.0 | 50.0 | - | 100.0 |
| | Pronghorn Antelope | COMP/MNE | 1/1 | 2/2 | 1/1 | 2/2 | 1/1 |
| | | % Completeness | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | Bighorn Sheep | COMP/MNE | 1/1 | - | - | - | 1/1 |
| | | % Completeness | 100.0 | - | - | - | 100.0 |
| Classic Bonito | Mule Deer | COMP/MNE | 6/6 | 1/1 | 3/4 | 1/1 | 3/3 |
| | | % Completeness | 100.0 | 100.0 | 75.0 | 100.0 | 100.0 |
| | Pronghorn Antelope | COMP/MNE | 7/7 | 2/2 | 2/2 | 4/4 | 3/3 |
| | | % Completeness | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | Bighorn Sheep | COMP/MNE | 1/1 | - | 1/1 | - | - |
| | | % Completeness | 100.0 | - | 100.0 | - | - |
| Late Bonito | Mule Deer | COMP/MNE | 4/4 | 4/4 | - | 2/2 | - |
| | | % Completeness | 100.0 | 100.0 | - | 100.0 | - |
| | Pronghorn Antelope | COMP/MNE | 5/5 | 4/4 | 3/3 | 6/6 | 2/2 |
| | | % Completeness | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | Bighorn Sheep | COMP/MNE | - | - | - | - | - |
| | | % Completeness | | - | - | - | - |
| Classic Bonito | Mule Deer | COMP/MNE | - | 0/1 | 0/1 | - | - |
| | | % Completeness | | 0.0 | 0.0 | - | - |
| | Bighorn Sheep | COMP/MNE | - | - | - | - | - |
| | | % Completeness | - | - | - | - | - |
| Average % completeness | | | 100.0 | 100.0 | 87.5 | 100.0 | 100.0 |

Although the sample size of compact bones is very limited, an examination of the relative completeness reveals an overall low intensity of fragmentation of compact bones for marrow (Table 6.11). When breakage of compact bones does occur, mule deer are the only species to undergo such processing. Interestingly pronghorn, a species for which lower limb bones are the most numerous apparently was not as heavily subjected to processing for marrow extraction, suggesting some inter-taxonomic differences in the preparation and cooking of artiodactyl carcasses.

Table 6.12: Fracture angle and outline of jackrabbit (*Lepus californicus*) and leporid limb bones at Bc 57 and Bc 58.

| Site | Time Period | Fracture Angle (Fresh) Oblique | | (Dry) Right | | Fracture Outline (Fresh) Curved | | V-Shaped | | (Dry) Transverse | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % | n | % | n | % |
| | Early Bonito | 260 | 87.84 | 36 | 12.16 | 264 | 95.31 | 0 | 0 | 13 | 4.69 |
| Bc 57 | Classic Bonito | 55 | 80.88 | 13 | 19.12 | 53 | 94.64 | 0 | 0 | 3 | 1.08 |
| | Late Bonito | 67 | 78.82 | 18 | 21.18 | 69 | 94.52 | 0 | 0 | 4 | 1.44 |
| Bc 58 | Classic Bonito | 45 | 86.54 | 7 | 13.46 | 44 | 93.62 | 0 | 0 | 3 | 1.08 |

The pattern observed for jackrabbit at Bc 57 and Bc 58, which diverges from that of large mammals, highlights the existence of inter-taxonomic differences in fragmentation. Without exception, jackrabbit bone survivorship is positively and significantly correlated with bone mineral density (Tables 6.9 and 6.10; Figures 6.12, 6.13, 6.14, and 6.15). An examination of fragmentation type (Table 6.12) reveals that between 78 and 88 percent of jackrabbit and leporid long bone fragments exhibit oblique fracture angles and around 95 percent display curved fracture outlines. Bearing in mind the low incidence of carnivore activity, this pattern strongly suggests that most if not all fragmentation was a result of human processing activities such as marrow extraction and cooking. In their study of inter-taxonomic differential fragmentation, Yeshurun et al. (2007) found a tendency, when density-mediated attritional forces were at work, for larger ungulate taxa to undergo greater fragmentation while smaller taxa tended to be *less* heavily fragmented. At Bc 57 and Bc 58, the reverse appears to be true. Although indices akin to %MGUI were not available for jackrabbit the results illustrate that jackrabbit was likely subjected to greater processing intensity than artiodactyl species. Coupled with the differential processing of artiodactyls noted above, the differing treatment of jackrabbit further strengthens the interpretation that processing intensity and food preparation strategies varied by species.

*Artiodactyl Skeletal Part Representation and Processing Techniques*

A closer look at the relationship between artiodactyl skeletal part frequency and meat, marrow, and grease utility indices reveals changes in procurement and processing strategies through time. As illustrated by Spearman's *rho* values (Table 6.13), during the Early Bonito subphase deer is positively and significantly correlated with meat utility ($r_s = 0.46$, $p < 0.05$) while pronghorn is positively correlated (approaching statistical significance) with the meat utility index during Classic ($r_s = 0.32$, $p = 0.14$) and Late Bonito ($r_s = 0.33$, $p = 0.12$).

Processing of deer and pronghorn for marrow appears most intense among Classic Bonito assemblages. Pronghorn in particular exhibits a statistically significant positive correlation ($r_s = 0.44$, $p < 0.05$) and deer a marginally insignificant positive correlation ($r_s = 0.36$, $p = 0.09$) with marrow utility. The positive correlation between pronghorn survivorship and bone density already noted is consistent with intensification of marrow extraction during Classic Bonito. With the exception of deer during Classic Bonito ($r_s = 0.43$, $p < 0.05$), element frequencies are generally uncorrelated with grease utility. During Late Bonito deer and pronghorn are both negatively (though not significantly) correlated with marrow and grease utility. At Bc 58, deer skeletal part representation exhibits no correlation with either meat or grease utility and a low negative and insignificant correlation with marrow utility.

The results highlight the prominence of meat procurement, marrow extraction, and grease rendering in the dietary strategies undertaken at Bc 57 and Bc 58. Where skeletal part frequencies are positively correlated with meat procurement during the Early Bonito and Late Bonito subphases, processing for marrow was less intensively pursued. The high degree of correlation with marrow utility during Classic Bonito is a function of increased fragmentation resulting in inflated counts of marrow-rich elements and is probably not a reflection of differential transport (Madrigal and Holt 2002:754-755). Thus although marrow extraction may have increased during Classic Bonito the emphasis on meat procurement evidenced by the Early and Late Bonito assemblages likely did not waver during the intervening period.

Table 6.13: Spearman's rho values for deer, pronghorn, and bighorn skeletal part frequencies against caribou meat, marrow, and grease utility indices calculated by Binford (1978).

| Site | Time Period | Taxon | Meat | Marrow | Grease |
|---|---|---|---|---|---|
| Bc 57 | Early Bonito | Mule Deer | $r_s = 0.46$<br>$p < 0.05$ | $r_s = 0.31$<br>$p = 0.18$ | $r_s = 0.34$<br>$p = 0.14$ |
| | | Pronghorn | $r_s = 0.18$<br>$p = 0.41$ | $r_s = 0.17$<br>$p = 0.46$ | $r_s = 0.18$<br>$p = 0.47$ |
| | | Bighorn | $r_s = 0.02$<br>$p = 0.98$ | $r_s = 0.21$<br>$p = 0.79$ | $r_s = 0.12$<br>$p = 0.88$ |
| | Classic Bonito | Mule Deer | $r_s = 0.30$<br>$p = 0.18$ | $r_s = 0.36$<br>$p = 0.09$ | $r_s = 0.43$<br>$p < 0.05$ |
| | | Pronghorn | $r_s = 0.32$<br>$p = 0.14$ | $r_s = 0.44$<br>$p < 0.05$ | $r_s = 0.19$<br>$p = 0.40$ |
| | Late Bonito | Mule Deer | $r_s = 0.18$<br>$p = 0.56$ | $r_s = -0.02$<br>$p = 0.95$ | $r_s = -0.12$<br>$p = 0.78$ |
| | | Pronghorn | $r_s = 0.33$<br>$p = 0.12$ | $r_s = -0.25$<br>$p = 0.23$ | $r_s = -0.11$<br>$p = 0.60$ |
| Bc 58 | Classic Bonito | Mule Deer | $r_s = 0.05$<br>$p = 0.87$ | $r_s = -0.11$<br>$p = 0.69$ | $r_s = 0.08$<br>$p = 0.78$ |

It has been shown, based on fragmentation patterns and skeletal part frequencies, that food consumption at Bc 57 and Bc 58 maximized the nutritional resources available in animal carcasses. Following capture animals were transported back to the sites where they were then processed for meat removal, marrow extraction, and likely bone grease rendering. The following section explores the extent to which patterns of burning and butchery reflect these processing techniques.

*Heat Exposure*

Evidence for heat-altered faunal remains was greatest among Early Bonito assemblages (6 percent) and declined through the Classic Bonito (1 percent) and Late Bonito (0.5 percent) periods. Eighteen specimens from Classic Bonito contexts at Bc 58 (39 from the broader assemblage) exhibited the effects of burning and of these 28 percent were partially smoked, indicating roasting. Partially smoked bone comprises the majority of burned remains at Bc 57, ranging from 7.5 percent overall during Early Bonito, to 1.4 percent during Classic Bonito, to 1.9 percent during Late Bonito (Table 6.14). At Bc 58, 33 percent of Classic Bonito remains exhibited complete carbonization or calcination while calcined and carbonized remains account for 1.2 percent of the Bc 57 burned assemblage during Early Bonito, 0.5 percent during Classic Bonito, and 0.1 percent during Late Bonito.

The ratio of partially burned remains to those burned completely is particularly consistent through the Early and Classic Bonito subphases and overall indicates that roasting was a common cooking technique (Figure 6.16). Moreover, this pattern of food preparation and discard is consistent across species; leporids and artiodactyls exhibit strikingly similar proportions of roasted and fully burned remains (Figure 6.17).

Table 6.14: Frequency of burning on faunal remains (listed by size) at Bc 57 by time period.

| Early Bonito | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Taxon | None | | Uniformly Smoked (defleshed green bone) | | Partially Smoked (roasted) | | Heavily Smoked w/calcination | | Calcined | |
| | n | % | n | % | n | % | n | % | n | % |
| Bighorn | 17 | 73.9 | 3.0 | 13.0 | 3.0 | 13.0 | - | - | - | - |
| Deer | 85 | 74.6 | 3.0 | 2.6 | 23.0 | 20.2 | 1.0 | 0.9 | 2.0 | 1.8 |
| Pronghorn | 81 | 79.4 | 4.0 | 3.9 | 14.0 | 13.7 | 1.0 | 1.0 | 2.0 | 2.0 |
| Large Mammal | 488 | 87.1 | 13.0 | 2.3 | 44.0 | 7.9 | 3.0 | 0.5 | 12.0 | 2.1 |
| Turkey | 132 | 97.1 | - | - | 2.0 | 1.5 | - | - | 2.0 | 1.5 |
| Jackrabbit | 744 | 89.4 | 14.0 | 1.7 | 65.0 | 7.8 | 1.0 | 0.1 | 8.0 | 1.0 |
| Cottontail | 636 | 92.7 | 7.0 | 1.0 | 37.0 | 5.4 | 2.0 | 0.3 | 4.0 | 0.6 |
| Leporid | 78 | 96.3 | 1.0 | 1.2 | 1.0 | 1.2 | - | - | 1.0 | 1.2 |
| TOTAL | 2261 | 89.2 | 45.0 | 1.8 | 189.0 | 7.5 | 8.0 | 0.3 | 31.0 | 1.2 |

| Classic Bonito | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | None | | Uniformly Smoked (defleshed green bone) | | Partially Smoked (roasted) | | Heavily Smoked w/calcination | | Calcined | |
| | n | % | n | % | n | % | n | % | n | % |
| Bighorn | 11 | 100.0 | - | - | - | - | - | - | - | - |
| Deer | 76 | 95.0 | - | - | 4.0 | 5.0 | - | - | - | - |
| Pronghorn | 116 | 100.0 | - | - | - | - | - | - | - | - |
| Large Mammal | 333 | 98.5 | - | - | 2.0 | 0.6 | - | - | 3.0 | 0.9 |
| Turkey | 104 | 99.0 | - | - | 1.0 | 1.0 | - | - | - | - |
| Jackrabbit | 178 | 95.7 | - | - | 7.0 | 3.8 | - | - | 1.0 | 0.5 |
| Cottontail | 384 | 98.2 | 1.0 | 0.3 | 4.0 | 1.0 | - | - | 2.0 | 0.5 |
| Leporid | 61 | 100.0 | - | - | - | - | - | - | - | - |
| TOTAL | 1263 | 98.1 | 1.0 | 0.1 | 18.0 | 1.4 | - | - | 6.0 | 0.5 |

| | Late Bonito | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | None | | Uniformly Smoked (defleshed green bone) | | Partially Smoked (roasted) | | Heavily Smoked w/calcination | | Calcined | |
| | n | % | n | % | n | % | n | % | n | % |
| Bighorn | 5 | 71.4 | - | - | 2.0 | 28.6 | - | - | - | - |
| Deer | 60 | 98.4 | - | - | - | - | - | - | 1.0 | 1.6 |
| Pronghorn | 125 | 98.4 | - | - | 1.0 | 0.8 | - | - | 1.0 | 0.8 |
| Large Mammal | 365 | 100.0 | - | - | - | - | - | - | - | - |
| Turkey | 102 | 98.1 | - | - | 2.0 | 1.9 | - | - | - | - |
| Jackrabbit | 231 | 97.9 | - | - | 5.0 | 2.1 | - | - | - | - |
| Cottontail | 704 | 96.8 | - | - | 23.0 | 3.2 | - | - | - | - |
| Leporid | 126 | 100.0 | - | - | - | - | - | - | - | - |
| TOTAL | 1718 | 98.0 | - | - | 33.0 | 1.9 | - | - | 2.0 | 0.1 |

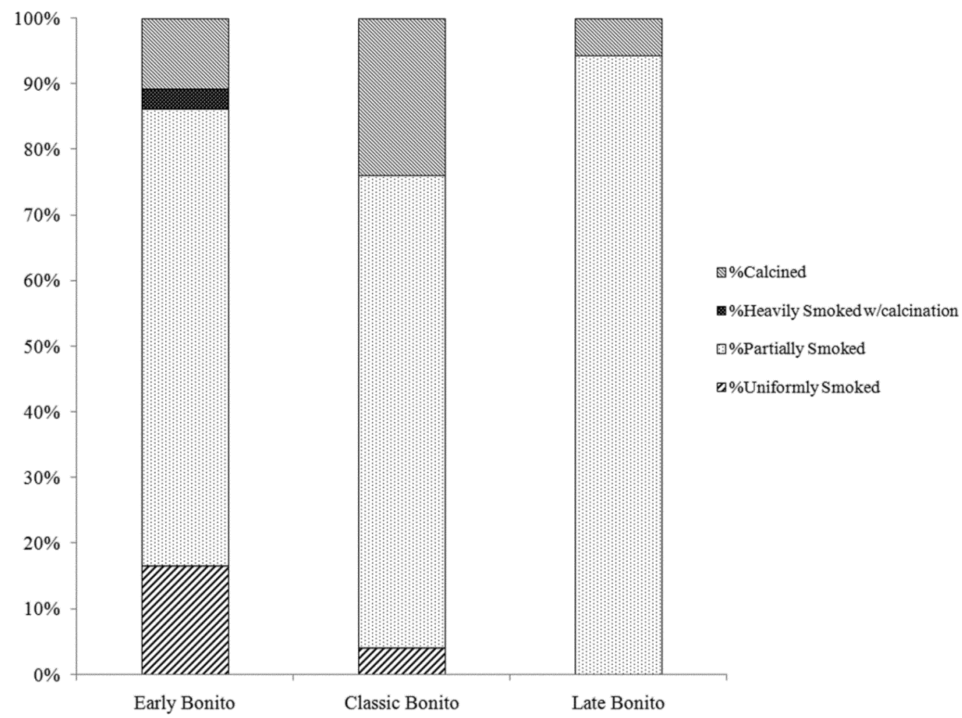



Figure 6.16: Types of heat alteration observed on faunal remains by time period at Bc 57.

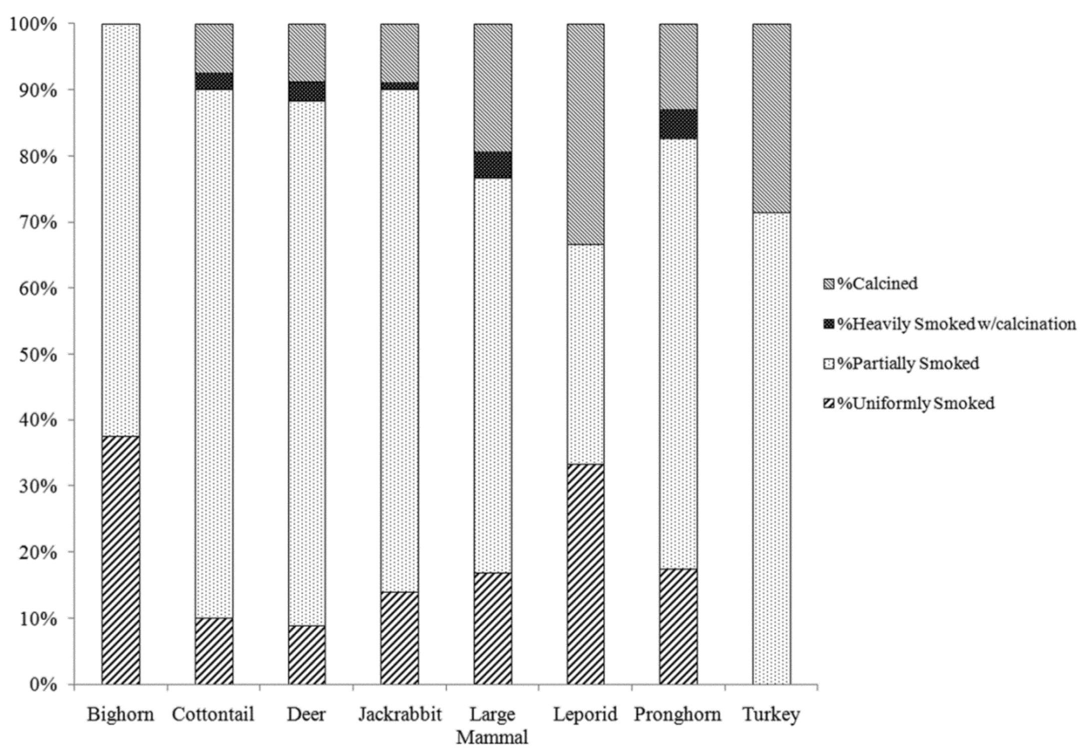



Figure 6.17: Types of heat alteration observed on faunal remains by species at Bc 57.

For comparison, 6.8 percent of the assemblage from the Marcia's Rincon small site 29SJ 627 displayed signs of burning and of these, 1.7 percent were roasted (Akins 1992:333-335). Similarly, 7.7 percent of the assemblage from neighboring 29SJ 629 and 12.8 percent from 29SJ 633 were "charred" (Gillespie 1991:296; 1993:371) At Pueblo Alto, although rates of burning were much higher among trash mound deposits, overall 11 percent exhibited some form of burning, only 1 percent was roasted (Akins 1987b:497-503).[7] While the evidence from Bc 57 suggests that roasting was a more common cooking practice there, given that burning was more frequent at 627, 629, 633, and Alto, the higher rate of roasting observed at the former may simply reflect differences in discard practices. For example, evidence of partial burning (roasting) at Pueblo Alto may have been obscured if disposal patterns dictated that refuse was intentionally burned or introduced to hearth deposits and thus carbonized or calcined completely. However, the contrast once again highlights the differential treatment of faunal remains, whether in cooking or disposal, among Early Bonito contexts at Bc 57.

*Butchery*

Evidence for butchery at Bc 57 (2.4 percent) and Bc 58 (1.5 percent) is high by Chacoan standards. By comparison of the roughly 30,000 analyzed remains from Pueblo Alto, 152 specimens (0.5 percent) exhibited signs of butchery (Akins 1987b:491-494). To put this figure in perspective, the total number of butchered artiodactyl specimens from the Bc 57 Early Bonito assemblage alone exceeds the overall frequency of butchered artiodactyl remains at Pueblo Alto. Evidence of butchery was similarly sparse among the Marcia's Rincon sites ranging from 0.9 percent at 29SJ627 to 0.05 percent at

[7] Specimens exhibiting "cooking brown" as defined by Akins (1987b:491) were excluded from counts for 29SJ627 and Pueblo Alto because the associated criteria for this burning condition were unclear and were not recorded for remains from Bc 57 and Bc 58.

29SJ 633 (Akins 1992:329; Gillespie 1991:302-310).[8] The pattern is even more pronounced when only artiodactyls are considered. At Bc 57 approximately 19 percent of pronghorn, mule deer, and bighorn remains exhibited some form of butchery relative to 4 percent at Pueblo Alto and 2 percent at 627. Lupo (1994) has demonstrated that butchery intensity may vary partly as a function of carcass condition. If the interval between when an animal is killed and subsequently butchered is sufficient for the onset of rigor mortis, severing of stiffened ligaments may require more intensive butchery thus increasing the potential to produce cut marks. Thus subjection of carcasses to different transport considerations such as delaying processing until a return from the kill-site is a possible explanation for the disparity in butchery patterns.

Evidence for large mammal butchery at Bc 57 is most common among Early Bonito assemblages followed by Late Bonito and Classic Bonito (Table 6.15). In fact, the rates of deer and pronghorn butchery are very consistent for Early and Late Bonito contexts. Classic Bonito assemblages exhibit an overall decline in evidence of artiodactyl butchery, a trend visible at both Bc 57 and Bc 58 (Tables 6.16 and Table 6.17). As noted above, pronghorn skeletal part survivorship exhibits a positive and significant correlation with bone density while both deer and pronghorn survivorship was significantly correlated with marrow and grease utility indices during the Classic Bonito subphase. Such an increase in the intensity of fragmentation would have a tendency to obliterate evidence of surface modifications such as cut marks and thus may have produced the apparent decrease in artiodactyl butchery.

Butchery of leporids is steady throughout all periods, though more common at Bc 58. Evidence for culinary processing of turkey peaked during the Late Bonito subphase,

[8] The incidence of butchery was not available for 29SJ 629 (Gillespie 1993).

a pattern consistent with the Pueblo III intensification of turkey exploitation discussed in Chapter Five.

Table 6.15: Frequency of butchery among large mammals at Bc 57 by time period.

| | Cut Marks | % Cut Marks | Percussion Marks | % Percussion Marks | Overall Butchery | % Overall Butchery |
|---|---|---|---|---|---|---|
| Early Bonito | 77 | 9.6 | 15 | 1.9 | 89 | 11.0 |
| Classic Bonito | 27 | 4.6 | 5 | 0.9 | 31 | 5.3 |
| Late Bonito | 51 | 9.0 | 3 | 0.5 | 53 | 9.4 |
| TOTAL | 155 | 7.9 | 23 | 1.2 | 173 | 8.9 |

As illustrated in Figures 6.18 and 6.19, pronghorn and deer were subjected to similar butchery patterns. The major parallels include heavy butchery of thoracic and lumbar vertebrae, pelvis, and upper limbs (femur and humerus), and likely relate to carcass transport and dismemberment. Segmentation of carcasses at various intervals along the vertebral column is a butchery technique commonly employed by Hadza hunters to facilitate carcass transport (Lupo 2006:45, 47). Examples of such carcass segmentation through butchery of vertebrae are shown in Figure 6.20. The discernible differences, in particular the greater emphasis on cranial and vertebral butchery among pronghorn may actually reflect inter-taxonomic differences in skeletal part representation, a question examined in more detail in Chapter Seven. The occurrence of cut marks on deer and pronghorn lower limb bones (distal metapodials and phalanges), though not disproportionately numerous, is consistent with skinning for hide removal. Overall, the placement of cuts on artiodactyl carcasses at Bc 57 closely approximates Guilday et al.'s (1962) model as well as that documented by Lang and Harris (1984:78-85) at the Pueblo IV period site Arroyo Hondo, indicating a degree of standardization in butchery techniques. However, butchery patterns do reflect some inter-taxonomic differences in the treatment of carcasses. As depicted in Figure 6.21 cut marks on jackrabbit remains are entirely concentrated around the lumbar vertebrae, pelvic girdle and upper limbs, typical of dismemberment and preparation for roasting or stews.

As suggested by the correlation of skeletal part representation with marrow and grease utility indices, utilization of marrow and bone grease is reflected in patterns of culinary processing at Bc 57. While percussion marks, a good indicator of marrow extraction, are absent from the Bc 58 assemblage, they are relatively frequent throughout all periods at Bc 57 accounting for 2 to 4 percent of butchery observed (Tables 6.17 and 6.18). Fracture patterns encountered in the Bc 57 assemblage considered typical of marrow extraction are depicted in Figure 6.22.

## Summary

Exposure of the faunal remains from Bc 57 and Bc 58 to the elements appears to have been limited as weathering was largely non-existent and the incidence of carnivore gnawing, while high for Chaco Canyon sites, was still quite low (around 2 percent).

In terms of fragmentation, it was demonstrated that the Bc 57 and Bc 58 assemblage is typical of human-generated refuse with fresh fracture patterns evident on 75 to 90 percent of the assemblage and a predominance of long bone shaft splinters. Comparison of artiodactyl skeletal part survivorship with bone mineral density revealed, with one exception, a general lack of correlation. In contrast, jackrabbit bone survivorship was positively and significantly correlated with bone density indicating that unlike artiodactyls, jackrabbit skeletal part representation was at least partially a function of density-mediated destruction. Artiodactyl bone survivorship was found to be

Table 6.16: Frequency of butchery among species (listed by size) at Bc 57 by time period.

Early Bonito

| Taxon | Unbutchered Elements | | Elements Exhibiting Cut Marks | | Elements Exhibiting Percussion Marks | | Total Elements Exhibiting Butchery | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Bighorn | 21 | 70.0 | 8 | 26.7 | 1 | 3.3 | 9 | 30.0 |
| Deer | 102 | 79.1 | 23 | 17.8 | 5 | 3.9 | 27 | 20.9 |
| Pronghorn | 87 | 77.7 | 25 | 22.3 | 2 | 1.8 | 25 | 22.3 |
| Turkey | 192 | 97.5 | 5 | 2.5 | 0 | 0.0 | 5 | 2.5 |
| Jackrabbit | 1194 | 97.9 | 24 | 2.0 | 2 | 0.2 | 26 | 2.1 |
| Cottontail | 992 | 82.6 | 12 | 1.0 | 0 | 0.0 | 12 | 1.0 |
| TOTAL | 2588 | 86.9 | 97 | 3.3 | 10 | 0.3 | 104 | 3.5 |

Classic Bonito

| | Unbutchered Elements | | Elements Exhibiting Cut Marks | | Elements Exhibiting Percussion Marks | | Total Elements Exhibiting Butchery | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Bighorn | 10 | 90.9 | 1 | 9.1 | 0 | 0.0 | 1 | 9.1 |
| Deer | 79 | 89.8 | 7 | 8.0 | 2 | 2.3 | 9 | 10.2 |
| Pronghorn | 110 | 84.6 | 19 | 14.6 | 2 | 1.5 | 20 | 15.4 |
| Turkey | 144 | 98.6 | 2 | 1.4 | 0 | 0.0 | 2 | 1.4 |
| Jackrabbit | 210 | 97.7 | 5 | 2.3 | 0 | 0.0 | 5 | 2.3 |
| Cottontail | 532 | 98.7 | 7 | 1.3 | 0 | 0.0 | 7 | 1.3 |
| TOTAL | 1085 | 91.2 | 41 | 3.4 | 4 | 0.3 | 44 | 3.7 |

| | Late Bonito | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Unbutchered Elements | | Elements Exhibiting Cut Marks | | Elements Exhibiting Percussion Marks | | Total Elements Exhibiting Butchery | |
| | n | % | n | % | n | % | n | % |
| Bighorn | 4 | 66.7 | 2 | 33.3 | 0 | 0.0 | 2 | 33.3 |
| Deer | 52 | 83.9 | 10 | 16.1 | 0 | 0.0 | 10 | 16.1 |
| Pronghorn | 94 | 73.4 | 32 | 25.0 | 3 | 2.3 | 34 | 26.6 |
| Turkey | 119 | 96.0 | 5 | 4.0 | 0 | 0.0 | 5 | 4.0 |
| Jackrabbit | 266 | 97.4 | 7 | 2.6 | 0 | 0.0 | 7 | 2.6 |
| Cottontail | 812 | 98.2 | 15 | 1.8 | 0 | 0.0 | 15 | 1.8 |
| TOTAL | 1347 | 87.1 | 71 | 4.6 | 3 | 0.2 | 73 | 4.7 |

Table 6.17: Frequency of butchery among species (listed by size) at Bc 58.

| | Classic Bonito | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Unbutchered Elements | | Elements Exhibiting Cut Marks | | Elements Exhibiting Percussion Marks | | Total Elements Exhibiting Butchery | |
| | n | % | n | % | n | % | n | % |
| Bighorn | 10 | 90.9 | 1 | 9.1 | 0 | 0.0 | 1 | 9.1 |
| Deer | 61 | 91.0 | 6 | 9.0 | 0 | 0.0 | 6 | 9.0 |
| Turkey | 4 | 100.0 | - | - | - | - | - | - |
| Pronghorn | 2 | 100.0 | - | - | - | - | - | - |
| Jackrabbit | 177 | 93.7 | 12 | 6.3 | 0 | 0.0 | 12 | 6.3 |
| Cottontail | 68 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| TOTAL | 322 | 91.2 | 19 | 5.4 | 0 | 0.0 | 19 | 5.4 |

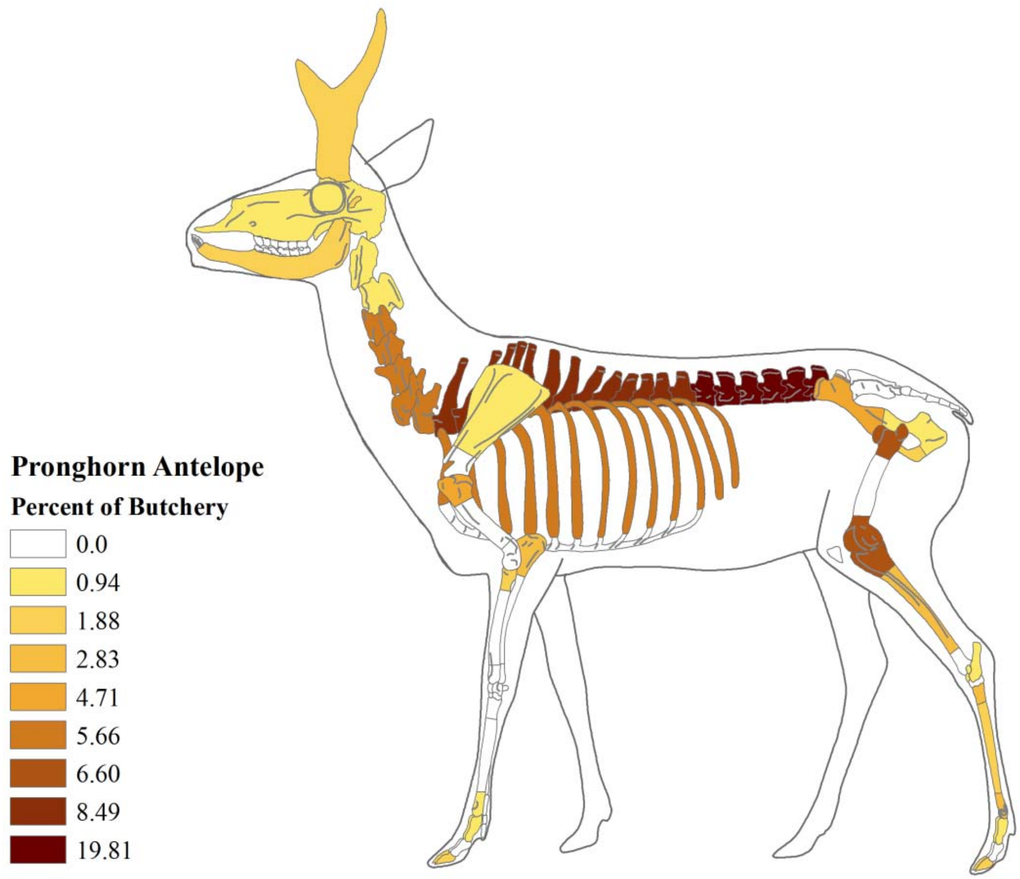



Figure 6.18: Pronghorn butchery pattern at Bc 57; after Orton (2010) and Yvinec et al. (2007).

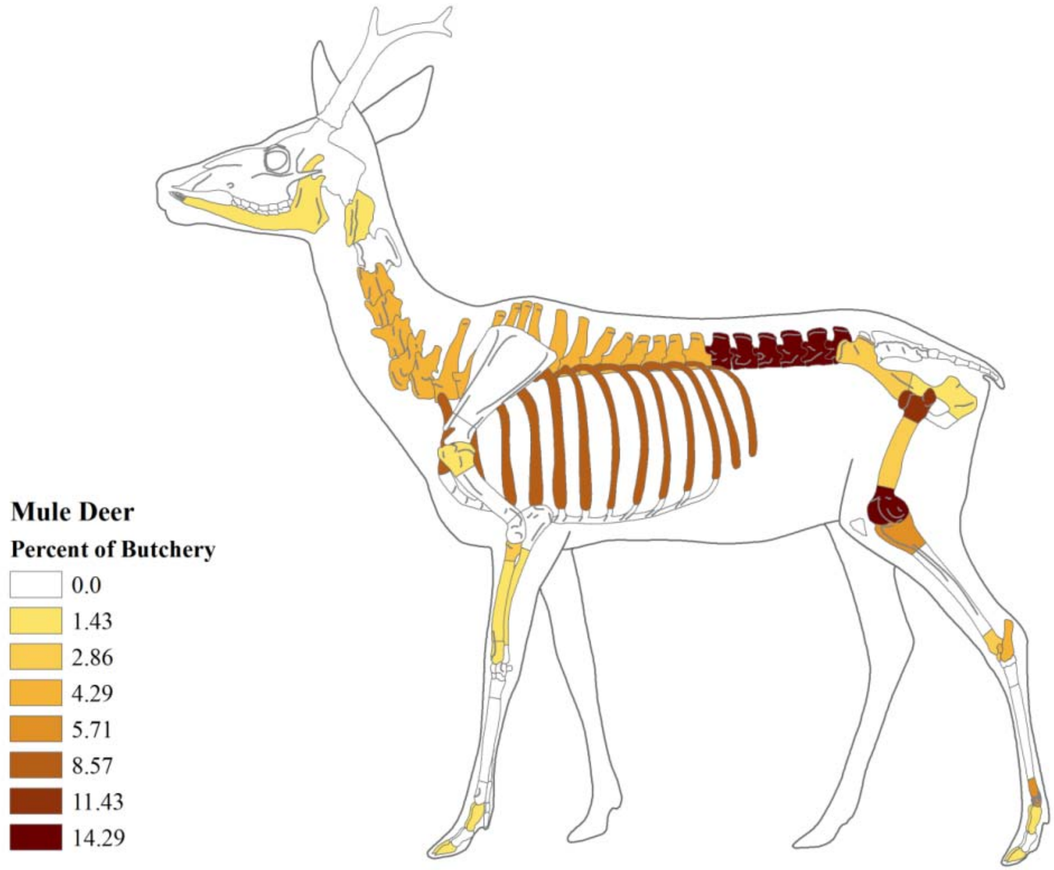



Figure 6.19: Deer butchery pattern at Bc 57; after Orton (2010) and Yvinec et al. (2007).


Figure 6.20: Examples of butchery of vertebrae at Bc 57; Early Bonito bighorn lumbar vertebrae, Room 4 (top); Late Bonito pronghorn lumbar vertebrae, Room 9 (bottom).

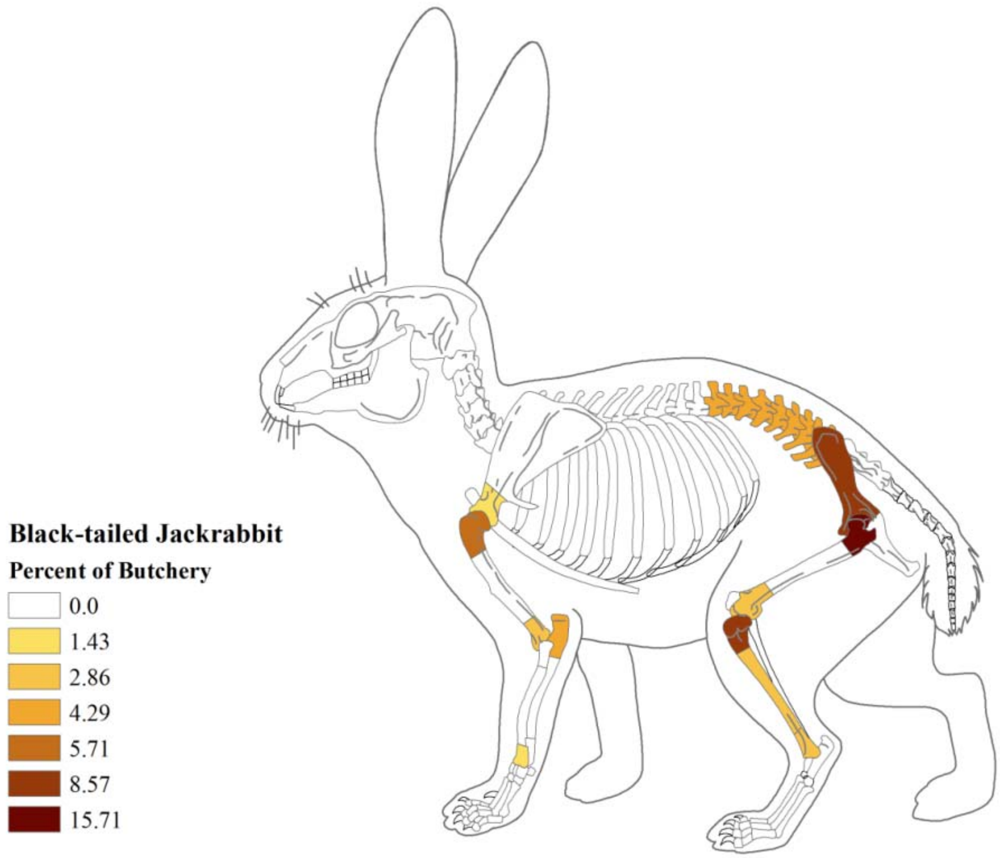



Figure 6.21: Jackrabbit butchery pattern at Bc 57; after Orton (2010) and Yvinec et al. (2007).


Figure 6.22: Examples of marrow fractures of pronghorn remains at Bc 57 from Early Bonito contexts in Room 4; distal femur also exhibits evidence of partial smoking or roasting.

positively and significantly correlated with MGUI providing strong evidence that skeletal part representation is a reflection of human economic decisions. Upon further investigation, artiodactyl remains were found to be positively and significantly correlated with meat and marrow utility indices, reinforcing the interpretation that relative abundance of artiodactyl remains is a direct reflection of dietary strategies, largely unbiased by attritional forces. Interestingly, processing of elements for marrow and grease is more pronounced during the Classic Bonito period and pronghorn remains were apparently subjected to greater fragmentation intensity. The pattern also indicates that easily accessible marrow was extracted from long bone cavities while the more labor-intensive splitting of compact lower limb bones was not pursued by the sites' inhabitants.

Early Bonito cooking techniques or at least discard practices at Bc 57 differed from that of other Chacoan sites such as Pueblo Alto and sites 627, 629, and 633. While the overall frequency of heat-altered faunal remains was roughly similar, the rate of partially smoked or roasted remains among Early Bonito deposits was markedly higher at Bc 57. The relative frequency of roasting at Bc 57 declined during subsequent periods to levels akin to other Chacoan sites. While it is possible that the greater proportion of partially smoked remains could reflect an Early Bonito culinary bias in favor of roasting animals, a potential departure from preexisting faunal refuse disposal practices could also account for the pattern. For example if, during subsequent periods, roasted remains were more frequently deposited in yet undiscovered external middens or were offered to other members of the community who then discarded the remains elsewhere one would expect a decline in the onsite presence of roasted skeletal parts. Either way it suggests that the treatment of faunal remains, whether in preparation or discard, diverged at Bc 57 during the Early Bonito subphase.

Bc 57 and Bc 58 are also exceptional among Chacoan sites for the high frequency of butchered elements. Evidence of cut marked bone is three times higher at Bc 58 and almost five times higher at Bc 57 than that observed in the Pueblo Alto great house faunal assemblage. The manner of butchery does not appear to differ significantly between artiodactyl species at Bc 57 and Bc 58 and the pattern is consistent with the apportionment of carcasses either for ease of transport or for distribution of body sections as documented by White (1962) at Zia Pueblo. Although the presence of cut marks on lower extremities is indicative of hide removal, the majority of butchery is evident along the axial skeleton and upper limbs. Processing of leporids tended to be focused on the lower axial skeleton and hind limbs and likely reflects preparation for the cooking pot. Although the rate of artiodactyl butchery appears to dip during the Classic Bonito subphase the pattern may be an artifact of increased marrow consumption and fragmentation during that period. Evidence for temporal and spatial variation in differential fragmentation is one of several questions explored further in Chapter Seven.

# CHAPTER 7: FAUNAL EXPLOITATION AND SOCIAL DIFFERENTIATION

The overall aim of this research is to determine the extent to which increasing Chacoan political centralization is reflected in patterns of faunal exploitation and changes in the organization of craft production. In this chapter I investigate the faunal record in order to identify potential temporal trends indicative of changes in social differentiation in Chaco Canyon.

In small- and intermediate-scale societies, communal ritual is a principal arena of political action and the ethnographic record attests to the importance of the intensification[9] of subsistence and craft production in support of associated feasts and ceremonies (Spielmann 2002:196-197). The material correlates of episodic subsistence intensification may include the presence of desirable food taxa (Hayden 1990:36) or distinctive patterns of skeletal element representation that reflect a bias toward high utility parts of a carcass (Jackson and Scott 1995; Kelly 2001:347-348). Based on the taphonomic analyses completed in Chapter Six, I determined the effects of density-mediated destruction of artiodactyl skeletal remains to be minimal. Thus, species and skeletal part frequencies may be interpreted as direct reflections of human behavior.

By exploring architectural data, species abundance, and skeletal part frequencies, this analysis tests the hypothesis that increasing political centralization, most pronounced

[9] Following Morrison (2006:236), I define subsistence intensification simply as an attempt to increase the concentration of production per production unit over a given time interval. Implicit is the assumption that subsistence intensification could have been a strategy undertaken within or outside the context of feasting events.

during the Classic Bonito subphase, is positively correlated with subsistence intensification and differential access.

The majority of previous faunal analyses completed on Chaco Canyon assemblages were conducted under the auspices of the Chaco Project and focused on two great houses and a cluster of small house sites in the Fajada Gap area of the canyon 5 km east of South Gap. The faunal remains from Bc 57 and Bc 58 afford, for the first time, a glimpse of faunal use spanning the Early (850-1040 CE), Classic (1040-1100 CE) and Late Bonito (1100-1140 CE) subphases among the cluster of small sites in the Casa Rinconada rincon directly across from the great houses of Pueblo Bonito, Chetro Ketl, and Pueblo del Arroyo. The close proximity (80-125 m) of Casa Rinconada, a large ceremonial structure constructed during the Classic Bonito subphase that was a likely focal point of communal ritual (Adler 1989; Adler and Wilshusen 1990; Van Dyke 2007b) emphasizes the importance of Bc 57 and Bc 58 as test cases for the study of social differentiation.

**Subsistence Intensification at Bc 57 and Bc 58**

The Early Bonito subphase (850-1040 CE) witnessed the earliest great house construction, possible early attempts at complex irrigation systems, and some of the earliest evidence for social hierarchy (Coltrain et al. 2007; Plog and Heitman 2010). The Classic Bonito subphase (1040-1100 CE), during which Chacoan building efforts and the use of complex water control methods was at its height, provides the best evidence for centralized decision-making. The late eleventh and early twelfth century transition to the Late Bonito subphase (1100-1140 CE) witnessed the proliferation of new and architecturally-distinct great house forms, an apparent expansion of great house construction into regions north of Chaco, and a steady decline in importation of exotic goods. In view of these periods of dynamic growth and structural change, what political strategies were brought to bear to mobilize labor, facilitate exchange, or integrate migrants?

The role of periodic pilgrimage fairs and large-scale communal events figures prominently in several influential models of eleventh century Chacoan sociopolitical dynamics (Toll 1985:396, 400-404; Van Dyke 2007a; 2008; Windes 1987b:561-667). Another recent study cites evidence for the elaboration of ritual and feasting during the subsequent twelfth century as a reflection of demographic change and ethnic heterogeneity in Chaco Canyon (Wills 2009:298-302). Such interpretations are based largely on the presence of distinctive architectural features such as public roasting pits or upon ceramic and material signatures that may indicate commensal feasting in great house settings. However, the possibility of similar practices in non-great house settings has not been systematically examined.

The location of these two small sites amid the densest concentration of great houses in the San Juan Basin and their position directly adjacent to an isolated great kiva makes them, for several reasons, ideal assemblages for an investigation of the roles feasting may have played in the eleventh century political centralization and twelfth century cultural transition that ushered in the McElmo phase. Several researchers have posited that great kivas were loci associated with resource redistribution, feasting, ceremonial exchange, and ritual dances (Lightfoot 1984:73; Plog 1974:127). In light of the demonstrated relationship between feasting and communal ritual (Spielmann 2002:197), the analysis of spatial and faunal trends addresses two central questions: (1)

To what extent do architectural data and patterns of faunal procurement and consumption reflect subsistence intensification and feasting behavior at Bc 57 and Bc 58?; and (2) What are the implications of feasting behavior for the tenth, eleventh and early twelfth centuries? I hypothesize that if subsistence intensification or feasting was undertaken, public food preparation facilities, an abundance of large game or communally procured small game, and an emphasis on high utility carcass parts should be evident at Bc 57 and Bc 58, particularly during the Classic and Late Bonito subphases when evidence for centralization is most pronounced.

An array of traits common to feasting behavior were outlined in Chapter Three and this study explores the degree to which several of these attributes are reflected in the archaeological record of Bc 57 and Bc 58. I first focus on the spatial patterning of food preparation facilities and faunal remains, associated artifacts, and whether deposition is associated with either public space or loci that might indicate communal food preparation. I then turn my attention to the composition of the faunal assemblage through an examination of temporal trends in the species procured and the relative abundance of skeletal elements that may reflect hunting strategies or the consumption of choice meat-bearing parts.

### *Architectural Evidence*

Among the expectations of distinctive feasting outlined in Table 3.1, large-scale provisioning is predicted to entail the use of specialized food preparation facilities. These may include structures such as roasting pits and ovens that may be located in communal or highly visible places such as plazas. Elsewhere in the Pueblo Southwest, increasing use of ovens and public roasting pits through time has been interpreted as evidence of the expanding role of feasting in social mediation during the Pueblo IV period (Lowell 1999:454-455). The use of special serving vessels has also been linked to the importance of visibility of feasting practices (Graves and Spielmann 2000; Mills 2007; Van Keuren 2004). This analysis will explore the legacy documentary record (Clark 1942; Collection 1947; Dobbin 1942; Ellingson 1942; Ellingson et al. 1942; Frome 1942; Golden 1942; Houchin 1942; Pearsall 1942b; Pierson 1942; Sullivan 1942; Sunderland 1942; Van Geem 1942), synthesized in Appendix A, for evidence of large-scale food preparation facilities to determine the extent to which the Bc 57 and Bc 58 patterns correspond to expectations for feasting behavior.

In Figures 7.1 and 7.2 a distinction is made between informal hearths and thermal features based solely on information gleaned from the excavators' descriptions. The former refer to those features explicitly identified by the excavators as temporary or informal in nature probably akin to the "circular unlined hearths" discussed by Lowell (1999:452). In a few cases excavators characterized a feature as a "fireplace," "firepit," or "hearth" as if to distinguish them from more temporary features and these are classified as thermal features in the present study. Finally, "firepits" here refer to those features that are slab-lined and/or more formalized in nature, similar to the "rectangular slab-lined hearths," "ovens," and "roasting pits," and "ceremonial hearths" described by Lowell (1999:452-458).

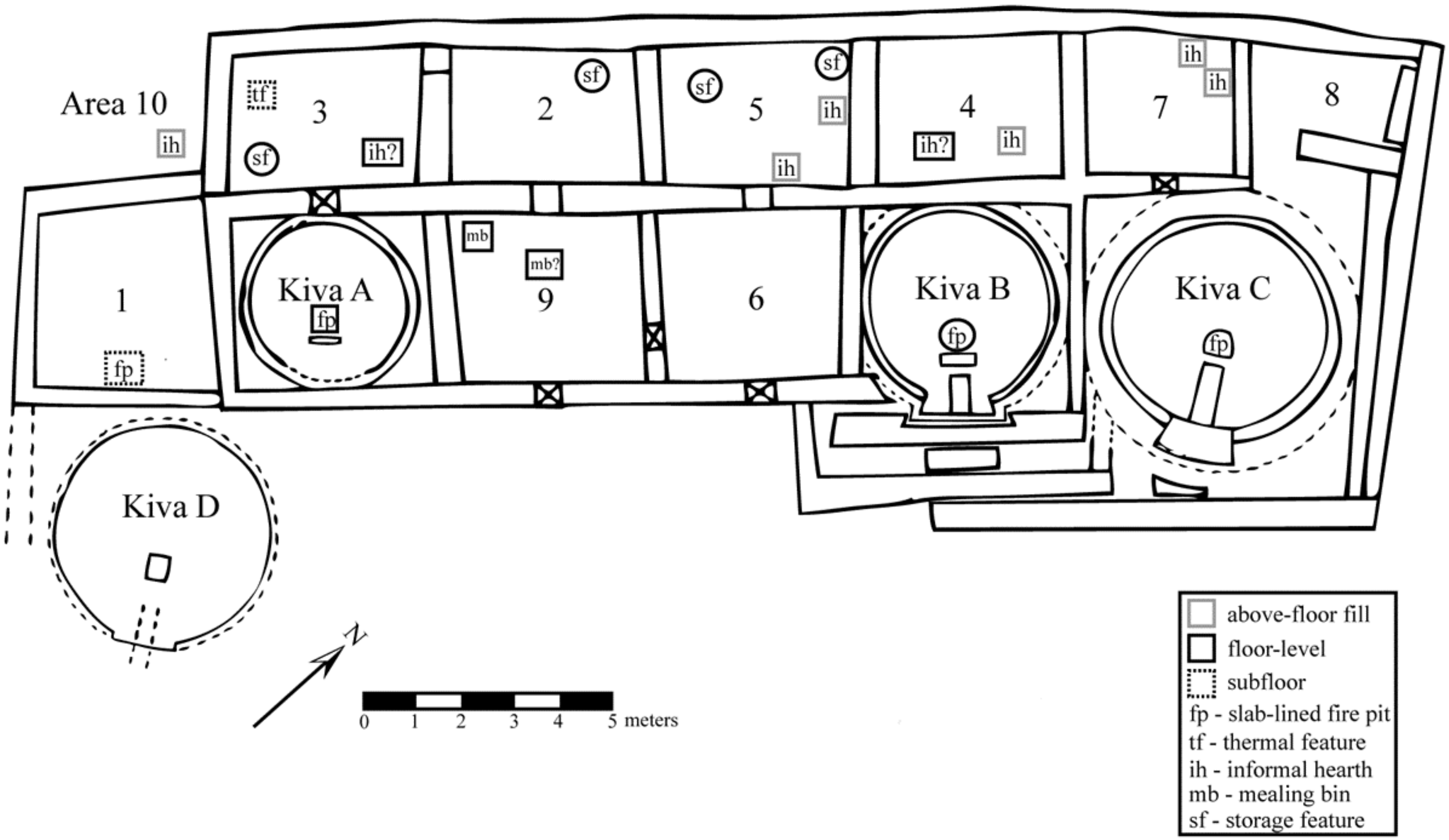



Figure 7.1: Plan of Bc 57 depicting features noted by excavators in above-floor fill, at floor-level, and in subfloor deposits.

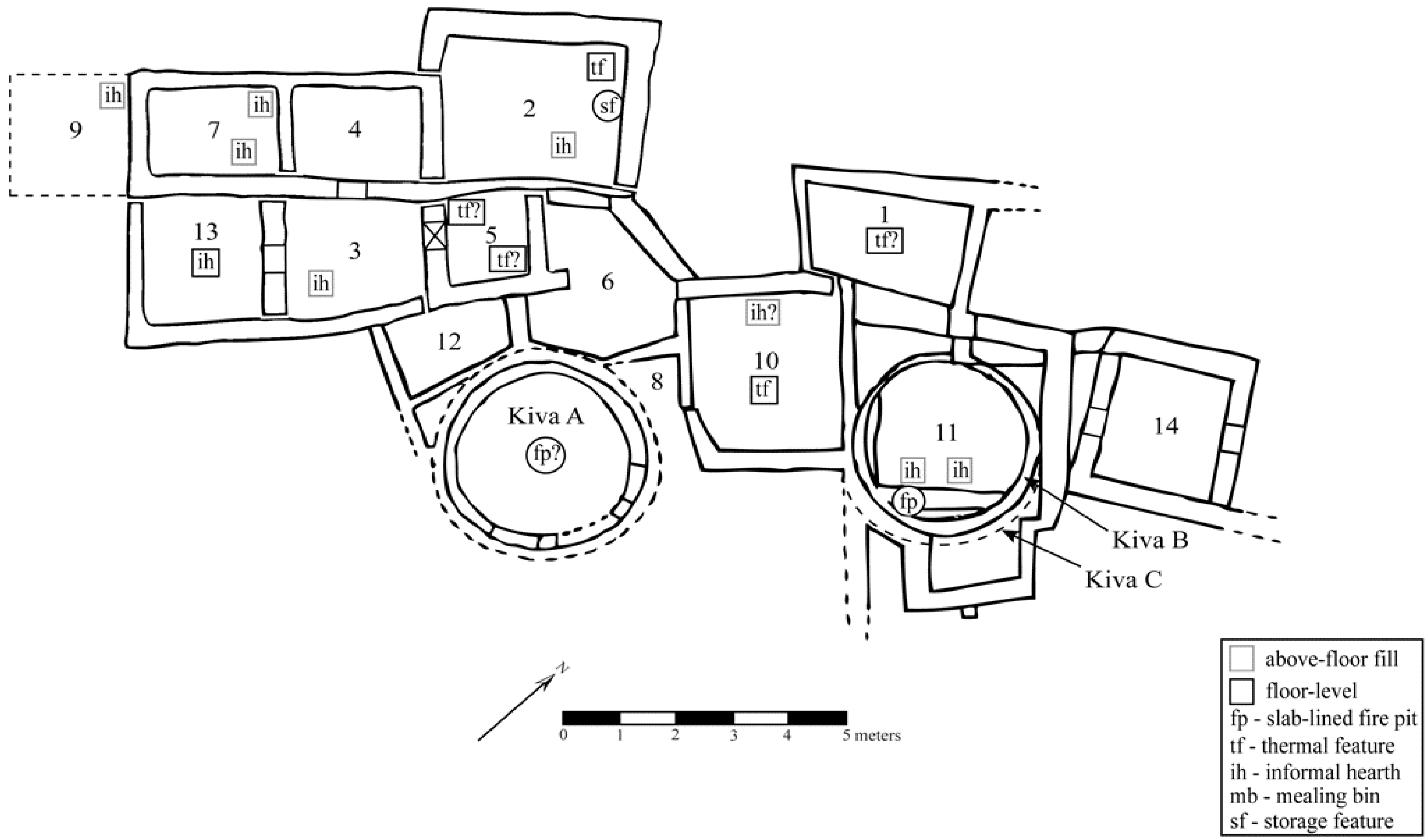



Figure 7.2: Plan of Bc 58 depicting features noted by excavators in above-floor fill, at floor-level, and in subfloor deposits.

Study of excavation field notes for Bc 57 revealed the existence of at least six informal hearths, one thermal feature, one slab-lined firepit, and three to four kiva firepits (Figure 7.1). While the latter were found within Kivas A, B, and C (no data was available for Kiva D), the slab-lined firepit was located beneath Room 1 at the southwestern end of Bc 57. The firepit, measuring 0.69 meters across and extending to a depth of 0.30 meters, was described by Dobbin (1942:7-8) as "lined by reddened sandstone slabs [with] a stone floor." When excavated, the firepit was encountered in subfloor deposits in Room 1, but as can be seen from the wall abutments in Figure 7.1, Room 1 appears to be a later addition to Bc 57 and thus the slab-lined firepit was likely at one time an extramural feature. The placement of the firepit external to the roomblock coupled with the details recorded by Dobbin approximates Lowell's (1999:452-454) typological description for a roasting pit, which she posits was associated with the roasting of meat.

The majority of informal hearths at Bc 57 were found among room fill deposits or on floor surfaces adjacent to room walls. Such features are typical of the Mesa Verde period in Chaco Canyon (Dutton 1938:93-94; McKenna 1991:132) and many of these informal hearths may represent later use of the site. The informal hearth(s) in Area 10 may be the exception. The excavator noted, "about 26 'fire sites' in [the] debris, usually with [a] broken piece of culinary ware and animal bones in association" but provided no measurements of the features' dimensions (Clark 1942:16).

At Bc 58, eight to nine informal hearths were documented by excavators and at least two, possibly as many as five other thermal features were found (Figure 7.2). One firepit "lined with stone" (0.38 x 0.28 m) was found in Room 11, built into an earlier kiva pilaster (Cornett n.d.; Reiter n.d.). It is unclear whether this firepit was rectangular in shape and whether "lined with stone" indicates that the sides were slab-lined or whether, as in Lowell's (1999:452-454) description of roasting pits, the feature's base was also lined with sandstone. Based on the small dimensions reported, the feature likely represents a domestic hearth.

The handful of hearths in rooms at Bc 58 suggest some degree of domestic activity at the site but the complete absence of any thermal features (other than informal hearths) in floor contact within square rooms at Bc 57 is at first surprising and pointed to the possibility that Bc 57 may have functioned as a storage and/or ceremonial structure rather than a domestic one. However, when placed in the context of neighboring small sites and adjusted for the number of rooms and kivas (Table 7.1), the low number of hearths at Bc 57 appears less aberrant (Chaco Research Archive 2011, Floor Feature Queries 1-14). Overall, the number of rooms exhibits a linear relationship with the frequency of thermal features, ($r^2 = 0.63$, $p = 0.06$; Figure 7.3).

Also depicted in Figures 7.1 and 7.2 are the locations and frequency of storage features. Four storage pits, features that might be associated with domestic food storage, were identified at Bc 57. Of these, one contained Mesa Verde black-on-white sherds suggesting it was used during the latest occupation. At least one, possibly two sets of mealing bins were also exposed during the excavation of Room 9. Only a single storage cist was documented for Bc 58 but this may be due to the lack of more detailed excavation notes. By comparison, at least thirteen floor-level hearths and twenty-nine storage features were recorded at Bc 50 and fourteen floor-level hearths and thirty-four storage features at Bc 51 (Chaco Research Archive 2011, Chaco Floor Feature Queries 1, 3). Again, when adjusted for the number of rooms and kivas at each site, the ratio of storage features to combined square room and kiva counts at Bc 57 (0.33) does not diverge markedly from the broader pattern ($r^2 = 0.59$, $p = 0.07$; Figure 7.3).

Table 7.1: Ratios of domestic features to combined counts of rooms and kivas among sites in the Casa Rinconada rincon.

| Site | Thermal Features / No. of Rooms | Storage Features / No. of Rooms |
|---|---|---|
| Bc 50 | 0.43 | 0.97 |
| Bc 51 | 0.27 | 0.65 |
| Bc 53 | 0.32 | 0.16 |
| Bc 57 | 0.25 | 0.33 |
| Bc 58 | 0.29 | 0.06 |
| Bc 59 | 0.17 | 0.17 |

The apparent time-depth of faunal deposits at Bc 57 and to a lesser extent Bc 58 indicates that food preparation, consumption, and discard in the area well pre-dates the construction of the roomblocks. After construction and partial abandonment of Bc 57 and Bc 58, hearths continued to be constructed and faunal refuse deposited within the walls of the structures. Bc 57 and Bc 58 are not public depositional contexts such as plaza or open midden areas but what is clear from their continued use and the presence of earlier underlying structures (Sunderland 1942:13) is that these sites, lying in proximity to Casa Rinconada, were repeatedly used for at least three centuries. The formal slab-lined roasting pit does not approach the size of the roasting pits found at the Pueblo Alto great house (1.0-1.3 m x 0.71-0.99 m) but the location and formality of the feature implies public food preparation (Windes 1987b:410-436).

Though the architectural evidence for large-scale cooking facilities is sparse, I turn now to the question of what species may have been procured, processed, and consumed at Bc 57 and Bc 58.

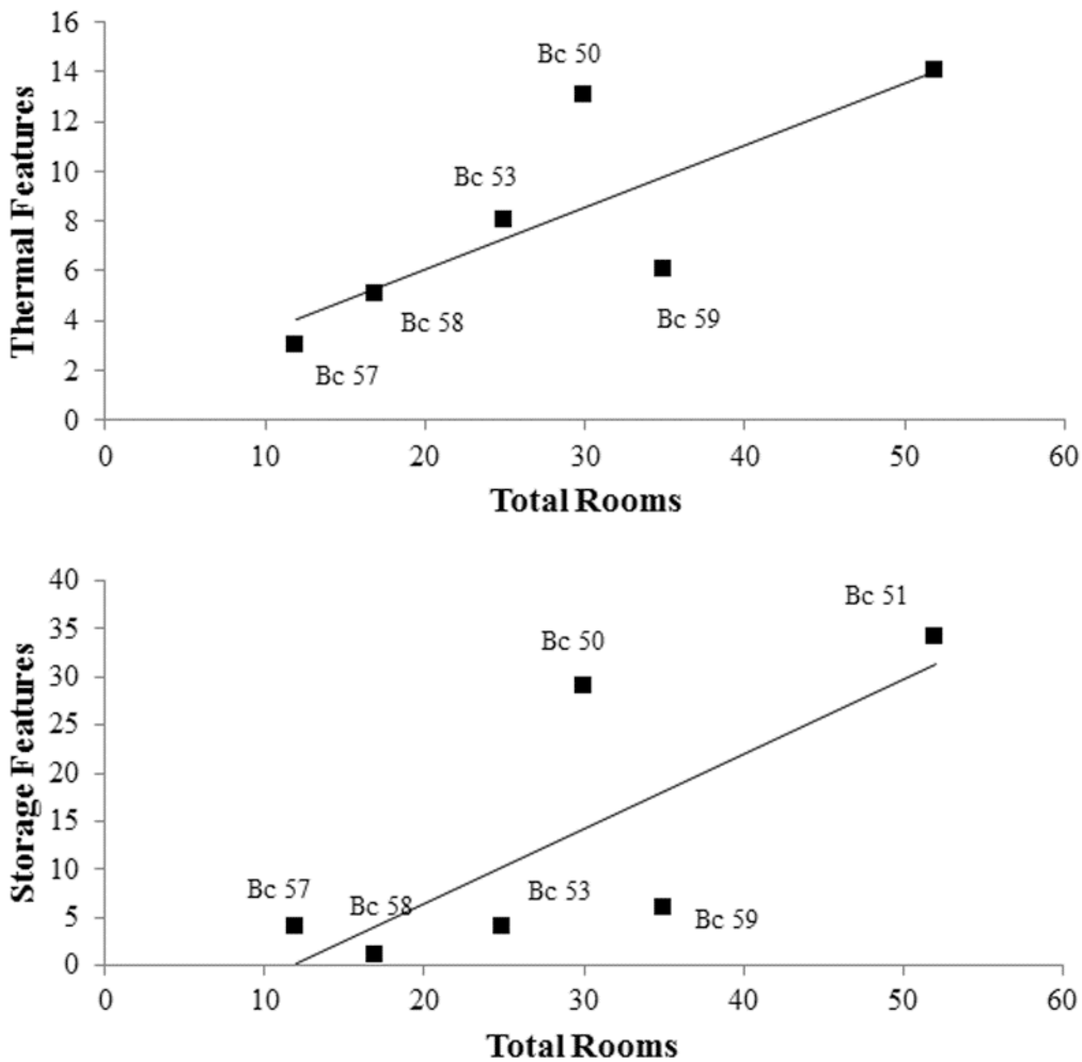



Figure 7.3: Plot of relationship between combined square room and kiva counts and both thermal features (top) and storage features (bottom) for sites in the Casa Rinconada Rincon.

### ***Species Representation***

A second potential correlate of *distinctive* feasts is an emphasis on species capable of feeding a large number of people. High relative abundance of large game is commonly interpreted as an indication of feasting or subsistence intensification (Dean 2001; Grimstead and Bayham 2010:859; Jackson and Scott 2003; Kelly 2001; Potter 1997; 2000). Historically among the Pueblos, jackrabbits were procured through cooperative hunts organized in conjunction with communal ritual (Hill 1982; Ortiz 1969:112; Parsons 1925:94-95; 1936:277-278; Titiev 1944:185, 191).

Beginning with a comparison of trends in faunal use at Bc 57 with that of Chaco and the broader Southwest, I calculate two measures, the Artiodactyl Index and the Lagomorph Index. The Artiodactyl Index (Spielmann and Angstadt-Leto 1996; Szuter and Bayham 1989), calculated as the sum of artiodactyls and large mammals divided by the sum of artiodactyls, large mammals, and leporids, measures the importance of large game (deer, pronghorn, and bighorn) relative to small game (jackrabbit and cottontail). High AI values signify greater reliance on artiodactyls.[10]

*Hunting Strategies at Bc 57 and Bc 58: Artiodactyl Procurement*

Compared with faunal trends in Chaco and the broader Southwest, the patterns at Bc 57 and Bc 58 are remarkable for the heavy reliance on artiodactyls, in particular pronghorn and mule deer. Figure 7.4 compares the Bc 57 and Bc 58 frequencies with the

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[10] In a recent study of the faunal remains from the Five Finger Ridge site, Fisher (2010:116-118) found a positive correlation between AI values and density-mediated destruction of leporid remains. In contrast, Ugan (2005:239-240) determined that changes in AI values at the Evans Mound and Median Village sites were unaffected by leporid fragmentation but rather exhibited a positive correlation with fragmentation of artiodactyls. Thus although the relationship remains poorly understood, the impact of density-mediated attrition on AI values should not be discounted.

results of recent research by Badenhorst and Driver (2009) that documents a general trend toward decreasing artiodactyl exploitation over time across the Southwest.

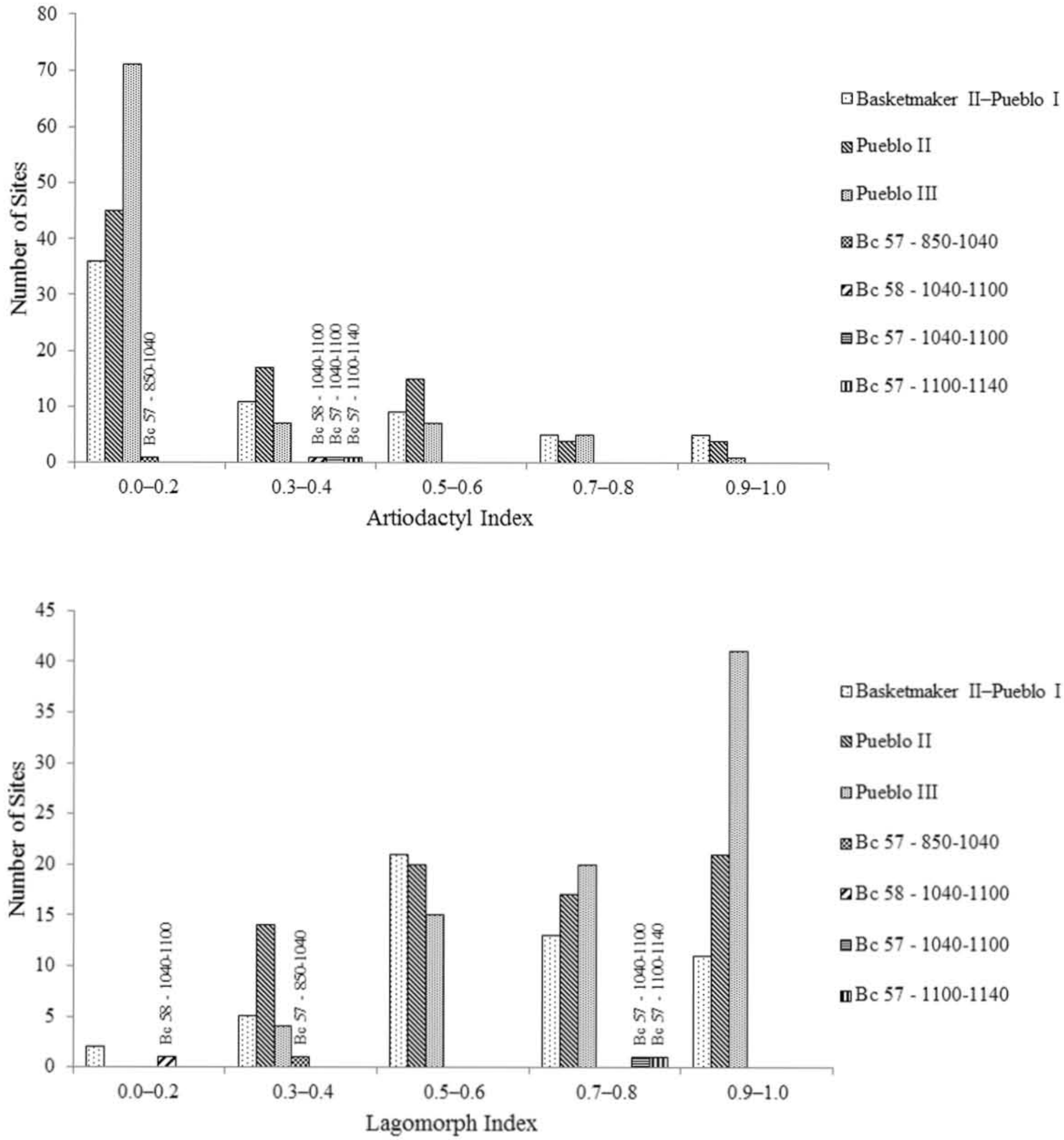


Figure 7.4: Artiodactyl Index and Lagomorph Index over time in the American Southwest with Bc 57 and Bc 58 values shown for comparison; Artiodactyl Index (top); Lagomorph Index (bottom); (partially based on Badenhorst and Driver 2009).

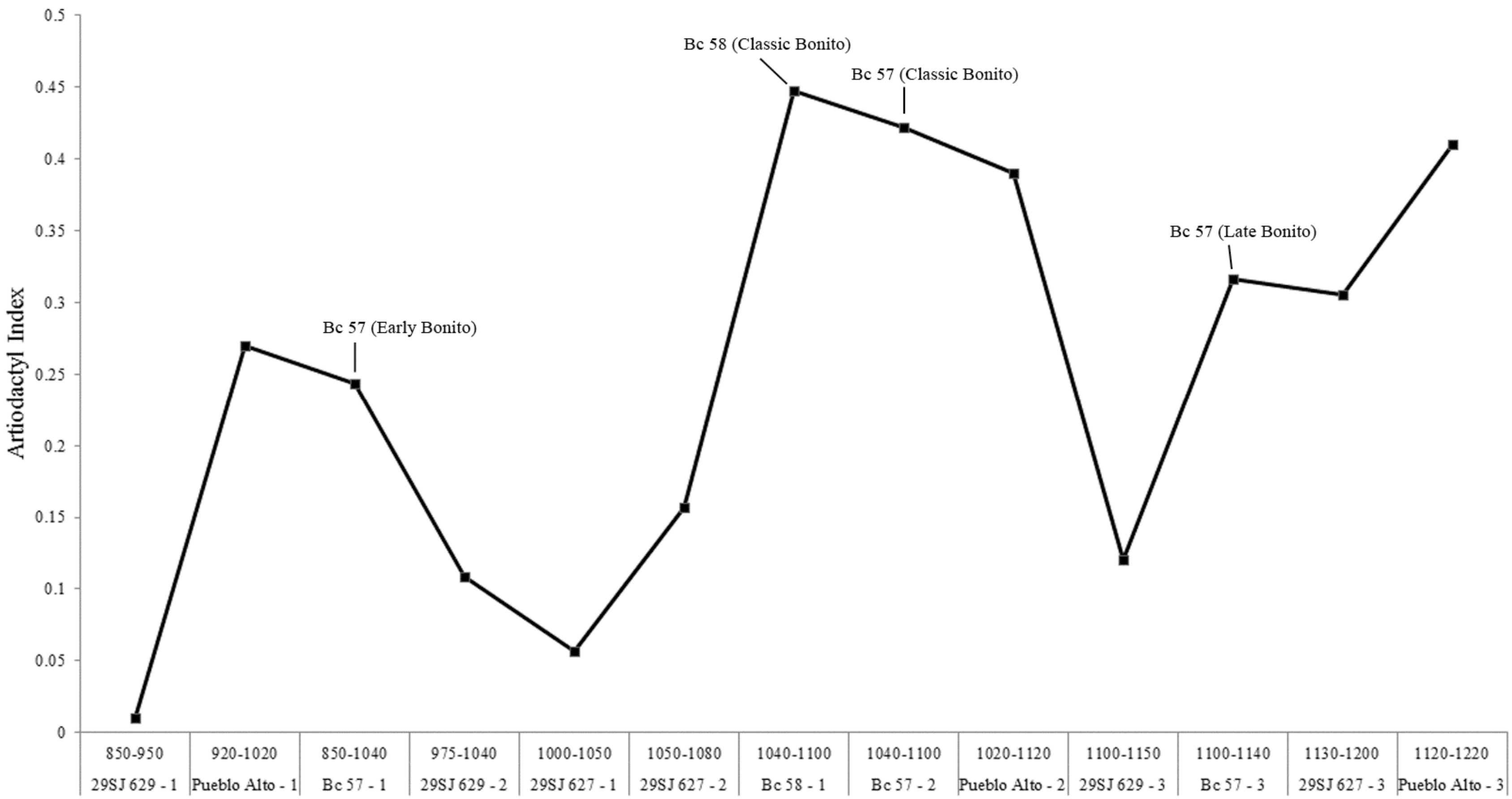


Figure 7.5: Artiodactyl Index by site over time for Bc 57, Bc 58, 29SJ 627, and Pueblo Alto. Pueblo Alto data are based on Durand and Durand (2008:100). Note: Based on available data AI values for 29SJ 627 and 29SJ 629 could be calculated for specimens identified to genus or species only.

An abundance of high-ranked or large fauna has been interpreted by some researchers as characteristic of feasting (Dean 2001; Grimstead and Bayham 2010:859; Potter 1997:354; 2000:475). Debate exists over whether large game procurement is a pursuit with a high caloric return rate (Broughton and Bayham 2003:784; Cannon 2000; 2003) or conversely is of low economic value and thus constitutes evidence of costly signaling behavior (Hildebrandt and McGuire 2002; 2003; McGuire and Hildebrandt 2005; McGuire et al. 2007). Grimstead (2010:75) has shown that although cost varies largely as a function of distance traveled in procurement, the high caloric return for large game justifies forays of even long distances (50 km or more). In ethnographic feasting examples such as the *kula* (Lepowsky 1983:200; Liep 1983:513-515) and *potlatch* (Romanoff 1992:224-225, 248, 253) the relative success of competitive feasts is predicated upon a feast-giver's ability to furnish guests with desirable, rare, or labor-intensive foods (Hayden 1990:36). Therefore, regardless of whether it represents optimal foraging behavior or costly signaling, artiodactyl procurement would have been crucial to large-scale provisioning and the ability to consistently obtain large game resources likely accorded prestige to an individual or group of hunters.

As predicted, consumption of large game increased noticeably at Bc 57 – Artiodactyl Index (AI) values nearly double from the Early Bonito (0.24) to Classic Bonito (0.42) period. AI values at Bc 57 and Bc 58 conform to the prevailing Pueblo II and Pueblo III temporal trend in that artiodactyl consumption decreases slightly during the Late Bonito subphase from an AI of 0.42 to 0.32 but values remain high relative to the majority of sites reported by Badenhorst and Driver (2009). Thus the levels of

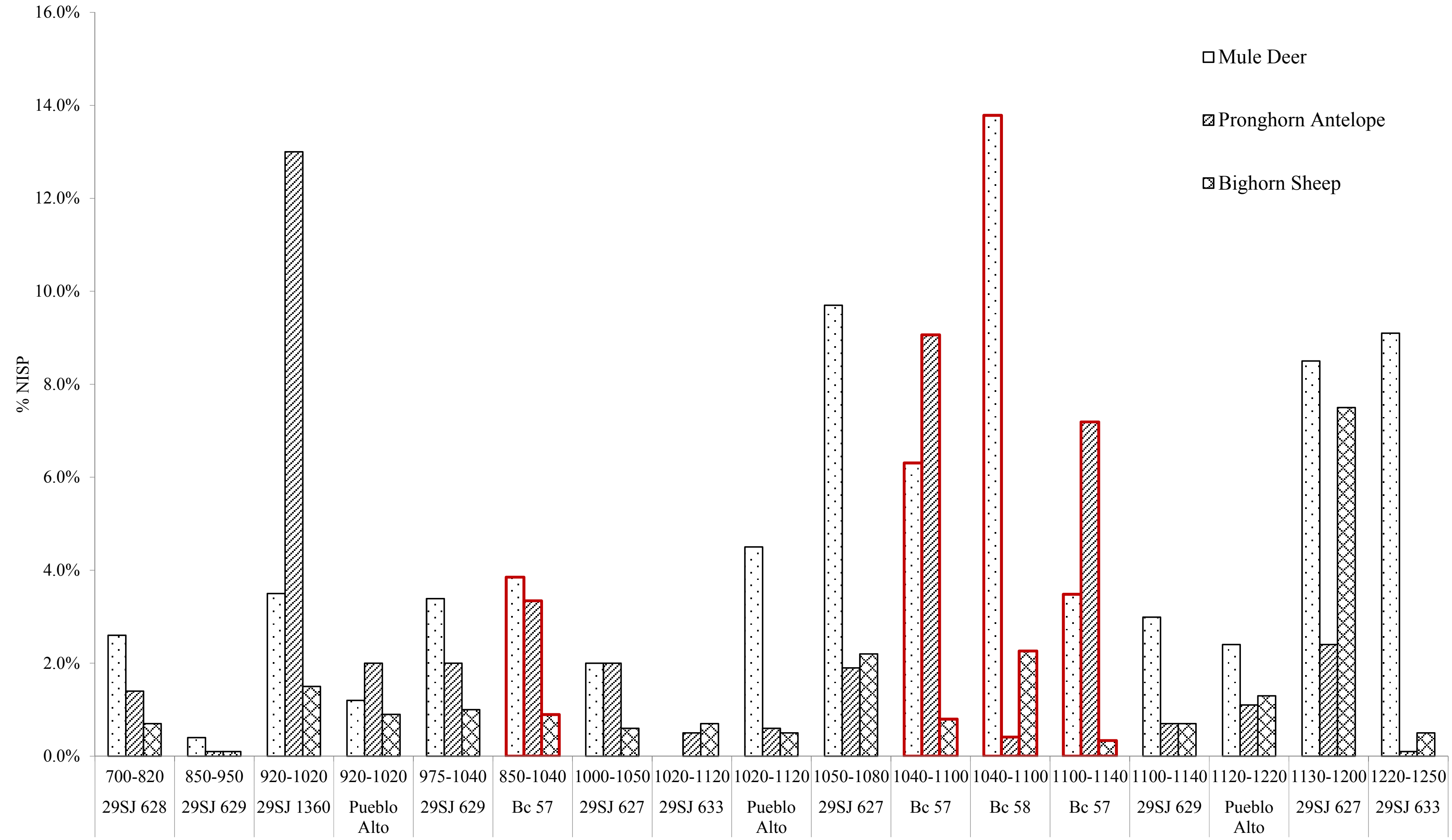


Figure 7.6: Artiodactyl percent NISP over time for Chaco Canyon sites (data for Chaco Project excavated sites based on Akins 1985).

artiodactyl consumption at Bc 57 and Bc 58, high even by Chacoan standards, were sustained throughout the Classic and Late Bonito subphases.

As reflected in Figure 7.5, the emphasis on artiodactyl procurement in Chaco suggests that Pueblo II and Pueblo III hunting practices at certain Chacoan sites were somewhat atypical of the pattern seen elsewhere in the Southwest. Although some researchers, e.g., Speth and Scott (1989), have argued that increased long-distance hunting of large game is often a response to the depletion of locally available game, if this were the case in Chaco such behavior might be expected to a similar extent across all sites. The high degree of variation visible in Figure 7.5 indicates otherwise and AI values at Bc 57 and Bc58 (0.45) are among the highest in Chaco, comparable only to those of the Alto great house and the late twelfth century component at the contemporaneous small site 29SJ 627.

Closer examination of artiodactyl procurement among sites within Chaco Canyon reveals that early twelfth century hunting strategies differed measurably between the Fajada Gap site cluster, Pueblo Alto, and Bc 58 on one hand and Bc 57 on the other (Figure 7.6). While the Late Pueblo I-Pueblo II (920-1020 CE) occupation at site 1360 in Fajada Gap exhibits a pronounced emphasis on pronghorn antelope (13 percent of the identified assemblage), subsequent levels of pronghorn among the neighboring sites (627, 629, and 633) remain low (3 percent or less). Thus the heightened focus on pronghorn at Bc 57 during the Classic and Late Bonito subphases (approaching 9 percent) contrasts with the broader canyon-wide trend. Deer consumption at these three Fajada Gap sites hovers around 10 percent for the Late Pueblo II-Pueblo III periods. Although Bc 58 (1040-1100 CE) exhibits a similarly high dependence on deer, the emphasis at Bc 57 was relatively low. The overall pattern at Bc 57 and Bc 58 of a Classic Bonito increase in artiodactyl procurement and high AI values sustained through Late Bonito corresponds to that documented for Pueblo Alto but differs in the apparent long-term focus on pronghorn at Bc 57.

The Bc 57 pattern deviates from previous reconstructions by Akins (1984; 1985:408-409). Because these previous studies privilege the Marcia's Rincon small sites, they portray a late eleventh/early twelfth century hunting strategy biased toward mule deer. In fact the observable trend led Vivian et al. (2006:450) to posit that the increasing population density in Chaco during Classic Bonito had prompted hunters to travel farther afield in search of deer and bighorn while cooperative hunting of pronghorn was on the decline. On the contrary it would appear based on the evidence from Bc 57 that pronghorn procurement was *intensified* through the Classic and Late Bonito subphases. Vivian et al. (2006:455) do in fact note the Late Bonito rise in pronghorn visible in Figure 7.6, but nevertheless, the frequency of pronghorn at Bc 57 greatly exceeds previously documented levels.

As discussed in Chapter Five, the presence of species such as pronghorn that are best obtained through cooperative hunting can be indicative of large-scale provisioning. Besides pronghorn a few other species in the Chaco region are well-suited for procurement through collaborative hunting. According to ethnohistoric accounts, communal hunting of local jackrabbit, cottontail, and coyote populations was often organized in conjunction with communal ritual and was observed at several pueblos including Hopi, Zia, San Juan, Santa Clara, and Jemez (Hill 1982; Ortiz 1969:112;

Parsons 1925:94-95; 1936:277-278; Titiev 1944:144, 185, 188-192; White 1962:226-227, 301-302).

*Hunting Strategies at Bc 57 and Bc 58: Leporid Procurement*

Shifting my focus to the hunting of leporids (cottontail and jackrabbit), use of Lagomorph Index (LI) values offers another useful means of assessing inter-site variability in faunal procurement. Communal hunts in support of ritual feasting that specifically targeted jackrabbits are expected to be reflected in ratios of cottontail to jackrabbit. The ratio has long been recognized as a useful measure of shifting trends in hunting and anthropogenic changes in the environment (Anyon and LeBlanc 1984; Bayham and Hatch 1985:423; Dean 2007b; Hayes and Lancaster 1975:185). LI is calculated by dividing the number of cottontail specimens by the sum of all cottontail and jackrabbit specimens. Following Driver and Woiderski (2008:6-7), loose teeth are excluded from the NISP counts used to calculate LI values.

Research has shown that the environment, specifically greater vegetative cover found at the higher elevations of the northern southwest, impacts natural ratios of cottontail and jackrabbit (Szuter and Gillespie 1994). As a result, the ratios observed archaeologically among assemblages from Chaco and sites on the Colorado Plateau tend to be biased toward cottontails while jackrabbit tends to predominate among sites of the southern Southwest (Szuter and Gillespie 1994:70-71). Although Szuter and Bayham (1989) have argued convincingly that increasing density and duration of human occupation results in lower ratios of cottontail:jackrabbit at sites in the southern southwest, the reverse has been found for Pueblo sites of the northern southwest (Driver 2002b:157; Driver and Woiderski 2008:8-9). Data from the Colorado Plateau indicate that cottontail:jackrabbit ratios vary in direct relationship with the density of human settlement and intensity of agriculture; cottontail frequencies increase with population growth and greater area under cultivation. Driver and Woiderski (2008:8) suggest several possible reasons for this pattern, principal among them possible anthropogenic changes to the local environment around villages and agricultural fields that may promote cottontail survival while diminishing jackrabbit reproductive success. Further complicating interpretations, high rates of jackrabbit procurement found archaeologically have been linked to communal hunting (Driver and Woiderski 2008:8; Schmidt 1999).

Given the extent to which local ecology impacts natural abundance of cottontail and jackrabbit, consideration of the Chaco environs is critical to an accurate interpretation of LI values. In Chaco, leporid hunting likely took place within the canyon bottom and adjacent areas such as the Gallo Wash, Fajada Gap, and South Gap (cf. Grimstead 2011). In contrast to the northern San Juan areas examined by Driver (2002b) the canyon generally lacks pinyon-juniper woodland vegetation below the higher elevation areas of Chacra Mesa (Cully and Cully 1985:53; Hall 2010:242) and is more akin to the Southern Arizona desert scrub biomes studied by Szuter and Bayham (1989) that support a range of grasses, forbs, and shrubs. Swaths of land cleared for farming and the areas around villages and farmsteads would have encouraged the growth of jackrabbit populations (1989:263). With the exception of greasewood (*Sarcobatus vermiculatus*) which has a relatively fast rate of growth, common canyon-bottom shrubs and grasses such as mound saltbush (*Atriplex obovata),* four-wing saltbush (*Atriplex canescens*), and galleta (*Pleuraphis jamesii*) have relatively slow growth rates. Following land clearing or field abandonment the slow rate of recovery of perennial shrubs on which cottontails rely for cover would have favored jackrabbit survival (Driver and Woiderski 2008:8-9). If the anthropogenic environment-leporid dynamic in Chaco can be expected to follow the Southern Arizona pattern, increasing cottontail:jackrabbit ratios may indicate lower population densities, decreasing amounts of land under cultivation or simply hunting forays into areas subjected to lower intensity land-use. Conversely, and most relevant to the issue of feasting, lower LI values could reflect either communal drives or hunts undertaken in and around intensively utilized areas.

Table 7.2: Lagomorph Index (LI) values for Chaco Canyon assemblages.

| Site | Time Period (CE) | Lagomorph Index (LI) |
|---|---|---|
| 29SJ 519 | ca. 650 | 0.59 |
| 29SJ 629 - 1 | 850-950 | 0.58 |
| Pueblo Alto - 1 | 920-1020 | 0.59 |
| 29SJ 629 - 2 | 975-1040 | 0.25 |
| Bc 57- 1 | 850-1040 | 0.46 |
| 29SJ 627 - 1 | 1000-1050 | 0.51 |
| Pueblo Alto - 2 | 1020-1120 | 0.57 |
| 29SJ 627 - 2 | 1050-1080 | 0.23 |
| Bc 57 - 2 | 1040-1100 | 0.70 |
| Bc 58 | 1040-1100 | 0.23 |
| Bc 57 - 3 | 1100-1140 | 0.73 |
| 29SJ 629 - 3 | 1100-1140 | 0.41 |
| Pueblo Alto - 3 | 1120-1220 | 0.49 |
| 29SJ 627 - 3 | 1130-1200 | 0.26 |

The greater Southwest pattern is characterized by an upward trend in LI values over time indicating increasing reliance on cottontail (Figure 7.4), and Bc 57 conforms to this trend (Badenhorst and Driver 2009:1835). Classic (0.70) and Late Bonito (0.73) LI values for Bc 57 are by far the highest observed for Chaco with the next closest being Pueblo Alto at 0.49 (Table 7.2). However, deposits from Bc 58 dating to the Classic

Bonito subphase exhibit one of the lowest LI values recorded (0.20), comparable to that seen at contemporaneous site 29SJ 627 (0.22).

Unlike the high frequency of pronghorn observed for Bc 57, the high cottontail frequency is not consistent with communal hunts. Instead, the Fajada Gap sites and Bc 58 appear as the more likely candidates for communal hunting of jackrabbit. That the Bc 57 LI values stand in such contrast to that of other contemporaneous sites including great houses implies an alternative procurement strategy. If rabbit hunts by the inhabitants of these other sites occurred in more disturbed areas such as agricultural fields, one would expect other indications of hunting forays in and around such areas. The presence of prairie dogs, ground squirrels, and pocket gophers, likely trapped as field pests, is one useful proxy measure of "garden hunting" behavior (Driver 2002a; Neusius 2008:305-306). In fact, the combined percent NISP for these species is low for Bc 57 (9.5 percent) compared with contemporaneous assemblages from Pueblo Alto (12.8 percent), 629 (21.3 percent), 627 (31.2 percent), and Bc 58 (13 percent). Low LI values and higher frequencies of garden taxa points to garden hunting at other Chacoan sites but the practice is unlikely to have generated the patterns observed at Bc 57. While the low LI value for Bc 58 is congruous with mass procurement, the high frequency of cottontails at Bc 57 highlights yet another anomalous attribute of the Bc 57 assemblage. Finally, the observed patterns do not completely preclude the possibility of communal rabbit hunts at either site although it may be more likely among the Fajada Gap and Bc 58 site inhabitants.

The parallels in resource utilization between Bc 58 and sites 627 and 629 simultaneously reinforce the general coherence of the Classic Bonito subphase hunting practices documented by Akins (Vivian et al. 2006:449-450) and underscore the exceptional nature of the Bc 57 assemblage. The temporal trend toward an emphasis on artiodactyls at Bc 57 and Bc 58 and the increasing procurement of pronghorn at the former lend support to the interpretation that large-scale provisioning was a subsistence strategy employed during the Classic and Late Bonito periods.

If artiodactyl hunting was undertaken as a form of subsistence intensification in support of feasting, the question remains whether skeletal part frequencies reflect the differential transport of or access to ruminant carcasses.

### *Skeletal Part Representation*

Skeletal part distributions can be useful indicators of transport decisions, processing patterns, and differential access. The distance traveled in search of game, the transport time, and size of prey are important factors determining which skeletal components are discarded in the field and those that are carried back to a residential site for consumption. When energetic costs are a primary concern, greater field processing and selective transport of elements is expected with increasing time and distance, a tendency commonly referred to as the "schlepp effect" (Lupo 2006; Metcalfe and Barlow 1992:353; Perkins and Daly 1968).

However, in order to isolate these factors as the underlying sources of variation in skeletal abundance it must first be demonstrated that density-mediated attrition was not a major factor impacting an assemblage. Comparison of artiodactyl skeletal-part survivorship with bone mineral density values in Chapter Six demonstrated that relative abundance of artiodactyl remains is in fact a direct reflection of dietary strategies, largely unbiased by attritional forces. Moreover, skeletal part frequencies were positively and significantly correlated with meat, marrow, and grease utility indices.

As proposed by Binford (1978), the transport strategy responsible for distribution of skeletal elements encountered archaeologically can be identified by examining the relationship between the relative utility of a given anatomical part and the frequency of that part in the assemblage. If observed skeletal element frequencies are a function of energetic costs or preferential access to prime cuts, relative abundance of anatomical parts would be expected to display an emphasis on high utility parts, a pattern Binford (1978:81) described as "gourmet utility" (Figure 7.7). Conversely, if largely whole carcasses including parts of both high and moderate utility were transported from the kill-site and parts of only the very lowest utility were abandoned, skeletal part frequencies at the destination site are expected to reflect either a "bulk utility" profile.

Given these expectations, skeletal part frequencies from Bc 57 and Bc 58 as well as contemporaneous small house sites 627 and 629 will be examined to determine how transport of carcasses varied by species, through time, and between sites. Skeletal part frequencies will be assessed using plots of %MGUI vs. %MAU and graphical representations of relative skeletal abundance. Chi-square comparisons of NISP by species and time period will then permit a more fine grained study of skeletal part frequency, highlighting those elements that deviate significantly from expected counts.

*Skeletal Part Frequencies at Bc 57 and Bc 58*

The analysis of skeletal part representation at Bc 57 and Bc 58 begins with an assessment of the extent of inter-species differences in artiodactyl skeletal part frequencies and how these distributions of skeletal parts changed through time at Bc 57 and Bc 58.

Figures 7.8, 7.9, and 7.10 depict the relationship between relative utility (%MGUI) and relative skeletal abundance (%MAU) for three artiodactyl species through the Early, Classic, and Late Bonito subphases at Bc 57 and Bc 58. Comparing these utility curves with the idealized signatures in Figure 7.7, it is clear that in nearly every case, the relationships indicate either a bulk utility or unbiased transport strategy. The "reverse utility" curves so common archaeologically at residential sites and often interpreted as indicative of density-mediated attrition are seen in only two cases, for deer during Late Bonito at Bc 57 and Classic Bonito at Bc 58 (Grayson 1989; Lyman 1985; Marean and Frey 1997). Though contrary to what might be expected for a heavily fragmented assemblage, when these two assemblages were compared with bone mineral density they exhibited a negative but insignificant correlation. Most importantly for the question of transport and differential access, in no instance do the utility curves reflect a gourmet strategy thus indicating that the representation of skeletal elements at Bc 57 and Bc 58 is *not* consistent with either transport bias or preferential access to high utility skeletal parts. Graphical comparison of skeletal part frequencies reinforces the patterns portrayed by the utility curves.

The standardized number of identified specimens (NNISP) is employed to depict skeletal part frequencies. This measure is calculated by dividing the number of identified specimens (NISP) for each element by the number of times the element is represented in the body. NNISP values were then converted to percentage values (%NNISP) by dividing each skeletal part by the greatest observed NNISP value (skeletal part NNISP/maximum NNISP).

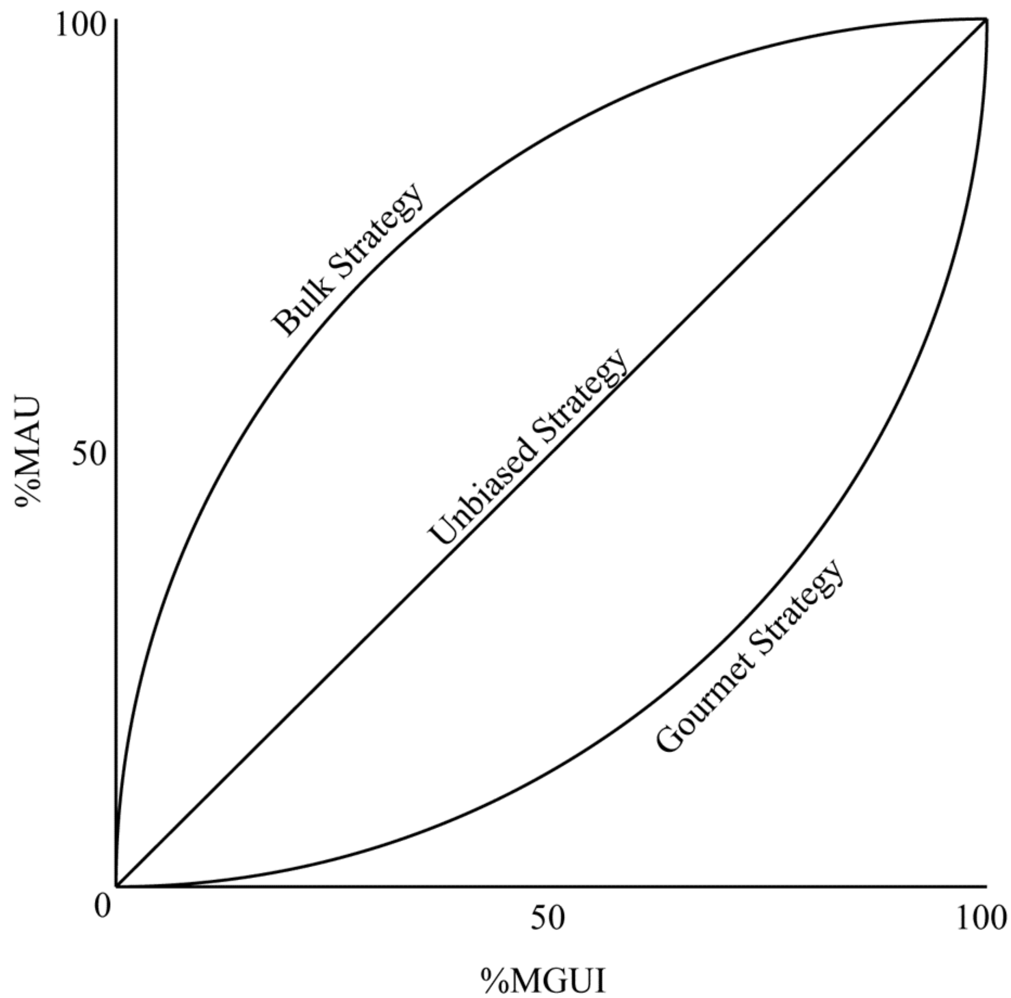


Figure 7.7: Predicted relationship between utility and skeletal part frequency based on Binford’s (1978) transport strategy model (after Metcalfe and Jones 1988:496).

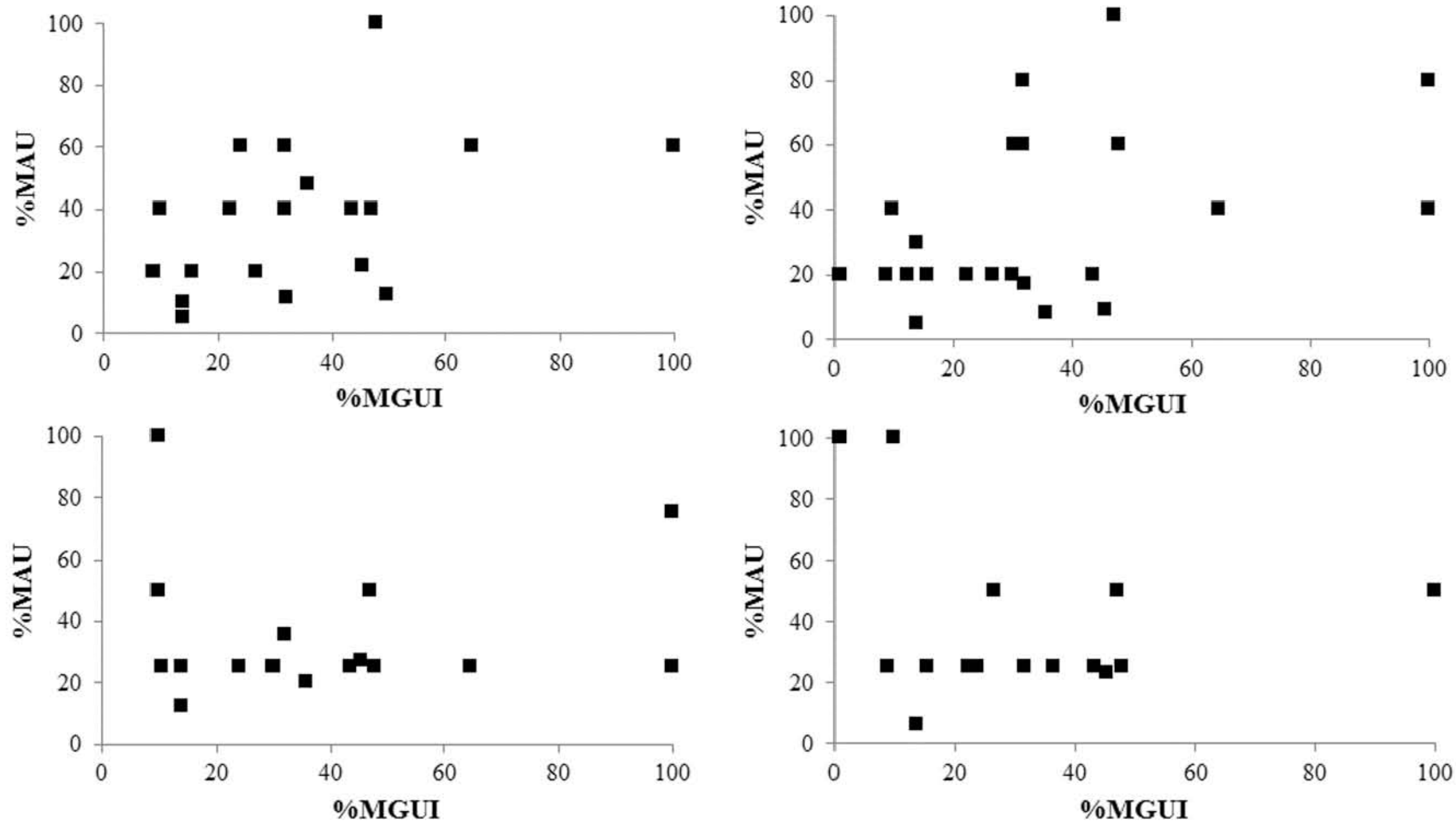


Figure 7.8: Relationship between %MGUI and %MAU for deer by time period at Bc 57 and Bc 58; Bc 57 - Early Bonito (top left), Bc 57 - Classic Bonito (top right), Bc 57 - Late Bonito (bottom left), Bc 58 – Classic Bonito (bottom right).

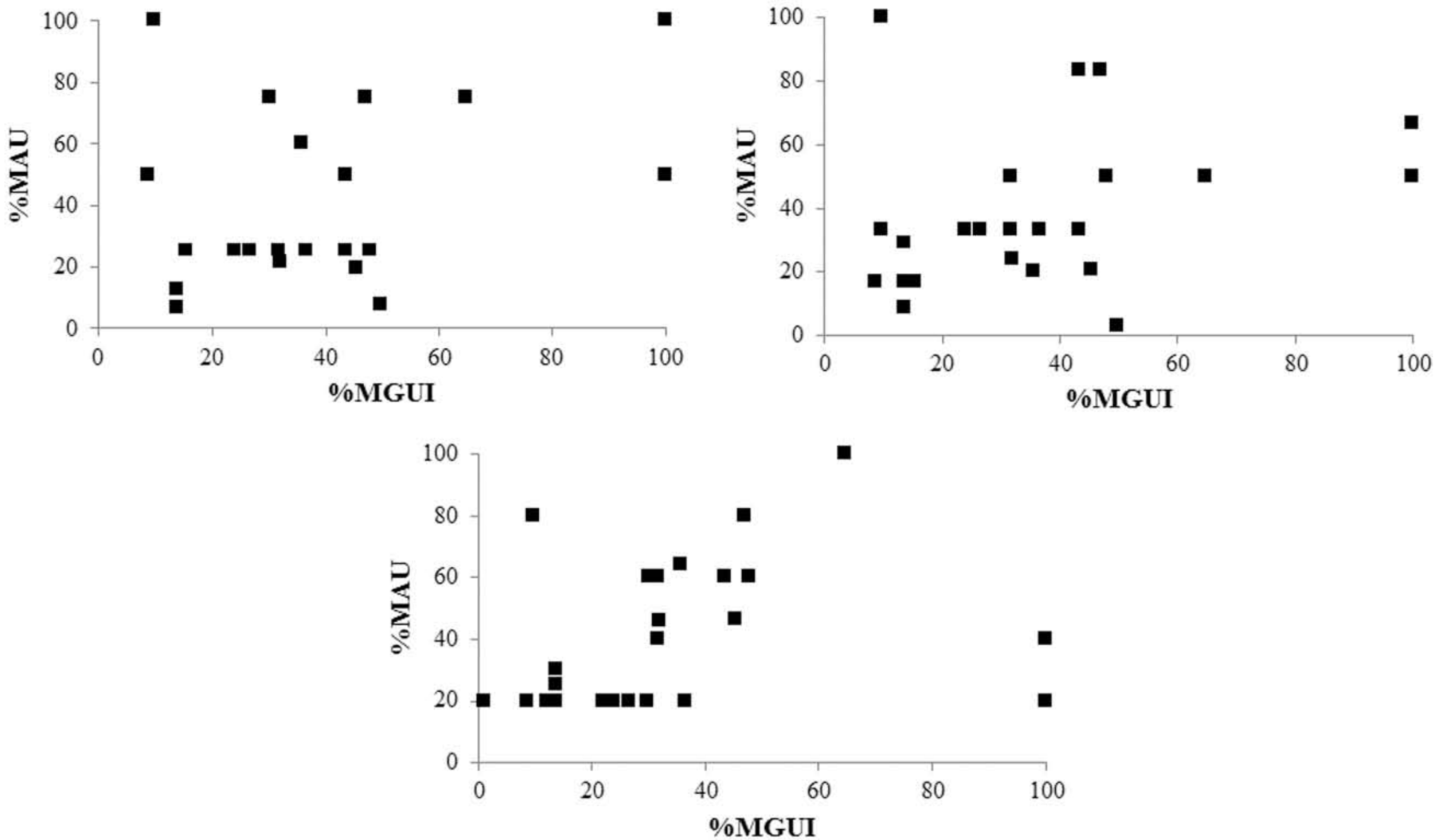


Figure 7.9: Relationship between %MGUI and %MAU for pronghorn by time period at Bc 57; Early Bonito (top left), Classic Bonito (top right), Late Bonito (center).

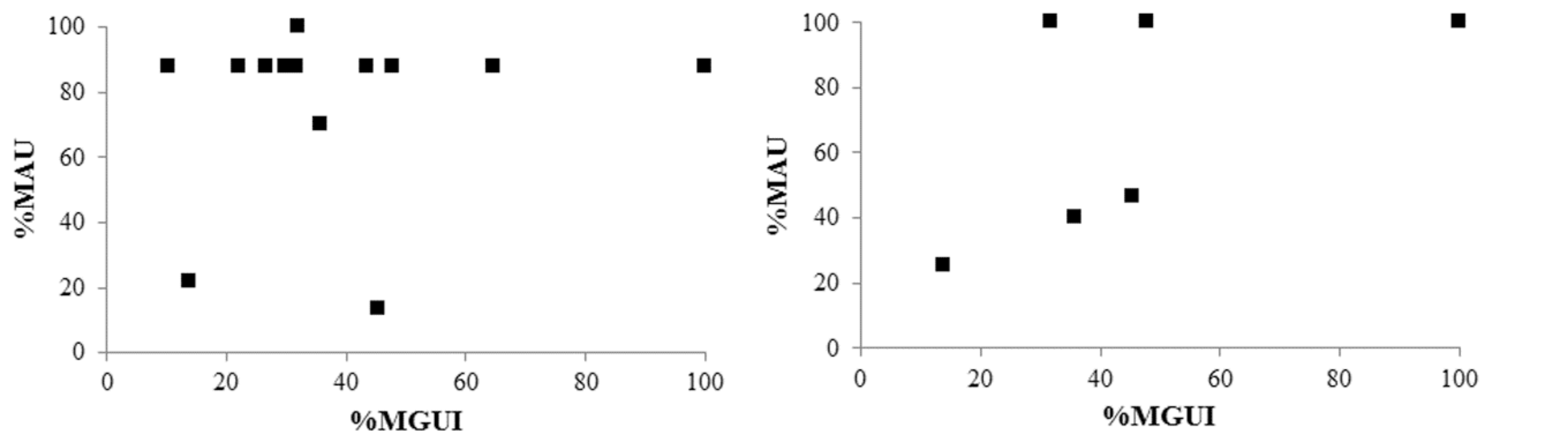


Figure 7.10: Relationship between %MGUI and %MAU for bighorn by time period at Bc 57; Early Bonito (left), Classic Bonito (right).

Figures 7.11, 7.12, 7.13, and 7.14, depicting relative skeletal abundance (%NNISP) at Bc 57 and Bc 58 through time lend support to the interpretation that whole carcasses were transported to Bc 57 and Bc 58. At Bc 57, all three artiodactyl species reflect an emphasis on hind limbs (pelvis, femur, and tibia). Deer and pronghorn, however, are represented by the whole range of skeletal elements including not only meat- and marrow-rich limb elements but also cranial, axial, and lower limb bones, indicating that whole or nearly whole carcasses were routinely transported from the kill-site. The pattern appears constant through the Early, Classic, and Late Bonito subphases, indicating that deer and pronghorn were subjected to similar transport and processing behaviors over the course of nearly three centuries. In contrast, although similar to other artiodactyl species during Early Bonito, bighorn sheep is represented by a much less complete array of skeletal elements during later periods.

Figures 7.11, 7.12, and 7.13 also suggest more subtle inter-taxonomic and temporal differences in skeletal part frequencies. Pronghorn exhibit higher frequencies of cranial elements and humeri while deer remains display higher proportions of radius and pelvis specimens. Temporally, the Early and Late Bonito periods reflect a greater number of vertebral (atlas, axis, cervical, thoracic, and lumbar) elements and Classic Bonito deposits contain higher relative counts of lower limb bones (astragalus, calcaneus, and phalanges).

The Classic Bonito pattern at Bc 58 (Figure 7.14) exhibits some parallels with that of Bc 57. As seen at Bc 57, deer skeletal representation includes limb elements as well as cranial and axial remains while bighorn is represented by hind limb remains. Pronghorn was only represented by two specimens, a cranial fragment and second phalanx, and the small sample size precludes further interpretation. Although butchery waste such as cranial and axial elements are common deer remains are characterized by a general lack of pelvis and limb parts relative to the Bc 57 deposits.

Surprisingly, neither the relative distance of hunting forays nor a desire for high utility carcass parts appear to have impacted artiodactyl skeletal part representation, as the whole range of skeletal elements is present for each species of artiodactyl at both sites. Presumably pronghorn would have been procured on the plains and scrublands surrounding Chaco while deer and bighorn would have required greater travel to upland areas along the margins of the San Juan Basin (a distance of 50-80 km). Graphical depictions of skeletal part frequencies can be helpful in highlighting broad patterns but are of little utility in detecting more subtle differences or assessing statistical significance, an essential step in validating inter-species differences and spatio-temporal trends.

Chi-square comparisons of skeletal part frequencies can further aid in recognition of inter-taxonomic and inter-site disparities as well as the identification of statistically significant differences. Sample size limitations necessitated combination of Early, Classic, and Late Bonito assemblages for inter-taxonomic comparisons and combination of all artiodactyl species was necessary for temporal comparisons. The extent to which counts of specific skeletal elements diverge from randomness is assessed by calculating adjusted residuals.

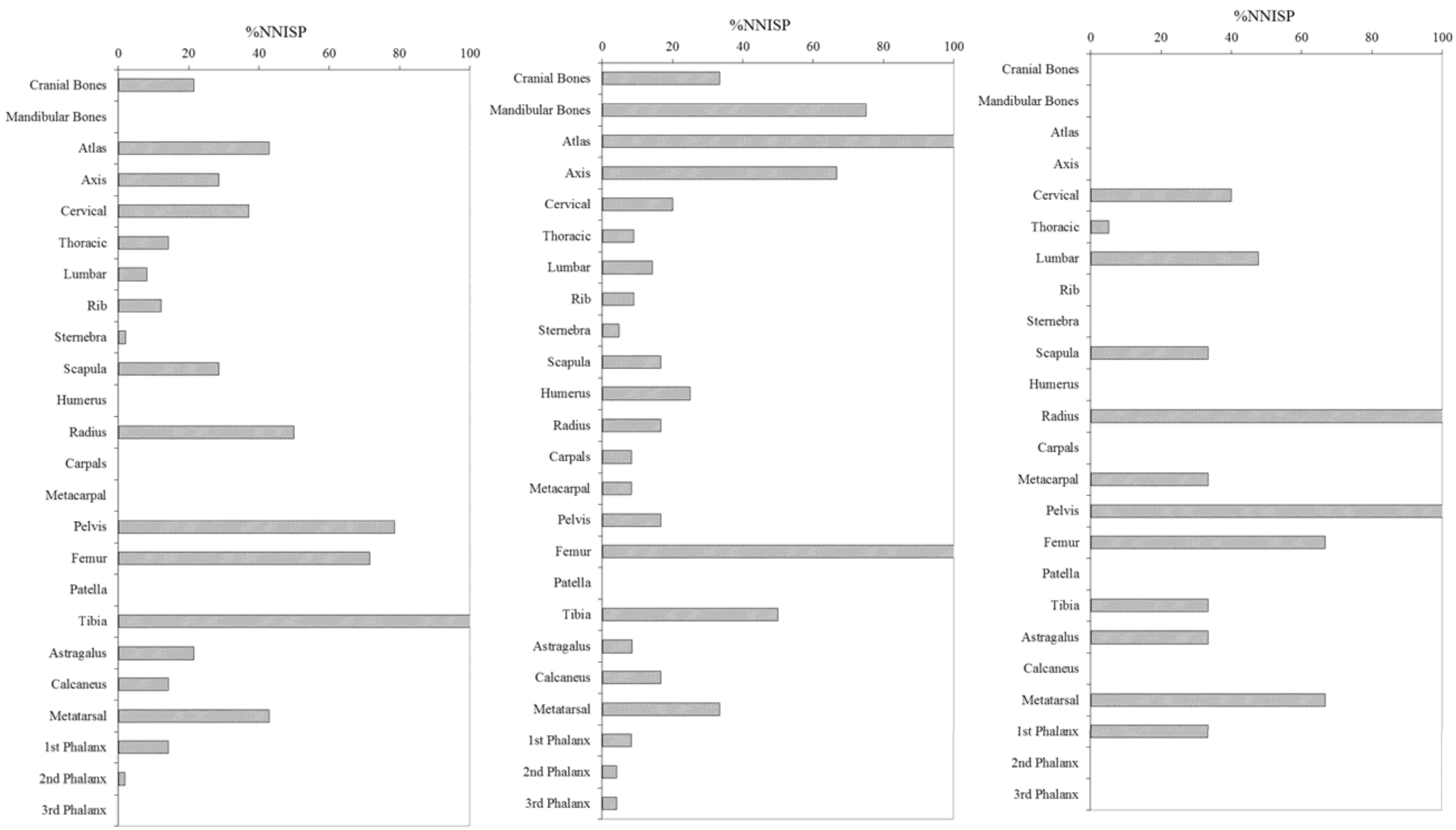


Figure 7.11: Bc 57 Early Bonito artiodactyl skeletal part frequencies (%NNISP) for deer (left), pronghorn (center), and bighorn sheep (right) in the.

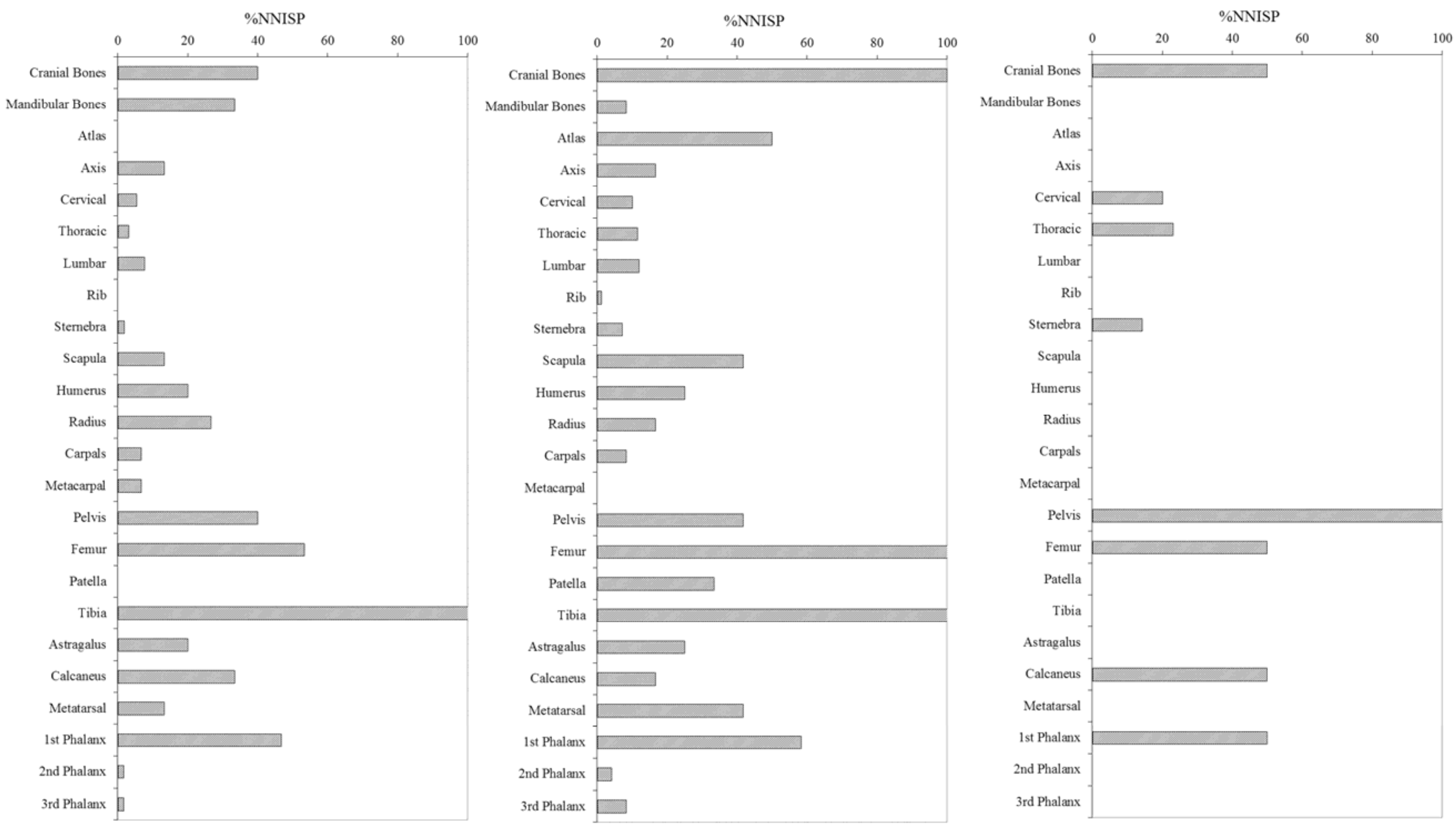


Figure 7.12: Bc 57 Classic Bonito artiodactyl skeletal part frequencies (%NNISP) for deer (left), pronghorn (center), and bighorn sheep (right).

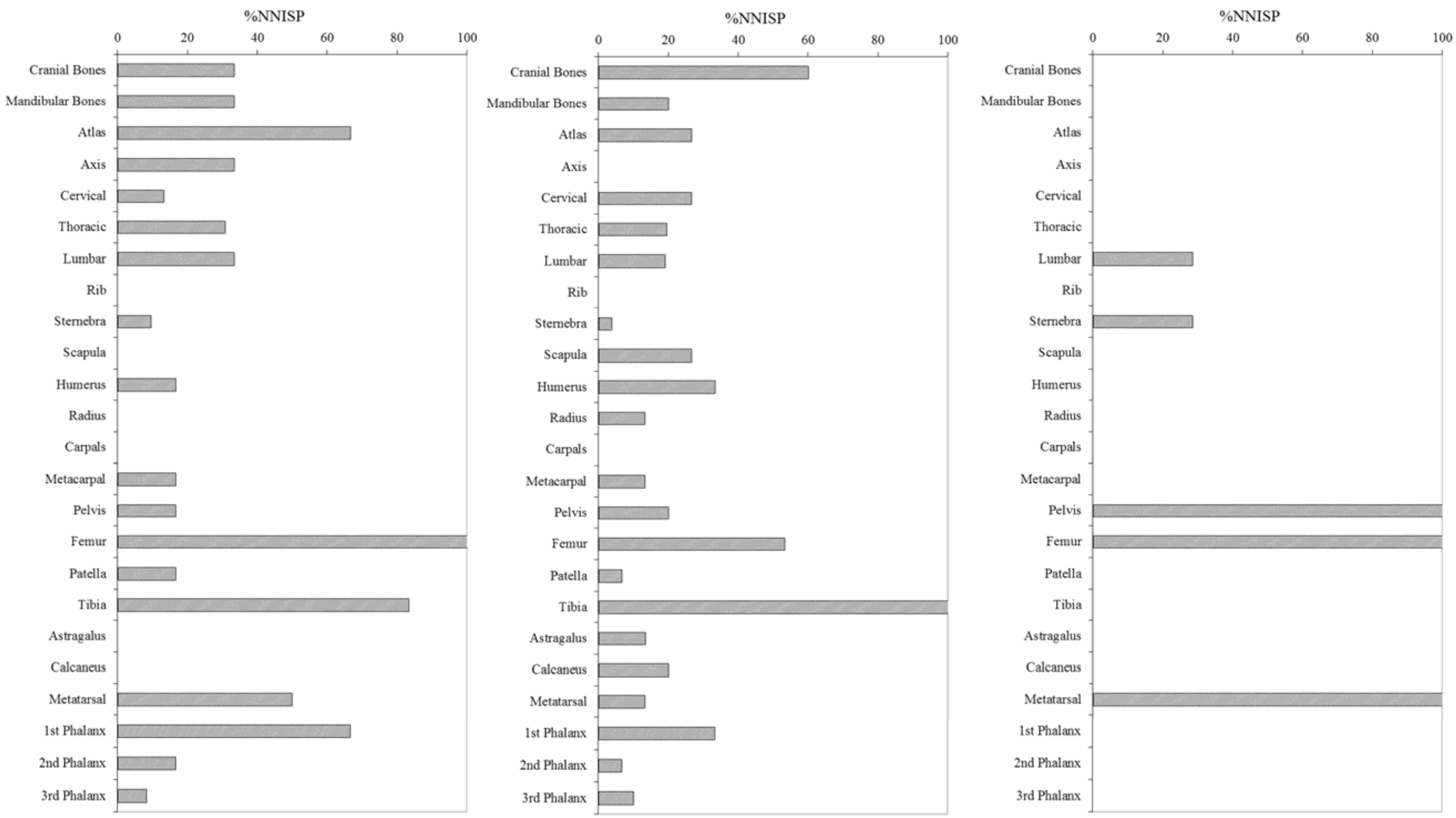


Figure 7.13: Bc 57 Late Bonito artiodactyl skeletal part frequencies (%NNISP) for deer (left), pronghorn (center), and bighorn sheep (right).

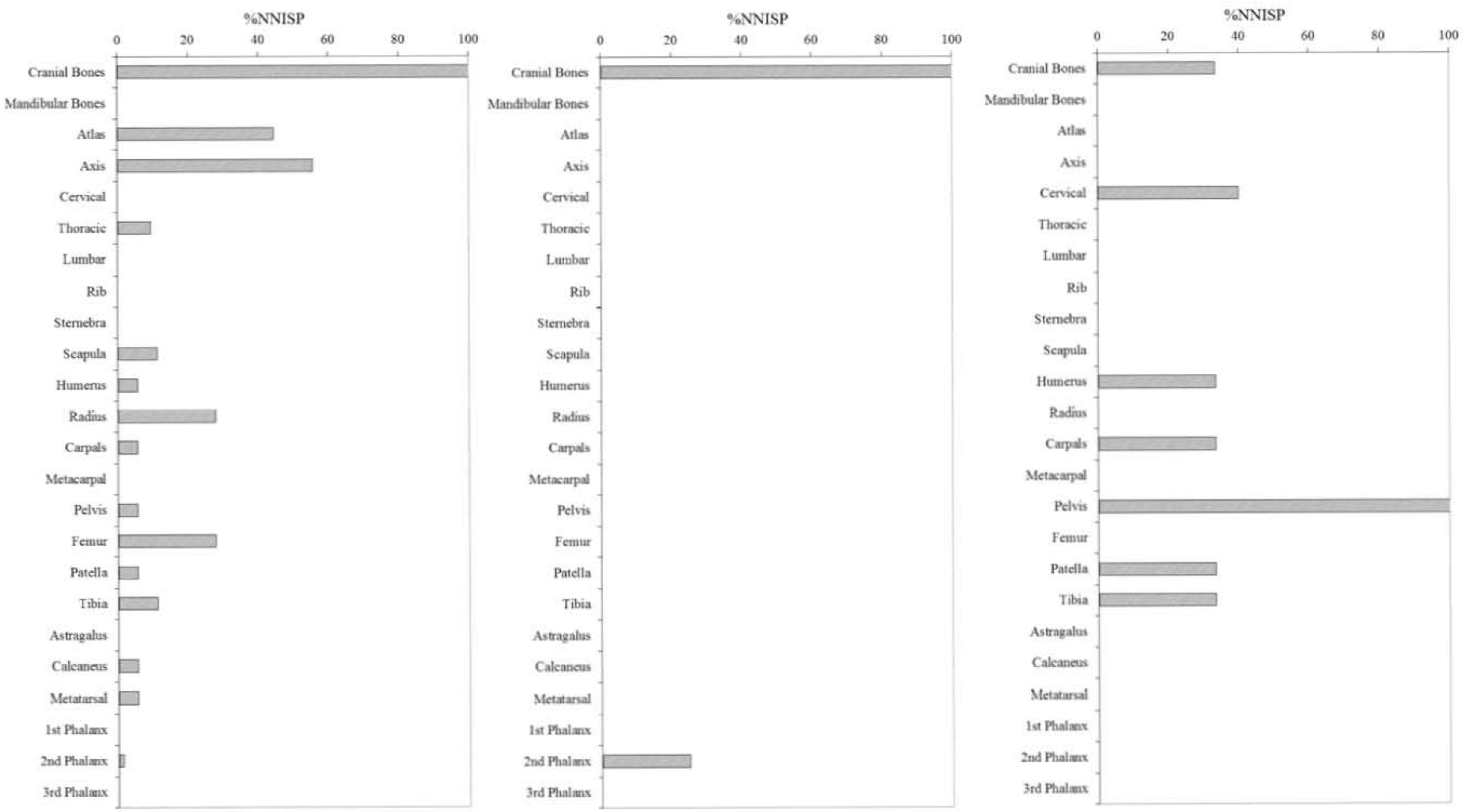


Figure 7.14: Bc 58 Classic Bonito artiodactyl skeletal part frequencies (%NNISP) for deer (left), pronghorn (center), and bighorn sheep (right).

Table 7.3: Chi-square table with adjusted residuals comparing pronghorn and deer NISP by skeletal element across Early, Classic, and Late Bonito deposits at Bc 57. Expected values are shown in parentheses; $\chi^2 = 16.757$ ($p = 0.540$, $df = 18$). For adjusted residuals, *denotes $p < 0.05$.

| | Species | | | |
|---|---|---|---|---|
| **Skeletal Part** | **Pronghorn** | **Adjusted Residual** | **Deer** | **Adjusted Residual** |
| mandible | 12 (10.44) | 0.731 | 7 (8.56) | -0.731 |
| atlas/axis | 16 (13.74) | 0.930 | 9 (11.26) | -0.930 |
| axis | 5 (4.98) | 0.010 | 4 (4.02) | -0.010 |
| cervical | 19 (19.79) | -0.274 | 17 (16.21) | 0.274 |
| thoracic | 35 (34.63) | 0.100 | 28 (28.37) | -0.100 |
| lumbar | 22 (20.34) | 0.570 | 15 (16.66) | -0.570 |
| innominate | 10 (15.39) | -2.106* | 18 (12.61) | 2.106* |
| scapula | 11 (9.35) | 0.821 | 6 (7.65) | -0.821 |
| humerus | 11 (8.25) | 1.451 | 4 (6.75) | -1.451 |
| radius | 6 (9.35) | -1.658 | 11 (7.65) | 1.658 |
| ulna | 7 (6.60) | 0.237 | 5 (5.40) | -0.237 |
| femur | 33 (31.33) | 0.471 | 24 (25.67) | -0.471 |
| tibia | 35 (37.93) | -0.762 | 34 (31.07) | 0.762 |
| astragalus | 5 (6.05) | -0.641 | 6 (4.95) | 0.641 |
| calcaneus | 7 (7.70) | -0.379 | 7 (6.30) | 0.379 |
| naviculo-cuboid | 4 (4.40) | -0.285 | 4 (3.60) | 0.285 |
| metapodial | 16 (16.49) | -0.186 | 14 (13.51) | 0.186 |
| first phalanx | 13 (14.29) | -0.523 | 13 (11.71) | 0.523 |
| second phalanx | 8 (7.70) | 0.166 | 6 (6.30) | -0.166 |
| third phalanx | 12 (8.25) | 1.978 | 3 (6.75) | -1.978 |

Beginning with an intra-site comparison of pronghorn and deer, Table 7.3 presents the results of a chi-square analysis of skeletal part representation through all time periods. A $\chi^2$ of 16.757 ($p = 0.540$, $df = 18$) is not significant and does not prompt rejection of the null hypothesis that variation in skeletal frequency is independent of species. The results of an analysis of relative completeness of compact bone in Chapter Six suggested some inter-taxonomic differences in preparation and cooking as did the less pronounced differences visible in the skeletal abundance plots. The lack of significant differences between pronghorn and deer skeletal part frequency indicates that pronghorn and deer were likely subjected to similar transport and butchery processes.

When artiodactyl species are combined and compared across time periods significant diachronic patterns emerge.

Table 7.4 depicts the results of a second chi-square test comparing Early and Classic Bonito skeletal frequencies ($\chi^2 = 32.948$, $p < 0.05$, $df = 18$). Analysis of adjusted residuals revealed that the divergence of atlas, axis, cervical, and first phalanx frequencies from expected values is statistically significant. As suggested by the skeletal abundance plots for Early Bonito deposits, artiodactyl cervical or neck vertebral remains are greatly overrepresented relative to expected frequencies, while those recovered from Classic Bonito deposits are underrepresented. Lower limb elements (first phalanges) are more frequent than expected among the Classic Bonito assemblage. Though marginally insignificant, fore and hind limb elements, specifically humerus, tibia, calcaneus, and naviculo-cuboid, are also more common than expected among the Classic Bonito assemblage.

Table 7.4: Chi-square table with adjusted residuals comparing combined deer, pronghorn, and bighorn NISP by skeletal region for Early and Classic Bonito deposits at Bc 57. Expected values are shown in parentheses; $\chi^2 = 32.948$ ($p < 0.05$, df = 18); For adjusted residuals, *denotes $p < 0.05$; ** denotes $p < 0.01$.

| | Time Period | | | |
|---|---|---|---|---|
| **Skeletal Part** | **Early Bonito** | **Adjusted Residual** | **Classic Bonito** | **Adjusted Residual** |
| mandible | 9 (8.05) | 0.503 | 6 (6.95) | -0.503 |
| atlas/axis | 15 (10.73) | 1.967* | 5 (9.27) | -1.967* |
| cervical | 22 (15.02) | 2.747** | 6 (12.98) | -2.747** |
| thoracic | 21 (19.31) | 0.592 | 15 (16.69) | -0.592 |
| lumbar | 15 (12.88) | 0.898 | 9 (11.13) | -0.898 |
| innominate | 16 (15.56) | 0.171 | 13 (13.44) | -0.171 |
| scapula | 7 (7.51) | -0.279 | 7 (6.49) | 0.279 |
| humerus | 3 (4.83) | -1.237 | 6 (4.17) | 1.237 |
| radius | 12 (9.66) | 1.135 | 6 (8.34) | -1.135 |
| ulna | 6 (5.36) | 0.408 | 4 (4.64) | -0.408 |
| femur | 24 (24.68) | -0.213 | 22 (21.32) | 0.213 |
| tibia | 21 (26.82) | -1.771 | 29 (23.18) | 1.771 |
| astragalus | 5 (5.90) | -0.553 | 6 (5.10) | 0.553 |
| calcaneus | 4 (6.44) | -1.434 | 8 (5.56) | 1.434 |
| naviculo-cuboid | 2 (3.76) | -1.343 | 5 (3.24) | 1.343 |
| metapodial | 15 (12.34) | 1.148 | 8 (10.66) | -1.148 |
| first phalanx | 4 (10.19) | -2.922** | 15 (8.81) | 2.922** |
| second phalanx | 3 (3.22) | -0.181 | 3 (2.78) | 0.181 |
| third phalanx | 2 (3.76) | -1.343 | 5 (3.24) | 1.343 |

As shown in Table 7.5, the chi-square comparison indicates that Classic Bonito skeletal part representation also differs significantly from that of the Late Bonito subphase ($\chi^2 = 33.148$, $p < 0.05$, df = 18). As with Early Bonito, adjusted residuals illustrate that axial elements, thoracic and lumbar vertebrae in particular, are overrepresented among Late Bonito deposits and less frequent than expected in the Classic Bonito assemblage. Overrepresentation of pelvis and hind limbs (femora, tibiae, astragali, and calcanea) in the Classic Bonito assemblage also approaches significance.

That Classic Bonito skeletal part frequencies diverge significantly from *both* the Early and Late Bonito assemblages lends weight to the interpretation that the Classic Bonito pattern is meaningful. Analysis of skeletal survivorship in Chapter Six revealed that the Classic Bonito artiodactyl assemblage at Bc 57 may have been subjected to greater processing for marrow extraction and grease rendering. Thus the possibility that less dense axial elements were differentially destroyed while denser lower limb parts such as tibia, astragalus, and calcaneus were preserved is a possible source of the Classic Bonito divergence in skeletal part frequencies. Although the first chi-square comparison indicated that inter-species differences were not a major factor influencing skeletal part representation, an additional means of controlling for fragmentation and assessing this conclusion is to perform a similar analysis on remains identified only as artiodactyl or large mammal. By incorporating these remains, one can mitigate the impact of variable processing intensity and fragmentation.

Table 7.5: Chi-square table with adjusted residuals comparing combined deer, pronghorn, and bighorn NISP by skeletal region for Classic and Late Bonito deposits at Bc 57. Expected values are shown in parentheses; $\chi^2 = 33.148$ ($p < 0.05$, df = 18); For adjusted residuals, *denotes $p < 0.05$; ** denotes $p < 0.01$.

| | Time Period | | | |
|---|---|---|---|---|
| **Skeletal Part** | **Classic Bonito** | **Adjusted Residual** | **Late Bonito** | **Adjusted Residual** |
| mandible | 6 (5.14) | 0.549 | 4 (4.86) | -0.549 |
| atlas/axis | 5 (5.14) | -0.093 | 5 (4.86) | 0.093 |
| cervical | 6 (9.26) | -1.579 | 12 (8.74) | 1.579 |
| thoracic | 15 (23.66) | -2.745** | 31 (22.34) | 2.745** |
| lumbar | 9 (14.40) | -2.132* | 19 (13.60) | 2.132* |
| innominate | 13 (9.26) | 1.811 | 5 (8.74) | -1.811 |
| scapula | 7 (5.66) | 0.822 | 4 (5.34) | -0.822 |
| humerus | 6 (6.17) | -0.102 | 6 (5.83) | 0.102 |
| radius | 6 (4.12) | 1.349 | 2 (3.88) | -1.349 |
| ulna | 4 (4.12) | -0.083 | 4 (3.88) | 0.083 |
| femur | 22 (18.52) | 1.226 | 14 (17.48) | -1.226 |
| tibia | 29 (25.21) | 1.170 | 20 (23.79) | -1.170 |
| astragalus | 6 (3.60) | 1.833 | 1 (3.40) | -1.833 |
| calcaneus | 8 (5.66) | 1.435 | 3 (5.34) | -1.435 |
| naviculo-cuboid | 5 (3.60) | 1.069 | 2 (3.40) | -1.069 |
| metapodial | 8 (9.77) | -0.838 | 11 (9.23) | 0.838 |
| first phalanx | 15 (12.35) | 1.123 | 9 (11.65) | -1.123 |
| second phalanx | 3 (5.66) | -1.630 | 8 (5.34) | 1.630 |
| third phalanx | 5 (6.69) | -0.955 | 8 (6.31) | 0.955 |

Table 7.6: Chi-square table with adjusted residuals comparing large mammal NISP by skeletal region for Early and Classic Bonito deposits at Bc 57. Expected values are shown in parentheses; $\chi^2 = 31.684$ ($p < 0.01$, df = 3); For adjusted residuals, *denotes $p < 0.001$.

| | Time Period | | | |
|---|---|---|---|---|
| **Skeletal part** | **Bc 57 - Early Bonito** | **Adjusted Residual** | **Bc 57 - Classic Bonito** | **Adjusted Residual** |
| Cranial | 21 (37.00) | -5.214* | 35 (19.00) | 5.214* |
| Axial | 89 (72.68) | 4.607* | 21 (37.32) | -4.607* |
| Upper Limb | 28 (27.09) | 0.332 | 13 (13.91) | -0.332 |
| Lower Limb | 10 (11.23) | -0.657 | 7 (5.77) | 0.657 |

Table 7.7: Chi-square table with adjusted residuals comparing large mammal NISP by skeletal region for Classic and Late Bonito deposits at Bc 57. Expected values are shown in parentheses; $\chi^2 = 20.10$ ($p < 0.01$, df = 3); For adjusted residuals, *denotes $p < 0.005$.

| | Time Period | | | |
|---|---|---|---|---|
| **Skeletal part** | **Bc 57 - Classic Bonito** | **Adjusted Residual** | **Bc 57 - Late Bonito** | **Adjusted Residual** |
| Cranial | 35 (23.52) | 3.848* | 17 (28.48) | -3.848* |
| Axial | 21 (34.38) | -4.167* | 55 (41.62) | 4.167* |
| Upper Limb | 13 (11.76) | 0.531 | 13 (14.24) | -0.531 |
| Lower Limb | 7 (6.33) | 0.374 | 7 (6.33) | -0.374 |

Table 7.8: Chi-square table with adjusted residuals comparing large mammal NISP by skeletal region for Classic Bonito deposits at Bc 57 and Bc 58. Expected values are shown in parentheses; $\chi^2 = 14.116$ ($p < 0.01$, df = 3); For adjusted residuals, *denotes $p < 0.05$; ** denotes $p < 0.01$.

| | Time Period | | | |
|---|---|---|---|---|
| **Skeletal part** | **Bc 57 - Classic Bonito** | **Adjusted Residual** | **Bc 58 - Classic Bonito** | **Adjusted Residual** |
| Cranial | 35 (32.93) | 0.790 | 17 (19.07) | -0.790 |
| Axial | 21 (29.13) | -3.169** | 25 (16.87) | 3.169** |
| Upper Limb | 13 (9.50) | 2.005* | 2 (5.50) | -2.005* |
| Lower Limb | 7 (4.43) | 2.075* | 0 (2.57) | -2.075* |

Chi-square comparisons of large mammal element classes between Early and Classic Bonito (Table 7.6) and Classic and Late Bonito (Table 7.7) do indeed reinforce the interpretation that Classic Bonito skeletal part frequencies at Bc 57 differ significantly from the preceding and subsequent periods. As seen in Table 7.6 ($\chi^2 = 31.684$, $p < 0.005$, $df = 3$), axial remains are once again significantly overrepresented among Early Bonito deposits and a new pattern, a significantly higher than expected frequency of large mammal cranial remains is apparent for the Classic Bonito subphase. An identical, statistically significant pattern (Table 7.7) occurs when comparing the Classic and Late Bonito assemblages ($\chi^2 = 20.10$, $p < 0.005$, $df = 3$). Thus although the slight differences in representation of limb elements seen above is not evident among large mammal remains, the relative underrepresentation of axial elements among Classic Bonito contexts remains clear.

Finally, addressing the same question in spatial terms, to what extent do contemporaneous deposits at sites Bc 57 and Bc 58 correspond or diverge in large mammal skeletal part frequencies? As seen in Table 7.8, a $\chi^2$ of 14.116 ($p < 0.005$, $df = 3$) demonstrates that the difference between the two sites is statistically significant. The adjusted residuals once again highlight the underrepresentation of axial elements at Bc 57 during the Classic Bonito subphase as well as the higher than expected limb frequencies relative to Bc 58.

Analysis of skeletal element abundance in Chapter Six demonstrated a general positive correlation with the economic utility of carcass parts spanning all periods. These results highlight another dimension of skeletal element abundance, illustrating that the Classic Bonito pattern at Bc 57 deviates both temporally within the site and spatially from that of neighboring Bc 58. High frequencies of skull and lower limb bones as well as vertebral remains are often cited as evidence of primary butchery (Jackson and Scott 2003:568; Kelly 2001:347; Zeder and Arter 2008:346). Evidence of butchery marks was most common for Early and Late Bonito deposits at Bc 57, but the possibility that increased fragmentation obscured similar patterns during Classic Bonito could not be ruled out. Regardless, signs of butchery are much more common at Bc 57 and Bc 58 than at other Chacoan sites (see Chapter Six). Thus an overrepresentation of vertebral elements among Early and Late Bonito deposits at Bc 57 and Classic Bonito contexts at Bc 58 along with the high frequency of crania and lower limb parts among Classic Bonito Bc 57 deposits is likely indicative of on-site butchery of whole carcasses.

One possible reason for the lower frequency of vertebral remains and higher frequency of meat-bearing pelvic girdle and limb bones at Bc 57 during Classic Bonito is that greater fragmentation of Classic Bonito remains removed axial remains and inflated limb bone and cranial counts. That the majority (90 percent) of large mammal cranial specimens from the Classic Bonito assemblage could be identified only as "cranial fragment" certainly points to the possibility that cranial counts are inflated by increased fragmentation. Likewise, among Classic Bonito remains from Bc 57 identified only as large mammal, only 12 percent of long bone specimens could be identified to element in contrast to Early Bonito (24 percent) and Late Bonito remains (23 percent). Thus it is conceivable that differential fragmentation is responsible for the observed differences in skeletal element frequencies. Since the relationship between fragmentation and identifiability is a non-linear one (Lyman 2008:252-253), the potential exists that a Classic Bonito increase in processing may both inflate counts of certain carcass parts while altogether precluding identification of other element classes. The question of intra- and inter-site variation in fragmentation intensity will be further explored below.

The results thus far prompt rejection of the hypothesis that procurement and consumption at Bc 57 and Bc 58 favored desirable or high utility carcass parts. In fact, the low incidence of high utility parts at Bc 58 suggests that desirable cuts may have been selected out of the assemblage. Skeletal abundance, specifically the high frequency of cranial, axial, and limb remains across all periods revealed a transport strategy in which whole carcasses were transported from the kill-site. Was this a common practice at other Chacoan sites? Skeletal part frequencies at Bc 57 and Bc 58 and the Marcia's Rincon sites 29SJ 627 and 29SJ 629 will now be explored in greater detail.

*Comparison with 29SJ 627 and 29SJ 629*

To situate the Bc 57/Bc 58 pattern in a broader Chacoan context, I examine the extent to which the former conform or diverge from contemporaneous small house sites. The artiodactyl remains from the Marcia's Rincon sites 29SJ 627 and 29SJ 629 were examined firsthand by the author to facilitate this inter-site comparison. Given the possibility that inter-site differences in fragmentation have biased skeletal part representation, assessment of differential fragmentation will be accomplished through analysis of NISP:MNE ratios (Lyman 2008:251-261; Scheiber 2001; Wolverton 2002).

The NISP:MNE ratio measures the intensity of fragmentation or the number of fragments on average to which a given element class is reduced. A higher ratio reflects greater fragmentation and smaller fragment sizes. A ratio of 3:1 would indicate that a given element was essentially broken into three parts while a ratio of 12:1 would reflect heavy fragmentation (Lyman 2008:252-253). A potential complication is the tendency for NISP to increase with fragmentation to a particular threshold before eventually declining as fragmentation intensity substantially reduces the number of identifiable specimens (Marshall and Pilgram 1993). Thus the possibility exists for a deceptively low NISP:MNE ratio value when fragmentation is sufficiently high to yield just a few identifiable specimens. To avoid this potential pitfall, where possible NISP:MNE ratio values will be considered in conjunction with the results of the skeletal part survivorship analysis performed in Chapter Six.

Table 7.9 compares NISP:MNE ratio values of four artiodactyl limb elements for deer, pronghorn, and bighorn across multiple sites and time periods. Contrary to the expectations outlined above, the Early Bonito subphase at Bc 57 exhibits the greatest fragmentation intensity with a total average NISP:MNE value of 2.60. Overall average NISP:MNE values during the Classic (2.19) and Late Bonito (2.31) periods at Bc 57 are lower, but still higher than either Bc 58 (1.75), 627 (1.37), or 629 (1.13). During the Early and Classic Bonito periods at Bc 57, deer remains are the most heavily fragmented. The trend apparently reversed during Late Bonito with pronghorn undergoing the most intense breakage, but the rate remained well below that of deer during antecedent periods. Through time at Bc 57, there is little consistency in the degree to which specific anatomical parts were fragmented.

The results indicate that fragmentation intensity was fairly low for all sites and time periods in this sample. Further, the NISP:MNE ratios indicate that the assemblages from 627 and 629 were actually less intensively fragmented than the remains from Bc 57 and Bc 58. Thus inter-site differences in skeletal part frequencies are unlikely to be a result of variation in fragmentation.

Table 7.9: NISP:MNE ratios for artiodactyl species by limb element at Bc 57, Bc 58, 29SJ 627, and 29SJ 628.

| | Bc 57 - Early Bonito | | | Bc 57 - Classic Bonito | | | Bc 57 - Late Bonito | | Bc 58- Classic Bonito | 29SJ 627 | | | 29SJ 629 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Deer | Pronghorn | Bighorn | Deer | Pronghorn | Bighorn | Deer | Pronghorn | Deer | Deer | Pronghorn | Bighorn | Deer | Pronghorn |
| Humerus | - | 1.50 | - | - | 1.50 | - | 1.00 | 1.67 | 1.00 | 1.00 | 1.00 | - | - | - |
| Radius | 3.50 | 2.00 | 3.00 | 4.00 | 1.00 | - | - | 2.00 | 2.50 | 2.00 | 2.00 | 1.33 | - | 1.00 |
| Femur | 3.33 | 3.00 | 2.00 | 2.00 | 2.00 | 1.00 | 2.00 | 4.00 | 2.50 | 1.33 | - | 1.00 | 1.50 | - |
| Tibia | 4.67 | 2.00 | 1.00 | 3.00 | 3.00 | - | 2.50 | 3.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 |
| Average | 3.83 | 2.13 | 2.00 | 3.00 | 1.88 | 1.00 | 1.83 | 2.67 | 1.75 | 1.33 | 1.67 | 1.11 | 1.25 | 1.00 |

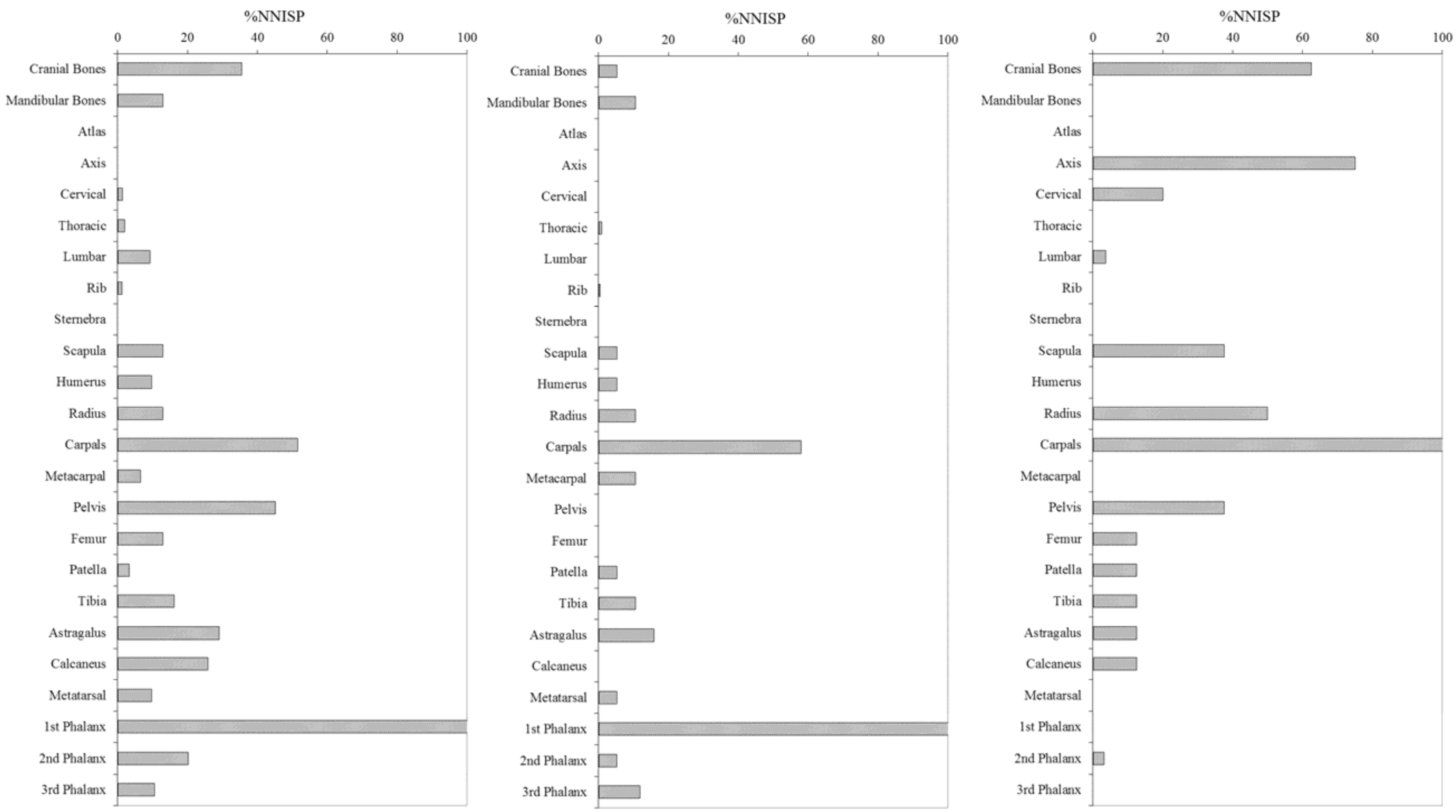


Figure 7.15: 29SJ 627 artiodactyl skeletal part frequencies (%NNISP) for deer (left), pronghorn (center), and bighorn sheep (right).

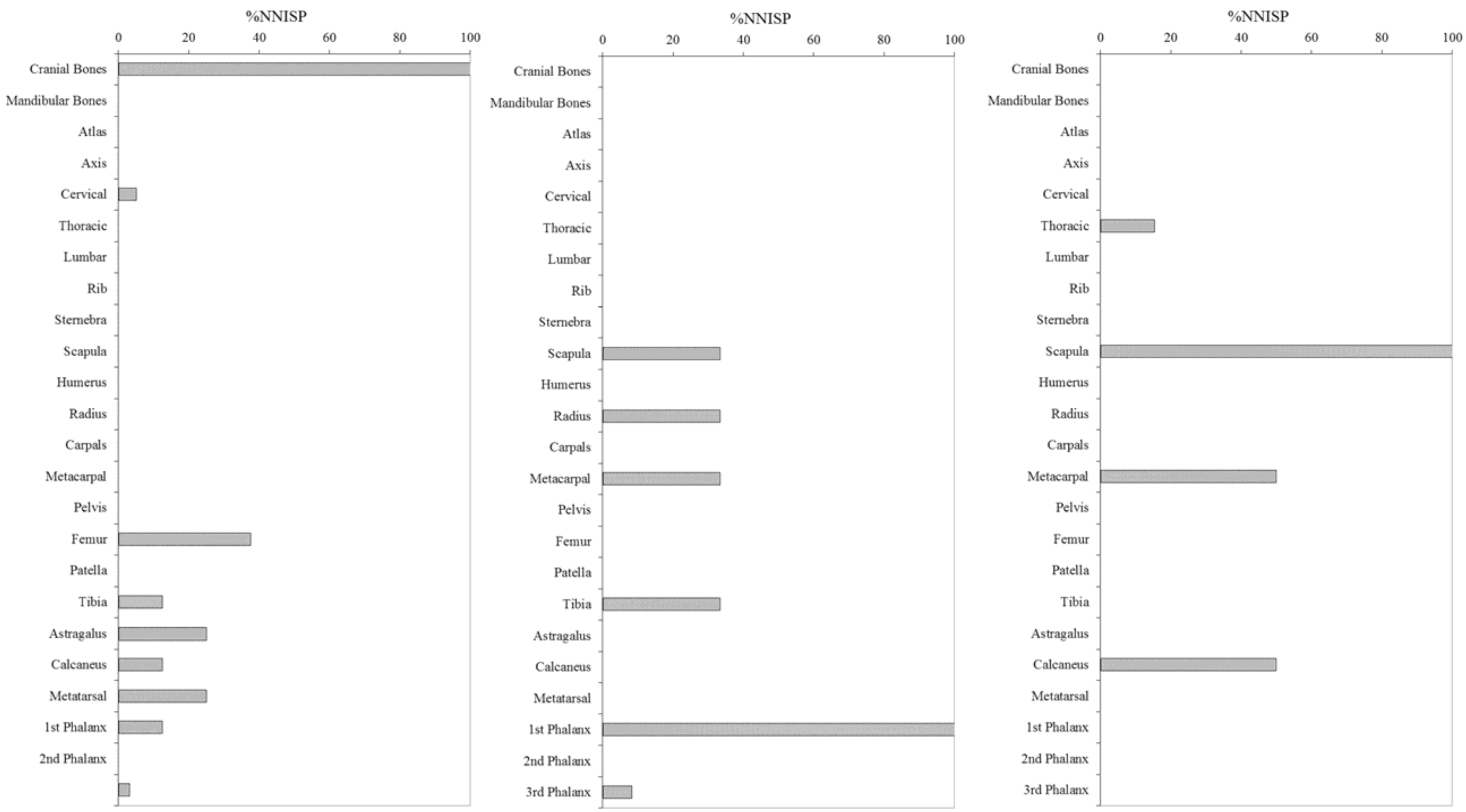


Figure 7.16: 29SJ 629 artiodactyl skeletal part frequencies (%NNISP) for deer (left), pronghorn (center), and bighorn sheep (right).

Depicted in Figure 7.15, skeletal abundance at site 627 diverges considerably from that of Bc 57. In particular, deer, pronghorn, and to a lesser extent bighorn exhibit high relative frequencies of lower limb bones (carpals, astragali, calcanea, and phalanges). With the exception of cranial, pelvis, and scapula fragments that account for a sizable portion of deer remains, axial elements (atlas, axis, cervical, thoracic, and lumbar vertebrae) are largely absent from the 627 assemblage and meat-rich upper limb bones occur in low numbers.

Though small sample size is a limitation of the site 629 assemblage, skeletal abundance reflected a high percentage of lower limb elements including metapodials, astragali, calcanea, and phalanges (Figure 7.16) similar to neighboring 627. Given the general lack of vertebral remains and upper limbs, neither pattern appears to typify the on-site deposition of complete carcasses. The %NNISP plots highlight several key dissimilarities between Bc 57 and Bc 58 on one hand and the Marcia's Rincon sites 627 and 629 on the other, but the question remains whether these represent statistically significant differences.

The results of a chi-square comparison of skeletal abundance at site 627 and the Classic Bonito assemblage from Bc 57 are shown in Table 7.10 and reinforce the interpretation that the Bc 57 pattern differs significantly ($\chi^2 = 81.672$, $p < 0.001$, $df = 18$). The adjusted residuals reveal that axial remains (thoracic vertebrae) and hind limbs (femora and tibiae) are significantly overrepresented in the Bc 57 assemblage while lower limb bones (first, second, and third phalanges) are significantly underrepresented relative to 627. The high relative frequency of vertebral remains at Bc 57 is all the more remarkable when one considers that axial remains in the Classic Bonito assemblage were underrepresented relative to both the Early and Late Bonito assemblages.

Comparison with sites 627 and 629 confirmed the distinctive nature of the Bc 57 artiodactyl remains but raises the question: why were whole carcasses repeatedly transported from kill-sites near and far to Bc 57 and Bc 58?

Table 7.10: Chi-square table with adjusted residuals comparing combined deer, pronghorn, and bighorn NISP by skeletal region for Classic Bonito deposits at Bc 57 and 29SJ 627. Expected values are shown in parentheses; $\chi^2 = 81.672$ ($p < 0.01$, df = 18); For adjusted residuals, *denotes $p < 0.05$; ** denotes $p < 0.01$; ***denotes $p < 0.001$.

| | Time Period | | | |
|---|---|---|---|---|
| **Skeletal Part** | **Bc 57 - Classic Bonito** | **Adjusted Residual** | **29SJ 627** | **Adjusted Residual** |
| mandible | 6 (5.22) | 0.460 | 6 (6.78) | -0.460 |
| atlas/axis | 5 (3.48) | 1.094 | 3 (4.52) | -1.0935 |
| cervical | 6 (4.79) | 0.748 | 5 (6.21) | -0.748 |
| thoracic | 15 (8.70) | 2.912** | 5 (11.30) | -2.912** |
| lumbar | 9 (8.70) | 0.1368 | 11 (11.30) | -0.1368 |
| innominate | 13 (13.06) | -0.022 | 17 (16.94) | 0.022 |
| scapula | 7 (6.53) | 0.250 | 8 (8.47) | -0.250 |
| humerus | 6 (4.35) | 1.064 | 4 (5.65) | -1.064 |
| radius | 6 (6.96) | -0.496 | 10 (9.04) | 0.496 |
| ulna | 4 (5.22) | -0.723 | 8 (6.78) | 0.723 |
| femur | 22 (11.75) | 4.117*** | 5 (15.25) | -4.117*** |
| tibia | 29 (16.10) | 4.484*** | 8 (20.90) | -4.484*** |
| astragalus | 6 (8.27) | -1.075 | 13 (10.73) | 1.075 |
| calcaneus | 8 (7.40) | 0.301 | 9 (9.60) | -0.301 |
| naviculo-cuboid | 5 (6.09) | -0.600 | 9 (7.91) | 0.600 |
| metapodial | 8 (6.96) | 0.533 | 8 (9.04) | -0.533 |
| first phalanx | 15 (28.29) | -3.625*** | 50 (36.71) | 3.625*** |
| second phalanx | 3 (14.36) | -4.161*** | 30 (18.64) | 4.161*** |
| third phalanx | 5 (11.75) | -2.711** | 22 (15.25) | 2.711** |

***Discussion***

Analysis of skeletal part frequencies yielded four main conclusions. First, utility curves were not consistent with transport bias of high utility carcass parts. The results instead revealed that artiodactyl procurement during the Early, Classic, and Late Bonito periods at Bc 57 and Bc 58 entailed the transport of whole deer and pronghorn carcasses despite hunts that likely ranged considerable distances; further, inter-taxonomic differences were not statistically significant. In contrast, bighorn sheep skeletal representation does appear to have changed through time. During Early Bonito bighorn skeletal part frequencies are similar to that of deer and pronghorn but during subsequent time periods procurement appears to have shifted to conform to expectations of long-distance procurement, characterized by a lack of axial elements and a greater emphasis on limb bones.

Second, a temporal trend at Bc 57 indicates a relatively lower frequency of “butchery waste” such as cranial, axial, and lower limb parts during Classic Bonito and a concomitant increase in meat-bearing upper limb bones, shoulder, and pelvic girdle elements.

Third, the evidence from Classic Bonito Bc 58 more closely approximates that of the Early and Late Bonito periods at Bc 57 and supports the interpretation that the Classic Bonito pattern at the latter remains the exception. While the divergence of the Classic Bonito assemblage at Bc 57 suggests greater access to meat-rich limbs the results of the analysis presented in Chapter Six imply that another factor may be at work. The positive correlation of Classic Bonito skeletal part frequencies with marrow and bone grease content and with bone mineral density in the case of pronghorn, points to greater fragmentation that may in turn have produced inflated limb counts.

Finally, the analysis demonstrated that the remains from Bc 57 and Bc 58 differ from that of sites 627 and 629. Both 627 and 629 exhibit much lower frequencies of axial remains and upper limb parts and relatively high numbers of lower limbs. Since it was shown that differential fragmentation is unlikely to be the source of inter-site variation, one explanation is the 627 and 629 assemblages were biased by schlepp effect. The high frequency of phalanges seen at 627 also might be expected if hide procurement was a strategy undertaken. Further, movement of axial or meat-bearing elements away from the sites could account for the differences. Although beyond the scope of this analysis, additional study of the 627 and 629 assemblages could shed further light on this question.

## Conclusions

Returning now to the questions posed at the beginning of this chapter: 1) Do architectural data and patterns of faunal procurement and consumption reflect subsistence intensification and feasting behavior at Bc 57 and Bc 58?; and 2) What are the potential implications of feasting behavior for the tenth, eleventh and early twelfth centuries? While architectural evidence for public food preparation was limited to a single slab-lined roasting pit at Bc 57, faunal procurement strategies at Bc 57 and Bc 58 appear partly consistent with large-scale provisioning. The low LI value obtained for the Bc 58 assemblage is congruous with communal hunts focused on jackrabbit procurement but the high LI values observed at Bc 57, signaling greater abundance of cottontail relative to jackrabbit, are not. The strongest evidence for subsistence intensification lies in the emphasis on artiodactyl exploitation at both Bc 57 and Bc 58.

### *Evidence of Subsistence Intensification*

The steady increase in consumption of large game observed at Bc 57 and Bc 58 through the last half of the eleventh and early twelfth centuries, while characteristic of the general canyon-wide trend, exceeds that of other Chacoan sites, including the Pueblo Alto great house. Hunting of pronghorn, a species commonly obtained through cooperative drive tactics and with the potential to yield large quantities of food from a single foray, intensified during Classic Bonito at Bc 57. The pattern was sustained through the Late Bonito subphase and although the latest components at the Alto great house and the Marcia's Rincon sites 627, 629, and 633 witnessed a resurgence in deer and bighorn consumption, the predominance of pronghorn at Bc 57 was unsurpassed elsewhere in Chaco.

Analysis of skeletal part frequencies led to a rejection of the hypothesis that only high utility carcass parts were imported in support of feasting. Instead, the results indicate that whole deer and pronghorn carcasses were regularly transported from kill-sites to Bc 57 and Bc 58 where they were then processed. Moreover, the pattern of skeletal abundance diverged from contemporaneous small sites 627 and 629. Whereas 627 and 629 exhibit comparatively high frequencies of large mammal lower extremities, Bc 57 and Bc 58 include a greater proportion of large mammal axial and meat-rich upper limb parts.

The conclusion that can be drawn is that, for three centuries, hunters returning to Bc 57 and Bc 58 chose to disregard energetic costs in favor of whole-carcass transport.

But what might have motivated such an investment of time and energy? The ethnographic record points to two possible explanations.

If canyon populations suffered from endemic nutritional stress, hunters may have sought to maximize the resources obtained during each foray. Binford's (1978:337) older Nunamiut informants recounted that during lean times, when prey encounter rates were particularly low, whole carcasses including those parts containing low amounts of marrow and grease were processed to extract nutrients. It follows that if nutritional stress was driving carcass transport at Bc 57 and Bc 58, skeletal remains would be expected to exhibit signs of heavy processing (Binford 1978:466). As illustrated in Chapter Six, Classic Bonito pronghorn skeletal part frequencies are indeed positively and significantly correlated with bone mineral density and both deer and pronghorn remains were significantly correlated with marrow and grease utility indices, implying greater processing. Thus dietary shortfalls may have influenced carcass transport decisions to some extent during the Classic Bonito period but the low processing intensity observed among both Early and Late Bonito deposits indicates that transport of whole carcasses cannot be completely attributed to resource stress.

A second possible explanation is that transport of whole carcasses was intended to display productive success (Hawkes and Bliege Bird 2002). Adams (2004:75) observed that the display of economic prowess through feasts in Kanan, Indonesia enhanced the social standing of a household or community. By demonstrating the ability to reliably produce surpluses of desirable foods and provision large numbers of people, feast-givers could better engage in feast debt relationships, establish themselves as suitable marriage partners and allies, and attract labor for tasks such as house building. The wider benefits of participation in commensal events should not be discounted because, as Wiessner (2002a:409-410) observed, it is under such circumstances that "social or political groups may be formed, unified, stratified, or reproduced."

If feasts entailed sharing with kin, affines, or a broader audience (Wiessner 2002a:417) or as White (1962:302-303) observed at Zia pueblo, carcass parts were selectively proffered to community leaders, it follows that the skeletal part frequencies should reflect an absence of particular element groups such as the shoulder and pelvic girdle or vertebral sections. Although no such pattern was observed at Bc 57, deer remains from Bc 58 are dominated by butchery waste (cranial and vertebral remains) but with a general lack of high utility parts such as shoulder and hip elements. Given that density-mediated attrition does not appear to have biased the Bc 58 assemblage, the Bc 58 signature is compatible with sharing of high utility elements.

Although evidence for selective removal of carcass parts is limited, the results do not exclude the possibility that meat was shared after it was stripped from the bone. Ethnographic accounts of food sharing at Zia and among the !Kung for instance (White 1962:302-303; Wiessner 2002a:415-416) indicate that dried meat was often shared in the weeks following a hunt. Similarly, stockpiling of dried meat was a common practice in preparation for *potlatch* feasting among the Fraser Lilloet (Romanoff 1992:225). As noted in Chapter Six, evidence of artiodactyl butchery at Bc 57 was nearly five times more common than at Pueblo Alto. If final butchery was delayed until a hunting party returned to the residential site, the resultant stiffening of joints and ligaments may have necessitated more intensive butchery (Lupo 1994) and thus signals that meat removal occurred on-site.

***Implications of Feasting***

The Bc 57 and Bc 58 assemblages yielded no clear evidence of the kinds of preferential access to high utility parts originally predicted. These expectations were established on the basis of patterns documented at sites such as Cahokia and elsewhere in the Mississippian region where elite populations may have been provisioned by attached hunters or non-elites (Jackson and Scott 1995; Kelly 2001). The Bc 57 and Bc 58 assemblages do exhibit a few notable parallels with the Cahokian assemblage that Kelly (2001:347-348) interpreted as indicative of elite feasting. Specifically, the regular co-occurrence of unfused artiodactyl long bones and their epiphyses, the relative completeness of elements of lower structural density such as vertebrae, pelvis, and scapula, the low degree of long bone fragmentation, and multiple series of articulating vertebrae, are qualities common to both assemblages.

Although provisioning of elites with high utility parts may have been characteristic of sites in the comparatively fertile American Bottom, I suggest that in the more marginal environment of Chaco Canyon, sustained access to large, calorie-rich game may have been a mark of affluence. At Zia pueblo, the two war chiefs *Masewi* and *Oyoyewi* initiate and oversee communal hunts and designate those households responsible for furnishing the required labor (White 1962:129-130). Similarly, if the ability to mobilize hunting parties aimed at procurement of large game was the province of powerful individuals in Chaco, continued success may have translated into inter-group nutritional disparities (Akins 1986:136) and could have served to reaffirm existing political inequalities (Helms 1993:162-163; 1998:129).

If Saitta (2000:161) is correct that the deterioration of environments and disruption of trade-routes in the late eleventh and early twelfth centuries precipitated "elite experimentation with new strategies of control" in Chaco, then the intensification of procurement of large game at Bc 57 and Bc 58 may represent the implementation of such a strategy. Redistribution of food, perhaps associated with the performance communal ritual at nearby Casa Rinconada, would have engendered solidarity at the village or inter-village level and perhaps illustrated the repeated success of a select few in orchestrating communal pronghorn hunts or securing access to distant hunting grounds.

Finally, much has been made in this chapter of Chacoan hunters' apparent disregard for energetic costs in the transport of carcasses to Bc 57 and Bc 58. However, it should be noted that the labor invested in large game procurement is not altogether surprising in view of the massive scale of other Chacoan undertakings, e.g., great house construction, complex irrigation, and the construction of Chacoan roads.

In sum, the results indicate that faunal procurement at Bc 57 and Bc 58 diverged from that of other Chacoan sites. These differences, evident among Early Bonito deposits, became most pronounced during Classic Bonito and the pattern was sustained through the subsequent Late Bonito subphase. Food production strategies were heavily focused on procurement of large game, particularly those traditionally captured through communal hunting. The nearly complete carcasses were then hauled long distances with little apparent regard for transport costs. On the basis of this evidence, I conclude that a pre-existing strategy of large-scale provisioning was intensified during the Classic and Late Bonito subphases and is thus positively correlated with the increasing political complexity witnessed elsewhere in Chaco Canyon.

# CHAPTER 8: BONE ARTIFACTS AND THE CHACOAN ECONOMY

Beginning with the Hyde Expedition's exploration of Pueblo Bonito nearly 120 years ago, excavations in and around Chaco Canyon have yielded more than two thousand bone and antler artifacts. Ubiquitous throughout sites from Basketmaker III through Pueblo III periods, these decorative and utilitarian objects were manufactured from the remains of at least seventeen different mammal and bird species and range in form from decorative beads, pendants, and tubes to awls, punches, flakers, and scrapers, among others. Despite the apparent time depth and at times great intensity of the Chacoan bone tool industry and its important implications for other dimensions of the Chacoan economy, these artifacts have received comparatively little attention in studies of the organization of craft production.

Previous research into Chacoan economy has focused principally upon turquoise and shell ornament production and ceramic and chipped stone industries (Cameron 1984; Cameron and Toll 2001; Mathien 1997; 2001; Toll 1984; 1985; 1991; 2001; 2006; Toll and McKenna 1997). Past studies of Chacoan bone artifacts have been limited to site-specific analyses of assemblages recovered during the course of the Chaco Project excavations (1972-1979) (McKenna 1984; Miles 1987; 1992; 1993). As discussed in Chapter Three, the purpose of this study is to examine variability in bone artifacts at the inter-site level spanning the sixth through twelfth centuries CE, focusing on one great house (Pueblo Alto), eight small house sites (Łeyit Kin, Bc 53, Bc 57, 29SJ 627,

Table 8.1: Worked bone artifacts from Chacoan sites examined in this study.

| | Tool Type | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | Awl | Needle | Pin | Antler Flaker | End Scraper | Tool Blank | Weaving Tool | Tinkler | Gaming Piece | Ornament | Punch | Spatulate | Rubbing Tool | Sounding Rasp/Whistle | Waste Product | Drill | Multi-Use Tool | Fragment | Unknown | TOTAL |
| 29SJ 299 | 6 | | 1 | | 1 | 2 | | 2 | 1 | 19 | | | | | | | | 1 | 12 | 45 |
| Pueblo Alto (29SJ 389) | 96 | 2 | 4 | 2 | 13 | | | | 2 | 13 | 3 | | 3 | 2 | | | 1 | | 102 | 243 |
| Bc 53 (29SJ 396) | 33 | 2 | | 2 | 3 | | | | | 0 | | | | | | | | | 8 | 48 |
| Bc 57 (29SJ 397) | 34 | 1 | | | 14 | | | | | 14 | | | | | | | | 2 | 5 | 70 |
| 29SJ 423 | 3 | | | | | | | | | 5 | | | | | | | | | 7 | 15 |
| 29SJ 519 | 1 | | | | | | | | | 14 | | | | | | | 1 | | 8 | |
| 29SJ 627 | 94 | 6 | 1 | | 6 | 2 | | 1 | 7 | 23 | 4 | 3 | 1 | 2 | | | | 4 | 94 | 248 |
| 29SJ 628 | 78 | 3 | | | 3 | 1 | 1 | 1 | 1 | 5 | 3 | 1 | | 2 | | | | | 41 | 140 |
| Spadefoot Toad Site (29SJ 629) | 14 | 2 | | | 3 | | 1 | 1 | 1 | 4 | | 2 | | | | | | | 26 | 54 |
| Eleventh Hour Site (29SJ 633) | 5 | | 1 | | | | | 1 | | 1 | | | | | | | | 2 | 8 | 18 |
| 29SJ 724 | 13 | 1 | | | | 9 | 3 | 2 | | 0 | | | | | | | | | 5 | 33 |
| Łeyit Kin (29SJ 750) | 20 | 1 | | | 2 | 1 | | | | 6 | | | | | | | | | 10 | 40 |
| 29SJ 1360 | 39 | 5 | 3 | 2 | 3 | 7 | | 2 | | 0 | 3 | | | | | 1 | | 1 | 17 | 83 |
| Shabik'eshchee (29SJ 1659) | 10 | | | | 3 | | 1 | | 1 | 9 | 1 | | | | 1 | | | 3 | 14 | 43 |
| TOTAL | 446 | 23 | 10 | 6 | 51 | 22 | 6 | 10 | 13 | 113 | 14 | 6 | 4 | 6 | 1 | 1 | 2 | 13 | 357 | **1104** |

29SJ 628, 29SJ 629, 29SJ 633, and 29SJ 1360)[11], and three Basketmaker III sites, (Shabik'eshchee Village, 29SJ 423, and the recently excavated 29SJ 519).

Although debate persists over the precise timing and nature of the transformation there is widespread agreement among Chaco scholars that the canyon witnessed unprecedented and far-reaching sociopolitical changes during the ninth, tenth, and eleventh centuries CE. The extent to which these developments entailed corresponding shifts in economic organization remains unclear. Through an analysis of worked bone artifacts this research assesses the scale, intensity, and organization of Chacoan craft production through time, addressing three fundamental questions: 1) To what degree does access to and selection of raw materials vary across time and space? 2) Are patterns of bone tool production and use consistent with economic intensification? 3) If so, do potential shifts in production correlate with the increasing political centralization of the Early, Classic, and Late Bonito subphases (850-1140 CE)?

## Methods

To address these questions, the data under consideration include the bone tool assemblages recovered during the course of the Chaco Project as well as three additional assemblages examined by the author (see Table 8.1). Existing data was utilized for the seven Chaco Project assemblages and of these three were studied first-hand in order to obtain additional data. Analysis of these collections, from sites 29SJ 627, 29SJ 629, and Shabik'eshchee was made possible by an inter-museum loan from the Chaco Canyon NHP Museum Collections. Study of the Bc 53 and Bc 57 assemblages was facilitated by a loan from the Maxwell Museum of Anthropology at the University of New Mexico.

[11] The worked bone sample from Bc 58 was exceedingly small and included only six specimens, none of which none represented awl forms.

Re-discovery of the previously "lost" Łeyit Kin assemblage required considerable investigation and the support of the staff of the Museum of Indian Arts and Culture in Santa Fe, New Mexico. The small collection of bone tools was located in the summer of 2008 and despite a lack of associated provenience information beyond a note indicating that the collection derived from Chaco Canyon, New Mexico, correlation of specimen numbers written on the artifacts with those listed in Dutton's (1938) Łeyit Kin site report was possible. Although only 40 of the original 73 bone artifacts remained, the discovery of the assemblage was a boon to this research.

Analysis of the Bc 53 (29SJ 396), Bc 57 (29SJ 397), Łeyit Kin (29SJ 750), 29SJ 627, 29SJ 629, and Shabik'eshchee assemblages was completed in the Archaeobiology Laboratory of the Smithsonian Institution's National Museum of Natural History. A variety of observations and metrics were recorded and every effort was made to ensure consistency with the criteria and terminology utilized by Chaco Project analysts. Bone artifacts were identified to element and lowest taxonomic level using the Smithsonian's vertebrate zoology comparative osteological collections. For consistency, the tool typology employed by previous Chaco Project bone tool studies was utilized in these analyses (McKenna 1984; Miles 1987; 1992; 1993).

This analysis is not intended to be an exhaustive study of the worked bone assemblages of Chaco Canyon. Site-specific studies of the bone artifact assemblages already exist for many of the sites in question (McKenna 1984; Miles 1987; 1992; 1993). Rather this study assesses overall trends in the Chacoan bone tool industry and investigates whether discernible shifts in patterns of production correlate with the increasing political centralization of the Early, Classic, and Late Bonito subphases.

Where possible date ranges for bone tool assemblages from Chaco Project sites were obtained directly from reports (McKenna and Truell 1986; Miles 1987; 1992; 1993). The chronology of Bc 57 is based on radiocarbon dates and mean ceramic dates obtained by the author while temporal assignment of the Łeyit Kin collection was made on the basis of Dutton's excavation report (1938:82-94). The majority of worked bone could be assigned to one of five broad time periods (Basketmaker III, Early Pueblo I, and the Early, Classic, and Late Bonito subphases). Temporal trends in faunal procurement were based on the synthesis by Akins (1985).[12]

Bone tools were likely employed in a variety of tasks including hide working, basketry production, pottery manufacture, and corn shucking, all of which apply stress to and degrade bone to varying degrees. Therefore durability should be a primary concern in raw material selection (Margaris 2009). Awls in many cases probably served dual functions in both basketry production and hide-working (Stone 2009:229). Thus the intensification in production and use of bone tools would be expected to result in a trend away from less durable and expedient types of bone tools toward durable raw materials and more standardized forms. Russell (2001a:272) reminds us, however, that non-physical properties of species and skeletal parts, in particular the inherent symbolic value ascribed, should not be discounted as factors guiding raw material choice. Figures 8.1, 8.2, 8.3, 8.4, and 8.5 provide examples of the bone tool and ornamental forms discussed in this study including the distinction between expedient and planned tool forms, curated

[12] In the few cases where assemblages exhibited a degree of temporal overlap between the Late Bonito subphase and the subsequent McElmo Phase, specifically the faunal remains from Pueblo Alto and site 633 as well as the bone artifacts from 633, these assemblages were subsumed within the Late Bonito category. I acknowledge that this assumption is not without problems and may be masking some variability since some researchers, e.g. Durand and Durand (2008), have documented diachronic patterns by differentiating between the "Chacoan" and "post-Chacoan" components.

tools, bone tubes, and whistles. Although expedient tools were frequent, the most common bone tool manufacturing method was the groove-and-snap technique (Stone 2011:92) in which the shaft of a metapodial is scored and split longitudinally.

To begin, trends in bone tool manufacture and use are examined through metrical analysis. Length, width, mass, and where applicable, tip diameter (1 mm below the tip of an awl) were recorded. Greater intensification is expected to be reflected by standardization or lower rates of variation in tool dimensions assuming the range of tasks remains constant.

Based on bone awl length measurements, a dichotomy between "long" and "short" awls was identified previously in Chaco at the small house site of 29SJ 627 (Miles 1992) and at the outlier Bis sa'ani community (Breternitz 1982). At Pueblo Alto, Miles (1987:659-663) found no such bimodal distribution but instead identified a central tendency toward awl lengths of 5 to 6 cm (2 cm less than the average at other Chacoan sites) with tip diameters in the 0.5 to 1.4 mm range. Although Miles did not explore inter-site spatial or temporal patterning in her studies of either 627 or Pueblo Alto, her analysis of the former revealed an increase in the frequency of bone tube beads, a pattern she evidently tied to population growth and the construction of additional kivas with which they tended to be spatially associated.

In a study of the worked bone assemblage from Salmon Ruin, partially contemporaneous with the Late Bonito occupation of Chaco, Lloyd (2006:149-151) identified several notable temporal patterns. Lloyd observed a trend toward increasing use of bird remains concomitant with a rise in frequency of bone tube beads from the Primary (1090-1130 CE) to Secondary (post-1130 CE) occupations. Metrical analysis revealed a discernible shift in tool morphology from the Primary to Secondary occupation (Lloyd 2006:120-129). Awls became longer, with wider tips during later periods and, consistent with Lloyd's expectation that standardization was more likely during the Primary (Chacoan) occupation, variance in tip diameter measurements increased through time. In addition, Lloyd's analysis revealed a broad similarity between the assemblage dating to the Primary occupation and contemporaneous Chacoan assemblages while the worked bone assemblage from the Secondary occupation contexts more closely resembles that of sites from the Mesa Verde region.


Figure 8.1: Example of planned awl form; *Antilocapra americana* (pronghorn antelope), Pithouse B at 29SJ 1360.

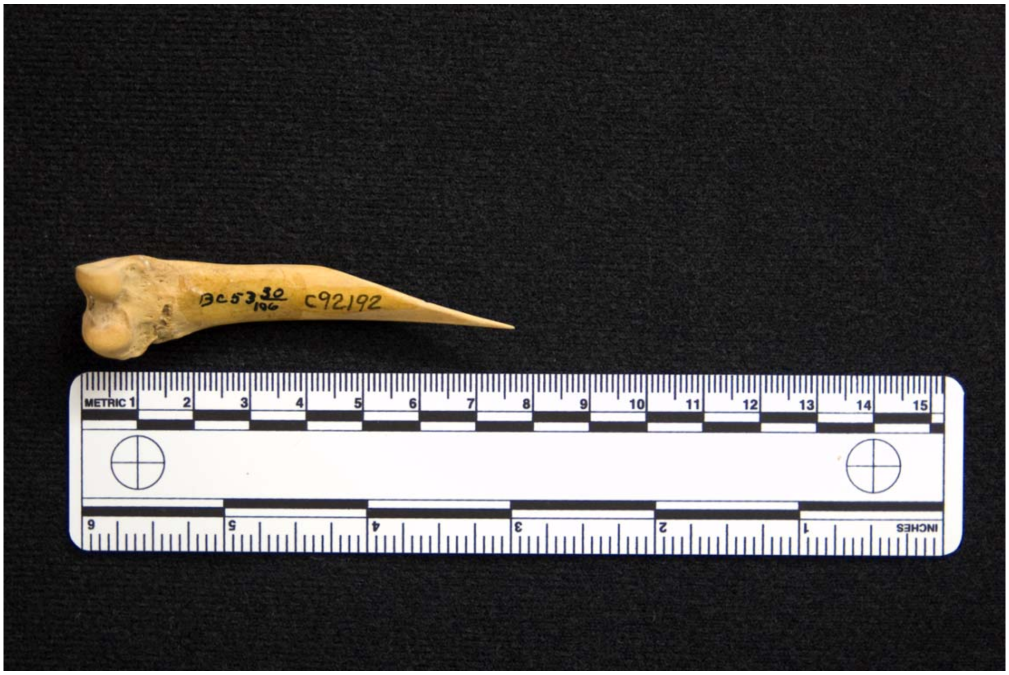


Figure 8.2: Example of expedient awl form; *Lepus californicus* (black-tailed jackrabbit) right femur, Bc 53, C92192.


Figure 8.3: Example of curated awl; large mammal long bone, Pithouse B, 29SJ 1360, C7201.


Figure 8.4: Bone tube beads from Kiva E at 29SJ 627, FS 5952, C28886.


Figure 8.5: Bone whistles, Kiva E, at 29SJ 627, FS 6003-6004, C28897-28898.

However, metrics are of limited utility in clarifying bone tool manufacture and use since tools are continually worn, sharpened, broken, and in some cases modified for secondary uses. When an awl has been curated, it is not unusual for the tool to undergo a substantial reduction in size and shape through time. Thus the final condition of a bone tool is often a poor indication of its original form and dimensions.

Curation of tools was undoubtedly an important element of craft production for the individual producer, preserving both the physical and imagined link to tradition. As Choyke observed:

> Intensively used tools and ornaments made of osseous materials would have represented the experience and *savoir faire* of the practitioners closely associated with them. Some tools and ornaments may even have been employed across generations, linking the more immediate past and present with the expected, comfortably predictable future (Choyke n.d.:27).

Studying the process of manufacture, use, modification, re-use, and curation, termed the "manufacturing continuum" by Choyke (1997), has the potential to yield multiple insights into the role of craft production. Variation in the time and effort invested in tool manufacture, the importance of conserving material through reworking, and discard practices may reflect the centrality of related craft industries (Choyke 2007:642). Beyond purely utilitarian considerations, curation may also serve as an expression of individual and collective memory.

Introduced by Choyke (1997; 2001), the *exploitation index* is an attempt to quantify the amount of labor and forethought invested in tool production and the extent to which artifacts were maximally utilized and/or curated. The index is calculated following Equation 8.1, for each bone artifact. A value of zero indicates that manufacturing labor was returned by full use, while a negative value reflects that the amount of use was less than expected given the labor invested. A value greater than zero indicates that manufacturing effort was exceeded by use intensity. For instance, an awl manufactured with little planning or effort but exhibiting heavy use-wear will score high on an exploitation index scale. In such a case, the heavy use illustrates the economic importance of the task in which the tool was used while the low investment of labor may be a function of high tool attrition rates and/or a need to conserve raw material.

$$\text{Exploitation index} = \frac{\text{Use intensity}}{\text{Manufacturing intensity}} - 1$$

where:

*Use intensity* = percentage of surface covered by use and handling wear; scored on an increasing ordinal scale of 0-5 with ‘0’ representing no use/handling wear and ‘5’ representing total coverage of the tool’s surface.

*Manufacturing intensity* = percentage of surface covered by manufacturing wear; scored on an increasing ordinal scale of 0-5 with ‘0’ representing no manufacturing wear and ‘5’ representing total modification of the tool’s surface.

Equation 8.1: Exploitation index (Choyke 1997).

The use of exploitation indices will be applied to the worked bone assemblages from Shabik’eshchee, the Marcia’s Rincon small sites 29SJ 627 and 29SJ 629, and small sites Bc 53, Bc 57, and Łeyit Kin, providing a temporally and spatially broad sample. As shown in Figures 8.6 and 8.7, the sites selected for analysis reflect two geographically distinct and partially contemporaneous site clusters. Located toward the eastern end of Chaco Canyon near Fajada Gap, the Marcia’s Rincon (627 and 629) assemblages yielded a suitably large sample of complete bone tools (n = 94) that could be attributed with relative certainty to specific occupational spans. The bone tool assemblages from 627 and 629 date to the Early (850-1040 CE) and Late Bonito (1100-1140) subphases. Sites Bc 53, Bc 57, and Łeyit Kin are located in the Casa Rinconada Rincon on the south side of the canyon opposite Pueblo Bonito. Although the temporal spans for Bc 53 and Łeyit Kin depicted in Figure 8.7 reflect the long-term use of both sites, the chronological placement of bone tool assemblages is better defined. For Łeyit Kin (n = 23), only worked bone recovered from floor contexts and above-floor fill from the latest structure was included in the analysis and thus likely derives from the Classic and Late Bonito occupations. The temporal span of Bc 53 (n = 37) is less narrow and the worked bone assemblage is attributed to the Early-Classic Bonito subphases. The samples from the Bc 57 collection spanned the Early (n = 8), Classic (n = 22), and Late Bonito (n = 14) subphases. The worked bone sample from the Basketmaker III site of Shabik'eshchee (n = 16) while somewhat smaller provided an important comparison for collections from the subsequent Bonito phase.

One might question why the collection of worked bone from site 29SJ 1360, which comprises one of the best preserved and apparently intact bone tool kits, was excluded from the exploitation index analysis. That the 1360 assemblage represented a set of tools in the early stages of manufacture and use sets it apart from all other bone tool assemblages thus diminishing its value as comparative data set and ultimately providing a poor indication of tool curation and discard practices.

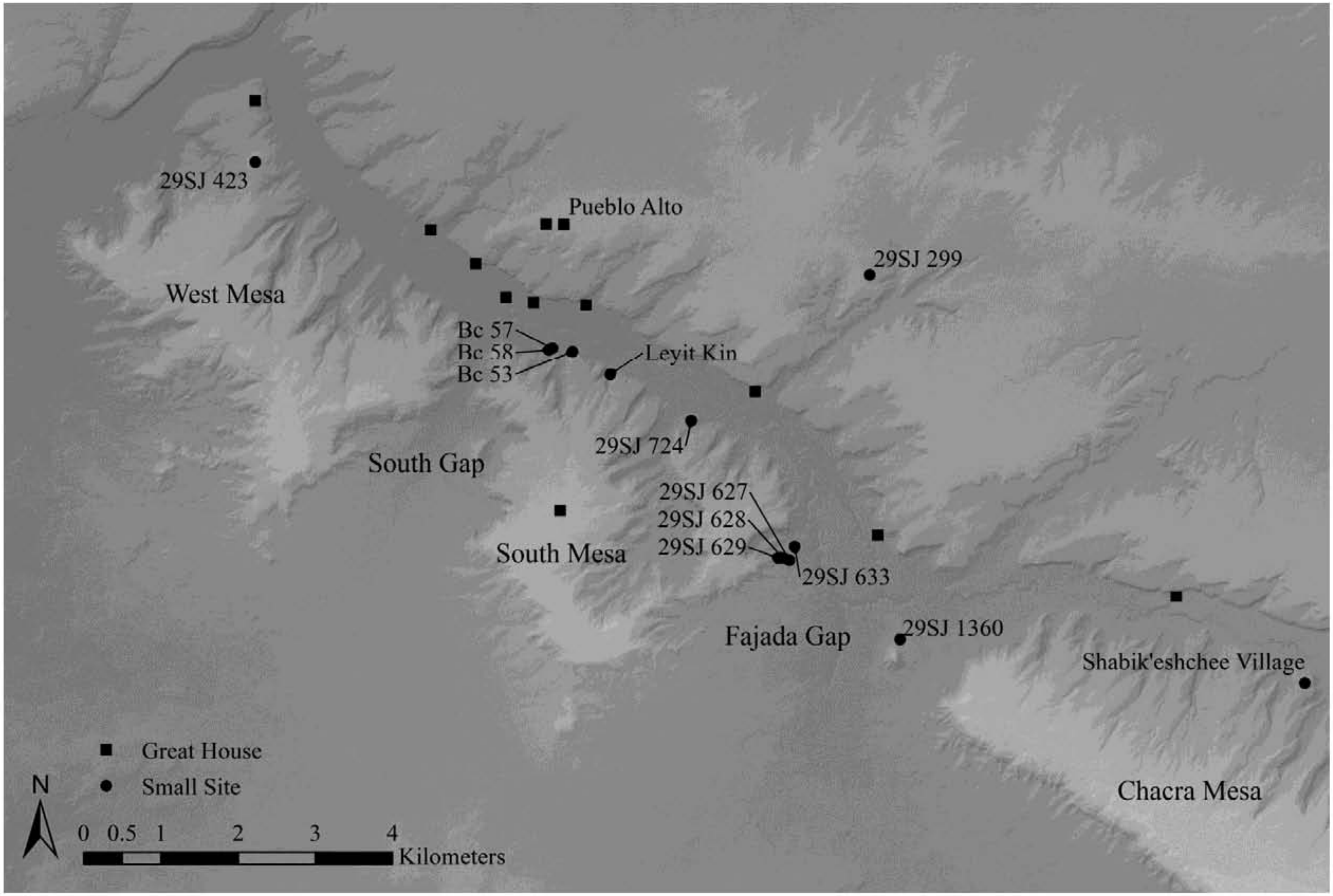

Figure 8.6: Map of Chaco Canyon and sites examined in this study.

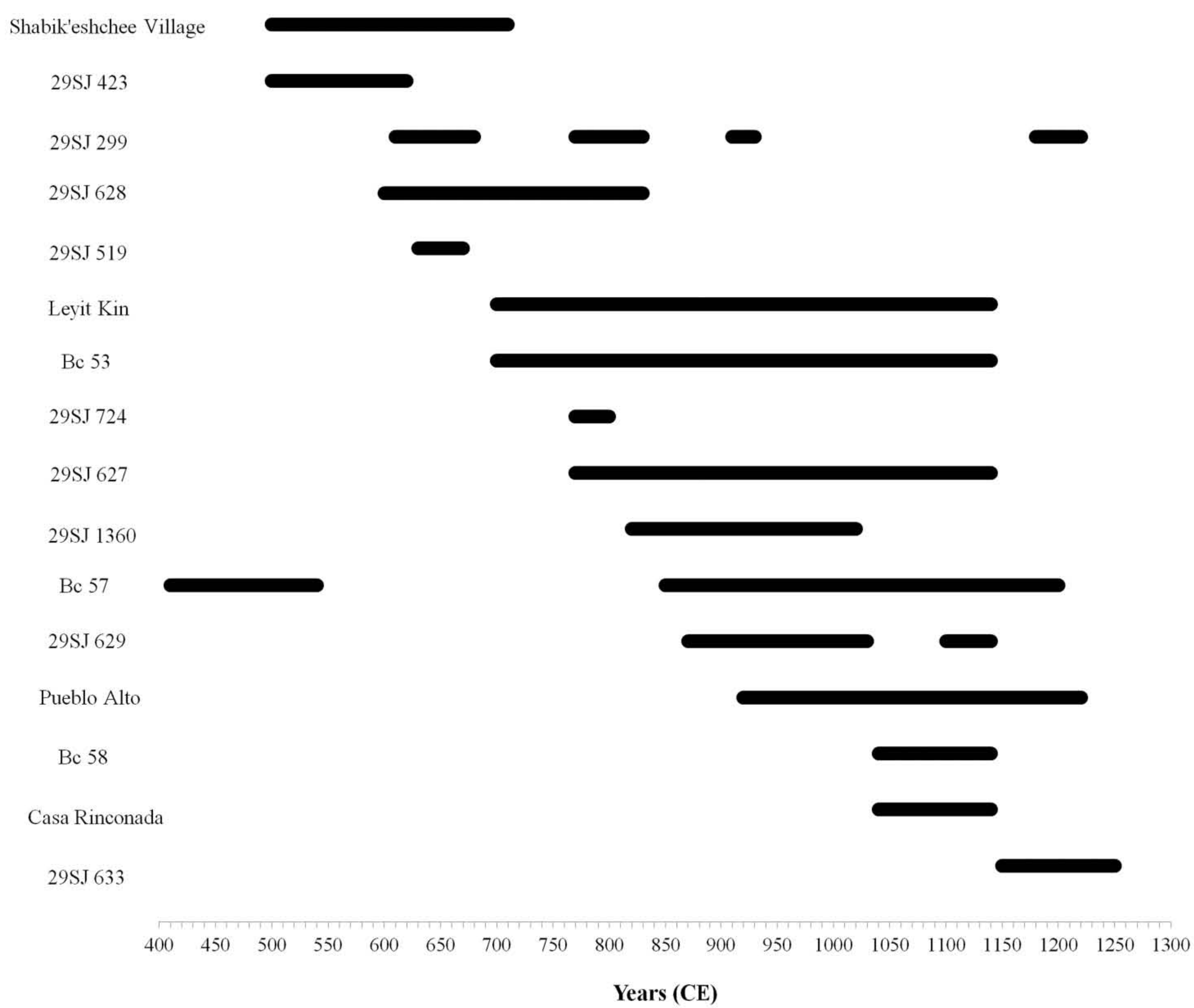


Figure 8.7: Temporal spans of sites included in this study.

Broad temporal trends in raw material selection strategies are assessed through inter-site comparisons of the proportions of species in the broader faunal assemblages with that of species selected as raw material for bone tools using correspondence analysis (CA). Correspondence analysis (CA) then may be used to address patterning at the inter-site level. CA is ideal for analyses where data frequently occur in the form of abundance or incidence data and is thus suitable for exploration of the relative abundance of species and skeletal parts. One strength of the method is that both types and assemblages can be plotted in the same space, affording examination of the distribution of both sites and species (Shennan 1997:324). Where CA is unable to adequately clarify spatial and temporal variability in species choice, scatterplots and ternary plots of species abundance by time period offer a more fine-grained approach.

To examine richness, diversity, and evenness species presence/absence, Simpson's Index, $D$ (Equation 8.2), and Simpson's Measure of Evenness, $E_{1/D}$ (Equation 8.3) are applied to examine changes in skeletal element choice through time (Magurran 2004:114-116). While presence/absence provides an indication of the absolute number of species present in an assemblage, the Simpson index captures the variance of the species distribution, calculating the probability that any two individuals will be drawn from an infinitely large community. The index is weighted by abundances of the most frequent species and thus emphasizes the dominance of particular types. Since $D$ increases as diversity decreases Simpson's index is often expressed as either 1-$D$ or 1/$D$ and the latter method is utilized here (Magurran 2004:115). Given the expectations outlined, increasing standardization in bone tool raw material selection would be reflected by decreasing Simpson index values. May (1975) observed that once richness exceeds ten, species abundance more heavily influences whether the index tends toward a high or low value. However, in this analysis, richness did not exceed ten and the inclusion of confidence limits was deemed unnecessary.

$$D = \sum \left( \frac{n_i [n_i - 1]}{N\ [N - 1]} \right)$$

where:

$D$ = Simpson's index
$n_i$ = number of individuals in the *i*th species
N = total number of individuals

Equation 8.2: Simpson's index ($D$)

$$E_{1/D} = \frac{(1/D)}{S}$$

where:

$D$ = Simpson's index
S = number of species in sample

Equation 8.3: Simpson's measure of evenness ($E_{1/D}$)

Simpson's measure of evenness, is calculated by dividing the reciprocal form of the Simpson index (1/D) by the number of species in the sample (Magurran 2004:115-116). The Simpson evenness index ranges from zero to one and, unlike the Simpson index, is not sensitive to species richness. As with the Simpson index, the Simpson evenness index would be expected to decline with increasing emphasis on particular species or skeletal elements.

## Results

This analysis revealed several noteworthy spatial and temporal trends in the Chacoan worked bone industry.

### *Metrics*

Awl measurements, shown in Table 8.2 and Figures 8.8, 8.9, 8.10, and 8.11, reveal that awl lengths at Bc 57 during the Early and Classic Bonito subphase are comparable to those recovered from sites 627, 629, and Bc 53. The Late Bonito pattern at Bc 57 is more akin to that of Pueblo Alto, Łeyit Kin, and the Primary Occupation at Salmon Ruin. Lower average awl lengths such as those seen in the latter three cases may indicate attempts by craftspeople to extend the use-lives of tools and thereby conserve resources. Given the contemporaneity of the sites, it is tempting to infer a parallel between Bc 57 (Late Bonito) and the Primary Occupation at Salmon Ruin based on similarity in mean awl lengths and further investigation revealed that the difference was not significant $t(5) = 0.16$, $p = 0.877$.

As noted above, awl length is subject to heavy use and curation. In contrast, awl tips were directly related to tool function and would have been continuously sharpened in order to maintain functionality and thus may constitute a potentially effective approach to assessing trends in craft production.

Coefficients of variation (CV) of awl tip widths for individual sites within the Bc site cluster and sites 627 and 629 are lower than those obtained for either Pueblo Alto or the Primary Occupation at Salmon Ruin, suggesting a greater degree of task specialization among these small house sites. The CV is by far the lowest for Bc 57 during the Late Bonito subphase, but this may be attributable to the small sample size. In

Table 8.2: Awl metrics for Chaco Canyon sites and Salmon Ruin; includes Bc 57, Bc 53, Łeyit Kin, 29SJ 627 (Miles 1992), 29SJ 629 (Miles 1993), Pueblo Alto (Miles 1987), and the Primary and Secondary Occupations at Salmon Ruin (Lloyd 2006).

| | Length (mm) | | | | | Tip Diameter (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | Range | $\bar{x}$ | σ | CV | n | Range | $\bar{x}$ | σ | CV |
| Bc 57 - Early Bonito | 2 | 76.00-115.78 | 95.90 | 28.10 | 29.33 | 4 | 1.03-2.13 | 1.40 | 0.63 | 44.85 |
| Bc 57 - Classic Bonito | 12 | 52.10-211.50 | 93.00 | 47.70 | 51.33 | 10 | 1.17-2.72 | 1.77 | 0.51 | 28.52 |
| Bc 57 - Late Bonito | 6 | 49.00-135.62 | 76.60 | 32.90 | 42.91 | 6 | 0.9-1.22 | 1.08 | 0.13 | 11.87 |
| Bc 53 | 18 | 6.00-28.00 | 88.72 | 36.67 | 41.34 | 28 | 0.92-3.03 | 1.54 | 0.53 | 34.33 |
| Łeyit Kin | 11 | 40.00-133.00 | 80.73 | 29.11 | 93.00 | 16 | 0.66-2.11 | 1.38 | 0.41 | 29.87 |
| 29SJ 627 (whole assemblage) | 63 | 49.00-161.00 | 97.00 | 28.00 | 28.87 | 47 | 0.60-2.70 | 1.10 | 0.30 | 27.27 |
| 29SJ 629 (whole assemblage) | 13 | 58.00-164.00 | 96.00 | 28.00 | 29.17 | 7 | 0.70-1.50 | 0.90 | 0.30 | 33.33 |
| Pueblo Alto (whole assemblage) | 74 | 25.00-164.00 | 72.00 | 25.00 | 34.72 | 63 | 0.4-3.6 | 1.10 | 0.52 | 47.27 |
| Salmon Ruin - Primary Occupation | 41 | 36.23-123.86 | 74.33 | 23.40 | 31.48 | 42 | 0.47-2.08 | 0.94 | 0.33 | 35.11 |
| Salmon Ruin - Secondary Occupation | 74 | 35.79- 195.49 | 81.80 | 22.83 | 27.91 | 75 | 0.12-4.81 | 1.23 | 0.78 | 63.42 |

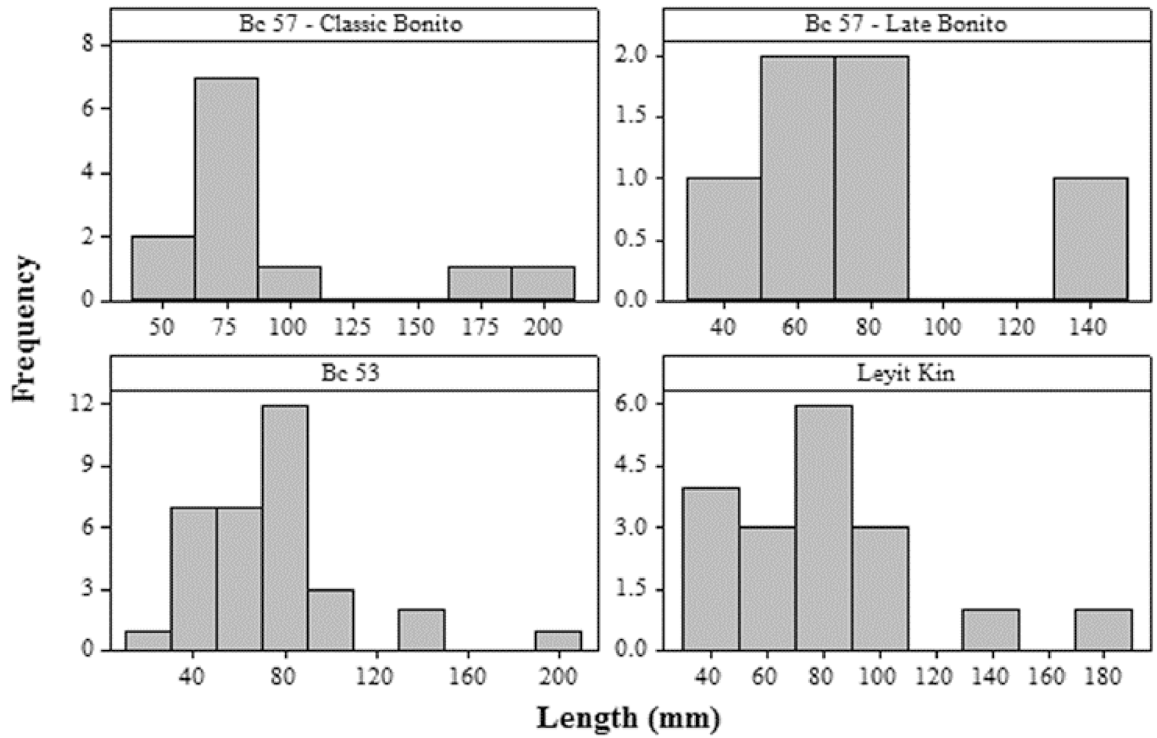


Figure 8.8: Histogram of awl lengths Bc 53, Bc 57, and Łeyit Kin.

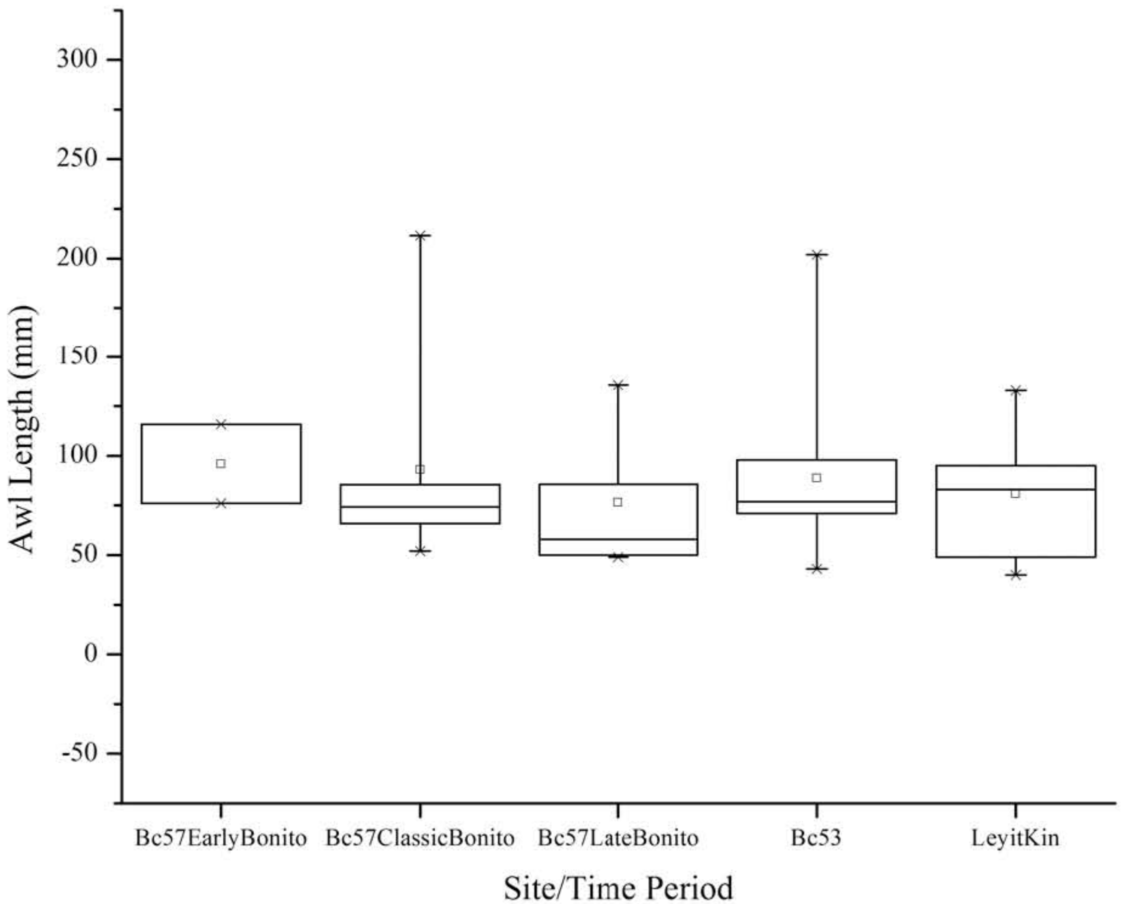


Figure 8.9: Box plot of awl lengths for Bc 53, Bc 57, and Łeyit Kin.

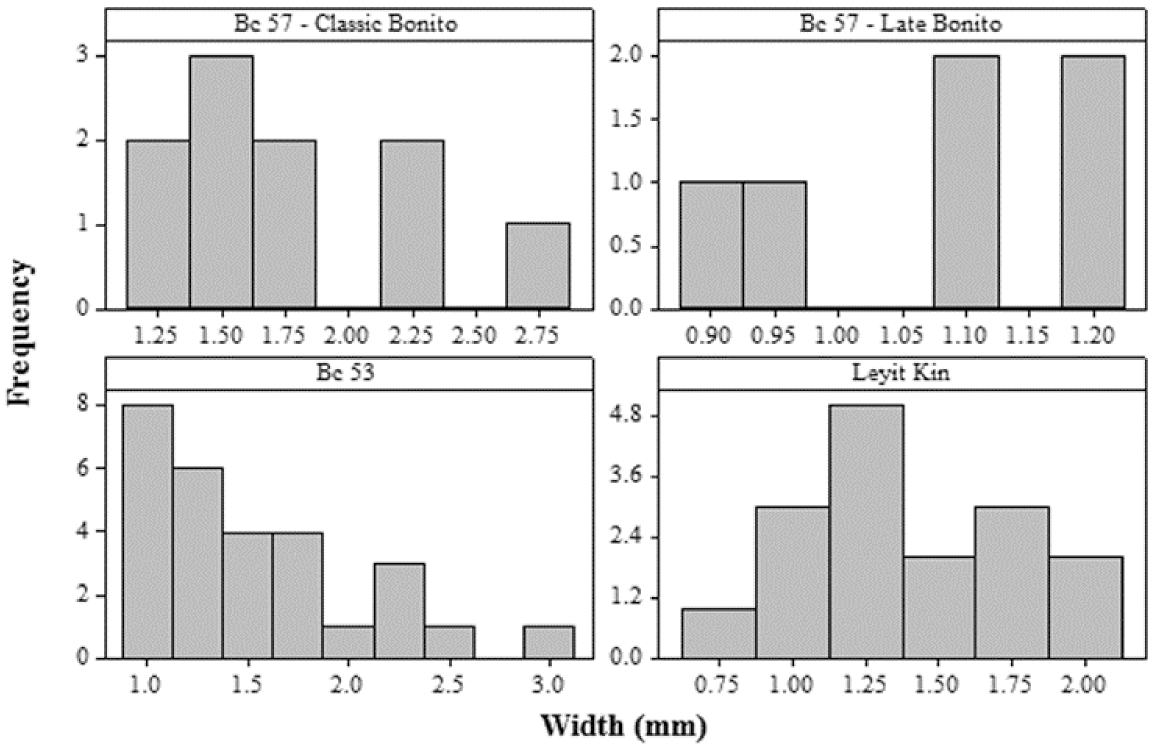


Figure 8.10: Histogram of awl tip widths Bc 53, Bc 57, and Łeyit Kin.

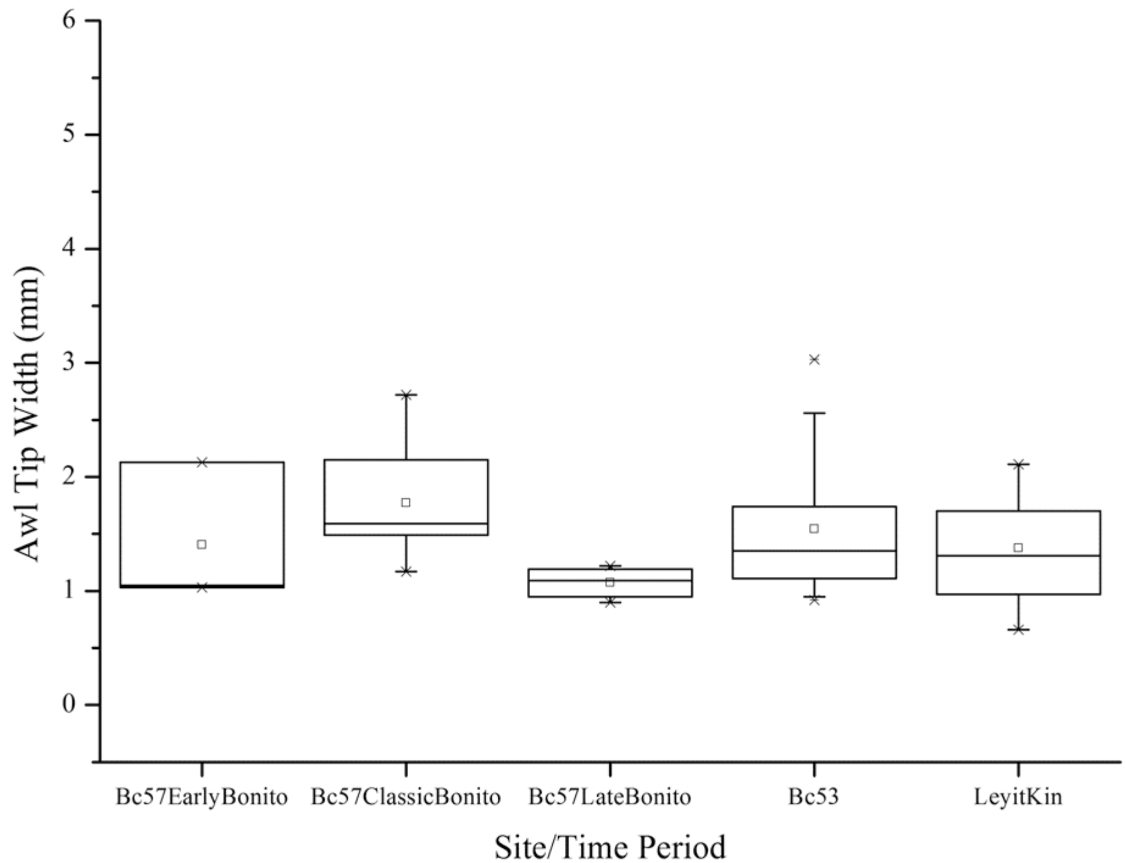


Figure 8.11: Box plot of awl tip width for Bc 53, Bc 57, and Łeyit Kin.

an attempt to further test this interpretation, an $F$-test for equality of variance that compared awl tip widths from the pooled small site assemblages with those of Alto was not significant, $F = 1.03$, $p = 0.45$. This leads to the conclusion that small site and great house samples do not exhibit significantly different standard deviations in tip morphology and calls into question the extent of inter-site differences.

A one-way ANOVA demonstrated that the difference in tip diameters among Bc 53, Łeyit Kin, and the Classic and Late Bonito assemblages from Bc 57 was marginally insignificant, $F(4, 58) = 2.33$, $p = 0.067$. As is visible in Figure 8.11, awl tip diameters in the Late Bonito assemblage from Bc 57 also appear to diverge markedly from the rest. When the samples from all small sites are pooled and compared with that of the Alto great house assemblage, a one-way ANOVA reveals a significant divergence in mean awl tip diameter at Alto (1.07 mm) and the Chacoan small sites (1.34 mm), $F(4, 58) = 11.51$, $p = 0.001$.

Unlike bone tools, tubes are less likely to undergo modification during their use-lives and thus may be more useful indicators of standardization. Table 8.3 presents length measurements of bone tubes recovered from Bc 57 and Łeyit Kin (combined for sampling purposes), 29SJ 627, and Pueblo Alto. Although interpretations should be approached with caution due to the small sample size, the CV values suggest that, as with awl tip widths, bone artifacts from the Bc sites exhibit the highest levels of standardization. Further, comparison of the combined Bc 57/Łeyit Kin sample with that of site 627 revealed that size differences are significant, $t(16) = 2.62$, $p = 0.019$. The range of variation observed for bone tubes recovered from the Bc sites and site 627 may signal a trend toward greater standardization through time in bone tube manufacture or perhaps among the Bc sites themselves. However, the small sample size, the inability to reliably attribute the manufacture of these artifacts to specific sites, and the broad temporal span of the proveniences at site 627 with which many bone tubes were associated, spanning the Early through Late Bonito subphases, precludes further interpretation.

Metrical analysis of bone tools and tube beads appears to indicate a general consistency among small house sites in craft production techniques. If measurements of awl tip widths are an accurate indication of task specialization, the greater standardization observed at the small house sites of Marcia's Rincon and the Bc site cluster stands in marked contrast to the Pueblo Alto pattern, suggesting that the former may have been the site of greatest economic intensification during the Bonito Phase. Exploration of differential intensity in bone tool manufacture and use has the potential to shed further light.

***8.2.2 Exploitation Index***

Examination of manufacturing and use intensity and exploitation index values at Shabik'eshchee (Figure 8.12) reveals that a majority of tools did not reflect extensive manufacture and were subjected to moderate use. The Early Bonito bone tool assemblage at 29SJ 629 exhibits an even lower degree of labor dedicated to manufacture and all but a few of these implements saw little use (see Table 8.4). Nearly 40 percent yielded negative exploitation index scores and very few artifacts at 629 tended toward the heavily manufactured end of the continuum or were subjected to heavy use (Figure 8.13). The Early Bonito pattern observed at neighboring 29SJ 627 contrasts sharply in the high degree of exploitation for all tool types and a considerably lower proportion of negative exploitation index values at 22 percent (Figure 8.14). Although expedient or *ad hoc* awls are common, manufacturing effort appears higher than at either Shabik'eshchee or 629 and in almost all cases the labor invested was returned through heavy use. Awls and to a lesser extent end/side scrapers exhibit high use intensity signaling that the intensity of this economic sector was greater at 627 than at either neighboring 629 or the earlier site of Shabik'eshchee.

Table 8.3: Bone tube metrics (Bc 57 and Łeyit Kin combined).

| | Length (mm) | | | | |
|---|---|---|---|---|---|
| | n | Range | $\bar{x}$ | σ | CV |
| Bc 57 & Łeyit Kin (Classic/Late Bonito) | 9 | 33.00-71.00 | 49.29 | 13.35 | 27.08 |
| 29SJ 627 (Early Bonito) | 17 | 19.00-72.00 | 35.00 | 13.00 | 37.14 |
| Pueblo Alto | 4 | 26.00-51.00 | 38.00 | 11.90 | 31.32 |

Table 8.4: Manufacturing and use intensity scores and average Exploitation Index scores by site and time period.

| | | | Percent of Tools Scored > 4 | | |
|---|---|---|---|---|---|
| Site | Time Period | n | Manufacturing Intensity | Use Intensity | Average Exploitation Index Value |
| Shabik'eshchee | Basketmaker III | 16 | 0.0 | 12.5 | 0.21 |
| Bc 53 | Early-Classic Bonito | 37 | 24.3 | 13.5 | 0.38 |
| Bc 57 | Early Bonito | 8 | 12.5 | 25.0 | 0.92 |
| Bc 57 | Classic Bonito | 22 | 27.3 | 40.9 | 0.31 |
| Bc 57 | Late Bonito | 14 | 7.1 | 7.1 | 0.66 |
| Łeyit Kin | Classic-Late Bonito | 23 | 8.7 | 17.4 | 0.83 |
| 29SJ 627 | Early Bonito | 60 | 20.0 | 15.0 | 0.48 |
| 29SJ 629 | Early Bonito | 29 | 10.3 | 10.3 | 0.05 |
| 29SJ 629 | Late Bonito | 5 | 0.0 | 20.0 | 0.07 |

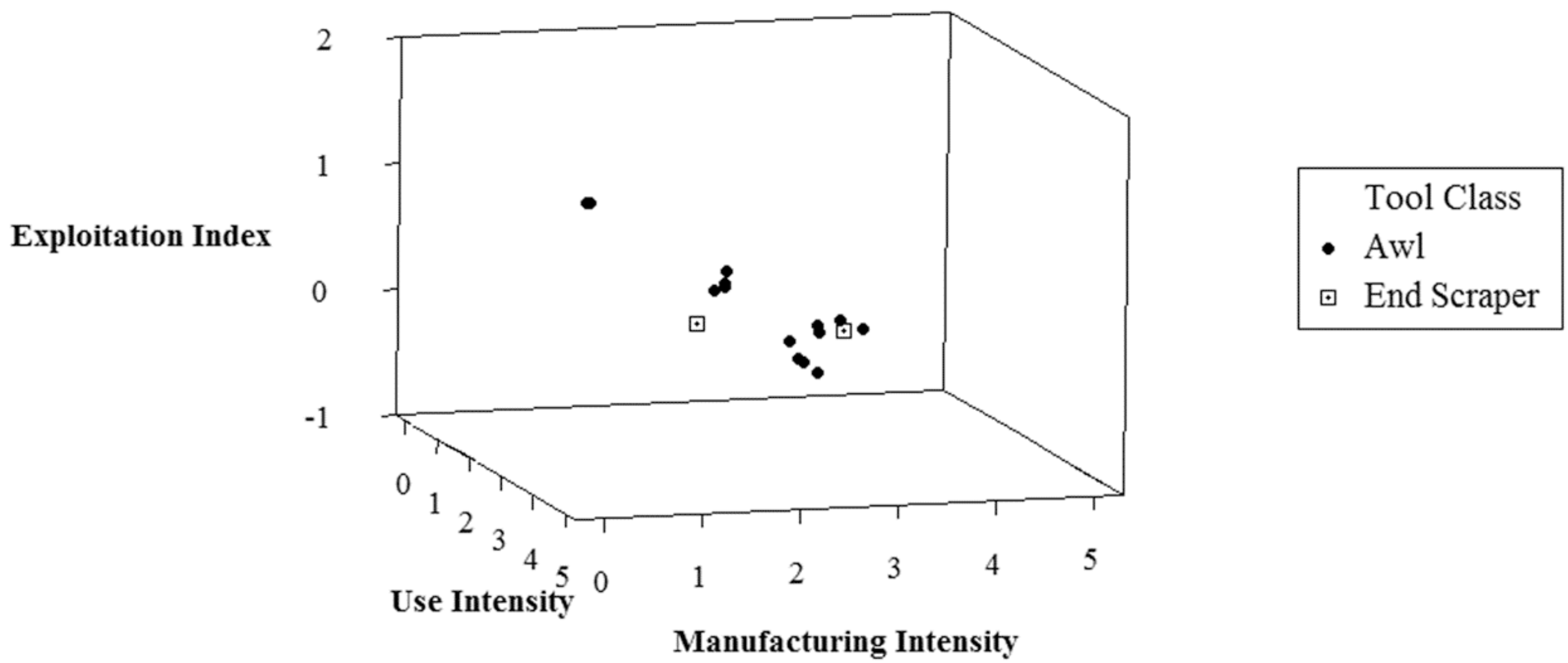


Figure 8.12: Bone tool manufacture and use at Shabik'eshchee.

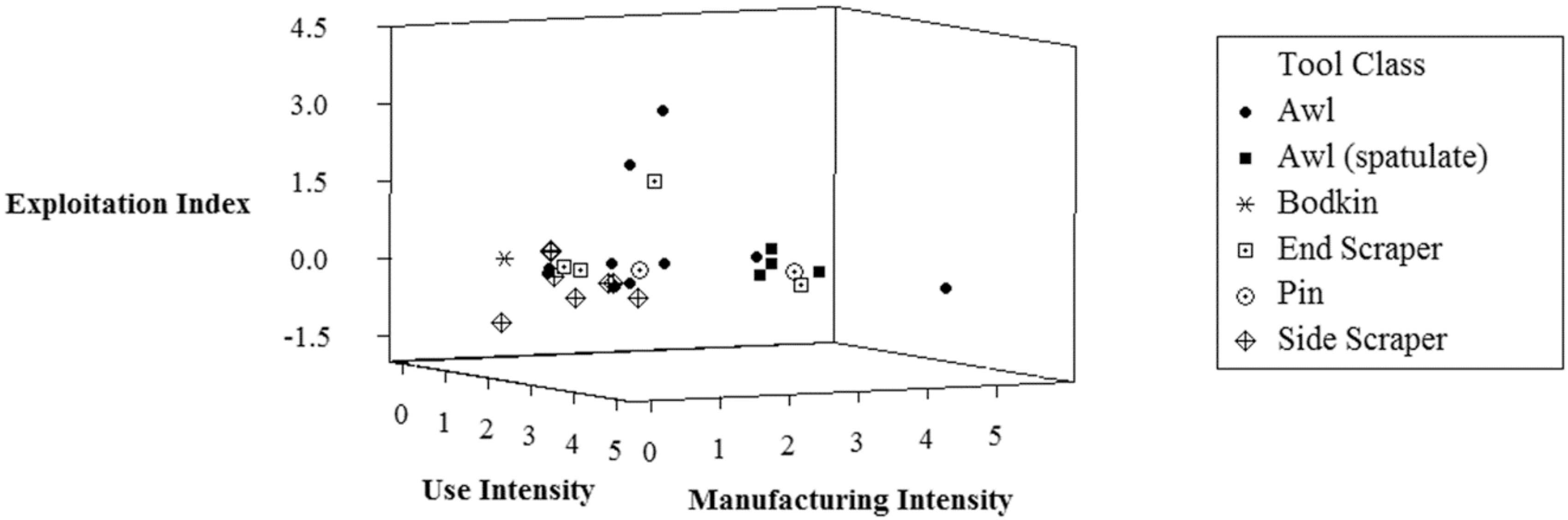


Figure 8.13: Bone tool manufacture and use at 29SJ 629 (Early Bonito).

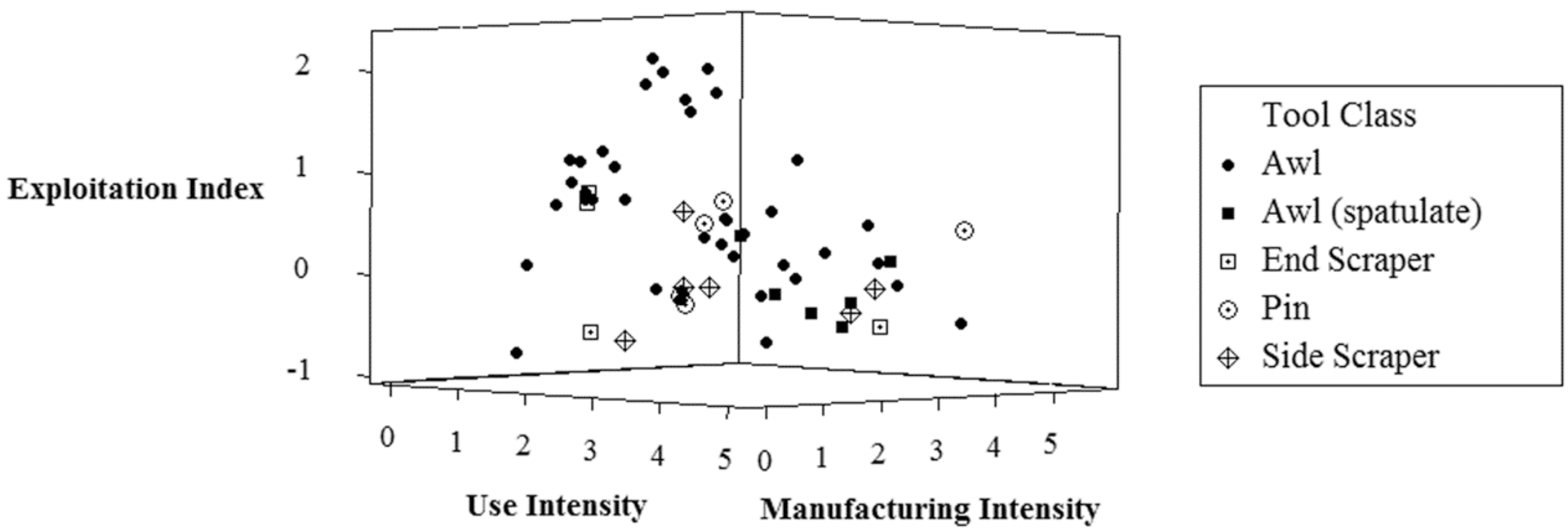


Figure 8.14: Bone tool manufacture and use at 29SJ 627 (Early Bonito).

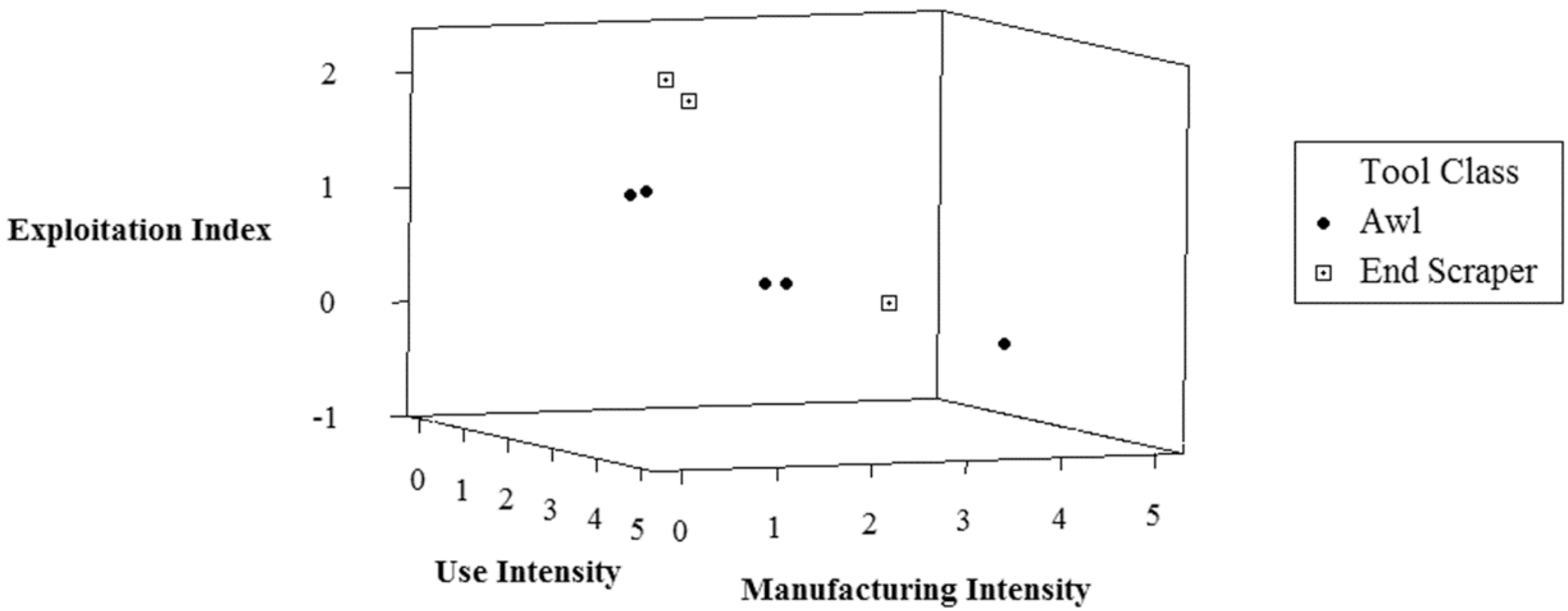


Figure 8.15a: Bone tool manufacture and use at Bc 57 (Early Bonito).

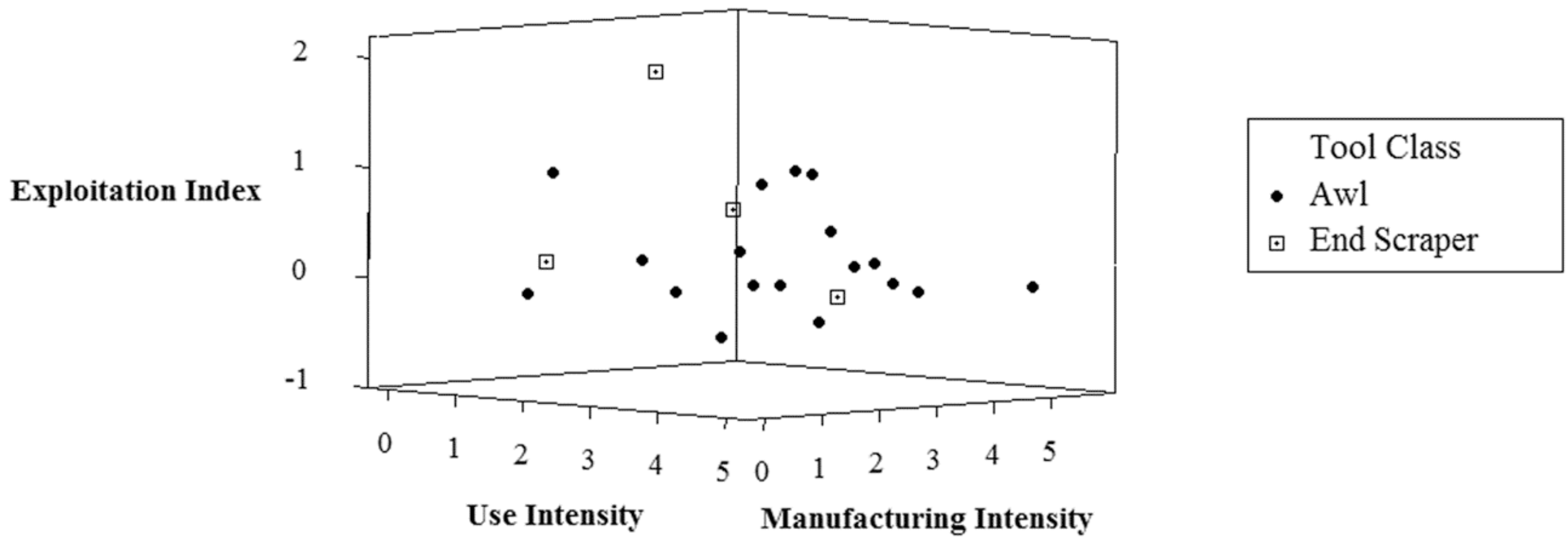


Figure 8.15b: Bone tool manufacture and use at Bc 57 (Classic Bonito).

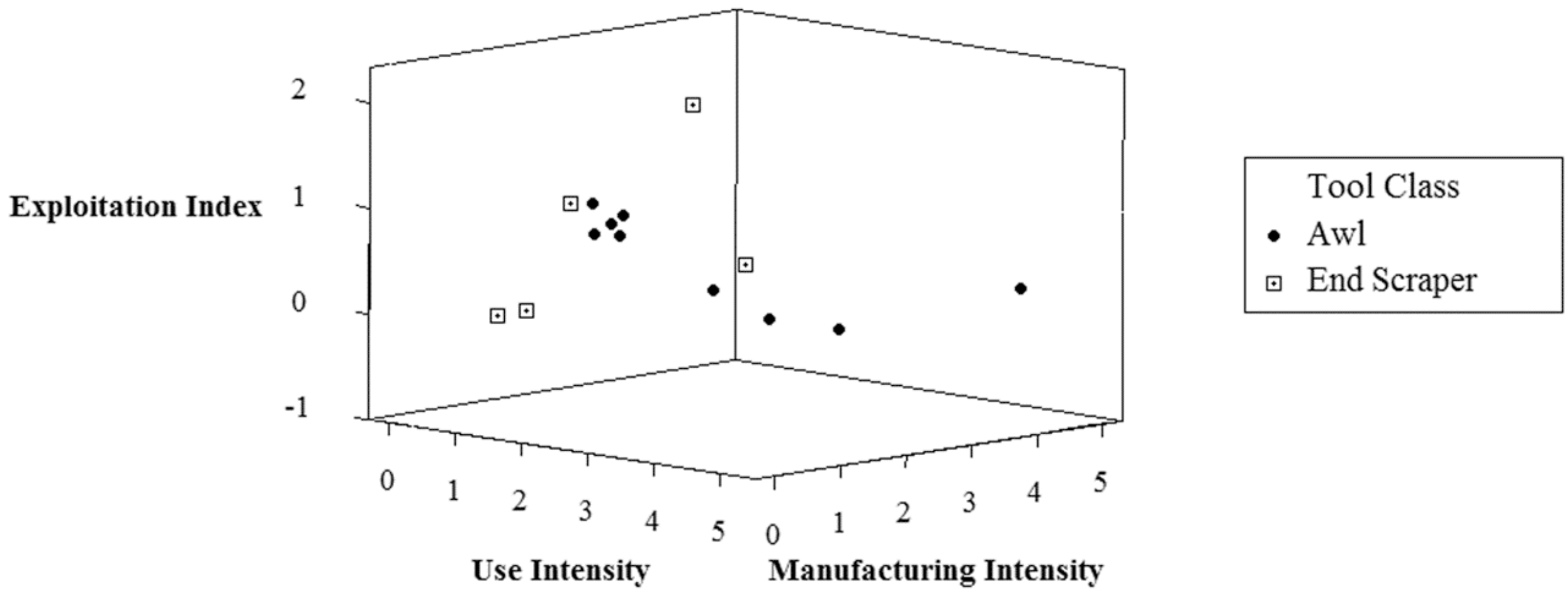


Figure 8.15c: Bone tool manufacture and use at Bc 57 (Late Bonito).

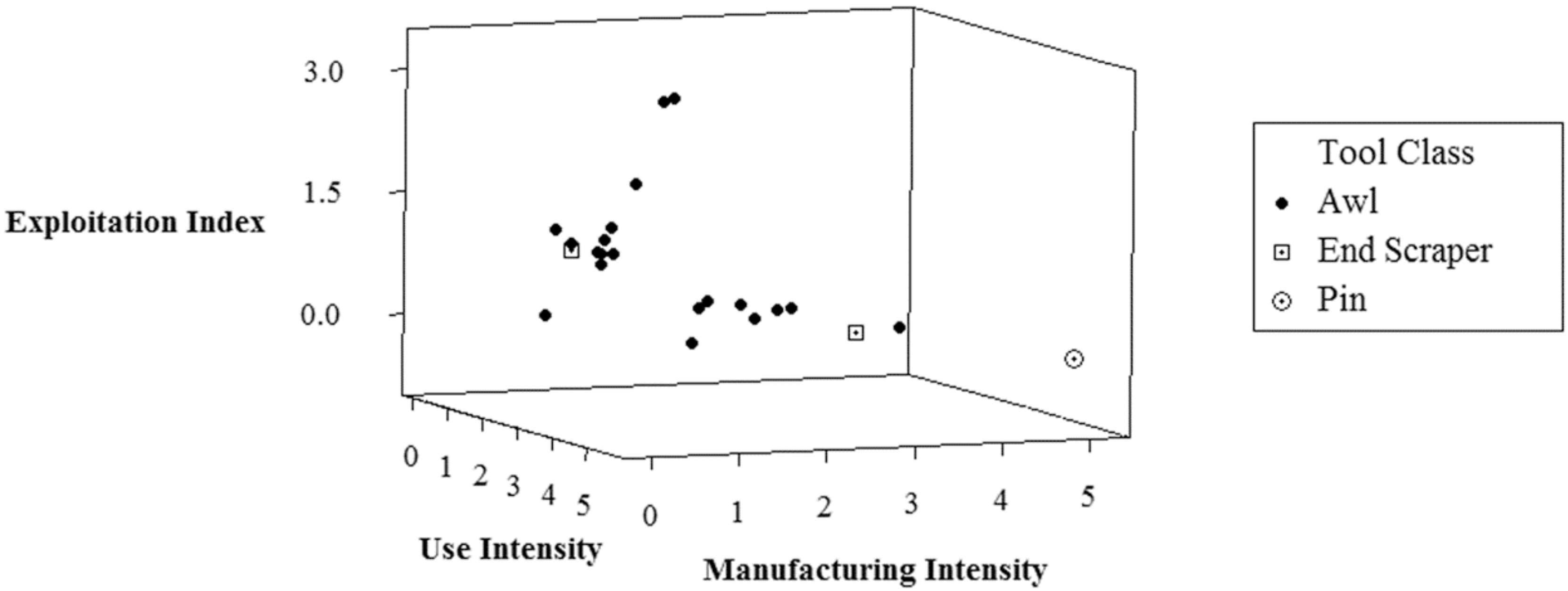


Figure 8.16: Bone tool manufacture and use at Łeyit Kin (Classic Bonito).

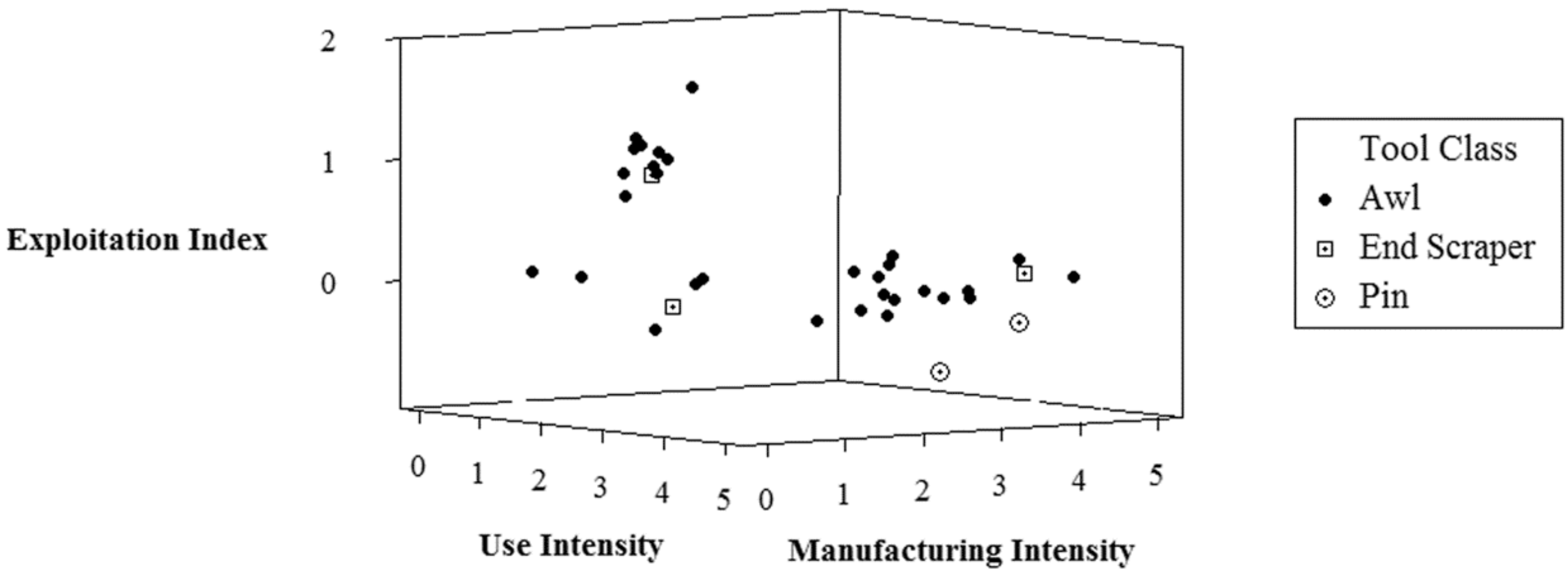


Figure 8.17: Bone tool manufacture and use at Bc 53 (Classic-Late Bonito).

Although the sample size from Early Bonito Bc 57 is somewhat smaller, the high exploitation index values and moderate degree of labor invested in manufacture places its signature somewhere between 627 and 629 (Figure 8.15a). The Classic Bonito pattern, however, more closely approximates the higher craft intensity at 627 (Figure 8.15b). During this period at Bc 57, the manufacturing process appears slightly more involved with a greater return through use; nearly 30 percent of bone tools were scored a four or greater in manufacturing intensity (versus 20 percent at 627) and negative exploitation index values were recorded for only 13 percent of bone tools. The frequency of *ad hoc* tools increased drastically during the Late Bonito period at Bc 57 while use intensity dropped signaling a decline in the importance of this particular economic activity during the early twelfth century (Figure 8.15c). Overall, the evidence from Bc 57 indicates that greater forethought invested in tool manufacture and higher rates of use occurred during the Classic Bonito subphase, a pattern consistent with craft intensification. But the question remains whether the Bc 57 signature is an isolated trend or is reflected at other contemporaneous sites nearby.

The Classic Bonito assemblage from Łeyit Kin and the Early-Classic Bonito collection from Bc 53 provide useful comparisons. Study of manufacture and use intensity at Łeyit Kin (Figure 8.16) indicates a preference for expedient tools over more labor-intensive types but, like sites 627 and the Classic Bonito assemblage from Bc 57, the intensity of use is high with only 4 percent of bone tools yielding a negative exploitation index value. Similarly, heavy use of expedient tools is prevalent at Bc 53, but unlike Łeyit Kin implements exhibiting a high degree of manufacturing wear are also frequent; 24 percent of tools were scored a 4 or higher in manufacturing intensity (Figure

8.17). Coupled with the relatively low rate of negative exploitation index values (18 percent), the Bc 53 pattern is also comparable to sites 627 and Classic Bonito Bc 57.

The curation rate was variable, being highest at site 629 (15 percent) and Łeyit Kin (15 percent). The rate was lowest at 627 (5 percent) and Bc 53 (8 percent), a surprising pattern given that craft intensity appears to have been highest at the latter two sites. A higher frequency of curated tools might be expected where craft production intensifies but extremely heavy-use could also result in higher discard rates. However, inter-site variation in the depositional pathways associated with bone tools could account for different curation rates. For instance, three awls were found in association with a human burial in Room 3 at Bc 57; long-curated tools interred off-site with their former owners could account for the differences seen here.

Based on Choyke's (1997) exploitation index, assemblages dating to the Classic Bonito subphase exhibited the highest rates of manufacturing effort and intensification in tool use. The frequency of curated bone artifacts was highly variable and could not be linked to any temporal trends. The Early Bonito pattern points to spatial variation in the intensity of craft production, a pattern explored in greater detail in the following sections.

### *Spatial Variation*

Before proceeding with the analysis of raw materials, a brief discussion of spatial and temporal variability in production loci is warranted (Table 8.5). Broadly speaking, the production units at small house sites were likely comprised of members of one or more resident households. Although the nature of production-units in great house settings remains poorly understood, evidence recovered from a layer of roof fall in Room

145 at Pueblo Alto provides tantalizing evidence of centralized production. Akins (1987b:538) noted a large concentration of artiodactyl limb bones in variable stages of modification and manufacture apparently stored as tool stock. Otherwise, relatively few bone artifacts have been found in contexts that reflect craft production; 94 percent of bone artifacts were found discarded in refuse deposits.

During the Basketmaker III period through the Early Bonito subphase, bone tool manufacture and use appears to have been centered within pithouses and kivas. The sizable assemblage found in situ within Pithouse B at site 1360 lends support to this interpretation. It is unclear whether the apparent decline in osseous artifacts recovered from floor-associated contexts during subsequent periods reflects a shift in cultural practices or simply the vagaries of preservation and recovery. The presence of a small amount of worked bone from floor deposits within roomblocks during the Classic and Late Bonito subphases implies that these areas were the focus of at least some craft production. The Late Bonito increase in discard of bone artifacts within room fill is attributable to a broader temporal shift in refuse disposal patterns (Wills 2009:297-298; Windes 1987b:617-618).

***Species Variability in Raw Material Choice***

CA is a useful exploratory method in that it is capable of depicting multiple dimensions of variability within a dataset. The first step here was an attempt to determine the primary source of variability and then identify a subset of sites exhibiting similar bone tool production strategies that might warrant closer investigation.

Table 8.5: Bone artifact provenience by time period.

| | Context | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Square Room | | | | Kiva/Pithouse | | | | Extramural Area | | | | Trash Midden | |
| Time Period | Fill | % | Floor | % | Fill | % | Floor | % | Fill | % | Floor | % | Fill | % |
| Basketmaker III/Early Pueblo I | 1 | 0.4 | 0 | 0.0 | 197 | 71.1 | 66 | 23.8 | 11.0 | 4.0 | 2 | 0.7 | 0 | 0.0 |
| Early Bonito | 46 | 17.1 | 14 | 5.2 | 127 | 47.2 | 48 | 17.8 | 6.0 | 2.2 | 0 | 0.0 | 28 | 10.4 |
| Classic Bonito | 10 | 17.2 | 2 | 3.4 | 4 | 6.9 | 0 | 0.0 | 3.0 | 5.2 | 0 | 0.0 | 39 | 67.2 |
| Late Bonito | 71 | 41.0 | 3 | 1.7 | 88 | 50.9 | 1 | 0.6 | 8.0 | 4.6 | 2 | 1.2 | 0 | 0.0 |
| TOTAL | 128 | 16.5 | 19 | 2.4 | 416 | 53.5 | 115 | 14.8 | 28 | 3.6 | 4 | 0.5 | 67 | 8.6 |

CA is an ordination method that employs a two-way (row-column) matrix in which the rows are proveniences and the columns are species counts. Counts are transformed into proportions rather than absolute frequencies and variation is measured in chi-squared distances rather than the Euclidean distances employed in Principal Components Analysis. The distances for each row or column are weighted by their mass (larger assemblages have more weight or *mass* and thus more heavily influence the outcome of the CA) and the result is a measure of the relative distance of points from the average, termed *inertia*. Then by calculating the sum of squares of inertia values and by using the cross-products matrix we are able to measure the deviation of points from the newly established best-fit lines. These best-fit lines are determined by calculating eigenvalues/eigenvectors and the best-fit lines then become the axes employed for the remainder of the CA. Rescaling the eigenvectors by calculating coefficients (the reciprocal of the square roots) and multiplying these by the row profiles is advantageous in that it permits rare types (in columns) to be given more weight and observations (in rows) to become weighted averages of their type coefficients, where the type relative frequencies are the weights.

As is visible in Figure 8.18a, axis one appears to capture meaningful temporal patterning in overall faunal procurement strategies with earlier sites (299, 423, 628, 724, and 1360) toward to left side of the distribution and the later components of sites 627, 629, 633, and Pueblo Alto toward the right-hand side of the plot. The plot delineates two, possibly three groups of sites – the first is defined by procurement of artiodactyls and this group may be subdivided based on a differential emphasis on pronghorn on the one hand and deer and bighorn on the other. The second clear grouping reflects a twelfth century bias at Pueblo Alto and 29SJ 633 toward exploitation of turkey. Due to the overwhelming focus on cottontail, jackrabbit, and various species of artiodactyl (bighorn sheep, mule deer, and pronghorn antelope) throughout most periods there is significant overlap among sites occupied from Basketmaker III through Pueblo II. Given the increase in turkey exploitation at many Chacoan sites during the late eleventh and early twelfth centuries this distribution of sites trending toward the right of the plot is unsurprising.

Axis one of Figure 8.18b in contrast does appear to capture a temporal dimension in bone tool raw material choice. On the left are the Basketmaker III sites where jackrabbit appears to have been a common raw material source. From the origin toward the right of the plot lies a roughly temporally sequential distribution of Bonito Phase sites dominated by artiodactyl remains and later turkey during the latest component at Bc 57. Thus from Basketmaker III to the ensuing Pueblo periods, there is a perceptible temporal shift from use of leporids in bone tool production toward artiodactyl, carnivores, and turkey. The tight grouping of Bonito Phase sites suggests a high degree of similarity but the possibility of additional inter-site variability warrants further investigation.

To summarize, the CA highlights a broad temporal trend in bone tool production and illustrates that by the Early Bonito subphase, a preference for artiodactyls and carnivores as raw material for bone tools had become well-established and widespread despite apparent differential access. The pattern is consistent with conditions in which greater durability and standardization are prioritized. Analysis using ternary plots

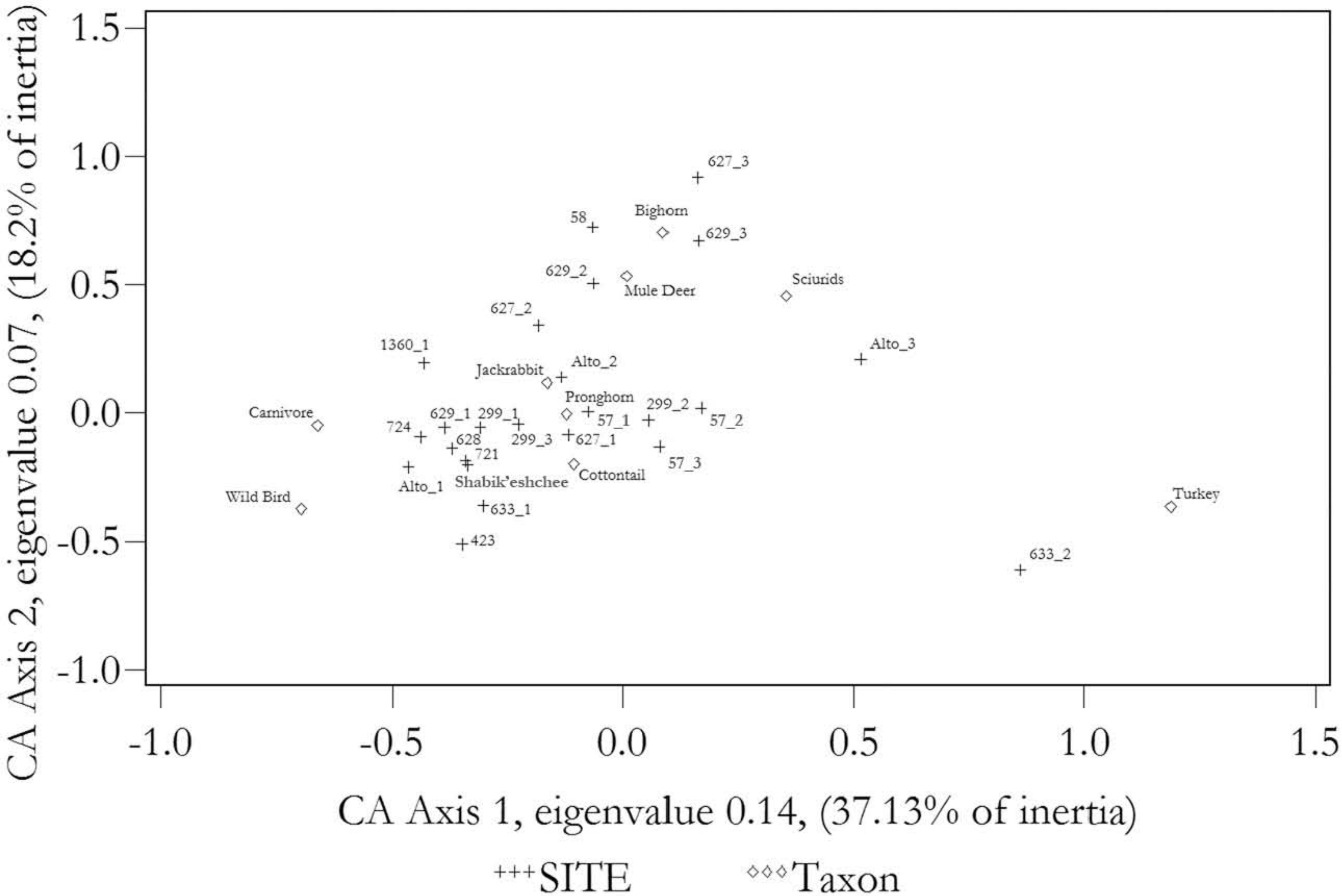


Figure 8.18a: CA plot of Basketmaker III through Pueblo III faunal procurement patterns.

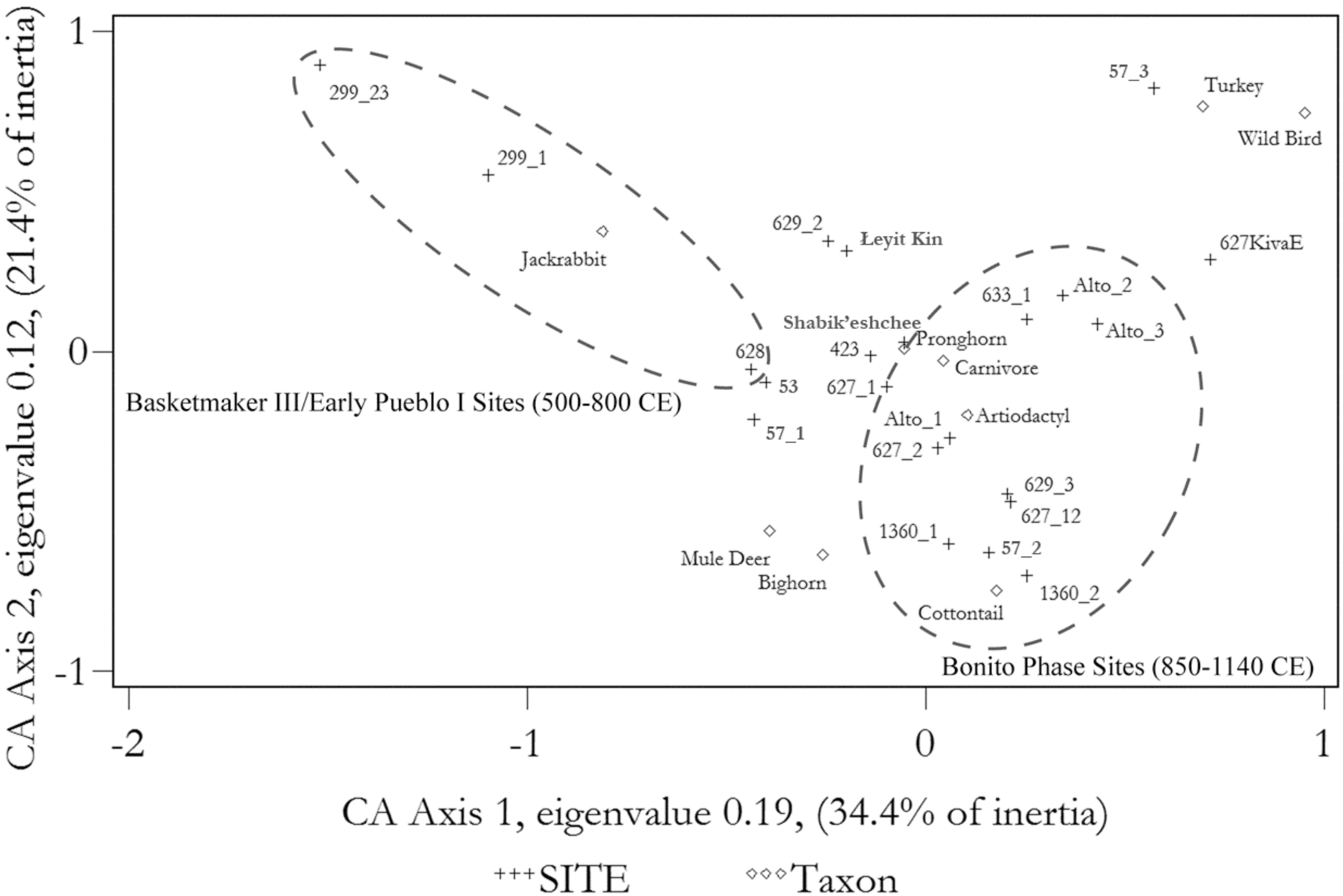


Figure 8.18b: CA plot of Basketmaker III through Pueblo III bone tool raw materials sources; the category "Wild Bird" includes worked bone identified to taxonomic class Aves.

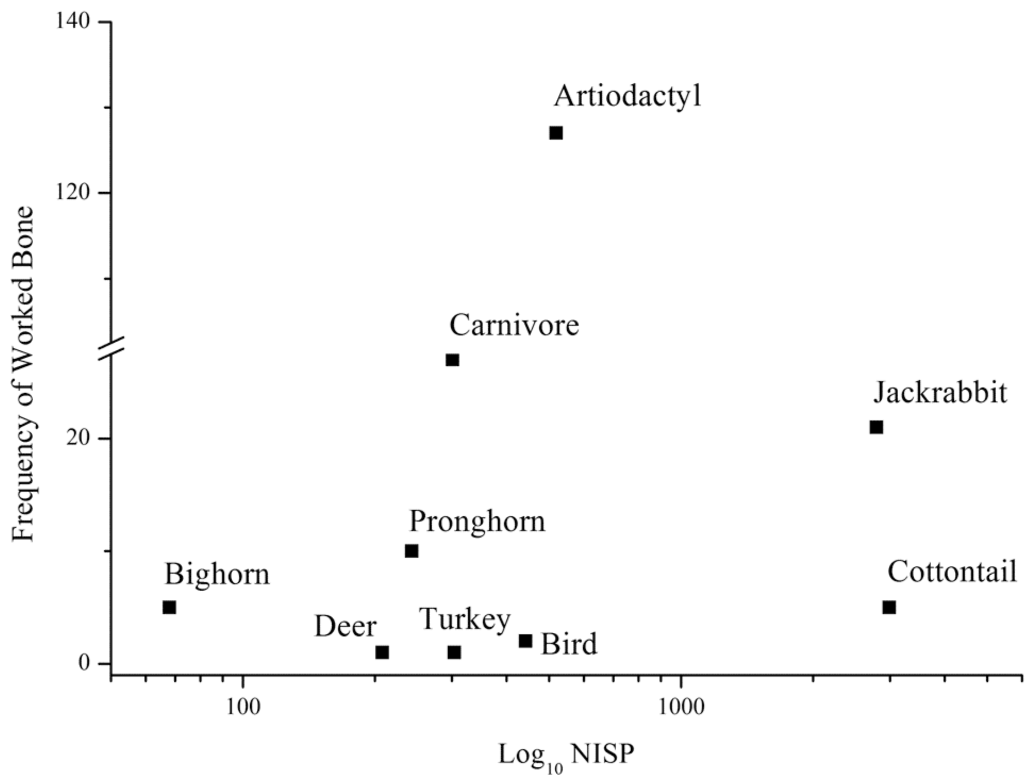


Figure 8.19: Comparison of raw material choice versus NISP for Early Bonito.

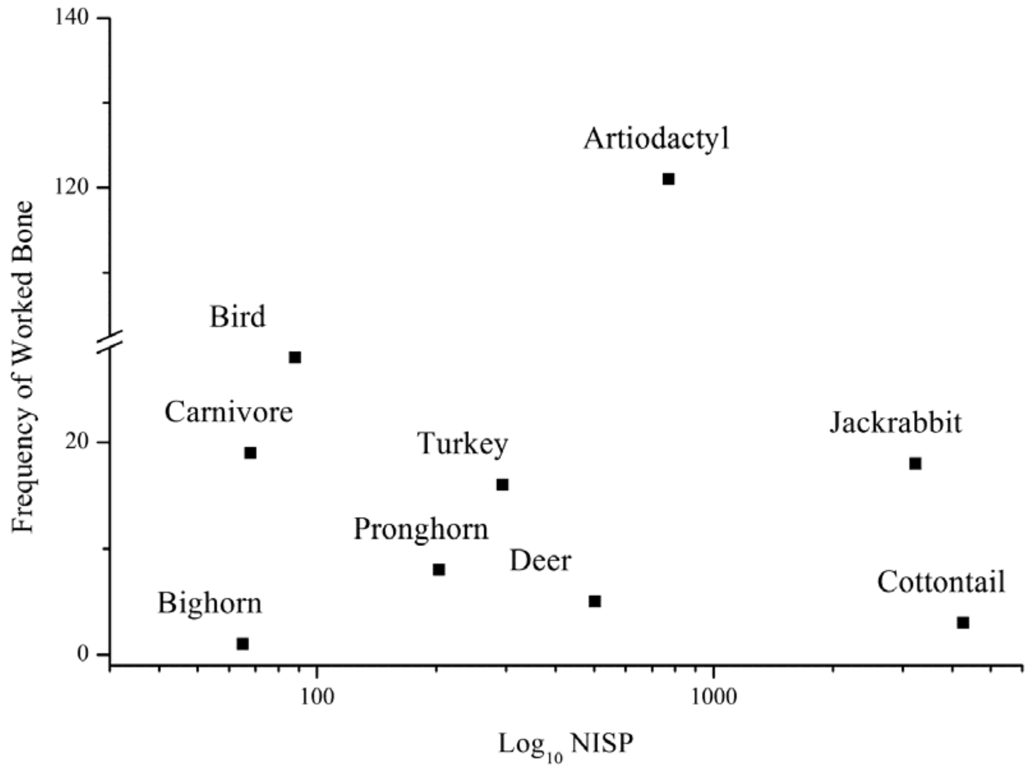


Figure 8.20: Comparison of raw material choice versus NISP for Classic Bonito.

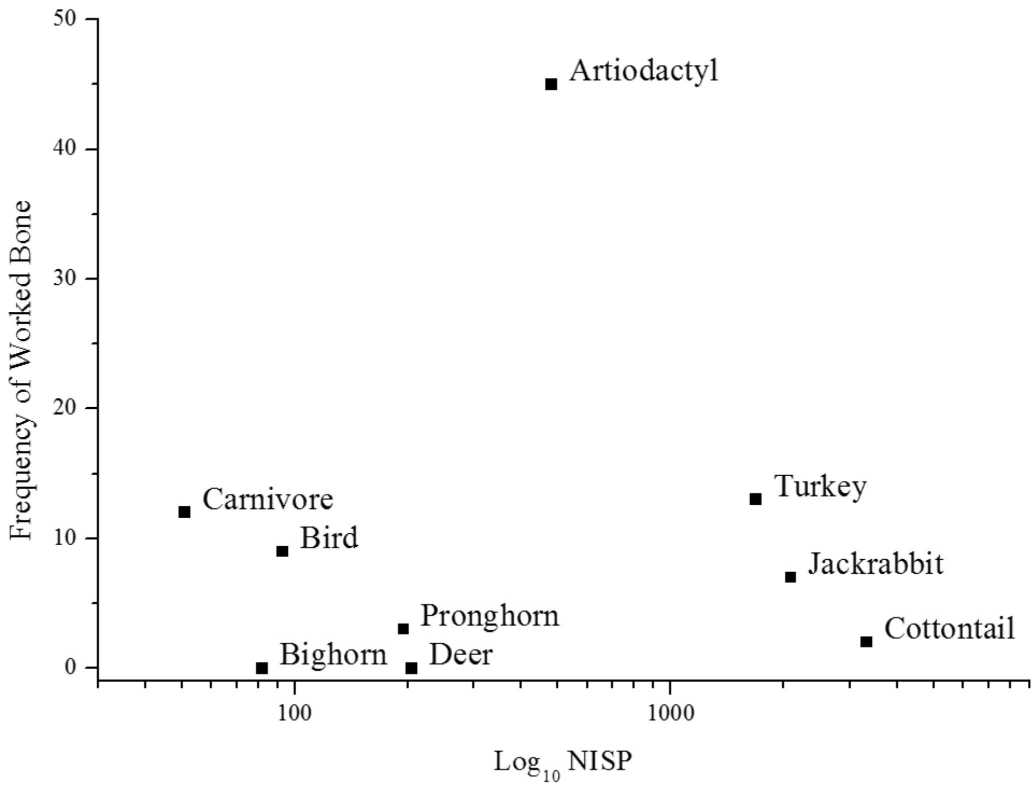


Figure 8.21: Comparison of raw material choice versus NISP for Late Bonito.

reinforces the pattern visible in the CA in which artiodactyl and to a lesser degree carnivore elements were the raw material of choice.

The Early Bonito subphase emphasis on these key species as well as the disproportionately higher overall frequency of bone tools recovered from sites in the Marcia's Rincon and Fajada Gap areas relative to that of Bc 57 and Pueblo Alto lends support to the interpretation that the former areas may have been the focus of early intensification of bone tool manufacture and use. This interpretation is further supported by the exploitation index analysis presented above wherein site 627 yielded the earliest evidence for intensification of tool manufacture and use.

Figures 8.19, 8.20, and 8.21 depict the temporal relationship between NISP for all faunal assemblages and the frequency with which species were selected as raw material for bone implements and ornaments. Artiodactyl, a category that here includes pronghorn, bighorn, and mule deer, as well as specimens identified as large mammal, remains the most common raw material source across the Early, Classic, and Late Bonito subphases. Despite particularly high NISP counts throughout, exploitation of cottontail and jackrabbit as tool stock exhibits very little fluctuation through time. Carnivore was widely accessible during Early Bonito and was accordingly utilized with some frequency. However, as availability declined during the Classic and Late Bonito subphases demand for carnivore skeletal elements in bone tool manufacture remained high suggesting that cultural preferences dictated its continued importance as a raw material. Access to turkey and other bird species was relatively unchanged from the Early to Classic Bonito subphases but demand for bird bone apparently soared during Classic Bonito. During the Late Bonito subphase the availability of turkey increased markedly but use of turkey bone rose only slightly compared to other species. The significance of the Classic Bonito shift toward use of bird remains through time is borne out by the analysis below.

Utilizing ternary plots to explore site-specific trends in species procurement and bone tool production, sites were separated into groups by Early, Classic, and Late Bonito subphases revealing several important trends. The obliteration of species-diagnostic anatomical features is common during the manufacturing process and use-life of bone tools. For this reason, comparisons of relative frequencies of fauna were limited to the broad “artiodactyl,” “leporid,” and “carnivore” categories to which even heavily worn bone artifacts can often be assigned.

Beginning with the Early Bonito subphase (Figures 8.22a) overall faunal procurement strategies at sites 1360 and Bc 57 diverge markedly from other Early Bonito sites (627, 629, and Pueblo Alto) with a heavy emphasis on artiodactyls. In addition, carnivore procurement is relatively high at both 1360 and the earliest component at 629. Otherwise, Early Bonito subphase sites all exhibit a general preference for leporid remains. While the rate of artiodactyl procurement varied widely, deer, pronghorn, and bighorn skeletal parts comprise the overwhelming majority of raw materials selected for bone tool manufacture at all sites (Figure 8.22b). Otherwise, use of durable carnivore bone was favored among the Marcia’s Rincon sites (627 and 629) and less durable, expedient tools fashioned from leporid remains were common at both 629 and Bc 57. Overall frequency of bone artifacts dating to this period is the lowest of the entire Bonito phase and the Fajada Gap sites (627, 629, 1360) account for the majority of the worked bone sample.

Although emphasis on artiodactyl increased slightly and leporid procurement remained relatively unchanged from the preceding period (Figure 8.23a), the Classic Bonito subphase witnessed a drop in hunting of carnivores and an increase in the frequency of bird remains, a pattern most evident at Bc 57. Selection of leporids as raw material for tools declined at most sites, Łeyit Kin being the exception (Figure 8.23b). The trend suggests a general shift away from expedient tools toward more durable forms. Relative to other species, the rate at which bird species including Cooper’s hawk, Canada goose, sandhill crane, and turkey were utilized as raw material for tools *and* tube beads increased by an average of 20 percent from preceding periods.

The Late Bonito pattern (Figures 8.24a and 8.24b) is similar to that of the Classic Bonito subphase with a continued preference for artiodactyl elements in tool manufacture. Whereas the number of bone ornaments exhibited only a slight (5 percent) increase from the Early to Classic Bonito subphases, the number of bone tubes and pendants increased by 20 percent during the Late Bonito subphase. The pattern is striking and reflects a significant shift in the bone tool industry. Despite low rates of carnivore procurement the frequency of its use as raw material displayed a marked increase at Pueblo Alto and the Marcia's Rincon sites 627 and 633. The total frequency of bone tools remained high at Pueblo Alto and Bc 57 but declined among the Marcia's Rincon sites.

To assess the significance of these trends a chi-square comparison was performed of species-related raw material selection and time period (Table 8.6). For the Early and Classic Bonito subphases, the chi-square test reveals that time period and species selected for manufacture of worked bone objects are interrelated ($\chi^2 = 16.934$, $p < 0.01$, $df = 3$). Examination of the adjusted residuals confirms that bird remains are indeed significantly overrepresented among Classic Bonito deposits, consistent with the trend observed above. In contrast the results of the chi-square comparison of Classic and Late Bonito worked bone manufacture (Table 8.7) were not significant, $\chi^2 = 0.829$ ($p = 0.842$, $df = 3$), but the expected frequencies and adjusted residuals highlight the continued growth in intensity of bird bone utilization.

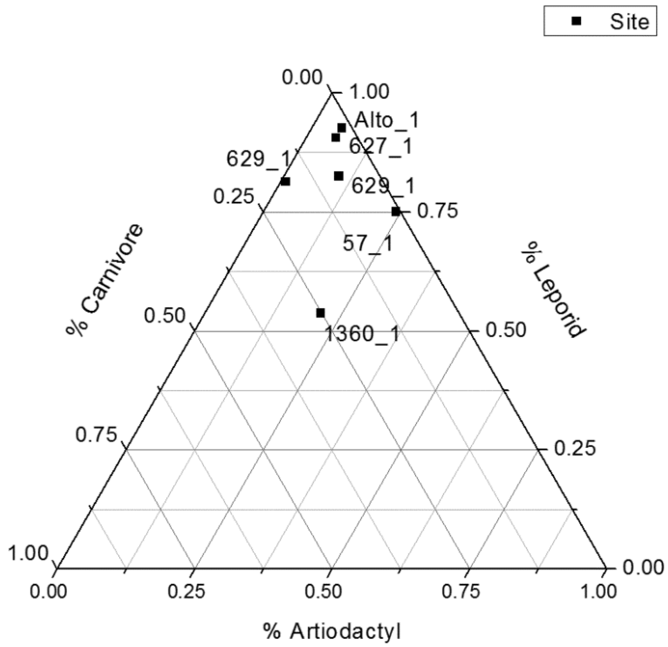


Figure 8.22a: Ternary plot of Early Bonito subphase faunal procurement patterns.

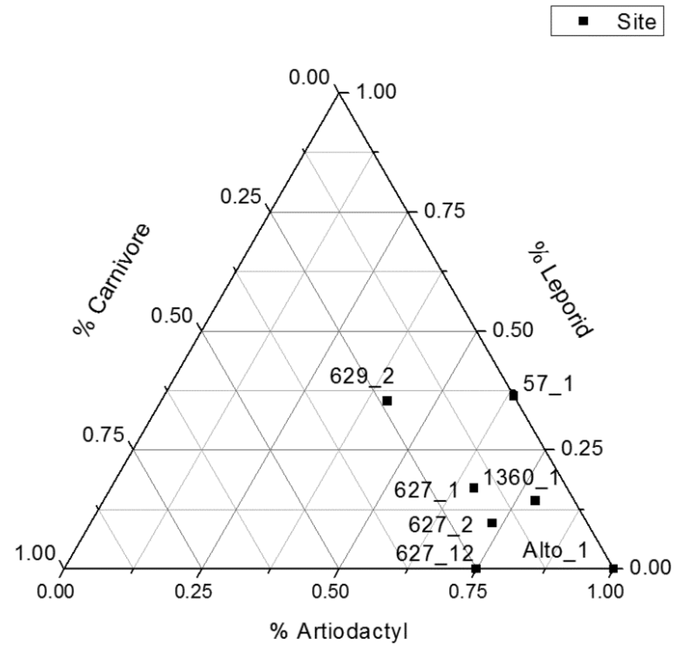


Figure 8.22b: Ternary plot of Early Bonito subphase raw material choices for bone tool manufacture.

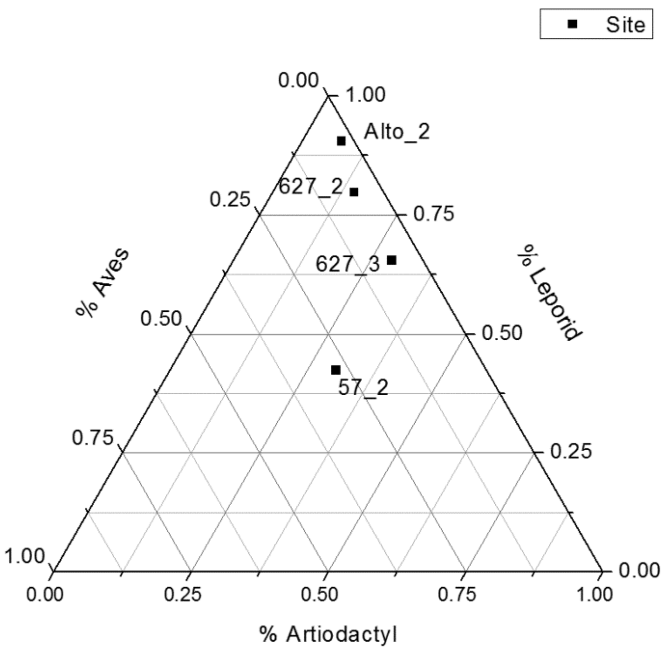


Figure 8.23a: Ternary plot of Classic Bonito subphase faunal procurement patterns.

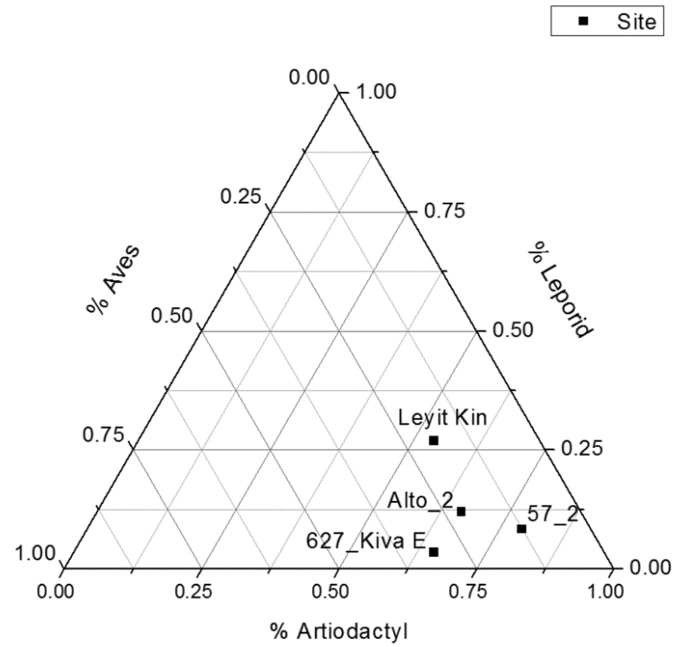


Figure 8.23b: Ternary plot of Classic Bonito subphase raw material choices for bone tool manufacture.

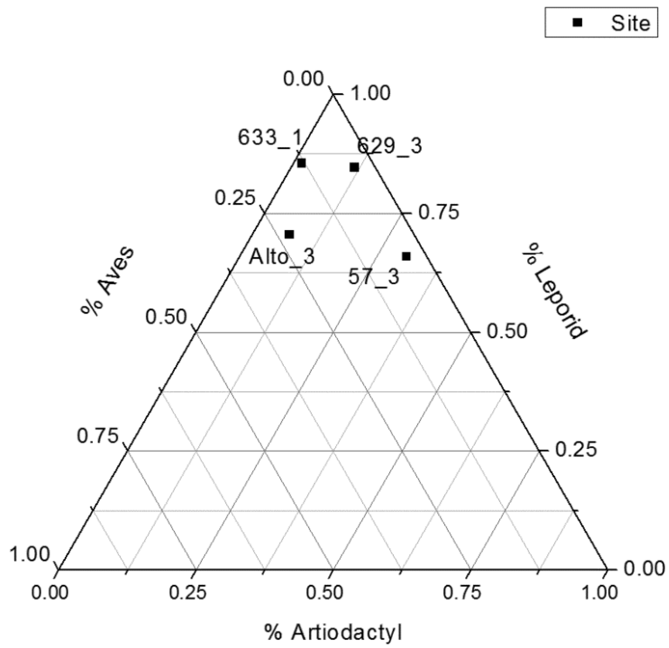


Figure 8.24a: Ternary plot of Late Bonito subphase faunal procurement patterns.

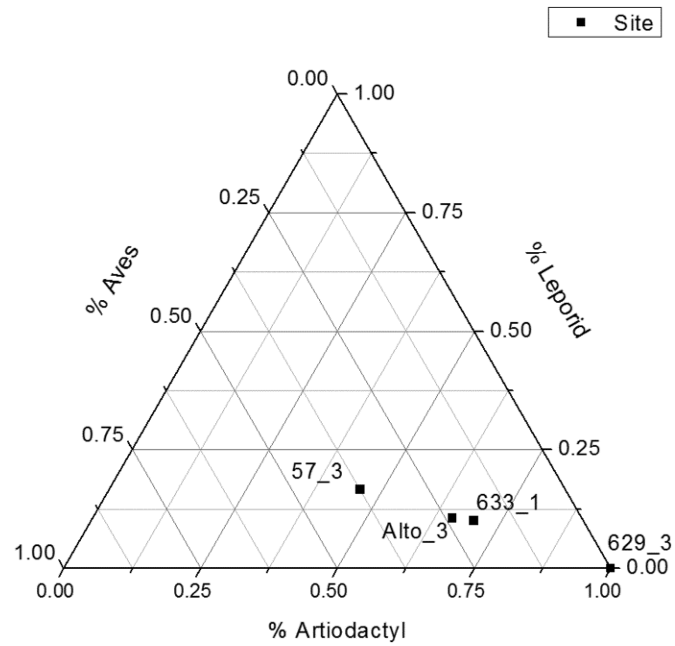


Figure 8.24b: Ternary plot of Late Bonito subphase raw material choices for bone tool manufacture.

Table 8.6: Chi-square table with adjusted residuals comparing species selected as raw material for bone tools and ornaments during the Early and Classic subphases at Pueblo Alto, 29SJ 627, 29SJ 629, Łeyit Kin, and Bc 57. Expected values are shown in parentheses; $\chi^2 = 16.934$, ($p < 0.001$, df = 3). For adjusted residuals, *denotes $p < 0.01$.

| | Time Period | | | |
|---|---|---|---|---|
| | Early Bonito | | Classic Bonito | |
| Taxon | Observed (Expected) | Adjusted Residual | Observed (Expected) | Adjusted Residual |
| Artiodactyl | 149 (143.11) | 1.028 | 281 (286.89) | -1.028 |
| Aves | 5 (18.64) | -4.044* | 51 (37.36) | 4.044* |
| Carnivore | 31 (29.96) | 1.018 | 50 (54.04) | -1.018 |
| Leporid | 33 (29.29 | 0.902 | 55 (58.71) | -0.902 |

Table 8.7: Chi-square table with adjusted residuals comparing species selected as raw material for bone tools and ornaments during Classic and Late Bonito subphases at Pueblo Alto, 29SJ 627, 29SJ 629, 29SJ 633, Łeyit Kin and Bc 57. Expected values are shown in parentheses; $\chi^2 = 0.829$ ($p = 0.842$, df = 3).

| | Time Period | | | |
|---|---|---|---|---|
| | Classic Bonito | | Late Bonito | |
| Taxon | Observed (Expected) | Adjusted Residual | Observed (Expected) | Adjusted Residual |
| Artiodactyl | 281 (276.6) | 0.585 | 328 (332.4) | -0.585 |
| Aves | 51 (55.4) | -0.8601 | 71 (66.6) | 0.8601 |
| Carnivore | 50 (50.9) | -0.1771 | 62 (61.1) | 0.1771 |
| Leporid | 55 (54.1) | 0.1854 | 64 (64.9) | -0.1854 |

Use of bird bone in tube and ornament manufacture increased in prevalence during the Classic Bonito subphase and the trend persisted through the Late Bonito subphase, signaling a growing intensification and expansion of the Chacoan worked bone industry. Interestingly, the pattern parallels a similar shift toward increasing bone tube production documented by Lloyd (2006:94) from the Primary (1090-1130 CE) to Secondary (post-1130 CE) occupations at Salmon Ruin.

In light of the similarity in raw material choice among the Marcia's Rincon sites (627, 629, 1360) and the clear evidence for differential access to artiodactyls it is tempting to infer exchange between these neighboring sites. While a plausible alternative interpretation is that despite limited access to artiodactyls the 627 and 629 inhabitants' supply of raw material was adequate to meet production needs, it should also be noted that the assemblage from Pithouse B at site 1360 contained an unusually high density of bone tools including several artiodactyl lower limb bones in variable stages of reduction and modification for use as bone tools. Similar to the evidence from Pueblo Alto discussed above, this evidence for specialized bone tool production has prompted other researchers to conclude that such bone tool production was "in excess of need" and may have been intended for local exchange (McKenna 1984:323-345, 387). If indeed the pattern reflects local exchange and site-level task specialization it is perhaps not surprising that site 629, the site which provides the strongest evidence for a turquoise and shell ornament workshop (Mathien 2001), exhibits a lack of standardization in bone tool manufacture and significantly lower overall counts of bone tools compared to neighboring contemporaneous sites. Similarly, based on a canyon-wide study of abraders Akins (1987a) found that passive lapidary, believed to have been associated with ornament production, was overrepresented at each of the Marcia's Rincon sites leading Akins to conclude that production was more commonly associated with small sites rather than great houses (Akins 1987a:375-379).

Analysis of species-related raw material choice revealed a temporal trend indicative of intensification of production through time as well as a preference for more durable raw materials. However as Emery noted, "the actual 'raw material' of the bone worker…is the skeletal element" (Emery 2009:8). An examination of skeletal element choice in bone tool manufacture affords an alternate means for testing the hypothesis that intensification was positively correlated with the sociopolitical changes of the Early, Classic, and Late Bonito subphases.

Table 8.8: Richness, Evenness, and Diversity measures by skeletal elements selected for use in the manufacture of bone awls at sites Bc 57, 29SJ 519, 29SJ 628, 29SJ 629, 29SJ 633, and Pueblo Alto.

| | Skeletal Element | | | |
|---|---|---|---|---|
| **Period** | **Richness** | **Evenness (Simpson's $E_{1/D}$)** | **Diversity (Simpson's *D*)** | **n** |
| Basketmaker III/Early Pueblo I | 5 | 0.95 | 4.77 | 21 |
| Early Bonito | 7 | 0.44 | 3.10 | 31 |
| Classic Bonito | 7 | 0.72 | 5.03 | 19 |
| Late Bonito | 10 | 1.39 | 13.91 | 18 |

Table 8.9: Richness, Evenness, and Diversity measures by species selected for use in the manufacture of bone awls at sites Bc 57, 29SJ 519, 29SJ 628, 29SJ 629, 29SJ 633, and Pueblo Alto.

| | Taxon | | | |
|---|---|---|---|---|
| **Period** | **Richness** | **Evenness (Simpson's $E_{1/D}$)** | **Diversity (Simpson's *D*)** | **n** |
| Basketmaker III/Early Pueblo I | 6 | 1.22 | 7.33 | 12 |
| Early Bonito | 6 | 0.63 | 3.79 | 14 |
| Classic Bonito | 6 | 1.00 | 6.00 | 9 |
| Late Bonito | 7 | 0.70 | 4.88 | 13 |

### *Skeletal Element Diversity*

Richness, evenness, and diversity were assessed by focusing only on the broad tool category “awl” for the Basketmaker III/Early Pueblo I periods and the Early, Classic, and Late Bonito subphases (see Table 8.8). When richness was plotted against sample size, no sample size effect was evident (Figure 8.25). The Early Bonito subphase is marked by a decrease in diversity and evenness of skeletal elements from the preceding Basketmaker III period, a pattern echoed in the diversity of species utilized (Table 8.9). Decreasing evenness in skeletal element selection appears to be the result of the increasing standardization of awl manufacture wherein metapodials constituted the preferred raw material. That both diversity and evenness of element and species selection increased slightly during Classic Bonito is unexpected but appears minor in comparison to the change that followed. The Late Bonito subphase contrasts sharply with preceding periods – a pattern not detected previously through examination of species choice. A dramatic increase in both diversity and evenness among skeletal elements reflects a growing disregard for earlier standards of awl manufacture. In fact the metapodials so heavily favored in antecedent periods are of minor importance during Late Bonito.

Moreover, this apparent ambivalence for tool raw material extends across all sites in the sample (Pueblo Alto, Bc 57, 29SJ 629, and 29SJ 633). When juxtaposed with the trend toward greater standardization through the Early and Classic Bonito subphases, the Late Bonito shift in awl manufacture is all the more compelling. The Late Bonito decline in species evenness appears to reflect the growing emphasis on utilization of turkey remains.

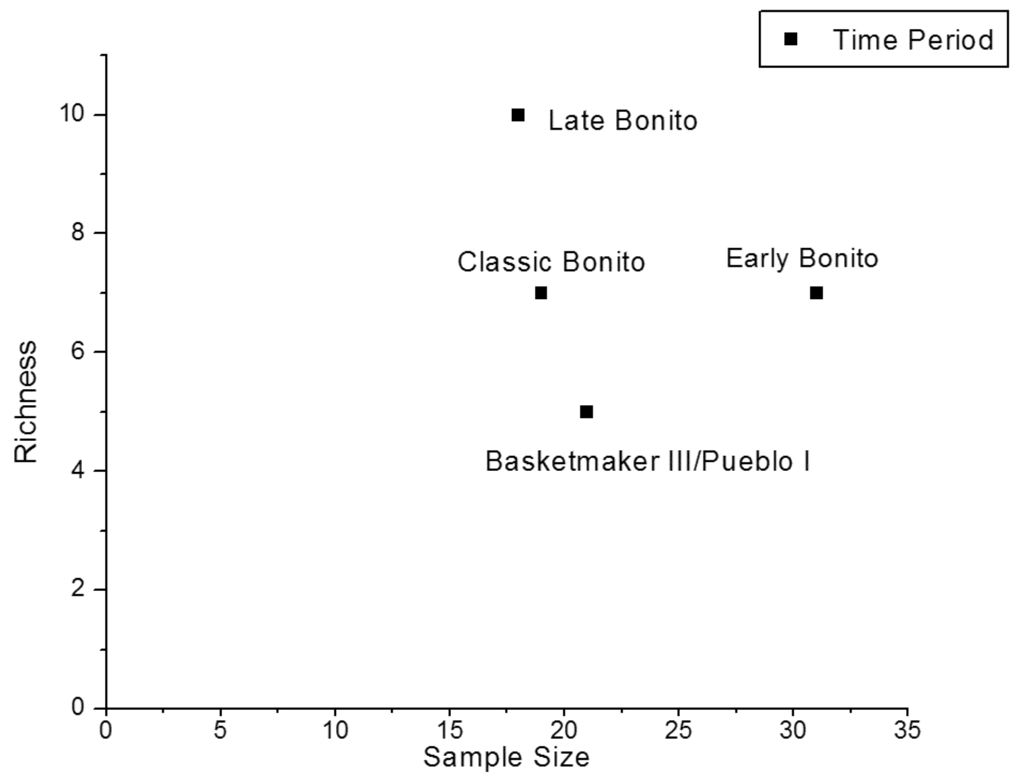


Figure 8.25: Plot of different skeletal elements (richness) by time period against sample size.

## Summary

Metrical analysis of bone tools and ornaments highlighted a general coherence in craft production patterns at small house sites and suggested that these patterns may have diverged from that of the Pueblo Alto great house. Application of Choyke's (1997) exploitation index to a broad range of sites and time periods shed light on a temporal trend indicative of increasing intensification of bone tool production and use from the Early through Classic Bonito subphases and an apparent spatial shift in craft production loci. During Early Bonito, the earliest evidence of substantial labor investment in tool production and exhaustive tool use derives from the Marcia's Rincon site 627. A similar pattern of manufacture and use then emerged during the Classic Bonito subphase among the Bc sites opposite the great houses of Pueblo Bonito, Pueblo del Arroyo, and Chetro Ketl. Both of these initial interpretations were supported by analysis of raw material choice.

Returning to the questions that framed this analysis, to what degree did access to and selection of raw materials vary across time and space? Were patterns of bone tool production and use consistent with economic intensification and if so, did potential shifts in production correlate with the increasing political centralization of the Early, Classic, and Late Bonito subphases? This analysis revealed two dominant temporal trends in the Chacoan worked bone industry. Variation in species was characterized by a gradual increase in reliance on artiodactyls from Basketmaker III through the Early and Classic Bonito subphases, followed by a Late Bonito trend toward the use of bird, especially turkey in the manufacture of bone tubes. While raw material preferences in awl manufacture became increasingly standardized throughout the Early and Classic Bonito subphases, the Late Bonito transition is marked by a lack of adherence to previous principles of bone tool production.

In spatial terms, there appear to have been at least two production centers that emerged and declined in overlapping succession, during the Early, Classic, and Late Bonito subphases. The Marcia's Rincon and Fajada Gap Sites emerged first during Early Bonito followed by Pueblo Alto during the Classic Bonito subphase. By the Late Bonito subphase, bone tool use had diminished among the Marcia's Rincon sites but remained steady at Alto. While bone tools appeared regularly at sites in the Rinconada area the magnitude does not approach that of either the Marcia's Rincon/Fajada Gap sites or Pueblo Alto.

That the earliest evidence for intensification of bone tool production and use derives not from great house contexts but the smaller, more dispersed villages is consistent with other evidence of Chacoan craft production (Akins 1987a; Mathien 2001; Windes 1992). Bone tool manufacture and use appears to have reached its apex during the Early and Classic Bonito subphases and was subsequently eclipsed by a growing demand for bone tubes and ornaments during the Late Bonito subphase. A limited number of bone whistles constructed from bird and jackrabbit elements were recovered from contexts at sites 627 and 628 and Pueblo Alto spanning the Early Pueblo I through Bonito phase and it is unclear how many of the bone tubes manufactured might have been destined for use as whistles. If the rise in frequency in bone tubes is at all indicative of greater use of whistles then the pattern could signal ritual elaboration and a proliferation of politico-religious specialists as Corbett (2004) has argued for the Chumash of the California coast. A similar upward trend in the prevalence of bone tubes was documented by Lloyd (2006) at Salmon Ruin during the post-Chacoan period. The results of my analysis suggest that the trend observed at Salmon is the continuation of an economic shift that may be traced as far back as the Classic Bonito subphase in Chaco Canyon a century earlier.

Intensification of hide-working and basketry production is implied by a rise in standardization in awl forms during Early and Classic Bonito. Reduced standardization during Late Bonito suggests that these perishable industries declined in importance relative to bone tube manufacture. The evidence for craft intensification coincides with other signs of social change in and around Chaco, including great house and great kiva construction, the emergence of Chacoan outliers (Sebastian 2006:399-401), and agricultural intensification. Changes in the worked bone industry were likely tied to these broader shifts in the Chacoan political and economic landscape during the Bonito phase.

The source of demand that spurred this apparent economic intensification remains unclear but probably stemmed from the intertwining growth of ritual obligations and trade opportunities within and beyond the canyon. Webster and Jolie (in press) have noted the dominance in ritual contexts at Pueblo Bonito of large carrying baskets, ceremonial staffs with spatulate ends, and wooden flutes during the Early and Classic Bonito subphases contrasted by the total absence of these artifact forms from subsequent Late Bonito deposits. Coupled with evidence from the related worked bone industry, the trend implies that craft production in Chaco was at least partially motivated by fulfillment of ritual. The pattern further underscores the pervasiveness of Late Bonito changes manifested in economic and ritual realms. Whether the latter reflects demographic change as some researchers have argued (Judd 1959:168-172; Vivian and Mathews 1965:109-111; Wills 2009) remains a source of debate.

# CHAPTER 9: SYNTHESIS AND INTERPRETATION

The goal of this dissertation research was to explore the socioeconomic effects of political centralization in Chaco Canyon. Although the nature of power, whether derived from differential access to ritual knowledge (Saitta 1997; Van Dyke 2011) or the management of agricultural surplus (Earle 2001; Sebastian 1992), remains a source of debate there can be little doubt that leaders existed in Chaco (Plog and Heitman 2010). The planning and execution of great house building projects, irrigation facilities, and the construction of a vast network of roads certainly are a testament to the effectiveness of powerful individuals in mobilizing labor.

A direct causal relationship between political complexity and the degree of social and economic differentiation need not be assumed (Feinman 2001; Roscoe et al. 1993). Nonetheless, any model of political change that neglects the socioeconomic implications is incomplete.

In small- and intermediate-scale societies, political action is often played out in the context of communal ritual. Successful performance of ritual may be predicated on the capacity for intensified subsistence and craft production (Spielmann 2002:196-197). The material correlates of intensification can include increased emphasis on desirable foods (Hayden 1990:36) and changes in the organization of craft production. In cases where political hierarchy is more pervasive, status and economic differentiation may be more overtly expressed through differential access (Emery 2003; Jackson and Scott 1995; Kelly 2001; Masson 1999) and specialized craft production (Brumfiel et al. 1980; Earle 1987).

With great house construction and implementation of water control facilities as proxy measures of political complexity, I set out to investigate the degree to which heightened levels of centralization during the Classic and Late Bonito subphases were correlated with intensified subsistence and craft production.

In Chapter Four, I demonstrated that the faunal assemblages from Bc 57 and Bc 58, sites located directly across from the Pueblo Bonito great house, reflected patterns of faunal procurement and consumption spanning the Early (850-1040 CE), Classic (1040-1100 CE), and Late Bonito (1100-1140 CE) periods and were contemporaneous with the construction and use of the adjacent great kiva, Casa Rinconada. In Chapter Five, study of seasonal indicators including deer and pronghorn mortality and the presence of seasonally migrant taxa indicated year-round hunting.

The taphonomic analyses completed in Chapter Six yielded several important conclusions regarding the Bc 57 and Bc 58 faunal assemblages. Comparison of artiodactyl skeletal part survivorship with bone mineral density revealed that the effects of density-mediated destruction of artiodactyl skeletal remains were slight. This discovery indicates that species and skeletal part frequencies observed in both assemblages may be interpreted as direct reflections of human economic decisions regarding the transport and processing of animal carcasses. Moreover, artiodactyl bone survivorship was found to be positively and significantly correlated with the general utility of skeletal parts (Binford 1978). Bc 57 and Bc 58 were also found to be exceptional among Chacoan sites for the high rate of butchery observed. Cut marked bone, the majority of which is evident along the axial skeleton and upper limbs of large game, is three times higher at Bc 58 and almost five times higher at Bc 57 than in the

Pueblo Alto great house faunal assemblage, a pattern that may reflect greater on-site butchery.

In Chapter Seven, I examined spatial evidence and faunal patterning at Bc 57 and Bc 58 for indications of subsistence intensification and differential access. Although architectural evidence of public food preparation was limited, the high rate of large game procurement at Bc 57 and Bc 58 is consistent with large-scale provisioning.

The last half of the eleventh century and the early twelfth century reflect a steady rise in large game procurement observed at Bc 57 and Bc 58. The pattern is characteristic of the previously documented trend in Chaco more broadly (Vivian et al. 2006:449), but Artiodactyl Index values show that the consumption of large game exceeded that of other Chacoan sites, including the Pueblo Alto great house. Pronghorn, a species likely captured through communal hunting and previously thought to have declined in dietary importance after the ninth century CE (Vivian et al. 2006), was in fact *intensified* during the Classic and Late Bonito periods at Bc 57.

Analysis of skeletal part frequencies yielded convincing evidence that, rather than focused only on high utility carcass parts, artiodactyl procurement during the Early, Classic, and Late Bonito periods involved the transport of whole deer and pronghorn carcasses over long distances. Further, the patterns of relative skeletal abundance differed from that of a separate, partially contemporaneous small site cluster located 4 km southeast in the Fajada Gap area of the canyon. By comparison, the latter exhibited much lower frequencies of axial remains and upper limb parts and relatively high numbers of lower limb bones.

On the basis of this evidence, I concluded that a strategy of large-scale provisioning already in place by the Early Bonito subphase was intensified during the Classic and Late Bonito subphases in conjunction with the increasing political complexity witnessed elsewhere in Chaco Canyon.

In Chapter Eight, I shifted focus to an examination of animal skeletal remains utilized in the Chacoan bone tool and ornament industries and the extent to which patterns of bone tool production and use are consistent with economic intensification. The analysis shed light on two temporal trends in the Chacoan worked bone industry. Variation in species was characterized by a gradual increase in reliance on artiodactyls from Basketmaker III through the Early and Classic Bonito subphases, followed by a Late Bonito trend toward the use of bird skeletal elements in the manufacture of bone tubes. Choice of skeletal elements utilized in awl manufacture became increasingly standardized during the Early and Classic Bonito subphases before a marked shift during Late Bonito in which previous principles guiding the manufacture of bone awls were apparently disregarded. Spatially, at least two production centers appear to have emerged and declined in overlapping succession during the course of the Bonito phase. By the Late Bonito period, bone tool use had diminished among the Marcia's Rincon sites but continued at the Pueblo Alto great house. Evidence for intensification of bone tool manufacture derives from small sites rather than great house contexts and is consistent with trends in other Chacoan craft industries (Akins 1987; Mathien 2001; Windes 1992).

Thus bone tool manufacture and use appears to have reached its apex during the Early and Classic Bonito subphases and was subsequently surpassed by a growing demand for bone tubes and ornaments during the Late Bonito period. An intensification of basketry production and hide-working is further implied by the increasing standardization of awl forms during Early and Classic Bonito while the reduced standardization during Late Bonito suggests that these perishable industries declined in importance relative to bone tube manufacture.

Unlike subsistence intensification that coincided with established correlates of centralization during Classic and Late Bonito, the best evidence for craft intensification stems from both the Early and Classic Bonito periods. It is likely that the growing demands of ritual and exchange during the tenth and eleventh centuries propelled this economic intensification.

The results of this study illustrate that the political changes underway in Chaco by the ninth century CE had direct implications for the organization of production. The faunal remains from Bc 57 and Bc 58 are consistent with subsistence intensification and procurement may have been tightly integrated with communal ritual, perhaps organized around a ritual cycle. The intensification of craft production is indicated by a trend toward increasing standardization and investment in tool manufacture at an early stage in Chaco's developmental trajectory and the demands of such economic intensification would undoubtedly have impacted levels of household production.

This study also contributes to our knowledge of economy and sociopolitical differentiation in the greater American Southwest. By exploring trends in faunal exploitation and craft production across temporally and spatially diverse contexts in Chaco, this project directly addresses the central debates over Chacoan complexity. The results of this study also relate to the similar debates that pervade research in the American Southwest and middle range societies in general (Bayman 2002; Blitz 1993;

Creamer and Haas 1985; Crown and Judge 1997; McIntosh 2005; McIntosh 1999:22-23; Milner 2006; Nelson 1995; Pauketat 1994; 2004; Pauketat et al. 2002; Peebles and Kus 1977; Potter 2000; Tainter 1980; Welch and Scarry 1995; Wills 2001; Yoffee 1979). The extent to which the spatial distribution of craft production activities reflected gendered spheres are relevant to the ongoing discourse on prehistoric craft production (Brumfiel and Earle 1987; Costin 1991:3; D'Altroy and Earle 1985; Spielmann 2002) and may have implications for researchers' burgeoning understanding of gender dynamics in Chaco Canyon and the broader Southwest (Crown 2000; James 2001).

The results have also generated many new questions and highlight new directions for future research in Chaco. For instance, where were various species procured and how did this fluctuate through time, e.g., Grimstead (2011)? What was the role of great kivas? Do other Chacoan communities exhibit similar faunal depositional patterns in proximity to great kivas? Do markers of human nutrition reflect differential access to protein-rich diets? How do the manufacture and use of bone tools vary between small sites and those great house assemblages yet to be studied? How does the association of various bone tool types vary among mortuary contexts in Chaco? To what extent do sites exhibit task specialization in perishable craft industries?

Previous analyses of faunal assemblages have privileged the Marcia Rincon site cluster and the Pueblo Alto great house but this study demonstrates the significant spatial and temporal variation in Chacoan subsistence strategies and reinforces the importance of additional studies aimed at understanding the economic relationships within and between clusters of small sites such as those located near Casa Rinconada and Marcia's Rincon. Further, to what extent were the Bc sites, located in such close proximity to the great houses of Pueblo Bonito, Chetro Ketl, and Pueblo del Arroyo, social and economically integrated?

Substantial bone artifact assemblages were also found during the excavation of Bc 50, Bc 51, Talus Unit, and Chetro Ketl and provide an opportunity to address some of these questions. The Pueblo Bonito collections alone account for nearly half of all bone artifacts recovered from Chaco Canyon. Thus well over half of the existing bone tools from Chaco Canyon remain to be analyzed and it is important that this critical source of data be incorporated into future studies of Chacoan political economy. The study of bone tools and use-wear has only recently expanded as a subdiscipline (Lemoine 2001; Olsen 2007; Stone 2011) but similar studies of production and use-wear have been conducted elsewhere in the American Southwest (James 2001; Olsen 1979), the Mesolithic and Neolithic Periods in Europe and Near East (Griffitts and Bonsall 2001; Russell 2001a; 2001b), and the Classic Maya lowlands (Emery 2001).

Finally this research demonstrates the value of archival information and the documentary record of more than a century of archaeological research in Chaco and the necessity of redoubling efforts to study existing ceramic collections and obtain a great many additional radiocarbon dates for sites and assemblages in order to refine our understanding of temporal change.

# APPENDIX A: BC 57 AND BC 58 EXCAVATION HISTORY

## Introduction

The intent of the following sections is to provide comprehensive and definitive accounts of the sites and the manner in which they were excavated. The narratives present the highest level of detail possible so as to illustrate to the reader the wide range in quality of data recording and recovery practices at the UNM-SAR Field Schools.

## Bc 57 – Excavation and Depositional History

### *Room 1*

Room 1 was excavated July 13-21, 1942 by several field school participants including Marion Van Geem, Susan Golden, M.A. Dobbin, Florence Sunderland, and Marion Pearsall. Although, the depth and horizontal location of finds were frequently recorded, the room was excavated as single unit and beyond general fill, floor, and subfloor designations, no stratigraphy was reported. The faunal remains from Room 1 were actually recovered in December 1937, very likely a result of excavation tests at Bc 57 during the 1937 excavations at Bc 50 and Bc 51 (Kluckhohn and Reiter 1939).

*Fill*

The composition of above-floor fill was not described by the excavators but three apparently shallow human burials were encountered in the Room 1 upper fill layers (< 0.3 m depth). Burial #1 was encountered on the first day of excavation and consisted of an adult 0.43 m below the east wall (Golden 1942:3, 5-7). The skeleton was wrapped in cotton and laid on its back, angled slightly to its left with the skull facing east. A corrugated grayware vessel and rodent mandible were found in association with the burial and both were underlain by woven matting (Golden 1942:2-3). All ceramics included in this analysis were from this upper fill stratum and were found in the vicinity of Burial #1.

Excavated on July 13 and 14, Burial #2 was the postcranial skeleton of an adult found only 0.12 m below the top of west wall, 0.60 m above floor level (Dobbin 1942; Golden 1942:5-6). Found in association were a single dark stone bead (FS 570079) and at least one, possibly two partial corrugated vessels along the individual's left side (Van Geem 1942:3-4). A piece of worked stone, reported by Van Geem and Dobbin as a one-handed mano (FS 570080), was retrieved from fill 0.07 m below the skeleton. Dobbin (1942:3) reported finding a moderate density of bulk sherds, lithics, and charred corn cob.

On the July 15, Burial #3 was an infant found 0.58 m below the top of the east wall (Golden 1942:3). The skeleton measured 0.71 m in length and was laid on its back with the skull tilted left facing north and the right arm tucked under the rib cage. Overlying the infant's right femur, a bowl with a black-on-white decorated exterior was stacked inside a bowl with a black-on-red interior decoration (Dobbin 1942:4-5). Dobbin again reports numerous sherds, consisting mainly of corrugated grayware as well as a possible black-on-white decorated ladle and broken black-on-white pot. A bone awl was unearthed in the southeast corner 0.53 m from the top of the east wall (Golden 1942:8).

*Floor*

On July 16, Dobbin reported finding a mano (FS 570102) and a canine tooth (FS 570105). When the room fill had been excavated to a depth of 0.65 m below the top of the east wall, a square test unit (0.81 m x 0.81 m) was excavated in the northeast corner of the room. Here a floor level was reached approximately 1.23 m below the original ground surface (Dobbin 1942:5-6). The remainder of above-floor fill was then removed to floor level. A broken metate (11 x 13 cm) was found lying against the south wall, 0.25 m below the top of the wall (Golden 1942:4).

*Subfloor*

On July 18, subfloor excavations began as a 0.30 m level was stripped away throughout the room (Dobbin 1942). At 0.89 m below the top of the east wall, a slab-lined hearth was located partially underlying the base of that wall (Golden 1942:6). Measuring 0.69 m across at the east wall, the pit extends 0.43 m out from the wall, is 0.30 m deep, and was lined with fire-reddened sandstone and was floored with sandstone (Dobbin 1942:7-8). In the southeast quarter of the room a partial mano and human cranial fragments and teeth (FS 570018) were recovered (Dobbin 1942:8). Golden (1942:7) reported finding additional skeletal material (FS 570411) in the northeast quarter.

Burial #4 was encountered 0.23 m below the floor and was excavated over the course of July 19-21 (Sunderland 1942:21-27). The skeleton was that of an adult lying flexed on its right side with head facing southeast. A wood board (0.46 m) ran along the spine of the skeleton and a long piece of wood (0.56 m) described as either a "planting stick or bow" lay across the rib cage extending to the left temporal area of the skull (Golden 1942:7; Sunderland 1942:24). Arranged in an arc around the individual's head were four ceramic vessels (from north to south): one broken but complete gray bowl (23 cm in diameter), a bowl (15 cm in diameter) with black-on-red exterior decoration and a gray-slipped interior containing a substance described as either hide or bark, a pipe (23 cm in length) with black-on-white decoration, and a black-on-white mug (Sunderland

1942:23-25). Above and below the skeleton were fragments of twilled matting of which Sunderland provided a sketch (1942:21).

At the northwest corner near the west wall, a juniper post embedded in lignite extended to a depth of 0.23 m into sterile soil (Golden 1942:7). The final subfloor excavations in Room 1 yielded "numerous animal bones and pot sherds…as well as several pieces of obsidian [and] much charcoal" 0.96 m from the top of the east wall (Golden 1942:8). A wooden slab 27 cm in length was found lying along the south wall, 0.71 m below the top of the wall (Golden 1942:8).

***Room 2***

Room 2 was excavated from July 14-27, 1942 by Florence Sunderland and two excavators identified only as John and Antonio. Sunderland (1942) kept very detailed field notes including plan and elevation sketches of the room excavations, piece-plotting significant finds, and taking note of Paul Reiter's working interpretations of the deposits. Based on photographs, the north wall masonry most closely resembles Type II (Chaco Culture NHP Museum Collection [1942]-a; Lekson 1984:17-18). Room 2 is noteworthy for the high frequency of groundstone recovered: twenty-eight hammerstones, six metates, four smoothing/polishing stones, two manos, and two palettes/lapidary stones.

*Fill*

Following initial removal of the upper fill in a single arbitrary 0.61 m level, the remainder of above-floor excavations proceeded in 0.30 m levels. Within the room fill, the excavators distinguished three main strata: an upper fill level that included an ashy deposit filled with faunal remains and ceramics (0-0.51 m), an underlying stratum of adobe roof-fall (at 0.51 m), and above-floor fill approximately 0.76 m thick.

The upper fill level yielded faunal remains, some human skeletal remains, two metate fragments (one near the ground surface and a second 0.46 m above floor level), a mano and hammerstone at 0.51 m above floor, and a large square “smoothed stone” (36 x 39 cm, 3 cm thick), probably a palette (Sunderland 1942:4). The upper fill also contained a concentration of black-on-white ceramics (FS 570054). Unfortunately this batch of ceramics is absent from the Maxwell Museum collection. Sunderland notes the recovery of bulk bone, FS 570053, but no such FS was encountered in the faunal collection. The Room 2 fauna assemblage included in this analysis (FS 570046) derives from the upper 0.94 m of fill, in particular from the ash deposit and immediately below the roof fall.

On July 15, Sunderland noted that the remaining upper fill was removed from the southwest quarter of Room 2, yielding more faunal remains and ceramics. Near the south wall, eggshell, a scraper, and polishing stone were found at a depth of 0.56-0.91 m. The stone lintel seated at the top of the south doorway was exposed and excavations continued 0.76 m down to the sill, upon which lay two polishing stones, a partial metate, a hammerstone, and five ceramic sherds. Although not mentioned by Sunderland, a test unit excavated to floor level was likely conducted since subsequent depth measurements are given relative to the floor.

The next day, excavations continued along the north wall along which two complete bowls were found, 0.36 m above floor level. Sunderland described the first as a La Plata Black-on-white bowl and based on the specimen card description and sketch, La Plata appears to be an accurate characterization (Anthropology [1942]-a:37-38).

Adjacent to this bowl, a second complete but fragmented black-on-white bowl was found inverted with a skull fragment underneath. According to the specimen card rendering, the bowl is very likely Mesa Verde black-on-white (Anthropology [1942]-a:24-25). Six more hammerstones were found in the northwest quarter of the room from 0.36-0.41 m above the floor. In the southwest quarter an ash deposit contained two hammerstones and four "bits of turquoise" 0.40 m above floor level. A "skinning knife" of "highly polished jasper" (18.4 x 5.4 cm, tapering to 3.2 cm in width, 1.9 cm thick) was then found nearby at 0.30 m above the floor (Sunderland 1942:7-8). Sunderland (1942:8) also reports finding a scraper and three polychrome sherds within the ash deposit (0.15 m above floor); the latter are very likely the same three St. Johns polychrome sherds included in the above floor ceramic tallies (FS 570092). A bone awl was found in the fill just north of and 3 cm below the south door sill, 0.56 m above the floor. By the end of July 16, a 0.25 m strip along the north wall had exposed an occupational surface while the remainder of the room remained at a depth of 0.50 m from the original ground surface.

On July 17, Sunderland returned to the western half of the room, troweling through the ash deposit while John excavated in the eastern half, "throwing debris" including adobe roofing material (Sunderland 1942:9). Sunderland reportedly recovered two smoothing stones, a metate stained with red ochre, a fragmentary piki stone, a low density of ceramics and a moderate amount of faunal material from the eastern half of the room. Near the center of the room John encountered a concentration of blue paint and two pieces of turquoise scrap in the fill immediately above the floor surface (Sunderland 1942:9-11). Continued excavations in the ash deposit produced at least fifteen hammerstones, four smoothing stones, ceramic sherds, a low density of chipped stone, an exhausted mano, human remains, and faunal material that included bird, rodent, and artiodactyl remains (Sunderland 1942:9). Sunderland's assessment of the faunal material is generally accurate and based on the human remains commingled with the faunal collection the deposit also likely included a human infant burial. Two bowls with black-on-white decorated interiors were found 0.46 m above floor level in the southwest quarter. One was identified as "poor" Escavada and the second, according to the specimen card description and sketch, exhibits stylistic elements consistent with Escavada black-on-white (Anthropology [1942]-a:26). A heavily fragmented Mesa Verde black-on-white mug was found nearby as was another metate stained with red ochre (at 0.10 m above floor) (Sunderland 1942:9-11).

*Floor*

When floor-level was reached throughout Room 2 on July 17, a pit feature was encountered and excavated. Referred to as a subfloor "cache," the pit was 30 cm in diameter, 0.30 m deep, ash-filled, with a low density of artiodactyl remains, "four kinds of pot sherds" of which Mesa Verde black-on-white predominated, and a probable stone jar cover 1 cm thick (Sunderland 1942:11). Unfortunately, no Mesa Verde black-on-white sherds could be found in the Room 2 ceramic assemblage and Sunderland's assessment could not be independently verified. At the base of the pit, was a layer of clean sand within which was buried a possible tchamahia described by Sunderland (1942:11) as a "jasper axe" (23 x 8 cm). If Sunderland was correct in her interpretation of Mesa Verde ceramics, it is quite possible that this cache was a dedicatory offering placed by the latest occupants of Bc 57. No other floor features were noted for Room 2.

*Subfloor*

On July 18 when the subfloor excavations began throughout the room, Sunderland was called away to record Burial #4 in Room 1. However, Sunderland reported that subfloor excavations proceeded in 0.30 m levels, yielding few ceramics, a polishing stone, pieces of turquoise, and a smooth square stone, probably a palette or lapidary in the first subfloor level. Although no subfloor architecture was detected in the western or northern portions of the room, walls were encountered in the eastern and the southern sections (Sunderland 1942:12)

Subfloor excavations continued on the morning of July 23, removing another 0.30 m of fill in the eastern half of the room. The subfloor architecture, extending 0.46 m below the south wall and 0.15 m under the east wall was described by Sunderland as "crude" in construction (1942:13). The eastern portion of the room was back-filled and excavation progressed in the southern half of the room in two 0.30 m levels moving from west to east. A redware bowl and carnivore teeth were found at 0.46 m below floor level in the southwest quarter and a metate with red ochre was recovered 0.64 m to the east at a depth of 0.36 m below floor level. In the afternoon, subfloor excavation continued to move eastward, yielding a smoothing stone, two hammerstones, chipped stone, and ceramic sherds 0.40 m below floor (Sunderland 1942:13). The latter are included in the ceramic analysis and include Lino Gray, Red Mesa, Gallup, Puerco, and Chaco black-on-white.

On July 24, subfloor excavations shifted back to the area along the north wall, uncovering a few sherds, a hammerstone, and a thin, use-compacted surface at a depth of 0.60 m below the floor. Sunderland reported that Paul Reiter interpreted this surface as a possible plaza area related to the building underlying Bc 57 (Sunderland 1942:14). Excavation of Room 2 ceased July 25 and the room was completely back-filled.

***Room 3***

From July 14-21, 1942, Room 3 was excavated as a single unit by Marion Pearsall, Harold Ellingson and Florence Sunderland. Pearsall's field notes provide the best account of this excavation and begin with her arrival at the room after approximately 0.30-0.60 m of fill had been removed by the other excavators. A photograph of the south wall masonry indicates that, like the north wall of Room 2, the south wall masonry is best characterized as Type II (Chaco Culture NHP Museum Collection [1942]-b; Lekson 1984:17-18).

*Fill*

A stratum of roof fall including intact but decaying timbers and strips of juniper along with bits of plaster (FS 570074) was encountered at a depth of 0.60 m in the eastern portion of the room (Ellingson 1942:2; Pearsall 1942b:2). A tree-ring sample was taken by Sunderland nearby (FS 570047). Pearsall reported a possible metate or lintel/sill (43 x 23 x 8 cm), at the same depth 0.30 m west of the roof timbers (Pearsall 1942b:2-3). The wall surfaces of Room 3 were covered in a layer of plaster 2 cm thick (Ellingson 1942:2; Pearsall 1942b:3).

On the morning of July 15, a human adult burial was found midway along the north wall approximately 0.40 m below the top of the wall (FS 570045). Predominantly grayware ceramics (FS 570057), "intrusive" rodent remains, and a bird bone awl (FS 570058) were also encountered around and below the burial but it is unclear whether the artifacts were actually associated with the burial (Pearsall 1942b:3). With the exception of the southeast corner the entire room was excavated to 0.69 m below the top of the north wall yielding more ceramic sherds (FS 570057), apparent masonry blocks and spalls (FS 570065), and more timber roof supports (tree-ring sample FS 570034).

On July 16, excavations continued in an effort to level the entire room to 0.69 m below the top of the north wall. Pearsall (1942b:4) reported finding more roofing timbers oriented north-south but little else in the way of cultural material other than ceramics (FS 570103). These comprised the majority of sherd tallies analyzed for Room 3 and were dominated by Gallup, Chaco, and Red Mesa black-on-white. Once the room was leveled off, the afternoon excavation entailed a 0.10 m wide test trench along the north wall yielding construction debris, grayware sherds, a complete ceramic bowl, 10 cm in diameter, 5 cm deep (FS 570083), 0.76 m below the top of the north wall, and two manos 0.94 m below the top of the wall (Ellingson 1942:3; Pearsall 1942b:4). One of these manos, found closer to the northwest corner, as well as a polished black stone axe and bone awl were found in situ on the floor surface, 1.14 m below the top of the north wall (Ellingson 1942:3). Ellingson expanded the floor test southward and identified a firepit 0.84 m from and roughly centered on the east wall (Ellingson 1942:3).

On the morning of July 17, removal of fill continued throughout the room. Pearsall characterized the fill as loose, filled with construction debris and “cedar pieces” with a low density of ceramics (FS 570009) and faunal remains (FS 570010). Although the ceramics could not be located for analysis, consistent with Pearsall’s assessment, the faunal remains for this context are not particularly numerous. Numbering just sixty-nine specimens, the fauna consisted mainly of cottontail, jackrabbit, pronghorn, deer, and bighorn sheep. In the eastern half of the room, another maul or stone axe (FS 570011) and a red-on-black decorated vessel (FS 570009) were recovered from the fill immediately above the floor and a polishing stone was found in floor contact (FS 570011). This red-on-black vessel is almost certainly the Wingate (Houck) polychrome vessel with swastika stylistic elements described and depicted on a specimen card (Anthropology [1942]-a:3). In the northwest corner, a bone awl was found in the fill nearly at floor level while along the south wall a black-on-white ladle, 23 x 9 cm (FS 570116) and chipped stone were located at floor level.

*Floor*

Pearsall notes the presence of a circular feature 10 cm in diameter on the floor surface at the southwest corner and a charcoal concentration 20-25 cm in diameter on the floor surface in the southeast quarter. A blocked doorway was found in the south wall. Based on the presence of "woodfiber shredded" Pearsall suggests that the former is likely a rodent burrow (Pearsall 1942b:5).

*Subfloor*

Subfloor excavations commenced in the east half of the room on July 18 with the removal of a single 0.30 m level and revealed a charcoal feature in the southeastern quarter, 30-46 cm in diameter and 12 cm deep that may relate to the similar feature noted at floor level. Subfloor deposits contained black-on-white ceramics (FS 570125), lithics/groundstone (FS 570127), and faunal material (FS 570126) of which the latter was included in this analysis.

Ellingson reported uncovering a "turkey grave" in subfloor deposits and included a floor plan of Room 3 with the turkey burial piece-plotted (Ellingson 1942:4). The turkey burial was 0.30 m below the floor surface and was capped by several large stones (Pearsall 1942b:6). Although the turkey remains (FS 570120) as well as those of what was determined to be a common raven were available for this faunal analysis, the subfloor ceramics were either not present in the Maxwell Museum collection or the provenience information had since been lost (51 bags of sherds are without either provenience designation or FS number). On the afternoon of July 18, the east half of the room was backfilled and work began in the western half. An ash-filled firepit 25 cm in diameter was located 0.20 m below floor level and contained a high density of black-on-red ceramics. Besides a carbonized corncob (FS 570141) found below the firepit and additional ceramics, the subfloor excavations yielded little else on July 18 (Pearsall 1942b:6).

On the final day of excavation in Room 3, July 20, work continued in the western half, removing a 0.30 m level that contained faunal remains (FS 700831) and ceramics (FS 570156). Ellingson and Pearsall excavated the rest of the human burial that lay against the north wall (FS 570045). The burial extended just below floor level and the individual lay in a flexed position, oriented east-west with headed tilted to the south, commingled with ceramic sherds (FS 570186) and three associated bone awls (FS 700832). Reiter took two photographs of the burial in situ and the remainder of the cranial (FS 50169), axial (FS 570170) and postcranial (FS 570171) skeleton were removed and catalogued (Pearsall 1942b:6-7). At this point on the afternoon of July 20 the excavation was halted and Room 3 was back-filled.

### ***Room 4***

Room 4 was excavated by Susan Golden and M.A. Dobbin from July 20-28, 1942 in 0.30 m levels. Golden reported that overall, the above-floor fill in Room 4 exhibited a high density of ceramic sherds, faunal remains, and "bulk stone" (probably chipped stone) and that evidence of ephemeral, informal hearths was present at multiple levels throughout the room fill (Golden 1942:10). Room 4 contained the largest deposit of faunal remains of any room at Bc 57 with 2,922 specimens. Although the lack of provenience information associated with the faunal collections precluded more specific interpretation, the excavators' accounts indicate that the majority of animal remains derived from above-floor fill deposits. The sheer abundance of groundstone (thirty-nine pieces) nearly equaled that of Room 2, consisting of eleven manos, ten "flat slabs" (probably palettes or lapidary), ten hammerstones, four metates, three axes, and a stone bowl (Dobbin 1942:14; Golden 1942:10).

*Fill*

On July 20, excavation of above-floor fill began throughout the room. Several manos and partial metates were recovered from the upper fill, 0.61-0.91 m below the tops of the south, east, and west walls. Along with a concentration of faunal remains, Dobbin (1942:9) reported four shattered but restorable ceramic vessels located in the southeast corner of the room fill, 0.91-1.22 m below the tops of the walls: one redware (FS 570190), one corrugated ware (FS 570016), and two black-on-white vessels (FS 570014).

Work continued in the southeast quarter on July 21, yielding more faunal remains and "several pieces of obsidian" along with eggshell, ash, and fragments of fire-reddened sandstone 0.91-1.22 m below the top of the south and east walls. A mano was found midway along the west wall, 1.07 m below the top of the wall and a wood fragment, 25 x 5 x 1 cm, (FS 570206) was found 0.81 m below the top of the south wall (Dobbin 1942:9).

July 22, a 0.76 x 0.76 m test unit was excavated to floor level in the northwest corner of Room 4, from which two manos and a metate were retrieved. Excavations simultaneously continued in the southeast corner, encountering a high frequency of ceramic sherds and faunal remains and uncovering numerous artifacts including a shell bead (FS 570224) 1.06 m below the top of the south wall, a spearpoint (FS 570240), smoothing/polishing stone, and two red sandstone beads (FS 570221) 1.22 m below the top of the south/east wall, and a grooved stone and two bone awls (FS 570222) 1.37 m below the top of the wall. Several pieces of wood were found throughout the room at a depth of 1.22 m below the tops of the walls and may reflect a layer of roof fall (Dobbin 1942:10-11).

On July 23, excavations continued in the southeast quarter, uncovering a projectile point and turquoise pendant as well as a corrugated vessel, ladle handle, and assorted ceramic sherds. Dobbin also reports “perforations” in the middle of the east and south walls. The gap in the east wall is 0.76 m, 1.22 m below the top of the east wall while gaps near the middle of the south wall 0.61 m in diameter are 1.37 m below the top of the south wall.

As work continued along the south wall during the following day several more artifacts were found 1.47-1.50 m below the top of the south wall beneath approximately 0.26 m of fill and fragments of tabular sandstone (Dobbin 1942:11-12). This deposit included two more projectile points, a worked sherd (FS 570282), an axe, and six hammerstones (FS 570314). A green projectile point was recovered from 1.17 m below the top of the north wall while a galena pendant (FS 570284) and stone axe (FS 570277) were found near the center of the east wall 1.40 m below the top of the east wall (Dobbin 1942:12-13).

During work on July 25, two manos and a mass of vegetal material (FS 570306), determined to be juniper scale leaves, were found 1.27 m below the top of the north wall (Dobbin 1942:13).

Work resumed throughout the center of Room 4 on July 27, yielding seven more manos and a high density of faunal remains, ceramic sherds, and "bulk stone" (Dobbin 1942:14).

*Floor*

On July 28, floor level was reached throughout Room 4 and several artifacts consisting mostly of groundstone were found in floor contact. A grooved stone axe (FS 570279) was found in the northeast corner along with a bone awl (FS 570374) and a stone bowl (FS 570373), 10 x 6 cm. On the floor in the eastern half of the room eight hammerstones, a mano and two metate fragments were uncovered (Dobbin 1942:14-15). Although it is unclear whether any hearths in floor-contact were found, Golden's notes suggest the possibility of at least one hearth in Room 4 (Golden 1942:9-10). Dobbin describes the south door way as 0.75 x 0.43 m with a sill 0.58 m above floor level. The south, east, and west walls (and possibly floor) were plastered with evidence of fire on south wall (Dobbin 1942:16; Golden 1942:12).

*Subfloor*

Although Golden indicates that Room 4 was excavated 0.46 m below floor, neither excavator provides any description of the nature of subfloor deposits (Golden 1942:12).

***Room 5***

Louise Houchin and B. Clark excavated Room 5 from July 15-28, 1942. Compared with other room fill deposits at Bc 57, the density of fauna and ceramics was relatively low. Based on photography of the east wall face, the masonry style is characteristic of Type II, similar to that of the north and south walls in Rooms 2 and 3 (Chaco Culture NHP Museum [1942]-c; Lekson 1984:17-18).

*Fill*

Work in Room 5 began July 15 with a 1.07 x 1.57 m test unit in the northwest corner excavated to a depth of 0.61 m below the top of the west wall yielding only ceramic sherds (Houchin 1942:2). With the exception of the northeast corner, the rest of Room 5 was excavated to the same depth on July 16 and Houchin reported the recovery of lithics and part of a "griddle stone" (Clark 1942:3; Houchin 1942:2).

On July 17, excavations continued throughout the room to a depth of 0.91 m below the top of the west wall. Although Clark notes the retrieval of only a pot handle (FS 570238) from what he describes as a "dump," Houchin lists the finds as faunal remains (four pieces), stone (ten pieces, likely chipped stone), and sherds along with four metates, two manos, and sixteen smooth (possibly polishing) stones (Clark 1942:3; Houchin 1942:3).

A depth of 1.22 m was reached July 18 revealing a roof fall stratum including adobe with impressions of reed and strips of cedar bark (FS 570015) from which two dendrochronological specimens were sampled (FS 700833). Commingled with the roof fall were faunal remains, a bone awl, two pieces of chipped stone, ceramic sherds, and a smooth stone (Clark 1942:3; Houchin 1942:4).

Work in Room 5 resumed July 20, removing another 0.61 m of fill and yielded additional faunal remains, wood, and ceramics. While Clark was off-site July 22-23, Houchin continued excavating above-floor fill, unearthing shell and bone beads (FS 570191 and 570192 respectively), two pieces of turquoise, eleven pieces of chipped stone, seven faunal specimens, and two wood fragments. By the close of July 23, 0.30 m of above-floor fill remained in the western half of the room while only about 0.13 m of fill remained intact in the eastern half.

July 24, both Clark and Houchin worked in the eastern half of the room and began leveling the western half to a depth of 0.13 m. A ceramic dipper handle (FS 570288) was found in the northwest corner and in the eastern portion ceramics, more turquoise, and seven pieces of chipped stone were encountered along with five more pieces of wood including one dendrochronological sample (Clark 1942:7; Houchin 1942:7).

The following day, the entire room was excavated to 0.13 m above-floor yielding three pieces of turquoise, ceramic sherds, and a projectile point (FS 570278) and exposing an ash deposit/possible informal hearth along the north wall (Clark 1942:7; Houchin 1942:8). By July 27, it seems Clark and Houchin were still bringing the entire room to level, 0.13 m above-floor. Eleven more pieces of wood were exposed along the west wall and a piece of shell (FS 570364) was recovered (Houchin 1942:9).

*Floor*

On July 28, the excavators began exposing the floor surface and came upon two features, both of which extended 0.46 m below the floor surface. One of these features was plaster lined, measuring 23 cm in diameter while the second was 61 cm in diameter and less formal in nature. Clark's notes include a plan view of the Room 5 floor that depicts the more formal floor feature in the northeast corner, the second in the west-central part of the room, and evidence of informal hearths along the north and south walls (Clark 1942:6). The south wall doorway was 0.97 x 0.79 m (0.48 m wide at the top), with a sill 0.48 m above floor (Clark 1942:10).

According to Houchin, the 0.13 m layer of above-floor fill also contained more turquoise, a bone bead (FS 570356), part of a corrugated vessel (FS 570363) near one of the hearth areas, and a canyon walnut specimen (FS 570358), as well six faunal specimens and fourteen pieces of chipped stone.

*Subfloor*

B. Clark and Louise Houchin reported reaching subfloor deposits on July 28. Sterile "gravel" was reached 0.61 m below floor level in western half of the room. Subfloor excavations in the eastern half encountered more refuse including ceramics and a "well-scattered" human burial (Clark 1942:11). Louise Houchin (1942:9-11) offers a more detailed description of the subfloor deposits, including a turkey burial that was partially above and below the floor, a "pecking stone" (FS 570441), small amounts of lithic, faunal, and ceramic material and the burial (Burial #8) that was apparently that of a human neonate (FS 570328, 570355). A possible piki stone was found in association with the infant burial. On July 30, Clark was relocated to excavations at Area 10.

Houchin apparently finished working in Room 5 on July 30, pulling two polishing stones (FS 570438 and 570439), four faunal specimens, six pieces of chipped stone, and more ceramic sherds from subfloor deposits at the east end of the room (Houchin 1942:12).

Above-floor ceramics (FS570301, 570363) were recorded July 25 and 28, 1942, while those recorded on July 30 were subfloor (FS 570415). The latter included twenty-five sherds identified as Lino Gray and three sherds that could be classified as Red Mesa black-on-white.

### *Room 7*

The exact timeframe of the Room 7 excavations is not known but based on FS dates and field notes, it was likely accomplished from August 1-11, 1942 by at least one excavator, Walter "Sully" Sullivan. Photographs were available of the south and east wall faces and would be expected, the former exhibits a masonry style typical of Type II (Chaco Culture NHP Museum [1942]-e; Lekson 1984:17-18). In contrast the east wall, which was apparently added some time after initial construction, displays a masonry style that is difficult to classify, with a mixture of both large and tabular, unshaped sandstone masonry (Chaco Culture NHP Museum [1942]-d; Lekson 1984:17-18).

#### *Fill*

When Sullivan arrived on-site, the upper 0.30 m of fill had already been excavated by members of the Navajo crew. One complete metate, metate fragments, several manos, and ceramic sherds were uncovered in this upper fill. Evidence of a layer of roof fall was encountered relatively close to the ground surface (0.36 m below the top of the south wall). Sullivan reported a wood beam 2.13 m in length and 15 cm in diameter, oriented north-south, spanning much of the western half of the room. Excavations around the roof support yielded a moderate concentration of ceramic sherds and a particularly high density of faunal remains, “especially at the south end of the room” (Sullivan 1942:10). At the southern end of the wooden beam and just west, Sullivan recovered a large piece of adobe with roofing impressions (Bc 57. 34.1). Further he reported smaller pieces of roofing material found throughout the room at this level. East of the large beam toward its southern end, Sullivan describes a concentration of seeds (Sullivan 1942:12).

Once the fill had been excavated to a depth 0.86 m leaving the beam pedestaled, the beam was cleaned and photographed. The beam was then cut into two pieces and removed to the laboratory. Sullivan reported that this level of fill from 0.45-0.86 m contained numerous faunal remains and ceramics. Based on provenience information associated with the faunal collections, this deposit consisted of 409 faunal specimens.

Excavations continued, producing a bone tube (Bc 57.30.12), faunal remains, and “plentiful” ceramics (Sullivan 1942:12). Two charred corn cobs (Bc 57.35.1 and Bc 57.35.2) were uncovered at a depth of 0.61 m, a small obsidian flake at 0.84 m deep (Bc 57.20.15), and a bone awl was found in the southwest quarter at a depth of 0.53 m.

Work appears to have then shifted to the northeast corner where excavators encountered either an informal hearth or ash-dump at a depth of 0.81 m. A bone awl (Bc.57.30.14) was found nearby at a depth of 0.97 m. Excavation extended to a depth of 1.18 m revealing two ground stone objects (Bc.57.20.4 and Bc 57.20.14).

When excavation reached a depth of 1.27 m, a possible hearth was identified in the northeast corner and Sullivan reported a dense concentration of faunal remains, ceramics, and bulk stone (Sullivan 1942:13).

Sullivan apparently stayed behind while most of the field school participants visited Jemez Pueblo over a two-day period. Excavating for only a few hours on each of these two mornings, Sullivan continued to encounter a high density of fauna and ceramics and unearthed a partial mano. Consistent with Sullivan's description, the faunal remains from fill 0.91-1.37 m are indeed frequent, numbering 261 specimens. At a depth of 1.35 m with still no indication of a floor surface, Sullivan found more faunal remains and ceramics (Bc 57.10.8), two manos, two worked sherds, and three more bone tools – two awls (Bc 57.30.16, Bc 57.30.18) and a scraper (Bc 57 30/17).

*Floor*

Around August 8-9, Sullivan reached floor level in the northeast corner. The floor was reportedly in poor condition and a partial mano was encountered apparently in floor-contact (Sullivan 1942:14). August 10, a partial metate was encountered on the floor in the northwest corner (Sullivan 1942:17).

*Subfloor*

Subfloor deposits were reached around 10AUG1942, extending as deep as 0.13 m below floor level, yielding four manos and two small pieces of turquoise (Sullivan 1942:14-17). Excavations in Room 7 ceased on August 11.

***Room 8***

Room 8 was excavated July 22-31, 1942 by Marion Pearsall and Harold Ellingson. Although no artifacts are listed in the CRA database, the excavators reported encountering numerous artifacts and a high density of ceramics, chipped stone, and faunal remains. The ceramic assemblage from Room 8 could not be located for analysis.

*Fill*

Surface clearance began on the morning of July 22 and the fill within an arbitrary unit 2.67 x 1.73 m was leveled to 0.56 m below the top of the southwest corner. Ceramic sherds (FS 570209), faunal remains (FS 570210), and bulk stone (FS 570219) were found in this near-surface fill (Pearsall 1942b:7). In the afternoon, worked continued in the test unit and a level of fill 0.46 m thick was stripped away. At day's end, the unit had been excavated to 1.02 m below the top of the southwest corner; no significant finds were reported.

On the morning of the July 23, excavations continued in the Room 8 test unit, peeling back 0.30 m levels and revealing ceramic sherds (FS 570258), fauna (FS 570259), and bulk stone (FS 570185), or in Pearsall's words, "lots of huge rocks, also piles of sherds and spalls of flint" (Pearsall 1942b:7). The test unit was then expanded northward and eastward so it measured 2.82 x 1.96 m and although the north and west walls were by this point visible, the south and east walls were not yet exposed.

On the morning of July 24, 1942, while excavating the eastern side of Room 8 to expose the top of the east wall, Pearsall (1942a:7) reported finding a concentration of faunal remains (FS 570322). This deposit is noteworthy in several respects. First, it yielded a partial scapula and radius of a domestic sheep (*Ovis aries*), reflecting intrusive historic deposits. As this portion of the excavation included the modern ground surface and extended to a depth of two feet, the find is not altogether surprising. Ceramics (FS 570323) and bulk stone (FS 570295) were also retrieved during this work in the eastern portion of the room. The afternoon was spent removing fill from along the north, west, and east walls.

Although other deposits of faunal remains were recorded by Pearsall, specifically FS 570210 and FS 570294 these batches of bones were not present in the Maxwell Museum collections. The former derived from surface and wall clearance and initial excavations in the western half of Room 8 while the latter was apparently recovered from fill deposits immediately overlying the first floor (Pearsall 1942a:7-8). Similarly, none of the ceramics associated with these fill contexts were present in the collection (FS 570209, 570258, 570323, 570387, 570199).

On either the afternoon of July 24 or July 25, Pearsall and Ellingson initiated a 0.91 m wide trench along the west wall in search of the floor surface and removed one 0.30 m level. Pearsall reported that the fill in this area was less compact than elsewhere in Room 8 and was devoid of refuse. The north and east walls are described as being 0.30-0.38 m thick and of "poor masonry "very large rocks crudely chinked up with smaller" (Pearsall 1942b:8). Although no photography exists of the Room 8 wall faces, Pearsall's description is consistent with the masonry observed in the east wall of neighboring Room 7.

*Floor*

Trenching along the west wall continued July 27 and began to yield faunal remains (FS 570294) and ceramics (FS 570387). The excavators reached one floor surface and unintentionally continued on, reaching a second surface 0.38 m below the first. Overlying the second (lower) floor was an upper layer of sherd-filled refuse (FS 570199) followed by a possibly intentional upper stratum of "sterile" soil. At a depth of 1.55 m, Pearsall and Ellingson also exposed an east-west running wall 0.56 m north of the Kiva C northern wall arc (Pearsall 1942b:8).

The morning of July 28 began with a trench along the newly-discovered south wall and established that the wall foundation extended only another 0.20-0.30 m deep. Work then began north of this wall to expose an upper floor surface and south of the wall chasing the east wall southward in the direction of Kiva C (Pearsall 1942b:9). This floor surface lies at the same level as the upper floor surface north of the south wall (Ellingson 1942:6).

On July 29, trenching (0.61 m wide) continued southward along the east wall reaching the intersection with the east wall arc of Kiva C. Within the interstitial space between the Room 8 south wall and Kiva C, an occupational surface was identified 0.79 m below the top of the east wall. A single white projectile point (FS 570434) was recovered from the Room 8 fill (Ellingson 1942:8; Pearsall 1942b:9).

July 30, excavations continued between the south wall of Room 8 and Kiva C to clarify the relationship between the various walls and floor surfaces. The north wall arc of Kiva C was constructed on the second (lower) floor surface while the south wall of Room 8 was built on the first (upper) occupational surface. Pearsall provided a detailed profile sketch of the area in question, demonstrating that the south wall was built subsequent to the initial construction of the intramural kiva to the south.

On the morning of July 31, Pearsall and Ellingson began clearing the outer, eastern edge of the east wall. The outer surface of the east wall was exposed down 1.22 m revealing an embedded roof support beam, 13 cm in diameter, 0.64 m above the floor (Pearsall 1942b:9).

*Subfloor*

No excavation of subfloor deposits was reported for Room 8.

***Room 9***

The excavation of Room 9 occurred in two stages, the first by Florence Sunderland and excavators John and Antonio (Marion Van Geem assisted on Burial #2) from July 24-28, 1942. On August 5, after finishing work in Room 8 and presumably after returning from the field school excursion to Jemez Pueblo, Marion Pearsall and Harold Ellingson took over the Room 9 excavations, which concluded on August 12. Room 9 also contained a high number of burials; at least five adult, juvenile, and infant burials were encountered in the above-floor fill.

*Fill*

After clearing away surface debris, Antonio began excavating in the eastern half of the room, John in the western half, removing a 0.61 m level of fill. A single adult human rib was encountered in the northwest corner 0.61 m below the top of the north wall but no further adult remains were recovered in this area (Sunderland 1942:15). At the same depth in the north-central portion of the room an infant burial was exposed and Marion Van Geem took over its excavation and mapping. Oriented northwest-southeast, the individual measured 38 cm in length and extended to a depth of 0.76 m below the top of the north wall. Although Van Geem (1942:16) recorded that no ceramics were associated with the burial, Sunderland (1942:15) indicates that John assisted Van Geem in excavation and recovered a black-on-white bowl against the west wall, 0.38 m below the ground surface just 5 cm west of the infant's skull.

Elsewhere in the room, Antonio unearthed a "log plank" 0.46 m below the ground surface oriented vertically within the fill. Sunderland (1942:15) reported two more human ribs in the eastern part of the room within the "1st strat level."

On the afternoon of July 24, another child burial (Room 9 – Burial #2) was uncovered midway along the east wall. Estimated to be about four to five years of age, the burial was only 0.30 m below ground surface in a sandy, charcoal and ash-filled deposit, capped by refuse (Sunderland 1942:16). The burial was flexed, positioned on its right side facing west with no evidence of matting or wrapping. Commingled with the burial were the "remains of rodents" and a complete black-on-white bowl. Based on Sunderland's field sketch of the interior and exterior designs and the object specimen card, the vessel is very likely Mesa Verde black-on-white (Anthropology [1942]-a:21-22; Sunderland 1942). The burial was then photographed by Paul Reiter and Sunderland reported that the right half of the skeleton was mostly absent. Despite the large, diverse faunal assemblage recovered from Strat 1 numbering 876 specimens, Sunderland makes little mention of such deposits. Juvenile human remains, likely from the second Room 9 burial were found mixed with the faunal remains. According to Sunderland (1942:17), Strat 1 yielded a sizable sample of ceramic sherds, a chipped stone scraper, and three pecking/hammerstones.

By the afternoon excavation of Strat 2 had begun, leaving a 0.69 x 0.69 m column intact in the northwest corner of the room. The density of ceramics and fauna remained high throughout this level, the latter consisting of 548 specimens, while bulk stone was rare. Numerous artifacts were recovered from Strat 2 including two bone needles, a small projectile point, a piece of tabular red stone, and several pieces of groundstone (two mano fragments, one complete metate, three pecking/hammerstones, and two polishing/smoothing stones.

In the afternoon, excavation of Strat 2 continued about 0.58 m below the top of the north wall. The second infant burial in Room 9 was unearthed along the wall in the southeast corner commingled with animal bone and the partial remains of another adult burial.

Strat 2 contained two more bone needles and several pieces of groundstone including two partial metates, a mano fragment, a partial palette, and several "worked stones" (Sunderland 1942:19). At the base of Strat 2, the room fill was level with the top of the north door and a closed doorway toward the southern end of the east wall was revealed.

On August 5, when Pearsall and Ellingson took over excavation of Room 9, the room had been excavated to a depth of 1.02 m below the top of the north wall and the check block in the northwest corner remained in place. Removing fill in levels, the excavators encountered a charcoal and ash concentration at the southeast corner containing a bone awl (FS 570493) and a piece of curved groundstone (FS 570470). Pearsall reported that the fill along the east side of the room was filled with faunal remains, ash, and charcoal (Pearsall 1942b:10).

August 6, as excavations continued, a badly disturbed human burial was exposed, lying extended (very slightly flexed) on its right side, facing northeast, commingled with faunal remains (FS 570445, 570448). The faunal remains from this context (FS 570472) numbered 114 specimens and a limited amount of human remains were found mixed with the faunal material. Excavation of the burial continued through August 7.

On the morning of August 8 as layers of fill were being removed Pearsall reported encountering a nearly complete black-on-white "mug" (FS 570519). However, upon consulting the object specimen card, the vessel is better characterized as a pitcher and the exterior designs typical of Escavada black-on-white (Anthropology [1942]-a:15).

*Floor*

A floor surface was reached on August 10, 0.64 m below the sill of the north doorway. The north door measured 0.91 x 0.64 m, tapering to a width of 0.53 m at the top. Two upright slabs were found protruding from the northwest check-block and during excavations on August 11 and 12, a slab-lined mealing bin approximately 1.45 x 0.86 m was exposed. On August 13, Pearsall indicated that a second mealing bin area with a metate may have been uncovered toward the center of the room. Unfortunately she was relocated to the laboratory and the other excavators' accounts fail to address the later stages of excavation (Pearsall 1942b:11). The presence of mealing bins in conjunction with slab metates are frequently cited as diagnostic in the shift to production and consumption of flour corn during the late twelfth century Mesa Verde phase (McKenna 1991:132, 135-136).

*Subfloor*

No excavation of subfloor deposits was reported for Room 9.

***Kiva A***

Kiva A was excavated from July 16-27, 1942 by Marion Van Geem and Ann Frome yielding a moderate amount of faunal remains (127 specimens), ceramics, and groundstone including six metates, eight manos, and a piki stone. Kiva A is the smallest of the kivas at Bc 57, circular and measuring approximately 3.76 m in east-west diameter at the outer wall. Although no artifacts beyond groundstone were reportedly recovered, two pieces of worked bone, an awl and a bead blank were identified within the general faunal assemblage.

*Fill*

Beginning July 16, the excavators began removing fill in “strat layers” (Ellingson et al. 1942:2) by which Frome likely meant “arbitrary levels” as was the practice elsewhere at Bc 57. According to Van Geem (1942:15), the check-block left intact as the kiva was excavated revealed no clear stratigraphy. The first day of excavation uncovered the majority of groundstone: a mano and metate were found high in the fill lying directly atop a layer of roof fall, while the broken piki stone, two additional metates and four manos were unearthed from the fill beneath. By the end of the first day of excavation, the bench of Kiva A, 0.20 m wide and only 0.23 m below the top of the wall, was already exposed.

From July 17-18, more fill was removed exposing the floor surface, about 0.64 m below the top of the bench. The fill contained little in the way of ceramics and yielded no complete vessels (Van Geem 1942:15).

*Floor*

Work resumed on July 21 and a slab-lined firepit was located in roughly the center of the room with an upright slab deflector and ventilator to the east. The firepit measured 0.56 m along its north-south axis and 0.38 m east-west and was 0.28 m west of the deflector (Ellingson et al. 1942:2-3; Van Geem 1942:13). Pulled from the debris that filled the firepit was an abundance of ash and charcoal, fire-reddened sandstone, two or three metates, two manos, and a hammerstone, as well as La Plata black-on-white and black-on-red ceramics (Van Geem 1942:8). The ventilator measured 0.41 x 0.51 m and from within the ventilator, a single animal bone and mano were recovered (Ellingson et al. 1942:3). A wooden lintel atop the ventilator shaft measured 17 cm in diameter (Van Geem 1942:11). A blocked doorway in the west wall is 0.58 m wide and at one time led into Room 3. The walls of the kiva were covered in ten to twelve successive layers of plaster (Van Geem 1942:11).

*Subfloor*

No subfloor deposits were explored in Kiva A.

***Kiva B***

Kiva B is a keyhole-shaped intramural kiva located in the northeast portion of Bc 57 just south of the larger Kiva C and measures 2.59 m in diameter. The room was excavated from July 28-August 12, 1942 by Marion Van Geem and Ann Frome and the deposits contained several bone tools including a weaving batten and pieces of groundstone (three manos and two metate fragments). Although photographs of the masonry style used in the construction of Kiva B were unavailable, Frome's description and sketch suggests either Type II or Type III (Frome 1942:34; Lekson 1984:18; Van

Geem 1942:30). While the kiva wall below the bench was coated in two layers of plaster, the upper portions exhibited "many" layers (Van Geem 1942:30).

*Fill*

Having left a check block in place along the north wall during excavation, Van Geem described several stratigraphic levels within Kiva B (Ellingson et al. 1942:11; Van Geem 1942:27). The upper level (0-0.38 m) consisted of aeolian sand, followed by a layer of adobe and sandstone construction debris (0.38-0.64 m). Excavation of these two upper strata yielded pink chipped stone (probably Narbona Pass chert) and sherds of black-on-white and culinary grayware ceramics and revealed the kiva wall surfaces covered in numerous layers of plaster (Frome 1942:26). Underlying these layers was a thin (5 cm thick) level of charcoal and adobe followed by another layer of windblown sand (0.69-0.86 m). Probable roof fall debris and a number of artifacts were recovered including a mano and faunal remains. Below these levels was a layer of charcoal and adobe (0.86-1.11 m) and finally a 0.61 m thick layer of windblown sand atop the upper floor surface.

After a field school trip to Mesa Verde on July 29, excavations resumed July 30-31, exposing the kiva bench (0.23-0.28 m wide) and ventilator shaft outside the east wall of Kiva B.

Work resumed again August 5, after the field school visit to Jemez Pueblo and Frome and Van Geem began to expose the first of seven kiva wall niches. The heavily plastered niches (three in the north wall, three in the west wall, and one in the south wall), were roughly oval in shape with a flat shelf at the base, 23 cm deep and ranged in width from 20-40 cm (Van Geem 1942:32). The fill contained more elements of roof fall (FS

570469) mixed with faunal remains, ceramic sherds, chipped stone, and the aforementioned bone batten. The faunal remains from this lower fill deposit were analyzed as part of the present study and the remains represented several genera including multiple species of hawk: *Buteo jamaicensis* (red-tailed hawk), *Buteo lagopus* (rough-legged hawk), and *Buteo regalis* (ferruginous hawk).

*Floor*

Removal of fill continued August 6-10 and a floor surface was reached on August 11. A large floor niche (1.55 m in length, 28 cm deep) was encountered at the base of the west wall arc (Van Geem 1942:33). A firepit (0.51 x 0.56 m) was excavated in the eastern half of the kiva and contained a 0.61 m deep deposit of ash, charcoal, and fire-reddened sandstone (Frome 1942:33). Directly adjacent to the east, was a ventilator that extended 0.81 m to the east wall and measured 0.48 m wide by 0.56 deep (Van Geem 1942:35). Upon investigation the ventilator was found to contain bird bone, chipped stone, and black-on-red and grayware ceramic sherds. A turquoise fragment was found embedded in wall plaster along the northeast wall arc (Frome 1942:33).

*Subfloor*

The excavators gave no indication of subfloor exploration.

***Kiva C***

From July 30-August 10, 1942 Kiva C was excavated by Susan Golden and M.A. Dobbin. The largest of the kivas at Bc 57, Kiva C is keyhole-shaped, measuring 4.65 m across at outer edges (Dobbin 1942:20; Golden 1942:14). Photography of the east wall of Kiva C reflects a crude masonry style similar to McElmo indicating that the structure was one of the latest additions to the site (Lekson 1984:18). Although faunal remains were moderately dense, ceramics and groundstone were more frequent throughout the fill. Groundstone recovered included eleven metates, nine manos, four passive abraders, and a probable altar piece.

*Fill*

Beginning July 30, the excavators began removing fill in a single 0.38 m level, leaving a check block in place against the northeast wall, recovering two manos and a piece of turquoise. The following day, the top of the bench, 0.25-0.30 m wide, was encountered 0.61 m below the top of the north wall. More turquoise, three metates, and two manos were pulled from the fill (Dobbin 1942:19-20).

*Floor*

On August 1, a test unit was excavated along the northwest wall to floor level, reached at 1.03 m below the top of the bench (Dobbin 1942:20). Portions of two metates and three manos were found in the fill immediately above-floor. Removal of fill from the remainder of the kiva revealed a layer of roof fall, two niches in the north wall, a sealed niche in the east wall, as well as four metates, three manos, and a pink (probably Narbona Pass chert) projectile point (Dobbin 1942:25). The kiva wall surface below the bench exhibited at least six layers of plaster (Dobbin 1942:23).

By August 7, the entire floor surface of Kiva C was exposed. Two pieces of either turquoise or malachite were retrieved from the floor surface and the top of a ventilator was cleared, measuring 0.48 m wide and 1.47 m in length to the south wall from the central firepit (Golden 1942:14). The fill within the ventilator was rich with artifacts, including two metates and a rectangular piece of groundstone with one rounded end (23 x 18 cm), interpreted by the excavators as a *tiponi* or "corn goddess" (Dobbin 1942:26-27). The firepit was poorly preserved and measured 46 x 58 cm in diameter (Dobbin 1942:27; Golden 1942:15). Two restorable ceramic vessels were found on the floor along the west wall (FS 570518, 570520). Both were analyzed as part of the present study; the former was identified as Chaco-McElmo and the latter as indented corrugated.

Finally a wall mural was exposed on east wall surface near the kiva recess. The designs consisted of a continuous yellow zig-zag motif with yellow and red dots (Dobbin 1942:27-30; Golden 1942:15-16)

*Subfloor*

No subfloor deposits were explored in Kiva C.

### *Kiva D*

Unfortunately, no excavation records are available for Kiva D. The Kiva D faunal assemblage, dated August 1, 1942, analyzed as part of this study was limited to only twenty-one specimens. The ceramic assemblage, also analyzed was sizable, consisting of 442 sherds.

### *Pithouse A (Pit A)*

Pit A, as it is referred to by its excavators, is actually a pithouse structure approximately 91 m south of Bc 57 and the exact dates of excavation are unknown. Although unrelated to Bc 57 itself, a brief review of Walter Sullivan's and Lloyd Pierson's excavation notes are provided since the faunal remains were included this analysis.

*Fill*

Excavation of Pit A was initially undertaken with the assumption that the deposit represented a refuse heap. The excavation was completed in natural/cultural stratigraphic levels. The upper fill stratum (0-0.46 m) consisted mostly of windblown sand, rock, ceramic sherds, and a low density of charcoal. In addition to sherds, two ladle handles, faunal remains, and part of a piki stone were recovered from the upper fill (Pierson 1942:4-5; Sullivan 1942:3). The second level (0.46-0.81 m) was composed of up to six layers of stratified sand and refuse with a much higher density of charcoal and a lower density of ceramics than the previous level. Faunal remains, ceramics, and a charred corn cob were retrieved from this second stratum. The third level (0.81-1.12 m), extended below the tops of the sidewalls of the structure and contained windblown sand and wall-fall.

*Floor*

At the bottom of the fourth level (1.12-1.35 m) Sullivan encountered a "wind blown sand floor at 53 in." approximately 0.46 m below the top of the upright slabs (Ellingson et al. 1942:19; Sullivan 1942:5). The pithouse was slab-lined, roughly square to round in plan view, measuring roughly 2.16 m across along the northeast-southwest axis. Although not mentioned by Sullivan, his sketch of the pithouse reveals what appears to be a slab-lined entry to the north of the pit structure (Sullivan 1942:4). Sullivan also suggests the presence of an opening in the southwest portion of slab-line walls and connectivity to "another pit," possibly an antechamber or second contiguous pithouse (Ellingson et al. 1942:19; Sullivan 1942:4).

*Subfloor*

Sullivan does not appear to have undertaken any subfloor excavations.

### *Area 10*

Area 10 is an extramural area at the southwest corner of Bc 57 and was excavated by Clark and Antonio from July 30-August 5, 1942.

*Fill*

Bounded by the south wall of Room 3 and the west wall of Room 1, the excavation of Area 10 yielded six metate fragments (FS 570431), several worked bone artifacts including at least two bone needles and an end scraper (FS 570458, 570459, 570561, and 470432), and egg shell (FS 570555). The deposit contained numerous animal remains (183 specimens were included in this analysis) and Clark (Clark 1942:16) reported encountering as many as twenty-six separate informal hearths. Given the location and apparent frequency of thermal features and presence of animal remains, it's conceivable that this area served as a food processing area perhaps along with other functions such as firing of ceramics.

*Floor/Subfloor*

No floor surface or subfloor deposits were reported at Area 10.

## Bc 58 – Excavation and Depositional History

### *Room 1*

*Fill*

Room 1 was excavated by Bahti and the above-floor fill was removed in seven levels. In addition to a layer of roof fall and numerous ceramic sherds and faunal remains the fill contained a human burial found lying on its left side facing east (Chaco Culture NHP Museum 1947:2).

*Floor*

Room 1 apparently contained at least two occupation levels of packed adobe, 3-8 cm thick. The walls were well-plastered down to the floor surface and lacked doorways (Cornett n.d.:5, 7, 10). A circular firepit, 28 cm in diameter and 11 cm deep was found in the center of the room but the formality of the feature and whether it was located on an actual floor surface is unclear (Chaco Culture NHP Museum 1947:2).

***Room 2***

*Fill*

Sturtevant excavated Room 2 to a depth of 2.74 m, 1.14 m below the floor surface and distinguished at least five layers of above-floor fill (Chaco Culture NHP Museum 1947:3, 13). An overburden of rock and construction debris was removed, revealing a layer of roof fall at a depth of 0.20-0.38 m. Sturtevant then encountered a layer of rock and windblown sand followed by a use-compacted surface at a depth of 0.48 m. Next, a thin layer of ash and charcoal appears to have been followed by a second use-compacted surface at a depth of 0.53 m. This latter occupational surface contained a temporary hearth 0.30 m square (Chaco Culture NHP Museum 1947:3). The fill layers yielded numerous artifacts and cultural fill including a low density of ceramic sherds, worked bone, a metate, stone scraper, and possible human remains.

*Floor*

The walls of Room 2, fully plastered, exhibited no doorways and Cornett reported that the masonry style of the north wall of Room 2 could be characterized as a “late” type (Cornett n.d.:5, 7). In the northeast corner of the room against the wall a small "fireplace" was located at a depth of 0.71 m and a single pit feature was found against the east wall at the base of which lay a shale (lignite?) deposit (Chaco Culture NHP Museum 1947:3, 12).

*Subfloor*

The subfloor deposits of Room 2 included an additional occupational level that Cornett described as an "unusual hard black floor" (Cornett n.d.:10). Underlying this surface were several possibly intentionally laid layers of ash, followed by a mixture of sand and charcoal overlying a layer of sterile sand (Chaco Culture NHP Museum 1947:13).

***Room 3***

*Fill*

Excavated by Whitney and Smith, the Room 3 above-floor fill included roof fall and refuse that contained groundstone (manos and metates), bone tools, corn cobs, and a high density of ceramics. Smith reported multiple temporary hearths consisting of "charcoal, ash, and burned areas" throughout the above-floor fill (Chaco Culture NHP Museum 1947:4).

*Floor*

According to Smith two floor surfaces were present in Room 3 but further detail was unavailable (Chaco Culture NHP Museum 1947:4). Although the walls of Room 3 appear to have been covered in a single continuous coating of plaster, the masonry styles of the east wall (Type III) differs from that of the north wall (Type IV) indicating that the room was likely built in stages (Cornett n.d.:4). Sealed doorways in the south and west walls at one time connected Room 3 to Rooms 13 and 4 respectively and both exhibited flat stone lintels still in-place. A doorway in the north wall connecting to Room 5, also with a stone lintel, was blocked less formally with loose construction debris (Cornett n.d.:8-9).

### ***Room 4***

*Fill*

The Room 4 fill was composed of faunal remains, ceramics sherds, and construction debris and at a depth of 0.41 m a layer of roof fall. Beneath the roof fall, another dense layer of sherds 15 cm thick overlaid the floor surface (Chaco Culture NHP Museum 1947:11).

*Floor*

The masonry style in the north wall was classified by Cornett as Hawley Type 8 or “McElmo” indicating twelfth century construction and as noted above the east doorway into Room 3 was blocked (Cornett n.d.:4, 8; Lekson 1984:18-19).

### ***Room 5***

*Fill*

Room 5 was excavated to a depth of 1.88 m and four distinct layers were identified within the above-floor fill. The uppermost 0.38 m level consisted of windblown sand and wall fall and underlying this overburden was a 15 cm thick layer of aeolian sand. Excavators then encountered a 13 cm thick layer of roof fall (wood, reeds, and adobe) and a 0.51 m thick matrix of sand, rock and charcoal. Two firepits were reported in Room 5 but no location – whether in fill or on the floor surface – was specified (Chaco Culture NHP Museum 1947:5). The south doorway into Room 3 was sealed albeit informally (Cornett n.d.:5).

***Room 6***

*Fill*

The masonry style exhibited in the north and west walls of Room 6 was classified by Cornett as Hawley Type 10 and although Lekson does not address the type specifically, it may reflect later "McElmo" construction (Cornett n.d.:4; Lekson 1984:18-19). The room fill consisted of aeolian sand and construction debris (Chaco Culture NHP Museum 1947:12).

*Floor*

Room 6 was also without doorways and on the floor of Room 6 excavators encountered a slab-lined bin 0.71 x 0.46 m. A metate and the probable remains of other storage bins were found scattered throughout the rest of the room (Cornett n.d.:8, 13).

***Room 7***

*Fill*

Excavated by Frosio, all that is known of the Room 7 fill is that it contained "rock and scattered refuse" (Chaco Culture NHP Museum 1947:8).

*Floor*

Although Room 7 reportedly lacked any doorways, two informal hearths were identified – one in the northeast corner at a depth of 1.09 m and a second 35 cm in diameter at a depth of 0.35 m, its horizontal location unspecified (Cornett n.d.:8, 12). Both hearths likely relate to the later Mesa Verdean occupation of the site.

***Room 8***

*Fill*

Although designated a “room” by the excavators, Room 8 is actually an extramural area enclosed on three sides by the south wall of Room 10, the north wall of Kiva A, and the east wall of Room 6. The area appears to have been utilized as a midden – the fill consisted of ash and charcoal, groundstone fragments, chipped stone, corn cobs, and a high density of faunal remains and ceramic sherds (Chaco Culture NHP Museum 1947:6, 11).

***Room 9***

*Fill*

Room 9 is another extramural area to the south of Room 7 that was excavated by Latimer. The fill consisted mainly of refuse and although no specimen cards remain, two complete bowls were apparently recovered from the Room 9 area (Chaco Culture NHP Museum 1947:5). Latimer encountered the remnants of a firepit toward the east end of the north wall, situated high in the refuse deposit (Cornett n.d.:12).

*Floor*

Two bins were exposed along the western edge of the Room 9 area on an occupation surface 0.43 m below the top of the north wall. The bins ranged from 43-46 cm in diameter, 20-23 cm deep (Chaco Culture NHP Museum 1947:11).

***Room 10***

*Fill*

Room 10, also excavated by Frosio, was a refuse-filled room that yielded high densities of charcoal, ceramic sherds, and faunal remains (Chaco Culture NHP Museum 1947:8). The above-floor fill deposit yielded by far the largest concentration of fauna analyzed to date, accounting for 34 percent of the overall faunal assemblage. The presence of an informal hearth high in the above-floor fill is implied by sooting of the masonry in the northwest portion of the room, 0.51 m below the top of the wall (Cornett n.d.:12). Similar to Room 6, Room 10 was constructed without doorways and the masonry of the north wall was classified by Cornett as Hawley Type 10, a category for which Lekson's scheme provides no equivalent (Cornett n.d.:4; Lekson 1984:18-19). As Cornett observed, this late masonry style and the fact that the north wall overlies the upper wall of adjacent Room 11 is a strong indicator that enclosure of the Room 10 area was subsequent to the construction of the eastern roomblock (Cornett n.d.:4).

*Floor*

A large firepit, 71 cm in diameter, was found on the floor of Room 10 (Chaco Culture NHP Museum 1947:8).

***Room 11/Kiva B/Kiva C***

*Fill*

Multiple occupation levels were encountered throughout the above-floor fill during the excavation of Room 11. Two informal hearths were located along the south wall on these temporary occupation levels: a circular firepit 36 cm in diameter was located at a depth of 0.51 m while a second possible firepit filled with carbonized corn cobs was found at a depth of 0.58 m (Cornett n.d.:12).

*Floor*

A third firepit also along the south wall was more formal in nature. Built into the pilaster of an earlier kiva (Kiva C), this firepit measured 0.38 x 0.28 m and was slab-lined (Cornett n.d.:12).

*Subfloor*

Underlying Room 11 were the remnants of two earlier kivas (Cornett n.d.:5). Kiva B, the uppermost of the two, is described by Cornett as being only partially constructed as evidenced by the presence of only two courses of masonry (n.d.:15). However the possibility exists that the upper courses of masonry may have been recycled for use in construction elsewhere at Bc 58. Upon removing a layer of fill beneath Kiva B, excavators exposed a second kiva (Kiva C), the interior of which was heavily plastered and in places blackened by soot. The exterior surface revealed a crude construction of "irregular stone laid upon mortar" (n.d.:15-16). In addition to the pilaster noted above that was later modified to accommodate construction of a slab-lined hearth, a second pilaster was encountered in the western portion of Room 11.

***Room 13***

*Fill*

Room 13 is the southernmost room of the southwestern roomblock. The walls of the room were constructed with a doorway (later sealed) connecting to Room 3. The north and east walls were classified as Type III and the south and west walls are McElmo in style (Cornett n.d.:4, 8; Lekson 1984:17-19).

*Floor*

A shallow firepit measuring 30 cm in diameter and 8 cm deep was exposed at floor level 1.07 m below the ground surface near the center of the room (Cornett n.d.:13).

### ***Room 14***

*Fill*

Located at the northeast end of Bc 58, Room 14 was excavated by Ogden and Devitt. The excavators identified two principal strata within the above-floor fill. The first was an ash layer extending to a depth of 0.66 m and consisted of a mixture of ceramic sherds, groundstone, corn cobs, and faunal remains. The remainder of fill included roof fall and lenses of aeolian sand (Chaco Culture NHP Museum 1947:4, 7).

*Floor*

Two sealed doorways were identified connecting Room 14 to Room 11 to the south and to an unexcavated area to the north respectively. Both doorways were 0.36 m wide and ranged in depth from 0.76-0.91 m (Cornett n.d.:9).

### ***Kiva A***

*Fill*

Located in the south-central portion of Bc 58 between the southwest and northeast roomblocks, Kiva A was circular rather than keyhole-shaped and was the largest kiva at the site and the above-floor fill consisted of "sand, adobe, and rock" (Chaco Culture NHP Museum 1947:12, 15).

*Floor*

The walls were constructed in a McElmo style, suggesting Kiva A was a later addition to the site. The walls and pilasters were covered floor to ceiling in several layers of plaster 3-4 cm thick. The bench is 18 cm wide, 1.40 m below the top of the north wall while the floor surface is another 1.04 m below the top of the bench. The pilasters in Kiva A are narrow, 13 cm thick, extending 0.76 m from the kiva wall (Cornett n.d.:14). Excavators encountered a subfloor ventilator in the southeast portion of the structure. The ventilator measured 0.51-0.61 m in width and extended 1.12 m from the southeast arc of the kiva, terminating at an upright slab deflector near the center of the room (Cornett n.d.:15). Rows of wood beams 3-5 cm in diameter were unearthed along the base of the ventilator and may have at one time supported the roof of the ventilator. Although a firepit was not noted by the excavators, subsequent excavation by the National Park Service revealed the existence of one near the center of the room (Chaco Archive 2011;Windes 1978). Two niches were exposed below the top of the bench in the west and north walls. The western niche measured 13 x 10 cm and was 20 cm deep while the northern niche dimensions were 7 x 6 cm with a depth of 11 cm (Cornett n.d.:15).

Table A.1: Artifact Distribution by provenience at Bc 57; adapted from Chaco Archive (Archive 2011a).

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 1 | Fill | From text; no field no. | Skeleton wrapped in cotton matting | Unspecified | - | Around burial #1 |
| Room 1 | Fill | From text; no field no. | Rodent jaw at SE edge of pot. | 1 | - | With burial #1 |
| Room 1 | Fill | Bc 57 10/17 | Pottery ladle bowl; black-on-white, about 6/8 of a ladle bowl in two pieces which do not fit together; broken, poorly mended; 4 1/4" diameter, 2 1/4" height. | 1 | Small bowl; black-on-white; W: 4 1/4", H: 2"; cracked, pieces missing, repaired and restored; 4 paralell lines around inside, within these triangles formed by short paralell lines; bottom: circle and dot, lines thick and rough. | In SE quarter of room. |
| Room 1 | Fill | Burial #1 | Northeast corner, H.L. S [?] W 8", V.L. 17" below top of E wall. Skull faced down and east. Lying on its back slightly on left side. Skeleton 10" long in poor condition, skull bashed in. Wrapped in cotton matting. Both skeleton and pot underneath by fiber matting. Over 14" long | 1 | - | Northeast corner, H.L. S [?] W 8", V.L. 17" below top of E wall |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | and wide - impossible to determine exactly. Rodent jaw at SE edge of pot. Pot-round, black inside and out, top corrugated. Top blackened.V. L. 16" from top of east wall. | | | |
| Room 1 | Fill | Burial #2 | Adult-head missing, skeleton was flexed on right side, atlas found in rt. thorax; H.L. 3rd cervical vertebra E-7" S-50", V.L. in debris 5 1/2" below top of W wall. Length from 3rd cervical vertebra to toe 47 1/4" | 1 | - | E-7" S-50", V.L. in debris 5 1/2" below top of W wall |
| Room 1 | Fill | Burial #3 | Infant skeleton (about 8 months), complete. H.L. W 73" S 62 1/2", V.L. 23" below top of E wall in debris. Length of skeleton- | 1 | - | H.L. W 73" S 62 1/2", V.L. 23" below top of E wall in debris. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 28" skeleton is lying on back with head turned to left, facing south. Right arm is under rt. ribs. | | | |
| Room 1 | Fill | Burial #4 | Adult skeleton-38" long - flexed position lying on rt. side. Piece of wood 17" long on vertebrae. Wood 20" long in front of ribs and hitting face. Head on the rt. side facing southeast. | 1 | - | H.L. S 40" E 33" V.L. 27" below top of W wall. |
| Room 1 | Fill | Bc 57 10/2 | Corregated cooking pot; corrugation covers pot; coils 1/4" wide; smooth gray interior, slightly blackened near base; exterior blackened from cooking on upper half; base and rim missing, about 1/2 of side missing, 1 1/2" hole in restored side; 9 1/2" from neck to base, 5 1/2" diameter at base, 8" | 1 | - | h.l. 47"N 58"E; v.l. 9" from top of S wall |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | diameter at widest part of bowl, 4 3/4" diameter at neck; light gray interior, medium gray exterior, exterior blackened. | | | |
| Room 1 | Fill | Bc 57 10/6 | Miniature pottery bowl, tiny, dark gray outside, lighter gray inside; broken; inside diameter of 1 1/4", height 1"; 3 pieces put together, restored with plaster. | 1 | - | In room fill |
| Room 1 | Fill | Bc 57 10/18 | Potsherds, culinary, indented; 39 pieces of one pot, possibly restorable; broken; gray, blackened in some areas. | 1 | - | Near burial #2 |
| Room 1 | Fill | Bc 57 10/20 | Smooth bowl; corrugated top; partially restored; top broken; 6 3/4" high, 4" diameter at top; black; | 1 | - | Northeast corner, 16" from top of east wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 1 | Fill | Bc 57 10/37 | Large pottery bowl; only half here; exterior quite smoke blackened; poor condition; 9" (?) diameter, 3 3/4" deep; B/R. | 1 | - | Unspecified |
| Room 1 | Fill | Bc 57 10/38 | Large pottery bowl; only half here; outside somewhat blackened from use; poor condition; 9 1/4" (?) diameter, 3 3/4" deep; B/R. | 1 | - | Unspecified |
| Room 1 | Fill | Bc 57 20/6 | Worked stone; very think flat piece of stone; broken; 2 1/8" X 2" X 1/8"; sandstone; gray with reddish stains on one side. | 1 | - | N.36.; 9" below top of S wall; in debris and [?] |
| Room 1 | Fill | Bc 57 20/12 | Bead; stone; small round stone bead; good condition; 1/8" across, 1/16" high; gray. | 1 | - | N-8", 6" below top of S wall; in debris. |
| Room 1 | Subfloor | Bc 57 20/18 | Turquoise fragments; 2 small bits of turquoise; good condition; size of rice grains; | 2 | - | In debris; below floor level. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | greenish blue. | | | |
| Room 1 | Subfloor | From text; no field no. | Piece of wood 17" long on vertebrae, probably a board. | 1 | - | With Burial #4 |
| Room 1 | Subfloor | From text; no field no. | Wood 20" long in front of ribs and hitting face; Longest piece of wood may be planting stick or bow. | | - | With Burial #4 |
| Room 1 | Subfloor | From text; no field no. | Matting specimens 2; Underside woven fabric, any over multiple, under multiple, is a twill, probably young Yucca bacata, under 2 & over 2; covering entire body | 2 | - | With Burial #4 |
| Room 1 | Subfloor | Bc 57 10/27 | Chaco style pottery mug, one sherd gone from side near handle, one nick out of the rim, base uneven so top leans to one side; black rings around bowl-shaped bottom, black line designs on top; no decoration on the rim; | 1 | - | 2'S, 5'E, under floor, in a grave |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | parallel lines across handle; 3" diameter on top, 4 1/2" diameter on bottom, handle 4 1/2" high and 3/4" wide, black-on-white. | | | |
| Room 1 | Subfloor | Bc 57 10/12 | Pottery pipe; black-on-white; whale pottery pipe; blackened at small end; good/excellent condition; 9 1/2" long, bowl 2 1/4" X 1 3/4". | 1 | - | 29"-38" S, 27" E, 9" below floor level. |
| Room 2 | Fill | Bc 57 20/32 | Stone ax head; ax head made of black stone-groove all around 3" back from blade; perfect condition; 6 1/4" long, groove 1/2" wide, 3 1/4" wide; from 1 3/4" to 1/4" thick; black. | 1 | - | 41"N, 72"W, 9" below floor. |
| Room 2 | Fill | Bc 57 20/33 | Stone ax head or knife; long slim ax head of black stone, no groove-very smooth; perfect condition; 7 1/4" long, 1 | 1 | - | 2'E, 6'N, 1' above floor; in ashes. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 3/8" to 2" at blade in width, 5/8" thick in middle-less at each end; black. | | | |
| Room 2 | Fill | Bc 57 10/21 | Pottery cup; handle broken-1 traingular piece out of side-half of top and rim gone; small muglike cup, wider at bottom than top, flat bottomed, paralell lines around top and bottom, step motif around middle; fairly good condition; 3 1/2" high, 2 3/4" diameter at top; 3 1/2" diameter at bottom; black-on-white; white bottom; design smudged over in two places on side of cup. | 1 | Mug; Mesa Verde b/w 1200-1300 A.D.; height 3 3/8", width of bottom 3 3/8", width of top 2 7/8"; cracked, repaired and restored; most of handle missing; black line at top, thin parallel ones; step and verticle line design in band around it, bottom thick black line. | 18"N, 24"E; 12" above floor. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 2 | Fill | Bc 57 10/28 | Pottery bowl with all of one side missing; black lines and triangles inside, no decoration outside; two tiny holes drilled intentionally in bottom, 1/2" apart and on either side of a crack; in "not good" condition; 5 7/8" diameter; black-on-white; much thicker than most bowls found in BC57. | 1 | Small black-on-white bowl, thick; width 6" X 5 3/8", height 2 1/2"; 1/8 of vessel missing from one side, restored; parallel lines and solid traingles. | 2 1/2 ' E against S wall; 18" above floor. |
| Room 2 | None | Bc 57 10/29 | Small bowl, black inside and red outside; triangular piece missing from bottom, nick out of rim, small chips in other places, base uneven so bowl leans to one side; condition "not too good"; 4 1/2" diameter, 2 1/4" high. | 1 | Small bowl; width 4 3/4", height 2 1/4"; cracked, pieces missing, chips off rim; black polished interior, red exterior. | Unspecified |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 2 | Fill | Bc 57 10/35 | Pottery bowl; crude ware; decorated on inside, not outside; two large pieces gone from rim; one patched with plaster-of-paris; good condition; 6 3/8" diameter, 2 3/4" deep; B/grey. | 1 | Medium sized bowl; top width-6 1/2", bottom width-ca.3", height-2 3/4"; cracked, (2) pieces of rim missing, repaired and restored; Bl/grey (wh?); alternating bl. line w/ line of dots around inside of bowl. | Unspecified |
| Room 2 | Fill | Unspecified | Back part of skull NE part of room H.L. 14"W 4ft S, V.L. 11" above floor. | 1 | - | NE part of room H.L. 14"W 4ft S, V.L. 11" above floor. |
| Room 2 | Fill | | 8 rib bones lying criss-cross of each other, 14"W 3ft S, V.L 5" off floor. | 8 | - | 14"W 3ft S, V.L 5" off floor. |
| Room 2 | Fill | Unspecified | 1/2 jaw bone (mandible), H.L. 7ft. W 3ft. N, V.L. 16" above floor. | 1 | - | H.L. 7ft. W 3ft. N, V.L. 16" above floor. |
| Room 2 | Fill | Bc 57 10/26 | Pottery bowl; found in five pieces; perfect after putting together; plain white slip outside; black line decoration inside; black lines at regular intervals around the rim; rounded bottom; perfect condition | 1 | - | 50" E, against N wall; 49" below top of N wall at that point. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | when pieces are fitted together; 6 7/8" diameter, 3 1/4" high; black-on-white; found upside down-crushed. | | | |
| Room 2 | None | Bc 57 10/30 | Pottery bowl; badly chipped up small bowl with black from inside chipped off in many places; red exterior; one side missing entirely; piece gone from rim; in poor condition; 5 1/4" diameter; 2 1/4" high. | 1 | - | Unspecified |
| Room 2 | None | Bc 57 10/31 | Pottery jar; small corrugated jar, all pieces from one side present but many sherds from other side missing; ordinary blackened culinary ware; rim plain; rest corrugated and indented; rounded bottom; poor condition-much missing; 3" | 1 | - | Unspecified (cards says "no data") |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | diameter at top, 4 1/2" diameter at largest part, 2 3/4" diameter at neck, 5" high. | | | |
| Room 2 | None | Bc 57 10/34 | Pottery bowl; small bowl, nick out of the rim; rather thick ware; badly worn so design is almost obliterated; good condition; 5 1/4" diameter, 2" deep; black-on-white. | 1 | - | Unspecified |
| Room 2 | None | Bc 57 10/36 | Large pottery bowl; half of interior in checker board, half in parallel lines; tiny piece missing from rim, small piece gone from bottom, another small piece mended with plaster-of-paris; excellent condition; 9 1/4" diameter, 4 1/8" deep; B/W. | 1 | - | Unspecified |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 2 | subfloor | Bc 57 20/36 | Turquoise; worked and polished; a very miniature piece; almost round; 1/16" to 1/8" diameter; green. | 1 | - | 6'N, 7'W, 6" below floor. |
| Room 2 | fill | Bc 57 20/39 | Turquoise; six bits of turquoise; only 1 smoothed; minute dimensions; blue-green. | 6 | - | 4 bits: E 2', N 4', 49" from top of W wall; in ash dump. 2 bits: in ash in center of room floor. |
| Room 2 | fill | Bc 57 22/15 | Stone scraper; large flakes; retouched on edge; good condition; 2" long, 1 1/2"; grayish-tan. | 1 | - | 6'S, 2'E, 6" above floor; in ash. |
| Room 2 | floor | Bc 57 30/45 | Bone awl; very short bone awl; head of bone=top of awl; bone tapers to a point; half of the point is split off (intentional?); excellent condition; 2 3/8" long, 1/2" to 0" wide, 1/2" to 0" thick; natural color. | 1 | - | Found just below and in front of door sill in S. wall. |
| Room 2 | fill | Bc 57 30/48 | Bone awl; long, flat, and narrow; one end blunt; printed [?] end broken; fair condition; 1 1/8" long, | 1 | - | Fill of N wall; back of Room 2. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 1/8" to 1/4" wide; natural color. | | | |
| Room 3 | fill | From text; no field no. | Burned black pot about 7" high; at head of infant | 1 | - | At head of infant burial in North corner |
| Room 3 | floor | Bc 57 20/3 | Ax head; stone artifact; [dry?]-rock; shape-like an ax head; [?-ology]-big hunks knocked out of the blunt end; blunt end battered; 6 1/2" long, 2" wide; 1 1/2" thick; black. | 1 | - | 30" N, 29"W; on floor; sand, intentional fill. |
| Room 3 | fill | Bc 57 10/1 | Pottery bowl; 2 small nicks out of rim (on opposite sides); 4" diameter, 2" deep, B/W, 5 black rings around rim on interior, no exterior decoration (white slip); whole except for 2 nicks out of rim; 4" in diameter, 2" deep; black lines quite thick and uneven-not carefully done-crude | 1 | Pottery bowl; small bowl, Bl/wh (Mesa Verde B/W 1200-1300A.D); W-4 1/8", H - 2 1/16"; Fair condition, chips off rim; 5 'parallel' lines around interior side of bowl | 15" E, 6" S; 8" above floor; in soft fill just above floor. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 3 | Fill | Bc 57 10/3 | Polychrome pottery- B/R interior and R/Buff exterior; Broken: 5 pieces missing from bottom; interior: black lines around rim, swastika in center, exterior: swastikas within circles (drawings on original card); fragmentary, but restorable, about 9 roughly triangular sherds missing to complete it; 7 3/4" diameter, 3" deep. | 1 | Black/red interior, red/yellow exterior; W-8", H-3 1/4"; Houck Polychrome (1125-1200 AD); Poor condition, cracked, pieces missing, chips off rim, mended/restored; black/red lines around interior, swastika design on bottom, red/yellow exterior with swastikas within circles. | In a 2'-3' square in S.E. corner of Rm3; 2" above floor, in soft fill directly above floor. |
| Room 3 | floor | Bc 57 10/4 | Pottery dipper-about 1/3 of dipper part missing; B/W ware with black rings around handle (just across top, not all around) and triangular designs in dipper, bottom blackened; handle intact, but 1/3 of dipper part gone; Handle 5 1/2" long and tapers 1"-3/4" thick, dipper 4" | 1 | ladle; B/W; 9 1/2" X 4"; Handle in good condition, bowl part is partially broken away; Handle is decorated with stripes. | Against south wall, 3 1/2' W, directly on floor in soft fill |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | diameter and 2" deep; handle is solid instead of hollow. | | | |
| Room 3 | Fill | Unspecified | Infant burial exposed in N corner with round, burned black pot-probably about 7" high-at its head. From room sketch(CDI Accession 001667, pg.2) 8" east of west wall, and 8" south of north wall | 1 | - | From room sketch(CDI Accession 001667, pg.2) 8" east of west wall, and 8" south of north wall |
| Room 3 | Fill | Unspecified | 5'4" E and 16" down from top of N wall where human rib stuck up several inches at a point right against the N wall-1 vertebra 5" from rib and loose on top of the fill. Took out bones scattered over an area of about 1' square-lumbar vertebra, | >7 | - | on top of the fill...scattered over an area of about 1' square |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | thoracic (?)-w or 3 ribs-also broken pieces of ribs-put in sack 570045-dug deeper-found more vertebrae, etc all in same sack potsherds (gray) with it (in sack 570057). | | | |
| Room 3 | Subfloor | Bc 57 10/5 | Bottom of hollow-bottomed olla, smoothed off after broken from olla, plain unpainted ware (gray); round-raised in middle like an inverted saucer; in very good condition; 3 1/2" in diameter, 1/2" high in middle; gray cooking ware. | 1 | - | In two peices, 4'S and 4'-5'W, 10" below floor. |
| Room 3 | Fill | Bc 57 30/2 | Bone awl; 2" length of piece of bone awl; well preserved but not all there; 2" long, 5/16" wide at widest part; bone; natural bone color. | 1 | - | 5'4" NE on NW wall; 16"-20" down from NW wall; intentional fill. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 3 | subfloor | Bc 57 30/3 | Bone awl; substance: bone; shape: long-slender; pathology-perfect; 7 3/4" long, 1/2" wide at widest part; natural bone color. | 1 | - | 2'S and 4 1/2' E, 3"-4" below floor; intentional fill. |
| Room 3 | subfloor | Bc 57 30/4 | Bone awl; long slender; substance-bone; pathology-tip broken off; good condition-except for broken tip; 7" long, 1/2" wide at greatest width; bone; natural bone color. | 1 | - | 2'S and 5'E, 6" under floor; intentional fill. |
| Room 3 | subfloor | Bc 57 30/5 | Bone awl; broken in two pieces (mended); tip missing; long slender; made of bone; broken but bone good; but [butt?] piece 3 1/9", other piece 3"; over all length 6 1/2"; natural bone color; no luster. | 1 | - | 2'S and 4 1/2' E, 4" below floor; intentional fill. |
| Room 3 | subfloor | Bc 57 30/6 | Bone awl; long very slender; substance-bone; pathology-almost round, curved-tip not | 1 | - | 2'8" S & 3'11" E, 5" below floor; intentional fill. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | too good; 6 3/4" long, 2/8" diameter; natural bone color. | | | |
| Room 3 | subfloor | Bc 57 30/7 | Bone awl; long slender; pathology-point broken off; good condition-except for broken point; 6 1/2" long, 5/16" wide; natural bone color. | 1 | - | 2'S and 4'E, 4" below floor; intentional fill. |
| Room 3 | subfloor | Bc 57 30/8 | Bone awl; point and half [?] of the awl gone; substance-bone; material good but not all there; 3 1/3" long, 3/8" wide; natural bone color. | 1 | - | 3'S and 5' E, 6" under floor; intentional fill. |
| Room 3 | subfloor | Bc 57 30/9 | Bone awl; awl-tapering to point-stiletto; tip broken off-notch in top and 2 small holes; tapers from oval blob of bone on one end to a long flat blade with point at the end; 8" long, tapers 1/2" to 1/4" wide, tapers 3/8" to 1/8" thick; bone (deer); | 1 | - | Under floor; N.W. corner near (not with) burial #5; few inches below floor; in soft earth. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | natural bone color; one of half dozen similar awls of type used in weaving found in same corner of room. | | | |
| Room 3 | Fill | Bc 57 30/10 | Bone awl; extreme tip end broken; fairly broad blob of bone on top-tapers quite rapidly to a tip; very good condition; 4 3/4" long, tapers 3/4" to 1/8" wide, tapers 1/2" to 1/8" thick; natural bone color; shorter and more spatulate than other awls found in same room. | 1 | - | Above floor; 3 1/2'E, 4 1/2'S, 4" above floor; in soft fill. |
| Room 3 | Floor | Bc 57 30/11 | Bone awl; stiletto type awl, tip broken off-top splintered somewhat; narrow even at the top and tapering to a point; broken tip-otherwise good condition; 6" | 1 | - | At floor level; 14" S, 56" W; on floor. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | long, tapers 3/8" to 3/16" wide, tapers 1/4" to 1/8" thick; natural bone color. | | | |
| Room 3 | Floor | Bc 57 30/29 | Bone awl- short; cracked along one side; circular nick (intentional) in top; stubby; tapers to a sharp point; good condition; 3 1/2" long, tapers 1/2" to 1/16" wide, tapers 1/4" to 1/16" thick; natural color. | 1 | - | 35" W, 11" S; floor level, on the floor. |
| Room 3 | Fill | Bc 57 34/2 | Mold in plaster; roof impression; imprints of reed in mud plaster; 3 grooves on top and two on the side; good condition; plaster 2" long, 2" wide, 3/4" thick; grooves 1/8" wide and run length of plaster; plaster of adobe mud; gray. | 1 | - | Toward top of room debris. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 3 | Floor | Burial #5 | Burial (bag 570045) in an area 2 1/2' square against N wall 5'-7' E and just below floor - lots of sherds around it- bone awls must have been in connection with the burial. Body lying E and W in flexed position with face turned toward S. On its right side, sherds from burial in sack 570186. Paul took two pictures-1rst with camera pointing E and 2nd with it pointing SW.. Also pictures from other sides (3 in all)-put skull and mandible sack 570169- vertebrae and ribs and sternum and pelvis (570170) also scapula from right side all the rest-2 femurs, right humerus, right ulna and radius, hand and foot bones, 2 | 1 | - | in an area 2 1/2' square against N wall 5'-7' E and just below floor |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | fibula, and 2 tibia in 570171 | | | |
| Room 4 | Floor | Bc 57 20/5 | Stone axe; rectangular; grooved all the way around; a little off center; broken on both ends; and 1 flat side; 6' X 4 X "2 1/2" [?]; brownish gray; | | - | NE corner at floor level |
| Room 4 | Fill | Bc 57 20/7 | Stone axe; somwhat edged rectangular stone; grooved all the way around; 2/3" | | - | 6'4" from SE corner; 6'6" from SW corner; 4'11" from top of S wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | of the distance from edge; broken, especially on one flat side; 3 3/4" X 2 3/4" X 1 1/4"; gray. | | | |
| Room 4 | Fill | Bc 57 35/10 | Corn cobs; charred; 21 blackened cobs with from 6 to 16 rows; charred; largest 2" X 1" X 3/4"; smallest 3/4" X 1/2" X 1/4"; black color. | | - | In debris above floor level. |
| Room 4 | Fill | Bc 57 22/2 | Projectile point; head broken; 15/16" long; tan. | | - | 67" from NW corner, 86" from SW corner, 46" below N wall; room fill. |
| Room 4 | Fill | Bc 57 20/8 | Stone axe; oval stone with an edge at each end; central groove all the way around; edges somewhat chipped; 5 1/4" X 3 1/4" X 1 1/2"; dark gray. | | - | Near center of E wall; 4'7" below top of E wall. |
| Room 4 | Fill | Bc 57 10/7 | Pottery disk; corrugated pottery shaped into a circle with a hole in the middle; good condition; 1 1/2" diameter; black. | | - | SE corner, 48" below S wall, in room fill. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 4 | Fill | Bc 57 35/11 | Eggshell; several pieces; thin shell; broken; yellowish. | | - | In room fill. |
| Room 4 | Fill | Bc 57 10/19 | Potsherds, bowl; red outside, polished black inside; 55 pieces, a few glued together. | | - | In debris; SE quarter; 3'-4' below top of wall. |
| Room 4 | Fill | Bc 57 10/23 | Worked potsherd; almost round; coiled bottom of corrugated pot; fair condition; 3" X 2 3/4" X 3/16"; dark gray. | | - | In debris above floor |
| Room 4 | Fill | Bc 57 10/24 | Figurine from top of pot; small animal apparently; white with collar of two black rings with dots between; at base are horizontal lines with vertical line; broken from pot; 1 1/2" tall, 1 1/2" at widest part; black-on-white. | | - | In room fill above floor |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 4 | Fill | Bc 57 10/25 | Pottery ladle handle; perforated; handle with 7 perforations on one side and 9 on the other; one small pebble rattles when handle is shaken; only a small portion of ladle bowl is present; 6" long, handle 1 1/2" in diameter; black-on-white; design on top of handle and in bowl. | | - | In debris above floor |
| Room 4 | | Bc 57 10/32 | Top of chaco style pottery mug; bottom missing; one piece gone from one side, also half of other side; handle gone; design covers entire surface; poor condition; 5" diameter at top, 4" at bottom; 5" tall; black-on-white. | | - | "Pieces picked out of bulk sherds." |
| Room 4 | Fill | Bc 57 20/9 | Smoothing stone; oval; very smooth; somewhat chipped; 2 1/4" X 2" X 7/8"; dark gray. | | - | SW quarter of room; 4' below top of S wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 4 | Fill | Bc 57 20/10 | Stone bowl; paint bowl; perhaps made from a concretion; good condition; 3 1/2"-4" outside diameter; 2 3/4" inside diameter; 2 1/2" tall; sandstone; red; yellow pigment on inside? | | - | NE corner, just above floor level. |
| Room 4 | Fill | Bc 57 20/13 | Beads (2); sandstone; rather flat beads, not very smooth; good condition; 5/16" across, 1/8" tall; red. | | - | SE corner- 4' below top of corner wall. |
| Room 4 | Fill | Bc 57 20/22 | Smooth stone; rectangular; light colored; use not known; good condition; 3 3/4" X 2 1/2" X 1 1/4"; grayish. | | - | Against S wall; 5' from SE corner; VL 4'10" from top of S wall. |
| Room 4 | Fill | Bc 57 20/28 | Smooth stone; fragment of flat smooth stone with rounded edge; broken; 1 3/4" X 1 1/2" X 3/16"; brownish. | | - | In debris, above floor. |
| Room 4 | Fill | Bc 57 22/1 | Projectile point; unbroken; 7/8" long; calcedony; white. | | - | 84' from NW corner, 67" from SW corner, 58" below top of S wall; room fill. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 4 | Fill | Bc 57 22/3 | Projectile point; spear head; chipped stone artifact; broken tip; 3 1/4" X 1" X 1/4"; flint-like stone; black. | | - | Beside S wall; about 4' below S wall; in room fill. |
| Room 4 | Fill | Bc 57 30/13 | Bone awl; animal bone with top broken off-groove along one side; broken; 5 3/4" long; animal bone; natural color. | | - | NE corner; just above floor level; intentional debris. |
| Room 4 | Fill | Bc 57 30/19 | Bone awl; broad handle; bone spit [?] and polished to point; good condition; 3" long, handle 3/4" X 1/2" X 1/4"; tapers; natural color. | | - | S.E. Corner; 4'6" from top of wall. |
| Room 4 | Fill | Bc 57 30/23 | Bead; shell; bead made from shell; good condition; 1/4" tall, 3/16" across; shell, olivella; cream color. | | - | Against S.Wall, W-32"; 42" below top of S Wall |
| Room 4 | Fill | Bc 57 30/30 | Bone, worked; piece of animal rib, smoothed, now broken; poor condition; 4 1/2" long, 1/2"-5/8" wide, 1/16" in thickness; natural bone color. | | - | S.E. Corner; 21" from top of E. wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 4 | Fill | Bc 57 30/31 | Bone, worked; top of worked piece of bone; broken; 2 1/2" X (3/4-1/4)" X 5/16"; natural color. | | - | In debris above floor level. |
| Room 4 | Fill | Bc 57 30/32 | Bone, worked; fragment of large bone, paint gone, top broken; 4 1/2" X 1 1/2" X (1/4-1/2)"; animal bone; natural | | - | In debris. |
| Room 4 | Fill | Bc 57 38/1 | Metal pendant; galena; perforated rectangle; good condition; 1/2" X 5/16" X 1/16"; dark, shiny. | | - | Near center of E wall; 55" below top of E wall; in room fill. |
| Room 5 | | Burial #8 | Remains of one burial (well scattered) in E half; scattered | 1 | - | East half |
| Room 5 | Fill | Bc 57 10/9 | Pottery dipper handle, end of dipper handle hollow, round with tunnel up tip, small hole on upper side 1 1/4" from broken end; Broken 2 1/2" from end; in excellent condition otherwise; length 2 1/2", diameter 1", tip 1/2" tall, 1/2" wide at | 1 | - | Fell outside N wall, in debris. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
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| | | | base; gray. | | | |
| Room 5 | Fill | Bc 57 10/10 | Grooved pot handle; wide and heavy; attachment and about 1 1/2" of "handle proper"; excellent condition "as far as it goes"; 2" from one extremity to others; width at widest part 1 1/4"; thickness of handle 3/8"; black on red; gray on under side. | 1 | - | NW quarter of room, above floor level, in shovel fill |
| Room 5 | Subfloor | Bc 57 20/11 | Pecking stone; ovoid; cracked on one side; both ends show signs of use for pecking; excellent condition; length 2 3/4", width 1 3/4", thickness 1 3/8"; reddish brown. | 1 | - | Sub-floor, intentional fill. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 5 | Subfloor | Bc 57 20/23 | Stone scraper; trapazoid-like shape; roughly chipped; 2 1/2" length, 1 5/8" width; 9/16" greatest thickness; petrified wood; black with tan streaks. | 1 | - | Sub-floor, intentional fill. |
| Room 5 | Fill | Bc 57 20/30 | Bits of turquoise; 25 pieces, 1 rectangular, mostly about the size of a pin head; good condition; green to blue color. | 25 | - | Floor +5" |
| Room 5 | Fill | Bc 57 22/5 | Notched arrow point- notch on the side rounded, other more rectangular in shape, chipped thinner on latter side; point slightly off center and edges do not come to point at quite the same L; excellent condition, point very slightly broken; length: 1", thickness at center: c. 1/8", width: at notches 1/2", at point 1/16"; | 1 | - | Near fire remains; S wall; 3'4" N, 2' 6" W; above floor level ± 2'; debris. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
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| | | | gray-ish. | | | |
| Room 5 | Fill | Bc 57 30/20 | Bone awl; round and notched at top; spatulate at bottom coming to a point; 2 partial holes at top; broken-mended 1" from bottom; excellent condition; length 3 1/4", thickness at top 1/2" tapering to 1/8" at bottom, width 5/8" at top; natural color. | 1 | - | ±1/8" above floor level; debris. |
| Room 5 | Fill | Bc 57 30/21 | Bone bead; large bone bead and hole about size of pencil; consistent size (i.e. not tapering); excellent condition; length 3", width 1/2", thickness 3/8"; natural | 1 | - | 3'9" S, 3'6" E; 2' above floor level; debris. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | color. | | | |
| Room 5 | Fill | Bc 57 30/22 | Shell bead; well smoothed olivella shell bead; very faint spiral groove about twice around top; (shell practically completely); excellent condition; length 1/2", diameter at center 3/16"; olivella shell; white color. | 1 | - | 3'8" N, 3" W; 4" above floor level; debris. |
| Room 5 | Fill | Bc 57 35/13 | Canyon walnut; in 3 pieces; fragmentary; dark brown color. | 1 | - | SE quarter; floor + 5± |
| Room 5 | Burial #8 | From text; no field no. | 1 griddle stone just above feet. | 1 | - | With Burial #8 |
| Room 6 | Floor | Bc 57 10/41 | Worked sherd; circular sherd of B/W pottery; fair condition; 1 1/4" to 1 1/2" diameter; B/W. | 1 | - | "Floor level" |
| Room 7 | | Bc 57 35/5 | Eggshells; small fragments of shell; poor condition; white color. | 1 | - | W. 1/10" N. 56"; 60". |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 7 | Fill | Bc 57 35/1 | Corn cob; 8 (?) row corn cob; charred; 2 1/2" long; burned black. | 1 | - | In fill 24" below top of S.Wall. |
| Room 7 | Fill | Bc 57 10/8 | Worked sherd; smudged pot sherd; worked along one edge; good condition; 1 3/4" long, 1 1/8" wide; gray. | 1 | - | 33"N X 19"W; 54" below S wall |
| Room 7 | Fill | Bc 57 20/4 | Rectangular piece of stone; all sides polished smooth; corner clipped off; good condition; 2 1/2" long, 1 1/2" wide, 3/4" thick; stone; gray. | 1 | - | 79.8 [?]"S&E, 17"W; 41" below top of S wall. |
| Room 7 | Fill | Bc 57 20/14 | Obsidian flake with some secondary chipping; good condition; 1 3/4" X 7/8". | 1 | - | In fill; 33" below top of S wall. |
| Room 7 | Fill | Bc 57 20/15 | Thin smoothed stone; good condition; edges chipped; 2 1/4" long, 1 1/2" wide, 1/6" thick; gray. | 1 | - | N 57", W 23", 41" under S wall. |
| Room 7 | Fill | Bc 57 20/24 | Oblong stone, chipped by work; good condition; 3 1/2" long, 2 1/2" wide, 1" | 1 | - | In fill. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | high; gray. | | | |
| Room 7 | Fill | Bc 57 20/25 | Hammerstone; roughly round; good condition; 2 1/4" long, 2" wide, 1 1/4" high; gray. | 1 | - | In fill. |
| Room 7 | Fill | Bc 57 20/26 | Hammerstone; roughly round; good condition; 1 1/2" long, 2 1/2" wide, 1 3/4" high; gray. | 1 | - | In fill. |
| Room 7 | Fill | Bc 57 20/27 | Hammerstone; roughly round; good condition; 2 1/2" long, 2" wide, 2" high; gray. | 1 | - | In fill. |
| Room 7 | Fill | Bc 57 30/12 | Bone bead; thin bone; smoothed and cut off at each end; slightly curved; good condition; 3 1/4" long, 1/4" wide, 1/8" high; natural bone color. | 1 | - | Top wall-18" |
| Room 7 | Fill | Bc 57 30/14 | Bone awl; made from bone fragment; all surfaces completely smoothed; slight groove down one side; good condition; 2 1/8" long, 1/4" wide, | 1 | - | N.Wall 6"S; E.Wall 14"W; 3'8" below top of S.Wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 1/8" thick; natural bone color. | | | |
| Room 7 | Fill | Bc 57 30/15 | Bone awl; point broken; smoothe; knob [?] at top; good condition; 2 3/4" long, 1/4" wide in middle; 1/8" thick; natural bone color. | 1 | - | 7"N & 32"N; top S. wall- 21" |
| Room 7 | Fill | Bc 57 30/16 | Bone awl; point broken; left side broken off; fair condition; 4 3/4" long, 1/2" wide, 1/4" thick; bone; natural bone color. | 1 | - | 43"N, 50"W; 53" below S.Wall. |
| Room 7 | Fill | Bc 57 30/17 | Bone scraper; broken end of impliment; broad bone with round sharp end; polished; fair condition; 2 3/8" long, 5/8" wide; natural bone color. | 1 | - | 2'4" N, 4'9" S; 53" below S.Wall. |
| Room 7 | Fill | Bc 57 30/18 | Bone awl; broken bone; splintered end smoothed; bone polished; good condition; 3 3/8" long, | 1 | - | 14" N, 27" W; 54" below S.Wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 1/4" wide, 1/8" thick; natural bone color. | | | |
| Room 7 | Fill | Bc 57 35/2 | Corn cob; 6 row corn cob; charred; 3/4" long; burned black. | 1 | - | In fill 24" below top of S.Wall. |
| Room 7 | N/A | Bc 57 35/14 | Seeds; small; black and tan. | Unspecified | - | Unspecified |
| Room 7 | Fill | Bc 57 34/1 | Roof impression; impression of roof beam and juniper strip implanted; fair condition; 5" long, 4" wide, 2" thick; burned black. | 1 | - | N.8" W.45"; S. wall- 14" [?] |
| Room 9 | | Bc 57 10/40 | Effigy pot; oval shape with wide flattened rim; part of a triangle; broken and parts missing; 4 1/2" long, 4" wide, 2" high; black-on-white. | 1 | Part of effigy vessel; approximately 4 1/4" L, 2 3/8" H (whole vessel?), 4"W; cracked but repaired; only part of vessel; Bl/wh; solid triangles and parallel lines on top, dots around sides. | Bottom of ventilation shaft |
| Room 9 | Burial #2 | Bc 57 10/22 | Pottery bowl; one nick out of rim; decorated on inside; sporadic black designs around rim on ouside; in practically perfect condition; 3" | 1 | - | 1'E, 4'S; 18" above door sill; in grave. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | high, 6 1/2" diameter; black-on-white triangular elements inside; spirals and zigzags outside; found with infant in burial 7. | | | |
| Room 9 | Fill | Bc 57 20/38 | Stone axe; 3/4 gone; once an axe and later used as a hammer; flat top; broken badly; 3 1/2" long, 3" high, 1 1/2" wide; blue-black. | 1 | - | Between floor and 12" above it. |
| Room 9 | Fill | Burial #9 | North 4', East 3'6", 2'6" down; Position of skeleton: northwest to southeast; Orientation: head-northwest, facing southwest; Length of grave 1'3"; Infant, poor quality; Only root fibers in fill, in skull, Very young infant, thoracic girdle intact but remainder very fragmentary. | 1 | - | North 4', East 3'6", 2'6" down |
| Room 9 | Fill | Unspecified | Another rib turned up in debris 15" below top of | 1 | - | in debris 15" below top of N wall 13"S and 21" W |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | N wall 13"S and 21" W. | | | |
| Room 9 | Fill | Burial #9 | Burial form: Male (?), South 4.2', East 7.5', 4" below door sill; Lots of large rocks-clayey soil around-debris; More or less face down; Head E-feet N; Length of Grave: 5'; Flexion: right angle; Skull badly broken-many other bones fragmentary also-badly disturbed-rodent nests around it-rodent bones-ashes over it-potsherds-some flint; Burial too much distrubed to call the sherds and flint found near it actually in association.; Notes: Found badly broken up burial with lots of intrusive rodent bones, sherds, etc. around. 61" W to middle of skull and | 1 | - | South 4.2', East 7.5', 4" below door sill |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 52" 3-down 4" below b.m. (bench mark=sill in north wall doorway)- more or less extended; face down, lying on right side slightly; bones in sacks 570448 and 570445 | | | |
| Room 9 | Fill | Unspecified | Turned an adult Rib 2 1/2ft S, 2ft. E and VS 2ft below N wall level. | 1 | - | 2 1/2ft S, 2ft. E and VS 2ft below N wall level |
| Room 9 | Fill | Unspecified | A rib (adult) turned up 2ft. 3" W and 8' S on 1rst strat. level. | 1 | - | 2ft. 3" W and 8' S on 1rst strat. level |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 9 | Fill | Bc 57 10/16 | Pottery mug; 1/3 of rim gone-slash in side 1" long; rounded bottom-then a ledge-then top narrows; handle-indented bottom; very good condition; 6" tall, handle 3" long, 3" diameter at top, 5" at widest part, 1 3/4" at bottom; B/W; traingular figures on top part; spirals on rounded bottom. | 1 | - | 51"S, 85"W, 8" below door sill; in ashes, lying on its side. |
| Room 9 | | Bc 57 10/39 | Worked sherd; previously round; black on red design on both sides; hole in center; paint and slip removed from outer edge 1/4"; 1 1/2" long, 1 1/4" wide. | 1 | - | Unspecified |
| Room 9 | Floor | Bc 57 20/31 | Stone maul with groove all around the middle; perfect condition; 2 1/2" long, 1 1/2" thick, 2" wide; natural color. | 1 | - | In a metate bin, 2'E, 5'S; on floor of bin. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 9 | Fill | Bc 57 20/34 | Stone artifact; small, nicely smoothed piece of grayish stone; worked to a uniform thickness; edge of an inch in width, then dips down to form a saucer like central part- this is only a broken piece of a much larger artifact apparently an arc; not squared off; 3" long, 1 5/8" wide, 1/2" thick to 1" from edge, 1/4" thick toward center; grayish (natural). | 1 | - | Thrown out in the fill-exact position unknown. |
| Room 9 | Fill | Bc 57 20/35 | Red clay; two pieces with broken edges; incision made on one piece; about 1" sq.; red. | 2 | - | From floor to 12" above. |
| Room 9 | Fill | Bc 57 20/37 | Hammer; shallow groove; rounded ends; good condition; 4 1/4" high, 3 1/2" across, 1 1/2" wide; stone; gray. | 1 | - | Between floor and 12" above it. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 9 | Fill | Bc 57 22/14 | Chipped arrowhead; chipped grayish stone arrowhead in perfect condition except for tiny nick off top; shoulder widens above notches; 1" long, 1/2" to 1/16" wide, 3/8" wide at shoulder; grayish stone. | 1 | - | 34"S. 13"E, 16" above door sill. |
| Room 9 | Fill | Bc 57 30/36 | Bone awl; bone awl-doesn't taper much-top rounded off-not the top of the bone, slightly wider in middle than at ends and thicker there too; perfect condition; 5 3/8" long, 1/8" wide at top. 1/4" in center, point 1/16", 1/16" thick at top, 1/8" in center; natural color. | 1 | - | 55" S, 32" W, 4" below door sill; in ashes-lying horizontally. |
| Room 9 | Fill | Bc 57 30/43 | Bone awl-tapering-quite short; groove of bone visible down one side; perfect condition; 3 3/8" long, tapers from 3/8" to 1/64" in width; natural color. | 1 | - | 4'S, 1'W; 8" above door sill. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 9 | N/A | Bc 57 30/44 | Bone awl-groove down one side-notch (intentional) at top; quite thick and short; perfect condition; 4" long, 3/8" to 1/16" wide, 3/8" to 1/16" thick; natural color. | 1 | - | "No information" |
| Room 9 | N/A | Bc 57 30/46 | Small bone awl; top of bone=top of awl; part of bone split off at the tip; excellent condition; 3 1/4" long, 3/8" to 0" wide, 1/8" thick; natural color. | 1 | - | "No data" |
| Room 9 | Fill | Bc 57 30/49 | Worked bone; both ends show incision marks with subsequent sawing through and smoothing the ends; 1 5/8" long, 1/2" diameter; natural color. | 1 | - | From floor to 12" above. |
| Kiva A | Fill | Bc 57 20/2 | Hammerstone; rock; 3-sided; edges smooth, worn down to rough surface on working end; broken off 2 1/4" from working end; 2 1/4" from working | 1 | - | v.l. 6" from top of wall; h.l. 6'5" S, 6'E; in debris. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | end to broken end; 6 1/2" in circumference at broken end; 2" long diameter; quartz-like; pink and buff color. | | | |
| Kiva B | Fill | From text; no field no. | Animal bones, room fill | Multiple | - | Kiva B, Room fill |
| Kiva B | Fill | From text; no field no. | Bone awl, room fill | 1 | - | Kiva B, Room fill |
| Kiva B | Fill | From text; no field no. | Bones (bird) found in vent shaft. | Multiple | - | Kiva B, vent shaft |
| Kiva B | Fill | From text; no field no. | Manos | Multiple | - | Kiva B, Room fill |
| Kiva B | Fill | From text; no field no. | Sherds, room fill. | Multiple | - | Kiva B, Room fill |
| Kiva B | Fill | From text; no field no. | Metates, room fill | Multiple | - | Kiva B, Room fill |
| Kiva B | Fill | From text; no field no. | Juniper log, room fill | 1 | - | Kiva B, Room fill |
| Kiva B | Floor | Bc 57 22/17 | Knife blade; chipping on both sides; broken on both ends; 1" X 3/4"; gray. | 1 | - | North side of vent. shaft. |
| Kiva C | | Bc 57 30/41 | Incised bone; cuttings on the bone; good condition; 4 1/4" long; natural color. | 1 | - | "unknown" |
| Kiva C | | Bc 57 30/42 | Incised bone; cuttings on the bone; bone broken; 7/8"; natural | 1 | - | "unknown" |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | color. | | | |
| Kiva C | | Bc 57 20/21 | Bits of turquoise; 3 small pieces; good condition; 2 pieces about size of grain of wheat; other piece 1/4" X 1/8" X 1/32"; greenish blue. | 3 | - | Near floor level, in fill. |
| Kiva C | | From text; no field no. | Metates | Multiple | - | Kiva C |
| Kiva C | | From text; no field no. | 2 small pieces of wood | 2 | - | Kiva C |
| Kiva C | | From text; no field no. | Sherds of one restorable pot on floor along west wall 70" long starting from keyhole W corner. Black on white. | 1 | - | Kiva C, floor along west wall |
| Kiva C | | From text; no field no. | Sherds of one restorable pot on the floor along the west wall 70" long starting from keyhole W corner. Gray corrugated, burned black. | 1 | - | Kiva C, floor along west wall |
| Kiva C | | From text; no field no. | Turquoise near E wall on floor | 1 | - | Kiva C floor, near east wall |
| Kiva C | | From text; no field no. | Piece of turquoise on floor in SW 1/4 of room | 1 | - | Kiva C, floor in SW quarter of room |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Kiva C | | None Given | A smooth stone ("corn goddess symbol") 0.23 m high x 0.18 m across bottom is found in ventilator shaft. | 1 | - | Kiva C, ventilator shaft fill |
| Kiva C | | From text; no field no. | Portions of three metates | 3 | - | Kiva C |
| Kiva C | | None Given | Large deep metate found in ventilator shaft fill. Broken in two pieces. | 1 | - | Kiva C, ventilator shaft fill |
| Kiva C | | None Given | Several pieces of another metate found in ventilator shaft. | 1 | - | Kiva C, ventilator shaft fill |
| Kiva C | | Bc 57 22/4 | Projectile point, arrowhead; small chipped stone point; perfect condition; 1 1/4" X 1/3" X 1/16"; chert; light greyish-buff color. | 1 | - | Against E wall; 2' below top of bench. |
| Kiva C | | Bc 57 20/20 | Turquoise, tiny flat bead; good condition; 1/8" in diamter; greenish. | 1 | - | Near center of kiva; 18" above floor level; in room fill. |
| Kiva C | | From text; no field no. | Manos | Multiple | - | Kiva C |
| Kiva C | | From text; no field no. | 2 manos | 2 | - | Kiva C |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Kiva C | | Bc 57 35/6 | Seeds (cactus?); brown shiny seeds; fair condition; 1/32" diameter; vegetable; brown; some black husks. | Unspecified | - | along N wall; 2'4" below top of bench. |
| Kiva C | | Bc 57 22/6 | Projectile point; excellent condition; 3/4" long; pink red calcedony. | 1 | - | Keyhole fill. |
| Kiva C | | Bc 57 22/13 | Projectile point; partially chipped; 7/8"; obsidian; black. | 1 | - | "Unknown" |
| Kiva C | | Bc 57 30/40 | Bone awl; short and fat; good condition; 2 5/8"; natural color. | 1 | - | "unknown" |
| Kiva C | | Bc 57 35/7 | Seeds; tiny pale round seeds; good condition; almost microscopic; vegetable; light tan. | Unspecified | - | W side of Kiva; 8" above floor. |
| Kiva C | | Bc 57 35/8 | Seeds; tiny light colored seeds; good condition; vegetable; light tan. | Unspecified | - | Near W wall; just above floor. |
| Kiva D | | Bc 57 35/12 | Corn cobs; charred; 6 pieces; 4-6 rows; charred; black. | 6 | - | 1' to 2' level. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Kiva D | | Bc 57 10/14 | Corrugated pottery; in 73 pieces; fragmentary; restorable; black-sooted. | 1 | - | Firepit-ash; scattered throughout upper level |
| Kiva D | | Bc 57 10/15 | Pottery handle; attached to portion of vessel, somewhat obliterated groove down mid line; good condition; handle: length 1 1/2", width 1/2", thickness 3/8"; white. | 1 | - | 1' to 2' level |
| Kiva D | | Bc 57 35/15 | Corn; charred corn cob fragment; 1" long. | 1 | - | Surface to 1' |
| Area 10 | N/A | Bc 57 30/38 | Bone scraper; tarsal bone of deer; short hand scraper; good condition; length 2 1/8", width of scraper 3/4", width at top 1/2"; (dark) natural color. | 1 | Worked bone; good condition. | N 1', W 5', 1' below f.m.; debris. |
| Area 10 | N/A | Bc 57 35/9 | Eggshells; 2 fairly good sized pieces; 5 very small pieces; good condition (for eggshells); largest piece 1/2" square; natural color; associated with fire remains. | 7 | - | 3" above f.m.; top of south wall up against east wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Area 10 | N/A | Bc 57 20/29 | Chopper; heavy stone; broken; apparently about 1/4 of original smooth stone; good condition; length 2 1/4", length beginning-end 1 1/2" [?], thickness 1", width [? illegible]; gray. | 1 | - | Debris |
| Area 10 | N/A | Bc 57 22/8 | Side scraper; small "trainguloid"; good; length 1/2", width at top 1", length of secondary edge 1"; obsidian; black. | 1 | - | Debris. |
| Area 10 | N/A | Bc 57 22/9 | Scraper; small; rectangular; good condition; length 1 1/4", width 7/8", thickness 1/2"; petrified wood; gray. | 1 | - | Debris. |
| Area 10 | N/A | Bc 57 22/10 | Stone punch; apparently a punch; point created by three strikes on upper side of traingle end of stone; very slightly broken at point; length 2", width 1 1/4", thickness | 1 | - | Debris. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 5/8"; petrified wood (?); gray, swirled with black. | | | |
| Area 10 | N/A | Bc 57 22/11 | Scraper; good condition; height at core 1/2", width 1 1/8", length of scraping edge 1 1/4"; petrified wood; gray to black. | 1 | - | Debris. |
| Area 10 | N/A | Bc 57 22/12 | Arrow point; broken half-point end only; length 3/4", width of upper end 1/2"; obsidian; black. | 1 | - | N 3', W 7'6", one foot below f.m.; debris. |
| Area 10 | N/A | Bc 57 30/37 | Bone punch; excellent condition; length 2"; bone; natural color. | 1 | - | N7', W7'; bench mark; debris. |
| Area 10 | N/A | Bc 57 30/39 | Bone bead; turkey leg bone; intentionally marked (very slightly) at one end; good condition; length 1 1/2", diameter 1/2"; (dark) natural color. | 1 | - | N 4', W 1'6", 1' below f.m.; debris. |

Table A.2: Artifact Distribution by provenience at Bc 58; adapted from Chaco Archive (Archive 2011b).

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Kiva A | Fill | Bc 58 20/53 | Worked (?) stone-granite (?); large smooth stone with battered ends; 141 mm X 216 mm; good condition; natural color. | 1 | - | 2'6" below bench level. |
| Kiva A | Fill | Bc 58 20/56 | Worked stone; red sandstone mano; broken; 128 mm long X 94 mm wide X 34 mm thick; worn; red (sandstone). | 1 | - | 34" level below bench. |
| Kiva A | Fill | Bc 58 30/28 | Bone; 110 mm length, 24 mm width, 12 mm thick; fair condition. | 1 | - | 48"W, 6'6"N data points; 36" depth bench level. |
| Kiva A | Fill | Bc 58 35/5 | Wood; small piece of wood (twig?) with bark; July 16, 1947 | 1 | - | 3' below bench level |
| Room 1 | Fill | Bc 58 20/40 | Turquoise; small, unfinished turquoise bead; flat and roughly circular; 5 mm X 2mm; good condition; greenish blue. | 1 | - | 3'2" from S. corner; 4'8" from W. corner; level B. |
| Room 1 | Floor | Bc 58 10/6 | Pottery; black-on-white medium sized bowl; PII red mesa; Ht. 4 1/2", Di 10"; 254mm across, 120mm deep; good condition, reconstructed; black-on-white. | 1 | - | Floor Level. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 1 | Floor | Bc 58 20/47 | Red stone pendant; wings on top and bottom; broken thin hole; 12 mm by 29 mm; fair condition; red color. | 1 | - | SE end; level 7. |
| Room 1 | Fill | Bc 58 30/20 | Worked bone, awl, hard, polished exterior, broken, hard interior; length 30 mm, upper diameter 6 mm; fair condition; light brown color. | 1 | - | Level B |
| Room 1 | Fill | Bc 58 30/21 | Worked bone; worked animal ulna (?) awl; 10.8 cm X 1.8 cm X 1.4 cm. | 1 | - | Level B |
| Room 1 | Fill | Bc 58 30/22 | Worked bone; end of piece of bone; rounded; hole made near rounded end; 3 X 1.2 X 1 cm; charred, fragmentary end; blackish color. | 1 | - | Level B |
| Room 1 | Floor | Bc 58 60/1 | Burial; very few bones present - mostly in tiny fragments, of a very fragile nature; July 23, 1943; bad, bone color | Unspecified | - | On floor |
| Room 2 | Subfloor | Bc 58 30/16 | Bone awls (2); =85 mm, greatest width=6 mm; =85 mm, greatest width 5 mm; one good, other fair condition. | 2 | - | South wall trench; between 8'1" and 9' from top of SE corner. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 2 | Subfloor | Bc 58 30/17 | Worked bone; awl-like, broken at small end; 50 mm long, 5 mm dia. | 1 | - | 4' from E wall, 9" from S wall; 6" above floor level (8'6" below top of SE corner of room 2). |
| Room 2 | Fill | Bc 58 10/2 | Pottery; horizontally broken; pipe stem?; poor condition; grey color; may be pot handle. | 1 | - | 10' from S. Wall; 10' from E wall; 7'3" below datum stake. |
| Room 2 | Fill | Bc 58 20/29 | Stone; probably stone pendant-not pierced; 56 mm X 40 mm X 3mm; reddish sandstone. | 1 | - | 1' from S.Wall; 2' from E.wall; 8' from top. |
| Room 2 | Fill | Bc 58 22/3 | Stone; worked stone scraper; 32 mm approx. diameter, 15 mm thick; good condition. | 1 | - | 2'1" from SE corner; 1'2" from surface. |
| Room 2 | Fill | Bc 58 30/10 | Bone; awl; 67 mm X 10 mm; broken at end. | 1 | - | 7'4" from SE corner Rm 2; 1'4" from NW corner Rm 4; 3'3" below level of SE corner (top) of Rm 2. |
| Room 2 | Fill | Bc 58 30/11 | Shell; olivella shell bead; 15 mm X 8 mm; fair condition; charred. | 1 | - | 4'2" from SE corner #2; 2'6" from NE corner #2; 37" down from level; found in fire pit. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 2 | Floor | Bc 58 30/12 | Bone; bone awl; 82 mm X 6 mm X 14 mm; fair to good condition. | 1 | - | From SE corner 3'10"; from NE corner 3'1"; down from level 4'2"; 1' below ash layer; occupation level. |
| Room 2 | Fill | Bc 58 30/19 | Worked bone gaming piece (?); small eliptical piece of bone; cross-hatched incisions on one side; 18 mm length X 8 mm wide X 2 mm thick; good condition. | 1 | - | 2'1" from S.wall; 3'8" from E wall; 4'11" down from SE corner. |
| Room 3 | Fill | Bc 58 20/19 | Stone; axe (?); black polished stone; repaired; 150 mm X 58 mm X 13mm; poor condition; black color. | 1 | - | 2 feet from west wall; 3' below wall (south); 1 1/2 ft. from S.wall. |
| Room 3 | Fill | Bc 58 30/1 | Bone; awl; 62 X 14 X 6; good condition. | 1 | - | 14" below wall surface. |
| Room 3 | Fill | Bc 58 34/1 | Roofing of wall material; Cast of beam preserved with gasoline and parafin; July 2, 1947; Width 47mm, Deep 55mm; Fair, Brown | 1 | - | 3' from wall; 3" from West wall, 5-6' below South side of doorway in West wall. |
| Room 3 | Fill | Bc 58 35/4 | Wood; 5 fragments - apparently unworked; July 8, 1947; see over; poor, natural | 5 | - | 28" from SW corner; 60" from NW corner; 30" from top of NW wall; near firepit |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 3 | Fill | Bc 58 30/3 | Horn; piece of horn-decayed; 73 mm X 30 mm X 22 mm; fair condition. | 1 | - | 7.6' from SE corner; 2.8' NE corner; 2.1' depth. |
| Room 3 | Fill | Bc 58 30/6 | Bone awl-repaired; incised horizontally from top toward point; 12 mm X 55 mm; good condition. | 1 | - | 4'5" from NE corner; 7'5" from SE corner; 1'5" in depth. |
| Room 3 | Fill | Bc 58 14/1 | Worked sherd; 33mm X 32mm X 6mm; black-and red. | 1 | - | 3' top of S.wall; 1 1/2' from S.wall; 3' from W wall. |
| Room 3 | Fill | Bc 58 14/2 | Pot sherd; appears to be piece of grey corrugated pottery-blackened on outer surface; shaped, but not pierced; 26mm X 20mm X 6mm; good condition. | 1 | - | 1'2" from W.wall; 2 1/2' from S.wall; 6' from top of W wall. |
| Room 3 | Fill | Bc 58 20/6 | Two hammerstones; chipped and marred surfaces; darker stone some what smoother in over all surface than the lighter stone; 77 X 72 X 46mm, 78 X 65 X 54mm; fair condition. | 2 | - | Unspecified. |
| Room 3 | Fill | Bc 58 20/10 | Stone; worked sandstone block; grooved on top and bottom with groove approximately 10mm deep. 76mm X 34mm X 20mm; fair | 1 | - | 1.2 ft below NE corner wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | condition; appears to be broken; light brown. | | | |
| Room 3 | Fill | Bc 58 20/11 | Stone; metate, one long side and greater part of center; 23.4mm X 13.3mm X 9.6mm; fair condition, white color. | 1 | - | 3.5 feet from NE corner; 10.6 feet from SE corner; 1.5 feet from surface. |
| Room 3 | Fill | Bc 58 20/12 | Stonework; mano-broken on one corner; surface of one side smoother comparatively than that of other side; 180mm X 122mm X 18mm; fair condition. | 1 | - | Unspecified |
| Room 3 | Fill | Bc 58 20/13 | Stonework; mano, two face surfaces; somewhat pitted; 163mm X 102mm X 28mm; fair condition. | 1 | - | Unspecified |
| Room 3 | Fill | Bc 58 20/24 | Fragment stone; mano; 132 X 110 X 27 mm; broken. | 1 | - | 3" from S. Wall; 5'5" from W.Wall; 2'6" from top of S.Wall. |
| Room 3 | Fill | Bc 58 20/25 | Stone; fragment of a palette; 52 X 48 X 5 mm; very smooth. | 1 | - | 1' from W.Wall; 4' from S.Wall; 5 1/2' from top of W.Wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 3 | Fill | Bc 58 20/17 | Stone; worked stone probably portion of disk or pendant; 28 mm X 15 mm X 3mm; broken; red color. | 1 | - | 2' 6" from NE corner; 8' 6 from SE corner; 3'2" deep. |
| Room 3 | Fill | Bc 58 20/14 | Stonework; manos-fairly smooth face surfaces; 164mm X 104mm X 32mm; fair condition. | 1 | - | Unspecified |
| Room 3 | Fill | Bc 58 20/15 | Sand stone; broken disk 108 mm in dia.; evidence of polish on one surface; 108 mm dia, 7 mm thick; broken; sand stone tan color. | 1 | - | 1.5' from NE corner wall. |
| Room 3 | Fill | Bc 58 20/21 | Stone; fragments paint palette; smaller; indicating presence of stain from red pigment; 100 mm X 80 X 10- for A 70 mm X 30 X 8; poor condition. | Unspecified | - | 7'5" from SE corner; 3' from top of wall; 5'4" from NE corner. |
| Room 3 | Fill | Bc 58 20/22 | Gypsum; rings (?); a) 24 mm X 7 mm X 7mm, b) 20 mm X 10 mm X 6 mm; poor fragmental condition. | Unspecified | - | N.E. corner; 3" above floor level. |
| Room 3 | Fill | Bc 58 20/23 | Stone mano; 220 X 110 X 90 mm; good condition. | 1 | - | 1/2' from S. Wall; 3" from W. Wall; 5' from top of W. Wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 3 | Fill | Bc 58 20/30 | Pecking stone; chipped and marred surface on sides; front and back darker and somewhat smoothed; 86 X 66 X 50 mm; good condition. | 1 | - | From fill. |
| Room 3 | Fill | Bc 58 30/15 | Bone; 2 beads, perforated disks; 4 mm X 1 mm; good condition; white color. | 2 | - | In fill of room. |
| Room 3 | Fill | Bc 58 20/26 | Worked stone; stone pendant; 29 mm X 4 mm; good condition; red color. | 1 | - | Fill of room; location unknown. |
| Room 3 | Fill | Bc 58 20/27 | Stone, fragment of a mano, 110 mm X 81 mm X 29 mm; broken. | 1 | - | 1' from W.Wall; 9' from S.Wall; 5 1/2' from top of W.Wall. |
| Room 3 | Fill | Bc 58 20/28 | Stone; gypsum; crescent in shape; piece could be ring fragment; 27 mm X 7 mm X 6mm; fair condition; white color. | 1 | - | Fill of room; location unknown. |
| Room 3 | Fill | Bc 58 30/4 | Bone; bone awl; under surface slightly broken; 7 mm X 89 mm; good condition. | 1 | - | 2'3" from NE corner; 3'9" from SE corner; 1'9" below surface. |
| Room 3 | Fill | Bc 58 30/7 | Shell; worked olivella shell bead; 8 mm long; good condition. | 1 | - | from fill of R#3 |
| Room 3 | Fill | Bc 58 30/8 | Shell; worked shell pendant; 11 mm dia.; excellent condition. | 1 | - | 4 ft below wall SW corner. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 3 | Fill | Bc 58 30/9 | Bone; tip of bone awl; 43 mm long X 11 mm wide; fair condition. | 1 | - | Extreme SE corner R#3; 3' down from top. |
| Room 3 | Fill | Bc 58 30/13 | Bone; bone awl; 59 mm X 3 mm X 10 mm; fair condition. | 1 | - | 4' from top of W.Wall; 2" from W.Wall; 4'3" from S.Wall. |
| Room 3 | Fill | Bc 58 30/14 | Bone; oval bone gaming piece; incised pattern on one side; 22 mm X 8 mm X 2 mm; good condition; similar piece found in R#11-site 59. | 1 | - | 2' from S wall; 1' from W wall; 3 1/2' from top. |
| Room 3 | Fill | Bc 58 20/31 | Pecking stone; flaked on two surfaces; pecked on others; 60 X 45 X 42 mm; good condition. | 1 | - | From fill. |
| Room 3 | Fill | Bc 58 20/32 | Pecking stone; smooth front and back; worn and pecked on side; 48 X 32 X 41 mm; good condition. | 1 | - | From fill. |
| Room 3 | Fill | Bc 58 22/4 | Stone; scraper ? chipped; 54 mm X 38 mm X 8 mm; good condition; red brown. | 1 | - | 2 feet from top of wall. |
| Room 4 | Fill | Bc 58 20/1 | Metate; broken metate; 340mm X 101mm X 193mm; fair condition. | 1 | - | 3'4" N.wall, 2'4" W.wall; 16". |
| Room 4 | Fill | Bc 58 20/7 | Turquoise; small flat ornament; 4 X 11 X 1mm; good condition. | 1 | - | 2' from North Wall Rm.2; 1' from West Wall rm.3; verticle: 8". |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 4 | Fill | Bc 58 22/6 | Flint; arrowhead; 30 mm X 8 mm; good condition; dark brown color. | 1 | - | "?"; floor. |
| Room 4 | Fill | Bc 58 20/5 | Stone; "miniature metate"- rectangular shape; slightly concave surface; length 210mm, width 129mm; fair condition; grayish tan color. | 1 | - | 3rd section from NW corner of Room 4. verticle: 10". |
| Room 5 | Fill | Bc 58 20/9 | Worked stone; pendant- unfinished; hole for attachment to necklace or bracelet half drilled thru; 35mm X 19mm X 3mm; good condition; dark beige color. | 1 | - | Unspecified. |
| Room 5 | Fill | Bc 58 22/1 | Stone arrow head; 26 X 12 X 2; excellent condition. | 1 | - | 217 degrees- 20' from pt.A; 36" below point A. |
| Room 5 | Fill | Bc 58 30/2 | Bone awl; solid, point broken, slightly broken; 6 mill. diam X 50 mill long; good condition; slightly discolored by earth. | 1 | - | 19" below wall. |
| Room 6 | Fill | Bc 58 22/2 | Flint arrow point; 220 mm long, 110 mm wide; good condition; white color. | 1 | - | D1- NE corner room 5-80"; D2-SE corner refuse area 1-30"; 13" (room 6, wall level); found in assosication with fire |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | | | | against ware. |
| Room 7 | Fill | Bc 58 20/8 | Stone; worked stone artifact; smoothed; one edge rounded; 24mm X 36mm X 9mm; good condition; gray color. | 1 | - | In room fill. |
| Room 7 | Fill | Bc 58 20/20 | Stone; fragments stone manos; see sketch; broken condition; detailed drawing on cards with measurements. | 1 | - | In fill. |
| Room 7 | Fill | Bc 58 20/33 | Stone; fragment of worked stone; 80 mm X 82 mm X 20 mm; broken (fragment); whitish-gray. | 1 | - | In fill. |
| Room 7 | Fill | Bc 58 35/1 | Wood; Roofing beam section; July 1, 1947; length 200mm x diameter 38mm; fair - preservation - parafin and gasoline | 1 | - | 1'8" from north wall, 1'2" from east wall - extended 2'3" toward center of south wall; 3'6" below NE corner |
| Room 8 | Fill | Bc 58 22/5 | Obsidian; small projectile point; 22 X 10 X 2 mm; good condition. | 1 | - | 3' from W corner; 3' from N corner; 2'6" depth. |
| Room 8 | Fill | Bc 58 30/24 | Bone awl; see sketch; 39 mm X 18 mm; good condition; natural color. | 1 | - | 6'10" from NW corner; 1'4" S of N wall; 2" deep. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 8 | Fill | Bc 58 20/16 | Stone work; tchamahia-working edge; chipped on one side; 200 mm X 71 mm X 10 mm; fair condition. | 1 | - | Unspecified |
| Room 9 | Fill | Bc 58 20/18 | Stone work; mano-broken, very pitted on both sides; 200 mm X 120 mm X 28 mm; poor condition. | 1 | - | Unspecified |
| Room 9 | Fill | Bc 58 35/2 | Eggshells; lighter inside than outside; 14 pieces; July 5, 1946; very small pieces, poor | 14 | - | North wall; 35" depth |
| Room 10 | Fill | Bc 58 20/50 | Worked stone; 1/2 a mano; 103 mm X 101 X 34; fair condition; brown color. | 1 | - | 39-54" from N.W. Corner; 39-54" Level. |
| Room 10 | Fill | Bc 58 14/3 | Worked sherd; black on red-design on inside surface; 47mm-34mm-5mm; broken condition; black on red. | 1 | - | In fill from 39" to 54" (from top of NW corner). |
| Room 10 | Fill | Bc 58 14/4 | Worked sherd; black on red; design on inside surface; 36mm-21mm-5mm; broken; black on red. | 1 | - | In fill from 39" to 54" (from top of NW corner). |
| Room 10 | Fill | Bc 58 20/45 | Stone; worked; 58 X 63 X 7 mm; fair condition. | 1 | - | 37" from NW corner. |
| Room 10 | Fill | Bc 58 20/44 | Stone; broken mano; 135 mm X 64 mm X 28mm; fair condition. | 1 | - | 37" from NW corner. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 10 | Fill | Bc 58 20/46 | Obsidian; worked; 40 X 35 X 5 mm; fair condition; black color. | 1 | - | 37" from NW corner. |
| Room 10 | Fill | Bc 58 20/51 | Worked stone; a chipped scraper; 40 X 33 X 7 [millimeterrs]; fair condition; brown color. | 1 | - | 39-54" from N.W. Corner; 39-54" Level. |
| Room 10 | Fill | Bc 58 30/25 | Bone, worked; fragment of bone with one end smoothed. Two cracks in opposite end; 69 mm X 13 mm X 7 mm; fair condition; natural color; associated with other animal bones. | 1 | - | 10'2" from NW corner, 7'8" from SW; 24" from NW corner Rm10. |
| Room 10 | Fill | Bc 58 30/27 | Bone (worked); about 3" long-tapered on both sides to a blade-like point; L=67, W=11; good but slightly chipped; yellow-brown. | 1 | - | Level 39"-[?]; from top of NW corner. |
| Room 11 | Fill | Bc 58 10/3 | Pottery. Large bowl; badly broken; two holes about 1/4 inch below rim; no design; HT 5 1/2", Di. 9 1/2"; diameter- 250 mm/diam. at base-110/height-150; poor condition; grey color. | 1 | - | 43" from S. wall and N. wall; 23" below datum point. |
| Room 11 | N/A | Bc 58 20/36 | Paint palette; flat stone worked on two sides; 60 X 60 X 10 mm; good condition. | 1 | - | Found next to pot. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 11 | N/A | Bc 58 20/48 | Polished turquoise; dark green; polished on both sides; edges rough; 15 mm-13mm-5mm; good condition; dark green color. | 1 | - | Level C; S. central |
| Room 11 | N/A | Bc 58 30/26 | Bone awl; fine point. smooth; 55 mm-9mm-4mm; good condition; beige color. | 1 | - | Rom 11-level C of Kiva; fill of level C in S.central part of kiva. |
| Room 12 | Fill | Bc 58 20/41 | Stone; worked; broken thin, flat, rectangular stone; worked on all sides; 76 mm X 64 mm X 13 mm; fair condition, broken and edges worn off in several places. | 1 | - | 0-1' level. |
| Room 14 | Fill | Bc 58 35/7 | Corn cobs; charred; July 22, 1947; 30mm by 12mm; fair, black | Unspecified | - | Near south wall; 26"-60" level; 30" form south wall |
| Room 14 | Fill | Bc 58 15/1 | Yucca fibre; charred fibre; 54mm X 20mm; charred; black. | 1 | - | 34" from N.Wall; 55" from E wall; 11" from top of E wall. |
| Room 14 | Fill | Bc 58 20/57 | Stonework; seemingly 1/2 of a rounded flat plate, semi-polished; 146 X 88 X 11 mm; about 1/2 missing, greyish-white. | 1 | - | In fill; between top of wall and 2' down. |
| Room 14 | Fill | Bc 58 20/58 | Stonework; fragmented part of a flat plate, not polished; 100 X 119 X 6 mm; | 1 | - | In fill; between top of wall and 2' down. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | fragmentary; greyish-white. | | | |
| Room 14 | Fill | Bc 58 20/59 | Stonework; seemingly 1/4 of a stone plate; polished on the sides and edges; 57 X 74 X 10 mm; fragmentary; greyish white. | 1 | - | In fill; between top of wall and 2' down. |
| Room 14 | Fill | Bc 58 20/60 | Stonework; a highly polished oval stone: pecking stone (?); 55 X 80 X 34 mm; good condition; greyish-brown. | 1 | - | In fill; between top of wall and 2' down. |
| Room 14 | Fill | Bc 58 20/61 | Worked stone; rounded flat stone probably used as scraper; diameter=52 mm; 5 mm thick; O.K. condition; grey and brown. | 1 | - | In fill; within 33" of south wall; 28" to 60" levels. |
| Room 14 | Fill | Bc 58 20/62 | Worked stone (perhaps); a portion (small) of a stone palate; polished and reddened on one side; 92 X 62 X 8 mm; fragmentary; grey, one side reddish. | 1 | - | N.E. Corner; 30" level. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| Room 14 | Fill | Bc 58 30/30 | Bone artefact; probably a bone awl with the point broken off; 3 sides highly polished, one with groove down middle; end has hole drilled into it; length= [?] mm, diameter= [?] mm; good condition, but with point broken; light tan color. | 1 | - | In fill; between top of wall and 2' down. |
| Room 14 | Fill | Bc 58 30/31 | Bone awl; worked (?) bone; well used awl, polished, scratched on back; 113 mm X 22 mm X 8 mm (widest points); good condition; natural color. | 1 | - | SW corner; 16" from SW corner; 32" down from S wall. |
| Room 14 | Fill | Bc 58 10/5 | Pottery; intended black-on-white; accidental or purposeful over-firing; parallel angular lines, mediumly seperated one from the other; 27cm 2mm wide, 12cm 3mm deep; partial bowl-designs in fair condition; brownish red on white; more than 3/4 of bowl preserved. | 1 | - | 33" SW corner, 7" SE corner, 26" depth. |
| - | - | Bc 58 20/39 | Worked stone; flat piece of sandstone (?) with edges ground; 9.6 X | 1 | - | 26" below highest wall point. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| | | | 5.6 X 4 cm; fair condition; gray color. | | | |
| - | - | Bc 58 20/37 | Worked stone; broken metate; sandstone; 20.5 X 14.4 X 5 cm [?]; broken; gray. | 1 | - | Occupation level A; 5' from N wall, 3' 6" from E wall. |
| - | - | Bc 58 10/1 | Pottery; section of smoking pipe; elbow including part of bowl; black on white overfired; 51 mm long, 11 mm diameter; small broken section; fair condition; black-on-white. | 1 | - | 3' below 1st floor level; NW corner. |
| - | - | Bc 58 20/2 | Palette; portion of palette, worked on one side; 120 X 134 X 12 mm; fair condition; white color. | 1 | - | "no data" |
| - | - | Bc 58 20/3 | 2 hammer stones; (1) 78 X 68 X 56mm; (2) 72 X 60 X 51mm; good condition. | 2 | - | "no data" |
| - | - | Bc 58 20/4 | Polishing stone; 42 X 44 X 14mm; good condition. | 1 | - | "no data" |
| - | - | Bc 58 20/43 | Worked stone; mano; 16.4 cm X 9 X 3.8 cm; fair condition; gray color. | 1 | - | 20'10" from Datum A; 7'4" from Datum B; in fill; stratification: none. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| - | - | Bc 58 20/38 | Black stone bead; small, flat stone bead; 5 mm diameter, 2 mm thick; good condition; black color. | 1 | - | Room floor; found in rifting surface dirt, may have come from side of test block or from fill under floor, NE corner. |
| - | - | Bc 58 20/52 | Stone; rounded, polished stone with evidences of white stripes; 3 mm-19 mm-5 mm; broken condition; black, with some evidence of white. | 1 | - | Fill thrown from several rooms. |
| - | - | Bc 58 22/7 | Chipped artifacts; arrowhead-broken; 13 [?] mm X 11 mm X 2 mm; poor condition.. | 1 | - | Refuse Area, Layer C. |
| - | - | Bc 58 30/5 | 2 small pieces of turquoise; A. turquoise 5 mm X 5 mm X 2 mm, B. turquoise 5 mm X 5 mm X 1.5 mm; C. turquoise no dimensions taken. | 2 | - | Refuse Area 1 west facing of mound; 41" below top of datum pt.; 22". |
| - | - | Bc 58 30/18 | Bone; smaller end has V notch, V [?] notch on top of large end; smaller end is roughly shaped triangularly; 38 mm length, 7 mm widest; fair condition; possibly a whistle. | 1 | - | 10" from S wall, 3' E wall; 8'6" below SE corner wall level; 6" above floor level; 3'8" below the 4'10" occupation level. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| - | - | Bc 58 20/34 | Worked stone; evidence of flaking on edge; 26 X 30 mm X 8mm; good condition; gray-brownish. | 1 | - | 6" from N Wall, 30" [?] from N pilaster; 8" from highest pt on N.Wall. |
| - | - | Bc 58 20/35 | Paint palette-fragments; 2 pieces; evidence of griding; edges smoothly ground; no color of paint; 60 X 48 mm X 4mm, 60 X 40 mm X 4mm; gray color. | 1 | - | D1, 6' 11"; D2, 6'; Even with D2 in windblown sand. |
| - | - | Bc 58 22/8 | Point; 14 X 22 mm; excellent condition; brownish-gray. | 1 | - | D1, 6'3"; D2, 8'11"; D, 2'9". |
| - | - | Bc 58 34/2 | Roofing material; Two large chunks with pole indentations; July 17, 1947; 160 x 162mm-150 x 122mm; Poor; Brown | 2 | - | Used to roof the ventilator on the East side of the Kiva |
| - | - | Bc 58 30/23 | Bone; worked-see diagram; 47 X 5 mm; good condition; natural color. | 1 | - | 17'6" from datum A; 7'4" from datum B. |
| - | - | Bc 58 35/6 | Wood; 3 log sections; July 17, 1947; 1) 266mm-57mm-44mm; 2) 390mm-55mm-47mm; 3) 262mm-60mm-29mm; fair, dark brown | 3 | - | From bottom of ventilator shaft |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| - | - | Bc 58 10/7 | Pottery; medium size bowl; black-on-white; pieces missing; design paint; bottom missing; PII; Ht 4 1/4", Di 7 1/2"; 187 mm in diameter; not very good condition; black-on-white. | 1 | - | Unspecified |
| - | - | Bc 58 10/8 | Pottery; small size bowl, black-on-white; pieces missing, evidence of handle on one side; perhaps a ladle; PII escavada; Ht 2 1/2", max Di 5"; fair condition; design worn; black-on-white. | 1 | - | Unspecified |
| - | - | Bc 58 20/42 | Worked stone (scrapper) [scraper]; see sketch-no significant features; 48 mm/length, 35 mm/width; thickness: 9mm; good condition. | 1 | - | "No other data." |
| - | - | Bc 58 10/4 | Pottery; bowl, black-on-white; interior decorations; reconstructed; PII; Ht.4", Di 8 1/4"; 212 mm diameter X 100 mm deep; poor condition; black-on-white. | 1 | - | 6"-S.E. corner, 70"-N.E. corner; 29"- top of E. wall. |

| Provenience | Provenience Level | Field Catalog # | Field Catalog Description | Count | Museum Description | Field Provenience |
|---|---|---|---|---|---|---|
| - | - | Bc 58 20/49 | Turquoiuse chip; one very small chip; 1 mm X 4 mm; good condition; blue color. | 1 | - | 64" from SW corner; 39" from SE corner; 40" from top of south wall; 2nd & 3rd floor levels. |
| - | - | Bc 58 35/3 | Charcoal; July 7, 1947; 39x19mm; fair | 1 | - | In fill; Kiva I |
| - | - | Bc 58 30/5 | Unidentified material; 4 beads; fair condition; A. white bead 5 mm X 2 mm, B. 5 mm X 2 mm; A. Grey bead 6 mm X 3 mm, B. 6 mm X 3 mm; | 4 | - | Refuse Area 1; west facing of mound; 41" below top of datum pt.; 22". |

# APPENDIX B: ARTIODACTYL MNE, MAU, AND %MAU

| Element | Early Bonito | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Deer | | | Pronghorn | | | Bighorn | | |
| | MNE | MAU | %MAU | MNE | MAU | %MAU | MNE | MAU | %MAU |
| Horn Cores | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranial Bones | 1.0 | 0.5 | 20.0 | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 |
| Mandibular Bones | 0.0 | 0.0 | 0.0 | 3.0 | 1.5 | 75.0 | 0.0 | 0.0 | 0.0 |
| Atlas | 1.0 | 1.0 | 40.0 | 2.0 | 2.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| Axis | 1.0 | 1.0 | 40.0 | 2.0 | 2.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| Cervical | 6.0 | 1.2 | 48.0 | 6.0 | 1.2 | 60.0 | 2.0 | 0.4 | 70.0 |
| Thoracic | 7.0 | 0.5 | 21.5 | 5.0 | 0.4 | 19.2 | 1.0 | 0.1 | 13.5 |
| Lumbar | 2.0 | 0.3 | 11.4 | 3.0 | 0.4 | 21.4 | 4.0 | 0.6 | 100.0 |
| Rib | 8.0 | 0.3 | 12.3 | 4.0 | 0.2 | 7.7 | 0.0 | 0.0 | 0.0 |
| Sternebra | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Scapula | 2.0 | 1.0 | 40.0 | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 87.5 |
| Proximal Humerus | 0.0 | 0.0 | 0.0 | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 |
| Distal Humerus | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 |
| Proximal Radius | 1.0 | 0.5 | 20.0 | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 87.5 |
| Distal Radius | 2.0 | 1.0 | 40.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 87.5 |
| Carpals | 1.0 | 0.5 | 20.0 | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 |
| Proximal Metacarpal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metacarpal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 87.5 |
| Pelvis | 5.0 | 2.5 | 100.0 | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 87.5 |
| Proximal Femur | 3.0 | 1.5 | 60.0 | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 |
| Distal Femur | 3.0 | 1.5 | 60.0 | 4.0 | 2.0 | 100.0 | 1.0 | 0.5 | 87.5 |
| Proximal Tibia | 3.0 | 1.5 | 60.0 | 3.0 | 1.5 | 75.0 | 1.0 | 0.5 | 87.5 |
| Distal Tibia | 2.0 | 1.0 | 40.0 | 3.0 | 1.5 | 75.0 | 0.0 | 0.0 | 0.0 |
| Astragalus | 3.0 | 1.5 | 60.0 | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 87.5 |
| Calcaneum | 2.0 | 1.0 | 40.0 | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 |
| Proximal Metatarsal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 87.5 |
| Distal Metatarsal | 3.0 | 1.5 | 60.0 | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 |
| 1st Phalanx | 2.0 | 0.3 | 10.0 | 1.0 | 0.1 | 6.3 | 1.0 | 0.1 | 21.9 |
| 2nd Phalanx | 1.0 | 0.1 | 5.0 | 2.0 | 0.3 | 12.5 | 0.0 | 0.0 | 0.0 |
| 3rd Phalanx | 0.0 | 0.0 | 0.0 | 2.0 | 0.3 | 12.5 | 0.0 | 0.0 | 0.0 |

Table B.1: Early Bonito MNE, MAU, and %MAU values for artiodactyl species at Bc 57.

| Element | Classic Bonito | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Deer | | | Pronghorn | | | Bighorn | | |
| | MNE | MAU | %MAU | MNE | MAU | %MAU | MNE | MAU | %MAU |
| Horn Cores | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranial Bones | 1.0 | 0.5 | 20.0 | 1.0 | 0.5 | 16.7 | 0.0 | 0.0 | 0.0 |
| Mandibular Bones | 3.0 | 1.5 | 60.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Atlas | 0.0 | 0.0 | 0.0 | 3.0 | 3.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| Axis | 1.0 | 1.0 | 40.0 | 1.0 | 1.0 | 33.3 | 0.0 | 0.0 | 0.0 |
| Cervical | 1.0 | 0.2 | 8.0 | 3.0 | 0.6 | 20.0 | 1.0 | 0.2 | 40.0 |
| Thoracic | 3.0 | 0.2 | 9.2 | 8.0 | 0.6 | 20.5 | 3.0 | 0.2 | 46.2 |
| Lumbar | 3.0 | 0.4 | 17.1 | 5.0 | 0.7 | 23.8 | 0.0 | 0.0 | 0.0 |
| Rib | 0.0 | 0.0 | 0.0 | 2.0 | 0.1 | 2.6 | 0.0 | 0.0 | 0.0 |
| Sternebra | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Scapula | 1.0 | 0.5 | 20.0 | 5.0 | 2.5 | 83.3 | 0.0 | 0.0 | 0.0 |
| Proximal Humerus | 0.0 | 0.0 | 0.0 | 2.0 | 1.0 | 33.3 | 0.0 | 0.0 | 0.0 |
| Distal Humerus | 0.0 | 0.0 | 0.0 | 2.0 | 1.0 | 33.3 | 0.0 | 0.0 | 0.0 |
| Proximal Radius | 1.0 | 0.5 | 20.0 | 2.0 | 1.0 | 33.3 | 0.0 | 0.0 | 0.0 |
| Distal Radius | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Carpals | 1.0 | 0.5 | 20.0 | 1.0 | 0.5 | 16.7 | 0.0 | 0.0 | 0.0 |
| Proximal Metacarpal | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metacarpal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pelvis | 3.0 | 1.5 | 60.0 | 3.0 | 1.5 | 50.0 | 1.0 | 0.5 | 100.0 |
| Proximal Femur | 2.0 | 1.0 | 40.0 | 4.0 | 2.0 | 66.7 | 1.0 | 0.5 | 100.0 |
| Distal Femur | 4.0 | 2.0 | 80.0 | 3.0 | 1.5 | 50.0 | 0.0 | 0.0 | 0.0 |
| Proximal Tibia | 2.0 | 1.0 | 40.0 | 3.0 | 1.5 | 50.0 | 0.0 | 0.0 | 0.0 |
| Distal Tibia | 5.0 | 2.5 | 100.0 | 5.0 | 2.5 | 83.3 | 0.0 | 0.0 | 0.0 |
| Astragalus | 3.0 | 1.5 | 60.0 | 3.0 | 1.5 | 50.0 | 0.0 | 0.0 | 0.0 |
| Calcaneum | 4.0 | 2.0 | 80.0 | 2.0 | 1.0 | 33.3 | 1.0 | 0.5 | 100.0 |
| Proximal Metatarsal | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metatarsal | 0.0 | 0.0 | 0.0 | 2.0 | 1.0 | 33.3 | 0.0 | 0.0 | 0.0 |
| 1st Phalanx | 6.0 | 0.8 | 30.0 | 7.0 | 0.9 | 29.2 | 1.0 | 0.1 | 25.0 |
| 2nd Phalanx | 1.0 | 0.1 | 5.0 | 2.0 | 0.3 | 8.3 | 0.0 | 0.0 | 0.0 |
| 3rd Phalanx | 1.0 | 0.1 | 5.0 | 4.0 | 0.5 | 16.7 | 0.0 | 0.0 | 0.0 |

Table B.2: Classic Bonito MNE, MAU, and %MAU values for artiodactyl species at Bc 57.

| Element | Late Bonito | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Deer | | | Pronghorn | | | Bighorn | | |
| | MNE | MAU | %MAU | MNE | MAU | %MAU | MNE | MAU | %MAU |
| Horn Cores | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| Cranial Bones | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| Mandibular Bones | 1.0 | 0.5 | 25.0 | 3.0 | 1.5 | 60.0 | 0.0 | 0.0 | 0.0 |
| Atlas | 2.0 | 2.0 | 100.0 | 2.0 | 2.0 | 80.0 | 0.0 | 0.0 | 0.0 |
| Axis | 1.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cervical | 2.0 | 0.4 | 20.0 | 8.0 | 1.6 | 64.0 | 0.0 | 0.0 | 0.0 |
| Thoracic | 7.0 | 0.5 | 26.9 | 15.0 | 1.2 | 46.2 | 0.0 | 0.0 | 0.0 |
| Lumbar | 5.0 | 0.7 | 35.7 | 8.0 | 1.1 | 45.7 | 1.0 | 0.1 | 28.6 |
| Rib | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sternebra | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Scapula | 0.0 | 0.0 | 0.0 | 3.0 | 1.5 | 60.0 | 0.0 | 0.0 | 0.0 |
| Proximal Humerus | 1.0 | 0.5 | 25.0 | 3.0 | 1.5 | 60.0 | 0.0 | 0.0 | 0.0 |
| Distal Humerus | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| Proximal Radius | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| Distal Radius | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| Carpals | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Metacarpal | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| Distal Metacarpal | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pelvis | 1.0 | 0.5 | 25.0 | 3.0 | 1.5 | 60.0 | 1.0 | 0.5 | 100.0 |
| Proximal Femur | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 20.0 | 1.0 | 0.5 | 100.0 |
| Distal Femur | 3.0 | 1.5 | 75.0 | 2.0 | 1.0 | 40.0 | 0.0 | 0.0 | 0.0 |
| Proximal Tibia | 1.0 | 0.5 | 25.0 | 5.0 | 2.5 | 100.0 | 0.0 | 0.0 | 0.0 |
| Distal Tibia | 2.0 | 1.0 | 50.0 | 4.0 | 2.0 | 80.0 | 0.0 | 0.0 | 0.0 |
| Astragalus | 0.0 | 0.0 | 0.0 | 2.0 | 1.0 | 40.0 | 0.0 | 0.0 | 0.0 |
| Calcaneum | 0.0 | 0.0 | 0.0 | 3.0 | 1.5 | 60.0 | 0.0 | 0.0 | 0.0 |
| Proximal Metatarsal | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 20.0 | 1.0 | 0.5 | 100.0 |
| Distal Metatarsal | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| 1st Phalanx | 4.0 | 0.5 | 25.0 | 5.0 | 0.6 | 25.0 | 0.0 | 0.0 | 0.0 |
| 2nd Phalanx | 4.0 | 0.5 | 25.0 | 4.0 | 0.5 | 20.0 | 0.0 | 0.0 | 0.0 |
| 3rd Phalanx | 2.0 | 0.3 | 12.5 | 6.0 | 0.8 | 30.0 | 0.0 | 0.0 | 0.0 |

Table B.3: Late Bonito MNE, MAU, and %MAU values for artiodactyl species at Bc 57.

| Bc 58 - Classic Bonito | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Element** | **Deer** | | | **Pronghorn** | | | **Bighorn** | | |
| | MNE | MAU | %MAU | MNE | MAU | %MAU | MNE | MAU | %MAU |
| Horn Cores | 4.0 | 2.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranial Bones | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 50.0 |
| Mandibular Bones | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Atlas | 2.0 | 2.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Axis | 2.0 | 2.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cervical | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.4 | 40.0 |
| Thoracic | 6.0 | 0.5 | 23.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lumbar | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rib | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sternebra | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Scapula | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Humerus | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Humerus | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Radius | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Radius | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Carpals | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 50.0 |
| Proximal Metacarpal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metacarpal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pelvis | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 2.0 | 1.0 | 100.0 |
| Proximal Femur | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Femur | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Tibia | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Tibia | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Astragalus | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Calcaneum | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Metatarsal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metatarsal | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1st Phalanx | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2nd Phalanx | 1.0 | 0.1 | 6.3 | 1.0 | 0.1 | 100.0 | 0.0 | 0.0 | 0.0 |
| 3rd Phalanx | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Table B.4: Classic Bonito MNE, MAU, and %MAU values for artiodactyl species at Bc 58.

| Element | 29SJ 627 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Deer | | | Pronghorn | | | Bighorn | | |
| | MNE | MAU | %MAU | MNE | MAU | %MAU | MNE | MAU | %MAU |
| Horn Cores | 2.0 | 1.0 | 22.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranial Bones | 2.0 | 1.0 | 22.2 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 16.7 |
| Mandibular Bones | 1.0 | 0.5 | 11.1 | 2.0 | 1.0 | 42.1 | 0.0 | 0.0 | 0.0 |
| Atlas | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Axis | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 3.0 | 100.0 |
| Cervical | 1.0 | 0.2 | 4.4 | 0.0 | 0.0 | 0.0 | 1.0 | 0.2 | 6.7 |
| Thoracic | 4.0 | 0.3 | 6.8 | 1.0 | 0.1 | 3.2 | 0.0 | 0.0 | 0.0 |
| Lumbar | 8.0 | 1.1 | 25.4 | 0.0 | 0.0 | 0.0 | 1.0 | 0.1 | 4.8 |
| Rib | 4.0 | 0.2 | 3.4 | 1.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 |
| Sternebra | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Scapula | 4.0 | 2.0 | 44.4 | 1.0 | 0.5 | 21.1 | 2.0 | 1.0 | 33.3 |
| Proximal Humerus | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 21.1 | 0.0 | 0.0 | 0.0 |
| Distal Humerus | 3.0 | 1.5 | 33.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Radius | 2.0 | 1.0 | 22.2 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 16.7 |
| Distal Radius | 2.0 | 1.0 | 22.2 | 1.0 | 0.5 | 21.1 | 0.0 | 0.0 | 0.0 |
| Carpals | 2.0 | 1.0 | 22.2 | 2.0 | 1.0 | 42.1 | 2.0 | 1.0 | 33.3 |
| Proximal Metacarpal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metacarpal | 1.0 | 0.5 | 11.1 | 2.0 | 1.0 | 42.1 | 0.0 | 0.0 | 0.0 |
| Pelvis | 5.0 | 2.5 | 55.6 | 0.0 | 0.0 | 0.0 | 2.0 | 1.0 | 33.3 |
| Proximal Femur | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Femur | 3.0 | 1.5 | 33.3 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 16.7 |
| Proximal Tibia | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 21.1 | 1.0 | 0.5 | 16.7 |
| Distal Tibia | 5.0 | 2.5 | 55.6 | 1.0 | 0.5 | 21.1 | 0.0 | 0.0 | 0.0 |
| Astragalus | 9.0 | 4.5 | 100.0 | 3.0 | 1.5 | 63.2 | 1.0 | 0.5 | 16.7 |
| Calcaneum | 6.0 | 3.0 | 66.7 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 16.7 |
| Proximal Metatarsal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metatarsal | 3.0 | 1.5 | 33.3 | 1.0 | 0.5 | 21.1 | 0.0 | 0.0 | 0.0 |
| 1st Phalanx | 29.0 | 3.6 | 80.6 | 19.0 | 2.4 | 100.0 | 0.0 | 0.0 | 0.0 |
| 2nd Phalanx | 25.0 | 3.1 | 69.4 | 4.0 | 0.5 | 21.1 | 1.0 | 0.1 | 4.2 |
| 3rd Phalanx | 20.0 | 2.5 | 55.6 | 9.0 | 1.1 | 47.4 | 0.0 | 0.0 | 0.0 |

Table B.5: MNE, MAU, and %MAU values for artiodactyl species at 29SJ 627.[13]

[13] Although Akins (1992:324) reported an *Ovis canadensis* (bighorn sheep) NISP of 73 at site 29SJ 627, only 49 specimens could be located in the collections at the Museum of Collections of Chaco Canyon NHP by the author and collections manager Wendy Bustard; 48 specimens were listed in the existing faunal

| Element | Deer | | | Pronghorn | | | Bighorn | | |
|---|---|---|---|---|---|---|---|---|---|
| | **29SJ 629** | | | | | | | | |
| | MNE | MAU | %MAU | MNE | MAU | %MAU | MNE | MAU | %MAU |
| Horn Cores | 4.0 | 2.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranial Bones | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mandibular Bones | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Atlas | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Axis | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cervical | 1.0 | 0.2 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Thoracic | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.2 | 15.4 |
| Lumbar | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rib | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sternebra | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Scapula | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 100.0 | 2.0 | 1.0 | 100.0 |
| Proximal Humerus | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Humerus | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Radius | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Radius | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 100.0 | 0.0 | 0.0 | 0.0 |
| Carpals | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Metacarpal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metacarpal | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 100.0 | 1.0 | 0.5 | 50.0 |
| Pelvis | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Femur | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Femur | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proximal Tibia | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Tibia | 1.0 | 0.5 | 25.0 | 1.0 | 0.5 | 100.0 | 0.0 | 0.0 | 0.0 |
| Astragalus | 2.0 | 1.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Calcaneum | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.5 | 50.0 |
| Proximal Metatarsal | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distal Metatarsal | 1.0 | 0.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1st Phalanx | 1.0 | 0.1 | 6.3 | 3.0 | 0.4 | 75.0 | 0.0 | 0.0 | 0.0 |
| 2nd Phalanx | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3rd Phalanx | 1.0 | 0.1 | 6.3 | 1.0 | 0.1 | 25.0 | 0.0 | 0.0 | 0.0 |

Table B.6: MNE, MAU, and %MAU values for artiodactyl species at 29SJ 629.

database. The source of the discrepancy could not be identified but the possibility exists that the bighorn sheep assemblage analyzed here is incomplete.

# APPENDIX C: RITUAL AND DIVERSITY OF RARE TAXA

As discussed in Chapter Three, the Pueblo ethnographic record provides clues for identifying potential archaeological markers of social differentiation. Among the Hopi, access to political positions is predicated upon ownership of ceremonial office and is thus limited to those *pavansinom* lineage segments. The potential material correlates of this ritual order might include totemic objects associated with core lineage segments. Employing direct analogy, evidence within domestic structures for altar pieces, such as figurines, polished stones, basketry, prayer sticks, and decorated and carved wooden implements and masks would be the strongest evidence for social differentiation. The rich deposit of painted wood recovered from Chetro Ketl in Chaco Canyon is one potential example (Vivian et al. 1978).

Ritual use of animals is another behavior that may reflect social differentiation. At Jemez Pueblo, Parsons (1925:68) observed that eagles are kept caged at the homes of the Eagle hunt society chiefs and their sons. Otherwise these birds are sacrificed by society members after a four-day vigil and their feathers distributed to other members of the pueblo in exchange for food offerings. Similarly, prayer sticks or "tied feathers" can only be obtained by lay people from society members (Parsons 1925:100-102). Access to carnivores is likewise the exclusive province of the Arrowhead, Fire, and Mountain Lion societies at Jemez (Parsons 1925:62, 102). Comparable restrictions governing the ceremonial handling of bear and mountain lion carcasses were observed at Zia Pueblo and upon completion of all necessary rites the final step entailed burial of the animals' remains at a designated shrine (White 1962:177-182). Thus when the remains of rare species such as bobcat or eagle are encountered archaeologically, one possible inference is that they reflect the sodality-specific ritual practices.

As previously noted, social differentiation frequently covaries with the extent of political centralization in nonstate societies. I hypothesize that increasing political centralization in Chaco Canyon is positively correlated with an increase in the frequency and diversity of ritually important, non-dietary species reflecting the elaboration of ceremonies and the proliferation of ritual practitioners.

References to ritual use of animals and social differentiation abound in the Pueblo ethnographic record. For instance at Jemez Pueblo, caging and sacrifice of eagles is restricted to members of the Eagle hunt society and “tied feathers” or prayer sticks important to the completion of many rituals can only be obtained by lay people from society members Parsons (1925:68, 100-102). Similarly, access to carnivores is the domain of the Arrowhead, Fire, and Mountain Lion societies Jemez (Parsons 1925:62, 102). White (1962:177-182) observed parallel restrictions related to the ritual handling of bear and mountain lion carcasses at Zia Pueblo and noted that the manner in which remains were disposed was vital to performance of the rite. Therefore rare species such as wild birds and carnivores encountered archaeologically may reflect differentiation in the form of the sodality or ceremonial societies.

The decision to examine diversity of bird species is a potentially problematic one since most or all species consumed were almost certainly imbued with symbolic importance. However, based on ethnographic and archaeological evidence, some species were more commonly utilized in ritual contexts than others. Wild bird species, raptors in particular, as well as carnivores such as bobcat, badger, and wolf can reliably be classified as ritually significant species even if they were also consumed on occasion. Other species such as dog or turkey were likely consumed on a regular basis but were also likely important to ceremonial practices (Fowles 2005:110-113; Hill 2000; McKusick 1986; Olsen 1990:110; Schwartz 1997:57; Sutton and Reinhard 1995:748). Further complicating matters, the role of some species such as turkeys evolved through time, shifting from one of ritual importance to that of an important food source and raw material for tool and ornament manufacture (Breitburg 1988; Hargrave 1965:161; McKusick 1986; Windes 1987c:686).

Given the expectation of increasing political complexity established in Chapter Three the elaboration of ritual and a proliferation of ceremonial specialists should in turn be reflected in a growing emphasis on procurement of animal taxa of ritual significance but comparatively little dietary importance. This trend is predicted to result in an increase in the frequency and diversity of these rare taxa. Based on ethnographic accounts, such species likely included raptors such as eagles, hawks, and owls, and carnivores such as bobcat, coyote, and wolf. Employing measures of richness, diversity, and evenness, this analysis will evaluate temporal trends in the frequency of these rare species.

Turning first to the question of temporal trends in rituality, this analysis entailed an exploration of richness, diversity, and evenness of ritually significant species at Bc 57.[14] Richness increases with sample size but attempting to control for sample size effects was deemed inappropriate in this instance. Plog and Hegmon (1993:490) have

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[14] The Bc 58 sample size was deemed too small to yield accurate results in this analysis. Only two probable non-dietary species, bobcat and red-tailed hawk were identified in Classic Bonito deposits at Bc 58.

cautioned against controlling for sample size when prehistoric behavior rather than sampling is responsible for sample size differences. Given that the archaeological units in question were fully excavated during a single field season by a single team the differences are more likely attributable to behavior by the site's inhabitants.

No single measure is likely to capture fluctuations in ritual use of fauna. Rather multiple measures that include overall frequency, richness, diversity, and evenness are tools that together can be employed to better characterize the changing use of rare taxa through time. As tempting as it might be to simply equate a rise in diversity of ritual species with increasing ritual activity, in reality the relationship is probably not as straightforward. An example will clarify. Given two assemblages of equal species richness and equal overall frequency where one sample exhibits a roughly even distribution of species and where the other includes one disproportionately common ritual species, there is no basis upon which to characterize one assemblage as more or less consistent with the growing frequency of ritual. Since diversity indices measure the variance of a species abundance distribution, the more evenly distributed assemblage will produce *higher* diversity and evenness values while the less evenly distributed sample will yield *lower* diversity and evenness values.

The alternative – the inclusion of a complete faunal assemblage – would yield results subject to the influence of both procurement strategies and ritual demands making interpretation difficult. For instance, Fisher (2010:17) has predicted that the diversity of species will vary as a function of hunting strategy, where prioritization of net energetic returns would result in high diversity and hunting motivated by attempts at costly signaling would target specific prey-types, thus resulting in lower taxonomic diversity.

Moreover, resource stress may be a driving factor behind diversification (Dean 2007a; Redding 1988). Therefore common subsistence species such as artiodactyls, leporids, turkey, and dog were excluded from the analysis.

Table C.1: Richness, evenness, and diversity of non-subsistence/ritual species at Bc 57 by time period.

| | Taxon | | | |
|---|---|---|---|---|
| **Period** | **Richness** | **Evenness (Simpson's $E_{1/D}$)** | **Diversity (Simpson's *D*)** | **n** |
| Bc 57 - Early Bonito | 10 | 0.16 | 1.58 | 82 |
| Bc 57 - Classic Bonito | 7 | 0.69 | 4.80 | 16 |
| Bc 57 - Late Bonito | 8 | 0.53 | 4.23 | 25 |

Simpson's index (*D)* is "one of the most meaningful and robust diversity measures available," accurately capturing the variance of a species abundance distribution (Magurran 2004:115). As *D* increases, diversity decreases and thus measure is often expressed as 1-*D* or 1/*D* so that the result increases with diversity (Equation C.1). The reciprocal form (1/*D*) along with Simpson's measure of evenness ($E_{1/D}$) and species richness were employed here to assess diversity (Equation C.2). Although May (1975:100) noted that high and low index values are more heavily influenced by the underlying species abundance distribution when species richness exceeds ten, this was not the case in this analysis and confidence limits were not applied.

The Shannon index is a diversity measure of surprising long-term durability despite its many shortcomings (Magurran 2004:106-107). Given the popularity of the method a brief explanation for its absence from this analysis is warranted. The Shannon index assumes that individuals are randomly sampled from an infinitely large community and that all species are represented in the population. Since an archaeofaunal assemblage often reflects an accumulation of species captured in a variety of geographically disparate patches over a potentially long duration, the latter assumption is not necessarily warranted. Thus the Shannon index is of questionable utility in an archaeological setting. Further, Magurran (2004:108) noted that the measure's range of potential outcomes is "narrowly constrained" thus making interpretation difficult.

$$D - \sum \left( \frac{n_i\,[n_i - 1]}{N\,[N - 1]} \right)$$

where:

$D$ = Simpson's index
$n_i$ = number of individuals in the $i$th species
N = total number of individuals

Equation C.1: Simpson's index (D).

$$E_{1/D} = \frac{\left({}^{1}/_{\mathrm{D}}\right)}{\mathrm{S}}$$

where:

$D$ = Simpson's index
S = number of species in sample

Equation C.2: Simpson's measure of evenness ($E_{1/D}$).

Table C.2: Frequency (NISP) of non-subsistence/ritual species at Bc 57 and Bc 58.

| Time Period | Taxon | NISP |
|---|---|---|
| Bc 57 - Early Bonito | *Aquila chrysaetos* (golden eagle) | 1 |
| | *Buteo jamaicensis* (red-tailed hawk) | 2 |
| | *Buteo regalis* (ferruginous hawk) | 2 |
| | *Canis latrans* (coyote) | 1 |
| | *Corvus corax* (common raven) | 65 |
| | *Lynx rufus* (bobcat) | 6 |
| | *Megascops kennicottii* (western screech owl) | 1 |
| | *Ptychocheilus lucius* (Colorado pikeminnow) | 1 |
| | *Taxidea taxus* (American Badger) | 1 |
| | *Urocyon cinereoargenteus* (common gray fox) | 2 |
| Bc 57 - Classic Bonito | *Aquila chrysaetos* (golden eagle) | 3 |
| | *Buteo jamaicensis* (red-tailed hawk) | 2 |
| | *Buteo lagopus* (rough-legged hawk) | 1 |
| | *Buteo regalis* (ferruginous hawk) | 1 |
| | *Callipepla squamata* (scaled quail) | 1 |
| | *Falco mexicanus* (prairie falcon) | 1 |
| | *Lynx rufus* (bobcat) | 7 |
| Bc 57 - Late Bonito | *Accipiter cooperii* (Cooper's hawk) | 1 |
| | *Aquila chrysaetos* (golden eagle) | 4 |
| | *Bubo virginianus* (great horned owl) | 1 |
| | *Callipepla squamata* (scaled quail) | 1 |
| | *Canis lupus* (gray wolf) | 1 |
| | *Corvus corax* (common raven) | 5 |
| | *Lynx rufus* (bobcat) | 11 |
| | *Taxidea taxus* (American badger) | 1 |
| Bc 58 - Classic Bonito | *Buteo jamaicensis* (red-tailed hawk) | 2 |
| | *Lynx rufus* (bobcat) | 1 |

As illustrated in Table C.1, species richness is highest during Early Bonito, declining slightly during Classic Bonito and remained relatively steady through the Late Bonito subphase. Overall, the concentration of rare taxa is by far the greatest during Early Bonito. Both species diversity and evenness were relatively low during Early

Bonito, increased dramatically during the Classic Bonito subphase, and then declined slightly during the subsequent period.

Comparison of rank/abundance plots (Figure C.1) for the Early, Classic, and Late Bonito subphases using Kolmogorov-Smirnov two-sample tests (Sokal and Rohlf 1995:440-445) determined that differences in underlying species abundance distributions were not significant. However, the test is a conservative one and given the small sample sizes, the lack of a significant result is unsurprising.

The lower Early Bonito diversity and evenness index values appear to be an artifact of the overwhelming dominance of raven remains among these deposits (Table C.2). Sixty-five specimens representing at least three individuals were identified as common raven in the Early Bonito assemblage from Bc 57. Lower diversity values here reflect the more intensive use of one particular species. As noted above, at least one of the raven individuals represented displays numerous cut-marks indicative of skinning and dismemberment. While this may reflect culinary processing, several points addressed in Chapter Five including widespread ethnographic accounts of the importance of raven feathers and the potential evidence for captive ravens elsewhere at Bc 57 suggest that the species held substantial ritual importance.

Interestingly, the Early Bonito deposits at Bc 57 provide the strongest evidence for use of ritually important species. That raven remains were also most common among Early Bonito contexts at Pueblo Alto implies a degree of consistency in ritual practices between the former and Bc 57. The apparent continuity in types of ritual taxa procured evinces the long-term stability of ceremonial practices throughout the Bonito phase at Bc 57. It should be noted that the concentration of ritual taxa at Bc 57 is not altogether unlike the pattern observed at 29SJ 627 (Akins 1992). When the concentration of raven remains is removed from the samples, the percent NISP of wild birds at Bc 57 (0.44%) is comparable to that of site 627 (0.49%).

Analysis of species richness and diversity provided the strongest indications for use of ritually important species during the Early Bonito subphase at Bc 57. However, there was no pronounced temporal shift in ritual taxa. Rather the pattern reflects temporal continuity in the species procured, attesting to the long-term stability of ritual practices at Bc 57.

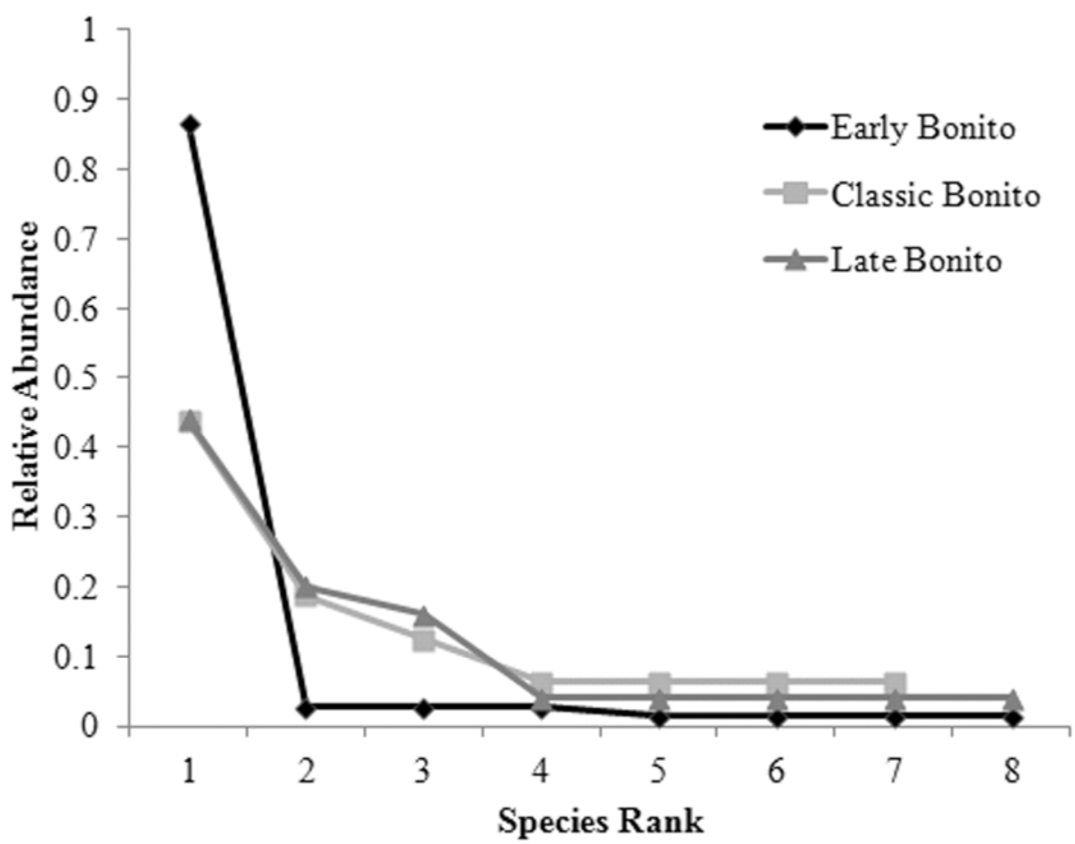


Figure C.1: Rank/abundance plot for non-subsistence/ritual species among Early, Classic, and Late Bonito deposits at Bc 57.

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