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ARCHAEOLOGY OF THE MOGOLLON HIGHLANDS: SETTLEMENT SYSTEMS AND ADAPTATIONS

edited by Yvonne R. Oakes and Dorothy A. Zamora

VOLUME 1. DEFINING THE MOGOLLON

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Submitted by
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ADMINISTRATIVE SUMMARY

The Luna Project began in 1989 with a 30.7 km (19.1 miles) survey by the Office of Archaeological Studies (OAS), Museum of New Mexico, along U.S. 180 from the Pine Lawn Valley north to Luna, within the Mogollon Highlands in Catron County, New Mexico. As a result of this and subsequent surveys in the area, 25 archaeological sites were recommended for excavation prior to road-widening of U.S. 180 and NM 12 by the New Mexico State Highway and Transportation Department (NMSHTD). Work was completed in four separate phases concomitant with the various NMSHTD projects, ending in December 1995. Most excavations were on land administered by the Gila National Forest; only three sites were partially on private land. Yvonne R. Oakes, assisted by Dorothy A. Zamora, served as project director. David A. Phillips, Jr., former director of OAS, and Timothy D. Maxwell, current director, were principal investigators.

The 25 excavated sites include 6 Archaic components (LA 37917 [AR-03-06-06-00824], LA 43766 [AR-03-06-06-00828], LA 45508, LA 70188 [AR-03-06-03-00056], LA 78439 [AR-03-06-06-00835], and LA 89846 [AR-03-06-03-03723]), 4 Early Pithouse period components (LA 39972, LA 39975 [AR-03-06-06-00372], LA 45508, and LA 70201 [AR-03-06-06-00833]), 6 Late Pithouse period components (LA 3563 [AR-03-06-06-00277], LA 43786 [AR-03-06-06-00416], LA 45507, LA 45510 [AR-03-06-03-00056], LA 70196 [AR-03-06-06-00832], and LA 70201 [AR-03-06-06-00833]), 5 Early Pueblo period components (LA 39969 [AR-03-06-06-00828], LA 39972, LA 43766, LA 70189 [AR-03-06-06-00830], and LA 75792 [AR-03-06-06-00286]), 6 Late Pueblo period components (LA 3279 [AR-03-06-03-00159], LA 39968 [AR-03-06-06-00827], LA 70185 [AR-03-06-03-00285], LA 75791 [AR-03-06-06-00834], LA 78439 [AR-03-06-06-00835], and LA 89846 [AR-03-06-03-03723]), 6 probable Athabaskan components (LA 37917 [AR-03-06-06-00825], LA 37919 [AR-03-06-06-00826], LA 70188 [AR-03-06-06-00830], LA 70189 [AR-03-06-06-00442], LA 75791 [AR-03-06-06-00834], and LA 89846 [AR-03-06-03-03723]), and 3 of unknown affiliation from redeposited sites (LA 9721 AR-03-06-06-00824], LA 70191 [AR-03-06-06-00831], and LA 89847 [AR-03-06-03-03724]). Excavated sites range from the several downslope redepositions to 10 rooms and a great kiva at a large Late Tularosa phase pueblo, LA 3279 [AR-03-06-03-00159], dating A.D. 1275-1325. A total of 2,581 cu m of dirt was removed from the sites by either hand or mechanical equipment and 254,694 artifacts were recovered. Dating of the sites was possible through ceramic cross-dating, and 182 radiocarbon or archaeomagnetic assays were supplemented by several obsidian hydration samples.

The broad temporal variability in sites allowed for many avenues of comparison. Subtle changes in subsistence availability and exploitation, ground stone and lithic artifact form and function, and ceramic styles and their trade were monitored and compared with results from other excavated sites within the Mogollon Highlands. The large data base amassed by the OAS excavations and studies has created an unprecedented opportunity to examine settlement dynamics on a regional scale within this particular area of the Southwest. Population ebb and flow has been documented for the different Mogollon periods, and site growth through time can now be charted, leading to a more synthetic understanding of land-use patterns by prehistoric peoples of the region.

MNM Projects: 41.453; 41.492; 41.538; 41.541.
NMSHTD Projects: SP-OF-O13-2(210; F-031-2(4); 88-134(NM 12); TPA-180-1(6).
CN 1858, CN 1491, CN 10015, CN 2352

Permits
1. Gila National Forest, Special Use Permits:
   a. Issued November 15, 1990, Expires December 31, 1999
   b. Issued May 6, 1993, Expired December 31, 1997
2. State Land Permit: Excavation Permit SE-70.

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ACKNOWLEDGMENTS

In 1989, when we undertook the initial cultural resource survey along U.S. 180, I had no idea that nine years and 25 sites later, we would be in the throes of producing a comprehensive, six-volume report on the archaeology of the Mogollon Highlands. It has been a challenging, but exciting, nine years. The mountains of west-central New Mexico are outstandingly beautiful and provided an inspiring background for our field work. Most of the sites were what archaeologists call "fun" to dig, except for the few that had that awful, sticky "gumbo" clay. The sites were widely varied and provided the crew with an unusual opportunity to excavate a broad range of cultural phenomenon. Analysis and interpretation of the ever-expanding data base took longer than anticipated, but seeing the patterns develop and the identical conclusions arrived at by independent analysts was extremely satisfying.

Most of the field work was conducted on land administered by the Gila National Forest. Our first expression of appreciation goes to the staff of this agency who were outstanding in their cooperation with us. Their guidance in many matters was greatly appreciated. We would like to particularly thank Bob Schiowitz, the former Forest Archaeologist, and the more recent Forest Archaeologist, Powys Gadd, for their attention to the project and for their cooperation. Personnel from the Reserve and Luna Ranger Districts, within which we worked, could not have been more helpful. Mike Gardiner, District Ranger at Reserve, listened many times to our requests for procedural changes and the various Reserve archaeologists, Richard Newton, Powys Gadd, and Bruce Ellis, were most cooperative. We also appreciated the assistance of Pat Morrison on selecting areas for survey for potential NMSHTD waste disposal. At Luna, Ranger Jerry Hibbits was a pleasure to work with, as well as the archaeologists, Cathy Dodt-Ellis and Gloria Curry, who oversaw our work and shared ideas with us. We considered all of the above Forest Service personnel to be our friends and we thoroughly enjoyed working with them.

A very special thanks also goes to the crew of the District 6 Highway Patrol Station at Reserve. Mike Peralta and his staff were most helpful on numerous occasions. They provided needed gates in right-of-way fences, informed us of any changes to sites due to weather or vandalism, moved several backdirt piles, and assisted in the mechanical excavation of a portion of the great kiva at LA 3279 (AR-03-06-03-00159) when time was critical. And especially to the folks of Reserve and Luna, we all thank you for your hospitality, friendship, and interest in our work. We lived among you, off and on, for five years and it often felt like that this area was more "home" than home. We were probably highly visible with our sometimes "far-out" clothes and hair styles, but we like to think we were adding flavor to the great mix of folks. To our many landlords over the years, we found all of you to be "the best." Our last day in the field was certainly memorable. Thank you Luna residents for turning out in mass for our farewell luncheon and party. Your pictures are on our wall!

To the many, many people who worked on this project, either in the field or the laboratory, I personally owe a large debt of thanks. Crew members changed over the years and yet the project stayed on track through the cooperative efforts of many. Volunteers were all great to work with and eased our load immeasurably. To all of the following people who contributed hard work and expertise to the project—thank you!

Field Staff

Joy Beasley	Lewis Kimmelman
Jennie Noble	Heather Bixler
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Lynn Drake	Vernon Lujan
William Saracino	Robert Emerson
Anthony Martinez	Pat Severts
Joan Gaunt	Sibel Melik
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Sonya Urban	Kristin Mier
Marcy Snow	Dean Wilson
Susan Moga	

All of the above field staff also were part of the lab crew.

Local Workers

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Howard Brown
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Faye Myrick
Steve Clevenger

I also wish to express my thanks to the OAS production staff who undertook the lengthy task of putting these volumes together. Maps and illustrations are by Rob Turner.

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INTRODUCTION

Over a seven-year period between 1989 and 1995, the Office of Archaeological Studies (OAS) implemented four separate surveys, testing programs, and data recovery plans for New Mexico State Highway and Transportation Department (NMSHTD) road-shouldering and bridge replacement projects along U.S. 180 and NM 12 near Reserve and Luna in Catron County, New Mexico (Figs. 1.1, 1.2). Fieldwork was initiated at the request of William L. Taylor of the NMSHTD. Project director for the overall archaeological investigations was Yvonne R. Oakes, assisted by Dorothy A. Zamora. The principal investigator was initially David A. Phillips and later, Timothy D. Maxwell. Lead agency for the project was the Gila National Forest. Forest archaeologist, Robert Schiowitz, and later Powys Gadd, served as liaison to the NMSHTD and the OAS.

A total of 108 sites were recorded by OAS on the various surveys. Of these, 41 sites were tested and 25 had data recovery plans prepared for subsequent excavations. Most sites were on lands administered by the Gila National Forest; only three excavated sites were on private land acquired by the NMSHTD. The 25 excavated sites (Figs. 1.3-1.6) represent either prehistoric or protohistoric occupations within the Mogollon Highlands. They include 38 identifiable components of which 6 were determined to be Archaic, 4 Early Mogollon Pithouse period, 6 Late Pithouse period, 5 Early Pueblo, 6 Late Pueblo, 6 Athabaskan, 2 unknown artifact scatters, and 3 sites redeposited by erosion.

Results of the work completed by OAS for the NMSHTD are presented in the six volumes of this report. Volume 1 provides the background for the study and includes the data recovery plan, an environmental assessment of the area in relationship to site use through time, and a new evaluation of culture history in the Mogollon Highlands. Volume 2 presents descriptions and maps of the 25 excavated sites. Volume 3 is focused on the results of the lithic and ground stone artifact analyses, while Volume 4 centers on the various ceramic analyses. Volume 5 combines miscellaneous artifact, bone tool, faunal, skeletal, macrobotanical, and palynological analyses. Volume 6 includes a detailed discussion and synthesis of the archaeological work performed by OAS.

The following section details the scope of work for each of the four NMSHTD projects and an additional related survey for potential rock waste disposal sites, survey for a U.S. 180 highway detour route, and a mapping and testing program for a site on the Gila National Forest.

Scope of Work

The archaeological fieldwork was divided into four phases coincident with the NMSHTD projects in the area. The divisions listed below present the individual sites located within each phase and their disposition.

Phase I: MNM Project 41.453
NMSHTD Project SP-OF-013-2(210);
CN 1858

The following 32 sites were all found within the parameters of Phase I along U.S. 180 from Cottonwood Campground to the summit of the San Francisco Mountains. All were recorded (Oakes 1989) and survey forms were filed with the Archeological Records Management Section (ARMS), Historic Preservation Division, State of New Mexico, and the Gila National Forest. Twenty were determined to require testing because they were either within proposed project limits or subsurface potential could not be determined. Subsequently, 14 were selected for data recovery (Oakes 1990).

Located on Survey

LA 3563	LA 43788	LA 70198
LA 4428	LA 70188	LA 70199
LA 37917	LA 70189	LA 70200
LA 37918	LA 70190	LA 70201
LA 37919	LA 70191	LA 70202
LA 39975	LA 70192	LA 70203
LA 39979	LA 70193	LA 70204
LA 39982	LA 70194	LA 75791
LA 43785	LA 70195	LA 75792
LA 43786	LA 70196	LA 78439
LA 43787	LA 70197	

Tested

LA 37917	LA 70188	LA 70201
LA 37918	LA 70189	LA 70202
LA 37919	LA 70190	LA 70203
LA 39975	LA 70191	LA 75791

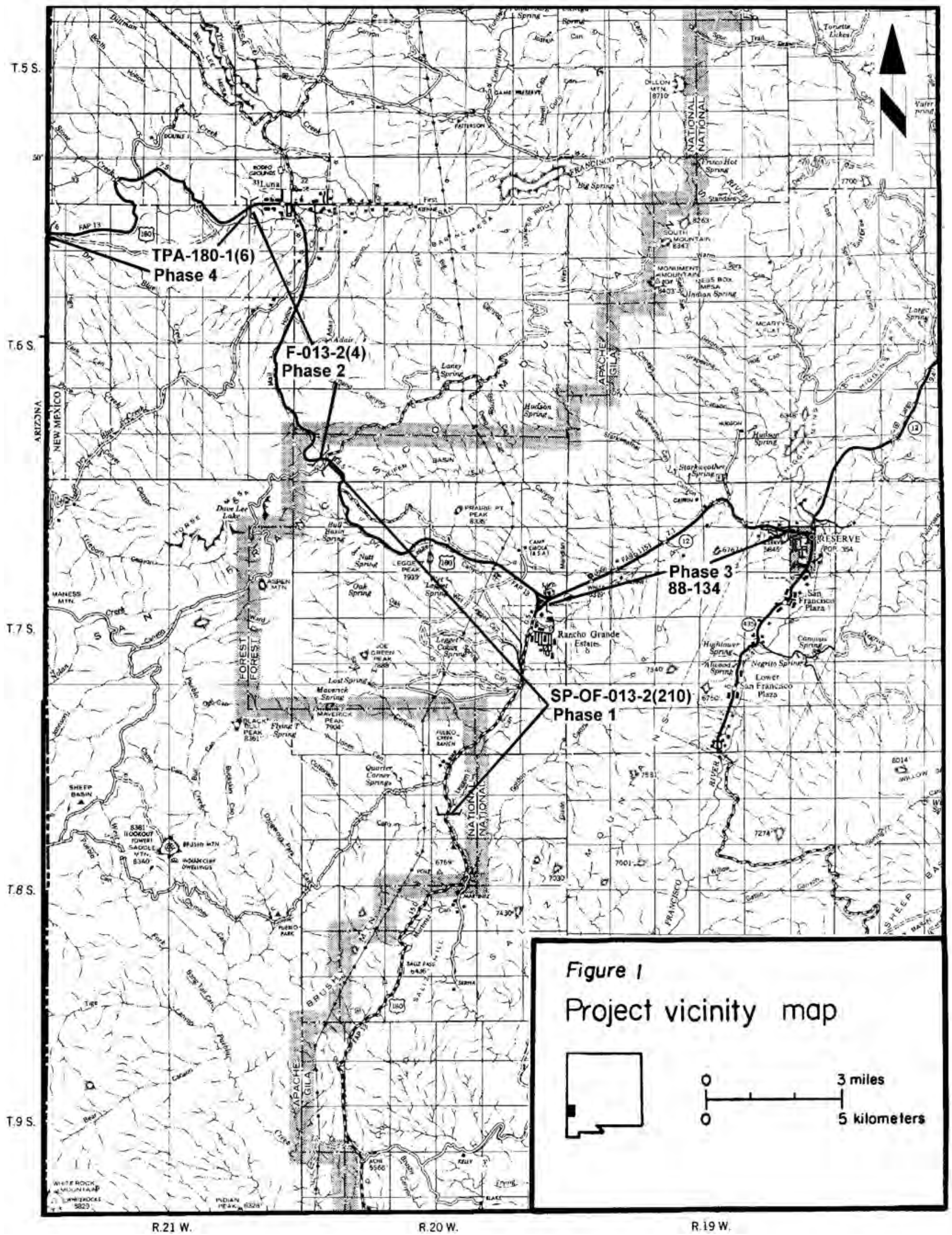

Figure 1
Project vicinity map

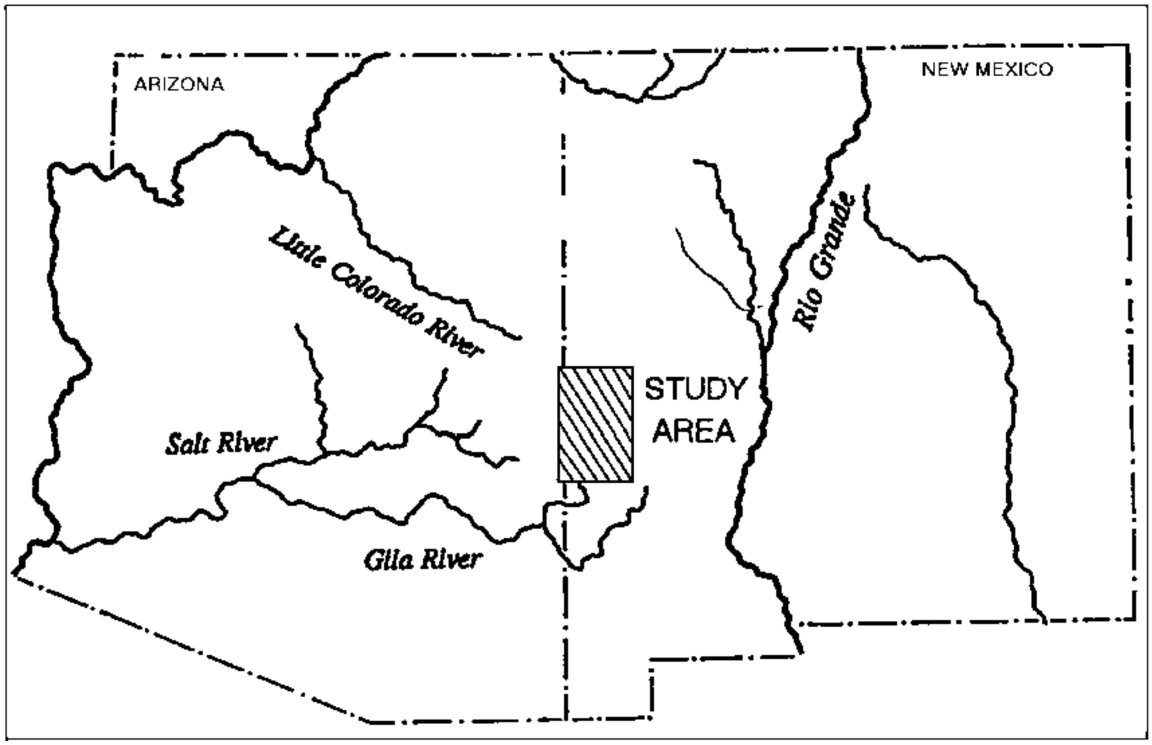

Figure 1.2. Mogollon Highlands study area.

LA 39979	LA 70192	LA 75792
LA 43786	LA 70196	LA 78439
LA 43788	LA 70200	

Excavated

LA 3563 [AR-03-06-06-00277]
LA 70188 [AR-03-06-06-00830]
LA 70201 [AR-03-06-06-00833]
LA 37917 [AR-03-06-06-00826]
LA 70189 [AR-03-06-03-00442]
LA 75791 [AR-03-06-06-00834]
LA 37919 [AR-03-06-06-00826]
LA 70191 [AR-03-06-06-00831]
LA 75792 [AR-03-06-06-00286]
LA 39975 [AR-03-06-06-00372]
LA 70196 [AR-03-06-06-00832]
LA 78439 [AR-03-06-06-00835]
LA 43786 [AR-03-06-06-00416]
LA 70197

Phase II: MNM Project 41.492
NMSHTD Project F 013-2(4);
CN 1491

Seven sites were located on this segment of highway right-of-way, which included the higher ranges of the San Francisco Mountains where no sites were found (Oakes 1989). The survey area extended from the summit of the mountains to the western edge of the town of Luna. One site was located just outside of proposed project limits and all others were subjected to testing. Four sites were submitted for data recovery and a research proposal was written (Oakes 1991).

Located on Survey

LA 45507	LA 70184	LA 70186
LA 45508	LA 70185	LA 70187
LA 45510		

Tested

LA 45507	LA 45510	LA 70185
LA 45508	LA 70184	LA 70187

Excavated

LA 45507
LA 45508
LA 45510 [AR-03-06-03-00056]
LA 70185 [AR-03-06-03-00285]

Table 1.1. Ownership and Acreage of Land Surveyed within Project Limits

Phase	Ownership	Measurements		Acreage	
		Linear Miles	Kilometers	Acres	Hectares
Phase I	Gila National Forest	11.1	17.9	241.8	96.7
	Private	.4	.6	11.5	4.6
	Total	11.5	18.5	253.3	101.3
Phase II	Gila National Forest	7.1	11.4	153.8	61.5
	Private	.5	.8	15.2	6.1
	Total	7.6	12.2	169.0	67.6
Phase III	Gila National Forest	7.3	11.7	917.9	367.2
	Private	.2	.3	.7	.2
	Total	7.5	12.0	918.6	367.4
Phase IV	Gila National Forest	23.7	38.1	543.1	217.3
	Private	.9	1.4	22.6	9.0
	Total	24.6	39.5	565.7	226.3
Totals	Gila National Forest	49.2	79.1	1,856.6	742.7
	Private	2.0	3.2	50.0	19.9
	Total	51.2	82.3	1,906.6	762.6

Phase III: MNM Project 41.538
NMSHTD Project 88-134;
CN 10015

Ten sites were located along NM 12 between Reserve and its junction with U.S. 180. All ten were tested and four were found to warrant excavation because of the presence of architecture or the potential depth of the sites (Oakes and Wiseman 1993).

Located on Survey

LA 39968	LA 39972	LA 39982
LA 39969	LA 39974	LA 43766
LA 39970	LA 39977	LA 69064
LA 39971		

Tested

LA 39968	LA 39972	LA 39982
LA 39969	LA 39974	LA 43766
LA 39970	LA 39977	LA 69064
LA 39971		

Excavated

LA 39968 [AR-03-06-06-00827]
LA 39969 [AR-03-06-06-00828]
LA 39972
LA 43766 [AR-03-06-06-00829]

Phase IV: MNM Project 41.541
NMSHTD Project TPA-180-1(6);
CN 2352

Four sites were recorded on a survey of proposed highway right-of-way from Luna to the Arizona state line (Zamora and Sterling 1992). No sites were found in the upper mountainous area west of the San Francisco River where it crosses U.S. 180. All four sites were tested and three were submitted for data recovery (Oakes and Zamora 1993). In addition, the historic Luna Irrigation Ditch was documented by Sterling (1992).

Located on Survey

LA 3279	LA 89845
LA 89846	LA 87847

Tested

LA 3279 [AR-03-06-03-00159]
LA 89845
LA 89846
LA 89847

Excavated

LA 3279 [AR-03-06-03-00159]
LA 89846 [AR-03-06-03-03723]
LA 89847 [AR-03-06-03-03724]

Additional Investigations: MNM Project 41.453
NMSHTD Project SP-OF-013-2(210)

An additional survey was conducted by OAS crew members on lands recommended by Gila National Forest personnel within the project region that might be suitable for the disposal of rock waste from highway construction activities. After the completion of the survey, it was decided by the NMSHTD not to use any of the surveyed locations. In all, 52 sites were recorded and are discussed in Oakes and Kimmelman (1995).

During reconstruction of U.S. 180, portions of the "Old Luna Road" were surveyed by OAS prior to using the dirt road as a detour. Two sites were located and tested. The work is described in Oakes (1992).

In 1993, the OAS received a cost-share grant from the Gila National Forest to conduct a mapping and testing program at East Ridge Pueblo in the Pueblo Park Campground off of U.S. 180. Two rooms and a kiva were partially excavated (Oakes 1993b).

Land Ownership

Most sites were within the highway right-of-way lands administered by the Gila National Forest. Only three sites (12 percent of the total) were on private land acquired by the NMSHTD. These include:

Phase II: LA 45507, Luna Village
LA 45508, Humming Wire
Phase III: LA 39972, SU Tanks

Table 1.1 presents land ownership and acreage investigated by OAS on the four projects; over 82 km (50 mi) were surveyed.

DATA RECOVERY PLAN

Four separate data recovery plans were prepared for the four highway projects along U.S. 180 and NM 12 (Oakes 1990, 1991; Oakes and Wiseman 1993; Oakes and Zamora 1993). However, all plans proposed the same avenues of research inquiry for the Mogollon Highlands sites. While the fit between research goals and achieved results was perhaps better than average, there were both unforseen surprises and missing gaps in excavation results. Some sites yielded unanticipated ceremonial features, including a great kiva, and others produced a lack of expected architectural units. Also, several sites thought to represent Archaic adaptations were determined subsequently to be Athabaskan in age, based on chronometric studies.

The first data recovery plan, upon which all following ones were modeled, was submitted in 1990. Since that time, our perception of cultural adaptations in the Mogollon Highlands has become more attuned to the subtleties of change that occurred temporally throughout the region. As fieldwork and research progressed, some issues became almost "nonissues," while others begged for more attention than we had initially intended. Therefore, while the written data recovery plans may seem static, dynamic changes in research orientation and expectations were occurring as more understanding of the area was obtained. The original data recovery plans may be found in the four reports listed above, whereas this chapter presents a synthesis of the four versions with some observations on their general applicability.

RESEARCH ORIENTATION

Based on testing data, the sites in the proposed project areas were estimated to range between the Middle Archaic (ca. 2000 B.C.) and the Late Pueblo period (ca. A.D. 1350). In actuality, they spanned the time between ca. 1950 B.C. and the more recently dated 1700s Athabaskan sites. Because of the suspected unbroken continuum in cultural periods and site types, we believed that the sites had the ability to answer important archaeological questions about prehistoric adaptations in the Mogollon Highlands. One area of interest was the degree of mobility evidenced by the varying cultural groups as influenced by the adoption of agriculture. This area of concern was subsequently selected as the primary line of pursuit. It was stated in a single theoretical premise: In the Mogollon Highlands, if there is indeed a continuum from full mobility in the Archaic period to full sedentism by the Pueblo period, and the change was influenced by increasing dependence on agriculture, then that shift should be evident in the archaeological record. In other words, we proposed a general model that suggested a positive relationship between cultigen dependence and decreasing residential mobility. The logic of this argument is that as cultigen dependency increases, the bulk of harvested food increases, cultigens are stored, and because storage entails investment in facilities and enables the continued use of sites, residential mobility declines. This model is, however, steeped in traditional archaeological thought and there have been many challenges to this assumption (Kent 1991; Kelly 1992, Young 1993; Nelson and Anyon 1996), but little supporting archaeologically based data.

We assert that the model needs testing on a sufficiently large data base so as to offer meaningful input on the issue. We do not particularly ascribe to the validity of the model; in fact, we believe there to be evidence to warrant a process of varying mobility strategies through time in the Mogollon Highlands. So the question becomes, could these strategies be observed in the archaeological record and were they actually related to the practice of agriculture?

Within the Mogollon Highlands, prehistoric sites are generally classified as Archaic, Pithouse, or Pueblo. This broad spectrum of types provided a convenient basis of comparison for the sites within the project area. Archaic sites in the Mogollon Highlands usually date well after 3000 B.C. and prior to A.D. 200. Pithouse period sites span several phases and generally occur between A.D. 200 and A.D. 950. Pueblo period sites may be divided into Early and Late and range from about A.D. 950-1000 to A.D. 1350.

Each of these groups was posited to exhibit varying degrees of mobility and sedentism as part of their subsistence strategies. we wanted to know what conditions fostered mobility versus sedentism among prehistoric populations in the Mogollon Highlands. Did mobility decrease before or after the introduction of cultigens, or was it not affected? How mobile were Archaic populations? How sedentary were Pueblo groups? How are Archaic sites structured as opposed to pithouse and pueblo sites if mobility strategies varied? Are the terms hunter-gatherers and pithouse dwellers valid distinctions or could they define the same population? Do resources utilized inform on mobility patterns? Do site artifact assemblages inform on length of occupation?

Thus, the data recovery plan focused on two aspects of Mogollon adaptations in order to examine variability in mobility patterns. We selected to study variations in site structure and subsistence activities among these differing cultural groups.

Current Theory

The Mogollon Highlands area near Reserve, Aragon, and the San Augustin Plains have long been thought to represent the homeland for the adoption of agriculture in the Southwest. The dating of charcoal lenses, supposedly associated with maize, at Bat Cave on the San Augustin Plains to approximately 4000 to 3600 B.C. (Dick 1965) revolutionized the then-existing concepts about the adoption of agriculture. Because no other Southwestern sites yielded such early dates at that time (Tularosa Cave at 400 B.C. was the next oldest), Haury (1962) proposed that agriculture was first introduced to the Southwest from Mesoamerica via a mountain route through the highlands at about 4000 B.C. He believed agriculture was limited to the Mogollon Highlands because of a favorable climatic regimen. He then assumed, on the basis of available radiocarbon dates, that the practice of agriculture did not spread to the rest of the Southwest until over 2,000 years later. Archaic hunter-gatherers were thought to have eventually adopted cultigens in response to environmental stress, ceased their continuous foraging in search of subsistence goods, settled down by streams and arable land, implemented the use of pottery, and eventually became sedentary, building pithouses and then surface rooms, and practicing full-scale agriculture.

Recently, this view has changed, primarily because of new investigations carried out in various locales in the Southwest. One of these involved research by the University of Michigan at Bat Cave (Wills 1988a). Their work has produced revised dates for the introduction of cultigens (maize and squash) at Bat Cave between 1100 B.C. and A.D. 0, consistent with other sites in the area such as Tularosa Cave. In the Tucson Basin, domesticated maize was recovered from the Milagro site, an Archaic adaptation dating to ca. 850 B.C. (Huckell and Huckell 1984). North of the Mogollon Highlands, Simmons (1986) recovered maize remains from LA 18091, dating 1000 B.C. One of the earliest dated sites with maize present is Tornillo Shelter in the Organ Mountains in southern New Mexico, with isotope-corrected dates of 1225 B.C. ± 240 (Upham et al. 1987).

It is apparent that a 2,000-year developmental period in the Mogollon Highlands before the spread of agriculture to other areas is no longer viable. In fact, Wills (1988a:148-149) thinks agriculture probably originated elsewhere: in the Rio Grande Valley or southern Arizona. He notes that by ca. 1000 B.C. it is documented in the Jemez Mountains, San Juan Basin, southern New Mexico, and the Tucson Basin. The presence of cultigens on Archaic sites in the Mogollon Highlands has only been documented for cave sites near the San Augustin Plains beginning in the Late Archaic period. No use of cultigens has yet been documented for the few Archaic sites recorded near the project area.

Growth in Archaic populations in the Mogollon Highlands may have occurred because of the widespread availability and diversity of subsistence resources. Resources known to have been generally present in upland areas include deer, elk, rabbit, antelope, mountain sheep, small game, berries, piñon nuts, acorns, available water, lithic raw materials, chenopods, and grasses (Fish et al. 1990). However, resources are subject to, among other factors, variability in timing and amount of available moisture, season of availability, degree of utilization by humans, presence of disease, mobility of resource, and low yield. Today, Archaic populations are characterized as loose knit with changing group size, being fully mobile, moving freely from resource to resource, and using primarily wild plant foods as availability warranted.

Thus, we have a traditional picture of Archaic hunters and gatherers moving unimpeded over the landscape prior to the utilization of agriculture. In recent years, debate has focused on the nature of Archaic mobility patterns in the Mogollon Highlands. Most recent models of Archaic settlement patterns postulate an annual round with winters spent in the highlands and summers in the nearby lowlands because of temporal and spatial variations in the abundance of resources (Hunter-Anderson 1986:49). Evidence of this pattern has not yet been found archaeologically. With this model, winter residences in the mountains are expected to be small; location is dependent on the availability of game (Hunter-Anderson 1986). In contrast, Wills (1988a:93) believes populations did not winter in the mountains, but rather in lowlands to the south where resources such as agave, sotol, mesquite, and cacti were plentiful. He maintains that high-elevation sites such as Bat Cave and Tularosa Cave imply a spring occupation (Wills 1988b:477). Obviously, congruence with the archaeological record is necessary for confirming Archaic mobility patterns. Spielmann (1990) suggests we look more carefully at resources and their patterns of availability and seasonality of distribution in the environment.

By 1000 B.C. maize and squash had made their appearance at several cave sites in the Mogollon Highlands. At some time after this, it is assumed that Archaic peoples incorporated cultigens into their subsistence systems. Traditionally, the adoption of cultigens has perhaps simplistically implied an end to mobility, the beginning use of ceramic vessels, and a shift to permanent residences. Researchers continue to debate the causes for agricultural adoption and these vary from human population stress on available resources (Cordell and Gumerman 1989; Huckell 1996) to a strategy for enhancing resource availability (Minnis 1985; Simmons 1986; Wills 1988a). However, Wills (1988a:5) sees the two models as noncompeting; increasing populations led to the employment of agriculture as a security measure, enhancing subsistence strategies already in place. He thinks the environment of the highlands would not have yielded enough surplus for winter consumption, therefore he sees the practice of agriculture as necessary rather than optional.

The cultivation of plants in the Mogollon Highlands requires planting crops in the spring and harvesting in the fall. Repeated return to fields during the growing season is also necessary. Thus, Wills (1990:324) points out that the concept of agriculture as a casual or simple adaptation is incorrect. For example, the practice of agriculture likely places potential limitations on mobility strategies. Mountain cultivation may indicate a conscious decision to stay in the uplands and utilize the resources there from spring through fall. Wills (1988b:477), however, cautions that spring use of mountains may have already been part of the Archaic seasonal round.

The use of storage facilities on early agricultural sites would allow populations to maintain mobile lifestyles between the highlands and lowlands (Wills 1988b:477), but as conversely noted by Hunter-Anderson (1986), may also permit them to reduce movement. As Wills (1988b:461) comments, this issue is unresolved because no early sites have yet yielded storage facilities.

The presence of residential architecture or ceramics has also not been documented in the Mogollon Highlands until after the adoption of agriculture. Thus, Wills (1988a:479) believes agriculture is not a necessary prerequisite for sedentism. If in the highlands agriculture was initiated as a supplement, not a substitute (G. Johnson 1989:372) for foraging strategies, then sedentism is not tied to the development of agriculture. The very quality, quantity, and diversity of resources that permit hunter-gatherer mobility, as pointed out by Fish et al. (1990:77-78), may also encourage sedentism.

A recent argument ties increasing sedentism to increasing population density (Wills 1990:325; S. Schlanger, pers. comm. 1990). People may be forced to reduce their residential mobility because permanent residence near producing fields is necessary for crop maintenance and because there may be increasing populations in the area that would tend to occupy prime land left unattended by part-time horticulturalists.

In the Mogollon Highlands, it is generally believed that maize agriculture did not play a significant role in the subsistence economy of Late Archaic populations (Matson 1991; Minnis 1992). However, another view sees foraging with associated mobility or sedentism as part of continuously changing subsistence strategies practiced throughout much of the prehistoric occupation of the highlands (M. Nelson 1990). Site use may shift on a seasonal basis, site populations may vary periodically, and structures change as needs vary. In the words of B. Nelson (1990:157), "Today, we expect diversity rather than unity, adaptive change as not necessarily permanent, and different trajectories occurring possibly simultaneously in the same area."

Research Expectations

Site Structure

Mobility and sedentary adaptations should be embedded within the organization of site structure. Analyses examined structural and temporal diversity between sites on the project and compared them with other excavated sites in the immediate region such as the SU site, Turkey Foot Ridge, Starkweather Ruin, Higgins Flat, and Promontory Peak.

Full mobility is traditionally thought to be characteristic of hunter-gatherers or Archaic populations. If this premise is true, site structure should be expected to primarily reflect short-term occupation of the project's Archaic sites. Expectations for fully mobile adaptations include expedient investment of labor in dwellings, hearths, and storage facilities. Also, artifact assemblages should be consistent with short-term occupation data. Domestication of cultigens is not expected, although it is possible. If Archaic peoples maintained a seasonal round between highlands and lowlands, only seasonal resources of either winter or summer acquisition should show up in the archaeological record. Schlanger (1990) has developed a testable model for predicting length of site occupation from comparisons of types and ratios of artifacts deposited on sites. This model was not used because complete assemblages were rare.

Expedient lithic reduction is generally associated with sedentary populations and curation with mobile societies. However, Moore (n.d.a) cautions that there can be many factors that allow these two strategies to be used by either group. Usually, the use of large, generalized bifaces during the Archaic period is thought to represent a curated lithic reduction strategy, while expedient tool production is characteristic of later, more sedentary, groups. The differences between these two strategies are explained in detail in Moore (n.d.a). These variations in technological modes were monitored and quantified for all project sites.

The diverse features and facilities found on Archaic sites suggest differing site functions. The presence of hearths, dwellings, and storage facilities on some documented sites (O'Laughlin 1980) and not on others indicates that a variety of Archaic site types may be archaeologically recognizable.

Moore (1989:18) has presented three basic site types for hunter-gatherer systems based on work by Binford (1980) and Fuller (1989). He postulates that sites should consist of either residential or base camps, field camps for resource collection, or extraction locales (i.e., quarries). The residential base camp occupied by foraging groups will exhibit a broad range of maintenance, production, and food-processing activities. There should be a low investment in habitation units and storage. Structures, if present, should be ephemeral, and indicative of short-term use. Residential camps occupied by collectors would exhibit the same wide range of activities but with a higher construction investment indicative of a longer, perhaps seasonal, occupation. Field camps are temporary locales used for specialized activities, with no storage (expect perhaps caching), and only ephemeral structures. Resource extractive locales were not expected to be represented in the project sites.

Moore (1989:21) notes that it is difficult to distinguish short-term residential camps of foragers from field camps of collectors. He believes that lithic artifact assemblages will vary with the type of site, and that general-purpose biface manufacture in general reflects mobility in a group. He suggests using a model such as Kelly's (1988), which examines variation in biface production between the several site types. In Kelly's model:

1. Biface manufacturing flakes are common at base camps and rare at field camps.
2. Utilized flakes are common at field camps as opposed to base camps.
3. Residential base camps exhibit a wide range of activities.

Because the Archaic sites on the project represented a mixture of lithic artifacts, including bifaces, unifacial projectile points, and biface flakes, this model was used to provide a basis for defining site activities and site types.

The presence or absence of storage facilities on Archaic sites is dependent on the type of site and the activities pursued. Storage is a viable choice when mobility is restricted. Storage facilities may be either temporary, located near gathering sites, or more permanently located near long-term residences (Hunter-Anderson 1986:35). Moore (1989:26) believes foraging base camps would have no storage because resources are for expedient use. However, base camps for collecting groups could have storage facilities. Field camps may have limited storage. If his propositions are correct, then we expect some Archaic sites to possess storage units and others not.

Length of site occupation may be determined from an examination of site structure and from artifact analyses such as recommended by Schlanger (1990). A seasonal occupation might be evidenced by depth of dwellings, presence of interior hearths, storage facilities, labor investment in structures, and types of resources recovered from sites.

Pithouse populations in the Mogollon Highlands range in date from A.D. 200 to A.D. 1000. They are typically characterized as sedentary with a labor investment in dwellings, hearths, and storage facilities. Occupation lengths are thought to vary from seasonal to annual or longer. If pithouse sites do represent mobile populations, then use should reflect seasonality or short-term occupation by groups employing collecting strategies.

Site structure on pithouse sites ranges from single pit units to villages of pithouses with intramural and extramural hearths, storage pits, and outside work areas. To look at the problem of mobility among pithouse dwellers we must, for example, look at site layout and labor investment. We must ask if the floors and walls have prepared surfaces. Are there numerous ancillary features within the structures? Is there a definable plan to site layouts? Are hearths formally constructed or do they exhibit expediency in preparation? Are hearths both inside and outside of structures? Are storage facilities both inside and outside of structures? Are there specific work areas? Seasonal or repeated use of pithouses may be evidenced by reconstruction within structures, ample storage facilities, layering of floor levels, and overlapping features.

The number of storage pits on a site relative to dwellings is an indicator of the quantity of goods being stored. The nature of stored resources and the form in which they are stored may indicate whether immediate or future use is intended. Storage facilities outside of pithouse structures are thought to indicate seasonal use.

Length of occupation can be determined by the same factors used to examine Archaic sites, i.e., Schlanger's artifact deposition model (1990), labor-investment comparisons, and degree of storage dependency.

Dependence on cultigens is traditionally assumed for pithouse sites; however, this is an assumption just recently being questioned in the archaeological literature. Hard (1990) has developed a simple model to assist in the quantification of degree of agricultural dependence. He uses a mean mano length index to show that through time, manos increase in length, and correspondingly, increase in grinding surface, which he believes suggests a greater dependence on cultigens. Hard's methods were applied to the mano assemblages from all project sites as a test of his model.

Pueblo sites of post-A.D. 1000 in the Mogollon Highlands are represented by supposedly permanent structures, storage facilities, middens, and dispersed fieldhouses. The shift from storage pits to above-ground storage units may be indicative of the shift to greater agricultural dependency (Hunter-Anderson 1986:49). It is traditionally thought that mobility was greatly constrained for these populations because of the substantial labor investment in dwellings and strong dependence on agriculture.

In opposition to hunter-gatherer sites, pueblo residences produced expedient lithic flake tools. Bifaces, such as projectile points and knives, were prepared for specific purposes rather than general use. Therefore, fieldhouses and camps will possess mostly expediently used artifacts with few bifaces (Moore 1989:24).

Subsistence Adaptations

The study of subsistence adaptations focused on the types of resources used by each group of site occupants to determine whether the resources were expediently prepared and whether storage was a part of subsistence systems. The various subsistence strategies, such as foraging, collecting, and farming, were examined in relationship to their effects on mobility. Seasonality of resource availability was determined and seasonal rounds proposed, loosely following a model by Hofman (1984). At this point, archaeologists do not have the data to confirm seasonal rounds between highlands or lowlands or in highland areas only. Sourcing of specific resources such as lithic raw material, ceramic clays, and trade wares were undertaken to provide information on the mobility of people and goods through the cultural systems. We also studied the balance between utilized floral and faunal resources as a key to determining seasonal mobility strategies.

The presence of domesticated cultigens, particularly maize and squash, on project sites was evaluated in terms of their relative presence in the food assemblages. Variations in ceramic styles, ground stone assemblages, and lithic tool use were also employed in the determination of subsistence practices for each site.

If Archaic populations were fully mobile, then subsistence activities should represent only the range of resources available or easily transported in the immediate environment. However, if they employed a collecting strategy, a wider range of resources was expected in site assemblages. Fully mobile people would tend to prepare items for immediate consumption or use, while those less mobile might be expected to cache or store resources. All Archaic populations should hunt; however to what extent is unknown.

Ground stone implements may retain some of the materials being ground and suggest whether immediate or future use was intended. Hearths, storage pits, and botanical samples were another source for determining types of food items present on the sites.

If Pithouse peoples are limited in their mobility, then subsistence activities should be more labor intensive and indicate planning for future use. Resource items may include those brought in from longer distances as well as those locally available.

Drying of food items indicates preparation for future use. Dried foods may be present in storage pits and ceramic vessels. The shift to preparation of dried food may have encouraged the use of pottery for boiling food prior to processing and preservation (Hard 1990). It is possible that the number of cooking vessels will rise as the use of dried food increases. A comparison of ratios of cooking vessel sherds with other artifacts in site assemblages should indicate such an increase.

Certain food items, such as maize, require intensive scheduled monitoring, harvesting, and processing before being consumed or stored. If pithouse site assemblages indicate a stronger dependence on other floral and faunal resources than on maize and squash, then we may assume that site dwellers were not to the point of being constrained by agricultural pursuits. Whether crops were necessary subsistence items was studied through comparison with other food resources.

Many of the Pueblo sites (ca. A.D. 1000 to A.D. 1350) in the project area were thought to be small pueblo units or fieldhouses. On some, only the activity areas were within the study area. The size of these small structures suggests a temporary occupation with limited activities. Other larger, primary residences, such as Higgins Flat, occur nearby in the region. The value of small Pueblo sites lies in their emphasis on a limited range of activities that are amenable to archaeological discovery.

Fieldhouses tend to correlate with aggregated local populations, are generally used seasonally, and are usually near producing fields. They may or may not contain storage facilities. Trash deposits should be surficial or very shallow. B. Moore (1978:10) has developed several expectations for assessing sites as fieldhouses. These include:

1. Fieldhouses should be independent units with no more than one to three contiguous rooms.
2. No ceremonial or ritual features should be present.
3. Nearby agricultural fields should be within unrestricted view of fieldhouses.
4. Period of use can range from daily to seasonal to

continuous throughout the farming season.
5. The range of activities should be limited.

Wilcox (1978) distinguishes farmsteads from fieldhouses and notes that farmsteads are year-round family residences that can have more than three rooms and other structures could be situated nearby. Arable land should be present but not necessarily within view of the site. Trash middens should be present and represent a wide variety of activities. B. Moore (1978:31) comments that it may be very difficult to distinguish fieldhouses from farmsteads. He notes that cold-season architecture, interior hearths, and ritual features should be lacking in fieldhouses, while year-round farmsteads should have substantial architecture with interior hearths for cooking and heating.

If project sites are fieldhouses, chipped stone material from the project sites should be used for the upkeep of farming implements and for hunting game. The lithic reduction technology should be expedient with no formal tool production. Moore (1989:32) states that ground stone should not be present; however, this author believes that processing and grinding food items for easy transport back to primary residences is a viable option for fieldhouse users. Moore (1989) also expects faunal remains to be present only in extensive trash deposits. However, we believe that horticulturalists will focus on hunting game near their fields, as in the garden-hunting hypothesis developed by Linares (1976). In fact, Speth and Scott (1989) believe that large game were often also hunted in a farming environment rather than only the small game as proposed by Linares. The trend to large mammal hunting seems to increase as dependency on cultigens goes up. Comparison of large versus small mammal remains on project sites examined this hypothesis for the Mogollon Highlands.

If some project sites are year-round farmsteads, the lithic artifact assemblages should indicate a wide variety of activities. Formal tools should be made only for specific uses. Ground stone tools should also be present. Higher frequencies of faunal remains should also occur on farmsteads.

The analysis of floral and faunal resources from three small sites was used to assess if these sites were used seasonally or year-round, or if there were quantifiable differences between them in terms of mobility and degree of dependence on maize.

Conclusion

We have used the 25 project sites as a data base for examining current research questions about occupation of the Mogollon Highlands by prehistoric peoples. Previously, deeply stratified cave sites of the Archaic period, and large pithouse and pueblo villages have been excavated in this area. However, there is a lack of smaller, early, open-air and later pithouse and fieldhouse sites to balance the skewing of the existing data base to these larger and more unique sites. We believe the project sites possess the integrity and the variety in site type to provide such a balance.

Some questions proved to be easily addressed through the implementation of the data recovery plan. Were a variety of Archaic site types present in the Mogollon Highlands? Did these sites evidence storage facilities? Do sites indicate a seasonal collection of resources? What resources were utilized by the various groups in the area? At what time do cultigens appear on the sites and in what proportion to other resources? Does increasing mano length correspond with greater dependency on agriculture? Does Schlanger's (1990) model work? Were ceramics being traded into sites or were they locally made? From how far away were lithic raw materials actually obtained?

Answers to the research questions were obtained through the analysis and compilation of appropriate data sets. Artifacts were subject to traditional analyses and those proposed in this data recovery plan. To address the question of residential mobility, lithic artifact analysis included a detailed study of biface manufacture and discard, following Kelly's (1988) model. We also looked at the amount of lithic manufacture versus the amount of lithic maintenance, the investment in storage facilities and domestic architecture, length of site occupations, and amount of reuse or reconstruction.

Sourcing of resources—floral, faunal, lithic raw material, and ceramics—was important for understanding the mobility patterns of each cultural group. Floral and faunal resources were especially useful for providing information on foods consumed and season of use. To examine the dependency on cultigens, we developed several lines of evidence to measure that dependency: frequency of cooking vessels present, percent of ground surface on manos, amount and kind of storage facilities, and relative amount of faunal resources.

Specialists such as palynologists and ethnobotanists, and chronometric dating laboratories were used to undertake several of the analyses, where necessary. General field and laboratory methods were presented in the original data recovery plans; however, more detailed and useful explanations are found under the description of each individual site in this report.

Placing structures and sites in an accurate temporal framework was critical for meaningful comparisons between site units and sites. Only a few sites in the Mogollon Highlands have been chronometrically dated. We obtained 182 absolute dates from radiocarbon, dendrochronological, archaeomagnetic, and obsidian hydration samples.

Site data was compared to other excavated prehistoric sites in the Mogollon Highlands to broaden the data base for the entire region. Through the examination of mobility patterns from the Archaic through the Pueblo periods, our knowledge regarding the diversity in subsistence adaptations by these groups within the Mogollon area was expanded significantly.

> [The Mogollon area is]. . . a confusion of wooded mesas. Each hollow seemed its own small world, soaked in sun, fragrant with juniper, and cozy with the chatter of pinyon jays, but top out on a ridge and you at once became a speck in an immensity . . . [Aldo Leopold in Sand Canyon Almanac as quoted by Reynolds 1991:11].

Comparisons have sometimes been made between the Mogollon Highlands and the Colorado Plateau. In general, the consensus is that plant and animal species are more abundant in the highlands but perhaps not quite as diverse (Minnis 1985:331; Dean et al. 1994:56); however, overall, the two regions are more similar than not. In terms of plant species, there is also a general similarity between the Tarahumara uplands of the Sierra Madre Occidental in northern Mexico and the Mogollon Highlands. There, the forests are also separated by ribbons of narrow valleys with forests of mostly pine, including Arizona, Ponderosa, Apache, and Chihuahua species (Fontana 1979:4-5). It also has a piñon-juniper belt with associated mahogany and many species of oak. On a recent visit to Tarahumara country by the project directors, many adaptations by the people living there today were seen that, on the surface, compared extremely well with the archaeological record from the Mogollon Highlands. For example, crops were planted in small family plots along meandering stream beds with the use of digging sticks, and homes were located away from fields against mesas facing maximum sun with most subsistence activity performed immediately outside of the dwellings. One of the OAS field crew was raised in this area, and strongly impressed us with his noted similarities between the two regions.

Site Settings

Within the vast Mogollon Highlands (Fig. 1.7), the project sites lie topographically either directly north or south of the San Francisco Mountains within the Luna and Pine

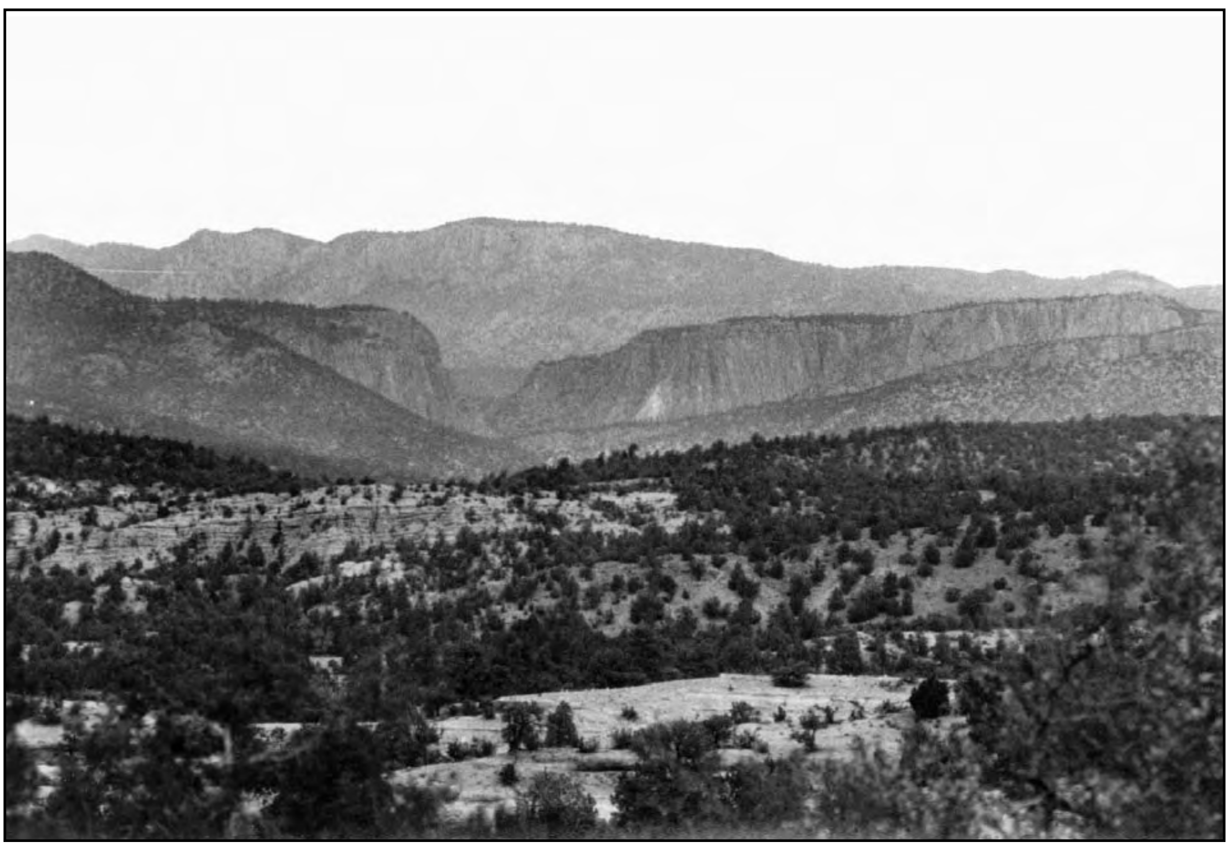

Figure 1.7. The Mogollon Highlands with the San Francisco River channel in the centerbackground, looking northwest.

Lawn valleys. Several sites are also situated on the lower flanks of this mountain range. No sites were located on the steeper elevations of the mountains. The two valleys are separated physically by 16 km of highway and mountainous terrain and by an elevational gradient of 244 m (800 ft). Several analyses in this report compared site data between the two valleys, looking for any evident variations as a result of these differences. Only one other valley, broad enough to support major prehistoric populations, exists within the Mogollon Highlands, the Tularosa Valley and its tributary, Apache Creek Canyon. Site data from this valley were also compared with project data.

Luna Valley

The Luna Valley, on the north side of the San Francisco Mountains, was formed by the downcutting of the San Francisco River as it emerged from the steep mountains and canyons directly to the west. The valley runs east-west and is approximately 6.7 km long and 1.1 km wide, flanked by broad terraces (Fig. 1.8) particularly on the north side. At the east end of the valley, the San Francisco River enters rocky terrain and only steep canyons border its course. Elevation of the Luna Valley centers at 2,135 m (7,000 ft). The valley is surrounded on all sides by extensive, heavily forested mountains cut by deep canyons through overlying basaltic flows. The rough, canyon-dissected area to the north and west is known locally as the "Mogollon Breaks" (Reynolds 1991:9).

Reynolds (1991:9), perhaps overdramatizing, describes the Luna area as: "Conceived in the fire and brimstone of Tertiary volcanos, this wild, wooded cowboy country, ever mysterious, sometimes graceful to the eye and sometimes awesome, is also almost useless to man. For where it is warm enough to grow his crops, it is too dry. And where it is moist enough for crops, it is too cold. And even if we could magically change the climate of the land, to warm the heights and moisten the steppe, it is everywhere too rough and rocky except for the toughest of cowboys and the ruggedest of cows."

Pine Lawn Valley

The Pine Lawn Valley sweeps in an arc from southwest to northeast, south of the flanking slopes of the San Francisco Mountains and just north of the Saliz Mountains. No perennial water flows through the valley; rather, it is drained by numerous intermittent streams such as the Dry and Wet Leggetts, Oak Springs Canyon, the Saliz, Spurgeon Draw, and SU Canyon. The Pine Lawn Valley is 16 km long and 1.2 km wide at its maximum, bound by the lower flanks of surrounding mountains and narrowed by encroaching cliffs and canyons at its southwest limit (Fig. 1.9). Elevation of the valley averages 1,890 m (6,200 ft). Bluhm (1960:538) describes it as 20 sq miles of habitable land.

Physiography and Geology

Physiography

Assigning the project area to a physiographic province involved somewhat of a semantic untangling of the diverse classifications into which the region has been previously divided. Part of the difficulty lies in defining the southern limits of the Colorado Plateau (Fitzsimmons 1959:114). Thrapp (1967:x) considers the Plateau to end at the escarpment of the Mogollon Rim, definable by steep uplifts in eastern Arizona. However, the rim softens as it trends diagonally eastward with physiographic changes almost imperceptible. Fenneman (1931:274-276) originally places the limits of the Colorado Plateau at the southern flanks of the San Francisco and Dillon Mountains, effectively dissecting the project area into two different physiographic zones.

Most, however, believe the Mogollon Highlands constitute some type of a transitional zone between the Colorado Plateau and the Basin-and-Range Province to the south (Fig. 1.10). Earlier researchers such as Fenneman (1931) label much of the highlands a transitional area as does Quimby (1949:36) and Plog et al. (1978:9). To others, this transitional zone has been given several appellations including the Mogollon Plateau, the Mexican Highlands, and the Mogollon Slope. P. Martin (1959:38) believes the area to be basically Basin-and-Range, specifically within the Mexican Highlands section. Elston (1989:43) considers this section to be just a prong of the Basin-and-Range Province separated from the Sierra Madre Occidental of western Mexico by lower land forms. In 1959, Fitzsimmons coined a new geologic term for the region, the Mogollon Slope, which extends from south of the Zuni River and dips gently to the south. However, he considered it still part of the Colorado Plateau, as do Chamberlin and Cather (1994:9), who retain the term in their current work. In variation, Graybill (1975:8) calls the same region the Mogollon Plateau, as do Cather and Johnson (1984:9). Note that Cather switched terminologies from Mogollon Plateau to Mogollon Slope by 1994.

Whatever term is used, the Mogollon Highlands are considered one of the most mountainous regions of the Southwest. The Continental Divide runs along the eastern edge of the study area. Mountain ranges include the San Francisco, Saliz, Tularosa, Gallo, Mogollon, Blue, and White, which are mostly flanked by alluvial fans. It

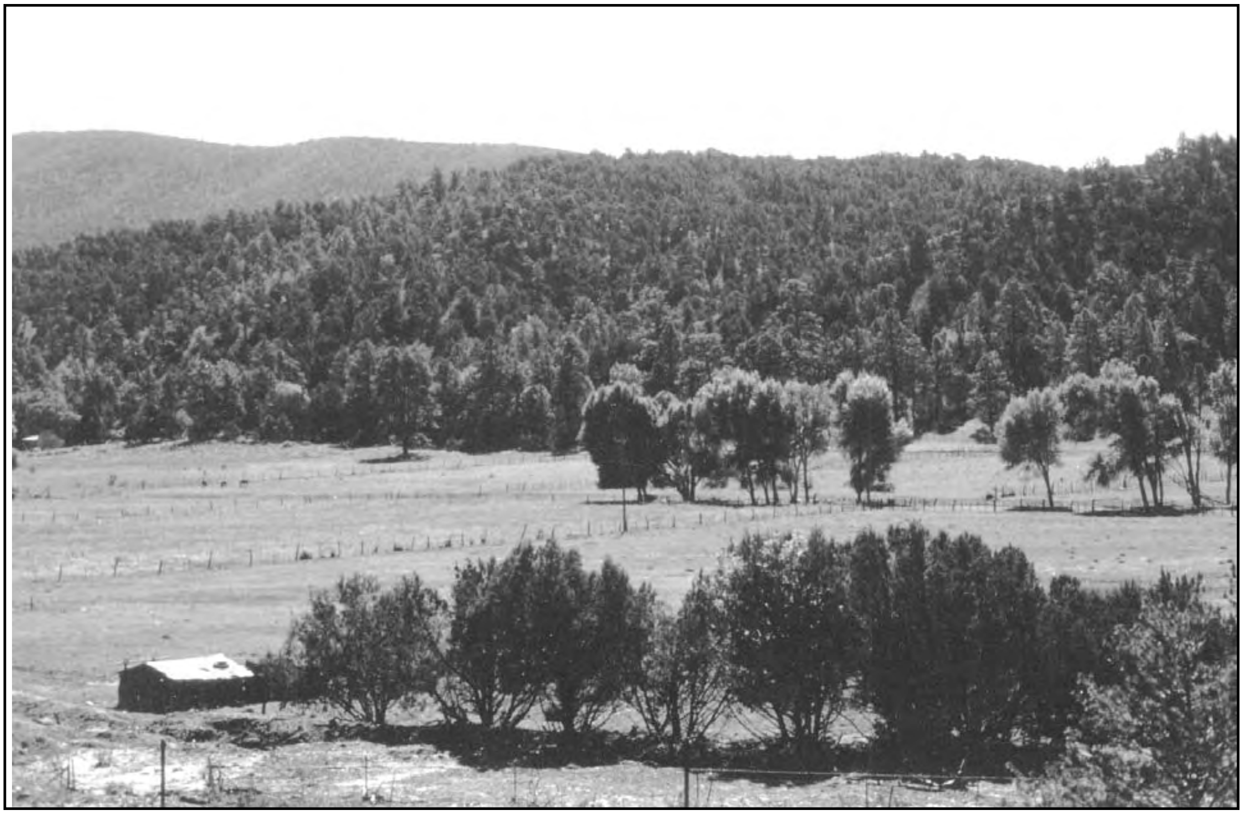

Figure 1.8. The Luna Valley, looking southwest.

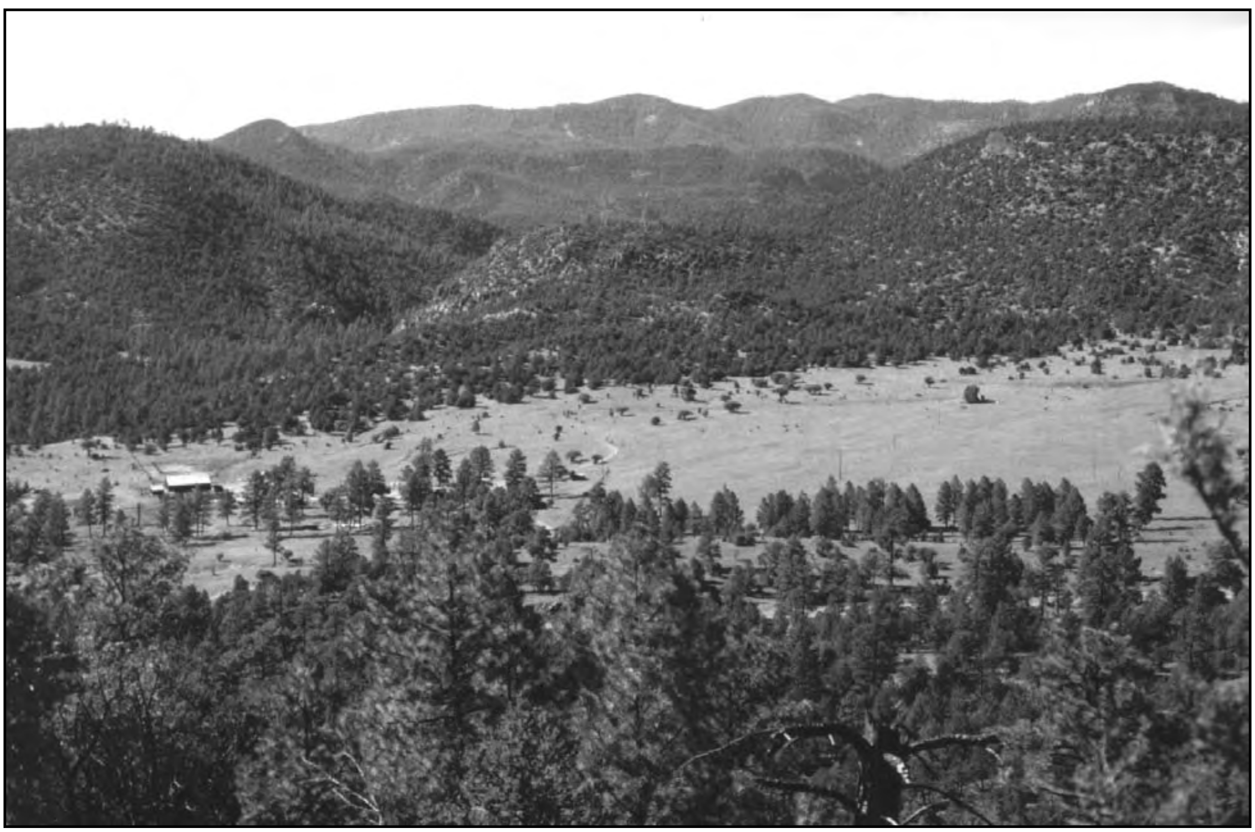

Figure 1.9. The Pine Lawn Valley from the Promontory site, looking west.

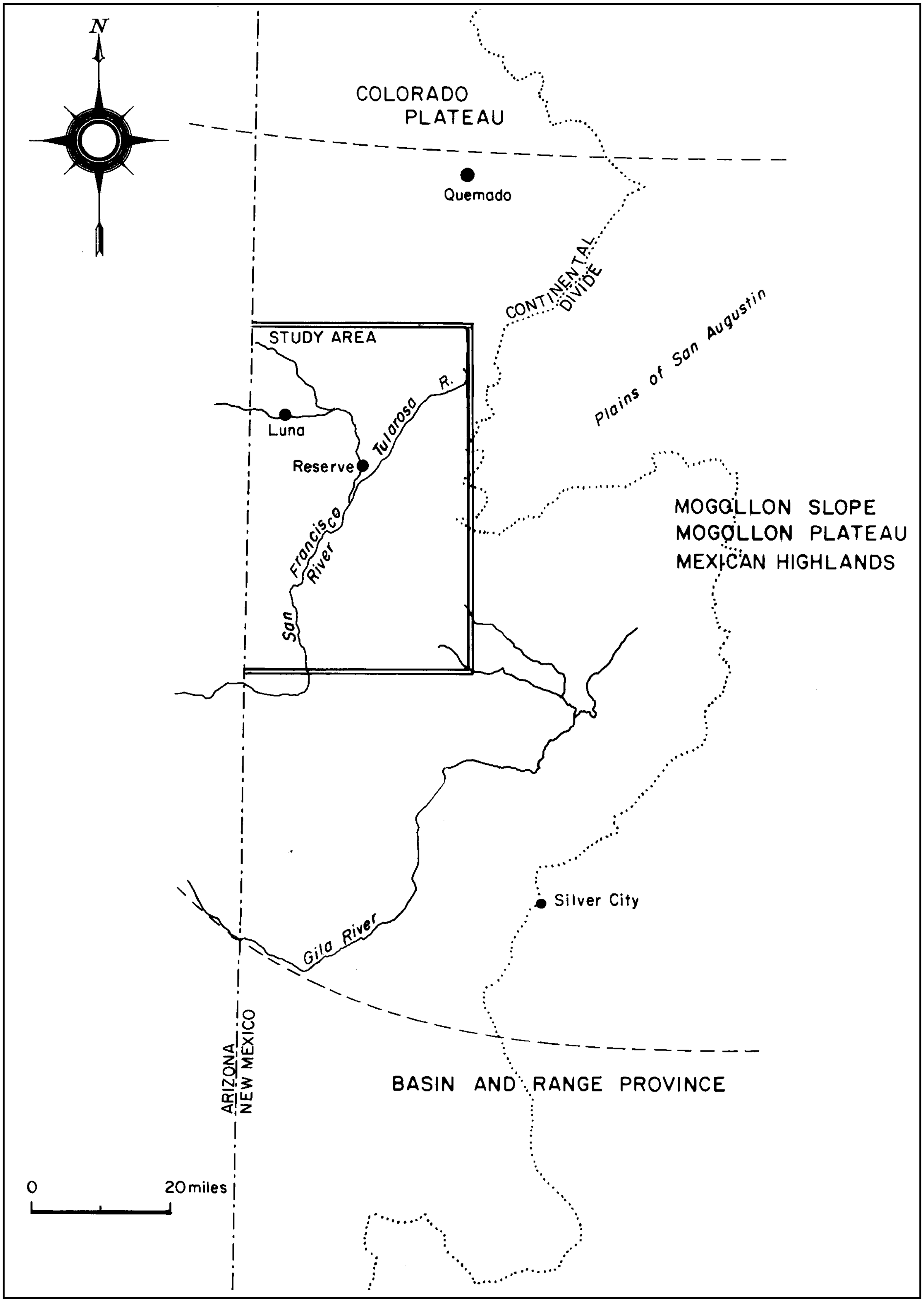

Figure 1.10. Physiographic map of study area and surrounding region.

Figure 1.11. The Plains of San Augustin, looking east. Bat Cave lies in the center of the photograph at the base of the point at the right end of the long mesa.

is an area of extreme relief, rough terrain, and complex geologic structures (Graybill 1975:8). Steep-sided plateaus and mesas are common and are mixed with rugged canyons, rolling plains, and narrow valleys (Maker et al. 1972:4-6). Hillsides are generally steep and rocky. Small pockets of isolated valleys are interspersed throughout the mountains (Brody 1977:28-29). However, as noted above, only three valleys are worth noting as potential centers of prehistoric populations. Elevation in the Mogollon Highlands ranges from about 1,525 m (5,000 ft) in the Reserve area to almost 2,440 m (8,000 ft) in higher mountains. Directly east of the Mogollon Highlands are the San Augustin Plains, an important area for early cultural development in the region (Fig. 1.11). This is an alluvium-filled basin that once held a Pleistocene lake covering about 410 sq km (255 sq mi), and had a maximum depth of 50 m or 165 ft (Fitzsimmons 1959:115).

The mountains contain conifer forests and woodlands with some extensive grasslands in several upland basins, particularly the San Augustin Plains (Wills 1996). Generally, the area is cooler, higher, and better-watered than most areas of the Southwest. The perennial San Francisco, Tularosa, and Gila rivers drain the mountains with numerable smaller intermittent streams. Many of these meander through narrow and deep canyons before passing through any type of arable land. The San Francisco is the major drainage within the project area. It begins at Luna Lake near the New Mexico border in Arizona and flows east through the Luna Valley. It then turns southeast to meet the Tularosa River and then south through Reserve and eventually flows back to the west into Arizona to meet the Gila River. Two of its principal tributaries are Leggett Creek and Pueblo Creek. Both contain archaeological sites investigated on this project. Seeps and springs frequently lie at the junction of talus slopes and older surfaces or at the edge of alluvial fans (Hunter-Anderson 1986:56).

Geology

Much of the Mogollon Highlands lies beneath 100-1,000 m of volcanic rock. There are approximately 150 Tertiary units in the region usually overlain by mid-Tertiary to Quaternary volcanic deposits (Elston 1989:43-45). Thus, bedrock consists mostly of igneous rock covered with alluvium; some sandstone is found in the northern area. The terraces and mesas are capped with basaltic flows while valleys contain clay and gravel deposits. These are poorly consolidated beds of volcanic debris and sedimentary rock termed the Gila Conglomerate. These various locales have produced a wide variety of raw materials suitable for prehistoric lithic manufacture. In the San Francisco Mountains, these deposits are called the Pueblo Creek Formation (Gallagher 1994:327). Fitzsimmons (1959:115) notes that most topographic features of the region have been formed as a result of volcanic accumulations.

The Plains of San Augustin supported the large Lake San Augustin during the late Pleistocene probably during the late Wisconsinian age. It was a closed internal drainage. Remnants of this lake may have been present well into the Holocene (Weber 1994:9-10; Chamberlin et al. 1994:106).

The area has produced at least five ash flow tuff sequences from three calderas. These calderas are the Mogollon (near Glenwood), the Bursum (northeast of the project area), and the Gila Cliff Dwellings calderas (Ratté 1989:69,81). There apparently has been some volcanic activity in the nearby White Mountains of Arizona as late as 2,000 years ago (Plog et al. 1978:9).

Modern Climate

Widespread acceptance in the 1960s of the linear model, which basically states that environment influences culture (Willey and Sabloff 1974), has led in the recent past to archaeological research based on the premise that variations observed in cultural systems are largely due to changes in climatic conditions. Or, in other words, culture is adaptively organized to solve specific problems posed by the environment (Oakes 1981:29). Today, there is a growing trend supporting the tenet that socioeconomic factors may instead be the primary cause for cultural change (Bayham and Morris 1990; Plog 1990). But, as pointed out by Larson et al. (1996:218), some environmental variables, such as amount, seasonality, and variation in annual precipitation, may significantly influence the availability, quality, and quantity of necessary resources, particularly in Southwestern settings, which many believe to be marginal. We agree with Larson et al. (1996) and suggest that environmental factors in the Mogollon Highlands played no small role in the changing cultural adaptations seen throughout the prehistory of the region. This and the following section explore those climatic variables that may have influenced cultural change.

Classification of the Mogollon Highlands into a climatic regime has changed over the years from steppe (Trewartha 1961), inferring a transitional zone between a desertic environment and a more humid one, to semiarid bordering on dry subhumid (Quimby 1949:41), to semihumid ranging to humid in higher elevations (Berman 1979:5). Most recent research considers the area to be temperate with the above-noted variablilty resulting from the differing topographic landforms (Ferguson and Hart 1985:13).

Precipitation

If the Mogollon Highlands basically lie within a semiarid environment, then availability of dependable water becomes critical for human and plant survival. However, it should be noted that several reseachers suggest that the highlands are the wettest area in New Mexico (Dean 1989:122). Particularly significant for this mountainous area is the fact that annual precipitation is supposed to increase in direct proportion to rises in elevation. On an average, precipitation increases about 102 mm (4 inches) for every 348 m (1,000 ft) increase in elevation (Maker et al. 1972:6). In Table 1.2, the differences in annual precipitation (charted from 37 to 60 years) among locales with varying elevations are actually not that dramatic (with the exception of Aragon in the Tularosa Valley); however, the differences in frost-free days are significant. Schoenwetter (1962:192) indicates that precipitation can vary between 254 and 508 mm annually (10-20 inches), while Hunter-Anderson (1986:54) estimates it can go as high as 762 mm (30 inches). Some areas on the higher mountain slopes and in deep, narrow canyons receive higher precipitation than surrounding areas (Aschmann 1974:254). This variability in availability and location of rainfall, both annually and over time, may have been of great importance for successful crop propagation to prehistoric occupants of the Mogollon Highlands.

Precipitation is affected by the location of the highlands between two major sources of rainfall, the Pacific Ocean and the Gulf of Mexico, producing two seasonal cycles of rainfall. The summer pattern is the heaviest. Violent convectional thunderstorms occur in late summer and early fall from the Gulf of Mexico.

These are usually very localized with rapid runoff. Flash floods are common in normally dry arroyos, which overflow and erode the surrounding floodplains (Schoenwetter 1962:193). Usually there is no rain in the spring between March or April and the end of June (Trewartha 1961:274; Dean 1989:122-123). May is the driest month. Heavy rains generally begin in July but often commence as late as mid-August. This late initiation of the rainy season, even if in late June, can be seriously detrimental to seed germination and the early growth of plants (Minnis 1985:72).

Winter precipitation derives from the Pacific Ocean and is more variable from year to year than summer rain-

Table 1.2. Climate Data for Mogollon Highlands*

Locale	Elevation (Feet)	Mean Temperature	Mean Rainfall (Inches)	Growing Season (Days)
Alma	4800	55.0EF	15.70	172
Aragon	6687	47.5EF	13.57	135
Jewett Ranger Station	7400	46.5EF	14.83	94
Luna Ranger Station	7050	45.7EF	15.72	87
Reserve Ranger Station	5832	50.8EF	14.88	120

*Compiled from Maker et al. (1972), Stockton (1975), and Gabin and Lesperance (1977).

fall and of less intensity (Dean 1989:123). Being less violent, the precipitation is absorbed more gradually by the soil and raises the water table. There is also usually a slow runoff in spring as snow melts, with most runoff occurring in March and April (Stockton 1975:34; Ferguson and Hart 1985:13). Many streams flow only during this period of melting snow or during heavy rains in summer (Quimby 1949:41). Low precipitation in winter and early spring can cause a severe lack of reserve moisture in the soil and possibly forestall the planting of crops until June or July, too late for the already marginal growing season.

Schoenwetter (1962:192) considers precipitation in the Mogollon Highlands to be undependable. And because of the potential for great variation in the availability of moisture, we concur (regardless that the highlands may be the wettest area in New Mexico) and submit that rainfall production from year to year and place to place was of major concern to prehistoric populations of the region. Potential adaptive responses to these climatic variables will be discussed later.

Temperature

Daily temperatures in the Mogollon Highlands can vary by as much as 4.4 degrees C (40 degrees F) with means for the region averaging around -1.1 degrees C (30 degrees F). The mean summer temperature is 16.6 degrees C or 62 degrees F (Quimby 1949:42). Temperatures rarely exceed 32.2 degrees C or 90 degrees F (Maker et al. 1972:8). However, high temperatures combined with strong, dry winds can cause an increase in evaporation, drying up available moisture (Ferguson and Hart 1985:15). In winter, temperatures can drop to an annual average of 7.7 degrees C (18 degrees F); however, winter days are usually mild to cool (Quimby 1949:38). Because moderate temperatures are critical to the growth of both wild and domesticated plants, the variations can cause serious consequences for agriculturalists. Every 30-m rise in elevation produces a decrease of .5 degrees C (3.3 degrees F) in average annual temperatures (Ferguson and Hart 1985:15). From another viewpoint, there is a 6.5 day decrease in the growing season for every 1 degree C drop in temperature (E. C. Adams 1979:291). Therefore, there is the potential for approximately 30 fewer days of growing season in the Luna Valley as opposed to the Pine Lawn Valley.

Temperatures in mountainous areas can also be affected by cold air drainage. This tendency of heavy cold air in topographically diverse regions to sink into low confined areas, such as narrow canyon bottoms, subsequently drops temperatures in these areas (Eddy 1983). This is termed an inversion layer and occurs most frequently in spring and fall. Higher topographic features will be above the inversion zone, but in the valleys and canyons, there could be a resulting shorter growing season. E. C. Adams (1979:290) believes populations to the north on the Colorado Plateau may actually have avoided such areas because of the cold air pattern. In the Mogollon Highlands, valleys with good potential for arable land are also more susceptible to late spring frosts than higher elevations because of the settling of cold air (Sandor 1983:42) and are thus prone to shorter growing seasons.

Growing Season

The length of growing season (number of frost-free days) for any particular place is dependent on elevation, slope, and wind conditions, which can vary greatly from year to year (Ferguson and Hart 1985:15). As with precipitation and temperatures, the growing season is strongly affected by increases in elevation. Usually the growing season lengthens as elevation and latitude decrease.

The length of growing season is one of the major potentially limiting factors for agriculture in the Mogollon Highlands (Peterson 1988a:122). It can be adversely influenced by cold air drainage, freezing winds, and higher than normal precipitation (Ferguson and Hart 1985:15). From Table 1.2, it can be seen that growing seasons in the Mogollon Highlands vary significantly from area to area. As mentioned above, there is a 33-day difference between the Reserve and Luna study areas. This difference greatly reduces the potential for successful crops at Luna, which can, in a good year, obtain a 100-day growing season (Quimby 1949:42), although it averages mostly in the high 80s to mid-90-day range. Adams (1979:293) cautions, however, that even in a year with a 135-day growing season (similar to Aragón in the Tularosa Valley), there could be a crop failure from frost every five years. He warns that if this occurs more than once in a 10-year period, long-term agriculture is not viable.

Paleoenvironment

The purpose of reconstructing the paleoenvironment for southwestern New Mexico is to relate past climatic variations to possible consequences for the more recent cultural development in the region.

Paleoenvironmental data are available from pollen samples, packrat middens, and lake diatoms beginning approximately 24,000 years ago. From then until about 12,000 B.C., pollen evidence is scanty, but Wills (1988a:52) suggests that vegetational zones may have been lower than today by 900-1,400 m. He believes the region consisted mostly of mesic alpine forests of spruce, Douglas fir, limber pine, and ponderosa. For the same general time period, Martin and Mehringer (1965), also using pollen data from several Southwestern areas, consider the Gila National Forest in particular to have been a combination of parkland, woodland, and desert vegetational zones. This last interpretation of the data seems to be slightly in opposition to Wills (1988a). However, Markgraf et al. (1984) and Davis (1989) basically concur with Wills, using pollen dated between 16,000 and 13,000 B.C. They specifically pinpoint the area around the San Augustin Plains as being open pine and spruce with a cooler climate than today with winter-dominant precipitation (Davis 1989:22). From 13,000 to ca. 8000 B.C., Davis (1989) sees the climate becoming somewhat drier although not necessarily warmer, with a decrease in pine pollen and maintenance of winter-dominant rainfall. Leopold (1951), Martin and Mehringer (1965), Irwin-Williams and Haynes (1970), and Wills (1988a) all hold to this same theory of rainfall shift, with some considering it more minor than others, and most believing that it started closer to 10,000 B.C. rather than 13,000 B.C. as does Davis (1989).

The period between 8000 B.C. and 5000 B.C. is termed the Early Holocene. It is usually considered a time of relatively less effective moisture. Mesic forests begin to shrink and be replaced by a piñon-juniper environment (Wills 1988a:51-56). Wills believes this is the start of current climatic patterns. Resources become more seasonally available and more abundant, water availability increases, and desert vegetation moves northward as far as the northern limits of the Mogollon Highlands. To the north on the Colorado Plateau, Matson (1991:165) notes that piñon and juniper were not yet present during this time. Antevs (1955) calls this the Anathermal and considers it to have been moist and cool. He later (Antevs 1962:194) classifies this period as subhumid and dominated by yellow pine and oak with numerous small bodies of standing water. Toward the end of the Early Holocene, ca. 6000 B.C., we see the general beginning of the Archaic in this region. This influx of hunters and gatherers coincides with the decrease in effective moisture, the gradual warming of the climate, and the introduction of desert species into the area (Antevs 1955).

The Middle Holocene (5000 B.C. to ca. 2000 B.C.) with higher temperatures and a drier climate is also commonly referred to as the Altithermal (Antevs 1949). Precipitation begins to change to a late summer regime. Pleistocene lakes disappear and are replaced by open grasslands. Alpine forests continue to shrink, piñon and juniper expand their range, and resource availability no doubt increases (Wills 1988a:51, 54, 92). Accompanying these changes are arroyo cutting, caliche build-up, and wind erosion (Antevs 1949). Wills (1988a:57) sees it as a period of dynamic change, mostly to the advantage of human populations because while forests and lakes decreased, the replacement vegetation, such as piñon, grasses, and cheno-ams, were more economically useful. However, Antevs (1955:320) calls it the period of the "Long Drought." Two severe short-term droughts were documented for this time by Benedict (1979:1), one between 5000 and 4500 B.C. and another at 4000 to 3500 B.C. Only the northern Colorado Plateau apparently remained mesic (James 1990:26). Simmons (1984:21-23) argues against an arid Altithermal regimen, believing the environment may have shifted to being slightly more favorable for human adaptations, but that the shift would have been very subtle.

The Late Holocene began at approximately 2000 B.C. and continues to the present. Changes include a shift to more effective moisture with a resurgence of pine forests and increased water availability from greater precipitation and higher water tables (Van Devender and Spaulding 1979:458; Wills 1988a:54). Antevs (1955:329) originally offered this same opinion, citing a decrease in xerothermic plants, stabilization of dunes, arroyo-filling, and the rise of wet meadowlands.

The confirmation of periodic droughts in prehistoric times occurred through the use of pollen and packrat midden data beginning in about 510 B.C. when Antevs

(1955) stated there had been a drought near the San Pedro River area in Arizona at this time. Successive severe droughts have been documented for several areas in southeastern Arizona, adjacent to the study area. Most droughts ranged from 10 to 20 years in duration, long enough to cause severe disruption of normal cultural processes.

While most of the earlier droughts are recorded for southern and eastern Arizona, Antevs (1955) relates them to probable similar occurrences in west-central New Mexico. Between A.D. 350 and 1000 and between A.D. 1050 and 1100, Berman (1979:37) suggests a higher than average winter precipitation at this time with resultant higher water tables and greater ground-water retention in late spring, excellent for the growing of crops. But during this same period, two episodes of a much drier and warmer climate are recorded by Schulman (1938). However, it does appear that the severity of overall climatic shifts is less at this time. Of interest is the fact that this particular period with reputedly the most sustained favorable climatic conditions is also the time of increasing population growth in the Mogollon Highlands.

After approximately A.D. 1050, there is a pronounced shift from winter- to summer-dominant precipitation, causing the degradation of floodplains, widespread erosion, channel entrenchment, and a pollen shift from aboreal (primarily pine) to mostly cheno-ams and more piñon and juniper (Hill 1970:83; Wood 1978:203). Undocumented droughts may have occurred between A.D. 1050 and 1100 in some of the minor drainages of the region (Jorde 1983:387-388). Jorde also thinks that the lowering of the water table may have induced the buffering mechanism of moving settlements next to permanent streams. Berman (1979:74) notes that Tularosa phase sites (A.D. 1100-1350) concentrated in higher elevations near Quemado and Cibola at this time, which may have been the result of another buffering mechanism prompted by decreasing moisture in the region. This elevational shifting of sites in different time periods will be discussed in detail in a later chapter. Lekson (1992a:27), as a lone dissenter, suggests that A.D. 1000-1100 was generally favorable for agriculture and was quite moist. This seems to contradict the above researchers who see the area as definitely drier and more arid after A.D. 1050.

Tree-Ring Data

Decadal variation in rainfall and temperature has been plotted for most of the Southwest by Dean and Robinson (1977), based on tree-ring analysis. The study allows for a reconstruction of localized climatic variability, beginning in A.D. 680. We mapped the data from five of their recording stations: Reserve, Luna, Aragon, the Little Colorado area to the west of the study area, and Zuni (Figs. 1.12-1.14). One and 2 standard deviations are shown on the charts. Originally, Dean and Robinson (1977) state that any variation exceeding 2 standard variations from the mean indicates significant cause to effect adaptive cultural responses. More recently, Dean (1988:138) has revised his interpretation, stating that a 1.1 standard deviation is more appropriate for indicating severe climatic fluctuations that would have had serious consequences for animal, plant, and human populations.

In Figures 1.12-1.14, there are several extremely high departures from the mean indicating very cold and wet conditions or very hot and dry ones (droughts). Dean et al. (1985:542) believe that these amplitudinal variations would have stimulated a number of possible behavioral responses such as population movement, aggregation, relocation of fields, use of water control, and changes in the proportion of agricultural products produced. If amplitudinal variation is not as pronounced, but there are still rapid oscillations in climate, this pattern indicates a somewhat unstable environment, and they suggest (Dean et al. 1985:543) that this is best countered by producing surplus food accompanied by long-term storage.

Figures 1.12-1.14 shows several periods of extreme fluctuation (over 2 standard deviations) in precipitation in the Mogollon Highlands. These radical departures from the mean mostly do not occur until approximately A.D. 1040 and include the periods of A.D. 830-840, A.D. 1040-1085, and A.D. 1290-1320 as times of heavy precipitation and a climate too cold to likely allow for the growing of crops. The first two periods are decidedly worse in the Reserve area. The long cold and wet period of A.D. 1040-1085 is not nearly as severe in the Little Colorado area; however, in A.D. 1290-1320, the climate there is much worse than in the other areas. At this time, Zuni is experiencing a severe, but short, drought (A.D. 1290-1310).

In contrast, there are six periods of extreme drought and many occurrences of lesser ones. These six include A.D. 875-885, A.D. 1030-1040, A.D. 1090-1100, A.D. 1125-1135, A.D. 1240-1250, and A.D. 1325-1340. The A.D. 875-885 period is the most severe in the Reserve area, while the Luna Valley and the Little Colorado are the most dry in A.D. 1090-1100. In the drought of A.D. 1240-1250, the Little Colorado suffers a much more severe arid spell by a whole standard deviation. The last three periods of drought in the Mogollon Highlands, variously between A.D. 1125 and 1340, were all periods of more moderate climatic conditions in the Zuni area.

Overall, the charts indicate constantly vacillating climatic conditions throughout Mogollon prehistory

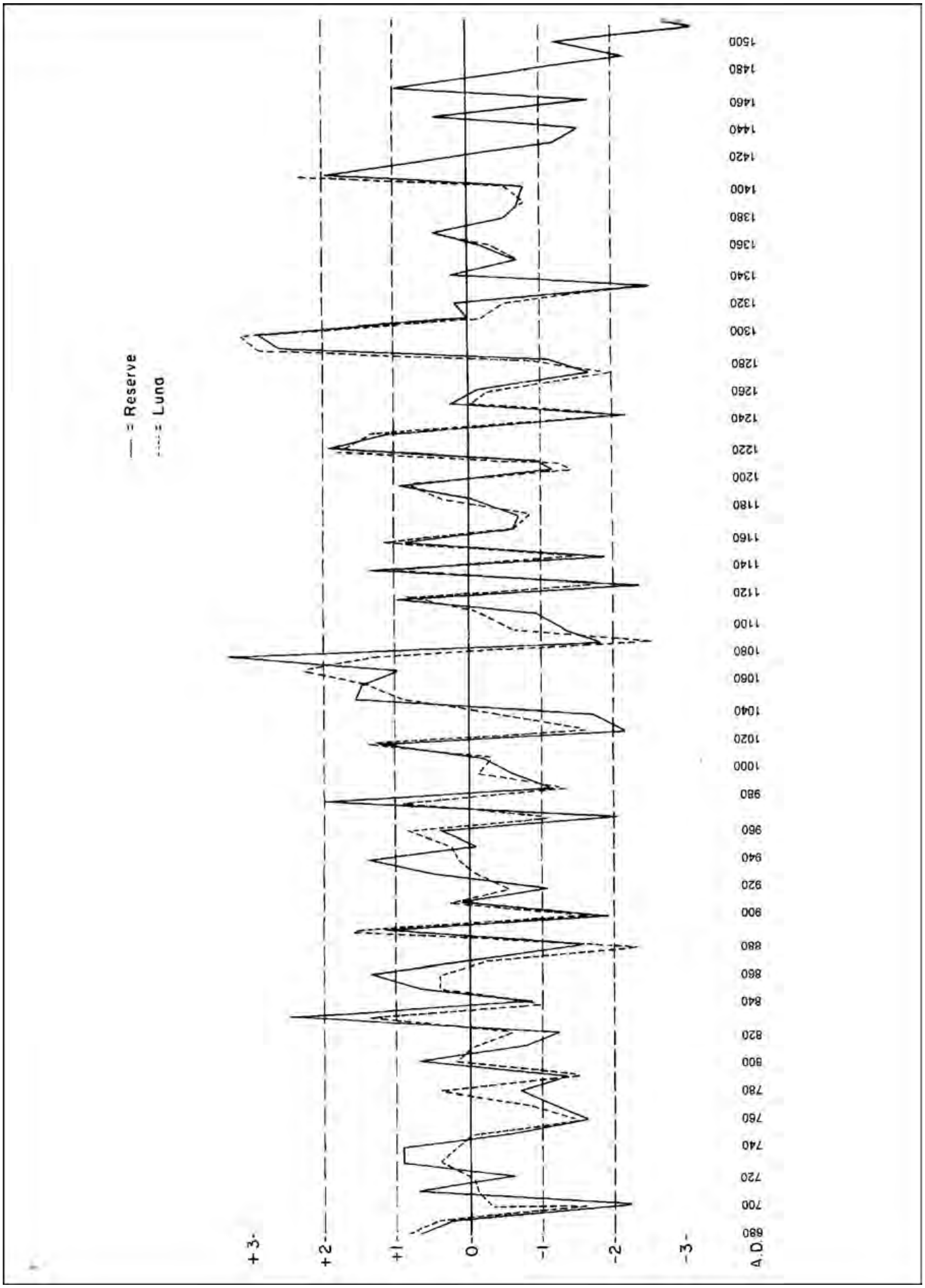

Figure 1.12. Variations in climate, Luna and Reserve, A.D. 680-1400.

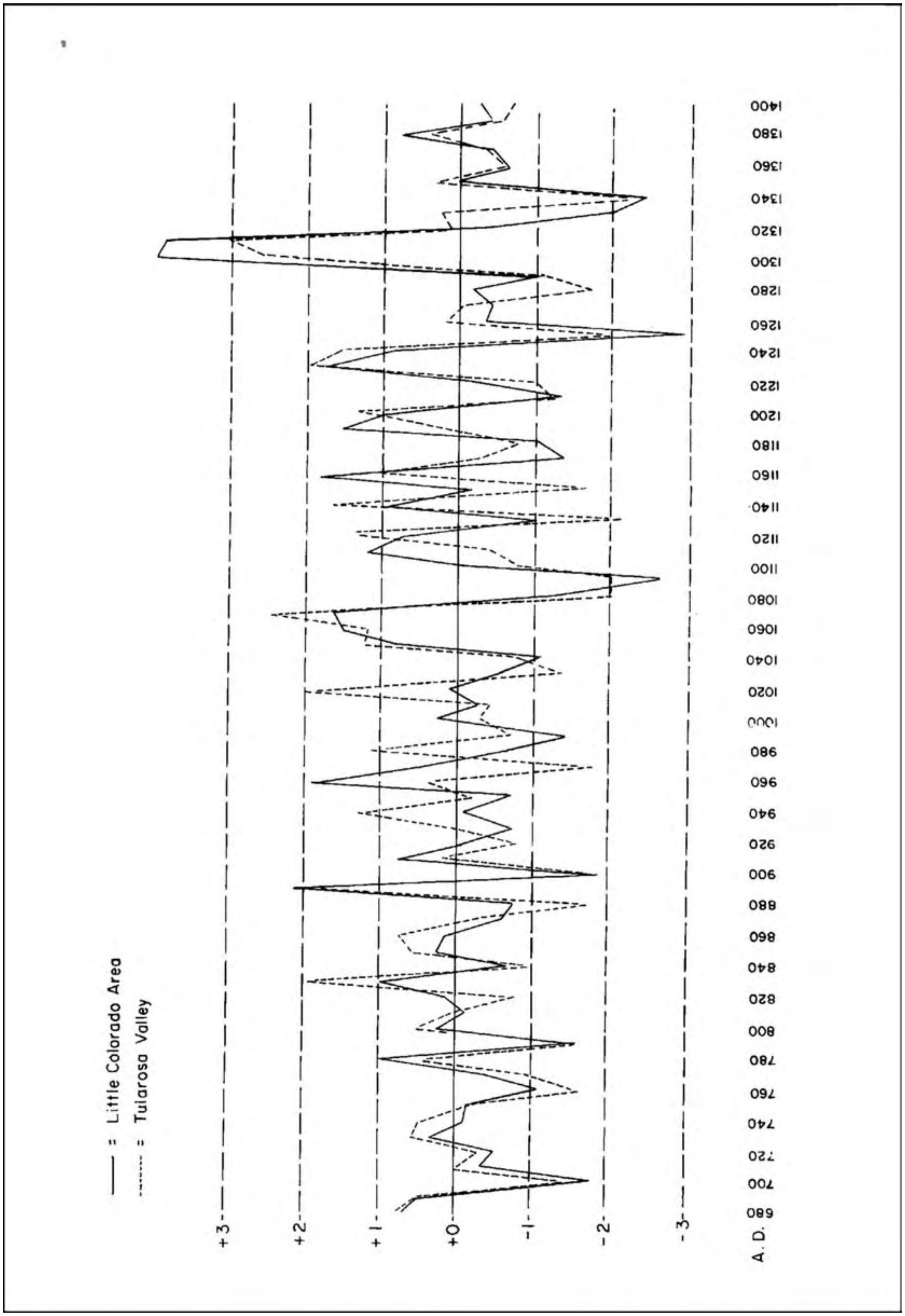

Figure 1.13. Variations in climate, Little Colorado area and Tularosa Valley, A.D. 680-1400.

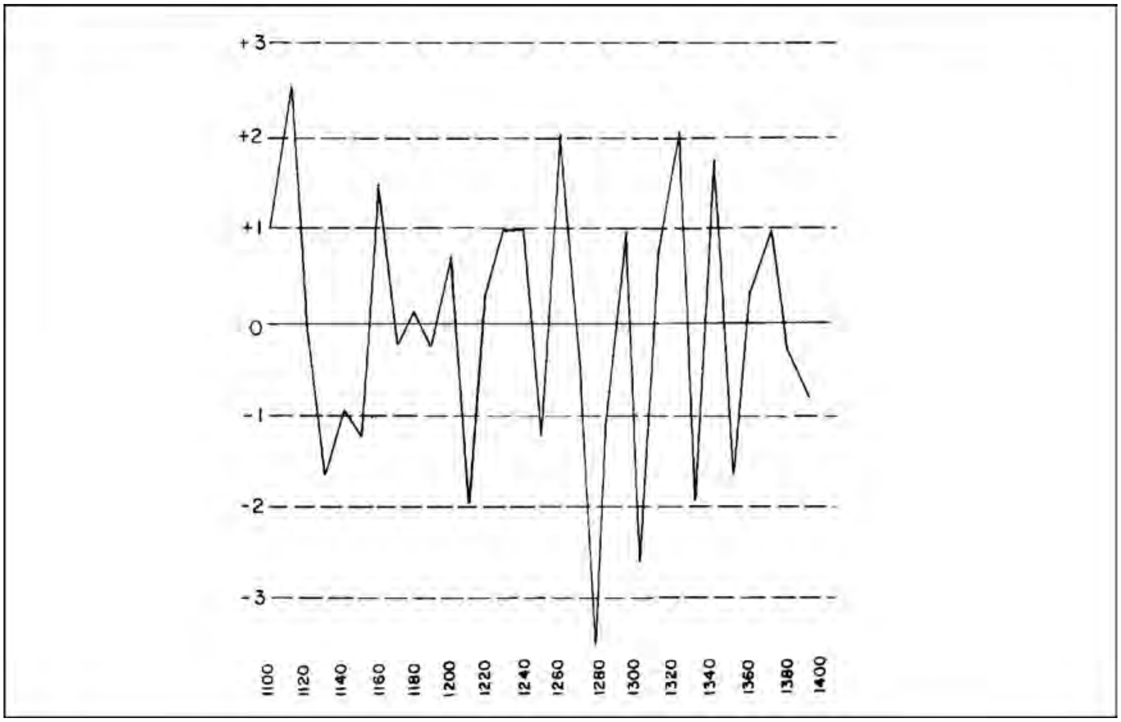

Figure 1.14. Variations in climate, Zuni area, A.D. 1100-1400.

between A.D. 680 and 1400. Combined with the several periods of extreme deviations from the mean, it would probably be safe to conclude that the potential instability of precipitation and temperature regimes in the Mogollon Highlands was an ongoing major problem that had to be faced by prehistoric populations through time. The severe droughts shown for A.D. 1240-1250 and A.D. 1330-1340 coincide with the final abandonment period in the highlands and may have played an important role in the decision to leave the Mogollon area. The involvement of climatic conditions in the shifting of populations in the Reserve period (A.D. 1000-1100) and again in the final abandonment of the region will be examined in detail in a later volume.

Resources Available

While the following paragraphs indicate a diverse and rich amount of natural resources available for use by prehistoric populations in the Mogollon Highlands, the above climatic study implies that this resource availability is highly variable. When environmental conditions are good, not necessarily even optimum, the area is abundantly rich and diverse: when conditions deteriorate, plant and animal resources may be drastically reduced. However, there were apparently enough "good" periods to sustain a viable human population in the highlands until approximately the A.D. 1200-1300s.

Biotic Zones and Vegetation

The Mogollon Highlands have been variously sorted into several classifications of biotic and vegetational zones. Original zonations for the area were defined by V. Bailey (1913) who separated the region into four units. These are basically:

1. *Lower Sonoran:* below 4,000 ft. It covers the area between Alma and Glenwood and is south of the study area.

2. *Upper Sonoran:* 4,000 to 7,000 ft. This zone includes the Plains of San Augustin and the lower mountain valleys such as the Pine Lawn and Luna valleys. It is characterized by piñon and juniper on upper slopes and low desert shrubs and riparian trees along streams.

3. *Transitional:* 7,000 to 9,000 ft. This area consists of grassy, open forests, primarily of western yellow pine.

4. *Canadian:* 9,000 to 12,000 ft. This includes only the highest mountain areas and contains thick forests of fir, spruce, and quaking aspen.

Berman (1979:7) bases her subsequent breakdown of biotic zones on Bailey (1913), but varies the elevations for the zones, dropping their ranges by 500-1,000 ft, and adding his Hudsonian zone to her classification while eliminating the Lower Sonoran from consideration. She places the Hudsonian zone at areas above 9,500 ft. The dominant vegetation consists of several varieties of spruce trees. Her raising of the Upper Sonoran zone to 4,500 ft may be more appropriate for the region. She also adds oak, grasses, saltbush, and greasewood as being present with cottonwood, walnut, sycamore, willow, and box elder along stream banks. Berman also lowers the elevation limits for the Transitional zone, noting that Gambel's oak also dominates along with ponderosa pine. Mention is made of numerous shrubs such as rabbitbrush, snakeweed, box elder, and mountain mahogany. Aspen and a variety of pines are present in higher elevations along with yellow pine. Sites within the project area fall within the Upper Sonoran and the lower portions of Berman's (1979) Transitional zone.

More recently, divisions have been based not so much on life zones but on the distinctions between tree and understory cover such as grasslands, woodlands, and forests (Ferguson and Hart 1985; Cepeda and Allison 1994). The former (1985:17-19) provide a classification scheme, which includes three units that are appropriate for the study area. These are:

1. *Great Basin Conifer Woodlands:* generally at 5,000 to 7,000 ft. This is a dominant piñon/juniper woodland, although in the lower elevations trees are sometimes widely spaced. It includes savannahs with grasses and herbs. The mountains around Reserve are indicated as being in this division.

2. *Montane Conifer Forest:* generally at 6,000 to 9,000 ft. This zone is primarily ponderosa pine with numerous shrubs, herbs, grasses, and occasional oak, juniper, and piñon. The area covers much of the Mogollon Highlands.

3. *Madrean Evergreen Woodlands:* This is a riparian community with cottonwood, willow, and walnut trees along streams.

These classifications are more similar than dissimilar to Bailey's (1913) units and seem to be mainly a reworking of terms. Cepeda and Allison (1994:331-334) use a similar construct to define vegetation zones. Their two units that are of interest to the study area include:

1. *Juniper Savanna:* This is classified as the ecotone between grassland and woodland. Trees are mostly oneseed and Rocky Mountain juniper with some scattered piñon. Dominant grasses include blue and sideoats grama.

2. *Coniferous and Mixed Woodland:* This woodland zone is comprised mostly of piñon, juniper, and oak. The grass is primarily blue grama. At higher elevations, this unit merges with pine forests and with the juniper savanna at lower elevations. Alligator juniper may be found between 6,000 and 8,000 ft. in localized areas.

Vegetation in the Mogollon Highlands can be seen to separate by elevation into specific zones. The piñon-juniper woodlands, with attendant oak, numerous grasses, and a variety of shrubs, have been considered the most desirable zone of all (Hunter-Anderson 1986:65). This roughly covers areas between 1,525 and 2,135 m (5,000 to 7,000 ft) in altitude. Most project sites are in this piñon-juniper unit, except for several near Luna, which are in a more pine-dominated forest.

Piñon nuts are considered a valuable food resource and their abundance focuses particularly in the southern foothills of the San Francisco Mountains. This resource, however, experiences great periodicity in availability and averages only one good crop every four years (Wills 1988a:93). Other wild vegetal resources not mentioned above that are present in the Luna-Reserve area include wild tobacco, acorns, and some agave.

Although agave has been observed in the Mogollon Highlands, Minnis and Plog (1976:300-306) note a tendency for it to be always associated with archaeological sites within the Apache-Sitgreaves National Forest. The OAS project directors have also observed it near sites in Apache Creek Canyon and downslope from the SU site in the Pine Lawn Valley. Minnis and Plog (1976) suggest that agave was introduced to these sites by human intention. Its many uses include fiber, as a beverage, ornamentation, as a food source, and for ceremonial equipment, cordage, nets, mats, baskets, sandals, and soap (Castetter et al. 1938:78).

Within these broadly defined vegetational zones may be found many variant microenvironments. Brody (1977:31-32) notes that the north sides of steep slopes and canyons may often be barren except for patchy grasses, prickly pear cactus, and perhaps yucca. Where soil is deeper and climate wetter, tree canopy is thicker with more grasses present. Above 2,135 m (7,000 ft), stands of isolated agave can be found on south-facing slopes. Natural bowls situated in saddles between mountain ridges are often well watered and drained and provide grassy meadows and a variety of shrubs. And berries grow frequently where alluvium is thickest.

Fauna

Availability of fauna as a natural resource can vary greatly depending on existing climatic conditions. Fauna are also an unpredictable resource and may not be available at the same locale, season, or abundance as a previous year or season. Still, the Mogollon Highlands are considered rich in wild game (Brody 1977:32; Hunter-Anderson 1986:54) and relatively speaking, they are (if severe drought years and extended rainy seasons are not taken into account). In 1825, James O. Pattie caught 250 beaver in two weeks on the San Francisco River (Danson 1957:12). In 1888, bears were frequently seen in the region, particularly in the southern San Francisco, Mogollon, and Blue mountains and near the headwaters of the Gila River (French 1990:198). In the early 1900s, Ben Lilly killed over 200 bears (including grizzlies) and perhaps 300 mountain lions in the Gila National Forest area. Jaguar were spotted in the region in 1902 (McFarland 1974:43).

Fauna found today in the Mogollon Highlands include mule deer, elk, mountain lion, black bear (and formerly grizzly bear), mountain sheep, bobcat, javelina, beaver, raccoon, porcupine, fox, coyote, and until recently, gray wolf. Smaller animals present are rabbits, gophers, skunks, chipmunks, squirrels, rodents, and a variety of lizards, snakes, turtles, frogs, and toads. Wild fowl include Merriam's turkey, eagles, hawks, buzzards, owls, jays, woodpeckers, sparrows, and wrens. Fauna recovered from OAS excavations in the project area include a great many of the above. Also, bison remains are not uncommon on archaeological sites in the region, including thousands found in early ceramic levels at Bat Cave.

However rich in faunal resources the Mogollon Highlands seem to be, prehistoric reduction of these available resources could have occurred periodically throughout the region. Causal factors include overkilling of wild game, increased wariness of humans by prey species, and movement of prey to new locations (Shaffer and Schick 1995:118). One solution to faunal depletion of large game in an area is to switch to the pursuit of smaller species such as rabbits or rodents (Hayden 1981) or increase the production of domesticated plants. Faunal use at WS Ranch in the southern portion of the Mogollon Highlands was compared to lower, less mesic sites (Shaffer and Schick 1995:124-135), and it was found that lower elevation sites had 85-99 percent of small species in their assemblages compared with only 58 percent from WS Ranch. Also, cottontails, which prefer dense cover, were more prevalent than jackrabbits. The authors suggest that resource depletion at WS Ranch was, therefore, not as severe as at other nearby sites. Potential faunal depletion for project sites will be examined in a later volume.

Extinct fauna recovered from the nearby San Augustin Plains include bison, mammoth, possibly mastodon, camel, and short-faced bear. Smaller animals found were muskrat, pygmy rabbit, ground squirrel, vole, horned owl, and neotonic salamander. There were also at least 30 species of mollusks because of the former presence of Lake Augustin (Weber 1994:11).

Soils

In the Mogollon Highlands, soils on slopes and ridge tops are generally thin and gravel-surfaced with stones and boulders frequently present. Best soil concentrations are usually found only in valley bottoms adjacent to stream systems (Graybill 1975:8). Clay-laden soils were found over much of the project area, and were difficult to excavate; however, habitation features had been dug into these clays by prehistoric peoples. Hevly (1983:22) notes that clay-rich soils have a high water-retention capacity. This attribute could have been useful for populations using water catchment basins, such as those found at Spurgeon Draw, LA 39968.

Soil classifications for the project area are derived from Maker et al. (1972:18-32) and include:

1. *San Mateo-Shanta association.* Found in the Luna Valley and environs. These soils are located on nearly level to gently sloping floodplains and the valley bottoms adjacent to major streams. Soil texture ranges from sand to clay but is commonly loam mixed with sand or clay. Irrigation is best suited for this area.

2. *Capillo-Tampico-Mirabal association.* This covers lands above 7,000 ft and just borders project site locations. Topography is gently sloping to moderately steep. Soils develop from mixed igneous and conglomerate rocks. Surfaces are often gravelly and sometimes stony. Soils in this association are moderately productive and support good stands of native vegetation, usually ponderosa, piñon, juniper, and oak. It also provides a wide variety of browse plants for wild game.

3. *Rock Land-Luzena-Santana association.* Most project sites are found within this association, located on the lower slopes and foothills of the surrounding mountains with some areas of hilly to steep lands. Narrow valleys, steep canyons, and escarpments also are part of the relief of this unit. Soils are mostly shallow and they include conglomerates and mixed igneous rocks. Rock outcrops are common on steep slopes and along canyon walls below higher ridges. Surfaces are usually stony or gravelly, frequently with stones and boulders lying on them. This is also a good habitat for wildlife because of the wide variety of grasses, shrubs, and trees.

Wood

The presence of adequate wood resources is critical to the survival of prehistoric populations in any given area. Various species and sizes of wood are used for construction purposes, for cooking of foods, and for producing fires for warmth. If not judicious about wood consumption, populations can cause areas to become deforested in relatively short amounts of time. Potential wood use on the Colorado Plateau was measured by Ambler (1993). A single mature juniper produces only 4 cu ft of wood per acre per year, or 1/32 of a cord. In the Dolores area of southwestern Colorado, Kohler and Matthews (1988) linked wood depletion to periodic changes in site location.

Within the project area, wood resources today seem to be more than adequate. Dense forest growth extends for many kilometers over much of Catron County. However, areas of this arboreal environment were undoubtedly subject to overexploitation by prehistoric populations, resulting in deforestation of portions of the landscape. Deforestation is caused by the cutting or clearing of trees around a settlement to such an extent that regrowth is not sufficient to maintain the needs of the resident population. This was enough of a problem to have caused high residential mobility in areas of the Colorado Plateau (Kohler and Matthews 1988:537). In the nearby Apache-Sitgreaves National Forest of east-central Arizona, Upham (1982:179-180) attempted to measure effects of wood use on forests and noted that a population of 500 would need to clear 160 ha of land annually to meet their needs. Over a settlement period of 30 years, 4,800 ha or about 50 sq km would have been cleared, causing a substantial impact on the environment.

Damages to wood resources are most often inflicted by agricultural groups using some type of slash-and-burn or "burnt plot" technique to clear land for agricultural crops (Stiger 1979; Sullivan 1982). Results of this resource overuse can be seen in a decrease of piñon nuts in piñon-juniper belts and an increase in jackrabbit populations with an attendant decrease in cottontails because of a jackrabbit preference for more open spaces (Kohler and Matthews 1988:539). Also, there can be a change in the tree species used by prehistoric populations to those that occur at other elevations or in other environmental niches. Charcoal from the project sites was examined in order to address this possibility of deforestation in the Mogollon Highlands based on observations by Kohler and Matthews (1988).

As stated above, residential mobility is often a necessary result of deforestation of settlement environs. Kohler and Matthews (1988:537-538) believe this movement is often attributed to climatic fluctuations or demographic factors, but state that climatic data frequently do not support the movement of a population to a different location within the same region. Studies presented later in this report document several movements of Mogollon populations to differing environmental zones and deforestation should be considered one of the possible causes.

Lithic Raw Materials

The Mogollon Mountains were formed as a result of Tertiary volcanic flows; thus, most available lithic raw material is of volcanic origin. Sedimentary and metamorphic rocks are present, but much less common, and available mostly in the northern portion of the highlands. Hough (1914:11) states that the local lithic material was not of particularly fine quality with much of it flawed. Our study found that there is a broad gradient in quality of materials with much that is very workable and some that is less suitable, but usable. Workable materials found within the Mogollon Highlands include rhyolite, andesite, basalt, ash-flow tuff, obsidian, agate, chalcedony, chert, quartzite, quartz, granite, hornblende, Gila conglomerate, argillite, sandstone, siltstone, mudstone, limestone, and shale. These provide an extremely varied source for lithic raw materials. Most commonly used materials by prehistoric peoples were rhyolite and Luna blue agate, a locally available igneous material.

Sources for these materials are not present everywhere within the region. Many are focused in specific areas. Olivene basalt tops broad, flat mesas and high terraces. Obsidian and ash-flow tuffs are found in the southern portion where volcanic calderas are situated. The obsidian (Gwynn Canyon variety) is of poorer quality and in smaller nodules than that found to the north and south of the Mogollon Highlands at Red Hill and Mule Creek (Findlow and Bolognese 1982) and was not as popular a choice as the other two types. Cherts and chalcedonies may be located in the gravels near the bases of mountain foothills and in valleys bordering stream flows. Luna blue agate is fairly prevalent and is found somewhat more localized in the northern portion of the area, particularly near the bases of andesitic flows. It is of exceptionally good quality in upper Apache Canyon (Ratté et al. 1994). Rhyolite commonly outcrops in the mountains and was observed in almost all road cuts made through bedrock zones. Conglomerates may be found in the scarps along the slopes of the San Francisco Mountains (Ratté 1989:80). Bearwallow Mountain andesite has been recorded in Dry Leggett Canyon, Starkweather Canyon, the Saliz Pass area along Pueblo Park road, and Hell Roaring Mesa (Elston 1989; Reynolds 1991; Ratté et al. 1994). Granite and quartzite can be found on the slopes of Prairie Point Peak. Quartz crystals are present here also and in other scattered areas. Sandstone is more available to the north along the San Francisco River particularly near its headwaters, at Kimball Springs, and some in the central area in Starkweather Canyon (Ratté et al. 1994:80, 92).

Modern Land Use

Today, use of the Mogollon Highlands is mostly for the grazing of livestock. Farming is limited, restricted to small tracts in valley bottoms near the San Francisco and Tularosa rivers at Reserve, Luna, and Aragon. Irrigation is practiced only in these valley situations. The short growing season does not allow for a dependency by local residents on agricultural crops. The many acres of forest land within the area are mostly controlled by the Gila

National Forest and see much recreational use along with, until recently, logging activity. This forest area also provides an excellent habitat for many species of wildlife (Maker et al. 1972:8).

Adaptation to Environmental Variability

The Mogollon Highlands have sometimes been inferred to be a marginal environment (Hunter-Anderson 1986; Larson et al. 1996), but this may only hold for certain areas at specific points in time; in other words, marginality is a relative concept dependent on specific situations (Speth 1990). While natural resources seem to have been plentiful in the Mogollon Highlands during much of the prehistoric past, it is evident that there frequently was great fluctuation in the availability of those resources for a wide variety of reasons.

For example, the Mogollon Highlands provide many resources available only seasonally. Deer and elk move to lower elevations in winter, and plant foods die off. Mechanisms to buffer these situations must frequently be employed by prehistoric populations. The climate also fluctuates seasonally and too little or too much precipitation at the wrong time or in the wrong place can cause environmental stress lasting for years, documented in the tree-ring charts shown earlier. The effects of climatic or resource variability, however, are not always predictable. The impact of droughts or wet regimes can depend upon the duration and strength of the perturbations, ability of resources (such as flora and fauna) to withstand variations, and the adaptive strategies of a population (Larson et al. 1996:216).

Prehistoric responses to environmental variability are often seen as buffering mechanisms—strategies put into play when stress occurs. These vary situationally and also probably with each individual group of people. Decreases in rainfall resulting in aridity can cause several different responses. Groups can increase their resource range to allow for specific locational variation or they can have already in place a broad zonal base for resource acquisition. They can also move from location to location pursuing available resources. Or, they can establish socioeconomic relationships with other groups in order to maintain information flow or to conduct actual resource exchange with those in other biomes (Hunter-Anderson 1986:24, 33).

Some of these adaptations are more suitable for mobile hunters and gatherers than agriculturalists, but all could be employed by any group at a given time. For agriculturalists, buffering aridity with its attendant drop in food resources, could mean increasing food storage, practicing irrigation, or aggregating along permanent streams (Jorde 1983:385-387). Schlanger and Wilshusen (1993:85) consider drought be a major cause of many prehistoric abandonment events.

Buffering responses can also vary in their length of employment. Many short-term, but dramatic, climatic oscillations can be buffered with short-term responses. Some of these include a spreading out of the population over a region, expansion of the resource base, use of water-control devices, increased production of storable foods, and food exchange with neighboring groups (Dean et al. 1985:543). More long-term responses to severe perturbations could include a reorganization of the labor force (Bender 1985:25), aggregation into favorable environmental zones, movement out of the affected area, or a shift in the resources pursued. Dean et al. (1985:549) would add the increased use of ceremonialism as another possible response. Emigration, or movement out of a stressed area, is considered by Rindos (1980:762) to be a frequent response to a decrease in an area's carrying capacity, for whatever reason.

Prehistoric populations in the Mogollon Highlands could have expanded their resource bases in times of subsistence stress in several ways. One would be the moving of settlements to richer areas or broadening of catchment areas. They could have varied their usage of favored flora and fauna species to those less popular. Expansion of trade networks was also a viable choice. Storage was certainly an option, if not already practiced. Minnis (1985:41) notes that one response to food stress can also be the sacrificing of the very young or very old in a population. All of these options could have been viable solutions to subsistence stress in the Mogollon Highlands. Our research pursues some of these avenues in later volumes.

DEFINING THE MOGOLLON CULTURE

DEFINITION OF CULTURE

The concept of a Mogollon culture continuum has been shrouded in controversy since its inception in 1933 and, with minor changes in emphasis, continues today, 65 years later. All project sites lie within the Mogollon Highlands in the northern portion of a larger region known as the Mogollon area. The problem stems from equating an unbounded cultural system with the physically bounded Mogollon area. Arguments for and against assigning a Mogollon culture to this portion of the Southwest are plentiful and the basis for these opinions are discussed below.

How is the Mogollon area best defined culturally? We begin by presenting a definition of culture that seems to embody what can reasonably be expected of such an entity. According to Whittlesey (1995:466), a culture is "one in which material culture patterns, social organization, subsistence and settlement patterns, and ideological systems are shared, uniform, and distinct from those of other groups." The possession, or lack thereof, of distinctiveness of the Mogollon culture seems to be the focal point around which controversy has swirled. We next look at how the Mogollon concept developed and explore some reasons for its questionable status.

CONCEPT OF A MOGOLLON CULTURE

Based on the early work of Emil Haury and the Gladwins from Gila Pueblo, Arizona, in the mid-1930s, the concept of a Mogollon culture first emerged in the writings of Haury in 1936 who saw it as a cultural manifestation distinctive from either the well-established Hohokam or Anasazi. Critical to his argument was an ending date of ca. A.D. 1000, which is when he believed the culture was taken over or swamped by the pueblo-building Anasazi. Haury (1936b) assigned specific phase designations to the Mogollon culture, imbuing it with a status equal to the two other long-standing cultures. Reaction against, and occasionally for, such a vastly new approach to Southwest prehistory was loud, sometimes indignant, and lasted well into the late 1950s and early 1960s. Questions regarding the distinctiveness of the Mogollon culture were constantly raised during the early history of the term. Brew (1946:42) asks if the differences between it and the other cultures were sufficient to designate a new culture. Kidder (1939:316) also strongly opposed the concept and decried its lack of distinctiveness, saying it has "all the earmarks of a peripheral, borrowing culture." He considered only the pottery to be unique and even then thought that it derived from the Snaketown, Arizona, area by way of Mexico. He was still fighting the concept in 1954 (Kidder 1954:299-300).

Other reactions to Haury's proposal for a new cultural entity in the Southwest took various avenues of reasoning. There were those who thought there was merit to the idea and suggested it was worth considering (Rinaldo 1941:5; Reed 1942:29; Martin 1943:122-123). Others strongly rejected the concept, generally on the basis of the lack of distinctiveness of the culture (Nesbitt 1938; Brew and Danson 1948:212; Daifuku 1952). Yet others saw the Mogollon culture basically as a fusion between the other two established entities—the Hohokam and the Anasazi (Roberts 1937; Wormington 1947). However, Judd (1940) believed it developed out of the Hohokam, while Brew (1946) thought it was well within the parameters of Pueblo adaptations. The idea of the Mogollon being a subgroup of the Anasazi was strongly supported by Reed (1948) and Kidder (1954). And today Haury (1988:96), after many years of considering the implications of the Mogollon cultural designation, seems to have come full-circle and admits that the Mogollon concept took on a life of its own and became too broad-based and too long-lived. He subsequently prefers the term Southern Pueblo.

The traits that gave rise to this distinctive culture are sometimes based simply on presence/absence criteria and other times on what seem like complex differences between cultural areas. Still other suggested variations have since been found not to be valid, pointing out an inherent problem with static trait lists. A major, well-documented difference has been the presence of brown wares in the Mogollon area and gray wares in the Anasazi, used as a basis to imply different ceramic technologies, hence different cultures. However, results of OAS ceramic analyses and testing of clay samples from both areas has determined that variation is based on the availability of specific clay resources within each area and not on stylistic or technological persuasions. Origination of the ceramics in the Mogollon area, assuming similar clay resources, has not been well researched; however, early brown wares are present at Snaketown and elsewhere in south-central Arizona at ca. 100 B.C. and may very well reach back to Mexico as Kidder (1939) suggests. If this point holds, the Mogollon and

Hohokam areas would share a beginning ceramic tradition as suggested by Feinman (1991:464) and Whittlesey (1995:473) with subsequent transmittal to the Mogollon area and later to the Anasazi territory (Wills 1994:22).

Haury (1936b) believes pottery usage began earlier in the Mogollon region than in the Anasazi, as do many researchers. However, his distinctiveness for the Mogollon area seems to have been based as much on the fact that he believed the culture to predate that of the Anasazi (as in the earliest pottery, the first to domesticate plants, and the first to use various artifact forms such as axes and certain metates), as on differing traits. We would argue that cultural distinctiveness cannot be predicated upon such an "earlier-than-thou" premise.

There do appear to be valid distinctions between the Mogollon and Anasazi in terms of architectural variations, a key point made by Haury (1936b) and stressed by others (Schroeder and Wendorf 1954:64; Reed 1956:11-12; Hunter-Anderson 1986:5; Dean 1988: 1987). Site layout has become a major comparison issue with Anasazi structures seen as more systematic, unilinear, and with an orientation to the front (Dean 1988). Mogollon sites seem to have no planned structural layout, no specific orientation, with pithouse entrances facing no specific direction. However, Mogollon pithouse entrances are now thought to generally face in a southeast direction (see later chapters).

Kivas in the Mogollon region are said to be rectangular (Reed 1956:12); however, most rectangular ones are great kivas and many others are circular. In the Anasazi area, most are circular, including great kivas, although square or rectangular rooms within roomblocks may serve a ceremonial function. So the distinctions become somewhat fuzzy; however, the trend to rectangular kivas is more prevalent in the Mogollon area.

Other minor variations noted in the literature include extended burials in the Mogollon versus flexed ones in the Anasazi area (Reed 1950). This distinction simply does not stand using data from OAS project sites alone. Another difference noted in skeletal data is that of vertical occipital deformation in the Mogollon versus lambdoidal cranial deformation in the Anasazi (Reed 1950). Likewise, these practices cut across both areas.

Most characteristics, then, that initially gave the Mogollon its distinctiveness, now seem only to represent minor variations in adaptations or ones explained by geologic circumstances. Site structure may be the only measure of comparison that cannot easily be explained. The differences need closer examination as to the timing of the appearance of unit houses in the Anasazi versus that of similar structures in the Mogollon. Jewett and Lightfoot (1986) believe they may have isolated a circular compound pattern for early Mogollon pithouse sites; however, follow-up on their work has not been attempted.

One other aspect of Haury's (1936b) definition of a Mogollon culture was that he strongly believed that it began in the Archaic Cochise culture of south-central Arizona, developed full-scale in the Mogollon Highlands of west-central New Mexico, and disappeared ca. A.D. 1000 when northern Anasazi traits or peoples "swamped" the indigenous pithouse population. It is critical to note that Haury never intended the Mogollon designation to be used for prehistoric adaptations in the area after A.D. 1000. Today, the term is often used to refer to all occupations of the region up to the time of abandonment in the early 1300s (Dean 1988).

Haury and others (Martin et al. 1956:201; Berry 1982) believe Anasazi traits such as above-ground pueblos and black-on-white pottery, possibly carried by Anasazi peoples, infiltrated the Mogollon area ca. A.D. 1000 causing a loss of Mogollon cultural identity. This idea is generally rejected by Mimbres archaeologists (LeBlanc 1986; Lekson 1995:1; Woosley and McIntyre 1996:29). If not willing to accept actual Anasazi migration into the area, other archaeologists at least note a visible breakdown of cultural differences at about this time (Hunter-Anderson 1986:5; Hegmon and Plog 1996:23). They are usually willing to ascribe to either a "swamping" of Anasazi traits or in situ development of structural and ceramic changes. We stress, however, that the dominant pottery of the area was Reserve and Tularosa Black-on white, which was not a local development. Evidence from our study of settlement patterns indicates that an Anasazi migration may actually have occurred. This will be pursued in later chapters.

Validity of the Concept

Today, hindsight and large data bases probably would not have warranted the definition of a distinctive Mogollon culture apart from the Anasazi and Hohokam. Those adaptations that impressed Haury and Martin in the 1930s do not seem all that unique in the 1990s. We do not believe the Mogollon culture should be relegated to peripheral status as early detractors wished, however. Peripheral implies being on the edge of where the major action is occurring. The action taking place prehistorically in the Mogollon Highlands was just as important in the development of Southwestern culture as activities occurring elsewhere. Rather, the Mogollon area may well have been ancestral in many ways to the development that occurred slightly later to the north on the Colorado Plateau, in terms of ceramic usage, domestication of crops, and pithouse evolution. And Haury (1936b) was undoubtedly correct when seeing a Hohokam ceramic connection by way of Mexico to the later Mogollon brown wares in the Mogollon Highlands. So, the entire cultural trajectory of the Southwest would seem to be a complex mix of constantly changing interrelationships between one area and another.

The concept of distinctiveness, whether for the Mogollon or Anasazi areas, has today been replaced by a subtle trend toward pan-Southwesternism. Even the terms Mogollon, Anasazi, and Hohokam are being called into question as meaningless, signifying variations that are minimal at best (Tainter 1982:6; Speth 1988:201-202; Wilcox 1988:205). Lekson (1996:175), without eliminating terms, argues for studying the Mogollon and Anasazi as parts of a whole, not as isolates. The ultimate approach would be to treat the Mogollon Highlands or Anasazi Plateau as little more than physiographic areas where peoples interacted with those from other pan-Southwest areas (Berry 1982:126). Attempts to identify a broader cultural milieu began perhaps with Reed (1948:9) and Kidder (1954:300) who agreed that the Mogollon and Anasazi might be subgroups of a larger Pueblo culture. By 1988, even Haury preferred the term Southern Pueblo (1988:196). Recently, McGuire and Saitta (1996:208) use the term Western Pueblo to describe the coalesence of the two after A.D. 1000, although Reid (1994:4) considers the term much misused and no longer useful.

A Question of Boundaries

Relative to the matter of Anasazi swamping, infiltration, or migration into the area from the north, is the problem with the northern edge of the Mogollon area. Some researchers have established boundaries whereby Mogollon sites lie on one side of a line and Anasazi on the other. For example, Wheat (1955:21) believes the demarcation to be north of the San Francisco River box, northeast of Luna, north of the Blue River in Arizona, and in the upper Tularosa River Valley. However, Reed (1946) and most archaeologists consider the northern boundary to run on an east-west line along the Cebolleta Mesa near Quemado. LeBlanc (1989a:346) believes that some sites as far south as the Tularosa Valley and Gallo Mountains may actually be Chaco outliers. Tainter (1984:46) and Hogan (1985:10) consider the Cebolleta Mesa area a possible Mogollon-Anasazi frontier or borderland because of mixing of Anasazi and Mogollon traits. However, most pueblo sites in the region and near Pietown, Magdelena, and Dusty are considered Anasazi (Gerow 1994:31). Much has been written about the presence of Mogollon brown wares in a seemingly Anasazi structural world in the Quemado area (Ruppé 1966; Tainter and Gillio 1980; Fowler 1985). Explanations for the mixing range from intrusions of Mogollon people (Ruppé 1966), to a trading frontier (Tainter 1982:4), migration of both Mogollon and Anasazi into the area (Tainter 1984:46), or an outgrowth of a local population that was neither Mogollon or Anasazi, but borrowed from both (LeBlanc 1988:338).

What such blatant mixing in this northern area actually means is unclear. By A.D. 800-900, Anasazi structures were definitely present as far south as Quemado. By ca. A.D. 1000, LeBlanc (1988:347) believes Anasazi populations had migrated into the northern Mogollon area and lists LA 3270, USDA Forest Service sites 168, 184, 194, 202, 398, and 421 as possibly Anasazi in origin. This idea is supported by our study of settlement patterns in the Mogollon Highlands at this time in prehistory. A massive increase in pueblo structures is documented in the region and is focused in the Gallo Mountain and Tularosa Valley areas. Whether or not we are looking at a period of Anasazi migration will be discussed in the chapter on settlement patterns.

HISTORY OF ARCHAEOLOGICAL WORK IN THE MOGOLLON HIGHLANDS

The Mogollon Highlands have a long and impressive history of archaeological work carried out by outstanding archaeologists of the times (Fig. 1.15). Most large reconnaissance surveys in the area were conducted between the 1930s and 1960. However, field school activity and highway projects have sustained a deep research interest in the region. Three overviews have dealt with the archaeology of the Mogollon Highlands. These include Berman (1979), LeBlanc and Whalen (1980), and Stuart and Gauthier (1981).

Recently, scholars have shown a renewed interest in the area, concentrating on problem-solving research. Many have concerned themselves with the origins of agriculture in the project area. Gilman (1983,1987) focuses on changing house forms as a response to varying resource needs. Minnis (1985) looks at various models for the adoption of cultigens, and Hunter-Anderson (1986) examines the role of increasing population pressure as a cause for intensification of agricultural production. Wills (1988a) studies the geographical characteristics of population changes and mobility leading to the use of domesticates within the project area. Also recently, Cordell and Gumerman (1989) have included the Mogollon area in a general scheme of changing adaptations occurring throughout the Southwest between A.D. 200 and A.D. 1540.

Further research in the study area is certainly warranted by our increasing data base. We now have an opportunity to examine in even further detail such aspects of Mogollon and pre-Mogollon culture as the shift from hunting and gathering to horticulture, changing settlement sizes through time, clarification of phase designations, locational patterning, reasons for agricultural variability, causes of economic stress, population dynamics, and changing resource utilization through time.

Surveys

The first systematic investigations in the area took the form of large reconnaissance surveys. Walter Hough led the earliest in 1904-1905 (Hough 1907). He explored areas along the Blue River in Arizona, around Luna and areas to the northeast and down into the Tularosa Valley, recording large pueblos with standing walls and numerous cave dwellings with intact artifactual material. Between 1928 and 1930, the Cosgroves conducted a survey of cave sites in southwestern and southern New Mexico including the Upper Gila area (Cosgrove 1947), producing amazing photographs of in situ artifacts left by Pueblo and Athabaskan groups. At the same time, in 1929-1930, the Gila Pueblo of southeast Arizona performed considerable survey within the Mogollon Highlands, mostly under the direction of Emil Haury. They recorded numerous pueblo sites in the Pine Lawn Valley-Reserve area (Haury 1936b). One of these was LA 39969, excavated on this project by OAS and which still contained a Gila Pueblo identification tag. In the early 1940s, Martin conducted a small survey of 2 sq miles in the Pine Lawn area and recorded 57 sites (Martin 1943). Between 1947 and 1955, the Peabody Museum Upper Gila Expedition, under Edward Danson, surveyed 14,500 sq miles on lands generally bounded by Springerville on the northwest, Magdalena on the northeast, Mimbres Mountains on the southeast, and Glenwood on the southwest (Danson 1957). They recorded 638 sites.

Later surveys have been much smaller in scope and have usually been conducted by field schools or cultural resource managers for highway projects or timber sales. In 1978, a survey of the Middle San Francisco River Valley by the University of Texas at Austin (Accola 1981) produced 101 sites in 971.7 ha. A subsequent nearby survey of Devil's Park in 1985 yielded 156 sites in 2,024.3 ha (Peterson 1988a). Most extensive highway-related surveys were conducted by Koczan (1983) and OAS staff (Oakes 1989; Zamora and Sterling 1992; Oakes and Kimmelman 1995). A total of 109 sites were recorded along these highway corridors and nearby arroyos. A timber clearance survey northwest of Luna by Clifton (1990) yielded 25 sites in 2,088 acres.

Excavations

The first known excavations in the Mogollon Highlands were conducted by Walter Hough (1914, 1919) as a result of his survey expeditions. He dug seven pit structures at Luna Village (LA 45507), an OAS project site, and was overwhelmed that there were such entities as subterranean dwellings. He also did minor shovel testing at the Hough site (LA 3279), a large Tularosa phase pueblo, near Luna and also one of the OAS project sites. Wendorf et al. (1963) also excavated one room and tested three others at the Hough site prior to OAS work. As

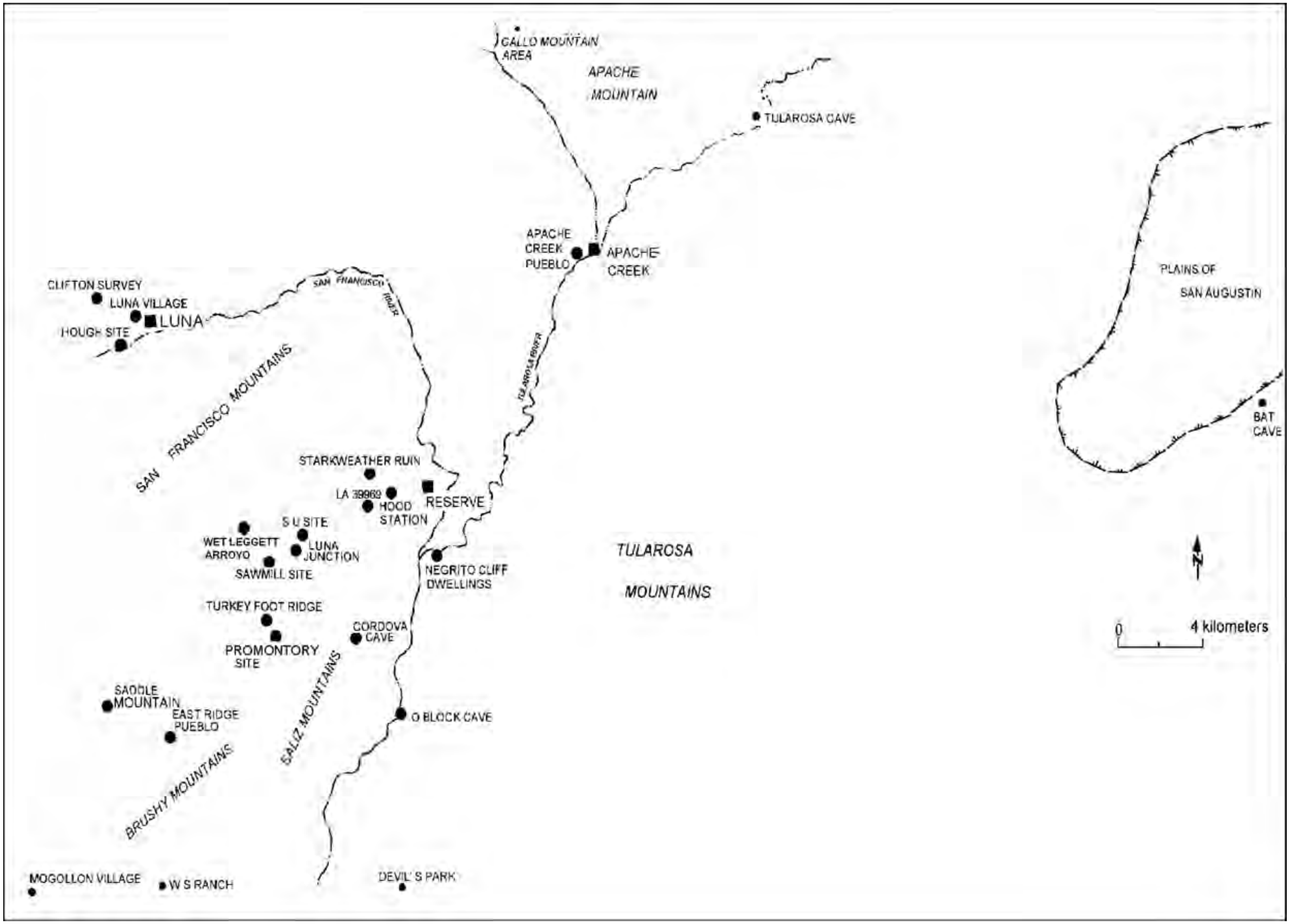

Figure 1.15. Location of sites discussed.

a result of Gila Pueblo's surveys in the southern highlands area near Alma, the next site excavated was Mogollon Village. This pithouse village was partially dug by Emil Haury in 1933 who uncovered 17 pit structures (Haury 1936b). Subsequent work was carried on here again in 1989 and in the following years by the University of Oklahoma (Gilman et al. 1991; Mauldin et al. 1996) and the University of Washington.

Because of Haury's excavation at Mogollon Village and his proposal in 1936 that the Mogollon was a separate cultural entity from the Anasazi or Hohokam, keen archaeological interest in the Mogollon Highlands was peaked. Researchers wanted to know if these pithouse dwellings were really the manifestations of a new culture. Nesbitt (1938) excavated Starkweather Ruin near Reserve. Haury examined sites to the south and west of the highlands looking for Mogollon cultural similarities, particularly at the Harris site in the Mimbres area and Bear Ruin in the Forestdale Valley of eastern Arizona (Haury 1940). Paul Martin, who enjoyed a long and productive career working in the Mogollon Highlands, entered the region in 1939, established a field school at Pine Lawn Camp, and commenced several years of work at the SU site, an Early Pithouse village in the Pine Lawn Valley (Martin 1940, 1943). He excavated a total of 23 pithouses and 3 surface rooms. Other early sites investigated by Martin and Rinaldo include the Promontory site (5 pit structures), Turkey Foot Ridge (4 pit structures), and Tularosa Cave, all with early Mogollon characteristics (Martin et al. 1949; Martin and Rinaldo 1950b; Martin et al. 1952). The SU site was further investigated by the University of New Mexico field school under Chip Wills in 1987-1988 (Wills 1989). They concentrated on outside activity areas, dating the site, and examining subsistence adaptations.

The supposedly earliest Archaic site, the Wet Leggett Arroyo site, dated to ca. 2550 B.C., was also excavated by Martin (Martin et al. 1952). It was the first site assigned to the Archaic Cochise culture, although since then its early date in relationship to surface artifacts on the site has been questioned (Antevs 1949). In 1948, Herb Dick uncovered early Archaic-age maize at Bat Cave on the eastern edge of the San Augustin Plains (Dick 1954). Radiocarbon evidence dated it around 4000 B.C. This discovery caused research interest to shift to verifying early agricultural practices in the Mogollon Highlands. Dates have since revised the Bat Cave maize to ca. 390 B.C. by reanalysis of the data by the University of Michigan in 1981 and 1983 (Wills 1988a).

By the late 1950s, archaeologists began to focus on the later Pueblo sites in the region. The Chicago Natural History Museum excavated a portion of the large Apache Creek Pueblo at Apache Creek. Work continued there in the 1950s (Peckham et al. 1956), again in the late 1980s by the University of Texas at Austin, and in the early 1990s by the Gila National Forest's Passport in Time program. Bluhm (1960) excavated the Sawmill site in the Pine Lawn Valley and uncovered a rectangular great kiva. Also in the Pine Lawn Valley, Peckham (1963) excavated yet another Early Pithouse site, Luna Junction, one of the OAS project sites. In the early 1970s, David Kayser (1972a, 1972b) completed several excavations in the Gallo Mountains-Largo Creek area. By the late 1980s, excavations were conducted by the University of Texas at Austin field school at the WS Ranch near Alma, a pithouse village under an A.D. 1300s Late Pueblo roomblock with a rectangular great kiva. In the 1990s, Oakes (1993b), under a USDA Forest Service grant, tested a small Late Pueblo roomblock, East Ridge Pueblo, at Pueblo Park Campground, and found a storeroom filled with charred maize. The site dated ca. A.D. 1166. Excavations of the 25 sites on this project are the latest investigative activities in the Mogollon Highlands.

Cave sites in the Mogollon region were found to be a source of rich and diverse cultural materials, much of it dating back to Middle Archaic periods. Hough (1914) recorded Tularosa Cave on his extensive survey and the site was later excavated by Martin et al. (1952). Martin also explored Cordova and O Block caves just south of Reserve. All contained complex stratigraphic levels with artifacts spanning long time periods. Other caves that have produced Archaic through Athabaskan artifacts include Negrito Cliff Dwelling and Hood Station near Reserve, and Saddle Mountain on the Arizona border.

Conclusions: Phase Designations

As a result of Haury's early work at Mogollon Village (1936b), he was able to assign different phases to the newly defined Mogollon culture. These designations are still used today as markers of changing adaptations in the Mogollon Highlands. These include:

Georgetown: A.D. 500-700
San Francisco: A.D. 700-900
Three Circle: A.D. 900-1000

In the early 1940s, after Martin's work at the SU site (Martin 1943), he added an earlier phase:

Pinelawn: pre-A.D. 500

These phases continue in use today with little alteration. We would suggest perhaps that the Three Circle phase begins as early as the late A.D. 800s in some places. Later Pueblo adaptations were assigned the Reserve and Tularosa phases by Martin and Rinaldo (1950). Dates for these phases are:

Reserve: A.D. 1000-1100
Tularosa: A.D. 1100-1250/1325

An Apache Creek phase was designated by Peckham et al. (1956) to cover architectural variations noted at the Apache Creek site in the Tularosa Valley that did not particularly fit the Reserve or Tularosa phases. The dates are:

Apache Creek: A.D. 1075-1300

While we argued earlier that the Mogollon culture may not be as distinctive as earlier thought and may actually be linked to Anasazi developments, we maintain the use of Mogollon phase names throughout this report, if for no other reason than to provide a basis of comparison of time periods and the changes that occurred within each of them. Until these particular heuristic devices are absorbed into a grander scheme of pan-Southwestern nomenclature, we support the usage of Mogollon phase designations. Discussion of each of the phases will follow in subsequent chapters.

CHRONOMETRIC OVERVIEW OF SITES WITHIN THE MOGOLLON HIGHLANDS

In the initial days of archaeological inquiry in the Mogollon Highlands, the chronometric dating of sites in the region, as in other areas of the Southwest, was based solely on the cross-dating of sites by means of ceramic data. Ceramic dating was initiated mainly by such early pioneers as Gladwin and Gladwin (1934), Haury (1936a), Colton and Hargrave (1937), and Martin and Rinaldo (1947). In the early 1930s, the development of dating sites by tree-ring sampling, or dendrochronology, was a major advancement in chronometric studies. The advent of radiocarbon dating in the late 1940s provided Mogollon researchers yet another opportunity to more accurately assign dates to the important cave finds at Bat Cave, Tularosa Cave, and Cordova Cave. However, radiocarbon dating was not as refined as it is today and, therefore, not as reliable a measure of time on these early sites as the investigators believed. Differences between the use of early and modern C-14 dates have created some interpretation problems, particularly in the Mogollon Highlands (Wills 1988a). Subsequent discoveries of archaeomagnetic, thermoluminescence, and potassium-argon dating techniques are excellent tools but have been little used in the Mogollon Highlands. The validity of the more recent obsidian hydration technique has numerous critics although several research projects in the area have employed it, particularly when other dating methods are not available. While definitive spans of mean dates can be obtained by using any or all of these above methods, each possesses unique problems that we shall briefly address before an overview of the dating of sites within the Mogollon Highlands is presented.

Chronometric Problems

The Luna Project employed five different methods of chronometric dating to obtain the best possible occupation dates for excavated sites within the project limits. None of these, however, were without their limitations. Each technique used is briefly discussed and the problems are described.

Ceramic Dating

The placement of sites into phases is often accomplished through the use of ceramic cross-dating. Sites without the presence of viable absolute dates can be placed usually within a 100-200 year time frame in the Mogollon Highlands by this method. However, this technique often relies on ceramic dates obtained from other regions and may not prove as accurate as on the original type site. Ceramic mean dating was used by Wilson (see Volume 4) as a refinement of this method with very good results. The broad range of many Mogollon ceramic types, however, precludes any absolute determination (with some exceptions) of begin or end dates for project sites.

Tree-Ring Analysis

Five tree-ring samples were submitted to the Laboratory of Tree-Ring Research in Tucson, Arizona. No samples had complete growth rings and all were either vv or ++vv dates (outer rings missing). Thus, none were cutting dates and they produced results that were too early. While it is an excellent dating tool, the major problem with tree-ring samples from the project area is that most of the wood used by prehistoric peoples in the Mogollon Highlands was juniper (see Volume 5), which is currently undatable. This problem has also been encountered by other researchers in the region. Berman (1989:80) reports only 19 published cutting dates for 14 sites as late as 1989. Dendrochronology also can be heavily skewed by the prehistoric use of old wood, which creates an overestimation of age when submitted for analysis.

Radiocarbon Sampling

The Luna project provided Beta Analytic, Inc., with 182 C-14 samples. All were charcoal fragments from charred posts, fuel wood, or burned floor or pit surfaces. Of these, only 99 were considered to be viable dates because the radiocarbon samples suffer from several major problems, one of which is the apparently common practice in the Mogollon Highlands of using old wood for fuel and confiscating wood from earlier sites for construction material. Smiley (1994:169-170) suggests that the use of dead or recycled wood can cause the overestimation of wood age by 200 years or more. The presence of clusters of dates of the same age for the same site tends to lessen the possibility of old wood being used, however (Smiley 1985). To counter any inaccuracies that could arise in dating the charcoal from the project area, extended counting time and the use of accelerator mass spectrometry was employed in several cases. All samples were also subjected to calibration from conventional age to calendar age and processed for isotopic fractionation.

Archaeologists who excavated the earlier-dated sites in the Mogollon Highlands did not have current C-14 techniques available to them and comparisons with these early radiocarbon dates are frequently difficult.

Archaeomagnetic Dating

Fifteen samples of burned hearth or wall plaster material were submitted to the OAS Archaeomagnetic Dating Laboratory. In several cases, sampling error or poor stability of the material produced unusable results. Overall, however, archaeomagnetic dates seem to have yielded the best results of all dating techniques used on the project.

Obsidian Hydration

Even though obsidian hydration studies in the Mogollon Highlands have produced poor results when compared with other chronometric data for the area (Peterson 1988a:114; Mauldin et al. 1996:397), this technique was used by OAS to attempt to date sites when no other datable material was available, or to confirm minimally represented dates. Specifically, 74 pieces of obsidian were sent to the Institute of Archeology, University of California, Los Angeles. These and 22 more samples were also submitted to the X-Ray Fluorescence Spectrometry Laboratory, University of California, Berkeley, for trace-element analysis to determine sources of the obsidian. The results are described in Appendixes 1.1, 1.2, and Volume 3.

In order to obtain the best possible obsidian hydration results, temperature cells were buried on four sites for one year to aid in the determination of hydration rates for the area. Results were mostly problematic, being extremely early for the type of sites and the cultural material recovered. Of the 74 samples, only 16, or 21.6 percent, fell within the range of possible dates for the project sites, and only one date was able to actually clarify the chronometrics on a site.

Dating of Cultural Periods

Within the Mogollon Highlands there are relatively few dated sites compared to the large numbers that have been recorded. Many of the dates derive from earlier excavated sites. For example, as of 1991, only 16 sites had been tree-ring dated within the region (Robinson and Cameron 1991) and, to date, only 41 sites have been dated by any absolute dating means. The vast majority of Mogollon sites have been dated by ceramics, architecture, or diagnostic projectile points. Recent work at the SU site and Bat Cave (Wills 1988a), at Mogollon Village (Mauldin et al. 1996), and our work on the Luna project account for many of the newer absolute dates. This study looks at the association between types of sites within currently established time frames and assesses the validity of chronologically defined periods. Known absolute dates for Mogollon sites are charted using available midpoint or intercept radiocarbon, archaeomagnetic, tree-ring, and obsidian hydration dates.

Archaic Period

Twelve sites with Archaic period dates have been recorded within the Mogollon Highlands (Fig. 1.16). (No absolute dates for the few Paleoindian sites are available.) Many of the earliest sites (Bat Cave, Tularosa Cave, Cordova Cave, and O Block Cave) were dated by uncorrected solid carbon techniques and likely have yielded dates that are too old, often ranging around 4000 B.C. or earlier (Berry 1982; Wills 1988a). These problematic dates have not been employed in Figure 1.16; instead, only dates that have been rerun, reanalyzed, or newly acquired are used. However, the uncorrected date for the controversial Wet Leggett Arroyo is shown at 2558 ± 680 B.C. (Libby 1955:113), based on geologic strata. We also include the date of ca. 1300 B.C. as the one that may be more likely for the site (Antevs 1949:56-59).

Figure 1.16 shows that consistent, documented Archaic occupation of the Mogollon Highlands did not begin until ca. 1200 B.C. and continued without any temporal gaps to ca. A.D. 200 at the traditional end of the period. Previous to OAS work in the area, sources of early absolute dates for Archaic sites were restricted to the above-mentioned caves, with the exception of the questionable Wet Leggett open-air site. As a result of our investigations, three open-air Archaic campsites (Old Peralta, Leaping Deer Ridge, and Haca Negra) produced radiocarbon dates earlier than 600 B.C., placing them among the oldest Archaic sites in the region. Two of these sites were buried under more than 1.0 m of alluvium and this type of deposition may present a real problem in locating more such sites (see McMahon, Volume 5). Later Archaic sites such as Raven's Roost and portions of the SU site and Mogollon Village are also open-air manifestations. These, and the WS Ranch site, extend in time past the generally accepted end of the Archaic period at A.D. 200 into the early Mogollon period, until at least A.D. 300.

Even with the few dates that are currently available, this unpunctuated pattern of 1,500 years of Archaic occupation continuing directly into the Mogollon cultural period with its attendant brown wares, pithouse structures, and dependency on agriculture, is significant. Wills (1996) argues that early Mogollon sites did not

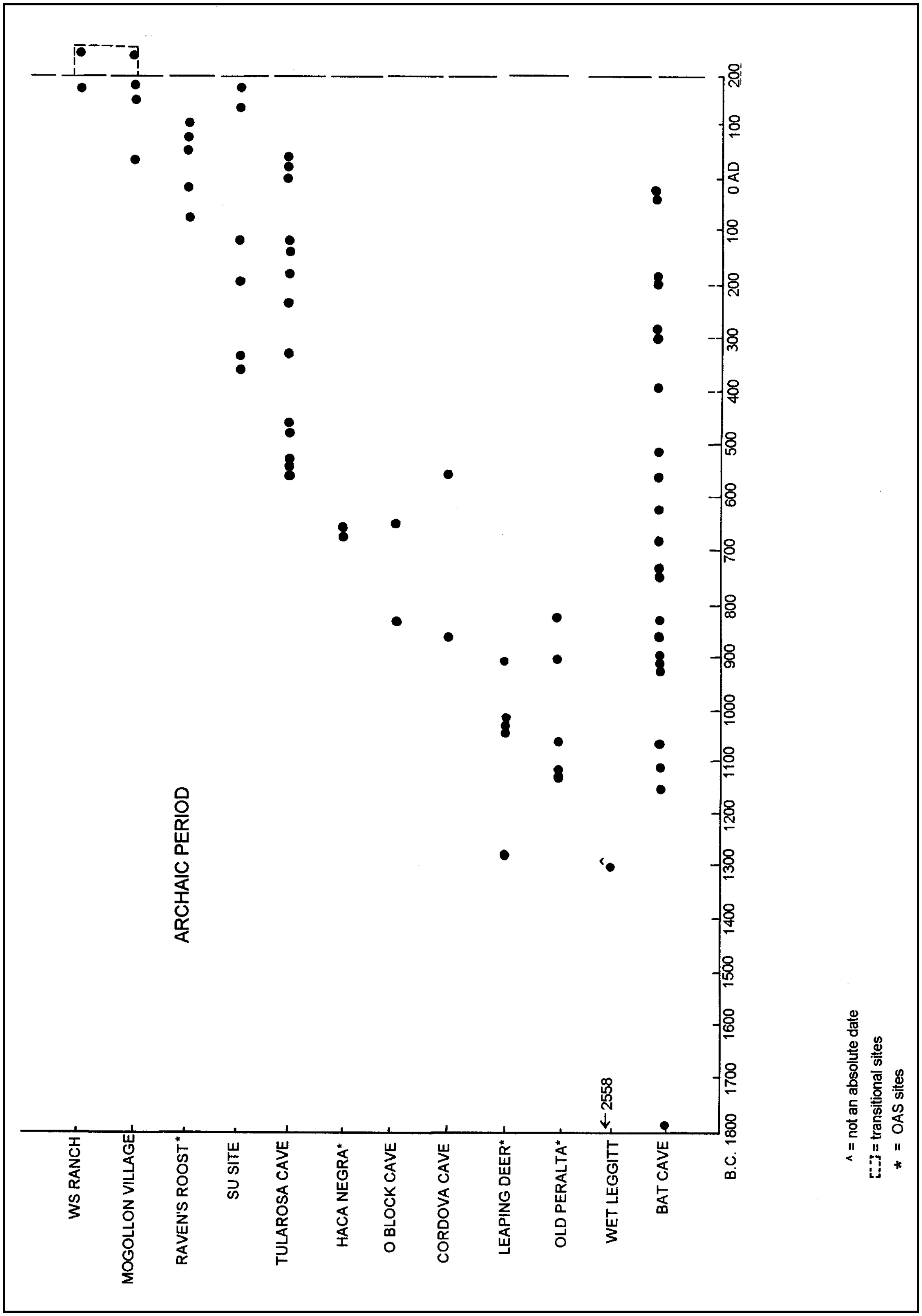

Figure 1.16. Archaic sites with absolute dates, sequentially ordered.

appear until approximately A.D. 450, leaving a gap between them and the earlier Archaic sites. He cites the appearance of new technologies, subsistence adaptations, and organizational strategies as concurring evidence of an abrupt change between the two periods (Wills 1996:19). Others, however, have considered the transition from Archaic to early Mogollon not as sudden an occurrence (Roth 1989; Gilman 1995).

Wills (1996) also concludes that the lack of pre-A.D. 450 dates for Mogollon period sites, specifically for the A.D. 300s, argues against a cultural continuum. Since Wills's (1996) publication, OAS has retrieved six calibrated and corrected radiocarbon dates for three sites within that A.D. 300-400 time frame (Fig. 1.17). One, Lazy Meadows, is a definite early Mogollon site with several pit structures and numerous brown wares. Small pit units were associated with another site (Raven's Roost) and brown ware ceramics were not present at all. These could actually be bridging sites between the Late Archaic and the Mogollon periods. However, Wills (1996) is certainly correct in suggesting that radiocarbon dates may overestimate the age of a site because of the structural composition of large wood samples; however, consistently taking this into account for all periods would move all radiocarbon-dated sites forward in time approximately 200 years, based on Smiley's (1985) study. Accepting this, then, would still leave several transitional sites between the Late Archaic and the Early Mogollon SU site, whatever the exact date.

Mogollon Period

Absolute dates have been obtained for 34 sites of the Mogollon period (Fig. 1.17), which ranges from ca. A.D. 200 (or possibly as late as A.D. 350) to almost A.D. 1400. Again, there is a continuum of dates through all phases of this period. The earliest dates, from the Pinelawn phase, indicate the presence of three seemingly well-dated sites between approximately A.D. 370 and 480: the SU site, LA 5407, and Lazy Meadows. A minor Pinelawn occupation between ca. A.D. 320 and 550 is represented at six other sites, some with structures, but all with early brown wares. The data are not sufficient to determine if structural Pinelawn sites actually begin at about A.D. 370, as shown in Figure 1.17, or if there are earlier undated sites with residential units. However, the presence of brown ware ceramics by at least A.D. 320 and the perseverance of Archaic sites to at least A.D. 350 suggests that a true transition from the Late Archaic to the early Mogollon period probably does exist.

Late Pithouse period sites of the Three Circle phase are poorly represented by absolute dates. Only Luna Village dates completely within the phase. The lack of Late Pithouse dates is undoubtedly linked to the lack of current excavation of these types of sites.

Reserve phase sites are notoriously undated in the archaeological literature. Of the four currently dated Reserve phase sites, three are from the recent OAS project. It is not surprising then that Reid et al. (1995:37) were led to comment on the lack of dating for Reserve sites in the Mogollon Highlands and conclude ". . . that Reserve Black-on-white ceramics span the A.D. 1100s . . . ." However, their statement implies a cultural hiatus between approximately A.D. 1000 and 1100, as the predominance of Reserve Black-and-white on a site is often used as a marker for the beginning of the Reserve phase at ca. A.D. 1000. The paucity of dates for this phase is regrettable, considering the many Reserve sites that were excavated in the early years of exploration in the highlands. But again, the lack of dates is based on the fact that few have been recently excavated or dated by absolute means. Also, there are no indications in Fig. 1.17 that there was any abandonment or depopulation of the area at this time, as premised in Reid et al. (1995). Settlement pattern studies indicate that there was actually a huge rise in population between A.D. 1000 and 1100. Of course, this pattern is based on the use of Reserve Black-on-white ceramics and the lack of later period ceramics as one of the dating mechanisms for the study. However, given the association of Reserve Black-on-white with some earlier Late Pithouse period ceramics, and radiocarbon dates of A.D. 1000 on the three Reserve phase sites on the OAS project, there is little doubt that the presence of these same types of ceramics, as seen on numerous surveys in the region would yield similar dates.

The Tularosa phase marks the end of the Mogollon period (Fig. 1.17). Eight sites have been well dated within the time frame of ca. A.D. 1100 to 1350. Seven other dated sites, or portions thereof, indicate sporadic use of the area during this time. Figure 1.17 allows the period to extend to A.D. 1400 but, in reality, A.D. 1350 should be the cut-off date for this phase based on occupation dates for the eight architectural sites.

Athabaskan Period

Prior to current OAS excavations in the Mogollon Highlands, there had been no Athabaskan sites with accompanying absolute dates. As a result of this work, there are now eight radiocarbon-dated sites (two in the nearby Datil Mountains; Oakes 1996). Interestingly, five of the sites also had earlier Archaic or Mogollon components. Figure 1.18 covers the temporal span between A.D. 1400 and 1800. While debate over the advent of Athabaskans into the Southwest forges ahead, early absolute dates keep appearing in the recent archaeological record. The eight sites in the Mogollon Highland area

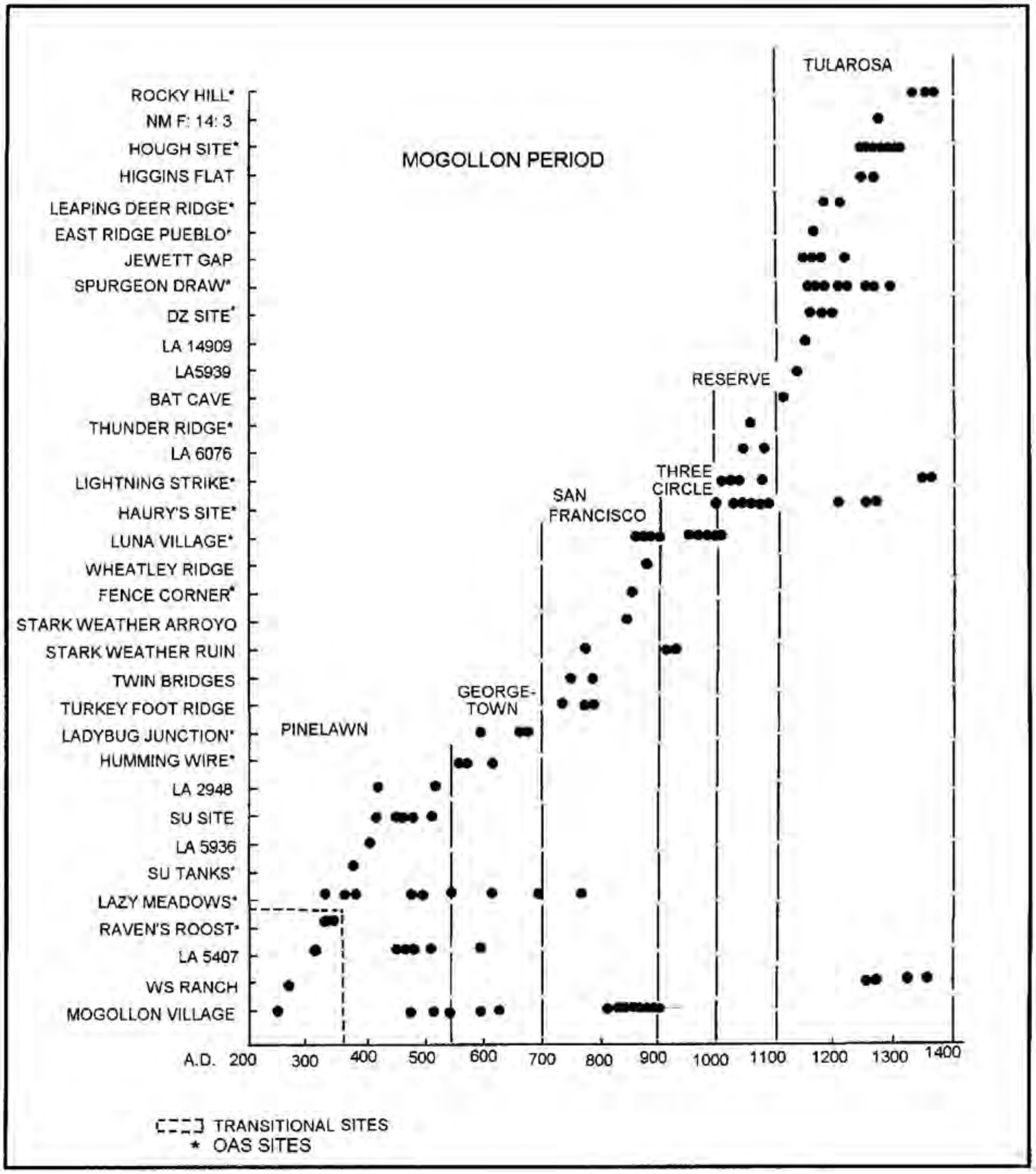

Figure 1.17. Mogollon period sites with absolute dates, sequentially ordered.

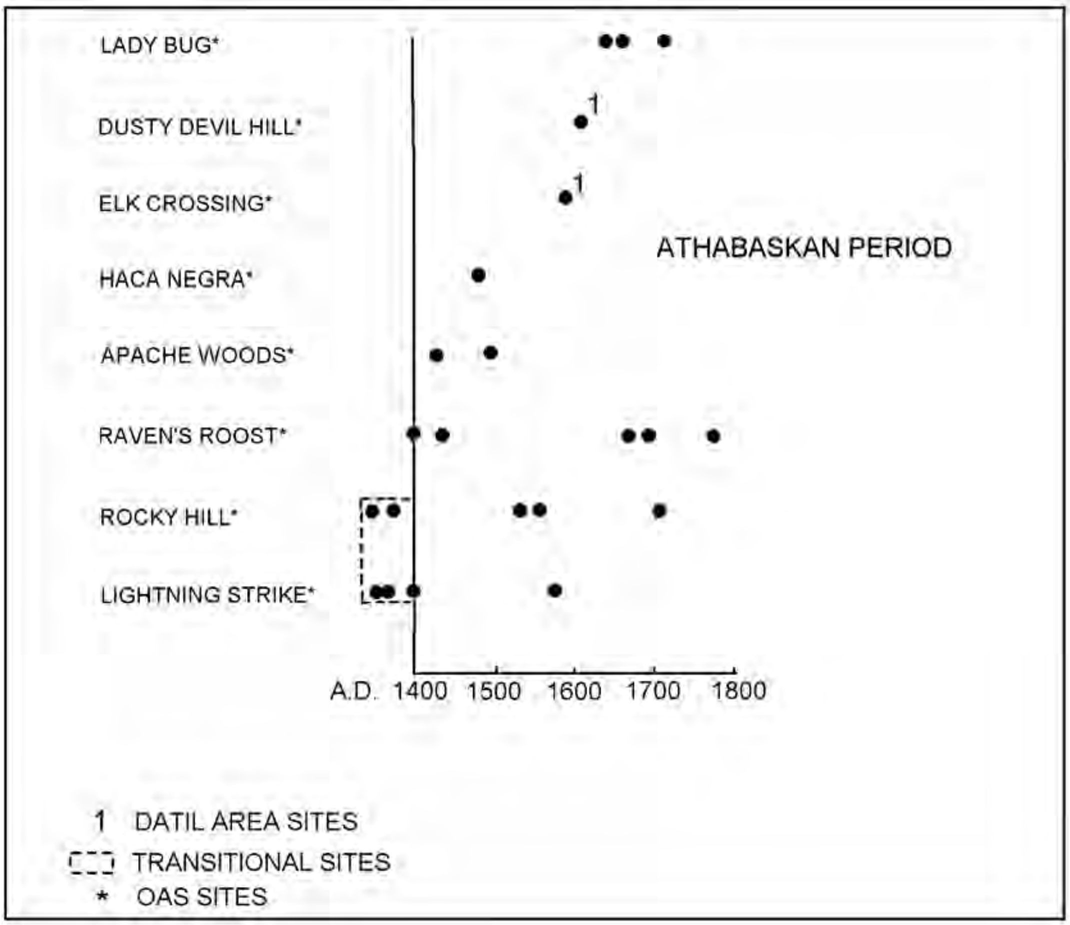

Figure 1.18. Athabascan sites with absolute dates in sequential order.

are all small campsites that have a lack of contemporary Cibola or Zuni pottery or earlier Archaic projectile points. They consist of small hearths or roasting pits and, in one case, of shallow pit dwellings and have dates ranging from A.D. 1400 to 1780. Three sites contain pottery identified as Apachean: Elk Crossing, Dust Devil Hill, and Ladybug Junction. Dates for these sites are A.D. 1590, 1610, and 1640, respectively.

Of great interest is the fact that the dates in Figure 1.18 extend back to the A.D. 1400s, inferring that Athabaskan peoples were in the region at this early date. One other suggested scenario is that these earlier sites may represent campsites of Zuni or Cibola people who could have been in the area. But no contemporary intrusive pottery was present on any of the sites except at Elk Crossing, where Piro Pueblo sherds were in association with Athabaskan sherds. Hodge et al. (1945) document that the Athabaskans and Piros enjoyed a trading partnership at this particular time (A.D. 1590). For now, it is left as an open question as to which cultural group(s) can claim association with the five nonceramic sites. We suggest that it was possibly Athabaskans and discuss it further in a later section.

Conclusions

The examination of the available absolute dates for sites within the Mogollon Highlands has produced several interesting insights into the dating of the various cultural periods or phases. Perhaps the most important observation is that boundaries of cultural periods are obviously tentative at best. While earlier Archaic, and some Paleoindian, peoples were definitely in the region before 1300 B.C., it is about this time that Archaic populations seem to establish frequent occupations in several locations. Determining the end of the Archaic period in the Mogollon Highlands is a much more problematic avenue of inquiry. Tradition sets a fixed date at A.D. 200; however, there may be no definite date for the transition from Archaic into the Mogollon period. Wills (1996), in a major break with conventional theory, believes there was an abrupt change between the two that occurred as late as the A.D. 400s. While our charts show Archaic manifestations occurring into the A.D. 300s, we believe the transition was likely gradual with no real "end" date to the Archaic way of life. However, because cultural schemes require "begin" and "end" dates, the date of A.D. 350 is probably the most accurate with the caveat that this date should be used more as a flexible standard than a fixed one. Also, during this transition to the Mogollon period, the earliest dated Mogollon sites apparently appear in the mid-to-late A.D. 300s providing an overlap with Archaic sites as would be expected if this transition was gradual as we suggest.

In contrast, the end of the Mogollon period does appear to have a finite boundary at A.D. 1350. However, the beginning of the following Athabaskan period is not easily defined. OAS dates indicate Athabaskan occupation of the area could have begun as early as the A.D. 1400s. Occupation by the late A.D. 1500s seems definitely warranted. Many more Athabaskan and early Mogollon period sites need to be dated before questions of cultural continuum or Athabaskan appearance in the Mogollon Highlands can be addressed.

ARCHAIC ADAPTATIONS IN THE MOGOLLON HIGHLANDS

The data recovery plan sets forth a single premise that has guided OAS research for the Luna project. Simply stated, it proposes that if there is a continuum from full mobility in the early prehistoric occupation of the Mogollon Highlands to full sedentism by the Pueblo period because of an increasing dependence on agricultural products, then that shift should be visible in the archaeological record (Oakes 1993a). As stated earlier, the premise is undoubtedly not as straightforward as it appears and variations were expected as research proceeded. The statement, therefore, provides us simply with a basis from which the relationship between subsistence and settlement patterns in the Mogollon Highlands can be tested.

To adequately address the hypothesis, it is critical to understand, as fully as possible, Archaic settlement and subsistence adaptations within the Mogollon Highlands, as they are the markers for comparison with any observable variations that occur later in time. Current theory and data from other areas of the Southwest will be used to complement the data obtained from the project area in order to present a synthetic overview.

Schroedl (1976:11) employs a basic definition of Archaic peoples as migratory hunting-and-gathering populations following a seasonal pattern of efficient exploitation of a limited number of selected plants and animal species within a number of different ecozones. Archaic populations can be further characterized as small bands with low populations that lack definite territoriality (Speth 1990:16). While these statements may hold true, they may also mask any regional or local variations within the broad Archaic period. For example, the extent of possible complexity is often overlooked in Archaic groups (Price and Brown 1985:3) and yet it may inform on levels of mobility employed by a particular group.

Several basic statements can be made, however, about the Archaic presence in the Southwest. It is generally agreed that Archaic manifestations are present by about 6000 B.C., although earlier dates are proposed for some Archaic sites in southeastern Arizona (Sayles 1983; Waters 1986). Ending dates are also not well established because of ambiguity in defining the transition to succeeding periods, but focus between A.D. 1 and 200. Some researchers argue for possible persistence of Archaic lifestyles up to A.D. 400 and even to the time of European contact (Hogan 1985:7; Sebastian 1989:41; Simmons 1989:39).

The Archaic temporal span is often divided into Early, Middle, and Late Archaic periods and sometimes into only Early and Late Archaic (Irwin-Williams 1979). However, there is no real consensus on how these break down temporally as they are often correlated with varying phases from various locales. Ideally, an Early Archaic site from the Mogollon Highlands should fall within the same chronological boundaries as an Early Archaic site from the Colorado Plateau or eastern Arizona. However, all seem to agree that the Late Archaic begins ca. 2000-1500 B.C. accompanied by a more moist climate regime allowing for exploitation of a greater variety of subsistence resources that, in turn, led Archaic populations to gradually expand in numbers. The Early Archaic period generally can be considered a large-game and vegetal gathering exploitation dating approximately 8000-5000 B.C., although Sayles (1983) contends it begins possibly as early as 10,000 B.C. Sites belonging to this time range are few in number and no diagnostic projectile points have been associated with the very earliest sites. The Middle Archaic is characterized by specific dart points and sites reflecting hunting-and-gathering adaptations are assigned to this period on the basis of C-14 dates. In actuality, sites for all of these periods are classified primarily on the results of C-14 dates. Projectile point styles also change through time and are often used as a substitute classificatory tool; however, their assignment to specific temporal periods is not as reliable as sometimes assumed. To facilitate further discussions, temporal divisions used for the lengthy Archaic occupation of the Southwest are: Early Archaic (ca. 9000-6000 B.C.), Middle Archaic (6000-1500 B.C.), and Late Archaic (1500 B.C.-A.D. 200). Correlation of these with adaptational changes through time will be discussed later.

Origins of the Mogollon Highlands Archaic

Paleoindian Presence

Prior to Archaic occupation of the Mogollon Highlands, varying Paleoindian populations were widely dispersed over much of the Southwest from about 9500 to 8000 B.C. Their subsistence adaptations were mostly geared toward large-game hunting, although ground stone implements have been increasingly found that indicate reliance on wild vegetal foods also. Movement of

Paleoindian populations over the Southwest may have been virtually unconstrained (Amick 1996), except possibly by physiographic or climatic barriers.

A Paleoindian presence in the Mogollon Highlands is apparently sparse. Three basal fragments of Folsom dart points have been found in small washes at Devil's Park south of Reserve (Peterson 1988a:114). The physical setting consists of a high montane elevation, somewhat unusual for Paleoindian sites. One point was on a Pueblo site and, thus, suspect to possible curation by the later Pueblo occupants. Immediately to the northeast, on the edge of the Highlands, several areas in the Plains of San Augustin have produced Paleoindian points. Lake San Augustin was considered to have been marshy at the time and its shores a likely source for bison procurement. One Folsom site on the Plains (AKE site) was excavated (Beckett 1980). In the Mimbres area to the south, no Paleoindian materials have been found (Minnis 1985). Four occurrences of Paleoindian points have been recorded in the St. Johns vicinity of east-central Arizona: a Clovis point at Lyman Lake and at St. Johns, 12 Folsom points from Concho, and 30 fluted points from the Vernon site (Huckell 1982).

Because of documented changing environmental conditions at the end of the Late Pleistocene, large mammals such as Bison antiquus gradually disappeared and were replaced by modern-day bison, deer, bear, elk, etc. Paleoindian peoples shifted to a broad-spectrum subsistence adaptation, point styles changed, and the Paleoindian period gave way to the Archaic. Continuity between the two has not been verified; diagnostic projectile points are often used to distinguish the periods but never seem to indicate an overlap or establish continuity (Irwin-Williams 1979), although time-wise they mesh. This is a critical area of research concern, and explanation of the transition from one period to the other is imperative for understanding the Early Archaic.

The Cochise Culture

The Cochise culture was originally seen as an Early Archaic broad-spectrum adaptation to the desert grasslands of southeastern Arizona (Sayles and Antevs 1941; Sayles 1983), characterized by a specific lithic technology and large numbers of grinding stones. Through time, it has come to include all Archaic sites in the Mogollon Highlands as well (even though they are in a mountain environment), based on early work in Archaic highlands sites by Martin et al. (1949). Wills (1988a:27-29) believes the basis for this inclusion was that the Cochise was the only early comparative chronological sequence for the area at the time. He argues that the Cochise should not be used as an all-inclusive term for Archaic sites everywhere in the southern Southwest. He also believes cultural boundaries should not be set for what he considers a classificatory scheme to describe a specific technology. Likewise, Huckell (1996:9) criticizes the concept for being poorly defined and not being distinctly different from other Archaic adaptations in the Southwest. However, the later-defined Oshara tradition (Irwin-Williams 1973), based upon specific projectile point styles to describe Archaic sites in the northern Southwest, seems to avoid the culturally loaded inferences associated with the Cochise. Although Wills and Huckell's criticisms seem to be valid, there is no replacement scheme for describing the Archaic of the Mogollon Highlands. Therefore, this section describes the Cochise culture sequence as used to include the Mogollon Highlands and looks at sites under this rubric with the understanding that the term may be a regional inflation of a local Arizona adaptation.

The basic cultural sequence for the Cochise culture was developed by Sayles and Antevs (1941) and described through a series of stages. Later, Irwin-Williams (1979) broadens these dates but leaves a major gap between two of the stages. Sayles (1983) fills the gap with the controversial Cazador stage. A comparison of the published stages is presented in Table 1.3 and described in the following paragraphs. However, recent work by Waters (1998) indicates that the Sulphur Spring stage may actually date between 8000 and 6000 B.C.

Sulphur Spring Stage. The viability of the stage was originally based upon the discovery of what appeared to be a very early Archaic site in Sulphur Spring Valley in southeastern Arizona, the Double Adobe site (Sayles 1983). The site contained percussion-flaked choppers, hammerstones, fire-cracked rock, and a number of small milling stones; however, no projectile points were found. Of significance was the additional presence of several Pleistocene mammals including mammoth, bison, and dire wolf, now thought not to be contemporary. Dating of the geological sediments on the site produced a possible range of occupation from about 10,500 B.C. to 9000 B.C. A total of seven sites have been assigned to this stage, but none are located outside of Arizona.

Critics of the stage bemoan the extremely small data base for the time period (Berry and Marmaduke 1982:120). The association of the Pleistocene mammal remains with the cultural artifacts has also been questioned by N. Whalen (1971) and Waters (1998) who think the megafauna at Double Adobe were extinct prior to the dates for the site and, therefore, both suggest the deposits are not in a primary context. Woosley and Waters (1990:364) believe the artifacts themselves may be bioturbated and not associated with the geological levels in which they were found. Correction of a later C-14 date obtained at the Double Adobe site yielded a 5806 B.C. ± 370 result (Cattanach 1966:1). This date is out-

Table 1.3. Variations in the Cochise Culture Sequence

Stage	Sayles and Antevs (1941)	Irwin-Williams (1979)	Sayles (1983)
Sulphur Spring	7500 to 3500 B.C.	9000 to 6000 B.C.	10500 to 9000 B.C.
Cazador	-	-	9000 to 6000 B.C.
Chiricahua	3500 to 1500 B.C.	3500 to 1000 B.C.	6000 to 1500 B.C.
San Pedro	1500 to 200 B.C.	1000 B.C. to A.D. 200	1500 B.C. to A.D. 1

side the time range assigned by Sayles (1983) to the Sulphur Spring stage and suggests the stage may not be as old as early researchers believed.

The Sulphur Spring stage is absent in the Mogollon Highlands as is any evidence of an Early Archaic occupation. Because of the tendency for Archaic sites to be buried under alluvial deposits in this region and because of the lack of excavation of aceramic sites, it is not known if Early Archaic sites could be present.

Cazador Stage. This stage was not assigned to the Cochise cultural sequence until 1983. It filled a gap left between the very early Archaic sites of the Sulphur Spring stage and more prevalent Chiricahua stage. The type site is again the Double Adobe in southeastern Arizona. Artifacts associated with the Cazador stage include chipped stone tools, bifacial blades, projectile points, milling stones, hearth stones, and modern fauna (Sayles 1983). Two other sites in the region are classified as Cazador.

The concept of a Cazador stage has not been well received. N. Whalen (1971), Berry and Marmaduke (1982), and Waters (1986) complain that the tools associated with the complex are not distinctive. Huckell (1984:137-138) agrees with this and adds that the Cazador artifacts are often found in the same locality and stratigraphic levels as ones from the preceding stage. An examination of projectile points found on the Double Adobe site (Sayles 1983:107) shows at least four different types represented, including shouldered and stemmed, corner-notched, eared, and leaf-shaped. Some are comparable to early styles found in lower levels at Ventana Cave. However, this much variety is unusual from a single locality and could indicate sequential deposition of artifacts through time.

No Cazador stage sites have been identified outside of southeastern Arizona. As with the Sulphur Spring stage, sites of this time may represent very local occupations by early Archaic peoples. No Archaic sites of this general time period have been located in the Mogollon Highlands.

Chiricahua Stage. Cave Creek in the San Simon Valley of southeastern Arizona is the type site for the stage (Sayles and Antevs 1941). Other potential Chiricahua sites include Ventana Cave northwest of Tucson (Haury 1950), Cienega Creek at Point of Pines (Haury 1957), and Wet Leggett Arroyo in the Pine Lawn Valley (Martin et al. 1949). Assemblages from these sites consist of a wide variety of artifacts. Chipped stone items exhibit a greater diversity and an increase in numbers on sites. These include bifacial tools, hand axes, projectile points, and milling stones with the inclusion of shallow basin metates (Wills 1988a:12-13). Maize reportedly appears for the first time during this stage (including pollen at Bat Cave, New Mexico, and at Cienega Creek near Point of Pines, Arizona [Wills 1988a:12]).

For the first time in this region, definitive projectile point styles can be distinguished. The Chiricahua point (found throughout the southern Basin-and-Range area) was first classified by Dick (1965) to describe points recovered from Bat Cave. This point type has subsequently been recovered from other sites in the Mogollon Highlands and as far away as Grants, the Jemez area, Galisteo Basin, Chaco Canyon, and southeastern Utah (Vierra 1980:369). Augustin and Pelona points have also come to be associated with the Chiricahua stage, each with definitive morphological characteristics (see Moore, Volume 3). Augustin and Gypsum Cave points are sometimes considered the same type (Matson 1991:175) and are considered roughly contemporaneous; however, no detailed study of their time depths has been attempted. Also, early Chiricahua points, Pinto Basin, and San Jose points of the Oshara tradition, representing southeastern Arizona, southwestern New Mexico, northern New Mexico, and southeastern Utah, have noted similarities (Berry and Marmaduke 1982:130) and raise the issue of a panwestern Archaic adaptation rather than development of localized cultures such as the Cochise and Oshara.

Chiricahua points are fairly common throughout eastern Arizona and extend into southwestern New Mexico and somewhat into Sonora and Chihuahua, Mexico (Sayles 1945:47). The increase in sites at this time is thought by Irwin-Williams and Haynes (1970:67) to result from a favorable post-Altithermal climate change. Sites designated as Chiricahua in the Mogollon Highlands include Bat Cave at ca. 3500 B.C. and Wet Leggett Arroyo at 2558 B.C.± 650 on the basis of similarities in artifact types and projectile point styles with the Arizona Chiricahua. Hogan (1985:9) notes that this is the first time that Cochise sites are located in mountain zones. He believes this represents a major shift in settlement dynamics with a dramatic adjustment to new subsistence resources and to seasonal environments.

Several researchers see problems with the Chiricahua data base. Antevs (1949:56-59) questions the association between the artifacts and the soil deposits at Wet Leggett Arroyo, suggesting the two are not necessarily of the same date. The validity of association between early levels at Bat Cave and C-14 dates is also questioned because of the arbitrary excavation of 12-inch levels throughout (Jennings 1967:123; Wills 1988a). Wills (1988a:18) says the Chiricahua points from Bat Cave were from levels that he believes postdate 850 B.C., which would make them Late Archaic rather than Middle. Wills (1988a:26) also notes that the Cienega Creek site in Arizona has newer C-14 dates between 750 and 450 B.C., placing it not within the Chiricahua stage but into the succeeding San Pedro. It would seem, therefore, that several lines of evidence point to a Late Archaic occupation rather than Middle Archaic for several of the classic Chiricahua sites. Of more significance is the fact that the appearance of maize at Bat Cave and Cienega Creek may not be as early as previously thought if the deposits at both were mixed.

San Pedro Stage. It is generally assumed that Late Archaic populations in the Mogollon Highlands are derived from the San Pedro Cochise out of southeastern Arizona (Haury 1957; Martin 1959; Berry 1982:31). Some sites are documented in the highlands during the earlier Chiricahua stage, but questions regarding the validity of their dating may place these sites actually into the Late Archaic. The type site is GP Benson 5:10 located along the San Pedro River in southeastern Arizona. Characteristic features of the San Pedro adaptation include shallow pit dwellings, bell-shaped pits, hearths, and occasional burials. Artifacts consist of a more varied grinding assemblage, core tools such as choppers and hammerstones, bone and horn tools, San Pedro projectile points, bifaces, drills, gravers, and the use of mica and fresh-water shell (Sayles and Antevs 1941; Sayles 1983). Pottery is not common in the Late Archaic but it is sometimes present in low numbers. The subsistence base is reportedly more eclectic than in earlier stages (Bronitsky and Merritt 1986:107) with evidence for the early domestication of maize. Together with the presence of habitation units and bell-shaped pits, these adaptations seem to suggest a more restricted mobility pattern than in previous Archaic periods.

Haynes (1968) suggests that the cause for the migration or shift of peoples into the mountainous Mogollon Highlands at this time may have been the extensive "Fairbanks Drought" in southeastern Arizona between 950 and 650 B.C. Berry (1982:33) suggests that the Mogollon Highlands offered an excellent escape from arid conditions for small groups of Archaic populations. Early identified sites in the region include Bat and Tularosa caves in New Mexico and Ventana Cave and Cienega Creek in Arizona. Numerous other sites have since been considered to be of San Pedro affiliation, primarily on the basis of their temporal range or the presence of San Pedro points.

While dates for the San Pedro stage in Arizona consistently begin at ca. 1500 B.C. and end somewhere around A.D. 1 with the introduction of pottery, few sites in New Mexico have yielded corresponding C-14 dates (Hogan 1985:9). However, several Archaic sites on the Luna Project did produce radiocarbon dates within acceptable ranges for the San Pedro stage.

The diagnostic San Pedro point is dominant during this stage and is found over a broad area of southwestern New Mexico, eastern Arizona, and into southern Colorado (Wills 1988a:13). Researchers have noted the similarity between San Pedro points and Basketmaker II points from the Anasazi area to the north (Berry 1982:33), and Bat Cave No. 8 points from Dick's (1965) excavations (O'Hara and Elyea 1985:83). Because San Pedro points are prevalent throughout the Late Archaic period and are often also found on later pithouse sites in the Mogollon Highlands, they should be considered only very general temporal markers. Another Late Archaic point also found in west-central New Mexico and eastern Arizona is the Cortaro, characterized by a basal concavity (Roth and Huckell 1992:356-357).

In sum, archaeologists have, for the most part, held to the belief that the San Pedro stage of the Cochise culture is the predecessor to the Mogollon culture found in the Mogollon Highlands. Wills (1988a) raises questions about this association, recalling for us that the Cochise was originally defined as a descriptive category for the classification of the lithic technology and settlement patterns found on Archaic sites in southeastern Arizona. It is now considered a full-blown cultural adaptation that he says was never the intent. He also asks whether we, as archaeologists, can justify calling the Mogollon Archaic part of the Cochise culture. He is correct in stating that the association is very tenuous and we suggest that much more study is needed on the derivation of the Mogollon Archaic; however, the Cochise classification system (for lack of another) is currently a useful tool for sorting out temporal and cultural adaptations that have been documented within the Mogollon Highlands.

Cochise versus Oshara Tradition

The Oshara tradition was developed by Irwin-Williams (1973) to account for the differences in lithic technology (from that of the Cochise) observed in the northern New Mexico area. It is basically a chronological sequence much like the Cochise, extending from ca. 5500 B.C. to A.D. 400. Phases within the tradition are classified much like the Cochise stages.

Projectile point differences between the two are minimal. Gerow (1994:26) notes that the San Pedro points of the Cochise and the En Medio points of the Oshara are often indistinguishable from Basketmaker II points. Likewise, Cochise Chiricahua and San Jose points of the Oshara are very similar and both appear ca. 3500 B.C. (Berry and Marmaduke 1982:130). Cochise Agustin points seem to be identical to those defined by Haury at Ventana Cave as Armagosa II (Matson 1991:137). And yet, cultural traditions, such as the Cochise and Oshara, have been defined mostly on projectile point typologies supposedly unique to each (LeBlanc and Whalen 1980:72).

Archaeologists have used the presence of specific points in research areas to distinguish between the two traditions. But are projectile point styles valid boundary markers? An examination of Archaic point findings by area shows considerable mixing of the two traditions. The Lower Chaco area has a number of Cochise Chiricahua points together with Oshara type points (Elyea and Hogan 1983:401). Mixing also is strongly evident in the Quemado-Fence Lake area (Hogan 1985:41) and on the Plains of San Augustin (Chadderdon 1990:35). Several Oshara-like points have been found within the Luna Project area also. Thus, boundaries between the two traditions may not actually exist, suggests Elyea and Hogan (1983). We concur that the concept of Archaic territorial boundaries may not be appropriate for this time period. Again, the question of a pan-Southwestern Archaic culture is raised. Are differences in projectile point morphologies sufficient to distinguish cultural entities?

Archaic Manifestations in the Mogollon Highlands

Site Classifications

The types of Archaic sites found in the Mogollon Highlands depend upon the definitions used by archaeologists to distinguish sites. For example, Anderson and Sessions (1979) use eight different functional classifications to describe Archaic sites on Gallegos Mesa. Others employ four to five criteria to distinguish such sites (Huse et al. 1978; Reynolds 1980; Simmons 1982). However, all of these classificatory schemes carry a high percentage of ambiguity. How many archaeologists can unambiguously differentiate a habitation locale from a base camp from a temporary camp? The embedding of several activities within the pursuit of specific subsistence resources is a reasonable assumption for Archaic hunters and gatherers that must be considered when assessing functionality of sites. Vierra (1980) reduces site classifications to only two types, base camps and task-specific sites. Kelly (1983) does as well with his residential and logistical sites. These represent, as much as possible, unambiguous classifications into which all Archaic sites can be placed.

In Vierra's model (1980), base camps for Archaic populations are by nature, temporary. They usually contain evidence of a range of domestic activities such as lithic tool reduction and manufacturing and food processing together with a variety of tool types and the presence of hearths and possible storage facilities. Task-specific sites are generally of shorter duration and frequently have fewer persons, although tasks such as piñon and acorn collecting may require larger groups. Functional tool variability on these sites may be tied to the specific task at hand, such as gearing up for hunting, quarrying, or processing of plant foods. But Vierra notes that the difference between the two site types is rarely dichotomous and some overlap is possible.

Kelly (1983) suggests that Archaic populations vary the above site make-up on the basis of the subsistence strategy being employed. He argues that vegetal resources can more effectively be retrieved through a series of residential group moves and few, if any, task-specific sites are needed. On the other hand, he believes that logistical moves to specific areas are required if faunal resources are the prime target.

Of the six excavated Luna Project Archaic sites, four can be considered base camps with well-prepared hearths or roasting pits, a diversity of artifacts, including some sites with numerous projectile points and grinding implements, and two with pits or small habitation units. All sites date to the Late Archaic period.

Within the Mogollon Highlands, Archaic sites have been found in two physical settings—in caves or rockshelters and in open areas. Cave sites have been well documented from the early days of research in the area and have produced some spectacular remains such as at Bat, Tularosa, Cordova, and O Block caves (Fig. 1.19). Open-air sites are less common and preservation is almost always much poorer. However, the Luna Project uncovered four open-air Archaic sites with intact cultural features, all buried beneath deep alluvial deposits. Two other sites were Archaic surface scatters; only one produced a hearth area. The six sites were within .6 km of a stream bed, two on terraces immediately above or set back from the San Francisco River, another in the middle of the floodplain of a seasonally flowing drainage, and three on ridges above another seasonal stream flow. The

Figure 1.19. Tularosa Cave. Main chamber is obscured by trash midden in center of picture, facing northwest.

three on ridges are in heavily wooded areas surrounded by piñon and acorn resources, while the other two are in more open environments. The cave sites recorded earlier are all adjacent to or high above water sources that are perennial in good years. Thus, diversity in location and types of Archaic sites within the Mogollon Highlands is apparent and is likely driven by location and types of subsistence resources available.

Archaic Site Features

Architectural features are not really identifiable for the Cochise culture until the Chiricahua stage (Middle Archaic). In this stage, these features are almost exclusively restricted to hearths or remnants of hearths. The majority of Chiricahua sites are located in southeastern and eastern Arizona. Those with hearth features include the Arroyo site (Bayham et al. 1986), the Fairchild site (Windmiller 1973), and Lone Hill (Agenbroad 1978). Cienega Creek, with hearths and burials, was originally considered to be of Chiricahua affiliation, but recent C-14 dates of 750-450 B.C. put it into the following San Pedro stage (Wills 1988a:26). The only Mogollon Highlands site with a dated Middle Archaic feature, a hearth, is Bat Cave (Matson 1991:157).

By the following San Pedro stage (Late Archaic), there is a substantial expansion of Archaic sites within the Mogollon Highlands and in southeastern Arizona. Hearths are commonly found and are almost all shallow basins except those from the Square Hearth site (Mabry and Clark 1994). Hearths have recently been found consistently on Archaic lithic scatters where excavations have stripped broad surfaces of sites. Many of these small Archaic hearths on the Luna Project have produced radiocarbon dates. Roasting pits or storage pits are also not uncommon on Late Archaic sites and are often well preserved and contain plant and animal material along with fire-cracked rock. Roasting pits were found on three of the six Luna Archaic sites while storage pits were present on two of the six sites.

Pit structure features are unambiguously identified for the first time in the San Pedro stage. In southeastern Arizona, they have been recorded at numerous sites including Hay Hollow (Bohrer 1972), Tumbleweed Canyon (Martin et al. 1962), Benson:8:3 (Sayles 1945), Snaketown (Berry 1982), Matty Canyon (Huckell and Huckell 1985), the Milagro site (Huckell and Huckell 1984), AZ:Q:12:27 near St. Johns (Westfall 1981), and the Valencia site (Doelle 1985). In the Mogollon Highlands, aside from Bat Cave, only the SU site near Reserve has been previously documented as having a Late Archaic pit structure (Wills 1994:4). On the Luna

Project, two of the six Archaic sites also contained pit units—Raven's Roost and Humming Wire. Late Archaic pit structures in surrounding New Mexico areas have been recorded at three sites in the Mimbres area—Eaton (Fitting 1974), Red Rock (Laumbach 1980b), and Winn Canyon (Fitting et al. 1982), although this last site contains pottery and has a late C-14 date extending to A.D. 385. Archaic pit structures have also been uncovered in the Franklin Mountains near El Paso (O'Laughlin 1980) and at the Moquino site near Grants (Beckett 1973).

Archaic pit structures are uniformly simple constructions consisting of circular or oval-shaped depressions with sides generally sloping inward and unprepared surfaces. Floors may be level or slightly concave. Shallow basin hearths or fires built directly on the floors may often be present, suggesting use of many of the pit structures in cooler weather. Large interior pits (many of them bell-shaped) are frequently found also, both inside and outside of the structures. One of the largest sites, Hay Hollow, contained 9 pit structures and 265 associated exterior pits (Bohrer 1972). Occasionally, postholes are located either around the periphery of the structure or a few have been placed randomly on the floor. Short side entries have been recorded in two cases in Arizona at the Hay Hollow and Square Hearth sites. Out of 12 sites with available data, the average size of pit structures is small, ranging from 4.4 sq m to 22.8 sq m with a mean of 8.4 sq m of floor space and a depth of 41 cm.

Burials

A few Late Archaic sites, all in southeastern Arizona, contained human burials. Site reports indicate that burials were found at four of eight sites in this area. No data are available except that they were all tightly flexed with no associated grave goods (Thompson 1987:21). Other Arizona sites with burials include Matty Canyon, a pithouse occupation, at 1550 B.C. ± 50 (Huckell and Huckell 1985) and the Square Hearth site, also with a flexed burial (Mabry and Clark 1994:1) and dating very late in the Archaic period between A.D. 50 and 200. Of interest is the presence of a single cremation. An exceptional burial site is Cienega Creek dating 565 B.C. ± 300 (Haury 1957; Wills 1988a:26). On the site were several burial pits. One contained 47 cremations deposited individually within the pit. From the archaeological evidence, it seems that the burials may have been initially placed in baskets prior to interment, indicating cremation occurred elsewhere on the site. No comparable Archaic burial sites have been found to date.

Material Culture

Archaic projectile points and stone tools have received due attention in above paragraphs and in the chapters describing Luna lithic assemblages (see Moore, Volume 3). Less well defined is evidence of an Archaic ceramic technology. Ciolek-Torrello (1995:541) describes early ceramics as few in number, of limited functional diversity, and not technologically sophisticated. All are a similar plain brown ware, called by different names in different regions of the Cochise culture area. One of the earliest dated ceramic sites is supposedly Hay Hollow at 400 B.C. (Whalen 1973), although Cordell (1984a:113) questions the association of the date with the ceramics. Other early ceramic sites that appear in the Late Archaic include the Square Hearth site at A.D. 40-190, Coffee Camp at 100 B.C. ± 50 with temper of organic fibers (Mabry and Clark 1994:4), and the Eagle Ridge site at 94 B.C. to A.D. 323 (Whittlesey et al. 1994:32), all in Arizona. In the Mogollon Highlands, the earliest pottery has been dated by dendrochronology to A.D. 515 at LA 5407 in the Gallo Mountains (Akins 1998) and ca. A.D. 240 at Bat Cave (Wills 1988b:457). In the Mimbres Valley, the earliest pottery dates to ca. A.D. 180 ± 60 at the McNally site (Anyon et al. 1981). Similarities in type and construction of these early ceramic wares in Arizona, New Mexico, and northern Mexico, seem to confirm for Whittlesey (Whittlesey et al. 1994:38) that these areas were part of a larger Archaic ceramic tradition.

There are several reasons offered for the introduction of ceramics during the terminal part of the Late Archaic period. Presumably, the increased need for storage to accommodate the expanding use of dried foods created through the introduction of maize agiculture is credited for the use of pottery at this time (Hunter-Anderson 1986; Thompson 1987). Another reason for the switch from baskets to pots is that the pots are more cost-efficient to produce (Hunter-Anderson 1986:48).

Baskets were obviously in use before the shift to pottery. Fragments of coiled baskets were recovered from burial pits at Cienega Creek dating to 565 B.C. ± 300 (Haury 1957:2). LeBlanc and Whalen (1980:90) also note the presence of baskets during the Archaic period, as well as fiber cordage and sandals. Quartz crystals are found on sites dating to all cultural periods; on the Luna Project, 26 quartz crystals were recovered from the fill of one Archaic pit at Raven's Roost. Several crystals were also found at EE:8:7 near Fairbanks, Arizona. No stone pipes have been retrieved from Archaic sites in the Mogollon Highlands, but four were recovered from Cienega Creek (Haury 1957). Without elaborating, Simmons (1989:61) suggests there may have been some interregional trade on the part of Archaic peoples based on findings of nonlocal goods and raw materials. Cotton textiles may have been one of those trade items, coming from the Hohokam into the Mogollon Highlands (Ford

1981:18). The finding of fresh-water shell and mica on some southeastern Arizona sites and a shell bead in the San Pedro level at Bat Cave (LeBlanc and Whalen 1980:91) also hints at a potential trade system.

Mobility and Sedentism

For many years in archaeology, there has been a perceived dichotomy when classifying prehistoric groups as either mobile or sedentary, creating an either/or choice for archaeologists when describing hunter-gatherer adaptations to a local environment. Recently, however, the dichotomy has been smoothed into a continuum as the realization has taken hold that there are numerous types of hunter-gatherer adaptations with many degrees of mobility or sedentism (B. Nelson 1990; Whalen and Gilman 1990). However, the concept of a continuum must not be viewed as an evolutionary track along which societies progress toward the goal of full sedentism. Rather, the varying patterns of mobility as related to sedentism may be highly complex, as Eder (1984:837-839) warns. Rocek (1996:50) also cautions that, in some cases, the patterns may be reversible if warranted by the natural or social environment.

Mobility

Full mobility implies constant movement of hunter-gatherers from one subsistence resource to another over the landscape. Seasonal mobility indicates movement to resource areas as particular resources become seasonally available. Residential mobility means that the whole group moves; logistical mobility involves only specified persons moving to a resource acquisition area for a short, or set, period of time (Binford 1980). Restricted mobility suggests that there are limitations on a group's movement, or range, due to environmental or social constraints. Combinations of any of these strategies could occur frequently throughout the existence of a particular group; thus, mobility becomes a relative term best measured against other groups rather than against a rigorously divided yardstick. Archaic populations are considered the best example of mobile groups in the prehistoric Southwest. Their movements shift among varying seasonal resources over a presumed, generally unconstrained region from year to year. This seasonal round is usually within a prescribed range that is comfortable for the groups, varying little from year to year. The pattern of mobility is probably similar to what we know to be true for the more recent Athabaskan groups.

The benefits of being mobile are several. High mobility allows a group to seek new resources when current ones are depleted or present in low numbers. Adjustments to changing resource bases can be more easily made (Lightfoot 1983:194) when population densities are low and the territory is unconstrained. Restrictive costs of mobility include the often long-distance move to spatially separated resources and the unpredictable nature of those resources (Stafford 1980:48). Moving from area to area also does not allow a group to control specific resources, and if other groups are in the region, increasing competition for those resources could occur.

Archaeological evidence for the practice of seasonal movement, or rounds, in the Mogollon Highlands can be sought through the presence or absence of interior hearths, the diversity of the artifact assemblage, the deposit of trash over a site as opposed to midden areas, and the presence of seasonally available resources (Lightfoot and Jewett 1986:15-17). However, blurring of the record can occur if sites are reused from year to year. The appearance of small pit structures lacking hearths, as at Raven's Roost and Humming Wire on this project, indicate that some warm weather occupation of the highlands by Archaic populations did occur. Grinding implements and roasting pits on several Archaic sites also suggest a late summer or early fall residence as seasonal foods ripen and are harvested. A preponderance of projectile points on several Archaic sites that also contain outdoor hearths infers that wild game was also pursued, usually an activity best done in the late fall. Only sheet trash was observed on Archaic sites in the Mogollon Highlands, indicating short-term usage.

If a group was to overwinter in the Mogollon Highlands, some form of shelter such as a pit structure equipped with interior hearths would be necessary. Storage of previously obtained foods is often required with overwintering, as wild game would be the only other source of nourishment at this time of year. Possible storage facilities were found at Raven's Roost and the SU site; however, there were none to few interior hearths present at either. Currently, there is no real confirmation that Archaic groups did actually spend the winter in the Mogollon Highlands. Reasons for overwintering in a less than optimal environment are usually tied to the presence of competing groups. "Staying put" allows a group to monitor resources and possibly control access to those resources (Wills 1988b:478). This action reduces group mobility, however, and fosters the use of logistical movement rather than residential. There is no indication from settlement pattern studies conducted for the project that Archaic populations were of high density (and therefore in competition) or that the environment was near carrying capacity in the Mogollon Highlands. This, combined with the lack of evidence for overwintering, suggests that Archaic populations in the region were basically unconstrained and moved seasonally in pursuit of available resources.

Sedentism

By definition, sedentism implies staying in one place and archaeological convention considers that to mean for a period of at least a year (Higgs and Vita-Finzi 1972:29). A more flexible definition by Rice (1975:97) requires that only part of a population remains at the same location throughout the year. More recently, Kent (1991) interprets sedentism for hunter-gatherers as any occupation over six months in length. Young (1993:3) dislikes the year-round label and prefers to define it as decreased residential mobility. Rocek (1996:49) agrees that sedentism is a relative process, not a goal achieved at the end of a progressive continuum. And because it is an often slow and gradual process, Rocek (1996:18) believes sedentism is difficult to define archaeologically and that very precise seasonal data from floral and faunal resources on a site are necessary to verify it.

Sedentism seems to be neither a prerequisite for the adoption of agriculture (Redding 1988:83) or an inevitable result of the pursuit of agriculture (Wills 1988b). However, a necessary condition for a group to become increasingly sedentary is an abundant and available subsistence resource base (Wills 1988b:479; Fish et al. 1990:77; Rocek 1996:51). Rafferty (1985:118) reasons that when one or more viable resources become abundant, it can lead to dependence on that resource at the expense of others that may be less available. Dependence on fewer resources also leads to greater productivity than does generalized acquisition and may have favored selection of such items (Leonard 1989). Other causes for the rise of sedentary communities include territorial constriction (Rocek 1996:53) precipitated by increasing populations in a region which, in turn, could lead to competition for the resources (Cohen 1985:101; Wills and Windes 1989:347). Still other potential causes for a gradual shift toward sedentism include an increasing dependence on stored foods allowing access to subsistence items for longer periods and the addition of ceramics to a group's technological base, which allows for better storage and preparation of food items (Schlanger 1990:103).

Archaeological indicators for increasing sedentism in a region include a possible increase in the recovery of large mammal remains because of groups having to go further away from the community for food as a result of local resource depletion. Thus, the focus on retrieval of large mammals is a result of their yielding a higher return for the cost involved (Speth and Scott 1989). Going further afield for resources also leads to a greater diversity in other plants and animals recovered (Hitchcock 1982:7) and should be quantifiable if there is good preservation. Other archaeological evidence that sedentism may be occurring includes deeper pit structures with interior hearths and other internal features, extensive trash middens, increase in burials, more formalized storage structures, and a greater diversity in artifact types (Young 1993:2). In general, the presence of pit structures, ceramics, or maize on a site is not considered to be a valid indicator of sedentism (Young 1993:1).

Within the Mogollon Highlands, there is no archaeological evidence that Archaic populations were becoming increasingly sedentary. Several shallow pit structures have been recorded for the Late Archaic period but they lack interior hearths and the other markers listed above. Population, according to the number of documented sites for the region, is not high; thus, there would have been no serious competition for resources, which should have been seasonally plentiful. Climatic data indicate no environmental stress that would have led to competition at this time. Occasional small amounts of corn are found in Late Archaic contexts. Early pottery may also be present but has only been dated as early as ca. A.D. 500 in the Gallo Mountains. Neither of these are evidence that sedentism is occurring, although both are characteristics of later sedentary societies.

Archaic Subsistence Adaptations

An examination of the subsistence strategies used by Archaic populations reveals that a wide-ranging variety of food resources constituted the Archaic diet. Their employment of seasonal rounds expanded the resource base immensely, allowing for exploitation of subsistence items from different environmental zones. Three types of resource acquisition are described here as they apply to Archaic people within the Mogollon Highlands.

Hunting

As is common in much of the prehistoric world, hunting in the Mogollon Highlands was probably not a critical variable in the subsistence system (Linskey 1975:246). Nevertheless, it was an important activity that produced very satisfying results. Wild game is an earned resource where locations are unpredictable and pursuit requires special knowledge regarding faunal habits and environmental conditions. Bayham (1979:223-225) also notes that game often aggregate where forage is plentiful and adds that if there is an overabundance, group selection should favor those species that are dietary preferences. From comparisons of data from three states, he also concludes that Archaic populations preferred small animal species to large (Bayham 1979:228). We contest this hypothesis for the Mogollon Highlands and test it by using the Artiodactyl Index developed by Bayham (1982). The index compares the amount of artiodactyls

Table 1.4. Archaic Faunal Remains

Taxa	Number	Percent
Jackrabbit	8	1.0
Cottontails	2	.2
Indeterminate rabbit	1	.1
Bird	1	.1
Dog	1	.1
Artiodactyl	30	3.9
Antelope	1	.1
Elk	1	.1
Mule deer	261	34.3
Small mammal	48	6.3
Medium mammal	100	13.2
Large mammal	125	16.4
Indeterminate mammal	184	24.2
Total	763	100.0

versus rabbits found on a site and also measures the potential resource depletion if large game are the preferred species. This index is calculated as the ratio of the number of artiodactyls relative to the number of artiodactyls plus leporids (Artiodactyls ÷ Artiodactyls + *[Sylvilagus + Lepus]*).

Two Archaic sites excavated by OAS provided sufficient sample size for examining preferences for large game versus small in the highlands. Raven's Roost yielded a value of .99, indicating an extremely high selectivity for large game (N=391 large game + 3 small). The Old Peralta site produced an index value of .94, also heavily skewed toward the use of large game. Bayham's (1979) results may have derived from an examination of sites from the southern Southwest where the predominant game is rabbit. At the Ormand site (Wallace 1998) in the vicinity of Cliff at about 2,000 ft lower in elevation and less mesic than the Mogollon Highlands, the Late Archaic units produced an index of .87, slightly lower than the Highlands indices but still high. In general, for the Archaic period in the Mogollon Highlands, it is fair to say that large game are the strongly preferred species and that there is no large game resource imbalance at this time.

Wild game remains found on Archaic sites in southeastern Arizona include jackrabbits, cottontails, badger, coyote, kit fox, desert tortoise, deer, antelope, and mountain sheep (Matson 1991:156). Most are jackrabbits, which may support Bayham's (1979) conclusions for this area. We do not know, however, if all of the above were subsistence items. In New Mexico, Archaic sites have additionally produced woodrats, prairie dogs, and turkey (Vierra 1996). Mogollon Highland sites within the Luna project area yielded 763 faunal remains (Table 1.4) with the addition of bird, dog, and elk. However, the majority of recovered fauna are large mammal at 54.7 percent of the total with another 24.2 percent being indeterminate mammal, and, therefore, possibly large. Only 1.3 percent are in the rabbit family. The heavy reliance on large mammals in the Mogollon Highlands as opposed to rabbits in the Arizona desert is interesting and indicates that there is, in effect, no one particular faunal assemblage that characterizes the entire Archaic subsistence system. Rather, Archaic populations are adapting to their specific environmental zones and pursuing those species that seem to be the most abundant in their areas. Bayham's (1979) abundance hypothesis (stated above) would seem to apply to the Mogollon Highlands in that mule deer are a preferred species and are the most commonly retrieved fauna in the Archaic period. Bison are present on later sites in the Mogollon Highlands but have not been recovered in Archaic sites. Turkey remains were not found in Archaic sites on the Luna project; however, dessicated turkey eggs and droppings were found at Tularosa Cave dating between 300 and 150 B.C. Heller (1976:60-61) thinks a portion of the cave may have been set aside as turkey pens.

Gathering

Gathering activities occupy most of a mobile group's time spent in subsistence pursuits. Unlike fauna, most major plant foods are dispersed over the landscape (particularly seedy annuals), variable in their annual yield, and unreliable as staple food items (Ford 1984:129). In most cases, the entire group would move from one sparse resource to another. For the Mogollon Archaic, it is believed they pursued a seasonal round between vegetal resources in the Mogollon Highlands and those in lower elevations in southwestern New Mexico or southeastern Arizona (Wills 1988a). Low elevation foods found on Late Archaic sites in Arizona include agave, sotol, yucca, mesquite, and cactus (Hayden 1981:519; Wills 1988a:93). However, agave was a commonly recovered material at Cordova Cave in the Mogollon Highlands (Cutler 1952:478).

Numerous Late Archaic sites (mostly in Arizona) have produced a wide range of vegetal remains including goosefoot, horse purslane, manzanita, grass seed, amaranth, dropseed, panic grass, cheno-ams, peppergrass, hackberry seeds, walnut, juniper seeds and berries, prickly pear cactus, sporobolus, and spurge (Matson 1991; Huckell and Huckell 1992; Geib and Huckell 1994). In New Mexico, additional vegetal resources include saltbush seeds, wild gourd seeds, needle grass, agave, piñon nuts, and four o'clock roots (Matson 1991; Vierra 1996). No manzanita, hackberry seeds, spurge, or peppergrass is noted for New Mexico. Luna project sites add 11 species to the Archaic diet. These are poverty weed, portulaca seeds, poppy-family seeds, pigweed, sage, oak, fleabane daisy, Mormon tea, nightshade, seepweed seeds, and the buckwheat family. Piñon nuts and juniper seeds are also prevalent in the Mogollon Highlands. Acorns and walnuts are somewhat less common. Of these four foods, only the acorn remains do not appear on Archaic sites, although oak is present. They do appear on later Athabaskan sites in the area, however. The consistent presence of ground stone on Archaic sites in the highlands is undoubtedly related to the processing of the many varieties of nuts and seeds utilized by the population.

Development of Agriculture

While reliance on agricultural products was certainly not heavy during the Archaic period, corn remains are not uncommon on Late Archaic sites. However, it is debatable whether or not populations were practicing full-scale agriculture. The definition of agriculture, as used by Rice (1980:20), assumes an intensive, major reliance on cultigens; while Wills (1988a:1) includes only cultivation of domesticates in his definition. On the other hand, horticulture is defined as a mixture of hunting and gathering combined with gardening; wild foods remain an integral part of the subsistence strategy (Welch 1991:77). This definition seems best suited for what we currently know about agricultural adaptations for the Archaic, that cultivation is likely a supplemental strategy (Minnis 1985), although Fish et al. (1990:80) believe it was a more important part of the Archaic diet.

The shift to agriculture, even in incipient stages, involves a conscious decision on the part of Archaic populations. It minimally requires planting, harvesting, and the storing of seeds (Wills 1990:323-325). Several reasons have been presented as to why this decision to embrace agriculture would have been made. One suggested cause is the presence of an imbalance in local populations whereby there were constraints on obtaining regional resources (Cordell 1984b:176; Wills 1990:325). Minnis (1985) has labeled this hypothesis a "model of necessity." Cordell (1984b:178) does not believe that a degrading environment was one of those constraints that led to the adoption of agriculture; rather, she espouses population stress as a causal factor. From climatic data, environmental stress does not seem to be a motivational force.

Another reason given for the shift to agriculture is that Archaic populations opportunistically took advantage of the availability of domesticates (Wills 1990:325). Wills (1988a:36) does not think that Archaic populations had any intention of giving up hunting and gathering; instead, they used agriculture as a supplement so that they could continue this lifestyle. In the Tucson Basin, Huckell (1990) believes the use of corn agriculture allowed populations to occupy some areas more intensively than they could have under normal conditions.

The advantage to incorporating even limited agriculture into a subsistence system is that, given low population densities, it is a low cost means of providing supplemental food resources (Simmons 1986:85-86). Reasons not to pursue agriculture are more numerous. Pryor (1996:889-890) provides a list of these which includes poor climatic conditions, already high vegetal productivity, low populations, dispersed resources that require a high rate of mobility, storage not being a part of subsistence strategy, and social restrictions.

The earliest appearance of the domestication of corn in the Southwest has for a long time thought to have occurred at Bat Cave in the Mogollon Highlands (Dick 1965). Based on Bat Cave dates, Haury (1962) assumed the entry was into the highlands through a mountain corridor from the Sierra Madre Occidental of Mexico by about 2500 B.C. and confined to the Highlands until ca. 550 B.C. when it dispersed to other areas. This model of migration held up until the late 1980s. Now, because of improvements in C-14 dating techniques, reanalysis of older C-14 results, and the addition of numerous Archaic dates to the data base, these early corn dates have become untenable. An examination of current Archaic dates for corn-associated sites (Table 1.5) reveals a totally new pattern of early corn dispersal in the southern Southwest.

Using reliable calibrated and corrected dates taken directly from corn remains, we see domestication of corn by at least 3600 B.C. in the Tehuacan Valley of Mexico (Kohler 1993:274). The few available dates from Table 1.5 indicate a northward track into the American Southwest. Several different routes have been suggested for the introduction of corn into this area, including a highland route along the Sierra Madre Occidental (Haury 1962) or through the river valleys of the Sonoran Desert into southern Arizona (Mabry and Clark 1994). However, the data from Mexico in Table 1.5 suggest a third possibility—from the northern Tamaulipas area up the Rio Grande Valley into southern New Mexico. Currently, the oldest corn-dated site in the Southwest is the Tornillo Rockshelter (Upham et al. 1987), dating possibly as early as 1733 B.C. using calibrated and corrected dates (Wills 1995:218). Three to four hundred years later, Bat Cave in the Mogollon Highlands, the Fairbanks site in southeastern Arizona, and Black Mesa in northeastern Arizona produce reliable dates for 1300-1000

Table 1.5. Early Corn-Related Dates for Archaic Sites

Dates (B.C.)	New Mexico	Arizona	Mexico
7400 to 6700			Guila Naquitz Cave Oaxaca (Flannery 1973:288)
5000			Tehuacán Valley (Kohler 1993:274)
3616 to 3372			Coxcatlán, Tehuacán (Wills 1995:218)
2493±28			North Tamaulipas (Dick 1954:141)
1733 to 1112	Tornillo Rockshelter (Wills 1995:218)		
1491 to 1320	Bat Cave (Wills 1995:218)		
1373 to 790		Fairbanks site (Huckell 1996:30)	
1314 to 845		Three Fir Shelter (Wills 1995:218)	
1225±240	Tornillo Shelter (Upham et al. 1987:413)		
1170±70	Bat Cave (Wills 1995:218)		
1074 to 830		Milagro site (Wills 1988b:454)	
1009 to 896		Cortaro Fan (Wills 1995:218)	
870±76	Chaco Wash (Simmons 1986)		
785±75		West End site (Huckell 1996:30)	
760 to 550	Haca Negra (Moiola, this report)		
740±120	Jemez Cave (Berry 1982:28)		
615±75		Charleston site (Huckell 1996:31)	
590±200	Fresnal Shelter (Tagg 1996)		
543±132		Cienega Creek (Berry 1982:19)	
523±200	Tularosa Cave (Berry 1982:28)		
520±270		Tumamoc Hill (Fish et al. 1986)	

B.C. occupations based on corn samples. From these places, dispersion may have been to the north from the Mogollon Highlands and from southeastern Arizona. Whether southern New Mexico was the jumping off point for the spread of corn domestication throughout the Southwest is not possible to determine because of the still-limited data base. If two controversial dates for Bat Cave at 2284-2039 B.C. and 2200-1750 B.C. on Black Mesa are not correct (and Wills [1995:218] does not think they are), then a more western route up the mountain chains or through the Arizona desert valleys becomes more viable. Thus, while the early corn dates, starting at least by 1733 B.C., seem valid and rigorously obtained, researchers oscillate between favoring the introduction of corn at ca. 1000-500 B.C. (Matson 1991; Huckell and Huckell 1992; Ciolek-Torrello 1995) or at ca. 2000 B.C. (Wills 1995). A date around 2000 B.C. seems the most reasonable.

The 760-550 B.C. date for Haca Negra, a buried Archaic site in the Luna Valley, is from pollen retrieved from under a burned slab in the bottom of a roasting pit (Moiola, Volume 2). This result is tenuous, however, because of the single date; but, it is not out of line with the other early corn dates for the Mogollon Highlands.

Squash and beans are generally not temporally documented as early as corn; however, two dates place domestication of these items earlier than dates obtained for corn at the same sites. Tularosa Cave, in the Mogollon Highlands, yielded beans at 893-233 B.C., three hundred years earlier than the corn date (Wills 1995:218). Sheep Camp Shelter, on the Colorado Plateau, produced a squash date of 1430-830 B.C., over 1000 years earlier than the corn date (Kohler 1993:274). Certainly, many more reliable dates need to be obtained before a valid interpretation of the introduction of corn and other domesticates into the Southwest can be set forth. The progress made in the last ten years is remarkable and speaks well for future research in this area.

THE PITHOUSE PERIOD IN THE MOGOLLON HIGHLANDS

Cultural Continuity from the Archaic Period

The transition from the Archaic Period to the following Pithouse (alternately called Formative or Ceramic) period is traditionally viewed as a gradual in situ transformation from a generalized hunting and gathering adaptation, with a late inclusion of the practice of horticulture, to one of growing dependence on agriculture, the use of pottery, and residence in pithouse dwellings. This gradualist approach has been questioned by some who see the transition as potentially much more sudden. For example, Berry (1982:4, 126) suggests that instead there may have been "punctuated equilibria" whereby the transformation was abrupt and episodic, possibly caused by the movement of populations into the area. This section examines both possibilities as explanation for the presence of Pithouse period occupations in the Mogollon Highlands.

The idea of a cultural continuum is assumed in most discussions of the Archaic-to-Pithouse transition (Cordell and Gumerman 1989; Reid 1989; Whittlesey et al. 1994). As Martin (1959:15) and Reid (1989:70) state, it is generally agreed that the Mogollon developed out the Archaic Cochise of southeastern Arizona. Continuity is seen in similar subsistence adaptations, settlement patterns, and artifact assemblages. Pottery is viewed as a new and useful addition to the Pithouse period but not necessarily an abrupt one (Whittlesey et al. 1994:38). Suggested causes for the gradual shift to the Pithouse period include a growing intensification of agricultural practices (Wills 1996), which in turn led to a reduction in residential mobility. Outside factors that may have created increased agricultural dependency include an imbalance between wild food resources and populations (Cordell and Gumerman 1989:7) or the related problem of economic competition between populations (Wills 1996).

The available radiocarbon data are not plentiful but do indicate a continuum from the Archaic to the Pithouse period; however, Wills (1996) is not sure these are good measures of continuity. There are, indeed, few good transitional site dates and those from Bat Cave, for example, that could be indicative of a smooth cultural continuation from the Late Archaic to the Early Pithouse period, are questionable because of stratigraphic discontinuities (Wills 1988a:18).

Whittlesey (1995:472-475) and Deaver and Ciolek-Torrello (1995:512) note extreme similarities between early Hohokam and Mogollon cultures and believe they could have developed from a common root. But obvious differences in material items and architectural styles lead Whittlesey to also suggest that perhaps there were different cultural groups co-residing in a common area. The idea of different populations sharing the landscape concomitantly with Archaic groups is not new in archaeological theory. Irwin-Williams (1967:453) goes against the thinking of her time and indicates that the Mogollon area may have been settled as a result of large-scale population movement. Berry (1982:126) puts it more forcefully when he says that the Mogollon ". . . is little more than an area-specific rubric for a number of migratory/refugia events—an occupational stacatto best thought of as a series of epiphenomena causally related to demographic adjustments within and between the Anasazi and Hohokam areas." Wills (1994,1996) also subscribes to the introduction of new peoples into the Mogollon region at this time rather than gradual changes among indigenous populations. He believes there was an "abrupt" adoption of year-round strategies from seasonal ones caused by new technologies and subsistence tactics and thus thinks temporal continuity cannot be completely substantiated (Wills 1994:20).

Definite verification of cultural continuity seems to be lacking at this point. To us, there appears to be more evidence for arguments of continuity rather than against it. However, the scarcity of good chronometric control is a problem and many more reliable dates for this transitional period are necessary before the issue can be resolved. Mortuary data could provide valuable insight regarding potential immigration of new populations, but is rarely available. Also, the cultural affinity of these new people has not been addressed by researchers.

Pithouse Period Phases

The Mogollon culture, irrespective of its origins, was originally divided into four temporally defined phases by Haury in 1936 and has seen only slight modification since. The taxonomic designations as used here have been presented earlier in this volume but are restated for ease of reference.

Pinelawn phase: A.D. 200-500
Georgetown phase: A.D. 500-700

San Francisco phase: A.D. 700-900
Three Circle phase: A.D. 900-1000

Phases may also be lumped generally into Early versus Late Pithouse periods, as fits the scale of discussion. While most researchers place only the Pinelawn phase into the Early Pithouse period, it seems to make more sense to also include Georgetown in this designation, based on close similarities between the two. Rigid adherence to phase designations can become a classificatory problem, blurring distinctions or limiting variations. As Martin et al. (1952:30) state: ". . . we know that there is no break between phases and that phases are merely arbitrary culture groupings set off in arbitrary units of time. A culture is a continuum broken only by our arbitrary divisions or phases."

General summaries of the different phases follow with specific discussions on architectural and subsistence variations presented.

Pinelawn Phase

As in the earlier Archaic period, populations at this time remain quite low in comparison to later phases. Subsistence procurement patterns were mainly hunting and gathering, but agriculture was growing in use. It is believed, however, that population pressures or environmental stress were not great enough to have warranted the apparent increased agricultural intensification or increasing territoriality suggested for the phase. Wills (1985:21) indicates that environmental conditions at the time were one of the best for sustaining natural resources and included increased ground water levels and low temporal variability in precipitation. Schoenwetter (1962:201) reached these same conclusions based on pollen studies in the Pine Lawn Valley. Shallow pit structures are the dwellings of choice and brown ware pottery replaces the use of baskets as containers everywhere in southwestern New Mexico and southeastern Arizona. The greater use of pit structures indicates some reduction in residential mobility, however slight. Overwintering in the potentially cold Mogollon Highlands occurred occasionally and is a departure from the Archaic pattern. Most sites are small with only a few moderately larger villages, suggesting a widely dispersed population of perhaps individual or extended families (Wills et al. 1994:309).

Residential units on Pinelawn phase sites are limited to shallow, generally circular, pit dwellings. Shapes can vary, however, from circular to ovoid to somewhat irregular even on the same site. Mean size of pit structures is 32.06 sq m, but can range from 3.3 sq m to 88 sq m. Depths of structures are usually no more than 70 cm below ground surface. When compared to Archaic pit dwellings those of the Pinelawn phase exhibit over a fourfold increase in mean size from the 7.46 sq m of the Archaic. Partial explanation for this dramatic increase has been offered by Martin et al. (1956) as the appearance of large ceremonial structures at this time. A later chapter on Architectural Variations provides greater detail on structural specifications and their interpretations for each of the Mogollon phases. This synthetic chapter provides only a summary of those details presented later.

Internal features within dwellings include basin-shaped hearths or slight depressions for firepits, storage pits, various entryway types, a number of different roof support systems, occassional benches and footdrums, and, rarely, antechambers. Deflectors, wall niches, and sipapus have not been reported for this phase. Variations in placement, shape, and size of these features are detailed in the later chapter on Architectural Variations and compared with other phases and periods. Generally, there is an increased complexity in Pinelawn phase pit structures as compared with the Archaic, which can be viewed as evidence of increased complexity in Pinelawn phase social organization.

External features, such as storage pits, are common on Pinelawn sites. These features may be bell-shaped or not. Huckell (1990) associates the abundance of storage pits with the introductory use of domesticates, something apparently found not only in the Mogollon Highlands, but over the entire Southwest at this time (Smiley 1985). Whether or not there was an overabundance of food stored in these pits is unanswerable with current data, but could inform on anticipated use of these items for overwintering in an area or on their potential as trade goods. Another outside feature that has been found in the Pinelawn phase is the occurrence of a low stone wall encircling portions of sites. Such walls have been noted at the Promontory site and at Site 107 near Apache Creek. Frequently, they are interpreted as defensive (Martin and Rinaldo 1947:23).

The more intensive use of pit dwellings, development of pottery, and employment of agriculture are major changes from the Archaic period, but the timing of those changes is poorly defined because of the subtlety of the archaeological record. The presence of pottery on a site is frequently used to indicate the transition, but there are often 200-year gaps in pottery use between similar early sites in the same region. While we have somewhat arbitrarily used a begin-date for the Pinelawn phase at A.D. 200, pottery and pithouses have been recorded on other sites as early as 393 B.C. (Lekson 1990:88) and as late as A.D. 350 in other areas. Wills (1996) believes ceramics may not have been present in the Mogollon Highlands until about A.D. 450 based on dates for the SU site, thought to be the earliest Pinelawn phase occupation in the region. However, so few early Pinelawn sites have been excavated in the area that have provided adequate dates, that Wills's (1996) argument is probably subject to major revision as new dates are obtained.

In opposition to Archaic sites, Pinelawn phase sites have long been considered to have consistently occupied high mesas or ridges thought to be defensive in nature (Bluhm 1960:540; LeBlanc and Whalen 1980:162; Cordell 1984a:114). Settlement pattern studies conducted by OAS indicate that this is simply not true. Pinelawn sites show up at a wide range of elevations and physiographic locations. Lekson (1992:73-74) also points out the presence of Pinelawn sites at varying locations and the lack of defensibility of many of them.

Ceramics on Pinelawn sites are limited to three interrelated types: Alma Plain, Alma Rough, and San Francisco Red, all of which are an indigenous brown ware. Techniques used to make the pottery are well developed and suggest their manufacture was an established practice before their discovery on sites dating to the A.D. 200-400s in the Mogollon Highlands (Wheat 1955:72). An origin outside of New Mexico in Mesoamerica along the eastern flanks of the Sierra Madre Occidental is considered a possibility (Martin 1959:79). However, definitive studies have never been conducted.

Miscellaneous or ornamental artifacts found on Pinelawn sites include clay effigies, stone and shell beads and pendants, pipes, bone dice, modified crystals, and a noted lack of axes. Martin (1943:121) makes a point of stating that no grooved axes are found during this phase. LeBlanc and Whalen (1980:191) say these are not present until the Late Pithouse period during the Three Circle phase. Most axes found in the Mogollon Highlands are of a greenstone thought to be available only in the Mimbres Valley. These usually represent beautifully finished, unutilized items, often considered ceremonial in nature. In general, however, there are few trade items present in this phase. These include artifacts of shell, such as bracelets, that presumably came from the Hohokam area. McGuire (1980:31) suggests the Hohokam may have received turquoise in return. Pottery is all indigenously made and no ceramic trade wares have been recorded at this time.

Projectile points of the San Pedro style continue in use from the Archaic period and are found frequently on Pinelawn phase and later Pithouse sites. Smaller, side-notched points make an appearance at this time, however. During this phase, almost all lithic raw materials are obtained from local sources except for obsidian, which is procured from both Red Hill to the north and Mule Creek to the south. Findlow and Bolognese (1982:299) believe this broad access area suggests the presence of a huge direct procurement system in place at the time. In other words, they see no social constraints to the acquisition of raw material from either area.

A general decline in the quality of workmanship in lithic artifact production has been noted by Martin and Rinaldo (1947:293) at the SU site, as well as the presence of only a few projectile points. Subsequent excavations at the SU site also yielded fewer than 400 faunal remains. Most were indeterminate, but the recognized majority were deer bone (Wills 1996). This low amount led Martin and Rinaldo (1947:290) to believe that hunting was of secondary importance during this phase. However, as Wills (1994:15) points out, preservation of material has much to do with the amount and types of fauna recovered. At Lazy Meadows on the Luna project, 63.0 percent of remains were large mammals. The potential exists for another 34.0 percent of the indeterminate mammal bone being large. The Bluff site (Haury and Sayles 1947:12) of this same time produced a small assemblage but 85.0 percent were large mammals. Neither site had any rabbit bones. At LA 5407 in the Gallo Mountains, faunal remains were plentiful and focused on large mammals (23.2 percent), rabbits (20.6 percent), and rodents (22.8 percent)(Akins 1998). The high frequency of rodents suggests the soil on the site was greatly disturbed by this species. One bison element was also recovered at LA 5407. Wills (1994) also notes that thousands of bison bones were recovered from the early ceramic horizon at Bat Cave, representing at least 20 individuals. A wide variety of other large mammal species were also found at this location.

While earlier Archaic faunal data reveal a 54.7 percent use of large mammals in the Mogollon Highlands, Pinelawn phase sites indicate only a 34.0 percent employment. However, this percentage rate is skewed by the low numbers of large game at LA 5407. The extensive faunal assemblage at this site has almost equal representation of large mammals and rabbits (see above). Rabbits are generally considered a secondary meat choice and their high frequency in this assemblage could indicate a depletion of large game in the immediate environment (Bayham 1979). Using the artiodactyl index developed by Bayham (1982) to measure the amount of potential resource depression on a site, the faunal assemblage at LA 5407 was further examined and produced an index value of .53. This value indicates that there was a high ratio of rabbits used on the site and that some depletion of the surrounding artiodactyl population likely occurred. Explanation for this large taking of rabbits could also stem from a high density of Pinelawn sites in the region or from the maintenance of agricultural fields at this substantial site (N. Akins, pers. comm. 1998). However, given supposedly ideal environmental conditions at the time, LA 5407 is the only Pinelawn site that produced this low ratio. Other Pinelawn sites yielded a higher percent of large game usage. Lazy Meadows in the Pine Lawn Valley yielded an artiodactyl index of .98 similar to that for Archaic period sites in the Mogollon Highlands. On the other hand, the Ormand site, near Cliff (Wallace 1998), is at a lower elevation and in a less mesic environment. It has an artiodactyl index of .80, also higher than that of LA 5407.

Metates used during the Pinelawn phase are all of the basin and slab types. Manos are predominantly one-hand tools. These particular ground stone preferences could suggest a low reliance on corn agriculture, which is generally thought to require trough metates and two-hand manos. Hard's (1990) model of mano length, as used to determine degree of dependence on agriculture, is examined in depth in Volume 3, Ground Stone. Adding Luna project data to Hard's research reveals that mano lengths vary only slightly through time. There is a mean of 12.4 cm for one-hand and 19.0 cm for two-hand tools during the Pinelawn phase. Two-hand mano lengths do increase somewhat during the Pueblo period while one-hand implements stay about the same. Ground surface areas on one-hand Pinelawn manos, however, are the largest for all phases at a mean of 128 sq cm. Hard (1990:148) suggests that lengths between 11 and 15 cm indicate low agricultural dependence, while those between 15 and 20 cm equate to moderate to high reliance. However, based on Hard's suggested mano indices alone, our research shows that one-hand manos always show low reliance while two-hand manos always reveal high dependency for all Mogollon phases. Therefore, the data seem inconclusive when correlating mano length to agricultural reliance.

While most Pinelawn phase sites yield at least some evidence of corn usage, the Bluff site, dating in the ca. A.D. 300s, does not (Haury and Sayles 1947:13), indicating that agricultural dependency is not a given for sites of this time. However, extensive corn remains from the SU site indicate that it was of economic importance to site residents (Wills 1994:13). Using flotation data from three sites (Lazy Meadows, the SU site, and LA 5407), a ubiquity score measuring the presence of corn at the sites was produced. Ubiquity scores are derived by determining the percentage of flotation samples that contain macrobotanical corn remains. Samples from an entire site rather than only interior features or floor contact were used for this examination because percentages from limited proveniences can produce varying results (Diehl 1996; Akins et al. 1998). The ubiquity score for the three combined Pinelawn sites is 80.6 percent, which indicates that corn was recovered in a very high number of locations on the sites and was probably a major subsistence item. However, the score is perhaps best used as a relative measure of the amount of corn on sites rather than a determination of the amount of dependency on corn.

For comparison purposes, the ubiquity of corn pollen on the three sites was also calculated, yielding a score of 57.1 percent. This is lower than the flotation score, but is comparable with other flotation and pollen scores from later phases. The lack of pollen data from LA 4507 may be lowering this score because the site produced a very high (94.4 percent) ubiquity score from flotations and probably would have likewise raised the pollen score, if available.

Minnis (1985) believes there is no indication for intensive domestication during the entire Pithouse period, while Wills et al. (1994:310) note there were no water control systems at the time and suggest land use was extensive rather than intensive, implying continued heavy emphasis on hunting and gathering strategies. Strong reliance on wild products such as cheno-ams, composites, acorns, piñon, walnuts, and agave is found in the well-preserved caves of the Tularosa Valley and at Promontory (Schoenwetter 1962; Wills 1994).

The continued reliance on hunted and gathered foods leads to the question of the degree of sedentism of Pinelawn peoples. While at least some movement is necessary to obtain the variety of foods in the Pinelawn diet, it would seem that Pinelawn populations would have needed to only slightly restrict or alter their residential patterns to absorb agriculture into their adaptations. The presence of hearths within pit structures, substantial storage pits within dwellings (such as at the SU site), potential ceremonial units, and numerous ground stone all indicate a reduction in mobility was occurring, if only short-term, such as occupation slightly into the cold weather season.

The best known Pinelawn phase occupations in the Mogollon Highlands are the SU and Promontory sites, each consisting of a village of pithouses with potential ceremonial units. Both are in the Pine Lawn Valley: the SU site is on a low ridge and Promontory is on a high overlook. Another village of 14 pithouses (Site 467, Danson 1957:33) is located near Luna. Smaller minor sites within the project area include a pithouse at Three Pines Pueblo (Martin and Rinaldo 1950a), and Luna Junction (also called Lazy Meadows) with three to four pithouses and situated near the SU site (Peckham 1963; Zamora, this report). LA 5407 in the Gallo Mountains is a complex pithouse site with high amounts of faunal and vegetal data (Akins 1998). Early ceramic-using occupations are also recorded at Bat and Cordova caves. Many other smaller single-unit sites dot the Mogollon Highlands landscape. To the south, in the Mimbres area, two sites of this same time period include the Duncan site with 28 pithouses (Lightfoot 1984) and Winn Canyon with 39 structures (Fitting 1973). In eastern Arizona, Pinelawn sites include the Bluff site with 23 pit units (Haury 1985c), Bear Ruin with up to 34 pithouses (Haury 1941), and Cave Creek with 7 structures (Sayles 1945).

An interesting aspect of these sites is that many of them are villages with moderate numbers of pit dwellings. The occurrence of numerous Pinelawn villages suggests an increased complexity in social organization that was not present in the earlier Archaic period. The change in group size alone warrants notation. Few Archaic sites in the Mogollon Highlands contain pithouses and only one or two structures are represented at most, for a mean of 1.5 pithouses per site. However, in the Pinelawn phase, pit dwellings range from 1 to 28 per site. Fifty percent were single-unit sites, producing a mean group size of 4.3 pit units per site. Pinelawn sites with 4 or more pit units account for 33.3 percent of all of the sites. Clearly, there is a distinct trend toward the utilization of a village infrastructure. Reasons for this tendency are fertile grounds for investigation.

The SU site produced 53 burials dating to the Pinelawn phase. Wills (1994:12) states that half were in sealed subfloor pits and some were in the fill of abandoned structures. Most had no associated grave goods; those that had grave goods included beads, bracelets, projectile points, and bone awls.

Georgetown Phase

Many archaeologists conclude that there is no separate Georgetown phase (Wheat 1955; Bluhm 1960; Fitting et al. 1982; Berman 1989) based on minimal stylistic and organizational variations between this and the earlier Pinelawn phase. Populations continue to inhabit small pithouse structures, either independently located or within settled villages. However, pithouses are more likely to contain interior hearths; other structural differences are minor. The only real evidence of change is in the higher numbers of San Francisco Redwares on Georgetown sites and the addition of the less common Alma Neckbanded. Neither textured nor painted wares appear yet in site assemblages.

A significant drop in population is sometimes associated with the Georgetown phase (Martin et al. 1952; Stuart and Gauthier 1981). LeBlanc and Whalen (1980:129) dispute this, saying that subsistence data from Tularosa Cave used to infer this drop are misinterpreted and do not indicate a decline in population. Settlement pattern and demographic research by this project show that site frequencies are, indeed, lower at this time, but could be a function of the identity of such sites being tied to the presence of San Francisco Red pottery, never a dominant ceramic ware. An actual decline in population at this time could be difficult to explain as settlements are beginning to occupy most areas of the Mogollon Highlands, environmental conditions seem ideal, and the use of agriculture is spreading throughout the region. It may be that the separation between the Pinelawn and Georgetown phases is more arbitrary than real. Those who decry the division may be correct in their assessment of no substantial differences between the two.

Georgetown phase sites in the Mogollon Highlands include Bear Ruin (Haury 1941), Crooked Ridge Village (Wheat 1954), and the Humming Wire site on the Luna project. Larger villages continue to appear during this phase, for example, Bear Ruin, which has 30-40 pithouses, and Crooked Ridge Village with 75-100 structures. Pithouse forms shift slightly from mostly circular to generally quadrilateral with rounded corners. Sometimes the bases of walls are coved as they meet the floor (Wheat 1954:65). Interior posts are most commonly a four-post pattern. As stated above, hearths within structures increase slightly in frequency, but remain simple basin depressions. Floor grooves and benches may be present but are not common.

Miscellaneous artifacts from Georgeown phase sites are similar to those from Pinelawn sites and include crystals, shell or bone beads and bracelets, effigies, and clay pipes. Turquoise and garnets are additions to the assemblages of this phase (Haury 1941). San Pedro projectile points, first recorded for the Archaic period, continue in use. Three-quarter grooved axes appear at Crooked Ridge Village at ca. A.D. 675 (Wheat 1954:128) for the first time. Doyel (1991) believes cotton and woven cloth was introduced to the Mogollon area about this time also.

When compared to other Mogollon phases, Georgetown sites occupy the lowest elevations within the Mogollon Highlands. While not a statistically significant variation, it may indicate a focus on lower, more arable land than during the Pinelawn phase. Plentiful corn remains have been recovered at Bear Ruin, Crooked Ridge Village, and Tularosa Cave. Charred corn and numerous metates and manos were retrieved at Bear Ruin (Haury 1941), and at Crooked Ridge Village, shelled corn and cobs were found in pots and cists (Wheat 1954:164). Also recovered from Crooked Ridge were beans, walnuts, and piñon. A ubiquity score of 88.8 percent was obtained from limited data from Mogollon Village (Dean and Powell 1991), indicating the definite high usage of corn on this site. Pollen data were not available.

Dependence on hunting during the Georgetown phase is not readily measurable. Early researchers did not collect or quantify faunal remains. The best data are from Bear Ruin in Forestdale Valley. Haury (1941:15) provides a long list of faunal material from this A.D. 675 site and suggests they may have all been food sources. These include deer, bison, bear, gray fox, raccoon, rabbits, prairie dog, wood rat, pocket gopher, mud turtle, turkey, horned owl, and hawk. Bison and turkey are minimally represented, while deer bones are the majority by a 3:1 margin. Rabbits are the most common small mammal. At the Humming Wire site on the Luna project, few faunal remains were recovered, but 61.6 percent of these were large mammals. In sum, we can only broadly infer that large game hunting was preferred at some Georgetown sites.

Burial data are fairly rich at two Georgetown sites. Bear Ruin produced 40 burials, mostly within shallow pits with perhaps 25 percent scattered throughout the village. None were found beneath house floors or in fill (Haury 1941:64). Most were on their backs with knees flexed to the side. Ninety percent of the burials had associated grave goods, generally pottery, including 17 vessels in one pit. No cremations were found. At Crooked Ridge Village, four burials were recovered in two outside pits (Wheat 1954:74). Grave goods included three ceramic containers.

By the end of the Georgetown phase, all indications are that settlements persist in their development with some attaining quite large sizes, as at Crooked Ridge Village. Reliance on hunting and gathering appears to remain strong, based on the limited data available. Corn products and ground stone are commonly abundant but degree of dependence is unknown at this point. The presence of sites at slightly lower elevations could indicate selection of land forms closer to perennial or reliable water sources for the purpose of growing crops.

San Francisco Phase

This and the following phase fall within the Late Pithouse period. While the earlier two phases are characterized by almost imperceptible change, the San Francisco is marked by much more variability. Broad variations in architectural styles appear, new ceramic types are produced, and site locations make use of different territory. It would seem that any organizational constraints previously adhered to by the Mogollon had been lifted and populations were free to initiate an assortment of organizational schemes. The number of recorded sites doubles to 60 from the earlier Georgetown phase, but still indicates a very low population in the Mogollon Highlands at this time. Currently, explanation for the several innovations appearing during the San Francisco are lacking.

Pithouse structures during this phase decrease to half of their previous size, to a mean floor area of 20.06 sq m. Why this would have occurred is unknown but suggests restructuring of family group size. Several sites with very large pit units (Starkweather Ruin and Turkey Foot Ridge) and floor areas of over 60 sq m may be indicative of communal activities. Pithouse shapes are mostly rectangular but can range from circular to subrectangular, as well as vary from site to site. Structures also are slightly deeper than in earlier phases, hinting at perhaps more year-round occupation. Also, plastering of walls becomes more common and the presence of cobbles to shore up or line portions of walls occurs for the first time, as at Wind Mountain (Woosley and McIntyre 1996) and on the Fence Corner site on the Luna project. Most recorded San Francisco dwellings contain interior hearths, another indication of possible overwintering or late season use. Hearths are, by far, of the basin type; however, the beginnings of rectangular-shaped firepits appear at Starkweather Ruin and Turkey Foot Ridge. Deflectors are present but not common. Entryways exhibit wide variability in their length, shape, and orientation, but mostly face east. However, quite a few structures lack lateral entrys altogether. Four-post roof supports slightly dominate over central post systems and other random patterns. Foot drums and wall niches increase in popularity, while only one bench and no ventilators have been recorded for this phase.

During the San Francisco phase, ceramics proliferate with many new styles and surface treatments. These include smudged wares, some scoring and incising, and the introduction of Mogollon Red-on-brown, Three Circle Red-on-white, and Mangus Boldface. The first two are of the local brown clays and were likely manufactured within the Mogollon Highlands. Mangus Boldface is a true trade ware coming from the Mimbres area to the south, probably the first ceramic ware used frequently by highlands populations that derived from outside of the immediate area.

Obsidian becomes the material of choice for projectile points during this phase (72.2 percent). A few San Pedro-style points remain in San Francisco phase assemblages, but most are small, corner-notched types. The varieties of miscellaneous artifacts expand to include possible loom weights and a variety of minerals including limonite and hematite. Influences from outside of the Mogollon Highlands are more pronounced, as evidenced by the importation of Mangus Boldface pottery from the Mimbres area and an increasing use of shell, probably obtained from the Hohokam. Anasazi influence is not strong at this point; only a few plain gray wares have been found on San Francisco phase sites.

Trough metates appear at about this time and are thought to indicate an improvement in ground stone technology for purposes of grinding larger amounts of corn. Storage of corn products for use over winter or for trade purposes is not suggested, however, by any observable increase in storage facilities on sites. And on one site, Site 31 near Vernon, Arizona (presumably of this phase) in four excavated pithouses, no corn remains were found (Martin and Rinaldo 1960a:119). Only the Fence Corner site (this report) produced flotation data from which to derive a ubiquity score—40.0 percent. Pollen data yielded a score of 60.0 percent. Both scores are considerably lower than for the earlier Pinelawn phase. It is difficult, however, to determine if this might be due to a true change in dependency on agriculture or the vagaries of preservation.

Good faunal data are available from three excavated sites—Mogollon Village (James 1991), Fence Corner (see Volume 2), and Wind Mountain (Woosley and McIntyre 1996). The percentage of large game in the combined assemblages averages 54.8 percent, which is equivalent to the large game recorded at Archaic period sites (54.7 percent). At Mogollon Village, Wheat (1955:155) notes that the faunal assemblage (not quantified) indicates as much reliance on hunting as on agriculture. The artiodactyl index indicates a very high ratio of artiodactyls in the faunal assemblages at Mogollon Village and Fence Corner during this phase (.91 and .94, respectively). No large game resource depression is suggested by these indices. The Wind Mountain assemblage presents an index of .52, suggesting about equal numbers of artiodactyls and rabbits were hunted. The site is to the south, outside of the Mogollon Highlands, and has a lower elevation and more xeric conditions, factors that could skew the comparisons. At the Fence Corner site, turkey usage appears for the first time as a measurable component of the recovered fauna (6.5 percent). A minimal representation (N=3 elements) of bighorn sheep is also present. Rabbits constitute 14.9 percent of all San Francisco phase faunal assemblages, but only 3.2 percent at Fence Corner.

Major San Francisco phase sites are Starkweather Ruin (Nesbitt 1938), Turkey Foot Ridge (Martin and Rinaldo 1950b), Wind Canyon (Woosley and McIntyre 1996), and Mogollon Village (Gilman et al. 1991). Village sizes run much smaller than in the Georgetown phase. Starkweather Ruin, with 18 pithouses, displays a typical site size. However, smaller pithouse sites of up to three units, such as Fence Corner site on the Luna project, also continue to dot the landscape. In addition, San Francisco phase sites move slightly higher in elevation, up out of the floodplains and generally onto the low hills and knolls of the mountain valleys. Wind Mountain, in contrast, is located on a higher ridge. Cordell and Gumerman (1989:9) suggest movement of settlements to various locations at this time may be a result of experimenting to find productive agricultural lands in a variety of environmental zones.

Mortuary data from three sites (Wind Mountain, Starkweather Ruin, and Mogollon Village) suggest a variety of interment practices. At Wind Mountain, 8 of 122 burials relate to the San Francisco phase. Two were in a single pit, the rest in discrete extramural pits. Seven of eight burials were flexed and six of the pits contained associated grave goods. These included up to four bowls per pit, a turquoise pendant, a stone tube, two bracelets, a pendant, and beads made of shell, a mano, and a polishing stone. The Mogollon Village burials were scattered throughout the site, in interior and exterior pits and in the fill of abandoned structures (Haury 1936b:24). In 48 burials, 8 (or 16.6 percent) had missing skulls. Several individuals had also been cremated. Offerings were associated with 30 percent of the burials (Wheat 1955:69). At Starkweather Ruin, three individuals were buried in sealed subfloor pits within structures. Two of the three burials possessed associated items, including two bowls, two shell bracelets, and a projectile point in one pit, and three broken ceramic vessels in another.

In sum, there are subtle indications that San Francisco phase settlements are becoming more sedentary, such as in frequent use of interior hearths, deeper structures, and plastering of walls to presumably keep out rodents. Diehl (1996:102) believes that the transition from foraging and minimal dependence on agriculture is complete by this time and sites are now basically sedentary. However, percentage of large game hunted in this phase shows no sign of lessening, or of being diminished by probable increasing reliance on corn agriculture. Lekson (1992:129) views the rise in site populations at this time also as an indication of sedentism and greater dependence on agriculture.

Three Circle Phase

There are twice as many pithouse sites and almost four times as many rooms in the Mogollon Highlands during the Three Circle phase as in the preceding San Francisco phase. This could be attributed to a healthy population growth rate; however, there are some major site placement variations that could indicate other factors are involved. Results of the settlement pattern study conducted by the OAS reveal that there is a new pattern of bimodality to site locality within the Mogollon Highlands. While most sites remain at 1,950 m (6,400 ft) in elevation along valley bottoms and good-flowing streams, over one-third, or 36.9 percent, are found above 2,255 m (7,400 ft) away from valleys and along secondary flows. And for the first time, sites begin to move out of the Pine Lawn area into the Gallo Mountains and the Luna Valley. These shifts to areas higher in elevation could explain the bimodality appearing in elevational patterning; however, the shifts themselves are very significant. Why leave the Pine Lawn Valley for new areas at higher elevations with shorter growing seasons and less dependable water? What precipitated the movement? Overexploitation of riverine and valley resources, both floral and faunal, could have occurred from sites simply locating in one place for too long with the land reaching maximum carrying capacity; conflicts with other settlements for those remaining resources could also have been a contributory factor. Another possibility is that new populations may have begun to move into the Mogollon Highlands, particularly on its northern borders near the Gallo Mountains. This idea warrants exploration, particularly since new ceramic types also appear in the area at this time.

Actual mean site size changes only slightly from 2.61 rooms per site in the San Francisco phase to 3.78 in the Three Circle. However, village size remains small with several exceptions. Luna Village contains over 50 pit structures (Hough 1907) and Galaz Ruin and Lee Village in the Mimbres area have 100 to 200 rooms (Lekson 1992:14). Individual pithouse sizes decrease in the Three Circle phase from a mean of 20.06 sq m of floor space to 15.66 sq m. However, the small villages seem more the norm than single-unit sites. Three Circle village sites include Luna Village, Wind Mountain, Galaz Ruin, Nantack Village, Turkey Foot Ridge, Twin Bridges, Cerro Colorado, a portion of Apache Creek Pueblo, Nan Ranch, Cameron Creek, Harris Village, and Lee Village. By this time, structural shapes are mostly rectangular or subrectangular. Walls tend to drop directly down to floors and are not uncommonly masonry-lined, or more precisely, made of cobbles pressed into the dirt lining of the pit structures. Hearths are common within structures and continue to be basin-shaped; however, rectangular slab-lined firepits make a showing at this time. Ash pits and hearth stones are frequently associated with hearths, while deflectors are only sometimes present. Rock-filled roasting pits are now found often within pithouses. Entryways range from short to long to none at all (the most common occurrence) with only a slight preference for an east-southeast orientation.

Posthole placement tends to be either a main central post with peripheral ones in association or a four-post pattern with posts frequently inset into room corners, as at Luna Village. Benches become fairly common and may be partial to fully encircling. Complex ventilators become more standard as do wall niches. Thus far, foot drums have only been recorded in the Apache Creek area. Jacal structures are noted for the first time at Luna Village (Hough 1923:5). Communal units are frequently identified by their large size, usually full bench, and complex ventilator system. In general, pithouses still exhibit wide stylistic variation in their entry orientations, use of ventilators, deflectors, benches, foot drums, number of roof supports, and hearth styles.

Ceramics indicate increasing ties with the Anasazi to the north. Mimbres Black-on-white continues to be found in the Pine Lawn area; however, Red Mesa Black-on-white and White Mountain Redware (northern pottery types) appear along the northern edge of the Mogollon Highlands, including at Luna Village. Duck effigy jars and spindle whorls also are evident for the first time at Luna Village (Hough 1919:426; Martin 1943:427). Shell continues to be an important trade item, presumably from the Hohokam area. Ornaments of this phase are made of glycymeris shell, turquoise, chrysocolla, azurite, jet, various stone materials, and bone. Hohokam-style palettes are present in the southern part of the region. Clay and stone pipes are more frequently found. McNeil (1986) concurs that Mogollon ornaments at this time exhibit influence of trade from both the Hohokam and Anasazi areas. Projectile points are mostly small, notched Pueblo types; 90.5 percent are made from obsidian. A few San Pedro types continue to be found and may be curated items.

Dependence on corn agriculture is supposedly higher in the Three Circle phase according to Diehl (1996:112), but he agrees his results, based on ubiquity counts of maize, are somewhat equivocal. Using our own data from five pithouses excavated at Luna Village, ubiquity scores for corn from flotations do not increase but rather continue a downward trend in corn presence on sites of this phase. We obtained a ubiquity score of only 16.6 percent, a considerable drop from the preceding phase. The ubiquity score for pollen from this site was slightly higher (37.9 percent), but still a decrease from the preceding phase. It is possible that these lower scores indicate less of a dependency on agriculture at this time whether from climatic or environmental stress, lack of sufficient arable land, or other factors, preventing adequate returns on agricultural investments.

However, two-hand mano use slightly increases, possibly suggesting more grinding of corn products. Most metates are of the trough type, also indicating intensive grinding of corn. However, hunting of wild game and gathering of natural foods continues to be a large part of subsistence adaptations, but not as heavy as in earlier phases. At Luna Village, Hough (1919:429) records deer, bison, bear, wolf, small mammals, turkey, hawk, and ruddy duck while OAS also reports the presence in the faunal assemblage of dog, fox, elk, mountain sheep, and pronghorn antelope. At Wind Mountain, Olsen and Olsen (1996) record dog, fox, elk, deer, pronghorn, bison, turkey, and bear. Galaz Ruin (Anyon and Le Blanc 1984) contained no bison, mountain sheep, or bear.

While faunal assemblages are varied, large game usage averages to only 20.8 percent of the animal remains at the three well-represented sites of Luna Village, Wind Mountain, and Galaz Ruin. However, the very high numbers of indeterminate bones skew the percentage rates for Wind Mountain and Galaz Ruin, with

Galaz showing only a 5.6 percent recovery rate for large game. Luna Village in the Mogollon Highlands has the highest artiodactyl index at .85, just slightly lower than for earlier and smaller Georgetown phase sites in the region. Wind Mountain to the south has an index of .57, similar to that for the site for the preceding phase. Again, lower elevations and less abundant large game may be causing this lower index value. Galaz Ruin is in the Mimbres Valley and is the most xeric site of all, producing an index of .18, suggesting very low use of artiodactyls by the site occupants. There could be an actual decline in availability of large game in the Mimbres Valley as a result of increasing sedentism (Hitchcock 1982; Speth and Scott 1989). The increased use of rabbits as a food resource suggests the use of available, but less preferred, items in the diet in order to meet subsistence needs.

Burial practices during the Three Circle phase show an increasing use of subfloor space, continued use of extramural pits, and rare employment of cremation. Luna Village yielded only five infant burials with small ceramic vessels in association (Hough 1923:7) and a single female adult in pithouse fill in OAS excavations. At Wind Mountain (Woosley and McIntyre 1996), 14 Three Circle phase burials were recovered from structural fill and one from a subfloor pit. Only one was a child. Associated grave goods were recovered from five of the burials, or 35.7 percent of the interments. These include one burial with four glycymeris shell bracelets, two San Francisco Red bowls, and shell and turquoise beads. Another grave contained a quartz crystal, stone pendant, and olivella and glycymeris beads. Three others yielded only sherds. A large burial population was found at Galaz Ruin dating to this time. Of 119 burials, almost all were flexed; 62 were in subfloor locations and 57 were in extramural pits. Grave goods were associated with 71.4 percent of these remains. These include 239 turquoise beads, 14 turquoise pendants, 375 shell beads, 31 shell pendants, 9 palettes, and 130 ceramic vessels (many of which exhibit "killing" by the presence of a hole made in the bottom). Careful examination for possible status differentiation produced no evidence for social ranking of individuals (Anyon and LeBlanc 1984). Missing skulls or burials with skulls only are found at Galaz in low numbers and unexplainable. One cremation is reported for Harris Village at this time (Haury 1936b).

In conclusion, this phase marks the end of the Pithouse period in the Mogollon Highlands. Throughout this approximate 800-year span, change evolves slowly from simple pit dwellings to complex architectural features with benches, foot drums, ventilators, roasting pits, and ash pits. While change is progressive from simple to complex, it is never rigid at any time. Rather, there are frequent variations or styles that predominate in one area over another or even within a single village. Broadening of trading relationships occurs to the south with the Mimbres area, to the west with the Hohokam, and with the Anasazi to the north. Dependence on hunting and gathering is a strong part of subsistence adaptations throughout the Pithouse period in the Mogollon Highlands. Some anomalies occur during the Pinelawn phase probably because of low sample size. Corn is at its highest frequency on the earlier Pithouse period sites and decreases through time throughout the period. Site locations for most of the Pithouse period remain at lower elevations along major streams within valley bottoms. By the end of the period, relocation of sites to higher elevations and use of new areas, perhaps by newcomers, occurs. Reasons for this move are unclear but could relate to the unavailability of large game and probable resulting competition for that resource or the need for more sufficient arable land to pursue agriculture.

THE PUEBLO PERIOD IN THE MOGOLLON HIGHLANDS

THE TRANSITION FROM PITHOUSES TO PUEBLOS

A major cultural marker in the delineation of Southwestern prehistory is the transition from pithouses to pueblos as the primary units of habitation. In the Mogollon Highlands, this shift occurs generally around A.D. 1000. Prior to this time, pithouses were becoming increasingly more complex, with added features such as lateral entries, ventilators, benches, and wall niches. Late in the Pithouse period, masonry-lined pit structures constructed with cobbles laid (or pressed into the soil) around the interior of the pithouses were not uncommon. Some archaeologists believe that during the later part of this period, above-ground storage facilities of jacal and adobe construction were easily transformed into masonry units and became the forerunner of above-ground habitation rooms (Lekson 1988a:227). Thus, it is thought that the change took place as part of a naturally evolving cultural process (Nelson et al. 1978:192; LeBlanc 1986:302). No influx of populations bringing new architectural or ceramic styles is postulated.

An opposing viewpoint suggests that masonry rooms and other manifestations were an abrupt introduction into the Mogollon Highlands and the Mimbres area, either borrowed or brought in by immigrating populations (Cordell 1984a:116; Hunter-Anderson 1986:90). Martin et al. (1956:202), Haury (1986:452), and E. C. Adams (1991:93) believe that new populations were actually the impetus for the change. Interestingly, while some argue for an abrupt change, they also argue for the abruptness being an evolutionary process along a sliding continuum, suggesting that these new forms and styles are local responses to environmental or social factors (Anyon et al. 1981:213; Lekson 1992a:15). However, laws of evolutionary processes would seem to dictate that there is no such phenomenon as an abrupt evolutionary change. We believe the change was abrupt rather than evolutionary and cite as evidence the widespread sudden adoption of masonry architecture, the concomitant occurrence of a huge increase in site frequencies, locational shifting of sites, and the introduction of new black-on-white pottery. An earlier chapter explains the reasons for endorsing this theory. We believe the trigger event was new populations entering the area.

Explicit causes for the abrupt appearance of above-ground masonry and black-on-white pottery are currently still being debated. Gilman (1983) suggests the change may be linked to population growth, increasing agricultural activities, and a shift to sedentism. New agricultural technologies and a possible decrease in available wood sources are other reasons given by Stuart and Farwell (1983:233). Wilshusen (1988) believes that the use of masonry over wood allows for the longer use life of a structure. Schlanger (1988), LeBlanc (1989b), and Sebastian (1992) indicate the transition to above-ground units was basically an economic process because of the resulting ability to produce larger storage facilities to take care of future consumption needs (Upham et al. 1994:202). On the Colorado Plateau, the shift to masonry rooms first appears at about A.D. 740 (Kohler 1993:281). Increasing populations and a shift in social organization (McGuire and Schiffer 1983:288) are cited as causes, although why these would induce such change is unclear.

While the shift to masonry rooms was regionwide, some pithouses continued in use in isolated cases. In the Apache Creek area, pithouses are found alongside masonry roomblocks at ca. A.D. 1050-1150 (Peckham et al. 1956:63). Along the Black River in eastern Arizona, this same scenario is repeated at about A.D. 1200 (Wendorf 1950). Another pithouse dating to about A.D. 1200 is located in the Pine Lawn Valley at Spurgeon Draw (see Volume 2). Usually, continued use of pithouses is thought to represent a shift in function from that of habitation units to that of communal structures or kivas. This is not to say that pit structures did not serve often as both living quarters and communal activity centers prior to A.D. 1000. Many instances of these are found throughout the Mogollon area.

PHASE DISTINCTIONS

Within the Mogollon Highlands, the Pueblo period is broken down into two phases: Reserve and Tularosa. The Reserve phase covers the time from about A.D. 1000 to 1100 although there is the possibility that it could have started slightly earlier in some areas. The following Tularosa phase extends from approximately A.D. 1100-1350, up to the time of the abandonment of the region.

The Reserve phase is defined as the time when the abrupt architectural, ceramic, and settlement pattern changes occur. The locational focus of the change is near Reserve in the Pine Lawn Valley where small masonry roomblocks appear, Reserve Black-on-white pottery is introduced, and sites move to varying topographic zones. A population explosion is also evident at this time and trade with other areas increases (E. C. Adams 1991:94). The Tularosa phase is usually characterized by the introduction of Tularosa Black-on-white, White Mountain Redware and polychrome pottery, the aggregation of sites into larger settlements, and a shift in land-use strategies. Also, the increased development of complex trade networks appears to be far-reaching at this time (Cordell and Plog 1979:420). While the Tularosa phase is considered a part of Mogollon cultural processes, Gladwin and Gladwin (1934) and Lekson (1990:104) believe the phase is more representative of the Little Colorado River area; many more large Tularosa sites are found there.

Material Culture

Unlike the preceding cultural histories, this section describes the variations in material culture for both phases at once to better present the developments occurring after A.D. 1000 and before A.D. 1350 as the result of ongoing dynamic cultural processes taking place in the Mogollon Highlands.

Architecture

Pueblo period architecture is typically characterized by masonry-walled roomblocks or pueblos. In the Reserve phase, the roomblocks generally consist of contiguous rooms usually in an L-shaped layout or a solid block of rooms, often appearing to be haphazardly arranged. Roomblocks average 4.1 rooms per site; 31 percent of sites consist of only a single room each. Sites with less than six rooms are often considered to be fieldhouses, although this designation has not been examined in depth for the Mogollon Highlands. Room size on Reserve phase sites averages 11.62 sq m, smaller than all preceding Pithouse period sites. However, there is for the first time evidence of size differentiation among rooms with different functions, such as between living quarters versus storage rooms and special activity rooms.

The masonry-walled rooms generally have no footings and consist of crudely stacked rocks or boulders with chinking spalls and a mud mortar sometimes applied. Some walls, however, are more carefully prepared and exhibit a tendency toward coursing. Floors range from packed earth (most common) to plastered to flagstone paving. Hearths may be basin-shaped or, more frequently, rectangular with a slab lining. Ashpits, storage pits, roasting pits, permanent mealing bins, ventilators, and occasional interior doorways are possible constituents of Reserve phase rooms. Benches, niches, or foot drums are usually not part of Reserve habitation units. Only a few adjoining jacal structures or ramadas have been found associated with roomblocks.

Tularosa phase sites continue in the use of masonry roomblocks but are significantly larger in size, averaging 12 rooms per site and 15.05 sq m per individual room. Many more sites are over 20 rooms during this phase than during the Reserve phase. Single-room sites drop from 31 percent to 13 percent at this time. Overall site frequencies also decline to about one-third of what they were in the preceding phase, but the population count remains almost the same, suggesting a change in structural organization.

Walls display more evidence of coursing and are sometimes arranged with flat-sided rocks facing the interior of rooms, creating a more finished appearance, such as those at the Hough site (Volume 2). Several sites (Sandstone Hill Pueblo and Hooper Ranch Pueblo) possess walls with vertical slab bases, a new occurrence. Footings are still not a part of construction techniques. Frequently, some interior rooms are linked by doorways suggesting family units. Other features found in Tularosa phase rooms include deflectors, ashpits, complex ventilator systems, roasting pits, mealing bins, storage pits, benches, niches, and shelves or small platforms.

Architectural change during the Tularosa phase includes a few new features, some with increasing complexity, but the pattern is basically a continuation of styles established during the Reserve phase. Refinement in construction techniques is apparent however, particularly in the deliberate building of self-contained family units within larger roomblocks.

Ceramics

The appearance of Reserve Black-on-white pottery in the Mogollon Highlands at ca. A.D. 1000 was, as stated earlier, originally thought to have been a local attempt to copy northern white wares and their design styles. This interpretation, however, has now been proven false. Based on petrographic analyses of clay and paste samples, production has been verified as occurring outside of the Mogollon area (Hill, Volume 4). Reserve Black-on-white is now considered to be a Cibola White Ware. The exact source of the ware has not yet been determined, but is believed to be to the north in the Cibola area or to the northwest in the Little Colorado region (see Volume 4).

Reserve Black-on-white was not actually the first such ware to appear in the Mogollon region. Mimbres Boldface and Classic occur as trade wares from the Mimbres region during the Late Pithouse period. Red Mesa Black-on-white, an import from the north, shows up in sites in the northern Mogollon region (for example, Luna Village, Volume 2) during the Three Circle pithouse phase. Reserve Black-on-white is thought to be a continuation of the Red Mesa style (Wilson 1996). Other ceramic types appearing for the first time during the Reserve phase include Puerco Black-on-white, White Mountain Redware, and a small amount of Wingate Black-on-red. Recent research conducted in eastern Arizona (Reid et al. 1995) suggests Reserve Black-on-white was not produced until ca. A.D. 1100. However, using data not widely published and the results of OAS investigations, it can be demonstrated that Reserve Black-on-white is present in the Mogollon Highlands by A.D. 1040 at the latest. See Wilson (1996) for a discussion on this issue.

In the following Tularosa phase, Reserve Black-on-white gives way to Tularosa Black-on-white, a similar design style, but with "busier" detail and often a crackled slip. However, many other ceramic types from outside of the Mogollon Highlands appear also at this time. Almost all are from areas to the north or northwest of the highlands. These include Tularosa White-on-red, Snowflake Black-on-white, St. Johns Black-on-red and Polychrome, Pinedale Black-on-white, Klageto Black-on-white, Heshotauthla Polychrome, and Tularosa Patterned Corrugated and Fillet Rim. Wide-reaching trade networks or increased social interaction among inhabitants of this portion of the Southwest are indicated by this growing variety of wares appearing in Mogollon sites. Apparently, Mogollon Highlanders made no attempt during the Pueblo period to produce their own black-on-white pottery, preferring to trade for it. However, they continued to make perhaps the finest corrugated and smudged wares ever made by prehistoric peoples.

Trade Items

Trade in ceramics, particularly Reserve and Tularosa Black-on-white, was very common during the Pueblo period and suggests a broad network of trading partners from various regions at this time. Most relationships are with areas to the north and northwest in the Cibola and Little Colorado regions. The importation of Mimbres white wares ceases during this period. However, trade with the Casas Grandes region of Mexico increases, beginning approximately A.D. 1150, providing shell ornaments previously supplied by Hohokam traders in Arizona. Casas Grandes also traded copper and macaws, perhaps in exchange for turquoise (McGuire 1980:31). Copper, in the form of bells, has been found at the Tularosa phase Delgar Ruin in the Tularosa Valley (Martin et al. 1956:72) and in a solid lump of almost pure metal at Foote Canyon Pueblo on the Blue River (Rinaldo 1959:276). Trade with the Hohokam network was not as strong as earlier, but Mogollon people still obtained some shell and small stone palettes from this source.

Beads, pendants, and other ornaments are found on many Pueblo period sites and may be trade goods. These include items of turquoise, malachite, chrysocolla, jasper, white calcite, gypsum, steatite, travertine, slate, fluorite, serpentine, and hematite. Chrysocolla can be found in the Santa Rita area of southern New Mexico (Anyon and LeBlanc 1984:308). Other materials available outside of the Mogollon area but also in southern New Mexico are fluorite and turquoise. Cordell and Plog (1979:420) note the possible practice of specialized lithic production at Carter Ranch near Winslow, Arizona, perhaps for the purpose of producing trade goods. It has been suggested that increased trade exchange with other areas may be a buffering mechanism in times of subsistence or environmental stress (Wills 1989:150).

Burial Practices

Burials occur in a variety of locations during the Pueblo period. In the Reserve phase, they may be found on or below room floors, in extramural pits, or in trash deposits. In the Tularosa phase, burials are located in the same places but with a seeming preference for subfloor contexts. They also occur in pits within kivas. Cremations are not recorded for the Mogollon Highlands but are common in the Mimbres area after A.D. 1150 (Creel 1989:309). The number of burials recovered from Pueblo period sites in the highlands is not large; Apache Creek Pueblo contains the most at 21 (Peckham et al. 1956:56). On several sites, children have been the only remains recovered, such as Haury's site and Spurgeon Draw. Burial positions are mostly flexed or semiflexed and most exhibit occipital deformation. There is no standard head orientation. In several cases, skeletal remains from floors or the fill of rooms are incomplete or scattered, suggesting post-mortem disturbance. At Wet Leggett Pueblo, a single skull was found on a floor and the causes for this are unknown (Martin and Rinaldo 1950a:416).

Grave offerings are commonly recovered in Pueblo period burials. They consist mostly of pottery vessels, with up to 15 pots recorded for a single burial (Starkweather Ruin; Nesbitt 1938:50). Sometimes bowls are nested and covered with an inverted bowl. Occasionally very small, unpainted vessels are included with burials, usually those of children. At Haury's site, corn, grass, and cholla flower pollen were found within pottery associated with children's burials. The grass pollen suggests that perhaps mats of grass were present in the burial pits. Other grave goods found in Pueblo burials include items of shell (such as beads, pendants, or bracelets), turquoise beads and pendants, beads of various materials, projectile points and other lithic tools, awls, quartz crystals, pieces of mineral pigment, and polishing stones. Hough (1914:37) notes that he found small clam shells in children's burials, but never with adults. At Starkweather Ruin, one vessel contained a basket inside of it (Nesbitt 1938:100). Several Tularosa phase burials have been found covered with mats, hides, or cloth at Higgins Flat Pueblo (Martin et al. 1956:184). However, no indication of status as determined from grave goods is evident within the Mogollon region, although a single, elderly man of unusually tall stature was buried within the great kiva at the Hough site and may be indicative of a prestige burial.

Settlement Patterns

By the end of the Pithouse period, site placement was beginning to shift away from valleys (particularly Pine Lawn Valley) into previously unsettled territory. At around A.D. 1000, when new architectural and ceramic styles flood the Mogollon Highlands, settlement patterns also exhibit diverse trends, and populations explode. The number of sites increases tenfold from the previous Three Circle phase. The room count increases by a factor of 16 from 300 to almost 5,000 rooms. The population estimate also dramatically jumps from just over 600 at the end of the Pithouse period to about 11,000 in the Reserve phase, using a low room count of 2.5 persons per room to adjust for possible site reuse.

Reserve phase sites mostly consist of small, masonry roomblocks with an average of 4.1 rooms per site, as stated earlier. The pattern of these small sites now spreading over a wide variety of topographic niches suggests a shuffling of previous settlement organization. Stafford (1980:73) suggests this movement is for the purpose of minimizing competition over increasingly scarce resources. Primary settlement locations exhibit a strong bimodality between the Pine Lawn Valley and the Gallo Mountain area (where the elevation is approximately 400 m [1,300 ft] higher). Reasons for this dispersal across several environmental zones could involve the simple need for more habitation space as populations explode, the necessity for more agricultural land (Rice 1980:31), reduction of competition for scarce resources, or the influx of new populations into the Gallo area. Further study on the causes for the shift in land-use patterns at this time needs to take place.

In the following Tularosa phase, the dispersal of sites across the Mogollon landscape is still a viable pattern. Bimodality continues, but settlement concentrations are now located in the Tularosa and Luna valleys. The Pine Lawn Valley is significantly depopulated. However, the larger sites are aggregating at lower elevations along major stream flows where better conditions for agriculture are found. This is possible evidence of a shift from extensive to intensive agricultural strateties (Hogan 1985:203). The sites are, in general, larger than during the Reserve phase—from an average of 4.1 to 12.0 rooms per site. Some sites reach over 250 rooms, such as LA 3259 in the Tularosa Valley. Of interest is the fact that the total number of rooms remains almost constant for the entire Pueblo period as does the population count, but the number of Tularosa sites drops to one-third that of the Reserve phase—a clear example of site aggregation. Together with the lack of population growth, we may be seeing evidence of either movement to control environmental stress or to avoid competition for more arable land (Kohler 1993; Cordell et al. 1994). Much more study on the underlying causes for site aggregation in the Mogollon Highlands should be a focus of future investigations.

Subsistence Adaptations

With the gathering of the population into more permanent settlements during the Pueblo period, it is usually assumed that subsistence focus was on agricultural products. Massing of peoples into larger communities would seem to preclude much dependency on hunted game at this time. Many suggest that hunting was reduced to that of a subsidiary subsistence pursuit as reliance on agriculture grew; however, that may not be true (Most and Hantman 1984:3). Using Bayham's (1979) Artiodactyl Index, the relative usage of large game was checked for sites of this period. Haury's site (Reserve phase) in the Pine Lawn Valley produced an index of .79, indicating a continuing selection for wild game throughout Mogollon prehistory. The index score is only slightly down from the .85 index determined for Luna Village (Three Circle phase) in the Luna Valley. Unfortunately, no other data from Reserve phase sites in the Mogollon Highlands are amenable to this type of analysis. At Haury's site, rabbit groups make up only 11.8 percent of the faunal population. Deer are the most common species in the assemblage.

For the Tularosa phase, artiodactyl indices were calculated for three sites in the Mogollon Highlands—the Hough and DZ sites in the Luna Valley and Spurgeon Draw in the Pine Lawn Valley, producing a mean score of .73. This number still indicates a strong preference for, and most importantly, an availability of large game in this phase. However, when broken down by areas, the Luna Valley score is .82, indicating no significant drop from 200-300 years earlier, but the Pine Lawn score is a low .33, suggesting a major decline in usage and availability of large game in the area. Settlement pattern studies show that during the Tularosa phase, the Pine Lawn Valley lost much of its site population. It is possible that resource depletion had reached a critical threshold in this heavily occupied valley which had served as the heartland of Mogollon culture for over 1,000 years. Just outside of the Mogollon Highlands, to the south, the index for the WS Ranch site (Shaffer and Schick 1995) is .55, while that of the Ormand site (Wallace 1998) is comparable at .62. The environments for both sites are less mesic and at lower elevations than the Mogollon Highlands, which may account for the lower scores (Cannon 1998), but also may indicate an overall pattern of resource depression for the region.

Dependency on agriculture is sometimes inferred by the increasing length and area of ground stone artifacts. Using data from Volume 3, it is shown that in the Pueblo period, one-hand mano use declines while two-hand use increases. However, both slab and trough metate types increase in frequency. Slab metates show a significant increase in used surface area, suggesting a variety of different materials were being ground. Mano lengths show no significant change through time. The data regarding major increases at this time in trough metates and use of two-hand manos, thought to be indicative of increased corn processing, are generally inconclusive.

Water-control devices, such as checkdams, contour terraces, and irrigation systems are usually symptomatic of intensive agricultural strategies in place to counter instability in resource productivity (Larson et al. 1996:220). These features are not common in the Mogollon Highlands and apparently are not present at all prior to the Pueblo period. They are found much more often in east-central Arizona (Lightfoot and Plog 1984) and the Mimbres Valley (Sandor 1983). Checkdams have been recorded in a few areas of the highlands at Devil's Park (Peterson 1988a:123), Apache and Largo creeks, and Gallita Springs (Berman 1979:49). They consist of low cobble or boulder alignments built across hillslopes or gullies to slow down or retain water. The Mogollon Highlands, unlike northern New Mexico, have no extensive irrigation systems. Lekson (1996:173) believes they were present, however, along the major streams where large Tularosa phase settlements are found. However, defining such features has been problematic to date. Terracing has been noted at LA 4987 near Apache Creek where six terraces run across steep slopes. They are rimmed with tuff boulders along which agave plants grow today (Kayser 1972a:8). The plants may have been introduced originally by prehistoric peoples (Minnis 1985). At Spurgeon Draw in the Pine Lawn Valley, there is evidence of a water retention basin that would have been used to capture rainfall (Crown 1987:212). These few instances of simple water-control facilities are not common enough to suggest large-scale agricultural dependency. However, it may be that such devices were not necessary in this primarily mesic environment.

Ubiquity scores of corn from flotation samples on various sites were calculated to further examine the potential dependency on agriculture during the Pueblo period. The only Reserve phase sites amenable to this study are the Haury site and Thunder Ridge (this report), which provided a ubiquity score of 13.3, the lowest for all phases of Mogollon occupation. Both sites are in the Pine Lawn Valley and suggest a very weak presence of botanical corn remains. Three sites (Hough site, Spurgeon Draw, and the DZ site) were used to determine the ubiquity score for the Tularosa phase at 65.5, a significant increase from the Reserve phase. Again, scores from the different areas show wide variations. The Reserve site of Spurgeon Draw produced the lowest score of 20.0. The site is within the Pine Lawn Valley and the score tends to indicate that not only faunal resources are depleted in this area, but also the potential for agriculture. In the Luna Valley, the Hough and DZ sites yielded a combined score of 77.3, suggesting a definite dependency on agriculture as well as the hunting of large game.

A ubiquity test on corn pollen was also attempted as a means of verifying the flotation results. Again, the score of 16.6 for the Reserve phase is the lowest of any Mogollon phase. The score increases in the Tularosa phase to 26.1. The results of the two corn ubiquity tests were plotted for a relative comparison of agricultural usage trends through time and both produced similar results (Fig. 1.20 and Table 1.6). The artiodactyl indices were then added to the data set for additional comparison to determine if both agriculture and wild game hunting may have followed the same pattern. The plotted artiodactyl index shows that through time only a slight decrease occurred in the presence of large game on Mogollon sites as compared to the ubiquity scores for corn. This faunal index plot indicates that hunting was always a major subsistence strategy throughout Mogollon prehistory. Reconciling this data with the corn ubiquity scores is difficult. However, the small sample size for many of the phases may explain the incongruities. Some degree of increased agricultural dependency would normally be expected by the Reserve phase rather than appearing at an all-time low, although some researchers would say that a low dependency on agriculture late in the Pueblo period is not untenable (Hill 1970:90; Madsen 1979:716; Gasser 1982). LA 5407, a Pinelawn phase site, has probably also skewed the early Pithouse faunal index downward because of excavation procedures at the site. The potential for poor preservation of bone and corn remains on some sites may also be a factor in the skewing of the scores.

If, however, the pattern is basically accurate, the abandonment of the Pine Lawn Valley during the Reserve phase for a variety of environmental micronich-

Table 1.6. Site Data for Artiodactyl and Corn Indices

Phase/ Period	Site	Artiodactyl Index	N	Mean Score for Period	Corn Ubiquity Score	N	Mean Score for Period	Pollen Ubiquity Score	N	Mean Score for Period
Archaic	Raven Roost	.99	394	.98						
	Old Peralta	.94	144							
	Ormand+	.87	8							
Pinelawn	Lazy Meadows	.98	64	.58	33.3	6	80.6	57.1	14	57.1
	LA 5407	.53	444		94.4	18				
	SU				100.0	7				
	Ormand+	.80	129							
Georgetown	Mogollon Village +				88.8	18				
San Francisco	Fence Corner	.94	264	.94	40.0	5	40.0	60.0	10	60.0
	Mogollon Village +	.90	420							
	Wind Mountain +	.54	307		33.3	3				
Three Circle	Luna Village	.85	100	.85	18.6	48	18.6	37.9	29	37.9
	Wind Mountain +	.58	1479		58.3	24				
	Galaz Ruin+	.18	877							
Reserve	Haury's Site	.79	98	.79	13.3	15	13.3	12.8	39	12.8
	Wind Mountain +	.24	25		55.5	9				
Tularosa	Hough Site	.82	2262	.73	86.2	80	65.5	24.4	45	26.1
	DZ Site	.58	24		35.2	17		32.4	37	
	Spurgeon Draw	.33	480		20.0	25		22.7	44	
	WS Ranch +	.55	1000							
	Ormand+	.62	440							
	Broken K+	.12	3633		14.2	42				

+ = Outside of the Mogollon Highlands, not used to calculate MEAN SCORES.

es elsewhere in the region, as discussed under Settlement Patterns, may be reflected in the graph. Also shown may be the subsequent aggregation into large villages along well-watered valleys that could have produced more available land for the cultivation of crops and exploitation of game in unoccupied areas, increasing subsistence productivity. Obviously, more data are needed before a reliable assessment of subsistence dependencies through time can be made.

Abandonment of the Region

By A.D. 1350 the Mogollon Highlands were virtually abandoned. One of the last recorded settlements is the Hough site in the Luna Valley dating between ca. A.D. 1275 and 1325. During the Pueblo period, prior to this regional abandonment, populations were at an all-time high and sites first disperse into a variety of environ-

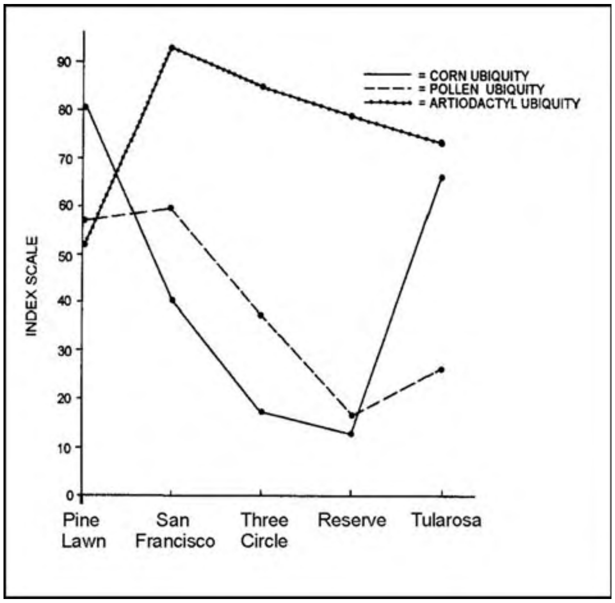

Figure 1.20. Ubiquities of corn and artiodactyls by phase.

mental zones and then coalesce into large settlements near arable land and flowing streams. Motivational factors that could force such a population into abandoning a region are numerable with little likelihood that any single cause accounted for the initiation of the process, even the Great Drought of A.D. 1276-1299. A multiplicity of factors probably contributed to such events with a single disaster serving possibly as a final moving force. Some of the problems that may have induced a regional migration include insufficiency of agricultural land, climatic disturbances, population growth, competition for resources, or the draw of a new religion.

While most land suitable for agriculture is found in the valleys along water courses, dispersal of sites into marginal areas occurred after A.D. 1000, possibly because of the need to accommodate the large population expansion at the time. Productivity in these areas was likely not adequate and competition for remaining available resources may have ensued. By A.D. 1100, communities were aggregating into large settlements along waterways and in valleys again. This aggregation may be seen as a response serving to eliminate competition and also acquire new land (Adler 1994:85). However, aggregation in the highlands is on such a large scale that there still may not have been sufficient lands to cultivate adequate crops. An overutilization of those lands would have also caused a drop in the carrying capacity. Thus, the failure of the intensive agricultural system to supply the needs of such a large aggregated population is suggested as a major cause of the abandonment of the Mogollon Highlands.

Prehistoric peoples in the Southwest have dealt with climatic perturbations through time and while they may have moved from highlands to lowlands or from valleys to mountains, seldom has the climate caused the abandonment of entire regions (Cordell 1984b:310; Van West 1990). Rather, climatic shifts may have served as only one of the influencing factors that led to the impetus for abandonment.

Population growth is frequently seen as a pressure upon local resources and an ultimate trigger for overutilization of resources and ensuing competition. Factionalism and internal strife often follow and could contribute to the decision to abandon an area.

The katsina cult was a strong influence in the revitalization of struggling populations (E. C. Adams 1991) and may also have been a force drawing people out of the Mogollon region.

There is no sign of warfare or epidemic disease during this last period in the Mogollon Highlands. Few sites have burned rooms. Departure from the Mogollon Highlands was apparently anticipated and carried out in an orderly manner. At one of the last occupied sites in the region, the Hough site, rooms are cleaned out, including the great kiva, and few artifacts remain in situ. This pattern strongly indicates that a reoccupation of the site was not anticipated and that abandonment was planned and orderly (Schlanger and Wilshusen 1993:92).

Various destinations have been suggested for this mass population movement. Dittert (1968:15) and Hogan (1985:44) suggest the Cibola area as a possible choice. Northern Mexico is proposed by Roberts (1937:23) and LeBlanc and Whalen (1980:13) where populations may have fused with indigenous peoples. The Zuni area is also frequently considered as a migration destination (Frisbie 1984:101; Lekson 1990:104). Use of the Mogollon region by Zunis is documented even prior to abandonment by Mogollon people. There is some suggestion of Mogollon architectural forms being reproduced in the Zuni area and a large increase in site densities is noted between A.D. 1250 and 1350 by Kintigh (1984:217). Another strong consideration as a destination is the Upper Little Colorado River area (Martin et al. 1961:3; Reid et al. 1996:73). Populations here peaked after the Mogollon Highlands were abandoned and retained large populations until the mid 1400s (Kintigh 1990:267). From here, many of the area's people moved on to Hopi, which may have been the ultimate end of the Mogollon migration process.

THE ATHABASKAN OCCUPATION OF THE MOGOLLON HIGHLANDS

Athabaskans in the Southwest

Most discussions related to the origins of the Athabaskan peoples in the Southwest are concerned with either their route of entry into the region or the time of their arrival. For this particular report, route of entry is a challenging research pursuit, but one that does not provide information regarding the Athabaskan occupation of the highlands. Briefly stated, there are two routes generally considered as possible entry corridors. One is by way of the High Plains from ultimately across the Bering Strait (Hodge 1895; Gunnerson 1956; Wilcox 1979; Schaafsma 1981; Towner and Dean 1996). Thus, the Athabaskans would have entered New Mexico from the east spreading gradually into the Rio Grande Pueblo areas and finally to western New Mexico at a later time (Wilcox 1981; Upham 1982). The other possible route is via the mountains on the west side of the Continental Divide (Thomas 1907; Amsden 1932; Spencer 1947; Riley 1954; Brugge 1983; Perry 1991). Lightfoot (1983:217) states that the intermontane route is no longer a viable consideration. Other researchers, however, disagree and continue to find evidence of very early sites in the San Juan region of northwestern New Mexico, supporting an intermontane route (Hancock 1992:287; Brown 1996:68). In reality, both routes could have served as viable entry corridors, perhaps at different times in prehistory; however, no one has explored this possibility.

The other issue related to Athabaskan origins concerns the timing of their appearance in the Southwest. An examination of initial entry times is extremely important for understanding subsequent Athabaskan occupations in the Mogollon Highlands. However, this is one of the most debated issues in the archaeology of late Southwestern prehistory or early protohistory. Archaeologists seem to either support an early 1500s or earlier entry or a later post-1600s appearance. In earlier days of research into this topic, most thought that entry into the Southwest was relatively late, ca. post-1600 or just after Spanish contact (Gregory 1981; Schaafsma 1981; Upham 1982) by way of the High Plains. More archaeologists are now probably willing to assign a date between 1500 and 1600 to Athabaskan entry into New Mexico (Gunnerson 1956; Kaut 1974; Wilcox 1981; Perry 1991). By the 1980s, many researchers were agreeing to a 1400s arrival date in the region, concurring with Hodge (1895), who believed this earlier entry was possible long before it was accepted by others. Proponents of a 1400s date include Opler (1983), Hogan (1989), Brown (1990), Brugge (1992), and Hancock (1992). Dates are increasingly based on results of radiocarbon analyses of Athabaskan sites. Interestingly, there are some very early estimated dates for the Athabaskan entry into New Mexico including the pre-A.D. 900s (Willey 1966) and the 1300s (Goddard 1907; Goodwin 1937; Harrington 1940; Hall 1944; Forbes 1966).

Those who accept an intermontane route for the initial entry of Athabaskans into northwestern New Mexico, specifically the upper San Juan Basin, assign dates ranging between 1600 and 1800 (Aschmann 1974; Lightfoot 1983; Pool 1985; Towner and Dean 1996). Earlier dates between 1450 and 1550 are supported by more recent research by Hogan (1989), Hancock (1992), and Brown (1996). These dates for entry into northwestern New Mexico are important for affixing dates to Athabaskan entry into the Mogollon Highlands of southwestern New Mexico, which derived presumably from the San Juan area or central New Mexico in the Acoma area. The earliest date suggested in the extant literature is 1583 (Schroeder 1963:7). Schroeder notes that Querechos (thought to be Apaches) were seen by Espejo at Acoma Pueblo.

Added to this mixture of possible entry dates are several interesting comments gleaned from some earlier documents. Forbes (1960:xvii-xviii) notes that the Pima in Arizona say that Athabaskans forced the abandonment of Casa Grande north of Phoenix in the 1400s. He also comments that White Mountain and San Carlos Apaches had contact with Pueblos at Dewey Flat on the Lower Gila in the 1400s. One other observation he records is that Benavides in 1694 (Forbes 1960:xvii) states that the Apaches of New Mexico often thought of themselves as the "original" people of the area, not the Pueblos. Also, Goodwin (1942:63) tells of a Western Apache oral tradition that places Western Apaches in the same areas as still-occupied pueblos, and that raiding of these communities by the Apaches occurred. This could have been as early as the 1500s in some areas of east-central Arizona.

To further assist in determining when the Athabaskans may have entered the Mogollon Highlands, historically documented sightings and Athabaskan events are examined (Table 1.7) along with a later look at the available archaeological data. The table is long and extends from the 1400s to the early 1900s when

Table 1.7. Chronology of Dated Athabaskan Sightings and Sites

Date	Location	Event	Reference
1400s	Casa Grande, AZ	Pimas say Athabaskan forced abandonment	Forbes 1960:xvii
1400s	Dewey Flat on Gila River, AZ	White Mtn. and San Carlos Apache say contacted Pueblos in area	Forbes 1960:xvii
1400s	Tonto Basin, AZ	Cliff dwellers chased by Apaches	Forbes 1960:xvii
1415	San Francisco Mtns., Reserve	C-14 date at Raven's Roost	Oakes, this report
1440	San Francisco Mtns., Reserve	C-14 date at Rocky Hill	Oakes, this report
1445	San Francisco Mtns., Reserve	C-14 date at Apache Woods	Oakes, this report
1475	Luna Valley	C-14 date at Haca Negra	Moiola, this report
1490	Picacho Mtns, AZ	C-14 date at Buried Dune site	Bayham and Morris 1990:31
1500	Santa Rita, NM	C-14 dates at LA 112354	Rogge et al. 1998
1540	Chichilticale Pass, AZ	Sighted by Casteñeda	Forbes 1960:8-9
1560	San Francisco Mtns., Reserve	C-14 date at Rocky Hill	Oakes, this report
1575	San Francisco Mtns., Reserve	C-14 date at Lightning Strike	Oakes, this report
1581	San Marcial on Rio Grande	Trading with Piro pueblos	Hammond and Rey 1928:286
1583	Little Colorado River area, AZ	Luxan saw warlike and mountainous people	Hammond and Rey 1929:105
1583-1599	Acoma and west of Zuni	Sighted by Antonio de Espejo	Schroeder 1963:6
1590	Datil area	C-14 date at Elk Crossing	Oakes 1996
1610	Chaco River area	C-14 dates	Eschman 1983:384
1610	Datil area	IC-14 date at Dust Devil Hill	Oakes 1996
1620	Below Socorro	Enmity with Piro Pueblos	Hodge et al. 1945:82
1620s	14 leagues west of Senecu pueblo	Benavides noted Athabaskans	Hammond and Rey 1966:232
1630	Headwaters of Gila	Noted by by Benavides	Hodge et al. 1945

Table 1.7. Continued.

Date	Location	Event	Reference
1630	Sevilleta Pueblo	Rebuilt after destruction by Athabaskans	Hodge et al. 1945
1640	Zuni	Athabaskans present	Schroeder 1963:7
1650	San Pedro Valley, AZ	C-14 date at Lone Hill site	Agenbroad 1978:68
1658	Zuni	Athabaskans raided pueblo	Schroeder 1963:7
pre-1661	Grasshopper Spring, AZ	Tree-ring date on wickiup with stone ring	Reid 1998:198
1661	Senecu pueblo	Depopulated due to Athabaskans	Hackett 1937:292
1666	Acoma pueblo	Spanish campaign against Apache	Schroeder 1963:7
1668-1680	Piro and Tompiro areas	Great damage from Apache raids	Scholes 1930:400-401
1672	Zuni	Priest killed in Apache attack	Schroeder 1963:7
pre-1680	San Pedro, AZ	Father Kino says Apache trading with Zuni	Danson 1957:112
pre-1680s	Sonora, Mexico	Father Kino says Apaches present	Hammond 1931:41
1680-1699	Headwaters of Gila River	Stronghold of Apaches	Schroeder 1952:144-145
1681	Senecu pueblo	An Apache camp there	Hackett and Shelby 1942:203
1686	Sonora, Mexico	Fray Alonso de Posada says Apaches invaded from 125 miles to north	Tyler and Taylor 1958:301
1692	Mogollon Highlands	Warm Springs Apaches present	Buskirk 1949
post-1700	San Francisco Mtns, Reserve	C-14 dates from Rocky Hill	Oakes, this report
1740-1750	San Francisco Mtns, Reserve	C-14 dates at Raven's Roost	Oakes, this report
1746	Gila River	Strong Apache presence	Ives 1939
1747	Gila River	Zuni and Spanish attacked Apaches	Ferguson and Hart 1985:60
1754	San Francisco River area	Noted by Zuni and Spanish	Ferguson and Hart 1985:60
1756	Pyramid Mtns, near Lordsburg	Two Apaches killed	Kessell 1971:146
1756	Cliff	Soldiers and Tarahumara archers met to track Apache	Kessell 1971:133

Table 1.7. Continued.

Date	Location	Event	Reference
1757	Gila River area	Apaches trading with sheep-raisers to north	Kessell 1971:142
1766	Gila, Mimbres, San Francisco rivers	Noted by Nicolas de Lafora with Marques de Rubi party	Kinnaird 1958
1780s	All areas	Pursuit by govt. to break up Apache and Navajo alliances	Kessell 1971:144
1785	Cliff	Seen by Cordero expedition	Kessell 1971:149
1788	Headwaters of Gila River	Jacobo Ugarte y Loyola fought with Chiricahua	Hammond 1931:43
1788	Sierra de la Floridas, AZ	Captain Don Manuel de Echeagary fought with Apaches	Hammond 1931:43
1795	Mogollon and San Francisco Mtns	Seen by Don Jose de Zuniga	Hammond 1931:43
post-1795	Globe-Miami area, AZ	C-14 date on roasting pit at Mazatzal Mtns	Ciolek-Torrello 1987
1796	Headwaters of Gila River	Apaches present	Matson and Schroeder 1957:352
late 1700s	Upper Salt River, White Mtns, north of Gila River	Apaches present	Schroeder 1963:18
1800	Zuni and Hopi	Trading with Apache	Lightfoot 1983:203
1806	Mogollon Mtns	Apaches and Navajos present	Schroeder 1963:11
1811	San Mateo Mtns	Apache and Navajo hostility	Schroeder 1963:12
1813	Datil Mtns	Apaches and Navajos present	Schroeder 1963:12
1813	Laguna and Acoma	Apaches present	Schroeder 1973
1816	Mogollon Mtns	Apaches and Navajos present	Schroeder 1963:12
1835	Sonora and Chihuahua, Mexico	Offered 100 pesos for Apache scalp	Thrapp 1967:10
1838	Gila Forest area	Navajos fled into country	Schroeder 1963:12
1840s	Gila River area	Full of Apaches	Colyer 1872:5
1850-1870	Mimbres Mtns	Mimbreno Apaches present	Ogle 1970:8
1852	Socorro and Valencia Counties	Coyotero and Gila Apaches present	Schroeder 1963:12
1856	Acoma	Mangas Colorado raided area	Schroeder 1974

Table 1.7. Continued.

Date	Location	Event	Reference
1885	Mogollon Mtns	Head of Teepee Canyon	McFarland 1974:25
1885	Near Alma	Englishman killed at WS Ranch	McFarland 1974:29
1885	Silver City	Apaches present	Thrapp 1967:323
1885	Mogollon Mtns	Apaches trailed from WS Ranch to San Francisco R and up Deep or Devil's Creek	French 1990:66
1885	Alma area	Seen crossing Robert's Park and on Duck and Buckhorn Creeks	French 1990:75,81
1885	San Francisco Mtns	Navajo scouts at SU Ranch, Camp Maddox on Pueblo Creek, and on Blue	French 1990:84-85
1885	Gila area	On Upper Gila and Sapello Creek	French 1990:85
1886	Alma area	On Soldier's Hill	French 1990:115
1900	Mimbres and Black Range	At head of Mogollon Creek, killed in north end of Black Range	McFarland 1974:56
1900-1935	Globe, AZ	Wickiup on Rancho Creek	Vivian 1970:125
1928-1930	Sierra Madres, Mexico	Some Chiricahua Apaches remaining in mountains	Opler 1987:28

Athabaskans are no longer present in the area. Figure 1.21 indicates the locations of these occurrences, plotted in order to observe possible patterns of movement over time from north to south, as suggested by researchers.

It is noteworthy that several sources in Table 1.7 also suggest an Athabaskan presence in southwestern New Mexico and Arizona in the 1400s. Admittedly, some of these dates are based on tribal memory or single radiocarbon dates, which can both vary by one hundred years or more. However, both sources could also be correct, indicating a true Athabaskan presence at this early date. There are several researchers who believe Athabaskans were in the Southwest at this time and possibly even earlier (Forbes 1960; Willey 1966; Opler 1983; Brugge 1992; Hancock 1992). An examination of population estimates for later time periods may give a clue to why some consider this early settlement date possible.

Hodge et al. (1945:89) state that Benavides estimated an Athabaskan population at the time of contact at 200,000 persons. Benavides also commented that the Apaches had more people than all the nations of New Spain together (Ayer 1916:39). Hammond and Rey (1966:232-233) note that in the 1620s, numerous accounts of Spanish chroniclers document an Athabaskan presence numbering in the tens of thousands. Thus, they argue that it is difficult to believe that Athabaskans were only few in number less than 100 years earlier in the mid-1500s or that they had just entered the Southwest, as many researchers today propose (Wilcox 1979; Gregory 1981; Schaafsma 1981; Perry 1991). Hammond and Rey (1966:234) say that either the low numbers at this time must be rejected or else there were many Pueblo refugees counted as Athabaskans in the 1600s.

Brugge (1981:284) takes up the same line of thinking, arguing again that by the late 1500s, Athabaskans could not have just arrived in the Southwest with an attendant low population. He contends the choice must be between a late arrival of many people in the 1500s or an earlier arrival with a low population. Basing his judgment on early Spanish accounts that cite numbers of Athabaskans present at the time of contact, he opts for an earlier arrival. Using data from Hill (1940), he notes Athabaskan populations in 1740 were estimated at 3,000-5,000. Plotting backwards, Brugge (1981:284) states that this figure would yield a contact population of 40,000-50,000, given no detracting factors. He believes

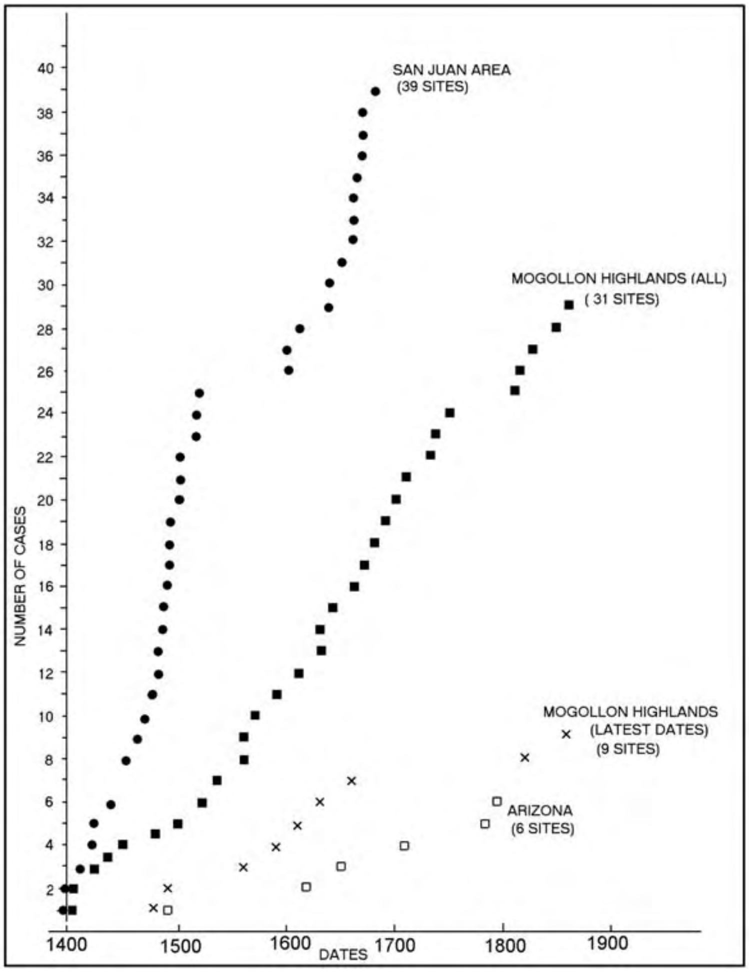

Figure 1.21. Comparative dates for Athabaskan sites.

that figure could be as low as, but probably no lower than, 30,000 people. He concludes, after looking at the several choices these figures present, that an assumed arrival by 1400 is definitely possible, and calculates that a doubling of population every 50 years would yield a contact population of 30,000 and an arrival population of 3,750 (Brugge 1981:286). However, if the contact population was larger than 30,000, as suggested by Benavides (Hodge et al. 1945:89), then the entry date could conceivably be pushed back even farther.

Athabaskan Presence in the Mogollon Highlands

The Mogollon Highlands and adjacent eastern Arizona have a total of three sites with radiocarbon dates in the 1400s (Fig. 1.21). While problems with dating old wood could exist, the dates must be considered possible indicators of very early occupation of the region. This would, therefore, push an entry date in northern or eastern New Mexico back to at least the 1300s as suggested by several researchers (Goddard 1907; Goodwin 1937; Harrington 1940; Hall 1944; Forbes 1966; Willey 1966; Opler 1983; Palmer 1992). Figure 1.21 also indicates that most of the earliest dated Athabaskan sites are in the San Juan area of northwest New Mexico, while sites in Arizona do not appear until ca. 1500. All of the radiocarbon dates for the Athabaskan sites in the Mogollon Highlands are given in Figure 1.21, along with only the latest date for each of nine sites. Using only the latest dates may adjust somewhat for the old wood problem and suggests that sites in the highlands do not appear until at least ca. 1475 rather than 1400.

In the 1500s, historical sightings by Spanish explorers place Athabaskans or Athabaskan-like peoples at Chichilticale in southeastern Arizona, among the Piro Indians on the Rio Grande, in the Little Colorado River area, at Acoma, and west of Zuni (see Table 1.7). Six radiocarbon dates also place Athabaskans at Datil, in the San Francisco Mountains near Reserve, and near Santa Rita at this time. More encounters are documented for the 1500s, stretching from the Rio Grande to southern Arizona, including the area immediately to the west of the Mogollon Highlands, suggesting the six C-14 dates obtained within the Mogollon country for this period probably have temporal validity.

By the 1600s, there is no question that Athabaskans were present throughout the entire Southwest, including the Sonora area of Mexico (Hammond 1931:41). Several researchers note that the Mogollon Highlands, particularly the rugged mountainous areas along the upper Gila River, were heavily occupied by Apaches (Hodge et al. 1945; Buskirk 1949; Schroeder 1952). In fact, by the 1700s, the Mogollon Highlands would seem to have been the focal area of the southern Apaches, as recordings of sightings and hostile encounters flood the historical documents. Hostilities between Apaches and other Indian groups generally seem to have begun by the early 1600s with much of the trouble occurring with the Piro Pueblos along the Rio Grande where, earlier, peaceful trading had taken place (Hammond and Rey 1928:286). Blame for this breakdown in relations with Pueblo groups is often placed upon the Spanish who interrupted the well-established partnerships, leaving the Apaches without means of obtaining sometimes necessary goods (Ivey 1992:222). These hostilities included enmity against the Spanish by at least the mid-1600s in the Mogollon area with encounters first noted at Acoma and Zuni pueblos just north of the highlands. Subsequent forays into the Mogollon Highlands by the Spanish, pursuing Apache raiders, produced sightings but only occasional confrontations with relatively few killed on either side. The tendency of the Apaches to split into small groups when pursued and their ability to easily negotiate the familiar steep canyons and slopes of the region probably prevented great loss of life for both parties. However, the Athabaskans of the Mogollon Highlands remained a thorn in the side of the Spanish well into the late 1800s (see Table 1.7). The last reported sighting of Apaches in the Mogollon Highlands comes in 1900 when a family was seen at the head of Mogollon Creek and tracked to the north end of the Black Range where at least one of them was killed (McFarland 1974:56).

In 1872, many Apaches of the region were confined by the U.S. government at Fort Tularosa in the Mogollon Highlands, on the Tularosa River at Aragón. Approximately 500 Apaches were kept under less than ideal conditions for approximately two years until even the stationed soldiers of Company H of the 15th Infantry complained in offical correspondence about the hardships of the poorly constructed and poorly staffed fort. In April 1874, the Apaches were moved to Ojo Caliente, Arizona, and Fort Tularosa was abandoned. Today, nothing remains of Fort Tularosa as it has been leveled and covered over by a modern structure.

While Apache groups dominated the Mogollon Highlands from possibly the 1400s to the late 1800s when Anglo settlements first appeared, they were not the only Athabaskan or Indian group utilizing the region. There is repeated mention in historical records, beginning in approximately the mid-1700s, of Zunis, Navajos, and Mexican Indians entering the region for specific purposes. In 1747, Zunis, along with the Spanish, skirmished with Apaches on the Gila River and were noted again in 1754 at the same place (Ferguson and Hart 1985:60). Sixty Tarahumara from Chihuahua and 140 Opata Indians from Sonora, Mexico, noted for their archery skills, joined with Spanish soldiers near Cliff in 1756 to track Apache renegades (Kessell 1971:146).

A Navajo presence in the Mogollon Highlands is more frequently noted. It is believed that after the Pueblo Revolt in 1680, Navajos moved south into Apache country. They are first recorded in 1754 in the vicinity of Laguna and Zuni, north of the highlands. Relations between Apaches and Navajos apparently vacillated between warm and cold for the next 150 years. The first enmity is mentioned in 1788, when Navajo guides were used by the Spanish on punitive expeditions against the Apaches at the headwaters of the Gila. This would assume that the Navajos had visited this country prior to 1788. Then, less than 20 years later, both Navajos and Apaches are occupying the Mogollon Mountains together. Seven years after that, in 1813, Navajos killed Apaches at Agua Caliente near the San Mateo Mountains and tracked Apaches into the Datil Mountains. Navajo employment as scouts or guides on military campaigns into the Mogollon Highlands was apparently common, being frequently mentioned between 1788 and 1857. The last documented occurrence was when the Navajo chief, Sandoval, joined the Bonneville expedition against Apaches on the upper Gila in 1857 (Schroeder 1963:7-15). However, Navajos maintained a continuous presence in the highlands until their forceful withdrawal to reservations in 1868 (Wozniak 1985:16). A favored stronghold of the Navajos in the 1860s (including chiefs Manuelito, Barboncito the younger, and Ganado Blanco) is said to have been the Escudilla Mountains bordering Arizona and New Mexico north of Alpine, Arizona (Schroeder 1963:15). Other commonly used areas for Navajos were the Datil, San Francisco, and Mogollon mountains.

The implications of other Athabaskans being in the Mogollon Highlands, at least as early as the mid-1700s, are important for interpreting the archaeological record in this region. Sites dated between the mid-1700s and the late 1860s thought to represent Apache occupations may not be Apache, but instead Navajo or possibly Mexican Indian. Current analytical techniques cannot distinguish them and, at this point in time, we do not even know if there actually are observable or quantifiable differences.

Using the data from Table 1.7 and Figure 1.22a-f gives a visual presentation of where and approximately when Apaches, or Athabaskans, appeared in the Mogollon Highlands. The maps are broken down into 100-year periods and include areas surrounding the Highlands as a measure of comparison. The 1400s map (Fig. 1.22a) displays few sites in southwestern New Mexico; all are from radiocarbon-dated features obtained on this project within the Mogollon Highlands. Of interest is the presence of sparse, but widespread, sites or tribal references to specific places and dates for southern Arizona. How and when did Athabaskan groups migrate through either northern Arizona or western New Mexico, according to traditionally assumed movements from north to south and east to west, to produce a presence in southern Arizona at this time? Why aren't there more sites, therefore, in western New Mexico? Intuitively, this map does not appear to be correct, with what little we know was occurring in New Mexico. The dates could just as likely be the result of incorrect C-14 readings or generalities within tribal traditions. However, there is the possibility of these actually being very early sites. The current data are so limited that definitive statements are not appropriate at this time. One idea that we have entertained concerns the long-shot speculation of these being early Mexican Indian sites or very early Chiricahua Apache sites that may have derived from Mexican origins rather than northern Athabaskan. In reality, our knowledge of Athabaskan movement over the landscape of the Southwest is extremely meager and this simple 1400s map raises even further questions about Athabaskan settlement of the various regions.

The 1500s map (Fig. 1.22b) displays fewer sites but they appear where we would expect them to, if migration was coming from northern or northeastern New Mexico. Only a very few sites are located in extreme eastern Arizona. What happened to the sites in southern and central Arizona?A case for the 1400s sites being representative of old wood readings could certainly be made from this map, thereby rendering this area generally void of Athabaskan sites until later in the 1600s. There seems to be no historical event in the late 1400s or early 1500s that would have caused the Athabaskans to retreat so thoroughly from this area at this time. Then again, 1500s Athabaskan sites may be present but unrecognized or undatable.

The 1600s map (Fig. 1.22c) reveals that almost all areas of southwestern New Mexico and a broad area in Arizona had Athabaskan representation. This pattern is to be expected as populations increase and new regions are settled. In New Mexico, most sites of this period have been recorded near existing pueblos at Zuni, Acoma, and the Piro area. By the 1700s, Arizona site distribution remains fairly stable, while a great increase is noted for Athabaskan sites in the Mogollon Highlands and a decrease in sites located near the large Pueblo communities. In fact, the highlands are now the focal point of Athabaskan settlement in southwestern New Mexico. An historical event that likely contributed to such a concentration in this rugged terrain, removed from large Pueblo villages, was the growing hostility between Apaches and the Spanish in northern New Mexico, manifest in the disruption of trading relationships with the large pueblos by the Spanish. Punitive expeditions by the Spanish against the Athabaskans were not uncommon at this time and what better place to elude capture or slaughter?

Two noticeable modifications in the 1800s map (Fig. 1.22d) mark the difference between it and the earlier 1700s locations. First, the number of Athabaskan sites in the Mogollon Highlands increases more than threefold, making this area even more of an Athabaskan settlement focus than in the 1700s. This number should actually be higher because there are also numerous sites present just to the west in the White Mountains of Arizona, but no documents on these sites were available to us. With the addition of the Arizona sites, the heavy Apache occupation shown in Figure 1.22d would continue to the west, increasing the already large Apache population in the mountains of the two states. Other areas in Arizona seem to maintain a status quo from the 1700s.

The other change from the 1700s is the reappearance of Apache sites surrounding major Pueblo communities at Zuni and Acoma and a stronger presence in the Datil Mountains. It would seem that trade with or raiding of these settlements had again assumed priority staus (Lightfoot 1983:203). During this time, the U.S. government was more relentless in their pursuit of Apaches than earlier and by the late 1870s had forced them onto reservations in Arizona and the Mogollon Highlands. The Apaches may have seen this antagonism as cause to pursue harassment of Pueblo groups (who sometimes sided with the government against them). Details of this period in the Mogollon Highlands are poorly documented, and Brugge (1981:288) suggests it is because the area is well removed from major settlements and no Spanish missionary work was actually pursued here. A more thorough study of Mogollon Apache and Pueblo relations during the course of the 1800s is beyond the scope of this report, but would be informative regarding the pattern observed in the 1800s map.

By the 1900s, the Apaches are virtually gone from the Mogollon Highlands, sent to reservations in Arizona, eastern New Mexico, Oklahoma, and Florida. Some that eluded capture were reportedly present in the Sierra

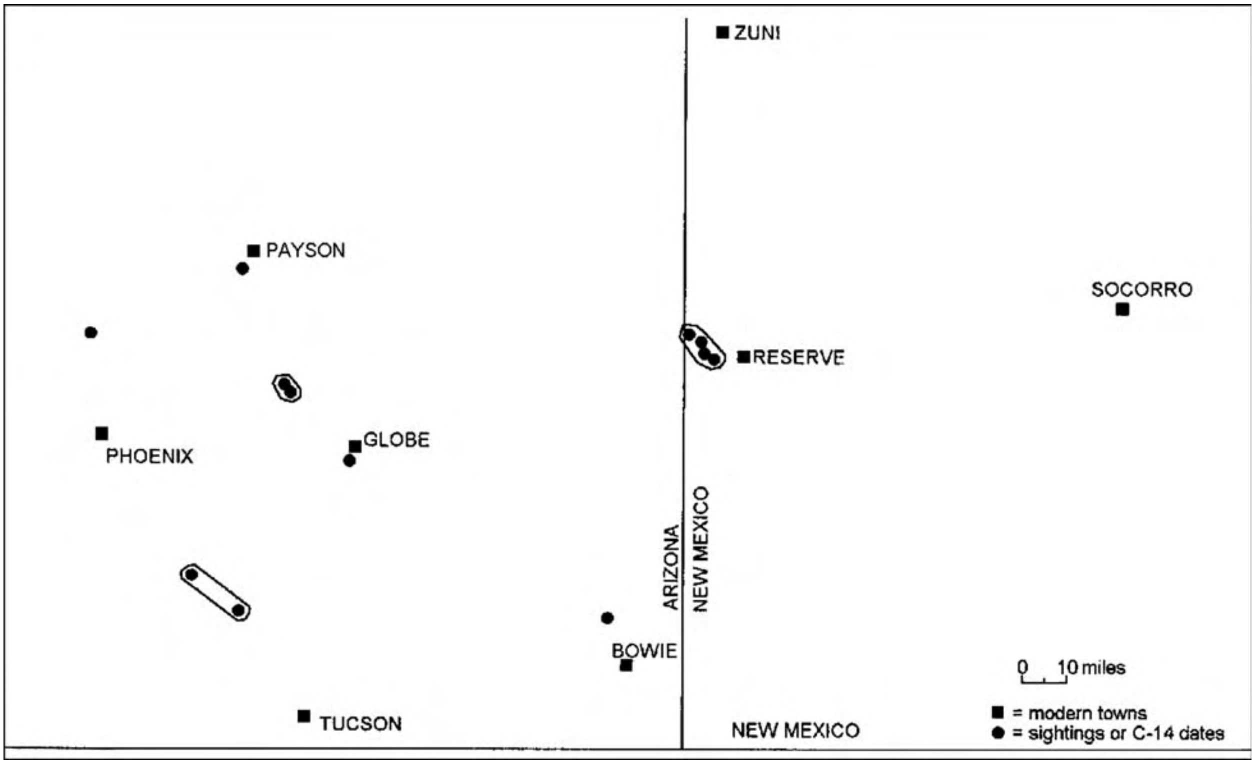

Figure 1.22a. Athabaskan presence, 1400s.

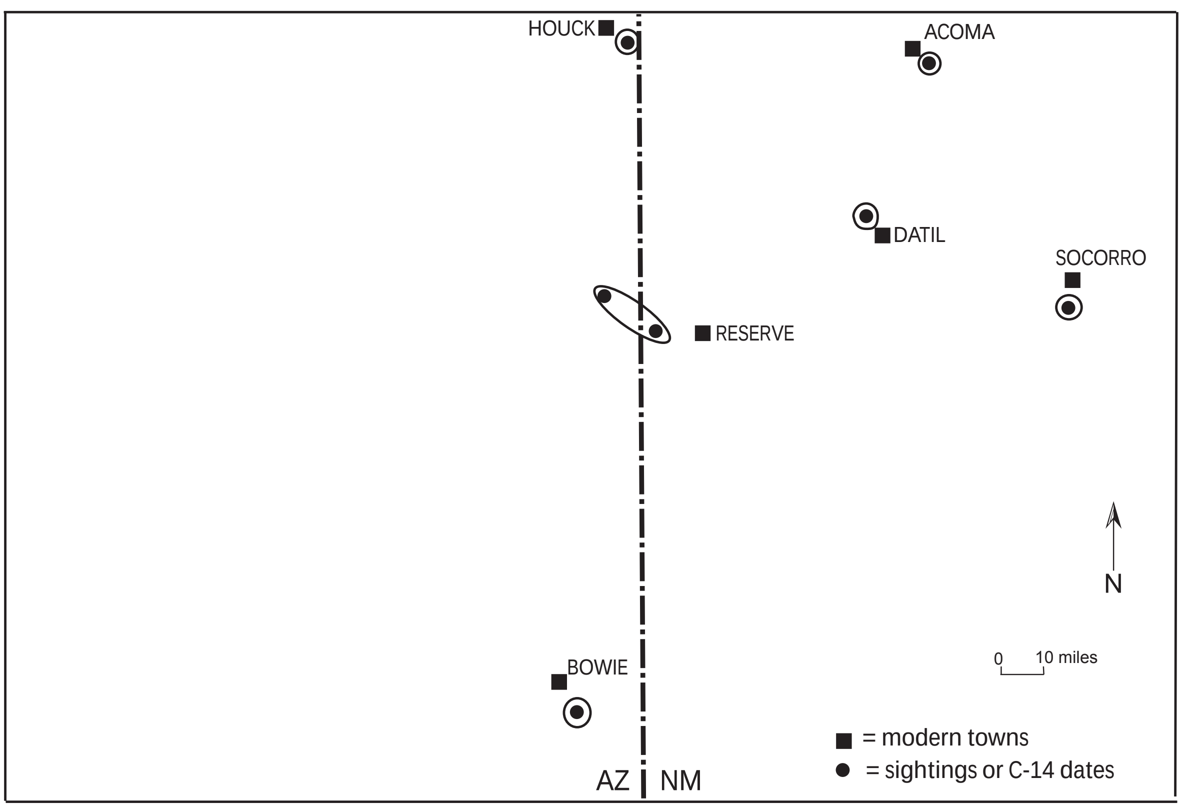

Figure 1.22b. Athabaskan presence, 1500s.

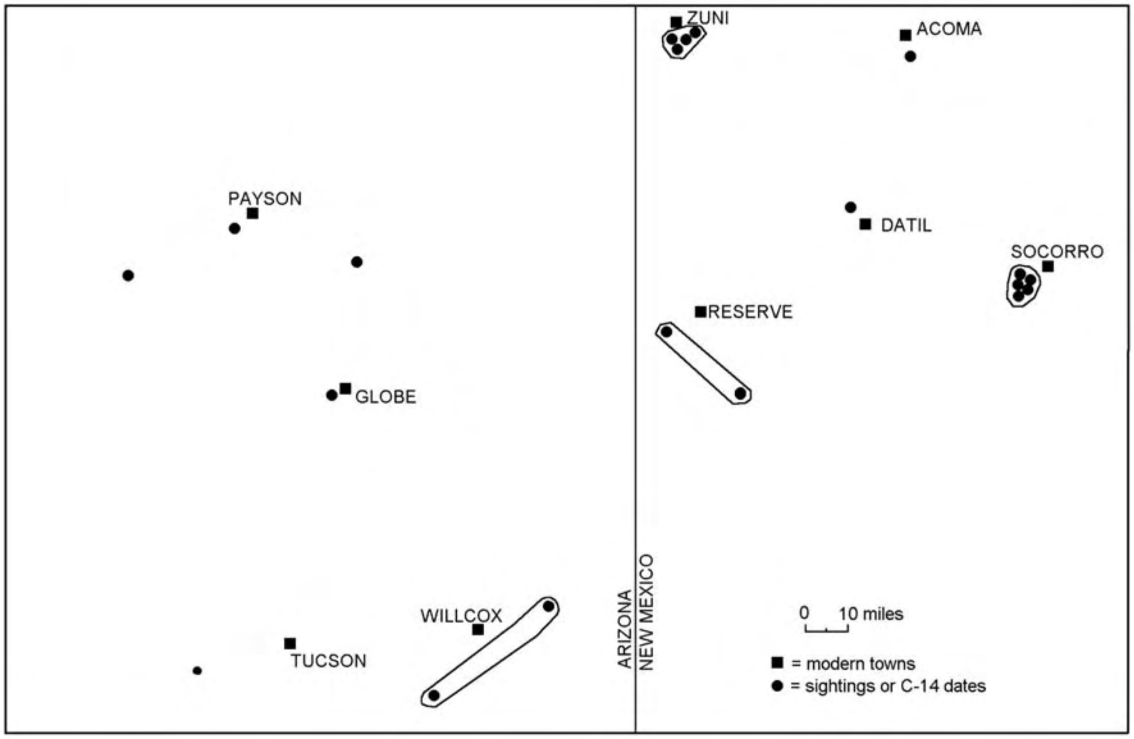

Figure 1.22c. Athabaskan presence, 1600s.

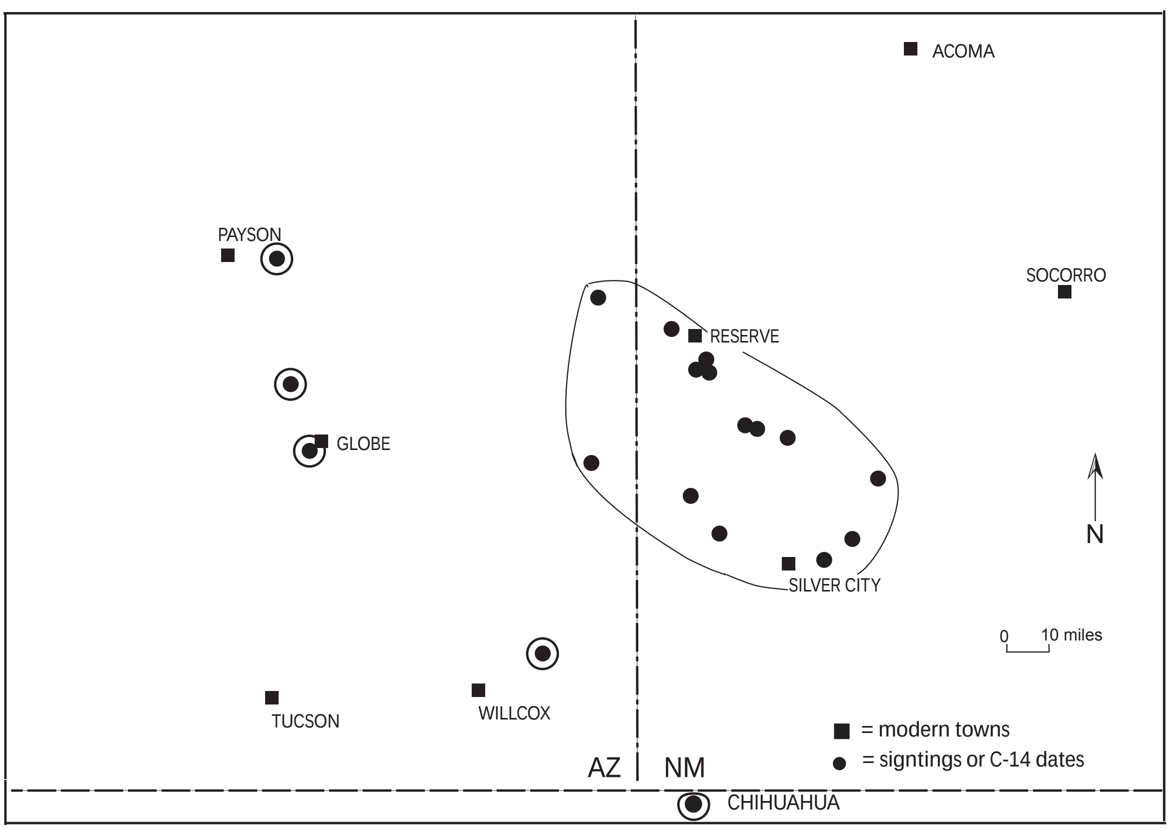

Figure 1.22d. Athabaskan presence, 1700s.

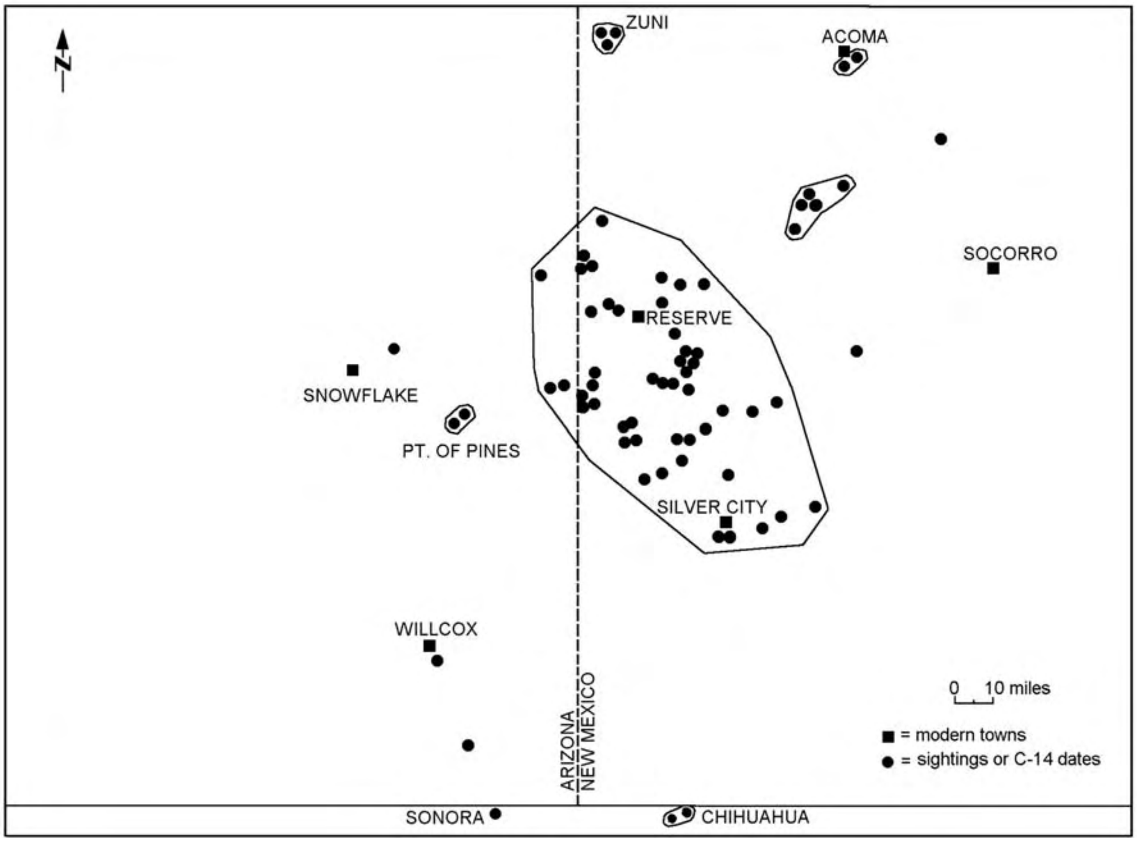

Figure 1.22e. Athabaskan presence, 1800s.

Figure 1.22f. Athabaskan presence, 1900s.

Madre Mountains of Mexico as late as the 1930s, occasionally raiding small ranches and settlements for supplies and sometimes kidnaping children for labor (Opler 1987:28).

Social Organization

Apaches occupying west-central New Mexico and eastern Arizona are generally termed Western Apache, with the exception of the Chiricahua and their possible replacements, the Warm Springs Apache (Goodwin 1935:55). The area between the Colorado River in Arizona and the Rio Grande and for 1,000 miles into Mexico is likewise called Apacheria (Thrapp 1967:x). The Apache tended to organize structurally by bands, which for them is an aggregation of extended families, spatially set apart from other bands into distinct territories (Kaut 1974:60). Apaches were relatively strongly attached to their individual bands, but less so to the concept of a larger Apache tribe (Opler 1983:369). Bands were further divided into local groups. Entire bands rarely assembled together at one place (Basehart 1959:8). Group sizes were fluid, ranging from fewer than 100 to approximately 300 (Basehart 1959:8; Lekson 1992b:5). Determining which groups occupied the Mogollon Highlands has proven to be difficult at best, partially because only after 1722 did the Spanish distinguish any of the Apache groups from other groups (Opler 1983:388). Even after that, overlapping territories were apparently not as uncommon as Kaut (1974:60) believes.

Between 1850 and 1875, Goodwin (1942) mapped five Western Apache groups: Northern Tonto, Southern Tonto, Cibeque, White Mountain, and San Carlos. The Northern and Southern Tonto occupied the area from Globe to Flagstaff, Arizona, and south to the San Pedro Valley. These groups had little bearing on events in the Mogollon Highlands and are minimally discussed further. Today, groups have been consolidated into three bands: Camp Verde (formerly Northern Tonto), Fort Apache (Cibeque and White Mountain Apaches, and some Chiricahua), and San Carlos (San Carlos, some White Mountain and Southern Tonto). In New Mexico, Schroeder (1974) names four groups including the Salineros (near Zuni Salt Lake), Colorados (near El Morro), the Gilenos (Datil and Gallo Mountains), and the Chilenos (San Francisco Mountains). More commonly used terms for New Mexican Apaches are the Gilas, Mogollones, Coyoteros (also in Arizona), the Mimbreños, and the Warm Springs Apache. Confusion abounds, but we have attempted to sort out those groups that may have left the archaeological remains found in the highlands today.

The Gila Apache are one of the first groups identified by name by the Spanish in 1630 (Hodge et al. 1945). Matson and Schroeder (1957:352) comment that they were one of the most warlike groups of Apache, no doubt because Spanish expeditions into the Mogollon area seemed to encounter them most often. They are consistently noted between 1630 and 1796 as being located on the headwaters of the Gila River (Hodge et al. 1945; Matson and Schroeder 1957). The group is variously said to have been forerunners of the Mogollones Apache, in league with the Mimbreños Apache, and apparently confused with the Coyoteros, Mogollones, Tontos, and Mimbreños Apache who were frequently called Gilas. Opler (1983:389) states that even Pinaleños, Chiricahua, and Yavapai were sometimes misidentified as Gila Apache. Mention of Gila groups attacking white settlers in Socorro and Valencia counties (Schroeder 1963:12) may not have actually been Gila Apaches. Thus, the headwaters of the Gila and possibly Socorro and Valencia counties to the north and east, are the only known territory of the group. The Mogollon Highlands, particularly in the vicinity of Reserve, lie just to the northwest of this area and almost certainly would have seen Gila Apache incursions.

All that is mentioned of the Mogollones Apache in the literature is that they numbered 900-1,000 in 1857 and were closely associated with the Mimbreños at that time (Ogle 1970:8). They are said to have generally occupied the Mogollon regions of New Mexico and Arizona. In 1874, the Mogollones were identified as one of the Apache groups from Ft. Tularosa who fled to Arizona. Whether the Mogollones derived from the Gila Apache is unverified. The scope of their territory is so broad that they also could have easily occupied many of the archaeological sites found in the Mogollon Highlands.

The Mimbreño Apache have occasionally been called the Copper Mine Apache, or sometimes considered part of the Gila Apache. In 1850, there were said to have been 200 warriors, and 400-750 by 1870 (Ogle 1970:8). In 1838, Chief Mangas Colorados is credited with eliminating Mexicans from southwestern New Mexico (Ogle 1970:30). The Mimbreños are generally located in the Mimbres Mountains area south of the Mogollon Highlands. However, there is mention of them also occupying the area between the Rio Grande and the San Francisco River and sometimes as far west as the White Mountains and as far south as Mexico (Ogle 1970:7). Another description of their territory (John 1989:51-52) bounds them on the west by the Gila Apache, north and east by the province of New Mexico, and south by the frontier of Nueva Vizcaya (deep into Mexico). Schroeder (1962:58) also mentions that they wintered in northwest Chihuahua between Casas Grandes and the extreme southwest corner of New

Mexico. While it seems their general territory may have extended west only as far as the San Francisco River, that boundary today is in the middle of the Mogollon Highlands.

The Coyoteros are thought to have been more agricultural than other Apache groups and yet Colyer (1872:4) states that they were one of the most powerful Apache groups. Their name means "wolfman"; however, little else is known about them except that they were comprised of two groups, the Pinal and the White Mountain Coyoteros, occupying western New Mexico and eastern Arizona as far west as the San Carlos drainage (Ogle 1970:8; Opler 1983:388). Colyer (1872:4) also places them on the north side of the middle Gila and into the Mogollon Mountains and southeast to the Pima villages of Arizona. In 1861, they were recorded (Schroeder 1963:13,15) in the White Mountains, and in 1866 in the Escudilla Mountains on the New Mexico-Arizona border (a favorite refuge). Apaches residing in the Tularosa Valley at this time also seemed to be Coyoteros. Thus, the Coyoteros also were known to have occupied many portions of the Mogollon Highlands.

The White Mountain Apache are extant today and were known formerly as being one of the friendlier Apache groups, frequently trading with Western Pueblos. The White Mountain and Chiricahua Apache relationship was so close that the Tontos used the same name for both. The White Mountain group used the more southern Chiricahua lands for ritual preparation sites on their rounds into Mexico. But Gladwin (1942) notes that they maintained separate territories and language. While today they are found on the reservation in the White Mountains of Arizona, in 1931 an old woman recounted going from the White River to the Blue Range on the border of New Mexico to gather piñon in the 1840-1850s. Another Apache tells of heading into the Mogollon Mountains in the mid-1800s to fight with the Navajos and take their livestock (Basso 1971:31, 43). By 1858, the White Mountain population was about 2,500 people with 600 warriors (Colyer 1872:5). By the late 1870s, the population stood at 1,400-1,500 (Pool 1985:34). At this time, the amicable relations with the Chiricahuas were halted when the White Mountain Apache were enlisted as scouts against the Chiricahua (Goodwin 1942).

Most researchers believe the Warm Springs Apache may have formerly been the Gila or Mimbres Apache (Lekson 1992b:1). They called themselves "Tchinene" or red-paint people. Opler (1983) thinks they were actually the eastern group of the Chiricahua; but some modern Warm Springs Apaches do not consider themselves Chiricahua, although there are close ties between them. Another source says Geronimo was their medicine man and Nana their captain leading them into constant conflict with the San Carlos and Chiricahua Apache. But, if so, how could they have been Chiricahua as stated above?In 1850, they are said to have ranged over all of southwest New Mexico, south of Glenwood, east to the Rio Grande, excluding what is now Hidalgo County. In 1850, there were about 900 in the Mimbres-Black Range area and 500 in the Mogollon Mountains (Basehart 1959:42). By 1869, there were about 1,600 Warm Springs Apaches located between the Mogollon, Mimbres, and Black Range mountains (Opler 1983). Thomas (1959:62) states that in the late 1870s, there were just under 1,000 residing near the Warm Springs Agency in the Black Range. Some were also living near Silver City in 1877 (Basso 1971:103). Not only was their territory vast, but Lekson (1988b:21) gives an estimate of that range at 18,000 sq miles. While the territory may have actually been just east and south of the Mogollon Highlands, forays into the area would certainly have been possible.

The last group of Apaches discussed are the Chiricahua. Kaut (1974:60) and Opler (1983:389) do not consider them part of the Western Apache group for reasons that are not clear, although Gladwin (1942) did note that their language was different. Also, Forbes (1966:338) states that the Western Apache are more similar to Navajos in their characteristics than to the Chiricahua, although the two intermarried (Murdock 1967). Our 1400s map (Fig. 1.22a) of Athabaskan locations suggests that the Chiracahua noted in southern and south-central Arizona at this time may not have been part of the overall Western Apache movement into the area, but perhaps an intrusion from Mexico. The Chiricahua were divided into three bands: eastern (southern New Mexico), southern, and central. There is confusion in the literature as to whether the Eastern Chiricahua were the red-paint people mentioned above (Opler 1983:401) or if the Warm Springs Apache were similarly identified (Lekson 1992b:1). Their principal territory was southeastern Arizona but they traveled throughout much of New Mexico, Arizona, and northern Mexico (Ogle 1970:10-11). By 1850, the Chiricahua population was estimated at over 3,000 people (Opler 1983:411). Their leader in 1861 was Cochise (Thrapp 1967:16). In 1788, the Chiricahua are mentioned as engaging in battle with the Ugarte y Loyola party in southern New Mexico (Hammond 1931:43). Because of their previously mentioned contacts with the White Mountain and possibly the Warm Springs Apache, it is likely that there was some Chiricahua Apache presence in the Mogollon Highlands.

Upon review, almost all Apache bands had occasion at some point to utilize the Mogollon Highlands. Current archaeological methodology is not able to distinguish the remains of the various groups. It can barely identify

Athabaskan groups as such, and then only if radiocarbon samples or structural remains are present. However, the 1700s and 1800s saw almost all of the Apache groups present in the Mogollon Highlands.

Athabaskan Material Culture

Structural Features

Little is known of early Athabaskan structural features before the 1700s. Archaeological evidence from OAS sites in the Mogollon Highlands suggests housing was primarily in temporary brush structures. Shallow, roughly circular depressions were found during excavations and dated from the late 1400s to the 1600s. The mean diameter of the remains was 2. 3 m with a floor area of 5. 69 sq m and a depression of 34 cm. No interior features were found. One had a possible elongated entry facing west. Only one Athabaskan utility sherd was found outside of a structural depression, and while lithic artifacts were present, they were not distinguishable from those of earlier Mogollon occupations at the sites.

The earliest regional historical documentation of Athabaskan dwellings comes from Saenz's journal which states that Athabaskans built a few half-huts of no more than branches wherever they stop (Kessell 1971:150). Eye-witness accounts in the mid-to-late 1800s note that shelter was provided by dome-shaped, brush-covered dwellings (Goodwin 1935:64). In Arizona, several of these have been found intact and the word "wickiup" is used to describe these later structures. Ogle (1970:19) describes them as usually 3. 4 to 3. 6 m in diameter and constructed by first making a framework of slender poles placed in a circle. The tops are then bent over and tied and the structure covered with branches or animal hides laid over the framework. The interior was usually dug out for 30 to 45 cm with excess dirt frequently piled around the outside. Donaldson and Welch (1991:99) note that floors were commonly not prepared, although hearths, when present, were centrally located. Construction of the dwelling was normally completed by women (Opler 1983:371). Hrdli ka (1905:482) provides additional information by stating that no forked supports were used and that dwellings were smaller in winter to keep in the warmth. Apparently there was no strict doorway orientation. He also notes that structures were frequently built in groups of three to six and that upon the death of the occupant, the dwelling was burned (Hrdli ka 1905:483-484). Forbes (1966:338) adds that tepees were never used by the Western Apache.

Donaldson and Welch (1991) have classified two types of brush structures—domed and conical. The domed units were for short-term use and averaged slightly over 3 m in diameter. Conical structures were larger and could have been used for several years.

Sometimes a single ring of rocks was placed as a foundation (Whittlesey 1998:172); however, this practice apparently ceased in the late 1870s (Donaldson and Welch 1991:96). Perry (1991:150) believes that domed structures were the earlier of the two. The wickiups of later times seem to have become popular after Apaches were removed to reservations (Donaldson and Welch 1991:94).

Caves and rock shelters were also used by the Apache as dwellings. Goodwin, in the 1940s, stated that the Western Apache did not live in caves but used them primarily as storage areas (Whittlesey 1998:197). However, several caves presumably used by the Apache have produced evidence of sleeping and food processing activities. Pine Flat Cave, at Point of Pines, Arizona, which dates to post-1870, yielded hearths, grass and bark-lined pits, burden baskets, and pitch-covered water bottles (Gifford 1980). On their extensive examination of caves in the upper Gila area in the late 1920s, the Cosgroves recorded numerous cave sites that they attributed to a late Pueblo occupation of the area. Many contained well-preserved bows, arrows, cotton cloth, yucca cordage, baskets, reed cigarettes, painted pahos, wood tablitas, sandals, and the frequent lack of Pueblo pottery (Cosgrove 1947). Hough (1907) on his northern Mogollon survey, notes numerous caves in the Luna, Blue, and Alma areas with the same array of intact items, but he does not assign a cultural affiliation to them. We strongly believe these are Apache shelters, shrines, and storage areas. In many of the caves were found grass-lined pits that the Cosgroves believe were used for sleeping quarters. Several of the caves are found on steep cliff faces with difficult access. The predilection for Apache sites to be located in inaccessible terrain has often been noted by early explorers (Matson and Schroeder 1957:339).

Sometimes, crudely stacked, dry-laid stones that form a circle or U-shape are recorded as Apache (Donaldson and Welch 1991:99). Their use may have been for shelter from wind or as hunting blinds. Artifacts are rarely found in association.

Storage cists are a common facility used by Athabaskans. They may be found in caves or in the open. Often the pits are lined with beargrass or juniper bark (Buskirk 1986:73-75). We wonder if some of these grass-lined pits found in caves may rather have been sleeping units as described by the Cosgroves.

Not infrequently, Apaches will occupy a former pithouse or pueblo site, often constructing stone-based structures within existing wall perimeters (Asch 1960; Vivian 1970; Wilson and Warren 1995). It is well-known that Athabaskans will also utilize stone and sherd material left on a site by former residents (Hrdli ka 1905).

Roasting pits for processing various subsistence items, such as corn, piñon, acorns, and mescal, are also common Apache features. Mescal pits are usually found in the southern part of Apacheria in desertic environments. Welch (1994:92) records over 200 roasting pits in the Grasshopper area of east-central Arizona. Several Athabaskan-related pits have also been found on this project. Contents include cheno-ams, composites, Mormon tea, prickly pear, and maize.

Artifacts

Unlike their Mogollon predecessors, the Apache did not leave behind a rich and diverse cultural record. Many sites retain no material goods, making assessment of them as Athabaskan difficult.

The Western Apache did make limited pottery; however, they never excelled at the craft. Baugh and Eddy (1987:793) believe Apaches relied mostly on Pueblo sources for their pottery. They say that only five confirmed Apache (Chiricahua) pots were in collections as of 1985. Early Athabaskan pottery consists of moderately large ollas made by a coiling and scraping technique and are thin-walled, fire-clouded, and have minor decorative treatment. Eventually, surface treatment involved striations, scoring, incising, fingernail indenting, or wiping over most of the vessel or just the neck (Brugge 1982:279). Mica was commonly used as temper; however, Whittlesey (1998:212), using Goodwin's 1942 notes, says that Apache informants formerly used ground prehistoric sherds or plant material as temper. Through time, vessels get smaller and possess thicker walls (Brugge 1982:283). Pottery was used by the Apache for boiling meat, brewing corn beer, to store corn, seeds, and tobacco, and to melt pitch, among other uses (Ferg and Kessell 1987:66). The pointed-bottomed ollas were set into the ground and seldom moved once placed, according to early informants (Whittlesey 1998:175).

Brugge (1982:285) says that some Apache groups were producing pottery by at least 1700. Baugh and Eddy (1987:793) believe that none was earlier than 1625-1725. At recent OAS excavations in the Datil Mountains, Athabaskan Thin Utility Ware was present at LA 104381, radiocarbon-dated to approximately 1610, and at LA 39998 at 1590 (Wilson 1998:97). OAS investigations on this project yielded a single Athabaskan red-slipped sherd associated with a nearby brush structure that had a C-14 date of ca. 1640. These dates are not unreasonable given the occupation of the Mogollon Highlands by Athabaskan groups by at least the 1500s. Numerous sherds of Apache Plain have also been recovered from Apache sites in central Arizona (Huckell 1978; Tagg 1985; Ferg 1995).

Today, most Apache groups no longer produce pottery. The San Carlos Apache ceased production around 1880, along with most other groups. But prior to this, the San Carlos used boiled globe mallow in their ceramic vessels to make them stronger and less porous (Hrdli ka 1905:487). Now, the proliferation of Euroamerican ceramics has contributed to the decline in labor-intensive pottery making by the Apaches (Ferg 1992:16).

Rather than pottery, the Apache appear to have preferred using baskets as containers. Their skill was unequaled at basket weaving. Most baskets are shaped like large ollas. Burden baskets are a specific type of basket carried on the back and held in place by a tump line across the forehead. Pitched baskets, usually with handles, are used for carrying water or food (Ferg and Kessel 1987:69). The Western Apache did not use the travois (Forbes 1966:338). Numerous baskets have been found in caves with food, such as corn and acorns, still in them.

In the southern part of Apache territory, saguaro cactus, as well as oak boles, the base of agave stalks, gourds, and cushaw squash, were used as containers or cups for holding water (Ferg and Kessel 1987:69).

Another type of container used by the Apache and found in several caves in the Sierra Madres in Chihuahua, Mexico, was a calfskin sack made by skinning a calf over the head. The ends of the feet were then tied and the genital area patched with cloth. These were found in 1927, full of acorns and hair still remaining on the sack (Opler 1987:32). It is likely that young deer would have served the same purpose prior to the availability of cattle.

Lithic artifacts made by Athabaskans are seldom diagnostic and cannot be visually distinguished from Archaic or other prehistoric groups. Ferg (1992:12) believes Athabaskans used a generalized flake-core technology. He suggests they manufactured a high percentage of multiple platform cores and few bifacial reduction cores. One specialized Athabaskan tool was a mescal knife used to trim leaves off of agave heads. This is a tabular stone flaked along one side to produce a cutting edge (Ferg and Kessel 1987:55,59).

Projectile points were frequently retrieved by Apaches from prehistoric sites and often reworked. Basso (1971:231) states that an informant remembers old men going to prehistoric ruins and filling sacks with pieces of white flint. The informant says he made arrows out of cane and used points of white flint in the mid-1800s (Basso 1971:73,75). This preference for white chert, and obsidian, is also noted by Ferg (1992:12). Apache projectile points are generally considered to be crudely made with minimal symmetry (Ferg and Kessel 1987:50). Whittlesey (1998:177) describes them as typically small and triangular with side notches, although she admits to a great variety in shape. For example, Wills

(1988a:19) sees a remarkable similarity between Chiricahua points of the Archaic period and Western Apache points from the White Mountain Reservation, both with concave bases, broad ears, and crude side notches. Attempts to define an "Apache" projectile point from OAS sites in the project area were unsuccessful because of frequent mixing of cultural components on a site.

Informants told Basso (1971:231) that four different types of points were used by the Apache: stone, steel, pointed wooden foreshafts, and a four-crosspiece rig for hunting quail. When hunting deer, arrow tips were poisoned so that a deer would die from just being scratched. The poison was made from the spleen of a deer, nettles, and an unidentified plant. Poison projectile points were also used in warfare.

Ground stone was both scavenged and produced by the Apache. The preferred metate type was the slab. In some cases, scavenged trough metates have been found on Apache sites with the sides ground down. Manos are both flat and rounded. Mortars were also employed to grind mesquite beans, walnuts, and acorns (Ferg and Kessel 1987:59-61). When death of an individual occurred, any metate presumably used by that person was broken (Rogge et al. 1994).

Apaches also collected turquoise and ornaments from prehistoric sites (Whittlesey 1998:212). Crystals were gathered and strung on necklaces as medicine charms (Ferg and Kessel 1987:127). Another nonessential item, a doll made of grass, was found on a 1756 Spanish expedition (Kessell 1971:150).

Apache clothing was almost exclusively made from animal skins; they had no cotton or wool (Goodwin 1935:64). Sandals have been recovered from Athabaskan caves (Hough 1907).

From the cave sites discovered by Hough (1907) and Cosgrove (1947), we get an idea of what may have constituted Apachean ceremonial or leisure items. These include carved wooden staffs, reed cigarettes, beads, flutes, pahos, torches, dice, and painted tablitas.

Trade with Western Pueblos and sometimes with the Spanish seemed to have sustained a large part of the Apache subsistence economy. Zuni, Hopi, and the Piro pueblos are frequently mentioned as trading partners (Hammond and Rey 1928:286; Goodwin 1937:404; Danson 1957:112). Items sought by the Apache were dark blankets, buffalo hides and robes, cornmeal, cloth, and abalone shell. Goods they gave in trade included salt, game, hides, baskets, and "older turkeys" (Hammond and Rey 1966:231; Kessell 1971:142; Ferg and Kessel 1987:86).

Burials

Little information is available on burial practices of the Western Apache. All of the data presented here are from Hrdli ka (1905:492-493) and Opler (1983:377). Apaches never buried their people near dwelling areas and sometimes placed remains as far as 6-8 km away. They preferred natural rock shelters or crevices that could be covered, earth at the base of hills, and nooks in small canyons. Sometimes, remains were placed on the ground and covered with wood and brush and topped with rock up to 1. 2 m high. No coffins were ever used. Tree burial was practiced among the White Mountain Apache but not among the San Carlos, and cremation was not employed by any Apache group.

Mention is made of 80 burials found in two canyons not far from an Apache village. It seems that men, women, and children were seldom buried close to each other, but are usually in the same general vicinity. Sometimes, personal goods were buried with them and occasionally broken.

Subsistence and Seasonal Rounds

The Apache subsistence strategy of participating in seasonal rounds covering vast territories in pursuit of food resources is well documented (Goodwin 1935; Griffin et al. 1971; Aschmann 1974; Lekson 1992b). This section attempts to define Apachean movement as it pertains to specific food sources and to particular areas of the Southwest.

If the Warm Springs Apache, numbered at 1,600, can be used as a model for the extent of territory covered by single Apache groups annually (Lekson 1988b:20), then their range of 18,000 sq miles can be projected for other Apache groups of similar size. In southwestern New Mexico, Apaches apparently moved freely between several environmental zones within widely diverse spatial and elevational parameters, including the desert and riverine areas of southern Arizona and New Mexico, the foothills and mountains of northern Mexico, and the mountains of the Mogollon Highlands and Mogollon Rim.

From where did Southwestern Apache groups begin their seasonal rounds? Most agree it was a north-south movement and suggest that the Mogollon Highlands were the homeland with travel to the south determined by the need for reliable, storable food resources sufficient to maintain populations over the winter (Goodwin 1935; Kaut 1974:60; Tuggle et al. 1984:109; Lekson 1992b:22-23,132). Several researchers note that

Apachean mobility was more pronounced prior to 1870, when the U. S. government severely restricted Apache movement (Griffin et al. 1971:69; Lekson 1992b:23).

Thus, movement is considered to originate from the north and head south every winter, primarily to northwest Chihuahua in the Sierra Madres and below the Gila and Salt rivers of eastern Arizona (Ball 1970:19; Griffin et al. 1971:69; Pool 1985:69). While groups generally returned to the same resource area, slightly different locations were used each year to allow resources to be replenished (Pool 1985:69). Also, within areas, groups apparently moved camp approximately every 15 days (Buskirk 1949:288). Sometimes, several groups would winter together in a favorite spot (Kaut 1974:60). Several researchers believe that Mogollon upland occupation occurred not only in summer but spring and fall as well (Griffin et al. 1971:70; Kaut 1974:60). Goodwin's notes say that the White Mountain Apache spent spring and summer in the lower Gila Valley and late fall on the Mogollon Rim, stopping in September on their return from the south to harvest their crops (Aschmann 1974:255). Winters in the uplands are assumed from this account. Also, Murdock (1967:57) notes that some Western Apache wintered on the White River, which is in the mountain area near Fort Apache. These last two references are the reverse of what other scholars have concluded, that winters were spent in the south and summers in the northern mountains. Overwintering in the south would be the more logical scenario, but not necessarily the most correct.

The Apache subsistence strategy was one of hunting and gathering, supplemented through time by trading with the Western Pueblos, raiding of the pueblos and the Spanish, and by the practice of agriculture. But Buskirk (1986:12) cautions this pattern may have varied considerably depending on the political climate or environmental conditions. The widely dispersed biotic zones in which Apache food sources were found seems to have been the driving force behind the broad annual movements. An example would be the two most critical foods for Apaches, mescal and acorns, found at very different elevations in very different climates.

In addition to mescal and acorns, other plant food items, listed in order of importance by Buskirk (1949:287-348), are:

Sunflower seeds	Beargrass fruit and seeds
Piñon nuts	Grama and dropseed grass
Juniper berries	Devil's Claw seeds
Sotol parts	Wild grapes, cherries, plums
Walnuts	Strawberries, manzanita
Mesquite beans	Pigweed, lambsquarter, beeplant
Saguaro fruit	
Saguaro seeds	Inner bark of pine trees
Cacti fruit	Maize and mushrooms
Cacti seeds	Wild onions, tomatoes,
Spanish bayonet	hyacinth bulbs, tule bulbs

In 1785, Cordero notes that mescal was a principal delicacy of the Apache (Kessell 1971:149). It is made from the agave plant and found in the southern reaches of Apache territory, particularly in the Sierra Madres of Mexico and in the desert lowlands of Arizona. It can be harvested in any season, but is perhaps best in the early spring (Buskirk 1949:298). Mescal was valuable to the Apache for its year-round availability and because it could be used variously as a type of gruel mixed with ground berries, as a flour for bread, also as an intoxicant, and shredded for thread. Another advantage was that it could be stored for up to six months (Basehart 1973:157). Processing mescal involved cutting the agave crowns from the plant, placing them in a large roasting pit with hot rocks upon which the crowns are spread, then covering them with layers of grass and earth, and roasting them for at least 24 hours. The cooked crowns could then be dried in slabs to be reconstituted later (Windmiller 1972:20). The processing often took the efforts of several people.

Acorns were a major winter staple for the Apache and are found in piñon-juniper zones, sometimes in the Mogollon Highlands where there are scattered stands, but mostly in the higher elevations in the southern areas (Lekson 1992b:82). They are available in late July and August. The White Mountain Apache climb up the trees and shake them down onto the ground, then gather them in baskets to return to their homes (Basso 1971:96). Because of having to move from stand to stand, and the limited window of opportunity for gathering, communal groups were frequently used for collecting of the acorns, sometimes taking up to a month (Buskirk 1949:283). To process, the nuts are shelled and ground to produce a coarse meal that can then be mixed with berries, meat, or other foods (Basso 1971:304). Leaching the nuts of tannic acid is not mentioned for the Western Apache as it is for eastern New Mexico groups.

Other plant foods used by the Apache include sunflower and grass seeds gathered by baskets in late summer. In 1756, Cordero states that the Apache made a type of pinol of grass seeds, which they reaped with great care (Kessell 1971:159). Both sunflower and grass seeds were stored and used as important winter food (Pool 1985:49).

Piñon nuts and juniper berries are found in similar locations and are gathered in October and November. Both can also be stored for use in winter. However, piñon availability can vary widely from region to region and on an annual basis. Reagan (1928:146-147) notes that the White Mountain Apache women collected the piñon cones and burned them, also roasting the nuts at the same time. Juniper berries are more reliable and processing involves drying the berries, then boiling them in water until soft. The mashed berries would then be ground into a pulp, molded into balls, and stored for later use (Basso 1971:96).

Sotol is found in the southern areas of Apache territory and is gathered in late spring or early summer. Walnuts are found at higher elevations in scattered stands along major streams (Lekson 1992b:21) and are gathered in late summer or early fall.

Mesquite beans are widely present, mostly in the southern areas, and are collected in the summer. Their availability, however, can vary greatly from year to year; thus, it is not always a reliable food source (Lekson 1992b:19). The beans are used to make a meal or cake (Ball 1970:19).

Saguaro and prickly pear cactus are found primarily in southeastern Arizona. The saguaro fruit is gathered in July and can be stored as a winter staple (Pool 1985:49). The prickly pear fruit (tuna) is usually gathered in September, sometimes earlier, and is pounded into dry cakes, which are then left to harden (Basehart 1960:39; Basso 1971:256). Spanish bayonet (yucca) is also a southern plant of New Mexico and Arizona; however,it can also be found, to some degree, in the lower elevations of the northern Apache area. It is available in early September and can be stored for winter use.

Other plant foods on Buskirk's (1949) list are minor resources and used on an as needed basis or as encountered. One interesting item used when food supplies are very low is the inner bark of pine trees. The Apaches would peel back the outside bark of ponderosa in a strip approximately 3-4 ft long and 1 ft wide. They would then remove the white, pulpy layer, which is usually about - inch thick. This would be placed in water and kneaded until the turpentine in the sap was worked out. It was then roasted slightly and eaten. It is said to taste almost like crackers (McFarland 1974:25).

Hunting large game was best pursued in the foothills and mountains of the northern highlands. Goodwin (1935) indicates that late spring was the preferred time of procurement when planting of crops was over and gathering of wild foods had not yet begun. However, prior to the growing of crops, the procurement period for wild plants may have been somewhat different. Deer was the most sought after meat source (Buskirk 1949:280). In 1885, one witness saw Navajo scouts between the Blue River and the WS Ranch near Alma kill 84 deer of all sizes in one day, carefully preserving the hides and intestines. The scouts said they did it to prevent the Apaches from getting them (French 1990:88). Earlier, in 1756, Saenz reports that he saw the Apache also eating pronghorn, rabbit, and quail (Kessell 1971:149). In 1796, bear, javelina, panther, and porcupine were added to the supposedly Athabaskan diet (Matson and Schroeder 1957:338). Today, the list has grown to include elk (although not often), mountain sheep, bear, mountain lion, bobcat, woodrats, squirrel, prairie dog, field mice, beaver, racoon, badger, birds, turkey, doves, pigeons, geese, ducks, tortoises, and snakes (Basso 1971:97; Pool 1985:54-55). Caterpillars were sometimes used to make a gruel, and bone marrow and blood were also used as subsistence supplements (Terrell 1974:43-44). After Spanish contact, Apaches also enjoyed mules, horses, sheep, and cattle.

There is, however, some controversy over a few of the items on the above list. Ogle (1970:18) states that Apaches did not eat bear, Kessell (1971:149) says bear was only hunted by religious practitioners, but Colyer (1872:6) notes that the Apache on the Gila River ate it. Likewise, in 1756, Cordero says beaver was eaten by the Apache (Kessell 1971:149) and Pool agrees (1985:55), while Ogle (1970:18) states that it was not eaten. Most researchers believe the Apache did not eat reptiles or fish (Ogle 1970:18; Basso 1971:31: Kessell 1971:159; Pool 1985:55); however, Lekson (1992b:16) says they ate fish occasionally out of the Rio Grande. Wolf and coyote were not eaten says Pool (1985:54), but Terrell (1974:43-44) says that the Cibecue Apache did consume them. Then, Pool (1985:54) says mountain lions were eaten and Terrell (1974:43-44) says only the White Mountain Apache partook of them. All seem to agree that while birds were consumed, birds of prey were not. It is not known whether or not the Apaches ate turkeys; Ferg and Kessel (1987:86) say they were kept as pets when young and then traded to the Zuni.

Growing corn, beans, and squash was never a major subsistence pursuit by the Apache, although some were more actively engaged in it than others, such as the Cibecue Apache, but not the Chiricahua (Opler 1983:370) or the Northern Tonto. However, agricultural products probably provided no more than 25 percent of any group's economic base (Kaut 1974). Small plots planted by the Apache have been recorded since the 1620s in southwestern New Mexico (Cremony 1868:217; Forrestal 1954:42; Forbes 1960:118; Pool 1985:58; Lekson 1992b:31), particularly along the Gila and San Francisco rivers. Interestingly, Benavides says that in 1630 each main village had its own recognized territory in which they planted corn and other crops (Forrestal 1954:42). The idea of permanent agricultural fields, Kaut (1974:60) believes, has provided groups with fixed points of reference and tied people to the land.

Apparently women sowed the seeds for the crops, watered them, and harvested at the proper time (Matson and Schroeder 1957:340). Seeds were also sometimes tossed near camps in sandy places, washes, or beside streams. Fields were irrigated by hand or positioned next to springs, seeps, or runoff areas (Pool 1985:59, 61). An elderly informant tells of people in the mid-1800s creating ditches with a digging stick and making dams in creeks to water corn. Women would carry the loose dirt off in baskets (Basso 1971:95). For the Apache, growing crops was not a full-time occupation. Early accounts recount them leaving their small fields to natural influences and going off to pursue other activities, returning only at harvest time. Maize kernels were found in one Athabaskan roasting pit at Ladybug Junction on the Luna project.

In reviewing north to south subsistence rounds as proposed by most writers (with the exception of Goodwin), the logistics of obtaining desired foods would require a reverse pattern of seasonal rounds. Agave, saguaro, Spanish bayonet, prickly pear, and mesquite all ripen in summer and, more importantly, are found mostly south of the Gila and Salt rivers. Acorns are available in the fall in the higher southern areas and in the Mogollon Highlands. Piñon nuts, juniper berries, and most game are primarily available in the northern mountain zones in the fall and into early winter. Aschmann (1974:255), using Goodwin's 1942 notes, is the only scholar to suggest the Apaches may have wintered in the north and spent a part of the summer in the south. This would seem to be the correct flow of movement logistically, based on seasonal plant availability. In corroboration, McFarland (1974:25), says that in December 1885, at Soldier's Hill near Glenwood, an Apache encampment was located in a canyon with piles of wood stacked around it. But, in contrast, the several Athabaskan brush structure remains found on this project did not contain interior hearths, suggesting a warm weather occupation. To support a summer highland occupation, French (1990:62) records a group of Apaches seen on the Blue River near Alma in May 1885. There also may be a semantic problem in describing north to south movements. Lekson (1992b:36) speaks of the eastern Chiricahua (who live in the southern area) going south to the Sierra Madres in winter for agave, so that "going south" may mean Mexico to many Apache groups residing in the south, but may not necessarily mean that to those who lived in the north.

In sum, the archival and archaeological data seem to send mixed signals as to the best times to be in specific locales. So few archaeological remains have been excavated, that the issue cannot be resolved without further recovery of plant and structural remains.

Athabaskan Sites in the Mogollon Highlands

Prior to this project, no Athabaskan sites had been excavated within the Mogollon Highlands area, although several have been recorded on surveys. The OAS investigations in the Luna-Reserve areas and in the nearby Datil Mountains produced eight excavated Athabaskan sites that have been dated by radiocarbon analysis. The two sites in the Datil Mountains (Hayden et al. 1998) yielded Athabaskan pottery and C-14 calibrated intercept dates of 1590 and 1610. The six sites on the Luna project contained four hearths, four shallow brush structure depressions, three roasting pits, one pit of unknown use, and several burned areas. Only one Athabaskan sherd was recovered. All are open-air sites and five of the six were located in the same piñon-juniper zone with oak stands nearby. The 21 C-14 calibrated intercept dates are: 1400, 1420, 1430, 1440, 1475, 1490, 1530, 1560, 1630, 1640, 1640, 1660, 1660, 1670, 1680, 1690, 1730, 1735, 1750, 1810, and 1815. Given the strong possibility of the use of old wood by site occupants and the seemingly out-of-place dates on the 1400s map (Fig. 1. 22a), valid dates for these sites might not actually begin until the 1500s. Complete descriptions of these sites may be found in Volume 2.

Other Athabaskan sites in the Mogollon Highlands have been recorded on survey and include cave sites. Athabaskan sherds have been found near Reserve at the Y Canyon Cave (Martin et al. 1954:70) and Negrito Cave, and an Athabaskan olla was found at Delgado Cave (Martin et al. 1954:70). The OAS crew also found arrows, presumably Athabaskan, cached in a small niche at O Block Cave. Other sites include small stone rings at Devil's Park (Peterson 1988a:114), and rock art with flower and star patterns east of Apache Creek (R. Newton, pers. comm. 1992). Hough (1907) mentions caves along the San Francisco River, on the Blue River, near Alma, and at Saddle Mountain that contained well-preserved bows, arrows, baskets, and ceremonial paraphernalia, all thought to be Athabaskan. Likewise, the Cosgroves (Cosgrove 1947) describe several caves in the upper Gila and Mimbres areas that contain the same complex of well-preserved artifacts.

Like Archaic sites in the Mogollon Highlands, there should be many more Athabaskan sites present than are currently documented. Survey crews should be aware that the potential for finding Athabaskan sites is high. Lithic artifact scatters should be particularly examined for hearths that could produce radiocarbon or archaeomagnetic samples that would date this type of site.

APPENDIX 1.1. OBSIDIAN HYDRATION AGE DATING ANALYSIS

Report 1

Glenn S. Russell[1]

Fifty-nine (59) samples of obsidian from 14 sites in the Luna and Reserve areas of the Mogollon Highlands of New Mexico (Mule Creek source) were submitted for age determination using the piece-specific obsidian hydration dating method as described below (Stevenson et al. 1996; Mauldin et al. 1996 for published examples of the method).

All data submitted include the sample or field number plus the UCLA OHL Number (Obsidian Hydration Laboratory Control Number), which identifies the thin-section slides. Future inquiries should include the OHL numbers if at all possible.

Table A1.1 summarizes, by sample, the hydration rim, density, EHT (effective hydration temperature), RH (relative humidity), intrinsic water content, Arrhenius equation/activation energy results, the resultant diffusion rate constant (microns squared/k years), and the resultant age in hydration years B.P.

The piece-specific hydration rate method utilized three analytical procedures, which are explained in the discussion below:

1. Measurement of the hydration rind thickness.
2. Calculation of rate constants determined from glass composition (the Ambrose/Stevenson relative density/intrinsic water method).
3. Measurement or estimation of soil temperature and relative humidity at the site.

This approach to the estimation of hydration rates differs from earlier methods, which were largely or entirely empirical, wherein hydration rim depths were "matched" to associated nonobsidian dating information to create a source-specific hydration rate. This method results in a hydration rate for each artifact.

Obsidian hydration dating is based on the observation that water ions form measurable rinds as a result of diffusion into rhyolitic obsidian glass. This rate is stated in the form of d^2=kt where d^2=thickness of rind in microns squared, k=piece specific factor and t=time period (the convention, used herein, is per thousand years). The rate (k) is affected by external factors (the environment, i.e., relative humidity and temperature) and by the internal chemistry of the glass, which varies sufficiently to require that each sample has its own rate.

Results and Analysis

These dates (Table A1.1) are experimental and subject to evaluation and revision. The estimation of EHT and RH is critical for the calculation of dates. The preferred method for the estimation of these variables involves direct measurement by burying EHT and RH measurement cells in the site. These data were available for this project. In addition, the calculation of dates assumes that the estimated environmental variables are characteristic for the entire depositional history of the artifacts with no change over time. These dates should be considered "hydration years B.P."

Below is an explanation of the methods or factors utilized. Work sheets on the determinations of the hydration rinds, density determination data, and slices are on file at UCLA. These data are available upon request.

Methods and Factors

Hydration Rim Measurement

A thin-section slide was prepared for each sample. The rind thickness was measured by taking five independent measurements under a Jenaval model polarizing light microscope with a Leitz filar micrometer attachment at 625X power. The rind or depth of water diffusion is visible because the rind of obsidian with added external water ions refracts light as a different angle than the internal parent material.

All flake surfaces visible in cross section on the microscopic slide are carefully examined. Usually there are only two surfaces visible, such as the dorsal and ventral surfaces of a flake. In practice, however, more than two surfaces are sometimes found (reuse or retouch edge flake scars). Only clearly visible intact hydration rinds with well-defined diffusion fronts are measured.

A measurement consists of the average of five measurements made at one point on the hydration rind.

[1]UCLA Institute of Archaeology, Obsidian Hydration Laboratory

Table A1.1. Obsidian Hydration Dates

OHL	RIM		EHT	RT	OH	RATE	AGE			SITE	SAMPLE	XRF
15652	2.2		11.3	0.995	0.1247	2.2	2202		L	45507	596	MM
15653	1.6		11.3	0.995	0.1198	2.1	1240		L	45507	847	CC
15654	5.9		11.3	0.995	1.3940	41.4	841	water	L	45507	1854	RH
15655	2.4		11.3	0.995	0.1248	2.2	2618		L	45507	2299	MM
15656	2.1		18.2	0.957	0.1236	4.6	960		L	39975	411	CC
15657	8.7		18.2	0.957	0.9011	51.6	1468	water/rim	L	39975	501	GC
15658	5.4		18.2	0.957	.01258	4.7	6180		L	39975	624	MA
15659	2.3		11.3	0.995	0.1254	2.2	2384		L	70185	326	MA
15660	3.4		11.3	0.995	0.4096	10.9	1064		L	70185	486	MM
15661a	5.0	X	11.3	0.995	0.8728	25.4	984	drill	L	70185	512	RH
15661b	11.0		11.3	0.995	0.8728	25.4	4761	rim	L	70185	512	RH
15662	4.3		11.3	0.995	0.1268	2.3	8193		L	45508	239	CC
15663	3.7		11.3	0.995	0.1221	2.1	6432		L	45508	242	MA
15664	4.3		11.3	0.995	01233	2.2	8555		L	45508	296	MA
15665	7.3		11.3	0.995	0.1207	2.1	25514	rim	L	45508	579	
15666	1.7		11.3	0.995	0.1207	2.1	1384		L	45508	612	M/C
15667a	1.9	X	14.5	0.981	0.1248	3.2	1141		R	70189	8	CC
15667b	2.8		14.5	0.981	0.1248	3.2	2478		R	70189	8	CC
15668	1.6		14.5	0.981	0.1256	3.2	801		R	70189	179	CC
15669a	3.3	X	18.2	0.957	1.8230	103.3	105	water	R	75791	19	RH
15669b	4.9		18.2	0.957	1.8230	103.3	232	water	R	75791	19	RH
15670	3.0		18.2	0.957	0.1293	4.9	1829		R	75791	69	MM
15671	3.0		18.2	0.957	0.1341	5.2	1732	rim est	R	75791	152?	GC
15672	0.9		18.2	0.957	0.4405	23.9	34	rim	R	75791	134	MA
15673	2.3		18.2	0.957	0.1237	4.6	1150		R	75792	447	MA
15674	4.0		16.9	0.976	0.1221	4.1	3948		R	70188	1150	MM
15675	5.4		46.9	0.976	0.1278	4.3	6712		R	70188	1272	MM
15676	4.4		16.9	0.976	2.2673	116.3	166	water	R	70188	1345	MA
15677	6.2		16.9	0.976	0.1734	6.7	5698		R	70188	1439	MA
15678	3.1		16.9	0.976	0.1133	3.6	2666		R	70188	1544	MM
15679	4.3		16.9	0.976	0.1230	4.1	4514		R	70188	1558	MM
15680	4.6		16.9	0.976	0.1596	6.0	3520		R	70188	1605	MA
15681	6.4		16.9	0.976	0.3001	13.8	2979		R	70188	1615	MA
15682	4.7		16.9	0.976	0.1214	4.0	5503		R	78439	142	MA
15683	2.4		16.9	0.976	0.0782	1.9	2988	water	R	78439	179	MM
15684	3.7		16.9	0.976	0.1258	4.2	3229		R	78439	232	MM
15685	8.2		16.9	0.976	0.1269	4.3	15644	rim	R	37917	33	MM
15686	3.8		16.9	0.976	0.1077	3.3	4342		R	37917	266	MM
15687	6.5		16.9	0.976	0.1278	4.3	9734	eroded	R	37917	267	MA
15688	6.1		16.9	0.976	0.1291	4.4	8445		R	37917	338	MM
15689	7.2		16.9	0.976	1.7249	89.7	578	water/rim	R	37917	540	MM
15690	3.0		14.5	0.981	0.1255	3.2	2820		R	37919	16	MA
15691a	2.7	X	14.5	0.981	0.1256	3.2	2280		R	37919	22	MA
15691b	3.0		14.5	0.981	0.1256	3.2	2815		R	37919	22	MA
15692	8.5		18.2	0.957	0.4963	27.3	2647	rim/water	R	39968	416	
15693	2.8		18.2	0.957	0.1253	4.7	1672		R	39968	512	
15694	3.6		18.2	0.957	0.1245	4.6	2790		R	39968	1918	
15695	3.0		18.2	0.957	0.1255	4.7	1914	core	R	39968	2173	MA
15696	1.6		18.2	0.957	0.1206	4.4	578		R	39968	2440	MM
15697	4.4		18.2	0.957	0.1249	4.7	4145		R	39969	410	

Measurements are made for each distinct hydrated surface for which a clear hydration rind is visible. The resulting measurements from various surfaces are themselves averaged if they are within 0.4 microns. If the variability is greater than 0.4 microns, they are reported separately (often diagnostic of reuse). Normally, a reported measurement is either a single or the average of two hydrated layers.

Unless specifically requested, the laboratory considers an analysis done if at least one clear hydration rind is measurable on a prepared slide. All reported measurements should be accurate to within ±0.2 microns. Although this measurement error could be used to calculate a plus and minus range for the date, it would not take into consideration other factors, such as environmental change over time, which may cause the hydration years B.P. to vary from the actual years B.P. date.

Calculation of dates based on the piece-specific rate method uses only the smallest verified rind from each sample, based on the assumption that the smallest measurement is more likely to date the depositional context from which the obsidian was recovered.

Environmental Factors (RH, EHT)

The rate or speed of hydration (higher rate means a younger date for a given rim thickness) is affected by the quantity of water ions available in the surrounding atmosphere referred to as relative humidity (RH). For an explanation of the algorithm or relationship between RH and hydration rate, see Friedman et al. (1994).

The other significant environmental factor affecting obsidian hydration is the rate of chemical reaction. This is defined by the Arrhenius equation (Laidler 1984), which requires measurements of the temperature at which the reaction is taking place. Since the temperature at any site changes constantly, a means was developed that "averaged" the temperature, accounting for the greater effect of temperature rise versus temperature drop on the chemical reaction. This is known as the "effective hydration temperature" (EHT). The superior method for measuring EHT (and RH) is via saturated salt cells buried for one year at various depths in a site, and subsequently analyzed. The UCLA lab both prepares and analyzes these cells.

Another method for estimating EHT is to use air temperature data from weather stations using Lee's equation (Lee 1969). However, air temperature is not equal to subsurface temperatures and our experience indicates that air temperature data used in Lee's equation results in EHTs understated by several degrees. This can have a significant effect on the calculation of dates. The UCLA laboratory has begun a project that compares buried cell data to data from nearby weather stations in order to better estimate subsurface EHT from weather station data. Additional corrections are applied to each sample for activation energy variation.

A different type of salt cell may be used to measure RH, another critical variable. Usually, EHT and RH cells are buried in pairs at various depths in a site to provide a profile of environmental variability with depth. In the absence of cell data, RH may be more easily estimated than EHT, assuming that the RH approaches 95-99 percent in most sites below 20 cm. The accuracy of any study of age determination is highly dependent upon this data, which is greatly enhanced if it is from the use of site specific cells.

Internal Chemistry

Work by Ambrose and Stevenson (1995) established relationships between the rate of hydration, the amount of intrinsic water (probably due to the depolymerizing effect of water ions on the silica matrix), and density. Stevenson and others (1993) also determined that the amount of water varies significantly from sample to sample in a single obsidian source, requiring artifact-specific measurements of this variable (density) for the purpose of rate estimation.

The density measurement utilizes the weight in air versus weight in liquid of each sample of obsidian taking advantage of the Archimedean principle. Weights are taken on a scale valid to four decimal places (UCLA uses a Mettler AG104 balance) using a heavy liquid to increase surface adhesion and reduce bubbles, thereby reducing errors.

Final Spread Sheet (Table A1.1)

All of the data defined above that affects the determination of "k" in the diffusion time/depth curve are then put into a single spread sheet by sample. Factors include RH, EHT, and intrinsic water content. The result is k. The age, in hydration years, is then determined by using the rim as the multiplier in the diffusion equation.

APPENDIX 1.2. OBSIDIAN HYDRATION AGE DATING ANALYSIS

Report 2

Glenn S. Russell[1]

Eight obsidian points from Luna-Reserve sites LA 3279, LA 39968, LA 39969, LA 45507, and LA 70196 were submitted for age determination using the intrinsic water piece-specific obsidian hydration dating method (see Stevenson et al. 1996; Mauldin et al. 1996, for published examples of the method).

Inasmuch as one of the primary goals of the Museum of New Mexico was to look for evidence of reuse, multiple slides were made from each artifact. A cut was made on each artifact along the side (blade cut) and along the base (basal cut). All rims (n=19) were analyzed and dated. The submitted data summary is by artifact and type of cut.

All data submitted include the sample or field number plus the UCLA OHL No. (Obsidian Hydration Laboratory Control Number), which identifies the thin-section slides. Table A2.1 summarizes, by sample, the hydration rind, density, EHT (effective hydration temperature), RH (relative humidity), intrinsic water content, Arrhenius equation/activation energy results, the resultant diffusion rate constant (microns squared/k years) and the resultant age in hydration years B.P.

METHODS AND FACTORS

Obsidian hydration dating is based on the observation that water ions form measurable rinds as a result of diffusion into rhyolitic obsidian glass. This rate is stated in the form of d^2=kt where d^2 = thickness of rind in microns squared, k = piece-specific factor and t = time period (per thousand years). The rate (k) is affected by external factors (the environment, i.e., relative humidity and temperature) and by the internal chemistry of the glass (i.e., water content), which varies sufficiently to require that each sample has its own rate (Stevenson et al. 1993).

The piece-specific hydration rate method applied herein utilizes three analytical procedures:

1. Measurement of the hydration rind thickness.
2. Measurement or estimation of soil temperature and relative humidity at the site.
3. Calculation of rate constants determined from glass composition (the Ambrose/Stevenson relative density/intrinsic water method).

This approach to the estimation of hydration rates differs from earlier methods, which were largely or entirely empirical, wherein hydration rim depths were "matched" to associated nonobsidian dating information to create a source-specific hydration rate. This method results in a hydration rate for each artifact.

Hydration Rind Measurement

A thin-section slide was prepared for each sample. We measured the rind thickness by taking five independent measurements under a Jenaval model polarizing light microscope with a Leitz filar micrometer attachment at 625X power. The rind or depth of water diffusion is visible because the rind of obsidian with added external water ions refracts light at an angle different from that of the parent material.

We carefully examined all flake surfaces visible in cross section on the microscopic slide. Usually there are only two surfaces visible, such as the dorsal and ventral surfaces of a flake. In practice, however, more than two surfaces are sometimes found (reuse or retouch edge flake scars). Only clearly visible intact hydration rinds with well-defined diffusion fronts are measured.

A measurement consists of the average of five measurements made at one point on the hydration rind. Measurements are made for each distinct hydrated surface for which a clear hydration rind is visible. The resulting rinds from various surfaces are themselves averaged if they are within 0.4 microns. If the variability is greater than 0.4 microns, they are reported separately (often diagnostic of reuse). Normally, a reported measurement is either a single or the average of two hydrated layers.

Unless specifically requested, the laboratory considers an analysis done if at least one clear hydration rind is measurable on a prepared slide. All reported measurements should be accurate to within ±0.2 microns. Although this measurement error could be used to calcu-

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late a plus and minus range for the date, it would not take into consideration other factors, such as environmental change over time, which may cause the hydration years B.P. date to vary from the actual years B.P. date.

Calculation of dates based on the piece-specific rate method uses only the smallest verified rind from each sample, based on the assumption that the smallest measurement is more likely to date the depositional context from which the obsidian was recovered.

Environmental Factors (RH, EHT)

The rate or speed of hydration (higher rate means a younger date for a given rim thickness) is affected by the quantity of water ions available in the surrounding atmosphere referred to as relative humidity (RH). For an explanation of the algorithm or relationship between RH and hydration rate, see Friedman et al. (1994).

The other significant environmental factor affecting obsidian hydration is the rate of chemical reaction. This is defined by the Arrhenius equation (Laidler 1984), which requires measurements of the temperature at which the reaction is taking place. Since the temperature at any site changes constantly, a means was developed that "averaged" the temperature, accounting for the greater effect of temperature rise versus temperature drop on the chemical reaction. This is known as the "effective hydration temperature" (EHT). The superior method for measuring EHT (and RH) is via saturated salt cells buried for one year at various depths in a site, and subsequently analyzed. The UCLA lab both prepares and analyzes these cells.

Another method for estimating EHT is to use air temperature data from weather stations using Lee's equation (Lee 1969). However, air temperature is not equal to subsurface temperatures and our experience indicates that air temperature data used in Lee's equation results in EHTs understated by several degrees. This can have a significant effect on the calculation of dates. Therefore, this report uses an EHT calculated via Lee's equation multiplied by 1.17 as a correction factor. (The UCLA laboratory has begun a project that compares buried cell data to air data from nearby weather stations in order to better estimate subsurface EHT from weather station data.)

A different type of salt cell may be used to measure RH, another critical variable. Usually, EHT and RH cells are buried in pairs at various depths in a site to provide a profile of environmental variability with depth. In the absence of cell data, RH may be more easily estimated than EHT, assuming that the RH approaches 95-99 percent in most sites below 20 cm. The accuracy of any study of age determination is highly dependent upon these data, which is greatly enhanced if it is from the use of site-specific cells. This report uses EHT and RH data provided by the OAS based on the recovery and analysis of several Luna-Reserve Trembour cells by ASC, Inc.

Internal Chemistry

Work by Ambrose and Stevenson (1995) established relationships between the rate of hydration, the amount of intrinsic water (probably due to the depolymerizing effect of water ions on the silica matrix), and density. Stevenson et al. (1993) also determined that the amount of water varies significantly from sample to sample in a single obsidian source, requiring artifact-specific measurements of this variable (density) for the purpose of rate estimation.

The amount of intrinsic water is the internal chemistry factor. Prior to the work of Ambrose and Stevenson, determining this quantity for each sample (because of nonhomogeneity of the water content) was difficult, costly, and time consuming. Based on a large empirical study of multiple obsidians, Ambrose and Stevenson determined a quantifiable relationship between relative density and intrinsic water.

The density measurement utilizes the weight in air versus weight in liquid of each sample of obsidian taking advantage of the Archimedean principle. Weights are taken on a scale valid to four decimal places (UCLA uses a Mettler AG104 balance) using a heavy liquid to increase surface adhesion and reduce bubbles, thereby reducing errors.

The algorithms that determine how to go from density to water content to effect a hydration rate is contained in software from Dr. Stevenson (ASC, Columbus, Ohio) and defined in the Ambrose and Stevenson (1995) article. The algorithms include correction factors for calculating density for the special liquid's temperature and for laboratory to laboratory calibration using a master quartz wedge.

Results and Analysis

All of the variables defined above that affect the determination of "k" in the diffusion time/depth curve are then input into a spread sheet by sample. Factors include RH, EHT, and intrinsic water content. The result is "k". The age, in hydration years, is then determined by using the rim as the multiplier in the diffusion equation (Table A2.1).

Please note that these dates are experimental and subject to evaluation and revision. The estimation of EHT and RH is critical for the calculation of dates. The preferred method for the estimation of these variables involves direct measurement by burying EHT and RH

Table A2.1. Obsidian Hydration Dates on Projectile Points

OHL	Sample	Cut	Rim	EHT	RH	OH%	Rate	Age
				per MNM				
15916	3279-216	blade	4.5	11.3	0.995	0.126	2.2	9037
15924	3279-219	base	4.5	11.3	0.995	0.126	2.2	9037
15917	3279-298	blade	3.8	11.3	0.995	0.170	3.5	4151
15925	3279-298	base	3.7	11.3	0.995	0.170	3.5	3935
15918	3279-674	blade	8.3	11.3	0.995	0.520	14.3	4803
15926	3279-274	base	7.5	11.3	0.995	0.520	14.3	3922
15919	39969-750	blade	5.7	18.2	0.957	0.602	33.7	963
15927	39968-750	base	4.9	18.2	0.957	0.602	33.7	712
15920	39969-928	blade	0.9	18.2	0.957	0.473	25.9	31
15928	39969-928	base	0.8	18.2	0.957	0.473	25.9	25
15921	39969-942	blade	4.4	18.2	0.957	0.489	26.8	721
15921	39969-942	blade#2	5.6	18.2	0.957	0.489	26.8	1168
15929	39969-942	base	4.7	18.2	0.957	0.489	26.8	823
15922	45507-1879	blade	4.4	11.3	0.995	0.405	10.7	1809
15930	45507-1879	base	4.4	11.3	0.995	0.405	10.7	1809
15923	70196-130	blade	3	18.2	0.957	1.056	60.6	149
15923	70196-130	blade#2	5.4	18.2	0.957	1.056	60.6	481
15931	70196-130	base	4.2	18.2	0.957	1.056	60.6	291
15932	70196-130	base#2	4.9	18.2	0.957	1.056	60.6	396

measurement cells in the site.

Assuming that a difference of 0.5 microns or more for the hydration rinds per artifact is beyond measurement error, four of the eight artifacts show evidence of reuse. The pattern of reuse, however, does not follow the expectation that the base would be older and the edge younger due to edge rework. This indicates a probably more wholesale reworking of the artifact. We also note that the resultant dates across the artifacts are highly variable. This is probably due to the significant difference in reported EHTs from site to site, the fact that all or most of these artifacts are from surface collections that often have a higher variability (due to thermal or mechanical stress), and the water content is also highly variable.