DETERMINING THE MOBILITY OF THE INHABITANTS AT DUNLAP-SALAZAR THROUGH ANALYSIS OF LITHIC RAW MATERIALS

by

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ABSTRACT

This study examines the development of village life amongst Native American populations in the prehistoric (1st millennium A.D.) southwestern United States. Early inhabitants of the area practiced a mobile way of life, leaving very little architecture in the archaeological record. Like other people throughout the world, many Native Americans transitioned to a more sedentary way of life. In the southwest, this initially consisted of living in semi-subterranean "pithouses," although the degree to which pithouse sites represent true sedentary villages is debated. Eventually, village formation culminated with the unquestionably sedentary pueblo way of life. The continuum that incorporates the changeover from a mobile way of life to a sedentary way of life in the southwest is known as the pithouse to pueblo transition.

This study aims to assess the degree of mobility of the people who lived at the Dunlap-Salazar pithouse site in Lincoln County, New Mexico which has been radiocarbon dated from 550-850 A.D. I use the relative percentage of local, regional, and long distance materials and of high quality chert as measures of lithic procurement strategies, and this indirectly mobility. First, I analyzed the stone debitage, waste material broken off during the manufacture of stone tools and discarded, to determine what raw materials were used to make the stone tools. I then located the possible sources

of these raw materials based on geologic records and maps to record the distances from these sources to Dunlap-Salazar. The distances represent how far Dunlap-Salazar occupants traveled to get the raw materials and show the percentage of local, regional, and long distance raw materials used. This, in turn, showed me the degree of mobility practiced by the Dunlap-Salazar inhabitants. Comparing these values against earlier (Archaic) and later (Pueblo) occupations across the Formative boundary, it is evident that Dunlap-Salazar, and pithouse settlements in general, fit a trend for an overall decrease in mobility over time but retained a significant level of mobility.

Chapter 1

INTRODUCTION

This study examines the development of village life among Native American populations in the prehistoric (1st millennium A.D.) southwestern United States. The rise of village life is a worldwide phenomenon, representing one of the fundamental cultural transformations in prehistory. Prior to village formation, most populations utilized a hunter-gatherer way of life which is usually marked by social fluidity and high mobility. At the opposite end of the spectrum, many populations became heavily agriculturally dependent, embraced town or city life, sedentary, and formed complex polities in order to regulate society. My research focuses on the intermediate phase of these two extremes, the initial stages of village formation, in order to better understand the changing economic, social, and political relations that are associated with the cultural adaptation of village life.

My study concentrates on one specific but critical aspect of the development of villages: the shift to sedentism. I quantify the relative percentages of stone debris (debitage) raw materials and sort them according to their origins (local, regional, or distant source areas). By doing so, I examine the lithic procurement strategies, and thus indirectly the mobility, of the inhabitants of the Dunlap-Salazar site, an early village, or proto-village in prehistoric New Mexico. Measuring to what degree the Dunlap-Salazar inhabitants were mobile is one way to determine whether the cluster of pithouses that make up the site represent a full blown village, or some sort of transitional, more fluid and semi-sedentary community in the process of becoming a true village.

Archaeology is a well suited discipline for studying village formation because it allows examination of the periods in which cultures were first experimenting with settled village life. Unlike modern and historic groups, where a wealth of written and observable information is available, we have no primary or firsthand accounts of prehistoric groups. We do, however, have material remains left by prehistoric inhabitants which we can use to make inferences about their cultures. Archaeology uses these remains to measure and better understand cultural processes. In the present case, it allows me to examine whether the Dunlap-Salazar inhabitants were traveling regularly over long distances, a pattern that undermines village cohesion and is characteristic of nomadic groups, or were restricting their mobility in a way typical of sedentary village dwellers. Partially due to it's long history of research and in part due to its good conditions for material preservation, the American Southwest is an ideal environment for examining the processes associated with the transition to village life.

Central to my study are data from the Dunlap-Salazar site, a pithouse settlement located in southeastern New Mexico. The presence of botanical remains and pithouses indicates that the inhabitants practiced agriculture and had invested in substantial housing. Dunlap-Salazar dates to a period in the second half of the 1st millennium AD that is characterized by large scale change throughout the Southwest. In particular, villages were appearing in many locations across the region, but in variable ways and at unequal rates. Prior to the occupation of Dunlap-Salazar, agriculture was practiced in

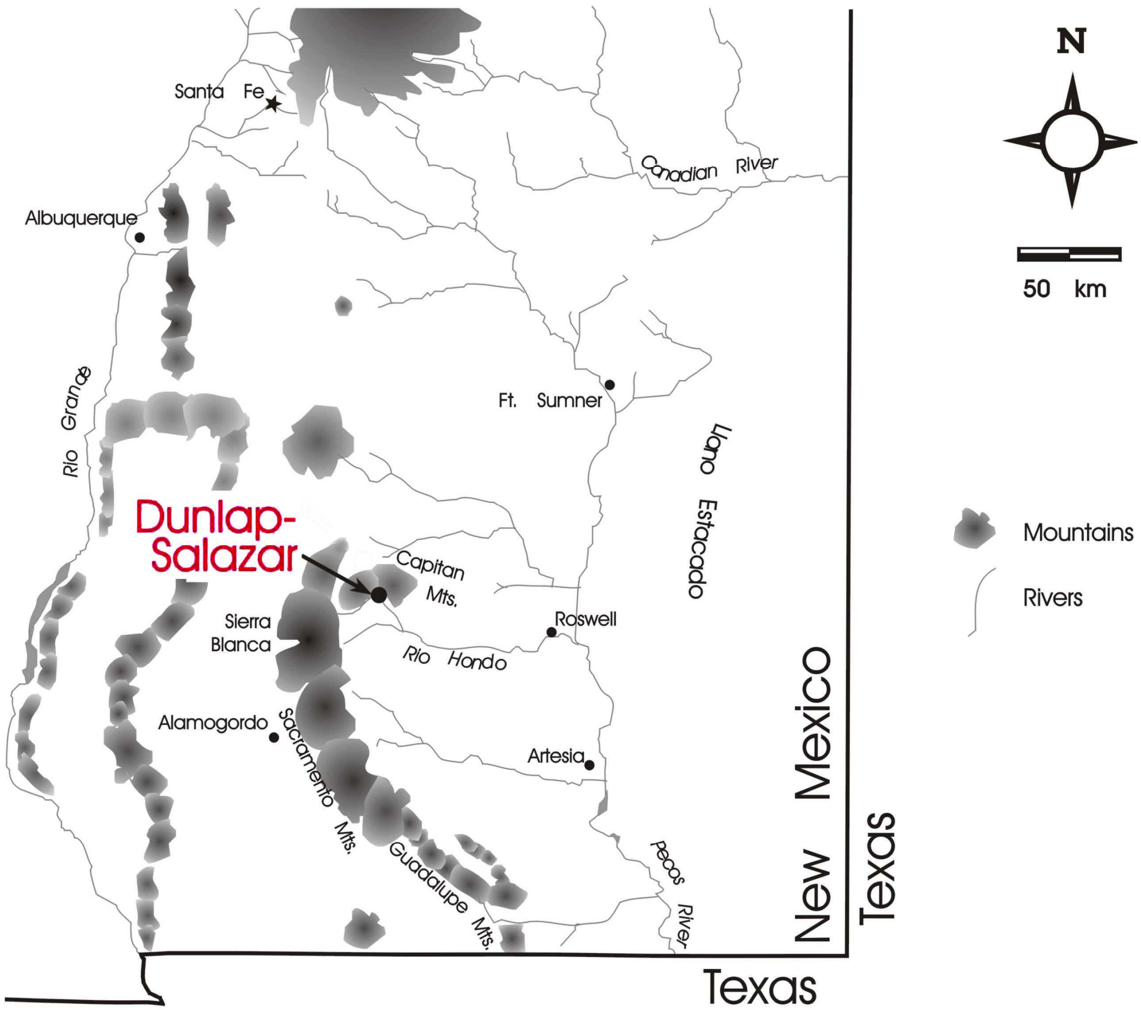

Figure 1: Location of the Dunlap-Salazar site (Taken from Rocek [1995]).

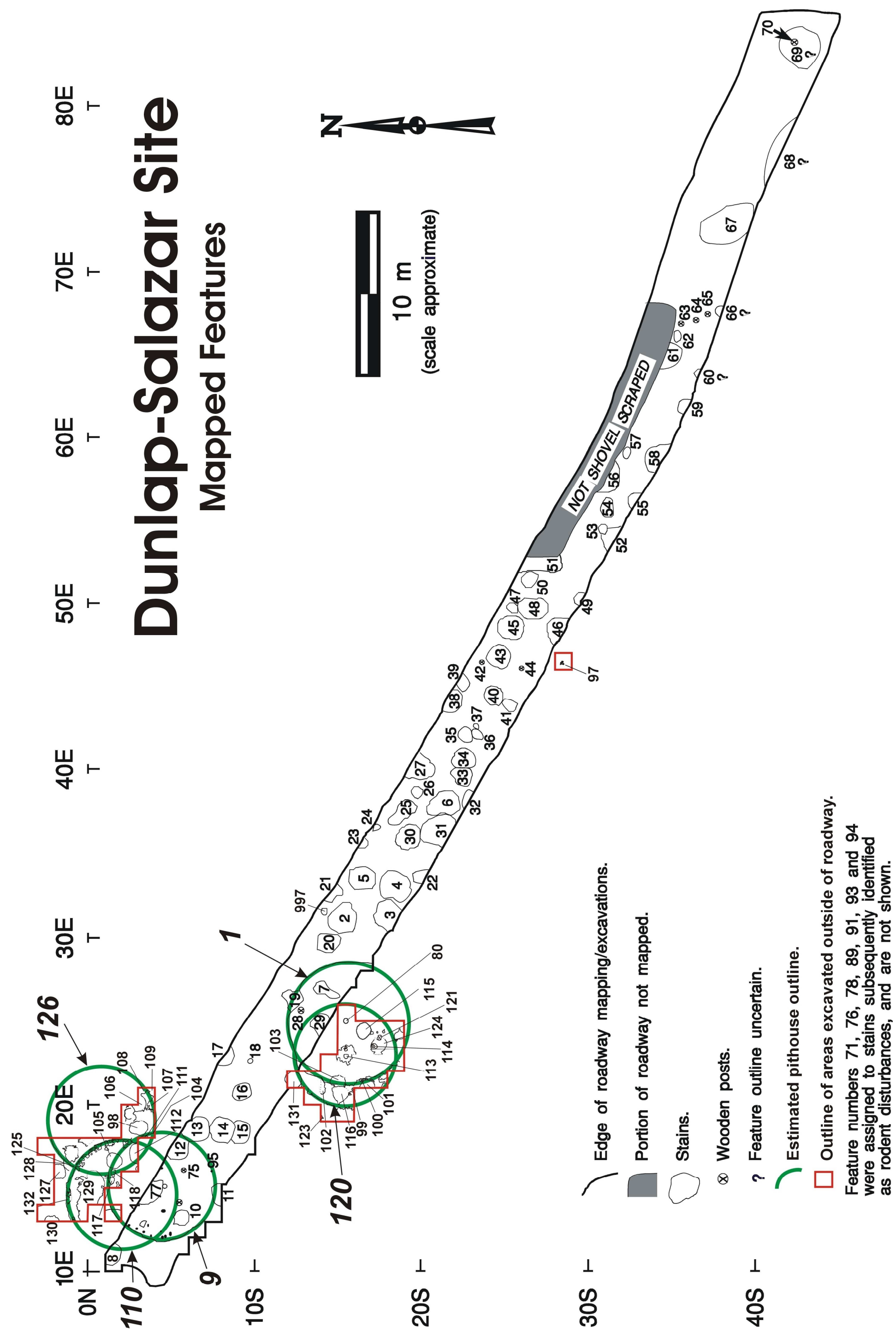

Figure 2: Map of Dunlap-Salazar (LA 51344), showing features, excavated units, and dimensions of the five pithouses (Taken from Rocek [1995]).

many parts of the Southwest over a period of roughly 3 millennia. In most regions, however, the majority of sites dating from this early agricultural period are relatively ephemeral artifact scatters. These sites contain no architectural remains or limited numbers of pithouses, the detection of which is very difficult and which offer little evidence of the existence of permanent, sedentary villages.

Between A.D. 700 and 1000, natives in several parts of the Southwest started to transition to a more sedentary way of life. This transformation was accompanied by architectural, storage, and social changes including signs of social stability, use of settled locations, substantial dwellings, construction of community structures, as well as continued or increased reliance on agriculture (Cordell 1997:254-258). This transition to unambiguous villages is most commonly associated with the pithouse-to-pueblo transition. During this architectural change, sites shifted from semi-subterranean individual family dwellings scattered across a settlement area to tightly clustered and more substantial above-ground apartment-like "pueblo" structures. Pueblos were grouped into multi-family room-blocks and were often associated with communal ceremonial structures.

As already mentioned, the adoption of pueblos occurred at different times and rates throughout the Southwest. In New Mexico for instance, 60 pithouse sites dating to post-AD 1000 have been excavated (Cordell 1997:252). In other areas, pithouses were occupied until regional abandonment without ever having shifted to pueblo architecture. Southeastern New Mexico is one of the areas that appears to have had a slow pattern of village development. Thus, it is by no means certain whether the group of pithouses at the Dunlap-Salazar site exhibit the characteristics of permanence and integration that characterize a village. Dunlap-Salazar predates the pithouse-to-pueblo transition in southeastern New Mexico and offers a glimpse of what may be either one of the earliest villages in the region or a proto-village in the process of transition.

In order to assess the nature of the Dunlap-Salazar occupation, I look specifically at how far and how often the site's occupants traveled by looking at the raw material sources of stone represented in the site's debitage assemblage. Debitage is the waste material produced while chipping stone tools or performing other sorts of lithic reduction and is common in any stone shaping process. The size and shape of the debitage varies greatly among different forms of tool production (Andrefsky 2005:16). While it is also possible to study the raw material of finished stone tools themselves, studying the debitage offers several advantages. Since debitage is the only lithic that represents every stage in tool production and is typically found in vast amounts at archaeological sites, sampling error is substantially reduced (McNally 2002:143). In addition, unlike finished tools that are often made with particular selected materials, debitage more directly reflects the overall range and relative abundance of lithic materials used by the site inhabitants. Finally, finished tools are more likely to be selectively reused or removed from a site whereas debitage is more likely to reflect the full range of stone worked by the site occupants.

Using debitage from the site, I tested three hypotheses about the mobility patterns of the Dunlap-Salazar population:

1) Since Dunlap-Salazar is early in the process of village formation in the region, the population is still mobile and uses a high percentage of non-local materials.
2) As the population became more established, the group eventually changed over time, becoming more sedentary, and causing the percentage of non-local materials to drop over the several centuries during which the site was used.
3) The evidence of mobility is reflected differentially in different types of raw materials.

Part of my study compares Dunlap-Salazar to earlier and clearly mobile (Late Archaic) sites, other pithouse period sites, and later pueblo period sites from the surrounding area in order to measure the change in the abundances of raw materials over time. Initially, hypothesis one fails because none of the sites contain a significant amount of long distance material obtained from well outside the immediate regional setting. Thus, truly long distance travel does not seem to characterize Dunlap-Salazar. However, it turns out long-distance mobility isn't indicated at *any* of the comparative sites either, including the clearly mobile earlier period occupations. Based on the pattern found in the comparison with these surrounding earlier period sites, I reclassify chert as a regional material and focus on *regional* mobility rather than *long-distance* mobility. Using the new chert classification, a modified version of hypothesis one does fit the data. A decreasing trend of regional mobility appears: pithouse sites, including Dunlap-Salazar, express an intermediate degree of mobility that is less than that of the preceding mobile sites and higher than the level of mobility utilized by the subsequent pueblo sites.

Using the new rock classification also suggests a trend, although weak, for a decrease in mobility throughout the occupation of Dunlap-Salazar as predicted by the second hypothesis. Finally, as suggested in the third hypothesis, I also find a clear pattern of variation in the way different lithic materials were used and collected, with chert being the most distinctive. Thus, although requiring some modification, my hypotheses all prove consistent with the data. The complexity of the data patterns raise new questions about the causes of lithic material variation, and I conclude my study by considering two alternative sets of explanations that may account for the observed shifts in lithic procurement and associated changes in mobility.

Chapter 2

BACKGROUND

A partial synopsis of the American Southwest is necessary in order to place the Dunlap-Salazar site within its proper cultural and chronological context. Following this contextual overview will be an in-depth description of the Dunlap-Salazar site itself.

2.1 Chronology

The first people to live in the American Southwest were the highly mobile Paleo-Indians. Although there is debate as to when the Paleo-Indians first settled in the Americas, it is widely accepted that the Clovis culture represents the earliest prominent material culture in the Southwest. Identified by the characteristic Clovis point, the Clovis culture prospered from 9500-9000 BC[1]. The subsequent Folsom culture, identified by the Folsom point, existed from 9000-8000 BC. Following the Folsom period are a number of sequences appearing in restricted areas within the Southwest and are identified by characteristic tools specific to that complex (Plog 1997:38-39). The Paleo-Indian period transitions into the Archaic period in certain regions between 8000-6000 BC. The Archaic is marked by increased regional differences and represents a time when people shifted away from Paleo-Indian practices. Beginning in 200 BC, the Archaic period gave

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1 Dates given are calibrated. Radiocarbon dates are subject to changes in the atmospheric composition, specifically 14C, over time. Calibrating these radiocarbon dates uses other sources of dating, such as dendrochronology and ocean sediment cores, to correct for the fluctuations of atmospheric 14C over time. The resulting calibrated dates are more reliable.

way to the Formative, commencing the start of the most profound changes in the Southwest, and leading to cultural patterns which can still be seen today (Plog 1997).

2.2 Characteristics of Each Period

Hunting and gathering was a heavily practiced subsistence strategy during the Paleo-Indian period. Clovis and Folsom projectile points from the Southwest are identical to those found in other parts of the United States of a comparable age. Based on this information, archaeologists infer that Clovis and Folsom people were highly mobile and secured social networks across large areas. Starting in the Folsom period and continuing particularly into the Archaic period, prehistoric adaptations show a transition away from a heavy reliance on big-game hunting towards a greater reliance on plants (Pleg 1997:39-40).

As time passed during the Archaic period, populations began to rely more heavily on domesticated plants (Plog 1997:46). Although investment in agriculture started in the Archaic, it did not reach its maximum level of dependency until the proceeding Formative period. The continual change in economic adaptations over the Paleo-Indian and Archaic periods correlate with the emergence of a social adaptation that caused profound changes within the Southwest and facilitated the emergence of the Formative period and its associated characteristics: village formation (Plog 1997: 53-55).

The Formative period has been defined by Willey and Phillips as having "the presence of agriculture, or any other subsistence economy of comparable effectiveness, and by the successful integration of such an economy into well-established, sedentary village life" (1958:146). Marking the beginning of the Formative by the 6th century A.D., the Southwest was transformed by numerous innovations, which included the widespread use of pottery, improved grinding stones, an increased use of cultigens, bigger storage pits, the bow and arrow, and pithouses. Each of these factors had impacts on aspects of society such as religion, economy, socio-political relations, and most noticeable in archaeology: material culture (Plog 1997).

2.3 Lines of Evidence

One of the characteristics of the early prehistoric periods in the Southwest is a high level of mobility. Clovis points have been found in a wide distribution all across the parts of North America that were not glaciated during the tail end of the Last Ice Age (Cordell 1997:67). The raw materials that were utilized to make Clovis points were of high quality, the sources of which were often located at a great distance from the sites they were excavated from. Alibates chert represents 85% of the raw materials at the Drake cache in Colorado and Tiger chert represents 89% of the raw materials at the Crook County cache in Wyoming. The sources of both of these resources are located more than 500 kilometers from the sites (Tankersley 2004:60-61). Groups from throughout the Paleo-Indian period traveled far distances to acquire high quality raw materials. Chert, jasper, and agate were transported at least 100 kilometers to the Lubbock Lake site in Texas and chert from the Folsom component of the Agate Basin site came from over 100 kilometers away to the south and northwest (Kelly and Todd 1988:237). Based on these and other findings, it is assumed that Paleo-Indian groups established roughly circular areas of exploitation with radii of around 160 kilometers (Fiedel 1992:70).

Projectile points are grouped into typologies based on similarities and can also help archaeologists measure mobility. These typologies represent the spatial boundaries of the material culture that these people used. The Paleo-Indian period consisted of two dominating and far reaching projectile point types already discussed: Clovis and Folsom. During the early Archaic the style zones of projectile points decreased, although they were still relatively uniform across 12,500 square miles of the north-central Southwest (Plog 1997:51). During the middle Archaic, the number of typologies increased, the associated boundaries decreased in size, and the use of more readily available local materials increased. Although Archaic populations were still very mobile, these three changes represent a reduction in mobility. These typological zones offer a means by which people can communicate with others who share a number of similar characteristics. In turn, distant social networks were utilized less as population density increased and mobility decreased (Plog 1997:51).

Although we do not know what precipitated domesticated plant usage, a reduction in mobility and a greater reliance on local social groups were followed by this emergence in the late Archaic. Although domesticates did not originate in the Southwest, but in Mexico at around 6000-5000 BC, plants such as corn, squash, and beans made it to the Southwest through exchange and diffusion. There is evidence that pinpoints the first usage of corn at around 1500 BC. Agriculture was not a replacement strategy, but served to provide enough resources in order to preserve the hunter-gatherer way of life (Plog 1997: 52).

These adjustments culminated in a radical change of life that enabled future developments, including village formation. The foundation for village formation was set down in the late Archaic and became fully achieved in the formative period. Archaic sites such as Bat Cave in west-central New Mexico have remains of storage pits, hearths, and burials. Intrusive hearths laid one on top of each other show that the inhabitants utilized the site continuously. The inhabitants laid ownership claims on the territories that they occupied based on the presence of burials (Plog 1997:53). The emergence of territorial identity allowed for cultural differentiation among geographically different, yet culturally similar groups and led to the development of the Mogollon, Hohokam, and Anasazi material cultures of the Formative period.

2.4 Mogollon Culture

With the start of the Formative and the first appearance of pottery, regional archaeological traditions became more clearly distinct than in the Archaic. The Mogollon cultural tradition is noted for having produced brown or red/brown ware pottery by using the coiling method and is the one most relevant to the Dunlap Salazar site. The Mogollon material culture's boundaries extend from the Verde River in central Arizona to the west, to near the Guadalupe Mountains in New Mexico to the east, to the Little Colorado River to the north, and to central Chihuahua and Sonora in Mexico to the south (Cordell 1997: 202-203). The Mogollon culture itself is divided into six branches, each with their own associated material culture. These include the Mimbres, San Simon, Black River, Forestdale, Cibola, and Jornada branches (Wheat 1955: 8). Although each branch has distinct features, shared characteristics support their inclusion in the Mogollon Culture.

The Dunlap-Salazar site is located within the Jornada branch of the Mogollon. The Jornada boundaries extend from just north of Carrizozo, New Mexico, to just south

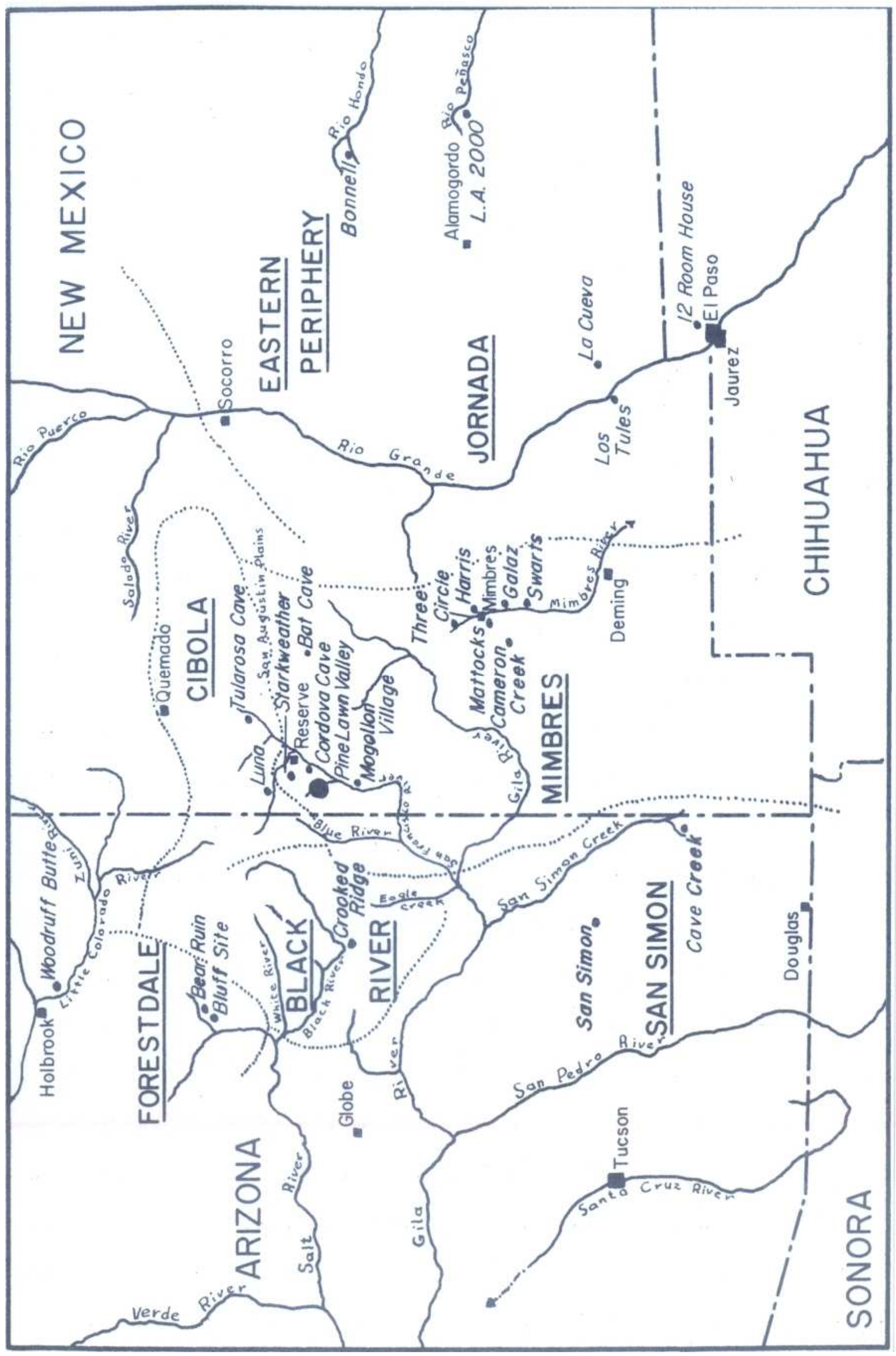

Figure 3: This map shows the location of the six branches of the Mogollon culture. These are the Mimbres, San Simon, Black River, Forestdale, Cibola, and Jornada branches (Taken from Wheat [1955]).

of Villa Ahumada, Chihuahua, to 75 miles west of El Paso, to 150 miles east of El Paso. The geography is typical of a basin and range environment and incorporates the Capitan and Sierra Blanca mountain ranges (Lehmer 1948:11). Jornada has been studied relatively little compared to other regions in the Southwest (Stuart and Gauthier 1981). For this reason the beginning of the Jornada sequence is not well subdivided, until around 900 A.D. when recognizable cultural phases developed (Lehmer 1948: 88).

Jane Kelley defined the Sierra Blanca Region as a localized area with distinctive cultural sequences within Jornada. The Sierra Blanca Region consists of southern and northern parts. The Glencoe Phase is the only phase in the southern part, which Dunlap-Salazar is located on the periphery of. Traditional literature states that pithouses emerged at around 1100 A.D. in the Glencoe Phase, however, due to new findings we know that pithouses existed prior to this date in this area. This phase is characterized by pithouse occupation until the area is abandoned in the 15th century A.D. The northern part consists of the Corona Phase and Lincoln Phase. The Corona Phase is contemporary with the early Glencoe Phase and also consists of a pithouse occupation. The north, however, experiences an architectural and social transition not adopted in the south. Around 1200 A.D., the Corona Phase transitions into the Lincoln Phase and it is at this point when the advent of Pueblo architecture occurs. This way of life lasts until the area is abandoned in the 15th century A.D. (Kelley 1984: 56-57; Rocek 1995: 219). Recent sources, including evidence from Dunlap-Salazar, tend to push back the appearance of the Formative pattern.

2.5 Dunlap-Salazar Site

The Dunlap-Salazar site (LA 51344) is a pithouse habitation situated in the highlands of the Rio Bonito Valley in Lincoln County (Rocek 1995:219-220). Recent AMS radiocarbon dates taken from various features within the site have yielded an occupation time span of 200-300 years, dating from ca. AD 550 to 850. Although the excavated portion of the site was heavily occupied between AD 550 and 750 or 850, parts of the site were also used into the twelfth century as indicated by the appearance of Chupadero B/W pottery, a type characteristic of this later period (Rocek 2007). Dunlap-Salazar predates the conventional dates of the Glencoe Phase and gives archaeologists a chance to study village formation during the early parts of this period in which village formation is not fully understood.

Features at the site include over forty storage pits, many bell shaped, and at least five pithouses. The pithouses are clustered into two groups and the stratigraphy shows that some are stratigraphically superimposed. Supported by radiocarbon dating, the stratigraphic evidence shows that the pithouses are not all contemporary with each other and represent separate building episodes over time. This evidence, in addition to the existence of storage pits that intrude into each other, adds chronological depth to Dunlap-Salazar (Rocek 2007).

Substantial attention has been given to determining the degree in which the inhabitants of Dunlap-Salazar were mobile and how agriculturally dependent they were. Although the scope of this paper focuses on the former, agricultural dependence is still relevant. The combination of storage pits, the recovery of a few beans, squash pollen, and ubiquitous maize cob fragments, the occasional kernel, at least one maize stalk segment, and the site's placement in a location conducive for agriculture all show that the inhabitants at Dunlap-Salazar invested time in growing domesticated crops (Rocek 1995: 223). Rocek examined and compared agricultural dependence between Dunlap-Salazar and the Robinson site, a pueblo habitation dating to the Corona and Lincoln phases located 30 km northwest of Dunlap-Salazar (Rocek 1995: 222). He concluded that although the Robinson site contains a substantially higher amount of maize and other plants overall, both sites have similar amounts of maize when compared as ratios to other plants or as measured by ubiquity levels. This is indicative that there may not have been such a profound difference in subsistence between these pithouse and pueblo settlements (Rocek 1995: 226-231).

Multiple lines of indirect evidence shed light on the degree to which the Dunlap-Salazar inhabitants were mobile. Groups who bury their food and abandon their settlements have been ethnographically documented to construct storage pits similar to the ones found at Dunlap-Salazar (DeBoer 1988; Gilman 1987: 558; Wills and Windes 1989). While the existence of maize is indicative of fall and spring occupation, in order to harvest and plant the crop respectively, floral evidence concerning mid-summer and winter occupation is ambiguous. The intrusive orientations of the storage and habitation features are also consistent with seasonal usage of the site (Rocek 1995: 223-224). While seasonal habitation seems like the best characterization for Dunlap-Salazar, the degree to which the inhabitants were mobile is undetermined and permanent village formation cannot be fully ruled out based on negative evidence. Agriculture and substantial housing are two prerequisites for village life, both of which are found at Dunlap-Salazar. The unknown degree to which these were used and the unidentified presence of other village traits renders the question as to whether the Dunlap-Salazar inhabitants formed a village unanswered. As indicated above, Rocek has argued that the Dunlap-Salazar inhabitants were mobile. My work tests this interpretation using lithic remains, a line of evidence not considered in Rocek's work.

Chapter 3

THEORY

3.1 Defining Mobility

The term “mobility” has been applied to many case studies, but given numerous meanings such as the number of residential moves, the distance (maximum or minimum) traveled, or the frequency with which moves occur (Andrefsky 2005:225). There are varying degrees of mobility that range from people being highly mobile, seasonally returning to a central village, occupying a village year-round but moving the village every few years, short-term sedentism, and deep sedentism which entails occupying one particular area for centuries (Beardsley et al 1956; Nelson et al 1986; Lekson 1990:333). Binford has introduced another classification of mobility based on hunter-gatherers by differentiating between residential and logistical mobility. The former is when the entire group relocates together and the latter is when individuals or small groups travel to and from the residential base to carry out specific activities (Binford 1980). Mobility is not always restricted to group movement however. Different types of individuals within the same group, such as men and women and young and old, may travel differently from other individuals. Also, different types of movements occur daily, seasonally, and annually (Kelly 1992:44). As discussed below, my measurements take into account both residential and logistical mobility.

3.2 Using Raw Materials as an Indication of Mobility

Relative amounts of raw materials and the distances of the sources of these resources to the site are used to measure mobility and determine the boundaries of gathering trips. The establishment of a village entails a concentration of people organized into a relatively stable social group settling in on a particular piece of land for an extended amount of time. Thus, while sedentism does not directly demonstrate the existence of an integrated village community, a high level of mobility is atypical of a fully developed village pattern.

Mobility is analyzed at Dunlap-Salazar by comparing relative amounts of raw materials in the debitage sample that were obtained by the inhabitants. Resource procurement can be incorporated in both residential and logistical mobility and discerning which type of procurement was involved can only be done with additional information (Kelly 1992:55). Three scenarios are possible to explain the presence of non-local resources. A group can be highly residentially mobile and gather resources during residential moves without having to rely on logistical mobility. Or a group can be highly logistically mobile, relying on long forays to obtain resources while remaining in a residential area for an extended amount of time. Which type of mobility was utilized by the inhabitants at Dunlap-Salazar is not the focus of this study. Mobility as a whole is analyzed and offers valuable implications on how sedentary the Dunlap-Salazar inhabitants were, regardless of the degrees to which they were residentially and logistically mobile. A third scenario, exchange, is discussed in the next section.

Numerous techniques, such as analysis of taphonomy, lithic assemblages, pottery, the landscape, cached materials, and subsistence strategies have been deployed by archaeologists in order to measure a population's level of mobility (Wendrich and Garnard 2008:11-13). This thesis focuses on the relative percentages of raw materials found in a sample of lithic debitage and will be used to indicate which materials were favored over others and how far the inhabitants had to travel to procure them. A further and more explanatory reasoning will be given in the methodology section regarding how raw materials from Dunlap-Salazar were identified, how distances traveled by the inhabitants were calculated, and how these data were used to interpret the inhabitants' degree of mobility.

3.3 Raw Material Procurement as a Secondary Activity: Exchange, Logistical Collection, and Combined Procurement Activities

A dichotomy exists between the ways in which people collect materials and resources. A group may exercise direct procurement in which they travel to a particular destination with the intention of acquiring a specific resource. Or the group may employ an indirect mode of procurement which entails trading with another group in order to gain something (Blades 2001:11). Trading can occur in two forms: down the line or market based. The former takes place on a small scale and involves small quantities. The latter is controlled by elites of a complex society and involves much larger quantities. In the case of Dunlap-Salazar, anthropologists know that this site does not represent a complex society that participated in a market trading system. Falsification is a powerful method that can greatly aid in defining what a particular topic is not. A comparison of the ceramic collections of Dunlap-Salazar and the state-level society of Cases Grandes indicates that trade was not a common or central activity of the Dunlap-Salazar inhabitants.

Cases Grandes is a puebloan community located in northwestern Chihuahua, just over 100 km from the New Mexico border. It was situated at the center of one of the most complex polities in the Southwest. This settlement first began construction in the early 13th century and reached its climax between the 14th and 15th century. The presence of large stores of exotic artifacts and animal remains clearly demonstrates that the Cases Grandes inhabitants participated in and dominated a high level of regional trade. Macaw feathers that are not native to the immediate area occupied by Cases Grandes have been found numbering in the hundreds. It is important to note that less than 200 macaw feathers have been recovered from all other Southwestern sites. Almost four million items of shell weighing 1.5 tons, native to the west coast of Mexico, has also been excavated. Most of the shell has been found in three rooms, two of which are in a single roomblock. This indicates that a small number of individuals were able to gather a large amount of wealth and have control over its distribution. Of greater importance to this thesis, however, is the ubiquity of the unique pottery style produced at Cases Grandes found over a wide region. This pottery style, Ramos Polychrome, has been found in great quantities at sites up to 70 miles away. From these details alone it is apparent that the population at Cases Grandes engaged in a high level of trade (Plog 1997:173-176).

In contrast, Dunlap-Salazar does not have a unique pottery style that is characteristic of the site, as Cases Grandes does. If large-scale trade was indicated at the Dunlap-Salazar site, it would make discerning between trade and logistical procurement difficult. However, the Dunlap-Salazar proveniences analyzed for this study contain only the regionally ubiquitous brown ware (Rocek 2007:2) which appears to have been locally manufactured (Howey and Rocek 2000). Similarly, no other class of material suggests that the inhabitants at Dunlap-Salazar participated in a complex large scale trade system. Thus, while small quantities of exotic materials at Dunlap-Salazar may well represent trade, bulk quantities of raw materials, particularly heavy materials such as lithics, are almost certainly the result of collections during logistical or residential moves by the site occupants themselves.

Multiple procurement activities are often carried out together to optimize resource gathering efficiency. A common scenario involves non-food resource gathering coupled with sustenance procurement. Activities that are performed alongside with sustenance gathering include looking for mates and lithic acquisition (Shackley 1996:6-7). Lithic procurement as a secondary activity has been ethnographically identified among the Nunamiut hunter-gatherers. There were no definitive indications that the Nunamiut made direct trips with the sole purpose of obtaining lithic raw materials. Instead, they were collected on trips with the main goal of acquiring sustenance (Blades 2001:12). In another ethnographic case, however, Australian aborigines knew the importance and location of high quality raw materials. The aborigines have been cited as embarking on treks with the primary purpose of getting these high quality raw materials. It should be noted that although lithic procurement is the primary reason for going, it is not always the sole activity performed (Andrefsky 1994:23). Thus, a wide range of procurement activities must be represented by the presence of high quality raw materials, but all represent dimensions of mobility by the site occupants.

In contrast to complex or market based systems, bulk quantities of materials are moved by highly mobile hunter-gatherers. By tracking the distribution of lithic tools, anthropologists can calculate the distances people travel, a method that has been particularly helpful to determine how mobile the Paleo-Indian hunter-gatherers of the central and northern plains were. Archaeologists have long investigated how nomadic hunter-gatherers, who maintain a small population density and traverse large geographical areas, were able to maintain viable reproduction pools. Relatively recently, a correlation became apparent that suggests that hunter-gatherers combined lithic procurement trips with mate seeking. Places of interaction often occurred near sources of lithic raw materials, some located as far away as 330 km. By learning the landscape, the hunter-gatherers were able to obtain lithic raw materials, find mates, and maintain distant social relations (Milne 2008:183).

Paleo-Indians and many Archaic groups also traveled within large areas to find mates and collect lithic materials, among other activities. Based on the archaeological record and the results of my study, discussed below, it is evident that the inhabitants at Dunlap-Salazar were not as mobile as these earlier hunter-gatherers. As stated in the background chapter, the time period in which Dunlap-Salazar existed marked the first widespread appearance of substantial pithouses, a greater reliance on cultigens, bigger storage pits, and the widespread use of pottery. All of these innovations are associated with decreased mobility and are not present in the Paleo-Indian and early Archaic periods. While I have made it clear that the Dunlap-Salazar occupants did not engage in trade at the scale present at Cases Grandes, my study offers definitive proof that the inhabitants were not as mobile as hunter-gatherers.

3.4 Ethnographic Evidence of Local Procurement Distances

As compared to studies of ceramic raw material procurement and sustenance collection distances, there have been relatively few studies of the distances traveled by people to acquire lithic raw materials. The distances traveled in order to obtain sustenance and ceramic raw materials are most likely to be comparable to the distances traveled to obtain lithics, since each activity is a type of logistical mobility. The distances a group travels is connected with the degree to which that group is mobile.

Browman devised the exploitable territory threshold model in order to quantify distances traveled by hunter-gatherers and agricultural societies to get certain resources versus the associated energy and information costs (1976). The "model is based on the assumption that resource exploitation involved choices which minimize energy and information expenditures or which maximize energy or information returns" (Arnold 1985:33). The model incorporates four different factors: the geodesic distance to the material (straight line between two points), the pheric distance (topographical variables are incorporated), the transport costs, and the social and psychological costs. All of these variables are quantified and plotted against each other in order to determine the threshold of an exploitable territory (Browman 1976).

Three theoretical non-numerical distances were derived from the application of the four above variables. Distance A represents the threshold in which returns increase faster than costs do and is the limit of the most optimal area of procurement. For my study, all materials found within this boundary are deemed local materials. Distance B is where returns begin to drop and costs greatly increase. Although returns are diminishing as one gets closer to Distance B, the returns are still positive. All materials found within distances A and B are considered regional materials for my study. Distance C is the final distance and represents the limit of exploitable land. The distances between B and C are considered unprofitable and are usually not utilized except in times of crisis (Browman 1976). Materials found within these limits are deemed non-local materials for my study.

Each non-numerical distance can be applied to people with all levels of mobility. Each group of people, however, will have different numerical values for each distance based on their individual characteristics. Browman reviewed literature of hunter-gatherer groups and agricultural societies. He found that hunter-gatherers journeyed up to 35 km, roughly one day's journey to hunt. Agriculturists traveled no more than 8 km, a one hour travel, to practice subsistence agriculture (Browman 1976). Both of these distances represent the A distance for the respective groups. To make these distances applicable to my study, I am making 8 km the limit in which materials are categorized as local and 35 km the limit in which materials are categorized as regional. Everything out of the 35 km radius is non-local. In a separate study, Arnold found that out of 110 cases, 85% of the resources used to make pottery were obtained within a 7 km radius of the potters' living area (1980). Arnold's study of pottery material procurement adds validity to my reasoning behind using 8 km as the local distance threshold. Reasoning for choosing these distances and the possible implications based on the results will be discussed in the methodology section.

3.5 Relative Chert Abundance As a Second Test

It is assumed that higher quality materials are less abundant and harder to collect compared to lower quality materials (Greenwald 2008:479). Stone weighs too much for a highly mobile group to carry anymore of it than is absolutely necessary and stone availability is always fluctuating. Highly mobile groups overcome these obstacles by producing standardized formal tools from high quality materials, when available, which serve multiple functions and are light in weight. Formal tools are typically retouched in order to prolong its lifespan and preserve the high quality material. In contrast, sedentary groups are not very mobile and do not require lightweight tools that are easily transportable. These groups are simply concerned if some sort of lithic source is immediately available to make suitable tools. Tools are used for short term tasks and are discarded when they become inefficient to be replaced by newly made expedient tools (Parry and Kelly 1987:298-300). In summary, it is expected that "the proportion of a given raw material present in an assemblage to be inversely related to the distance from its source, and to be positively related to its quality" (O'Shea and Milner 2002:217).

A previous study (Greenwald 2008) conducted in the Hondo Valley of Lincoln County, New Mexico, about 15 km south of the Dunlap-Salazar site, showed that the amount of chert in an assemblage is correlated with the degree of mobility among highly mobile populations in the Archaic Period and sedentary populations in the Formative Period. Chert is a high quality microcrystalline material that has been used worldwide for thousands of years to make tools. As mentioned above, high quality materials are typically less abundant and harder to find. Even if a high quality material, such as chert, is located within a local area, a higher degree of mobility is required in order to procure a large amount of it. The results from the Greenwald study show that Archaic sites had a higher percentage of chert (70.4% to 79.9%) in the assemblage than Formative sites which had 17.3% to 57.6% chert in the assemblage (2008). I have adopted this test to complement my main test which measured the distances to sources of lithic materials. As will be discussed in a further section, Railey has argued that the introduction of the bow and arrow influenced lithic material selection and the tool assemblages of prehistoric villages in the Southwest. According to Railey, the points for arrows require a small amount of material to make, opening up lithic sources which produce small pieces of natural stone, and thus produce fewer pieces of debitage. These two factors changed the types and percentages of raw materials represented in the debitage collections at sites which must be taken into consideration for this study (Railey 2008:27-28) .

3.6 Availability of Raw Materials As a Factor

Testing mobility involves multiple factors and considerations depending on the timing and location of the people in question. The availability of lithic resources is an additional variable which has been studied and has provided conclusive results. A study carried out by Andrefsky examines three sites located in the North American west with the objective of determining the relationship between settlement type (mobile vs. sedentary) and availability of lithic materials (1994:24).

For example the Pinon Canyon Archaeological Survey, in Las Animas County, Colorado, identified 195 sites with architecture. The study focused on two types of architecture: short-duration dwellings (tipi rings) associated with mobile inhabitants and long-duration dwellings (stone-walled features) associated with sedentary inhabitants. A total of 86 short-duration sites and 14 long-duration habitations were verified. A survey of the geology showed that there are easily obtainable sources of local high quality lithic materials available in the area. This unique situation gives mobile and sedentary people relatively easy access to high quality materials that are not normally easily accessible. After analyzing the tools used by both the mobile and sedentary inhabitants, it became evident that there is little difference in the percentage of local materials used. Local materials were used to make 90.6% of short-duration site tools and 91% of long-duration site tools (Andrefsky 1994:25-27).

Although the case mentioned above is specific to that locality, it does prove that lithic material distances may not be completely conclusive when gauging mobility. Although such a test has been proven to work at different sites, I think it is necessary to use the relative chert abundance test as an additional test to measure mobility at the Dunlap-Salazar site.

As discussed earlier, Andrefsky claims that the percentage of raw materials in a debitage sample reflects not just the location of the raw materials, but the availability of them across the region (1994:24). Also discussed previously is the theory that higher quality materials are more difficult to obtain (Greenwald 2008:479). If the latter of the two were not correct, than Andrefsky's theory would point out that even a very mobile population would use locally available high quality materials. In turn, sourcing the lithics used by the population would not deliver the correct results concerning the mobility of the group. As for Dunlap-Salazar, however, this is not the case. Geologic surveys have shown that chert, a high quality material, is found as pebbles or nodules and because of this is difficult to locate in pieces sufficiently large for flaking (Kelly 1984:2). Therefore, chert, even if locally available, is hard to find, and we are able dismiss the issue of raw material availability raised by Andrefsky and apply the chert abundance comparison to this study. Lastly, no other high quality material (e.g. obsidian) is locally available, making chert the perfect raw material to use for the quality test.

Chapter 4

METHODOLOGY

4.1 Introduction

I employ a multifaceted approach to analyze the debitage collection from Dunlap-Salazar. To identify the material type and mineralogical composition of each lithic specimen, I primarily use visual tests such as the color and grain size, supplemented by tests of hardness (based on the Moh's Hardness Scale) and reactivity with acid. Dr. Leavens of the Geology department helped me by verifying selected samples from my identifications. In addition, I use an x-ray diffractometer to analyze selected samples for their mineralogical makeup. These combined techniques facilitate the identification of the numerous types of lithic materials present in the debitage sample at Dunlap-Salazar.

I studied the debitage found in the proveniences associated with the five known pithouses at Dunlap-Salazar. During the excavation at Dunlap-Salazar, a grid plan and arbitrary levels were used to assign proveniences to artifacts and features. The grid plan consisted of one by one meter squares, the southwest corner of which were assigned north-south and east-west coordinates. Arbitrary 10 centimeter levels were dug until there was a break in the natural stratigraphy which in most cases was the floor of a feature. Lot numbers were assigned to the artifacts found within each specific grid square and arbitrary level.

Within each pithouse, I look at debitage from top, middle, and bottom arbitrary levels. This strategy permits checks on biases based on turbation or any outside disturbances that would displace artifacts. The goal is to analyze 100 pieces of debitage from each set of arbitrary layers that are analyzed. In certain cases, there is not a sufficient number of debitage pieces within the top, middle, or bottom arbitrary layers to reach the 100 piece goal. In these cases, the maximum amount of debitage within the set of arbitrary layers is counted. In other cases, an exact count of 100 pieces of debitage can not be reached, particularly when I hadn't reached the 100 piece mark and therefore started a new lot bag to collect data on the debitage within it. To prevent bias by only partially counting the debitage in the lot bag, I counted all of the debitage in it, even if this put me over the 100 piece minimum. In its entirety, 1,593 pieces of debitage from 80 lots in the five pithouses have been identified and used in this study.

4.2 X-Ray Diffraction

X-ray diffraction identifies minerals in a sample of lithic material. Specimens are ground into a powdery state, mixed with alcohol, placed on a glass slide, and shot with X-rays. Each type of lithic material, whether it is igneous, sedimentary, or metamorphic, has a unique combination of minerals and I use X-ray diffraction to identify select samples (Odell 2004:38). Positively identifying certain samples using this method aids me in visually identifying similar types of lithic materials.

Using the X-ray diffractometer is an uncomplicated procedure and having access to such an expensive machine is invaluable to my study. First, I chip off a piece of rock using a small metal geologic hammer, no more than 2 millimeters in diameter in either direction, from the specimen in question. The broken off piece of rock is placed in a diamond mortar and crushed until made into a powdery substance. Acetone is added to the powder and it is crushed again to assure that there are no gritty chunks in the sample. After the sample is a homogeneous consistency, it is added to a quartz slide. A quartz slide does not cause diffraction itself as such an occurrence would skew any desired results. Two to three minutes are allowed to pass to allow the acetone to dry so only the lithic material remains on the slide. When this is complete, the slide is put into the diffractometer and run. The entire process takes around an hour and twenty minutes.

The readings from the machine are recorded by a computer using the MDI software. When the sample is finished being analyzed by the diffractometer, the results are analyzed by the software program JADE 3.1 (MDI Corporation). JADE 3.1 takes my diffraction pattern results and compares them to a library of known specimens in the JCPDS (Joint Committee on Powder Diffraction Standard) CD-ROM. I match up my results with known results of minerals and lithic materials until I find a suitable match. For example, granite typically has high levels of quartz and feldspar. If the specimen I run in the diffractometer turns out to have high peaks of quartz and feldspar, I could compare it with the peaks of known granite in the JCPDS library. If my unknown specimen matches with the known specimen, then I've made a positive identification. Overall, I ran 15 samples through the diffractometer, some of them unknown samples needing identification and some previously identified by myself visually and tested to affirm my identification.

4.3 Visual Identification

The main part of my identification process involves visual identification which is a very common and quite accurate technique (Odell 2004:28) that has been widely used in the field reports (McNally 2002; Quaranta and Alldritt 2000; Davis 2007) that are referenced in the analysis section of this thesis. Certain visual characteristics of lithic materials are helpful in determining what type of material a particular rock is. The two major visual attributes I look at are color and grain size. In looking at these traits, I am aided by a zoom binocular microscope with a magnification up to 40X. Although the color of certain types of rocks can range from geographic location to location, it can still be useful in narrowing the range of possible rock types and can hint at the mineralogical composition of the rock. For instance, igneous rocks fit into one of four groups based on their mineralogical composition. Felsic rocks have a silica content of over 65%, intermediate rocks have a silica content between 55-65%, mafic rocks have a silica content between 45-55%, and ultramafic rocks have a silica content below 45%. The amount of silica in an igneous rock greatly affects color; the less silica, the darker the rock. Therefore, felsic igneous rocks are much lighter in color (white and tan) than mafic igneous rocks (black and brown) (Pellant 2002:32-33).

Grain size is the second important visual characteristic I look at. Grain size tells a great deal about different types of rocks. For instance, basalt and gabbro have the same mineralogical composition. Both of these igneous rocks are mafic and contain predominately calcic plagioclase and pyroxene. However, gabbro is a coarse-grained rock (crystals 5 mm or more diameter) whereas basalt is a fine-grained rock (crystals less than 0.5 mm in diameter) (Pellant 2002). Grain size is helpful in identifying metamorphic and sedimentary rocks as well. The grain size in a metamorphic rock indicates at what temperature and pressure the rock formed. The value of these characteristics is what defines each metamorphic rock. For example, slate is fine-grained because it formed under low pressure, schist is medium-grained because it formed under moderate heat and pressure, and gneiss is coarse-grained because it formed under high heat and pressure. Some sedimentary rocks are also classified by grain size. Sandstones contain sand size particles (2mm-62.5µm) and siltstones contain silt size particles (62.5µm-3.9µm) (Pellant 2002: 37-39).

4.4 Additional Tests

To supplement the visual identification I also test a specimen's hardness and reactivity with acid. Hardness is measured on the Mohs' hardness scale from 1 (softest) to 10 (hardest). As a reference, talc has a Mohs' hardness of 1 and diamond of 10. Mohs' scale helps in the identification of minerals so it can be used to identify the type of rock. For instance, limestone is made of calcium carbonate in the form of the mineral calcite. Calcite has a hardness value of 3 and a knife blade has a hardness of 5.5, so scratching limestone with a knife scratches the limestone (Pellant 2002:25). Therefore, a rocks reaction to being scratched by particular comparative materials is indicative of what type of rock it may be. I use this test to differentiate limestone from chert and fine grained rocks such as siltstone and shale.

The large presence of dolomite and limestone in the Dunlap-Salazar debitage collection, as will be discussed later, makes reactivity with acid a very important test for me. Both contain the carbonate mineral calcite (CaCO3) which is reactive with acid. For my experiment I use a diluted hydrochloric acid (10% HCl) to test a specimens' reactivity with acid. Dolomite and limestone are difficult to tell apart visually and both contain calcite, however limestone reacts much more vigorously with acid than dolomite. I apply hydrochloric acid to any specimen I think is one of the two to distinguish between them. Although chert has very distinctive traits, limestone and dolomite grad into chert which produces raw materials that are not entirely either chert, limestone, or dolomite. To distinguish between materials that are pure and materials that are a cherty limestone, dolomitic chert, etc. I use reactivity with hydrochloric acid to differentiate between the varying compositions of materials. Chert does not react with hydrochloric as vigorously as limestone and dolomite do. For a piece of debitage that is difficult to classify as chert or limestone/dolomite, I assign the piece to the material type that I think composes a majority of the piece. No other rocks containing minerals reactive with hydrochloric acid were present in the debitage sample.

4.5 Sourcing and Recording the Distances of Lithic Materials from Dunlap-Salazar

After identifying the raw material of each piece of debitage in my sample, the next step is to locate the sources of these lithic materials. I rely on geologic maps and records of the immediate area surrounding Dunlap-Salazar to find the sources of the lithic materials. I do not have the advantage of using geochemical techniques to source the raw materials; such techniques are beyond the sophistication of this study. Similarly, I do not have the opportunity to personally visit potential source areas to collect samples for comparison. Instead, I located published information about possible locations of each raw material found in the debitage sample.

After I identify the likely locations of the raw materials I measure the distances from the source to Dunlap-Salazar, this representing the distance traveled by the population to obtain the lithics. There are two ways of measuring the distance from site to source; the geodesic distance is a straight line from source to site and the pheric distance takes into account the topography between source and site (Arnold 1985:33). These two distances are not always identical. For many cases, including the European Upper Paleolithic, Neolithic, and American Southwest Paleo-Indian period, procurement took place over hundreds of kilometers and most likely wasn't done in a straight line. Although the pheric distance is preferable, it is beyond the scope of this thesis, and I rely on the simpler geodesic distance as a first approximation of travel distances in this work.

4.6 Determining the Local, Regional, and Long Distance Boundaries

The main variable I look at for my study is which lithic materials were procured from local, regional, and long distance sources. The percentages of these three categories relevant to each other shows me how mobile the Dunlap-Salazar population was. I apply quantitative values to these three categories to make them relevant to mobile hunter-gatherers and sedentary agriculturists for comparison. As previously stated, it has been documented that mobile hunter-gatherers typically travel up to 35 km away and agriculturists travel up to 8 km away to obtain their respective resources (Arnold 1985:34) . By applying 8 km to the local boundary and 35 km to the regional boundary I am able to compare the Dunlap-Salazar inhabitants' use of resources to those of mobile hunter-gatherers and sedentary agriculturists. Long distance raw materials are simply materials from any distance outside of the regional boundary, in other words more than 35 km away. The objective of assigning these distances to my boundaries is to compare Dunlap-Salazar relative to Archaic period clearly mobile hunter-gatherers and Pueblo period unambiguously settled villages. I also examine the overall amount of long distance raw materials, since highly mobile groups who engaged in trade would be expected to have small quantities of exotic materials.

4.7 Comparison

The final procedure in this study analyzes the results and compares them with the results from other sites. These sites include Archaic, other pithouse, and pueblo sites. Comparing Dunlap-Salazar with sites that are older, contemporary with, and younger allows me to place Dunlap-Salazar within it's proper context. Doing so gives me another means of evaluating the inhabitants' level of mobility and determining if they more likely resembled mobile Archaic people, similar pithouse people, or later, relatively more sedentary puebloan people in terms of mobility. Information used for comparison with other sites came from field reports on sites located near Dunlap-Salazar that share a similar geological landscape.

In addition to comparing Dunlap-Salazar with other types of populations, I also look at how the inhabitants within Dunlap-Salazar changed in terms of mobility over time. Analysis consists of looking at the debitage samples from the five pithouses in chronological order. This intra-site comparison allows me to test for a change in the amounts of chert, local, regional, and long distance lithic materials over time, and hence to infer changes in mobility. Particularly informative was the change in lithic materials between the oldest and youngest pithouses, maximizing the strength of the intra-site chronological comparison.

Both the inter-site and intra-site comparisons proved very useful in determining the level of mobility of the inhabitants at Dunlap-Salazar. Performing such comparisons is useful because sedentism is not a one way path that inevitably reaches a point of no return in which the inhabitants reach full sedentism and cannot revert back to a mobile way of life. In other words, there is no threshold for sedentism and a group of people can fluctuate in how mobile they are over time (Kelly 1992:50). Comparing the relative measurements of mobility among the Archaic, pithouse, and puebloan groups allows me to deduce where each group fits on the mobility spectrum.

Chapter 5

DATA

This section provides the raw data that I collected when I analyzed the debitage collection from Dunlap-Salazar. The following section will discuss the implications and results obtained from the raw data.

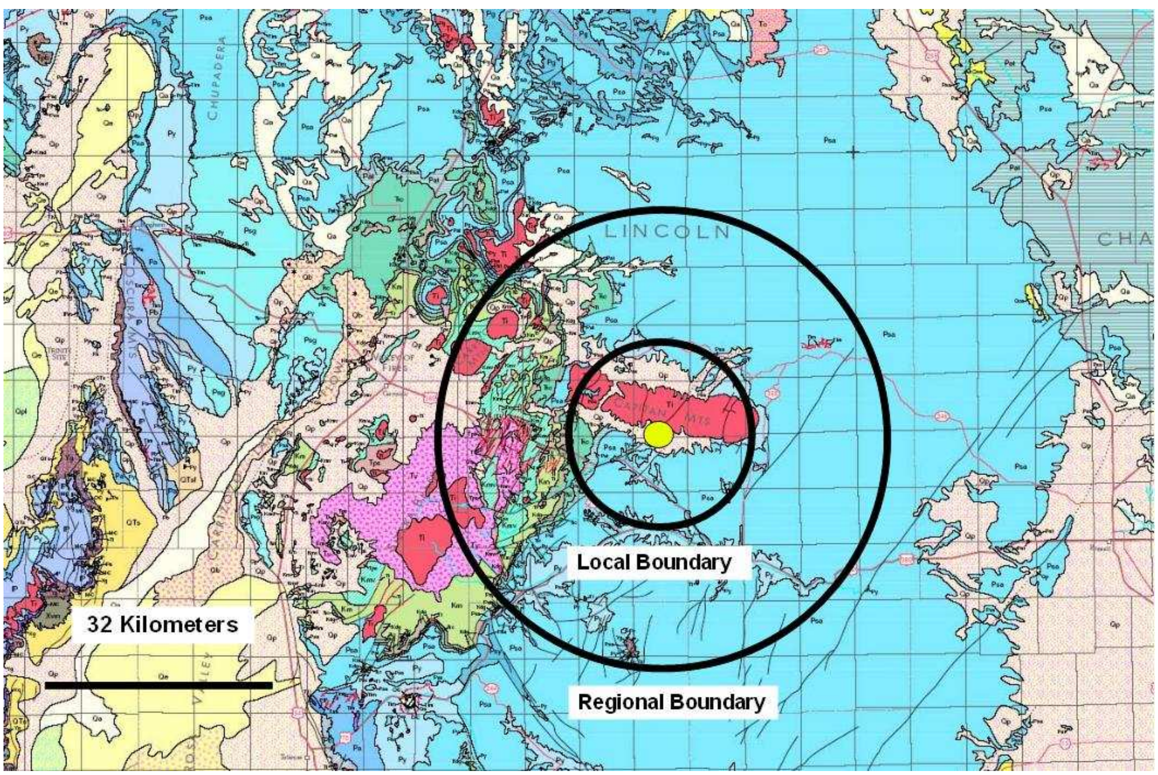

Figure 4: Geologic map of the area surrounding Dunlap-Salazar (represented by the yellow circle. The local boundary (radius of 8 kilometers) and regional boundary (35 kilometers) are drawn on the map to show their respective limits.

Table 1: This table lists the raw materials that were identified in the debitage sample and within which boundary each falls under. The approximate distance from the source to the site is given for each raw material.

Local				**Regional**		**Long Distance**	
Dolomite	<5 km	Siltstone	<5 km	Shale	16-24 km	Dacite	48 km
Granite	<5 km	Syenite	<5 km	Dolerite	16-24 km	Gabbro	161 km
Limestone	<5 km	Chert	8 km	Andesite	24-32 km	Gneiss	161 km
Pink Microgranite	<5 km	Orthoquartzite	8 km	Basalt	24-32 km	Anorthosite	>35 km
Sandstone	<5 km	Quartz	8 km	Rhyolite	32 km	Pyroxenite	>35 km
				Trachyte	32 km		
				Diorite	32-35 km		

1	Quartz, Orthoquartzite, Chert	6	Dolerite	11	Limestone, Sandstone
2	Siltstone, Dolomite	7	Trachyte		
3	Granite, Microgranite, Syenite	8	Rhyolite		Not located on the map: Gneiss Gabbro Pyroxenite Anorthosite
4	Shale	9	Diorite		
5	Basalt, Andesite	10	Dacite		

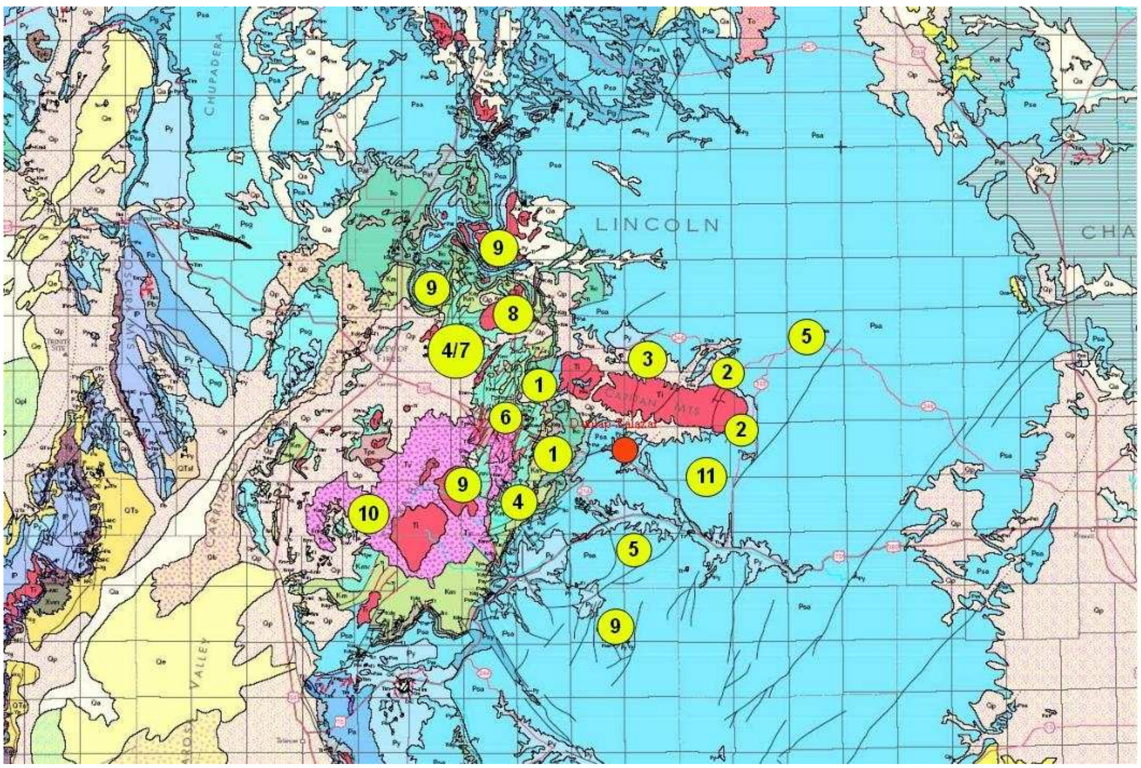

Figure 5: Approximate location of the lithic raw materials that were identified in the debitage sample.

Figure 6: A map displaying the regional setting surrounding Dunlap-Salazar and the geologic sources of the raw materials found in the analyzed debitage sample [Taken from Allen and Foord (1991)].

5.1 Locations of the Lithic Material Sources

As previously mentioned, I identified the sources of the lithic raw materials in the debitage sample by looking at geologic maps and published reports. Clearly, using petrographic and geochemical techniques to directly compare regional parent material from known sources with the Dunlap-Salazar debitage would be a preferable approach to determine the exact locations of the sources. However, since collection and analysis of such comparative samples is beyond the scope of this thesis, the information on regional geology available in maps and reports allows an approximate sorting of lithic materials according to probable source areas.

The following materials are located within 8 kilometers of Dunlap-Salazar—hence, locally available by the distance breakdown I use here. Quartz, quartzite, and chert, the latter being one of the most ubiquitous materials in the debitage sample, have been identified in the Chinle Formation (Upper and Middle Triassic) which is located exactly due west of Dunlap-Salazar. Chert, in particular, is very difficult to locate because no major sources of chert have been identified, but it can be found as nodules in the higher elevations. The San Andres Formation (Middle Permian) is one of the largest exposed geologic strata in the immediate area surrounding Dunlap-Salazar. This contributes to the fact that a large amount of the lithic materials in the debitage sample originates from the San Andres Formation, most notably limestone, sandstone, and chert. Siltstone and dolomite can be found within the Yeso Formation (Lower Permian), which is located on the north and south sides of the Capitan Mountains (Kelley 1984:2; Wilks 2005). The Capitan Mountains, located just north of the site, is highly uniform in its composition and texture. This geological feature is composed of granite, microgranite, and syenite, all of which are represented in a small percentage of the debitage sample (Kelley 1971:35; Lovelace 1972:2).

Moving out in distance from Dunlap-Salazar, the following lithic materials are regionally available, between 8 and 35 kilometers away. Located between 16-24 kilometers away from the site, Mancos Shale is the closest source for shale in the region (Wilks 2005). Carrizo Mountain is the second closest source for shale and is around 32 kilometers away (Kelley 1984:2501-252). Basalt and andesite can be found in intrusive sills and dikes located in two locations: 32 kilometers northeast and 24 kilometers south of Dunlap-Salazar. North trending dikes of dolerite are present around 16-24 kilometers west of the Capitan Mountains (Scholle 2003). Around 32 kilometers to the northwest of Dunlap-Salazar are the Carrizo and Patos Mountains. Carrizo Mountain has been noted as having a similar composition as Capitan Mountain, with the exception that there is a concentrated zone of trachyte. Patos Mountain on the other hand, is not very similar in makeup to Capitan Mountain and is important to this study for its inclusion of rhyolite (Allen and Foord 1991:100). I have found four possible sources of diorite within the regional setting. These include Pajarito Mountain which is located 32 kilometers to the south, Bonito Lake Stock which is 32 kilometers to the southwest, and Lone Mountain and Jicarilla Mountains which are both on the outskirts of the regional boundary, 35 kilometers, to the northwest of the site (Allen and Foord 1991: 100-102; Wilks 2005).

The long distance materials represent lithics that were transported more than 35 kilometers to Dunlap-Salazar. Although I only identified one piece of dacite in the debitage sample, dacite can be found in the Sierra Blanca Mountains, specifically in Godfrey Hills and Nogal Peak (Allen and Foord 1991:101). Gabbro and Gneiss are the last two lithic materials that I were able to locate in New Mexico. Gabbro can be found 100 kilometers exactly west of Dunlap-Salazar and gneiss is located in large quantities in northern New Mexico, the closest location being 250 kilometers away (Wilks 2005). Anorthosite and pyroxenite could not be located using geological maps or records so I labeled them long distance.

5.2 Raw Data

Total Debitage Sample

Table 2: The percentage of local, regional, and long distance raw materials in the entire analyzed debitage sample.

Total: 1593 pieces

Andesite: 133
Anorthosite: 21
Basalt: 244
Chert: 240
Dacite: 1
Diorite: 59
Dolerite: 44
Dolomite: 276
Gabbro: 45
Gneiss: 13
Granite: 8
Gray Orthoquartzite: 1
Limestone: 217
Pink Microgranite: 2
Pyroxenite: 1
Quartz: 3
Rhyolite: 14
Sandstone: 43
Shale: 48
Siltstone: 140
Syenite: 7
Trachyte: 27

Table 3: This chart represents the total number of each raw material in the entire analyzed debitage sample.

Local: 937 (58.8%)
Regional: 569 (35.7%)
Long Distance: 81 (5.1%

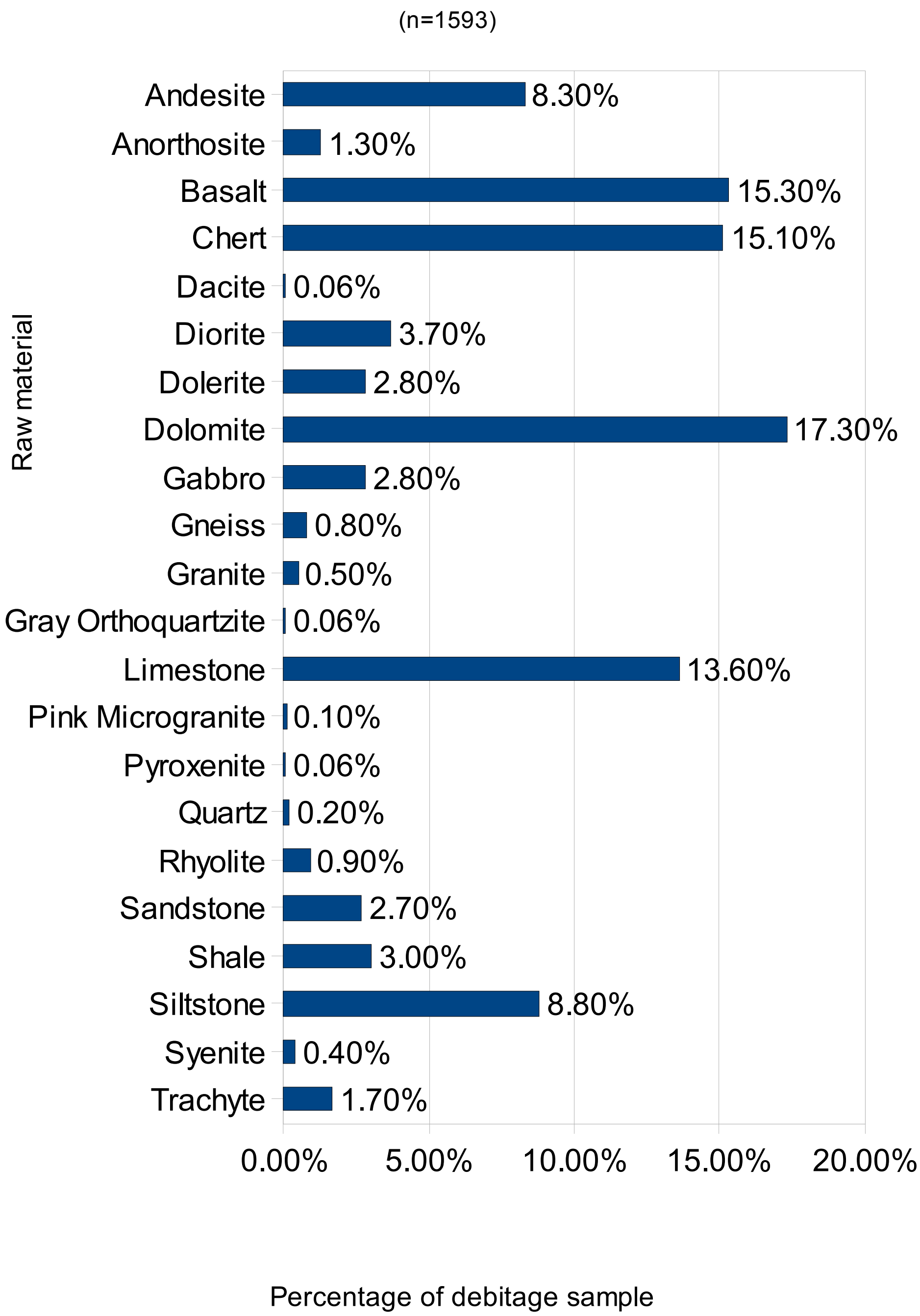

Figure 7: This chart represents the percentages of each raw material in the entire debitage sample that was analyzed.

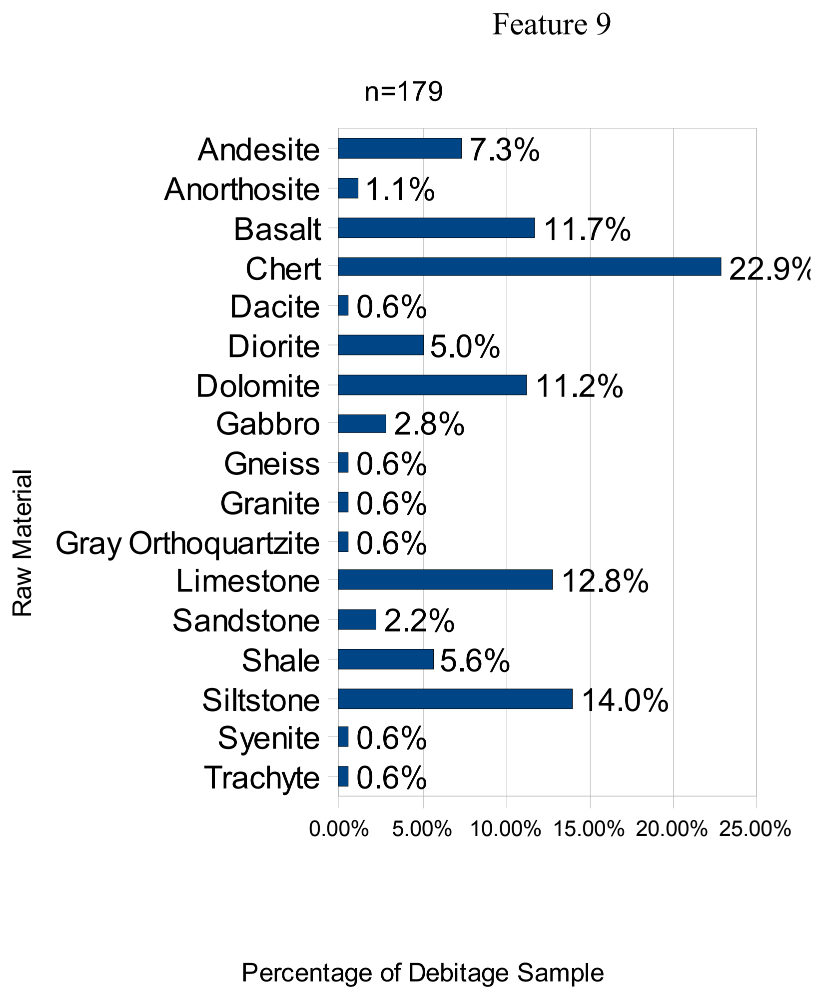

Figure 8: The percentages of each raw material in feature 9.

Table 4: The total number of each raw material in feature 9.

Feature 9: 179 pieces

Andesite: 13	Dolomite: 20	Limestone: 23
Anorthosite: 2	Gabbro: 5	Sandstone: 4
Basalt: 21	Gneiss: 1	Shale: 10
Chert: 41	Granite: 1	Siltstone: 25
Dacite: 1	Gray Orthoquartzite: 1	Syenite: 1
Diorite: 9		Trachyte: 1

Table 5: The percentage of local, regional, and long distance raw materials in feature 9 that was analyzed.

Local: 116 (64.8%)
Regional: 54 (30.2%)
Long Distance: 9 (5%)

Feature 1

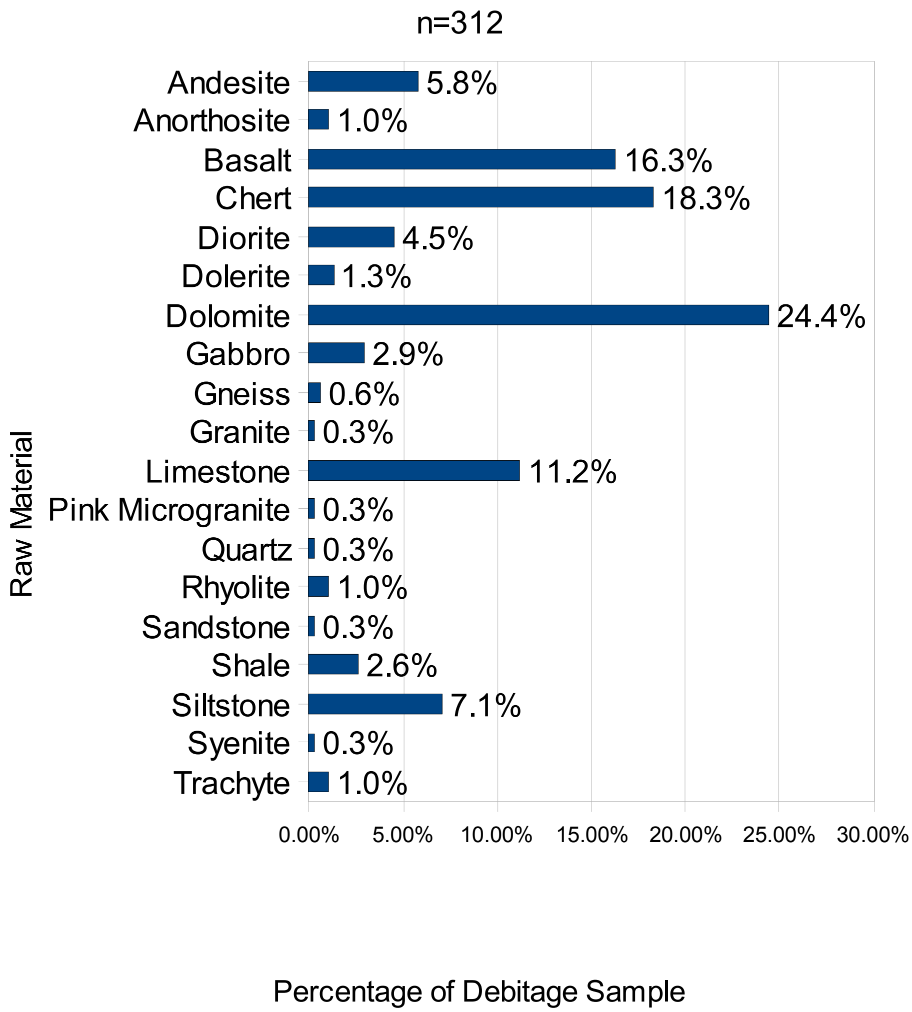

Figure 9: The percentages of each raw material in feature 1.

Table 6: The percentage of local, regional, and long distance raw materials in feature 1.

Local: 195 (63.8%)
Regional: 104 (33.3%)
Long Distance: 14 (4.5%

Table 7: The total number of each raw material in feature 9.

Feature 1: 312 pieces

Andesite: 18	Dolomite: 76	Rhyolite: 3
Anorthosite: 3	Gabbro: 9	Sandstone: 1
Basalt: 51	Gneiss: 2	Shale: 8
Chert: 57	Granite: 1	Siltstone: 22
Diorite: 14	Limestone: 35	Syenite: 1
Dolerite: 4	Pink Microgranite: 1	Trachyte: 3
	Quartz: 1	

Feature 110

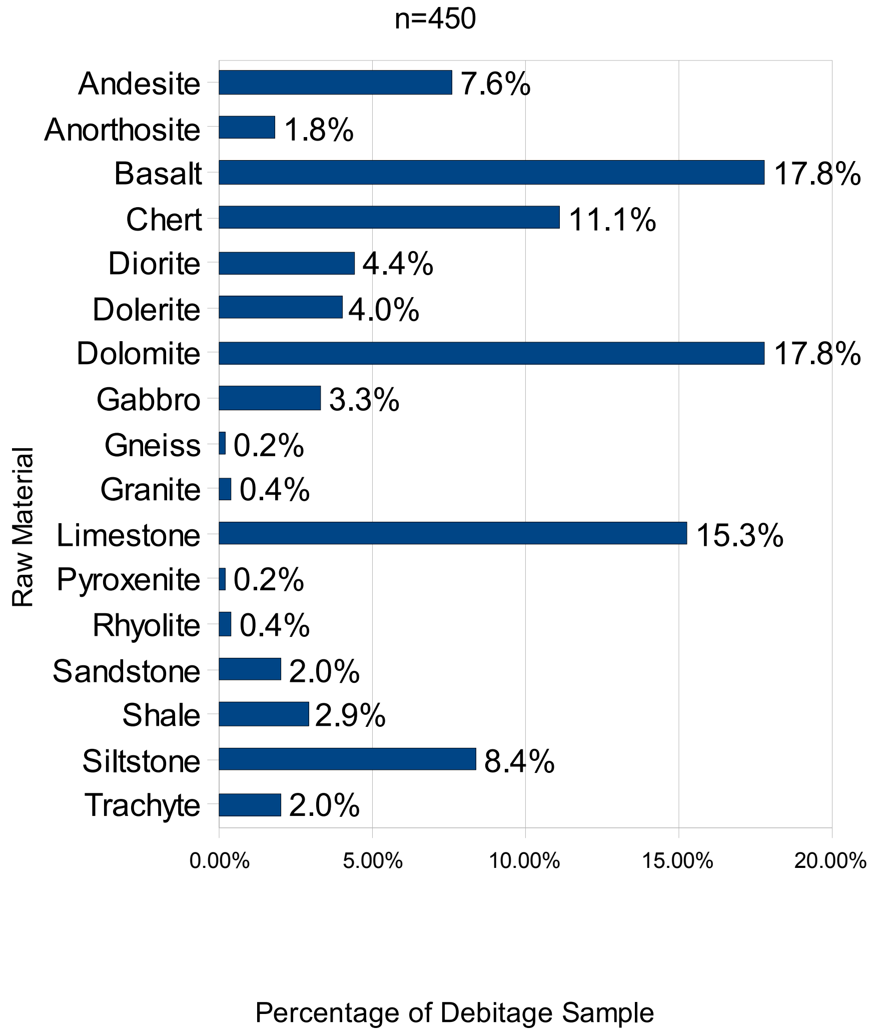

Figure 10: The percentages of each raw material in feature 110.

Table 8: The percentage of local, regional, and long distance raw materials in feature 110.

Local:	248 (55.1%)
Regional:	176 (39.1%)
Long Distance:	25 (5.6%

Table 9: The total number of each raw material in feature 110.

Feature 110: 450 pieces

Andesite: 34	Dolomite: 80	Pyroxenite: 1
Anorthosite: 8	Gabbro: 15	Rhyolite: 2
Basalt: 80	Gneiss: 1	Sandstone: 9
Chert: 50	Granite: 2	Shale: 13
Diorite: 20	Limestone: 69	Siltstone: 38
Dolerite: 18		Trachyte: 9

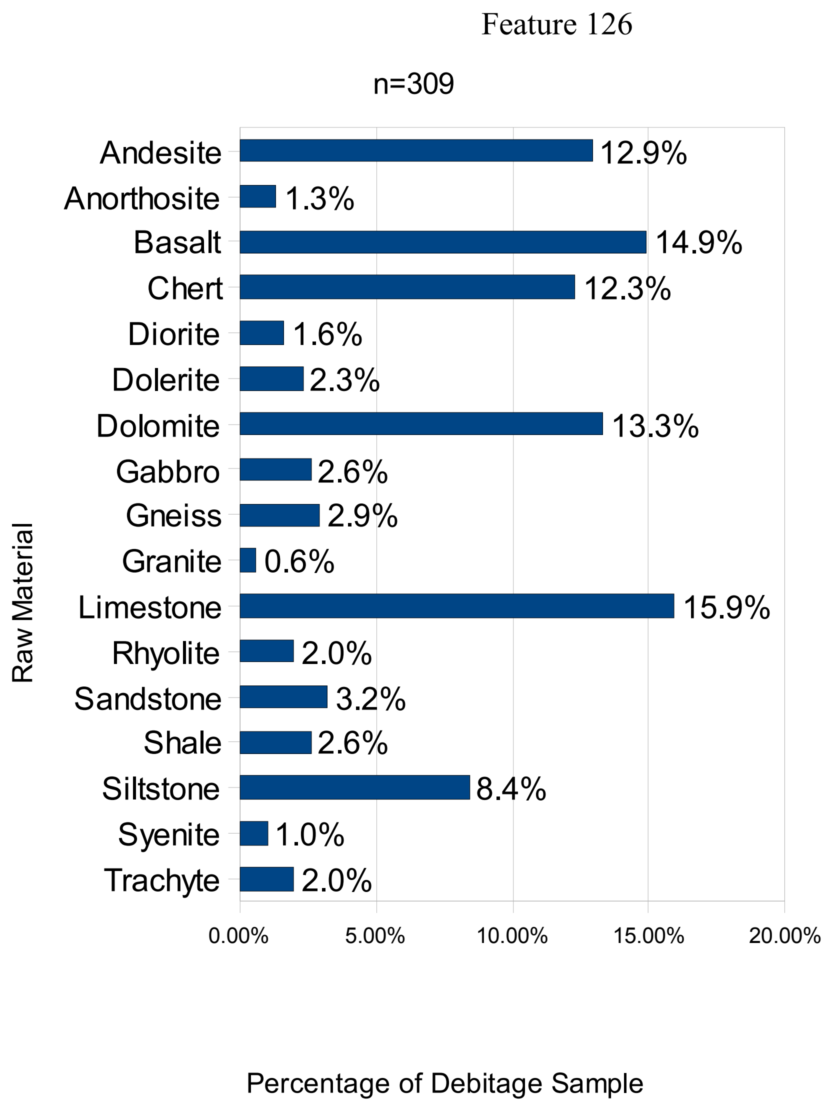

Figure 11: The percentages of each raw material in feature 126.

Table 10: The percentage of local, regional, and long distance raw materials in feature 126.

Local: 169 (54.7%)
Regional: 117 (37.9%)
Non-Local: 21 (6.8%)

Table 11: The total number of each raw material in feature 126.

Feature 126: 309 pieces

Andesite: 40	Dolomite: 41	Rhyolite: 6
Anorthosite: 4	Gabbro: 8	Sandstone: 10
Basalt: 46	Gneiss: 9	Shale: 8
Chert: 38	Granite: 2	Siltstone: 26
Diorite: 5	Limestone: 49	Syenite: 3
Dolerite: 7		Trachyte: 6

Feature 120

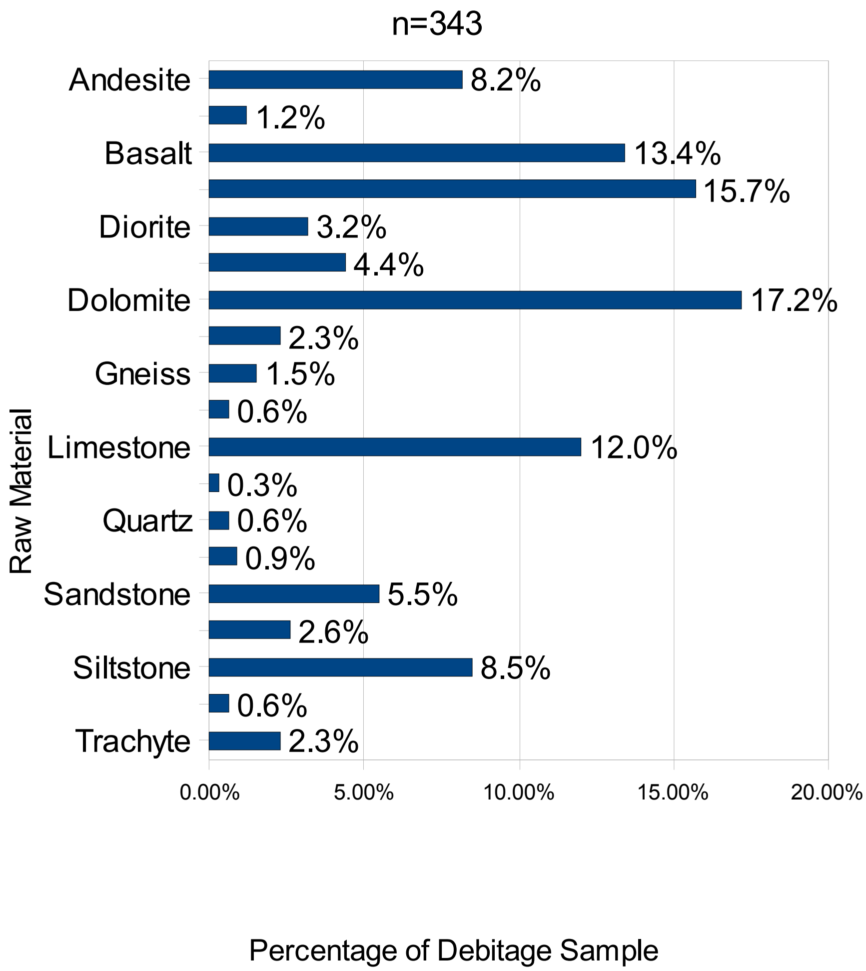

Table 12: The percentages of each raw material in feature 120.

Table 12: The percentage of local, regional, and long distance raw materials in feature 126.

Local: 209 (60.9%)
Regional: 130 (37.9%)
Long Distance:l 17 (5%

Table 13: The total number of each raw material in feature 120 that was analyzed.

Feature 120: 343 pieces

Andesite: 28	Dolomite: 59	Rhyolite: 3
Anorthosite: 4	Gabbro: 8	Sandstone: 19
Basalt: 46	Gneiss: 5	Shale: 9
Chert: 54	Granite: 2	Siltstone: 29
Diorite: 11	Limestone: 41	Syenite: 2
Dolerite: 15	Pink Microgranite: 1	Trachyte: 8
	Quartz: 2	

Chert Abundance

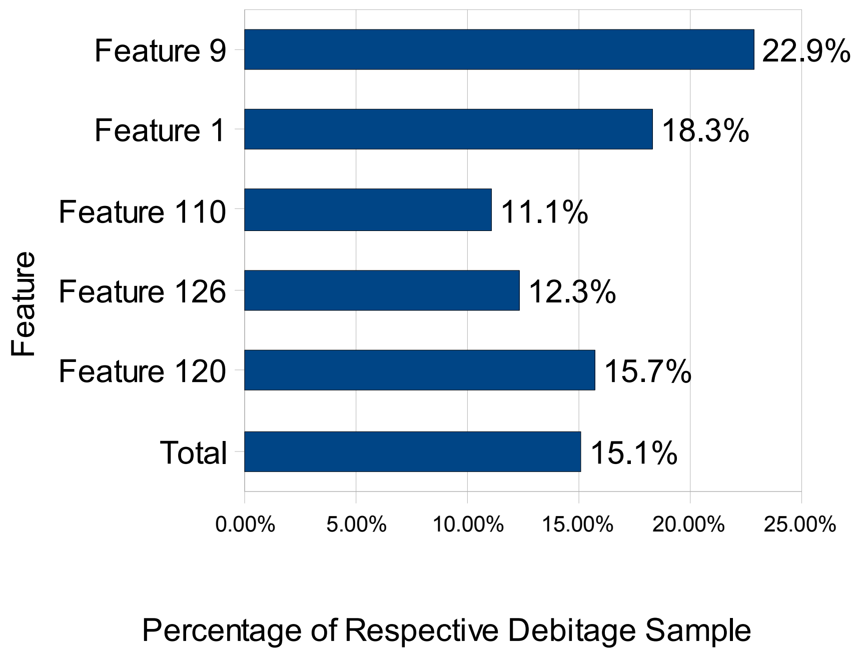

Figure 13: The percentage of debitage in each feature as well as the total analyzed debitage. The features are arranged in chronological order with Feature 9 being the oldest and the features below getting continually younger.

Table 14: The dates (14C cal.) for the five pithouses excavated at the Dunlap-Salazar site.

Pithouse	Date (14C cal.)
Feature 9	554.5 A.D.
Feature 1	624 A.D.
Feature 110	663 A.D.
Feature 126	665.5 A.D.
Feature 120	727.5 A.D.

5.3 Lithic Material Patterning Within the Levels of each Pithouse

For my analysis, I compare the relative amounts of lithic materials between pithouses and not between the arbitrary levels I identified within each pithouse. I group the three arbitrary levels (top, middle, and bottom) within each pithouse and use the data collectively to define the types and amounts of raw materials in each pithouse. On the basis of chronometric analyses, Rocek (personal communication) argues that pit features at Dunlap-Salazar were filled quickly after there original function ended, and that any minimal temporal stratigraphic differentiation within them was destroyed by subsequent taphonomic processes such as rodent disturbance. For this reason, the distribution of the lithics is fairly uniform within each feature. Assuming no biases (such as correlation of rock type with level, or disturbance of upper levels relative to lower ones), I calculated the expected values of each raw material within each layer of the five pithouses by multiplying the total number of flakes by the relative abundance of flakes in the given layer by the relative total abundance of that rock type. A visual examination of lithics recovered from each level (top, middle, and bottom) in each pithouse (tables 15 and 16) shows plenty of variation, but no clear patterns or trends in differences among layers. Particularly when lithics are lumped into the major categories of “local”, “regional”, and “long distance”, there is no suggestion of systematic trends. For instance, while Feature 1 might be said to suggest a shift from Gneiss and Gabbro in the lowest level to Anorthosite and Gabbro above, the number of long-distance materials is nearly constant (4, 5, and 5 respectively). Similarly, while one pithouse might suggest an increase in one category among levels, another pithouse is just as likely to show no trend or the opposite pattern. Given this lack of evidence of patterned inter-level variation, I have assumed that inter-level differences do not represent useful chronological patterning or taphonomically induced biases, and have simply combined counts from the three layers within each pithouse in all subsequent analyses.

Table 15: The number of lithics for each type of raw material separated by layers within each pithouse. The materials in red are long distance, blue are regional, and black are local.

	F1 bot	F1 mid	F1 top	F9 bot	F9 mid	F9 top	F110 bot	F110 mid	F110 top	F120 bot	F120 mid	F120 top	F126 bot	F126 mid	F126 top
Anorthosite		2	1	1	1		3	2	3	1	2	1			4
Dacite				1											
Gabbro	2	3	4		1	1	1	3	11	2	5	1	1	2	5
Gneiss	2							1		1	4			2	7
Pyroxenite							1								
Andesite	11	3	4	4	3	6	14	8	12	7	10	11	11	11	18
Basalt	14	25	12	8	3	10	21	25	34	10	11	25	21	8	17
Diorite	3	7	4	1	3	5	8	9	3	9	2		4	1	
Dolerite		3	1			6	2	11	5	5	6	4	3	4	
Rhyolite		3				2	2			1	1	1		2	4
Shale	2	1	5	3	3	15	7	2	4	4	5		4	2	2
Trachyte	2		1	1			1	4	4	4	1	3	5	1	
Chert	21	20	16	5	8	28	12	24	14	22	11	21	15	15	8
Dolomite	27	25	24	7	7	4	16	33	31	17	17	25	10	20	11
Granite		1		1		1	2				1	1		2	
Gray Orthoquartzite						13									
Limestone	10	6	19	4	6		23	21	25	14	9	18	11	14	24
Pink Microgranite	1									1					
Quartz	1										1	1			
Sandstone	1			2		4	6	3		2	15	2	3	6	1
Siltstone	5	7	10	7	3	1	9	13	17	9	12	8	3	11	12
Syenite	1									1		1	1	2	
N	103	106	101	45	38	96	128	159	163	110	113	123	92	103	113

Table 16: The percentages of lithics for each type of raw material separated by layers within each pithouse. The materials in red are long distance, blue are regional, and black are local.

	F 1	F 1	F 1	F 9	F 9	F 9	F 110	F 110	F 110	F 120	F 120	F 120	F 126	F 126	F 126
	bot	**mid**	**top**	**bot**	**mid**	**top**	**bot**	**mid**	**top**	**bot**	**mid**	**top**	**bot**	**mid**	**top**
Anorthosite		1.9	1.0	2.2	2.6		2.3	1.3	1.8	0.9	1.8	0.8			3.5
Dacite				2.2											
Gabbro	1.9	2.8	4.0		2.6	1.0	0.8	1.9	6.7	1.8	4.4	0.8	1.1	1.9	4.4
Gneiss	1.9							0.6		0.9	3.5			1.9	6.2
Pyroxenite							0.8								
Andesite	10.7	2.8	4.0	8.9	7.9	6.3	10.9	5.0	7.4	6.4	8.8	8.9	12.0	10.7	15.9
Basalt	13.6	23.6	11.9	17.8	7.9	10.4	16.4	15.7	20.9	9.1	9.7	20.3	22.8	7.8	15.0
Diorite	2.9	6.6	4.0	2.2	7.9	5.2	6.3	5.7	1.8	8.2	1.8		4.3	1.0	
Dolerite		2.8	1.0			6.3	1.6	6.9	3.1	4.5	5.3	3.3	3.3	3.9	
Rhyolite		2.8				2.1	1.6			0.9	0.9	0.8		1.9	3.5
Shale	1.9	0.9	5.0	6.7	7.9	15.6	5.5	1.3	2.5	3.6	4.4		4.3	1.9	1.8
Trachyte	1.9		1.0	2.2			0.8	2.5	2.5	3.6	0.9	2.4	5.4	1.0	
Chert	20.4	18.9	15.8	11.1	21.1	29.2	9.4	15.1	8.6	20.0	9.7	17.1	16.3	14.6	7.1
Dolomite	26.2	23.6	23.8	15.6	18.4	4.2	12.5	20.8	19.0	15.5	15.0	20.3	10.9	19.4	9.7
Granite		0.9		2.2		1.0	1.6				0.9	0.8		1.9	
Gray Orthoquartzite						13.5									
Limestone	9.7	5.7	18.8	8.9	15.8		18.0	13.2	15.3	12.7	8.0	14.6	12.0	13.6	21.2
Pink Microgranite	1.0									0.9					
Quartz	1.0										0.9	0.8			
Sandstone	1.0			4.4		4.2	4.7	1.9		1.8	13.3	1.6	3.3	5.8	0.9
Siltstone	4.9	6.6	9.9	15.6	7.9	1.0	7.0	8.2	10.4	8.2	10.6	6.5	3.3	10.7	10.6
Syenite	1.0									0.9		0.8	1.1	1.9	

Chapter 6

RESULTS

6.1 Creating a Comparative Context

As discussed earlier, highly mobile populations procure large amounts of long distance materials. Since Dunlap-Salazar dates to the period of the earliest village formation in the region, I've hypothesized three things: (1) the population was still mobile and used a high percentage of non-local materials; (2) evidence of mobility is reflected differentially in different types of raw materials; and (3) as the population became more established over the several centuries during which Dunlap-Salazar was occupied, the group became more sedentary, causing the percentage of non-local materials to drop.

To evaluate these hypotheses, I compare my results with data from sites of presumed known mobility within the same region as Dunlap-Salazar. I've chosen two late Archaic sites (the pre-village period characterized by relatively high mobility), three sites from the pithouse time period in addition to Dunlap-Salazar, and two puebloan village sites (the period of well established villages, and presumably relatively low mobility) to compare and contrast with Dunlap-Salazar. These sites are not an exhaustive or systematic sample, but were selected to represent nearby sites with readily available published lithic material samples that straddle the period from before to after Dunlap-Salazar. The three sites from the pithouse time period were selected in particular to span the range of variation in debitage samples from this time period. As discussed below, surprisingly, the regional data do not show several of the anticipated trends in lithic material change.

Fresnal Shelter (LA 10101) is one of two Archaic sites used to compare with Dunlap-Salazar and is located about 75 kilometers southwest of the site. It is situated at 1,920 meters in elevation (about 120 meters, or 400 feet higher than Dunlap-Salazar) in the Fresnal Canyon in the Sacramento Mountains, which is on the eastward margin of the Tularosa Basin (McNally 2002:147; Bohrer 2007:20). Initial site usage dates back to 5500 B.C. and ends at around A.D. 500, but the best radiocarbon material comes from the late Archaic portion of the site starting between 1200 and 1000 B.C. (McNally 2002:144; Bohrer 2007:19)—thus, on the order of one and a half thousand years before Dunlap-Salazar. Based on faunal analysis, Fresnal Shelter is believed to have been a base camp for fall and winter deer hunting (Lentz 2006:19).

Table 17: The types, numbers, and percentages of raw materials present at Fresnal Shelter organized by location.

Boundary	Raw Material	Number	Percentage
Local			
	Chalcedony	190	11.6%
	Chert	782	47.9%
	Oolitic Chert	2	0.1%
	Limestone	517	31.7%
	Claystone	1	0.1%
	Dolomite	1	0.1%
	Sandstone	10	0.7%
	Siltstone	105	6.5%
	Silicified Wood	1	0.1%
Regional			
	Diorite	3	0.2%
	Quartz	1	0.1%
	Quartzite	2	0.1%
Long Distance			
	Obsidian	17	1.0%

Table 18: The summary of of local, regional, and long distance raw materials present in the debitage collection at the late Archaic Fresnal Shelter.

Local: 98.6%
Regional: 0.4%
Non-Local: 1%

High Rolls Cave is located within close proximity to Fresnal Shelter in the Sacramento Mountains at an elevation of 1,895 meters (Akins et al. 2006:5). Radiocarbon dates taken from three stratum at High Rolls Cave show three main occupations: the earliest between 1510 $\pm$ 60 and 1300 $\pm$ 60 B.C., the middle between 1310 $\pm$ 40 and 940 $\pm$ 40 B.C., and the latest between 350 $\pm$ 60 and 240 $\pm$ 70 B.C. (Lentz 2006:262-263). Thus, the end of the occupation is a bit less than a thousand years before Dunlap-Salazar.

Table 19: The types, numbers, and percentages of raw materials present at High Rolls Cave organized by location.

Boundary	Raw Material	Number	Percentage
Local			
	Chert	4523	83.1%
	Limestone	511	9.4%
	Basalt	220	4.0%
	Siltstone	3	0.1%
Regional			
	Rhyolite	177	3.3%
	Quartzite	3	0.1%

Table 20: The summary of local, regional, and long distance raw materials present in the debitage collection at the Late Archaic High Rolls Cave.

Local: 96.6%
Regional: 3.4%

LA 139420 is located about 25 km southwest of Dunlap-Salazar along the Rio Ruidoso within the Great Basin conifer woodland zone in the Hondo Valley at about 1,745 meters, only about 50 meters below Dunlap-Salazar in elevation. A total of 51 potential features were identified, including storage pits, a roasting pit, hearth, and two post holes. Fifteen radiocarbon dates were taken from the site and provide an occupation range from A.D. 300-700, with an indication of heavy site usage from A.D. 540-640 (Campbell and Railey 2008:15-16), overlapping Dunlap-Salazar in age.

Table 21: This figure shows the types, numbers, and percentages of raw materials present at LA 139420 organized by location.

Boundary	Raw Material	Percentage
Local		
	Chert	44.5%
	Limey Chert	17.4%
	Limestone	19.6%
	Basalt	1.6%
	Chalcedony	0.3%
	Gypsum	0.1%
	Sandstone	0.1%
Regional		
	Rhyolite	13.3%
Long Distance		
	Obsidian	0.9%
Unknown		
	Indet. Igneous	1.2%
	Indet. Sedimentary	0.4%
	Meta-Sediment	0.3%
	Indeterminate	0.1%

Table 22: The summary of local, regional, and long distance raw materials present in the debitage collection at the pithouse period LA 139420 site.

Local: 83.6%
Regional: 13.3%
Long Distance: 0.9%
Unknown: 2%

LA 139361 is a pithouse period site located about 15 km south of Dunlap-Salazar along the Rio Ruidoso within the Great Basin conifer woodland zone at about 1,910 meters, similar to the two archaic sites elevation, but in the Hondo Valley. LA 139361 and the previously mentioned LA 139420 were excavated in the same project. A storage pit with associated human burial containing three adults and a neonate was excavated at the site. A rich secondary midden fill within the pit has led the excavators to speculate that the pit was situated within a habitation site. One radiocarbon date from maize has yielded a date of site usage between A.D. 660-790 (Campbell and Railey 2008:14), towards the end of the period of occupation of the excavated portion of Dunlap-Salazar.

Table 23: The types, numbers, and percentages of raw materials present at LA 139361 organized by location.

Boundary	Raw Material	Percentage
Local		
	Limestone	49.4%
	Chert	17.3%
	Limey Chert	1.2%
	Chalcedony	0.6%
Regional		
	Rhyolite	12.3%
Unknown		
	Indet. Igneous	18.5%
	Indet. Sedimentary	0.6%

Table 24: The summary of local, regional, and long distance raw materials present in the debitage collection at LA 139361.

Local: 68.5%
Regional: 12.3%
Unknown: 19.1%

LA 49490 is a pithouse site located at the southwestern end of Ruidoso Downs in Lincoln County, New Mexico. The site is just south of the Rio Ruidoso at an elevation of 1,985 meters, about 200 meters above Dunlap-Salazar and about 30 kilometers to the SSW. A total of 24 features were excavated at the site: a majority of them are storage pits, one is a burned pithouse, and five contain human remains (Brown 2007:11-12). The chronology of the site has been determined from numerous dating techniques. Projectile point analysis offers a wide range of dates from ca. A.D. 250-1200 and the ceramic assemblage suggests occupation during the late eleventh or early twelfth centuries A.D. Two radiocarbon samples taken from charred material produced calibrated dates of A.D. 1040 to 1260, A.D. 1050 to 1100, and A.D. 1140 to 1280 (Brown 2007:46). Relying on these dates concludes that LA 49490 post-dates Dunlap-Salazar by a couple of centuries or more and was contemporaneous with the Glencoe and Corona phases.

Table 25: The types, numbers, and percentages of raw materials present at LA 49490 organized by location.

Boundary	Raw Material	Number	Percentage
Local			
	Chert	22	14.6%
	Chalcedony	1	0.7%
	Limestone	1	0.7%
Regional			
	Basalt	114	76.0%
	Rhyolite	11	7.3%
Unknown			
	Indeterminate Igneous	1	0.7%

Table 26: The summary of local, regional, and non-local raw materials present in the debitage collection at the pithouse period LA 49490 site

Local: 16%
Regional: 83.3%
Unknown: 0.7%

The Angus site (LA 3334) is located upstream of Dunlap-Salazar, high on the Rio Bonito Valley at an elevation of 2,088 meters near Angus, New Mexico, about 300 meters above Dunlap-Salazar and 25 km to the WSW (Alldritt 2000:3). The site consists of five pueblo rooms, a kiva, a ramada area with associated hearths, two pit structures, and an external storage pit (Zamora and Oakes 2000:31). A total of 19 radiocarbon dates were obtained from the Angus site. These dates correspond to three distinct times: ca. A.D. 1015, A.D. 1310, and A.D. 1425. The earlier of the three dates, ca. A.D. 1015, corresponds to the pithouse structure found on the site. The main occupation occurred at ca. A.D. 1310 with the construction of pueblo rooms 2 and 3 and the storage pit. Dates have not been obtained for the kiva, but the excavators believe it is associated with these nearby features. This period corresponds to a couple of centuries up to about 500 years after the period represented by the excavated portion of Dunlap-Salazar. The last occupation at the Angus Site, at ca. A.D. 1425, may have been by Athabaskan (Apache) nomads who moved into the region following abandonment by the puebloan population in the early 15th century . Possible Athabaskan pottery and projectile points have been found in pueblo room 1 and may by conclusive evidence that the site was reoccupied after the puebloan population abandoned it (Oakes 2000: 95-97).

Table 27: The types, numbers, and percentages of raw materials present at the Angus site organized by location.

Boundary	Raw Material	Number	Percentage
Local			
	Shale	1923	83.6%
	Chert	122	5.3%
	Quartzite	123	5.3%
	Siltstone	19	0.8%
	Limestone	9	0.4%
	Chalcedony	3	0.1%
Regional			
	Andesite	78	3.4%
	Rhyolite	6	0.3%
Long Distance			
	Obsidian	7	0.3%
Unknown			
	Igneous	11	0.3%

Table 28: The summary of local, regional, and non-local raw materials present in the debitage collection at the transitional/pueblo period

Local: 95.5%
Regional: 3.7%
Long Distance: 0.3%
Unknown: 0.3%

The Lower Stanton Ruin pueblo site (LA 69102) is located in the Sierra Blanca Region east of the Sacramento Mountains and south of the Rio Bonito at 1,844 meters, about 40 meters above Dunlap-Salazar and less than 5 km to the WSW of the site. Although the exact site layout can not be concluded based on the excavations carried out, adobe surface structures have been identified in a rectangular orientation. Three radiocarbon dates taken from a hearth and trash pit yield dates of ca. A.D. 1455, A.D. 1415, and A.D. 1355. Lower Stanton Ruin fits into Kelley's Lincoln phase pueblo period in the Sierra Blanca Region (McNally 2002:152-156), on the order of 600 years after the date of the excavated portion of Dunlap-Salazar.

Table 29: The types, numbers, and percentages of raw materials present at Lower Stanton Ruin organized by location.

Boundary	Raw Material	Number	Percentage
Local			
	Siltstone	749	46.5%
	Chert	361	22.4%
	Limestone	113	7.1%
	Chalcedony	73	4.5%
	Sandstone	31	1.9%
	Quartzite	25	1.6%
	Claystone	5	0.3%
	Quartz	2	0.1%
	Granite	2	0.1%
	Orthoquartzite	1	0.1%
Regional			
	Andesite	167	10.4%
	Diorite	76	4.7%
	Rhyolite	4	0.2%
	Basalt	1	0.1%

Table 30: The summary of local, regional, and non-local raw materials present in the debitage collection at Lower Stanton Ruin pueblo.

Local: 84.6%
Regional: 15.4%

Comparing all of the regional sites, my results show several notable trends. First, the amount of long distance material is very low at *all* sites from this time range, nor is there any evidence of a trend over time as seen in figure 14. Thus, while the previously cited Paleo-Indian evidence indicates long-distance bulk transport of lithics associated with very high levels of mobility, by the late Archaic period (and subsequent to it), there is no suggestion of such long-distance movement in sites at this region. Hence, mobility from this study is more likely to be identified at the regional scale, rather than the long-distance scale.

As seen in figure 14 however, the regional sites *do* show interesting, if unexpected, patterning in the abundance of regional material over time. Between the Archaic and pithouse sites, there is an increase in the amount of regional material; this increase is followed by a drop in the amount of regional material at the pueblo sites, returning to a level comparable to the low values seen in the Archaic.

Examining changes in raw material types, there is also a trend toward a decrease in the amount of chert over time as seen in figure 16 . This is anticipated, since chert is the highest quality widely used material at any of the sites. Archaic sites have a very high percentage of chert, pithouse period sites display a wide range of percentages, but all lower than the Archaic. The pueblo period sites' percentages remain low and overlap with the pithouse sites, but given the range of the pueblo sites' samples, a larger, more systematic sample would be necessary to evaluate whether any average trend exists between the pithouse and pueblo periods.

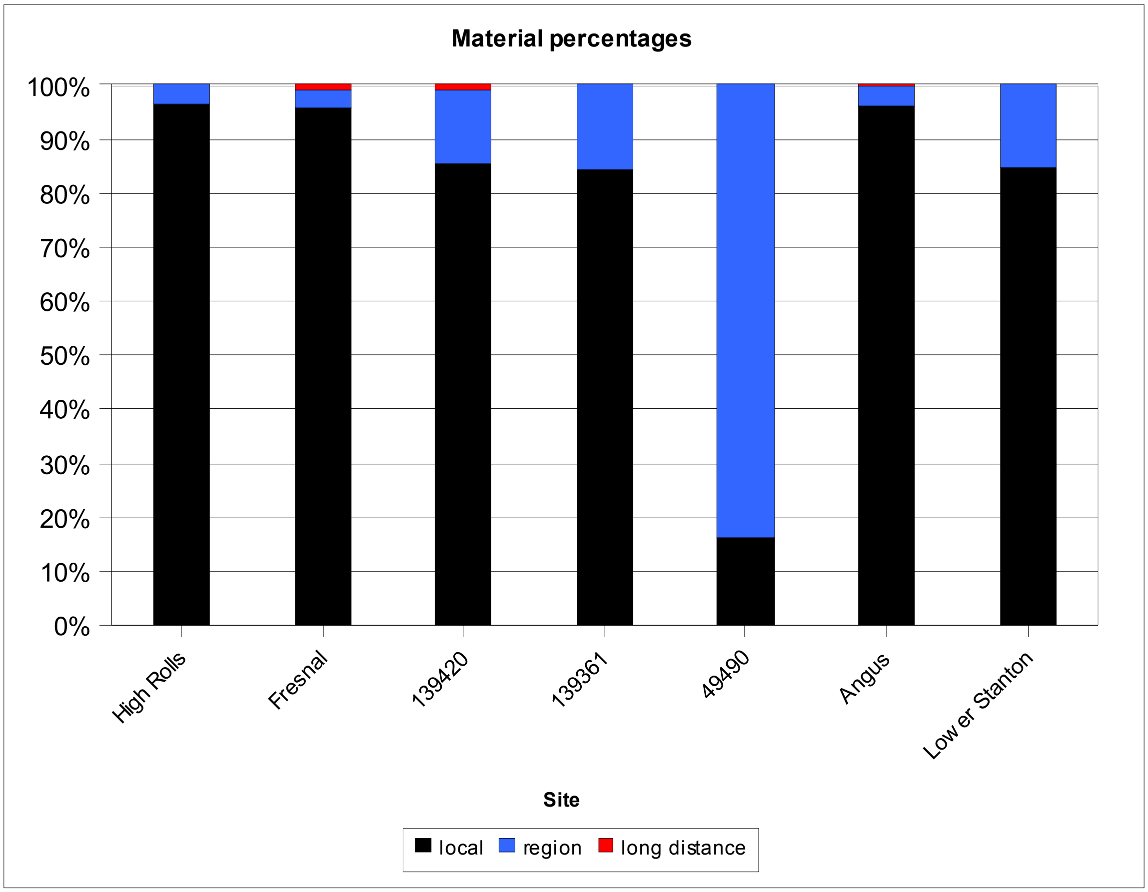

Figure 14: This chart show the percentages of local, regional, and long distance materials at the regional sites around Dunlap-Salazar.

6.2 An Inter-Site Comparison of Local, Regional, and Long Distance Materials

As mentioned earlier in this section, I expected the Archaic sites to contain high percentages of long distance material, in fact the highest among all of the time periods. Contrary to my initial expectations, *none* of the sites are dominated by, or heavily represented by long distance materials. Interestingly, the debitage sample from Dunlap-Salazar yields the highest percentage of long distance material (figure 15), but this represents only about 5% of the raw materials. As discussed above, such relatively small amounts are readily explicable in terms of long distance material typically procured via trade as opposed to having been obtained by a population expressing a high degree of mobility. Paleo-Indians, as discussed in a previous section, utilized a high degree of mobility and acquired their lithic assemblages by way of long distance bulk transport.

Among the regional sites, Dunlap-Salazar also stands out because its debitage sample contains the second highest percentage of regional material (figure 15). The site's high percentage is consistent with the other pithouse sites which also contain relatively high percentages of regional material and which equal or exceed that of pueblo period sites. This pattern is consistent with my expectations for significant *regional* mobility. However, a notable complication is indicated in the low percentage of regional material at Archaic sites, lower than sites from *either* of the later periods. Thus, interpretation of this regional material trend is ambiguous, and is addressed further below.

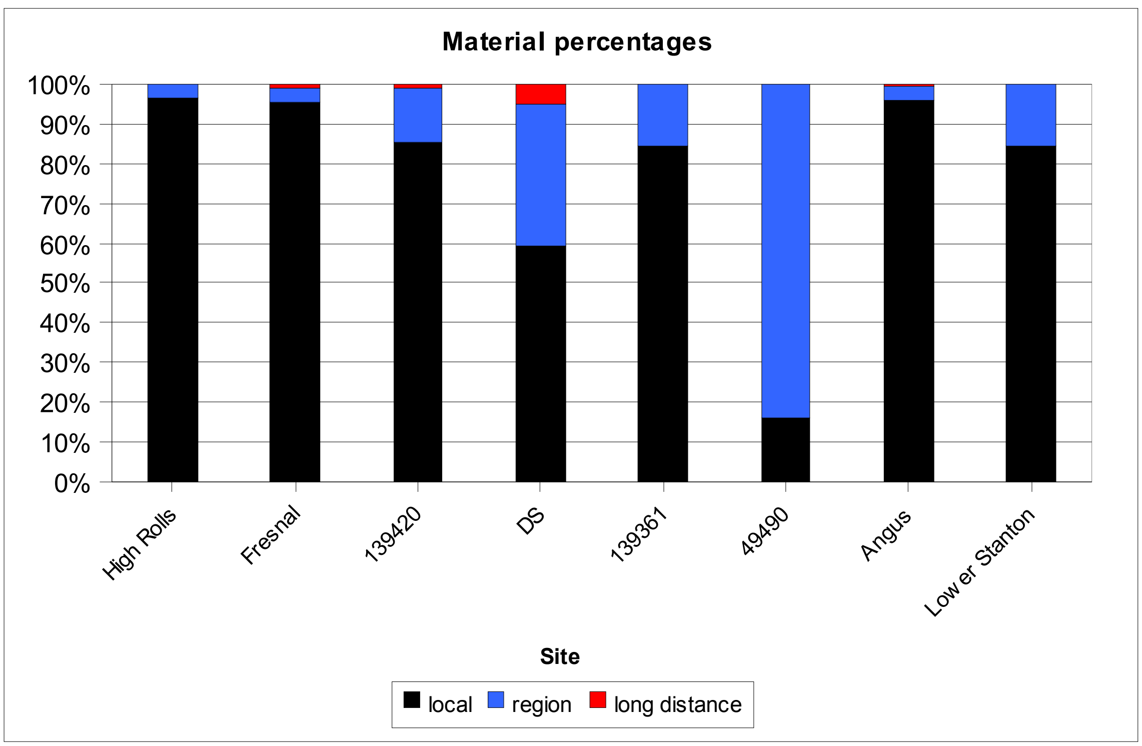

Figure 15: This chart show the percentages of local, regional, and long distance materials at Dunlap-Salazar and the surrounding regional sites.

6.3 Variation Among Materials: Chert

Comparing the regional sites, including Dunlap-Salazar, over time shows that there is a decrease in chert over time (figure 16). Dunlap-Salazar has a low percentage of chert which is comparable to the other pithouse sites and notably lower than that of the Archaic sites. This may suggest decreasing mobility from the archaic into the pithouse period. Given the high variation and limited sample of the two pueblo period sites, the trend between Dunlap-Salazar and the pueblo period cannot be determined because the percentages of chert at the two pueblo sites straddle the chert values from the pithouse sites. If chert represents mobility, as according to Greenwald (2008), it can be inferred from the data that the Dunlap-Salazar inhabitants were less mobile than the Archaic site inhabitants and within the range of mobility of other pithouse inhabitants; the trend relative to the pueblo site inhabitants is unclear. Railey also reported a similar pattern in his analysis of Archaic and Early Formative sites along US Highway 70 in the Rio Hondo drainage of southern New Mexico (2010:36).

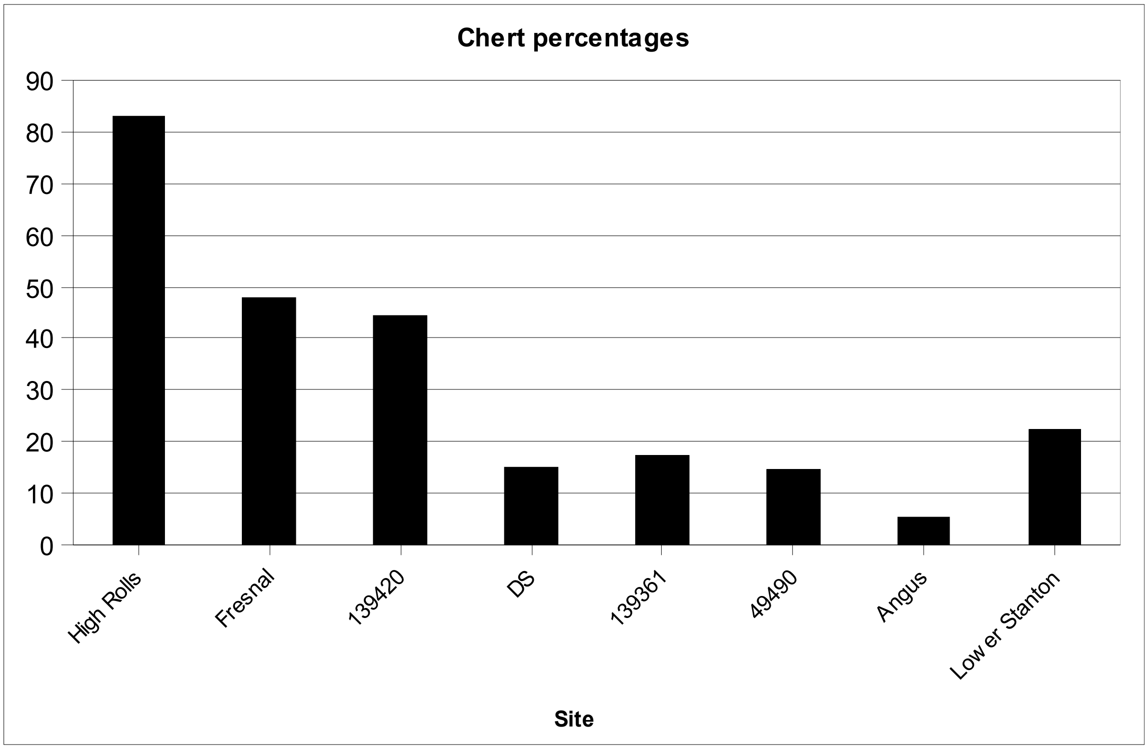

Figure 16: Chert percentages at Dunlap-Salazar and surrounding regional sites.

6.4 Intra-Site Trend Over Time

While there are several suggestive trends *among* the regional sites of different periods discussed above, it is instructive to examine variation *within* Dunlap-Salazar. As seen in tables 31 and 32 and figure 17 a comparison of the percentages among the five houses excavated at Dunlap-Salazar suggests that there are no trends in the quantity of local or long distance materials over time. However, there is a trend for an increase in regional material and perhaps a trend toward a reduction in chert over time. Since each structure is chronometrically dated, it is possible to directly evaluate the pattern of correlation between date and change in raw materials. The positive correlation of regional materials with time is strong (.87), attaining a significance of just less than .06 as seen in table 33. Given the low statistical power of this test with the small sample of five pithouses, this result is suggestive, though not conclusive.

Table 31: This table shows the amount of local, regional, and long distance materials by count at Dunlap-Salazar.

	Counts				
Feature	**9**	**1**	**110**	**126**	**120**
Date	554.5	624.0	663.0	665.5	727.5
local	116	195	248	169	209
regional	54	104	176	117	130
long distance	9	14	25	21	17
chert	41	57	50	38	54

Table 32: This table shows the amount of local, regional, and long distance materials by percentage at Dunlap-Salazar.

	Percentages				
Feature	**9**	**1**	**110**	**126**	**120**
Date	554.5	624.0	663.0	665.5	727.5
local	64.8	63.8	55.1	54.7	60.9
regional	30.2	33.3	39.1	37.9	37.9
long distance	5.0	4.5	5.6	6.8	4.8
chert	22.9	18.2	11.1	12.4	15.2

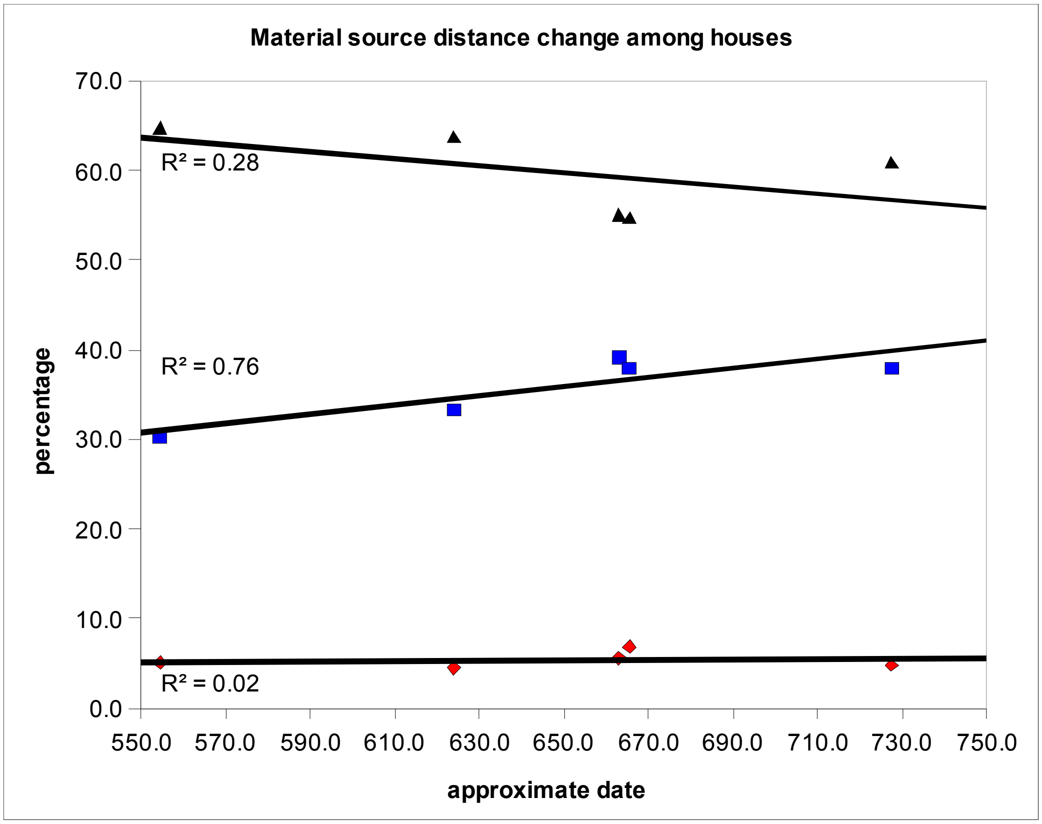

Figure 17: This figure shows the trends of local (black triangle), regional (blue square), and long distance (red diamond) materials over time among the pithouses at Dunlap-Salazar.

Table 33: This table shows the correlations between date, percentage of regional material, percentage of long distance material, and percentage of chert at Dunlap-Salazar.

		regional_perc	long distance perc	chert_perc
date	Pearson Correlation	.869	.147	-.747
	Sig. (2-tailed)	.056	.814	.147
	N	5	5	5
regional_perc	Pearson Correlation		.470	-.970**
	Sig. (2-tailed)		.424	.006
	N		5	5
long distance perc	Pearson Correlation			-.574
	Sig. (2-tailed)			.312
	N			5

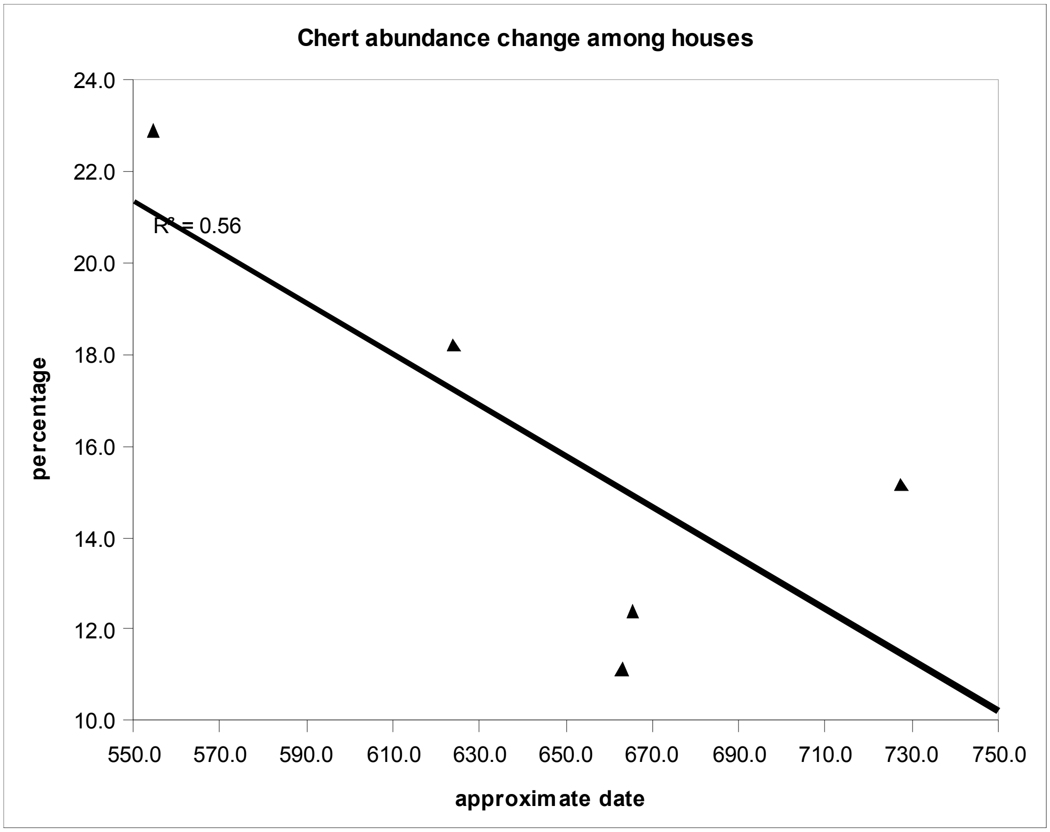

Figure 18: The trend of the percentage of chert among the pithouses at Dunlap-Salazar.

Tables 31 and 32 and figure 18 also show a very suggestive trend toward a decrease in chert abundance over time with a negative correlation of -.75. However, again given the small sample size, the possibility that this apparent trend is the result of chance remains possible ($p<.15$). As outlined in my discussion above, these results match the rather puzzling archaic to pithouse period trends, where despite the presumed trend of a decrease in mobility over time, chert abundance drops while regional lithic abundance increases. I discuss these results further below.

6.5 Summary

It is evident that after comparing the regional sites, long distance material is not a good indicator of mobility in the period considered here. All of the sites have a very low percentage of long distance material. Dunlap-Salazar has the highest percentage of long distance material which may not represent mobility, but may reflect trade.

The regional material patterns in an interesting way: the pithouse sites have more regional material than the Archaic and pueblo sites. Dunlap-Salazar fits the pithouse pattern by having a high amount of regional material. Overall, this pattern is consistent with me expectations for a reduction in mobility levels in the period following the pithouse period. However, given the *low* levels of regional materials in the Archaic sites, this trend remains ambiguous as well, and can not be directly assumed to support the hypotheses about changing mobility over time. The complexity of these patterns is discussed further below.

Within Dunlap-Salazar, the data show that the only strong trend is an increase of regional material over time. This trend is counterintuitive because it implies an increase in mobility over time among the Dunlap-Salazar inhabitants. The chert results prove to be the most consistent with initial expectations. Comparative data shows that chert is highest among the Archaic sites and the earliest pithouse site. The relatively low levels of chert at Dunlap-Salazar follows this decreasing trend of chert over time. This would be consistent with my expectations for a steady decrease in mobility between the Archaic site inhabitants and pithouse site inhabitants. However, a comparison with the pueblo sites is not possible because of the small sample of only two sites which yield a range of chert values overlapping the pithouse pattern. Finally, consistent with the regional pattern from archaic into the pithouse period, there is a small suggestive trend of decreasing chert among the pithouses at Dunlap-Salazar over time, perhaps consistent with my expectation for a decrease in mobility. Given the small sample of houses, however, even the fairly strong negative correlation of chert abundance with time remains ambiguous.

Chapter 7

DISCUSSION

7.1 Correlation of Regional Material vs. Chert at Dunlap-Salazar

The negative correlation between chert and regional material at Dunlap-Salazar implies that as the inhabitants utilized less chert, there was a direct increase in the amount of regional material used. Thus, when chert was rare, site inhabitants had the choice of using alternative (generally, lower quality) local material, more long-distance material, or collecting more regional materials. However, the two former patterns do not seem to occur; when little chert is found the total percent of local material decreases and long-distance materials remain rare (negatively correlating only weakly with chert); instead, *regional* materials exhibit a strong increase with a drop in chert. This pattern is consistent with the trend among the comparative Late Archaic through Pueblo period sites, which show a negative correlation, though weak and statistically insignificant, between chert and regional raw materials (figure 19). Not surprisingly, given the longer time interval, wider range of site settings, and correspondingly greater diversity of lithic resources involved in the inter-site comparison as opposed to the Dunlap-Salazar data, the pattern here is less marked. But again, the alternative to chert appears to be regional materials rather than long-distance procurement or simply increased procurement of lower quality local stone.

As previously noted, the low quantities of long distance and regional materials at the Late Archaic sites were unexpected. We know, however, that high percentages of long distance materials are typical of even earlier periods such as the Paleo-Indian. Given the limited investment in architecture, sporadic use of storage and agriculture, and broad regional stylistic patterns, Late Archaic inhabitants were undoubtedly still highly mobile, but presumably traveled on a smaller scale than earlier peoples, which would explain the small amount long distance lithic material found on the Late Archaic sites.

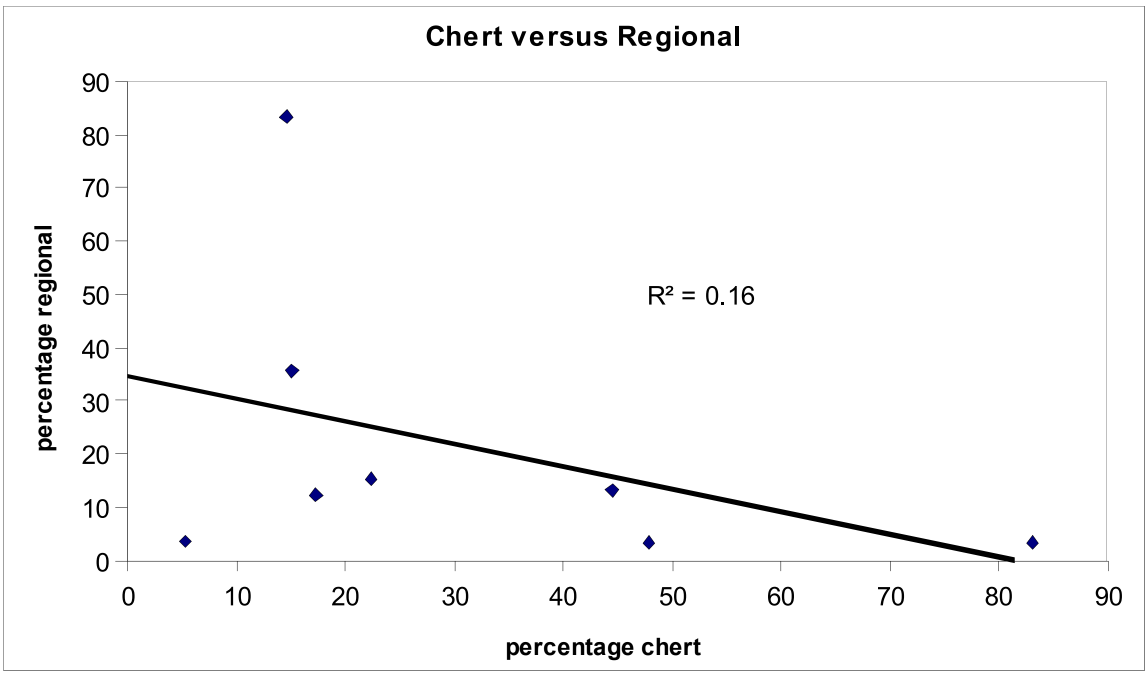

Figure 19: The regional trend between chert and regional material among all of the sites analyzed.

While the presumed reduced long-distance mobility of this period accounts for the paucity of long-distance materials, the low percentages of *regional* materials seen at Late Archaic sites remains surprising. I propose that this paradox may be caused by my classification of chert as a local material. Although chert *is* in fact widely available locally, it typically occurs in small nodules, most of which would be difficult to use for flint knapping. In order for Archaic populations to have acquired the large amounts of usable chert seen in the debitage samples at Archaic sites, they most likely collected chert over a large area rather than just within the 8 km “local” limit defined here. In other words, substantial use of chert doesn't strictly represent local mobility, but in fact represents *regional* mobility.

On this assumption, we can examine the pattern of resource change over time if we move chert from the “local” to the “regional” scale. Under such a redefinition, the percentage of “local” material (with chert excluded) increases steadily over time among the regional sites as seen in figure 20. LA 49490 (the lone dot in the bottom right of figure 20) is the only exception to the pattern, and stands out as an outlier; in fact it is notable for it’s small sample size and the uniquely high percentage of basalt which contrasts it with all of the other sites in the sample. If we exclude LA 49490 from the analysis, the correlation of increased local raw material is substantially strengthened (.72) with a significance of less than .07. The pithouse sites (including Dunlap-Salazar) group together, at the upper end of, but overlap the Archaic sites in local lithic abundance, and contrast with the pueblo period sites, particularly the most recent of the sites, Angus (figure 21).

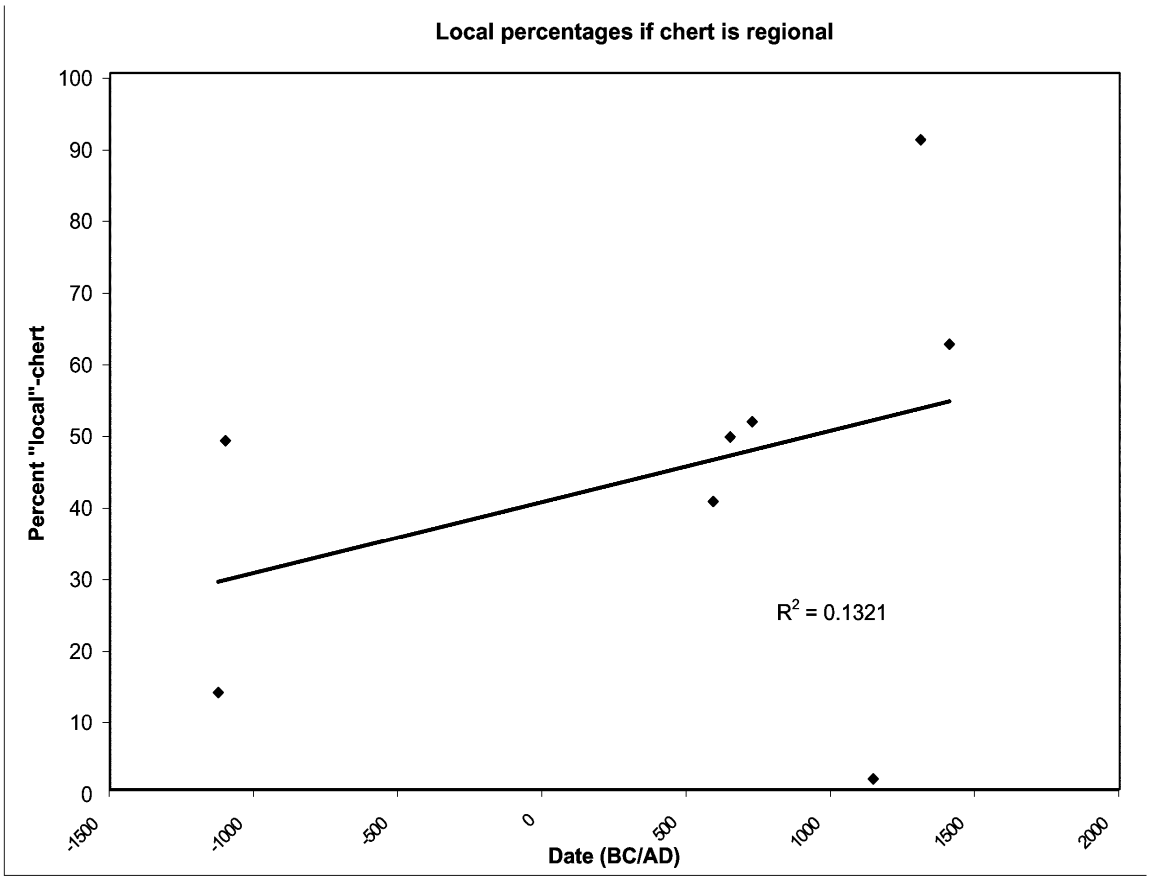

Figure 20: The trend for the percentage of local material if chert is classified as a regional material at each site; all comparative sites included.

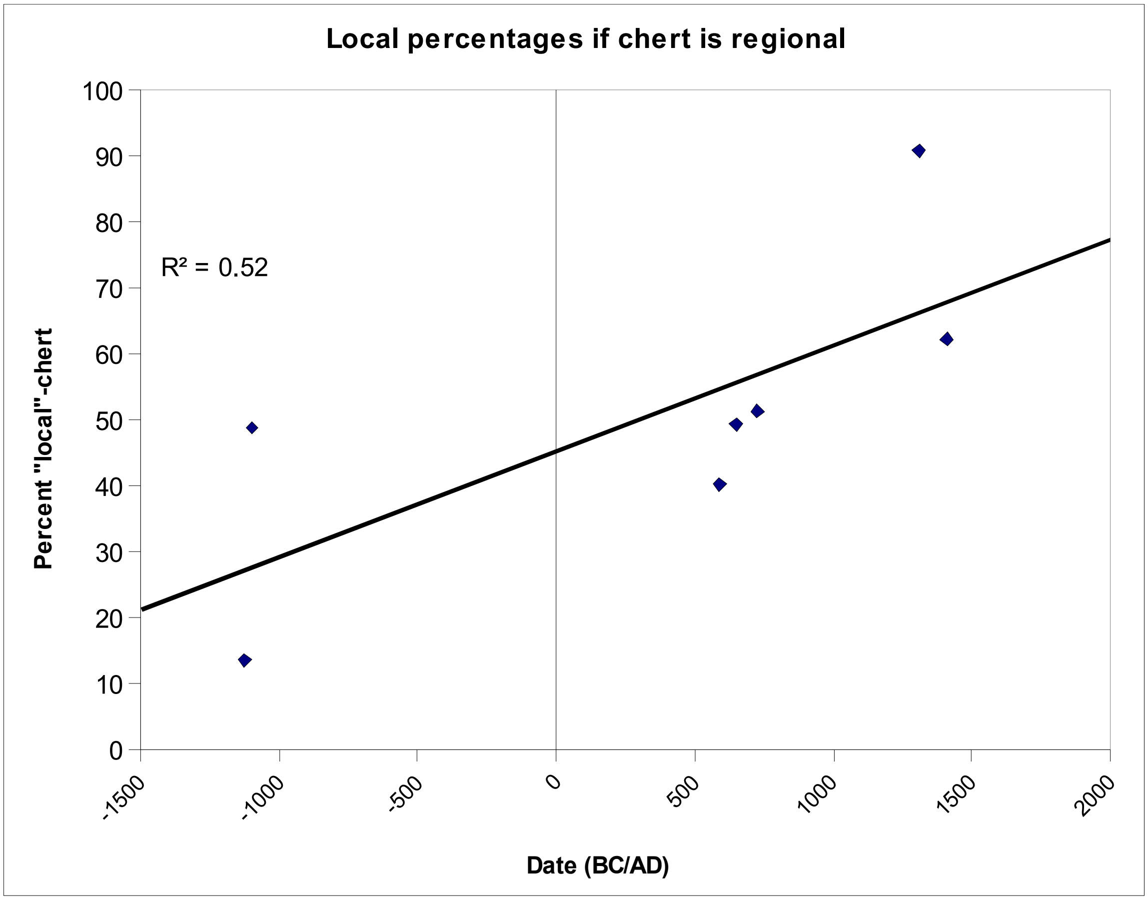

Figure 21: The adjusted trend for the percentage of local material if chert is classified as a regional material at each site if LA49490 is not included.

The Dunlap-Salazar intra-site pattern is interpretable in these terms as well. While chert percentages among Dunlap-Salazar houses decrease and regional percentages increase over time (figure 17 and figure 18), a plot of regional *plus* chert is consistent with a weak, albeit statistically insignificant decrease over time (r=-.59, p<.29; figure 22).

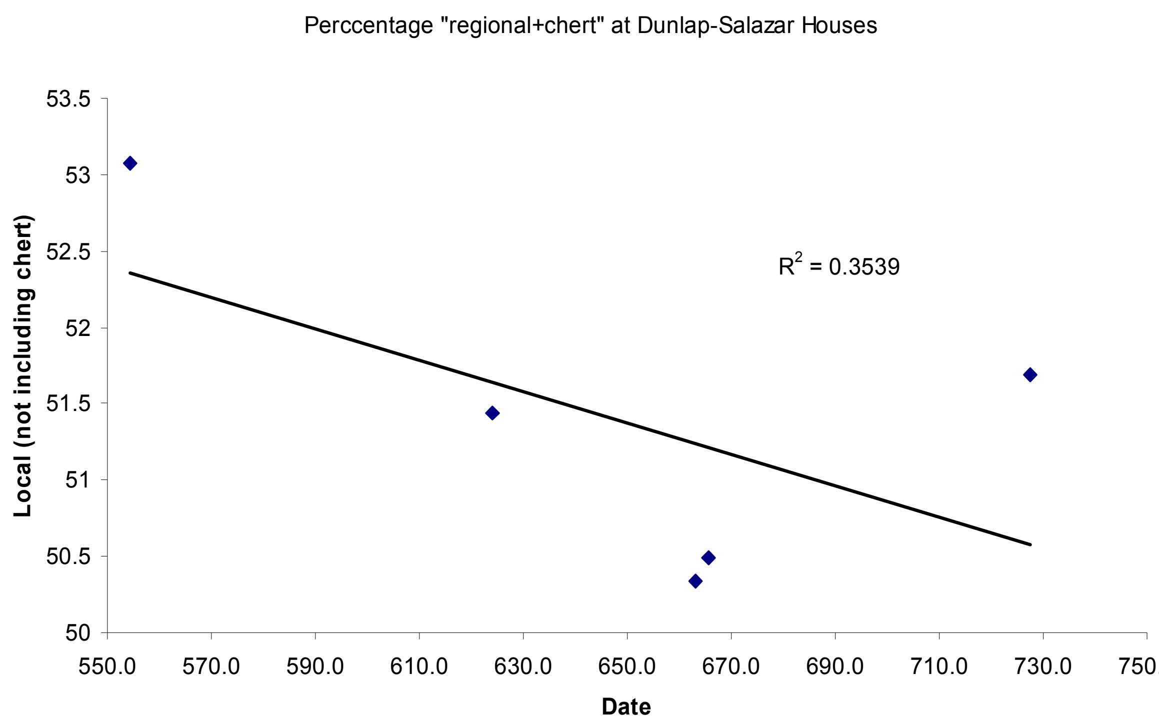

Figure 22: The trend in "regional plus chert" among Dunlap-Salazar houses, plotted in chronological order.

Thus, while the patterns predicted by my hypotheses for lithic procurement at Dunalp-Salazar are *not* found in there original forms, neither is the expected pattern of lithics at Late Archaic sites. However, if chert is reinterpreted as a regional, rather than a local scale resource, the paradox of the Late Archaic lithic pattern is resolved, and the Dunlap-Salazar lithic pattern is transformed into the sort of intermediate level that would be predicted by an intermediate level mobility, and perhaps a trend toward decreasing mobility over the course of the site occupation. It must be noted, however, that the latter interpretation is particularly tenuous, since the correlation is far from statistically significant.

7.2 The Introduction of the Bow and Arrow as a Factor Influencing Lithic Material Selection

Railey (2010) has proposed an alternative theory explaining changes in lithic raw material selection over time which is potentially at odds with the mobility interpretation discussed previously. As discussed above in the section entitled "Relative Chert Abundance As a Second Test," this interpretation argues that as populations become more sedentary, they tended to use more expedient and low quality materials to make tools, since mobile populations are likely to be more "picky" in selecting materials that they had to transport with them and curate. On the other hand, while sedentary populations have less opportunity and less need for such selectivity—they tend to use locally available lithics of variable quality in relatively wasteful (expedient) ways, since they do not need to transport them long distances and husband their supplies. Although Parry and Kelley argue that the shift towards expedient tools in the Southwest occurred around the same time as reductions in mobility and intensification of farming, Railey suggests that the introduction of the bow and arrow corresponds better with the shift towards the increased use of expedient tools than does a reduction in mobility (Railey 2010:20).

Railey argues that this transition accounts for the shifts in tool assemblages and lithic material selection for populations in the Southwest in the Late Archaic and later.

Prior to the bow and arrow, the atlatl, or spear thrower, was the most widely used weapon in North America. The atlatl is a long shaft with a hook on the end of it which holds the dart in place. The shift towards the bow and arrow occurred at around A.D. 500-700, coinciding with the changeover towards increased expedient tool production. Importantly, the average shapes and sizes of darts and arrows are very different: effective dart points are larger and heavier whereas effective arrows are smaller, lighter, and thinner. Railey (2010:19-20) argues that this shift in projectile attributes changed the techniques used for tool production and the materials selected by flint knappers for manufacture.

Making a larger atlatl dart involves the use of a complex biface reduction process, requiring large pieces of raw material and producing a higher number of flakes than that are required to make a small arrow out of a flake. Not only are fewer flakes produced during arrow production, but they are smaller and more difficult to recover during excavation and screening. Thus, Rialey (2010:21-22) argues that flake assemblages from sites postdating the introduction of the bow and arrow are disproportionately skewed against the small flakes produced during arrow manufacture. Lastly, arrow production conserves high quality materials much better than dart production because it creates fewer errors and uses less material.

Railey suggests that these biases, rather than shifts in mobility, explain why site assemblages postdating the bow and arrow seem more expedient than site assemblages that predate it. Tool assemblages, thus, would lack the debitage produced during arrow production and contain a high presence of early stage flaking. This early stage flaking produces flakes that are much cruder and characteristic of the debitage produced by expedient tool production. Similarly, the bias against the recovering of the small flakes at arrow-using sites would result in less high quality material, such as chert, being recovered. According to Railey, the use of the bow and arrow may be an explanation for seemingly expedient tool assemblages instead of a reduction in mobility (2010:25-26).

Railey's interpretation is provocative, and may require a reconsideration of the causes for changes in lithic technology in the Late Archaic through pithouse periods. Resolution of Railey's interpretation versus Parry and Kelley's is beyond the scope of this thesis. Intriguingly the argument applying to lithic *procurement* strategies (as opposed to lithic reduction strategies) might not differ under Railey versus the Parry and Kelly view. Specifically, the sort of contrast between a strategy emphasizing large biface reduction for dart points versus small flake shaping for arrow points would still entail a need for larger pieces of high quality lithic materials for the former—precisely the argument made above for why chert should be considered a regional, rather than a local resource. Thus, under both the Parry and Kelly and the Railey interpretations, the shift seen from abundant chert in the Archaic to less chert and more regional lithics in the pithouse period to mostly local lithics in the Pueblo period implies a progressive decrease in lithic "pickiness", and thus a collection of materials from an increasingly restricted area. Whether the ultimate cause is, as suggested by Parry and Kelly, an overall reduction in residential mobility that restricted access to high quality materials and reduced the impetus for a curated technology made by an expedient technology focused on low-quality materials practical, or alternatively whether it is, as suggested by Railey, a technological shift towards smaller projectiles (arrow points instead of dart points) which required smaller blocks of high quality raw material broken down into smaller pieces (resulting in fewer of the high-quality materials being found in excavations), both scenarios are consistent with an interpretation of the shift in raw materials documented here as reflecting more localized collection of stone raw materials.

Clearly Railey's argument warrants considerably more research, and might require refinement of the interpretations of the *types* of mobility reflected in the lithic data, and the degree to which mobility is confounded with other technological changes. Nevertheless, the trend towards increasing local raw materials over time is consistent under a variety of scenarios with a pattern of gradual reduction in mobility over time.

Chapter 8

CONCLUSION

In my study I set out to test three hypotheses about the Dunlap-Salazar occupation: (1) the population was still mobile and thus used a high percentage of non-local materials; (2) evidence of mobility is reflected differentially in different types of raw materials; and (3) as the population became more established over the several centuries during which Dunlap-Salazar was occupied, the group became more sedentary, causing the percentage of non-local materials to drop.

After compiling data from Dunlap-Salazar, I then pulled together the data from sites in the surrounding region spanning the Late Archaic through Pueblo period in order to establish a comparative basis for evaluating the Dunlap-Salazar observations. I found that the Late Archaic sites not only contained very low percentages of long-distance materials (suggesting limited long distance mobility), but overall they contained unexpectedly high amounts of local material and low quantities of regional material as well. While I was able to determine that high percentages of long distance material is typical of populations which utilized much higher degrees of mobility, such as the Paleo-Indians, the high percentages of local material seemed hard to explain.

After running statistical analysis of the local, regional, and long distance materials, and chert I found a strong negative correlation between regional material and chert among all of the sites. Using this information and the fact that the Late Archaic sites contain the highest percentages of high quality chert, I proposed that chert was actually being collected on a regional scale and reclassified chert as a regional material. Although chert can be found locally, gathering a large amount of this scarce material suitable for flaking (particularly the flaking of the relatively large bifaces typical of the Archaic) is indicative of regional mobility. Reanalysis of the data with this alternative assumption provided me with more consistent results. While hypothesis one cannot be tested because of the insignificant amounts of long distance material at all sites (again, suggesting that large scale mobility beyond 35 km was uncommon by the Late Archaic), my tests fail to falsify hypotheses two and three. Furthermore, by comparing the debitage samples within each pithouse at Dunlap-Salazar, I was able to conclude that the inhabitants became less mobile throughout site occupation.

While it is clear that the Dunlap-Salazar population invested effort in growing domesticated crops and building substantial architecture, even after this study it is still uncertain whether they settled into a village. As discussed earlier, lithic analysis cannot differentiate between residential and logistical mobility. Parry and Kelley's (1987) theory identifies the trend of decreased mobility at Dunlap-Salazar as a decrease in residential mobility—people moving their residence frequently and far tend to collect raw materials over a larger area and are likely to be pickier about what they collect. Railey's (2010) alternative hypothesis, however, attributes the trend of a decreased usage of lower quality materials as a result of several factors associated with the technological transition to the bow and arrow. In this latter case, the trend may not be associated with shifts in residential mobility, but could simply reflect a reduction in logistical mobility in collecting raw materials (though Railey's argument doesn't rule out residential mobility either).

In either case, however, it appears that the Dunlap-Salazar inhabitants conform to the regional trend of a decrease in mobility over time. If the site is truly a "village," significant numbers of people were periodically going out beyond the typical day range of resource collection to procure stone or other resources, and did this more regularly and/or further than is typical in later Pueblo period sites. Alternatively, the inhabitants may have actually been continuing a limited, regional-scale mobility pattern, comparable to but more restricted than that which characterized the Late Archaic. The cause for shift from chert to alternative regional lithic materials is not clear, however, and might relate to Railey's arguments about the decreased need for large pieces of high quality flaking material as the manufacture of large atlatl dart bifaces gave way to small arrow points.

My work suggests several directions for future research. First, it would be useful to expand the regional comparison by including more sites and sampling them more systematically. Hopefully, stronger correlations would become apparent through more substantial testing. In addition, more definitive ways of sourcing the lithics would be extremely helpful in specifying the particular source location of each raw material—a large-scale regional program of collecting and characterizing source materials would be invaluable. Despite these limitations, however, my findings offer intriguing results that *do* succeed in suggesting that pithouse period sites, as exemplified by Dunlap-Salazar, expressed different mobility patterns from both the immediately preceding and immediately succeeding sites. Also, my results are suggestive that change was occurring *over the course* of the period covered by Dunlap-Salazar as well. Whether or not

Dunlap-Salazar qualifies as a “village”, it exhibits a greater degree of regional mobility than what is characteristic of the well established villages of the Pueblo era, but was moving in the direction of the patterning of those villages over time.

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