THE ARCHAEOLOGY OF PUEBLO POPULATION CHANGE ON THE JEMEZ PLATEAU, A.D. 1200 TO 1700: THE EFFECTS OF SPANISH CONTACT AND CONQUEST

Approved by:

____
Dr. Michael Adler

____
Dr. Cathy Lebo

____
Dr. David Meltzer

____
Dr. Ann Ramenofsky

THE ARCHAEOLOGY OF PUEBLO POPULATION CHANGE ON THE JEMEZ PLATEAU, A.D. 1200 TO 1700: THE EFFECTS OF SPANISH CONTACT AND CONQUEST

A Dissertation Presented to the Graduate Faculty of

Dedman College

Southern Methodist University

in

Partial Fufillment of the Requirements

for the Degree of

Doctor of Philosophy

with a

Major in Anthropology

by

Jeremy Kulisheck

(B.A. University of New Mexico, Albuquerque, New Mexico, 1991)
(M.A. Southern Methodist University, Dallas, Texas, 1996)

May 14, 2005

UMI Number: 3167262

ACKNOWLEDGEMENTS

Funding for all phases of this research project was provided by a variety of sources. Major funding for the fieldwork portion of the research came from a dissertation improvement grant from the Wenner-Gren Foundation for Anthropological Research, Inc. (Grant No. 6356). Additional funding for fieldwork was provided by a dissertation research grant from an anonymous donor through the Institute for the Study of Earth and Man at Southern Methodist University (SMU). Funding for collections work was provided by a visiting scholar award from the Field Museum of Natural History, a graduate research fellowship from the Clements Center for Southwestern Studies at SMU, and thesis research funds from SMU's Dedman College Graduate Student Assembly. Funds that covered a portion of the write-up came from a dissertation completion fellowship awarded by the Department of Anthropology, SMU. Additional and critical financial support for all phases of my research came from Richard Kulisheck and Eliza Frank.

A number of people helped me with my fieldwork between 1996 and 2001, and I am grateful to all. Many helped out during my first year in the field, 1996, including Martin Honeycutt, Lana Coggeshall, Jason LaBelle, Joe Gray, Jacob Kaltenbach, Gerry Raymond and especially Elizabeth Burghard, who gave up four weeks of her summer to lend a hand. Among those who helped out between 1998 and 2001 included Tim Johnson, Jacob Kaltenbach, Eliza Frank, and Dave Dabney. Ana Steffen and John Young provided invaluable in-field advice on lithics and geological matters. Rita Skinner of the USDA Forest Service, Santa National Forest, Jemez Ranger District, found us housing on Fenton Hill in 1996, allowed me to copy a large volume of site records, and provided me with paint, site tags and assistance with a host of other logistical issues. Phil Neff and Larry Panana at Jemez District helped keep the water running and the lights on in the Fenton Hill trailers. In 2000, Ron Herrera at Jemez District allowed me access to San Juan Mesa, despite closures due to fire danger. Several people provided me with field equipment for the research. In 1996, Mike Adler supplied me with a range of equipment from Fort Burgwin Research Center, and my fellow graduate student Lisa Bibb loaned me additonal equipment. Ann Ramenofsky at the University of New Mexico graciously loaned her total station for mapping at several sites. In 1998, I was thankful for the loan of a Brunton compass and other equipment from Mike Bremer at the Santa Fe National Forest. Permits to conduct field work on the Santa Fe National Forest were facilitated by Mike Bremer at the Santa Fe. I am also grateful to Governor Randy Padilla of Jemez Pueblo, and Bill Whatley of the Governor's Office, for the opportunity to consult with the Pueblo during the permitting process.

For a variety of reasons, I was unable to incorporate most of my collections research results into this study. However, the ability to examine collections from many sites at several institutions was invaluable to formulating observations about ceramic variation on the Jemez Plateau. I am grateful to Jenny Sandlin, Pat Nietfeldt, and Louise Stiver at the Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico for access to the collections from Guisewa (LA 679), and to Dody Fugate in the Lab's Mera Room for assistance with the Mera collections from many Jemez sites, and the type collections for the Rio Grande Glaze wares. Tony Thibodeau and Julia Clifton provided important additional information on other Jemez collections stored at the Lab, and Curt Schaafsma shared his knowledge of the history of various research projects, and his chronology for Rio Grande Glaze wares. The initial site data for the project was generated from the New Mexico Cultural Resource Information System by Tim Seaman and Leslie Bischoff at the Archaeological Records Management Section (ARMS), New Mexico Historic Preservation Division, also located at the Lab, and Louanna Haecker of ARMS helped me access the site files for Guisewa and other sites located at the Lab.

Brenda Dorr provided access to excavated materials from Bj74 (LA 38962), Paul Reiter's papers, and other collections at the Maxwell Museum of Anthropology, University of New Mexico. Ralph Luebben allowed me to examine additional materials from Bj74 held at Grinnell College, and his original notes and ceramic analysis worksheets. I am grateful to Jonathan Haas and Winifred Creamer at the Field Museum of Natural History for providing me the opportunity to perform analysis on their collections from excavations at Seshukwa (LA 303) and Kwastiyukwa (LA 482), and additional access to their database and notes on ceramics from large sites in the northern and central Rio Grande Region. At the University of Colorado Museum, Diana Leonard and Linda Cordell allowed me to utilize the Anna O. Shepard Archives, along with the accompanying collections. I am also grateful to Linda for her hospitality while I was in Boulder.

The intellectual and procedural assistance I received in researching and writing this dissertation was unparalleled and I am sure that there are many who helped that I will fail to mention, and to those, I apologize. Foremost assistance came from the members of my committee. Mike Adler, my committee chair at SMU, was instrumental at all stages of the prepatory work, field work, research and writing, and helped me in so many ways that I cannot identify them all. I am especially grateful, however, for his intellectual support in shaping arguments linking population to agricultural intensification and settlement change. Ann Ramenofsky, my outside committee member, provided me assistance beyond and far out of proportion with her responsibilities to a student not from her university. Between 2001 and 2004, Ann reviewed a long series of drafts from each chapter and provided invaluable comments, criticisms and suggestions along the way. Many of the ideas in this study took shape during conversations with Ann, and I am especially grateful for her help in understanding issues regarding estimating population size from the archaeological record and the history behind the issues of Native American demography during the early historic era. I am thankful to Cathy Lebo for her willingness to remain on my committee after her departure from SMU to Johns Hopkins University, and for enduring a grueling field trip to the edges of San Juan Mesa. David Meltzer provided crucial insights at various stages, and gave a thorough reading of the final dissertation draft. I am also grateful to to David for approving this dissertation topic, and sending me along to Mike to help it reach fruition.

I am also grateful to many of the other faculty, staff and students in the Anthropology Department at SMU for their help. Garth Sampson provided important early insights on small sites research. David Wilson taught me a variety of skills related to photography, mapping, and illustration. By allowing me to house-sit in 1997, Tony Marks provided me a quiet place to write and conduct research. David Friedel graciously permitted me to work in his lab during the winter of 2004, which allowed me to finish much of the writing in peace, silence and serenity. Caroline Brettell and Vicky Lockwood facilitated me staying in the program during my long tenure as an ABD student. The administrative staff at the Anthropology Department, including Carol Carroll, Janice Brown, Pamela Hogan and Lana Coggeshall all helped me with a variety of procedural matters during different stages of the dissertation research and writing. Many of my fellow students, including Jim Kendrick, Hilary Chester, Risa Diemond, Katherine Monigal, Jim Ambrosino, Michael Bletzer, and John Seebach provided me with intellectual support through the research and writing process.

Many persons in other departments at SMU, and at other institutions also provided me with intellectual support at various stages of my research. At SMU, I am grateful to Dennis Cordell and David Weber in the History Department for their conversations with me on issues of historical demography and the historiography of the Spanish Borderlands. At the SMU libraries, Billy Stovall and Eileen Lemons at Interlibrary Loan and John Phinney at ISEM helped me track down a variety of obscure sources. For many of the years after 1996, the University of New Mexico (UNM) seemed to be a home away from home. Rick Watson and Elinore Barrett from the Department of Geography shared their knowledge with me on Pueblo farming practices and early historic demography, respectively. At UNM's Anthropology Department, I received enormous intellectual and research support from students in the graduate program, including Ana

Steffen, Shawn Penman, Elizabeth Bagwell, Gerry Raymond, David Vaughn, Jon Van Hoose, Jennifer Boyd, and Connie Constan. I am especially grateful to Ana Steffen, who has shared her knowledge and love of the Jemez Mountains and its archaeology with me throughout my research. Several scholars in the History Department at the University of Minnesota, including Bob McCaa, Carla Rahn Phillips and Patricia Jo Kulisheck, provided me with intellectual assistance. I am especially grateful to Bob McCaa for helping me develop a greater sophistication in thinking about demography; and to my mother, Patricia Jo Kulisheck, for helping me run down critical historical references, and for discussing with me a variety of the finer points of historiography. At the Laboratory of Anthropology's library, Laura Holt and Mara Yarborough helped me track down a variety of obscure reference through Interlibrary Loan. Gail Cooke of the New Mexico Environment Department helped me puzzle through the mysteries of soils. John Wolff of the University of Texas at Arlington and Jamie Gardner of Los Alamos National Laboratory shared their knowledge of the geology of the Jemez Mountains. Judy Davis of the Maxwell Museum was responsible for the speedy transformation of my field analysis observations from paper scratches to computerized data. My old friend and classmate Christopher Koeppel helped me quickly swot up an understanding of early historic population dynamics in the U.S. Southeast. And my good friend Dave Dabney drafted several of the figures found in this thesis, and provided me with important technical support on a variety of computer issues.

Throughout the years, I have benefitted from intellectual conversations with a large number of Southwestern scholars, archaeological and otherwise, including Kurt Anscheutz of the Rio Grande Foundation, James Snead of George Mason University, Tom Swetnam and Ron Towner of the Laboratory of Tree-Ring Research at the University of Arizona, Robert Dello-Russo of Escondida Research, Bob Preucel of the University of Pennsylvania, Dave Eck from the New Mexico State Land Office, Brad Vierra of Los Alamos National Laboratory, Jim Railey of TRC, and many others. Special thanks goes to Selma Morley of the University of California at

Los Angeles and and Matthew Liebmann of the University of Pennsylvania for sharing with me the results of their dissertation research on other aspects of Jemez Plateau archaeology. And I am especially grateful to Mike Elliott of the Jemez Mountains Research Center, the father of modern Jemez Plateau archaeology, for his willingess to provide me his unparalleled knowledge of the plateau's archaeological record.

One reason that I took so long to complete such a modest research project was my foolish insistence on attempting to work full time while researching and writing this dissertation. Along the way, I had a series of employers who were unusually supportive. I am grateful for the support I received from my supervisors at the Jemez Ranger District Carol Raish and Rita Skinner. Carol, especially, encouraged me early on to pursue my research. At ARMS, where I worked from 1998 to 2001, I received tremendous support from both my supervisor Tim Seaman and my co-workers. Tim provided me time off to conduct field work, and allowed me to take a lengthly leave of absence in 2001 to begin my writing. My co-workers, including Louanna Haecker, Steve Townsend, Ana LaBauve, Scott Geister, Dede Snow and Neil Berry all provided me with invaluable intellectual and logistical support, and have continued to do so even after my departure. Scott, in particular, has been gracious in supplying me with a number of datasets extracted from the New Mexico Cultural Resource Information System that have been incorporated into this study. At my current place of employment, the Pecos/Las Vegas Ranger District, my supervisor, Brent Abel, has demonstrated enormous patience while I have finished my writing and has been generous in allowing me to creatively modify my schedule around my academic commitments. I am very grateful to Brent, Pecos/Las Vegas District Ranger Joe Reddan, and Mike Bremer of the Santa Fe National Forest, for facilitating my leave of absence in 2004 that allowed me to complete my writing.

Most of all, I am grateful to my friends and family who have provided me with the material and emotional support through all of the years. On a long series of research and fieldwork trips, Padraic Taaffe, Dave Dabney, Shawn Penman, Jacob Kaltenbach, Hilary Chester, Devin O'Leary, Ana Steffen, Katherine Monigal and others gave me a bed or a couch or a floor to sleep on. I am especially thankful to Dave, Hilary, Ana, Shawn, Katherine and Jacob for their emotional support and for shoring up my flagging confidence during many of the more difficult moments of my research. A special thanks goes to Alan Hamilton for helping situate excactly where this dissertation project lay in the progress of my life and career. My parents, Patricia Jo and Richard Kulisheck have been unflagging in their financial, intellectual and emotional support throughout the 13 long years it took me to complete the entire graduate school cycle. I have no words that are sufficient to describe the gratitude I have for their unconditional love and faith in my ability to see through this research project.

Last and greatest thanks goes to my wife, Eliza Frank. Her love, dedication and support made this project possible, and I could not have done it without her. Thanks, darling.

Jeremy Kulisheck B.A. University of New Mexico, Albuquerque, New Mexico, 1991
M.A. Southern Methodist University, Dallas, Texas, 1996

The Archaeology of Pueblo Population Change on the Jemez Plateau, A.D. 1200 To 1700: The Effects of Spanish Contact and Conquest

Advisor: Professor Michael Adler

Doctor of Philosophy conferred May 14, 2005

Dissertation completed May 11, 2005

The decline of Native American populations after 1492 was one of the most dramatic events in recent North American history. However, the demographic experiences of different Native groups across the continent varied widely. This study addresses the factors contributing to variability in Native population decline by measuring demographic change among Pueblo peoples on the Jemez Plateau of north-central New Mexico. Population change on the Jemez is explored by examining the archaeological record of field houses, and by using variability in field house use to measure changes in agricultural intensification and population density.

The decline of Pueblo populations in the northern Southwest has been a recent concern of researchers, but research has been hampered by a lack of suitable archaeological and historical evidence. To circumvent these evidentiary problems, I examine relative change in population through its relationship to agricultural intensification and settlement use. The process of intensification is directly dependent on population density, and changes in intensification are manifested in the settlement patterns of subsistence agriculturalists. In the northern Southwest, Pueblo farmers' use of secondary settlements dedicated to agriculture, field houses, conform to the effects that intensification has on settlement behavior. Intensification at field houses is best measured by settlement use, and several variables of field house architecture and associated artifact assemblages can be examined to monitor variability in usage.

Field houses are prevalent on the Jemez Plateau between A.D. 1200 and 1700. To examine changes in intensification, I examine variability in use at 30 field houses using in-field surface analysis techniques. Examination of nine usage indicators demonstrates that the use of field houses increased significantly between the periods A.D. 1200 to 1525 and 1525 to 1650. This evidence runs counter to expectations that the plateau suffered a significant population decline during either the sixteenth or early seventeenth centuries. Instead, population decline occurred in the late seventeenth century. The timing of Pueblo population decline on the Jemez indicates that disease may not have been a major factor in demographic change, and that warfare, emigration, and shifts in ethnic identity may have instead been significant.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

for my Mother and Father

CHAPTER I

INTRODUCTION

This dissertation examines the demographic history of the Jemez Plateau of north-central New Mexico from an archaeological perspective. First occupied by Pueblo peoples in the early A.D. 1200s, the plateau was virtually abandoned by Native Americans by 1700, after almost two centuries of contact with and colonization by Europeans. The goal of this dissertation is to understand the process of Native American depopulation on the Jemez Plateau in relation to the entry of Europeans into the New World, and in particular their appearance in what is now the northern Southwest United States. This goal is addressed by examining variability in archaeological indicators of Pueblo demographic organization through the pre-European era, into the periods of contact and colonization, and on to the time of final abandonment. On the Jemez Plateau, the indicators are aspects of variability in the archaeological record of small settlements known as field houses. Variability in aspects of the field house record provides information on changes in field house use over time; changes in the use of field houses provide insights on the demographic changes which took place on the Jemez Plateau.

This introductory chapter has three sections. The first section discusses the decline of Native American populations in North America and the Southwestern United States, and the factors influencing patterns in that decline. This section provides a background and context to the issue of demographic change on the Jemez Plateau. The second section states the general approach taken by this study to the research problem of population decline, a general demographic rather than strict population approach. It also outlines the operational steps which are necessary to address the issue of demographic change on the Jemez Plateau from a general demographic approach, and how this approach differs from previous studies of Pueblo population decline. The third section is an outline of the structure of the dissertation with summaries of each of the chapters.

Native American Population Decline: A Background

The depopulation of the Jemez Plateau in relation to European contact and colonization reproduces in miniature a pattern of Native demography observed across the North American continent over the past 500 years. Two broad themes characterize Native demography over this time period. The first is dramatic population decline. In AD 1500, Native Americans alone occupied North America. Today, they make up only between 1.5 and 3.5 percent of the total population of the continent (Statistics Canada 1996; US Census 2000). The remainder of North America's inhabitants are overwhelmingly of Old World descent. A variety of explanations have been offered to understand the dramatic transformation of the North American population from one completely Native American to one dominated by non-Natives. All of the causes emphasize Native American population decline, which made possible the replacement. Disease, warfare, genocide, forced relocation, economic exploitation, dietary changes and impacts on fertility have all been implicated as potential causes of Native American population decline (Crosby 1972,1986; Jaffe 1992; Larsen 1994; Livi-Bacci 1992:50-56; Stannard 1992; Thornton 1987, 2000; Verano and Ubelaker 1992). Among these, introduced Old World epidemic diseases have emerged as the single most important of these causes (Black 1992; Dobyns 1966, 1983, 1993; Joralemon 1982; Larsen and Milner 1994; Meltzer 1992; Merbs 1992; Ubelaker 2000; Zubrow 1990). The decline of Pueblo populations in the northern Southwest, where the Jemez Plateau is located (see Figure 1.1), has been blamed on many of the same factors, again with disease as the

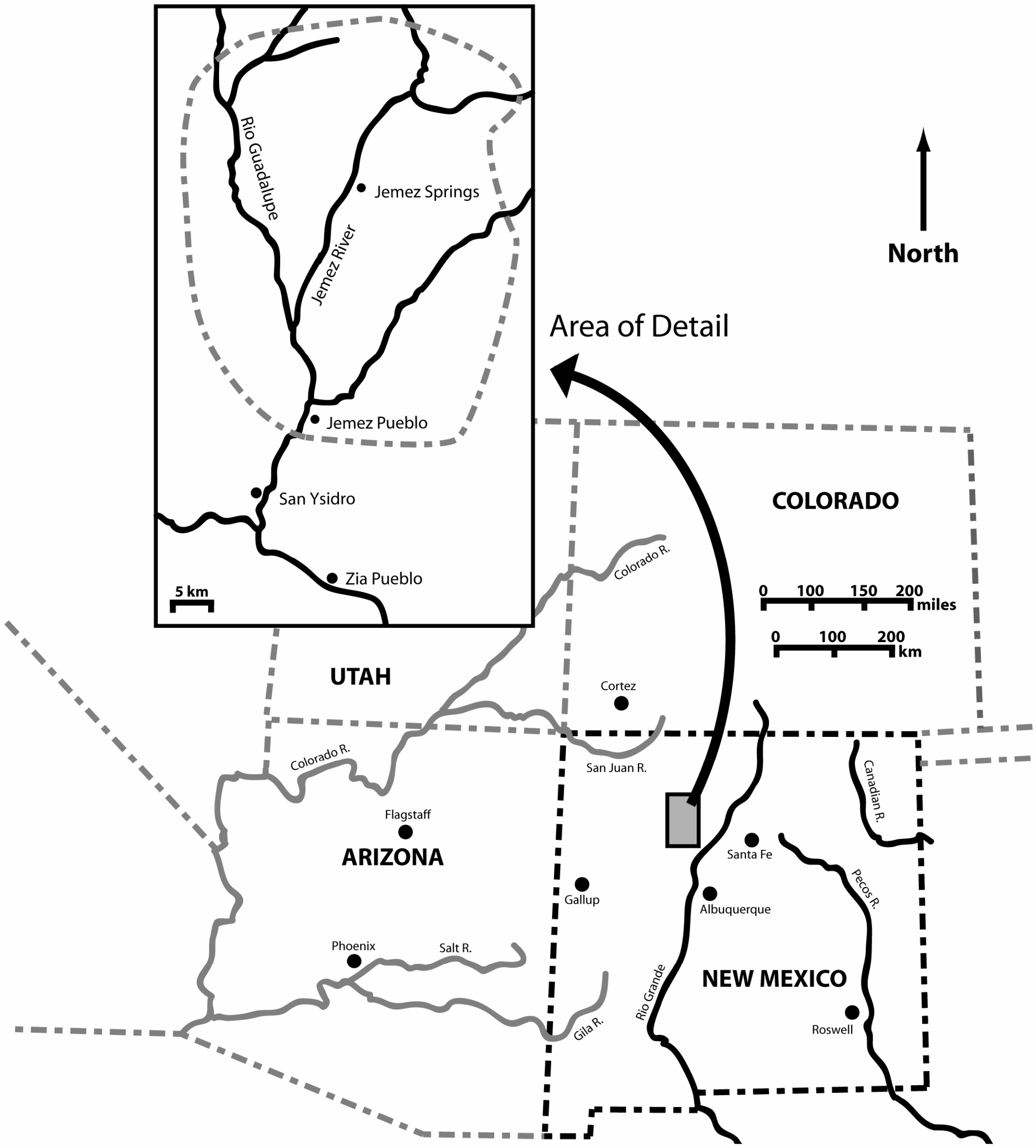


Figure 1.1. The location of the Jemez Plateau within the Southwestern United States. Adapted from Kulisheck (2001b:Figure 1). Map by David Dabney.

primary driver of population loss (Dobyns 1990; Lycett 1989; Palkovich 1994,1996; Ramenofsky 1996; Reff 1991,1993; Roberts and Ahlstrom 1997; Upham 1986,1992).

The second theme is that the population decline experienced by Native North American populations has not been uniform, either through time, or across space. Research on population decline among Native Americans over the past thirty-five years has identified dramatic differences in the persistence and survival of Native American groups in the various areas of North America. In an analysis of Native American population data taken from the *Handbook of North American Indians*, Douglas Ubelaker compared the timing and rates of population decline in the different regions of Native North America. Between regions as diverse as the Arctic, the Plains the Northeast, and the Southwest, differences in the timing for the century of greatest decline varied by up to two hundred years. For example, in the Northeast, the greatest population decline appears to have occurred in the seventeenth century; California, by contrast, experienced its greatest drop in population during the nineteenth century. The magnitude of the decline also varied from 50 percent in some regions, to over 90 percent in others, with the greatest decline taking place in areas such as the Southeast, and the greatest rebound in places such as the Southwest and the Plains (Ubelaker 1992:173; see also Baker and Kealhofer 1996; Denevan 1992; Ubelaker 1988). The result has been a dramatic redistribution of Natives in North America, above and beyond their transformation from an absolute majority to a tiny minority. While prior to AD 1500 the bulk of Native American populations resided east of the Mississippi, today most Native Americans live west of that river (Paisano 1993).

The variability in Native population decline seen between the regions of North America also is visible at the smaller, intra-regional scale. Among the Pueblo of the American Southwest, who include the people that once inhabited the Jemez Plateau, was no uniformity in population decline between the various sub-regions occupied since AD 1500. Ann Ramenofsky has observed that while between 53 and 68 percent of Pueblo communities were abandoned in highland areas during the first two centuries of Spanish exploration and colonization of the Rio

Grande Valley of northern and central New Mexico, between 70 and 83 percent of communities in lowland areas were abandoned. Today, 15 upland communities persist along the Rio Grande and its tributaries, while only one lowland community remains (Ramenofsky 1996; see also Lycett 1995; Schroeder 1979).

Differences in the persistence of various Native American populations over the past 500 years points to the fact that differing cultural, geographic, demographic and historical factors were critical to determining the timing, rate and severity of population decline among any one Native population (Baker and Kealhofer 1996; Larsen 1994; Newson 1992, 1995; Ramenofsky 1990, 1996; Shoemaker 1999). By the same token, the significant variability in decline between groups indicates that different causes of decline were of greater or lesser importance relative to the specific environmental and historic conditions of any one group. That differences in decline took place at a variety of different scales, both between regions and within them, implies that understanding demographic decline among the Pueblo of the Southwest must begin in part with a consideration of smaller units of examination than the entire region And these smaller units should be investigated not only for a consideration of the causes of decline (for examples of this approach, see Earls 1985, Lycett 1995), but for the investigation of the sources of variability which have contributed to the differential persistence of Pueblo communities.

The Research Problem: Approaches and Methods of Resolution

The central problem of this dissertation is to understand the processes which led to the decline and disappearance of the Pueblo population of the Jemez Plateau. To address this issue, I establish a research framework for studying variability in population decline among Native Americans through the examination of the archaeological record, and apply that framework as a research program to the record of the Jemez. Creating such a framework requires defining the articulations between demography and the social variables of settlement and economy. It also stipulates the establishment of methods for identifying the aspects of the archaeological record relevant to changes in settlement and economy, and the creation of meaningful measures for evaluating those changes. The rationale for selecting the variables of settlement and economy for consideration is threefold. First, of all of the aspects of social organization, settlement and economy have demonstrated the most intimate links to the demographic organization of social groups (Netting 1990,1993; Stone 1996). Second, settlement and economy are two aspects of organization identified as central to defining the social experience of early modern Pueblo peoples (Adler 1996a; Adler et al. 1996; Cordell et al. 1994; Kohler 1989). And third, these variables are amenable to study through archaeological means. The nature of late prehistoric and early historic Pueblo settlement and economy—occupation in dwellings of earth and stone and intensive subsistence farming—are reflected in visible and accessible aspects of the Southwestern archaeological record.

Given the requirements presented above for creating a research framework for investigating demographic decline on the Jemez Plateau, a series of programmatic steps can be defined which provide formalization to the central ideas of the framework. These steps include:

- explication of the links between demography, economy and settlement, and the theoretical basis for those linkages; and an explanation of how those relationships are observable and measurable in the archaeological record;
- description of the organization of settlement and economy in the late prehistoric and early historic Southwest, and its range of variability; and a consideration of the implications of that organization for the demography of early modern Pueblo peoples;
- definition of the settlement and economic dimensions specific to the late prehistoric and early historic Jemez Plateau;
- isolation of the aspects of the archaeological record of the late prehistoric and early historic Jemez record which are relevant to the variables of settlement and economy;

- creation of measurable and quantifiable archaeological scales which monitor change in the aspects of the Jemez archaeological record selected for study; and
- construction of a temporal scale which is both appropriate to the phenomena used to examine demographic change (the aspects of the Jemez archaeological record isolated and measured above), and to the pace and nature of change taking place between contact and abandonment on the Jemez Plateau.

Accomplishing each of these operations creates both the data necessary for examining the process of demographic change, and the scales necessary to evaluate the timing and magnitude of the change.

From both a procedural and epistemological standpoint, adopting this research framework represents a departure from the primary strategies which have been employed to examine demographic change in the Southwest after the arrival of European peoples. The differences between this study and those which have preceded it are manifested in three major shifts of approach. First, the methods employed in this study represent a move away from the approach of creating population counts for Native populations—from archaeological remains, historic accounts and other sources—and then evaluating the changes in those counts for the purpose of identifying one or more potential causes responsible for demographic decline. This is the main avenue of investigation taken by studies which have so far examined the issue of population decline among the Pueblo of the Southwest during their contact with and colonization by European peoples (Barrett 2002; Dobyns 1983, 1990; Palkovich 1985; Schroeder 1992; Simmons 1979; Upham 1992; Wilson 1985). The approach taken here is different. While the focus of this study remains population, I examine this variable within the frameworks of settlement and economy, embedding demography within the context of Pueblo social organization. In doing so, I eschew a strict search for absolute numbers in pursuit of a more holistic view of demographic change. I do not, however, abandon the search for possible causes of population decline; indeed, an identification of possible causes is necessary for the exploration of variability in the process of population decline. Rather, it means that the potential causes of decline must be evaluated within the context of the social system into which they enter as a dynamic factor.

The turn away from counts as the primary measure of demographic change has a second, and related consequence for how this research is conducted. The approach taken in this dissertation is to examine settlement use, rather than settlement occupation and abandonment, as the field of variability relevant to measuring the timing and magnitude of population decline. Central to this approach is the notion that temporal variability in the ways particular classes of settlements are used is relevant to demographic change. In the instance of the Jemez Plateau, the class of settlements examined are field houses, seasonal residences used by single households for performing agricultural activities at remote fields and gardens. The focus on settlement use rather than occupation and abandonment represents a major departure from the methods traditionally employed for evaluating demographic change in the wake of the European arrival in North America. Most regional archaeological approaches to Native population during the historic era have employed settlement occupation as the measure for identifying the causes of population decline (Campbell 1992, Ramenofsky 1987; Smith 1987; Snow 1995, 1996; Snow and Starna 1989). The central logic of these studies is that the timing and severity of settlement abandonment serve as indirect indicators of the cause or causes of population decline. For example, the early and severe decline of settlement occupation in the Pacific Northwest and in the Southeast has been interpreted as an indicator of the early introduction and catastrophic effects of Old World epidemic diseases. The strategy of using settlement occupation to examine the timing and degree of abandonment has been taken in the Southwest as well (Earls 1985; Haas and Creamer 1992; Lycett 1995; Ramenofsky 2000; Ramenofsky and Feathers 2002; Schroeder 1979,1992). This approach is complicated by the nature of the late prehistoric and early historic Southwestern settlement record. The record is dominated by large communities which were variably occupied for hundreds of years, often across the temporal boundary between the prehistoric and historic eras (Cordell 1994; Cordell et al. 1994; Kohler 1989). At the same time, there has been a commensurate lack of archaeological investigation appropriate to the scale and complexity of this late record (Cordell 1989; Crown et al. 1996). These complexities have made it particularly difficult to examine the phenomenon of population decline in the Southwest relative to other regions of North America (Ramenofsky 1987:34).

On one level, the employment of settlement use requires a degree of investigative sophistication greater than the determination of whether a settlement is occupied or abandoned during any given time period. At the same time, however, this approach obviates the need to examine all settlements from each time period relevant to population decline. Rather, it requires only that a representative sample of settlements from each time period be compared to one another to determine whether there is a significant difference in usage. Examining a select number of sites for settlement use is employed here as an avenue for avoiding the problems associated with the low and variable resolution of settlement occupation data currently available for the late prehistoric and early historic record of the Southwest.

A third consequence of adopting this research framework is that study begins with a an examination of the pre-contact demographic context of Pueblo population. Taking this approach would seem intuitive, but has seldom been followed in the major studies of Native American culture change after contact (Rubertone 2000).[1] Most investigations of population shifts among the Pueblo during the post-contact era have begun their evaluation of change at the time of contact itself. This is because the emphasis of these studies has been on the fundamental difference of the changes introduced at contact, relative to forces which had shaped the nature of Native North American society prior to the arrival of Old World peoples on the North American continent. Studies of the effects of epidemic diseases on Pueblo populations provide an archetypal example. The vast majority of the maladies brought to the North America by Old World populations were not present on the American continents prior to AD 1500, and the potential for such diseases to be devastating to Native North Americans was high (Black 1992;

Dobyns 1983, 1993; Joralemon 1982; Meltzer 1992; Merbs 1992; Ramenofsky 1987, 1992). While disease is the most striking example, many other aspects of Old World ecology, technology and social organization, such as forms of domestic production like pastoralism, and the types of organization associated with state-level polities and world-system economic networks, were also unknown to the original inhabitants of North America (Borah 1964; Cronon 1983; Crosby 1972,1986; Diamond 1997; John 1975; Sale 1990; Steele 1994; Turner 1983). Naturally, then, the pioneering studies of Native demographic decline have placed their emphasis on the potential effects of these new and different forces; there has been commensurately less emphasis on how variability in the Native experience conditioned the actual impact of those forces (Baker and Kealhofer 1996). However, if only introduced causes are considered in the study of Native American decline, then only variation in the introduction in the forces implicated in decline—the timing of the arrival of Europeans and others from the Old World, their numbers, the nature of their contact with Natives—can be considered when evaluating the problem of Native differential persistence and decline. While these variables are critical, they provide only one-half of what is needed in understanding the process of decline. I argue that if the multiple disciplines concerned with the demographic transformations of Native Americans which have taken place over the past five centuries wish to understand variation in the process of population decline, they must necessarily begin with the existing demographic situation of a Native American group at the time of contact. Only once that situation has been described can the potential effects of contact be examined. Otherwise, the reaction of Native Americans to the consequences of contact would be resolutely uniform; it would vary only with variation in the arrival and nature of the entry of Old World peoples into the American hemisphere.

Structure of the Dissertation

The remainder of this dissertation is devoted to exploring the dimensions of the problem of population decline among the Pueblo peoples of the Southwest and of the Jemez Plateau. It is achieved by executing the operational steps of the research framework outlined above. In organization then, the remainder of the dissertation replicates and explicates the structure and context presented so far in this chapter.

Chapter II contains background information necessary to contextualize the issue of Pueblo population decline in the sixteenth and seventeenth century northern Southwest. The chapter has two sections. The first section provides definitions cultural, temporal and geographic parameters relevant to the discussion of population decline, including “Pueblo,” “Spanish,” and “northern Southwest.” The second section outlines current historical knowledge regarding the Spanish conquest of the northern Southwest in the sixteenth and seventeenth centuries, and the implications of the conquest for understanding the nature of Pueblo population decline during this era.

Chapter III provides an intellectual context for the research problem, by placing the issue of population decline on the Jemez Plateau within the milieu of Native North American population decline over the past five centuries. The chapter has three sections. The first section describes the issue of Native American population decline, examining what is known about the decline in the northern Southwest relative to the larger context of North America, and how other regions, the Southeast in particular, have been able to advance research into the question of Native population decline. The second section reviews the data sources available in the northern Southwest for population decline, including historical accounts and archaeological evidence, such as settlement, human remains, and artifacts. The third section examines how researchers in the northern Southwest have made use of that evidence to fashion reconstructions of Pueblo population decline. It also explores why Southwestern scholars have been unable to answer fundamental questions regarding the timing, severity and variability of population decline in the region. And it presents a new model for evaluating ideas about Pueblo population decline using archaeological methods and evidence.

Chapter IV introduces the methodological approach of this study for understanding through archaeology the demography of the Pueblo during the late prehistoric and early historic eras. It establishes the links between the variables of demography, settlement and economy, and how these links can be examined through the archaeological record. The chapter is divided into three sections. The first section contrasts two distinct archaeological perspectives on demography: the enumeration of population sizes; and the embedding of demographic principles and change within the context of society and economy. Relative to the question of population decline, and the particular problems presented by the late prehistoric and early historic data sets available for the Southwest, the methodological advantages of the socioeconomic over the enumerative approach are presented. The second section describes the relationship between demographic variables and the economic organization of subsistence farmers. In particular, the relationship between population density and a central aspect of subsistence agricultural organization, intensification, is explored. This section also provides a description of how changes in intensification manifest themselves in the use of settlements and landscapes, in such a way that archaeologists are able to examine and understand these changes, and in turn understand changes in demographic organization. The third section examines how the process of agricultural intensification and population change was manifested in the settlement and landscape history of the late prehistoric Southwestern archaeological record. In particular, it explores the apparent paradox between the settlement patterns expected under a regime of agricultural intensification, and the contrary settlement pattern of aggregation which occur among the Pueblo during the late prehistoric era.

Chapter V is an exploration of the various archaeological instruments available for measuring the processes of agricultural intensification, settlement change and demographic decline. The focus of the chapter is upon one class of settlements, field houses, as a useful instrument for examining changes in these processes, given the nature of the late prehistoric and early historic archaeological record of the Southwest, and particularly the Jemez Plateau. The chapter is divided into three sections. The first section discusses the range of archaeological instruments available for the study of agricultural intensification, with an emphasis on the study of agricultural fields. This section examines the potential and the limitations of using field remains for studying intensification, and finds them deficient for examining the question of intensification on a regional scale. Instead, a settlement approach is forwarded, with an emphasis on field houses. The second section provides a functional definition of field houses as agricultural settlements, and places these structures in the context of periodic circulation as a form of mobility and economic behavior. This section explores the relationship of field houses to the process of population change and agricultural intensification. The third section identifies the architectural and assemblage variables of field houses relevant measuring changes in agricultural intensification.

Chapter VI establishes the relevance of the Jemez Plateau area to the issue of population decline among Pueblo peoples in the northern Southwest during the early historic era, and to the method of using field houses as an instrument for examining the process of population decline. The chapter is divided into three sections. The first section provides general background information on the physiography, geology and environment of the Jemez Plateau, with specific reference to the variables of settlement and agriculture. The second section describes contains a history of previous archaeological research on the plateau, with a focus on past examinations of the field house record. The third section provides a provisional phase sequence for understanding change in the archaeological record, and a review of historic evidence relevant to the sixteenth and seventeenth century Pueblo occupation of the Jemez Plateau. The provisional phase sequence is designed to provide a chronological context for the processes of settlement aggregation, population growth and increased population density that took place on the plateau in the early modern Pueblo era.

Chapter VII is a presentation of the aspects of the Jemez field house record relevant to examining the concepts of use intensity, intensification, and demographic change. It also defines the archaeological and temporal scales which are necessary for measuring that record. And it contains the data collected for this study from field research, and from prior projects, and describes the variability observed in that data. The chapter has four sections. The first section is a description of the archaeological data set It identifies how the particular field houses examined for field study were chosen from the entire population of known field house sites on the Jemez Plateau. The second section discusses the use of surface evidence for examining the field house record, with a review of the strengths and drawbacks of utilizing surface evidence. The third section describes the behavioral variables monitored in the study, and the methodologies used for collecting data relevant to these variables. The fourth describes the temporal framework constructed for examining changes in field houses through the late prehistoric and early historic eras, and the ceramic classification developed to assign sites to the time units of the temporal framework. This section introduces provisional ceramic types needed to partition time on the Jemez Plateau.

Chapter VIII takes an initial look at the data from the study sample field houses to develop a chronology and provide dates of occupation for the sites, and evaluate bias in the dataset. The chapter has three sections. The first section describes the architectural and assemblage datasets generated from the study sites. The second section presents the ranked occurrence seriation that is used to assign field houses to study time units based on ceramics. This section also evaluates the use of occurrence seriation against frequency seriation, and assigns occupation dates to sites that lack ceramic assemblages. The third section evaluates the biases introduced into the architectural and assemblage datasets due to environmental variables such as surface visibility and surficial geology. This section also provides corrections for these biases.

Chapter IX is a discussion of the variability observed in field houses in the Jemez Plateau through time and its implications for population decline. The chapter examines the evidence that the variability seen is indicative of changes in agricultural intensification and population density, and the meaning of those changes to the process of population decline. The chapter has two sections. The first section is an analysis of variability in the architectural and assemblage datasets relative to the behavioral variables which measure field house use. The second section evaluates the patterning seen in field house use and discusses its implications for changes in agricultural intensification and population density through time. In particular, these patterns are placed in the context of prior hypotheses regarding Pueblo population decline in the northern Southwest.

Chapter X contains an evaluation of the results of the dissertation, and a summary of each of the dissertation's chapters.

Chapter I Endnote

---

1 A notable exception to the approach of not considering that Native experience prior to contact has been in paleoepidemiological studies. These studies, both in the Southwest (Merbs 1989; Spielmann et al. 1990; Stodder 1990, 1996; Stodder and Martin 1992) and elsewhere (Larsen 1990; Larsen et al. 1990, 1996; Larsen and Ruff 1994; Miller 1996; Owsley 1992) have routinely included investigations of precontact Native biological material and incorporated considerations of precontact Native health into their examination of the effects of contact. See Chapter III for a further discussion of paleoepidemiological studies and other examinations of human remains.

CHAPTER II

ANTHROPOLOGICAL AND HISTORICAL CONTEXT FOR PUEBLO POPULATION DECLINE

The intent of this study is to depart from traditional frameworks of both method and data for studying the decline of Pueblo populations during the era of conquest and colonization by the Spanish. Making such a departure requires two somewhat opposite prerequisites. The first is the creation of new definitions for concepts such as Pueblo, and Spanish, and for the units of time that are used both for the general discussion of Pueblo population change, and for the evaluation of the causes of population change. Such definitions are needed to establish the parameters of demographic change, by placing spatial and ethnic boundaries around different groups of people. The second is an outline of current historical knowledge regarding the Spanish exploration and colonization of the Pueblo world. This dissertation is archaeological in its approach, but its central research questions regarding Pueblo population decline have been raised in part by assumptions generated from the historical record. The lastest historical information is reviewed not only to understand the source of those assumptions. Possible alternative interpretations of the Spanish conquest of the northern Southwest, and the response of Pueblo peoples, can also be gleaned from the record. These alternatives point to questions that the historical record can raise, but not answer, and can look to archaeology for further explication.

Study Parameters

Like most previous studies of Native American population decline in the Southwest, the northern Southwest and its Pueblo inhabitants are isolated as a single geographical and cultural unit. Implicit within this frame of research are several spatial, temporal and cultural boundaries that need to be made explicit. These include the concepts of the northern Southwest, the Pueblo, the Spanish, and of the late ancestral and early modern eras. I define these terms because the general issue of interaction between the Spanish and the Pueblo straddles the more traditional frames of prehistoric archaeological research, historic study, and ethnologic research. In most cases, the terminology used in any one of these frames is inadequate to describe time, space and people beyond its own boundaries. Just as the problem of Pueblo population decline crosses these traditional boundaries, these terms attempt to do so as well. These terms are also general to the Southwest as a whole; the specific spatial, temporal and cultural parameters that distinguish the Jemez Plateau are covered in Chapter VI.

At the center of this study are the Pueblo peoples of the northern Southwest. The late ancestral and early modern inhabitants of the Jemez Plateau were Pueblo peoples, as are their descendants who now inhabit the community of Walatowa adjacent to the plateau (Sando 1979, 1982). As such, this study of the demographic experience of the Pueblo inhabitants of the Jemez is intended in part to provide a larger understanding of variability in the response of the Pueblos to the demographic challenges of Spanish entry into their world.

The term "Pueblo" has a variety of cultural, spatial, and temporal meanings. As a consequence, the use of the term will be qualified as much as possible to distinguish between these meanings. From a cultural or ethnological perspective, "Pueblo" refers to the members of a linguistically diverse set of communities distributed across Arizona, New Mexico and northern-most Chihuahua. They have been grouped together and distinguished form other Southwestern Natives on the basis of a variety of shared lifeways. These include religious belief and practice, cosmology, artistic tradition, sociopolitical organization, and shared ancestry (Dozier 1970;

Eggan 1950, 1979; Sando 1992) . The unifying themes emphasized in this study are the traditional reliance of these communities on subsistence agriculture for their economic livelihood, and the traditional residence of the members of these communities in compact, permanent aggregated settlements.[1] In this study, the terms "Pueblo peoples" and "Pueblo individuals" are used to refer to the collective of individuals who share, or have shared, the central themes of Pueblo identity, and who inhabit or have historically inhabited Pueblo communities. The term "the Pueblos," by contrast, refers to the collective of Pueblo communities (see Ortiz 1972).

The term "Pueblo" also has spatial connotations. The "Pueblo world" refers to region occupied by both contemporary Pueblo peoples, and their ancestors (Adler 1996b). The Pueblo world falls within the Southwest of the United States, but is not equivalent to this latter area. The Southwest is a diverse geographic and cultural area identified by archaeologists and other scholars as united by the themes of climatic aridity and prehistoric occupation by subsistence farmers (Cordell 1997:1-6). Of these, the ancestors of contemporary Pueblo peoples belonged to only a few groups of this diverse set of subsistence farmers, which is reflected in the diversity of their descendant Native populations of the Southwest today, both Pueblo and non-Pueblo. The Pueblo world, then, refers to the northern portion of the Southwest that is and has been occupied by Pueblo peoples and their ancestors (Figure 2.1). From a geographic perspective, I use the term "northern Southwest" interchangeably with "Pueblo world," with the recognition that the former term, like the latter, refers to an area that is defined by cultural boundaries rather than by physiographic characteristics (Adler 1996b; Adler et al. 1996).

From a temporal perspective, the term "Pueblo" can also be qualified to reflect both cultural continuity and change between contemporary Pueblo peoples and their ancestors. This study uses the terms "ancestral Pueblo" and "modern Pueblo" to refer to the collective of Pueblo individuals who lived during different eras. (The temporal limits of these eras are given in Table 2.1.) In this sense, the terms are similar to those employed in earlier cultural and temporal schemes, such as the Pecos Classification. They refer to distinct intervals of time, but also

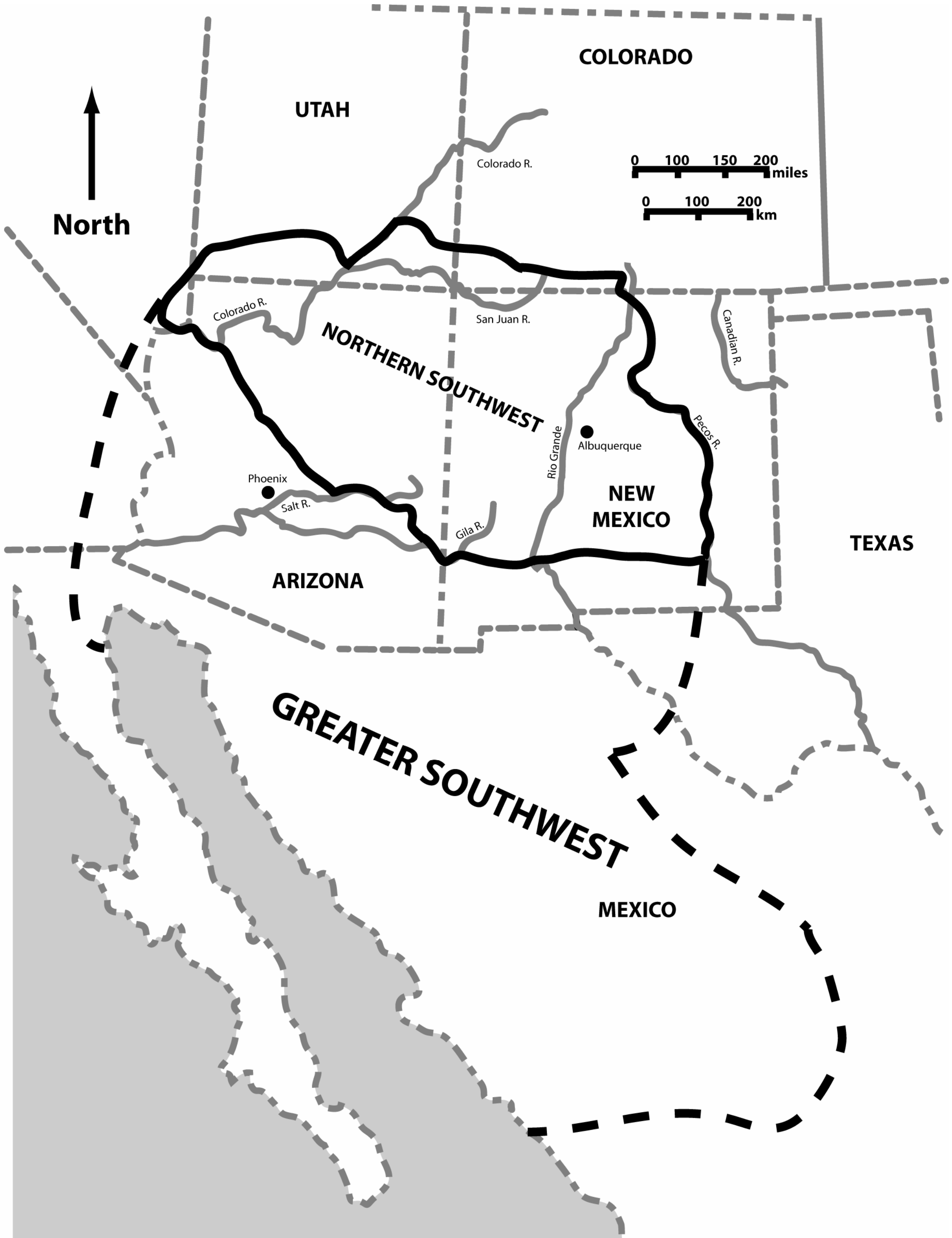


Figure 2.1. The location of the northern Southwest, relative to the greater Southwestern region. Adapted from Adler (1996b:2) and Phillips (1998:795). Map by David Dabney.

Table 2.1. Major Cultural Eras Used in this Study, Compared to Other Southwestern Chronologies

Date (A.D.)	Pueblo Eras (This Study)	SAR	Pecos (Anasazi)	Mogollon	Northern and Central Rio Grande
2000					
1900	Late Modern Pueblo				
1800			Pueblo V 1600-present		Historic 1600-present
1700					
1600					
1500	Early Modern Pueblo				
1400		Aggregation 1275/1300-1540	Pueblo IV 1300-1600		Classic 1325-1600
1300				Late Pueblo 1200-1400	
1200		Reorganization 1130/1150-1275/1300	Pueblo III 1100-1300		Coalition 1200-1325
1100	Ancestral Pueblo	Differentiation 1000/1050-1130/1150		Early Pueblo 1100-1200	Developmental 600-1200
1000			Pueblo II 900-1100	Late Pithouse 750-1100	

Sources: SAR and Pecos periods, Gumerman and Cordell (1989); Mogollon periods, Lehmer (1948); northern and central Rio Grande periods, Wendorf and Reed (1955).

associate aggregates of material and inferred sociocultural traits that characterized the peoples who lived during those intervals (Reed and Stein 1998). They are offered here as a substitute to existing temporal schemes because these chronologies have typically assigned breaks within the initial period of interaction between Pueblo peoples and the Spanish based on the first occurrence of historic accounts (Kidder 1927; Wendorf and Reed 1955). Some chronological schemes do not attempt at all to incorporate the era of Spanish-Pueblo interaction (for example, Gumerman and Cordell 1989). The divisions made by these studies can be summarized into general temporal categories of "prehistoric era" and "historic era", or more specific to the time span under consideration by this study, "late prehistoric era" and "early historic era," the approximately two centuries prior to and following the first occurrence of historic accounts. These terms are retained in this study in discussions of existing studies of population change, because they are relevant to how these studies have examined population change among Pueblo peoples.

The term "ancestral Pueblo" has been recently suggested as an alternative to "Anasazi" (Adler 1996b; Plog 1979; Sando 1982; Whitely 2002). Here it is used in its most literal sense to temporally and culturally bind together those groups believed to be ancestral to the Pueblo: the various subgroups of the Anasazi in the Four Corners, in northeastern Arizona, and north-central New Mexico; several of the identified subgroups of the Mogollon, including the prehistoric inhabitants of the area below the Mogollon Rim of east-central Arizona, the Mogollon highlands of Arizona and New Mexico, and the northern Jornada region of south-central New Mexico; and the Sinagua of central Arizona. Implicit in the use of the term "ancestral Pueblo" is that these people of the prehistoric era, while lineally and culturally ancestral to the Pueblo of the historic era, were distinct in important aspects of their social, economic, political and demographic organization. This study draws the line between the "ancestral Pueblo" and the "modern Pueblo" in the late A.D. 1200s and early 1300s. It is during this time that the main patterns of settlement, economy, religion, and polity that are present at the advent of the historic era emerge (Adams 1991). Likewise, the modern Pueblo era can be subdivided into two major periods. The people and society extant between the emergence of the modern era in the early 1300s and the end of the initial exploration and colonization of the Southwest by the Spanish, marked by the events of the Pueblo Revolts of the late 1600s, are referred to as the "early modern Pueblo." The "early modern Pueblo" are distinguished from the "late modern Pueblo," those who have lived since A.D. 1700, based on their integration into the Spanish and European geopolitical world. While the process of integration by Pueblo peoples into the European-dominated world began in the early 1500s, the integration can be considered recognized and acquiesced to by the Pueblos only after 1700.

The focus on the Pueblos to the exclusion of other northern Southwestern Native American cultures, such as the Apache, the Navajo and other mobile, traditionally hunting and gathering groups, does not imply that the interaction of the Pueblos with other Natives was unimportant to understanding demographic change during the early historic era. In fact, quite the opposite has been argued, both for the Pueblos in general (John 1975; Schroeder 1968; but see Schaafsma 2002; Wilson 1985) and for the Pueblo peoples and communities of the Jemez in particular (Brugge 2002). Rather, the Pueblos have been singled out because their interaction with the Spanish was distinct from other Natives in the northern Southwest. They are the only Native group in this region over who the Spanish ever exercised any effective political control, and the only group among whom the Spanish lived on a sustained basis. While it is of some value to compare the Pueblo experience to that of other North American and northern Middle American Native groups who experienced colonial domination by the Spanish in the sixteenth, seventeenth and eighteenth centuries in places such as La Florida, the Californias and Nueva Vizcaya (see Baker and Kealhofer 1996; Kessell 2002; Reff 1991; Weber 1992), the inclusion of the Pueblo's immediate Southwestern neighbors provides less insight into the process of population decline among any one of the groups. This is especially so if we accept that demographic change among Natives groups in response to European entry was potentially variable, and that the nature of contact between Natives and Europeans was one source of that variability.

The term "Spanish" here is used to refer to the mainly European explorers and colonists whose entry into and colonization of the northern Southwest was sponsored by the Spanish crown and its New World representatives. It is recognized that while the majority of these explorers and colonists were indeed from the various regions of Spain, particularly during the sixteenth century, this category also included a variety of Europeans from other nations, converted Spanish Jews and Muslims, Africans, and persons of mixed descent, including those of mixed Old World-Native American descent. Some of the Spanish expeditions also included large numbers of Middle American Natives; while the role that these Natives played in the interactive process between the Spanish and Pueblo peoples is not well understood, they did come in significant numbers and their presence was likely an important factor in determining the nature of culture change in the first few centuries of interaction between Spanish and Pueblo peoples (Flint 1997, 2002; Riley 1974, 1995; Simmons 1964).

The cultural categories of "Pueblo" and "Spanish" become problematic, particularly in the later seventeenth century, as sustained interaction between these two groups of people produced individuals of both mixed descent and multi-faceted cultural identities (Gutierrez 1991; Knaut 1995). These problems are compounded for the archaeologist attempting to distinguish Spanish occupations from those of Pueblo peoples, given the general material poverty of the Spanish in the sixteenth and seventeenth centuries (Snow 1974, 1979). However, these categories serve as general descriptors for the Europeans and Natives considered here; they are not used as analytic categories, with the recognition of the complexities and nuances that each term represents.

The temporal parameters for this study reach from the middle A.D. 1200s to around A.D. 1700. Strictly, this interval was chosen because it corresponds to the period of Pueblo occupation in the Jemez Plateau; prior to and after this time span, there is scant evidence of habitation of the area by Pueblo peoples (Elliott 1991). Broadly however, this interval is relevant to the issue of Pueblo population decline because it stretches from the advent of the modern Pueblo through the initial and little understood period of their interaction with Old World peoples. It is also the interval in which archaeology can provide its largest contribution to the understanding of the process of Pueblo demographic change. Indeed, two the reasons the Jemez Plateau was selected from among other areas of occupation by Pueblo peoples is its delimited era of occupation, and its extant and accessible archaeological record.

After the turmoil of the Native revolts against the Spanish in the 1680s and 1690s, our historic documentation of interaction and culture change improves dramatically, particularly in regards to demographic change. For example, the first surviving vital records for Pecos Pueblo date to the late 1690s, and continue through the abandonment of the pueblo in the 1830s. These parish records of births, deaths and marriages have provided a rich and detailed record of demographic change that speaks loudly to why the community of Pecos failed to be viable (Levine 1999; Levine and LeBauve 1997). At the same time, the ability of archaeology to contribute to the understanding of culture change within Pueblo communities diminishes. This is mainly because most Pueblo settlement in the eighteenth century and afterward was confined to the grant and reservation boundaries that are extant today (Lekson 1990). On a few reservations, such as that of the Zuni, archaeological research has provided a much more complex picture of culture change than was previous anticipated from the ethnographic work conducted there (Dublin 1998; Howell and Stone 1994; Rothschild et al. 1993). On most other late modern Pueblo tribal lands however, archaeological research has been restricted, and major research programs examining change over the last several hundred years are unlikely in the future. Thus this time period is ideal for following the development of an early modern Pueblo community from the emergence of its late prehistoric demographic pattern through the period of contact and colonization that came with the advent of the historic era.

European Exploration and Colonization of the Northern Southwest: Outline and Issues

The history of the sixteenth and seventeenth century Spanish entry into the northern Southwest is well studied, if not well understood. Within the discipline of history, Bolton and his students focused on the Southwest as part of their effort to raise the legacy of Spanish North America to the equal of English colonial America (Broughton 1993; Weber 1992). The first part of the twentieth century saw the transcription and translation of the major corpus of historic documents extant from the exploration and colonization of the region (Ayer 1916; Bandelier 1890-1892; Forrestal 1945; Hackett 1923-1937; Hackett and Shelby 1953; Hammond and Rey 1940, 1953, 1966; Hodge et al. 1945; Millich 1966). These, along with other minor documents from the archives of Spain and Mexico, formed the basis for the major syntheses of the exploration of the region (Bolton 1945, Hallenbeck 1987; Hammond and Rey 1928), the missionary effort among the Pueblo (Bloom and Mitchell 1938; Scholes 1929, 1930, 1932; Kubler 1942), the nature of Spanish civil society (Scholes 1935), conflicts between Church and State (Scholes 1936-1937, 1937-1941) and the clash between Pueblo and Spanish societies, that culminated in the Pueblo Revolts of 1680 and 1696 (Espinosa 1942, Hackett and Shelby 1942). In addition to providing the basis of New Mexico history during the sixteenth and seventeenth centuries, these sources have been used to generate reinterpretations of the course of Spanish colonization (Flint and Flint 1997; Gutierrez 1991; Knaut 1995). New source material has also been recently uncovered, from both the earliest (Flint 1997, 2002) and latest (Kessell 1989; Kessell et al. 1992, 1995, 1998, 2000, 2002) portions of this era, providing new insights on Spanish motives and actions during the first two centuries of their presence in the northern Southwest.

From this body of information, both primary and secondary, can be distilled the aspects of Spanish exploration and colonization efforts that may be considered relevant to demographic change among Pueblo peoples. These aspects of the Spanish entry include the timing, nature and extent of interaction between the Spanish and Pueblo peoples, at least from the Spanish lens and perspective. These key facts of the Spanish-Pueblo interchange, as reported by the Spanish, have become the critical points of contention among scholars regarding the nature of population decline within the Pueblos.

The Spanish conquest of the northern Southwest can be divided into two phases: exploration, during the sixteenth century, and colonization, during the seventeenth. The exploration of the northern Southwest took place largely in the form of organized expeditions entering the region from the south, from the newly colonized regions of Nueva Galicia and Nueva Vizcaya. These provinces correspond to modern north-central Mexico, occupied by the Spanish soon after the conquest of Mexico by Cortés. The expeditions were fueled by a desire to expand Spain's sphere of mineral exploitation; adventurers signed on to the enterprise with the hopes of achieving individual wealth. Expansion of the sphere of the Catholic church also served as a motive and justification for bringing additional Native Americans under the control of the Spanish empire. The area of the northern Southwest was targeted for exploration first in the 1530s, soon after the colonization of north-central Mexico. Tales of large Native populations and mineral riches came along the Native channels of economic and social interaction that connected the northern Southwest to northern Mexico. They also came somewhat more directly from the first Spaniards to pass through the region, four survivors of the ill-fated Narvaez expedition to the North American Southeast who had crossed into northern Mexico in 1536 after being shipwrecked on the coast of Texas. These Spaniards, led by Alvar Nuñez Cabeza de Vaca, never visited the Pueblo communities of the northern Southwest; however, passing somewhere through what is now southern New Mexico, west Texas, or northern Coahuila and Chihuahua, they had heard tales of large Native populations and mineral riches to the north (Hedrick and Riley 1974; Simmons 1979).

These collective descriptions of the colonial potential of the northern Southwest sparked the organization of a series of expeditions to the region in the mid-and late sixteenth centuries. The first two were launched soon after the reports of the Cabeza de Vaca party, in the interval between 1539 and 1542. After a long hiatus, and a fading of memories about the northern Southwest among the Spanish, five additional parties set forth in the period between 1581 and 1593. Relevant statistics on each of the parties, insofar as they can be gleaned from historic accounts, are summarized in Table 2.2. The approximate routes taken by each party are shown in Figure 2.2.

In terms of the time they spent within the northern Southwest, the size of the parities, and the places they visited there are few commonalties between the various expeditions. Only two of the parties set forth with explicit intentions of establishing a colony among the Natives of the northern Southwest (Coronado and Castaño de Sosa). Two were intended primarily as reconnaissance missions (Marcos de Niza and Chamuscado-Rodriguez). Another was launched as a "rescue mission" for priests left behind at the Pueblos, but its primary intent was to scout the potential wealth of the northern Southwest (Espejo). One party came to the region solely for the purpose of arresting the members of another, and departed once the task was accomplished (Morlete). One amounted to little more than a raiding party (Levya de Bonilla). The ground they covered varied widely. Only the parties led by Coronado and Espejo visited most of the major areas inhabited by Pueblo peoples. Other expeditions visited only one or some of the areas, and the members of one party, those of the Levya de Bonilla y Humana expedition, perished on the Plains to the east of the Pueblo world, before returning to or further communicating with New Spain to the south.

However, several observations regarding commonalties among the expeditions can be made. First, the timing of the expeditions can only be described as sporadic. Between the departure of the Coronado expedition from the Pueblo world in 1542 and the arrival of Rodriguez and Chamuscado's small party in 1581, there is no evidence any Spaniard set foot in the northern Southwest for thirty-nine years. In the 1580s and 1590s, the parties arrived more frequently, but short hiatuses exist between the Espejo foray in 1583 and the arrival of Castaño de Sosa's abortive colony in 1590, and the demise of the Levya de Bonilla band in 1593 and the ultimate

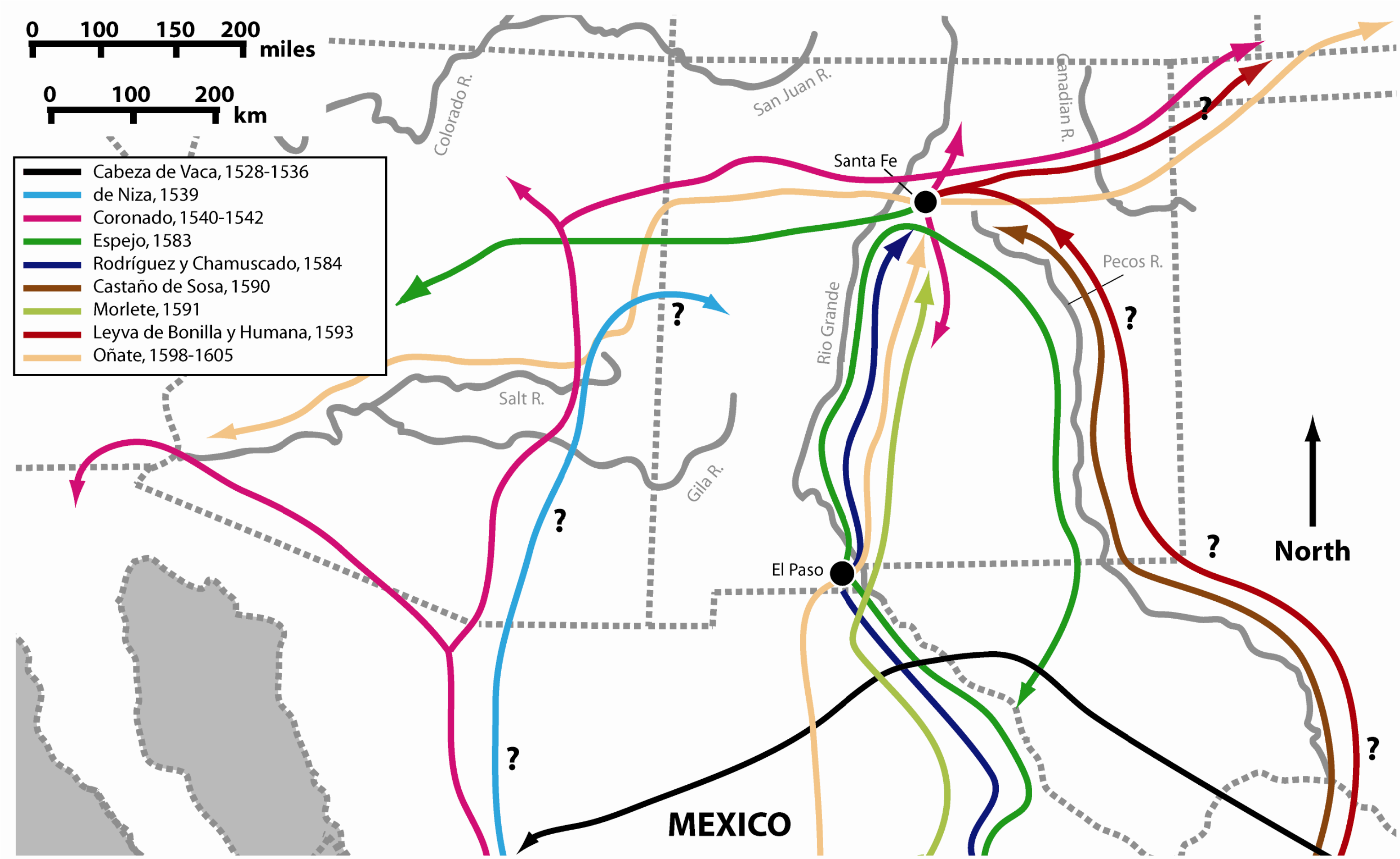


Figure 2.2. Approximate routes taken by Spanish exploring parties in the northern Southwest, A.D. 1528 to 1605. Question marks indicate that the route shown is uncertain. Adapted from Kessell (2002:21, 87) and Weber (1992:32, 66). Map by David Dabney.

Table 2.2. Spanish Exploration Parties in the Northern Southwest, A.D. 1539-1601

				Visited?										
Party	Dates in N. SW	No. Months in N. SW	Size of Party	Rio Abajo	Salinas	Central Rio Grande	Jemez/Zia	Galisteo	Tewa Basin	Pecos	Taos/ Picuris	Acoma	Zuni	Hopi
Marcos de Niza	Apr. 1539- May 1539	2	20+	No	No	No	No	No	No	No	No	No	Yes	No
Coronado	July 1540-April 1542	21	1300+	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rodriguez-Chamuscado	Aug. 1581-Feb. 1582	7	13+	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No
Espejo	Feb. 1583-July 1583	6	15+	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Castaño de Sosa	Dec. 1590-May 1591	6	170+	No	No	Yes	No	Yes	No	Yes	Yes	No	No	No
Morlete	Mar. 1591-May 1591	4	50+	Yes	No	Yes	No	No	No	No	No	No	No	No
Bonilla-Humana	1593	12?	Unk.	No	No	No	No	No	Yes	Yes	No	No	No	No
Oñate	1598-1601	n/a	250+	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sources: dates, party sizes, Hallenbeck (1987); Hammond and Rey (1940, 1953, 1966). Areas visited, Barrett (1997); Schroeder (1979).

Note: approximate party sizes are based upon numbers reported in accounts; additional numbers of servants, slaves and others may not be included in this total.

arrival of the Oñate colony in 1598. This isolation contrasts with some other areas of North America, such as Florida in the sixteenth century and California in the seventeenth, where coastline exploration by ship and the passage of commerce made contacts between Natives and Spaniards quite frequent, even prior to colonization (Weber 1992).

A second observation that can be made is that most of the parties, with the exception of Coronado's, were rather small in size. The reconnaissance parties were composed of no more than a few dozen persons. Castaño de Sosa's colony, which did not take root, and Oñate's, which did, were both rather small when compared to the size of the Coronado party, the former two numbering only in the low hundreds. The reasons for these small party sizes are multiple; for example, the Oñate party, which finally established a persistent Spanish presence in the northern Southwest, remained stalled in northern Mexico for three years, awaiting the necessary legal permission to set forth (Hammond and Rey 1953). Many prospective colonists abandoned the party even before its departure. But the small sizes of the expeditions after Coronado reflect the tentative confidence the Spanish held that the northern Southwest would yield wealth and opportunity to its conquerors. The small numbers also indicate that, after 1542, it was known by the Spanish that the Native population of the region was not vast. Coronado came to the Pueblo homeland fully expecting another Mexico or Peru, and the size of his party was a reflection of what was needed to assert Spanish control over a region of such human magnitude. In the 1580s and 1590s, while the Spanish remained hopeful that that the region had the potential to yield wealth, their hope was tempered by the recognition that the golden cities reported in the early part of the century, if real at all, did not lie within the Pueblo world itself.

A third commonality among the expeditions was violence as a common mode of interaction with Pueblo peoples and with the other Natives of the region. Regardless of size of the party or its original intentions, each eventually found themselves at war with members of Pueblo communities. Without exception, from Coronado onward the Spanish met the Pueblo with brutality and violence, conquering villages that refused to assent to Spanish demands, and murdering Pueblo peoples for the purposes of revenge or demonstration of authority (Knaut 1995). Some Pueblo communities were temporarily abandoned due to Spanish depredations; others were vacated in advance of Spanish arrival, doubtless due to the reputation the Spanish explorers had quickly earned through their interaction with the Pueblos. The Spanish explorers also routinely seized foodstuffs, blankets, and other goods from the Pueblos to feed and provision their parties. The frequent de-evolution into violence of interaction between the Spanish and Pueblo peoples in the sixteenth century highlights the perceptions of the Spanish as to the way their relationship with the Pueblo peoples was to be negotiated. Rather than trading partners, potential allies or some other equal relationship, the Spanish viewed and treated the Pueblo peoples as subjects, even prior to any meaningful imposition of Spanish governance or control over the region. Thus, they demanded food, shelter, servants and supplies from the Pueblos, with no consideration that the taking of such goods and services should be compensated. Rather, these things were there for the Spanish to rightfully acquire as conquering peoples, even given the edicts against such treatment of American Natives codified into Spanish law in 1542 and 1573. The often violent response by the Pueblos to such behavior demonstrates the organization and willingness (contrary to some early ethnographic stereotypes) of these villages to mount resistance against threats perceived to strike at their livelihood and survival. The abandonment of villages in advance of later Spanish parties also testifies to the risk adversity of many Pueblo communities, who chose temporary dispersion over the certainty of either expropriation or violence.

A fourth, and perhaps most significant observation regarding the Spanish expeditions of the sixteenth century are the remarkable similarities in their general portrayal of Pueblo settlement, economy, and sociopolitical organization. To be sure, there are some significant disparities between the accounts of the various expeditions. For example, the differing names applied to both individual Pueblo communities and geographic features by the various expeditions make it difficult to correlate descriptions of villages and areas of Pueblo settlement from account to account. Differences in the areas visited by the various parties also begs the question whether those regions not explored, and communities not mentioned, were abandoned or only sparsely populated at the time, or simply fell beyond the trajectory of the party. Some differences in particular details stand out. For example, Espejo's chronicle of the expedition he led contains population estimates for the various regions visited that are far higher than any reported before or after him. His descriptions of the Pueblos' buildings were also greater in scale than those of both earlier and later chronicles. While the same in layout and construction to the dwellings reported by Rodriguez and Chamuscado before, and Oñate after, the village roomblocks reported by Espejo rose to up to nine stories, twice or three times as tall as those reported by other reporters. Despite these details, however, the general picture painted by each eyewitness account of Pueblo lifeways was remarkably similar to one another. This contrasts markedly to experiences elsewhere in North America. For example, the Luna expedition of 1560 to the interior of the U.S. Southeast found a demographic situation and political order radically different from that encountered by de Soto's party only a quarter century earlier. Luna reported widespread abandonment, and an absence of the chiefly hierarchy with which de Soto had parlayed only a few decades before (Galloway 1994; McEwan 2000; Smith 1994, 2000). This sameness in the sixteenth century accounts of the northern Southwest is even more striking when considering that the 1580s saw the arrival of a drought of unprecedented proportions (Dean 1994; Salzer 2000). It is difficult to imagine that this episode of climatic deterioration could not have had a significant impact on Pueblo communities in the late sixteenth century, but the impacts were not so great as to register in the descriptions of Pueblo settlement, economy, polity and society rendered by the Spanish observers of the time.

Collectively, the expeditions of Marcos de Niza, Coronado, Rodriguez and Chamuscado, Espejo, Castaño de Sosa and Morlete provided the first opportunities for direct contact between the Pueblo and the Spanish, and some of the first opportunities for the arrival of Old World peoples to impact the demography of the northern Southwest. There is little evidence in the historic record of sixteenth century exploration of introduced long-term effects, such as disease. However, there is ample documentation of short-term effects; the violence and death brought by the Spanish in the form of warfare, execution and murder is well documented, as is the community abandonment that the specter of violence engendered. While the historic record is explicit as to the nature of these short-term impacts, they contain no insight as to whether they had a lasting demographic impact on Pueblo populations. From another angle, the Spanish also periodically abandoned members of their exploratory parties among the Pueblo, adding members to the community. Some, like the missionaries of the Rodriguez and Chamuscado expedition, were killed by their hosts soon after settling in (Hammond and Rey 1966). Others, like the unknown number of Middle American Natives from the Coronado expedition who remained among the Pueblo after the departure of the main party in 1542, may have represented a contribution to the size, and possibly organization of some Pueblo communities (Riley 1974, 1995). But the actual numbers of those left behind is unknown. Often the most marginal and anonymous members of the exploring parties, only a handful of these individuals are named in Spanish accounts.

The arrival of the expedition led by Juan de Oñate in the northern Southwest in May of 1598 marked the transition from the period of exploration by the Spanish to that of colonization. Like the expedition of Castaño de Sosa, Oñate's party came both to explore and to colonize. Leading a party of 129, Oñate established his colony near present-day San Juan Pueblo, by seizing and occupying a Tewa village. Using this as a base camp, he commenced a series of expeditions to seek supplies and oaths of loyalty from the Pueblos; in doing so, he and his party visited all of the main occupied areas of the Pueblo world, and visited many of the villages in each (Schroeder 1979; Barrett 2002). Between 1598 and 1601, the party set out in expanding arcs, exploring the country beyond the Hopi to the west, and the Plains to the east. Oñate's colony grew by 73 in 1600 with a second party of colonists; however, in 1601, approximately two-thirds of the colonists abandoned the northern Southwest for Mexico, leaving only about 60 Spanish colonists in the region during the first decade of the seventeenth century.

Much like the previous explorers of the northern Southwest, it was not the intent of Oñate's colony to create an autonomous Spanish settlement the region. Like those who had conquered and colonized other regions of what became Spanish America, the colony was to be maintained by supplies and tribute from the Native population, and from the profits of any enterprise, such as mining, that could be established. These terms defined the initial nature of sustained interaction between the Spanish and Pueblo peoples at the beginning of the seventeenth century. Prior to 1610, it appears that the Spanish occupation of the Southwest was confined to the Tewa Basin area, in the vicinity of their colonial capitol near San Juan, and it is likely that all of the first Spanish settlers made their residence there. Although the Spanish did not issue the first formal *encomienda*—an award to a colonist that gave him the right to collect tribute from a Native community—until 1608 (Anderson 1985; Snow 1983), Oñate's colonists sought tribute from the Pueblo from the very first days of their entry into the region (Knaut 1995; Hammond and Rey 1953). These episodes of tribute collection formed the first sustained contact between the Pueblo and the Spanish. Missionaries also accompanied Oñate, and were quickly assigned to proselytize among the various Pueblo communities. In 1598, missionaries were sent to Taos and Picuris, the pueblos of the Tewa Basin, the Galisteo Basin, the central Rio Grande area, the Salinas area, the Rio Abajo, the Jemez, Acoma, the Zuni area, and the pueblos at Hopi. By 1601, however, virtually all of the Franciscan friars had abandoned their posts, and prior to 1610, missionaries were active only in the communities of the Tewa Basin and the central Rio Grande (Scholes 1932; Scholes and Bloom 1944-1945).

After 1610, Spanish control over the Pueblo world was gradually extended to its entire span, from Hopi in the west to Salinas in the east. At least to the extent that *encomiendas* and missions were established, the imposition of Spanish religious and secular institutions over all of the northern Southwest was essentially complete by 1630. The terms of the Spanish occupation, however, changed little from its first decade of occupation, in several respects. First, the Spanish population remained extremely small, particularly when compared to the surrounding Pueblo population. Following Oñate, virtually no persons joined the colony, aside from a few soldiers, government officials, and missionaries. In 1609, there were only about 60 Spanish colonists; that number had not increased by 1620. By the late 1620s, following the arrival of a few more colonists and missionaries, there were no more than 250 Spanish inhabitants of the province. This size appears to have remained largely constant throughout the remainder of the seventeenth century; thirty families and 200 soldiers, including those of mixed descent, were counted in 1639, and in 1661, the Spanish population was estimated at less than 100 (Knaut 1995:132-135). In the aftermath of the Pueblo Revolt, up to one thousand or more Spaniards were counted among the dead and the refugees who reached El Paso in 1680 (Hackett and Shelby 1953). These numbers are likely exaggerated, however, as many, if not most, of the refugees were of Pueblo and of mixed Spanish-Pueblo descent, suggesting that at the end of the eighty years of Spanish colonial rule in the northern Southwest, the European population sat only in the hundreds at most (Knaut 1995:134-135).

Second, the Spanish population remained concentrated in its colonial capitol, that by 1610 had been moved onto the then-uninhabited plateau to the south of the Tewa Basin, at the new provincial capitol of Santa Fe. By the later decades of the seventeenth century, many of these Spanish residents had established *ranchos* and *estancias* in the countryside (Simmons 1969), but the numbers of these seasonal settlements, their extent, and the degree of involvement these settlements had with adjacent Pueblos is unknown; they receive only passing mention in the historic literature and few are known from the archaeological record (Ivey 1992). Missionaries were certainly resident at many of the Pueblos, especially those with established churches and conventos. Other communities without missions were likely visited on a regular basis. However, many missions went untended for periods of years or even decades, particularly in outlying areas such as Jemez and Zuni (Bloom and Mitchell 1938; Scholes 1938). Other Spaniards may have been resident in the Pueblos, such as *encomenderos*; such residence was from time to time mentioned in historic documents. As it was technically illegal for Spaniards to reside within Pueblo communities, however, there was no official tally, and the total number of these Spanish squatters are unknown. One indicator of Spanish and Pueblo interaction that implies sustained contact between communities was the steady increase in mention in the time between the founding of the colony and the Pueblo Revolt of persons with mixed Spanish and Pueblo descent. That relatively few women were part of the original Spanish colonizing party meant that many Spanish men sought unions with Pueblo women, and by the latest part of the seventeenth century, a majority of persons identified as having a Spanish affiliation were of mixed descent. Many of these persons did not live fully within either community, and many people of mixed descent and melded cultural heritage lived within Pueblo communities (Gutierrez 1991; Knaut 1995).

Third, the isolation of the northern Southwest from Mexico to the south did not appreciably change with the establishment of the colony in 1598. As part of the missionary effort a supply caravan was established between Mexico and the colony in the northern Southwest. On its way north, it carried supplies for the missionary effort, such as tools and religious items, in addition to missionaries and civil authorities. On its return trip, it was often commandeered by the civil governor of the province to transport goods for sale in the south, such as piñon nuts, salt, hides, and non-Pueblo Native American slaves (Scholes 1930). While this caravan was scheduled to travel once every three years, in the early decades of the seventeenth century its arrival was erratic and often appeared only twice a decade. This tenuous connection of the northern colony to the rest of Mexico meant that there was little direct interaction between its residents, either Spanish or Pueblo, and the larger population of the Spanish empire beyond.

Despite the small size of the of the Spanish colonial presence in the northern Southwest, its interference with the social, religious and economic order of the Pueblos appears to have been sufficient to have sparked widespread and sustained resistance by Pueblo individuals and communities to colonial rule, which culminated in the revolts of 1680 and 1696. Andrew Knaut has identified multiple historical references to Pueblo resistance to Spanish rule, beginning with the infamous battle between the community of Acoma and the Oñate party in 1598-1599 and a lesser known conflict with the pueblos of the Salinas region, and continuing throughout the seventeenth century (Knaut 1995). While sustained and complete resistance against the Spanish was hampered by Pueblo political and social disunity, the Pueblo were able to exploit the small size and numbers of the Spanish colonists, their tenuous hold on control of the province, and the lack of strong leadership among the elites of the colony, manifested most clearly in the conflict between religious and secular authorities (Knaut 1995; see also Scholes 1936-1937, 1937-1941). Pueblo resistance took the form mainly in the killing of individual Spaniards, often missionaries, but also included general uprisings by one or more communities. These acts of resistance culminated in the general revolt of 1680, which served to expel all Spaniards from the northern Southwest. Resistance to the return of the Spanish in 1692 was no less violent (Kessell et al. 1998); however, a second general revolt staged by the Pueblo in 1696 was unsuccessful at dislodging the Spanish from the region.

Together, the themes from the historic record described above provide a mixed picture of interaction between the Spanish and the Pueblo in the seventeenth century. Overall, the Spanish population of the colony was small, and isolated from the larger Spanish world by distance and by a lack of economic or geopolitical importance; the northern Southwest was neither a source of lucrative minerals nor strategically located as a bulwark against the colonial encroachment of other European powers. However, the biological, social and economic interaction between the Spanish colonists and their Pueblo subjects was intense and sustained. Despite the asymmetry of the interaction, however, the historic record indicates that Spanish domination was often returned with Pueblo resistance, implying that control over the Pueblo communities of the northern Southwest by the Spanish was both far from absolute, and sporadic in its enforcement. The tenuous status of the Spanish colony in the seventeenth century creates a great deal of ambiguity in ascertaining the effects of the colonial process on Pueblo demography.

Chapter II Endnote

[1] Pueblo peoples today maintain strong ties of identity to the institutions of subsistence farming and aggregated residence (Sando 1992); however, few engage in these forms of economic practice or residential pattern. Since 1950, there has been a shift from subsistence farming to wage labor, professional work, commercial farming and livestock-raising, and other economic pursuits that are part of the modern capitalist economy. Subsistence agriculture persists, however, as a supplemental economic pursuit. Likewise, since the widespread adoption of the automobile and the advent of government housing construction on reservations, most Pueblo individuals who live in traditional communities have moved from residences in aggregated, multi-family dwellings to more dispersed, suburban single-family homes. However, many families continue to maintain homes within the older multi-family dwellings that are used during community-wide rituals and celebrations.

CHAPTER III

EXISTING RESEARCH ON PUEBLO POPULATION DECLINE IN THE SIXTEENTH AND SEVENTEENTH CENTURIES

In general, research regarding Native American population decline in the northern Southwest has lagged behind that conducted in other regions of North America. It is generally recognized that some degree of population decline, likely caused by the introduction of Old World infectious disease, took place in the Southwest. Accounts of disease among the Pueblos appear in Spanish documents of the sixteenth and seventeenth centuries, and the archaeological record attests to the abandonment of many settlements and regions occupied by Pueblo peoples during the era in which the Southwest was first explored and colonized by Europeans. However, despite several investigations of the process of early historic Pueblo population decline, no coherent picture has emerged regarding the dimensions of the decline. There is no agreement on basic issues such as when population decline began, the severity of the decline, the role of disease in the process of decline, or why some regions of the Southwest were abandoned by Pueblo peoples while settlement in others has persisted.

This inability to resolve basic questions regarding the timing and severity of Pueblo population decline during the sixteenth and seventeenth centuries stands in contrast to other regions of North America. In the U.S. Southeast, scholars from many disciplines, including archaeology, have moved towards a synthetic understanding of the process of Native American population decline. The potential for the devastation of the dense, largely sedentary agricultural population of the region by introduced infectious diseases has been evaluated by large-scale archaeological studies of settlement abandonment. The susceptibility of the region's inhabitants to disease has been examined by paleoanthropologists who have studied Native Southeasterners' health, both before and after contact, and under the context of mission settlement. And historians have examined how Europeans created widespread social disruption across the region by encouraging and participating in warfare as a means of undermining the settlement efforts of their colonial rivals. Together, these scholarly efforts have supported the hypothesis that introduced infectious diseases had a devastating and early effect on many Native Southeastern populations; that disease was devastating because of the demographic organization and general poor health of Southeasterners; that exploration and Native resettlement policies carried out by the Spanish and later other Europeans facilitated the introduction of disease and created conditions for even greater susceptibility by Natives; and that Native involvement in the geopolitical conflict between Europeans created a social milieu in which significant population recovery could not take place. This convergence of research around the process of population decline and its biological and social consequences has not occurred for the northern Southwest.

This chapter examines the previous studies of Pueblo population decline during the sixteenth and seventeenth centuries, and the intellectual and evidentiary contexts from which these studies were created. The current understanding of sixteenth and seventeenth century Pueblo population decline is the product of many sources. Fundamentally, this view represents the intersection of general ideas about the critical forces driving Native North American depopulation, and the particular historical and archaeological evidence which has been available and identified as relevant to the question of population decline. As such, I precede the review of previous research on Pueblo population decline with a consideration of the general intellectual history of Native American population decline in North America, and with listing of the evidence that has been available to examine population change within the northern Southwest of the sixteenth and seventeenth centuries.

The chapter has two objectives. The first is to understand why no coherent picture of Pueblo population decline has emerged from past studies of the issue. In examining these studies three major themes emerge. One is a continuing reliance on evidence, both archaeological and historic, which is either inappropriate or insufficient for evaluating questions regarding the process of population decline. A second is the failure to consider the demographic organization of early modern Pueblo peoples when calculating the impact of Spanish entry on Pueblo populations. A third is neglect of the entire range of demographic forces (migration, fertility, and identity, in addition to mortality) when considering the process of Pueblo population change.

A second objective follows from the details of the first. This is to establish a framework for evaluating ideas about the nature of population decline. This framework uses Pueblo demographic organization from the centuries prior to the arrival of the Spanish as a starting point and considers the dynamism of this organization in relation to the specific social, economic and environmental challenges faced by the Pueblo in the centuries prior to the arrival of the Spanish. Given this framework, I suggest the strategies which can be used for examining the question of population decline during the sixteenth and seventeenth centuries, and the evidentiary sources which could be utilized to execute such strategies. Fundamentally, I argue that the use of archaeological evidence and methods will be central to the resolution of any of the major issues of population decline, based upon the information needs required.

Native Population Decline in North America: A Background

Studies of population change among Pueblo peoples are firmly rooted in the intellectual trends created by the examination of Native population decline in North America and elsewhere in the Western Hemisphere. Native American demographic change over the past five centuries is composed of a large and diverse set of topics, the full examination of which is beyond the scope of this dissertation. As a consequence, I confine my discussion to a consideration those aspects of Native North American demography from the sixteenth to nineteenth centuries which have most influenced the nature of past and current research on population change among Pueblo peoples, and which point to future directions for such research. I will not deal, except where relevant, with the demographic experience of Native Americans in Mesoamerica, Central America and South America, or research pertaining to Native North American population change during the nineteenth and twentieth centuries. For recent reviews of research concerning Native population change in Mesoamerica, see McCaa (2000); for Central America, see Perez (1997); for South America, see Cook (1998) and Newson (1995). For reviews of recent research on demographic change among Native North Americans during the later nineteenth and twentieth centuries, see Shoemaker (1999) and Thornton (2000). A consideration of population decline among Natives in other parts of the Americas has also been incorporated into reviews which consider the issue of Native American population decline in the Western Hemisphere as a whole over the last 500 years (Borah 1976; Crosby 1972, 1986; Denevan 1992; Dobyns 1966, 1993; Henige 1990, 1998; Jaffe 1993; Thornton 1987; Ubelaker 1988, 1992, 2000).

In considering the history of Native North Americans over the past years, the issue of population decline has been unavoidable. Regardless of the pre-1492 size of Native American populations, or the causes which may have driven decline, the present-day distribution of Native peoples and their status on this continent as a tiny minority among a non-Native population begs the question. As a consequence, researchers considering Native population trends from the very earliest have attempted to identify the causes of the decline. In the first continent-wide survey of Native North American population, James Mooney wrote:

> [t]he fact is that between the discovery of America and the beginning of the federal government the aboriginal population had been subjected to nearly three centuries of destructive influences, which had already wiped out many tribes entirely and reduced many others to mere remnants…. The chief causes, in order of importance, may be classed as smallpox and other epidemics; tuberculosis; sexual diseases; whisky and attendant dissipation; removals, starvation and subjection to unaccustomed conditions; low vitality due to mental depression

> under misfortune; wars. In the category of destroyers all but wars and tuberculosis may be considered to have come from the white man, and the increasing destructiveness of tuberculosis itself is due largely to conditions consequent upon his advent [Mooney 1910:286].

Since Mooney's summary, the vocabulary used for describing the causes of Native population decline has changed. However, there have been few additions to his list, little change in the ranking of the causes, and no dissent as to the role that contact with and conquest by European imperial powers had in introducing and driving these forces of population decline (see, for example, Borah 1964; Jaffe 1993; Thornton 1987, 2000). What has changed, however, are the methods and evidence used to assess the potential causes of Native population decline, and the ideas regarding the timing and severity of their impact. In Mooney's time, identification of the causes of Native North American population decline was based primarily on the immediate ethnographic experiences of anthropologists, and the limited historic accounts of Native American societies that were available at the beginning of the twentieth century. Today, almost a century later, the issue of population decline is informed by both data and theory from a variety of disciplines, including physical anthropology, historical demography, archaeology, theoretical epidemiology, ethnohistory and other fields.

There have also been major changes in perceptions of how the process of Native North American population decline unfolded over the past 500 years. The most significant development over the past forty years has been the emergence of disease as the paramount cause of population decline. A second and related idea is the notion that significant population decline may have taken place prior to face-to-face interaction between Natives and Old World peoples, as a consequence of the rapid spread of introduced Old World infectious diseases. Together, these two themes have largely directed the course of population studies examining Native North American population decline, particularly during the first three centuries following the arrival of Old World populations in the Western Hemisphere.

However, for the most part Native North American population decline has not been examined from the perspective of general demographic theory, which weighs the relative influence of changes in fertility, mortality and migration when considering human population change (Thornton 1987:42-44). Rather, most studies of population change have taken the form of either empirical observations regarding changes in datasets, or hypothetical considerations based on the potential behavior of both humans and disease. Together, these types of arguments have created an *ad hoc* body of ideas about the process of Native population decline in North America. This observation is less a criticism of that work than a reflection of the nature and diversity of the data available for assessing population decline, and the challenges in interpreting that data. In some areas, work has been approaching synthesis, and from it a picture of the direction that research should take in the future is emerging. What follows is a selective outline of the history this research, with an emphasis on the topics which have most influenced the direction of study of population decline among Pueblo peoples.

Earlier Research

James Mooney (1928) and Alfred Kroeber (1934, 1939) were the first to systematically investigate population decline among Native North Americans as a general issue. These researchers perceived that by the beginning of the twentieth century, population decline among Native North Americans had been dramatic and had been significant in driving culture change since the arrival of peoples from the Old World into the Americas. Indeed, there was a widespread perception among anthropologists during the early twentieth century that many, if not all Native North American groups were destined for disappearance as distinct biological and cultural entities through the twin forces of miscegenation and assimilation (Hinsley 1981). Such research was conducted before the dramatic increase in Native North American populations during the twentieth century was statistically apparent, and prior to the resurgence in Native

North American cultural identity which has taken place within most Native communities since 1960 (Shoemaker 1999; Thornton 1987).

While early researchers emphasized the severity of Native North American population decline prior to the early twentieth century, and associated the causes of that decline squarely with the effects of entry by European peoples into North America, their characterization of Native American demographic change over the past 500 years differs from much current research in two ways. First, they perceived that Native American populations prior to 1500 were quite small, between 1 and 1.2 million for North America (Mooney 1928; Kroeber 1939), when compared to an estimated 67 million population in Europe during the fifteenth century (Livi-Bacci 1992:31). And second, they saw population decline as a phenomenon which took place within the context of face-to-face interaction between Natives and Old World peoples, and that population decline was a consequence of the effects of direct interaction in the form of exploration, trade, warfare, and the imposition of colonial rule. In particular, with the exception of Kroeber, most scholars emphasized the impact of Old World infectious diseases on the diminution of Native American populations (Dobyns 1966:411-412).

The conclusions of a small pre-Columbian Native population and population decline under the conditions of colonization made by early researchers is a direct consequence of the demographic information available during the early twentieth century (Ramenofsky 1987; Ubelaker 1976). Both Kroeber's and Mooney's population estimates were derived from early ethnographic and ethnohistoric accounts; depending upon the Native American group, the dates for these estimates ranged from the early seventeenth to mid-nineteenth centuries. The estimates were used as a baseline for Native American population size, and population decline was calculated by comparing the estimates to early twentieth century population data. The assumption that the population size reported at earliest contact was an accurate estimate of population size prior to the arrival of Old World peoples in the Americas is a reflection of the perception, widespread among anthropologists during the early twentieth century, that little cultural change had taken place among Native North Americans during the duration of human occupation on the continent (Trigger 1989:195). Thus, early historic Native groups could not have been markedly different from their late prehistoric counterparts.

Disease Depopulation: The Dobyns Hypothesis

The transformation of our understanding of Native North American population decline has been centrally identified with the work of Henry Dobyns (Ramenofsky 1987), in particular with his 1966 article on the estimation of Native American populations at the time of contact with Old World populations (Dobyns 1966). Dobyns concurred with earlier researchers that population decline among the Natives of North America had been severe, and that among all of the causes of population decline, disease was the most significant. However, Dobyns elevated the significance of introduced Old World infectious diseases to a new level when considering their impact on Native North Americans. What was novel about the work of Dobyns was the notion that Old World infectious diseases had stricken most Native North Americans before their first face-to-face interaction with Old World peoples, and that the initial devastating demographic and cultural effects of disease were largely independent of this direct interaction. Rather than disease introduction being a consequence of sustained face-to-face contact, infections were spread among the Natives of North America through both intermittent direct and indirect contact with the very first Old World peoples in the Western Hemisphere. For example, Dobyns believed that the smallpox epidemic which struck central Mexico during the Cortes invasion of 1519-1521 spread quickly from Mesoamerica to North America, carried not by European hosts, but rather spread by contact between infected Native Americans, along routes of communication and trade. Other diseases found their way into the North American interior through early- and mid-sixteenth century through Mexico, the Caribbean, and contact with European explorers along the Atlantic and Pacific coast. As a consequence of these disease episodes, Dobyns argued that all of Native North America suffered precipitous population declines during the early to mid sixteenth century, long before European explorers would have had a chance to make estimates of their size. By the middle part of the century, the first Native North American groups recorded by European explorers had been reduced in size by up to 95 percent (Dobyns 1983).

Dobyns drew inspiration for his hypothesis that introduced Old World infectious diseases had an early and devastating effect on Native North Americans from two sources. The first was the studies conducted by Sherburne Cook, Woodrow Borah and Lesley Byrd Simpson on the effects of Old World infectious diseases in central Mexico (Borah and Cook 1960, 1963; Cook and Borah 1960; Cook and Simpson 1948). Using data from Native tribute collection records and Spanish censuses, these scholars were able to determine that the Native populations of central Mexico experienced precipitous declines in size, coincident with reports of the devastating effects of Old World infectious diseases on Natives in this region (Cook 1946). These studies, along with those examining the effects of disease on the Natives resident in missions in the Californias in the seventeenth and eighteenth centuries (Cook 1937, 1939, 1940, 1946), quantified that Old World disease could cause mortality and decline among Natives at a scale resulting in the reduction of populations by up to ninety-five percent (Dobyns 1966). The second source was Dobyns's own examination of the spread of Old World infectious diseases from central Mexico to the Inca Empire following the fall of central Mexico to Cortes in 1521, but prior to the invasion of the Inca Empire by Pizzaro in 1532 (Dobyns 1963a). The reported mass mortality experienced by the Native American inhabitants of the Inca realm in the later 1520s, and the social disruption and political unrest which it engendered, demonstrated to Dobyns the ability of infectious diseases to travel in the New World faster than the Spanish conquistadors who had first introduced them, and the capability of such diseases to initiate culture change and sociopolitical dissolution even in the absence of actual conquest on the part of Europeans.

While both Mooney and Kroeber estimated Native North American populations to be just to either side of one million at the close of the fifteenth century, Dobyns placed the size of the North American population as being nine to twelve times as large. Along with his revised estimate of the size of Native American populations prior to 1492, Dobyns also evaluated the various techniques by which Kroeber, Mooney and others arrived at their estimates of Native populations. He found them wanting for several reasons, but the primary methodological shortcoming was their inability to account for significant population decline between the time of first contact between Natives and persons from the Old World and the moment, sometimes hundreds of years later, when the Native populations were first enumerated. Specifically, these estimates could not account for the effects of Old World infectious diseases on mortality among Native North Americans. Dobyns wrote: "[a]ny method of aboriginal population estimation which seeks to project back through time census or ethnographer's enumerations of recent Indian populations must assume that disease agents have affected the population trend of the group under investigation and seek data as to the nature and extent of their effect (Dobyns 1966:412)."

To correct for this shortcoming, Dobyns reversed the temporal direction of population reconstruction through the application of the inverse projection method. This method, like the earlier estimates of Native American population size, began with historic estimates of Native population size. Rather than estimating size from earliest known enumeration, however, Dobyns's historic population counts reflected regional Native population sizes at their historic nadir. From these enumerations, the effect of disease was then factored in, expressed as a depopulation ratio reflecting the change in population from initial contact to the time of population recovery. Because Dobyns assumed that the effects of disease on Native Americans hemisphere-wide would be uniform, a ratio of 20 to 1 or 25 to 1 was employed, drawn from the previous work on Native depopulation in Mexico and California, respectively. Thus, beginning with a 1930 nadir population of 490,000 for Natives in North America, Dobyns generated population estimates for 1492 of 9.8 million and 12.25 million using the Mexico and California depopulation ratios, respectively (Dobyns 1966:415).

Dobyns's case for disease as the central cause of Native population decline is compelling for several reasons. First, Native North Americans lived in a disease environment prior to 1492 in which the vast majority of infections endemic to the Eastern Hemisphere were absent (Black 1992; Crosby 1986, 1991; Meltzer 1992; Ramenofsky 1992). Because Native American communities lacked prior exposure to these diseases, which included smallpox, typhus, malaria, plague, typhoid fever, mumps, influenza and other contagions, when first exposed they both sickened and died in disproportionate numbers (Crosby 1972, 1986). Unlike Old World populations, where most adult individuals had been exposed to and survived these diseases in childhood, Native Americans had not, and persons of all ages were vulnerable to their effects, including mortality. Thus, Old World diseases struck Native communities for the first time with devastating results, infecting and killing both children and adults in equal numbers.

Second, disease has the potential to travel among human populations far more swiftly, and by a greater diversity of routes, than the European explorers who first potentially introduced Old World infectious ailments to Native North Americans. The notion that diseases could have spread deep into North America before European colonization and conquest suggests that severe population decline could have taken place among Natives prior to the appearance of these Native peoples and communities in the European accounts of their societies. Contagious Old World diseases, when introduced at points such as central Mexico or the Florida coast, spread into the interior of the North American continent, from community to community, and along routes of trade and exchange. The consequence was immediate and dramatic population decline even in areas of North America far from the first points of interaction between Natives and Old World peoples (Dobyns 1983, 1992; Milner 1980; Ramenofsky 1987).

Given the potential for disease to raise mortality both greatly and rapidly, the consequences of epidemics of introduced infectious Old World ailments among Native North Americans could have been enormous, both for Native societies and for our conventional understanding of their organization. If disease struck Native communities before their first face-to-face contact with Old World peoples, there was the potential for dramatic population decline prior to their first documentation by European explorers. As such, Native communities and societies could have been much larger in size than could be established from a reliance on enumerations from the earliest recorders; if diseases such as smallpox impacted Native communities at their maximum mortality potential, then it is conceivable that the populations recorded by early European explorers had already been reduced in size between fifty and ninety-five percent (Dobyns 1966, 1983; Reff 1981, 1991, 1992).

A corollary of the potential for significant pre-contact mortality among Native North Americans was that significant culture change may have taken place as a consequence of dramatic population decline. As populations collapsed, so too did major patterns of political organization and cultural identity. Consequently, the Native North American groups encountered by the first European explorers in the seventeenth, eighteenth and early nineteenth centuries were much changed from those which were present in the late fifteenth and early sixteenth centuries, prior to the introduction of disease. In particular, these post-disease Native populations were likely to be significantly smaller in size, more dispersed in their settlement pattern, less intensive in their subsistence practice, and less hierarchical in their political organization, among other differences (Dobyns 1966, 1983, 1992; Doolittle 1988; Dunnell 1992; Milner 1980; Ramenofsky 1987; Reff 1981; Rushforth and Upham 1992; Smith 1994, 2000, 2002; Upham 1982).

Dobyns's arguments for the rapid spread of introduced Old World infectious diseases and the depopulation of North America were incorporated, along with more evidence-based studies of Native depopulation in other parts of the Western Hemisphere such central Mexico, into general considerations of the European conquest of the New World (Crosby 1967, 1972, 1986; Diamond 1997; Jennings 1975, 1993, McNeill 1976; Stannard 1992). For many scholars, the concept of depopulation from disease played a central role in understanding how a small number of Europeans were able to assert dominance over the civilizations of the New World, including those of North America. The notion of depopulation also served revisionists arguing that the early descriptions of Native North Americans as simple in their social and political organization merely reflected the disorganized nature of Native American society following devastating epidemics. Even scholars who blamed the destruction of Native North American societies on other forces, such as genocide (Stannard 1992), found that they had to incorporate disease depopulation into their understanding of the European conquest of New World peoples.

Despite the general acceptance of Dobyns's ideas regarding the depopulation of Native North America during the early sixteenth century, prior to 1980 little empirical evidence had been generated to support his claims from either historic or archaeological sources. Regardless of the potential for introduced Old World infectious diseases to cause significant mortality among Native North Americans, the possibility of rapid spread and devastating pre-contact population decline presents a variety of methodological challenges distinct from the traditional examination of disease effects within a population using documentary evidence. Because there is a potential for significant mortality and population decline among Natives prior to any sustained contact with Old World peoples, one cannot employ the traditional methods of demographic history, such as the examination of the numbers and causes of deaths listed in vital records or written eyewitness accounts of epidemics. Such documents were not produced by the non-literate societies of pre-contact Native North America. Rather, the investigation of disease effects must rely on novel techniques for understanding population decline, such as the modeling of disease behavior in hypothetical populations, or the examination of the material record, including archaeological and human skeletal remains.

Testing the Dobyns Hypothesis With Archaeology

While Dobyns's hypothesis of Native North American disease depopopulation had been incorporated in the scholarly and general understanding of the interaction between Natives and Old World peoples, its acceptance had not been built on actual evidence of depopulation. Instead, Dobyns's model of depopulation drew its logic from the mathematical and epidemiological possibilities of disease effects, and a few early eyewitness descriptions of large Native populations, primarily in the US Southeast (Dobyns 1983, 1990). Because of the lack of historic records available to document disease effects and population decline, which set apart the North American demographic experience from that of Middle and South America, archaeological research was required to evaluate Dobyns's ideas (Milner 1980).

A variety of archaeological studies explicitly concerned with the dramatic decline in Native North American populations during the sixteenth century were produced in the 1980s and early 1990s for many, but not all, of the major regions of North America. The most prominent among the studies are summarized in Table 3.1, excepting those conducted for the northern Southwest; these are discussed in a following section. The results of the studies are surprisingly diverse, in some cases confirming the Dobyns hypothesis, in other cases modifying some of its major tenets, and still others rejecting the hypothesis completely. Together, the results of the studies, which for many of the regions of North America should be considered preliminary, suggest that the effects of introduced Old World infectious diseases were both spatially and temporally variable, in contrast to the monolithic effects predicted by Dobyns (Ramenofsky 1987:174-176; 1990).

The U.S. Southeast provides some of the most dramatic archaeological evidence for significant population decline. If Dobyns is correct in asserting that introduced Old World infectious diseases had the potential to incur population declines of up to ninety-five percent among previously unexposed populations, then dramatic declines in settlement frequencies and the abandonment of regions should be a central indicator of disease depopulation (Perttula and Ramenofsky 1981; Ramenofsky 1987). Such declines are apparent in several areas of the Southeast, particularly in the more westerly portions of the region, which saw the widespread disappearance of settlements in the lower Mississippi Valley (Ramenofsky 1987) and the abandonment of the Ouachita Mountains area (Perttula 1992). In other areas where settlement evidence is less complete or more equivocal, other indicators point to substantial population decline. Sociopolitical de-evolution, for example, is assumed to be a consequence of dramatic population decline (Galloway 1994; Smith 1987, 2000). Several indicators of hierarchical

Table 3.1. North American Archaeological Studies of Sixteenth Century Population Decline

Researcher	Region	Data	Confirmation of Dobyns Hypothesis?	References
Ramenofsky	Lower Mississippi Valley (Southeast)	--Settlement Frequencies --Settlement Size	Yes	Ramenofsky 1985 Ramenofsky 1987
Ramenofsky	Middle Missouri Valley (Midwest)	--Settlement Frequencies --Settlement Size	Maybe[a]	Ramenofsky 1987
Ramenofsky	Central New York (Northeast)	--Settlement Frequencies --Settlement Size	Maybe	Ramenofsky 1987
Smith	Interior Southeast	--Settlement Frequencies --Burial Evidence --Status Indicators	Yes	Smith 1987 Smith 1994 Smith 2000 Smith 2002
Perttula	East Texas/Ozark Highlands (Southeast)	--Settlement Frequencies --Regional Occupation --Status Indicators	Yes	Perttula 1991 Perttula 1992
Campbell	Columbia Plateau (Northwest)	--Settlement Frequencies --Feature Use --Refuse Accumulation	Yes	Campbell 1990
Snow and others	Mohawk Valley (Northeast)	--Settlement Frequencies --Settlement Size	No	Snow 1995 Snow 1996 Snow and Lanphear 1988 Snow and Starna 1989
Doolittle	Valley of Sonora (Southwest)	--Settlement Frequencies --Settlement Size	Maybe[a]	Doolittle 1984 Doolittle 1988

Note: The use of "maybe" in indicating the confirmation of the Dobyns hypothesis reflects ambiguity on the part of the researcher in interpreting in her or his results; it is not an independent assessment of the data.

[a] Population decline occurs in the seventeenth century, but prior to conquest and occupation of the regions by Europeans.

political organization (chiefdoms) such as monumental architecture, settlement hierarchies, prestige grave goods, craft specialization and long-distance trade disappear or diminish in several areas of the Southeast, including the interior uplands of Georgia, Mississippi and Tennessee (Smith 1987) and in east Texas and Arkansas (Dye 1986, Jeter 1989; Perttula 1991, 1992).

Dramatic declines in the number of Native American settlements during the sixteenth century have also been reported from other regions of North America, including the Pacific Northwest (Campbell 1990). However, the results of many of the studies examining regions outside of the U.S. Southeast have not conformed with one of the central tenets of the Dobyns hypothesis: sixteenth century population collapse. In the Middle Missouri region of the western upper Midwest, for example, Ann Ramenofsky documented rapid settlement abandonment similar to that in the lower Mississippi Valley (Ramenofsky 1987). However, widespread abandonment in this area dates to the seventeenth, not sixteenth century, indicating that although disease likely spread to the upper Midwest prior to the occupation of this region by Europeans, the diffusion of Old World infectious diseases among Native North Americans was far less rapid than predicted by Dobyns. Ramenofsky's examination of settlement data in central New York indicate that population decline there took place in the seventeenth century, very possibly in the context of direct and sustained interaction between Natives and the Europeans occupying the coast of the region (Ramenofsky 1987). A detailed examination of settlement data within a smaller portion of the Northeast, the Mohawk Valley of upstate New York, found that populations likely increased during the sixteenth century, with dramatic population decline taking place between the mid-seventeenth and late eighteenth century, squarely within the era of direct and sustained contact between Natives and Europeans in the U.S. Northeast (Snow 1995, 1996; Snow and Starna 1989).

Other regions of North America, such as Alta (U.S.) California, have not been the subject of explicit archaeological studies examining the question of Native depopulation. However, scholars in California have been critical of the Dobyns hypothesis on the basis of general surveys of settlement data and other forms of archaeological evidence. The lack of evidence for population decline among the Natives of Alta California during the sixteenth century is somewhat surprising, as like the Southeast, the region likely had intermittent contacts with Spanish and other European explorers who plied the Pacific coast, creating the conditions for infectious disease introduction. While not as dramatic as the Southeast, Alta California also experienced population growth and increasing sedentism in late prehistory that would have facilitated the spread of infectious diseases (Walker 2001). However, there is no known archaeological evidence indicating a population decline prior to the eighteenth century. General surveys of mortuary evidence and existing settlement data from the sixteenth and seventeenth centuries, have found no evidence of a dramatic collapse in population size (Kealhofer 1996; Walker and Thornton 2002). Rather, these data suggest an incremental population increase and elaboration of mortuary ritual up to 1769, when the first Spanish mission communities were established in the region, and interaction between Natives and Europeans became intensive and sustained (Kealhofer 1996:58-64).

In showing that elements of the disease depopulation model closely fit some regions and not others, archaeological study has demonstrated a range of demographic responses by Native North Americans to infectious disease. In areas where population densities were high, and contact with Europeans was sustained prior to colonization, such as the U.S. Southeast, introduced Old World infectious diseases had a devastating effect. In other areas, where populations were smaller, more dispersed, and discontinuous in their distribution, and contact with Europeans was more intermittent, disease incidence was more sporadic. In general, these regions did not experience sustained decline until colonized and subjugated by the European colonial powers. While some have viewed the lack of evidence for early Native population decline in some regions of North America as a referendum on the notion of depopulation from disease as a whole (Snow 1995, 1996), most archaeologists and other researchers have seen the wide variability in Native response to the introduction of disease as central to understanding the process of Native population decline in North America (Baker and Kealhofer 1996, Walker 2001). In an attempt to comprehend the patterning of population decline in the U.S. Southeast, Ramenofsky (1990) has introduced the concept of *differential persistence*. The term "differential persistence" refers to the historical experience of survival on the part of some Native North American groups versus the decline and extinction of others. The reality of differential persistence, even in areas where infectious diseases appeared to have devastating effects, is indicated by the survival of some Native Americans. Ramenofsky wrote: "[a]s current tribal rosters suggest, not all native populations in the Forested East died in the sixteenth century. Clearly, there were differential responses to disease. Explanatory assumptions come and go, but the problem of persistence or extinction remains (Ramenofsky 1990:32)." Rather than confirm or dismiss the concept of depopulation from disease, which had been the main talking points among researchers examining population decline in the Southeast up to that point, Ramenofsky suggested variables in the settlement pattern and geographic distribution of Native groups which could influence both morbidity and mortality from introduced infectious diseases. While not yet documented in North America, differential persistence among Native groups due to variables such as geographic location, settlement pattern and climatic conditions has been historically recorded in other parts of the Western Hemisphere, including regions which experienced dramatic and early depopulation, such as central Mexico, Central America, and the western coast of South America (Cook and Borah 1974; Newson 1992, 1993, 1995; for a discussion, see Ramenofsky 1996:166-168). For example, Linda Newson found that in Nicaragua, between contact and the beginning of the nineteenth century, Native populations declined 94.6 percent in the west, while declining 76.6 percent in the central portions of the country and on the Mosquito Coast; in areas beyond Spanish control, the decline was only 21.2 percent (Newson 1992:299). In Ecuador, she found significant differences in Native population decline between the different geographical regions of the country, with a depopulation ratio of 21.1 to 1 on the coast (similar to Dobyns's 20 to 1 ratio for the depopulation of Mexico), but a depopulation ratio of only 5.1 to 1 in the *sierra* and 3.7 to 1 in the highland *selva* for the period between A.D. 1500 and 1600 (Newson 1993:1188). Cook and Borah (1974) reported similar geographical variation in Native depopulation in central Mexico.

The Early Historic Southeast: Towards a New Model for Native Population Decline

For many researchers, the testing of the Dobyns hypothesis and, in some cases, the confirmation of significant early depopulation from disease, has engendered a shift in the emphasis of research on the nature of Native American population change over the past 500 years. This shift is graphically illustrated in Figure 3.1. Prior to 1990, the central question of population change for researchers concerned with Native North American populations was confirmation or refutation of the Dobyns hypothesis. Testing the hypothesis allowed for the consideration of only two alternative ideas: that disease and attendant population decline was introduced in the early sixteenth century across the North America, or that population decline was initiated at variable times relative to the first sustained interaction between Natives and Old World peoples. Because the population change suggested by the Dobyns hypothesis was so significant, other issues, demographic or otherwise, could not considered without resolution of this issue (Figure 3.1, part a). Testing the hypothesis had two effects. First, it confirmed that early depopulation did take place as Dobyns had asserted it would. Second, however, it demonstrated that it only held true in some places and during some time periods; significant disease depopulation was not a uniform phenomenon. While providing a problematic answer to the question posed by the Dobyns hypothesis, these conclusions created the intellectual space to ask new questions about the nature of Native population change during the sixteenth and seventeenth centuries, and about the social, economic, political, ecological, and demographic context of that change (Figure 3.1, part b). Since 1990, research in some regions has shifted to reflect this change, and has focused on understanding the process of Native population decline,

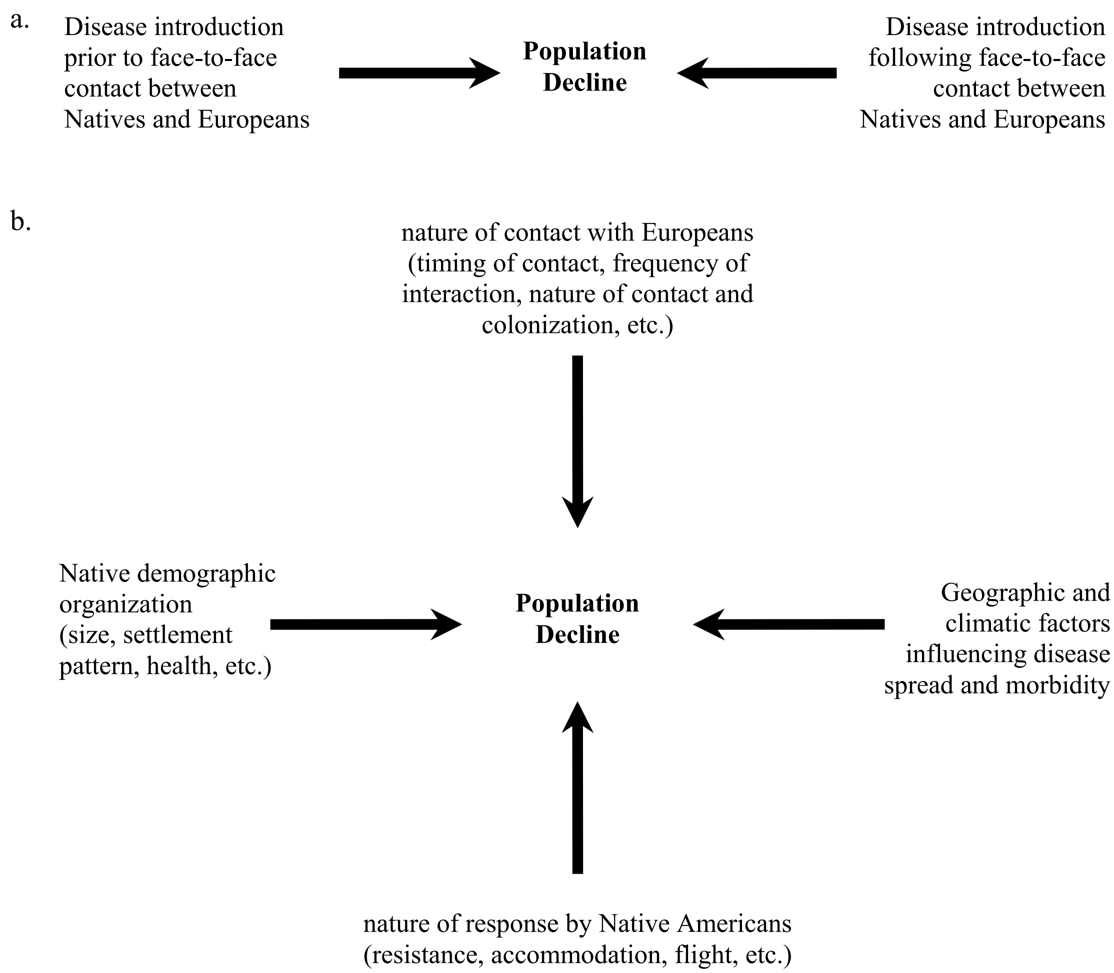


Figure 3.1. Models for understanding variability in the effects of introduced infectious Old World diseases on Native North American population decline before (a.) and after (b.) the testing of the Dobyns hypothesis. Each idea followed by an arrow represents a variable which can affect the likelihood of population decline following disease introduction.

rather than the simple affirmation or rejection of the idea that dramatic population decline took place (Baker and Kealhofer 1996; Ubelaker 2000; Walker 2001; Wesson and Rees 2002).

Research on the nature and causes of Native American population decline in the U.S. Southeast provides as an example of this change in direction. The general acceptance of the notion that introduced Old World epidemic diseases caused dramatic decline among many of the Native American societies of the region has allowed for the consideration of the nature and cause of this dramatic decline, and its consequences. Several areas of research stand out. First is the examination of the demographic conditions which made dramatic depopulation possible, but also provided for the differential survival of some cultural groups at the expense of others. Second is the study of colonial rule, and why populations within the Southeast under Spanish control during the sixteenth and seventeenth centuries were much less likely to persist than those beyond Spanish rule. And third is the impact of European policy and action on making permanent the process of population decline, and in preventing the recovery of Southeastern populations. In each area, a variety of disciplines have contributed to these conclusions.

Research in the last ten years has provided a great deal of progress in understanding both the patterns and the causes of differential persistence between the various populations of the Southeast, and the relationship of differential persistence to the dramatic culture change experienced during this period. Differences in geographic location, population density and political organization appeared to have played central roles in determining which groups within the Southeast persisted into the late seventeenth and early eighteenth centuries, and which disappeared. The study of the ethnogenesis of early historic Native American groups, such as the Choctaw, Chickasaw, Creek, Natchez and others, has shown these entities to be amalgamations of disparate groups (Davis 2002; Galloway 1994, 1995, 2002; Jeter 2002; Rodning 2002; Smith 1987). Patricia Galloway, examining the origin of the Choctaw, implicates depopulation from disease for the emergence of these non-hierarchical tribal entities out of an earlier era, in the fifteenth and early sixteenth century, when the west-central Southeast was dominated by hierarchical chiefdoms. She observes that the long archaeological record of chiefdoms in the Southeast has demonstrated these entities to be inherently unstable polities, subject to disruption and collapse during periods of instability. At the same time, these chiefdoms would have had the largest and most dense populations, and would have been the most integrated into regional networks of exchange. These factors would have made them the most susceptible to disease; other, less hierarchically organized groups such as devolved chiefdoms or tribally organized groups occupying more marginal areas would be less likely to suffer catastrophic mortality. Writes Galloway, "[c]hiefdoms would lose their organization, and we have seen that this would mean their destruction. On the other hand, segementary tribes…would suffer far less, since they retained the web of tradition at a lower level of distributed expertise, and since their dispersed settlement pattern and infrequent gatherings would not favor the spread of disease (Galloway 1994:397-398)." Thus the groups which would have persisted into the eighteenth century were precisely those which were more peripheral and less hierarchically organized, and should represent an agglomeration of residual groups. This pattern seen in ethnohistoric accounts, oral history and archaeological evidence by Galloway in the west-central portion of the Southeast has also been observed in the north-central uplands, where major centers were abandoned for dispersed settlements (Smith 1989, 1994), and in the western portion of the Southeast, where densely occupied river valleys were abandoned while more dispersed settlement in upland areas persisted (Perttula 2002a). Together, these patterns suggest the demographic, geographic and political factors central to differential persistence in the region, and cultural mechanisms by which persistence was achieved by particular groups.

Unlike the remainder of the Southeast, Natives in much of Florida and the southern Atlantic coast experienced the early imposition of colonial rule by Spain. The first colony was established in Florida by French Protestant settlers in 1564, but their settlement was destroyed and replaced the next year by the Spanish. By 1587 the Spanish began in earnest the process of establishing missions among Native communities (Hann 1996; Milanich 2000). One of the consequences of Spanish rule was the complete extinction of the Native groups there, including the Timucua, Guale and Apalachee, in contrast to the unconquered groups of the Southeastern interior (Worth 2002). In Florida, disease transmission to Natives was intensified by the contacts of their Spanish rulers with other portions of the Spanish New World empire; the conditions of colonial rule also intensified both morbidity and mortality. Quantitative evidence for epidemics in the area is limited, but reference to disease episodes indicates that they were both commonplace and devastating (Hann 1988, 1996; Hann and McEwan 1998; Milanich 2000; Worth 1998). Infectious disease was joined by other sources of mortality that accompanied colonial rule, including increased malnutrition from subsistence changes, changes in the labor regime, chronic demographic instability caused by forced relocation and *repartimeinto* labor demands, and violence from both Native resistance to Spanish rule and from warfare between the Spanish and their European imperial competitors, into which the Natives of Florida found themselves enmeshed.

Paleoanthropological studies on the remains of Florida Natives during the sixteenth and seventeenth centuries have documented the effects of both malnutrition and labor demands as a consequence of Spanish rule. Prior to arrival of Old World peoples and their diseases in the Southeast, skeletal evidence indicates that overall health among its Native inhabitants was poor. Natives in the Southeast suffered from a poor diet and a variety of nutritional stresses, as indicated by both dental and skeletal pathologies and stable isotope evidence (Hutchinson et al. 1998; Larsen and Harn 1994; Larsen et al. 2001). They also suffered from a variety of endemic, chronic infectious diseases, including tuberculosis and treponematosis (Larsen 1994; Powell 1992; Schultz et al. 2001). The general poor health of Native Southeasterners prior to 1500 is consistent with a high dependence on agriculture for subsistence, high population densities, and social inequality (Steckel and Rose 2002). This poor health across the region provided, along with dense populations and extensive networks of trade and communications, conditions ideal for high morbidity and mortality from infectious diseases. Even with this evidence of general poor health prior to the imposition of Spanish rule, increased frequencies of skeletal and dental pathologies, along with isotopic evidence, indicates dietary health became even worse once Spanish domination was imposed (Hutchinson and Norr 1994; Larsen 1990; Larsen and Harn 1994; Larsen et al. 1990, 2001).

Studies of paleopathology provide confirmation for historic evidence that changes in the labor regime also contributed to poor health and mortality. The use of *repartimiento* labor was widespread for both tending crown fields and bearing loads during transportation; historical accounts describe Native bearers were worked so hard that they collapsed from exhaustion and died on the trails that led from the Native towns to the center of the Spanish colony at Saint Augustine (Worth 1998). Pathologies and infections expressed on skeletal material confirm stresses from labor demands, including increases in skeletal robusticity and in frequencies of osteoarthritis (Larsen et.al. 1996, Ruff and Larsen 1990, 1994, 2001). Historic records indicate that the imposition of the new Spanish labor regime affected fertility as well. *Repartimiento* labor drew males away from towns, leaving strongly unequal sex ratios heavily weighted towards women and girls. These unequal sex ratios led to fewer unions, lower rates of reproduction, and fewer children to replace the increasingly large numbers of Natives killed by disease, overwork, malnutrition, violence, and warfare (Worth 1998).

While the imposition of colonial rule over the Southeastern Natives of Florida and the Atlantic coast provides an understanding of how other social and economic factors served to multiply the depopulating effects of disease, this is not the case for the Natives in the interior and the west of the region. Here, while the effects of disease were clearly devastating during the sixteenth century, populations should have experienced recovery during the seventeenth and eighteenth century, and an incipient recovery may be evident from both settlement evidence (Ramenofsky 1987) and from evidence in improving lifespan indicated by human remains (Burnett 1993). However, connection of these regions into the trade and slave-gathering networks of the French and British colonial enterprises in the later part of the seventeenth century provide evidence as to why population recovery was not possible throughout much of the region. During the late seventeenth and eighteenth centuries, much of the interior and western Southeast had been turned into a war zone by the French and the British, much as Florida and the Atlantic coast had been in the late sixteenth and seventeenth centuries (Gallay 2002; Steele 1995). The Europeans employed Native groups as proxies in their geopolitical conflict, but the nature of the warfare did not follow more traditional Native patterns, with genocide being a common fate for losing groups in conflict (Dye 2002; Galloway 2002). Slave raiding was also introduced into the interior by the British during this period, leading to the permanent removal of significant numbers of the population (Gallay 2002; Wright 1981). Warfare and slave-taking contributed to settlement instability and abandonment in the northern portion of the interior, as groups attempted to move beyond the reach of groups allied with the British (Smith 1989). Together, these forces likely prevented interior and western Southeast Natives from allowing the social and demographic adjustments to disease made during the late sixteenth and seventeenth centuries to be translated into a population recovery. The inexorable flow of Europeans settlers and African slaves into the region in the late eighteenth century served to fill areas abandoned during the sixteenth and seventeenth centuries, providing no areas of potential expansion to Natives if a population recovery could have been mustered (Wood 1989). By the beginning of the nineteenth century, the Natives of the Southeast found themselves to be a small minority within their homeland, and the stage was set for their final dispossession and removal in the early 1800s.

Pueblo Population During the Historic Period: Data Sources

Existing scholarly research on the question of Pueblo population decline in the sixteenth and seventeenth centuries is a product of both the general intellectual currents regarding Native North American population decline, and the evidence available in the northern Southwest to examine Pueblo population decline. In the search for evidence regarding the demographic fate of Native North Americans over the past 500 years, researchers have examined a variety of sources, both from the historic and the archaeological records. Most, but not all, of the historic and archaeological sources of demographic information which have been used in other regions of North America, are available for the investigation of population decline among Pueblo peoples. A list of these major information sources is presented in Table 3.2. These sources include not only those which have been employed, with greater or lesser degrees of success, by other researchers in the northern Southwest, but is also based upon information sources which are potentially available, and correspond with methods which have been employed elsewhere. The inclusion of any particular information source on the list does not imply that it does, or will have value, in answering central questions regarding demographic change among Pueblo peoples; my listing of them here is only an indication of potential. The next two sections are a consideration of the usefulness of these sources so far, and of their future potential.

Historic Sources

Historic sources for evidence of Pueblo population change during the sixteenth and seventeenth centuries reside in two bodies: the documents generated by the Spanish during the sixteenth and seventeenth centuries; and the oral histories maintained by the Pueblos today of the events of that era. These two sources are distinct in the types of documents that are available for researchers to utilize, and in the nature of the evidence they contain relevant to population decline.

<u>Spanish Sources: General Accounts and Documents from Particular Events and Proceedings</u>

The corpus of historical textual material from the first two centuries of Spanish entry into the northern Southwest has received considerable attention from scholars, but is neither substantial or complete, particularly when compared with later centuries or other regions, such as California. The relatively small volume of historic material is unsurprising, given the small size of the expeditions which probed the communities of the region, the spare numbers of colonists

Table 3.2. Sixteenth and Seventeenth Century Sources of Demographic Evidence

- HISTORICAL SOURCES
  - general accounts
    - explorer's accounts
    - secular colonial accounts—governmental reports and popular accounts (*residencias*, *informes* and *relaciones*)
    - ecclesiastical accounts—official and popular (*informes* and *relaciones*)
  - particular documents
    - legal proceedings (wills and *testamentos*, *títulos* and *peticiones*)
    - ecclesiastical documents (letters, *padrones*, *informes*, *diligencias matrimoniales*, and inquisition documents)
    - government orders and proclamations
    - official and personal correspondence (*visitas*)
  - oral history
    - ethnographies and ethnohistories
    - land claims settlement documents
    - oral interviews and testimony

- ARCHAEOLOGICAL SOURCES
  - settlement data
  - landscape-scale data
  - evidence from human remains
    - disease morbidity and mortality evidence
    - indicators of health
    - cemetery remains (demographic structure)
  - artifact and ecof act remains
    - food/dietary remains (faunal and macrobotanical remains, pollen evidence)
    - household goods (ceramics and lithics)

Source: for historic document types, Barnes and others (1981); Beers (1979).

and missionaries who came to impose their rule and religion over the Pueblos, and the economic and political insignificance of the region to the overall colonial enterprise of the Spanish in the Americas. Limitations in the volume of documents, the time periods for which they are available, and the kinds of written records which have persisted to this day should *a priori* indicate that historic sources alone cannot provide a full picture of Pueblo demographic change during the sixteenth and seventeenth centuries. However, the limitations of historic documents as sources for demographic information regarding Pueblo peoples are not simply a consequence of their number, type and temporal coverage. As Knaut (1995; see also Broughton 1993) observed, the Spanish made themselves, their activities, and their accomplishments the central subjects of most accounts from the first two centuries of Spanish presence in the northern Southwest, particularly during the seventeenth century, the first century of colonization. Recovering the experiences of Native peoples from European accounts requires both focused and selective reading (Feinman 1997:371-373; Galloway 1991; Lightfoot 1995:204-206; Wood 1990). Thus, only a specific suite of document categories are relevant to the issue of population decline. These categories can be divided into two groups: general accounts of the northern Southwest and Pueblo peoples from the sixteenth and seventeenth centuries; and specific records generated from particular events or proceedings.

The first group of documents consists of general accounts of the northern Southwest and its Pueblo inhabitants. For the sixteenth century, these are the accounts of the exploring parties, typically (but not always) written by one of the parties' members. For the seventeenth century, they are reports on the status of the colonial enterprise in the region. Those with the greatest relevance to the status of the populations of the Pueblos were written by Franciscan missionaries, likely because the Pueblo peoples were the central focus of the missionary enterprise. The primary general accounts containing demographic information from the sixteenth and seventeenth centuries are listed in Table 3.3. The central value of general historical accounts to understanding the demography of sixteenth and seventeenth century Pueblo peoples are their listings of

Table 3.3. Sixteenth and Seventeenth Centuries Spanish Documents Containing Population Information

SIXTEENTH CENTURY

Coronado 1540-1542
 Casteñeda 1596(?) (Hammond and Rey 1940:191-282)

Rodriguez-Chamuscado 1581-1582
 Gallegos 1582 (Hammond and Rey 1966:67-113)
 Pedrosa 1600 (Hammond and Rey 1966:115-120)

Espejo 1583
 Espejo 1585 (Hammond and Rey 1966:213-230)
 Luxán 1602(?) (Hammond and Rey 1966:153-211)

Castaño de Sosa 1590-1591
 Castaño de Sosa 1592 (Hammond and Rey 1966:245-297)

Oñate 1598-1609
 Oñate 1598 (Hammond and Rey 1953:309-327)

SEVENTEENTH CENTURY

Oñate 1598-1609
 Velasco 1609 (Hammond and Rey 1953:1093-1096)

Zarate Salmerón 1616-1626
 Zarate Salmerón 1638 (Milich 1966)

Benavides 1623-1626
 Benavides 1630 (Ayer et. al. 1916; Forrestal 1945; Morrow 1996)
 Benavides 1634 (Hodge et. al. 1945)

Unknown 1630s?
 Prada 1638 (Hackett 1923-1937[3]:106-115)

Pacheco 1642-1644
 Pacheco 1643 (Scholes 1944)

Unknown 1641-1644 or 1656
 Marquez 1664 (Baldwin 1984; Scholes 1929, 1944)

Unknown 1663-1666
 Cardoso 1667 (Scholes 1929)-

Unknown 1660 or 1680
 Vetancurt 1698 (Vetancurt 1960)

Ayeta 1673-1679
 Ayeta 1679 (Hackett 1923-1937[3]:296-305)

Unknown prior to 1680
 Villagutierre y Sotomayor 1702 (Barrett 2002)

occupied communities and estimates of population sizes. Statistics derived from these documents include counts of individual Pueblo communities, both across the northern Southwest and within its various sub-areas. Other statistics include figures of total population: for single communities; for the various sub-areas of the northern Southwest; and for the region as a whole. Sizes of communities can also be reckoned from measures such as descriptions of the number of building stories, houses, or rooms within house-blocks.

A second type of document which can be examined for demographic evidence beyond general accounts are specific records generated from particular events. These include wills and *testamentos*, for the disposal and distribution of property after the death of an individual; vital records of the occurrence of life events, such as births, baptisms, marriages and deaths; juridical papers generated from legal proceedings, including inquisition documents; *visita* accounts of both civil and ecclesiastical inspections; tax and tribute (*encomienda*) records; personal letters; and documents recording the pursuit of military campaigns (Barnes et al. 1981; Beers 1979). Many of these categories of documents were generated during the sixteenth and seventeenth century Spanish presence in the northern Southwest, but the types of documents that remain in libraries and archives are selective. Documents related to both ecclesiastical and legal proceedings are some of the most common documents to have survived, and they have been used extensively to reconstruct the details of both the Spanish exploration and colonization of the northern Southwest. Scholes (1936-1937, 1937-1941), for example, used these legal sources to document the general dysfunction of Spanish colonial rule in the seventeenth century, as they provide a record of conflicts between ecclesiastical and secular authorities.

<u>Pueblo Sources: Oral History</u>

In addition to documents from the Spanish tradition, oral history and other traditional history maintained by the Pueblos may be an important source of information about demographic change; however, the potential of these sources has been little explored. The union of ethnographic inquiry and archaeological research has deep roots in Southwestern archaeology, as evidenced by the methods employed by Bandelier in writing the text which essentially established the practice of archaeology in the region (Bandelier 1890-1892), and reflected in the methodologies of other contemporary researchers. For much of the early and middle twentieth centuries, the archaeology of ancestral Pueblo societies was closely wedded to the ethnographic study of modern Pueblo peoples; some researchers, like Florence Hawley Ellis and Albert Schroeder, were active in ethnological research, while others, including A.V. Kidder and Emil Haury, hired ethnologists to assist in their research, with the assumption that understanding of modern Pueblo cultural practice would assist in the illumination of patterns in ancestral Pueblo material culture. However, oral history and other ethnographic evidence has been little incorporated in archaeological research over the past 35 years. By the 1970s, a younger generation of researchers had largely disassociated themselves from what was essentially a direct-historical approach to understanding Southwestern prehistory, noting that it failed to provide the necessary explanatory power to understand cultural evolution and change among the prehistoric peoples of the region (Cordell and Plog 1979; Hill 1970; Longacre 1968, 1970; Watson et al. 1971; see also Woodbury 1993:303-336). At the same time, there was an increasing sense among more senior and ethnologically-oriented researchers that direct-historical methods and reliance upon ethnographic information had its interpretive limits (Ford et al. 1972). On the other hand, there has been recognition, both discipline-wide and within Southwestern archaeology, that oral and collected traditional Native historical sources can be of value when critically employed (Bahr et al. 1994; Brandt 2001; Dongoske et al. 1997; Echo-Hawk 2000; Lightfoot 1995; Teague 1993; Whitely 2002a). This is particularly so for demographic changes among early modern Pueblo peoples.

There are three sources for obtaining demographic information from oral history: conventional ethnographies and ethnohistories; documents from land claims settlements; and from the testimony of living Pueblo peoples themselves. The first source for oral histories are conventional ethnographic and ethnohistoric studies. In particular, those which were conducted in the later nineteenth and earlier twentieth centuries are of particular value (Bandelier 1890-1892; Fewkes 1896, 1900; Harrington 1916; Kroeber 1916; Mindeleff 1891, 1900), as many were aimed directly at identifying the cultural affiliation of abandoned communities, in an age when both cultural continuity was assumed and now-conventional archaeological dating techniques were unavailable. Such information was also collected, however, in the course of more conventional ethnographies (for example, the information collected in Parsons 1939), although much of the content of ethnographies from the earlier part of the century were concerned with synchronic social structures, rather than with change through time. Ethnographic information from land claims, the second source of oral history, is also a lucrative venue in searching for evidence of demographic change, as these testimonies were collected specifically for the purpose of identifying the maximal extent of ancestral settlement by the Pueblos. The collection of this testimony was instigated by the establishment of the Indian Claims Commission of 1946, for the purpose of resolving outstanding claims by Native American tribes against the United States (Indian Claims Commission 1974). Much of the Pueblo testimony from the 1950s and 1960s was collected by Hawley Ellis, and is published (Ellis 1956; 1974a, 1974b, 1974c). Research conducted more recently has not been published, such as that conducted for the Pueblo of Zuni, and remains as legal documents relevant to the various cases brought by the Pueblos. However, in the case of Zuni, this research has been incorporated into more general works which provide important information on the movement of early modern Pueblo peoples (Ferguson and Hart 1985). Testimony from Pueblo interviewees themselves is a third source, although it has not yet been solicited explicitly for the purpose of demographic change during the historic era. However, historians and ethnographers who are Pueblo members have written testimony relevant to settlement and population change during the early modern Pueblo era (Sando 1979, 1982), or have collaborated in projects which have included this type of testimony (Bayer et al. 1994).

Archaeological Sources

Like historic sources, there are a variety of archaeological remains available for examining demographic change among Pueblo peoples and communities during the sixteenth and seventeenth centuries. The archaeological record pertaining to these periods, like that of the U.S. Southwest in general, is intact, well-preserved, and available for study to a far greater degree than in other regions of North America, such as the U.S. Southeast. Like all archaeological records, there are specific issues of preservation which characterize the archaeological record of the early modern era in the northern Southwest; these are discussed in more detail below when considering the different forms of evidence available. The main challenge to utilizing the record for examining demographic change among the Pueblos is not the availability of the evidence but rather the lack of work which has been conducted to date. The northern and central Rio Grande drainage, where the bulk of the Pueblo population resided during the sixteenth and seventeenth centuries, has received substantially less research than some other portions of the Southwest, such as the San Juan Basin area to the northwest (Cordell 1989; Crown et al. 1996). This lack of research, along with the nature of the previous research that has been conducted, forms the main limitation to archaeological research on demographic change among Pueblo peoples, despite the large potential for future research.

The portions of the archaeological record available for evidence of demographic change fall into four domains: settlement evidence; landscape scale evidence; evidence from human remains; and artifact and ecofact remains.

Settlement Evidence

Evidence for the occupation and abandonment of settlements has been a central source of data for examining depopulation throughout North America, because settlement data provides the regional perspective that is often necessary to differentiate between different general categories of population change, such as increased mortality (rapid abandonment), decreased fertility (gradual abandonment) or migration (abandonment in some areas, and growth in others). The generally good preservation of the settlement record in the northern Southwest, along with the nature of that record, make it a valuable data source in evaluating population decline.

Early modern Pueblo settlement patterns were characterized primarily by residence in large, aggregated village communities. The explanations for aggregated residence during this era are diverse, and are considered in more detail in Chapter IV. The consequence of this residence pattern, however, means that virtually all of these primary residences (aggregated village sites) are known to archaeological researchers. There has never been a complete and systematic inventory of all of the sites which display archaeological evidence of occupation of the early modern era derived from primary survey data. However, systematic survey efforts conducted during the early part of the twentieth century by Kidder, Nelson, Mera and others have resulted in a de facto complete record of these sites (Fisher 1930, 1931; Kidder 1915, Mera 1933, 1934, 1935, 1940; Nelson 1913, 1914). This early systematic survey has been supplemented by the recording of the aggregated village sites missed by early surveys by land managing agencies and the New Mexico Historic Preservation Division (see, for example, Marshall and Walt 1984). As a result, it is doubtful that there are any large village sites over the size of fifty rooms which are unknown to archaeological researchers. Lycett's (1995:292-316) and Barrett's (1997a, 2002) compilations of large site occupation information in the northern and central Rio Grande region likely constitutes a reasonably complete list of large communities occupied in that area during the early modern Pueblo era.

Landscape-Scale Evidence

Changes in land use, and the landscape scale evidence which such use produces, has significant demographic potential. In particular, landscape use can serve as a compliment to evidence of differential occupation from large aggregated village sites, as landscape use mirrors such occupation through time. Thus, variation in large site occupation will be writ large spatially, through temporal variation in the distribution of limited activity localities, special-use features, artifacts, and areas of culturally modified sediments and vegetation. Further discussion of the value of landscape-scale data, such as the distributions of fields, for examining community and regional population change is found in Chapter V.

The utilization of landscape data has been hampered by a lack of survey in the areas surrounding the large aggregated village sites in the northern Southwest. The location of areas of systematic survey within the northern and central Rio Grande region are shown in Figure 3.2. Excellent survey data is available from at least one region, the Pajarito Plateau, but this area is largely abandoned by the early sixteenth century (Hill and Treirweiler 1986; Powers and Orcutt 1999). Other landscape studies have also focused on sites which date to the thirteenth, fourteenth, and fifteenth centuries, such as those conducted in the Chama Valley on the Caja del Rio, in the vicinity of Nambe Pueblo, and in the Rio Grande de Ranchos valley, south of Taos (Anscheutz 1998; Arbolino 2001; Snead 1995). Published landscape studies have been conducted around only two large sites with significant sixteenth and seventeenth century occupations, San Marcos Pueblo (LA 98) in the western Galisteo Basin (Lange 1995; Lightfoot 1990; Lightfoot and Eddy 1995), and Pecos Pueblo (LA 625) in the upper Pecos River drainage (Fliedner 1981; Head and Orcutt 2002). Other major surveys have been conducted in the vicinity of large aggregated village sites from the sixteenth and seventeenth centuries, but being primarily of a management nature, they have had less of an emphasis on landscape or non-site features, such as field systems. These surveys have been conducted in the Picuris area, the Tewa Basin, the Galisteo Basin, the middle Rio Grande, the Salinas area, the Rio Abajo and the Jemez Plateau (see Figure 3.2). Specific issues regarding the nature of survey on the Jemez is discussed in Chapter VI.

Human Remains

Human remains are probably the most conventional source of archaeological evidence about the structure of human populations, given the wide range of information that can be

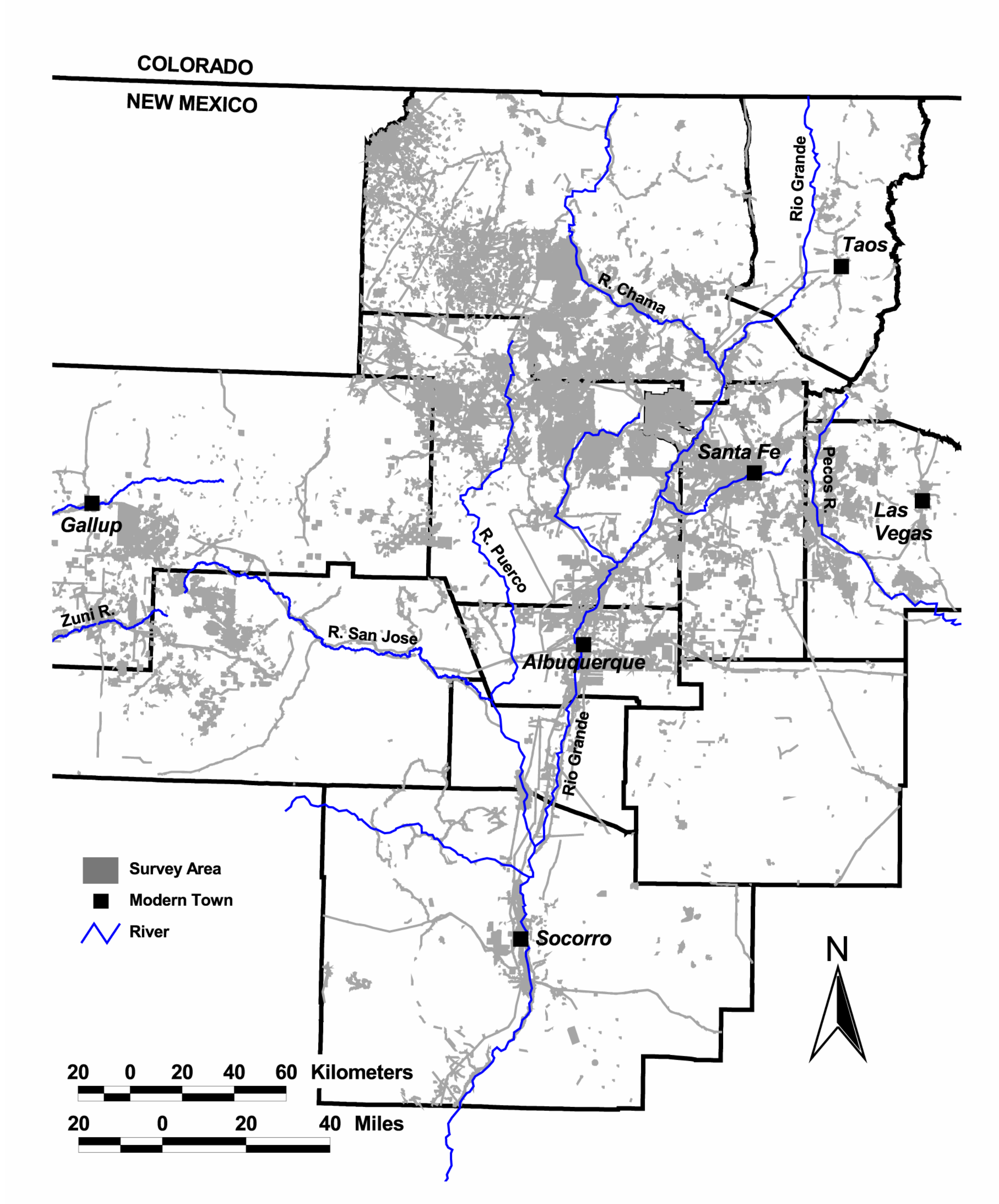


Figure 3.2. Previous archaeological survey in 13 New Mexico counties covering the northern and central Rio Grande watershed. The previous survey databases from which this figure was created are not yet complete; not all previous surveys may be shown. However, concentration of previous survey in river valleys and forested areas is approximately correct. Previous survey data courtesy of the Archeological Records Management Section, New Mexico Historic Preservation Division, and the USDA Forest Service, Santa Fe National Forest.

obtained from skeletal material, particularly large series of individuals from a single community. Generally, the potential information from human remains can be grouped into two three categories: demography, pathology, and burial evidence. Demographic information which can be reconstructed from skeletal assemblages includes age and sex distributions, allowing for the reconstruction of fertility and mortality, and changes in these two variables through time (McCaa 2002; Meindl and Russell 1998). Examination of the nature and incidence of skeletal pathologies can be conducted to create estimates of overall community health, identify illnesses, and determine causes of mortality (Goodman and Martin 2002). Burial evidence, in particular evidence of mass or catastrophic mortality, may be indicative of significant mortality events such as episodes of infectious disease mortality or warfare (Haas and Creamer 1992; Milner 1980). The main benefit of utilizing human remains for studying change relevant to population decline is that evidence from skeletal series dating to the sixteenth and seventeenth centuries can be compared to evidence from earlier centuries, while the unit of examination (the individual skeleton) remains the same; several studies of Pueblo human remains dating to the sixteenth and seventeenth centuries have adopted this comparative framework (Ruff 1991; Stodder 1990).

Human skeletal remains from sites in the northern Southwest occupied during the sixteenth and seventeenth century are scarce, and their availability for study are diminishing as collections of remains are being repatriated and reburied pursuant to the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA). There are only a half-dozen major analyzed collections of human remains from villages dating to the sixteenth and seventeenth centuries.[1] Of these, most have been repatriated and reburied (see Fine-Dare 2002). However, several significant analyses have taken place, particularly on the remains from Pecos Pueblo (Ruff 1991; Spielmann et al. 1990) and on other collections (Howell 1995; Stodder 1990) that have focused on the demographic effects of the sixteenth and seventeenth centuries on Pueblo populations.

Artifacts and Ecofacts

Artifacts and archaeofloral and archaeofaunal remains can provide direct and indirect evidence of population change within individual communities. Directly, volumetric studies of artifacts, in particular ceramics, can be used to examine changes in the size of a population at a community through time (Varien and Mills 1997; see also Hassan 1981; Schacht 1981), as the artifacts serve as a proxy for population size. Indirectly, changes in the composition of artifact and ecofact assemblages can indicate changes in behavior which is relevant to changes in the size of a community population, such as changes in the species of game found in faunal assemblage of a site (Szuter 1991; Szuter and Bayham 1989). Hypothetically, artifact and ecofact remains can be obtained from any of the large community sites of the northern Southwest occupied during the early modern Pueblo era, but existing collections are limited by the lack of excavation which has been conducted for these time periods, as discussed above.

In summary, there is a diversity of sources of evidence for Pueblo population decline during the sixteenth and seventeenth centuries. The potential to generate new evidence relevant to population change is high, particularly through archaeological investigation. But existing evidence is severely limited, by the number of historic documents which are extant from the era, and the number of sites which have been excavated or otherwise intensively investigated. These limitations have led researchers to rely upon a narrow set of existing information for population decline, which, along with the intellectual trends discussed in the previous section, are responsible for the nature of current studies of Pueblo population decline.

Population Decline in the Northern Southwest: Previous Research

With some notable exceptions, the direction of research regarding population decline among Pueblo peoples has followed that for Native North America as a whole. Like scholars in regions such as the U.S. Southeast, Southwestern researchers have shifted from the understanding of Pueblo population decline as primarily a consequence of direct interaction between Pueblo and

Spanish peoples, to a consideration of the potential for introduced Old World infectious diseases to be a driving force in depopulation, even prior to the establishment of Spanish colonial rule in A.D. 1598—in short, a consideration of the Dobyns hypothesis. Unlike researchers in the Southeast, however, they have not been able to move far beyond the questions posed by the Dobyns hypothesis: did depopulation take place rapidly in the early sixteenth century?; and was the decline precipitous and capable of inducing significant sociocultural change? Because the questions of timing and severity of population decline have not been resolved, Southwestern researchers have not been able to progress past the issues posed by disease depopulation to consider the issue of differential persistence, and its causes and consequences.

The recognition of this lack of resolution is vital, considering that it is not perceived or shared by researchers from outside of the northern Southwest. For example, in his review of bioarchaeological studies in the Spanish Borderlands of North America relative to those which have been conducted in Florida, Walker states that the Southwest experienced a precipitous population decline from in the sixteenth century from the introduction of infectious diseases, based upon a single reference (Walker 2001:289; the reference is to Upham 1992). Yet, even while the view taken by this particular reference has been contested by other researchers. Similarly, in a general discussion of Native North American population, Thornton notes that the same effects of disease that were felt in the Southeast also befell the Natives of the Southwest (Thornton 2000:17-18). These assertions highlight less the ignorance of some researchers of the state of knowledge about population decline in the northern Southwest than how far the region lags behind the rest of North America in general, and the Southeast in particular, in creating a clear understanding of the nature of population change among Pueblo peoples in the sixteenth and seventeenth centuries.

This section reviews the major studies which have been conducted regarding Pueblo population change during the sixteenth and seventeenth centuries, and the approaches and evidence which have been employed to examine the issue of population decline during this era.

Like the rest of North America, researchers have always considered that there was a significant decline in Native populations in the northern Southwest during the sixteenth and seventeenth centuries. And like the rest of the continent, the understanding of that decline has been significantly reorganized by the introduction of the Dobyns hypothesis. The section is divided along these lines.

Earlier Research

The persistence of Pueblo populations in what is essentially the Pueblo homeland contrasts markedly with many, if not most, Native North American societies, particularly those east of the Mississippi River, who saw not only the dwindling of their numbers, but also removal from their ancestral home territories. Despite this persistence, researchers from the first have recognized that Pueblo peoples experienced significant population decline between the arrival of the Spanish in the sixteenth century to their demographic nadir in the nineteenth century. Lacking chronological frameworks derived from archaeological remains, early scholars such as Bandelier turned to Spanish historical records first as a method for identifying and dating abandoned Pueblo communities (Fowler 2000:177-180; Wilcox and Masse 1981). At the same time, historians set about identifying, translating and synthesizing the body of Spanish documents related to the earliest centuries of European exploration and colonization in the northern Southwest (Broughton 1993). By 1941, the sixteenth and seventeenth century historic record of the Pueblo world was essentially known, and a pattern of widespread community abandonment and population decline was evident. Spicer, surveying the pattern of population changes among the Pueblos from the vantage of the early 1960s, described essentially the same patterns of population loss among the subregions of the Southwest which are accepted by many researchers today: abandonment of the Rio Abajo, the Salinas area, the Galisteo Basin, and elsewhere (Spicer 1962:169; compare to Barrett 2002; Lycett 1995; Ramenofsky 1996).

Like Mooney and Kroeber for the whole of North America, researchers in the Southwest prior to the 1980s also viewed population decline as a consequence of sustained, face-to-face interaction with Old World peoples (Dozier 1970:63; Simmons 1979; Spicer 1962:165-169; see also Kroeber 1939:151-153). A significant dissenter from the idea of population decline from Pueblo-Spanish interaction was Albert Schroeder, who saw the widespread abandonment of settlements and entire areas within the region as driven by forces largely independent of the arrival of the Spanish. Schroeder wrote: “between A.D. 1540 and the 1820s, a number of inter-Indian hostilities and population shifts occurred, many of which ran their full course only indirectly influenced by the presence of the Spaniards. Ecological factors and intertribal enmities played a far greater role in affecting native population shifts than did the presence of, or pressures from, the Spaniards (Schroeder 1968:291; see also Schroeder 1963).” In particular, Schroeder attributed the abandonment during the sixteenth century of many communities to warfare between their Pueblo inhabitants and the Athabaskan peoples who recently arrived in the northern Southwest. Abandoned communities were located along the eastern, southern and western peripheries of the Pueblo world: in the Galisteo Basin, on the eastern slope of the Sandias, in the Rio Abajo and in the Zuni area.

Even regarding the topic of warfare between Native Americans, however, researchers such as Schroeder saw the direct and indirect evidence of the arrival of Europeans into the region as central to why conflict between the Pueblos and other Natives led to population decline and community abandonment. While conflict was not absent prior to the arrival of the Spanish, the dominance of the Pueblos in both settlement and numbers meant that warfare and raids by Athabaskans and others had little effect on Pueblo population or community abandonment. One researcher wrote:

> [h]ow often quarrels precipitated fights between Apaches and Pueblos, or how often accumulated stores at pueblos tempted raiders in pre-colonial times is uncertain, but Apaches were unusually cautious fighters and pueblos were

> formidably defended bastions. As long as their capacity to attack and to escape depended solely their own swift moccasins and as long as the amount of loot could not exceed that which a man could carry on foot, the scale of Apache depredations against Pueblos was necessarily limited [John 1975:59].

The introduction of the horse fundamentally changed this equation, tipping the balance of conflict in favor of non-sedentary peoples such as the Athabaskans, whose lifeways were rapidly transformed by exponentially greater mobility. Spanish economic policies also interfered with the existing patterns of interaction between the Pueblo and other Native groups. While dominated by trade prior to the founding of the New Mexico, Spanish efforts to capture and export non-Pueblo Southwestern peoples as slaves to the mines in regions to the south led mobile Natives to make raiding and war the primary form of interaction with the Pueblos, who were seen as allied with the Spanish in the burgeoning industry of slavery (Brooks 2002). Together, these changes introduced by the Spanish were fundamental in creating a new pattern of warfare and conflict in the northern Southwest, with the abandonment and consolidation of many Pueblo communities a result (John 1975:58-97).

Disease

Among Southwestern researchers, the notion that disease introduction could fundamentally reorder the demography and settlement of the region was forwarded in the early 1980s, developed from the Dobyns model of sixteenth century disease introduction and Native North American demographic collapse. Not that the idea that Pueblo peoples suffered and died due to European disease was novel; epidemics were assumed by most researchers to have been a factor in the depopulation of which researchers were well aware. Earlier researchers had identified disease as one of the several factors responsible for the decline of Pueblo populations. However, mortality from introduced infectious disease appeared from historic documents to be mainly an eighteenth century and later phenomenon; prior to 1700, there are only two reported incidences of epidemic infectious disease in the northern Southwest (Palkovich 1994). Rather, it was the critical elements of Dobyns's argument that made the discussion of disease different than it had been among a previous generation of archaeologists and historians: the potential for the introduction of Old World infectious diseases without face-to-face contact between Natives and Europeans; and population collapse, accompanied by dramatic culture change, in the early to middle sixteenth century.

The circumstances of late Southwestern prehistory make the idea of depopulation and cultural transformation attractive. In the fifteenth century, prior to the arrival of the first Spaniards, the Southwest witnessed the dissolution of many of its longstanding cultural traditions, including social collapse across all of the Hohokam and Mogollon worlds. This century saw the abandonment by village-dwelling agriculturalists of a number of long-occupied regions in the northern Southwest, including the Mimbres and Jornada Mogollon areas, and the Mogollon Rim, all abandoned between 1400 and 1450 (Hegmon et al. 1999; Nelson and Anyon 1996; Reid 1989; Spielmann 1996). In the southern Southwest, the dissolution of cultural traditions was even more dramatic, with the abandonment of the Classic Period Hohokam towns of the Salt-Gila Basin some time around or after AD 1450 (Dean 1991), and the abandonment of Paquimé and other Casas Grandes communities within the same time frame (Dean and Ravesloot 1993; Phillips 1989; Phillips and Carpenter 1999; Whalen and Minnis 2001:38-42). The chronological correlation of these cultural upheavals and regional abandonments with one another is problematic (see Dean 1991; Dean and Ravesloot 1993; Roberts and Ahlstrom 1997). However, the fifteenth and sixteenth centuries are among the most poorly known in the Southwest from the perspective of abandonment and demographic change (Adler et al. 1996; Dean et al. 1994, Duff 1998). Small revisions in the chronology of abandonment and cultural change of these regions raise the possibility that they are early sixteenth, rather than fifteenth century occurrences. The potential for changes in the chronology of late prehistoric Southwestern abandonments has led some researchers to suggest that the disappearance of so many major cultural traditions in the southern Southwest could be a consequence of the introduction of Old World infectious diseases during the first decades of the sixteenth century (Roberts and Ahlstrom 1997).

In contrast to the southern Southwest, abandonment and cultural dissolution in the late prehistoric northern Southwest was neither ubiquitous nor complete. However, abandonment and population contraction were both significant processes. The possibility that disease introduction and demographic collapse according to the Dobyns hypothesis was responsible in part for this contraction was first advanced by Steadman Upham (1982, 1986, 1992; Rushforth and Upham 1992). Like Dobyns (1983), Upham argued for the early sixteenth century introduction of Old World infectious diseases into the northern Southwest, and a sixteenth century collapse of Pueblo populations. Upham's discussion of the Dobyns hypothesis as applicable to the northern Southwest came as part of a larger attempt to understand the growing trade, increased interaction, apparent site hierarchy formation, and other factors emergent in the centuries prior to the arrival of the Spanish which pointed to cultural complexity among early modern Pueblo peoples (Cordell 1985; Cordell et al. 1987; Lightfoot 1984; Lightfoot and Upham 1989; Plog 1983, 1985; Upham 1982, 1984, 1988; Upham et al. 1981; Upham and Plog 1986). This cultural complexity was inconsistent with the relative egalitarianism described at late modern Pueblo communities in the ethnographic literature of the later nineteenth and twentieth centuries, and in the historic literature of the seventeenth and eighteenth centuries. The potential for significant depopulation from infectious diseases prior to the arrival of the first European observers of Pueblo sociopolitical organization provided a parsimonious explanation for this inconsistency between the archaeological past and the ethnographic present. As such, Upham adopted the Dobyns hypothesis to postulate that significant depopulation took place among the Pueblos in the sixteenth century, based upon the differences in reported population sizes from explorers in the late sixteenth century (from the Espejo expedition [1583]), and the later population estimates of missionaries (Benavides [1623-1626]) (Upham 1982:36-46).

The notions of dramatic population decline and significant sociopolitical change immediately prior to the first descriptions of early modern Pueblo culture and society are provocative considering the long-standing assumptions regarding cultural continuity and analogous organization linking the early modern Pueblo from the centuries prior to the arrival of the Spanish with the late modern Pueblo (Cordell and Plog 1979, Lekson 1990). There have been three major reactions to Upham's application of the Dobyns hypothesis to the explanation of Pueblo demographic change during the sixteenth and seventeenth centuries. These are support, refutation, and evaluation.

The major studies of Pueblo population change during the historic period are summarized by researcher in Table 3.4. Some of the studies are syntheses and evaluations of existing historical and archaeological information (Dobyns, Palkovich and Barrett). The remainder are based on new research, including the examination historic source material (Reff) and archaeological survey and excavation (Earls, Creamer and Haas, Lycett, and Ramenofsky). A few of the studies have also attempted to apply general epidemiological concepts to the specific demographic and ecological conditions of the northern Southwest (Upham and Ramenofsky).

Those who support the Dobyns hypothesis are unsurprisingly Upham (1986, 1992; Rushforth and Upham 1992) and Dobyns himself, in works touching on or dedicated to Pueblo population change (1983, 1990, 1991). These two scholars have marshalled a range of evidence to support the Dobyns hypothesis. Primary support for the hypothesis is drawn from the potential for mortality among Pueblo peoples from Old World infectious diseases, particularly smallpox (Upham 1986; Rushforth and Upham 1992), and the ability for infectious diseases to travel significant distances along routes of communication and disease (Dobyns 1992). The potential for disease mortality, generated from empirical historical studies elsewhere, are used to generate depopulation ratios for Pueblo inhabitants of the northern Southwest, ranging from 50 to 95 percent depopulation (Dobyns 1983; Upham 1982). Empirical support for the early introduction

Table 3.4. Archaeological Studies of Sixteenth and Seventeenth Century Pueblo Population Decline

Researcher/ (Region)	Data Sources	Causes Evaluated	Conclusions	References
Upham (Western Pueblo/Region-Wide)	--historic records --theoretical epidemiology --settlement data	--disease	--16th century population decline --numerical decline 50-95% --significant social change	Upham 1982 Upham 1986 Upham 1992 Rushforth and Upham 1992
Dobyns (Hopi/Region-Wide)	--historic records --theoretical epidemiology --settlement patterns	--disease	--16th century population decline --numerical decline 90-95%	Dobyns 1983 Dobyns 1990 Dobyns 1991 Dobyns 1992 Dobyns 1993
Reff (Region-Wide)	--historic records	--disease	--17th century population decline --numerical decline 50-85% --disease introduced with colonialism	Reff 1991 Reff 1993
Palkovich (Eastern Pueblo/Region-Wide)	--historic records	--disease	--17th century population decline --effects of disease not uniform between Pueblos --migration a cause of community abandonment	Palkovich 1985 Palkovich 1994 Palkovich 1996
Earls (Rio Abajo)	--historic records --settlement patterns --subsistence remains	--disease --warfare	--17th century population decline --migration a cause of community abandonment	Earls 1985 Earls 1992
Creamer and Haas (Eastern Pueblo)	--historic records --settlement patterns --excavated ceramic/tree-ring evidence	--disease --warfare	--archaeological chronology insufficient for dating population decline	Haas and Creamer 1992 Creamer 1994
Lycett (Galisteo Basin/Eastern Pueblo)	--theoretical epidemiology --settlement patterns --landscape studies	--disease	--16th century population decline	Lycett 1989 Lycett 1995

Table 3.4. (continued)

Researcher/ (Region)	Data Sources	Causes Evaluated	Conclusions	References
Ramenofsky (Chama Valley/Eastern Pueblo)	--theoretical epidemiology --settlement patterns --surface ceramic evidence	--disease	--effects of disease/regional abandonment not uniform between Pueblos --reported 16th century abandonment may be 17th century	Ramenofsky 1996 Ramenofsky 2000 Ramenofsky and Feathers 2002
Barrett (Eastern Pueblo)	--historic records	--disease --warfare --drought/ famine --social/ economic change	--17th century decline --numerical decline 75% -- regional abandonment not uniform between Pueblos	Barrett 1997b Barrett 2002

of disease is drawn from a variety of sources: the differences between Spanish population estimates cited above is one; significant settlement pattern changes between the fifteenth and sixteenth centuries are a second (Dobyns 1990, 1991; Upham 1992). These latter assertions of settlement pattern change rely in many instances on novel interpretations of ceramic chronology, particularly within the western portion of the Pueblo world, which place the occurrence of types such as Jeddito Black-on-yellow much later than is generally accepted (Dobyns 1990). These chronological revisions allow for the abandonment of communities along the Little Colorado River and in the Sinagua area in the early sixteenth century, even though these abandonments are conventionally placed in the early- to mid-fifteenth century (Adams 1996; Duff 1998, 2002:33-42). Archaeological data is also employed to generate population estimates, derived from both room counts at sites with architecture and from non-architectural artifact scatters. These archaeological population estimates from the centuries prior to the arrival of the Spanish are contrasted with the estimates from historic records from the sixteenth and seventeenth centuries (Upham 1992).

Those who have argued against the application of the Dobyns hypothesis to the northern Southwest have relied primarily upon evidence from historic records. They find that the use of historic population estimates by Dobyns and Upham to support a claim of sixteenth century depopulation is selective, and that when the entire corpus of historic literature is examined, evidence for significant population decline cannot be found until the seventeenth century. Ann Palkovich, examining historic estimates of Pueblo population size from the sixteenth to nineteenth centuries, found that disease incidence in general corresponds poorly with the directionality of Pueblo population change, despite a general downward trend in population size through this period (Palkovich 1985). She suggested that the population figures within the historic record, particularly from the sixteenth and seventeenth centuries, may be too poor to assess population change during this era (Palkovich 1996). Daniel Reff also found the descriptions of Pueblo population sizes from this period to be poor. However, he did not believe they support a sixteenth century population decline in the northern Southwest (Reff 1991). This is in contrast to northern Sonora, where significant population decline and sociopolitical de-evolution took place in the late sixteenth and early seventeenth century prior to direct colonization (Reff 1981; see also Doolittle 1988). The reason for this, Reff argued, is the issue of proximity: the limited and indirect level of contact between the Pueblos and the northward-creeping Spanish colony in northern Mexico was too intermittent and discontinuous to transmit infectious diseases into the northern Southwest. In the absence of compelling historical evidence of epidemics or population decline among the Pueblos, Reff believed that decline from disease was initiated along with the imposition of colonial rule in the seventeenth century (Reff 1991).

Most researchers examining the applicability of the Dobyns hypothesis to the northern Southwest have chosen to evaluate the idea as it is: as a hypothesis to be tested against data. These studies have mainly taken the form of archaeological field studies, focusing on historic remains from one or more sites within a particular sub-region of the northern Southwest. The results of the studies have been extremely mixed. A regional study by Winifred Creamer and Jonathan Haas focused on large village sites and determined mainly that it is difficult to study this portion of the record and consider the issues of abandonment(Creamer and Haas 1992; Creamer 1994). Because the sites are so large, and their occupation histories so complex, the records of these sites represent shifting population sizes through time, making the evaluation of population change problematic (Creamer 1994).

Other field studies have provided a wide range of results both supporting and challenging the Dobyns hypothesis. Examining landscape use in the Galisteo Basin, Mark Lycett found evidence for a decline in landscape utilization during the sixteenth century. By tying the intensity of landscape use to population size, he found support for the Dobyns hypothesis (Lycett 1995). Amy Earls, examining settlement patterns and subsistence remains in the Rio Abajo, found greater support in that region for an early- to mid-seventeenth century population decline in that region (Earls 1985). In contrast to both of these studies, examining surface assemblages at large community sites in the Chama valley, Ann Ramenofsky found evidence for occupational persistence into the late seventeenth century in settlements which have conventionally been considered abandoned by 1600 (Ramenofsky 2000; Ramenofsky and Feathers 2002). The study by Elinore Barrett focused on historic records in addition to archaeological data, but unlike earlier historic studies it seeks to evaluate demographic change among the Pueblos rather than support one or another position. Based on available historical data, Barrett finds the greatest change in both population estimates and occupied communities takes place in the early seventeenth century (Barrett 2002).

Population Decline: What Has Been Learned?

As a result of these studies, what do we know about Pueblo population change during the sixteenth and seventeenth centuries? All of the studies agree that Pueblo populations declined, but this conclusion is not new. Once the first historic research and ceramic chronology at the end of the nineteenth century tied the large abandoned communities of Rio Grande region and the vicinities of Hopi and Zuni to the west to the sixteenth and seventeenth centuries, it was apparent that significant community abandonment and population decline had taken place alongside Spanish colonization. This fact has never been in dispute among scholars of Pueblo population change.

The studies have also established that disease was an important, if not the most important, factor in understanding the cause of population decline and community abandonment among the Pueblos. And yet, the importance of disease has not been established by field or archival research, but rather by the theoretical studies which have demonstrated the potential for mortality from the introduction of Old World infectious diseases into Pueblo communities (Lycett 1995; Ramenofsky 1996; Upham 1986). Ironically, all of the studies agree there is little historical reference to epidemics in the northern Southwest during the sixteenth and seventeenth centuries (see also Palkovich 1994). However, all also recognize that epidemiological history of Pueblo peoples, like all Native Americans previously unexposed to Old World infectious disease, were particularly susceptible to these diseases (in terms of both morbidity and mortality), and that the frequency of epidemics in Mexico meant that Old World infectious disease would be introduced into the northern Southwest given sustained contact. Ramenofsky wrote that, regardless of the documentary evidence, "the possibilities of disease transmission are simply too great to argue that infectious diseases were not present and did not cause attrition of native peoples [in the northern Southwest] prior to 1680 (Ramenofsky 1996:177)."

But the diversity of results in studies over the past two decades highlight that there are many facts that are not known about Pueblo population change during the sixteenth and seventeenth centuries. This statement stands in contrast to the consensus gathering in other regions of North America, especially the Southeast. First, it is still unknown whether population decline due to factors introduced by the Spanish was initiated during the sixteenth or the seventeenth century. Answering this question is critical, as it plays directly to the question which introduced the Dobyns hypothesis to the northern Southwest in the first place; whether significant cultural transformation took place as a consequence of depopulation prior to face-to-face contact between the Spanish and Pueblo peoples. The notion of radically different sociopolitical organization among the Pueblos during the centuries prior to the arrival of the Spanish has been rejected based upon archaeological data and on theoretical issues (Adams et al. 1993; Bishop et al. 1988; Duff 2002; Johnson 1989; Feinman et al. 2000; McGuire and Sattia 1996; Mills 2000). However, this does not preclude the possibility of transformations in other spheres of Pueblo life, disrupting the cultural connections between the past and the present.

Second, not knowing the timing of the decline makes it harder to determine the severity of population decline among the Pueblos. It is clear that at least some population decline took place among some communities and subregions of the northern Southwest during the seventeenth century, but it is unknown whether these declines were part of a larger sustained trend, or were initiated with the imposition of colonial rule by the Spanish.

Third, the relative importance of disease as a cause of decline is also unknown. The timing and severity of population decline are both important for understanding the role of disease in Pueblo population change. Severity of population decline is a key indicator of epidemics from infectious diseases in the absence of other evidence (Ramenofsky 1987). Establishing that the decline took place after the arrival of Old World peoples in the Western Hemisphere in 1492, but prior to the establishment of the Spanish colony in the northern Southwest in 1598, would also establish the importance of disease. While disease as cause of population decline would have to be distinguished from factors unrelated to European entry into the New World, a sixteenth century disease introduction would allow introduced Old World infectious disease to be separated from other potential causes of population decline which could be directly attributed to Spanish colonization during the seventeenth century. Within the context of increased warfare and conflict, economic demands for subsistence goods and labor, enforced settlement pattern changes, and other imposed changes on the Pueblo social order which colonization brought, the relative importance of disease is obscured. In many cases, it may be viewed as much as a symptom of the other forces of population decline as a cause in its own right.

Towards Explanations for Population Decline in the Northern Southwest

The review of questions that remain unanswered regarding nature of population decline among Pueblo peoples in the sixteenth and seventeenth centuries provides a starting point for identifying what steps need to be taken to arrive at answers to these questions. Fundamentally, two issues need to be addressed: first, why haven't existing studies been able to successfully resolve questions regarding the timing and severity of Pueblo population decline, and address the issue of differential persistence? And second, what direction should this, or any future study of Pueblo population change in the sixteenth and seventeenth century, take to arrive at answers for these questions?

Existing studies have fallen short of resolving questions regarding Pueblo population decline for two reasons. First, many of these studies have relied wholly or in part on evidence which is either insufficient or inappropriate for addressing Pueblo population decline. Second, existing studies have for the most part been framed in such a way that they do not consider Pueblo demographic organization prior to or during the sixteenth and seventeenth centuries, or Pueblo responses to changes introduced by the Spanish. It is easy to fault existing studies for these shortcomings, but the exposure of these problems illuminates larger shortfalls within the state of knowledge in Southwestern archaeology regarding the early modern Pueblo era, shortfalls largely beyond the control of the researchers who have conducted these studies. At the same time, elements of existing studies provide direction for how to construct an archaeology of population change during the early modern Pueblo era. This final section is an attempt to delineate the shortcomings of existing studies. As introduced in the last chapter, it also presents an alternative model for evaluating ideas about the nature of Pueblo population decline, constructed from the contributions made by existing studies; the recent advances made in other regions of North America, such as the Southeast; and from general demographic, archaeological, and anthropological theory.

Existing Studies of Pueblo Population Decline: Problems and Prospects

Despite the lack of consensus regarding the timing and severity of Pueblo population decline, existing studies of this issue share two common attributes. The first is a reliance on a narrow range of evidence sources; indeed, often conflicting studies draw their differing conclusions from the same bodies of archaeological and historical evidence. The second is an approach common to most studies which isolates the sixteenth and seventeenth centuries from other time periods in the historical development of Pueblo peoples, and gives primary explanatory weight to causes of population change introduced by the Spanish.

Evidence

As reviewed in the previous section, the potential to generate new evidence regarding Pueblo population change during the sixteenth and seventeenth centuries is great, particularly through additional archaeological research. However, existing evidence is limited. While some archaeological studies have focused on generating new information (see Earls 1985; Haas and Creamer 1992; Lycett 1995; Ramenofsky 2000; Ramenofsky and Feathers 2002), other studies, including all of those utilizing historical information, have used existing sources. These existing sources, such as numbers of individuals observed resident in communities in the accounts of sixteenth century explorers, or evidence for the abandonment of large village communities, have demographic value that is relevant to the general issue of Pueblo population decline. Indeed, it is these sources which first made apparent to scholars at the end of the last century that population decline had taken place among Pueblo peoples since the first arrival of Spanish. However, they are inadequate for evaluating questions regarding the timing and severity of population decline. The most commonly used historic evidence is inappropriate because it cannot be contrasted and compared through time, having been assembled through a a range of estimation methods which cannot be assessed. The most widely utilized archaeological evidence falls short because it is currently only available at spatial and temporal scales which are too coarse to adequately address the issues of the timing and severity of sixteenth and seventeenth century population decline.

It is not enough to simply proceed with the assumption that because the evidence currently extant is the evidence that is available, we must make do with what we have. Nelson, Kohler, and Kintigh (1994) observe that this is a common misperception made by archaeologists in population estimation, and that it is unproductive. Reviewing the evidence in several regions of the Southwest, including southwestern Colorado and the Mimbres area, they find that dramatically different reconstructions of population size and population change are made using equally plausible assumptions about the relationship between the archaeological evidence used and the number of people in the past this evidence is taken to represent. In evaluating these archaeological measures, which mainly consist of settlement counts, room counts within settlements, and structure sizes, they find that it is currently not possible associate these measures with accurate population numbers, even though there is clearly some relationship between these measures and population (see Ramenofsky 1987:24-31). In short, while the archaeological evidence Nelson, Kohler and Kintigh review reflects population in some sense, it is inadequate for examining the issues of population size or population change; they suggest alternative sources of evidence which they feel are more appropriate to the scale of population change relevant to archaeological research questions (Nelson et al. 1994:125-136). By making do with existing evidence, however, rather than searching for more appropriate evidence, alternative reconstructions from the same sources leads to conflict rather than resolution. This is exactly the situation which has arisen regarding the issue of Pueblo population decline. The shortfalls which characterize existing historic and archaeological evidence are distinct, and are considered here separately.

The existing historical evidence employed for examining Pueblo population decline is rather narrow, and researchers have relied primarily on the population and community numbers taken from the general accounts detailing the northern Southwest in the sixteenth and seventeenth centuries. These sources are attractive because they provide enumerations of individuals which appear to have the same comparative value as numbers generated from sources such as censuses. They have been employed by several researchers, including Upham (1982; Rushforth and Upham 1992), Dobyns (1991, 1993), Reff (1991), Palkovich (1985, 1994), Earls (1985, 1992), Haas and Creamer (1992), Lycett (1995) and Barrett (1997b, 2002) (see also Kulisheck 2001a, 2003; Schroeder 1979, 1992; Wilson 1985). However, the validity of the numbers regarding the size of Pueblo populations found in these documents is difficult to assess, even setting aside the issues of context and interpretation (Palkovich 1996; Reff 1994). Fundamentally, the numbers that appear in the general accounts of the sixteenth and seventeenth century northern Southwest, particularly population numbers, are estimates, rather than counts. As a consequence they cannot be assessed for either their accuracy or precision using standard demographic techniques. Typically, historical measures of populations are created from counts of individuals, either from direct sources such as censuses, or from indirect enumerations, such as tax rolls, ecclesiastical and secular vital records, such a registers of births, deaths and baptisms, and other sorts of surveys which have the effect of enumerating all or a portion of a population (Willigan and Lynch 1982). Behind the numbers of the general chronicles of the sixteenth and seventeenth centuries, there are no such records. In a few cases, estimates are described as derived from enumerations. Zarate Salmerón, writing in the 1630s, stated that his figure of "34,650 baptized souls" was "taken from baptismal records", but there is no mention of how these records were assembled to arrive at this number (Millich 1966:35). The numbers given in Vetancurt's 1698 volumes (Vetancurt 1960-1961 [1698]) for both the total size of population of the Pueblos, and the numbers of persons in the various areas of the Pueblo homeland are said to have been taken from a 1660 census (Barrett 2002:62, 135), but there is no known record of this census, no direct link between the census and the numbers listed by Vetancurt, and no way of assessing how Ventancurt derived these numbers from the census data, if he even did so. The numbers listed in a description of the Pueblos produced by Marquez in 1664 has often been cited as a reliable and accurate enumeration of the populations of the Pueblos (Palkovich 1985, 1996; Wilson 1985), perhaps because the many of the numbers cited therein are not rounded, giving them the feel of a count, rather than an estimate. However, little is known about the source of this document. The name listed on the enumeration list, Fray Bartolomé Marquez, is that of the copyist of the original document, and both the author and date of the original are unknown (Scholes 1929, 1944). Based upon the descriptions within the document, it appears to date to either 1641-1644, or 1656 (Baldwin 1984; Ivey 1989; Scholes 1944), but how the numbers for each community and area described were calculated is neither stipulated nor detectable.

Without historical demographic data, we have no way of knowing whether the numbers found in general accounts are valid representations of the populations of the Pueblos in the sixteenth and seventeenth centuries, even if it assumed that the chroniclers who presented these numbers were making a good-faith effort to correctly describe the size of the communities they visited. Rather, in the absence of actual data, there are strong reasons to doubt the accuracy of such estimates. Historic demographic research has demonstrated that European observers during the seventeenth and eighteenth centuries were consistently unable to make accurate population estimates, even when relying on quantitative data, such as house counts, tax records, and vital records of baptisms and deaths (Glass 1973). Many of the problems experienced by European enumerators in the seventeenth century would have also affected the estimates made by seventeenth century Spanish observers in New Mexico, assuming that the latter were able to rely on now-lost records of baptisms and other vital events. In seventeenth and eighteenth century England and Wales, for example, vital statistics collected by the Church of England routinely excluded Dissenters and those of other faiths, significantly depressing enumerations, particularly of baptisms (Glass 1973:15-16). If numbers such as the Marquez counts and Zarate's estimate of overall Pueblo population are taken from baptismal records, they may exclude significant numbers of Pueblo peoples who refused baptism or otherwise resisted the embrace of Catholicism (Knaut 1995). Modern historical demographers have been able to detect and sometimes correct for errors in historical data, such as under-representation in baptismal counts and age heaping in censuses with a variety of techniques, such as the application of model life tables (Willigan and Lynch 1982). With the absence of data from sixteenth and seventeenth century New Mexico, no such evaluation of estimates from this era can be conducted.

This does not mean that the descriptions of Pueblo populations which come from the general Spanish accounts of the sixteenth and seventeenth centuries are of no value. For example, the differences in the numbers cited by Spanish explorers between different regions can provide relative measures of difference in the size of populations between the various areas of the northern Southwest; examining accounts through time can provide a picture of which regions were thriving or declining relative to others, even if the degree of decline itself cannot be measured. However, they cannot be used to create absolute measures of population change through time by the comparison of one set of population sizes created by one observer at one point in time with the numbers of another from a second point. To do so would impart to these numbers a level of accuracy which cannot be assessed, and create the impression that population change is taking place when other factors influencing how observers arrived at their estimates might actually account for the differences observed.

Beyond this major limitation regarding the demographic information from general accounts, there are several other qualifiers which must be applied to such information, including descriptions of settlements: their names, their locations, and their sizes. First, it has proven difficult to correlate the Pueblos described in one account to those listed in others, or with archaeologically known community locations, a challenge which has vexed scholars since the time of Bandelier (1890-1892; see also Harrington 1916). This is especially true for the sixteenth century, where explorers often rendered only an imperfect transliteration of the indigenous name for a community. In many cases, names were obtained from (often non-linguistically affiliated) neighboring Pueblos, or were assigned by the Spaniards themselves, derived from the geographic setting of the community or in commemoration of the day which the community was "discovered" (Schroeder 1979). In some respects, the picture becomes clearer during the seventeenth century, particularly for those communities which saw the construction of mission and *visita* churches. These communities were often referred to by the names of the saints to which the churches were dedicated, and in many instances, these place names persist to this day. In some cases, however, even seventeenth century accounts provide incomplete or contradictory settlement information. For example, Fray Alonso Benavides, custodian of the New Mexico missions from A.D. 1626 to 1629, listed fourteen communities in the Rio Abajo area as occupied during his tenure, but names only those three at which mission churches had been constructed (Morrow 1996:7-11). As a consequence, it is unclear which of Benavides's remaining eleven correspond to the sites listed by the Espejo and Rodriguez-Chamuscado parties in the 1580s, by

Oñate in 1598, or with those sites which display ceramic assemblages indicating occupations in the early seventeenth century (Barrett 1997:3-6, 2002:55, 61; Earls 1992; Marshall 1984; Schroeder 1979, 1992).

Second, not all chronicles describe areas which are known to be occupied from archaeological evidence. Evidence of these omissions is most prevalent in accounts from the sixteenth century, as exploring parties failed to reach many of the regions occupied by Pueblo peoples; no expedition until Oñate's visited all of the areas occupied by Pueblo peoples (see Table 2.2). Even then, in many peripheral areas, such as the Jemez and the Rio Abajo, Oñate did not visit all of the communities occupied at the time (Hammond and Rey 1953:322, 346). That such areas were not visited gives rise to two questions. The most obvious regards the number and size of communities in these areas. The second and more intriguing question is whether these regions were actually occupied. It is entirely possible that some regions were not traveled to by Spanish parties because they were sparsely occupied or completely abandoned at the time of the expedition. One would expect that the it would be less likely for particular regions to be excluded from seventeenth century accounts, as chroniclers from this century had long-term access to the entire region, and could count on information from the missionaries, *encomenderos*, and other Spaniards and Pueblo individuals throughout the colonies. However, there is archaeological evidence suggesting seventeenth century occupations of communities in several areas of the northern and central Rio Grande which do not appear in any Spanish accounts, such as the Rio Chama drainage (Ramenofsky 2000; Ramenofsky and Feathers 2002), the Magdalena area (Marshall and Walt 1984), and the Chupadera drainage, located between the Salinas and Rio Abajo areas (Kulisheck 2003a).

And third, sixteenth century descriptions functioned as snapshots, estimating the size of communities at a single moment. What we know of the seasonal dynamism of early Pueblo communities, from both the archaeological and ethnographic records (Dublin 1998; Preucel 1990; Sebastian 1983), challenges the idea that a description of a village at any one point during the year might accurately reflect the true size of the community. While Coronado's party stayed several years in the northern Southwest, much of that time was spent in the vicinity of just a few communities in the Central Rio Grande; the expeditions of his lieutenants were made during the winter (Hammond and Rey 1940). Other expeditions prior to 1598 were of much shorter duration, and necessarily saw the communities of the northern Southwest during one or two seasons.

Unlike the historic record, the potential evidence for archaeological investigation of Pueblo population decline is more broad; however, the employment of existing evidence has been limited to the occupation and abandonment of large communities. This type of evidence has been incorporated into most archaeological studies of Pueblo population change during the sixteenth and seventeenth centuries (Barrett 2002; Dobyns 1990; Earls 1992; Haas and Creamer 1992; Lycett 1995; Ramenofsky 1996; see also Kulisheck 2003a; Schroeder 1992).

Despite the fact that the locations of large aggregated villages occupied by early modern Pueblo peoples are well known, the large settlement record has fallen short for the evaluation of questions the timing and severity of population decline in two areas. The first and perhaps most daunting shortfall is that the sites prominent within the record of the early modern Pueblo era are extremely challenging to study. The ubiquitous aggregation which takes place during this era results in fundamental changes to the size, longevity, and nature of occupations at Pueblo habitations. Settlements during the early modern era expand to a scale not previously seen, with single villages often exceeding 1000 rooms in size (Adler 1996a, 1996c), and occupations that often extended into the hundreds of years (Kohler 1989). Despite the size and longevity of these settlements, they did not necessarily have large, continuous occupations; rather, they tended to have unstable and fluctuating occupancy, which did not follow a normal distributional curve (Cordell 1994; Cordell et al. 1994). The reconstruction of these occupational fluctuations, even at sites with occupation spans of less than 100 years, has required extensive excavation (see Crown 1991). These challenges are exacerbated by the research methods and limited infrastructure of archaeological research during the last forty years. In the early part of the twentieth century, when fieldwork labor was cheap and the emphasis on recovery during excavation focused on only a small portion of total deposits, researchers such as Nelson could dig literally hundreds of rooms at a number of large aggregated village sites in a single field season (Fowler 2000:282-284; Snead 2001:106-112). However, the spatial and temporal resolution of these early studies is low, and there are large data gaps which make demographic reconstruction difficult, such as an absence of tree-ring dates, or well-defined proveniences for time-diagnostic artifacts. As labor costs have risen and recovery techniques have become more sophisticated, commensurately smaller portions of large aggregated village sites have been excavated. These methods, such as sampling (see, for example, Creamer 1993) or the excavation of small portions of sites to be destroyed by development (see, for example, Fallon and Wering 1987; Marshall 1987) are of little value to demographic studies, because they do not produce the large-scale intra-site occupation data that is necessary to monitor changes in population through time.

The second problem is that large sites, precisely because they are large, have dominated both the research frameworks and the archaeological research on the early modern Pueblo era. As noted above, the trend in the northern Southwest was ever greater residence in large, aggregated communities. However, this trend of population shifts from small to large settlements was not unidirectional across the temporal span of Southwestern prehistory, and in several instances large site abandonment was a consequence of a shift to a dispersed, small site settlement pattern, not population decline (Nelson 1999; Nelson and Hegmon 2001). Preliminary evidence in some areas of the northern and central Rio Grande, such as the Rio Abajo, indicate that such a shift may have also taken place during the sixteenth and seventeenth centuries (Kulisheck 2003a; Mera 1940). Because of the prospect of shifts in the distribution of populations to different patterns of settlement, large site occupations may not accurately represent regional population levels, even if greater chronological control were resolved.

Together, these two shortfalls indicate that the record of large site occupation and abandonment cannot address the issues of timing and severity in population decline. The scale of the large site record, in terms of the time span of occupation, and the differential occupation of those settlements across that time span, has not been reconciled to the resolution of the data pertaining to large site occupations, a resolution which is based largely on survey and unsystematically collected surface evidence and is generally poor. As a consequence, evidence of the abandonment of a large site is of limited value; the decline in population represented by the abandonment could be small, or it could be significant, but this difference cannot be distinguished. The prospect of shifts in the distribution of populations to different patterns of settlement, particularly to small sites, also means that large site occupations may not accurately represent regional population levels, even if issues chronological control and differential occupation were resolved.

Approach

The problems existing studies have had utilizing and generating evidence are symptoms of more comprehensive problems with the way these studies have approached the issue of sixteenth and seventeenth century Pueblo population decline. For the most part, the structure of Pueblo population studies has pushed researchers to rely on existing data sets inadequate for resolving the critical issues of timing, severity and differential persistence. These problems of approach can be divided into two categories. The first is the failure of studies to incorporate information regarding the organization of the Pueblos during the centuries prior to the arrival of the Spanish into an understanding of sixteenth- and seventeenth-century population change. The second is the emphasis on changes in mortality to the exclusion of other variables integral to population change, fertility and migration.

Rubertone (2000) has noted that there has been a shift in archaeological studies of Native North Americans during the early historic era away from an emphasis on continuity with the prehistoric era. Newer studies seek to emphasize change to Native American societies from European colonization, in part to challenge the assumptions of continuity made by earlier direct historical studies. But at same time, Rubertone emphasizes, these revisionist studies can paradoxically have an isolating effect, essentially partitioning the understanding of Native American culture change through the ages at the line of contact with the peoples of the Eastern Hemisphere. As such, the revisionists may not fully consider important connections between late prehistoric and early historic which are relevant to the nature of early historic era change. Several recent U.S. Southeastern studies of Native American population decline, including those by Galloway (1994, 1995, 2002), Perttula (1991, 1992, 2002a, 2002b), and Worth (1998, 2002), have addressed this shortcoming by rooting explanations of historic era change within understandings of late prehistoric era demographic, economic and political organization. In the U.S. Southwest, with a few exceptions (notably Upham 1982), general demographic studies have begun to consider Pueblo population decline in the sixteenth century. Because the concern of these studies has been the effects of Spanish exploration and colonization on early modern Pueblo populations, they initiate their consideration with the arrival of the first Spaniards, between A.D. 1539 and 1542. For those studies which have relied primarily upon historic documents for evidence of population change (for example, Barrett 2002; Palkovich 1985, 1994; and Reff 1991), there is little other option, as the first Spanish documents date to this time. However, most archaeological studies also follow this pattern, particularly in the use of extant survey-level site occupation evidence and consideration of site abandonment (Barrett 2002; Dobyns 1990; Earls 1992; Haas and Creamer 1992; Lycett 1995; Ramenofsky 1996; see also Kulisheck 2003a; Schroeder 1992). Few of these studies characterize the nature of settlement patterns or site usage during the late prehistoric era and contrast it with the early historic era.

An emphasis on the population history of the Pueblos in the sixteenth and seventeenth centuries, with a corresponding neglect of the centuries preceding these, has channeled focus away from two critical variables relevant to population change: the sociocultural context of

Pueblo populations during the centuries prior to the arrival of the Spanish, in particular, settlement patterns and the economic organization of agricultural production; and the response of Pueblo peoples to the forces of demographic change. Instead, the activities of the Spanish, and the forces of potential depopulation introduced by the Spanish, have been treated as the critical variables. The result has been to deemphasize the differential effects of the Spanish on different Pueblo groups, and provide no more than anecdotal consideration to Pueblo resistance and response. The consideration of the effects of introduced European infectious diseases provide two examples of this masking. In applying his hypothesis to the northern Southwest, Dobyns (1983, 1991, 1993) argues that European infectious diseases struck the northern Southwest in the early sixteenth century as a consequence of disease introduction into populations of central Mexico just a few years before. His inference of devastating effects on Pueblo populations from these diseases is based on potential for morbidity and mortality from these diseases among unexposed populations (characteristics of the disease) rather than issues of demographic organization of the Pueblos themselves (characteristics of the hosts). While morbidity and mortality from infectious diseases is highly variable, and the settlement pattern and demographic organization of the exposed population is critical to the incidence of morbidity and mortality (Austin Alchon 2003; Baker and Kealhofer 1996; Ramenofsky 1990, 1996; Ramenofsky et al. 2003), Dobyns gives this no consideration, assuming that such incidence among Pueblo peoples would be similar to that of central Mexican populations. Reff (1991), by contrast, considers the interaction between the Spanish and Pueblo peoples as too infrequent, and distances traveled by the Spanish too great, for disease transmission to be possible throughout the sixteenth century; in this case, the lack of disease transmissions lies with the characteristics of the vector (the Spanish), not the hosts (Pueblo peoples). In neither case do the researchers consider Pueblo settlement pattern or other demographic variables as relevant to the timing or severity of disease effects, nor that responses by the Pueblo, such as shift from aggregated to dispersed settlement patterns, or migration away from points of contact with disease vectors, may have affected rates of disease morbidity and mortality (Palkovich 1985).

By the same token, all studies of population change in the northern Southwest have emphasized mortality as the primary cause of change; those who have evaluated other causes (Palkovich 1985; Barrett 2002), have done so only in counterpoint to the consideration of mortality. This emphasis on mortality in understanding population decline stands in contrast to almost all studies of population change during the ancestral and pre-Spanish early modern era and the late modern era, where population change is seen as the outcome of migration and changes in mobility strategies (for the ancestral and pre-Spanish early modern era, see Cameron 1995; Clark 2001; Dean et al. 1994; Duff 1998, 2002; Kohler 1993; Kulisheck 2003a; Mills 1998; Nelson 1999; Nelson and Hegmon 2001; Nelson and Schachner 2002; Swedlund 1994; for the late modern era, see Herr and Clark 1997; Levine 1999; Levine and LeBauve 1997). It is also in contrast to studies conducted in other portions of North America which have shown migration (Smith 1989, 2000) and changes in fertility (Jackson 1994, 2000; Shoemaker 1999; Thornton 2000; Worth 1998) to be important in driving population change during the early and late modern eras.

The failure to integrate Pueblo sociocultural organization as it existed in the centuries prior to the arrival of the Spanish, and the emphasis on mortality as a cause of population change are factors that have historic roots in both how Pueblo population decline in the sixteenth and seventeenth centuries became a topic of interest for researchers, and where it is situated in the larger field of Southwestern archaeology. Part of the blame for both of these emphases lies with the way that the Dobyns hypothesis has dominated the debate regarding population decline. One key assumption of this hypothesis is that the effects of disease on North American populations would be uniform. A second is that the effects of mortality would be so great that it would overshadow any other impacts on Native demography. The willingness of many scholars to engage the Dobyns hypothesis, among them Upham, Palkovich, Lycett, Earls, Reff, and

Ramenofsky—has led them to primarily address issues of catastrophic effects and mortality rather than considering differential effects and other demographic variables (but see Palkovich 1985:420-421, 1996:191-192; Ramenofsky 1996).

The same situation has held true in the Southeast as well; early studies were also framed in the context of the Dobyns hypothesis (Ramenofsky 1987; Smith 1987). However, research programs there have progressed beyond this emphasis, while they have not in the Southwest. Again, part of the problem lies with a continuing inability to resolve the Dobyns hypothesis; while some scholars in the Southeast continue to reject the Dobyns hypothesis (see, for example, Kelton 2002), this has not stopped other researchers from creating sophisticated reconstructions of population change which give consideration to the effects of late prehistoric era Native organization, Native response to introduced change, and the effects of contact and conquest on other demographic variables such as fertility and migration. A significant barrier to Southwestern researchers emulating the research designs of the Southeast by incorporating information regarding Pueblo sociocultural organization during the last few centuries prior to the arrival of the Spanish lies in the fact that—in contrast to the Southeast—the period between A.D. 1450 and 1600 remains one of the most poorly known in Southwestern prehistory. The excavation of large village sites provides a measure of the lack of research on the one hundred and fifty year time span straddling the boundary between prehistory and history in the region. Only in the last fifteen years have large sites with occupations dating to this period been the subject of major investigations (Creamer 1994; Creamer et al. 2002; Haas and Creamer 1992; Lycett 2002; Preucel 2000; Preucel et al. 2002; Ramenofsky 2000; Ramenofsky et al. 2002; Spielmann 1991, 1994), as the sixteenth and seventeenth centuries have once again become a period of interest. During the forty-five years prior, however, few large villages occupied in the span between A.D. 1450 and 1600 were excavated. Of these, many were poorly or incompletely reported, as in the case of the excavations conducted at Cuyamungue (Wilmeth 1956), Sapawe (Snow 1963), Yunque Yunque (Ellis 1989), and Picuris (Dick 1975, 1998). In other cases, the excavations have been of a salvage nature, where the areas excavated have been limited to areas of disturbance (Marshall 1982, 1986, 1987). Comparatively, there has been far more research conducted on sites and landscapes prior to A.D. 1450, which has led to a greater understanding of Pueblo organization during this time period (for example, see Adams 2002b; Creamer 1993; Cordell 1979, 1997:400-403; Duff 2002; Duff and Adams 2004; Spielmann 1998). However, the Southwest was struck with tremendous instability during the mid-1400s, that resulted in significant changes to the settlement and economy of Southwestern peoples; in the northern Southwest, this meant the abandonment of dozens of villages, and significant changes in landscape use (Adler et al. 1996). These significant changes mean that the extrapolation of Pueblo sociopolitical organization from the period prior to A.D. 1450 to the next century and a half is problematic, leaving a significant gap in understanding between the prehistoric and historic eras.

Towards an Archaeology of Population Change during the Sixteenth and Seventeenth Centuries

It is clear that there is a need for a shift in research direction in order to arrive at conclusive statements about critical questions regarding population change. What is needed is an archaeology of population change; that is, an approach to early modern Pueblo era population change which is archaeological in its guiding principles and viewpoint, its methodologies, and in its evidence. There are three elements to an archaeology of Pueblo population change. The first is the construction and use of relevant evidence. The second is the incorporation of Pueblo sociocultural organization into the understanding of population change through a consideration of the archaeological record of the centuries prior to the arrival of the Spanish, in addition to the sixteenth and seventeenth centuries. The third is the integration of all relevant demographic variables into the consideration of Pueblo population change, including not only mortality, but also fertility, migration, and identity. These elements can be taken from several sources, including the work on Native population change which has been conducted elsewhere in North America, from population reconstruction methods utilized in the archaeology of the prehistoric

Southwest, and from ideas within the general body of demographic archaeology and anthropology. It can be also be drawn from several of the existing studies of sixteenth- and seventeenth century Pueblo population change in the northern Southwest; despite the criticisms I have leveled at aspects of existing research, many of these studies contain innovative ideas and methodologies which provide crucial direction for how future studies should be carried out.

Construction of Evidence

Fundamentally, the evidence utilized to examine population change during the sixteenth and seventeenth centuries must be appropriate to the potential tempo of change during that era. The evidence must be divisible into temporal units of comparison which are relevant to the question of the timing and severity of population decline and the potential causes which would affect these phenomena. In the consideration of the Dobyns hypothesis, at its most simple evidence must allow for a comparison of Pueblo population sizes between the sixteenth and seventeenth centuries, something that archaeological evidence of large site occupations, for example, does not currently allow. The evidence must also be comparable between relevant temporal units; it must measure the same demographically relevant phenomena within each temporal unit. Estimates of regional Pueblo population sizes are available from a variety of points in time throughout the sixteenth and seventeenth centuries, but because of the potential differences what these estimates actually measure, and how they measure, mean that they cannot be compared. And the evidence must be available on a regional, or sub-regional basis; it cannot be specific to a single large community. It is clear now that large communities were abandoned during the sixteenth and seventeenth centuries, but because of the nature of the early modern Pueblo large site record, it is not clear what these abandonments mean in terms of the direction of Pueblo population change. For evidence meeting these criteria, there are two avenues researchers can pursue. They can search the existing historical and archaeological records for evidence, or they can set about creating new evidence through archaeological field and collections work.

The most prominent existing sources of information regarding Pueblo population change—enumerations of Pueblo populations and communities in general historical accounts, and evidence of large site occupation and abandonment—are insufficient for resolving the critical questions regarding population decline during the sixteenth and seventeenth centuries. There are other sources of archaeological and historical evidence, but many of these have not been extensively utilized. Some of these sources have the potential to produce new evidence regarding population change among Pueblo peoples in the sixteenth and seventeenth centuries, while others are limited to providing only supporting evidence. In general, the ability for historic sources to provide evidence regarding the timing and severity of population decline is extremely limited. By contrast, the archaeological record contains a range of evidence sources which can be brought to bear on this question. Fundamentally then, resolution of the questions of timing and severity of decline, and the ultimate issue of differential persistence of Pueblo populations across the northern Southwest will be resolved only through archaeological research (Ramenofsky 1990, 1996). Historic research can provide important supplements to archaeological conclusions, but cannot alone produce answers regarding these questions. A review of the remaining potential sources of evidence relevant to Pueblo population decline provides justification for this assertion.

The failure of historic documents of a general nature, such as explorers' accounts, to provide meaningful evidence regarding Pueblo population decline in the sixteenth and seventeenth centuries cannot be resolved by turning to other types of documents, such as those which deal with particular individual events. This document category has been less utilized by researchers than general accounts, and includes legal records, vital records, correspondence, and accounts of inspections and military campaigns. Some types of documents within this category have great potential for the reconstruction of population trends, but in general, the extant body of historical materials available for the sixteenth- and seventeenth-century northern Southwest does not contain these types.

Some existing archaeological and historical studies (Earls 1985, Gutierrez 1991; Knaut 1995) have utilized legal documents to identify the specific effects that Spanish actions may have had on Pueblo populations. For example, many legal proceedings document the expropriation of the goods and labor of Pueblo peoples in violation of Spanish law. In other instances, they reference the abandonment of communities; warfare, violence and raiding; and matrimonial and extramarital unions which are indicative of both the factors affecting reproduction among Pueblo individuals and between Pueblo and Spanish peoples. However, these cannot provide for the quantification of population change. They can provide support to explanations of change, but because of their anecdotal nature, cannot themselves describe those changes.

Documents of greater relevance to issues of population change are vital records, the records kept mostly by ecclesiastical authorities to mark the births, baptisms, marriages and deaths of their parishioners. These are some of the primary records with which historical demographers ply their craft, using them to create a variety of demographic measures, including community size, family structure, and the composition of communities by age, sex and ethnicity (Willigan and Lynch 1982). They have been used with particular effectiveness in evaluating population change among the mission communities of California (Cook and Borah 1976; Jackson 1994a; Walker and Johnson 1992) and Texas (Jackson 1994b), and for Pueblo communities in the eighteenth and nineteenth centuries (Kessell 1987; Levine 1999; Levine and LeBauve 1997). However, there are no such documents from the sixteenth and seventeenth century northern Southwest. Obviously, such documents could not have existed from the sixteenth century, when the few missionary efforts by Franciscans left behind by exploring parties quickly ended in martyrdom. However, such documents were generated during the seventeenth century; as evidenced from contemporary reference to these documents (for example, Millich 1966:35) and from their discovery by later, eighteenth century chroniclers (Adams and Chavez 1956:234). However, because these records were stored at the local level in mission churches, their destruction was assured during the Pueblo Revolt of 1680, as Pueblo peoples sought to rid their communities of all vestiges of the Spanish presence, burning churches, smashing religious objects and destroying Spanish documents and texts (Beers 1979:68; Gutierrez 1991:105). In 1776, Fray Francisco Anastacio Domínguez inventoried the available ecclesiastical records of the New Mexican province, and found seven volumes of vital records at Santo Domingo Pueblo; these documents were later swept away and destroyed by flooding in 1886 (Beers 1979:70).

There is certainly the potential that new documents—both general and particular—relating to the sixteenth and seventeenth century will yet emerge. The productivity of several research projects over the past decade have demonstrated this potential (Flint 2002; Flint and Flint 1997, 2003; Hedricks and Wilson 1995; Kessell 1989; Kessell et al. 1992, 1995, 1998, 2000, 2002). The accounts of the re-conquest of northern New Mexico by Don Diego de Vargas, for example, have been built in part from particular documents such as personal letters, civil reports, governmental decrees and records of legal proceedings. Additional sixteenth and seventeenth century documents found in the future will most likely fall within these particular categories. However, there is also the promise that new general accounts of the northern Southwest during the sixteenth and seventeenth centuries will also emerge, as there are references to additional documents produced by Benavides, Zarate Salmerón, members of the Rodriguez and Chamuscado party, and others which have not yet come to light (Wilson 1992). Because of the nature of these documents, however, it is unclear whether they will do more than only marginally increase our understanding of the populations of the Pueblos in the sixteenth and seventeenth centuries. This is because almost all of the documents which have survived from this era are those which were sent from the region to Mexico and Spain, documents designed for consumption by civil and ecclesiastical authority figures and by legal courts of inquiry. The documents which have the greatest ability to inform on population changes, such as vital records and tax and *encomienda*-related records, were by their nature kept within the Spanish colony, and were almost certainly destroyed during the violence and chaos at the end of the seventeenth century. While our knowledge of the Spanish colonial enterprise in the northern Southwest may continue to grow, this is less likely to be true of our understanding of sixteenth and seventeenth century population changes among Pueblo peoples, based on Spanish documents. Rather what we know now is likely all we will ever know, with the likelihood for further elucidation only at the margins of demographic understanding.

Unlike written Spanish history, there are many fewer limits to the potential for traditional Pueblo history to produce evidence relevant to early modern Pueblo population change. While a few Pueblo groups have completely dissolved, such as the Tompiro of the Salinas region, and others have experienced relocation and assimilation in to other communities, such as the Piro of the Rio Abajo and the Tano of the Galisteo Basin, many Pueblos occupied during the sixteenth and seventeenth centuries persist and maintain traditional histories of the times prior to and after the arrival of the Spanish in the Pueblo world. Despite this tremendous potential, however, there are actual substantive barriers to the availability and use of evidence from traditional history for understanding Pueblo population decline. First, the structure of traditional history is such that evidence directly relevant to the issues of the timing and severity of population decline is difficult to derive from these histories. Second, the ability for scholars to access these traditional history, where they have not been previously written down and made available to the public, is likely to be significantly restricted by Pueblo peoples' concerns regarding secrecy, and the current political climate governing the interaction between Pueblo communities and anthropological and archaeological researchers.

Traditional oral history is distinct from both sixteenth and seventeenth century accounts and from modern archaeology and historiography in the ways it documents the events and processes which have taken place in the past, with significant implications for its ability to contribute to understanding population change. In discussing the cognitive historic space which traditional history creates, Bahr has identified three distinct temporal realms which are created. The first is the direct experience of the interviewee; the events in the past that the oral historian him or herself has experienced. The second are events which are in the historical past, not experienced by the interviewee, but associated with ancestral individuals from which the individual is descended. The third are events in the mythological past, through which the interviewee has institutional ties, such as clan, society, moiety or community, but the direct, lineal ties are obscured by deep time (Bahr et al. 1994:2-6; see also Henige 1982; Vansina 1985). From an interpretive perspective, these three realms range from the straightforward to the problematic. For example, events typically experienced directly by the interviewee, such as community political struggles, are often able to be contextualized against contemporary outside observations. By contrast, events taking place in the mythological past may involve fantastic occurrences; have supernatural beings and animals as protagonists; collapse or expand physical distances; and are expressed in temporal scales which do not conform to modern equivalents. These descriptions of the mythological past are more challenging to correlate with the scientific notions of time, space, causality and action which characterize archaeological inquiry (Mason 2000; Whiteley 2002a).

Typically, the events of the early modern Pueblo era straddle the boundaries between the second and third temporal realms of oral history. While the formation of modern Pueblo patterns of settlement, subsistence and social organization in the early fourteenth century lies in a mythological cognitive space, the events of the Spanish conquest are much more firmly rooted in a cognition which is historical. Even when referencing known historical events, oral and traditional history of the sixteenth and seventeenth centuries (like contemporary Spanish documents [Galloway 1991; Reff 1994]) cannot be separated from the cultural context in which such history is generated when considering how events are described, and the nature of the evidence derived. The historiographic "methods" of maintaining oral tradition within Pueblo communities are directed by particular cultural concerns which dictate what aspects of the past are worth remembering, and in what context they are to be remembered. By the same token, oral historians among the Pueblos also tend to follow historical "rules;" as a consequence, they can also be subjected to criteria of evaluation such as consistency, reliability and authority (Whitely 2002a). Like Spanish accounts, even if the issues of context and interpretation are set aside, there are still challenges in distilling demographic information of value from oral and other traditional histories. In the main, the limiting factors are the types of observations oral history makes about the past (what aspects of past events and practices are discussed), and the omission of information critical to the scholar concerned with demographic researcher but irrelevant to the Pueblo oral historian.

A main contribution oral histories to the understanding of population decline is the range of evidence relevant to the abandonment of communities (Herr and Clark 1997; Nelson and Schachner 2002). Already published Pueblo traditional histories, including those collected at the end of the nineteenth century and those utilized in land claims settlement cases, contain evidence relevant to the cultural affiliation of abandoned communities. More recent collaborations, such as works by Ferguson and Hart (1985) and Bayer and others (1994) also contain descriptions of the movements of early modern Pueblo groups, again bearing on the cultural affiliation of large community occupations and abandonments. Oral history can also contain evidence relevant to sociocultural explanations of community abandonment. Whiteley's understanding of the destruction of Awat'ovi as part of a process of revitalization, in addition to being an act of resistance, is an example informed by oral history (Whiteley 2002b). However, oral histories can't provide the essential information regarding the nature and timing of population decline, as the concerns of the Pueblo traditional historian regarding these issues are distinct from that of the modern demographer. Existing histories have not contained evidence relevant to these questions, and the structure of Pueblo oral history indicates that new histories will not provide such evidence. In the consideration of population decline at least, oral history, like other historical sources, must be considered supplementary, rather than central, to the construction of the data needed to examine demographic change.

Even given the supplemental role that traditional history can play in understanding demographic change, the production of new written histories based on existing knowledge is unlikely to provide major contributions to sixteenth- and seventeenth-century population change in the near term. Historical knowledge, like other types of traditional knowledge maintained within the Pueblo communities, is often privileged, and is not shared with others for whom the knowledge is not intended, particularly non-members of the community (Brandt 1977; 2002; Dongoske et al. 1997). Thus, it is unlikely that direct solicitation of oral histories will be well received among those who maintain such histories at the Pueblos. Rather, they will be shared with non-Pueblo peoples when it is believed to be appropriate, either for the benefit of the community itself (as it has been in the past for land-claims cases), or for other reasons decided upon by Pueblo members distinct from the concerns of non-Pueblo scholars.

The failure of historic evidence, both from Spanish historic accounts and written Pueblo traditional history, to provide evidence relevant to issues of timing, severity and differential persistence means that archaeological research will be central to the understanding these issues. But the main form of existing archaeological evidence—the large site occupation record—has proven to be inappropriate for understanding these issues, due to its temporal and spatial scale. As a consequence, archaeologists will need to construct new forms of evidence with greater relevance to the scale and nature of the problem of Pueblo population decline during the sixteenth and early seventeenth centuries.

Efforts in the creation of new archaeological evidence can be divided into two categories based upon the portion of the record which receives focus. First, the large site record can be examined in different ways than it has been examined in the past. Portions of the large site record, such as artifacts, human remains, or dietary remains can be examined for evidence of temporal change which is relevant to demographic change. Or the large site itself can be examined for variable occupation through time, through the application of methods which circumvent the problems concerning the large size of these sites and the resources needed to apply traditional archaeological methods for reconstructing differential site occupation. A second avenue for creating evidence relevant to population change is examination of the archaeological record of the sixteenth and seventeenth centuries beyond the large sites: the record of small sites and landscapes occupied and utilized during the sixteenth and seventeenth centuries. Neither the large site nor the small site and landscape records are necessarily superior as sources of evidence; existing studies have generated evidence from both of these sources with variable results. This variability demonstrates how new archaeological evidence can be central to understanding the issues of the timing and severity of population decline, or may only be supplemental to understanding these processes.

After a long hiatus, large Pueblo sites with sixteenth and seventeenth century occupations have once again become the subject of archaeological investigation in Southwestern archaeology (Creamer 1994; Creamer et al. 2002; Haas and Creamer 1992; Lycett 2002; Preucel 2000; Preucel et al. 2002; Ramenofsky 2000; Ramenofsky and Feathers 2002). This research is focused on the various effects of the Spanish entry into and occupation of the northern Southwest on Pueblo life, but because most of these studies focus upon a single large site, they cannot address issues of regional population decline, even though they produce, and have potential to produce, important evidence relevant to the process of population decline. Human remains, and evidence of changes in artifact use, in addition to evidence of changes in the size of a large site occupation, are all relevant to population decline, but the scale of the conventional investigation of these evidence sources through excavation means that their actual contribution to understanding issues of regional decline are limited. In addition, there are problems specific to certain classes of evidence, such as human remains, which form additional barriers to the use of these evidence sources.

It is unlikely that evidence from human remains will be able to make a significant contribution to our understanding of sixteenth- and seventeenth-century Pueblo population decline, at least in the near future. For the ability to examine change across the boundary between prehistory and history, and to look at differential population change between the various subregions of the northern Southwest, extensive multiple skeletal collections are required, as exist, for example, for northern Florida Native sites (Larsen 2001). The sole existing comparative study of early historic human remains from the northern Southwest, however, relied upon collections from only three sites (Stodder 1990). While existing excavated collections are limited, there are many unexcavated sites from the sixteenth and seventeenth centuries in the northern Southwest which have the potential for yielding large skeletal assemblages. However, given the current climate in which late modern Pueblo peoples have strenuously objected to the excavation of human remains, and have demanded rapid repatriation of those which have been excavated (Stodder and Martin 1996), the ability to obtain collections of a sufficient size and scope to discuss population change at any scale greater than the site appears to be extremely unlikely anytime soon. The value of evidence generated from human skeletal remains is that it can provide insight into the identification of causality in population change. Questions addressed by evidence from skeletal remains include: what are the new or changing causes of mortality?; who among the population is most affected?; and, how do sixteenth- and seventeenth-century patterns differ from those of prior centuries? While answers to these questions are vital, limited sample sizes will prevent evidence from human remains from contributing to the resolution of larger questions regarding the timing or rate of population decline. Thus, evidence from human remains will play a supporting role in understanding the process of population decline.

The investigation of dietary remains such as faunal and macrobotanical material is less limited than that of human remains, but poor recovery practices limit the use of excavation collections, especially those from the first portion of the twentieth century when a significant portion of the excavation conducted at large early modern Pueblo sites was conducted. For example, at the sites in the Galisteo Basin excavated by Nelson, Lycett found faunal remains in room assemblages expressed as dry volumes, as counts or simply as present or absent. In many cases the listed absence of remains more likely reflected low frequencies of such remains (Lycett 1995:447). In the collections from Pecos excavated by Kidder, Spielmann was unable to find any faunal remains at all (Spielmann 1991:199-200). New excavations will correct for the bias of past work, particularly that which is focused on dietary change during the early modern Pueblo era (for example, Graves and Spielmann 2003), but this work will be limited by the same constraints which apply to excavation in general as a research methodology, and will be more relevant to site-specific rather than the regional-scale research which is necessitated for understanding the timing and severity of Pueblo population decline.

For all conventional methods of generating archaeological evidence relevant to population change, the scale of large sites and challenges in carrying out extensive excavation are the greatest barriers to large site investigations making a contribution to an understanding of regional population change. The creation of evidence using innovative methods which avoid these scale and resource issues provides the greatest potential for the investigation of large sites to bear directly on the issue of regional population change. Jonathan Haas and Winifred Creamer (1992) attempted to do this through limited stratigraphic excavation at large sites in several areas of the northern and central Rio Grande region aimed at the development of regional chronology and the retrieval of materials for absolute dating. While the approach may yet be successful for the refinement of the ceramic chronology of the northern Southwest during the early modern Pueblo era (Creamer et al. 2002), it is an apparent failure for determining the differential nature of large site occupations, because of the small portion of each site sampled (Haas and Creamer 1992).

An alternative to new excavation is to use previous excavation data for reconstructing occupations. Mark Lycett (1995) used data from excavations undertaken by Nels Nelson in 1912 of 456 rooms and other areas at six large villages sites in the Galisteo Basin occupied from the fourteenth to the seventeenth centuries. Although the resolution of the evidence generated from Nelson's work was low, given the limited recovery techniques and variable curation practices of the early twentieth century, the material was generally of such a volume and spatial scale that patterns in occupation could be observed in artifact frequencies and loci of artifact deposition. Lycett's ability to utilize previously excavated collections and their associated architectural information stems from the unusual situation of a single excavator (Nelson) conducting research at several sites in a single area, albeit differing in excavation strategy from site to site (Lycett 1995:478). This technique can be extended to other areas within the northern Southwest only with difficulty, as Nelson's practice of excavating many sites in a single region was not repeated, although there are several areas, such as the Zuni area, the Hopi mesas, the Chama drainage, the Pajarito Plateau, and the Santa Fe area where multiple sites from the early modern Pueblo era have been excavated.

In contrast to research conducted using excavated data is the surface approach taken by Ann Ramenofsky at several large early historic sites in the Chama Valley (Ramenofsky 2000; Ramenofsky and Feathers 2002), and at San Marcos in the Galisteo Basin (Ramenofsky and Pierce 1999; Pierce and Ramenofsky 2000). One aspect of this approach is to obtain absolute dates of surface materials from large sites. While such dating can provide evidence of abandonment (or challenge it; see Ramenofsky and Feathers 2002), it suffers from the same scale problems as Haas and Creamer's excavation work: too few dates are produced relative to the scale of the large site occupation, rendering unclear what kind of occupation each date represents. Another aspect of Ramenofsky's work, however, is to examine the differential distribution across large site surfaces of materials which are datable through relative methods, as a way to determine differential levels of site occupation through time. Observations about differential occupations at large sites through surface ceramic distributions has been made for sites dating to the early modern Pueblo era before (Elliott 1982; Marshall and Walt 1984; Mera 1940); however, these observations were either qualitative or based on small or unsystematically collected samples of surface artifacts. At the site of San Marcos in the Galisteo Basin, Ramenofsky systematically sampled the surface of the entire site, which allowed her to identify midden areas and the time periods during which the middens were utilized (Pierce and Ramenofsky 2000). She then associated midden use with roomblock occupations, and created a chronology of differential occupation at the site scaled to the manufacturing spans of the different time-diagnostic ceramics present (primarily Rio Grande glaze paint wares), time spans between 50 and 150 years in duration. The results of her study are of a lower resolution, both temporally and spatially, than would have been achieved through a traditional determination of differential occupation through systematic excavation (see, for example, Crown 1991). However, she was able to construct the sequence of differential occupation at San Marcos using only two seasons of fieldwork for site mapping and surface collection, at a site which is 60 or more acres in size, and one of the largest village communities in the northern Southwest. Her application of similar methods of site mapping and surface collection to several other large sites in the Chama Valley (Ramenofsky 2000) indicates that, unlike extensive excavation, this is a methodology which can be employed on a regional scale.

Other methods for sorting site occupations on surface evidence, or for examining the differential use of sites during different time periods, may also avoid many of the challenges of working with the large site record. Robert Preucel (2000) has been able to determine that the large site of Old Kotyiti was constructed as a single unit in the A.D. 1680s through an analysis of the site's architectural attributes. However, the site is unusual in that most of its architecture is exposed, having been left open after excavations in the early twentieth century, and there are few sites which share this degree of architectural exposure. Ceramics, by contrast, are ubiquitous on the surface of large village sites, making the application of Ramenofsky's technique more far-reaching.

An alternative to using the large site record to examine regional population change is to avoid it altogether, in favor of other portions of the record. Although survey coverage for areas of the northern Southwest occupied during the early modern Pueblo era has been limited, this survey has indicated the extensive use of small limited activity sites, and use of landscapes based on the distribution of nonstructural features, artifacts, and geomorphological modification (Anschuetz 1998; Head and Orcutt 2002; Hill and Trierweiler 1986; Marshall and Walt 1984; Powers and Orcutt 1999; Snead 1995). The record of small structural sites has not been examined for the purpose of discussing sixteenth- and seventeenth-century population change, except in a qualitative fashion (Kulisheck 2001a, 2003; Mera 1940). Small structural sites are the evidence source for this study and are discussed in detail in Chapter V. Lycett (1995) has examined the landscape-scale distribution of artifacts and non-structural features relative to small and large structural sites as a measure of population change in the Galisteo Basin. Lycett tied artifact frequencies and non-structural site distributions to methods of land-use utilization (Pueblo versus historic or European), and found marked changes in the distribution of these artifacts and frequencies in the sixteenth and seventeenth centuries when compared to earlier centuries. Lycett applied this methodology to only one area in the basin, but found qualitative support for the patterning he observed in other surveys in adjacent areas. Because Lycett utilized artifacts (primarily ceramics) that are, given most geomorphological settings in the northern Southwest, ubiquitous, his methods, or other similar landscape-based approaches utilizing ceramics, can be applied to other non-site landscape artifact distributions in the region for comparative purposes. A similar logic can be applied to limited activity and non-structural features; however, these features must also be widespread in both their spatial and temporal distribution, and their use, either in frequency or form, must be related to population and sensitive to changes in regional population size.

The examples of suitable evidence, and sources for that evidence, presented above from existing studies demonstrates that there is no single type or source of archaeological information on population change that the issue of Pueblo population decline during the sixteenth and seventeenth century requires. The evidence utilized will be dependent upon the sub-region within the northern Southwest which is studied, the specific questions asked, the scale of the study, and the resources the researcher has available to conduct field and collections work. However, all evidence must be relevant to the general issues of population change, and, given the state of research into Pueblo population decline in the northern Southwest, relevant to the specific research questions posited by the Dobyns hypothesis. To do so, they must meet the criteria of temporal divisibility, comparability, and regional scale. The examples presented above demonstrate that these are not impossible criteria to meet.

<u>Consideration of Pre-Spanish Pueblo Sociocultural Organization</u>

The nature of Pueblo population change during the sixteenth and seventeenth centuries was as much a consequence of the cultural organization of Pueblo society, and the behavioral responses of Pueblo peoples to the cultural and biological forces introduced by the Spanish, as it was a consequence of the nature of the Spanish conquest and its intended and unintended effects. Thus, all studies of population change among Pueblo peoples during the sixteenth and seventeenth centuries must accomplish two tasks. First, they must begin with an understanding of the sociocultural organization of Pueblo peoples during the centuries prior to the arrival of the Spanish. Second, they must be comparative, using the centuries prior to the arrival of the Spanish as a baseline against which demographic change during the sixteenth and seventeenth centuris can be measured.

The accepted approach to understanding culture change during the sixteenth and seventeenth centuries has been to assess the actions of the Spanish during their exploration and colonization of the northern Southwest, and the consequences of those actions whether intended or unintended. Understanding the demographic impact of the Spanish conquest is critical, from the introduction of infectious diseases, to interventions in Pueblo subsistence production, to forced labor and relocation, to effects on the sociopolitical interaction between the Pueblos and other non-Pueblo Native groups in the region. But while important, this approach presupposes a thorough understanding of the sociocultural organization of Pueblo peoples at the time of the first arrival of the Spanish, a constant upon which the variables of Spanish conquest may be applied. The reality of Southwestern archaeology is such that the opposite is true; that of all of the periods of Pueblo prehistory and history, the century preceding Spanish conquest is the most poorly known. General epidemiological studies (Austin Alchon 2003; Ramenofsky et al. 2003), historical examinations of disease effects (Newson 1992, 1993, 1995; Shoemaker 1999), and archaeological test cases from the U.S. Southeast (Perttula 1992, 2002a, 2002b; Smith 1989, 2000) have all demonstrated that the demographic, economic and political organization of Native American groups has been important to understanding the effects of introduced infectious diseases. Their effects on the Pueblo would have also been conditioned by these variables (Palkovich 1996; Ramenofsky 1996). The demographic effects of other consequences of conquest, such as enforced change of subsistence production practices and the diversion of Pueblo labor would likewise be conditioned by the organization of agricultural production among Pueblo peoples prior to conquest (Earls 1985).

But a simple understanding of Pueblo sociocultural organization for the purpose of modeling the effects of Spanish conquest is insufficient for understanding demographic change during the sixteenth and seventeenth centuries. Sociocultural organization must also be understood to anticipate the behavioral strategies Pueblo peoples may have employed in response to the challenges of conquest. Many of the forces of change introduced by the Spanish, such as infectious diseases and a hierarchical colonial political system, were unfamiliar to Pueblo peoples. However, Pueblo peoples had developed a wide range of strategies for addressing change, ranging from short- and long-term environmental fluctuation (Dean 1988; Dean et al. 1985; Orcutt 1991), to warfare and conflict among the Pueblos (Haas and Creamer 1993, 1996; LeBlanc 1999; Wilcox and Haas 1994), to interaction with other, non-Pueblo Native peoples (McGuire et al. 1994; Spielmann 1991). The employment of these strategies was responsible for the configuration of Pueblo sociocultural organization during the centuries prior to the arrival of the Spanish. While not developed to deal with the specific changes introduced by the Spanish, many of these strategies could have been modified and employed as responses to disease morbidity and mortality, for example, or to the imposition of Spanish economic and political regimes. Identifying these strategies is critical to understanding demographic change during the sixteenth and seventeenth centuries, as some of the strategies have the same archaeological consequences as the effects of disease and other potential causes of population decline introduced by the Spanish. For example, community abandonment has been used by archaeological researchers in the northern Southwest (Barrett 2002; Haas and Creamer 1992; Lycett 1995; Ramenofsky 1996) and elsewhere (Campbell 1990; Ramenofsky 1987; Smith 1987) as a central indicator of depopulation caused by infectious disease mortality. However, community abandonment, accompanied by migration or settlement pattern change, was a common prehistoric strategy for dealing with environmental fluctuations affecting subsistence, or internal sociopolitical change, and is not normally understood as a consequence of population decline due to mortality (Adler et al. 1996; Cameron 1995; Cameron and Tomka 1993; Nelson 1999; Nelson and Hegmon 2000; Nelson and Schachner 2002). Community abandonments during the sixteenth and seventeenth centuries, whether undertaken for reasons related to the Spanish conquest of the northern Southwest, or due to economic and political factors similar to those of the previous two centuries and unrelated to the Spanish, must be understood in a completely different demographic light if they are not a consequence of depopulation due to mortality (Kulisheck 2003a).

Consideration of the centuries prior to the arrival of the Spanish means investigating the portion of the archaeological record from this time period alongside that of the sixteenth and seventeenth centuries. This is what historical studies have fundamentally been unable to do, and what the best existing archaeological studies, reviewed in the evidence section above, have achieved. Comparability between the two eras requires more than the production of evidence from both, however; it also requires a standardizing the understanding of sociocultural variables relevant to population change, such as settlement pattern and subsistence agricultural production, across the historical boundary. And while there are large gaps in the data for last one hundred years prior to the arrival of the Spanish, the Southwest as a region does not lack for programmatic literature discussing the basic sociocultural variables of Pueblo organization (for example, Fish and Reid 1996; Gumerman 1994; Gumerman and Gell-Mann 1994; Leonard and Wills 1994) which can be brought to bear on sociocultural organization during the fourteenth and fifteenth centuries and serve as a baseline for the sixteenth and seventeenth centuries. Likewise, the literature on the strategies of Pueblo peoples for responding to social, economic and environmental change is also substantial, and can also be adapted to understanding archaeological patterns during the sixteenth and seventeenth centuries. The intellectual challenge which faces archaeologists investigating early modern Pueblo sociocultural organization is not one of theory-building. Rather it is one of research, and bringing existing ideas to bear on the results of that research.

Integration of Other Demographic Variables

Fluctuations in the site of any human population are determined by just three variables: fertility, mortality, and migration (Pollard et al. 1993). Where one segment of a human population is recognized as distinct and is embedded within a larger population, as Pueblo peoples were relative to the Spanish and other non-Pueblo Native peoples in the northern Southwest, a fourth variable, identity, is also critical to understanding population change. Identity is the affiliation of an individual to a group; the affiliation may be self-assigned or it may be imposed by an enumerator assembling observations in which affiliations constitute a variable within the observations, such is the case with census counts, records of vital events, or indicators of archaeological occupation, such as pottery sherd frequencies at a habitation site. Identity can be a consequence of, but is not dependent upon descent; as such, an individual's group affiliation may change through their lifetime, or vary synchronically relative to different observers and the individual's self-identification. During the second half of the twentieth century, changes in how U.S. citizens were identified as Native Americans, primarily through changes in self-identification, has been the largest single contributor to the growth of the overall U.S. Native American population during this period (Shoemaker 1999; Thornton 2000). Identity was also a central variable to the character of population change in the northern Southwest in the eighteenth century, as Native Americans were assimilated into the Spanish population through intermarriage, adoption, and slavery (Brooks 2002; Levine 1999), increasing the Spanish population at the expense of Native groups.

The primary concern of existing studies of Pueblo population decline has been mortality; however, other studies have implicated changes in fertility, migration, and shifts in identity as being responsible for population decline among Natives North Americans in the sixteenth, seventeenth, eighteenth and nineteenth centuries (Jaffe 1993; Shoemaker 1999; Thornton 1987, 2000). The consideration of demographic variability other than mortality should not be seen as a rejection of mortality as an explanatory variable for Pueblo population change. Rather, it is a recognition that changes in other variables can contribute to population decline, and that changes in one variable are linked to changes in others, and that these linkages are critical to understanding overall patterns of population change[2].

Figure 3.3 adapts the four demographic variables influencing Pueblo population size to the conditions of the sixteenth and seventeenth century northern Southwest. The variable of identity is combined with migration and is also conceived of as assimilation. Because Pueblo peoples are a group defined by identity, rather than by their geographic distribution (see the definition for Pueblo peoples in Chapter II, above), migration could not have resulted in a change in population size unless also associated with a loss of identity, as migrating Pueblo peoples were assimilated into other Native groups. By the same token, migration was not necessary for a loss of identity, as Pueblo peoples could have also been assimilated into Spanish communities, as they were in the eighteenth and nineteenth centuries.

The incorporation of the demographic variables of fertility, migration and identity into archaeological research designs is challenging, but no more so than mortality. The understanding of migration, and correlated changes in identity among migrants as they assimilate into new communities, is a fledgling intellectual pursuit among researchers in the northern Southwest (Bernardini 1998; Cameron 1995; Clark 2001; Duff 1998, 2002; Ezzo et al. 1997; Lekson et al. 2002; Mills 1998; Woodson 1999). These studies have examined a range of evidence, including

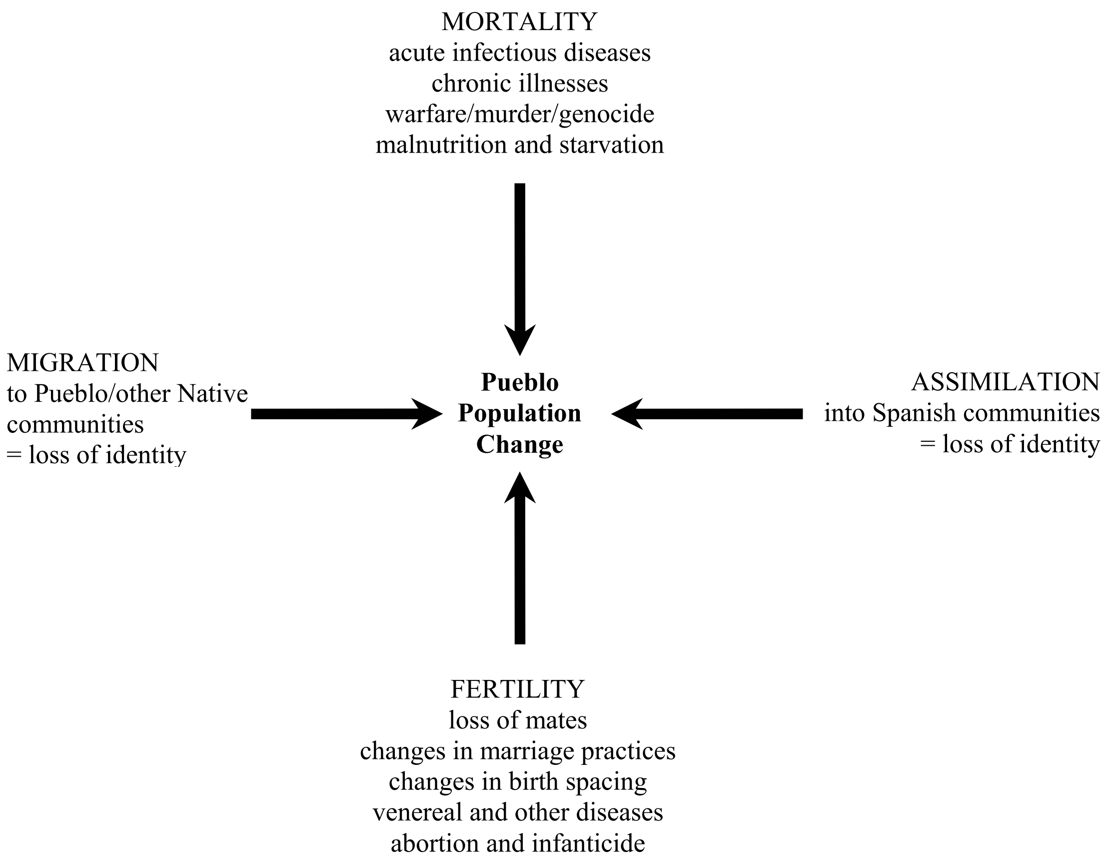


Figure 3.3. A new model for understanding the factors contributing to Pueblo population decline during the early historic era, incorporating the four major demographic variables influencing population change, and the specific elements of each of those variables.

ceramic design, community layout, and human biological evidence for identifying migration and understanding the process of identity transformation. The study of migration and assimilation has also been informed by historical studies of Pueblo migrations, particularly in the eighteenth, nineteenth, and twentieth centuries (Herr and Clark 1997). The investigation of migration and identity change among Pueblo peoples during the sixteenth seventeenth centuries will likely be informed by, and inform, studies of these demographic forces during prehistory. However, the basic archaeological domains which should be considered have been pinpointed by existing research.

Archaeological investigation of fertility changes have traditionally been investigated through the examination of human remains, because of the relationship between mortality and fertility due to the effect which fertility has on ages of death within human populations and thus skeletal samples (Stodder and Martin 1996; Swedlund 1994; for a general discussion, see McCaa 2002). However, the limitations on studying skeletal remains from early modern Pueblo era makes this avenue difficult to pursue. Instead, researchers would be better to start with general propositions regarding the fertility of Pueblo populations based on existing prehistoric skeletal data and the association of general fertility patterns with patterns of sociocultural organization. Given these baseline, there is a need to develop archaeological correlates for the historically documented fertility effects which are known to have been introduced by infectious diseases (references), changes in economic and subsistence production (Worth 1998), and shifts in settlement patterns (Jackson 1994).

Together, these programmatic statements regarding the construction of evidence, the consideration of Pueblo sociocultural organization during the centuries prior to the arrival of the Spanish, and the integration of demographic variables provide direction for new studies of population change among the Pueblo peoples of the sixteenth and seventeenth century northern Southwest. The statements do not stipulate the exact form or scale of these studies. Indeed, existing studies in the Southwest and in other North American regions such as the Southeast, elements of which have been drawn to formulate these statements, have been successfully conducted at a variety of scales, and using a range of evidence and methodologies for measuring and analyzing population change. However, what these programmatic statements do stipulate is that future research must primarily be archaeological. The question of population decline among Native Americans during the sixteenth and seventeenth centuries is by its nature an archaeological problem, as the programmatic statements make explicit. The remainder of this dissertation is an attempt to actualize these programmatic statements into a program of research.

Chapter III Endnotes

[1] The six major collections of analyzed remains are from Pecos (Hooton 1930; Mobley 1980; Ruff 1981, 1991; Spielmann et al. 1990), Hawikku (Corruccini 1972; Howell 1994, 1995; Howell and Kintigh 1996; Stodder 1990, 1994, 1996; Stodder and Martin 1992) San Cristóbal (Stodder 1990, 1994, 1996; Stodder and Martin 1992), Gran Quivira (papers in Hayes 1981), Pa'ako (Dyer Alkauskas 1985 Ferguson 1980; Rodgers 1954), San Antonio (Ferguson 1980) and Kechipawan (Lahr and Bowman 1992). See also Lycett (1995:217-258).

[2] For example, the catastrophic mortality of the bubonic plague epidemic which struck most of Europe in the A.D. 1330s and 1340s was followed by increases in fertility rates among the surviving populations. As a consequence, although this catastrophic mortality event removed approximately one-third of the European population, due to adjustments in fertility by A.D. 1400 Europe had a larger population than was present in A.D. 1300 (Livi-Bacci 1992). If the Dobyns hypothesis is correct, and there was catastrophic mortality across North America in the early A.D. 1500s, then it is clear that Native American fertility rates did not respond to this mortality event in the same fashion as European fertility rates did.

CHAPTER IV

POPULATION, AGRICULTURAL INTENSIFICATION, AND SETTLEMENT CHANGE

There is no set research agenda for studying Pueblo population change in the sixteenth and seventeenth centuries, nor should there be. As I made clear in the previous chapter, although current methods and evidence are insufficient for accurately measuring population change, there are potential avenues within archaeological research for examining the question of population decline in the first two centuries of the Spanish presence in the northern Southwest. The approach taken will be contingent on the nature and scale of evidence available for the area of study in question.

My approach is guided by the nature of available archaeological evidence in the study area, the Jemez Plateau, and the challenges associated with estimating population change on a regional level. The early modern Pueblo record of the Plateau is composed of dozens of small and large village communities, thousands of small field houses, and hundreds of hectares of field features. (The nature of Jemez Plateau settlement and landscape patterns is detailed in Chapter VI.) I start from the proposition that changes in Pueblo populations and communities during the sixteenth and seventeenth centuries must be comprehended from an archaeological perspective, and within the trajectory of ancestral and early modern Pueblo population history. In particular, I argue that Pueblo population change during the early modern Pueblo era can be best understood by examining its effects on the intensification of agricultural production. I also argue that changes in agricultural intensification can be measured archaeologically through examination of changing settlement and landscape use.

This perspective is based on the understanding that ancestral and early modern Pueblo farmers were rational economic actors and decision-makers, who used information and experience to make choices about subsistence behavior within the social and environmental constraints imposed by the landscape of the northern Southwest (Hegmon 1991; Netting 1993; Stone 1996a; Winterhalder 1990). The value of the rational actor approach for understanding population change relies upon two assumptions. The first is that changing conditions of population density force farmers to make choices about maintaining sustainability in subsistence production, and that their choices will reflect perceived least-cost solutions given social and environmental constraints. As the population density of a region increases, contemporary cultivation methods are no longer sufficient to maintain yields sufficient to support its population, or to accommodate the land needs of the additional farmers. Faced with this situation, the subsistence farm household must make choices about whether to increase the productivity of their output, organize with neighbors and kin to resist encroachment on holdings by others, or abandon the area and seek farming opportunities elsewhere. The second assumption is that agricultural settlement locations are determined by the choices made by farmers given changes in population density, and will be manifested in archaeological observable patterns of settlement.

The decision to examine population change from the perspective of economic and settlement change represents a difference in approach, rather than just methodology, from more traditional methods of measuring population change within the archaeological record. The difference can be seen as analogous to the distinction that T.H. Hollingsworth (1969) drew between historical demography and demographic history. For Hollingsworth, historical demography is the quantitative measurement of historical population characteristics and population change through time. Demographic history, by contrast, is the examination of population change within its historical context: that is, the relationship between population and social, economic, political, and other events and processes[1]. A similar distinction can be drawn between archaeological demography and demographic archaeology. Archaeological demography can be defined as the enumeration and description of population and population change using archaeological methods, such as quantifying regional populations through settlement sizes. This approach corresponds to the traditional archaeological methods of measuring population change. Demographic archaeology, on the other hand, is the examination of population and population change in the context of sociocultural organization and culture change, as reflected in the archaeological record. The examination of population change through the perspective of agricultural intensification and settlement change is one manifestation of this approach. The two approaches are not mutually exclusive; rather, they are typically complimentary. Indeed, the archaeological methods for enumerating populations were developed because of the observation that there is a relationship between population and other sociocultural variables, and that the enumeration of population size would aid in understanding sociocultural organization among prehistoric populations (Cook 1972; Hassan 1979, 1981; Naroll 1962; Schacht 1981). The application of either approach is situational, dependent upon both the nature of the research question, and the ability of the archaeological record to provide relevant answers.

The remainder of the chapter is intended as a demonstration of this thesis. It has three objectives. The first is to demonstrate that, within the context of the archaeological record of the early modern Pueblo era, regional population change is often better examined from the perspective of changes in agricultural intensification. The second is to explicate the connection between changing population and shifts in agricultural intensification, on one hand, and agricultural intensification and settlement and land use change, on the other. The third is to examine the archaeological record of the late ancestral and early modern Pueblo eras prior to the arrival of the Spanish for trends in agricultural intensification, settlement change, and population change.

Measuring Population Change from the Archaeological Record

Population is a straightforward variable, made up of observations regarding the presence or absence of individual humans. But individual humans, at least in the sense that demographers count them, do not exist in the archaeological record.[2] Because the humans who created the archaeological record are dead and gone, and consequently unavailable for enumeration, archaeologists must turn to other aspects of the archaeological record besides humans themselves to examine prehistoric population change. Many of the prior studies of Pueblo population change during the sixteenth and seventeenth centuries have used the approach of archaeological demography, with the goal of enumerating Pueblo populations and population change (Dobyns 1983, 1990; Earls 1985; Schroeder 1992; Upham 1992). These studies are in line with the conventional measures of population and population change employed by archaeology, in the northern Southwest and beyond. These methods attempt to hold one or more variables which serve as a population proxy constant—variables such as the number of ceramic vessels, or space used for habitation—and then measure the frequency of such proxies through time.

The approach taken here is one of demographic archaeology: I seek to explain population change from the perspective of sociocultural change, as measured by variability in aspects of the archaeological record. It differs from a strict demographic, or enumerative approach, on several critical points. First, it assumes that the variable of population is more easily understood from the vantage of socioeconomic organization, not the other way around. Second, it uses population density, rather than population size, as the central value in measuring population change. Third, it is an examination of population trends, rather than an attempt at enumeration. And fourth, it examines variability, rather than varying frequencies of constants, as a measurement of change. The use of demographic archaeology to examine population change in response to the entry of Old World populations into North America is not new. Several researchers in the Southeast have taken this perspective when confronted with difficulties using settlement data to enumerate Native populations in the first centuries after the arrival of Old World populations in that region (e.g. Smith 1987; Perttula 1992). The use of culture change as an indicator of population change has also served as a component of studies of Pueblo population decline in the Southwest (Earls 1985; Lycett 1995; Spielmann 1989).

The desire to measure absolute regional population sizes, and examine changes in absolute population size, is derived from the understanding that population is a critical determining variable in economic, political, and environmental change (Boone 2002; Cohen 1977; Hassan 1981; Shennan 2000, 2001; Swedlund 1994; Zubrow 1976). Methodologies devised to measure population size based on archaeological proxies such as habitation space were developed in response to this concern with population as a determinant variable in culture change (Schacht 1981). Over the past 30 years, however, Southwestern archaeologists have had greater success examining cultural change from perspectives other than that of population enumeration. For example, the debate regarding sociopolitical complexity in the early modern northern Southwest discussed in the last chapter was resolved in the absence of population data for this time period. Other indicators of sociopolitical complexity more easily examined in the archaeological record, such as settlement patterns, exchange relationships, and mortuary behavior were instead relied upon to resolve the debate (Duff 2002; Feinman et al. 2000; McGuire and Sattia 1996; Mills 2000). The success Southwestern archaeologists have had in examining agricultural intensification through avenues other than population is described in further detail in Chapter V.

At the same time, Southwestern researchers have found it difficult to enumerate populations from settlement data. This is because enumerating human populations from archaeological evidence is inherently difficult. While population itself is a straightforward variable, the relationship between population and archaeological variables representative of population size is not. At the scale of the region, counting settlements, measuring settlement sizes and counting rooms within settlements have been the most common methods for estimating past population sizes in the northern Southwest (Blake et al. 1986; Dohm 1990; Euler 1988; Plog

1974:87-98, 1975; Plog 1986; Powell 1983; Schlanger 1986, 1988; Swedlund and Sessions 1976; Watson et al. 1980:213; for a general discussion of these methods, see Cook 1972; Hassan 1981; Naroll 1962; Schacht 1981; Zubrow 1976). However, several aspects of the relationship between population and settlement make population estimation problematic. First, there is no regular relationship between settlement variables, such as floor area or habitation rooms, and population size; the number of persons occupying a certain area of floor space or a habitation room will change as the size of a settlement changes (Cook and Heizer 1968; Naroll 1962; for a discussion of this effect, see Dohm 1990:203-209; Ramenofsky 1987:14-19). Second, it is difficult to establish contemporaneity between settlements when the duration of the chronological units assigned to settlements is greater than the duration of the settlements themselves (Plog 1986). The assumption that settlements are contemporaneous results in the overestimation of regional populations (Nelson et al. 1994; Nichols and Powell 1987; Powell 1988; Schacht 1984). And third, it is difficult to control for variable occupations at large sites, a common problem when dealing with regional data based on surface collections rather than excavation evidence. Where excavated, it has been found that the occupations of late, large settlements in the northern and central Rio Grande region tend to be very variable, and are characterized by occupational instability, periodic abandonments, and seasonal fluctuations in population (Cordell 1994; Cordell et al. 1994;111-112, 116).

Lately Southwestern archaeologists have attempted to estimate population trends by confronting some of the complications with population estimation by abandoning absolute counts and incorporating settlement variation in period-by-period estimates of occupation. In their examination of population change in the Mesa Verde region from A.D. 900 to 1300, Nancy Mahoney and her colleagues (Mahoney et al. 2000; see also Adler 1994,1996a; Varien 1999; Wilshusen 2002) examined relative trends in population using room counts, and adjusted occupation spans by using ceramic discard rates as an occupation span measure for each period. The relative confidence of their examination of population trends in the Mesa Verde region is derived from the high quality of the archaeological data for the area, including a wide range of tree-ring dated, excavated sites from all time periods and a fine-grained ceramic chronology. Indeed, Mark Varien has characterized the region as "one of the most intensively studied in the world (Varien 1999:13)." Other regions of the Southwest face similar data challenges but lack the research depth that allows archaeologists measuring population change to calibrate variables used as proxies for population. This is particularly true for the regions occupied during the early modern Pueblo era; as was outlined in Chapter III, the archaeology of this era, and particularly fifteenth, sixteenth, and seventeenth centuries, is probably the most poorly known within the history of Pueblo peoples and their ancestors (Cordell 1989; Dean et al. 1994). Under these circumstances, examining population change through the lens of more easily measured cultural variables such as agricultural intensification is warranted.

An approach that examines changes in settlement and agricultural production predicates the use of population density, rather than population size, as the value for measuring population change. Population size is the total number of people inhabiting a given area, while population density is the number of people relative to the size of the area. Both population density and population size are useful for describing population change, but are distinct, from both an explanatory and a methodological perspective. From an explanatory perspective, absolute population size (the scale of population) is considered relevant to sociopolitical change (Johnson 1982, 1989), while relative population density (the arrangement of population) is relevant to socioeconomic change (Netting 1990). From a methodological perspective, population size can only be derived from the sum of the settlement proxies representative of population within a defined area. As a consequence, the entirety of settlement within that area must be known for a measurement of population size to be made (Kowalewski 1990). Population density, by contrast, is reflected in the configuration of settlements and landscape use, as a consequence of the nature of agricultural production relative to population density (Stone 1996a). To arrive at a measure of regional population density, then, only a representative sample of settlement and/or landscape use within a region need be examined.

The measurement of regional population density, rather than regional population size, precludes the ability to discuss absolute, quantitative population change among the Pueblo during the sixteenth and seventeenth centuries, which has been both the method and the objective of most previous studies of Pueblo population decline. The use of density as a measure only allows for a discussion of trends in the direction of population change. But neither the issues of the timing and severity of population decline, nor the issue of differential persistence, require an enumeration of total population size. A central tenant of the Dobyns hypothesis is that introduced Old World infectious diseases would have affected Native American populations regardless of their size; thus, the effects of infectious disease on the Pueblos would be the same as they would for numerically more vast populations of central Mexico (Dobyns 1966, 1983). Critical to testing the Dobyns hypothesis is identifying the timing of population decline, and determining the severity of the decline—the actual size of the population loss is less relevant. By contrast, studies of differential persistence have identified population density as a variable critical to understanding population change, with density being a central determinant of which areas received the greatest impact from the effects of introduced Old World infectious diseases (Galloway 1994, 1995; Perttula 2002a; Ramenofsky 1987, 1996; Smith 1989, 1994).

The fundamental challenges of population enumeration result from the fact that the aspects of the archaeological record selected as proxies for individuals and held constant through both time and space—rooms, roofed area, number and size of ceramic vessels, etc.—vary as a consequence of change in population size and density. Thus, the enumeration project always runs at odds with the actual relationship between population and archaeological variability. If there is any one advantage to examining variability in the aspects of the archaeological record which reflect economic and settlement change to understand the nature of population change, it is that it uses variability in the archaeological record to measure change, rather than trying to factor it out. Methodologically, this is the greatest advantage of the approach taken here.

Population, Agricultural Intensification and Settlement Pattern

In this study, Pueblo population change during the early modern era is examined from the perspective of the intensification of agricultural production. I selected agricultural intensification as an avenue to population change for two reasons. First, agricultural intensification among subsistence agriculturalists, including Pueblo farmers, is related to population change in a regular, uniform and reliable fashion. Second, agricultural intensification is manifested in the use and distribution of settlements and utilized landscapes in ways that can be measured through archaeological research.

Population and Agricultural Intensification

Measuring changes in population through agricultural intensification may seem circuitous; however, the relationship between variability in population—in particular, population density—and variability in agricultural intensification is both straightforward and consistent. Robert Nettingwrote: "[t]he relations of rural population density and agricultural intensification in preindustrial societies shows an uncomplicated logic, an intuitively obvious and satisfying geometrical relationship. If a certain number of people must derive their subsistence from a limited area of land, they can no longer utilize it by extensive means….They must, perforce, make more frequent use of land and increase its production by annual cropping and multicropping (Netting 1990:23)." Thus, increases in population density within an area will result in increases in the intensification of agricultural production. In general, population density is an expression of the number of people inhabiting an area per unit of space within that area. In this discussion, *population density* refers to the number of people inhabiting and farming an area of land; that is, land use density, as opposed to residential density. *Agricultural intensification* describes in increase in the concentration of agricultural production, or an increase in production output per unit of land and unit of time (Stone 1996a:29). The variables at play in the intensification were best summarized by H.C. Brookfield (1972:31): "intensification must be measured by inputs only of capital, labor, and skills against constant land. The primary purpose of intensification is the substitution of these inputs for land, so as to gain more production from a given area, use it more frequently, and hence make possible a greater concentration of production."

The relationship between agricultural intensification and population density was first observed by Ester Boserup, a development economist examining the labor practices of subsistence agriculturalists in developing nations. Boserup proposed that as population densities in a region would increase, land would become more scarce. As a consequence, farmers in that region would move from shifting cultivation to annual cropping while maintaining productivity by investing more labor maintaining smaller amounts of farmable land. Increased labor investment becomes necessary as fallow periods decrease. As natural nutrient regeneration is diminished, farmers must spend more time employing methods to maintain soil productivity, such as intercropping, mulching, and manuring, and adopt strategies to reduce the risk of crop failure, such as weeding and guarding against crop predators (Boserup 1965; Netting 1990; Stone 1996a:28-40). Boserup proposed five different stages of agricultural intensification employed by subsistence farmers under increasing (or decreasing) population density, and the correlate activities associated with each stage (Table 4.1). Her observation regarding the relationship of population density as an independent variable in determining the nature of agricultural production turned on its head the more conventional Malthusian wisdom that population was limited by the limits of agricultural production, and that population had the capacity to outstrip production (Netting 1993). However, both cross-cultural and longitudinal studies conducted since Boserup first proposed her model have validated the relationship between increasing population density and increases in agricultural intensification by subsistence farmers (Boserup 1981:18-23; Brown and Podolefsky 1976, Kates et al. 1993; Stone 1996a; Stone et al. 1990:9-11; Turner etal. 1977;

Table 4.1. Boserup's 5 Stages of Agricultural Intensification

Land Use Type	Intensification Method	Period Sown	Period Fallowed	Population density (per km²)
forest fallow	none (field cleared by axe and fire)	1-2 years	15-25 years	0-14
bush fallow	field clearing by hand, weeding and hoeing or ploughing	2-8 years	8-10 years	4-16
grass fallow	grazing of animals during fallow	≥2 years	1-2 years	16-64
annual cropping	manuring or fertilizer application	1 crop/year	A few months	64-256
multicropping	intercropping, irrigation, terracing	≥2 crops/year	No fallow	256+

Sources: Boserup (1965:15-16); Netting (1993:264).

for a review, see Stone 1996b). Boserup (1965; see also Netting 1990) noted that intensification would keep pace with population growth regardless of access to technology, and her hypothesis has been validated by the absence of production-shortfall induced famine in developing nations over the past sixty years, regardless of their technological development (Dreze and Sen 1989; Sen 1981).[3]

Research into the process of agricultural production over the past thirty-five years, however, has also demonstrated that while the relationship between increases in population density and agricultural intensification is straightforward (Netting 1990), the course of intensification does not always follow a unilineal trajectory (Morrison 1994, 1996; Stone 1996a:34-52). Pivotal to the idea that agricultural intensity is driven by increases in population density is that subsistence farmers are rational economic decision makers, and that they will in all instances attempt to minimize labor input (Boserup 1965; Netting 1990). Ethnographic research indicates that when subsistence farmers are faced with land scarcity, their choices for maintaining their subsistence needs extend beyond the single route of greater labor and capital investment offered by the Boserup model. Glenn Stone has observed that intensification occurs along a non-linear slope that features a point of diminishing returns at which intensification will no longer offer returns commensurate with the time and labor input, unless capital or infrastructural improvements are made (Stone 1996a:31-37; Stone and Downum 1999). This point of diminishing returns, typically dictated by local ecological and environmental conditions, is where farmers will choose alternatives to intensification, rather than move to a new regime of cultivation—for example, shifting from long (forest or bush) fallow to short (grass) fallow cropping. The decision-making alternatives possible for subsistence farmers faced with land scarcity are diagrammed in Figure 4.1. These alternatives may include migration, involvement in craft production or other non-agricultural enterprises, such as wage labor, or conflict with others encroaching on existing agricultural land. Migration appears to be the most common response to land scarcity. In her initial model, Boserup (1965) held land constant because she observed that it

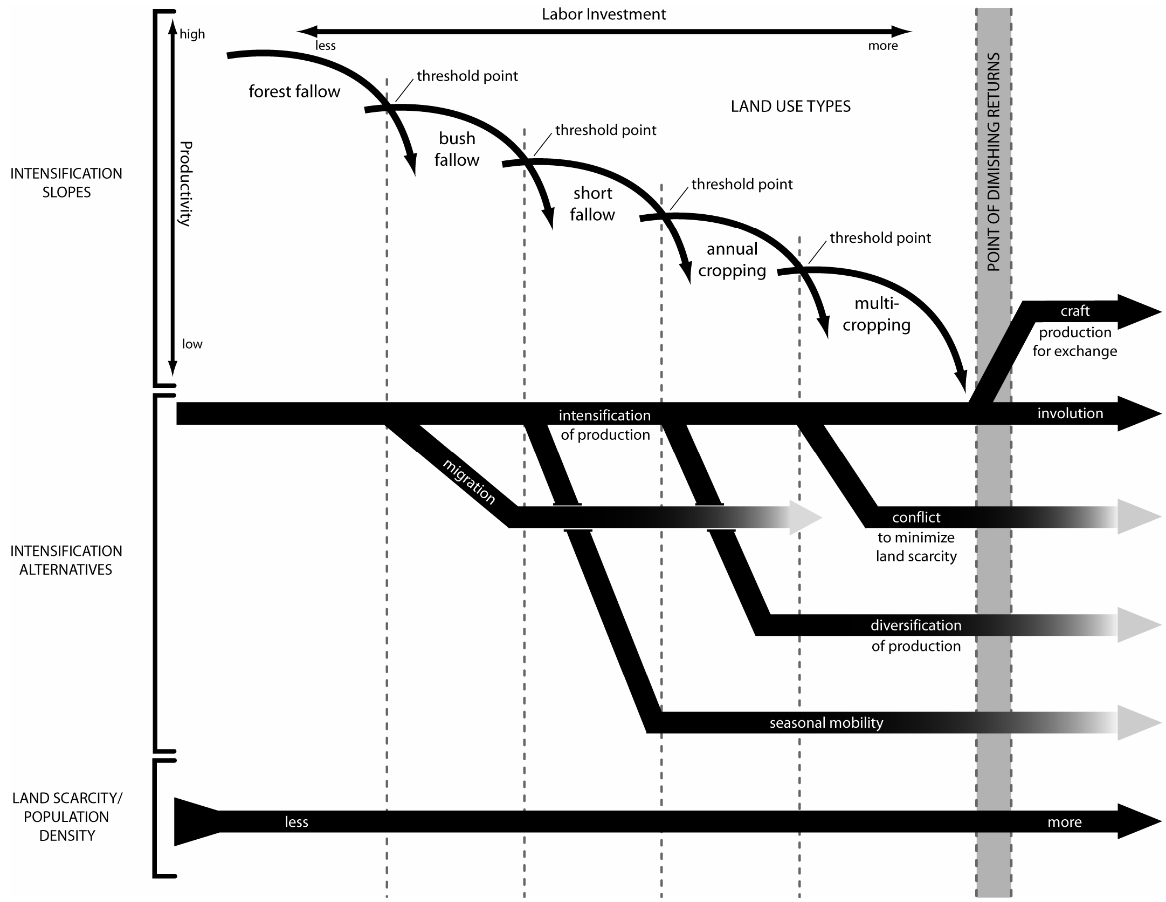


Figure 4.1. Schematic representation of land use types under increasing intensification, and potential alternatives. In the top part of the figure, curves representing each land use type depict the diminishing return from each intensification strategy as additional labor is invested. The threshold point represents point at which further labor investment will no longer result in increased productivity (Stone 1996a). When reaching a threshold point, a subsistence farmer will either switch to a more intensive method of land use, or will choose an alternative to intensification if it is available and is of less cost. The order of alternatives shown is schematic only; they are not necessarily correlated with the specific threshold points shown here. The grey bar on the right represents the absolute point of diminishing returns where greater labor alone will no longer raise productivity. Diagram of intensification curves adapted from Stone (1996a:36). Illustration by David Dabney.

is always easer to expand production at the extensive margin rather than intensify existing plots (see also Adler 1996a). Migration or other forms of movement as a strategy for avoiding the costs of intensification generally assumes a low ratio of population to farmable land, and is possible only in these situations (Stone 1996a). The decision to engage in craft specialization usually occurs when intensification is spent as a method for increasing production. On average, the returns that are accrued from engaging in household production for surplus, or engaging in non-agricultural labor, are lower than those from even intensive agricultural production on small farming plots, and farmers will never choose these alternatives when the possibility of farming is available (Netting 1990). Conflict arises mainly as a method for limiting the growth of population density through immigration or encroachment (Adler 1996a; Stone 1996a). Another strategy which may arise is diversification: only a part of production may be intensified, or new extensive cultivation is added to an intensive regime (Morrison 1996). This strategy of combining intensive and extensive techniques has been documented among late modern Pueblo farmers, such as the Hopi (Maxwell and Anschuetz 1992).

Factors other than population density can also affect the course of intensification. Sociopolitical pressures (Bender 1985; Brookfield 1972; Morrison 1994) and market incentives (Netting 1993) can drive the intensification process, although these factors may be less important to subsistence farmers not embedded into stratified societies or market economies, neither of which was the case for ancestral and early modern Pueblo farmers. The environment may be critical in determining the course of intensification, by limiting the returns possible by switching from a less to a more intensive form of production, and encouraging farmers to seek alternatives such as migration or conflict (Brookfield 1972; Stone 1996a; Stone and Downum 1999). However, when environmental variation has been considered alongside population density, environment has not been found to be a determinant of farming intensity, and environmental variability provides little explanatory value to differences in farming intensity in cross-cultural examinations, when compared to population density (Netting 1993; Pryor 1986; Turner et al. 1977).

The caveats that must be applied to understanding the relationship between population density and agricultural intensification have led some researchers to question the utility of using Boserup's ideas to explain change in the archaeological record (Leach 1999; Morrision 1994, 1996). However, the caveats simply mean that the process of population growth and change in agricultural production must be contextualized within ecological and political circumstances. It would be naïve to assume that intensification would be uniform relative to population growth (Stone 1996a, 1996b; Wilk 1996). The fundamental question to be asked is whether the archaeological record is adequately examined to describe changes in agricultural intensification and the political and ecological factors that can affect its course relative to population growth (or decline) are sufficiently understood. In the context of the northern Southwest, these issues are considered in more detail in the last portion of the chapter.

Agricultural Intensification, Settlement Patterns and Landscape Use

Because agricultural intensification can be observed and measured through archaeological investigation, it is a robust avenue for examining population change. Agricultural intensification is manifested in two aspects of the archaeological record: settlement patterns and landscape modification. The utility and measurement of settlement and landscape use relative to intensification, and in the context of the archaeological record, are discussed in detail in Chapter V. However, they are introduced in this chapter for two purposes. The first is to demonstrate that the intensification of agricultural production can be inferred from patterning in the archaeological record. The second is to provide a context for plotting the development of agricultural intensification during the late ancestral and early modern Pueblo eras, prior to the arrival of the Spanish, through settlement changes and shifts in land use.

Changes in the settlement patterns of subsistence agriculturalists are manifested by agricultural intensification as a consequence of increases in population density. The changes that occur are based on the *proximity-access principle*: the concept that the greater one's need to access any landscape feature, the greater premium one will place on residing near that feature (Stone 1996a:14). First suggested by Von Thunen to explain the location of farms relative to market towns, Stone notes that the principle is the same for subsistence agriculturalists and the location of their residences relative to their fields (Stone 1991, 1996a:14-15). As greater investment is made in a field, the more visits to the field are required. Under these conditions, travel becomes an increasing time cost. By locating one's residence closer to the field, the cost can be minimized. Under conditions of increasing intensification, there is a tendency for farmers to move from nucleated settlements of multiple households to dispersed settlements composed of single households, located adjacent to agricultural lands (Adler 1994; de Montmollin 1989; Drennan 1988, Stone 1996a:42, 1998; Sanders and Killion 1992). Nucleated settlements have the advantage of offering equal travel times to a variety of different plots, such as those accessed by farmers practicing shifting cultivation or by those using multiple plots as a risk management strategy. As use shifts to fewer plots under intensification, either throughout the year or year after year, the location advantage of nucleation diminishes and farmers disperse to household-scale settlements to minimize travel (Figure 4.2).

Intensification can also result in the appearance of non-habitation features and other material remains across the landscape. These modifications occur as farmers invest greater amounts of labor, capital, and technology into their fields. The modifications take several forms. The first are the installation of features and landscape treatments that improve the physical qualities of the fields, and serve to conserve soil, water, and heat. These features are manifested as terraces, borders, retention walls, soil dams, and surface treatments such as gravel mulches (Maxwell and Anscheutz 1992). These features are primarily forms of capital or infrastructure-based intensification, as they represent one-time or low-maintenance investments in labor that

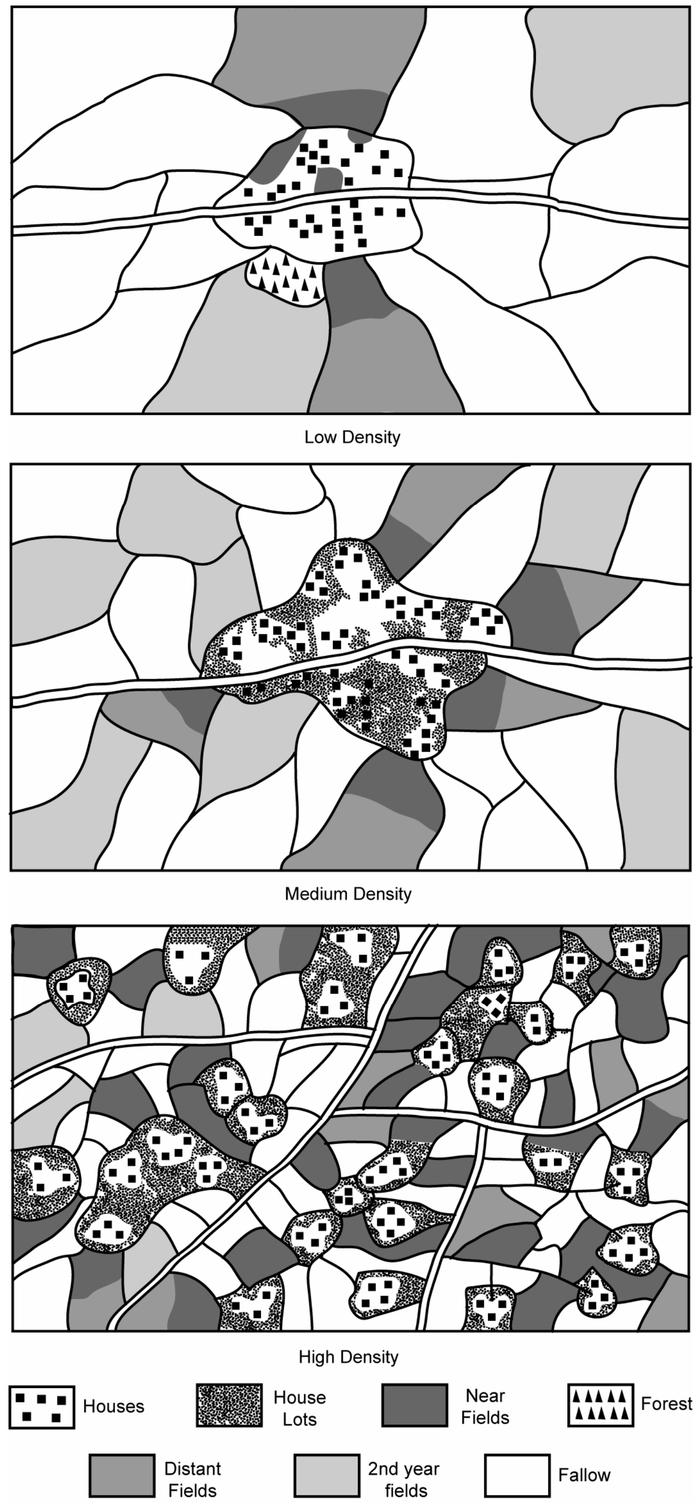


Figure 4.2. Settlement pattern changes under three regimes of increasing population density and concomitant agricultural intensification. Simplified from Netting (1993:112). Illustration by David Dabney.

result in multi-year improvements in the productivity of a farming plot (Blaklie and Brookfield 1987; Kirch 1994; Stone 1996a). The second is the modification of soil chemistry through the pedological improvement of soils, through practices such as the application of manure and other organic waste. These modifications indicate labor intensification through the production, processing, and application of fertilizers. The third is the residual evidence of improvements in plant care. These residues reflect investments in both labor and capital. Water delivery features such as channels and canals, and predator control features, such as fences and walls, represent both capital and labor intensification. Artifact residues such as stone agricultural implements, broken ceramics, and microfloral remains (pollen and phyoliths) indicate labor intensification in the form of soil treatment, pot watering, and weeding (or the propagation of weedy species).

In addition to the appearance of landscape features directly related to intensification, features that appear as a result of the effect that agricultural intensification has on rules of land tenure can also be indicators of intensification. One consequence of intensification is the formalization of ownership rules over property. The most direct way to assert ownership is to maintain a physical presence in a field, but in lieu of that presence farmers construct or designate features to indicate their ownership (Stone 1994). Some features indicating field ownership may be the same as those constructed for field improvement, such as walls or hedgerows, but others may be constructed specifically for the purposes of indicating ownership (Stone 1994:317-318). Under shifting cultivation regimes, there is no imperative to assert ownership over a field following cultivation, as no permanent investment is made in the productivity of a farming plot. Once harvest has taken place, none of the value which the farmer has brought to the plot remains. The return of the plot to fertility under fallow will be accomplished by natural process, not by any action of the farmer. Under such long fallow regimes, individual households assert ownership over a plot only when it is under cultivation. After its abandonment to fallow, the household claim on ownership of the field ceases. As a consequence, shifting cultivators tend to assert ownership of land on the level of the multi-household group, not at the level of the individual household (Adler 1996a; Boserup 1965:79; Netting 1990:46, 1993:161-166) As farming intensifies, the cultivator increases capital and labor investment in the productivity of the farming plot, and that invested value remains even after the harvest is taken. Consequently, individual households will assert ownership over single farming plots to reclaim invested fertility maintenance, even if the plot is not annually cultivated (Adler 1996a; Boserup 1965:79-81; Kohler 1992; Netting 1990:46-49, 1993:167-172).

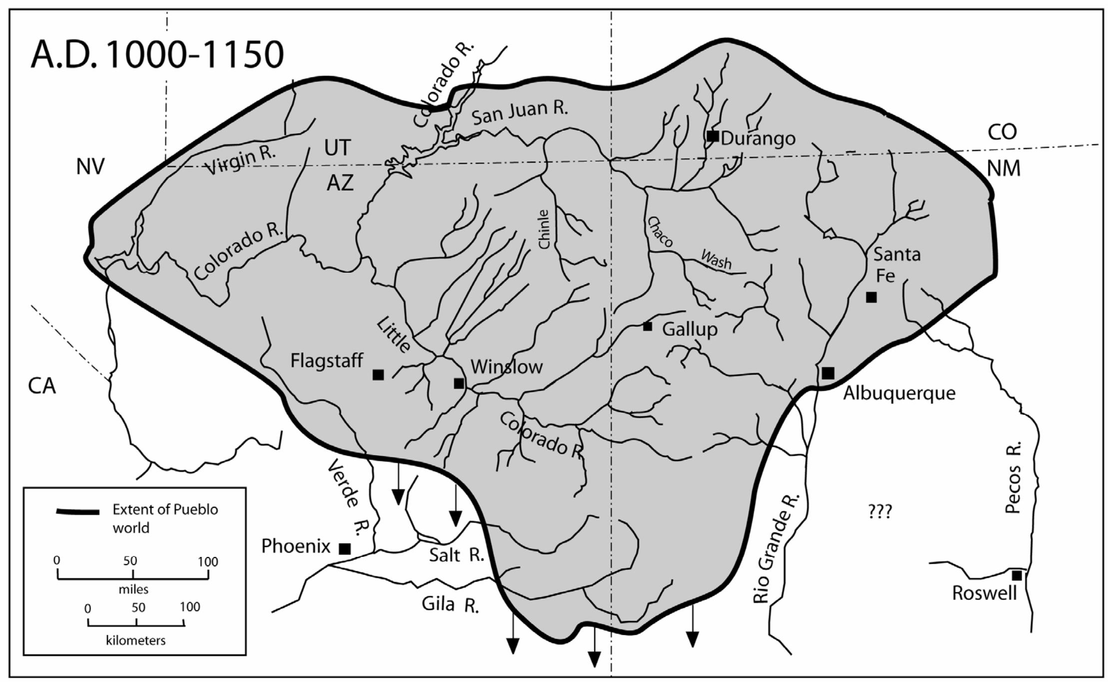
Settlement Change among Late Ancestral and Early Modern Pueblo Peoples: Aggregation and Abandonment

The manifestation of agricultural intensification in the archaeological record allows for changes in the intensification of production to be examined through the course of the late ancestral and early modern Pueblo eras. This time span encompasses the years between A..D. 1150 and 1600, from the maximal extent of ancestral Pueblo settlement in the northern Southwest, to the arrival of the first Spanish colonizers in the greater Southwestern region. Two trends dominate this period in the history of the northern Southwest; the abandonment of much of the area by ancestral Pueblo and other Southwestern populations, and the congregation of peoples into aggregated or nucleated settlements. A third trend gaining increasing attention among archaeologists is the proliferation of agriculturally related landscape features and landscape modification during this time period. Together, these three trends have implications for the size and density of early modern Pueblo populations. My goal in reviewing late ancestral and early modern Pueblo settlement and land use trends is to understand the population implications of abandonment and aggregation in the context of the settlement and land use behavior by subsistence agriculturalists under the changing conditions of population density. The objective here is not to predict intensification behavior based on inferences about population trends; rather, it is the opposite. It is to use knowledge about how intensification manifests itself in settlement and landscape use to create some broad descriptions of demographic trends between A.D. 1150 and 1600.

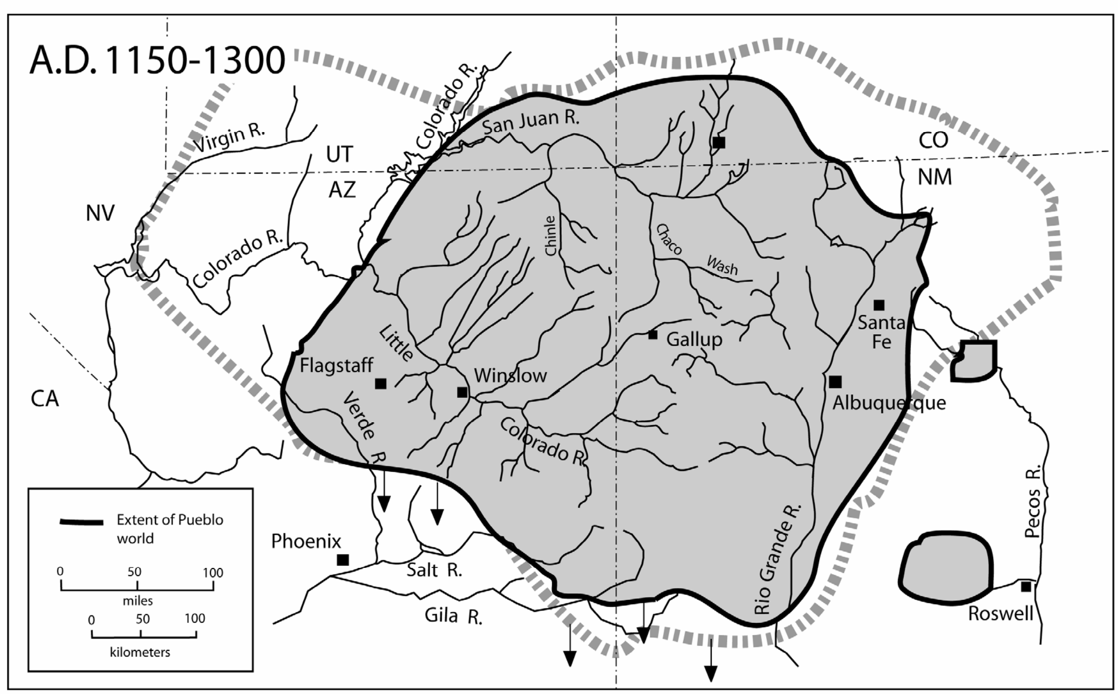
Regional Abandonment in the American Southwest Since A.D. 1150

Abandonment is a phenomenon that takes place on many spatial scales, from the settlement to the region. Traditionally, Southwestern and other archaeologists have viewed abandonment—particularly the abandonment of regions—as an event driven by specific causal factors. Recently however, abandonment behavior by subsistence agriculturalists has been reconfigured to be understood as a normal behavioral process for adjusting to changing environmental and social conditions (Cameron 1995; Cameron and Tomka 1993; Duff and Wilshusen 2000; Fish et al. 1994; Nelson 1999). Several scholars, including Mark Varien and Margaret Nelson, have departed from the abandonment concept entirely, and have reorganized the abandonment process around the concept of intermittent mobility and settlement change by subsistence farmers (Nelson and Hegmon 2001; Nelson and Schachner 2002; Varien 1999). Because my focus here is the abandonment of regions, the term is retained, but the notion of abandonment as a strategy for maintaining subsistence agricultural practice, rather than its failure, is also adopted.

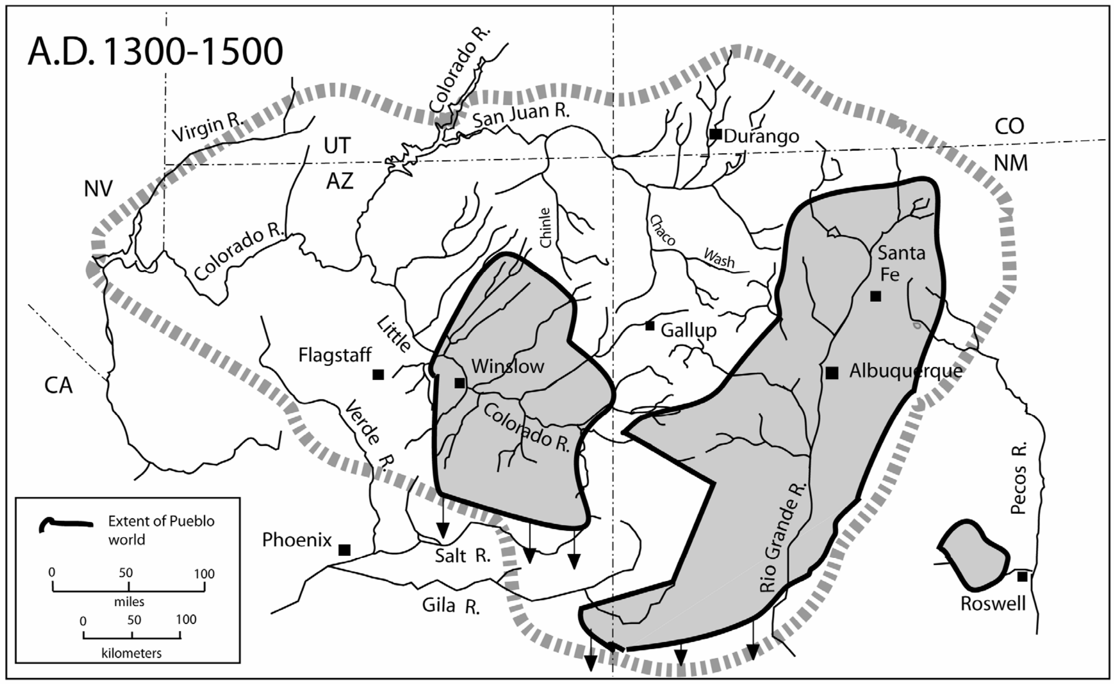
Regional abandonment in the Southwest has popularly been conceived as a singular event, exemplified by the abandonment of the San Juan Basin at A.D. 1300. In reality, abandonment occurred in the majority of the occupied regions of the northern Southwest, and these abandonments took place in an asynchronous manner (Upham 1984), with the bulk of abandonment taking place between A.D. 1300 and 1450 (Duff 1998). The maximal extent of the ancestral Pueblo occupation of the American Southwest appears to have peaked in the early part of the twelfth century (Adler et al. 1996; Dean et al. 1994). After this, a long period of regional abandonment was initiated. The spatial contraction of the northern Southwest is represented in Figure 4.3. Prior to A.D. 1300, abandonment took place on the margins of the northern


A.D. 1000-1150
Colorado R.
San Juan R.
Durango
CO
NM
NV
Virgin R.
UT
AZ
Colorado R.
Chinle
Chaco
Wash
Santa Fe
Gallup
Little
Flagstaff
Winslow
CA
Albuquerque
Colorado R.
Verde R.
Pecos R.
???
Rio Grande R.
Phoenix
Salt R.
Gila R.
Roswell
Extent of Pueblo world
0 50 100 miles
0 50 100 kilometers

a.


A.D. 1150-1300
Colorado R.
San Juan R.
Virgin R.
UT
AZ
CO
NM
NV
Colorado R.
Chinle
Chaco
Wash
Santa Fe
Gallup
Little
Flagstaff
Winslow
CA
Albuquerque
Verde R.
Colorado R.
Pecos R.
Rio Grande R.
Phoenix
Salt R.
Gila R.
Roswell
Extent of Pueblo world
0 50 100 miles
0 50 100 kilometers

b.



c.

Figure 4.3. Patterns of regional abandonment in the northern Southwest and the contraction of the Pueblo world, A.D. 1000 to 1150 (a), 1150 to 1300 (b), and 1300 to 1500 (c). Adapted from Adler, Leonard and Van Pool (1996:416-419). Provided courtesy of Michael Adler.

Southwest, but following this date, major core areas in both the northwestern and southern portions of the region were also vacated. By A.D. 1500, remaining settlement in the northern Southwest was concentrated in the east and in a few refugia in the west: along the middle and upper Rio Grande and its tributaries, along the eastern edge of the Great Plains from the upper Pecos River to Chupadera Mesa, in west-central New Mexico along the Rio San Jose (Acoma) and the Rio Puerco of the West and their tributaries (Zuñi), and on the Hopi Mesas (Adler et al. 1996).

The interest of this study lies in the demographic consequences of the abandonments for those areas which remain occupied in the latest periods prior to the Spanish exploration and occupation of the American Southwest, rather than in the cause or causes of regional abandonment per se. A range of causes has been forwarded through the years, including: climate change; environmental degradation, both anthropogenic (such as deforestation) and natural (such as arroyo cutting); disease; changes in land use and exchange relations; raiding and conflict with non-Pueblo peoples, such as Athabaskan or Numic-speaking peoples; internal dissent and conflict; and warfare between ancestral Pueblo groups (Adler et al. 1996:398; Cameron 1995:190-110). There is no consensus among Southwestern archaeologists as to which causes were most implicated in regional abandonment, and it is not my intent to further explore this issue. However, regardless of the cause or causes of abandonments, they had two possible demographic outcomes: population disappearance and decline, or migration and increasing population density in areas not abandoned.

The first alternative, population decline, appears unlikely. Several studies have supported the idea of overall population decline (Berry 1982; Dean et al. 1994; Euler 1988; Upham 1982). Subsequent investigations indicate that much of what is interpreted as numerical decline is actually a consequence of uneven knowledge regarding the occupation and distribution of settlements across the northern Southwest. In a synthesis of regional population trends encompassing most of the ancestral Pueblo and Hohokam areas of occupation, Jeffery Dean and his colleagues observed that, when measured using settlement evidence, Southwestern populations peaked at around 1000, fluctuated for about two hundred years, and then declined precipitously after 1200. They noted that most of the decline is probably not a consequence of the actual disappearance of people, but rather because the regions which were most densely occupied after 1300 were not included in their data set: "no estimates are as yet available for post-1300 population centers such as the Roosevelt Basin, the Hopi Mesas, the Acoma-Laguna area, and parts of the Rio Grande drainage. Although population may have dropped after 1300, the major decline undoubtedly occurred after 1500 as a result of the introduction of European diseases and European colonists (Dean et al. 1994:73)."

The idea that most abandonments were a consequence of emigration is more strongly supported. The identification of migration in the archaeological record has proven challenging to investigate, and the issue of migration has been avoided by most Southwestern archaeologists over the past forty years, largely for theoretical reasons (Cameron 1995). The paramount challenge to studying the migration process is identifying the relocation point for emigrants. While unnatural growth in population can be used as a general measure of in-migration, in most cases it is difficult to identify the origin point of the immigrants. The wholesale movement of communities that reform in new locations, so-called site-unit intrusions, are rare in the Southwest (Cordell 1997:405; Cameron 1995:108), although several examples have been identified (Lekson et al. 2002; Roney 1995; Woodson 1999). It appears that most abandoned communities dissolved at the household level, and the community identity reflected in settlement pattern and methods and styles of ceramic manufacturing was also abandoned as individual households moved to existing and newly forming communities in distant areas (Bernardini 1998; Cameron 1995; Cordell 1997:405-406; Duff 1998, 2002; Kohler 1993; Mills 1998). Methods for the identification of migrants at the level of the site are now being developed through the analysis of settlement layout and human remains (Clark 2001; Ezzo et al. 1997) These methodologies require extensive excavation, and in some instances, the destructive analysis of human remains.

As discussed in the previous chapter, such methods face logistical and ethical challenges that make their application problematic.

Whether the abandonments that took place after A.D. 1150 were the product of population decline or migration to ever fewer areas cannot be resolved by population enumeration methods using settlement data, due to problems with data quality and resolution (Dean et al. 1994). However, if regional abandonments were mainly a consequence of emigration, then the remaining occupied areas should have experienced rising population densities as a consequence of immigration; this general pattern is supported by the overall size and number of settlements that are known from the remaining regions (Duff 1998). The trend is also supported by landscape evidence of agricultural intensification in the span of time between A.D. 1150 and A.D. 1450. Table 4.2 lists the types of intensification-related features and other evidence found in areas of the northern Southwest occupied during this time span. Not evident in this table are differences in the numbers and scale of landscape features between those regions abandoned prior to A..D. 1300, and those occupied into the 1400s. For those areas occupied after A.D. 1300 the scale and numbers of agricultural features are much greater. For example, Adler notes in relation to the Mesa Verde area, the scale of intensification features on the landscape after A.D. 1300 in the middle and upper Rio Grande region is of a magnitude greater than in Mesa Verde prior to A.D. 1300 (Adler 1996a:354). However, the record of landscape features and modification is incompletely known. Many regions occupied during the span of time between A.D. 1150 and 1450 have been little investigated, and the presence, types and distribution of landscape features in these areas are unknown.

The organization, distribution, and nature of settlements after A.D. 1150 can also inform on the process of agricultural intensification, and by extension, whether population densities increased in occupied areas following the abandonment of others. The settlement record of the late ancestral and early modern Pueblo eras is highly visible, as populations aggregated into increasingly large settlements (Adler et al. 1996; Cordell and Gumerman 1989:12-15; Kohler

Table 4.2. Areas in the Northern Southwest With Evidence of Agricultural Intensification

Area (Subarea)	**Evidence for Intensification**	**Dates (A.D.) Earliest**	**Latest**	**Reference**
Northwest Frontier	check dams	1050	1200	Schwartz 1960
Kayenta	check dams ditches grid gardens linear border terraces	1050	1250	Lindsay 1961 Stewart and Donnelly 1943
Sinagua	check dams linear border terraces	1125	1275	Bremer 1989 Downum and Sullivan 1990
Mogollon Rim	check dams linear border terraces	1300	1400	Tuggle et al. 1984 Woodbury 1961
Northern San Juan/Mesa Verde				
Mesa Verde	check dams ditches linear border terraces reservoirs	1100	1300	Rohn 1963 Stewart 1940 Steward and Donnelly 1943
Yellowjacket/ McElmo Creek	check dams linear border terraces reservoirs	1075	1300	Schroeder 1967-1968 Winter 1978
Upper Little Colorado	check dams ditches grid gardens linear border terraces	1300	1400	Lightfoot and Plog 1984 Plog and Garrett 1972
South/East Frontier				
Salinas	ditches linear border terraces reservoirs	1300	1675	Toulouse 1945
Pecos	check dams grid gardens linear border terraces reservoirs rock piles	1200	1700	Head 2002
Galisteo Basin	check dams ditches grid gardens gravel mulches linear border terraces pits rock piles	1350	1700	Lang 1995 Lightfoot 1990 Lightfoot and Eddy 1995 Wills et al. 1990

Table 4.2. (continued)

Area (Subarea)	**Evidence for Intensification**	**Dates (A.D.)** Earliest	Latest	**Reference**
Southern Mogollon	check dams ditches linear border terraces	1000	1150	Herrington 1982 Kayser 1974 Sandor 1992 Sandor et al. 1990
Northern and Central Rio Grande				
Taos	check dams ditches grid gardens linear border terraces rock piles/circles	1275	1350	Arbolino 2001 Cordell et al. 1984 Woosley 1986
Chama	check dams ditches gravel mulches grid gardens linear border terraces pits reservoirs	1200	1500	Anscheutz 1995, 1998 Buge 1984 Cordell et al. 1984 Maxwell 1995, 2000 Maxwell and Anschuetz 1992
Gallina	linear border terraces	1000	1250	Green et al. 1958
Santa Fe/Caja del Rio	check dams grid gardens linear border terraces rock piles/crescents	1300	1425	Herhan 1995 Wills et al. 1990
Española Basin	grid gardens gravel mulches	1300	1500	Dominguez 2002
Pajarito Plateau	check dams grid gardens linear border terraces	1150	1450	Powers et al. 1999
Jemez Plateau	check dams linear border terraces	1325	1600	Fliedner 1974, 1975
Lower Jemez River	grid gardens linear border terraces	1200	1600	Wills et al. 1990

Note: Areas conform to those listed in Adler (1996b); see papers in Adler (1996c) for sub-areas.

1989). This pattern is problematic, however, since it runs counter to expectations under conditions of increasing population density—that farmers should increasingly disperse to single household-scale dwellings and settlements.

Settlement Aggregation Since A.D. 1150

The process of settlement aggregation takes place in step with abandonment after A.D. 1150 (Adler et al. 1996). However, periodic episodes of aggregation precede A.D. 1100, most notably during the Basketmaker III and Pueblo I periods (Orcutt et al. 1990, Wills and Windes 1989; Wilshusen and Blinman 1992, Wilshusen and Ortman 1999), during the Pueblo II period as part of the Chaco phenomenon (Vivian 1990), and during the Classic Mimbres period among the Mogollon (Nelson 1999:33-40). What is different about aggregation after A.D. 1150 is that, by A.D. 1300, it is a ubiquitous process, with virtually all early modern Pueblo peoples living in aggregated communities (Cordell et al. 1994:130; Cordell and Gumerman 1989:12-13; Lipe 1994). The rise of post-A.D. 1150 aggregation across the northern Southwest is detailed in Table 4.3.

The pattern of aggregation is curious from the standpoint of agricultural intensification because the nucleation of population is what is expected under conditions of low population density, suggesting at least *prima facie* that populations declined as communities aggregated. However, these conditions are contradicted by the landscape evidence discussed above. Furthermore, population decline has never been suggested as a cause of aggregation among the ancestral and early modern Pueblo; in fact, population growth, an increase in population density, or both, has figured into virtually all explanations of settlement aggregation in the American Southwest. The various driving forces behind settlement aggregation have been most recently summarized by Adler, Van Pool and Leonard (1996), Cordell (1996), and Cordell, Doyel and Kintigh (1994). They include: climate change, defense and response to conflict, either with Pueblo groups, or between Pueblo and non-Pueblo peoples, agricultural production needs,

Table 4.3. Aggregation in the Northern Southwest after A.D. 1150

Region	Aggregation Date Range	Maximal Size (in rooms)
Northwest Frontier	1150-1225	190
Kayenta	1150/1200-1300	350
Hopi/Middle Little Colorado (Duff 2002)		
Hopi	1250-present	800
Middle Little Colorado	1250-1425	1200
Sinagua (Duff 2002)		
Flagstaff/Anderson Mesa	1300-1400	850
Verde	1300-1400	
Mogollon Rim	1250-1400	800
Northern San Juan/Mesa Verde	1200-1300	600
Cibola		
Zuni	1150/1250-present	1400
Upper Little Colorado	1150/1250-1400	450
Eastern San Juan		
Eastern San Juan/Rio Puerco	1300-1500	400
Acoma-Laguna	1150/1200-present	370
Southern Mogollon		
Mimbres/Eastern Black Range	1200-1450	300
San Francisco/Middle Gila	1150-1350	300
Quemado	1150-1350	500
South/East Frontier		
Northern Jornada	1200-1400/1450	200
Salinas/Chupadera	1300-1600/1700	1450
Rio Abajo (Kulisheck 2003a)	1250/1300-1700	750
Pecos/Plains/Northeastern Front Range (Head 2002)	1200/1250-1840	1150
Galisteo Basin	1275-1805	1550
Northern and Central Rio Grande		
Taos	1275-present	1000
Chama	1250-1600	2000
Santa Fe/Española Basin	1250-1450/present	1200
Pajarito Plateau	1250-1600	400
Jemez Plateau (Kulisheck 2003a)	1300-1650	1850
Albuquerque/Lower Jemez River	1200-1700/present	1200

Sources: papers in Adler (1996c), Adams and Duff (2004) unless noted.

Note: Areas referred to follow those listed in Adler (1996b). Due to differences in room size and function between areas and through time, room size should be considered a general measure only; rooms count are not directly comparable between regions.

specifically the need to pool labor; the development of exchange relationships and elite formation and control; increases in population density; and the reduction of competition over agricultural and other resources (Adler et al. 1996:383-397; Cordell 1996:230-233; Cordell et al. 1994:109-112).

As in the case of abandonment, it is not the purpose of this study to identify the cause or causes of aggregation. However, it is important to identify the relationship, if any, between increases in population density and the formation and growth of aggregated communities. It is also necessary to explore the possibility that aggregation is driven by changes in the subsistence economy of prehistoric Southwesterners. Several researchers have suggested that aggregation is directly tied to both of these processes.

Arguments regarding increases in population density are typically proximal to other explanations, and are invoked in tandem with other explanations. As Adler, Van Pool and Leonard have noted, "population density and agricultural intensification are often associated with some increase in settlement aggregation. However, it is probably more parsimonious to consider increases in population density, at least on the regional level, as an *enabling* process for consequent aggregation (Adler et al. 1996:395, emphasis original; see also Cordell 1996:232; Van West 1996:223-224)." What should be clarified, however, is that settlement aggregation by subsistence agriculturalists should never be viewed as a logical result of rising population density; indeed, in the absence of other factors, populations should increasingly disperse into single household settlements as population densities increase, as dictated by least effort principles (de Montmollin 1989; Drennan 1988, Stone 1996a:42, 1998; Sanders and Killion 1992).

In spite of the economic and empirical relationship between intensification and dispersal, several researchers have argued that intensification created a demand for pooled labor, which in turn necessitated aggregated settlement (Leonard and Reed 1993; Longacre 1966; Woosley 1988). While it is clear that intensification can create demands for labor pooling (Netting 1981; Stone 1991,1998; Stone et al. 1990), there is no necessary relationship between pooled labor groups and aggregated settlements. As Stone noted in his study of labor pooling and settlement among the Kofyar of Nigeria, large agricultural labor groups were formed from households in a dispersed single-household settlement pattern (Stone 1998). While labor pooling may have an effect on the patterning of dispersed settlements (Stone 1991), there is no necessity for aggregation.

That the social consequences of intensification are partially responsible for aggregation makes a more compelling case than the need to pool labor. Several researchers have argued that the intensification of production in the northern Southwest led to a greater need to enforce rules of ownership over farm land as a method for reducing competition for such land. In the simplest form of this argument, aggregation is seen as necessary to prevent competition in situations of increasing population density. Rather than different groups being in conflict because of adjacent territories, the congregation of group members into an aggregate settlement allows the existence of buffer zones between groups where conflict over land as a resource can take place (Hunter-Anderson 1979). However, there is no necessary relationship between the reduction of group ranges and the creation of buffer zones, on one hand, and aggregation on the other. The reduction of the home range, rather, would logically lead to greater dispersion within the remaining range, as intensification would be necessary to maintain production within a smaller home range. Under this scenario, the purpose of the aggregate settlement is unclear; it would not have needed to have served as a defensive purpose, as conflict should have been reduced, not increased (Hunter-Anderson 1979).

The competition-reduction idea has been revived with greater sophistication by Adler as one of competition management (1994, 1996a; see also Stone and Downum 1999). Adler argued that agricultural intensification caused by increasing population densities, including those driven by emigration, would have driven changes in the rules for land tenure. As land for farming became more scarce, and production on remaining lands intensified, social groups (as opposed to individuals) would have played a greater role in asserting ownership over agricultural land.

Increasing territoriality, while providing greater certainty for farmers within a group, would have also created a greater potential for conflict, both within the group, and between groups. Regarding conflict between groups, aggregation provided a means of defense, and allowed for the enforcement of territoriality, reducing competition as the community enforced the right of an individual farmer to cultivate a plot of land. The guarantee of such a claim was no longer left to the farmer alone (Adler 1996a; Stone and Downum 1999). At the same time, aggregates functioned to mitigate intra-group conflict. The layout of aggregated communities was designed to facilitate integrative activities, such as katchina religion ritual, that served to provide social order for the community, enforce community rules, and adjudicate intra-community conflicts over resources such as land use and ownership (Adams 1991; Bernardini 1998). Under this scenario, aggregation did not enable intensification (as it does under the cooperation hypothesis), but was rather an outcome of, or even an alternative to, the intensification process. In the latter instance, the enforcement of ownership rules can be seen as a way of preventing further increases in population density through emigration, and avoiding the additional costs of intensification that would be incurred as more farmers were crowded onto existing farmable land (Stone and Downum 1999).[4]

Resolving the Aggregation-Intensification Paradox in the Northern Southwest

The above discussion indicates that the process of aggregation took place not because, but rather in spite of the process of agricultural intensification. While a central cause or suite of causes for aggregation is not identified, it is clear that aggregation is *not* caused by increases in population density or the demands of agricultural intensification. Rather, aggregation, on the other hand, creates a series of challenges for the subsistence farmer (Colton 1960), most pressing being the increase in economic costs of maintaining intensive farming practices (Kohler et al. 1986; Kohler 1989). It is unsurprising then, that both prehistoric and contemporary intensive farmers who reside in aggregated communities devise solutions to deal with these costs.

These solutions are manifested in the mobility practices of subsistence farmers who live in aggregated settlements. In his examination of cross-cultural data comparing the intensification of agricultural production and residential location, Stone found several examples where aggregated residential patterns coincided with intensive cultivation regimes. In each case, however, farmers dwelling in these aggregates maintained secondary settlements adjacent to fields, to mitigate the costs of travel times during the seasons when labor investment in fields was required. Stone wrote: "we should expect the primary producers to be pulled toward dispersion if farming is really field labor intensive. Where this pull is matched or overridden by a pull toward the town, we should expect the development of satellite settlements…(Stone 1996a:48)." The economic nature of subsistence farming allows for the maintenance of a secondary residence pattern. Like Von Thunen before him, Stone recognizes that economic priorities dictate the settlement behavior of agricultural producers. Because farming is a seasonal activity (particularly in the temperate zones that include the northern Southwest of the United States), there is no contradiction between residence in an aggregated settlement during the portions of the year when there is no need or no ability (due to weather conditions) to invest labor in fields. Whatever the motivation for part-time residence in aggregated communities, this pattern of residence does not require that subsistence farmers not apply least-cost and proximity-access principles to their farming behavior and live adjacent to their fields during the times of the year when labor investment in fields is intensive.

The Southwestern settlement record confirms that ancestral and early modern farmers were no exception to these economic principles, despite episodes of aggregation. Without reference to intensification, almost 50 years ago Emil Haury observed that

> [s]till another effect on the settlement plan arising from the concentration of people concerned the maintenance of the agricultural activities. Previously, it would appear that household groups, living as small independent communities, were close to their fields. Nucleation meant that some fields were far away. This demanded more time in transit to and from field work and greater risk of loss of

> crops to marauders. The distant farmhouse, strategically located with respect to fields, was the solution. This served jointly as a temporary home, as an observation post, and for crop storage at harvest time. On the whole, archeologists have not paid much attention to these units, but generalizing on my own experience, it would appear that the farmhouse was a function of urbanization and that few, if any will be found dating from before about [A.D.] 1000 [Haury 1956:7].

Within Haury's statement are two critical assertions: that secondary farming settlements ("the distant farmhouse") should be the least-cost solution sought by Pueblo farmers living in aggregates, and that such farming settlements should only be found under conditions of aggregated residence. The archaeological record of the northern Southwest renders aspects of both of these assertions problematic; these issues are considered in greater detail in the next chapter (Chapter V) relative to the definition of farming settlements both as agroeconomic residential entities and as archaeological phenomena. Broadly, however, both assertions are empirically supported by the settlement record. Since A.D. 1150, when ubiquitous residence in aggregated settlements was initiated, secondary settlements adjacent to fields and gardens also proliferated, and have been recorded in most areas where aggregates also appeared. Table 4.4 reports where satellite farming residences have been identified; this list compares favorably with the timing and appearance of aggregation throughout the northern Southwest shown in Table 4.3. Haury's assertions are further supported by evidence for the appearance of satellite residences in conjunction with earlier episodes of aggregation. In these cases, too, farming residences appear alongside aggregates, during Basketmaker III and Pueblo I in the Four Corners area (Adams 1978; Kohler 1992; Orcutt 1986; Orcutt et al. 1990), and during the Pueblo II (Early Pueblo)[5] period among the Mimbres Mogollon (Lekson 1992; Nelson 1993; Nelson et al. 1978). Likewise, farming residences disappear in both the Four Corners region (Kane 1986; Kohler 1992) and among the Mimbres Mogollon (Nelson 1999) with the dissolution of an aggregated settlement pattern.

Table 4.4. Field House Occurrence in the Northern Southwest after A.D. 1150

Area (Sub-Area)	**Dates (A.D.)** Earliest	**Latest**	**Reference**
Sinagua			
Flagstaff/Anderson Mesa	1075	1400	Bremer 1989 Downum and Sullivan 1990 Pilles 1978, 1996 Sullivan 1994 Sullivan and Downum 1991
Verde	1150	1400	Pilles 1996
Mogollon Rim	1300	1400	Tuggle et al. 1984 Woodbury 1961
Eastern San Juan			
Acoma-Laguna	1250	1700	Dittert 1968 Schoenwetter and Dittert 1968
Southeast Frontier			
Pecos	1200	1700	Fliedner 1981 Head 2002
Galisteo Basin	1350	1425	Haecker 1987
Northern and Central Rio Grande			
Chama	1250	1550	Skinner 1965
Santa Fe/Española Basin	1275	1500	Snead 1995
Pajarito Plateau	1150	1600	Orcutt 1993 Powers et al. 1999 Preucel 1990
Jemez Plateau	1250	1650	Crown et al. 1996 Elliott 1991 Fliedner 1974, 1975
Albuquerque/Lower Jemez River	1325	1650	Biella 1979

Note: Areas where other structures, such as unit pueblos, may have been recycled as field houses, including the Hopi/Middle Little Colorado area (Adams 2001) and the Mesa Verde sub-area of the Northern San Juan (Varien 1999) have not been included.

Resolving the paradox between aggregation and agricultural intensification means that it is possible to use settlement information to examine the process of agricultural intensification, and by extension, population change, during the early modern Pueblo era. However, it redirects the study of intensification away from large aggregated settlements to smaller, limited activity sites used as seasonal farming residences. Fortunately, the Jemez Plateau has a well-defined record of these residences. The next chapter considers the definition of these residences, commonly known as field houses, and the relationship of their morphology and use to the process of agricultural intensification.

Chapter IV Endnotes

[1] Hollingsworth defines historical demography as the "study of the ebb and flow of the numbers of mankind in time and space by a combination of geography and history using statistics, and the main concern is to achieve accurate estimates of human numbers (Hollingsworth 1969:37)." By contrast, "[d]emographic history must clearly be history….It must describe past events in a coherent way, using population as its yardstick, and population changes as the events of main interest that other factors must explain (Hollingsworth 1969:39)."

[2] Humans do of course exist materially in the archaeological record, in the form of skeletal remains. Yet because of the ways in which dead bodies are disposed (typically buried or cremated), they are not accessible in the same way living humans are to the demographer, or in the way that settlements or settlement variables are available to be counted by an archaeologist, in the sense that their totality is unenumerable on a regional level. From a demographic standpoint, skeletal remains are most valuable in that representative aggregates of remains can be used to create meaningful reconstructions of the vital structure of a population, (mortality patterns and schedules, age by sex structures, fertility patterns, etc.). See Chapter III for further discussion of this issue in relationship to skeletal remains from sites in the northern Southwest. For recent reviews of demographic methods for examining skeletal remains, see Meindl and Russell (1998) and McCaa (2002).

[3] Amartya Sen (1981) observes that famines have been a consequence of political and economic factors that blocked access to food; enough food was present, if not available, in the regions occupied by those starving. Nonetheless, some analysts argue that Green Revolution technological innovations introduced into many developing nations over the past forty years are a supporting factor in sustaining population growth (Netting 1993; Stone 1996a), rendering the implications of intensification for the prospects of food shortages in prehistory unclear.

[4] The competition management hypothesis for aggregation receives additional support from the observation that many archaeological cases of settlement dispersion under conditions of increasing population density took place in areas where peer economic groups were governed in a state-level polity, such as in Mesoamerica (de Montmollin 1989; Drennan 1988). In theses instances, state power could adjudicate disputes between economic peers. In the northern Southwest, however, economic peer groups were also political peers, and economic competition could only be adjudicated through unmoderated interaction (that is, conflict) between the peer groups.

[5] In contrast to Table 2.1, the Early Pueblo period (also referred to as the Mimbres Classic) in the Mimbres Mogollon region lasts from approximately A.D. 1000 to 1130, or late Pueblo II (Hegmon et al. 1999). The time range for the Early Pueblo period shown in Table 2.1 is for the Jornada Mogollon region.

CHAPTER V

FIELD HOUSES, AGRICULTURAL INTENSIFICATION AND POPULATION CHANGE

Unlike the connection between population and agricultural intensification, the relationship between the intensification of agricultural production and the archaeological record is not completely straightforward. This is because intensification—specifically, the intensification of labor—is not a thing, but a process that involves deployment of the fundamentally intangible qualities of time and effort. Neither time nor labor can be discovered within the archaeological record; instead, the material consequences of their expenditure must be observed and converted back into measures of time and labor input. There are several aspects of the archaeological record that can be examined for changes in the intensification of production, including human remains (for pathologies associated with labor practices, bone chemistry related to diet, and the contents of coprolites), floral and faunal remains (for the utilization of wild versus cultivated species, and diet breadth), and artifacts (for the utilization of agriculturally related technologies, and changes in food processing and storage behavior). On a regional scale, researchers generally must examine agricultural fields, or the location and organization of settlements relative to the economics of subsistence farming. Fields and settlements both present opportunities and challenges to the archaeologist; the utility of either portion of the regional record is mainly predicated on the nature of field and settlement remains in a particular region.

In this study I take a settlement-based approach to examining the intensification of agricultural production, focusing on the use of seasonal farming residences, referred to on the

Jemez Plateau and throughout much of the northern Southwest as "field houses." This is in contrast with other regional-scale studies of intensification in the northern Southwest, where an emphasis has been placed on the evolution of field systems and on landscape use. The use of field houses in the northern Southwest has long been correlated with the intensification of production (see Kohler 1992; Wilcox 1978). However, most field house studies have focused on other (albeit related) topics, such as settlement expansion and aggregation (Preucel 1990), changes in systems of land tenure (Kohler 1992; Snead 1995), the effects of environmental fluctuations on settlement location (Orcutt 1993, 1999a), and the effects of sociopolitics on settlement patterns (Upham 1988; Sullivan 1994). Only a few studies have directly examined the relationship of field houses to agricultural intensification (Downum and Sullivan 1990; Sullivan and Downum 1991). More commonly, studies have emphasized identifying the function of field houses and distinguishing them from other types of settlements (Berger and Sullivan 1990; Gregory 1975; McAlister and Plog 1978; Powers et al. 1999; Preucel 1990; Ruscavage-Barz 2002a; Schlanger and Orcutt 1986; Sebastian 1983).

In searching for material correlates of intensification, most archaeological investigators have focused on the locus where time and labor are immediately invested: the cultivation plot itself (Anscheutz 1998; Dominguez 2002; Glassow 1980; Hill 1998a, 1998b; Lang 1995; Larson et al. 1996; Lightfoot 1990; Lightfoot and Eddy 1995; Maxwell and Anscheutz 1992; Maxwell 1995, 2000; Snead 1995; Plog and Garrett 1972; Rohn 1963). There are two possible explanations for the Southwestern focus on fields, rather than settlements, to understand the process of increasing investment in agricultural production. The first explanation has already been suggested in Chapter IV, relative to aggregation. As a process, ideas regarding the forces behind aggregation conform poorly with the settlement patterns expected under conditions of intensification as increasingly dense populations aggregate, rather than disperse. Rather than looking at settlement patterns to study intensification, researchers have looked to intensification as a way to explain settlement, or more precisely, aggregation. The second possible explanation is also hinted at in Chapter IV. In many areas occupied by late ancestral and early modern Pueblo peoples, the archaeological record of field modification is prominent and easily available for study.

There are no inherent advantages to examining fields versus settlements when studying the course of intensification; both sets of evidence have methodological and conceptual issues that must be dealt with to make them sources of data relevant to aggregation. There are three reasons I have chosen to examine settlements at the expense of fields. The first two are pragmatic. On the Jemez Plateau, field locations occupy geographically and pedologically diverse locations, resulting in a variable material record of intensification. Not all potential methods of intensification employed by Pueblo farmers on the Jemez are equally amenable to regional-scale investigation. For example, some areas feature large-scale highly visible evidence of capital intensification in the form of grid gardens, linear border terraces, and check dams (Fliedner 1974, 1975). Most field locations, however, are devoid of these features. Rather than indicating that the use of these locations was not intensified, the investment of time and labor at these localities took place in such as way that it did not leave a record visible at this scale, and that other types of intensive field investigation less suitable to a regional orientation would be necessary to resolve the degree of intensification. By contrast, field houses are ubiquitous in all areas of the Plateau (Elliott 1982), and during all time periods. There are no areas where there are field features, but no field houses (see Chapter VI). Beyond these pragmatic concerns, however, there are issues regarding regional-scale evidence of fields in the northern Southwest and its relationship to the process of agricultural intensification that render the use of this record problematic, even when it is ubiquitous, as I discuss later in the chapter. The most desirable option, of course, would be to examine settlements and fields at both regional and locality-based scales. No necessity dictates the choice of one set of evidence to the exclusion of the other, and the choice made in this study was based solely on the scale of the project. I can only hope that in the future that the results of this study will be incorporated into a larger and more definitive study of intensification in the area that would incorporate other and more diverse types of evidence.

This chapter examines the utility of examining the settlement record—specifically the field house record—for understanding changes in intensification. First, I address the relationship of the material aspects of fields and settlements to the intensification process, and the specific problems with utilizing regional-scale field evidence to study intensification in the northern Southwest. I then examine how field houses are defined and identified for the purpose of studying intensification, and how these requirements are different from existing definitions of field house phenomena. I also explore the various material attributes of the field house record that can be monitored to examine the process of intensification.

Fields and Settlements in the Study of Intensification

In the northern Southwest, both field remains and the settlement record are available for examining the intensification of agricultural production on a regional scale. Ubiquitous settlement aggregation of populations during the early modern Pueblo era makes the study of primary settlements problematic. The appearance of secondary agricultural settlements in tandem with aggregation, however, means that a settlement record sensitive to changes in intensification persists. Field features, too, appear with aggregation, and also indicate a trend toward the increasing intensification of agricultural production. However, both the nature and preservation of fields in the Southwestern record lessen their utility as a gauge of intensification.

The Record of Agricultural Fields in the Northern Southwest

As discussed in the previous chapter, field features proliferate in the archaeological record of the northern Southwest after A.D. 1150. The increasing frequency with which these features appear has been taken, both generally (Adler 1996a; Cordell et al. 1984; Kintigh 1985; Maxwell 1995) and systematically (Glassow 1980; Lightfoot and Plog 1984) as a move toward greater intensification of agricultural production through time. From a general perspective, the presence of these features versus their absence, and their increasing frequency through time, should be an indicator of greater intensification, insofar as they represent investments of time and labor in fields not seen in earlier time periods. However, as an instrument for systematically measuring agricultural intensification, field features present a series of challenges. In the northern Southwest, a range of field types and the features expected to accompany those fields have been defined. These types are summarized in Table 5.1. Within this typology there is an assumed progression from lesser to greater degrees of intensification. Glassow identifies three groups of field types that he sees as representing different stages of labor investment. Dry farm, seepage, water table, slope wash and *ak-chin* fields represent the least amount of labor investment; floodplain, terrace and linear border fields represent moderate amounts of investment; and irrigated fields represent the greatest amount of investment (Glassow 1980:54; see also Lang 1995).

The construction of physical features, however, represents only one avenue for increasing agricultural yields. There are other methods ancestral and early modern Pueblo farmers could have and did employ, each of which would have left very different kinds of evidence in the archaeological record. The intensification of fields follows three main avenues:

1. the improvement of the physical qualities of the field (the setting of the field) through the construction of terraces, borders, retention walls, soil dams, and through the application of surface treatments such as gravel mulches;
2. improvement in the pedological qualities of the soil, through the addition of manure and other fertilizers;
3. improvement in the care delivered to the crops themselves through the reduction in competition from other plants through weeding; the supplementation of available moisture through irrigation and hand-watering; increasing the yield of a plot through

Table 5.1. Documented Field Types in the Northern Southwest

Field Type	Description
dry farm	receives moisture only from precipitation
seepage	obtains moisture from seeps or springs directly upslope
water table	obtains moisture from the groundwater of high water tables, near streams, lakes and rivers
slope-wash	receives moisture from sheet wash off adjacent slope; located at break of slope
ak-chin	located on alluvial fans at mouth of arroyo or canyon; receivez moisture from intermittent flooding
floodplain	located on bottoms or flood terraces of permanent or intermittent streams; receives moisture from flooding
terrace	located behind check-dams placed in small drainages; receives moisture from flooding
linear-border	located within parallel rock alignments which have been placed along contours of a slope; receives moisture from sheet wash off slope
enclosed-border	located within rectangular or subrectangular enclosures of linear borders; receives moisture from precipitation
gravel-mulched	often located within enclosed borders, and covered with gravels or cobbles; receives moisture from precipitation
irrigated	obtains moisture from springs, seeps, intermittent or permanent streams via channels or ditches

Sources: Glassow (1980); Lang (1995); Maxwell and Anscheutz (1992); Winter (1978).

Note: progression of field types from top to bottom implies greater levels of intensification (see Glassow 1980).

intercropping or by encouraging the propagation of nutritious weedy species; and by offering protection from predators such as insects, birds and herbivorous mammals. A sample of archaeological methods for examining these broad areas of intensification are summarized in Table 5.2.

Physical field improvements such as check dams, linear border terraces, and gravel mulches represent the intensification of agricultural production in several respects. They retain soil, moisture and heat. As such, they lengthen the growing season, lessen the potential for loss from frost or drought, provide greater nutrients and moisture during the growing season, and protect plants from damage by wind and flooding (Anscheutz 1998; Dominguez 2002; Doolittle 2000; Lightfoot 1990; Maxwell 2000; Maxwell and Anscheutz 1992). However, as a measure of intensification, physical field improvements correlate poorly with annual labor investment in farming activities. The construction of many types of field improvement features, particularly the more permanent constructions of stone that persist in the archaeological record, fall under what Patrick Kirch has termed *landesque capital intensification* (Kirch 1994:19; see also Whitmore and Turner 2001). Under this kind of intensification, the main labor expenditure occurs at initial construction. While the benefits from such features in reduced risk and increased yield may persist for many years following construction, there are few or no labor inputs necessary in those subsequent years. Rather, the amount of labor needed to maintain or increase yield may actually fall. Thus, the mere presence of field improvement features may significantly overstate the degree of intensification employed by farmers utilizing these features. Stone and Christian Downum (1999:118-119) term this problem *hypervisibility*. Field features, particularly those composed of stone, can persist in the archaeological record to a degree far greater than their importance to the intensification of the field in which they occur. In a related example, they note that ethnographic evidence from Nigeria indicates that simple field clearance can result in the deposition of stone alignments, which serve no further agronomic function. They interpret

Table 5.2. Archaeological Methods for Investigating Intensification of Agricultural Fields

Method	Region	Reference
Investigation/quantification of field improvement features	U.S. Southwest Mesoamerica Polynesia	Donkin 1979 Dunning and Beach 1994 Evans 1990 Glassow 1980 Kirch 1990 Kirch 1994 Ladefoged and Graves 2000 Smith and Price 1994
Soil chemistry studies	Scotland Mesopotamia Peru	Bull et al. 1999 Miller and Gleason 1994 Sandor 1992 Wilkinson 1990
Soil and sediment structure studies	Northern Europe	van de Wasteringe 1988
Artifact residues for the application of fertilizers	Mesopotamia Greece	Bintliff and Snodgrass 1988 Wilkinson 1982 Wilkinson 1989 Wilkinson 1990
Artifact residues for the frequency and duration of field-related activities	U.S. Southwest Mesoamerica	Hayes 1991 Lindauer 1984 McAnany 1992 Santley 1992 Sullivan 1984
Pollen and phytolith studies	U.S. Southwest	Anscheutz 1998 Berlin et al. 1977 Winter 1978
Investigation of water delivery systems (including ditches and canals)	U.S. Southwest Mesoamerica Peru	Dillehay et al. 1989 Doolittle 1990 Nichols 1987 Vivian 1974

alignments found in the region of north-central Arizona occupied by the Sinagua commonly interpreted as terraces (and thus as evidence of field improvement—see Berlin and others [1977]) to be more likely the simple result of field clearance, and irrelevant to the long-term improvement of the farm plots to which they are adjacent.

The high visibility of constructed field features may also divert attention away from other less visible, but more intensively farmed portions of the field record. We know from the ethnographic record that late modern Pueblo farmers utilized diverse field locations (Bradfield 1971; Ford 1931; Hack 1942). As has been pointed out in tropical contexts, the places where field features persist may be the most marginal portion of the total area farmed by a community (Farrington 1985:4-5). The most intensively farmed plots, as measured by the amount of time spent tending these fields, may be in less visible locations elsewhere. This line of reasoning has particular resonance for the early modern Pueblo settlements of the northern and central Rio Grande regions that are haloed by constellations of physical field improvements. These large settlements are almost always located adjacent to the floodplains of large rivers, such as the Rio Grande and Rio Chama, or smaller streams such as the Rio Pojoaque, Rio Tesuque, Galisteo River and the lower Jemez River (see Anscheutz 1998; Buge 1984; Cordell et al. 1984; Herhahn 1995; Lang 1995; Lightfoot 1990; Lightfoot and Eddy 1995; Maxwell 1995, 2000; Maxwell and Anscheutz 1992; Wills et al. 1990). Here, floodplain farming may have been performed, taking advantage of fertile river bottom soils, with no physical improvement of the field but with a high labor investment devoted to field clearance. Alternatively, irrigation channels capturing live water from the streams, or runoff from intermittent feeder drainages could have been employed to reduce the risk of failure. Canals would have represented both high initial capital investments (the construction of the irrigation channels) and ongoing labor investment to maintain the irrigation system (Hill 1998a, 1998b). In either case, the use of flood plains would be obliterated by subsequent flooding, and the construction of later irrigation works by Spanish, American, and late modern Pueblo farmers (Doolittle 2000:384-387). Given the poor preservation of intensification evidence on floodplains, it is difficult to assess the relative importance of field improvements visible in terrace and upland areas, as the total extent of the cultivated area and the diversity of cultivation methods is unknown.

A third and more mundane problem regarding physical field improvements is the issue of function. While features such as stone alignments are often associated with slope terracing or the retention of sediment and water in drainages, their function may have been only peripheral to agricultural production (protecting fields from flooding) or entirely unrelated to farming. Check-dams are representative of this interpretive ambiguity.[1] Reflecting on previous assumptions about the function of check dams, Anne Woosley wrote: "[f]ew archaeologists who have worked in the Southwest have the slightest doubt about what check dams do. We all 'know' that they conserve water run-off on slopes by slowing the run-off velocity; they trap silt behind them, thereby impeding erosion; and they provide areas for the planting of crops (Woosley 1980:329)." She observes that these well-worn assumptions are in many cases unsupported empirically. While check dams may serve a flood control purpose, they may not be part of a field or irrigation system, or may not even serve an agricultural purpose (Doolittle 1985; Woosley 1980:329-332). Check dams in central Mexico, for example, have been interpreted as flood control features, rather than for the purpose of water and soil retention for farming (Dunning and Beach 1994).

Beyond physical field features, there are other improvements to fields that more clearly represent labor investment. These include improvements to soils, and investments in plant care, such as weeding; control of crop pests and predators; hand watering; intercropping; and encouraging the propagation of weedy species. In contrast to physical field improvements, these methods of labor intensification require innovate or intensive investigations methods. Their potential utilization by ancestral and early modern Pueblo farmers is also imperfectly understood.

Improvements in the chemical and physical composition of field soils have gone largely unexamined, probably because of the belief that Southwestern farmers had little ability to make significant improvements in these qualities of fields. With a lack of large domesticates in the northern Southwest prior to the arrival of Europeans, animal manure was not available to enhance field soils. Other organic household waste including kitchen leftovers and human waste could have been applied to gardens and fields, particularly those directly adjacent to dwellings (Doolittle 1992; Sullivan 1984). However, most studies of agricultural settlement in the Southwest have focused on existing soil productivity. Ancestral and early modern Pueblo farmers apparently selected productive soils from the outset (see Matson et al. 1988:247-248; Larson 1996:70-71; Orcutt 1999a:305-306; Tuggle et al. 1984; Van West 1994:18-19 for examples), and maintained soil fertility through sediment replacement or fallowing, abandoning fields when significant declines in fertility took place (Sandor 1995; Sandor et al. 1990).

Improvements in the survival and productivity of crops have received somewhat greater attention when such labor investments have left durable and visible remains in the archaeological record. Large-scale water delivery systems in the form of canals and reservoirs are often easily observed in the archaeological record and their appearance in other portions of the Americas has been central to identifying the process of agricultural intensification (Doolittle 1990; Nichols 1987; Whitmore and Turner 2001; Denevan 2001). In the Southwest, however, the situation is more problematic. Canal irrigation has been the rule for the past 300 years for virtually all the farmers of late modern Pueblo communities, with the exception of the Hopi, leading to the assumption by cultural anthropologists that the use of canals was widespread among early modern Pueblo farmers as well (Dozier 1960, 1970; Eggan 1950, 1979; Ford 1977; Wittfogel and Goldfrank 1943). However, there is little actual evidence for extensive canal systems prior to the Spanish in the northern and central Rio Grande region. As discussed above, the combination of flooding and widespread modification of river bottoms since European settlement has meant that most potential canal systems along major drainages would have been obliterated. A few short ditches have been found along minor drainages, such as the Rio Grande de Ranchos near Taos, and San Marcos Arroyo south of Santa Fe; these have been identified as part of a larger mix of field improvement features (Lang 1995; Moore 1995). More widespread relict irrigation systems have been identified in the Tewa Basin and in the Taos area (Ellis and Dodge 1989a; Greiser and Grieser 1995; Greiser and Moore 1995), but a variety of methodological problems have made these features difficult to positively identify as prehistoric, rather than historic (Anscheutz 1998:160-170; Tyler 1986). The use of canal irrigation by early modern Pueblo farmers west of the Rio Grande region seems more likely. While no irrigation canals have been found along the Little Colorado River in Arizona (Adams 1998) and have been only recently and tentatively identified along the Zuni River and its tributaries in New Mexico (Damp et al. 2002), the practice of widespread canal irrigation is suggested by the location of both primary aggregated settlements and secondary agricultural settlements adjacent to floodplains (Adams 1989; Kintigh 1984, 1985; Lange 1989, 1996). In the middle Little Colorado region, a lack of field improvement features such as check dams and linear border terraces after A.D. 1275 strongly suggests a switch to farming the floodplains of the Rio Puerco and Little Colorado River, including the use of irrigation canals (Jones 1996; Lange 1989, 1996). Regardless of whether irrigation was employed, however, there is little actual evidence in either the eastern or western Pueblo regions for irrigation canals remaining in the archaeological record.

Despite being more modest than canal irrigation in its ability to deliver water to plants, the practice of hand watering may be easier to study. It has been widely identified in the ethnographic literature regarding late modern Pueblo farming practices, particularly as part of the use of very intensively maintained plots, such as gardens (Bohrer 1960; Ladd 1979). A few investigators have noted that ceramic residues in possible field locations may be consequence of pot watering (Berlin et al. 1990; Lang 1995). However, there has been no systematic investigation of the relationship between watering and ceramics in fields. Artifact residues have also been used as a more general measure of field activities (Lindauer 1984; Sullivan 1984).

Weeding, the propagation of weedy species and intercropping can potentially be studied through the examination of pollen and macrobotanical remains from relict fields (Fish 1994). In the American Southwest, there has been a few instances when field improvement features have been sampled for pollen (Anscheutz 1998; Berlin et al. 1977; Fish 1983; Winter 1978). One of the largest challenges of sampling pollen from potential field is the poor preservation of pollen in exposed contexts, and most studies of unimproved potential field locations has been conducted to simply identify the presence of domesticates (Bohrer 1982; Clary 1983, 1987; Dean 1995). The development of new analytical techniques (Dean 1995) may aid in identifying plant diversity through pollen and other types of remains (such as phytoliths).

Overall, investigation focused on agricultural field features can be a productive avenue for examining the improvement of field productivity, particularly when several avenues of investigation are employed. In the Chama Valley, use of pollen evidence, and the distribution of agricultural implements such as hoes, in addition to recording and excavation of field improvement features is one example (Anscheutz 1998; Maxwell 2000). The investigation of check dam features through soil chemistry and sediment structure in the Mimbres Mogollon area is a second (Sandor et al. 1990; Sandor 1995). However, the relationship between physical improvements and intensification is not straightforward, considering the other ways that labor can be deployed in fields to enhance productivity. Physical field features have been the focus of investigation because they constitute the most visible and accessible portion of the field record. When other, less visible strategies such as reduction in fallow times, weeding, hand watering, intercropping and predator protection are employed, field studies become more challenging and less productive. In particular, the use of specialized analyses such as pollen analysis and the analysis of soil chemistry are not amenable to landscape scale studies, and are best used as a supporting adjunct to more coarse-grained methods. The investigation of artifact distributions as residues of waste application and in-field activities is more promising, but its potential in the Southwest remains mostly unexplored. Most artifact distribution studies in the region have focused on the use of landscapes for foraging and collecting (Camilli and Ebert 1992; Ebert 1992; Schlanger 1992), site formation and structure (Sullivan 1987; Sullivan and Tolonen 1998) or inter-site variability (Bayman and Sanchez 1998; Sullivan 1995).

Settlements and Agricultural Intensification in the Southwest

As outlined in Chapter IV, there is a straightforward relationship between settlement patterns and agricultural intensification. In the northern Southwest, the ubiquitous aggregation of residence alongside intensification obfuscates this relationship. The coincidence of aggregation and intensification requires a reorientation in settlement study towards secondary agricultural settlements. These settlements resolved the apparent conflict that arose for Pueblo farmers in the early modern era, between the imperative towards aggregated residence and the need to spend more time in fields (Haury 1956; Herr and Clark 2002; Preucel 1990).

Like fields, there are several attributes of settlements that can be monitored for shifts in intensification practices. But like field studies, not all are amenable to examining aggregation on a regional scale, or fit the particulars of the Southwestern archaeological record. This study examines several measures of settlement use. These measures monitor the duration of periodic use; that is, the extent to which a secondary agricultural settlement is occupied throughout the year. It examines the structure of individual settlements (their architecture and artifacts) and measures changes in site structure through time. This is in contrast to studies of settlement location, that examine the relationship between settlements across space; that is, their distribution across the landscape.

The use of the spatial relationship between settlements to monitor changes in agricultural intensification relies on two assumptions. The first is that agricultural resources are distributed uniformly across the landscape. This assumption underpins Boserup's (1965) original observations regarding the relationship between population and density and intensification. If the distribution of agricultural resources, such as water and arable land, are patchy, as they are in the northern Southwest, rural settlement will be both differential and diverse across space (Doolittle 1980; Morrison 1996; Stone 1996a:52-53). It is possible to control for the patchy distribution of arable land if one knows the overall distribution of both settlements and resources on a regional scale (see, for example, Glassow 1980; Kintigh 1984). However, this approach encounters the same problems as regional population estimation that were discussed in the last chapter: it requires grasp of total regional settlement distributions, and is not amenable to incomplete data (see Kowalewski 1990).

A second assumption is that agricultural residences are primary residences. Settlement relationships, and whether households congregate in an agglomerated or a dispersed pattern, relies on the concept that residential location represents a compromise between the imperative to travel and the cost of labor. Establishing one or more secondary residences committed specifically to farming represents an alternative with very different implications for settlement patterns. For aggregated primary settlements, the implication is clear: proximity to arable land need not be a central determining factor of settlement location, and other considerations, such as defensibility, can guide settlement location choice. (Like aggregation itself, understanding the forces driving aggregated primary settlement location choice are beyond the scope of this study. For discussions of aggregation settlement location, see Haas and Creamer [1993, 1996], Hunter-Anderson [1979, 1986] Varien [1999, 2002], Varien, Van West and Patterson [2000], and Wilcox [1996]). For secondary agricultural settlements, the picture is more confused. At the most basic level, these settlements should reflect the locations of fields. In several studies, it has been shown that as regional population increased, and the agglomeration of residence into aggregated settlements moved forward, the number of secondary agricultural settlements increased, as did their distance from primary settlements (Adams 1978; Kohler 1992; Orcutt 1993; Preucel 1990). However, these patterns are probably more a consequence of the process of colonization (peoples expanding into previously unoccupied farmlands), rather than one of intensification. Under conditions of intensification, where all usable farmland is allocated and farmers utilizing a variety of field locations, increasing population densities force farmers to use fewer plots and shift their risk management strategies from diversification to investment. Under these conditions, the total number secondary agricultural settlements in a region will probably decline, rather than increase, despite increases in population density (Orcutt 1999a; Sullivan and Downum 1991). When combined with the potential effects of uneven resource distribution and climatic variation limiting the distribution of fields (Orcutt 1993, 1999a), and the relationship of land tenure rules and ownership histories on the distribution of fields (Sallade and Braun 1982), there are a variety of competing forces influencing the location of secondary agricultural settlements relative to primary settlements, fields, and to one another. Unlike for primary settlements, there has been no general model developed to explain the principles that dictate secondary agricultural residence location.[2]

Rather than develop a model for explaining the location patterns of secondary agricultural settlements, I use existing models for examining the use, as measured in duration of occupation, of such settlements to study the relationship between settlement structure and the intensification of agricultural production on the Jemez Plateau. The choice of looking at settlement use, rather than settlement location, was based not only on the lack of a general model; I am optimistic that such a model could be constructed, and several studies, particularly those of Pajarito Plateau settlement patterns, where the settlement record has been very well recorded, have made major contributions toward such a model (Orcutt 1991, 1993, 1999a; Preucel 1987, 1990; van Zant 1999). The decision to examine settlement use is also based on the incomplete settlement record of the Jemez Plateau. The next chapter contains greater explication of the Jemez settlement record, but for now it is sufficient to say that survey coverage is biased and incomplete, and the surveys that have been conducted are very uneven in their quality. In particular, chronological information is quite poor, especially when compared to areas such as the Pajarito Plateau (Crown et al. 1996). An approach that uses a sample of sites, rather than regional data, avoids the problem of reconciling datasets of unequal quality. It also reduces the scale of examination to where sites can actually be reanalyzed relative to the research problem, rather than relying on existing data collected for other purposes.

Before explicating the methods used for examining secondary agricultural settlement use, it is necessary to understand the behavioral basis for, and the material record of such settlements in the northern Southwest. The next section addresses the exact behavioral and material nature of secondary agricultural settlements in the region relevant to examining the variable of settlement duration.

Periodic Circulation, Field Houses and Intensification

The term "secondary farming settlement" has explicit connotations for the behavior of seasonal farmers relative to the forces of primary settlement aggregation and the intensification of agricultural production. It contains four conceptual elements. The first is the element of time; occupations at these sites are restricted to only a part of the year. The second is the relationship to task specificity; they are established for and devoted to providing residence during farming activities. The third element is the concept of residence, that these are domestic settings that are related to, but not specifically for, specific tasks, and are distinguished from the localities devoted to the tasks themselves. The fourth element is that of mobility; these settlements are not autonomous but are part of a larger settlement system in which farmers make periodic moves from settlement to settlement.

These four conceptual elements can be operationalized into two broader ideas for understanding the relationships between seasonal farming settlements and the intensification process. The first is the idea of periodic circulation, the process by which farmers move to and from aggregated primary settlements and secondary agricultural settlements. The second is the concept of the field house, and the definition of periodically occupied settlements in the settlement system of the northern Southwest.

Periodic Circulation

Periodic circulation is the movement of peoples between a place of primary residence to a secondary residence. It is distinguished from other types of circulation based upon duration. Preucel has defined four categories of circulation based on the duration of absence from the primary residence: short-term, periodic, seasonal, and long-term (Preucel 1990:17-20). Short-term circulation is that which takes place on a daily basis (the trip to and from the destination to the primary residence takes place within the span of a day), while long-term circulation is the temporary transfer of residence on the span of greater than a year. Periodic and seasonal circulation, in terms of duration, fall between these two poles of a day and a year. Preucel distinguishes between periodic and seasonal circulation based on the duration of absence from the primary residence within the span of a year. There are significant differences in kind between daily and long-term circulation, on one hand, and periodic and seasonal circulation, on the other, relating to the types of activities (economic, social, ritual, etc.) and the nature of the residential facilities associated with these activities (Preucel 1990). However, the differences between periodic and seasonal circulation are scalar, and to distinguish between the two partitions variability in the duration of secondary residence in such a way that it unnecessarily inhibits the study of that variability. Because the term "seasonal" implies a set period within the span of a year, I have retained the term "periodic" here because it is inclusive of any residence away from a primary settlement for a duration between 2 and 364 days.

Periodic circulation has been defined as one among several modes of mobility among subsistence agriculturalists in the northern Southwest. Unlike for hunters and gatherers (see Binford 1980; Kelly 1992), there has been no comprehensive framework constructed for understanding the mobility practices of subsistence agriculturalists. Instead, ideas regarding the mobility of farmers and farming societies have gravitated around several different scales of movement, motivated by the desire to understand a variety of different aspects of social and economic behavior in the northern Southwest. Three major scales of mobility can be identified:

periodic circulation, short-term sedentism, and migration (Herr and Clark 2002; Kulisheck 2003a).[3] These three scales of mobility are distinguished from one another on the scales of time, space, residence, and kind (that is, the motivations behind why people choose to make the move). Periodic circulation describes the movement that takes place between aggregated primary residences and secondary agricultural residences. It has also been used for the mobility observed during the earliest (Basketmaker/Pithouse) periods of ancestral Pueblo occupations, where peoples reliant on a mix of wild and cultivated resources circulated between an inter-annually occupied winter residence and a series of periodically utilized hunting, gathering and farming locations (Diehl and Gilman 1996; Lightfoot and Jewett 1986; Powell 1983; Rocek 1998).

Short-term sedentism constitutes the movement of households or multi-household communities from one residence to another at a scale greater than a single year (Nelson and Anyon 1996; Nelson and LeBlanc 1986; Varien 1999). This scale of mobility is believed to have characterized settlement change throughout most of the Southwest prior to the onset of community aggregation at A.D. 1150. It represents the abandonment and founding of small settlements, typically on the scale of a generation or two, as a normal response to the depletion of natural resources, climatic variation, shifts in social boundaries, and evolving rules of land tenure (Nelson and Anyon 1996; Kohler and Matthews 1988; Varien 1999, 2002). This mobility pattern was sustained at aggregated sites after A.D. 1150, despite the relatively greater persistence of some of these large sites. At these sites, it appears that the mobility of households and higher-order groups shifted between aggregated communities. As discussed in Chapter III, this resulted in wide swings in the size of aggregated settlement occupations, but not always site abandonment. While the moves associated with short-term sedentism are typically considered to be intra-regional, inter-regional movement may have also occurred, as is postulated for the Post-Classic (late Pueblo) Mimbres region,[4] where entire communities may have shifted from one set of valleys to another as resources were depleted (Nelson and Anyon 1996).

Migration is typically characterized as the movement from one region to another, occurring across distances of a magnitude greater than short-term sedentism (Clark 2001). Distinct from short-term sedentism, however, migration is typically associated with the terminal abandonment of regions, and appears related to changes such as large-scale climatic impacts (Cordell 1996; Dean 1994; Salzer 2000; Van West and Dean 2000) or the catastrophic failure of social systems to maintain community coherence (Adams 1991; Bradley 1996; Herr and Clark 2002). It is also associated with the transformation of community identity, as reflected in settlement pattern and ceramic tradition, a consequence of individual households moving to existing and newly forming communities in distant areas (Bernardini 1998; Cameron 1995; Duff 1998, 2002; Kohler 1993; Mills 1998; but see Clark 2001, Lekson et al. 2002).

Mobility models developed for hunters and gatherers have been criticized as unsuitable for describing the mobility behavior of subsistence farmers. In particular, the model forwarded by Binford, Kelly and others that distinguishes between logistical and residential forms of mobility has been critiqued for defining mobility as being driven by economic concerns, while ignoring social relations that can dictate and condition mobility practices (Preucel 1990; Varien 1999). Where periodic circulation is defined centrally as an economic pursuit (Herr and Clark 2002; but see Preucel 1990), however, the mobility model developed for hunters and gatherers appears to be quite useful. Although it is clear that periodic circulation as manifested in the use of secondary agricultural settlements arose as a consequence of social concerns (aggregation), it emerged as an economic solution to the challenges imposed on farmers by socially driven changes in residence. Periodic circulation is of course affected by social conditions. For example, field location can often be determined by rules of tenure and a consequence of ownership histories, influencing the location of the secondary agricultural settlement relative to the primary settlement (Moore 1980; Sallade and Braun 1982). However, periodic circulation to agricultural settlements is fundamentally an economically related activity.

For hunters and gatherers, two categories of mobility have been established: residential and logistical (Binford 1980; Kelly 1983). Residential mobility is the movement of the primary settlement by all members of a productive group. The objective of such residential moves is to occupy an area of resource availability (a resource "patch"), with the next residential move determined by the depletion of resources in the existing patch. Logistical mobility is the movement from a primary residence to a specialized resource procurement, monitoring or storage locality by a subset of members of a productive group. Logistical mobility is a response to the spatially incongruous distribution of resources. When resources are spatially disparate, a residential move will not resolve issues of resource availability, as the residential move towards one resource will result in movement away from another (Binford 1980:15). As a consequence, strategies employing residential moves are more likely to be utilized by those occupying regions where subsistence resources are continuously distributed, while strategies employing logistical moves are more likely to be employed by those in regions with patchy or seasonally available resources. To the extent that all regions of the earth have both patchy and continuous resources, residential and logistical mobility strategies should not be considered opposing types or even opposite poles, but rather independent strategies deployed to cope with the differential distribution of subsistence resources relative to places of primary residence (Binford 1980, 1983; Kelly 1992).

Periodic circulation to secondary agricultural residences, as defined by Preucel (1990) and used here, is a form of logistical mobility (Stone 1996a:51). Care must be taken not to conflate periodic changes in residence with residential mobility (Eder 1984), despite the fact that periodic circulation stipulates a change in residence, from primary to secondary. By doing so, one misses the fundamental difference in kind between logistical and residential moves. Residential mobility is the movement of the primary residence, and it is under this understanding that the residential mobility concept has been adapted to describe residential moves under the conditions of short-term sedentism (Nelson and Anyon 1996; Varien 1999). Logistical mobility assumes the stability of the primary residence but allows for secondary residence when it is necessary for resource procurement activities that occur over durations greater than a day. In Binford's parlance of hunter-gatherer sites, these secondary residences are known as "field camps." (Binford 1980:10). In simplified terms, the interplay of logistical and residential mobility, as conceived by Binford and operationalized by Preucel and Varien, was as follows. Within the small agglomerated settlements of the ancestral Pueblo era, farmers made logistical moves to and from fields on the scale of daily circulation. With declines in soil productivity, the depletion of nearby wild resources, or climatic shifts, the small settlement was abandoned and a residential move to a new location was made. Within the large aggregated settlements of the early modern Pueblo era, farmers made logistical moves to and from nearby and distant fields on the scale of both daily and periodic circulation. Where moves were made on a periodic basis, secondary settlements were utilized for domestic purposes. Residential moves were made by households and larger order groups from one aggregated primary settlement to another, with the decision to move predicated by a variety of social, economic and environmental factors.

The utility of conceiving periodic circulation between primary settlements and secondary agricultural residences as a logistical form of mobility is that it emphasizes the task specificity of the move; that the move is undertaken for the purpose of carrying out agricultural activities. It is also useful because it distinguishes that the move is undertaken by a subset of settlement occupants rather than by the entire settlement. By identifying the importance of task-specific groups, the use of the logistical mobility concept can exploit the variability in the composition of agricultural labor relative to the process of intensification (Netting 1993:85-100). There are significant differences in the organization of labor between hunters and gatherers and farmers, related to the scale at which resources are shared in both production and consumption (Hegmon 1989, 1991; Winterhalder 1990). Because of widespread sharing within hunting and gathering groups, task groups tend to be composed of the members of multiple households that pool both the procurement of resources and their consumption (Winterhalder 1996, 2001). Sharing of resources also occurs within agricultural societies, but with the increasing intensification of agricultural production, the size of the group that cooperates in the production and consumption of subsistence resources tends toward the individual household (Adler 1996a; Hegmon 1991). Because aggregation, as the driving factor for the widespread appearance of periodic circulation in the northern Southwest, occurred in tandem with the intensification of agricultural production, we should expect that the task groups that utilized secondary agricultural settlements and the scale of these settlements should be commensurate with the scale of the household as a human group.

From a historic perspective, Preucel has identified seasonal agricultural settlements at several scales. Using data from the ethnographic present of late modern Pueblo communities, he defined two types of settlements: field houses and farming villages (Preucel 1990:42-46). For Preucel, field houses are isolated dwellings associated with individual fields, utilized by a single household. Historically, he found field houses to be more common among the pueblos of the middle and upper Rio Grande region. Farming villages are clusters of individual field houses grouped together for purposes of security or economic cooperation in the maintenance of irrigation facilities. Historically, they were more commonly associated with the western Pueblos of Laguna, Acoma and Zuñi. Based on historical examples, farming villages were situated to tend fields that were very distant from primary settlement locations (greater than 8 kilometers distant), while field houses attended fields closer to the primary settlement (between 1.6 and 8 kilometers) (Preucel 1990:48-49). Preucel believes that both field houses and farming villages were present during the early modern Pueblo era, and identifies sites on the Pajarito Plateau that he believes functioned as farming villages, in addition to field houses. Based upon the historic evolution of farming villages in the vicinity of Zuñi, however, farming villages appear to be exclusively a late modern Pueblo phenomenon. At Zuñi they arose during the seventeenth century as a consequence of the introduction of *acequia*-style irrigation agriculture and increasing conflict with adjacent nomadic groups (Navajos and Apaches), both factors that are related to the imposition of Spanish rule over the area (Dublin 1998:94-97; see also the discussion of changing relationships between the Pueblos and nomadic groups as an agent of population change in Chapter III). Field houses, however, are believed to be widespread across the northern Southwest during the early modern era (Haury 1956; Moore 1980; Wilcox 1978). Relative to scale, field houses as facilities used by single households are commensurate with the household scale of workgroups expected during the early modern Pueblo era within a logistically organized system of periodic circulation.

Field Houses: Definitions

In examining the relationship between agricultural intensification and the use of secondary farming settlements, I follow the convention of Southwestern archaeology in terming these settlements "field houses." For this study, a field house is defined as a locality near or adjacent to a garden, a field, or multiple fields, that serves as a residence during the performance of garden- or field-related activities. The parameters of this definition are stipulated by the research needs of this study to measure variation in field house use, by the relationship of field house use to the process of intensification, and by current knowledge of the practice of seasonal residential circulation by subsistence farmers. Centrally, this definition is *conceptual*; it is derived from observations regarding the residential behavior of subsistence farmers, rather than physical aspects of the archaeological record. Accordingly, the definition does not stipulate the empirical manifestation of field houses as archaeological phenomena, other than that a field house is a bounded spatial phenomenon and is archaeologically observable.

This definition is derived from, but is distinct relative to prior definitions of field houses. The differences stem from the objectives of this research relative to prior studies. As was related in the introduction to this chapter, virtually all prior considerations of field houses in Southwestern archaeological research have concerned their identification, and the distinction of field houses from other types of localities, primarily general residences that are localities of year-

‘round or non-task specific residence (hamlets or villages). This has led to a variety of definitions as to what constitutes a field house, primarily based upon empirical criteria, although often with reference to settlement concepts such as periodic circulation, aggregation, and the intensification of agricultural production.

The central challenge to defining field houses is that the term lies at the intersection of functional concepts and empirical phenomena that are not completely isomorphic (Wilcox 1978). From a functional (that is, a conceptual) perspective, field houses are periodic residences supporting agricultural activities. However, the ethnographic and archaeological literature suggests that this residential behavior is quite variable, and this variability is significant for site formation processes. That is to say, field houses will look very different, depending upon how they are utilized. Conventionally, field houses are assumed to be small one or two room structures of earth or stone, with a distinctive archaeological signature (Berger and Sullivan 1990; Gregory 1975; Moore 1980; Preucel 1990; Sullivan and Downum 1991). However, the farming practices of historic late modern Pueblo peoples and the archaeological record support the potential that some periodic residences may have been open air encampments, or structures constructed of perishable materials, such as brush or poles. As such, there would be no structural remains at these localities, only artifact scatters (Sebastian 1983; Sullivan 1984). Abandoned primary settlements may have been recycled as field houses, and occupied periodically for the purpose of maintaining agricultural fields. Periodic occupations such as these have been defined through excavation in the Mesa Verde region (Varien 1999:125) and in the Little Colorado area (Adams 2001). From surface evidence, however, these sites were initially identified as primary residences. At the same time, field houses that began their use-lives as periodic residences may appear as primary settlements if they were later reoccupied and converted into primary residences, as was the case in the eastern Mimbres Mogollon region (Nelson 1999; Nelson and Hegmon 2001). Given this variability, there is no “ideal” field house, but rather a range of material remains associated with temporally variable patterns of residential behavior associated with task-specific activities, and with the settlement history of the area in which field house use occurs.

While periodic residence associated with agricultural activities does not result in an ideal field house, at the same time the small structural remains often identified as field houses in the archaeological record of the northern Southwest may not have served as periodic agricultural settlements. The term "field house" implies functionality; however, among Southwestern archaeologists it is more commonly used as a descriptive signifier for the remains of small masonry and earthen structures where functions are not assumed (for example, see Anderson 1990:2.15-2.16). This shorthand usage of the term is employed with exploratory research, such as reconnaissance survey, much in the same way that the categories "pithouse," "kiva," "roomblock" and "unit pueblo" are used to describe material phenomena in terms comprehensible to the archaeologist but with a formal suspension of the actual function of the locality encountered. Ethnographic examination of small structure use indicates that small masonry or earthen structures have historically served a variety of purposes within the settlement system of late modern Pueblo peoples. These functions include: periodic residences supporting hunting, gathering, and pastoral activities; storage; shrines; observation posts or shelters; ritual retreats or menstrual huts; wayfaring stations; sweat lodges; resource processing stations; game traps or corrals; and primary residences (Ellis 1978; Moore 1980).

Given that secondary agricultural settlements, and periodic agricultural residential behavior, is not self-evident in the archaeological record, researchers have struggled with a variety of criteria to define field houses. Critical to understanding the process of defining field houses is that most researchers were not interested in isolating field houses as a conceptual or behavioral phenomenon, and identifying the material correlates of that phenomenon, as is my goal. Instead, most definitions have been designed to establish empirical criteria that distinguish field houses as an archaeological settlement category from other types of archaeological settlements and special-use associated localities. As such, most field house definitions have focused on creating boundary definitions for what can constitute a field house based on cut points in categorical or continuous variables such as structure size, method of construction or characteristics of associated artifacts, including assemblage size, assemblage class richness, and assemblage class evenness.

Early definitions of field houses relied upon normative assumptions regarding patterns of periodic agricultural circulation and for the construction of different types of behavior, assumptions that were derived from ethnographic information about late modern Pueblo farming behavior. For these definitions, field houses were small structures, and were intuitively distinguished from functionally different small structures on the basis of their location to large primary settlements (villages), to features assumed to be agricultural (such as check dams and linear border terraces), and arable land (Pilles 1969; Schoenwetter and Dittert 1968; Skinner 1965; Woodbury 1961). These definitions can be called *normative* definitions. With the recognition that small structures could serve a variety of functions, attempts were made to identify material correlates of periodic agricultural residence with specific architectural forms. These definitions began with a conceptual definition of field houses, based on ethnographic descriptions of field house use by late modern Pueblo farmers, other Southwestern Native farmers and other subsistence agriculturalists, and assigned different functions to normative architectural types (Sutton 1977, Moore 1980). These definitions could be termed as *validated normative* definitions, in contrast to the intuitive normative definitions they replaced. Together, intuitive and validated normative definitions can be described as *attribute-based* definitions.

Dissatisfaction with normative definitions for empirical phenomena led to definitions that focused on variability in the nature of small sites and small structures as a way to distinguish field houses from other types of sites. One approach was to focus on concept of task-specificity within the idea of the field house as functional class, and classify field houses as limited activity sites. As such, they could be distinguished from other sites, both primary residences and other limited-activity sites, based on artifact diversity, in addition to architectural attributes (Gregory 1975;

Plog and McAllister 1978; Preucel 1990; Ruscavage-Barz 2002a). Special-activity sites should have less diverse assemblages than primary residences, and field houses should have assemblages distinct from other types of limited activity sites. These definitions can be called *diversity-based* definitions. Many researchers have found this approach frustrating, because of the small assemblages sizes that often accompany small structures, and a lack of patterning that correlates with different architectural forms. In almost all cases, definitions of sites based on diversity have resulted in a high degree of ambiguity, with significant numbers of small sites with unclassified functions. Given these shortcomings, it is unsurprising that some researchers continued to utilize normative definitions (for example, Bremer 1989; Crown 1983; Pilles 1978), as they at least allowed for more confident sorting of small sites.

Definition of field houses recently has shifted more to emphasize the concepts of time and residence within the idea of field houses, to distinguish field houses from other types of structures on the basis of duration. In this concept, field houses are distinct from other sites based how long they are occupied, either interannually or intra-annually. Specifically, they should be distinguishable from primary residential sites because their occupation is necessarily periodic. These definitions can be termed *duration-based* definitions. The focus on time and residence versus task-specificity makes sense, considering that field houses are residences to support task-specific activities, rather than loci of task-specific activities themselves, and this aspect of residence versus special activity has implications for the diversity and size of artifact assemblages (Sebastian 1983). Monitoring duration has taken several forms, focusing on both architecture and artifacts. Architectural investment, sorted into categories similar to those associated with attribute-based definitions, such as architectural form, size and number of rooms are matched with measures of artifact assemblages. Based on differences in the records encountered by surveys, and due to differences in data collection, several assemblage attributes have been monitored to examine duration, including assemblage size (Downum and Sullivan 1990), assemblage class evenness (Powers et al. 1999), and assemblage class richness (Schlanger and

Orcutt 1986; Stone 1993). On the axis of architecture, field houses should be smaller, have fewer rooms, and represent less investment than primary settlements; for artifacts, field houses should have smaller assemblages, exhibit fewer artifact classes, and a more uneven distribution of artifact classes, as generic measures of duration. One significant shortfall of these measures (excepting class richness) is that they have difficulty distinguishing between the degree to which a site is occupied throughout the year, versus how long a site is occupied year after year (Schlanger and Orcutt 1986; Sebastian 1983).

Lynne Sebastian's efforts to deal with the issues surrounding the definition of field houses is distinct in its consideration of the lack of isomorphism between field houses as functional class of periodic residences and small structures as an empirical class of archaeological phenomenon (Sebastian 1983). In particular, she recognizes that from a functional perspective, field houses need not be structures that persist as architectural remains in the archaeological record (they can be built from portable or perishable materials), and that artifact scatters can be evidence of field houses as well. In her study, she takes both a location-based and duration-based approach to defining field house locations, without reference to either architecture or assemblage characteristics. The challenge of her study is that she distinguishes the duration of occupations on macrobotanical remains as an indicator of seasonality, from a selection of excavated sites. To extrapolate these observations on seasonality, she is forced to correlate seasonality with architectural forms, and fall back on a more attribute-based definition of different small site types.

A second distinct study that cannot be categorized with others is one that looked at small site function in the Long House Valley (Dean and Lindsay 1978). The study was devised to test the efficacy of the split between habitation and limited-activity sites that made was made by the Southwest Anthropological Research Group (SARG) database, a common reference set used for research in the late 1970s and early 1980s. The authors of the study note that this line usually was empirically drawn between artifact scatters and structural sites. Unlike Sebastian, they did not consider that artifact scatters could represent field houses, inferring rather that they represent evidence of wild resource gathering loci (a concept that Sebastian critiques). However, by taking a location-based approach to considering site function as a test of assumptions about how a site was used, they did not exclude any site type from their sample based on empirical criteria alone. Based on conceptual definitions of activities such as field house use and wild resource gathering, they generated expectations regarding where within their survey area sites with different functions would be located relative to resources such as wild foodstuffs and arable land. They found that while large structural sites (which they tentatively assumed to be primary habitations) patterned well with environmental variability, small structures versus artifact scatters did not, suggesting that there was not only diversity of function within these two categories, but that there could be functional overlap between the two (Dean and Lindsay 1978:115-116). This study, along with elements of Sebastian's (1983) and others (see Orcutt 1993, 1999a) distinguish field houses from other types of sites on the basis of location. A *location-based* definition is the type of definition used in this study.

A location-based approach is taken here because duration-based definitions distinguish field houses from other sites based on variability in the central aspect of field house use that is necessary for measuring the intensification of agricultural production: time. The main problem with diversity-based and duration based definitions of field houses is that they limit the ability to examine variability in field house usage, since variability is used to distinguish between different categories of settlement, rather than different intensities of use. As such, their utility is confined to examinations of variability between different classes of sites, rather than variability within any particular class of sites. This makes sense, given that they were designed more to distinguish between different types of sites for the purpose of describing changing settlement patterns through time. The reality that all settlement classification systems must deal with is that variables such as function, periodicity and duration of occupation, size and configuration are much more fluid than can typically be captured within the spatial and temporal resolution of a settlement study based largely low resolution data, such as that from surface remains (Stone 1993; for a discussion of this effect, see Shennan 2000). To that extent, all settlement classification systems will misclassify a certain number of sites. The challenge then, of a classification system is to direct the bias of misclassification in such as way so that it favors the inclusion of the phenomena of interest within the classification system.

The location-based alternative definition of field houses is one that makes only limited reference to the material attributes of sites. This operational definition for field houses is derived from the functional criteria used to distinguish field houses as behavioral phenomena: they are residences, they are task-specific, and those tasks are agricultural. It begins by treating all sites located adjacent to arable lands as potential field houses. Thus, initially, sites that are not located on arable land, at elevations too high to maintain sufficient growing seasons, and in elevation-based or topographic locations unable to acquire sufficient moisture for cultivation, are excluded. Second, sites that have formal attributes that exhibit no evidence of residence, such as rock art localities lacking other features or artifacts, or cavate structures physically too small to provide shelter for humans, are excluded. This is a relatively small category of sites within an early modern Pueblo settlement system, and it is based on the flawed assumption that an absence of features and artifacts is evidence of an absence of residence. While I recognize this flaw, I have no means for either identifying or evaluating residential behavior for which I have no material evidence, and so I must exclude it from consideration. And third, sites that contain an array of features that run counter to the assumption of task specificity are excluded; that is, sites that contain roomblocks, pitstructure depressions, and plazas (Dean and Lindsay 1978; Downum and Sullivan 1990; Powers et al. 1999). In other words, sites that appear to be primary residences (aggregated village sites). This category too is based on a flawed assumption, because it is known that settlements that serve as primary residences at some time during their use life may also serve as periodic agricultural residences at other times (Nelson 1999; Varien 1999). However, because of the scale of most primary settlements on the Jemez Plateau, again I have no way of distinguishing occupations that represent periodic as opposed to primary residence. Even at smaller settlements, distinguishing the periodic residential component from the use as a primary residence has required excavation (Adams 2001), and assemblages indicative of periodic residence potentially present in the generally massive primary settlements of the Jemez would be swamped by the assemblages associated with the primary residential occupation.

Making these exclusions from the totality of sites leaves a variable set of sites that have the potential to be the remains of field houses. This method of identifying potential field houses could potentially include considerable by-catch as sites that meet these criteria but are not loci of periodic agricultural residence remain within the population. However, this fraction is probably small given the nature of the settlement record of the Jemez Plateau, as described in the next chapter, Chapter VI. In Chapter VII, this definition is applied to provide an initial population from which a sample of sites for an analysis of variability was drawn. The utility of this method for defining potential field house localities in relation to the formal attributes of the archaeological record of the Jemez Plateau is evaluated at that juncture.

Field Houses: Socioeconomic Alternatives

This study relies on the perspective that field houses were the consequence of Pueblo farmers reaching an economic solution to the conflicting imperatives to aggregate residence and intensify agricultural production. While this represents a majority opinion among Southwestern archaeologists, other perspectives have been offered to explain the appearance of field houses as a functional class (periodic residences) and as an empirical phenomenon (small structures). It is necessary to assess these alternative perspectives before I can move forward with the interpretation of field houses taken in this study.

The first perspective was that taken by Bruce Moore (1978, 1980), based on a review of ethnographic literature regarding the use of field houses and small structures. Moore argued that field houses can occur in any situation where the spatial incongruity between residential locations and field locations, not just under the specific conditions of residential aggregation. These can result in cases where the distribution of arable land is patchy or where land ownership histories spatially separate farmers' residences from their farm and garden plots. The former instance occurs in cases where farmers are non-intensive or engaged in a mixed subsistence pattern of both farming and hunting-gathering (Eder 1984). The latter instance occurs under conditions of intensive farming where land tenure rules have fragmented land ownership (Sallade and Braun 1982). Moore's observation regarding the correlation between aggregation and field house use is correct. As an indicator of logistical mobility, field houses may occur in any situation where farmers are forced to shift from a pattern of daily circulation to one of periodic circulation to minimize the costs of travel, regardless of whether their primary residence is aggregated or dispersed. This is borne out by studies of ancestral Pueblo settlement patterns where field houses are found associated with relatively small primary settlements (Adams 1978; Ward 1978). Moore's perspective has the potential to confound an assumption that underpins the current study, that field house use through time should be continuous as a consequence of aggregation, with variation in field house use through time informing on changes in intensification and in population. If field houses are present during periods when primary settlements are not aggregated, the relationship between field house use and primary residential population sizes is likely different, and comparisons between field houses associated with aggregated and non-aggregated settlements would be problematic. This is not the case, however. On the Jemez Plateau, like the rest of the northern Southwest, primary residential aggregation is ubiquitous by A.D. 1350 and remains so into the 1700s (Crown et al. 1996). As such, comparison of sixteenth and seventeenth century field house use to that of earlier periods is warranted.

The second perspective was that of Timothy Kohler (1992), taken in an investigation of aggregation, population growth and agricultural intensification in the Mesa Verde region during the late Basketmaker III and Pueblo I periods (A.D. 600 to 900). In this study, Kohler sought to find archaeological evidence of changes in land tenure practices as the ancient Mesa Verde landscape filled up, and farmers increasingly found themselves in conflict over the best field locations. As a measure of changes in tenure rules, Kohler argued that field houses were constructed as material indicators of field ownership. While acknowledging the function of field houses as secondary residences in a system of periodic circulation, he also observed that some occur in a proximity so close to primary settlements that they fall within the range of daily circulation, and so do not serve a time cost minimization function. The concept that field house were markers of field ownership, and field house appearance was a consequence of land tenure changes closely followed other field house studies that saw their prevalence as an index of inter-community competition (for example, Preucel 1990). It has also become a popular interpretive perspective for understanding the distribution of field houses in studies of settlement patterns (Orcutt 1993, 1999a; Snead 1995; Sullivan 1994).

In concluding his study, Kohler noted that there is "no completely satisfactory distinction [that] can be made between the expectations of models that view field houses as the result of attempts to minimize the cost of having to maintain fields at some remove from habitations, and models that view field houses as attempts by some corporate group to restrict access to resources (Kohler 1992:632)." This view is based on a flawed notion of the relationship of land tenure to land use. By admitting an inability to distinguish between the two models, Kohler conflated land use and land tenure; however, they are not the same (Adler 1996a). Field houses, from the perspective of cost minimization, are a function of land use. Because the forces driving changes in tenure and the forces driving field house use are the same (the intersection of aggregation and intensification) we should expect them to co-occur. However, we should not confuse why field houses are constructed with the social functions they may serve in a land tenure system. Land tenure is a system of rules that allocates arable lands and other resources among people. There is no necessity that this allocation should have an unambiguous material signifier, let alone one that persists in the archaeological record (Brookfield 1972). Stone calls the material signifiers of land allocation or ownership "perimetrics", and distinguishes between two kinds (Stone 1994). Pure perimetrics are markers constructed specifically for demarcating ownership, or for physically restricting access, such as fences or walls. Latent perimetrics mark boundaries, but were not created for that purpose; they can include human-created dividers such as roads or trails, or natural features such as streams, trees, and shrubs. Within a land tenure system, field houses are latent, not pure perimetrics. In the settings where field houses were not necessary as residences for periodic circulation (that is, situations of daily circulation), the use of other perimetrics would be expected. This is borne out by ethnographic examples, both among late modern Pueblo communities, and other ethnographic groups. Among the Hopi and Zuni, stones marked with glyphs or wooden posts have been used as territorial, property and field boundary markers (Cushing 1920:152-153; Forde 1931:368-369; Titiev 1944:62). Within the Eastern Pueblo, stone markers have also been used, along with natural boundary markers (Ellis 1966). In four examples of African cultivators, Stone noted the use of roads, paths, bushes, hedges, embankments, mat fences, alignments of sticks, and streams (Stone 1994:318-321). We should be able to distinguish between whether field houses were constructed for purposes of demarcating ownership or were built as residences in a system of periodic circulation by examining the use of perimetrics in an intensive cultivation system where daily circulation is practiced. In these settings, illustrated in the examples above, field houses are absent, and so Kohler's interpretation of the social forces behind field house construction should be discarded. This does not mean that Kohler is incorrect about land tenure changes in the Mesa Verde area. In fact, because of the correlation between changes in land tenure, aggregation and field house use, his argument that the Mesa Verde area saw changes in land tenure rules during Pueblo I times is very convincing. However, he is mistaken to assume that because field houses are highly correlated with, and their construction can be driven by, changes in land tenure practices, they must be physical markers of land tenure.

Measuring Field House Variability

Field houses demonstrate changes in agricultural intensification through changes in the intensity of their usage. Intensity of use relative agricultural production is best expressed as duration of occupation. There are two temporal dimensions of occupation duration: the duration of periodic use, or the number of days within each year the field house is utilized and occupied; and duration of lifetime use, the cumulative number of years a field house is used between its establishment and its abandonment (Diehl 1997; Lightfoot and Jewett 1986). Both types of occupation duration are reflections of intensification. Greater duration of periodic use is a reflection of greater labor investment in the field; concurrently the farmer spends more time resident in the field house adjacent to the field. Greater duration of lifetime use reflects both greater capital and increased labor intensification in a field, as it is indicative of continuing return to a single field location. In this respect, it reflects efforts to maintain the sustainability of a field by preserving the quality of its soil (the reduction of fallow times).

There are two domains within the material record of field houses that can be examined to measure duration of occupation: architecture, and associated artifact assemblages. Each of these domains have a number of dimensions, some of which are sensitive to the duration of periodic occupation, while others are sensitive to the duration of lifetime occupation.

Architectural Variability

Buildings, including field houses ranging from brush shelters to masonry structures, reflect the duration of their occupation in two ways. Investment in *construction* reflects the perception by the builder of the duration that the structure will be occupied. Investment in *remodeling* reflects activity on the part of the structure's occupants to extend the duration of occupation following construction beyond the structure's originally intended use life.

The idea that architecture can be used as a measure of occupation duration is based on general models for understanding structure design by builders of vernacular architecture. It assumes, given utilitarian functions and absent social pressures such as institutional inequality, decisions regarding building design will follow least effort principles (Binford 1990; Diehl 1992, 1997; Diehl and Gilman 1996; Kent and Vierich 1989; McGuire and Schiffer 1983). These principles are played out in the tension between the variables of *construction* and *maintenance* (McGuire and Schiffer 1983). The goal of construction is to minimize building costs, while the goal of maintenance is to minimize the costs of retaining a structure's functionality throughout its use life. As a building's construction costs are increased, its maintenance costs are decreased, and vice versa. Thus, anticipated duration of occupation should correlate with these two variables. The longer a structure is anticipated to be occupied, the greater investment there is in up-front construction, and the less maintenance will be required over the duration of that occupation (Diehl 1997; Kent 1991; McGuire and Schiffer 1983).

Michael Diehl has operationalized the opposing goals of construction and maintenance into the concepts of reliability and maintainability , for the purpose of developing material correlates for different aspects of structure design that are relevant to duration of occupation (Diehl 1997). Reliability is a measure of the length of time a structure can be occupied before it is uninhabitable. Maintainability is the ease with which a structure can be returned to habitability or use following its failure. These two axes of structure design are related to the two different aspects of occupation duration. Reliability corresponds to the duration of periodic use (habitability through the course of the year), while maintainability corresponds to the duration of lifetime use (a return to habitability year after year).

Several design aspects are indicators variability in reliability and maintainability (Diehl and Gilman 1996). Three aspects relate to reliability. *Overdesign* is the capability of a design element to exceed the stresses of daily usage. It can, for example, be reflected in the strength properties of daily usage, and the substitution of stone for earth or wood in the construction of walls, or the use of thicker rather than thinner beams for vertical posts or roof beams can be considered forms of overdesign. *Standardization* reflects the regularity in the size and composition of building materials, such as building stones, that promote the stability of a structure. *Redundancy* is the degree to which a design element is replicated by functionally identical elements, allowing for the preservation of structural integrity if one of several elements fail. Within maintainability, standardization promotes the maintenance of a structure, as failed elements can more easily be replaced. A second element of maintainability is *compartmentalization*, the independence of architectural elements such as walls and ceilings. In a compartmentalized design system, the failure of one element doesn't necessarily entail the failure of others, and thus may not entail their reconstruction or replacement to return the structure to habitability.

If construction represents the perceived duration of occupation at the inception of a settlement, remodeling is a reflection of the extension of occupation duration. The abandonment of a settlement prior to the end of it perceived use life cannot be discerned from architecture alone (Kent and Vierich 1989). However, the extension of occupations can be measured by applying the same criteria of evaluation as initial construction. As a process, remodeling has two different variants with implications for duration of occupation. *Reconstruction* or rebuilding of a structure reflects an extension of lifetime use, beyond what would be simply achieved by maintenance. The *addition* of previously unanticipated facilities (such as additional rooms), however, can reflect the extension of the duration of periodic use (see Kent and Vierich 1989:124).

Both the general theory and operating principles linking architectural design and construction to the duration of occupation have been confirmed by cross-cultural examinations of architectural variability (Binford 1990; Diehl 1992; Kent and Vierich 1989). These studies support the concept that various design attributes of structures, including occupied space per inhabitant (structure size), wall height, construction material and compartmentalization of architectural elements all vary with duration of occupation. The general theory of architectural design and duration of occupation has also been successfully employed by archaeological studies in the northern Southwest, principally to examine the duration of occupation at early ancestral Pueblo pit house structures (Diehl 1997; Gilman 1987, 1997; Lightfoot and Jewett 1986; Powell 1983). For example, to measure changes in the duration of periodic occupation, Diehl (1997) examined six architectural attributes—hearth construction, intramural plastering, type of wall construction materials, post hole densities, pit house depth, and remodeling—and found significant increases in the duration of periodic occupation at Mimbres Mogollon pit houses between A.D. 200 and A.D. 1000.

Although ideas regarding architectural design and duration of occupation have not been formally applied to field houses, variability of architectural attributes and their relationship to occupation duration and agricultural intensification have been noted. Most commonly, these take the form of general observations regarding variability in the substantiveness of field house architecture (Kohler 1992; Preucel 1990; Sebastian 1983). More systematically, in the Sinagua area of north-central Arizona, construction material and enclosed area have been found to vary concurrent with variability in artifact assemblage attributes, and are interpreted to represent variation in the duration of periodic occupation. In the case of the Sinagua, the variation is interpreted as evidence of increasing population growth and corresponding agricultural intensification following the eruption of the Sunset Crater volcano after A.D. 1066-1069 (Berger and Sullivan 1990; Sullivan and Downum 1991). The suggestion that investment in field house architecture is not a reflection of anticipated duration of use, not a measure related to agricultural intensification, and is reflective of "social values" and symbolic rather than utilitarian economic concerns (Snead 1995:43-44, 105-109) is not supported by either theoretical considerations (McGuire and Schiffer 1983) or cross-cultural evidence (Binford 1990; Diehl 1992; Kent and Vierich 1989) regarding the construction of small, short use-life structures.

Variability in Artifact Assemblages

Like architecture, artifact assemblages can be examined for variability in the duration of occupation at field houses in two different ways. *Accumulation* is a measure of the discard of a particular class of artifacts within an assemblage over time. *Diversity* is a measure of the distribution of artifacts in an assemblage between different artifact classes. Both measures best monitor the duration of lifetime occupation. Used in tandem, however, the two measures in some circumstances can distinguish between assemblages that are a consequence of longer periodic duration of occupation versus longer lifetime duration of occupation.

The use of accumulation as a measurement of the duration of settlement occupation is based on the concept that material items—ceramic pots and bowls, stone *manos* and *metates*, and chipped stone tools—have regular limited use-lives. Given their materials, manufacture, use, and discard, these items will fail at a predictable rate and will be, if not reused or recycled, discarded (Mills 1989; Schiffer 1987:53-54; Shott 1989a; Varien and Mills 1997). Most accumulation studies have focused on ceramics, as these remains are ubiquitous and plentiful at the settlements where most accumulations research has been carried out. Discard rates for different classes of ceramic vessels have been calculated from ethnographic and ethnoarchaeological studies, experimental research, and archaeological studies comparing assemblage composition to known occupation spans (see Varien and Mills 1997; Varien and Potter 1997 for reviews of these studies).

Several archaeological studies in the northern Southwest and elsewhere have successfully used discard rates and artifact accumulation to calculated the calculate the duration of lifetime occupation at settlements (Kohler and Blinman 1987; Nelson et al. 1994; Pauketat 1989; Schlanger 1990, 1991; Varien 1999). Artifact assemblage size, as a measure of accumulation, has also been referenced as an indicator of occupation duration for field houses, or as an even more general indicator of "use intensity" (Berger and Sullivan 1990; Downum and Sullivan 1990; Kohler 1992; Orcutt 1993).

Diversity is a second measure of artifact assemblages that can reflect the duration of a settlement occupation. Diversity is an expression of the distribution of artifacts within an assemblage between different classes (Jones and Leonard 1989). As a quantitative measure, diversity is composed of a set of statistics that describe the dispersion of cases within a nominal level variable (McCartney and Glass 1990). There are two primary aspects to the measurement of diversity. *Class richness* is the measure of the number of classes represented within an assemblage. *Class evenness* is the measure of the size of class membership (the number of individuals within a single class) relative to other classes within the assemblage (Dunnell 1989; McCartney and Glass 1990).

Where artifact classes are associated with distinct classes of behavior, differences in inter-site artifact diversity has been used as a measure of diversity in site function (Binford 1978; Binford and Binford 1966; Conkey 1980; Jefferies 1982; Odell 1981; Yellen 1977). The relationship between assemblage diversity and site function is based on the assumption that differences in diversity between assemblages is a consequence of the fact that the assemblages are, or are drawn from, different populations (of artifacts, not people) whose composition is a consequence of differing patterns of human behavior. However, there is also a strong relationship between assemblage size and measures of diversity, particularly class richness (Grayson 1981; Grayson and Cole 1998; Jones et al. 1983; Kintigh 1984, 1989; Meltzer et al. 1992; Thomas 1983). Assemblage size affects the diversity of assemblages that are both populations, and samples that are drawn from populations, although in different ways (Dunnell 1989). Class richness can be a function of sample size when sample sizes are insufficient to capture the breadth of classes present in the population from which the sample has been drawn. In this instance, differences in class richness between samples is a methodological consequence, and not a product of human behavior (Jones et al. 1983; Kintigh 1984). By contrast, class richness is a consequence of population size (or samples of a sufficient size that correctly represent the breadth of diversity within a population; see Dunnell [1989]) when there are differential rates of discard and accumulation between different classes. This is known as the Clarke Effect, and is a product of the same artifact characteristics that underpin accumulation studies: that artifact failure and discard is a stochastic process. When the duration of the discard rate of an artifact class exceeds the duration of a site occupation, then it is less likely to be present in the assemblage associated with that site than an artifact class where the discard rate is shorter than the duration of occupation (Schiffer 1987:54-55; Schlanger 1990, 1991; Shott 1989b). Differences in class diversity between sites, then, are a consequence of the duration of occupation, not behavioral diversity (Plog and Hegmon 1993; Schlanger 1990; Shott 1989b). In this respect, the Clarke Effect measures duration of lifetime occupation in a manner similar to accumulation.

In some circumstances, accumulation and assemblage diversity can be used in tandem to distinguish between periodic and lifetime duration of occupation. Assuming equivalent occupation size (the number of persons occupying a settlement), two field houses with lifetime occupations of equal length will be similar in both accumulation and diversity. Where accumulation rates within one class is constant but diversity varies, however, there may be differences in the duration of periodic occupation between the two field houses. Orcutt (1993) has suggested that as periodic occupation spans increased, greater numbers of domestic tasks were shifted from primary settlements to field houses, or replicated by field houses. Similar shifts have been observed in the ethnographic record of secondary agricultural settlements (Stone 1996a).

As discussed above, measures of class diversity have been most often applied in field house studies to distinguish between field houses and other classes of small structures and "limited activity" sites, either as a reflection of function (Plog and McAllister 1978; Ruscavage-Barz 2002a) or duration of periodic occupation (Powers et al. 1999; Schlanger and Orcutt 1986; Stone 1993). Only in the Sinagua area has class diversity between field houses been considered. Here the addition of functional classes of artifacts through time has been seen as a measure of longer spans of periodic occupation, a consequence of more intensive farming practices (Berger and Sullivan 1990).

Measuring Field House Occupation Spans: Preliminary Considerations

Changes in both architecture and artifact assemblages often have equifinal causes and the use of a variety of measures of field house occupation duration can control for alternative explanations. For example, both assemblage size and sample diversity are sensitive to occupation size (the number of persons present at a field house). Larger assemblage size and diversity at one field house relative to another could, for example, represent the activities of a larger task group (several members of a household in residence, rather than a single member) rather than a longer occupation, as predicted by the Clarke Effect (see Shott 1989b). The occupation by a larger task group would reflect greater labor intensification, where a longer duration occupation would reflect greater capital intensification in the plot, or simply a location with greater initial productivity. These alternatives can be negotiated by reference to architecture. Enclosed area, for example, should be greater if occupation is a consequence a larger task group. Remodeling may also represent the shift to the use of a larger task group during the use-life of a field house, if a room has been added, or the field house has been reconstructed to have a greater enclosed area.

That being said, architecture in particular can be strongly affected by variability throughout the use-life of a structure (Cameron 1991, 1999) and by post-depositional processes, such as scavenging (Cameron 1991; van Zandt 1999). Natural formation processes will also have a strong effect on the size and diversity of exposed surface assemblages associated with field houses. The small size and likely short lifetime duration of most field house occupations mean that they should have far less complicated use-lives when compared to other classes of settlements occupied during the early modern Pueblo era (see McGuire and Schiffer 1983 for a general consideration of the relationship between use-life and the factors influencing architectural design and remodeling). Because post-depositonal processes as a source of variability between sites are site- and locality-specific phenomena, they are discussed in the context of the sites analyzed for this study in Chapter VIII.

Chapter V Endnotes

---

[1] Check-dams and other field features can also vexingly difficult to date. That the Civilian Conservation Corps and other public works programs constructed thousands of these features across the northern Southwest during the middle part of the last century only complicates matters further (Doolittle et al. 1993).

[2] Preucel does develop a model for the development of secondary agricultural settlements that stipulates increases in the frequencies of settlements and their distance from primary aggregated settlements with population growth (Preucel 1990:32-36, 58-62). But his model is driven by intra- and inter-group competition, and does not account for agricultural intensification.

[3] Both myself (Kulisheck 2003a) and Herr and Clark (2002) refer to periodic circulation as I use the term here as "seasonal circulation." Herr and Clark (2002:126-127) also distinguish between short-term and seasonal circulation. For Herr and Clark, "short-term circulation" is a combination of Preucel's categories of daily circulation and periodic circulation, based on similarity in duration, rather than kind. Daily circulation has not been a subject of interest to Southwestern archaeologists, and I do not discuss it further here.

[4] See Chapter IV, Endnote 4. The Post-Classic, or Late Pueblo period in the Mimbres Mogollon region spans A.D. 1130 to 1400 (Hegmon et al. 1999).

CHAPTER VI

THE JEMEZ PLATEAU

This study employs the archaeological record of the Jemez Plateau for examining changes in field house use, and its relationship to changes in agricultural intensification and regional population, and ultimately for exploring the question of Pueblo population decline during the sixteenth and seventeenth centuries. The Jemez Plateau is one of the major culture areas within the northern and central Rio Grande region of the northern Southwest. It lies on the western margin of that region, in north-central New Mexico, approximately 55 kilometers north of the city of Albuquerque in the southwestern quadrant of the Jemez Mountains. The Jemez Plateau was the site of significant early modern Pueblo settlement between A.D. 1250 and 1700, and field houses were a prominent component of the Pueblo settlement system throughout much of this occupation.

Throughout this chapter, I use the term “Jemez” as a short-hand for connoting the Jemez Plateau as a physiographic and cultural location, and refer to its inhabitants as “the Pueblo peoples of the Jemez.” This is not an intentional attempt to obscure the ethnic identity of the people resident on the plateau in early modern times. The late modern Pueblo peoples who are resident at Walatowa, also known as Jemez Pueblo, self-identify as “Jemez” (transliterated in Towa as *Hemish*), and identify the early modern occupants of the plateau as their direct ancestors, a contention that is indisputable based on recorded historic and ethnohistoric evidence (Sando 1979, 1982). In this sense, “Jemez” also means “the Jemez people”, the linguistically and ethnically distinct group of people who live today and have lived in late modern times at Walatowa, and lived in early modern times on the Jemez Plateau. In this study, however, I reserve usage of the term "Jemez" to refer to the geographical entity and cultural province of the Jemez Plateau. I use the somewhat clumsy term "Pueblo peoples of the Jemez" to identify the early modern Jemez people that occupied the plateau to emphasize that these people were a Pueblo people, and although culturally and linguistically distinct, shared economic and settlement characteristics (among others, see Chapter II) with other similar Pueblo groups in the northern Southwest.

Culturally, the Jemez is considered to be within, but on the western periphery of the northern and central Rio Grande Region. The Jemez is included in the northern Rio Grande in overviews by Wendorf and Reed (1955), Cordell (1979,1989), Crown, Orcutt and Kohler (1996), and Creamer, Snead and Van Zandt (2004); it is excluded from the "glaze-paint" area (an area characterized by the production and distribution of Rio Grande Glaze wares) by Mera (1940) and Shepard (1942). The western boundary of the Jemez abuts areas that are not typically considered culturally part of the northern and central Rio Grande: the Gallina area to the northwest (Crown et al. 1996), and the southeastern San Juan Basin/upper Rio Puerco area to the southwest (Roney 1996; Baker and Durand 2003). Conventionally, throughout the early modern era the Jemez is identified as ethnically and linguistically distinct area, occupied by peoples who spoke the Tanoan language Towa, and distinguished themselves as different from their closest neighbors, the Keresan-speaking peoples occupying the lower Jemez River drainage (Ellis 1956; Mera 1935; Ford et al. 1972). From the perspective of chronology and settlement patterns, Crown, Orcutt and Kohler consider the Jemez to be the most poorly known of six areas in the northern Rio Grande (Crown et al. 1996:190-191).

The objective of this chapter is to present a context for examining the field house record of the Jemez Plateau as a means for assessing population change. It is a three-fold task. A review of the physical and environmental characteristics of the plateau provides the parameters for defining what structures in the Jemez are potential field houses, and the geographic and biological constraints to the process of intensification in the area. A summary of the research history charts the evolution of the current understanding of the field house record of the area and the larger settlement of which that record is a part. And an overview of the chronology, settlement patterns, and early history of the region supplies a baseline for the current state of knowledge in the area, as a background to further investigation of population change.

Physical Setting of the Jemez Plateau

The Jemez Plateau is a distinct physiographic province in the southwestern portion of the Jemez Mountains (see Figure 6.1). The plateau is an upland area composed long south- to southwest-facing mesas separated by deep narrow canyons. The physiography of the area is largely a product of the volcanic activity of Valles Caldera and subsequent geological activity over the past 2 million years. As a consequence the Jemez is a geological and physiographic cognate of the better-known Pajarito Plateau, located 18 kilometers east of the Jemez in the southeastern portion of the Jemez Mountains. As a cultural province, the Jemez Plateau is bounded by the Sierra Nacimiento on the west and Peralta Ridge on the east. The southern end of the region is marked by the termination of Borrego Mesa, and includes the broad alluvial floodplain where the present-day Jemez Pueblo (Walatowa) is located. To the north, the extent of Pueblo occupation is only into the drainage of the Rio Cebolla. As a physiographic province, however, the Jemez extends to the north an additional 17 kilometers, to Calaveras Canyon and Mesa del Ojo. Currently, the majority of the Jemez Plateau is managed by the federal Forest Service (85 percent); other portions are managed by the Valles Caldera National Preserve, an autonomous federal preserve (four percent), and by the Pueblos of Jemez and Zia (11 percent), both of which are federally recognized Indian tribes. Private in-holdings on all jurisdictions account for less than five percent of land ownership.

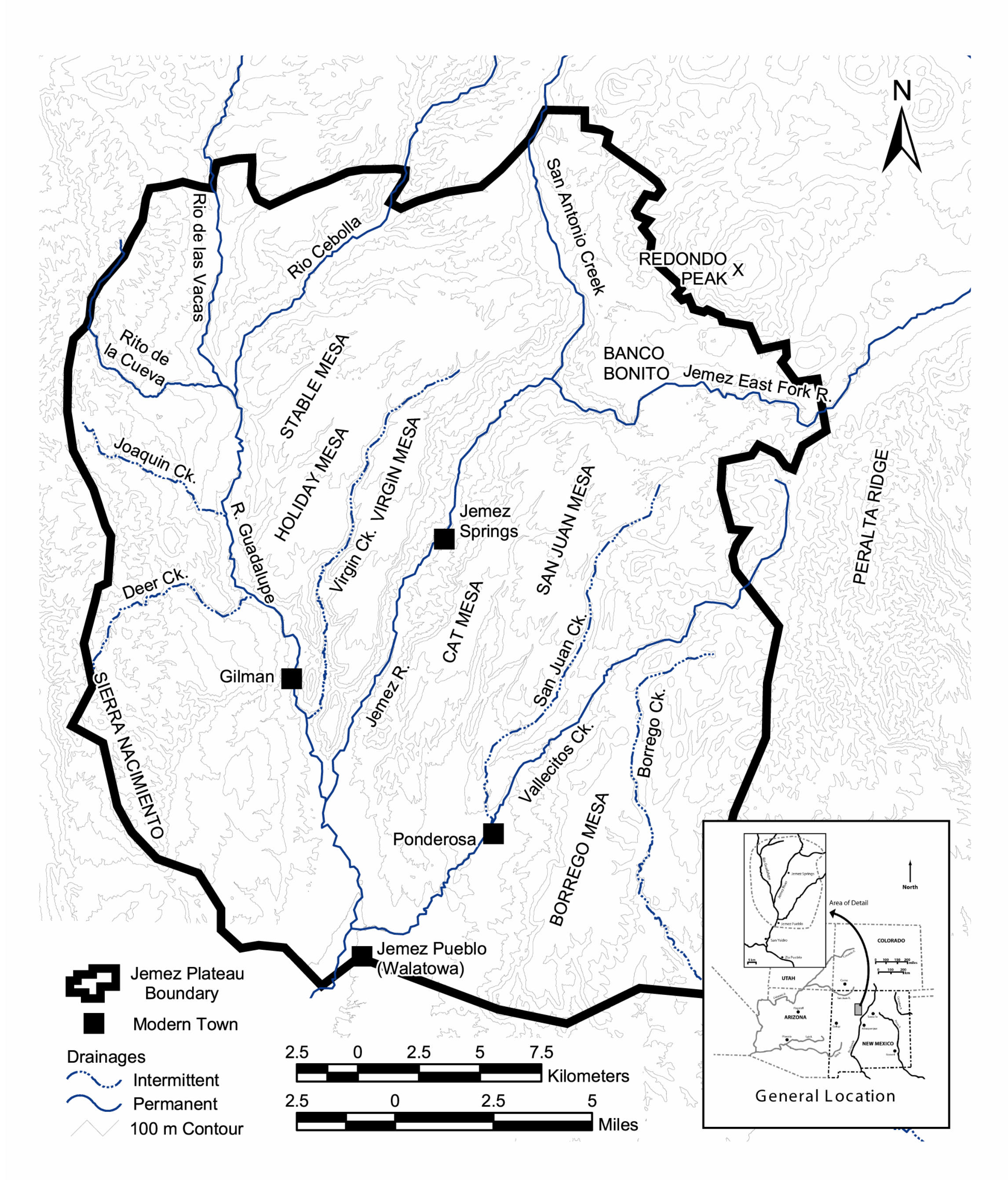


Figure 6.1. Physiography of the Jemez Plateau. Contour, drainage and town location data courtesy of the USDA Forest Service, Santa Fe National Forest, and the Archeological Records Management Section, New Mexico Historic Preservation Division.

Contemporary Physiography

The Jemez Plateau is an upland area. The record of early modern Pueblo settlement is found at elevations ranging from 1704 meters (5602 feet) above sea level at Jemez Pueblo, to 2158 meters (7081 feet) at the southern tip of San Juan Mesa, to 2482 meters (8144 feet) on the Banco Bonito. Higher elevation country borders the plateau to west, northeast and east in the Sierra Nacimiento, on the slopes of Redondo Peak, and on Peralta Ridge.

Landforms on the Jemez Plateau consist of mesa tops, canyon bottoms, the scarp slopes that separate the two, and the escarpment foothills that ring the eastern and western boundaries of the area (Figure 6.2). Virtually all of the relatively flat ground in the area occurs on the mesa tops, with slopes of less than 15 percent. Despite gentle slopes, however, the mesas of the Jemez are not table flat. Most are significantly dissected, with surfaces composed of narrow ridges of alluvium separated by small, intermittent drainages. This pattern is most pronounced on upper San Juan Mesa, where the terrain is more hill-like. It is less so on Borrego Mesa, where the basalt bedrock is less incised, and on the Banco Bonito, a recent landform with an undulating surface, where little erosion has taken place. Canyon bottoms are the least steep landforms in the area and occur as narrow strips at the bottoms of deep canyons. Wider canyon bottoms are present only in the Cañon de San Diego, along lower Paliza Creek in the Ponderosa area, and along the Jemez River and Rio Guadalupe near their confluence. Most of the canyon sides consist of sheer cliffs and talus slides; only in the lower reaches of the large canyons are there substantial terraces (Rogers 1996). The foothills and mountains that border the mesas to the east and west are generally steep country, but do feature some terrace, bench and saddle areas more gentle in slope.

There are three perennial streams on the Jemez Plateau: the Rio Guadalupe, formed by the confluence of the Rito la Cueva, Rio de las Vacas, and Rio Cebolla in its upper reaches; the Jemez River, formed by the confluence of San Antonio Creek and the East Fork River; and Vallecitos Creek, which flows from Paliza Canyon. Several other intermittent streams carry

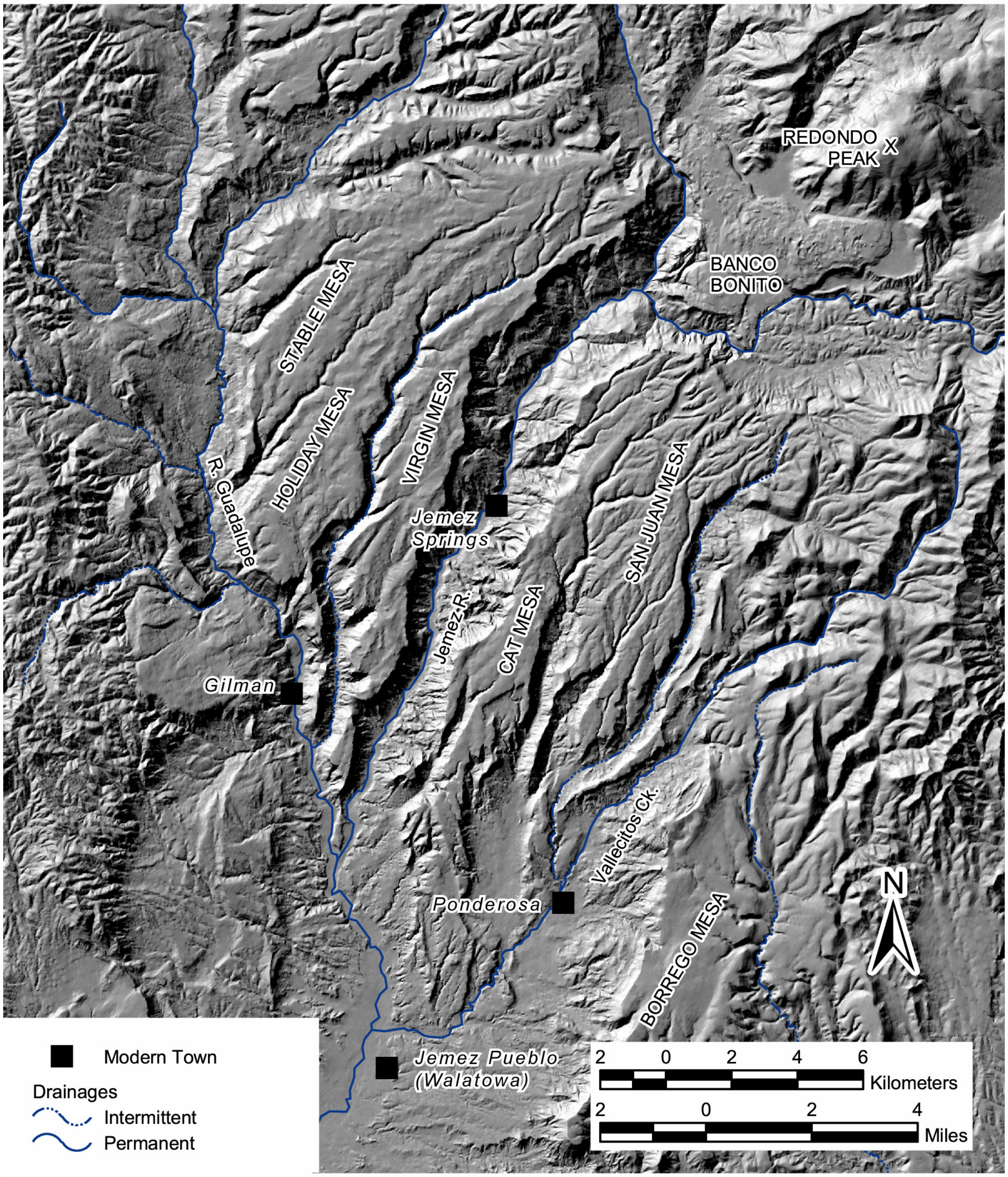


Figure 6.2. Topography of the Jemez Plateau. Data for hillshade relief image courtesy of the USDA Forest Service, Santa Fe National Forest.

water for much of the year, including Deer Creek and Joaquin Creek, and the drainages in the Cañon Cebollita, in Virgin Canyon, and San Juan Canyon. The intermittent drainages in Borrego Canyon and its tributaries that drain the Borrego Mesa area are the only drainages on the plateau that are not part of the Jemez River watershed. This drainage system empties out far to the southeast directly into the Rio Grande, just to the south of Santo Domingo Pueblo. The only sources of water located atop the Jemez mesas are a few springs located atop Cebollita Mesa; the other mesa tops are presently devoid of permanent water sources. Other springs are located in various canyon bottoms. Geothermal hot springs are found along the flanks of the Banco Bonito and Virgin Mesa, and at the bottom of the Cañon de San Diego. At least some of these hot springs appear to have been used prehistorically (Luebben et al. 1988).

Geology

The formation of the Jemez Plateau was primarily due to the eruptive cycles of the Jemez volcanic field. The field is located at the intersection of the Jemez lineament and the Rio Grande rift (Heiken et al. 1990; Self et al. 1986). The distribution of bedrock geology on the Jemez Plateau is shown in Figure 6.3. The Jemez volcanic field first became active approximately 16 million years ago (mya) (Gardner et al. 1986; Heiken et al. 1990; Self et al. 1996), and experienced three major eruptive episodes that contributed to the formation of the current Jemez landscape. The youngest episode, emplacement of the Southwest Moat rhyolites, took place between 60 and 42 thousand years ago and resulted in the formation of the Banco Bonito (Wolff and Gardner 1995; Reneau et al. 1996). The second and most important episode was the deposition of Bandelier tuffs, a product of ash flows from two eruptions of the Valles Caldera between 1.61 and 1.23 million years ago (Self et al. 1996; Smith et al. 1970). All of the major mesas of the Jemez Plateau, excepting the Banco Bonito and Borrego Mesa, are products of this eruptive cycle; the deep canyons that separate the mesas are the consequence of fluvial drainage and alluvial erosion during the Pleistocene and Holocene (Rogers 1996). Borrego Mesa, along

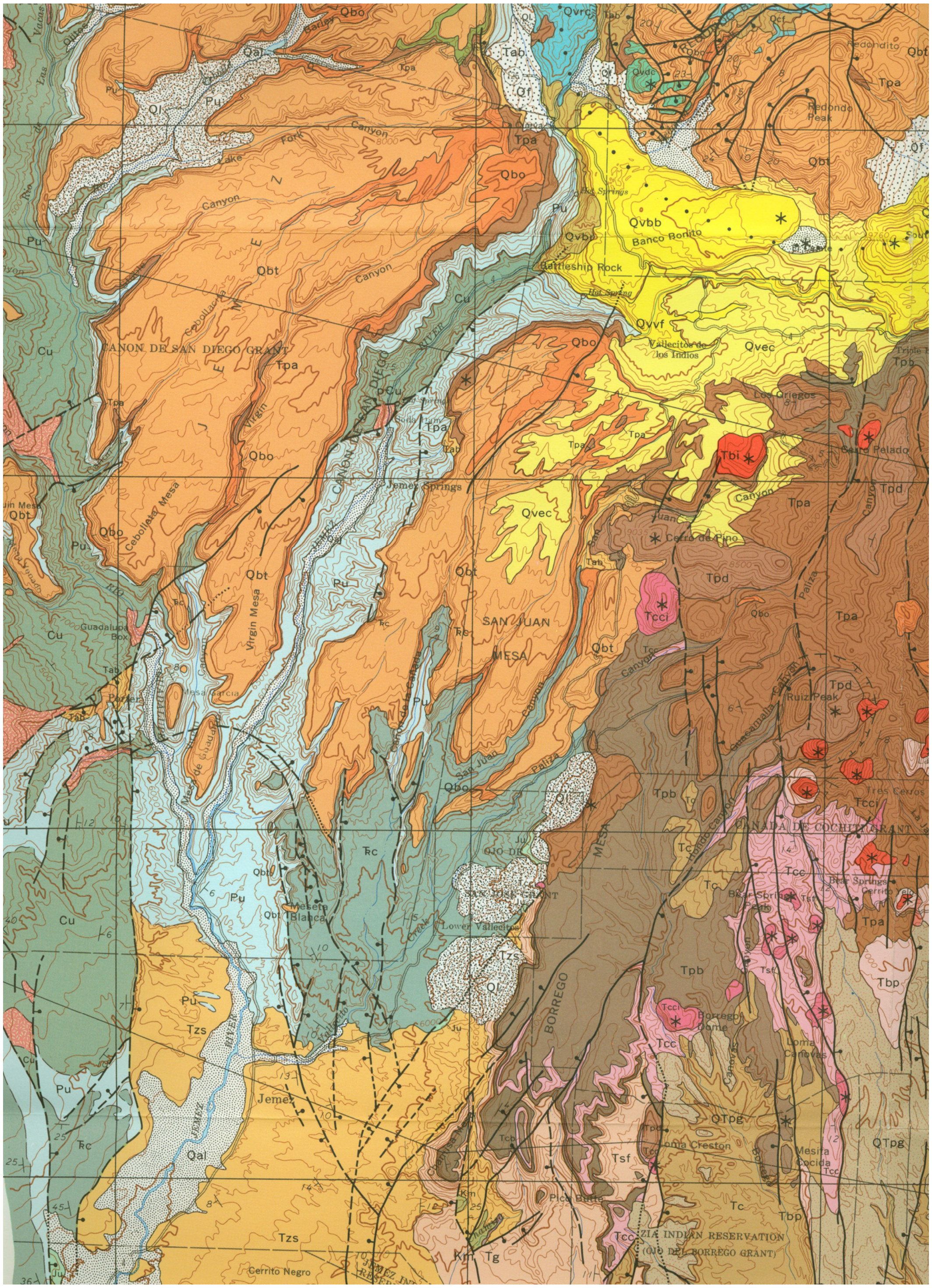


Figure 6.3. The geology of the southwestern Jemez Mountains. See attached key for a description of geological symbols. From Smith and others (1970).

System	Series	Formation	Symbol	Description	Comments
QUATERNARY	Holo-cene		Ql	Landslide deposits	
			Qf	Fan deposits	Coarse sand and gravels
			Qal	Alluvium	Silt, sand and gravels
	Pleistocene	Valles Rhyolite	Qvbb	Banco Bonito Member	Porphyritic obsidian
			Qvec	El Cajete Member	Pumice
			Qvbr	Battleship Rock Member	Tuff
			Qvvf	Valle Grande Member	Volcanic domes,flows
			Qvrc	Redondo Creek Member	Dome, dike, flows, tuff
			Qvdc	Deer Canyon Member	Dome-flow, dike, tuff
		Bande-lier Tuff	Qbt	Tshirege Member	
			Qbo	Otowi Member	Includes pumice
			QTpg	Pediment gravel	Cemented gravels
			QTg	River gravels	Pebbles, gravels, boulders (Precambrian)
TERTIARY	Pliocene		Tbi	Bearhead Rhyolite	Volcanic domes
		Paliza Canyon Formation	Tpd	Dacite, rhyodacite and quartz latite	
			Tpa	andesite	
			Tpb	basalt	
		Canovas Canyon Rhyolite	Tcci	Volanic domes	
			Tcc	flows and tuffs	
	Miocene		Tcb	Basalt of Chamisa Mesa	
			Tab	Abiquiu Tuff	Includes Pedernal Chert
			Tzs	Zia Sand Formation	
OLDER ROCKS			Km	Mancos Shale (Cretaceous)	
			Ju	Jurassic rocks, undivided	Limestone and sandstone
			TRc	Chinle Formation (Triassic)	
			Pu	Permian rocks, undivided	Sandstone
			Cu	Carboniferous rocks, undivided	Limestone and sandstone
			pCu	Precambrian rocks, undivided	Granitic rocks

Figure 6.3 (continued). Key to map symbols. Abridged from Smith and others (1970).

with the Borrego Dome area to its east, and the hills and mountains of Peralta Ridge, are products of the third and oldest cycle of volcanism, and are composed primarily of basalts, andesites, and rhyolitic domes (Gardner et al. 1986). The materials of the Jemez volcanic field overlie and abut two other major geologic formations. One is a series of Paleozoic and Mesozoic sedimentary rocks, exposed in the mouths of canyons and lower along the eastern slope of the Sierra Nacimiento (Heiken et al. 1990; Smith et al. 1970). The second are Precambrian granitic basement rocks, found at higher elevations along the eastern Nacimiento slope (Woodward 1987).

Geologic deposits provided a variety of raw materials for the early modern Pueblo residents of the Jemez Plateau, including building stone, material for the manufacturing of chipped and ground stone tools, and material for the fabrication of ceramics. Virtually all of the geological materials available are suitable for building stone, and there are no building sites greater than approximately 500 meters from any significant outcrop. Variability in parent material, however, does place constraints on the ability to be worked or shaped, and availability of stone may affect the degree of workmanship exhibited in the masonry of architecture in different areas. Tuff is available on all of the mesa tops except for Borrego; this stone, consisting of welded rhyolitic ash, is easily workable. The sedimentary rocks available in many of the lower canyon bottoms settings are also available in tabular blocks that are easily workable. In many of the upper canyons on the eastern side of the plateau, on Borrego Mesa and in the foothills of Peralta Ridge, residual cobbles of basalt and alluvial andesite and dacite cobbles are the main available building stone, although tuff is available in the form of landslide and talus deposits. The basalt, andesite and dacite materials are much harder than the tuff and sedimentary materials available elsewhere and would have been much more difficult to shape or work.

The Jemez Mountains are a well-known major source of raw material—obsidian and chert—for the manufacture of chipped stone tools (Banks 1990; Baugh 1997; Boyer and Robinson 1956; Findlow and Bolognese 1982; Warren 1974; Winter 1981, 1983). The mountains have one major chert source (Church and Hack 1939; Warren 1974), and three major sources of obsidian (Baugh and Nelson 1987; Newman and Nielsen 1985; Walsh 1998, 2000; Wolfman 1994), but none of these are located on the Jemez Plateau (Head 2000, LeTourneau et al. 1997, Warren 1977a,1979a). To obtain tool stone, early modern Pueblo flintknappers would have had to directly procure material from these sources, obtain it through exchange, retrieve materials from secondary alluvial contexts, or rely on locally available materials. The four major sources for lithic raw material are Cerro Pedernal and San Pedro Mountain (Pedernal chert), Polvadera Peak (El Recuelos obsidian), Cerro del Medio (Valle Grande obsidian), and Obsidian Ridge and Rabbit Mountain (Cerro Toledo obsidian). These sources are located between 17 and 27 kilometers to the north, northeast and east of the Jemez Plateau. Where Pedernal chert outcrops in the vicinity of San Pedro Mountain, it contributes material to the Rio Guadalupe drainage and would have been available as gravels (Banks 1990; LeTourneau et al. 1997). The Valle Grande and Cerro Toledo obsidians outcrop near the headwaters of the East Fork of the Jemez and San Antonio Creek and might be expected as gravels in the Jemez River drainage, but their actual presence is unknown. There are at least two minor sources of obsidian on the eastern side of the Plateau, the rhyolite domes along Peralta Ridge that are part of the Bearhead and Canovas Canyon Formations. These obsidians have been found in alluvial contexts in Paliza Canyon and Borrego Canyon (Baugh and Nelson 1987). Basalt and basaltic andesite are common raw materials at sites on the Jemez Plateau. These materials could be from the Paliza Canyon Formation basalts found across the eastern portion of the plateau, or they could have been imported from known sources in White Rock Canyon (Head 1999; Walsh 1998, 2000; Warren 1979a). Additional materials, including quartzites, petrified wood, orthoquartzites, and cherts, may have been available from the sedimentary deposits found in the southern portion of the plateau (LeTourneau et al. 1997).

Raw materials for ground stone tools reported from excavated sites on the Jemez Plateau have included quartzite, sandstone, vesicular basalt and other types of basalt, rhyolite, tuff, and jasper (chert) (Acklen and Railey 1999; Elliott 1991; Elliott et al. 1988; Gauthier and Elliott

1989; Lent et al. 1992; Luebben et al. 1988; Mackey 1982; Reiter 1938; Reiter et al. 1940; Peterson et al. 1992; Schmader 1986; Sciscenti 1962). All of these materials are available on the plateau and there is no evidence of importation.

The geological provenience of clays used for the manufacturing of ceramics on the Jemez Plateau are unknown, but sedimentary sources present in the southern portion of the plateau are suitable for geological deposits of clay (most Jemez ceramics are plain or slipped graywares, suggesting the use of mostly geological clays). Tempering materials used include tuff and vitreous black andesite, both locally available. Where other materials were employed, ceramics are assumed to have been imported (Reed and Goff 1999; Shepard 1938).

Soils

The sediments and soils on the Jemez Plateau are of mostly alluvial origin, based on analogy with the soils of the nearby Pajarito Plateau. In general, the sediments of the Jemez and Pajarito mesas are divided into three categories: soils on the gently sloping mesa-tops, soils at the mesa-edges and steeper slopes below canyon walls, and canyon bottom alluvial deposits (McFadden et al. 1996). The best-developed soils are those on mesa-tops, and are located at least one hundred meters from a large canyon drainage. These soils have basal sediments that are up to 3 meters thick. The sediments that make up these soils are the product of alluvial fan formation that took place on the Jemez and Pajarito Plateaus prior to the major incision of canyons. They do not appear to be formed from the in-situ decomposition of the underlying tuffs. Soils located on mesa margins and in canyon bottoms are more weakly developed. Alluvial deposits in canyon bottoms feature the thinnest sediments and the most weakly developed soils. Because of the deepness and narrowness of most canyons on the Jemez and Pajarito Plateaus, alluvial deposits appear to have been cycled through rather quickly throughout the Pleistocene as periodic flooding scoured sediments away (Drakos et al. 1996; McFadden et al. 1996).

Most mesa-top soils are well-watered cool forest soils (Miller et al. 1993) that would have been suitable for sustaining agriculture, given appropriate rainfall and frost-free days. Soils found at the southern ends of the mesas, and in the canyon bottoms tend to have thinner and more poorly developed horizons but nonetheless would have been suitable for cultivation, and are cultivated today (with irrigation) in the most of the major canyon bottoms. The use of mesa-top soils for agriculture has been confirmed by palynological studies of field locations on the Pajarito Plateau, on Mesita del Buey (Bohrer 1982), and in Bandelier National Monument (Fish 1983:584).

Contemporary Ecology and Environmental History

The Jemez Plateau features five major zones of vegetation, along with small segments of three others (Figure 6.4). Virtually all early modern Pueblo habitation sites occur in just three of these zones: a lower montane coniferous association dominated by Ponderosa pine and Gambel oak at higher elevations, a coniferous woodland association composed of Two-needle (Colorado) piñon and One-seed juniper at lower elevations, and the transition zone between the two (Miller et al. 1993). These overstory associations dominate the mesa-tops of the Jemez, and much of the canyon bottoms. Riparian vegetation is limited to stream-side areas except in the lower reaches of the largest drainages. Vegetation patterns as they occur today have been significantly modified over the past 150 years and are likely dramatically different from the time of the early modern Pueblo occupation of the area. Within the Ponderosa Pine and Gambel Oak association, the overstory is second-growth, and most conifers are immature or semi-mature, with few trees present over 30 centimeters (12 inches) in diameter. Tree densities in many areas are quite high, with an estimated 1000 to 2500 stems per hectare (400 to 1000 stems per acre), resulting in dense stands and a closed canopy. This density has resulted in stunted growth and high rates of infestation by mistletoe, budworm, and other pests. Gambel Oak, New Mexico Locust and other shrubs are present primarily in disturbed areas and along forest stand margins, but are absent

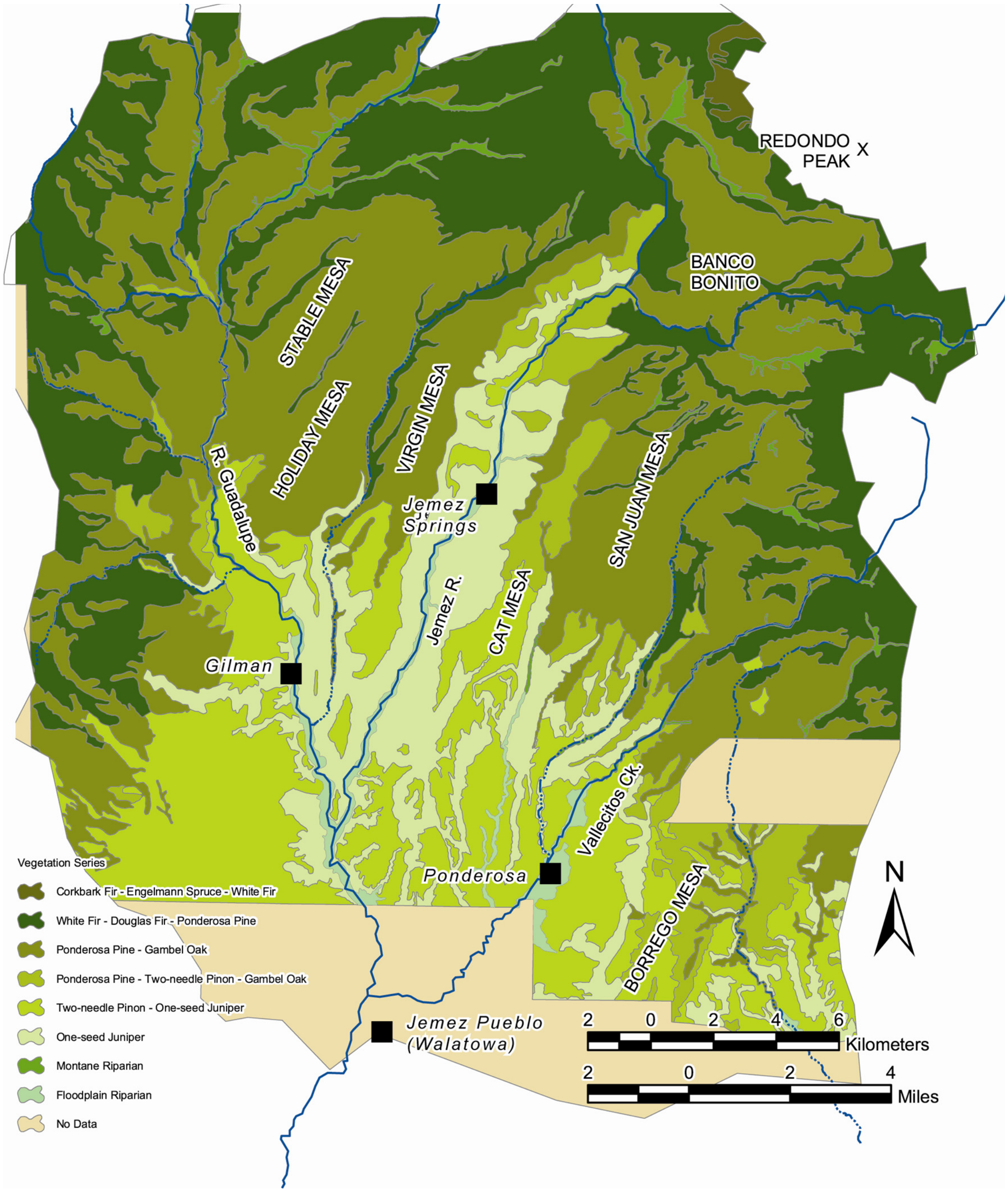


Figure 6.4. Major vegetation series present on the Jemez Plateau. Data adapted from Miller and others (1993). Series categories from Dick-Peddie (1993). Data available only for lands managed by the Forest Service. Vegetation data courtesy of the USDA Forest Service, Santa Fe National Forest.

within dense stands. Meadow areas are composed primarily of Kentucky Bluegrass and Arizona Fescue. These areas are rare and where they do occur, Ponderosa Pine and other conifer seedlings (Douglas Fir and White Fir at higher elevations) are currently encroaching upon them. In the Two-needle Piñon and One-seed Juniper association found at lower elevations, second-growth immature and semi-mature trees dominate many stands, and much of the herbaceous ground cover is absent.

Modifications to historic patterns of overstory vegetation over the past 100 to 150 years have included grazing, fire suppression, and logging (Allen 1989; Allen et al. 1996). Historically, the Ponderosa Pine and Gambel Oak association was likely characterized by a parkland environment, dominated by old growth ponderosa pine in densities of 20 to 25 trees per acre, an open overstory (Covington and Moore 1994), and an understory dominated by herbaceous species, including Kentucky Bluegrass, Arizona Fescue, Mountain and Screwleaf Muhly, Mutton Grass, Squirrel Tail and sedges (Dick-Peddie 1993). Immature trees and midstory species such as Gambel Oak or Rocky Mountain Juniper would have been occasional or prevalent only in disturbance areas. This open setting was maintained by the occurrence of frequent ground fires, which killed small conifer seedlings, shrubs and understory species but did not harm healthy mature trees (Covington and Moore 1994; Savage 1991). The occurrence of frequent ground fires ceased throughout all of the forested Southwest between the 1880s and the 1910s (Swetnam 1990; Swetnam and Baisan 1996; Touchan et al. 1996). The cessation of ground fires on the Jemez Plateau is documented from fire scar records taken in the Monument Canyon area at the northern end of Cat Mesa. An examination of fire scars from mature living and dead and down conifers found that Monument Canyon experienced ground fires on an average of every eight years in the period between A.D. 1648 and 1892 (Touchan et al. 1996). After 1909, ground fires in this area ceased. The disappearance of ground fires is the result of the introduction of grazing into the area, followed by comprehensive suppression of all wild fires. Sheep and cattle were first introduced onto the Jemez Plateau in the early 1700s with the establishment of the Cañon de San

Diego and Ojo de San Jose Grants, but large numbers of livestock were not placed on the landscape until the later part of the nineteenth century (Scurlock 1981). Within the Ponderosa Pine and Gambel Oak association, grazing by sheep and other species can discourage ground fires by removing the grasses that carry fire, and by creating vegetation-free trails which act as fuel breaks to slow moving, low intensity burns (Savage 1991; Swetnam and Baisan 1996). In addition, the removal of grasses by grazing breaks up ground cover, and allows conifer seedlings to become established, creating a dense forest stand (Allen 1989:273-275). The policy of extinguishing all wild land fires followed by the Forest Service and other land management agencies after 1930 also prevented fire from maintaining the open nature of the Ponderosa pine parkland. On the portion of the plateau west of the Cañon de San Diego, in the Cañon de San Diego land grant, wide-scale railroad logging was conducted in the 1920s and 1930s. The clear-cutting practices used resulted in the removal of all accessible old-growth ponderosa pine. Truck logging was conducted in the eastern and northern portions of the plateau, in areas on the privately held Baca Location Number One (now the Valles Caldera National Preserve) and on the Santa Fe National Forest, with less severe results (Glover 1990; Scurlock 1981).

Impacts over the last 150 years on the Two-needle Piñon and One-seed Juniper association have been less dramatic but are significant. Fire is less important for the maintenance of woodland ecosystems in the northern Southwest (Covington and DeBano 1990; Pieper and White 1990). Neither Two-needle (Colorado) Piñon nor One-seed Juniper have value as commercial saw timber, although their cutting for fuelwood during the early and late modern eras by both Pueblo peoples and later Spanish and Anglo settlers likely resulted in significant reductions of these woodlands (Betancourt et al. 1993; Gottfried et al. 1995; Kohler and Matthews 1988). Grazing has been responsible for the removal of most herbaceous understory vegetation (Gottfried et al. 1995).

A variety of fauna is found on the Jemez Plateau and most were encountered directly, or in the form of track and sign, during fieldwork for this project. Historically, large fauna found across the plateau would have included elk, mule deer, black bear, grizzly bear, mountain lion, coyote and Mexican wolf. Smaller animals found within the Ponderosa Pine and Gambel Oak and Two-needle Piñon and One-seed Juniper associations include: long-tail weasel, spotted skunk, ringtail, tassel-eared (Abert's) squirrel, rock squirrel, porcupine, mountain cottontail, blacktail jackrabbit, several species of chipmunks, western rattlesnake, bull snake, other snakes and lizards, woodhouse toad, and a variety of birds, including hawks, owls, jays and magpies, woodpeckers, songbirds and roadrunners (Kricher 1993).

Except at the very highest elevations, conditions are xeric across the Jemez Plateau. The average annual rainfall at Jemez Springs, at an elevation of 1920 meters (6300 ft.), is 43.6 centimeters (17.15 inches), while averaging 76-89 centimeters (30-35 inches) on the rim of the Valles Caldera to the northeast of the plateau (Railey 1999). At Jemez Springs, there are an average of 170 frost-free days, with a range of 122 to 190 days reported over a period from 1911 to 1983 (Elliott 1991). At the rim of the Valles Caldera, the number of frost-free days averages only 90 to 100 days (Railey 1999). Michael Elliott (1991) has argued that cold air drainage and pooling, along with the south to southwest aspect of the mesas of the Jemez Plateau (including the Banco Bonito), have contributed to longer growing seasons on the mesa tops relative to their high elevation. Due to the deep nature of the canyons within the Jemez Plateau, the number of frost-free days on adjacent mesas was likely 10 to 30 days longer, as cold air drains from mesa-tops into canyon bottoms, and as the mesa tops receive solar radiation denied to the canyons by steep-sided canyon walls. Accounting for the differences in elevation and setting between Jemez Springs, which sits in the bottom of the Cañon de San Diego, and mesa-top settings the number of frost-free days across the region averages between 130 at the highest elevations to 200 at the southern end of the plateau.

The western Jemez Mountains lack a tree ring record for paleoclimatic reconstruction prior to the late 1500s, as the existing record has been built from living and dead and down trees (Touchan et al. 1996). There are two pollen core records of climatic change available for the

Jemez Mountains as a whole. The first, more coarse-grained record, taken from Alamo Bog, located in the Valles Caldera nine kilometers north of the plateau, indicates that climate has remained relatively stable over the past 4500 years, with somewhat more mesic conditions between 500 B.C. and A.D. 1275, and drying conditions thereafter (Stearns 1981). The second pollen record, taken from Laguna de los Pinos, located on the northern margin of the Jemez Mountains 28 kilometers to the north, is more detailed. It indicates warmer and drier conditions in the area after A.D. 950, with low summer precipitation but higher rates of winter precipitation. Cooler conditions prevailed between A.D. 1100 and 1350, with warmer, more mesic conditions prevailing after from 1350 to 1420, drier conditions from 1420 to 1500, and greater rainfall after 1500 (Ensey 1997). Drought episodes seen in tree-ring records elsewhere, during the A.D. 1420s and 1580s, are also evident in the Laguna de los Pinos pollen record, but appear to be less severe in the Jemez (Ensey 1997:50).

The record of climatic change in the area over the last 1000 years extrapolated from regional tree-ring studies in the Santa Fe area to the east and the San Juan Basin to the west correlates well with the Jemez pollen records. Tree ring reconstructions of precipitation since A.D. 985 indicate high variability in rainfall between 990 and 1430, with lower variability in the period between 1430 and 1735 (Rose et al. 1981). Major droughts are indicated for the decadal intervals of 1217-1226, 1415-1426, 1577-1598, 1778-1787, and 1955-1964 (Rose et al. 1981, D'Arrigo and Jacoby 1991). Neither the Medieval Warm Period or Little Ice Age climatic phenomena experienced in Europe during the early and middle second millennium A.D. are observable in the rainfall or climate records of the northern Southwest (Dean 1994; Salzer 2000).

Both Ponderosa Pine and Gambel Oak forest and Two-needle Piñon and One-seed Juniper woodland experienced drought-induced mass mortality events in the past (Betancourt et al. 1993, Swetnam and Betancourt 1998). Consequently, the transition zones between the Ponderosa Pine and Gambel Oak forest, Two-needle Piñon and One-seed Juniper woodland, and One-seed Juniper savanna associations have been highly mobile across elevation. The location of any site relative to the vegetation association in which it is currently located is not a good predictor of vegetation conditions at the time of occupation. The high mobility of these boundaries was seen in the aftermath of the drought that struck New Mexico between 1950 and 1956. During this episode, the transition zone between the forest and woodland associations on the mesas of the Pajarito Plateau shifted 300 to 350 meters upslope in elevation, a distance of several kilometers (Allen and Breshears 1998). Further south in central New Mexico, woodlands saw a 150 to 200 meter upslope retreat to savannah during the same period of time, again moving the ecotone boundary several kilometers (Betancourt et al. 1993). Tree reestablishment patterns in both forest and woodland conditions across the northern Southwest also suggest that similar mass mortality and vegetation zone boundary shifts also took place during the drought of 1577 to 1598 (Betancourt et al. 1993; Touchan et al. 1996).

History of Archaeological and Historical Research

The current state of knowledge regarding settlement patterns and chronology on the Jemez Plateau is a consequence of the past research in the area. In general, site location through survey and the excavation of small sites has been extensive but investigations at large sites have been limited. Consequently, settlement patterns in the area are well known, but the chronological sequence and change in occupation through time are less well understood, particularly in comparison to the nearby Pajarito Plateau (see Powers and Orcutt 1999).

The archaeological record of the Plateau was first defined in the last two decades of the nineteenth century by Adolph Bandelier (1890-1892; Lange et al. 1966-1984), J. P. Harrington (1916), and W.H. Holmes (1905), who established that the Jemez was a center of early modern Pueblo occupation. Each recorded several of the large settlements located in the area and made preliminary maps of the ruins. Harrington collected ethnohistoric information on many of the large sites, while Bandelier collected both ethnohistoric and documentary historic information (see also Bandelier 1910). In addition, Holmes provided the first descriptions of field house sites on the plateau, speculating that they functioned as shelters for "watchers, hunters, herders (if within the Spanish period), shrines, or places of resort on special occasions connected with religious observances (Holmes 1905:211-212)." Holmes noted that the distribution of field houses was widespread and numerous, noting that "the ruins of small stone houses…are encountered by the explorer at every turn...in riding through the deep forests of the uplands they may be counted by the score (Holmes 1905:211)."

This early survey work was followed between 1909 and 1922 by a program of excavation initiated by Edgar Lee Hewett of American Institute of Archaeology (later the School of American Research) and Museum of New Mexico in Santa Fe, and coordinated with the Smithsonian Institution and the Royal Ontario Museum (Elliott 1993; Reiter 1938). The excavations were carried out by Frederick W. Hodge, Kenneth Chapman and Jesse Nusbaum, and later by Wesley Bradfield and Charles Lummis. Their research concentrated on the large settlement of Guisewa (LA 679), and two nearby villages located on Virgin and Holiday Mesas, Amoxiumqua (LA 481) and Kwastiyukwa (LA 482). In the style of many of Hewett's research programs, the main goal of excavation appeared to be the securing of collections for museum display, or the preparation of a ruin for public exhibit. There was no attempt to control for provenience of artifacts or record the stratigraphic location of remains, or generate any functional or historical inferences about the occupation of the ruins (Elliott 1993; Fowler 2000). Major descriptions of the work come from Reiter's (1938) summary of the work, from field notes, and from popular reports on the excavations (Bloom 1923; Hodge 1918).

Significant attempts to construct chronology, define large and small site occupations, and establish connections between the Jemez and other culture areas were made by the joint field school of the University of New Mexico and the School of American Research, between 1928 and 1949. The field school carried out extensive excavations at several large and small early modern Pueblo sites located in the Cañon de San Diego and along the East Fork River. Work included the almost complete excavation of Unshagi (LA 123), a 263 room pueblo in the Cañon de San Diego (Reiter 1938), partial excavation of Nanishagi (LA 541), a 350 room pueblo located just to the southwest of Unshagi (Reiter et al. 1940), and a rockshelter, Jemez Cave (LA 6164), also located in the Cañon de San Diego near the town of Jemez Springs (Alexander 1935; Alexander and Reiter 1935). The field school also excavated four sites in the East Fork drainage, including a rock shelter, a small pueblo of noncontiguous rooms, a 50 room pueblo (Hot Springs Pueblo, LA 24533) and a six room pueblo built into a rock shelter (Bj 74, LA 38962) (Reiter 1939; Luebben et al. 1988). Excavations also continued at Guisewa under the direction of Hewett (Baker and Toulouse 1937; Elmore 1936; Toulouse 1937a, 1937b).

Work by the joint field school was central in defining the ceramics of the Jemez Plateau, and by extension, the chronology of the region, derived from the ceramic sequence defined by field school's director, Paul Reiter. Although the basic decorated types from the Jemez had already been described in other publications (Hawley 1936; Kidder and Amsden 1931; Mera 1935) Reiter provided the most detailed stylistic and technological portrait of Jemez ceramics to date (Reiter 1938) He also established the basic criteria for distinguishing between early and late types of Jemez Black-on-white. In addition, Reiter detailed the transition in plain wares from Rio Grande Blind Corrugated (Reiter's Jemez indented-blind corrugated) to Rio Grande Plain through time (Reiter 1938:98). Alongside Reiter's stylistic and formal analyses, Ana Shepard performed petrographic work on both the local Jemez wares and the Rio Grande glaze wares found at Unshagi. She established that all Jemez Black-on-white and plain wares were manufactured with locally available tempers (tuff and vitreous pyroxene andesite), while virtually none of the glaze wares were manufactured with these tempers. Instead, the glaze wares were tempered with mostly olivine basalt, crystalline andesite, devitrified tuff, and vitreous andesite. The variety in tempers and pastes led Shepard to assert that most if not all of the glaze wares found at Unshagi were of imported manufacture (Shepard 1938). In a later report, Shepard associated the use of olivine basalt as a tempering agent with manufacture in the area around Zia Pueblo, crystalline andesite with the Galisteo Basin, devitrified tuff with the Pajarito Plateau, and vitreous andesite with the area near Bernalillo (Shepard 1942:138).

In addition to advances on ceramics, great strides were made assembling and synthesizing historic documents related to the sixteenth century exploration and seventeenth century occupation of the Jemez Plateau by the Spanish. All of the known documents of the time were summarized and analyzed by France Scholes (1938). Scholes also attempted to relate Spanish accounts to what was known of the archaeological record. Additional historical observations were summarized by Lansing Bloom and Lynn Mitchell (1938). This historical synthesis coincided with larger efforts to translate and publish the corpus of major documents relating to the Spanish presence in New Mexico in the sixteenth and seventeenth centuries that included important descriptions of the Jemez Plateau and its Pueblo residents during this time period (Espinosa 1940; Hackett and Shelby 1942; Hammond and Rey 1940, 1953; 1966; Hodge et al. 1945).

Concurrent with but unrelated to the work of the joint field school was the survey of New Mexico ruins undertaken by H.P. Mera of the Laboratory of Anthropology. As part of his survey, between 1928 and 1939 Mera made the first systematic sketch maps of most early modern Pueblo large settlements on the Jemez Plateau. He also made surface collections of ceramics from these ruins and from several field house sites (Elliott 1982; Mera 1935).

Little archaeological work was conducted on the Jemez Plateau between the 1940s and the 1970s. Florence Hawley Ellis conducted extensive ethnohistoric and ethnological research at Jemez Pueblo as part of the land claims settlement case brought by Jemez Pueblo against the United States in the 1950s; her documentation is one of the only sources of oral historical information relating to the early modern Pueblo occupation of the plateau (Ellis 1956). Ellis also conducted limited excavations in Jemez Pueblo, near the current Catholic Church, in 1955, but the results of these excavations remain unpublished. In Cañon de San Diego, a field house with few associated artifacts was excavated by the Laboratory of Anthropology for a highway widening project in 1961 (Sciscenti 1962). Excavations were also conducted at Guisewa in 1965, by now a State Monument managed by the Museum of New Mexico, for the installation of a waterline (unpublished Museum of New Mexico field journal, Archeological Records Management Section, New Mexico Historic Preservation Division, Site Files, LA 679 File, Folder 5, Laboratory of Anthropology, Museum of New Mexico, Santa Fe). As part of dissertation research examining connections between the Jemez and the adjacent Gallinas culture area, in 1975 James Mackey of the University of California, Santa Barbara, conducted excavations at the Vallecitos Pueblo (LA 109322) located along Vallecitos Creek in the village of Ponderosa, and at three field houses located near Jemez Springs (Mackey 1982).

The agricultural landscape of the Jemez Plateau was examined systematically for the first time in 1969 and 1970 by Dietrich Fliedner of the Universität des Saarlandes (Germany). Fliedner conducted a survey of the canyon sides of the Cañon de San Diego and the East Fork drainage in the vicinities of the pueblos of Unshagi (LA 123), Nanishagi (LA 541), and Hot Springs Pueblo (LA 24553) (Fliedner 1974, 1975). He located 277 small building sites, including field houses, cavate structures, and what Fliedner termed "observation cabins." He also recorded several kilometers of late prehistoric trail remnants, approximately 250 hectares (625 acres) of field locations, and field improvement features such as linear border terraces, grid gardens and rock piles (cairns).

Most of the archaeological investigation conducted on the Jemez Plateau since the 1970s has consisted of surveys and excavations conducted under the sponsorship of the Forest Service, in compliance with federal historic preservation law. This work has resulted in the survey of approximately 32,880 hectares (81,250 acres), or approximately 38 percent of the plateau, and the recording of 3,438 sites, most of which date to the early modern Pueblo era (Figure 6.5). Twenty-four field house sites, have also been partially or fully excavated as part of heritage preservation-related work (Table 6.1). Within the plateau, the majority of survey has concentrated on areas above 2200 meters in elevation, and within the Ponderosa Pine and Gambel

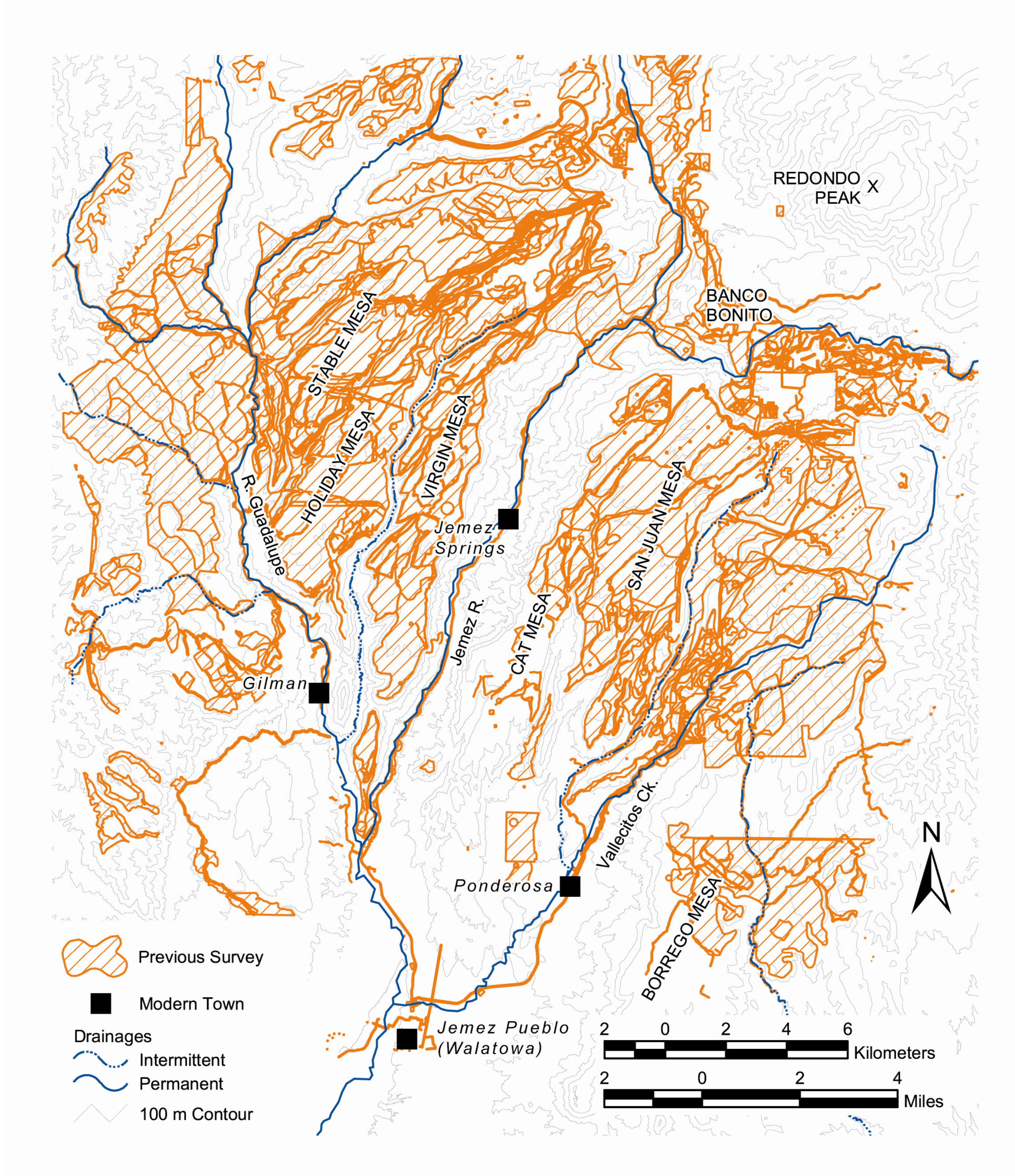


Figure 6.5. Previous archaeological survey on and in the vicinity of the Jemez Plateau. Each red polygon represents an individual survey; there is significant overlap between the survey areas of many projects. The previous survey databases from which this figure was created are not yet complete; not all previous surveys may be shown. Previous survey data courtesy of the USDA Forest Service, Santa Fe National Forest, and the Archeological Records Management Section, New Mexico Historic Preservation Division.

Table 6.1. Excavated Small Structural Sites from the Jemez Plateau

LA No.	Forest Service No.	Description	Age of Occupation	Year Excav-ated	Reference
5688	-	1 room field house	1625-1700	1960	Sciscenti 1962
12761	-	3-2 room field houses	1500-1700	1975	Mackey 1982
24552	AR-03-10-03-00503	1 room field house	1350-1700	1985	Elliott et al. 1988
24582	AR-03-10-03-00537	2 or 3 room field house	1500-1700	1985	Elliott et al. 1988
24584	AR-03-10-03-00539	2 or 3 room field house	1350-1700	1985	Elliott et al. 1988
24595	AR-03-10-03-00552	1 room field house	1350-1500	1980	Gauthier and Elliott 1989
24925	AR-03-10-03-01513	2 room field house	1500-1625	1984	Gauthier and Elliott 1989
24926	AR-03-10-03-01515	2 room field house	1500-1625	1984	Gauthier and Elliott 1989
24927	AR-03-10-03-00902	2 room field house; 1 room field house	1500-1700	1985	Elliott et al. 1988
24928	AR-03-10-03-00903	1 room field house	1500-1700	1985	Elliott et al. 1988
24929	AR-03-10-03-01534	2 room field house	1350-1500	1985	Elliott et al. 1988
38962	AR-03-10-03-00010	6 room pueblo in rockshelter	1500-1700	1939, 1949	Luebben et al. 1988
55183	AR-03-10-03-01240	1 room field house or ramada	1350-1500	1986	Schmader 1986
66994	AR-03-10-03-01886	2 room field house	1500-1800	1992	Lent et al. 1992
67011	AR-03-10-03-01905	1 or 2 room field house	1500-1700	1992	Lent et al. 1992

Table 6.1. (continued)

LA No.	Forest Service No.	Description	Age of Occupation	Year Excav-ated	Reference
67034	AR-03-10-03-01930	2 room field house; 1 room field house	1250-1350 1500-1740	1992	Lent et al. 1992
67035	AR-03-10-03-01931	2 room field house	1500-1700	1992	Lent et al. 1992
67062	AR-03-10-03-01961	2 room field house	1500-1740	1992	Lent et al. 1992
68520	AR-03-10-03-02003	1 or 2 room field house	1350-1550	1988-1989	Elliott 1991
68522	AR-03-10-03-02005	2 room field house	1350-1500	1988-1989	Elliott 1991
69562	AR-03-10-03-02030	2 room field house	1500-1700	1998	Acklen and Railey 1999
69563	AR-03-10-03-02032	1 room field house	1500-1625	1998	Acklen and Railey 1999
75719	AR-03-10-03-02056	2-1 room field houses	1250-1350 1500-1700	1991	Peterson et al. 1992
84924	AR-03-10-03-01806	1 room field house	1500-1700	1991	Peterson et al. 1992
90186	AR-03-10-03-02513	2 room field house	1500-1700	1992	Lent et al. 1992
90189	AR-03-10-03-02516	2 room field house	1500-1700	1992	Lent et al. 1992
102677	AR-03-10-03-02844	2 room field house	1500-1625	1998	Acklen and Railey 1999

Note: Ages of occupation have been inferred from recovered ceramics and other chronometric information, and may not agree with the dates assigned by the excavators.

Oak forest and White Fir, Douglas Fir and Ponderosa Pine forest associations. Lower elevation areas have received less attention. In addition, the main concern of data collection has been site location, with less emphasis placed upon settlement pattern definition or the construction of chronology. However, there have been some significant exceptions to this pattern of research. A survey of larger settlements conducted by Michael Elliott in 1980 provided baseline evidence on occupations at 34 large sites, including site layouts and basic sequences of occupation (Elliott 1982; see also Elliott 1991). Excavations conducted at field houses in the 1980s by Elliott and others resulted in the confirmation, refinement and expansion of the ceramic chronology constructed by Reiter from the large site excavations conducted in the 1920s and 1930s (Gauthier and Elliott 1989; Elliott 1991; Elliott et al. 1988). In response to the need for constructing chronological information for the Jemez Mountains, the Forest Service sponsored an overview of available sources (Wolfman 1994).

Several research projects have also taken place concurrently with the heritage preservation-oriented work. The School of American Research, as part of a larger project for constructing a chronological sequence for the northern Rio Grande, conducted test excavations at four large settlements, Kwastiyukwa (LA 482), Nanishagi (LA 541), Seshukwa (LA 303), and Kiatsukwa (LA 132 and 133) (Haas and Creamer 1992). Selma Morley, a graduate student at the University of California, Los Angeles, examined stylistic variability in Jemez Black-on-white ceramics and its relationship to other ceramic traditions in the northern and central Rio Grande region (Morley 2002). Matthew Leibmann, a graduate student at the University of Pennsylvania, is conducting a settlement analysis of Pueblo Revolt (A.D. 1680 to 1692) sites located on Guadalupe Mesa and its vicinity (Liebmann 2003); this work is ongoing.

Settlement and Population Change: Existing Archaeological and Historic Evidence

Previous archaeological and historical research on the early modern Pueblo era occupation of the Jemez Plateau has generated a series of expectations regarding Pueblo population change during the sixteenth and seventeenth centuries. These expectations include significant population decline during the seventeenth century; the concentration of the remaining population into one or a few large settlements; and changes in the mode of agricultural production by the early modern Pueblo farmers of the area commensurate with population and settlement change. The extent to which these assertions are correct can be evaluated empirically with existing settlement and documentary evidence. A review of these records finds the assertion of population decline and associated settlement and agricultural change to be very problematic. Not only are these assertions lacking in evidentiary support, but additional research is necessary evaluate their validity.

Jemez Plateau Chronology and Settlement Patterns

Previous archaeological research on the Jemez Plateau is by itself insufficient to assess the nature of population change during the sixteenth and seventeenth centuries. However, enough is currently known about the record of the plateau to create a general chronological and settlement context for studying population change. The Jemez currently lacks a general comprehensive chronological sequence that is particular to the record of the region. As a remedy, I propose a phase sequence for ordering the ancestral, early modern, and late modern Pueblo occupations of the plateau. This phase sequence is shown in Table 6.2. It is derived in part from phases that have been created by Mackey (1982) and Elliott (1991, 1998), but several of the phases are new. The phase sequence is intended to be descriptive; that is, the phases are meant to function as short-hand categories for organizing temporal changes in settlement, settlement patterns, and material culture. It is also intended to allow comparison to changes taking place in adjacent areas, and in the northern and central Rio Grande and eastern San Juan regions as a whole. The phases do not have any spatial significance or reference to intra-area differences in cultural identity (contrast with Kelley 1966; Hegmon et al. 1999), nor should they be considered

Table 6.2. A Proposed Phase Sequence for the Jemez Plateau

Date (A.D.)	SAR	Pecos	Northern/Central Rio Grande	Jemez Plateau
				Cañon after 1700
1700		Pueblo V 1600-present	Historic 1600-present	Guadalupe 1600/1625-1700
1600				
1500				Jemez 1425/1450-1600/1625
		Pueblo IV 1300-1600	Classic 1325-1600	
1400	Aggregation 1275/1300-1540			Paliza 1325/1350-1425/1450
1300				
			Coalition 1200-1325	Vallecitos 1200-1325/1350
1200	Reorganization 1130/1150-1275/1300	Pueblo III 1100-1300		
1100	Differentiation 1000/1050-1130/1150			
1000		Pueblo II 900-1100		
			Developmental 600-1200	San Ysidro prior to 1200
900	Expansion 770-800-1000/1050			
800		Pueblo I 700-900		
700	Initiation 200/500-750-800			

Sources: Elliott (1991, 1998); Mackey (1982).

units of culture change. In addition, this phase sequence is not the temporal sequence used by this study to examine population change on the Jemez Plateau. That temporal sequence is organized around the specific issues related to Pueblo population decline during the sixteenth and seventeenth century, and is described in Chapter VII.

Significant settlement by ancestral and early modern Pueblo peoples spans the period between approximately A.D. 1200/1250 and 1700. There is no significant evidence for Pueblo settlement on the plateau before or after these dates, although intermittent or seasonal use of the area is indicated. The nature of Pueblo settlement can be described for each of the phases listed in Table 6.2. Here I discuss settlement mainly in the context of the larger sites (those with five or more rooms) that are assumed to have been primary settlements, as this is the most well-known portion of the record. The settlement data discussed here was synthesized from the site files of the Archeological Records Management Section, New Mexico Historic Preservation Division, at the Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico, and the Archeological Record Management Section's New Mexico Cultural Resource Information System database. The large site data summarized here is listed in Appendix A. The ceramic terminology used here differs slightly from conventional usage. Type definitions, where different, are found in Chapter VII.

San Ysidro Phase (prior to A.D. 1200). This phase is new for this study. The San Ysidro phase corresponds to Wendorf and Reed's (1955) Developmental period, consisting of settlements composed of solitary pithouses and pithouse villages. Like the Developmental period throughout the northern and central Rio Grande (Cordell 1989), the San Ysidro phase is poorly known in the Jemez. Only a few possible pit house sites and artifact scatters exhibiting White Mound and Red Mesa Black-on-white and Lino gray ceramics, are known from the valley and terraces along the Jemez River from its junction with the Rio Guadalupe south to its junction with the Rio Salado (Elliott 1991, 2002b). No surface structures from this period have been identified.

Most settlements from this era are probably buried under recent alluvial deposits (Rogers 1996), and new settlements will probably only be exposed by ground-disturbing activity.

Vallecitos Phase (A.D. 1200-1325/1350). This phase was first defined by Mackey (1982) and Elliott (1991, 1998). It consists mainly of small settlement occupations in the lower reaches of the major canyons of the Jemez Plateau; the full distribution of sites with Vallecitos phase components is shown in Figure 6.6. A few solitary small pueblos with Vallecitos Phase occupations are present on the mesa tops. Jacal and ramada-type field house sites first appear during the Vallecitos phase, located within canyon bottoms and on terraces. Several field houses with Vallecitos Phase ceramic assemblages were found by during this study on lower San Juan Mesa (see Chapter VII), and have recently been identified on the lower portion of Virgin Mesa (Elliott 2002b). A variety of agricultural features, such as check dams, grid gardens, and linear border terraces are found in association with Vallecitos-era sites, but these features may have been constructed during later occupations. The ceramics that characterize Vallecitos phase occupations include Vallecitos Black-on-white, Santa Fe Black-on-white, Wiyo Black-on-white, St. John's Black-on-red and Polychrome, and Rio Grande Corrugated plain wares (Bice and Sundt 1972; Elliott 1998). The absence of Kwa'he Black-on-white and Wingate Black-on-red suggests that no Vallecitos occupations predate A.D. 1200, and probably post-date A.D. 1250. Early varieties of Rio Grande glaze ware (Glaze A), including Agua Fria Glaze-on-red and San Clemente Glaze Polychrome, may characterize late occupations.

The Vallecitos Phase corresponds largely to Wendorf and Reed's (1955) Coalition period, with similar types of occupations and ceramic assemblages as sites located across the northern and central Rio Grande region. Most settlements are small, with five to 40 rooms. There are eight sites with more than 50 rooms, and two very large sites (Patokwa, LA 96 and Little Boletsakwa, LA 136) that exhibit Vallecitos phase occupations, although the bulk of the occupation at these latter two sites dates to later time periods. Most of the sites greater than 50 rooms appear to be solitary, although this is probably an artifact of limited survey in the area of

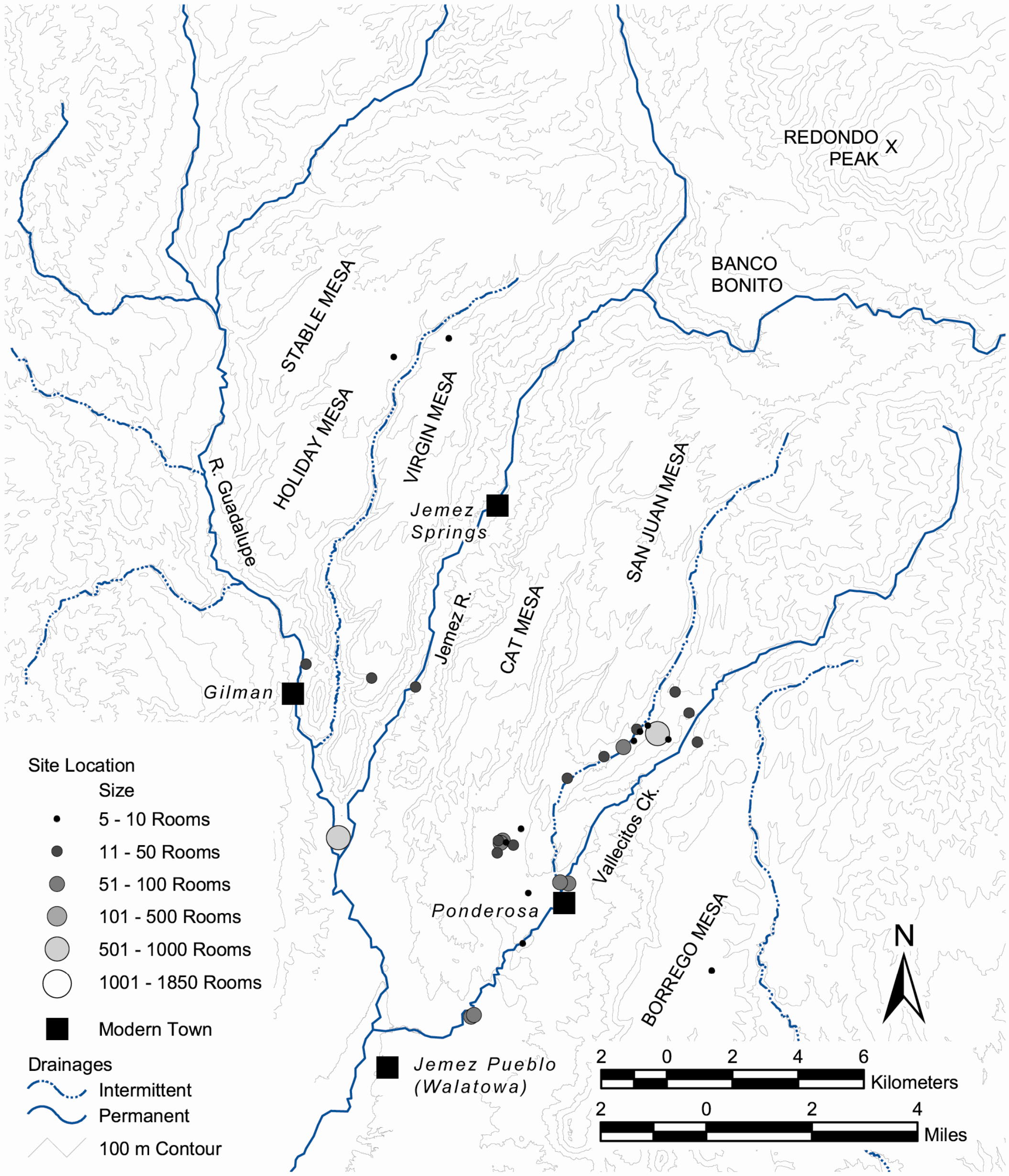


Figure 6.6. The locations of sites with five or more rooms dating to the Vallecitos Phase (A.D. 1200 to 1325/1350). Site data from Archeological Records Management Section files at the Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico.

these settlements (compare Figures 6.5 and 6.6). In areas where survey has been conducted in the vicinity of these larger sites, they are surrounded by a constellation of smaller settlements. These site clusters can be identified in the Cañon de la Cañada, San Juan Canyon, and Paliza Canyon areas. There are probably several other site clusters located along lower Vallecitos Creek, along the Jemez River from Vallecitos Creek north towards Jemez Springs, and along the Rio Guadalupe from the Jemez River north to the Guadalupe Box. Site clusters are not likely on the mesas; the Vallecitos settlements located in these settings have been found during large block surveys and are not surrounded by similar settlements, although Vallecitos phase field houses do occur.

This pattern of smaller settlements clustered around a larger central site is similar to the later Pueblo III (A.D. 1200-1300/1325) occupation described by Roney (1996) for the eastern San Juan/upper Rio Puerco valley to the west and southwest. Ceramics at the settlements in the two areas are also similar, although McElmo and Mesa Verde Black-on-white are substituted for Santa Fe and Vallecitos Black-on-white (see also Baker and Durand 2003; Davis and Winkler 1959). At the two settlement clusters defined by Roney nearest to the Jemez Plateau, Mesa Prieta and Cañada de las Milpas, located 27 and 11 kilometers, respectively, south of the modern town of San Ysidro, Vallecitos Black-on-white manufactured on the Jemez has been identified (Bice and Sundt 1972; Bice et al. 1998). In contrast, Vallecitos Phase sites do not resemble late sites in Gallina area to the northwest. Vallecitos phase settlement of the Jemez Plateau has traditionally been linked to the abandonment of the Gallina area, based on ethnographic evidence (Ford et al. 1972), architecture (Mackey 1982), and perceived ceramic affiliations between Gallina Black-on-white and Vallecitos Black-on-white (Ellis and Dodge 1989b). Elliott (1998), however, has examined stylistic and technological similarities between Black-on-white wares from the Jemez to both Gallina Black-on-white and Santa Fe Black-on-white, and found the Jemez wares to be within the Santa Fe Black-on-white tradition. Together with settlement evidence, the stylistic similarities of Vallecitos Black-on-white to Santa Fe Black-on-white suggest a northern and central Rio Grande and/or southern San Juan Basin origin and affiliation for Vallecitos Phase populations. The abandonment of the Gallinas area between A.D. 1250 and 1300 may have contributed households to the growing settlements of the Jemez Plateau, but the distinct material culture tradition of the area appears to have dissolved along with its occupation (Crown et al. 1996).

Paliza Phase (A.D. 1325/1350-1425/1450). This phase was first described by Elliott (1991, 1998). It is characterized by the formation of many medium-sized (up to 350 rooms) and a few very large (up to 1400 rooms) sites. The bulk of this occupation is was in the southeastern portion of the plateau, as shown in Figure 6.7, although occupations at many of the large settlements were initiated during this phase. The formation of these large communities appears to have been fed in part by migration of peoples abandoning the various portions of the Four Corners and San Juan Basin (Cameron 1995; Cordell 1995). Aggregation of the entire population into settlements greater than 50 rooms was likely completed during the Paliza phase. Only a few sites with occupations in the five to 20 room range are occupied, and several of these are settlements from the Vallecitos phase where the age of the occupation may have been misidentified, or occupations were converted to a seasonal basis and the sites used as field houses or farmsteads. The installation of agricultural features in many of the canyon bottoms and slopes, and also on Borrego Mesa, occurred during this phase, along with the widespread construction of field houses in both drainage bottoms and on mesa tops (Elliott 1991, 1998; Fliedner 1974, 1975). Ceramics that characterize Paliza Phase occupations include late Vallecitos Black-on-white (including Reiter's Jemez "rough" [1938:127-129]), early Jemez Black-on-white (Type A; see Elliott et al. 1988; Gauthier and Elliott 1989), Agua Fria Glaze-on-red (Glaze A), San Clemente Glaze Polychrome (Glaze A), Cieneguilla Glaze-on-Yellow (Glaze A), Largo Glaze-on-red and Glaze Polychrome (Glaze B), rare Abiquiu Black-on-gray, and Rio Grande Blind Corrugated plain wares. Only plain wares and Jemez Black-on-white are typically found at field houses (see Elliott 1991).

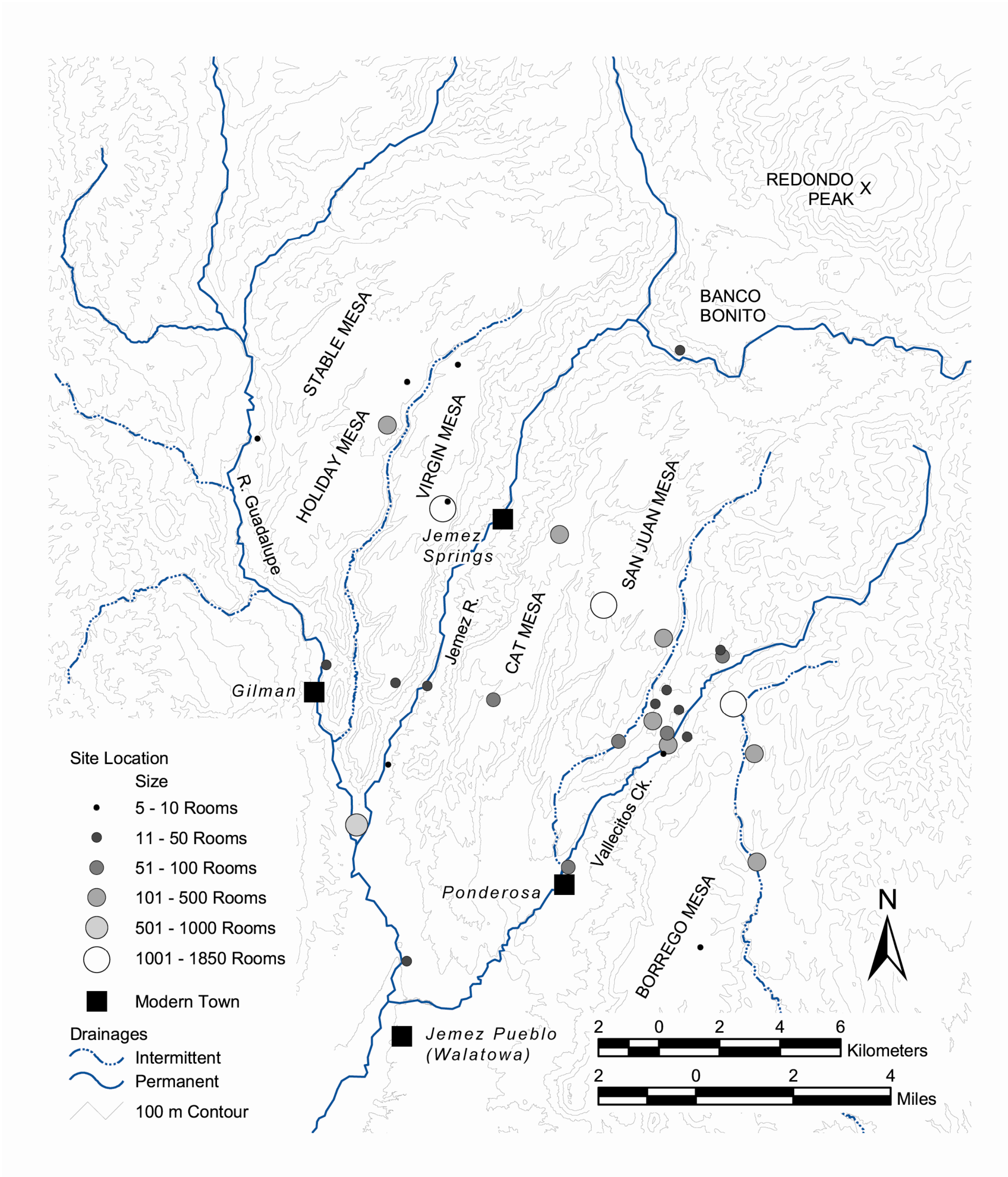


Figure 6.7. The locations of sites with five or more rooms dating to the Paliza Phase (A.D. 1325/1350 to 1425/1450). Site data from Archeological Records Management Section files at the Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico.

The Paliza Phase corresponds to the early portion of Wendorf and Reed's Classic Period, and mirrors many of the changes in settlement occurring in other portions of the northern and central Rio Grande at this time. The size and layout of medium-sized settlements from the Paliza Phase (which Elliott [1991, 1998] terms "plaza pueblos") is consistent with the layout of other settlements of similar size across the northern and central Rio Grande region, from Rio Abajo and Chupadera areas in the south to the Chama Valley and Espanola Basin in the north. This settlement pattern, featuring a set of roomblocks enclosing one or two rectangular plazas, surrounded by a constellation of smaller, more randomly placed and less substantial roomblocks, is remarkably regular across the region during the period of the manufacture of Glaze A and B series ceramics (Cordell 1989). Its presence here indicates the participation of the Jemez Plateau in a widespread regional tradition that emphasized high degrees of social control, likely related to the management of heterogeneous populations resultant from the influx of migrants from the west and south (Bernardini 1998). However, two very large pueblos, Pejunkwa (LA 130) and Wabakwa (LA 478) have only Paliza Phase occupations, but feature the sprawling multi-plaza layout of later Jemez Phase occupations.

Jemez Phase (A.D. 1425/1450-1600/1625). This phase was first defined by Mackey (1982) and Elliott (1991, 1998). It is characterized by the growth and florescence of most the largest settlements of the Jemez Plateau, corresponding with the abandonment of a few large sites over 600 rooms and many medium-sized settlements up to 375 rooms (see Figures 6.8 and 6.9). Based on large site occupation alone, population appears to have peaked during the Jemez phase, and there was population growth among the settlements on the western portion of the plateau. Many communities on the eastern part of the plateau were abandoned, but several large communities in the Paliza Canyon area and on San Juan Mesa continued to be occupied. The widespread usage of agricultural intensification features in canyon bottoms and field houses throughout the region continued, and it is difficult to distinguish whether many of these features

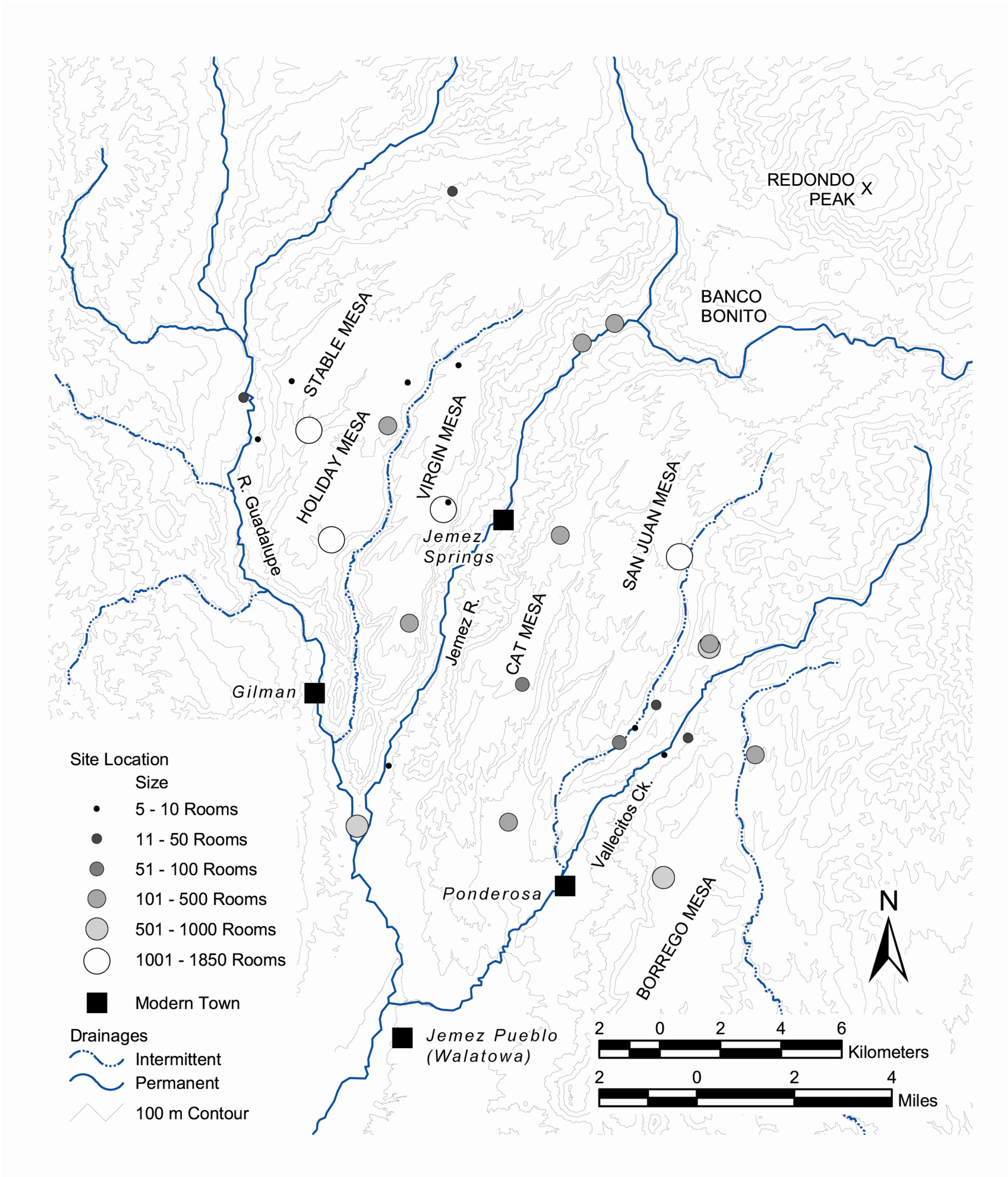


Figure 6.8. The locations of sites with five or more rooms dating to the early Jemez Phase (A.D. 1425/1450 to 1500/1525). Early Jemez Phase occupations are indicated by the occurrence of Glaze C and D series Rio Grande glazewares and the presence of indented-blind (smeared indented) corrugated plainwares. Site data from Archeological Records Management Section files at the Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico.

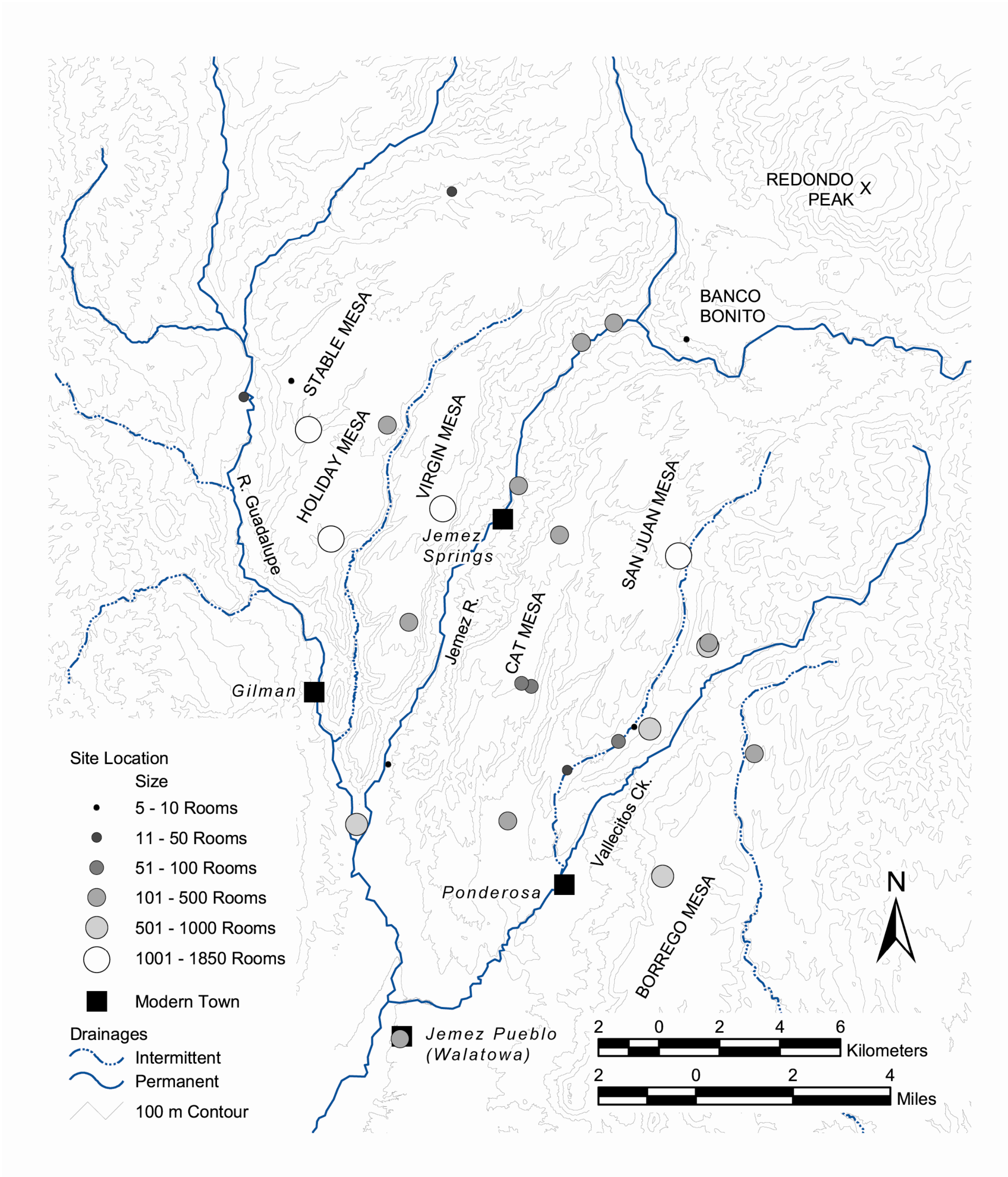


Figure 6.9. The locations of sites with five or more rooms dating to the late Jemez Phase (A.D. 1500/1525 to 1600/1625). Late Jemez Phase occupations are indicated by the occurrence of Glaze E series Rio Grande glazewares and the absence of indented-blind (smeared indented) corrugated plainwares. Site data from Archeological Records Management Section files at the Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico.

date to the Paliza or the Jemez phase, or were utilized during both phases. Field houses, in particular, exhibit broad diversity in form and assemblage characteristics.

Ceramics that characterize occupations of the phase include later varieties of Jemez Black-on-white, Espinoso Glaze Polychrome (Glaze C), San Lazaro Glaze Polychrome (Glaze D) and Puaray Glaze Polychrome (Glaze E), and rare Bandelier Black-on-gray (Reiter 1938; Elliott 2002b). Rio Grande Blind Corrugated wares are present in the early Jemez phase but cease to be manufactured by between A.D. 1500 and 1525; they are replaced by Rio Grande Plain wares (Elliott et al. 1988; Elliott 1991). Plain wares on the plateau after A.D. 1500 fall within the same tradition as plain wares elsewhere across the northern and central Rio Grande, featuring smoothed or polished and reduced interiors (see Chapter VII) . Jemez Black-on-white (Type B) also appears to have evolved stylistically during the phase, with the increasing occurrence of aberrant rims and exterior paint on bowls (Elliott 1991), and stylistic motifs that changed in tandem with the Rio Grande Glaze wares (Graves and Eckert 1998; Morley 2002). Jemez Black-on-white and plain wares continue to be the most frequently found ceramics at field houses, but Puaray Glaze Polychrome (Glaze E) also appears in increasing frequencies at field houses dating to the end of the Jemez Phase. Prior to the Jemez phase, Jemez Black-on-white (Type A) was exported from the area in only minute quantities (see Habicht-Mauche 1993; Kidder and Amsden 1931). After A.D. 1500, Jemez Black-on-white (Type B) appears to have been exported to the northwest in greater amounts, as it is sometimes found in Navajo sites, particularly after A.D. 1600 (Reed and Reed 1992).

The Jemez Phase corresponds to the late portion of Wendorf and Reed's (1955) Classic Period. The layout of the large Jemez settlements—massed, agglomerated roomblocks surrounding a series of plazas, and often featuring a great kiva—are similar to other settlements in the northern and central Rio Grande during this time (Bernardini 1998; Cordell 1989). The location of the majority of these settlements on mesa tops, and away from major drainages, however, is distinct from most other village locations in the northern and central Rio Grande during this time period (Elliott 1991), with the exception of the Pajarito Plateau (Powers and Orcutt 1999).

Guadalupe Phase (AD 1600/1625-1700). This phase is new for this study. During this phase, occupations persist primarily at only the very largest of all settlements, as shown in Figure 6.10. Only two sites (or clusters of sites) over 50 rooms and under 600 rooms, Guisewa (LA 679) and Walatowa (LA 8860) are occupied during this time period, and both sites are the locations of Spanish mission communities after A.D. 1621 (Scholes 1938). The occupation of sites under 50 rooms along the Rio Guadalupe, in San Juan Canyon and in Paliza Canyon are reoccupations of sites first occupied during the Vallecitos Phase and abandoned at the end of the Paliza Phase, a pattern of reoccupation mirrored in part in other areas of the northern and central Rio Grande (Kite 1988; Kulisheck 2003a; Marshall and Walt 1984; Mera 1940). Guadalupe phase occupations have been identified at many field house sites as well, based on the presence of ceramics, European artifacts, or chronometric dates (Acklen and Railey 1999; Elliott 2002b; Kulisheck 2001a; 2001b). These field houses have been identified in a wide number of locations, including in the upper Cañon de San Diego, near the confluence of San Antonio Creek and the East Fork of the Jemez, on the lower portions of Virgin Mesa, and by the current study on the central and lower portions of San Juan Mesa. Based on the proximity and association of these late field houses with large settlements indicating occupation during this phase, many more of these sites are likely present on the plateau. There is at least one Guadalupe Phase site which is qualitatively different from other occupations, the small rockshelter pueblo Bj 74 (LA 38962). This five room pueblo, excavated in 1939 and 1949 by the University of New Mexico, exhibits evidence of a year-round occupation, featured fourteen burials, and has tree-ring dates and ceramics consistent with a mid-sixteenth century occupation (Luebben et al. 1988). It is unknown if there are other sites like Bj 74 in the Jemez. Ceramics that characterize Guadalupe Phase occupations include: a late and historic type of Jemez Black-on-white (Type C) (including

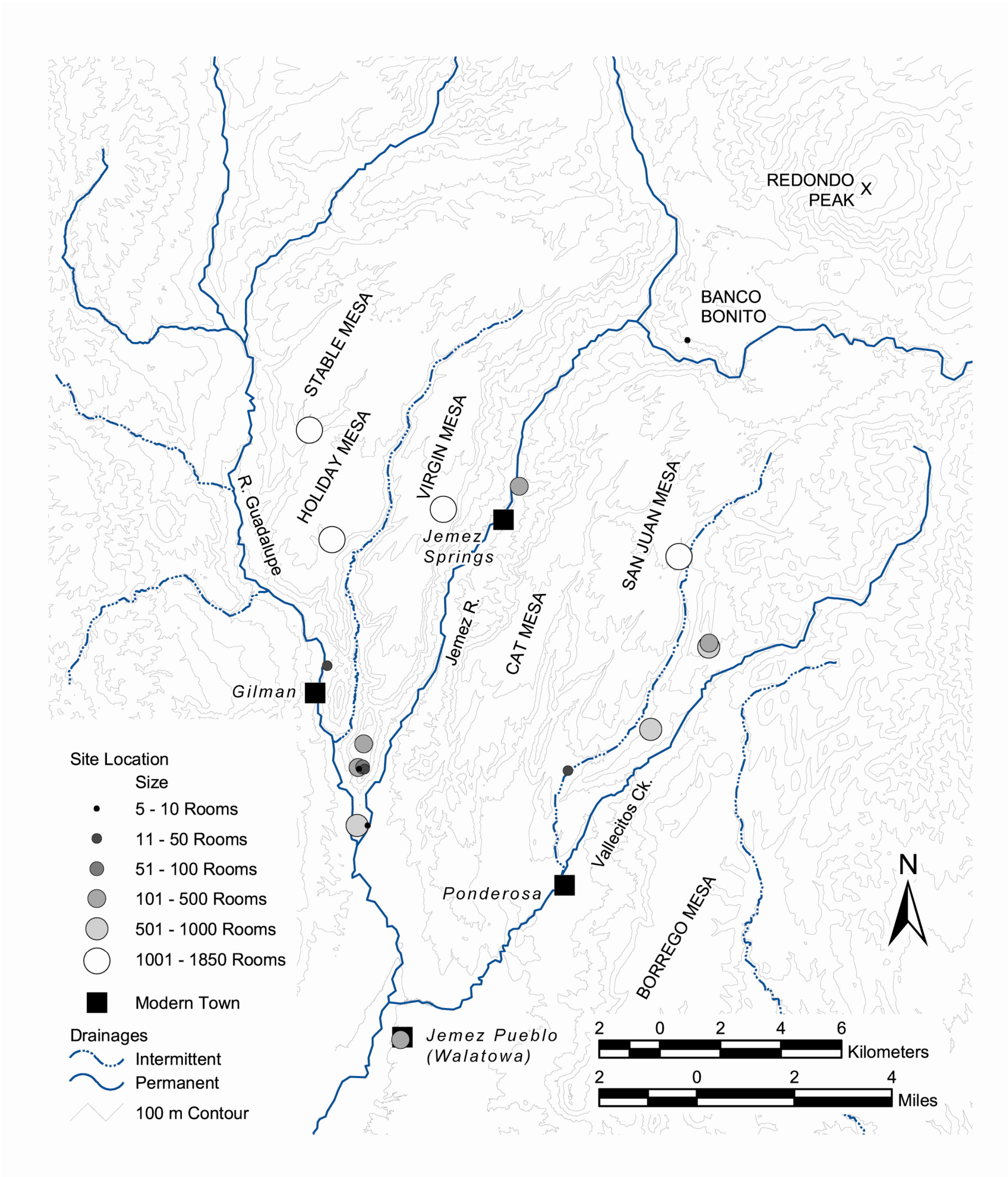


Figure 6.10. The locations of sites with five or more rooms dating to the Guadalupe Phase (A.D. 1600/1625 to 1700). Site data from Archeological Records Management Section files at the Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico.

European forms [soup plates]—see Lambert 1981); Kotyiti Glaze-on-red and Glaze Polychrome, including European forms; and Rio Grande Plain, with high proportions of jars featuring polished and smudged or reduced interiors (Type B). This study found that ceramics bearing European forms, such as soup-plates, were utilized not only at mission communities (Elliott 1993, Lambert 1981), but also at field house sites (see also Kulisheck 2001b).

There appear to be no major changes in the internal configuration of large settlements from the Jemez Phase to the Guadalupe Phase until the advent of the Pueblo Revolt in the latter part of the phase. Following the revolt in 1680, new construction took place at Patokwa (LA 96) and Boletsakwa (LA 135). The new construction at these existing pueblos is similar to the highly planned, plaza-oriented layout of the Paliza Phase, and may be indicative of cultural revivalism in the wake of the eviction of the Spanish (Liebmann 2003). The post-revolt village of Astialakwa (LA 1825; shown in Figure 6.10 as a concentration of five sites), has a very different layout, consisting of dispersed unconnected roomblocks. Probably occupied by individuals from multiple villages in the Jemez, and by other, ethnically and linguistically different Pueblo peoples from other areas within the northern and central Rio Grande region, this dispersion may a product of the social differences between disparate groups gathered together for mutual defense. This pattern of settlement appears to have persisted at Walatowa (LA 8860), the community currently occupied by the descendants of the early modern Pueblo peoples of the Jemez Plateau (Liebmann 2003).

Cañon Phase (after A.D. 1700). This phase is new for this study. Virtually all Pueblo occupation of the Jemez Plateau ceases during this phase; the only permanent habitation appears at Walatowa (LA 8860) (Dodge 1982), with other settlement and seasonal use probable along the Jemez River in the lower reaches of the Cañon de San Diego, along the lower Rio Guadalupe, and along Vallecitos Creek. Seasonal occupation of the mesa tops may continue during this period, as indicated by the retrieval of Ogapoge Polychrome and Tewa Red and Brown sherds from field houses on Holiday Mesa (Lent et al. 1992).

The Sixteenth and Seventeenth Century Jemez Plateau in Historic Documents

Documents relevant to the Jemez Plateau dating to the sixteenth and seventeenth centuries contain significant although disparate information pertinent to settlement and population change, as perceived by Spanish observers. The record of sporadic contact, intermittent occupation and only occasional description of the plateau is consistent with other areas of the northern Southwest, particularly those on the periphery. Estimates of the Pueblo population and numbers of settlements on the Jemez made by sixteenth and seventeenth century observers are summarized in Table 6.3.

Spanish entry onto the Jemez Plateau took place several times during the sixteenth century, providing basic estimates of population size and settlement counts, but the reliability of these estimates is limited by the fact that not all explorers may have actually ventured to the Jemez villages; counts and population estimates may have been based on second-hand reports: The Rodriguez-Chamuscado expedition of 1581 (reported on by Gallegos) visited only two of the 15 settlements they counted in the region, and two years later, Espejo appears to have not visited the area at all. Of the 11 sites reported by Oñate, eight appear to have actually been visited (Barrett 2002:43-44).

Oñate sent a missionary to the Jemez Plateau in 1599, and a church was believed to have been constructed at one of the sites, but the Franciscan left the Southwest along with other clergy members in 1601 (Hammond and Rey 1953); there are no other reports of missionary activity on the plateau for the next twenty years (Scholes 1938). The first *encomienda* established in the Spanish province was imposed on the Pueblo peoples of the Jemez in 1608 (Snow 1983), indicating regular interaction between the area and the Spanish in San Gabriel and Santa Fe, but the people of the area are described as heathens in 1614, implying that at this date there were still no missionary efforts among them and the peoples of the Jemez fell outside of the sphere of formal Spanish control (Scholes 1938).

Table 6.3. Jemez Plateau Population Estimates from Spanish Sources

Date (A.D.)	Reporter	Population Size	# of Villages	Source
1541	Barrionuevo	-	7 or 10[a]	Hammond and Rey (1940:259)
1581	Gallegos	-	15	Hammond and Rey (1966:107)
1583	Espejo	30,000	7	Hammond and Rey (1966:223-224)
1598	Oñate	-	11	Hammond and Rey (1953:322)
1622	Zarate Salmerón	6566	2	Millich (1966:26)
1629	Benavides	3000	2	Ayer et al. (1916:25)
1641-1644[b]	None listed	1860	1	Ivey (1989); Scholes (1929:48, 50, 1944:245)
1663-1666	Cardoso	-	1	Scholes (1929:55)
1660 or 1680	Vetancurt	5000	1[c]	Vetancurt (1961[4]:98,100)

Sources: Kulisheck (2001a:85; 2003:38)

[a]Three sites visited by Barrionuevo are identified as "Aguas Calientes;" these may be communities located in the Cañon de San Diego, or they may be villages located in the Ojo Caliente River drainage, in the Chama area. The Aguas Calientes villages are most commonly interpreted as located in the Jemez; see Barrett (1997) and Schroeder (1979b).

[b]Based on some descriptions listed in this document, Baldwin (1984) believes that it could date to as late as 1656. However, Ivey (1989) states that the bulk of the references to events in the document support the early dates assigned by Scholes (1944).

[c]Vetancurt states that prior to *congregación* (1621), there were five Jemez villages.

The foundation of missions in the region in 1621 was described in detail by the first priest to lead the effort, Fray Gerónimo Zarate Salmerón (Milich 1966), and later by the custodian of the New Mexico missions Fray Alonso Benavides (Ayer et al. 1916; Hodge et al. 1945). Two mission settlements were established, one at the existing Pueblo of Guisewa (LA 679), the mission of San José, and one at a completely new village, the mission of San Diego, at Walatowa (LA 8860) (Elliott 2002a; Scholes 1938). At other New Mexico pueblos, mission policy had been to establish staffed churches and *visitas* at already occupied communities (Weber 1992). Zarate, however, decided that *congregación* was the best policy for missionization in the Jemez (Milich 1966:26). Benavides, documenting Zarate's efforts a decade later, described why. The Jemez nation, Benavides wrote "[is] one of the most indomitable and belligerent of this whole kingdom. Above all, they are very great idolaters. Their pueblos were founded among some terribly rugged uninhabitable mountains....This friar [Zarate], recognizing the impossibility of administering well those Indian mountaineers, induced them to live in a pueblo [Guisewa], which with their help he founded in a very suitable place of this same nation (Hodge et al. 1945:69)." Zarate's missions were destroyed in 1623, and Benavides reported that the years that followed were a time of turmoil. Writing to the King of Spain in 1630, he observed "…the Hemes nation, the which, when I came in as Custodian, had been dissipated through all the Kingdom, and already almost depopulated by famines and wars which were on their way to finish them off….And although more than the half of this nation have died, Your Majesty has withal more than three thousand tributaries congregated there (Ayer et al. 1916:24)." Benavides then re-established the two missions under the supervision of Fray Martín Arvide. Benevides wrote:"… I promptly endeavored to reclaim it and to gather it together in the same province, and placed there a Religious who attended to it with care. And we have congregated it [the Jemez nation] in two pueblos; that is, in the [Pueblo] of San Joseph [Guisewa], which is still standing, with a sumptuous and beautiful church and monastery; and in the [Pueblo] of San Diego, of the

Congregation [Walatowa], which for this purpose we founded new, bringing thither what Indians there were of that nation who were going about astray (Ayer et al. 1916:24)."

Following Zarate and Benevides's detailed descriptions of the missionary efforts of the 1620s, there is little mention of the Jemez Plateau in the historic record until the 1670s. After 1634, San Diego is the only mission community mentioned in documentation, and San José was certainly abandoned prior to 1658 (Elliott 2002a; Scholes 1938). Most references to the area refer to troubles in the missionary effort, including the murder of a priest in 1639, the suicide of another in 1661, and uprisings and conspiracies by the Pueblo peoples of the Jemez and other areas throughout the 1640s and early 1650s (Scholes 1938). The mission at San Diego was apparently staffed between 1672, when most missionaries from the Spanish colony met at Walatowa (LA 8860), and the revolt of 1680 (Bloom and Mitchell 1938).

The period of the Pueblo Revolt on the Jemez Plateau is well represented in Spanish documents; these have been recently summarized elsewhere (Barrett 2002:96-99; Elliott 2002a) and will not be recapitulated here. Important, however, is Elliott's (2002a) reconstruction of settlement during this period, based on the corpus of recently translated documents relating to the activities of the 1692 re-entry into to New Mexico of the Spanish led by Don Diego de Vargas (Kessell et al. 1992, 1995, 1998). Based on descriptions in de Vargas's documents, Elliott has identified occupations by Pueblo peoples at Patokwa (LA 96) and Boletsakwa (LA 135) at the time of the Spanish return in 1692-1694, with occupation at mission communities at Patowka (San Diego al Monte) and Walatowa (LA 8860) (San Juan de los Jemez), and of the refugee fortress at Astialakwa (LA 1825) (Elliott 2002a; see also Liebmann 2003). Following the second Pueblo Revolt of 1696, most of the Pueblo peoples of the Jemez fled the area and sought refuge with the Navajo, at the Pueblo communities of Laguna, Acoma and those at Hopi, and other with Native American groups. Refugees began to return to the area in 1706 and resettled at Walatowa (Bloom and Mitchell 1938). Since 1706, Walatowa has remained the only settlement occupied by Pueblo peoples on the Jemez Plateau (Sando 1979, 1982).

A superficial reading of the Spanish documents pertaining to settlement and population on the Jemez Plateau would give an impression of site abandonment and demographic decline, particularly after 1620 (Barrett 2002; Kulisheck 2001a, 2001b, 2003). This is how these documents have been interpreted in most overviews incorporating evidence from the Jemez into overviews of Pueblo population decline during the sixteenth and seventeenth centuries (Dobyns 1991, 1993, Earls 1985, 1992, Haas and Creamer 1992, Lycett 1995; Palkovich 1985, 1996, Reff 1991; Rushforth and Upham 1992, Schroeder 1979, 1992; Simmons 1979; Upham 1982; Wilson 1985). The policy of *congregacíon*, or the concentration of several disparate populations into a single community, is associated with the process of population decline, both in New Mexico (Kulisheck 2001a; Schroeder 1979) and in other portions of Spanish North America (Jackson 1994a, 1994b). However, the archaeological evidence fails to correspond with this interpretation, a fact recognized by researchers like Scholes as early as 1938 (see Scholes 1938:93-94; see also Barrett 2002:134-135; Kulisheck 2001a, 2001b, 2003). During the Guadalupe Phase, the period of direct Spanish control over the Jemez Plateau, there are occupations at five large settlements on the plateau, at several smaller settlements, and the use of at least several dozen field houses. The extent to which this represents evidence contrary to the picture of population decline that emerges from the Spanish documents cannot be established. The settlements maintaining occupations during the Guadalupe Phase are among the largest on the plateau, and have not been subject to either extensive excavation or controlled examination of surface ceramic distributions. Although thousands of field houses have been recorded on the Jemez Plateau, only in the past few years has there been any attempt to distinguish between occupations from different time periods (see, for example, Elliott 2002b), and the total number of small seasonal sites utilized during this time period cannot be estimated. Clearly, there is significant evidence to question the interpretation derived from the historic documents that the Jemez Plateau experienced significant population decline and settlement abandonment in the seventeenth century (Kulisheck 2001a, 2003). However, additional evidence is needed to evaluate the issues of the timing and magnitude of population decline, if any, on the plateau during the sixteenth and seventeenth centuries.

CHAPTER VII

STUDY DATA AND RESEARCH METHODS

Examination of the question of sixteenth and seventeenth century population decline on the Jemez Plateau, through changes in the usage of field houses, requires two instruments. The first is a temporal scale appropriate to evaluating differing hypotheses regarding population decline across the Pueblo world in the sixteenth and seventeenth centuries, relative to the overall trajectory of population change in the early modern Pueblo era. The second are measures that can assess changes in the use of field houses relevant to changes in agricultural intensification, and to population change.

This chapter describes the methods that were used to evaluate changes in field house use in this study, and the chronological framework that was constructed to allow for the examination of changes in field houses through time. It also describes the methodology used to assign field houses to different temporal units relevant to population change. These methods were applied to 30 field house sites located on the eastern portion of the Jemez Plateau. The work consisted of the in-field, non-collection analysis of architectural attributes and surface artifact assemblages, conducted during approximately 23 weeks of field work in 1996, 1998, 1999, and 2000. How this sample of field houses was selected from the over two thousand field houses that have been recorded on the Jemez Plateau is also outlined in this chapter.

The Site Dataset

Data for this study is derived from surface assemblages and architectural features at 30 field house sites located on the eastern portion of the Jemez Plateau (Figure 7.1). These sites were selected from a population of 1100 recorded archaeological sites located on the eastern portion of the plateau. The eastern portion of the Jemez Plateau consists of all of the areas east of the Jemez River and San Antonio Creek, and includes the Banco Bonito, Cat Mesa, San Juan Mesa, the Paliza Canyon area, and Borrego Mesa. The decision to examine sites on only one side of the Plateau was purely logistical. Although roughly equal numbers of sites have been recorded on the eastern and western sides of the plateau, I chose the east side because, based on the large site data discussed in the last chapter, occupations on the east side are more evenly distributed across all phases of occupation. Based on the large site data, occupations on the west side are weighted more heavily towards the Jemez and Guadalupe phases. Other than the temporal distribution of large sites, in other respects, the east and west sides are similar. They both have the same range in elevation from north to south, and have roughly the same proportions of mesa top, canyon bottom, and foothills/mountain front settings. They have similar patterns of overstory vegetation, and both are dominated by Bandelier tuff geological formations and bedrock geology. Geology on the margins of the two sides are different, with the west side margin along the Sierra Nacimiento consisting of sedimentary and granite rocks, whereas the east side margins are characterized by basalts and other volcanics along Peralta Ridge and on Borrego Mesa.

The population of 1100 potential field house locations was selected from a dataset of site locations provided by the Archaeological Records Management Section (ARMS), New Mexico Historic Preservation Division. The data originates from the New Mexico Cultural Resource Information System (NMCRIS) database, a comprehensive database of all recorded sites in the state of New Mexico, compiled from Federal, State, tribal, municipal, private and academic site records. From this universe of all recorded sites as of May 1995, those sites falling on the eastern

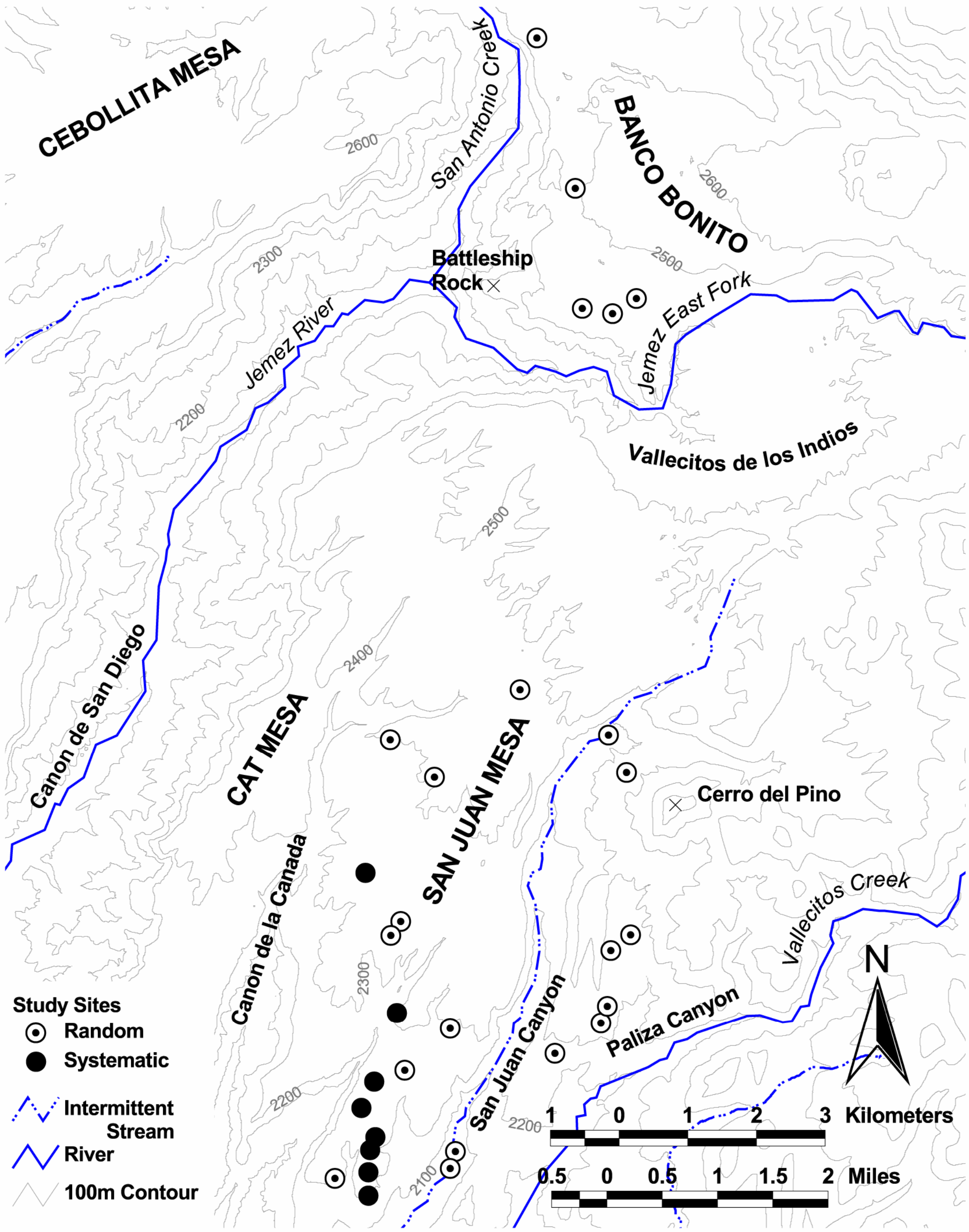


Figure 7.1. Location of the study sites on the eastern Jemez Plateau. Note difference in scale from figures in Chapter VI.

side of the plateau were selected, and sites located on private or tribal land, listed with a cultural affiliation other than "Anasazi" or "Pueblo",[1] and having an earliest occupation date after A.D. 1692 were excluded. The remaining sites are the population of 1100 potential field house sites.

All 30 sites selected for this study have some type of architectural remains. As a check against the exclusion of artifact scatters that may represent field houses from the potential field house population, the distribution of all artifact scatters, not just those that are identified as "Anasazi" or "Pueblo", was also examined. Using the same NMCRIS data, 72 artifact scatters were identified on the eastern part of the plateau, 39 of which are included in the 1100 population of potential field house locations. All 72 of these sites were assigned an "Anasazi" or "Unknown" cultural affiliation in the NMCRIS dataset. Of the 33 sites not included in the initial population, 10 are located above 2500 meters elevation, and are probably in locations unsuitable for farming. Of the remaining 23 sites, 8 are located in a cluster on the southeastern margin of the plateau in the Borrego Dome area, with the remainder distributed randomly among the larger potential field house population. If artifact scatters do have the potential to represent field house locations, the small number of sites excluded from the potential field house site population, and their low numbers overall, suggest that as an archaeological phenomenon they are not significantly overlooked by this study.

Twenty-eight (28) sites were originally selected at random from the pool of 1100 sites for intensive field analysis. The sites were selected without regard to their age of occupation. Virtually all of the sites within the pool of 1100 had not been assigned by previous recorders to a time range narrower than A.D. 1350 to 1700. The sample size was determined solely by the amount of work that could be accomplished during the time allotted for field work. The sites were examined during the 1996, 1998 and part of the 1999 field seasons. Of these sites, five were removed from the sample when they could not be relocated. One site turned out to be a small rock overhang with a small structural bin or cist constructed into it. The entire structure has a clearance of no more than 75 centimeters, and could not have functioned as a shelter or residence for humans. There were no artifacts associated with this small storage feature, so the site was removed from the sample. This left a total of 22 field house sites in the final site random sample.

In addition to the 22 sites that were selected at random, eight sites were also systematically selected for field analysis, based on their potential to date to after A.D. 1625. The rationale for the addition of these sites is based on fieldwork results from the 1996 and 1998 field seasons indicating that many more field house sites potentially dating to the seventeenth century might be present than were previously expected. When this research was first initiated in 1996, it was assumed that the Jemez Plateau had experienced significant population decline and concentration in mission sites by the early 1600s. The appearance of several sites with potential seventeenth century occupations in the random sample, and the chance encounter with several other field houses not in the sample that featured seventeenth century remains, required a reevaluation of this assumption. The original data set was reassessed by examining the original site records of 889 of the 1100 original population of sites, by using the NMRCRIS data to exclude those site that could not have had seventeenth century occupations (that is, the database information was precise enough to indicate that the site occupation ended prior to A.D. 1600). Of these 889 sites, original records indicated potential seventeenth century occupations at 36 sites, based on the occurrence of seventeenth century ceramic types and Spanish-associated artifacts, such as metal tools. Preliminary field visits were made to all of the 36 sites, and 24 were confirmed to have potential seventeenth century occupations. Of these, 8 were randomly selected for study during the 1999 and 2000 field seasons.

Surface Archaeology

All of the material remains analyzed during this study were surface phenomena, and all remains were analyzed in the field. The only materials collected were two dendrochronological specimens that had been exposed by past illegal excavations at two sites (the dating results from these two specimens is listed in Appendix B). The decision to conduct analyses based on a no-excavation, no-collection strategy is based on the assumption that surface phenomena constitute a valid fraction of both architectural and assemblage remains at field houses on the Jemez Plateau. This assumes that the analysis of surface remains is valid in settings where post-depositional processes have not destroyed or significantly altered surface evidence that is necessary to our understanding past human activities (Dunnell and Dancey 1983; Lewarch and O'Brien 1981; Schlanger and Orcutt 1986). While not all research questions can be addressed by surface remains, neither can we ignore the utility of surface phenomena in the interpretation of past occupation at a locality. In general, all site remains, buried or not, have experienced post-depositional life histories as a consequence of discard behavior, human activities, and natural taphonomic forces (Schiffer 1987). Thus, there is no difference in analytic value between surface and buried remains. Dunnell and Dancey set the parameters for the study of surface remains, stating that "the surficial distribution of artifacts constitutes an appropriate source of archaeological data independent of subsurface remains. As long as surface distributions contain patterned information that is analytically separable from postdepositional patterning, they are useful data (Dunnell and Dancey 1983:270)." The choice between examining surface or subsurface remains, then, is a research choice, and surface remains are an equivalent or even superior choice to subsurface remains depending on one's specific research question. Alan Sullivan wrote:

> [i]f indeed there are limitations in the interpretive value of surface archaeological phenomena, then those limitations need to be demonstrated analytically rather than simply assumed. Along these lines, it is worth recalling Dunnell and Dancey's (1983:269) aging but nonetheless timeless observation that the subsurface record is ultimately derived from surficial depositional events and processes. The obvious and crushing logical consequence of their sagacious comment is that if, as some archaeologists allege, the surface archaeological record is [inherently] flawed, then the interpretive sanctity of the subsurface record may be somewhat overrated [Sullivan 1998:xi-xii].

The study of surface remains have been used widely both in the Southwest and elsewhere to examine a variety of research questions, including the issues of site chronology and function examined by this study (Downum and Brown 1998; Schlanger 1992; Schlanger and Orcutt 1986; Powers et al. 1999). In particular, surface remains have been utilized to specifically examine these questions at sites identified as field houses (Sullivan and Downum 1991; Berger and Sullivan 1990). The utility of surface approaches in the Southwest has also been demonstrated through the examination of other research questions, including the use of landscapes for foraging and collecting (Camilli and Ebert 1992; Ebert 1992; Schlanger 1992), site formation and structure (Sullivan 1987; Sullivan and Tolonen 1998), and inter-site variability (Bayman and Sanchez 1998; Sullivan 1995).

Studies of surface assemblages are particularly appropriate in arid lands settings, because in most upland areas there has not been significant burial of remains through alluvial deposition or other geomorphological processes, and vegetation rarely constitutes a significant obstruction to surface visibility (Wandsnider and Camilli 1992; Downum and Brown 1998; Simmons 1998; see also Kowalewski 1990). As outlined in the last chapter, the Jemez Plateau has a variety of geomorphological settings and has experienced significant changes in vegetation cover over the past 150 years due to both climatic events (drought) and human activities. In general, surfaces across the Jemez Plateau have remained stable, with no significant geomorphological changes except within the floodplains and terrace systems of the major drainages (the Jemez River, the Rio Guadalupe, and Vallecitos Creek) (Rogers 1996). The minor intermittent drainages, including San Juan Canyon, have no floodplains and have not experienced major modifications to their terrace systems since the end of the Pleistocene (Drakos et al. 1996).

Vegetation can have a significant effect on the visibility of surface remains (Bintliff 2000; Camilli and Wandsnider 1992). The sites examined in this study are distributed across two major vegetation associations, the Ponderosa Pine, Two-needle Piñon and Gambel Oak association at lower elevations and the Ponderosa Pine and Gambel Oak association at higher elevations (see Chapter VI). (The former is a transitional woodland-to-forest association that combines elements of the Ponderosa Pine and Gambel Oak forest association and the Two-needle Piñon and One-seed Juniper woodland association.) These two associations contain somewhat different overstories but both have understories that are quite open. Surface visibility, however, is conditioned by overstory, rather than understory conditions, due to the human-caused effects to vegetation. In many of the lower elevation locations among the Ponderosa Pine, Two-needle Piñon and Gambel Oak association where Ponderosa Pine are scarce and One-seed Juniper are common, grazing has removed understory vegetation (grasses, herbs and forbs)and mineral soil is exposed on the surface. In the higher elevation series the effects of grazing have also removed understory vegetation, but the ground surface is obscured in most areas by pine needle litter due in large part to fire suppression practices that have raised both the tree densities and the resulting needle cast along the forest floor. This difference in surface visibility might be mitigated by the removal of needle litter. This has been demonstrated recently by the resurvey of a 223 hectare (550 acre) area previously surveyed on the western Jemez Plateau. Situated in the Ponderosa pine and Gambel Oak forest association, this area was burned over by a catastrophic wild fire in 1991. A post-fire resurvey of the area located 20 percent more sites than during the initial survey (45 during the initial survey, 54 during the resurvey) because the fire had removed the surface pine needle litter. Two-thirds of the newly discovered sites (6 of 9) are either artifact scatters, or have features (rock alignments) that are not traditionally associated with structural field house remains, compared with only 4.5 percent of the previously discovered sites (2 of 45) (Raish 1992). The value of removing surface needle litter as a method of compensating for differences in surface visibility is evaluated in Chapter VIII. The methods for removing surface needle litter are described in the next section.

No-collection methods of artifact analysis such as the one used in this study have been criticized as inferior to studies of surface evidence that utilize collected materials (Bintliff 2000; Butler 1979; Plog et al. 1978; Redman 1987). Ultimately, these criticisms relate to logistical issues, concerns regarding data preservation, and criticism of the reliability of analysis results. On-site surface analysis is not appropriate for a site that is to be destroyed. It is also inappropriate in many cases during initial survey, where anticipated remains are unknown, and it is difficult to devise analytical methods without knowing potential ranges of variability. These situations do not apply to the current study. The sites used in this study have been previously recorded and the range of materials to be found can be anticipated. The main challenge faced by this study is the reliability of in-field analysis results. Controlled study of in-field analysis versus laboratory analysis of collected artifacts found there were no significant difference in reliability between results from the two methods (Beck and Jones 1994). Problems in reliability observed in previous studies were likely a problem of differences in training between field workers and laboratory analysts, or poor design of in-field data collection methods. Because the sites used in this study are in stable condition, the results of this study can be tested and replicated. Because of continuous processes of artifact exposure and burial, it is anticipated that the surface assemblages encountered by future researchers will differ somewhat from those encountered in this study (Beck and Jones 1994). However, general patterns of variability should not change when adjusted for sample size effects.

Beyond issues of validity and reliability, surface and in-field analysis was selected for this study based on two pragmatic concerns. The first is the opposition to excavation and other disturbing analyses by descendent communities. All of the area included in this study falls within the area ancestrally occupied by Jemez Pueblo (Walatowa). As a community, Jemez Pueblo has had a long-standing general aversion to anthropological research, based on negative experiences with ethnologists and other researchers early in the 20th century (Sando 1982; see also Zumwalt 1992:248-249). The Jemez community's involvement in the recent repatriation of human remains from Pecos Pueblo, another community ancestral to many members of Jemez Pueblo (Fine-Dare 2002:1-3), has also led to a general opposition to archaeological research as a matter of course.[2] While Jemez Pueblo neither condoned nor opposed the current study, my research was designed to minimize lasting impacts to the archaeological record of past settlement of that community's ancestors. As a consequence, artifact locations were recorded to ensure that all artifacts temporarily removed for in-field identification, analysis, illustration and photography were replaced to original discovery locations. The only disturbance to sites came from compaction and the removal of surface vegetation by repeated tracking to reused locations such as datum points and the artifact weighing station. Revisits to study sites a year or more following the analysis of surface remains found that these sites had successfully revegetated and there was no long-term evidence of disturbance.

The second pragmatic concern related to the curation of artifacts from excavation and from surface collection. Museums and other artifact repositories in the Southwest and across the United States are currently experiencing a crisis in the space they have available for archaeological collections, and funding to maintain existing collections in a stable condition (Sullivan and Childs 2003:23-35). By doing all artifact analysis in the field, I wanted to not contribute to the excess of collections now present in institutions. I also wanted to demonstrate that meaningful research results could be obtained from surface remains without collection. Leaving the surface assemblage in the field also allows for future researchers to utilize those artifacts for other research problems, not constrained by the collection methods specific to this study.

Analytic Variables and Methodology

Examining variability in field house use, this study focuses on four aspects of past human behavior. The first is the age of the occupation; that is, the time frame or period(s) in which the field house was occupied. The second is the duration of occupation at the field house, both periodic and lifetime. Included in consideration of occupation duration are the dimensions of anticipated duration of occupation, actual duration of occupation, and incidence of reuse or reoccupation. The third aspect of human behavior monitored is the estimated number of people associated with site use. The fourth is the diversity of domestic activities performed at the field house. All four of these aspects of human behavior are monitored through various aspects of the field house material record. This section details the material evidence in the field house record utilized to make inferences regarding past behavior, and the specific field methods used generate data from those material phenomena.

Behavioral Variables and Material Phenomena

Each of the four behavioral aspects of field house occupations have material phenomena from which inferences can be made about those occupations (Table 7.1).

Age of Occupation. Primary determination of the age of occupations at study sites is based on the occurrence of established time diagnostic ceramic types. Because several of the established types employed are believed to contain intra-type temporal variability, a set of potentially temporally sensitive attributes is also monitored to distinguish between provisional types. Dating of sites based on ceramic occurrence rather than frequency seriation or mean ceramic dating was chosen because of the small sample sizes of the surface assemblages at many of the sites in the study sample, and the need to reduce the analyzed portion of larger assemblages for attribute analysis. It is also based on the lack of a range of established types that have occurrence spans brief enough for frequency seriation to properly function. One objective of the attribute analysis was to identify additional temporal variability that can be used in future frequency seriation of other sites on the Jemez Plateau. A complete discussion of the challenges and prospects for the frequency seriation of ceramic assemblages at field houses can be found in Chapter VIII.

Duration of Occupation. Duration of occupation is monitored through four phenomena: masonry standardization, remodeling and reconstruction, assemblage size, and assemblage class richness. The first measures anticipated duration of occupation, while the remaining three monitor actual duration of occupation. Two aspects of architecture, the shaping of masonry

Table 7.1. Behavioral Aspects of Field House Occupations and Material Correlates

Behavioral Variable	Material Phenomenon	Measures
Age of occupation	occurrence of time-diagnostic ceramic types	occupation and use of a site within one or more time periods
	frequency of time-diagnostic ceramic attributes	relative ordering of sites continuously through time
Duration of occupation	shaping of masonry blocks, size of masonry blocks	investment in architecture (anticipated duration of periodic or lifetime occupation)
	interspatial variability in masonry shaping and block size, bond-abutment relationships	remodeling and reconstruction (actual duration of periodic or lifetime occupation)
	assemblage size	artifact discard (actual duration of lifetime occupation)
	assemblage class diversity	artifact discard (actual duration of lifetime occupation)
Use group size	size of enclosed area	relative size of group (number of persons) using and occupying the site
Diversity of domestic activities	assemblage class diversity	number of domestic activities performed at site
	presence of extramural features	number of domestic activities performed at site

blocks and the standardization of block size, are indicators of architectural investment and thus anticipated occupation duration (Diehl and Gilman 1996). A third measure, volume of masonry could be used to estimate former wall heights, a variable found to be important for inferring the anticipated duration of occupation at small structures (Diehl 1992). Because of strong post-depositional processes discussed below, however, the volume of stone could not be monitored. Intra-structure variability in measures of standardization, along with evidence of bond-abut relationships where standing walls are present, are indicators of intentional modification of the anticipated use-life of a structure (Cameron 1991; Diehl and Gilman 1996). Both assemblage size and assemblage class richness (as a measure of assemblage diversity) are products of occupation duration. Plain ware sherds are the most common class of ceramics found at field houses sites, but whole ceramic assemblages are used in this study to examine accumulation. Plain ware vessels are assumed to have been used primarily as food preparation and liquid storage containers, and the remains of this ware is the standard artifact used for accumulations studies (Varien and Mills 1997), and are used in this study. Because of unequal discard rates between different classes of artifacts, assemblage class richness is also a product of duration (Shott 1989b). Lithic functional classes are monitored for this effect.

Use Group Size. The size of the group of individuals using the field house is inferred from estimated enclosed area, calculated from rubble mound size and from number of rooms. Enclosed area is used here as relative proxy for field house users, due to the complexities associated with using settlement size measures for estimating absolute population size discussed in Chapter IV (see also Nelson et al. 1994). In addition, while it is assumed that field house enclosed area is related to population size in some way, the relationship may not be the same as that in primary residential settlements. For example, enclosed area might receive less use than extramural areas, and thus the amount of enclosed space per person could be less, as is the case for hunter-gatherer structures in temperate areas (Weissner 1974). The number of persons utilizing a structure can also be inferred from artifact accumulation and artifact class diversity.

But these measures are affected by duration, whereas duration does not appear to effect structure size (Diehl 1992; Kent and Vierich 1989). Because of the independence of structure size, it can be used as a constant against which assemblage variables can be compared to determine whether assemblage variability is a consequence of duration or of population size.

Diversity of Domestic Activities. The diversity of domestic activities performed at field houses can be inferred from both assemblage diversity and from the presence of extramural features. Because both sample size and occupation duration can have an effect on assemblage diversity, this phenomenon serves as a better measure of occupation duration than it does for activity diversity. While increases in intermittent occupation duration may have increased the actual breadth of domestic activities performed at field houses (Orcutt 1993), it would be difficult to distinguish between whether activities were actually being added to the domestic repertoire, or whether occupations are of such a duration that they span the discard rate of the artifacts associated with the artifacts indicative of the additional domestic behaviors. Diversity in lithic functional classes is monitored relative to assemblage size to see if there increases in class richness that would not be predicted by sample size alone. The presence and diversity of extramural features, which generally represent investment rather than discard (waste concentrations or residues of activity, such as thermal features, are an exception), are better for generating inferences regarding activity diversity. This is because the presence of extramural features is not a consequence of stochastic periodicity (the failure and discard rates of artifacts). Unfortunately, surface visible extramural features (and based on excavations, buried extramural features as well) are uncommon in the study sample and apparently in general on the Jemez Plateau, as they are on the Pajarito Plateau (Powers et al. 1999). Their presence, then, rather than their functional diversity, is the measure of behavioral diversity here, although inferred function is necessary to assess the particular significance of any given extramural feature to the breadth of domestic activities.

Field Methods

Recording activities at each of the 30 study sites followed a two stage process focusing first on site layout and architecture, and second on associated artifact assemblages. All sites were recorded on the 1993 version of the Laboratory of Anthropology (LA) Site Record form. Additional forms for architectural attributes and ceramics were also employed (see Appendix C).

A plan map was made for each site using a tripod-mounted Brunton compass and measuring tape relative to one or more arbitrary datum points. These measurements were used to create detailed maps of the structural architecture of the site, and any other relevant natural or cultural features present at the sites, such as extramural features. Several sites exhibited significant variation in elevation across the site surface, despite their relatively small size. However, because Brunton-and-tape cannot precisely capture variations in elevation, topographic differences were estimated during mapping.[3] Architectural attributes were also captured on a separate form (Appendix C). Photographs were taken of architectural attributes to ensure control over inter-site variability of qualitative architectural attributes.

Artifacts associated with field houses were located by walking systematic parallel traverses spaced 1 to 2 meters apart across the entire site surface, radiating out from the site architecture to the point where no artifact was encountered more than 30 meters from the last, or where a major physiographic break (such as a drainage) or change in slope was present (based on the assumption that artifacts from the site would not have been redeposited upslope). All artifact locations were marked with pin-flags. All of the artifacts in proximity to the site architectural remains were assumed to be in association with the architecture, an artifact "halo" that was the consequence of both discard behavior by the users of the field houses and post-depositional dispersion (Bintliff and Snodgrass 1988). Only one of the 30 sites studied has the potential for a surface assemblage that overlapped with another associated with a separate architectural feature, although several of the sites had evidence of two structures. At these sites it was assumed that the assemblages were mixed. Within surface assemblages, only ceramic and lithic materials were found.

At sites where surface needle litter obscured a significant portion of the site, needle litter was removed from a portion of the site surface using a light-tined metal garden rake (the same type that would be used for raking leaves) to expose mineral soil. At sites where artifacts were present, raking areas were selected by a snowball method, where raking was begun in areas adjacent to or containing artifacts, and continued in directions where artifacts were exposed through raking. At sites where artifacts were initially absent, raking was conducted systematically in a concentric fashion beginning at the margins of the site's field house rubble mound. Because of variability in site sizes, no standard area was raked at each site, but was generally halted at topographic breaks, or at sites artifacts located prior to raking, when raking no longer yielded additional artifact exposure.

The ceramic fraction of the surface artifact assemblage was either completely recorded or was sampled if it numbered over 100 sherds. Where assemblages exceeded 100 sherds, these were systematically sampled from the surface population until the sample size reached approximately 100 individuals. For example, site LA 24645 had a surface ceramic assemblage of 616 sherds identified during the initial walk-over of the site. A sample approximating 100 sherds would be one-sixth of the size of the population. To arrive at this sample, the 1-2 meter traverses used to identify the population were re-walked and the first five pin flags marking sherd locations were pulled; the sixth flag encountered was left in place. This process, repeated across the entire site surface, left 102 flagged sherds, each of which was analyzed. Sherds that were considered to be particularly time-diagnostic, such as Rio Grande Glaze ware rim sherds, were left marked for identification, photography and illustration, but were not included in the analysis sample. Although excluded from the sample to ensure that the attribute analysis would accurately reflect the distribution of variability in the surface assemblage, these sherds were useful in occurrence dating, which can be biased when samples sizes are kept small. This is particularly true if the most time-diagnostic individuals (in this case, Rio Grande glaze ware rims) are rare. Analyzed sherds were individually weighed to control for taphonomic effects on assemblage size (Orton 1982, 1993), as assemblages were of different ages and in several different areas of vegetation. In addition to the base analysis, rim sherds were subjected to an additional analysis developed from Shepard (1956) and listed in Appendix D. The locations of all analyzed sherds were measured in two-dimensional space using the same datum as used for site mapping.

The method of systematic sampling was employed here for three reasons. First, practically, because of the generally small sample sizes, an artifact-based sampling method versus an area-based method (analyzing sherds from random, systematic or judgemental sample plots) was less time consuming, as no spatial grid needed to be created. Second, systematic sampling avoided the problem of sample bias from the clustering of sherds from a single vessel, an effect caused by the discard of an entire vessel (in broken pieces) in a single location (Blinman 2000:51-52). And third, because it was necessary to quantify the entire surface ceramic assemblage population to develop a systematic sample, measurement of the surface assemblage population size allows assemblage characteristics observed in the sample to be estimated for the population where differential assemblage population sizes is relevant to inter-assemblage comparisons (for measures such as accumulation).

The number of lithic artifacts in the surface assemblage was typically much smaller than the ceramic artifact total. All surface lithics were tallied according to raw material type, reduction stage (if chipped stone) and inferred function or formal type, if the individual piece exhibited inferred use-wear or retouch.

Chronology

Comparing measures of field house use requires that field houses can be assigned to temporal units relevant to population change. In other portions of the northern and central Rio Grande, studies that have addressed the issues of agricultural intensification and population change have been able to use existing chronological frameworks and ceramic chronologies to provide dates for sites based on surface evidence alone (for example, see Head and Orcutt 2002; Snead 1995; Powers and Orcutt 1999).[4] The current state of archaeological knowledge regarding population change and temporal variability on the Jemez Plateau, however, requires the construction of a new framework for establishing the age of field house sites on the plateau from surface evidence. Although a new overall chronological framework for the Pueblo occupation of Jemez Plateau was presented in Chapter VI, this sequence is designed to understand the nature and pace of cultural change in relation to larger trends in the northern Southwest, and relative to the current state of knowledge regarding the archaeological record of the plateau. The question of demographic change requires the creation of temporal units specifically relevant to population change and its effects on field house use. Existing ceramic chronology on the Jemez Plateau is insufficient for examining change at the scale of these units. As a consequence, a revision of the existing ceramic types for the plateau is also required.

Definition of Temporal Units

In order to monitor change in the field house record relevant to issues of population change on the Jemez Plateau, it is necessary to construct a chronological framework that divides time into units relevant to that change. The temporal units used in this study are presented in Table 7.2. The division of time into these units is based on hypotheses about population change across the early modern and early late modern Pueblo eras. The hypotheses of population changes across this period are derived from the research hypotheses regarding population change during the sixteenth and seventeenth centuries on the Jemez Plateau and in the northern Southwest discussed in Chapter III. For other centuries prior to and following this time span, hypotheses for population changes are taken from the overall record of culture change discussed in Chapter VI. The basis for the definition of each unit are discussed in chronological order.

Table 7.2. Study Time Units

Date (A.D.)	Northern/Central Rio Grande	Jemez Plateau	Study Units
1800			
		Cañon after 1700	IV (1700-1825)
1700	Historic 1600-present		
		Guadalupe 1600/1625-1700	V (1625-1700)
1600			
			IV (1525-1625)
1500		Jemez 1425/1450-1600/1625	III (1450-1525)
	Classic 1325-1600		
1400		Paliza 1325/1350-1425/1450	II (1325-1450)
1300			
	Coalition 1200-1325	Vallecitos 1200-1325/1350	I (1200-1325)
1200			

Unit I (A.D. 1200-1325) corresponds to Wendorf and Reed's (1955) Coalition Period. It is a period of population growth and expansion in the northern and central Rio Grande, as a consequence of internal growth and immigration from the San Juan Basin and elsewhere (Cordell 1989, 1995; Kohler 1989). Overall however, population levels in the region are assumed to be low relative to later periods.

Unit II (A.D. 1325-1450) corresponds to the early Classic Period, a span of time characterized by significant population growth, probably stimulated by large-scale immigration into the northern and central Rio Grande region (Cordell 1989, 1995; Crown et al. 1996).

Unit III (A.D. 1450-1525) corresponds to the middle Classic Period, which is associated with widespread abandonment and population decline across the greater Southwest, and village abandonment and population instability within the northern and central Rio Grande (Bernardini 1998). The direction of population change in the northern Southwest during this period is unknown.

Unit IV (A.D. 1525-1625) corresponds to the period of time between the first possible appearance of European infectious diseases in North America, as suggested by the Dobyns hypothesis (Dobyns 1983; Upham 1982, 1986) and the beginning of the imposition of Spanish colonial rule, adjusted to the establishment of missions on the Jemez Plateau. If the Dobyns hypothesis is applicable to the northern Southwest, this would be a period characterized by the significant decline of Pueblo populations. If there was no significant decline from disease during this period, alternative directions for population change are unknown.

Unit V (A.D. 1625-1700) corresponds to the period of time between the establishment of missions on the Jemez Plateau, and the final abandonment of the plateau as documented in historic records, following the second Pueblo Revolt of 1696. Across the Pueblo world, this is a period of gradual but significant population decline, according to historic records (Barrett 2002; Palkovich 1985; Reff 1991).

Unit VI (A.D. 1700-1825) corresponds to the period in time between the end of the second Pueblo Revolt and the end of the Spanish Colonial era. This is a period of relative stability among Pueblo populations, according to historic documents such as census records (Palkovich 1985; Simmons 1979). However, populations are believed to have been much smaller than in previous periods. Based on historic records and the record of large site occupations, the Jemez Plateau had no permanent Pueblo population during this period.

The focus of this study are the changes in population that take place between periods IV and V and the preceding and following periods them. Periods IV and V, corresponding to the time span A.D. 1525-1700 is the traditional time span of interest to those examining Pueblo population decline as a consequence of Spanish conquest (Barrett 2002; Dobyns 1990; Earls 1992; Haas and Creamer 1992; Kulisheck 2003a; Lycett 1995; Ramenofsky 1996). The other periods are included here to contextualize population trends during the sixteenth and seventeenth century with overall population change on the plateau. As discussed in Chapter III, it is critical to engage in such contextualization, for two reasons. First, it is necessary to distinguish the effects of Spanish-introduced forces of population decline from forces internal to Pueblo social, economic and political organization driving population change. Isolating the examination of population change to the sixteenth and seventeenth century forces an assumption that Pueblo populations prior to this period were stable. Not only do we know that Pueblo populations were not stable in the pre-Spanish early modern era, but it also appears that the fifteenth century was characterized by an unusually high degree of population instability in the northern and central Rio Grande area (Bernardini 1998). Depopulation in any one region of the northern Southwest during the sixteenth century, then, needs to be understood in the context of this potential instability. Second, there is a potential for inter-regional variability in the effects of introduced infectious diseases, despite the assertions of the Dobyns hypothesis of uniformity in the timing and magnitude of population decline from disease (Palkovich 1985, 1996; Ramenofsky 1996).

Because the size and distribution of populations will be central to disease transmission, inter-regional variability in population size must be assessed.

The units used here are of unequal duration. This would be a concern if differential levels of settlement were compared between periods. Under these conditions, intra-period differences in settlement occupation would need to be calibrated to account for unequal length to make population proxy quantities directly comparable (for example, see Mahoney et al. 2000; Wilshusen 2002). The method used here sidesteps this problem by not quantifying the population change between the various periods. Instead, it establishes relative measures of population density for each period that is based on site structure, so that observations about population are independent from the number or density of sites and their population proxies during any single period. Rather, the challenge in taking the approach used here is to control for spatial and temporal variability within each period. Spatial variability could be a consequence of agricultural diversification strategies; if so, then field house use would be variable within a single period (see Kohler 1992; Orcutt 1993). At the same time, population change may be taking place at a rate more rapid than reflected by 75 to 150 year long periods, or taking place "out of phase" with unit divisions based on the hypothesized population changes posited in this study. Both of these issues can be evaluated by examining within-period variability among field houses, although it would be difficult to distinguish between intra-period spatial or temporal variability.

Ceramic Chronology

The assignment of field house sites to one or more of the temporal units defined for this study is based on a ranked occurrence seriation of diagnostic ceramic types. The ranked occurrence seriation and its assignment of study sample sites to different time units is described in Chapter VIII. This section defines the types that are used in the occurrence seriation. I utilize mostly existing types, but I also create several new provisional types to take advantage of temporal variability that has not yet been formally classified by others into types. The typology used here is sherd-based; both the unit of analysis and the unit of classification is the sherd. Existing ceramic types in the northern and central Rio Grande are particularly amenable to sherd-based analyses because most type definitions, unlike many San Juan Basin and Colorado Plateau types, are made on the basis of surface treatment and surface modification attributes, rather than differences in stylistic motifs (Habicht-Mauche 1993). In a sherd-based analysis of ceramics, classes based on surface characteristics are superior to stylistic characteristics because they are ubiquitous, except in the situations where sherd surfaces have eroded away. This means, of course, that several types could be distributed across a single whole vessel, particularly given the variability in surface treatments seen across plain ware vessels (Habicht-Mauche 1993). Such co-occurrence is not a problem given the definition of types here as only temporal units. As long as the types that have the potential to co-occur are not mutually exclusive in their temporal distribution (i.e. the entire temporal span of the first co-occurring type does not overlap in duration with the entire temporal span of the second), then the types remain valid as temporal indicators.

The ceramic sherd types used in this study, along with their temporal duration, are listed in Table 7.3. The definition of both "type" as a unit of classification, and the definition of the individual types, follows Habicht-Mauche's application of the type-variety system of ceramic classification to northern and central Rio Grande ceramics (Habicht-Mauche 1993:9-10), but differs in several important respects. Southwestern pottery types are complex units that, as created, have both intensional and extensional dimensions (Blinman 2000; Lambert 1998; Lyman et al. 1997). That is to say, types have been created by Southwestern researchers both as units for capturing the temporal and spatial distribution of pottery-making peoples (intensionally defined), and have been defined as sorting categories based on empirical differences (extensionally defined) (Dunnell 1971:15-18; Ramenofsky and Steffen 1998). In her application of the type-variety method of ceramic classification, Habicht-Mauche does not attempt to create intensional definitions for northern and central Rio Grande ceramic types. Rather, she is interested in

Table 7.3. Diagnostic Ceramic Types Found at Jemez Plateau Field Houses

Ceramic Type	Date (A.D.)	Reference for Date
Plain Wares		
Rio Grande Plain—Type A var. Jemez	1200-1700	
Rio Grande Plain—Type B var. Jemez	1500-1825	Habicht-Mauche 1987; Kidder and Shepard 1936
Rio Grande Corrugated var. Jemez	1200-1350	Habicht-Mauche 1993; Vint 1999
Rio Grande Blind Corrugated var. Jemez	1250-1500	Habicht-Mauche 1993
Kapo Black	1650-1760	Vint 1999
White Wares		
Santa Fe Black-on-White	1200-1350	Vint 1999
Vallecitos Black-on-White	1230-1400	Sundt 1987
Jemez Black-on-White—Type A	1350-1500	Elliott 1994
Jemez Black-on-White—Type B	1500-1700	Elliott 1994
Jemez Black-on-White—Type C	1620-1700	Lambert 1981
Glaze and Matte Polychrome Wares		
Agua Fria Glaze-on-Red (Glaze A)	1340-1425	Habicht-Mauche 1993
Cieneguilla Glaze-on-Yellow (Glaze A)	1375-1425	Sundt 1987
San Clemente Glaze Polychrome (Glaze A)	1340-1425	Habicht-Mauche 1993
Espinosa Glaze Polychrome (Glaze C)	1425-1490	Vint 1999
San Lazaro Glaze Polychrome (Glaze D)	1490-1515	Vint 1999
Puaray Glaze Polychrome—Type Early (Glaze E)	1515-1600	Warren 1977b
Puaray Glaze Polychrome—Type Late (Glaze E-F)	1600-1650	Warren 1977b
Kotyiti Glaze Polychrome (Glaze F)	1625-1700	Vint 1999
San Marcos Glaze Polychrome (Glaze F)	1620-1700	Lambert 1981
Tewa Polychrome	1650-1730	Vint 1999
Puname Polychrome	1700-1760	Vint 1999
Ogapoge Polychrome	1720-1760	Vint 1999

creating clarity and consistency in the extensional definition of types, particularly where there are hierarchical relationships between types, such as Santa Fe black-on-white and Pindi black-on-white. The type-variety system of classification with its hierarchical units of ware, series, type and variety is useful for describing these hierarchical relationships.

Rather than treating the classificatory units of the type-variety system as sorting categories, I use two of the units, type and variety, as intensional units for describing the distribution of ceramics in time and space (Figure 7.2). The term series is not used here, and ware is used only as a sorting unit, not as a unit implying affinity or genetic relationships between ceramic types and their makers. Here, are used types measure variability through time, while varieties are used to measure variability through space. “Types” are classes of ceramic sherds that are defined on the basis of their duration in time. The goal of classifying sherds into types is to create units that have a maximum spatial extent (to allow different sites with the same types present to be included in a single chronological sequence) and a minimal temporal extent (so that greater temporal precision can be achieved). “Varieties” are sub-classes within individual types defined on the basis of attributes within a type that vary according to the geographic distribution of the type. Unlike types, varieties as used here do not serve an analytical purpose in this study, but are used to clarify the basis for the definition of several new types used in this study, where several existing ceramic types defined on the basis of spatial differences in attributes were combined into a single new type based on similar attributes with the same temporal duration. In this classificatory scheme, I only identify varieties where it is relevant to the creation of new types, or the application of an existing type to ceramic variability seen in Jemez ceramic assemblages. In other cases where variety names are omitted, it is assumed that there is no spatially relevant variability in the type, or that the spatial variability in the type is unimportant to the definition of the type as it is used here as a temporal unit.

Plain (Unpainted) Wares. Temporal variation in the plain ware tradition on the Jemez Plateau appears to follow that of the northern and central Rio Grande region as a whole. As a

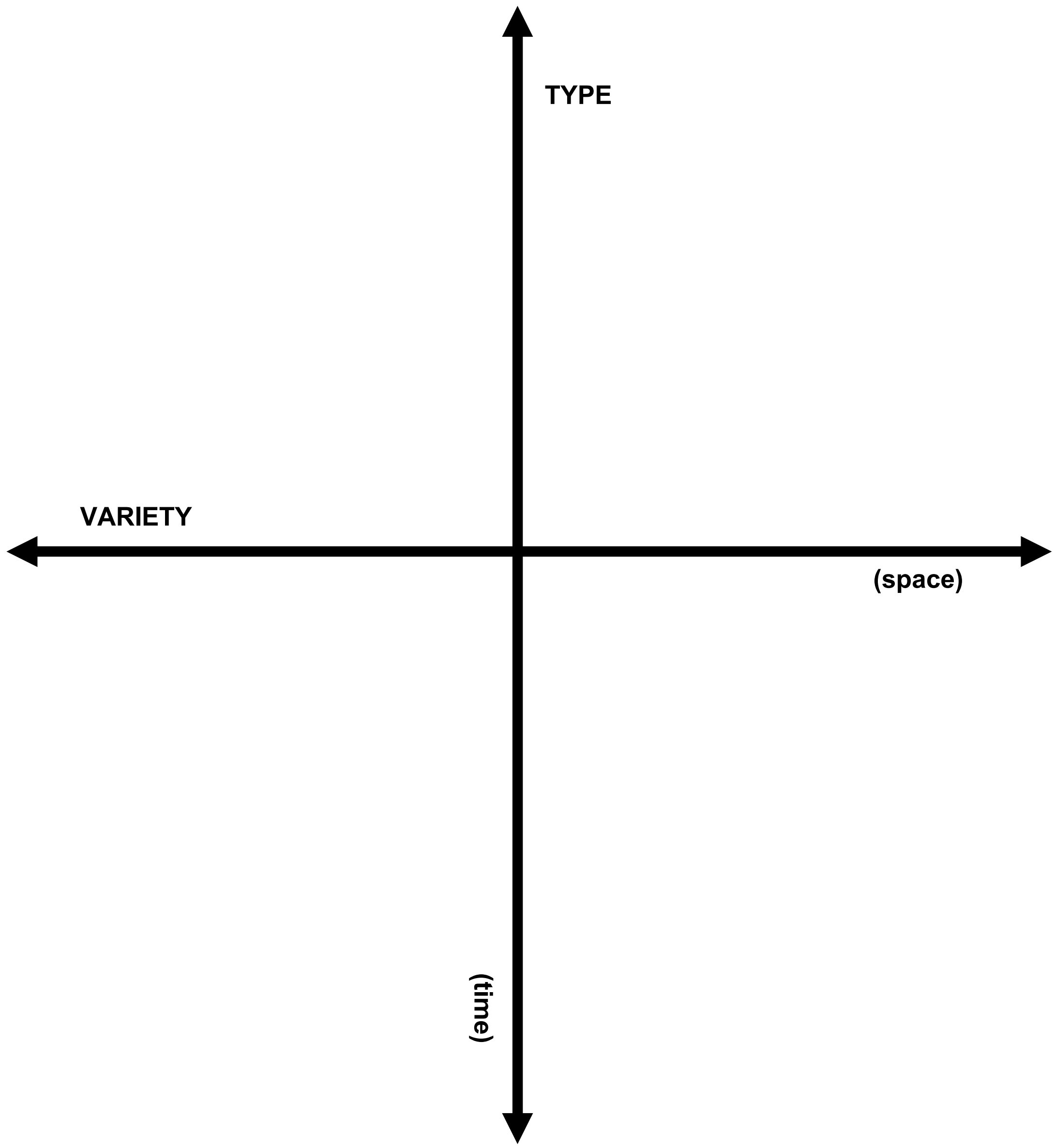


Figure 7.2. Habicht-Mauche's type-variety system for the classification of northern and central Rio Grande ceramics. In this study, types delineate duration of manufacture in time, while varieties demarcate extent of manufacture in geographic space. Varieties are subordinate to types. A type may have several varieties, but a variety can have only one type.

consequence, I have named the ceramic types to reflect their similarity to other areas in the region and designate the variability, which appears to be mainly in paste and temper rather than surface finish, to be varietal rather than typological. While affiliating the Jemez plain wares with those from other areas across the northern and central Rio Grande, I assume that these types on the Jemez have the same temporal duration across the region, however, there is no empirical support for this assertion. As a consequence, I made observations on the temporally sensitive attributes of plain wares to examine this hypothesis. The variability in surface attributes, and the attributes used to monitor temporal variability in plain wares, are listed in Table 7.4.

Although the type names listed in Table 7.3 imply that there are region-wide types, in reality the type names presented here are new, a consequence of the widespread neglect of systematic consideration of plain ware variability. Most researchers have failed to create formal types for plain wares, except where such wares exhibit "stylistic" attributes such as slips, polishes or designs exercised through corrugation or incision (Harlow 1973; Mera 1934, 1935; Sundt 1987). Instead, most researchers have followed the conventions established by Kidder and Shepard (1936) to classify ceramics simply according to surface treatment without reference to type names (see, for example, Kohler and Gray 1993; Vint 1999). Habicht-Mauche has been one of the few who has attempted to impose typological control over the classification of plainwares, and the creation of types here follows from her efforts.

Rio Grande Plain, variety Jemez. As a type, Rio Grande Plain encompasses all sherds that do not exhibit intentional corrugation, indentation, incision, punctation or other forms of accentuating variability in the relief of the ceramic surface. In general, exterior polish or the application of a slip has been a criteria for designating formal types, and so this type would exclude materials with those specific attributes where they have been designated by other researchers. This type is new for this study and encompasses all materials previously classified in other studies as "plain", "striated", "smudged", or including other attributes that do not describe intentional accentuation of surface relief or are not used to delineate formal types. It also does

Table 7.4. Jemez Plain Ware Types
a. diagnostic surface attributes

Type	Diagnostic Surface Attributes
Rio Grande Plain Type A	rough or smoothed interiors and exteriors on closed forms
Rio Grande Plain Type B	rough or smoothed exteriors, partially or completely polished interiors on closed forms. High frequency of interior surface reduction or “smudging” (blackening)
Rio Grande Corrugated	corrugated, indented corrugated, clapboard corrugated and other intentional partial retention of coil construction patterns on exterior surfaces of closed forms, lacking evidence of intentional partial obliteration of corrugation
Rio Grande Blind Corrugated	corrugated, indented corrugated, clapboard corrugated and other intentional partial retention of coil construction patterns on exterior surfaces of closed forms, with evidence of smearing, scraping, wiping or other intentional partial obliteration of corrugation
Kapo Black	polished and reduced exteriors on closed forms

b. attributes monitored to validate temporal assignment

Attribute	Variable Type	Monitors
surface modification	categorical	intentional accenuation in variability of surface relief (corrugation, punctation, incision, etc.)
surface treatment	categorical	intentional finishing of the surface through scraping, smoothing or polishing
surface reduction	presence/absence	reduction or “smudging” (blackening) of the surface

not make reference to any particular paste characteristics or tempering materials, encompassing the range of variability of raw materials that would have been available to potters across the region.

The type as defined here is somewhat of a negative category, defined by what it is not, suggesting that it has the potential to be divided into several temporally significant types based on the distribution of different attributes, as has been done in other areas (see Harlow 1973; Mera 1934, 1935). Across the northern and central Rio Grande region, two separate provisional types can be suggested, based on the presence or absence of polishing and smudging on the interior of closed forms (jars). *Type A* has minimally finished surfaces on both the interiors and exteriors of closed forms, and is found throughout the late ancestral and early modern era of the northern Rio Grande region, and after A.D. 1300/1325 in the central Rio Grande region (Rio Abajo and Salinas; see Marshall and Walt [1984] and Vivian [1964]). *Type B* has partially or completely polished interiors, and reduced or "smudged" interiors on closed forms. The Jemez varieties of these two provisional types are distinguished from other area varieties by the presence of tuff temper, or black glassy vitreous pyroxene andesite temper (Shepard 1938). Reiter observed at Unshagi that the latter temper type replaces the earlier temper type around the time where blind corrugated plain wares disappear from the Unshagi assemblage (Reiter 1938:107).

The appearance of distinct interior finishing on Rio Grande plain ware vessels, as seen on Rio Grande Plain Type B, appears to follow the widespread disappearance of corrugated wares from plain ware assemblages after A.D. 1500. Rio Grande Plain Type B corresponds the Faint Striated type defined for Pecos Pueblo that dates to approximately A.D. 1500-1700, and the Heavy Striated type that replaces it for the period A.D. 1700-1840 (Kidder and Shepard 1936:316-319; Powell 2002:240, 244); Faint Striated has also been identified at Pa'ako, Puaray, and San Marcos (Habicht-Mauche 1987). Smoothed plain wares found at Abo and Pueblo Pardo dating to A.D. 1500-1700 and identical to the Pecos Faint Striated (Toulouse 1949:14; Toulouse and Stephenson 1960:23-24). Plain wares with interior polish are also found in the Salinas area at

Gran Quivira (Vivian 1964:103). Interior polished plain wares have been retrieved from Cerro Indio, Plaza Montoya and San Pascualito in the Rio Abajo (Marshall and Walt 1984:323, 326); the former two have A.D. 1500-1700 components, while the third site dates to A.D. 1300-1490. Based on their occurrence at disparately located sites, it is believed that these interior finishing attributes occur region-wide in Rio Grande Plain after A.D. 1500 (Snow 1982:266).

Most descriptions of Jemez ceramic assemblages describe both subtypes of Rio Grande Plain as “plain” or “Jemez Plain”. Few of the excavators of late plain ware assemblages in the Jemez have noted the distinctive surface finishing of Type B when describing plain wares, but this subtype was very evident in the ceramic assemblages analyzed for this study. Highly smoothed or polished interiors were ubiquitous in the plain wares recovered from three sites in the Horseshoe Springs area, near the confluence of the Jemez River and San Antonio Creek (Reed and Goff 1999:68). The three sites all date to between A.D. 1500 and 1700 (see Table 6.1). Walatowa (LA 6680) was first occupied after A.D. 1620; about one-tenth of the plain ware sherds recovered from waterline trench excavations had smudged and polished interiors (Dodge 1982:72). To test the temporal validity of region-wide observations regarding the duration of the Jemez variety of Type B (polished and smudged interiors), the attributes of interior and exterior surface finishing and the presence or absence of interior and exterior surface reduction or “blackening” were monitored.

Rio Grande Corrugated, variety Jemez. This type corresponds to the Rio Grande Corrugated defined by Vint (1999) and Habicht-Mauche (1993), and the Jemez Mountain Paste Corrugated defined by Sundt (Bice and Sundt 1972). It includes all plain wares that have corrugated, indented corrugated, and clapboard corrugated surfaces, or exhibit other intentional partial retention of coil construction patterns on exterior surfaces of closed forms, and lack evidence of intentional partial obliteration of corrugation. The Jemez variety is distinguished by the presence of tuff temper (Bice and Sundt 1972:165). Rio Grande Corrugated has been generally poorly defined in excavated Jemez Plateau assemblages, and is most prominent in the assemblage from Vallecitos Pueblo (Mackey 1982). The date range used here is the same as that used for the Pajarito Plateau and Santa Fe area. To test the temporal validity of region-wide observations regarding the duration of the Jemez variety of Rio Grande Corrugated, the attribute of exterior surface modification (the presence of corrugation or other intentional modifications) was monitored.

Rio Grande Blind Corrugated, variety Jemez. This type corresponds to Habicht-Mauche's (1993) Tesuque Gray. Her Tesuque Gray type was meant to impose order on a variety of corrugated, indented corrugated, ribbed and other wares that have intentional partial retention of coil construction patterns on exterior surfaces of closed forms that have had some intentional partial obliteration of that surface pattern through smearing, rubbing, wiping or scraping (see Habicht-Mauche 1993:14-15 for a list of these northern Rio Grande types). I have changed the name of the type to clarify its similarity to Rio Grande Plain and Rio Grande Corrugated types in paste and temper composition, and its distinction from these two types in surface modification. The term "blind" follows Kidder and Shepard (1936) as a generic term encompassing smeared, rubbed, wiped and scraped partially obliterated surfaces. The date range used here is the same as that used for the Pajarito Plateau and Santa Fe area. The Jemez variety of Rio Grande Blind Corrugated is distinguished by the presence of primarily tuff temper (Shepard 1938:206-207), although I have also observed Blind Corrugated sherds that exhibit vitreous pyroxene black andesite temper. The type has been well described for the Jemez Plateau based on the excavated assemblage from Unshagi, where Reiter calls it Indented Blind Corrugated, following Kidder and Shepard at Pecos (Reiter 1938:104-107). To test the temporal validity of region-wide observations regarding the duration of the Jemez variety of Rio Grande Blind Corrugated, the attribute of exterior surface modification (the presence of partially obliterated corrugation or other intentional modifications) was monitored.

Kapo Black. This type corresponds with the type defined by Harlow (1973). It is a plain ware distinguished by reduced and polished exteriors on closed forms. Where exterior surfaces are not reduced, the type is termed Kapo Gray. Kapo Black and Kapo Gray can be easily confused with Rio Grande Plain Type B if no distinction is made between on which surface of a closed form sherd polish and/or reduction occurs. The occurrence of Kapo Black on the Jemez Plateau has been poorly described. It has been found in the excavated assemblages of a few field houses on the western plateau, on Virgin Mesa (Lent et al. 1992), and in the excavated assemblage from Guisewa (Lambert 1981). It has also been reported from surface collections in the Cañon de San Diego, on the Banco Bonito, and elsewhere. The Kapo Black from Guisewa was assumed to be imported from the Tewa Basin area, but this type could have also been locally manufactured. The analysis of paste and temper characteristics is needed to distinguish a separate Jemez variety. The date range used here follows that used for the Pajarito Plateau (Vint 1999).

White Wares. The white ware sequence on the Jemez Plateau has for the most part been considered endemic to the area, and has received less attention than other white wares in the northern and central Rio Grande region. Here, I use all existing types, but divide the chronologically final type, Jemez Black-on-white, into three provisional types based on temporal variability that has been observed by other researchers. Beyond the three existing types identified here, a large number of other existing white ware types from the northern and central Rio Grande have been located at large sites on the Jemez Plateau. However, I have included only those that are known to have occurred at field houses. To validate the temporal variation proposed for the several provisional types proposed for Jemez Black-on-white, I made observations on the temporally sensitive attributes of white wares that monitor this variability. The variability in surface attributes, and the attributes used to monitor temporal variability in white wares, are listed in Table 7.5. The type descriptions below contain only those attributes relevant to the chronological sorting of types used in this study; other distinctive attributes may be present, and cited sources should be consulted for full discussions of type variability.

Santa Fe Black-on-white. This type corresponds to the Santa Fe Black-on-white type defined most recently by Habicht-Mauche (1993) and Ruscavage-Barz (2002b). Within the type,

Table 7.5. Jemez White Ware Types
a. diagnostic surface attributes

Type	Diagnostic Surface Attributes (Open Forms Only)								
	open - closed ratio	interior slip	exterior slip	slip color	interior polish	exterior polish	interior paint	exterior paint	rim shape
Santa Fe Black-on-white	very high	thin, uneven	rare, thin if present	blue-gray	uneven	absent	present black	absent	direct
Vallecitos Black-on-white	very high	thick, even	thick, even	white	uniform	rare, uneven if present	present black	absent	direct
Jemez Black-on-white Type A	high	thick, even	thick, even	white	uniform	uneven	present black	absent	direct
Jemez Black-on-white Type B	even	thick, even	thick, even	gray or cream	uniform	uneven	present faded	present faded	can copy glaze
Jemez Black-on-white Type C	bowls only	thick, even	thick, even	gray or cream	uniform	uneven	present faded	present faded	copies Spanish forms

b. attributes monitored to validate temporal assignment

Attribute	Variable Type	Monitors
vessel type	categorical	type of vessel (open, closed, or aberrant form)
sherd placement	categorical	inferred placement of the sherd on the vessel
rim shape	categorical (5 sub-categories)	shape of rim (including maximum thickness, thickening location, angle, and termination) when present
surface treatment	categorical	intentional finishing of the surface through scraping, smoothing or polishing
slip	presence/absence	presence of all-over clay surface covering
paint	presence/absence	presence of organic or mineral paint design elements

Sources: Elliott (1991, 1994, 1998).

open forms (bowls) are common and closed forms (jars) are rare. Among open forms, interiors are slipped or unslipped, and exteriors are almost never slipped; slips when present on interiors are thin and incomplete. Because of the thinness of the slip when it is present, the white slip over the gray vessel surface tends to have a bluish-gray cast. In the rare instances where slips are present on open form exteriors, white slip is used like a paint. Open form interiors and closed form exteriors are variably polished, and open form exteriors are unpolished. Open forms have paint on the interior only. The date range for Santa Fe Black-on-white used here is the same as that used on the Pajarito Plateau, ending around A.D. 1350 (Vint 1999). Habicht-Mauche (1993:19-22), however, reports that Santa Fe Black-on-white persists as late as A.D. 1410 at Arroyo Hondo, implying that this type could persist past A.D. 1350 in other areas, including the Jemez.

The occurrence of Santa Fe Black-on-white on the Jemez Plateau has been poorly defined. It has not been found in any quantity in excavated assemblages from the plateau. As a type, Santa Fe appears to have been manufactured widely across the northern Rio Grande region, and appears to have occurred in a number of varieties based on differences in paste and temper. However, it does not appear to have been manufactured on the Jemez Plateau, unlike several other regionally distributed white ware types, or varieties manufactured on the Jemez Plateau have not yet been distinguished from those made elsewhere in the Jemez Mountains (Sundt 1991). The variety found on the Jemez Plateau probably corresponds to Habicht-Mauche's Santa Fe variety.

Vallecitos Black-on-white. This type corresponds to the Vallecitos Black-on-white defined by Habicht-Mauche (1993) and by Sundt (Bice and Sundt 1972). The type is poorly defined, and no description of the type has been based on an excavated assemblage from the Jemez Plateau itself. The primary description of the type comes from Sundt (Bice and Sundt 1972), based on excavated ceramics from the Prieta Vista site, located near Mesa Prieta about 35 kilometers south of the Jemez Plateau, and Mera's surface collections from sites in the Vallecitos

Creek area. Like Santa Fe Black-on-white, Vallecitos Black-on-white is dominated by open forms, although there are higher percentages of closed forms of Vallecitos Black-on-white at Prieta Vista than other black-on-white types. Unlike Santa Fe Black-on-white, slips are thick, very white, and are applied on both interior and exterior surfaces of closed forms. Open form interiors are well-polished and painted, while exteriors are only smoothed and are unpainted.

The date range used here is the one assigned by Sundt (1987), with a final date of approximately A.D. 1400. Significantly, Reiter does not report finding Vallecitos Black-on-white at Unshagi, despite the fact that he places the founding date of the village at around A.D. 1375 (Reiter 1938:123-124). However, he does identify an early type of Jemez Black-on-white that he calls Jemez Black-on-white “rough”, that fits the description of Vallecitos Black-on-white, particularly the later tendencies of the latter type described by Sundt (Bice and Sundt 1972). Reiter’s refusal to recognize that he had Vallecitos Black-on-white in the earliest component at Unshagi may have been driven by his hypothesis that Jemez Black-on-white was an intrusive type descended from Mesa Verde Black-on-white or Gallina Black-on-white that replaced Vallecitos Black-on-white, which was descended from Santa Fe Black-on-white (see also Lang 1982).

Jemez Black-on-white. This type corresponds to the type described by Elliott (1991, 1994, 1998), Habicht-Mauche (1993), Lambert (1981) and Reiter (1938). Jemez Black-on-white is better described than Vallecitos Black-on-white; however, the type encompasses a range of temporal variability that has not been fully classified in a typological fashion. Overall, Jemez Black-on-white is characterized a lower ratio of bowls to jars than Santa Fe and Vallecitos Black-on-white. Jemez Black-on-white has thick white slips on the exterior of closed forms, and on both the interior and exterior surfaces of open forms. On open forms, both interiors and exteriors are well polished. A variety of date ranges have been reported for the type, but the best range appears to be A.D. 1350 to 1700. Elliott (1994) believes that the type was not manufactured prior to A.D. 1375, and the first secure dates are from Unshagi around A.D. 1400. The last dated associations of Jemez Black-on-white is with sites dating to the Pueblo Revolt era of A.D. 1680 to 1696, including Boletsakwa (LA 136), Patokwa (LA 96), and Astialakwa (LA 1825). This last site appears to have been fully constructed and occupied during the Revolt Era (Liebmann 2003), providing a final date associated with the appearance of this type. Significantly, no Jemez Black-on-white has been recovered from Walatowa (LA 6680), although this site was apparently founded in the A.D. 1620s (Dodge 1982); it is possible that the areas excavated at Walatowa were not those occupied in the 1600s. Additional confirmation of an A.D. 1700 final date for Jemez Black-on-white comes from Navajo sites in the San Juan Basin, where it occurs as a common trade ware after A.D. 1500. There, Jemez Black-on-white virtually never appears at sites dating to the Gobernador Phase (A.D. 1690-1780), such as pueblitos (Reed and Reed 1992).

To ceramic specialists outside of the Jemez Plateau, Jemez Black-on-white has been considered to be a long-lived invariant type that does not change throughout its approximately 300 years of manufacture, similar to types such as Chupadero Black-on-white (Crown et al. 1996; Habicht-Mauche 1993; Sundt 1987). However, analysts working with collections from within the plateau have observed temporal variability in several attributes that appears to pattern over time (Elliott 1991, 1994, 1998; Lambert 1981). From this variability, three provisional types can be suggested. *Type A* is characterized by white slips and black, well defined paint lines on the exterior of closed forms and the interior of open forms. Open form exteriors are rarely painted. The ratio of open to closed forms is high, although not as high as Santa Fe or Vallecitos Black-on-white. Open form rims are direct. This provisional type is manufactured between A.D. 1350 and 1500 (Elliott 1994). *Type B* is distinguished by gray to tan slip colors and paint lines that are often faded to gray, brown or yellow on the exteriors of closed forms and the interiors and exteriors of open forms. Open form exteriors are almost always painted. The ratio of open to closed forms is approximately even. Open form rims are direct, or they mimic Rio Grande glaze ware forms, particularly Espinoso Glaze Polychrome (Glaze C). This provisional type is manufactured between A.D. 1500 and 1700 (Elliott 1994). *Type C* is identical to Subtype B in all other aspects except in vessel form. Open forms exhibit rims that copy Spanish forms, such as soup plates; other forms, such as chalices and candlesticks, also occur. This form is defined from vessels recovered from the mission component of the large village of Guisewa (LA 679), and as such, dates to after A.D. 1620 (Lambert 1981). Although Guisewa was abandoned after A.D. 1638, it is unknown if any of these forms continued to be manufactured within the Jemez Black-on-white type, and so the end date for the subtype is the same as that for Type B.

Rio Grande Glaze Wares and Matte Polychrome Wares. These wares are ones that were regionally produced in the early and early late modern eras. Based on the analysis of temper types, they appear to have never been produced, however, on the Jemez Plateau (Dodge 1982; Shepard 1938, 1942; Warren 1979b). Because of their regional distribution, the glaze ware and matte polychrome types are generally well-dated, but are also rare on the Jemez, particularly at field houses (Elliott 1998). Glaze wares and matte polychrome wares have differing temporal distributions and distinguishing characteristics, and are discussed separately.

Rio Grande Glaze Wares. The Rio Grande glaze ware types used here correspond to those in Warren (1977b, 1979b) and Vint (1999). There are approximately a dozen recognized glaze ware types, and within many of these are several varieties identified based on differences in tempering materials (Shepard 1938; Warren 1979b). Variability in the duration of Rio Grande glaze wares has been recognized, and the primary suite of attributes, encompassed in the form of open form rims, differs in duration between different areas of the northern and central Rio Grande region (Earls 1987:71-72; Lycett 1995; Snow 1982). Eight types are found at field houses on the Jemez, including one that is divided into two sub-types. The formal variability between these types and their temporal distribution is based on the variability observed on the southern Pajarito Plateau and in the Cochiti area. The use of these areas to establish the chronology of the Jemez glaze wares is based on manufacture of almost all Jemez glazes in these and directly adjacent areas: Zia, Santo Domingo, and southern Pajarito, based on the analyses of temper types from seven sites on the Plateau (unpublished notes, Anna O. Shepard Archive, Drawer 4, Folder 38, University of Colorado Museum, Boulder, Colorado; Shepard 1938; Warren 1979b). While patterns of exchange may have limited the time range representation of glaze ware types further than the spans observed in the manufacturing areas, they should not exceed these time spans.

The Rio Grande glaze ware types are distinguished from one another through time primarily on the basis of the rims of open forms (Table 7.6). Distinctions between the body sherds of open and closed forms can also be made a variety of surface attributes (Table 7.7). The rim and surface attributes used here follow those of Warren (1977b, 1979b) and Vint (1999) and are based on general observations regarding the temporal variability in glaze wares across the northern portion of the northern and central Rio Grande area (Mera 1933; Kidder and Shepard 1936; Shepard 1942; Snow 1982), with three exceptions. First, the dates for the three Glaze A types are drawn from Habicht-Mauche and Sundt rather than Vint or Warren on the basis that these more restrictive dates reflect the time span of their occurrence in areas outside of their manufacturing range (Habicht-Mauche 1993; Sundt 1987). Second, in her analysis of glaze wares from excavated assemblages in the Cochiti area, Warren identified two subtypes of Puaray Glaze Polychrome, based on rim form and the condition of the glaze paint. The Early Type of Puaray Glaze Polychrome is associated with Mera's (1933) E group of temporally diagnostic rim forms, while the Late Type is considered transitional between the E and F groups (and is labeled here as "Glaze E-F", following Warren). This variability was also observed in Puaray Glaze Polychrome sherds analyzed during this study, and these provisional types were retained. Third, there is no reported date range for San Marcos Polychrome from the Cochiti or Pajarito areas, so the date range used here is based on the occurrence of this type at Guisewa (Lambert 1981) and the terminal date for Kotyiti Glaze Polychrome.

Matte Polychrome Wares. All of the matte polychrome wares that have been found at field houses have been seventeenth century in age or younger (Lent et al. 1992). Older types, such as those of the White Mountain redware series, have been found at larger sites, but have not been retrieved from field houses. The three polychrome types used in this study correspond to those defined by Harlow (1973), with date ranges from Vint (1999).

Table 7.6. Rio Grande Glaze Ware Rim Attributes
a. open form rim attributes

Rim-Based Temporal Groups	Diagnostic Rim Form Attributes
Glaze A (three types)	rim exhibits no thickening; maintains the angle of the vessel body wall; has a rounded or flat termination
Glaze C (one type)	rim is medially or medially to terminally thickened; maintains the angle of the vessel wall, or turns outward slightly without a clear break; has a pointed or slightly rounded termination; has a plano-convex shape (convex interior) or a convex interior with a slightly concave exterior
Glaze D (one type)	rim is medially thickened; turns outward slightly to significantly without a clear break; has a pointed or rounded termination; has a convex interior and concave exterior
Glaze E Type Early	rim is medially to distally thickened; turns inward significantly without a clear break; has a pointed to rounded termination; has a plano-convex (convex interior) or bi-convex shape
Glaze E-F Type Late	rim is medially to distally thickened; turns inward significantly with a clear break (shoulder) on the exterior; has a rounded to flat termination; has a plano-convex (convex interior) or bi-convex shape
Glaze F (Koyiti glaze type, all varieties)	rim exhibits no thickening; turns inward significantly with a clear break (shoulder) on the interior and exterior; has a rounded or flat termination; has a parallel or convex interior-concave exterior shape
Glaze F (San Marcos glaze type, all varieties)	rim exhibits no thickening; turns outward significantly with a clear break on the interior; has a pointed or round termination; has a parallel shape

b. rim attributes monitored to validate temporal assignment

Rim Attributes	Variable Type	Monitors
junction	categorical	break between the body of the vessel and the rim (continuous, rounded, abrupt)
angle	categorical	angle of rim relative to the angle of the vessel body wall
shape	categorical	rim shape as a consequence of thickening and angle
thickness location	categorical	location of greatest thickness, if present (proximal to the vessel body, medial, distal)
termination	categorical	shape of the rim termination (pointed, rounded, flat)

Sources: Warren (1977b); Shepard (1956).

Table 7.7. Rio Grande Glaze Ware Surface Attributes

Rim-Based Temporal Groups	Diagnostic Body Sherd Attributes
Glaze A (three types)	occurs in both "red" and "yellow" slips; red slip colors range from bright orange-red to dull brick red to dull black red; yellow slip colors range from gray or dirty white to buff, yellow or tan; occurs as both bichromes and as polychromes in both slip colors; glaze paint is very black, often matte and seldom vitreous, and often well executed; yellow slipped polychromes have red slip as a design element only on the exterior of open forms; red slipped polychromes have white slip as an overall treatment on either the interior or the exterior of open forms
Glaze C (one type)	occurs in "yellow" slips only, with slip colors ranging from gray to white to pink; occurs as a polychrome only; glaze paint is very black and is often well executed; red slip as a polychrome design element occurs only on the exterior of open forms; red slip is used as an overall treatment on the interior of closed forms below the rims
Glaze D (one type)	occurs in "yellow" slips only, with slip colors ranging from pinkish-orange to orange, seldom buff, gray or tan (most analysts call this slip color "red" [Warren 1977b]); occurs as a polychrome only; glaze paint is black or brown with only fair execution; red slip as a polychrome design element occurs on the interior of open forms
Glaze E Type Early and Glaze E-F Type Late	occurs in both "red" and "yellow" slips; red slip colors are from bright orange to dark orange to dark brick red; yellow slip colors are white to pink; occurs as both bichromes and as polychromes in both slip colors; glaze paint is from yellowish tan to very black in color, and with fair to poor execution; dark brick red slip is used as a design element on both red and yellow slipped polychromes
Glaze F (two types)	occurs in both "red" and "yellow" slips; red slip colors are orange to brick red; yellow slip colors are white to buff to pink; occurs mostly as bichromes and as rare polychromes in both slip colors; European forms occur only in red slip colors; glaze paint is from yellowish tan to very black in color, is often runny, and with fair to poor execution

Sources: Warren (1977b); H.P. Mera Room Ceramic Type Collections, Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico, Santa Fe.

Ceramic Dating of Sites

The application of the ceramic chronology of existing types and provisional subtypes to assign field house sites to the temporal units is based on the occurrence of one or more of these time-diagnostic types. The assignment of each type to one or more of the temporal units is presented in Table 7.8, an incidence matrix of the types and the units. Because of the unequal duration of the types, both minimal and maximal date ranges can be established for any particular site. In most cases, this study utilizes the minimal dates assigned to each site, but the use of minimal date ranges must be assessed relative to the overall assemblage of a site, and in particular to the size of the surface ceramic assemblage. For example, the occurrence of two diagnostic ceramics that do not overlap in their occurrence might indicate a reoccupation and reuse of the site, but the frequency of the two ceramic types is relevant to whether the occurrence of the two types together represents separate occupations, or merely represents the movement of sherds from one site to another across an intensively utilized and eroding landscape. The application of the dating method to individual sites in the study is discussed relative to the results of dating in the next chapter.

Table 7.8. Incidence Matrix for Occurrence of Time-Diagnostic Ceramics

	Study Time Units					
Ceramic Types	**I**	**II**	**III**	**IV**	**V**	**VI**
Rio Grande Plain—Type A	X	X	X	X	X	
Rio Grande Plain—Type B				X	X	X
Rio Grande Corrugated	X	X				
Rio Grande Blind Corrugated	X	X	X			
Kapo Black					X	X
Santa Fe B/w	X	X				
Vallecitos B/w	X	X				
Jemez B/w—Type A		X	X			
Jemez B/w –Type B				X	X	
Jemez B/w—Type C					X	
Glaze A (three types)		X				
Glaze C-D (two types)			X			
Glaze E (one type)				X		
Glaze E-F (one type)				X	X	
Glaze F (two types)					X	
Tewa Polychrome					X	X
Puname Polychrome						X
Ogapoge Polychrome						X

Chapter VII Endnotes

[1] NMCRIS has 17 cultural affiliations that can be assigned to sites and site components. Excluded codes included “Archaic”, “Navajo”, “Apache”, “Hispanic”, “Anglo/Euro-american”, and “Unknown.” The other 9 cultural affilations do not appear on the Jemez Plateau. Ancestral and early modern Pueblo sites are divided between NMCRIS’s “Anasazi” and “Pueblo” designations based on whether they date to before or after A.D. 1600.

[2] This attitude is changing as researchers have demonstrated a commitment to involving the Jemez community in research projects. Matthew Liebmann, of the University of Pennsylvania, for example, has involved community members in his research on changing settlement structure during the era of the Pueblo Revolt (A.D. 1680 to 1696) that is currently in progress.

[3] Brunton compasses contain a clinometer that allows for measuring changes in elevation, but this feature is better suited to estimating slope over greater distances, and was found to be unreliable over the very short distances that characterized the area of most of the sites. A transit or total station would be more appropriate to this task but was not considered necessary for the level of study conducted here.

[4] This understates the chronological sophistication that underlies many of the recent studies, in particular those conducted for the southern Pajarito Plateau (Powers and Orcutt 1999) and the area surrounding Pecos Pueblo (Head and Orcutt 2002). These two studies, for example, used existing ceramic typologies to generate new fine-scale time periods and calibrated ceramic dates using area tree-ring chronologies. They also assigned mean ceramic dates to sites, derived from the frequency seriation of surface assemblages. The goal of this dating precision, however, was to assess existing research problems that reference more traditional chronological units, and to assess intra-period variability specific to the sequence of culture change of each sub-area.

CHAPTER VIII

FIELD HOUSE DATA I: DESCRIPTION, CHRONOLOGY AND SOURCES OF BIAS

The purpose of this dissertation so far has been to create a body of ideas about population change that are appropriate for examining archaeological evidence that has the capacity to examine population change. In addition, those ideas must place Pueblo population change within the context of settlement patterns and subsistence practices during the early modern Pueblo era, and account for the suite of demographic variables: mortality, fertility, migration, and identity. For the Jemez Plateau, this has meant examining changes in the use of secondary agricultural settlements or field houses, and linking these changes to agricultural intensification and population change. This chapter and the one that follows it (Chapter IX) bring to bear the ideas about field house use and it relevance to intensification and population on the data generated from a sample of field houses on the Jemez Plateau that date from the advent of Pueblo settlement in the area to its abandonment, the period from roughly A.D. 1200 to 1700. This chapter describes that the dataset used, the construction of the chronology employed to date the study sample sites, and the biases introduced into the dataset from forces other than field house use. The next chapter examines temporal variability in the dataset.

This chapter has two objectives. The first is to apply the ceramic chronology created in the last chapter to the study sample sites. This is achieved through a reclassification of site assemblage ceramics according to the criteria laid out in Chapter VII, and the application of a ranked occurrence seriation to assign each site occupation to one or more of study time units.

The second is to identify the instances where the characteristics of study sample site assemblages and architecture are consequences of environmental factors or post-depositional processes rather than variability in past human behavior, and correct for these biases. The biases are greatest among assemblages, and datasets from excavated sites are substituted to maintain a large enough sample of sites to produce valid results.

Description of the Assemblage and Architectural Data Sets

The data used in this study are derived from observations made on two domains of the Jemez Plateau field house record: surface artifact assemblages and attributes of architectural remains. In addition to being accessible to surface-based methodologies, these two groups of archaeological remains were identified as sources of data relevant to the four aspects of field house usage identified in the last chapter: age of occupation, duration of occupation, use group size, and diversity of domestic activities. A summary of the data sets used in this study and their distribution across the 30 sample sites, along with relevant contextual environmental and topographic information, is displayed in Tables 8.1 and 8.2.

Surface Artifact Assemblages

Surface artifact assemblages are divided into two major groups of materials: ceramic and lithic remains. Ceramics are in the form of sherds; these are differentially distributed across the 30 sample sites (Figure 8.1). Lithic remains are in the form of chipped stone items, ground stone, and unmodified human transported items. Like ceramics, lithic items are differentially distributed across the 30 sample sites (Figure 8.2).

The classificatory frameworks employed for examining variability within and between field house artifact assemblages are intensional; that is, they have been devised and imposed on the analyzed sets of surface remains for the purpose of generating data relevant to the specific research problems of this study. Ceramic remains are classified according to two different

Table 8.1. Study Sample Sites Summary Environmental Data

LA No.	Forest Service No.	Sample Type	Elevation (meters)	Elevation (feet)	Overstory Vegetation Association[a]	Ground Visibility	Topographic Location
23540	AR-03-10-03-00099	Random	2340.9	7680	PipoQuga	1-25%	Mesa top
23543	AR-03-10-03-00102	Random	2365.2	7760	PipoQuga	26-50%	Mesa top
23552	AR-03-10-03-00111	Random	2231.1	7320	PipoQuga	1-25%	Canyon bottom
23565	AR-03-10-03-00124	Systematic	2273.8	7460	PipoPiedQuga	51-75%	Mesa top
23566	AR-03-10-03-00125	Systematic	2249.4	7380	PipoQuga	76-99%	Mesa top
23568	AR-03-10-03-00128	Systematic	2307.3	7570	PipoPiedQuga	51-75%	Mesa top
23572	AR-03-10-03-00131	Random	2279.9	7480	PipoPiedQuga	76-99%	Mesa top
23653	AR-03-10-03-00212	Random	2066.5	6780	PipoQuga	1-25%	Canyon bottom
23672	AR-03-10-03-00231	Random	2343.9	7690	PipoQuga	26-50%	Mesa top
24441	AR-03-10-03-00390	Random	2328.6	7640	PipoQuga	1-25%	Mesa top
24503	AR-03-10-03-00454	Systematic	2328.6	7640	PipoPiedQuga	51-75%	Mesa top
24526	AR-03-10-03-00477	Random	2414.0	7920	PipoQuga	1-25%	Mesa top
24557	AR-03-10-03-00509	Random	2481.1	8140	PipoQuga	1-25%	Mesa top
24574	AR-03-10-03-00526	Random	2404.9	7890	PipoQuga	1-25%	Mesa top
24605	AR-03-10-03-00565	Random	2377.4	7800	PipoQuga	76-99%	Mesa top
24628	AR-03-10-03-00608	Random	2203.7	7230	PipoPiedQuga	76-99%	Mesa top
24639	AR-03-10-03-00619	Systematic	2206.7	7240	PipoPiedQuga	76-99%	Mesa top
24641	AR-03-10-03-00621	Systematic	2225.0	7300	PipoPiedQuga	51-75%	Mesa top
24644	AR-03-10-03-00644	Systematic	2237.2	7340	PipoPiedQuga	51-75%	Mesa top
24645	AR-03-10-03-00645	Systematic	2237.2	7340	PipoPiedQuga	51-75%	Mesa top
56865	AR-03-10-03-01730	Random	2340.9	7680	PipoQuga	51-75%	Mesa top
70370	AR-03-10-03-02083	Random	2465.8	8090	PipoQuga	1-25%	Mesa top

Table 8.1. (continued)

LA No.	Forest Service No.	Sample Type	Elevation (meters)	Elevation (feet)	Overstory Vegetation Association[a]	Ground Visibility	Topographic Location
70379	AR-03-10-03-02092	Random	2478.0	8130	PipoQuga	1-25%	Mesa top
70380	AR-03-10-03-02093	Random	2481.0	8140	PipoQuga	1-25%	Mesa top
70384	AR-03-10-03-02097	Random	2475.0	8120	PipoQuga	1-25%	Mesa top
73233	AR-03-10-03-02291	Random	2475.0	8120	PipoQuga	1-25%	Mesa top
74782	AR-03-10-03-00889	Random	2304.3	7560	PipoQuga	26-50%	Mesa top
90370	AR-03-10-03-02642	Random	2377.4	7800	PipoQuga	1-25%	Mesa top
90577	AR-03-10-03-02786	Random	2054.3	6740	PipoQuga	26-50%	Canyon bottom
90622	AR-03-10-03-02814	Random	2474.9	8120	PipoQuga	1-25%	Canyon bottom

[a] PipoQuga—Ponderosa Pine and Gambel Oak Association PipoPiedQuga—Ponderosa Pine, Piñon Pine and Gambel Oak Association

Table 8.2. Study Sample Sites Summary Artifact and Architectural Data

LA No.	Sherd #	Sherd Weight (g)	Lithics #	Lithic Classes	Feature Size (m^2)	# Rooms	Masonry Shaping Class	% Blocks <10cm	% Blocks 10-30cm	% Blocks 30-60cm	% Blocks 60cm+	# Extramural Features
23540	25	180.4	0	0	42.3	2	76-99%	5	20	70	5	1
23543	4	45.8	3	1	12.6	1	26-50%	15	55	30	0	0
23552	7	38.4	0	0	76.8	2	1-25%	5	35	60	0	0
23565	583	3059.2	45	6	53.4	2	1-25%	25	35	25	15	1
23566	2255	10442.8	107	6	89.3	1	26-50%	20	30	30	20	4
23568	701	2853.9	21	4	61.2	2	26-50%	20	40	30	10	0
23572	1800	6770.1	120	4	111.4	2	76-99%	5	30	50	15	0
23653	1	1.4	1	1	27.2	1	76-99%	0	35	50	5	0
23672A/ 23672B[a]	91	804.8	4	2	19.2/ 34.6	1/ 1	26-50%/ 26-50%	10/ 25	35/ 40	50/ 35	5/ 0	0/ 0
24441	67	324.1	8	1	50.4	2	51-75%	10	40	45	5	0
24503	266	2105.5	2	2	21.9	1	51-75%	25	40	35	0	0
24526	65	656.8	0	0	45.1	3	26-50%	5	45	50	0	0
24557	10	67.3	7	3	48.6	3	51-75%	10	40	50	0	0
24574	153	1065.9	13	2	76.4	2	76-99%	10	25	45	20	0
24605	16	73.7	8	3	49.1	1	1-25%	5	70	25	0	0
24628	122	378.5	39	3	47.0	3	1-25%	30	45	25	0	0
24639	1154	5129.8	83	7	80.3	4	76-99%	15	25	40	20	0
24641	413	1711.5	29	6	55.0	2	51-75%	10	40	50	10	1
24644	758	3777.1	71	7	60.4	2	51-75%	10	35	50	5	0
24645	616	2753.5	81	7	45.5	1	76-99%	20	20	45	15	3
56865	31	153.9	17	4	75.7	2	1-25%	5	45	50	0	0

Table 8.2. (continued)

LA No.	Sherd #	Sherd Weight (g)	Lithics #	Lithic Classes	Feature Size (m²)	# Rooms	Masonry Shaping Class	% Blocks <10cm	% Blocks 10-30cm	% Blocks 30-60cm	% Blocks 60cm+	# Extramural Features
70370	0	0.0	0	0	18.4	1	0%	5	35	50	10	0
70379	26	239.6	0	0	26.6	2	1-25%	5	30	65	0	0
70380	22	175.1	0	0	21.2	1	1-25%	5	55	40	0	2
70384	17	159.3	1	1	26.1	1	1-25%	0	40	60	0	0
73233	0	0.0	0	0	19.2	1	26-50%	0	25	70	5	0
74782	80	347.6	6	1	30.2	1	76-99%	10	30	55	5	0
90370	60	197.3	11	4	79.6	2	1-25%	80	20	0	0	0
90577A 90577B[a]	10	47.3	5	2	49.6/ 8.3	2/ 1	51-75%/ 26-50%	10/ 0	35/ 35	45/ 65	10/ 0	0/ 0
90622	1	3.6	0	0	42.3	2	51-75%	0	60	40	0	0

[a] Two sets of architectural data are listed because each of these sites has the remains of two structures

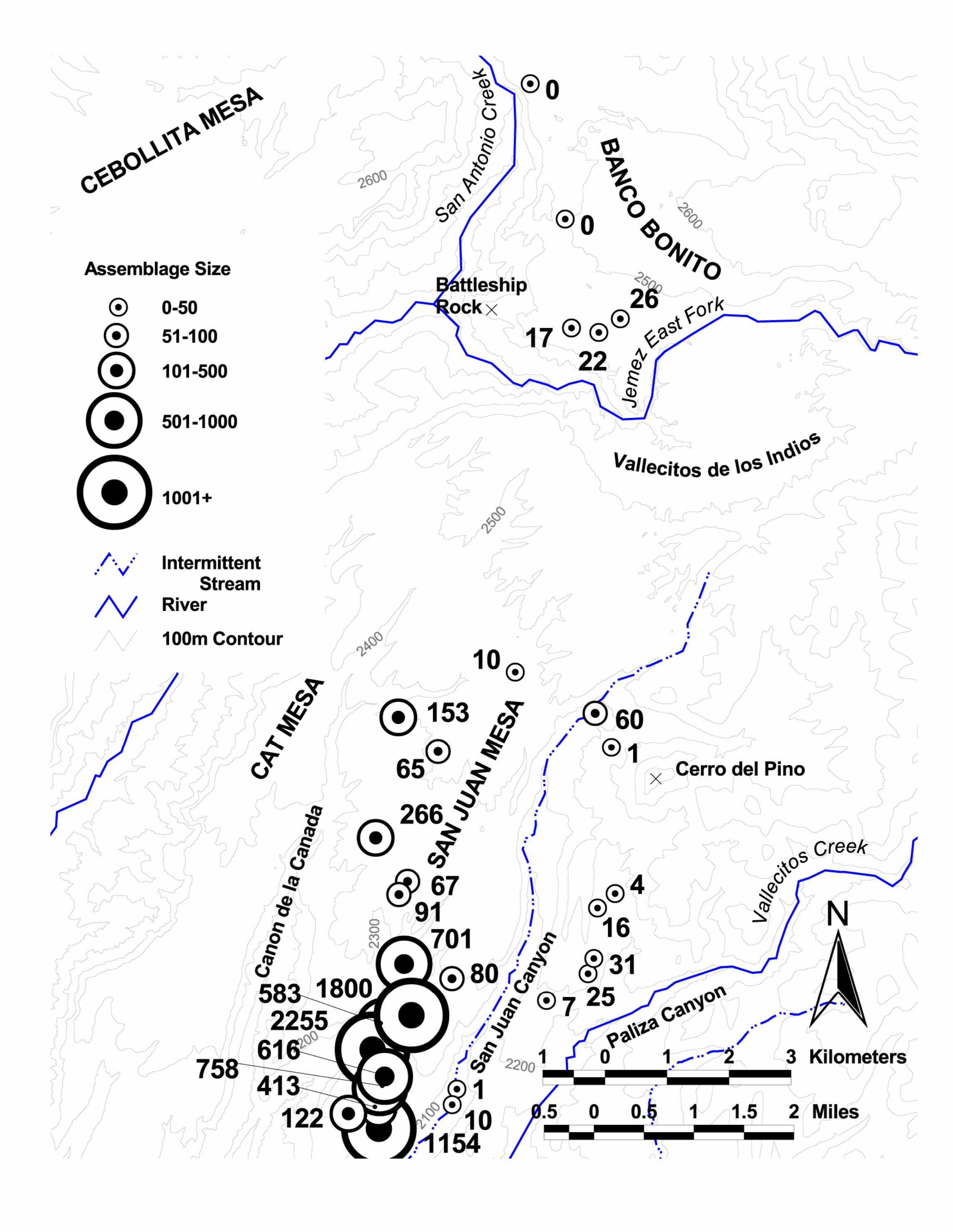


Figure 8.1. Distribution of ceramic assemblage sizes at the 30 study sites. The numbers accompanying the site symbols are actual counts of the ceramic sherds found at each site.

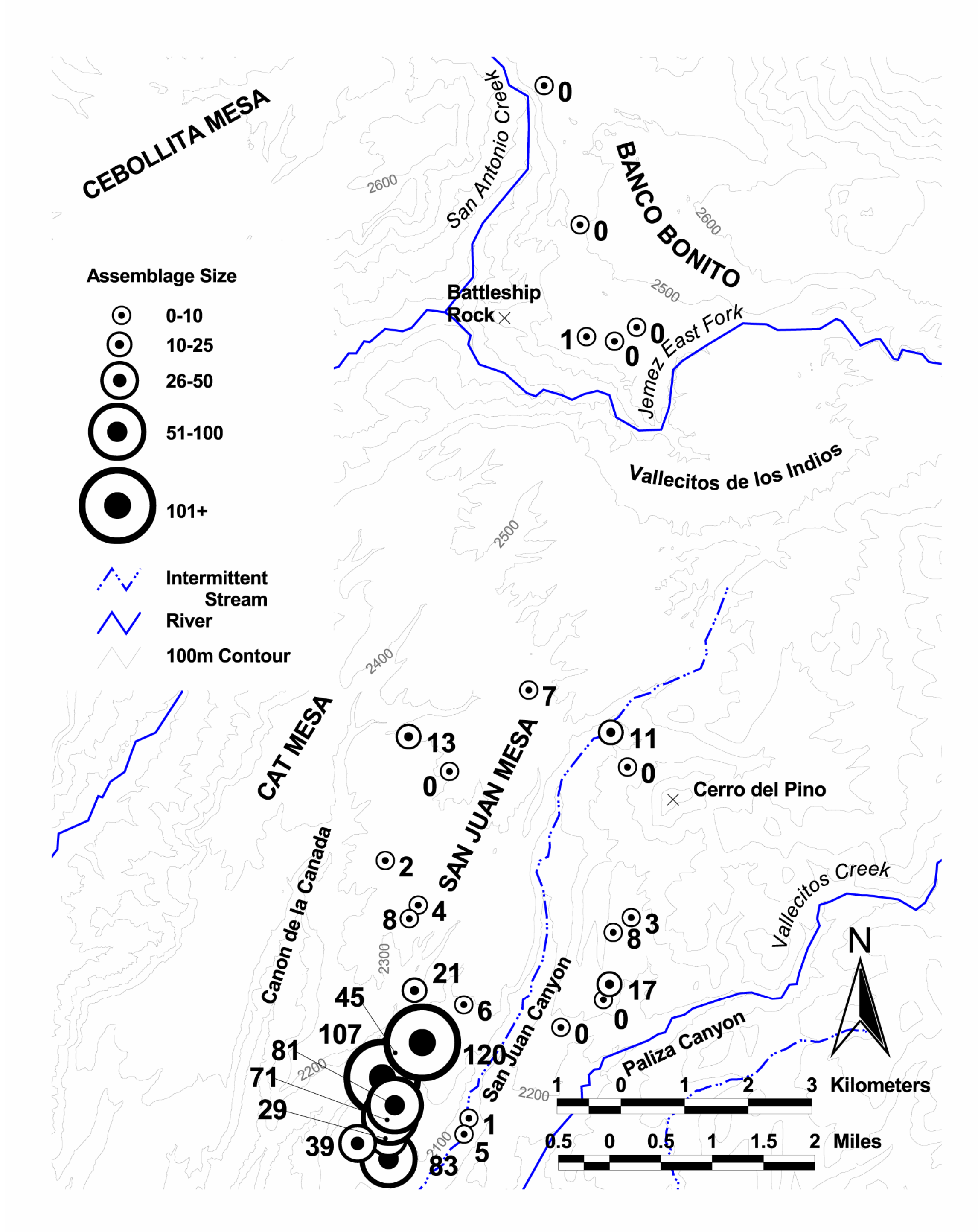


Figure 8.2. Distribution of lithic assemblage sizes at the 30 study sites. The numbers accompanying the site symbols are actual counts of lithics found at each site.

frameworks, each appropriate to different research objectives. First, ceramics are used to provide ages of field house occupation. For this purpose, they are sorted according to classes defined by the inferred duration of the manufacture of time specific surface attributes. Second, ceramics are used for measuring the accumulation of material remains and for measuring artifact class diversity, for the purpose of examining duration of field house occupation and the diversity of domestic activities performed at field houses. To satisfy this objective, ceramics are sorted into functional classes defined by the inferred function of parent vessels, which are in turn derived from the inferred shape of the parent vessel, and from surface treatment. Lithic remains are also used to examine duration of occupation and the diversity of domestic activities at field houses. They are sorted according to classes defined by inferred general function, based on morphology, raw material, and nature of reduction (the method and extent of chipping or grinding).

Because lithic remains are aggregated into a single data set across a wide variety of raw material types and reduction technologies, lithic class sizes are measured in counts of individual items. The size of ceramic classes, however, is measured in weight rather than in counts of sherds. Weight is used to describe assemblage size and proportions because mean sherd size is not uniform between sites. However, the materials used in the manufacture of ceramic remains assigned to different classes are homogeneous enough so that weight can be used to equalize differences in sherd size that have been introduced into field house assemblages through post-depositional processes. These differences are observable in a preliminary examination of ceramic remains at 16 of the 30 sample sites. These 16 sites have surface assemblages that contain over 50 sherds. For these 16 sites, one-way analysis of variance (ANOVA) shows differences between mean log10 sherd weights[1] at a significance level of <0.001 (sum of squares 32.863, df=15, mean square 2.191, F=20.433).

Differences in sherd weights between sites appears to be a consequence primarily of elevation, and secondarily of site age. In general, as elevation increases, sherd size also increases. A scatter plot of mean log10 sherd weight against elevation shows 10 of 16 sites within the 95 percent confidence interval (Figure 8.3). The reason for the patterning due to elevation is that elevation serves as a proxy for overstory vegetation. As overstory vegetation increases, the depth and continuity of forest floor litter (pine needles and other fallen organic matter) also increases, decreasing surface visibility and making smaller sherds harder to identify from the surface (see Bintliff and Snodgrass 1988). Greater continuity in forest floor litter also discourages understory growth (grasses), discouraging grazing. Greater grazing activity in areas where there is greater understory growth may also be contributing to smaller sherd sizes through trampling (Nielsen 1991; Orton 1982). Further consideration of the effects of site elevation, overstory vegetation, and surface visibility on variability in surface artifact characteristics is made in a following section.

Six of the sixteen sites do not follow the pattern of elevation as a predictor of sherd size. In the case of five of these six sites, the age of the site appears to be the factor overriding elevation in dictating sherd size. Older sites should have smaller sherds than younger ones. Although grazing, as a recent phenomenon, would affect the size of sherds at sites of all ages equally, other bioturbative forces contributing to sherd breakdown over time, such as freeze-thaw cycles, should result in smaller sherds at older sites (Bintliff 2000; Skibo et al. 1989). The three sites below the lower confidence interval (sherds larger than predicted by elevation) are the three youngest, based on time-diagnostic ceramics. Two of the three sites above the upper confidence interval (sherds smaller than predicted by elevation) are two of the three oldest sites. The last of the six sites has sherds of a size predicted neither by age or by elevation. This site is among the nine youngest sites, but falls above the upper confidence interval, meaning that its sherds are smaller than would be predicted by elevation. This site had its surface burned down to mineral soil by a prescribed (intentionally set) fire the year previous to analysis, and had experienced significant surface sheet-wash erosion between the time of the fire and the analysis. It may be that the burning and subsequent erosion exposed or made visible more small sherds that would

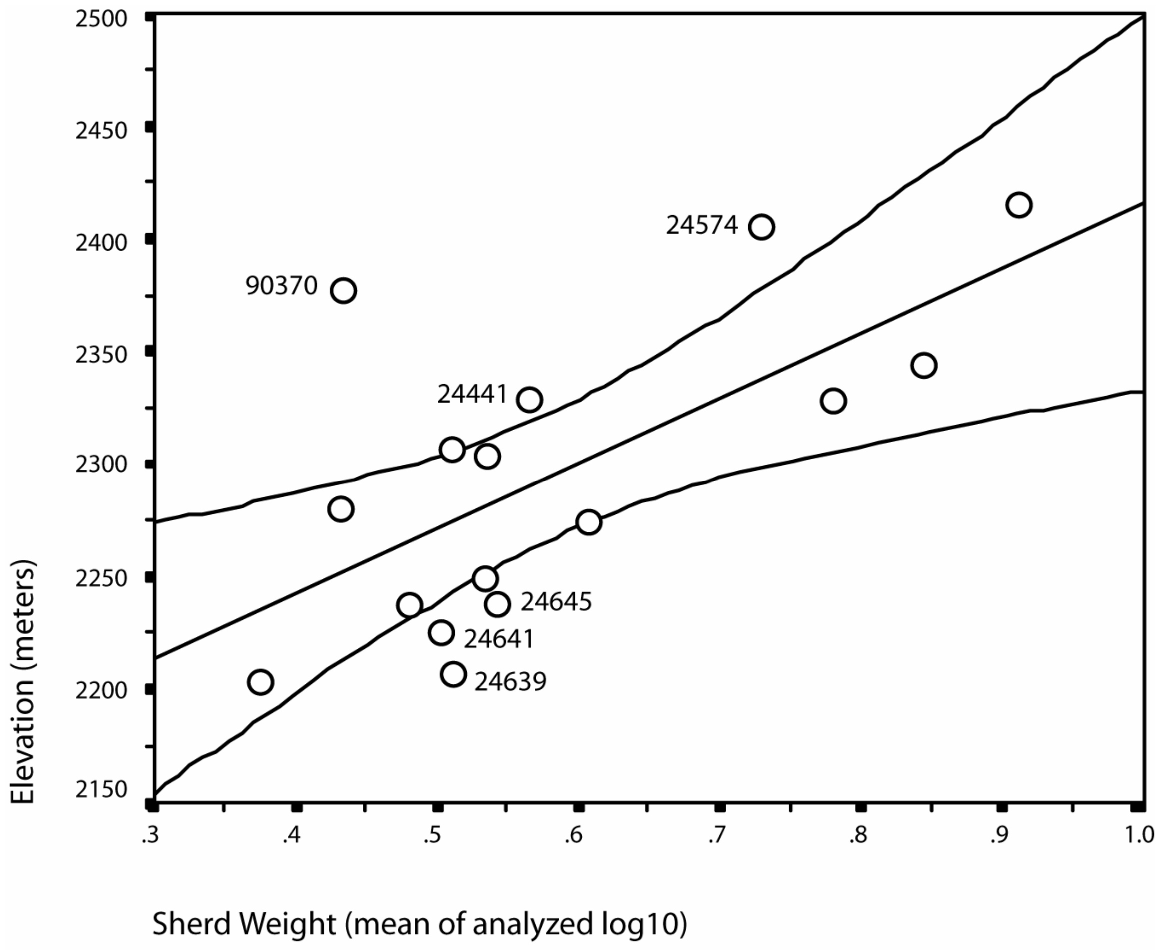


Figure 8.3. Scatterplot displaying the relationship between the size of sherds found at individual sites (expressed as the log10 mean of weight in grams) relative to site elevation. The circles represent the 16 sites that have assemblages that have over 50 sherds, have diagnostic ceramics that allow for the preliminary chronological assignment of occupation, and lack evidence of multiple occupations. Only those sites that are outliers are labeled by LA number. The upper and lower lines represent the extent of the 95% confidence interval. See the text for the explanation of outliers.

normally remain buried or would be difficult to identify without the complete removal of surface vegetation.

Architectural Remains

Observations regarding variability in the remains of architecture found at the study sample sites are divided into several domains, related to structure size, architectural investment, and activity diversity. Structure size is measured by the size of the structure mound (structure size), and by room counts. The distribution of these two variables across the 30 study sample sites is displayed in Figure 8.4. Architectural investment is measured by shaping of masonry blocks, and by the size of the blocks used in construction. Activity diversity is explored through the presence of extramural features. The distribution of masonry block shaping classes, and the occurrence of extramural features, is displayed in Figure 8.5.

Chronology

Use and occupation at 28 of the 30 sample sites in this study were dated using a ranked occurrence seriation of ceramics. The choice of this dating strategy was based on several factors. First, there were no materials ubiquitous within the surface assemblages of the sites that would have allowed for chronometric dating of the sites that was not cost-prohibitive. Obsidian is present at several sites, but is not ubiquitous. Ceramics are virtually ubiquitous, but thermoluminescence dating is currently too expensive to be used on a project of this scale. Dendrochronological samples were collected from two sites, but did not yield dates (see Appendix B). Second, occurrence seriation of ceramics was chosen over frequency seriation because the small assemblage sizes and relatively short duration of lifetime occupations at the sample sites prohibited the use of frequency seriation and other related techniques, such as mean ceramic dating. Third, the use of a relative dating method that is not dependent upon the quantity of materials within an artifact assemblage allows sites with significantly different surface

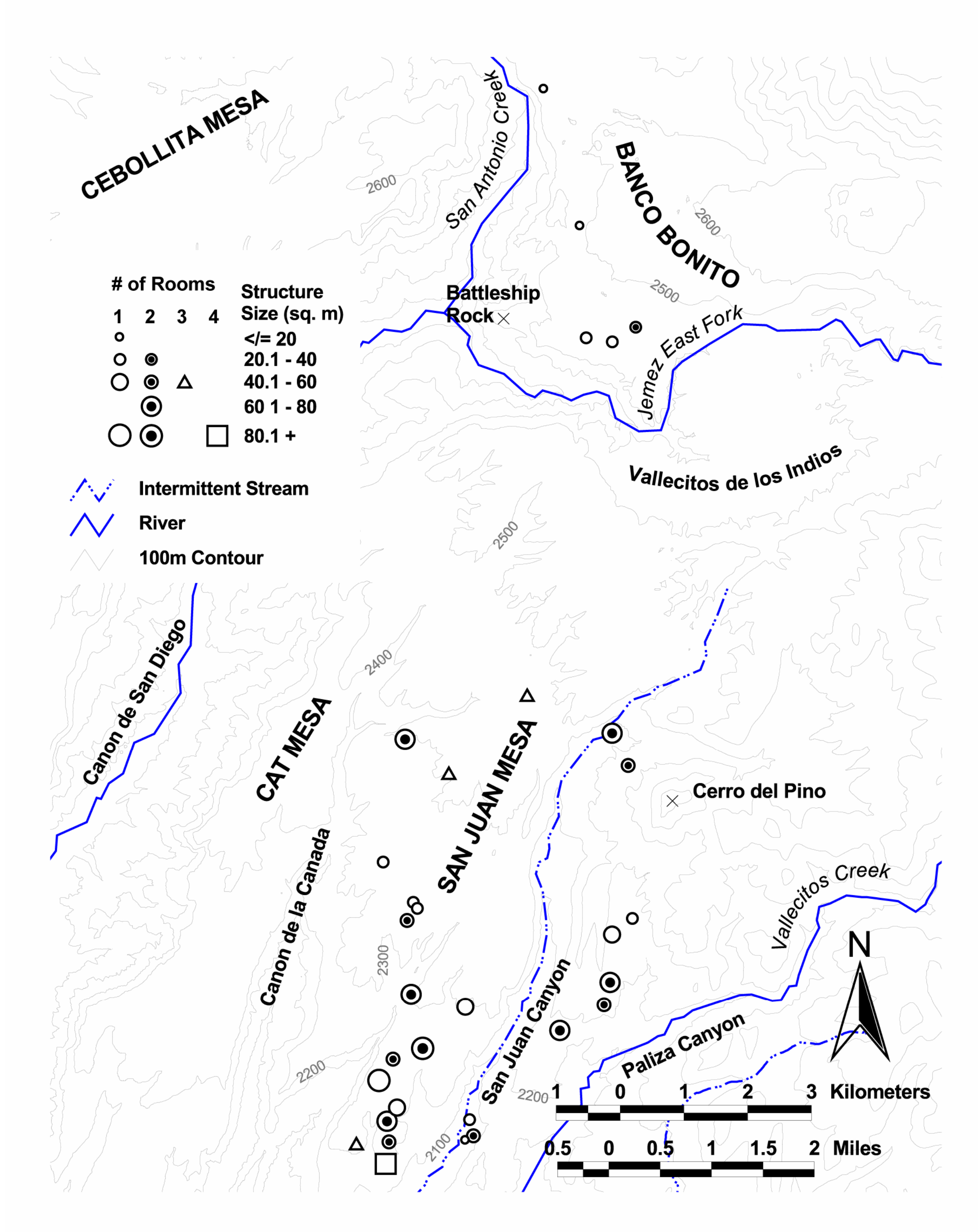


Figure 8.4. Distribution of structure sizes and room counts across the 30 study sample sites. Structure size is calculated from structure mound size. Room counts are inferred from visible masonry alignments and rubble mound shape, and include partially enclosed space.

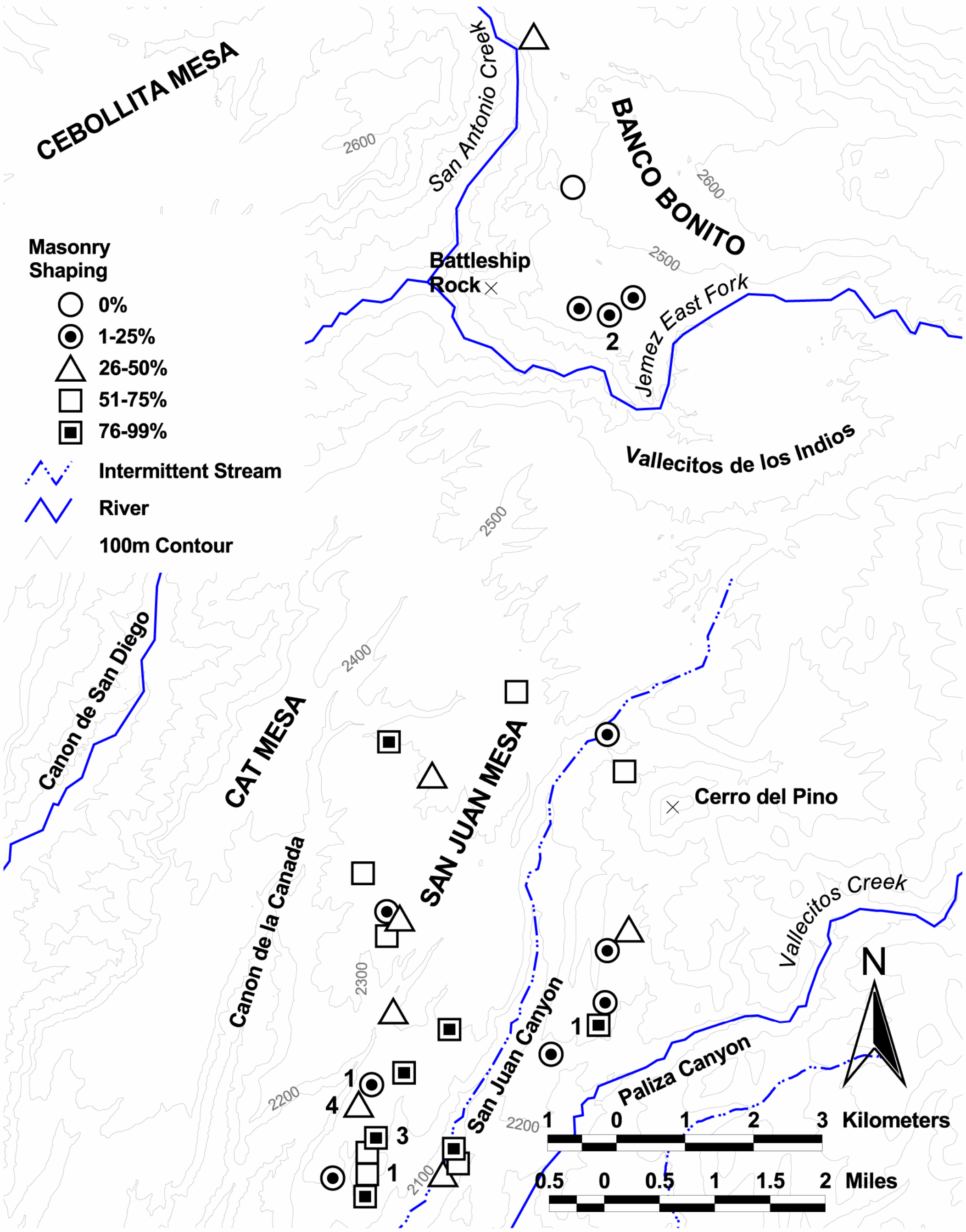


Figure 8.5. Distribution of masonry shaping classes and non-agricultural extramural features across the 30 study sample sites. Shaping classes are expressed as a percentage of the total number of blocks within the rubble concentration and scatter that exhibit intentional shaping (modification of the raw cobble, typically by pecking). Only those sites where extramural features were recorded are labeled with a feature count.

assemblages to be included in a single sample. Because this study relies on variability in field houses as a measure of population change, the selection of field houses solely on the "date-worthiness" of their surface ceramic assemblages may have excluded a significant range of variability in field house usage, including temporally sensitive differences in use.

However, although the use of occurrence seriation does buffer against some of the problems associated with chronometric dating rare materials, or the sample size problems associated with the use of frequency seriation, there are some problems that even occurrence dating of sites cannot surmount. First, discard rates will affect the composition of a ceramic assemblage, and short-duration occupations will be more likely to exclude rarer types altogether: this is critical for assemblages at sites on the Jemez Plateau, where rarer types, such as Rio Grande Glaze wares, are some of the best dated types. Second, long occurrence spans, which are characteristic of both common plain and black-on-white types from the Jemez, can stretch out occupations to such a span so that a site falls within all of the time units possible for any site. And third, an occurrence seriation can do nothing for a site that has no ceramic assemblage at all. To address these difficulties, several strategies are taken. First, the occurrence seriation used here ranks ceramic types based upon my confidence regarding their date range, derived from published sources describing those ceramics. Second, the provisional types identified in Chapter VII are employed in an attempt to limit the effect of long-lived types. And third, sites without ceramic assemblages (there are two in the study sample) are dated using inferences drawn from what is known about the land use history of the area where the sites are found.

This section describes ranked occurrence seriation that is used in this study and the dates of lifetime occupation that are assigned to each site based on seriation. Several other issues are also addressed in this section. The first subsection validates the use of occurrence seriation by evaluating and rejecting the use of frequency seriation for dating small assemblages from sites that have a short lifetime duration of occupation. Demonstrating, rather than simply asserting, the ineffectiveness of dating based on frequency-based variation is important, because such variation has been cited as potentially important for distinguishing the age of Jemez Plateau ceramic assemblages (Elliott 1991, 1994, 1998; Gauthier and Elliott 1989; Reiter 1938). The second subsection evaluates the utility of the provisional types created in the last chapter for use in the occurrence seriation. The third subsection presents the ranked occurrence seriation and the dating of study sample sites. The fourth subsection discusses the dating of the two sites that lack surface ceramic assemblages.

Many of the tasks carried out in this section, including the evaluation of frequency seriation and the evaluation of the provisional types, require well-dated assemblages in which potential variability can be examined. To this end, a subset of the study sample site assemblages were selected to examine this variability, and for comparison to assemblages from an excavated large site (Unshagi, LA 123) and from excavated field house sites. While many field house sites on the Jemez Plateau cannot be precisely dated given the black-on-white and plain ware ceramics found, a significant number of the sites within the study, have established ceramic types that allow the preliminary assignment of these sites to shorter time spans. Of the 30 study sites, 19 can be assigned to shorter time periods than typically assigned span of A.D. 1325-1700. This figure is likely inflated because eight of the 30 study sample sites were systematically selected based on the presence of established ceramic types that date to study time units IV and V. Of the remaining 22 sites that were randomly selected, 11, or half, can be assigned to a time range narrower than study time units II to V. The sites can be separated into two groups, early and late, with some sites falling in both groups. The early group dates to A.D. 1200-1525 (corresponding to study time units I through III), and is based on the incidence of Rio Grande Corrugated, Rio Grande Blind Corrugated, and Glaze A types. The late groups dates to A.D. 1525-1700 (corresponding to study time units IV and V), and is based on the incidence of Glaze E, Glaze E-F, Glaze F and Glaze Late types. Using these diagnostic ceramics, there are:

8 early assemblages, 3 with greater than 50 sherds;

7 late assemblages, all with greater than 50 sherds;

4 mixed (early and late) assemblages, all with greater than 50 sherds;

9 assemblages that have neither early nor late types, 2 with greater than 50 sherds; and

2 sites that have no ceramics,

for a total of 28 assemblages at 30 sites. The incidence of established ceramic types at all 30 sample sites are displayed in Table 8.3.

Evaluation of Frequency Seriation

This study employs occurrence seriation rather than frequency seriation for the dating of field house ceramic assemblages. Frequency seriation is one of the oldest methods of dating archaeological sites and was pioneered in the northern Southwest (Lyman et al. 1997:37-72). While some frequency-based ceramic dating methods, such as mean ceramic dating and multidimensional scaling continue to be employed (for example, Christenson 1994; Goetze and Mills 1993; Kohler and Blinman 1987; Orcutt 1999b; Powell and Benedict 2002; Van Dyke 1997), most researchers employ ceramic occurrence dating through the use of cross-dated or tree-ring dated ceramic types. However, frequency seriation must be at evaluated as a technique for dating field houses on the Jemez Plateau, because variation in both attribute and type frequencies have been suggested as time-diagnostic (Reiter 1938), even at field houses (Elliott 1991, 1994, 1998; Elliott and Gauthier 1989). When evaluated, I find that frequency seriation is an inherently inappropriate method for determining the age of field house ceramic assemblages, based on how field house ceramic assemblages formed and the conditions necessary for frequency seriation to be successful.

The lack of suitability of field house assemblages is demonstrated by examining relative frequencies of open versus closed vessel forms among whitewares between nine of the field house assemblages that have a single early or late assemblage (three early, six late). Summary data for vessel forms is listed in Table 8.4. Patterning (or lack thereof) in the temporal distribution of relative vessel form frequencies are compared to those from stratified trash

Table 8.3. Incidence Matrix of Established Ceramic Types at Study Sample Sites

Ceramic Types	23540	23543	23552	23565	23566	23568	23572	23653	23672	24441	24503	24526	24557	24574	24605	24628	24639	24641	24644	24645	56865	70730	70739	70380	70384	73233	74782	90370	90577	90622
No Ceramics																						X				X				
Rio Grande Plain	X			X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	
Rio Grande Corrugated																X			X	X								X		
Rio Grande Blind Corrugated	X		X												X	X	X		X	X	X						X	X		X
Kapo Gray/Black																														
Santa Fe B/w																														
Vallecitos B/w																X		X	X	X							X			
Jemez B/w	X		X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X		X	X			X	X	X	
Other White									X																					
Unk. White	X	X		X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X		X	X			X	X	X	
Glaze A (three types)										X																				
Glaze C-D (two types)														X																
Glaze E (one subtype)												X															X			
Glaze E-F (one subtype)					X	X								√			X		√	√										
Glaze F (two types)											√								X	X										
Glaze Late				X	X	X											X	X												
Glaze Yellow Unk.				X		X			X					X					X								X			
Glaze Red Unk.				X	X				X	X				X			X	X	X								X			

Note: "X" indicates that the type is present in the analyzed sample from the site. "√" indicates that the type is present in the surface assemblage of the site, but is not part of the analyzed assemblage. Plain ware provisional types are collapsed under "Rio Grande Plain," while white ware provisional types are collapsed under "Jemez Black-on-white" or "Unknown White." Sites identified as "early" (A.D. 1200/1250-1500) are shown in light gray, while sites identified as "late" (A.D. 1500-1700) are shown in black. Sites with both early and late ceramics are shown in dark gray.

Table 8.4. Summary Ceramic Frequency and Weight Data for Nine "Early" and "Late" Study Sample Sites

		RG Plain A	RG Plain B	RG Plain Total	Santa Fe B/w	Vallecitos B/w	Jemez B/w A	Jemez B/w B	Whiteware Bowl Total	Whiteware Open	Whiteware Closed	Whiteware Form Total
24628	**Count**	**57**	**1**	**58**	**15**	**8**	**2**	**2**	**27**	**29**	**6**	**35**
	Weight	179.8	0.8	180.6	46.3	29.2	9.2	3.0	87.7	95.6	9.5	105.1
90370	**Count**	**16**	**1**	**17**	**1**	**3**	**8**	**1**	**13**	**13**	**3**	**16**
	Weight	44.4	2.5	46.9	8.0	9.6	24.3	5.1	47.0	47.0	5.8	52.8
24441	**Count**	**28**	**17**	**45**	**1**	**2**	**3**	**1**	**7**	**7**	**7**	**14**
	Weight	116.3	100.0	216.3	1.6	5.9	5.1	4.0	16.6	16.6	62.2	78.8
24526	**Count**	**16**	**16**	**32**	**0**	**0**	**9**	**6**	**15**	**19**	**6**	**25**
	Weight	205.2	150.2	355.4	0.0	0.0	56.7	54.5	111.2	150.2	105.9	256.1
23565	**Count**	**41**	**36**	**77**	**0**	**1**	**4**	**3**	**8**	**10**	**13**	**23**
	Weight	208.2	206.0	414.2	0.0	2.3	30.2	10.3	42.8	50.0	69.0	119.0
23566	**Count**	**24**	**39**	**63**	**0**	**1**	**5**	**1**	**7**	**8**	**24**	**32**
	Weight	116.8	168.4	285.2	0.0	4.7	34.0	1.5	40.2	40.6	116.2	156.8
23568	**Count**	**37**	**49**	**86**	**0**	**3**	**7**	**4**	**14**	**15**	**7**	**22**
	Weight	147.4	204.8	352.2	0.0	10.7	17.6	25.7	54.0	55.6	30.7	86.3
24641	**Count**	**15**	**63**	**78**	**2**	**0**	**4**	**3**	**9**	**10**	**8**	**18**
	Weight	51.5	280.6	332.1	6.1	0.0	6.0	25.1	37.2	38.4	38.2	76.6
24503	**Count**	**31**	**18**	**49**	**1**	**1**	**22**	**4**	**28**	**29**	**23**	**52**
	Weight	186.2	152.6	338.8	2.8	8.8	213.6	48.9	274.1	274.5	209.2	483.7

Note: Sites are listed in relative order, earliest to latest. Weights are shown in grams. Light gray columns sum only those immediately preceding; totals are not cumulative middens at the large village site of Unshagi (LA 123), and to assemblages from 14 excavated field houses on the Jemez Plateau. Vessel form among whitewares is one of the several assemblage-level attributes that has been proposed to vary in frequency through time. Vessel form, rather than the other surface attributes used to define white ware types in Chapter VII, is used here because this variable has been recorded in previous studies, while the reporting of other attribute data has been more spotty. While the relative frequency data for the nine sites drawn from the study sample is expressed in weight, relative frequencies of vessel forms from Unshagi and from the excavated field houses are expressed in counts, consistent with the data available from published sources.

The relative frequencies of vessel forms in whitewares from the nine assemblages drawn from the study sample shows a lack of significant patterning. Figure 8.6 compares relative frequencies of open versus closed forms across the nine assemblages. Only the two earliest sites show a strong pattern, with over 80 percent of the assemblage composed of open forms. Beyond these two sites, the percentage of open forms is significantly less, but there is no temporal patterning within the remaining seven sites, suggesting the dominance of open forms within whiteware assemblages may be confined prior to A.D. 1325. However, it is already known that closed forms are rare among pre-A.D. 1325 whiteware assemblages in the northern and central Rio Grande (Habicht-Mauche 1993; Sundt 1987), and this observation does nothing to further consideration of the hypothesis that the relative frequency of closed forms increases through the duration of the manufacture of Jemez Black-on-white.

This lack of patterning contrasts markedly with data from Unshagi, where a pattern of increasing closed forms among whitewares is clearly seen through the progression of the site occupation. The largest data sets come from the four stratified trash midden units (Reiter 1938:97-102, 189-192). Unshagi dates to between A.D. 1375 and 1605, based on ceramics and tree ring dates. Data for all open and closed whiteware forms (including Jemez Black-on-white and Reiter's "Jemez Rough"—probably Vallecitos Black-on-white) from the four test units have

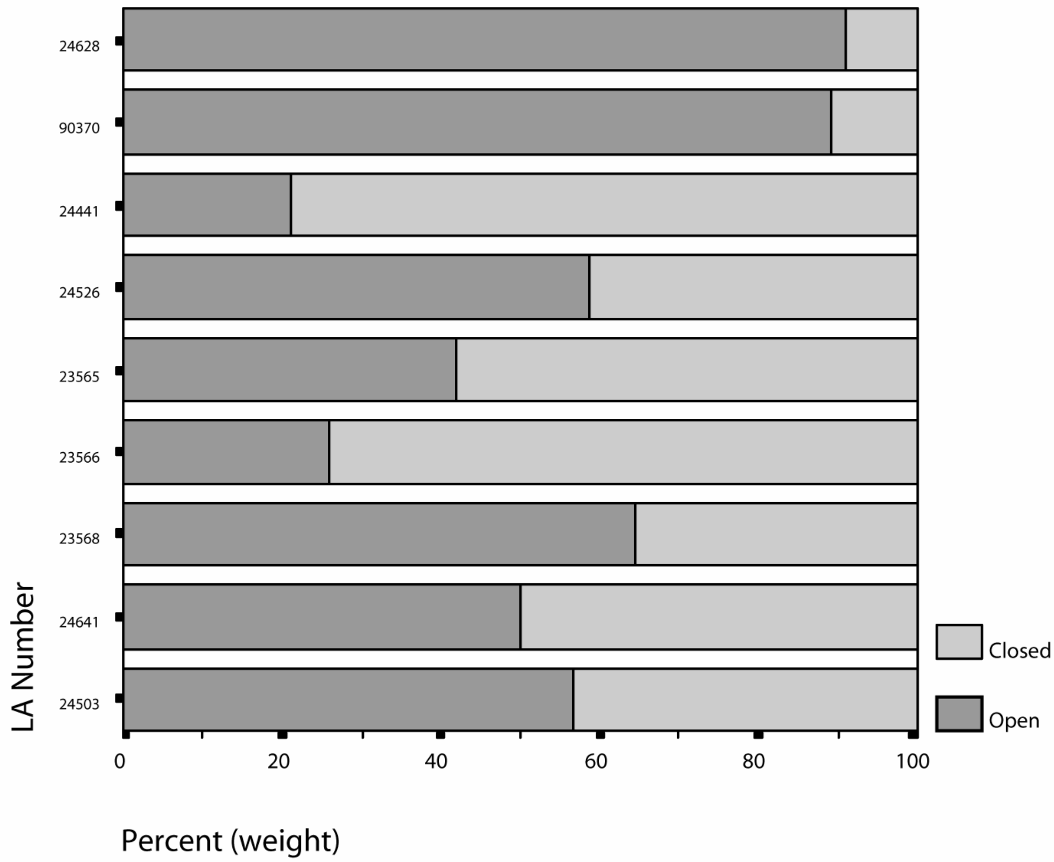
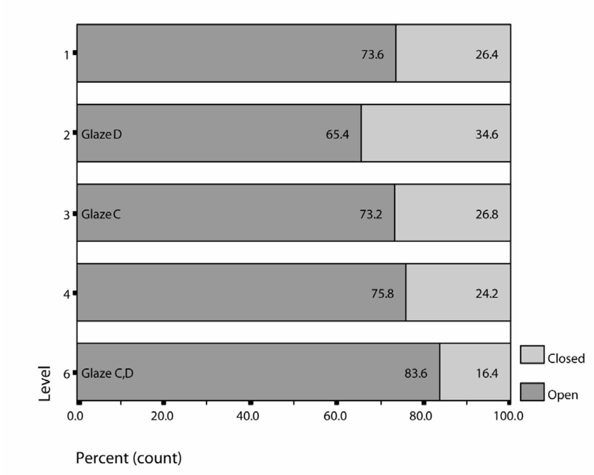


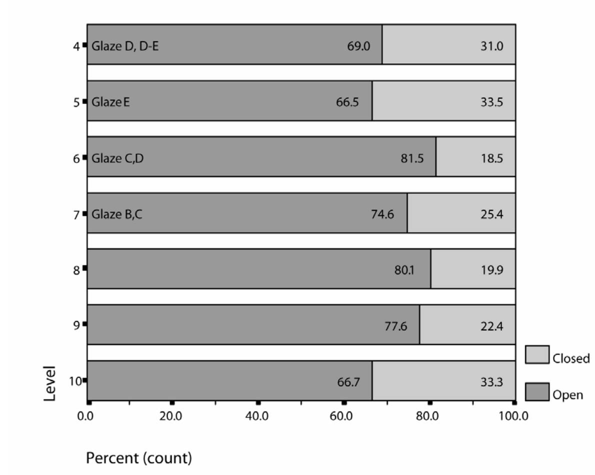
Figure 8.6. Comparison of percentages of closed versus open form whiteware vessels, by weight, across three early and six late sites. The sites are ordered top to bottom from earliest to latest occupation.

been converted to relative frequencies and are shown in Figure 8.7. The patterning in relative frequencies showing a progression from lesser to greater percentages of closed forms through time is strong, with a few qualifiers. Three of these units, Test Cuts L, M, and N, were excavated within the trash midden on the east side of the site. The four levels of Test Cut M are the best dated, based on the incidence of time-diagnostic Rio Grande Glaze ware rims within each level, and demonstrates an approximate 10 percent increase in closed forms over time, from the time span A.D. 1340-1420 to A.D. 1490-1650, based on the date ranges for the Glaze wares. The trend within relative frequencies of the five levels of Test Cut N also support this pattern. Test Cut N lacks diagnostic Glaze rims; however, the overall number of Rio Grande Glaze wares occurring within each layer decreases with depth, consistent with lower frequencies of earlier Glaze ware types found across the site (Reiter 1938:97). Test Cut L also supports the pattern of increasing closed forms among whitewares, if Level 10 is excluded (as Reiter recommends, due to extremely small sample size [1938:190]). Test Cut E is from the midden on the south side of the site. It displays the same pattern of increasing frequencies of closed forms stratigraphically, but based on the Rio Grande Glaze ware rims present, the levels of the test cut do not appear to represent any time depth, dating consistently between A.D. 1425 and 1515.

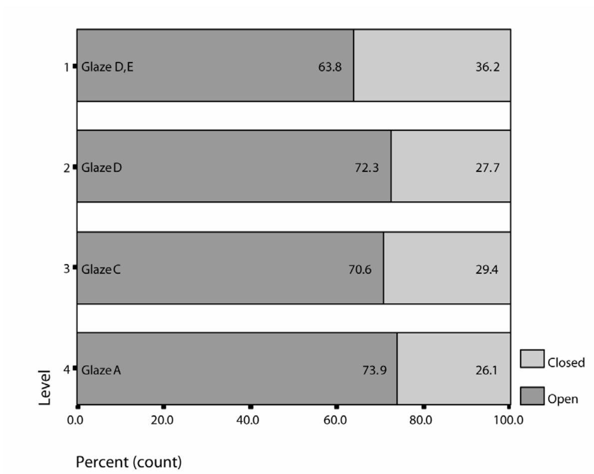
While the temporal patterning of open to closed whiteware vessel ratios from Unshagi is compelling, it is not repeated in assemblages from excavated field house sites. Figure 8.8 shows the relative frequencies of closed to open forms in 14 excavated field house site assemblages for which age of occupation estimates have been made for the sites based on the occurrence of Rio Grande Glaze ware ceramics, or from chronometric (radiocarbon or tree-ring) dates, and that contain more than 20 whiteware sherds. (Again, counts, not weights are used to express relative frequencies, consistent with the data available.) The assemblages from the first four sites could be considered "early" sites, based on the same criteria used for this designation with the current study sample sites, and the following ten assemblages could be considered "late". This lack of patterning does not appear to be a consequence solely driven by the small size of some of the



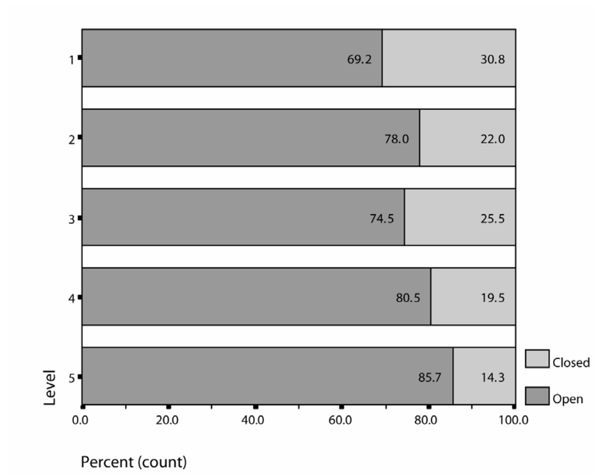
Test Cut E



Test Cut L



Test Cut M



Test Cut N

Figure 8.7. Ratios of open to closed whiteware forms from four test trenches in middens at the large site of Unshagi (LA 123). Data are from Reiter (1938:Appendix I). Figures shown within the bars reflect the actual percentages of open versus closed forms, and differ from the cumulative percentages listed in Reiter's original data. Excavation was conducted in natural levels, and levels are displayed highest to lowest (earliest to latest). Time-diagnostic ceramic types occurring within the level are shown at left in bars.

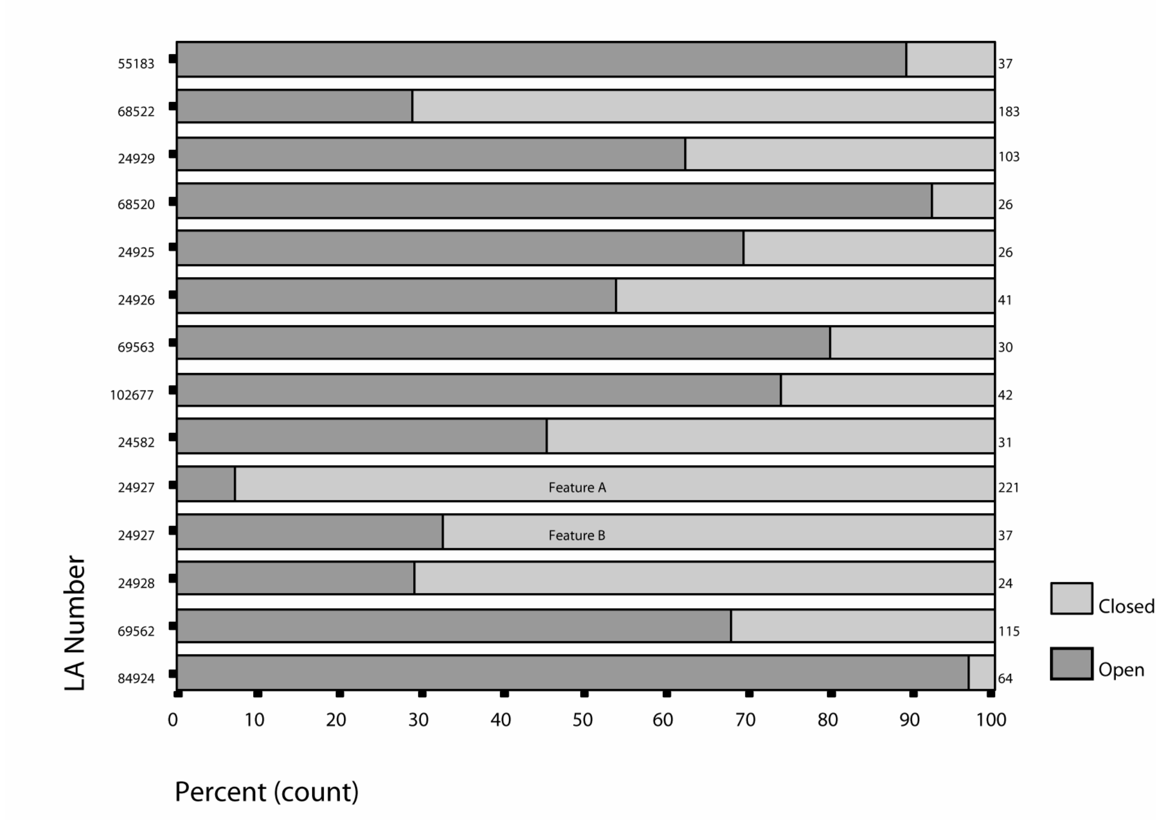


Figure 8.8. Ratios of open (dark gray) to closed (light gray) whiteware forms from 14 excavated field house sites, arranged earliest to latest, based on the dates given in Table 6.1. The numbers along the right vertical axis are the total number of sherds used to calculate the ratios. Data for each site taken from the references listed in Table 6.1.

excavated assemblages. Of the four largest assemblages, two are “early” (LA 24929 and LA 68522) and two are “late” (LA 24927, Feature A, and LA 69562), but among these four assemblages, there is no correspondence within the two pairs of assemblages that would indicate similar behavioral patterns of assemblage formation.

The lack of temporal patterning within the relative frequency of whiteware vessel forms in both surface assemblages of the sample sites from the current study, and the assemblages from excavated field houses, reveals a larger problem in trying to detect temporal trends in assemblage-level relative frequency data from small, short-duration occupation sites. The problem results from a strong lack of class evenness between assemblages of similar ages. Rather than a product of behavioral differences between these sites (a possibility that cannot be ruled out), this lack of class evenness is more likely a consequence of the small size of the assemblages that accompany field houses, and the nature of the discard that formed the assemblage. That small sample sizes can have a distorting effect on the results of frequency seriation is not a new observation (see Grayson 1989 for a review). What is important to recognize is that this problem is inherent to the sites under study here, and is not a methodological consequence. As discussed in Chapter V, the effect the size of an analyzed assemblage can have on its diversity is driven by either one of two factors. Either the assemblage analyzed is too small of a sample to adequately represent the diversity present in the population from which it is drawn, or the population from which the analyzed assemblage is drawn itself is a consequence of an occupation too short in duration to reflect the discard behavior possible given the activities performed at the site. The latter effect will result in differential measures of diversity for sites that are the product of similar behavioral episodes, and will manifest itself as strongly in class evenness as in class richness, particularly in artifact classes that have higher discard frequencies. It is this latter effect of small unrepresentative assemblage sizes, rather than the former effect of small sample sizes, that appears to be in action among field house ceramic assemblages. That it is not being driven by sampling methods—either the use of surface assemblages as a sample of total field house assemblages, or the systematic sampling of large surface assemblages—is supported by the fact that the lack of patterning persists even when excavated field house assemblages are examined. Although excavated assemblages clearly do not represent the totality of the discarded assemblage, because all but a few field house excavations on the Jemez Plateau have been conducted as "data recovery" projects meant to exhaust the available buried deposits present, they likely very closely reflect the total recoverable assemblage present at the field houses at the time of excavation.

Thus, ceramic assemblages at field houses probably accurately represent the classes of ceramic vessels used (class richness measures are accurate), they do not accurately reflect the relative frequencies with which such vessels were used (class evenness measures are not accurate). This is a consequence of the fact that the total ceramic assemblage at most field houses is the product of the discard of a very few vessels, itself a consequence of the short-duration occupations at most field houses, relative to primary settlements. Class evenness comparisons between sites rely on average rates of failure and discard being constant within artifact classes. Average failure and discard rates for different classes can be calculated from large assemblages of sites of known size and duration (Varien and Potter 1997), or from ethnographic observations of discard and breakage rates of large numbers of vessels over a significant period of time (Nelson 1991; Shott 1996; Varien and Mills 1997). However, because the breakage of any individual vessel is a stochastic event, the distribution of class membership sizes (class evenness) will not approach the average distribution unless the assemblage size is large.

This effect explains why temporal patterning in open to closed whiteware vessel frequencies is apparent in the Unshagi test cut data, but is lacking in the field house assemblage data. The difference is not a consequence of larger sample sizes at Unshagi, versus smaller-sized assemblages at the field houses. To be sure, most of the individual analyzed samples from each level of each test cut are significantly larger than those from the field houses, typically two to five times larger than the largest field house assemblages. However, even those test cut samples that are comparable in size to the largest field house assemblages (six of 21 samples with less than

200 sherds) conform to the overall trends in relative open to closed vessel frequencies visible in the larger samples. This is because these samples, regardless of their size, were drawn from populations (trash middens) formed by the discard of thousands or tens of thousands of vessels[2], and as such, class membership size accurately reflects vessel failure and discard rates at the site. An alternative explanation for differences in the distribution of open and closed forms between primary settlements and field houses based on differences in activities has been offered by Elliott (1988; Gauthier and Elliott 1989). This explanation may be correct, but cannot be confirmed based on the analysis of individual field house assemblages, due to the problem of stochastic discard rates and small assemblage sizes.

This inherent problem with the use of frequency data from small, short duration site assemblages may have implications for frequency-based dating methods, but these are not further explored here. Instead, an occurrence based seriation of site occupations is instead employed. As noted above, class richness is likely to be more accurately represented in small, short-duration assemblages than class evenness. However, when surface assemblage sizes are extremely small, class richness also becomes an issue. To deal with this effect, the occurrence seriation is ranked to reflect differing levels of confidence relative to varying assemblage sizes, and different levels of dating confidence associated with the various ceramic types found at the field houses.

Application of Ranked Occurrence Seriation

The ranked occurrence seriation for dating the study sample sites relies upon types that differ somewhat from the conventional descriptions given for the ceramic types on the Jemez Plateau. These surface attribute-based types are employed to maximize the utility of dating using sherds. Given the conventional types, significant numbers of sherds would be placed in unknown categories having no temporal significance (such as "unknown Black-on-white", if the white ware sherd lacked paint), despite the reality that many of these sherds would have identifiable attributes that have temporal significance. In addition to describing the ranked occurrence seriation used in this study, this subsection also describes the reclassification that was used to re-sort sherds into new, attribute-based types. As well, the new provisional types introduced in Chapter VII are evaluated relative to their utility as temporal markers within an occurrence seriation.

In addition to the attribute data that was recorded in the field for each sherd, each was also assigned a conventional type. These conventional types were used to sort the nine sites used as "early" and "late" anchors in the evaluation of frequency-based dating methods presented in the last section, and are shown in Table 8.3. New types were assigned to all 1804 sherds examined at all of the study sites through a resort into new temporal classes based on the surface attributes listed in Tables 7.4 and 7.5. (These new classes are also referred to here as types, in accordance with their use as temporal markers; see Chapter VII.) The criteria for resorting into new types is listed in Appendix E. The results of the type reassignments are shown in Table 8.5, displaying the distribution of the new provisional types and the redistribution of existing types across the 28 sample site assemblages. In addition to moving sherds from categories without temporal value, the reclassification also placed sherds into the new provisional types (for Rio Grande Plain and Jemez Black-on-white) introduced in Chapter VII.

Re-sorting sherds according to surface attributes results in the assignment of sherds to types not reported at sites when typing according to conventional type attributes was initially carried out in the field. In these cases, plainware sherds initially assigned using established attributes to Rio Grande Plain are reassigned to Kapo Gray/Black. Among the whitewares, some sherds assigned using established attributes to Jemez Black-on-white and unknown whiteware categories are reassigned to the Santa Fe Black-on-white and Vallecitos Black-on-white types. Overall, the number of unknown whitewares drops significantly, as surface treatment and presence or absence of slip are used as criteria for type assignment, in addition to the presence of paint.

Table 8.5. Incidence Matrix of Established and Provisional Ceramic Types at Study Sample Sites after Resorting

Ceramic Types	23540	23543	23552	23565	23566	23568	23572	23653	23672	24441	24503	24526	24557	24574	24605	24628	24639	24641	24644	24645	56865	70730	70739	70380	70384	73233	74782	90370	90577	90622
No Ceramics																						X				X				
Rio Grande Plain—Type A	X			X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X		X	X	X	
Rio Grande Plain—Type B	X			X	X	X	X		X	X	X	X		X		X	X	X	X	X			X	X			X	X		
Rio Grande Corrugated																X			X	X								X		
Rio Grande Blind Corrugated	X		X												X	X	X		X	X	X						X	X		X
Kapo Gray/Black				X	X	X				X	X	X		X			X	X	X	X										
Other/Unk. Plain																														
Santa Fe B/w							X		X	X	X					X			X	X			X		X			X		
Vallecitos B/w	X	X	X	X	X	X			X	X	X					X	X		X	X	X						X	X	X	
Jemez b/w—Type A	X			X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X			X			X	X	X	
Jemez b/w— Type B	X			X	X	X			X	X	X	X	X	X	X	X	X	X	X					X			X	X	X	
Jemez b/w—Type C					√													√												
Jemez b/w (Undiff.)	X			X	X	X	X		X	X	X	X		X		X	X	X	X		X		X	X			X	X		
Other White									X																					
Unk. White	X	X		X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X		X	X			X	X		
Glaze A (three types)										X																				
Glaze C-D (two types)														X																
Glaze E (one subtype)												X															X			
Glaze E-F (one subtype)					X	X								√			X		√	√										
Glaze F (two types)											√								X	X										
Glaze Late				X	X	X											X	X												
Glaze Yellow Unk.				X		X			X					X					X								X			
Glaze Red Unk.				X	X				X	X				X			X	X	X								X			

Note: "X" indicates that the type is present in the analyzed sample from the site. "√" indicates that the type is present in the surface assemblage of the site, but is not part of the analyzed assemblage. Sites identified as "early" (A.D. 1200/1250-1500) are shown in light gray, while sites identified as "late" (A.D. 1500-1700) are shown in black. Sites with both early and late ceramics are shown in dark gray.

There are two explanations for this significant departure of the reclassified types from the established types assigned in the field. First, the assignment of established types to sherds in the field relied in part on what Shepard (1956) has called "pottery sense", the intuitive perception of a sherd's typological membership based on the recorder's imperfect knowledge of attribute suites associated with various types. The reliance on pottery sense to classify sherds into established types has the tendency to bias classification towards some diagnostic attributes and away from others. For example, the assignment of Santa Fe Black-on-white to a sherd is often weighted toward the attributes of paint quality, design elements, and the presence of a carbon streak, in addition to the surface attributes that were included in the reclassification conducted for this study. Thus, if these particularly diagnostic attributes, at least given my "pottery sense" of what constitutes a Santa Fe Black-on-white sherd, were absent, the sherd was likely to be classified as an unknown whiteware, even if other surface attributes would indicate that the sherd was indeed classifiable as Santa Fe Black-on-white. The bias of weighting some attributes over others may also be emphasized by biases stemming from preliminary site interpretation; for example, if I believed, based on a variety of other artifact and architectural characteristics of a site, that the site occupation was late, I would be more likely to classify a sherd with surface attributes indicative of Santa Fe or Vallecitos Black-on-white as Jemez Black-on-white.[3] Second, the reclassification of sherds based on surface attributes can assign sherds originating from a single vessel to more than one type if more than one combination of surface attributes occurs on a single vessel (Habicht-Mauche 1993). The distribution of sherd placement among whitewares strongly suggests that this is the case. Across all 28 field house assemblages, 96.9 percent and 93.8 percent of sherds classified as Santa Fe Black-on-white and Vallecitos Black-on-white, respectively, were body sherds, while only 87.5 percent and 67.7 percent of sherds classified as Jemez Black-on-white Type A and Jemez Black-on-white Type B were body sherds. Because the presence of paint and polish on open form exteriors—the two modes used to distinguish Jemez Black-on-white from earlier whiteware types—are more likely to occur on the upper portions of open forms, near the rim, it is probable that many of the sherds reclassified as Santa Fe Black-on-white or Vallecitos Black-on-white originated from vessels that would be classified as Jemez Black-on-white based on their exterior surface attributes adjacent to the vessel rim. The result of the reclassification is that, even if the attribute suites are applied objectively (eliminating the effects of "pottery sense" bias), earlier types are likely overestimated at the expense of later types. For the provisional types utilized here, Rio Grande Plain A is probably over represented relative to Rio Grande Plain B, and each whiteware type is probably over represented relative to the type(s) that follow it chronologically. This effect is mitigated, however, if the occurrence, rather than frequency, of the potentially time-diagnostic attribute suites across plain and whiteware assemblages are used to establish the age of a site at sites with larger assemblages. In addition, types are ranked based on the reliability of their dating potential (taking into account that an "early" sherd may represent a later occupation), less reliable types can be ranked lower within larger assemblages relative to more reliable types, and greater confidence intervals can be placed on sites that feature only sherds belonging to less reliable types.

There are several provisional types that were created in Chapter VII used in the reclassification of the study site ceramic assemblages. These types are Rio Grande Plain Type A and Rio Grande Type B, and Jemez Black-on-white Type A and Jemez Black-on-white Type B (Jemez Black-on-white Type C is also new to this study, but was found only outside of analyzed assemblages and was not included in the reclassification; see Table 8.5). The utility of these provisional types can be assessed by examining their occurrence and frequency at the nine sites separated into "early" and "late" groups and used in the test of frequency-based dating above. Absolute frequencies of these provisional types in weight and count are given in Table 8.4; the evaluation of the provisional types that follows uses weight.

A comparison of relative frequencies of Rio Grande Plain Type A to Rio Grande Plain Type B at the nine "early" and "late" sites conforms well to expectations, except that the widespread frequency of Rio Grande Plain Type B occurs earlier than anticipated (Figure 8.9).

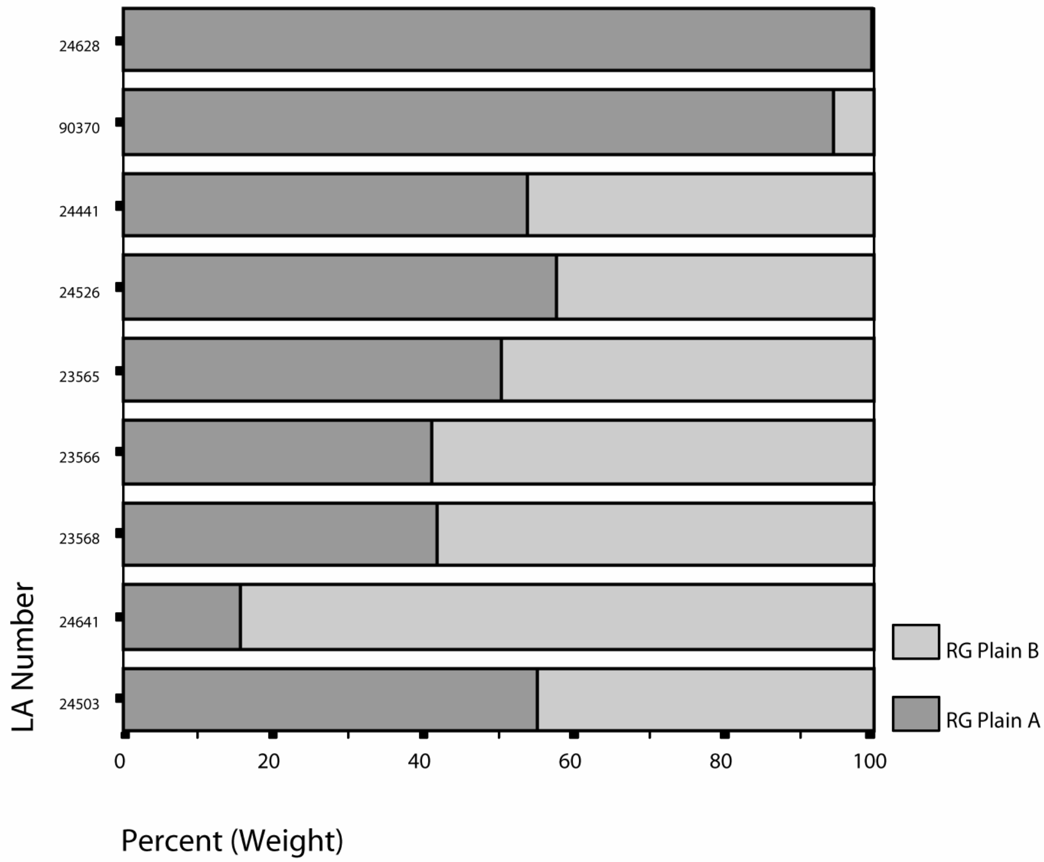


Figure 8.9. Comparison of percentages of Rio Grande Type A sherds against Rio Grande Type B sherds, by weight, across three early and six late sites. The sites are ordered top to bottom from earliest to latest occupation.

This conclusion is based on the assignment of two "early" assemblages (LA 24628 and LA 90370) on the presence of Rio Grande Corrugated and Rio Grande Blind Corrugated, provisionally dating to between A.D. 1200 and 1525, and the third "early" assemblage (LA 24441) on the presence of Glaze A, provisionally dating to between A.D. 1325 and 1450. If the dating of LA 24441 is correct, and the occupations of LA 24628 and LA 90370 predate A.D. 1325, then significant frequencies of Rio Grande Plain Type B post-dates A.D. 1325. If site LA 24441 is removed, however, then significant frequencies of Rio Grande Plain Type B could post-date A.D. 1450 or 1525. Data from additional site assemblages, particularly those belonging to the "early" time category, will be necessary to evaluate this pattern.

Patterning of relative frequencies among whitewares is less evident. Relative frequencies of the four sequential types show some patterning of Santa Fe Black-on-white and Vallecitos Black-on-white versus Jemez Black-on-white, with the three "early" assemblages having 40 percent or more of their whiteware assemblage composed of these two types, and the six "late" assemblages having 20 percent or less of the two types (Figure 8.10). That sherds of these two early types occur at all at the "late" sites may be due to two factors. First, it may be due to the effect described above, where these sherds represent the least finished portions of vessels that would be normally classified as Jemez Black-on-white. Second, these earlier sherds may be "bleed-overs" from adjacent early or multicomponent site surface assemblages, a consequence of post-depositional horizontal transport of sherds from sheetwash erosion. Four of the six "late" sites (LA 23565, LA 23566, LA 23568, and LA 24641) are located in an area where sites that fall within the "early" category have been recorded.[4]

Even the minimal patterning seen in the relative frequencies of whiteware types breaks down when the provisional Jemez Black-on-white Type A and Jemez Black-on-white Type B are compared. As seen in Figure 8.11, the relative frequency of these two types does not pattern through time. However, this patterning should not be taken to reject the hypotheses regarding the patterning in relative frequencies of surface attributes characterizing these two types, as proposed

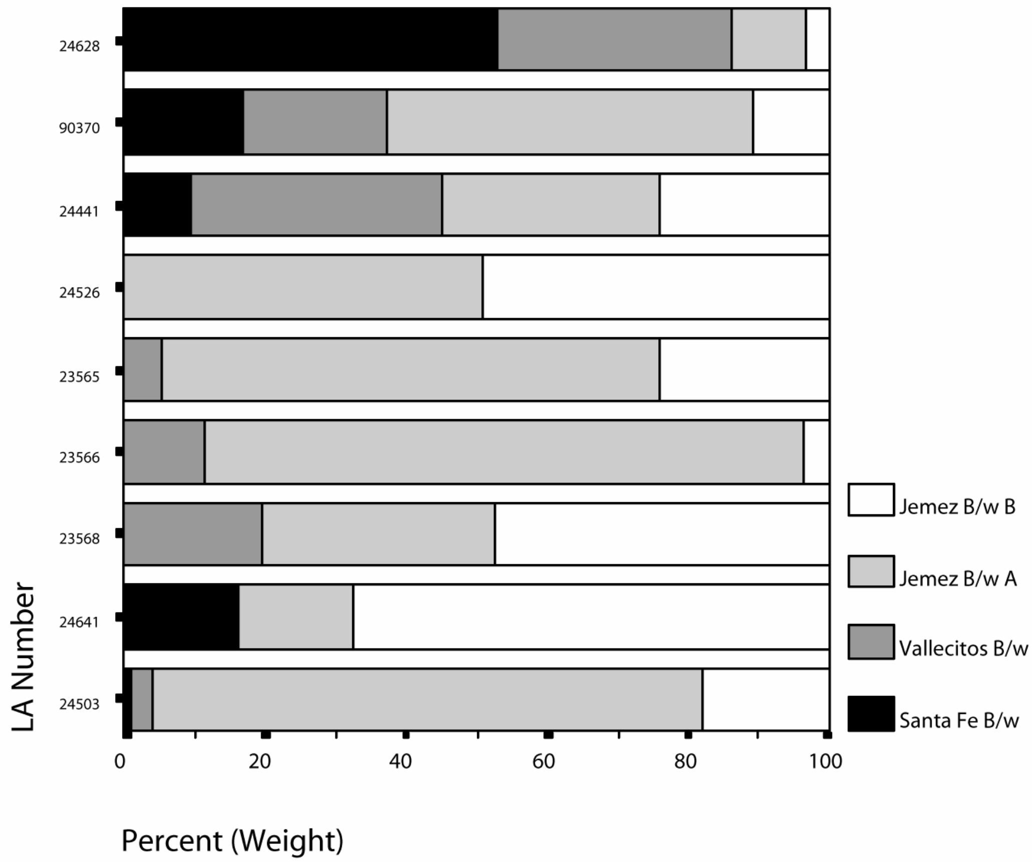


Figure 8.10. Comparison of four white ware types, by weight, across three early and six late sites. The sites are ordered top to bottom from earliest to latest occupation. The types are ordered earliest to latest from left to right.

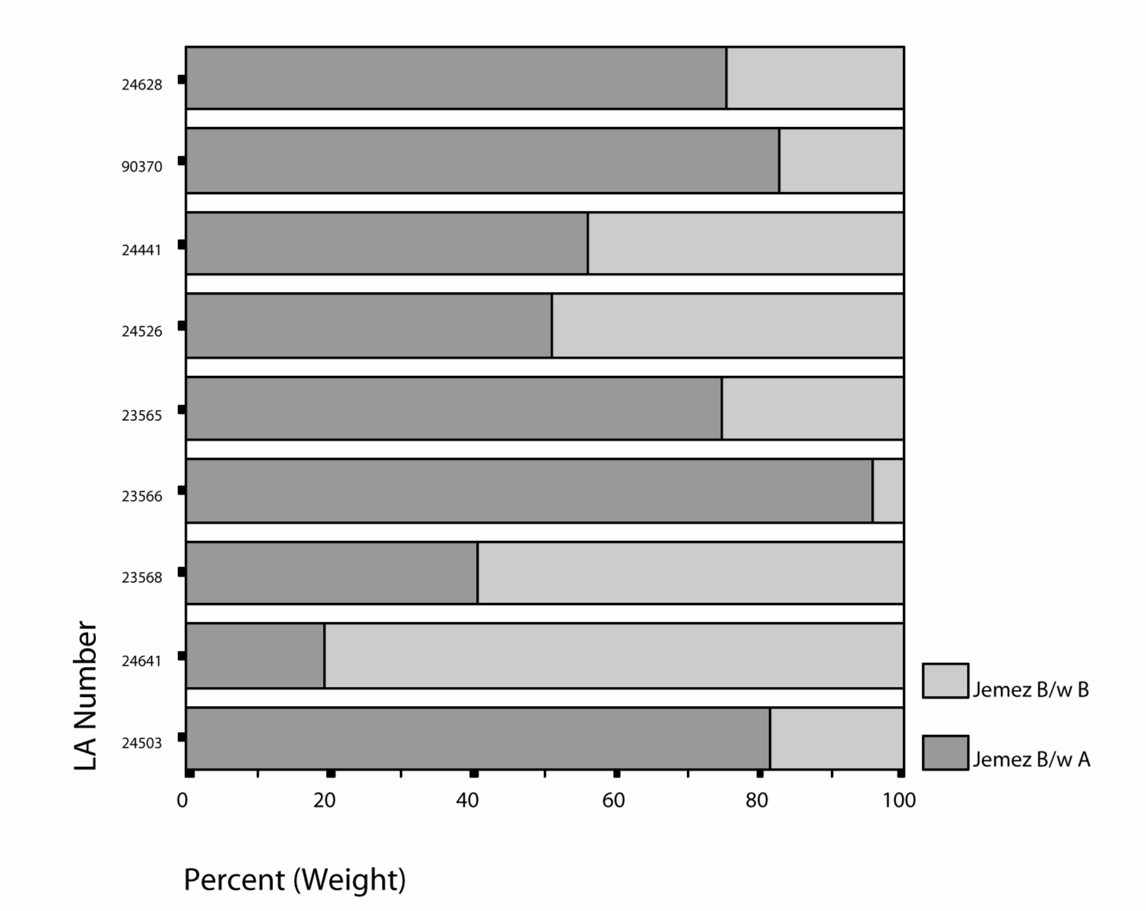


Figure 8.11. Comparison of Jemez Black-on-white Type A sherds against Jemez Black-on-white Type B sherds, by weight, across three early and six late sites. The sites are ordered top to bottom from earliest to latest occupation.

by Elliott (1991, 1994, 1998) and in Chapter VII. Rather, the lack of patterning is likely a result of the fact that temporal variation among the two provisional Jemez Black-on-white types is frequency, rather than occurrence, based. That is to say, Jemez Black-on-white Type B does not replace Jemez Black-on-white Type A, but rather the former increases in frequency through time at the expense of the latter. That such patterning is not evident in the nine well-dated sites is for the same reasons that plague the use of frequency-based dating at these sites in general.

The final age estimate assignment made for 28 of the current study's 30 sample site are based on a ranked occurrence seriation, where the certain types (both established and provisional) are weighted relative to confidence regarding their span of manufacture and/or occurrence on the Jemez Plateau. The problems inherent in generating frequency-based chronological data from ceramic assemblages discussed above preclude frequency from being used. Ironically, then, the dating precision I achieve here is not a consequence of validating new types, or by quantifying assemblage frequencies, two initial goals that were set out when an intensive attribute-based analysis of the ceramics found at the study sample sites. Rather, the relative precision that is achieved over other, previous studies of Jemez Plateau field houses is accomplished by greater attention to typological details and systematic evaluation of entire ceramic assemblages. By looking at the field house assemblages associated with field houses more thoroughly than previous observers, I was able to identify more types overall, and eliminate the typological ambiguity created by reliance on "pottery sense" alone, which leads to overassignment of individual sherds to undifferentiated categories (such as "unknown whiteware" or "unknown glazeware").

The final temporal assignments of each of the 30 sample sites to the study time units are listed in Table 8.6. The occurrence-based assignments were made on the basis of first-, second-, and third-order ceramic types, ordered according to the duration of their time of manufacture and/or occurrence on the Jemez Plateau, and confidence regarding accuracy of that time range being the actual range of manufacture and/or occurrence. The assignment of ceramic types to

Table 8.6. Revised Assignment of Site Occupations Based on Ranked Occurrence Seriation

	Study Time Units							
Site (LA Number)	**I**	**II**	**III**	**IV**	**V**	**VI**	**Confidence**	**Assemblage Size** (Count/**Weight**)
23543	--	--					Low	4/**45.8**
24628	X	X	--				High	121/**378.5**
24644 early[b]	X	X	--	X	X	--	High	758/**3777.1**[a]
24645 early[b]	X	X	--	X	X	--	High	616/**2753.5**[a]
90370	X	X	--				High	60/**197.3**
90577	X	X	--	--	--		Med.	10/**47.3**
23572	X	X	--	--	--		Med.	1800/**6770.1**[c]
70739	X	X	--	--	--	--	Med.	26/**239.6**
70384	X	X	--	--	--	--	Med.	17/**159.3**
70730	--	--	--				Low	0/**0.0**
73233	--	--	--				Low	0/**0.0**
90622	--	--	--				Low	1/**3.6**
23552	X	X	X				Med.	7/**38.4**
56865	X	X	X	--	--		Med.	31/**153.9**
24605	X	X	X	--	--		Med.	16/**73.7**
23672	X	X	X	--	--		Med.	91/**804.9**
23540	X	X	X	--	--	--	Med.	25/**180.4**
23653	--	--	--	--	--		Low	1/**1.4**
24557	--	--	--	--	--		Low	10/**67.3**
70380	--	--	--	--	--	--	Low	22/**175.1**
24441	--	X	--	--	--	--	High	67/**324.1**
24574			X	X	X	--	High	153/**1065.9**[a]
74782	--	--	--	X	--	--	High	80/**347.6**
24526				X	--	--	High	65/**656.8**
23565	--	--		X	X	--	Med.	583/**3059.2**[a]
23566	--	--		X	X	--	High	2255/**10442.8**[a]
23568	--	--		X	X	--	High	701/**2853.9**[a]
24644 late[b]	X	X	--	X	X	--	High	758/**3777.1**[a]
24645 late[b]	X	X	--	X	X	--	High	616/**2753.5**[a]
24639	--	--	--	X	X	--	High	1154/**5129.8**[a]
24641				--	X	--	High	413/**1711.5**[a]
24503	--	--			X	--	High	266/**2105.5**[a]

Note: "X" indicates a probable occupation during the study time unit, while "--" indicates a possible occupation.

[a] Weight estimated from analyzed sample.

[b] Because of discontinuous occupation, site is listed twice, with the alternate occupation distribution shown in gray.

[c] Weight and count estimated from analyzed sample.

first-, second-, and third-order categories is shown in Table 8.7. A site is assigned a “probable” occupation during a study time unit if it features the occurrence of a first-order type, and probable occupations are indicated for each time unit in which first-order types occur. If one or more second-order types occur at the same site, a “possible” occupation is assigned for each time unit in which the second-order types occur that have not already been assigned a “probable” occupation. The occurrence of third-order types at the site are ignored if first- and second-order types are present. If there are no first-order types present at a site, “probable” occupation during a study time unit is assigned based on the occurrence of one or more second-order types, and probable occupations are indicated for each time unit in which second-order types occur. If one or more third-order types occur at the site, a “possible” occupation is assigned for each time unit in which the third-order types occur that have not already been assigned a “probable” occupation. If there are only third-order ceramics present at a site, a “possible” occupation is assigned for each time unit in which third-order types occur. Sites are assigned “high”, “medium”, and “low” dating confidences based the occurrence of first-, second- and third-order types, respectively. There are two exceptions to this rule. First, two sites, LA 23543 and LA 90622, feature second-order types, but because their assemblages are so small (4 sherds/45.8 g and 1 sherd/3.6 g, respectively) their dating confidence was downgraded to “low” and their occupations were indicated only as “possible”. Second, two sites had “possible” occupations assigned to study time units despite the fact that they have no surface assemblage. The dating of these two sites is considered in more detail below.

Dating Sites Without Ceramic Assemblages

For the two sites that lack any surface assemblage, dates of occupation had to be assigned without recourse to architectural attributes, which are kept separate from determinations of age to keep these two data domains independent from one another. Instead, these two sites were assigned possible ages of occupation based upon their location. The two sites, LA 70730 and LA

Table 8.7. Ranking of Ceramics Based on Date Range Confidence

	Study Time Units					
Ceramic Types	**I**	**II**	**III**	**IV**	**V**	**VI**
First Order Types						
Rio Grande Corrugated	X	X				
Jemez B/w—Type C					X	
Glaze A (three types)		X				
Glaze C-D (two types)			X			
Glaze E (one type)				X		
Glaze E-F (one type)				X	X	
Glaze F (two types)					X	
Second Order Types						
Rio Grande Blind Corrugated	X	X	X			
Kapo Black					X	X
Santa Fe B/w	X	X				
Vallecitos B/w	X	X				
Glaze Late				X	X	
Third Order Types						
Rio Grande Plain—Type A	X	X	X	X	X	
Rio Grande Plain—Type B				X	X	X
Jemez B/w—Type A		X	X			
Jemez B/w –Type B				X	X	
Jemez B/w undifferentiated		X	X	X	X	

73233, are both located on the Banco Bonito, in the northeastern portion of the Jemez Plateau. Based on a variety of factors, the occurrence of field houses on the Banco Bonito appears to be constricted in time to primarily study time units II and III (A.D. 1325-1525). First, such dating is consistent with surface remains found at other field houses on the Banco Bonito. Although there are few surface remains at Banco Bonito field houses, surface assemblages consist of Jemez Black-on-white and Rio Grande plain wares; both Rio Grande Corrugated/Blind Corrugated and Rio Grande Glaze wares are absent, except for one site featuring Agua Fria Glaze-on-red (Rio Grande Glaze A) (Kulisheck 2003b; Viklund 1988). Second, such dating is consistent with the occupations of large settlements in the vicinity of the Banco Bonito, Hot Springs Pueblo (LA 24553), Unshagi (LA 123) and Nanishagi (LA 541). These three sites are the only large settlements that fall comfortably within an 8 kilometers radius of the Banco Bonito. All three of these sites have occupations falling within Time Unit II, and the latter two are also occupied during Time Unit III (Elliott 1982; Reiter 1938; Reiter et al. 1940). Third, the two excavated field house sites on the Banco Bonito, LA 68520 and LA 68522, had surface assemblages consistent with other Banco Bonito field house sites. These sites did not yield diagnostic ceramics beyond Jemez Black-on-white and Rio Grande Plain, consistent with surface assemblages, and one of the sites yielded a tree-ring date consistent with a mid- to late fifteenth century occupation (LA 68522, LTRR JAM-50, PP, 1367p – 1434vv). And fourth, such a date range is consistent with the climatic conditions that would have made it possible to farm on the high altitude Banco Bonito. The field houses of the *banco* are among the highest found on the Jemez Plateau, located at elevations between 2410 and 2525 meters (7900 and 8300 feet). Warmer temperatures prevailed after A.D. 1350 across the northern Southwest (Salzer 2000) and within the Jemez Mountains (Ensey 1997), making farming possible in the late fourteenth and fifteenth centuries.

However, even with these rationale, the dating precision of these two sample sites must be considered low. While the patterning of ceramic assemblages on the Banco Bonito is quite consistent, it does not correspond with the assumptions made regarding the incidence of ceramic types in other portions of the Plateau, namely the persistence of Rio Grande Blind Corrugated to A.D. 1500 and the common occurrence of Rio Grande Glaze wares (particularly Glaze E) after A.D. 1515. Functional differences between Rio Grande Plain and Rio Grande Blind Corrugated may account for the absence of the latter from the Banco Bonito field houses, but this type is found at field houses elsewhere on the Jemez. It is also possible that Rio Grande Blind Corrugated does not persist beyond the mid-1400s, and excepting the rare Rio Grande Glaze C or D sherd, Unit III assemblages are characterized only by Rio Grande Plain and Jemez Black-on-white. This appears to be the case even at field houses with relatively large excavated assemblages, such as LA 68522.

Evaluating Biases in Assemblage and Architectural Datasets

Prior to considering variability in the study sample field house datasets relative to use intensity, other factors that may be contributing to patterns of variability in the study sample must also be considered. Bias due to other factors is a consideration with any study of data variability, but two aspects of the current study make their consideration particularly important. The first is that the datasets are derived from remains that are the product of small, short-term duration occupations. Second, the datasets have been constructed from surface evidence. The effects of short-duration occupations on the aspect of variability in artifact assemblage class evenness has been demonstrated in the last section; it has the potential to affect class richness among artifacts as well. Reuse and recycling are also factors that can problematize data construction from architecture at loci of short-duration occupations. The last chapter provided a brief consideration of the potential effects of differential vegetation zones on surface visibility, and other environmental variables. The potential for these differences to affect patterning in artifacts and architecture are also considered here.

The two specific conditions affecting the formation of the record from which datasets are drawn—small, short-term occupations, and the use of surface remains—dictate the examination of several situations where variability stemming from factors other than use intensity could be dictating the distribution of the data. For artifacts, it is necessary to distinguish whether variability in class richness and in the accumulation of specific artifact classes (specifically, plain ware ceramics) is a consequence of total assemblage size, or whether it is a consequence of variability in the size of the surface assemblage. For architecture, the effects of raw material availability, reuse, and recycling of materials must be considered. Because of the prominence of masonry construction as a characteristic of Jemez Plateau field house architecture, surface visibility is less of a concern in the evaluation of architectural dataset construction. However, surface visibility is important to the identification of extramural features. Potential sources of bias in the artifact and architectural datasets are considered in turn below.

Artifacts and Surface Visibility

As outlined in Chapter VII, variability in class richness can either indicate differences in the duration of lifetime occupation at a field house (as a consequence of differential discard rates among different artifact classes), or it can be an indicator of activity diversity. The volume of accumulated artifacts (such as plain ware ceramics) is an indicator of the duration of lifetime occupation, or it can be a proxy for relative population size. However, for either class richness or artifact accumulation to be used as measures of use intensity, it is necessary to distinguish whether variability in these two characteristics are a consequence of differences in assemblage size (the artifacts present at the site) or sample size (the artifacts on the surface available for analysis) (see Jones and Leonard 1989 for this distinction relative to class richness). If variability in class richness or artifact accumulation between sites is a consequence of assemblage size, then it is indicative of differences in use between sites. However, if variability is a consequence of sample size, then it is a result of differences in the percentage of the total site assemblage that is present on the site surface, a product of surface visibility and differential patterns of burial and exposure (erosion), and is unrelated to variability in site use.

As can be seen in the summary data listed in Table 8.2, artifact sample sizes between the study sample sites are extremely variable. Several factors indicate that the effects of surface visibility on artifact sample size may be a significant contributor to this variability. First, the sites are distributed across two different ecological associations (the Ponderosa Pine, Two-needle Piñon and Gambel Oak association at lower elevations and the Ponderosa Pine and Gambel Oak association at higher elevations) that differ in surface visibility. As discussed in Chapter VII, surface visibility in the Ponderosa Pine, Piñon Pine and Gambel Oak association is greater than that in the Ponderosa Pine and Gambel Oak association due to greater openness in the overstory, less accumulation of forest floor litter, and higher rates of surface erosion due to the removal of understory vegetation by grazing in the former association. Second, sample size appears to be strongly influenced by elevation, as can be seen in Figures 8.1 and 8.2. In addition to serving as a proxy for overstory closure, elevation accounts well for intra-association variability in overstory vegetation.[5] Its effect on artifact assemblage variability has already been observed relative to ceramic sherd size earlier in this chapter.

The relationship between assemblage size, surface visibility and elevation is examined in Figure 8.12. The scatterplots, a. and b., show a strong relationship between artifact frequencies (ceramic weights and lithic counts) and elevation for the 26 study sample sites that are located on mesa tops. Above approximately 2300 meters (7545 ft.), variability in assemblage size is low, with no assemblages containing more than 3,000 g of ceramics, or more than 25 lithic items. Below this elevation, most of the total range of variability in both ceramic weight and lithic counts is present. Unsurprisingly, the 2300 meters line on the eastern Jemez Plateau corresponds closely with the boundary between the the Ponderosa Pine, Two-needle Piñon and Gambel Oak association and the Ponderosa Pine and Gambel Oak association.

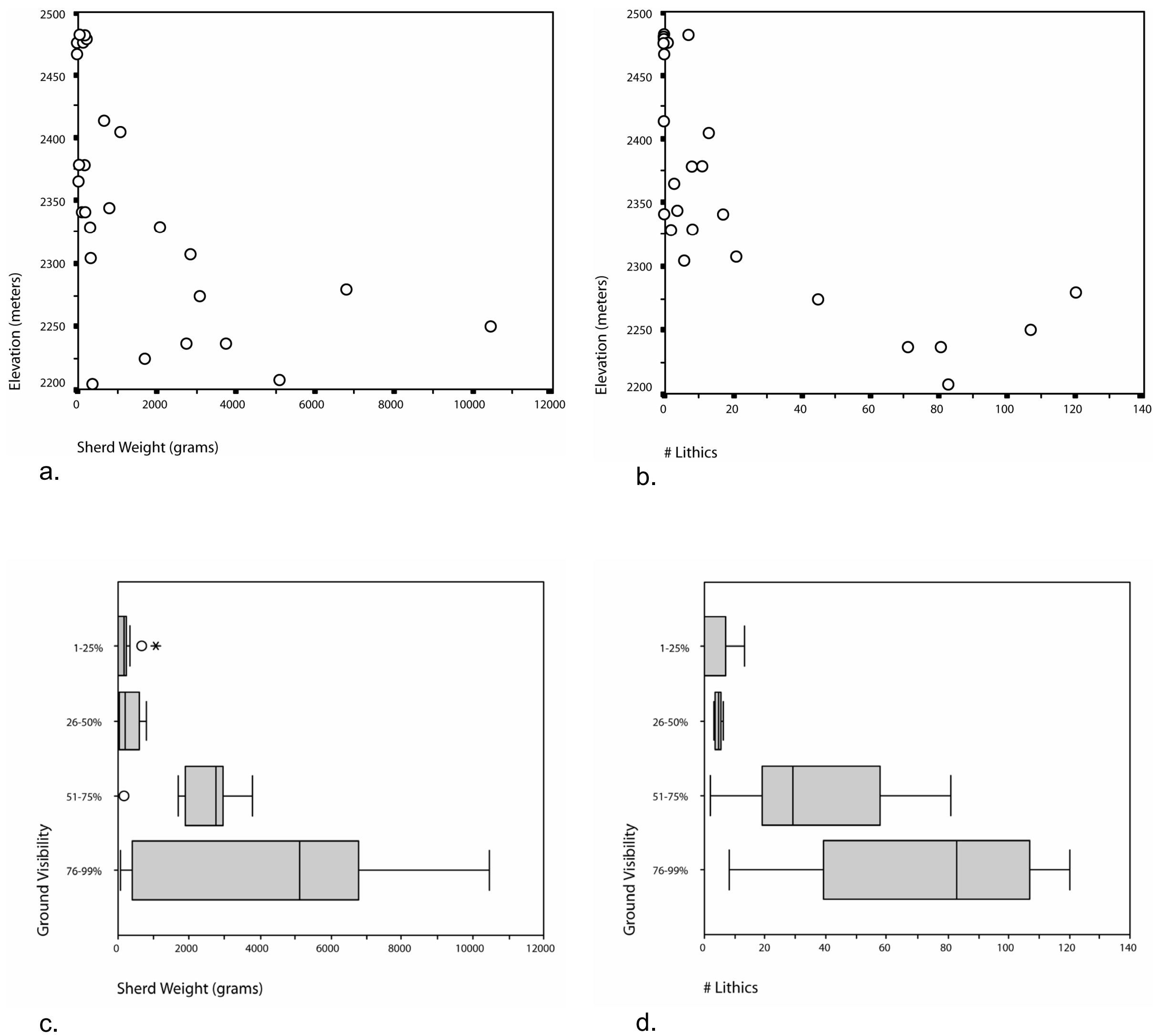


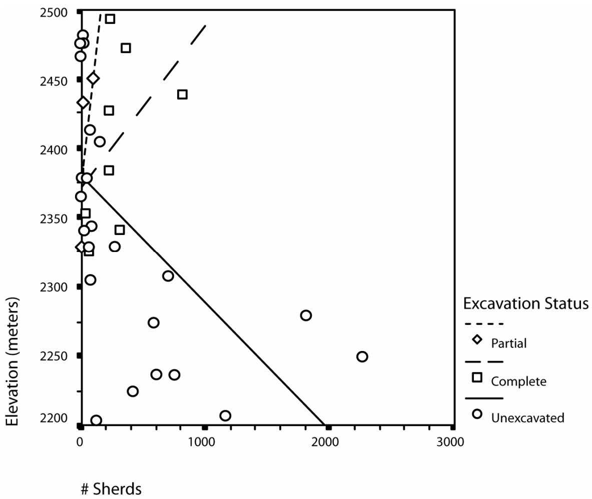
Figure 8.12. Two measures of the relationship between artifact sample size and artifact visibility, as reflected in ground visibility and elevation. Figures a. and b. show the relationship between the total weight of sherds, and the total number of lithics, respectively, at 26 of 30 study sample sites (four canyon-bottom sites are excluded from the sample). Figures c. and d. show the distribution of sherd weights and the total number of lithics, respectively, at all 30 study sample sites. Within the boxplots, open circles represent outliers, while asterisks represent extremes.

The boxplots in the lower portion of Figure 8.12, c. and d., show a similar relationship between ground visibility and assemblage size. Where ground visibility falls below 51 percent (n = 18), assemblage sizes are small and variability between assemblages is small. When ground visibility is equal to or greater than 51 percent (n = 12), however, variability in assemblage size between sites is high. Statistical comparison of variability within each of the ground visibility categories confirms the differences visible within the boxplots. A Kruskal-Wallace test applied to differences between sherd weights within the four ground visibility categories yields an asymptotic significance value of 0.004 (category means ranks: 1-25% = 10.29, 26-50% = 12.50, 51-75% = 22.43, 76-99% = 22.80).[6] For counts of lithics, one-way analysis of variance (ANOVA) shows differences between mean log10 counts[7] within the four ground visibility categories at a significance level of <0.001 (sum of squares = 10.414, df = 3, mean square = 3.471, F = 16.303). Together with the variation visible in the scatterplots of elevation and the boxplots, these statistics suggest a strong relationship between sample size and surface visibility.

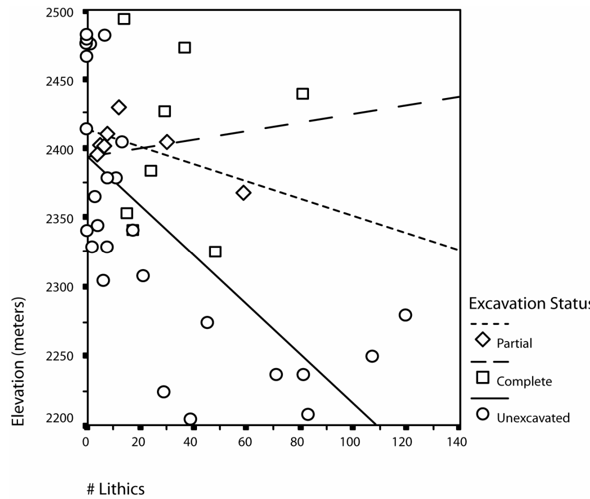
That there is a relationship between surface visibility and surface assemblage size does not preclude actual differences in total assemblage size between sites that lie at different elevations. It is possible that higher elevation sites were used during time periods when field house use was less intense overall; as discussed in the previous section, field house use on the Banco Bonito, where the study sample sites with the greatest elevation values are found, appears to have been used during a restricted time period. It is also possible that there is spatial variability in field house use, with higher elevation farm plots cultivated less intensively than lower elevation plots during the same time periods. To determine whether the effect of elevation on surface assemblage size is a consequence of variability in surface variability or in use, the 26 mesa-top study sample sites can be compared to 18 Jemez Plateau mesa-top field house sites that have been either partially or completely excavated; counts of ceramics are available from 11 of the excavated sites, and counts of lithics from 15 of the sites. Because weight data is not available in the published reports of ceramics from the excavated sites, counts between the excavated and unexcavated sites must be compared.[8]

Comparisons between the unexcavated study sample sites and excavated sites are shown in Figure 8.13. The scatterplot on the right (b.), shows the relationship between elevation and counts of lithics. While there is a strong relationship between sample size and elevation among unexcavated sites, as indicated by the linear regression line, this relationship is weaker among the partially excavated sites, and there is no relationship between elevation and sample size among the completely excavated sites. The scatterplot on the left (a.) shows the relationship between elevation and counts of sherds. While a strong relationship between sherd counts and elevation is shown by the linear regression line for unexcavated assemblages, no relationship is indicated for either the partially or the completely excavated sites. These graphs indicate that the differences between lower and higher elevation study sample site surface assemblage sizes are a function of differences in surface visibility, not differences in use.

The effect of surface visibility on sample size was known empirically prior to beginning analysis of surface assemblages, based on a study of assemblage size measures at sites prior to and following a catastrophic wild fire that removed all surface organic material (Raish 1992). The use of raking to expose additional numbers of artifacts obscured under forest litter was unsuccessful, despite the raking of hundreds of square meters at most sites with ground visibility of less than 50 percent. At only one site did raking yield significant numbers of artifacts that were not immediately visible on the surface. The failure of raking is likely due to several factors. First, the accumulation of forest litter leads to soil formation and aggradation, and over time will result in the actual burial of artifacts. Second, the abundance of artifacts at sites with ground visibility of greater than 50 percent is probably not due to surface exposure itself, but rather a consequence of sheetwash erosion uninhibited by ground cover exposing shallowly buried artifacts. Almost universally, artifacts found at sites with overall low surface visibility were



a.



b.

Figure 8.13. Comparison of sherd (a) and lithic (b) sample sizes at the 25 mesa top study sample sites with assemblage sizes from partially and completely excavated mesa-top field house sites.

located in areas that featured an immediate overstory lacking interlocking crowns (assuring a lighter accumulation of organic litter) and a slope being actively eroded by sheetwash.

The patterns in assemblage size relative to ground visibility confirm that in the northern Southwest, increases in overstory vegetation, a consequence of increasing rainfall with increases in elevation, have a significant effect on the size of surface assemblages relative to total site (surface and buried) assemblages. The differential effects of rainfall on the surface visibility of artifacts has been observed for different regions of Europe, where increases in rainfall mean decreases in surface erosion and deflation, and increases in soil formation and artifact burial (Bintliff and Snodgrass 1988). Because rainfall in the northern Southwest can differ significantly over short distances due to elevation, its effect on surface visibility can be compressed into a single area or region, rather than distinguishing different regions. As a consequence, the effect must be controlled in areas where elevation varies significantly, such as the Jemez Plateau.

Architecture: Raw Material Availability, Reuse, Scavenging, and Surface Visibility

Variability in architectural remains along several axes can provide insight on the use intensity of a structure. As discussed in Chapter VII, both the frequency with which masonry blocks are shaped, and the size of the blocks used in construction, can be used to measure the anticipated duration of periodic or lifetime occupation. However, both of these variables can be guided by factors other than the intentions of early modern Pueblo stonemasons. Raw materials place constraints on the size of construction materials, and dictate the effort that is necessary to shape source materials into blocks that provide performance characteristics superior to unworked material. Likewise, the post-abandonment scavenging of construction materials may leave disproportionate fractions of inferior construction remains, as larger and better shaped blocks are carried away to be incorporated into new buildings. In either case, these effects would serve to depress measures of the amount of effort expended in the construction of a structure, and result in an underestimate of the anticipated duration of structure occupation.

Observations regarding raw materials used for masonry at the 30 study sample sites can be compared to the distribution of classes for the two variables of architectural masonry used in this study. These two variables are the percentage of masonry blocks that show some evidence of shaping (pecking or other retouch), expressed as percentage range classes, and the percentage of masonry blocks that fall within one of four size categories. Table 8.8 contains the distribution of masonry raw material types relative to these variables, along with the topographic location of the 30 study sample sites. Prior to any observations regarding the relationship between raw materials and masonry attributes, it is interesting to note the overall dominance of tuff as the construction material of choice at all but two of the sites, regardless of spatial or topographic location. For example, three of the five sites that lie within canyon bottoms, while close to available sources of tuff, are located non-tuff on bedrock geology (LA 23653 and 90577, Chinle Formation Limestone; LA 90622, Paliza Canyon Formation Dacite), and with access to non-tuff alluvial cobbles. Relative to the immediate bedrock geology or alluvial materials, however, tuff appears to have been selected because it is both more workable, and because it is lighter and easier to transport. Even the one site that does incorporate a significant number of alluvial cobbles into its construction, LA 90370, was constructed primarily of tuff cobbles. Three of the five sites located on the Banco Bonito, the one mesa top location that does not have Tshirege Member Bandelier Tuff as its primary bedrock geology, also have tuff as their primary construction material. This is despite the fact bedrock geology on the *banco*, which is well exposed, consists of mainly decomposing rhyolite (porphyritic obsidian), but this material composes only between five and 15 percent of total masonry at these structures. As a consequence, it is unsurprising that site topographic location had little influence on the percentage of shaped masonry, because Jemez masons were willing to travel to obtain better construction materials. As can be seen in Table 8.9, the relationship between the percentage of shaped blocks and topographic location is statistically independent.

Table 8.8. Distribution of Masonry Raw Material Types Relative to Shaping and Size Classes

LA No.	Raw Material Type[a]	Topographic Location	% of Shaped Masonry Blocks	Block Size Classes: % Blocks <10cm	% Blocks 10-30cm	% Blocks 30-60cm	% Blocks 60cm+	Scavenged?
23540	50% Qbt, 50% Qbo	Mesa top	76-99%	5	20	70	5	No
23543	100% Qbt	Mesa top	26-50%	15	55	30	-	No
23552	100% Qbt	Canyon bottom	1-25%	5	35	60	-	No
23565	100% Qbt	Mesa top	1-25%	25	35	25	15	No
23566	80% Qbt, 20% Qbo	Mesa top	26-50%	20	30	30	20	No
23568	100% Qbt	Mesa top	26-50%	20	40	30	10	No
23572	100% Qbt	Mesa top	76-99%	5	30	50	15	No
23653	100% Qbt	Canyon bottom	76-99%	-	35	50	5	No
23672A 23672B	100% Qbt / 100% Qbt	Mesa top	26-50%/ 26-50%	10/ 25	35/ 40	50/ 35	5/ -	No/ Yes
24441	100% Qbt	Mesa top	51-75%	10	40	45	5	No
24503	100% Qbt	Mesa top	51-75%	25	40	35	-	Yes
24526	20% Qbt, 80% Qbo	Mesa top	26-50%	5	45	50	-	No
24557	100% Qbt	Mesa top	51-75%	10	40	50	-	No
24574	100% Qbt	Mesa top	76-99%	10	25	45	20	No
24605	25% Qbt, 75% Qbo	Mesa top	1-25%	5	70	25	-	No
24628	100% Qbt	Mesa top	1-25%	30	45	25	-	Yes?
24639	100% Qbt	Mesa top	76-99%	15	25	40	20	No
24641	100% Qbt	Mesa top	51-75%	10	40	50	10	No
24644	100% Qbt	Mesa top	51-75%	10	35	50	5	No
24645	80% Qbt, 20% Qbo	Mesa top	76-99%	20	20	45	15	No
56865	100% Qbt	Mesa top	1-25%	5	45	50	-	Yes?
70370	5% Qvbb, 95% Qvbr	Mesa top	0%	5	35	50	10	Yes?
70379	15% Qvbb, 85% Qvvf	Mesa top	1-25%	5	30	65	-	No
70380	10% Qvbb, 90% Qvvf	Mesa top	1-25%	5	55	40	-	No
70384	10% Qvbb, 90% Qvbr	Mesa top	1-25%	-	40	60	-	No
73233	100% Qvbr	Mesa top	26-50%	-	25	70	5	Yes?
74782	100% Qbt	Mesa top	76-99%	10	30	55	5	No
90370	95% Qbo, 5% Tpb	Canyon bottom	1-25%	80	20	-	-	No
90577A 90577B	100% Qbt / 100% Qbt	Canyon bottom	51-75%/ 26-50%	10/ -	35/ 35	45/ 65	10/ -	No/ Yes
90622	100% Qbt	Canyon bottom	51-75%	-	60	40	-	No

[a] Qvbb—Banco Bonito Rhyolite; Qvvf—Valle Grande Rhyolite; Qvbr—Battleship Rock Tuff; Qbt—Bandelier Tuff, Tshirege Member; Qbo—Bandelier Tuff, Otowi Member; Tpb—Paliza Canyon Basalt

Table 8.9. Distribution of Structures at Study Sample Sites across Topographic Location and Percentage of Masonry Blocks Shaped
a. as individual sites

Topographic Location	**% of Blocks Shaped** 0-25%	26-50%	51-75%	76-99%
Mesa top	23565	23543	24441	23540
	24605	23566	24503	23572
	24628	23568	24557	24574
	56865	23672A	24641	24639
	70370	23672B	24644	24645
	70379	24526		74782
	70380	73233		
	70384			
Canyon bottom	23552	90577B	90577A	23653
	90370		90622	

b. as frequencies of structures

Topographic Location		**% of Blocks Shaped**				**Total**
		0-50%		51-100%		
		0-25%	*26-50%*	*51-75%*	*76-99%*	
Mesa top	Count	15		11		26
		8	*7*	*5*	*6*	
	Expected Count	14.6		11.4		26.0
		8.1	*6.5*	*5.7*	*5.7*	
Canyon bottom	Count	3		3		6
		2	*1*	*2*	*1*	
	Expected Count	3.4		2.6		6.0
		1.9	*1.5*	*1.3*	*1.3*	
Total	Count	18		14		32
		10	*8*	*7*	*7*	
	Expected Count	18.0		14.0		32.0
		10.0	*8.0*	*7.0*	*7.0*	

4 x 2 table: N = 32	$X^2 = 0.750$	df = 3	p = 0.861
2 x 2 table: N = 32	$X^2 = 0.117$	df = 1	p = 0.732

Note: Statistics calculated based on both the four initial classes of relative shaping frequencies, and the pooling of these classes into two (zero to 50 and 51 to 100 percent). The four initial classes were collapsed into two as the calculation of the Pearson chi-square statistic on a 4 x 2 table only barely meets the requirements of a minimum expected count of greater than or equal to one and a sample size that is four to five times the number of cells included in the analysis (see Nelson 1993:34-35). Although the statistics generated on the 2 x 2 comparison are weaker than those from the 4 x 2 comparison, they generally agree.

Despite the dominance of tuff as a construction material, differences in raw material types do appear to have an influence on the percentage of shaped masonry. Table 8.10 shows the distribution of sites among raw material types and classes of masonry shaping percentages. When the four classes are pooled into two categories of fewer (zero to 50 percent) and more (51 to 100 percent) shaped blocks, shaping appears to be significantly affected by raw material type. The significance appears to be largely driven by the five sites located on the Banco Bonito (LA 70370, 70379, 70380, 70384, and 73233). The primary construction material at these sites is Battleship Rock Tuff or Valle Grande Rhyolite, and these two materials are more difficult to shape than the two varieties of Bandelier Tuff that is the primary construction material at other sites. Where Battleship Rock Tuff is available on the top of the *banco* and around its margins, it is compacted and partially welded (Self et al. 1996:40-41). While the Bandelier tuffs are also increasingly welded near the top of their deposits (where bedrock would have been exposed on the surface), more poorly welded and easily shaped blocks are available within canyons between the mesas and in smaller, intra-mesa alluvial drainages. Battleship Rock Tuff is also more poorly welded lower in its deposit, but the Banco Bonito is a recent enough landform not to have experienced intra-mesa alluvial erosion (Wolff et al. 1996), and more workable raw material is immediately unavailable on the top of the *banco*. This more workable stone is only available on the steep wall of the *banco* that faces the Cañon de San Diego. Valle Grande Rhyolite is a porphyritic rhyolite that is clastic and even less amenable to shaping than the Banco Bonito Tuff.

The relevance of raw material appears to carry through to the size of masonry blocks. Overall, relative frequencies of masonry blocks at all sites are concentrated into two size classes: ten to 30 centimeters, and 30 to 60 centimeters. The five Banco Bonito sites follow this pattern, but are underrepresented in the less than 10 centimeters and greater than 60 centimeters classes. The lack of larger material is probably due to a lack of clasts this size from the Banco Bonito Rhyolite, Valle Grande Rhyolite or Battleship Rock Tuff deposits. Smaller material is likely scarce because these deposits are relatively recent and there has been relatively little erosion or

Table 8.10. Distribution of Structures at Study Sample Sites across Masonry Raw Material Types and Percentage of Masonry Blocks Shaped
a. as individual sites

Raw Material Type	% of Blocks Shaped 0-25%	26-50%	51-75%	76-99%
Qbt (Bandelier Tuff, Tshrige Member)	23552 23565 24628 56865	23543 23568 23672A 23672B 90577B	24441 24503 24557 24641 24644 90577A 90622	23653 23572 24574 24639 74782
Mixed/Other[a]	24605-Qbt/Qbo 70370-Qvbb/Qvbr 70379-Qvvf/Qvbr 70380-Qvvf/Qvbr 70384-Qvbb/Qvbr 90370-Qbo/Tpb	23566-Qbt/Qbo 24526-Qbt/Qbo 73233-Qbbr		23540-Qbt/Qbo 24645-Qbt/Qbo

[a] See Table 8.8, Footnote (a) for codes to lithic raw material types.

b. as frequencies of structures

Raw Material Type		% of Blocks Shaped 0-50%		51-100%		Total
		1-25%	*26-50%*	*51-75%*	*76-99%*	
Qbt (Bandelier Tuff, Tshrige Member)	Count	9		12		21
		4	*5*	*7*	*5*	
	Expected Count	11.8		9.2		21.0
		6.6	*5.3*	*4.6*	*4.6*	
Mixed/Other	Count	9		2		11
		6	*3*	*0*	*2*	
	Expected Count	6.2		4.8		11.0
		3.4	*2.8*	*2.4*	*2.4*	
Total	Count	18		14		32
		10	*8*	*7*	*7*	
	Expected Count	18.0		14.0		32.0
		10.0	*8.0*	*7.0*	*7.0*	

4x2 table: N = 32	$X^2 = 6.717$	df = 3	p = 0.081
2x2 table: N = 32	$X^2 = 4.453$	df = 1	p = 0.035

Note: The Pearson chi-square statistics shown beneath b. were calculated twice for the same reasons stated in Table 8.9 note. Dependence at the less than 0.05 significance level is indicated for the 2x2 table (the pooled categories), but is not for the 4x2 table, although this value remains low.

other deterioration contributing to the availability of small-sized raw material. One other site, LA 90370, deviates far more significantly from the general pattern of masonry shaping with blocks concentrated in the two middle size classes. This site is one of the few that has a structure constructed from alluvial cobbles, and the use of this block type is the source of the unusually high number of blocks falling in the less than 10 centimeters category.

The scavenging of architectural materials from structures is difficult to diagnose from surface remains because a lack of surface stone may also be a consequence of superstructures constructed from sediment and/or organic materials that have not persisted. Seven of the 32 structures at the 30 sample sites show evidence of potential scavenging, based on a lack of masonry relative to the size of the field house structure. Table 8.11 suggests that there may be a bias against higher percentages of shaped blocks at sites with evidence of scavenging, but this pattern is not statistically significant. The data in Table 8.8 also suggest that there may be lower frequencies of masonry blocks greater than 60 centimeters at sites with evidence of scavenging, but the study sample is too small to evaluate this proposition. Overall, it is difficult to distinguish whether the potential biases in masonry suggested are a consequence of scavenging, or of a relationship between the decision to construct a non-masonry superstructure and the characteristics of masonry selected for the foundation of such a superstructure. More excavation at sites where superstructural stone is lacking will be required to resolve this issue.

Related to the issue of scavenging is the potential reuse of structure foundations. In some cases, later field houses appear to have been constructed adjacent to earlier ones, and in others, later structures were apparently placed directly atop earlier ones. At two of the study sample sites, new field house structures were apparently constructed adjacent to abandoned structures, and at each of these two sites one of the pair of structures was apparently scavenged, presumably for the construction of the adjacent structure. At two additional sites, the ranked occurrence seriation of ceramics points unambiguously at two discontinuous occupations (see Table 8.6). However, there is no architectural evidence at these structures for two distinct occupations. It is

Table 8.11. Distribution of Structures at Study Sample Sites across Evidence for Masonry Scavenging after Abandonment and and Percentage of Masonry Blocks Shaped
a. as individual sites

Scavenging Evidence	% of Blocks Shaped 0-25%	26-50%	51-75%	76-99%
Absent	23552	23543	24441	23540
	23565	23566	24557	23653
	24605	23568	24641	23572
	70379	23672A	24644	24574
	70380	24526	90577A	24639
	70384		90622	24645
	90370			74782
Present	24628	23672B	24503	
	56865	73233		
	70370	90577B		

b. as frequencies of structures

Scavenging Evidence		% of Blocks Shaped 0-50% 1-25%	0-50% 26-50%	51-100% 51-75%	51-100% 76-99%	Total
Absent	Count	12		13		25
		7	5	6	7	
	Expected Count	14.1		10.9		25.0
		7.8	6.3	5.5	5.5	
Present	Count	6		1		7
		3	3	1	0	
	Expected Count	3.9		3.1		7.0
		2.2	1.8	1.5	1.5	
Total	Count	18		14		32
		10	8	7	7	
	Expected Count	18.0		14.0		32.0
		10.0	8.0	7.0	7.0	

4x2 table: N = 32	$X^2 = 3.725$	df = 3	p = 0.293
2x2 table: N = 32	$X^2 = 3.161$	df = 1	p = 0.075

Note: The Pearson chi-square statistics shown beneath b. were calculated twice for the same reasons stated in Table 8.9 note. Neither statistic indicates dependence between the two variables at the less than 0.05 significance level.

likely that the foundation for the earlier occupation structure was reused in the construction of the later occupation structure. In these cases, the structure size measured for the later structure may not accurately reflect the size of the earlier structure.

A final issue relevant to the analysis of architectural attributes is the potential effect of surface visibility on extramural features. Table 8.12 summarizes the types of extramural features found at study sample sites relative to elevation and surface visibility. This summary indicates that ground cover does not appear to have an effect on the visibility of masonry or stone features. However, thermal features were identified only at sites with a ground visibility of greater than 50 percent. This is logical, considering that the three thermal features recorded were identified by the presence of small to moderate sized (less than 10 centimeters maximum dimension) fragments of fire-cracked rock, soil discoloration, and/or flecks of charcoal and ash. Where forest litter cover is heavy and continuous, these features would not be visible, and could be buried by aggradation and soil formation.

Controlling for Bias in Short-Term Occupation Surface Remains

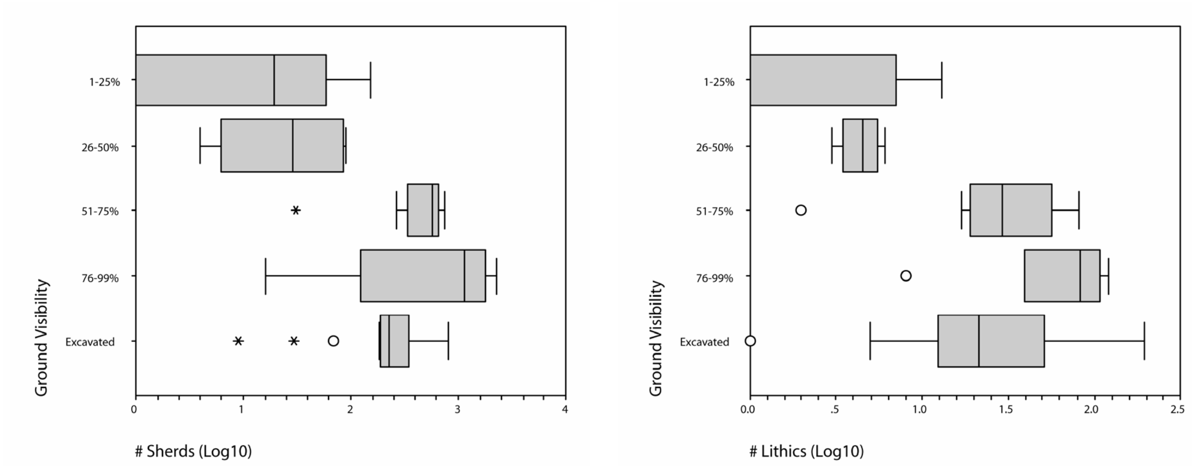
The biases affecting surface artifact assemblages and architectural remains on the Jemez Plateau can have a significant effect on interpretations of variability in field house use. However, these biases can be worked around by changing analyses methods, excluding some sites from particular analyses, and by comparing data from study sample sites to published data from excavated field house sites.

The effects of surface visibility on artifact sample sizes are very significant. However, the surface artifact assemblages at some sites may accurately reflect the class richness and total assemblage sizes present at those sites. Which sites have usable samples can be established by comparison to completely excavated sites, based on the assumption that excavated field house sites have recovered assemblages that are approximately representative of the discarded assemblages at those sites. The boxplots displayed in Figure 8.14 show that the median values

Table 8.12. Extramural Features Found at Study Sample Sites

LA No.	Elevation (meters)	Ground Visibility	Topographic Location	Extramural Features (non-agricultural)	Extramural Features (agricultural)[a]
23540	2340.9	1-25%	Mesa top	masonry bin/cist (1)	
23543	2365.2	26-50%	Mesa top		stone alignment (1)
23565	2273.8	51-75%	Mesa top	thermal feature (1)	
23566	2249.4	76-99%	Mesa top	thermal feature (1) masonry bin/cist (1) masonry unknown (1)	stone bordered/ gravel mulched area (1)
23653	2066.5	1-25%	Canyon bottom		stone alignment (1)
24641	2225.0	51-75%	Mesa top	masonry bin/cist (1)	
24645	2237.2	51-75%	Mesa top	thermal feature (1) masonry unknown (2)	
70370	2465.8	1-25%	Mesa top		stone terrace alignment(4)
70379	2478.0	1-25%	Mesa top		stone alignment (3)
70380	2481.0	1-25%	Mesa top	masonry pile/cairn (2)	stone terrace alignment (6)

[a] Agricultural extramural features are listed here for evaluating the effects of ground cover on feature visibility only. They are not included in subsequent discussions of activity diversity.



a. b.

Figure 8.14. Boxplots of log10 sherd counts (a) and log10 lithic counts (b) from study sample sites grouped into ground visibility classes and compared to completely excavated assemblages. Within the boxplots, open circles represent outliers, while asterisks represent extremes.

and dispersion ranges of study sample sites that fall within ground visibility classes of 50 percent or less do not correspond to the distribution of values at excavated sites. However, there is apparent correspondence between the distribution of values at site that fall within ground visibility classes of 51 percent or greater. This is confirmed by separate variance two sample t-tests[9] comparing study sample sites within each of the two shaping classes of 51 percent or greater to the excavated sites. In none of the four cases are differences between the groups of assemblage sizes significant at the <0.05 level. For log10 ceramic counts, the t-test between sites in the 51 to 75 percent class to excavated sites shows a significance level of 0.277 (t = 1.140, df = 11.722, mean difference 0.2546, standard error difference 0.2233); the t-test between sites in the 76-99 percent class to excavated sites shows a significance level of 0.517 (t = 0.699, df = 4.751, mean difference 0.3021, standard error difference 0.4321). For log10 lithic counts, the t-test between sites in the 51 to 75 percent class to excavated sites shows a significance level of 0.809 (t = 0.248, df = 11.367, mean difference 0.061, standard error difference 0.2452); the t-test between sites in the 76-99 percent class to excavated sites shows a significance level of 0.184 (t = 1.469, df = 7.325, mean difference 0.3753, standard error difference 0.2555).

For the purposes of examining variability in artifact assemblages at field houses through time, the 16 completely excavated sites that have published lithic and ceramic frequency data can be substituted for the 18 study sample sites with a ground visibility of 50 percent or less. By sheer coincidence, the substitution of excavated sites for study sample sites with low ground visibility is ideal, because the two classes of sites are similar to one another in elevation, topographic location, and overstory vegetation (see Table 8.13). Field houses on the Jemez Plateau have been primarily excavated to mitigate damage from timber sale-related road construction and from the construction of campgrounds and other recreation facilities. These historical factors have led to the excavation of field houses in higher elevation mesa top settings (coincident with timber cutting in the Ponderosa Pine and Gambel Oak Association) and in canyon bottom settings—the same contexts that have contributed to low surface visibility at the

Table 8.13. Comparison of Artifact Assemblage Data, Overstory Vegetation, Ground Visibility and Topographic Location For Study Sample and Completely Excavated Field House Sites

LA No.	Elevation (meters)	Sherd No.	Lithic No.	Lithic Classes	Vegetation Overstory Association[a]	Ground Visibility	Topographic Location
24925	**2493.3**	**228**	**14**	**7**	**PipoQuga**	**Excavated**	**Mesa top**
24557	*2481.1*	*10*	*7*	*1*	*PipoQuga*	*1-25%*	*Mesa top*
70380	*2481.1*	*22*	*0*	*0*	*PipoQuga*	*1-25%*	*Mesa top*
70379	*2478.0*	*26*	*0*	*0*	*PipoQuga*	*1-25%*	*Mesa top*
70384	*2475.0*	*17*	*1*	*1*	*PipoQuga*	*1-25%*	*Mesa top*
73233	*2475.0*	*0*	*0*	*0*	*PipoQuga*	*1-25%*	*Mesa top*
90622	*2474.9*	*1*	*0*	*0*	*PipoQuga*	*1-25%*	*Canyon bottom*
24926	**2471.9**	**361**	**37**	**7**	**PipoQuga**	**Excavated**	**Mesa top**
70370	*2465.8*	*0*	*0*	*0*	*PipoQuga*	*1-25%*	*Mesa top*
68522	**2438.4**	**808**	**81**	**6**	**PipoQuga**	**Excavated**	**Mesa top**
68520	**2426.2**	**227**	**29**	**4**	**PipoQuga**	**Excavated**	**Mesa top**
102677	**2426.2**	**191**	**57**	**8**	**PipoQuga**	**Excavated**	**Canyon bottom**
24526	*2414.0*	*65*	*0*	*0*	*PipoQuga*	*1-25%*	*Mesa top*
69563	**2411.0**	**220**	**56**	**5**	**PipoQuga**	**Excavated**	**Canyon bottom**
24574	*2404.9*	*153*	*13*	*2*	*PipoQuga*	*1-25%*	*Mesa top*
69562	**2401.8**	**555**	**11**	**4**	**PipoQuga**	**Excavated**	**Canyon bottom**
24929	**2383.5**	**218**	**24**	**2**	**PipoQuga**	**Excavated**	**Mesa top**
24605	2377.4	16	8	3	PipoQuga	76-99%	Mesa top
90370	*2377.4*	*60*	*11*	*4*	*PipoQuga*	*1-25%*	*Canyon bottom*
23543	*2365.2*	*4*	*3*	*1*	*PipoQuga*	*26-50%*	*Mesa top*
24928	**2353.1**	**29**	**15**	**2**	**PipoQuga**	**Excavated**	**Mesa top**
23672	*2343.9*	*91*	*4*	*2*	*PipoQuga*	*26-50%*	*Mesa top*
23540	*2340.9*	*25*	*0*	*0*	*PipoQuga*	*1-25%*	*Mesa top*
56865	2340.9	31	17	4	PipoQuga	51-75%	Mesa top
24927	**2340.9**	**307**	**17**	**4**	**PipoQuga**	**Excavated**	**Mesa top**
24503	2328.6	266	2	2	PipoPiedQuga	51-75%	Mesa top
24441	*2328.4*	*67*	*8*	*1*	*PipoQuga*	*1-25%*	*Mesa top*
55183	**2325.6**	**69**	**48**	**6**	**PipoQuga**	**Excavated**	**Mesa top**
23568	2307.3	701	21	4	PipoPiedQuga	51-75%	Mesa top
74782	*2304.3*	*80*	*6*	*1*	*PipoQuga*	*26-50%*	*Mesa top*
23572	2279.9	1800	120	4	PipoPiedQuga	76-99%	Mesa top
23565	2273.8	583	45	6	PipoPiedQuga	51-75%	Mesa top
23566	2249.4	2255	107	6	PipoQuga	76-99%	Mesa top
24644	2237.2	758	71	7	PipoPiedQuga	51-75%	Mesa top

Table 8.13. (continued)

LA No.	Elevation (meters)	Sherd No.	Lithic No.	Lithic Classes	Vegetation Overstory Association[a]	Ground Visibility	Topographic Location
24645	2237.2	616	81	7	PipoPiedQuga	51-75%	Mesa top
23552	*2231.1*	*7*	*0*	*0*	*PipoQuga*	*1-25%*	*Canyon bottom*
24641	2225.0	413	29	6	PipoPiedQuga	51-75%	Mesa top
24639	2206.7	1154	83	7	PipoPiedQuga	76-99%	Mesa top
24628	2203.7	122	39	3	PipoPiedQuga	76-99%	Mesa top
24595	**2161.1**	**9**	**5**	**3**	**PipoQuga**	**Excavated**	**Canyon bottom**
23653	*2066.5*	*1*	*1*	*1*	*PipoQuga*	*1-25%*	*Canyon bottom*
90577	*2054.3*	*10*	*5*	*2*	*PipoQuga*	*26-50%*	*Canyon bottom*
12761	**1972.1**	**258**	**8**	**6**	**PofrwSaex-JumoFapa**	**Excavated**	**Canyon bottom**
5688	**1944.6**	**328**	**1**	**1**	**Jumo**	**Excavated**	**Canyon bottom**
75719	**1780.0**	**671**	**193**	**4**	**PofrwSaex-JumoFapa**	**Excavated**	**Canyon bottom**
84924	**1780.0**	**182**	**19**	**5**	**PofrwSaex-JumoFapa**	**Excavated**	**Canyon bottom**

Note: Sites ordered from highest to lowest in elevation. Excavated sites shown in bold**,** sites with ground visibility of less than or equal to 50 percent shown in italics.

[a] PipoQuga—Ponderosa Pine and Gambel Oak Association
PipoPiedQuga—Ponderosa Pine, Piñon Pine and Gambel Oak Association
Jumo—One-seed Juniper Savanna Association
PofrwSaex-JumoFapa—Floodplain Riparian Association

study sample sites. Beyond this bias in location, however, the selection of field houses for excavation has been random, and has not been guided by research questions that could bias data generated from the assemblages of these sites. Field houses were selected for excavation only because they were to be damaged or destroyed by development activities, independent of variability in their architecture.[10]

Biases in classes of architectural data are less pronounced, and fewer modifications to the data are needed. In considerations of masonry shaping and block size, site LA 90370 can be excluded, because unlike all other sites within the study sample, this site was constructed primarily from alluvial cobbles, significantly affecting both variables. The percentage of shaped masonry blocks also appears to be affected by the raw materials available for the construction of the five study sample sites located on the Banco Bonito. These sites can be excluded from comparisons of shaping, but will included in comparisons of block size, as there appears to less of a bias from raw material in this latter variable. Qualitative examination of masonry shaping and block size distributions suggest that scavenging may have an effect on these variables, but this effect does not appear to be significant and may be related to construction methods rather than post-abandonment masonry removal. Sites with possible evidence of scavenging will be included, but will also be monitored to see if their distribution patterns independently from other variables monitoring the same behavioral phenomena (duration of occupation). Reconstruction and reuse can obscure the structure size of earlier structures replaced by later reconstruction. The two sites that show evidence of reconstruction will have structure size values excluded for their earlier components. Extramural features made from masonry (stone) will be included in examining field house variability, because their identification does not appear to be affected by ground visibility. The visibility of extramural thermal features, however, is conditioned by surface visibility, and these features will be excluded from consideration of the distribution of field house sites.

Chapter VIII Endnotes

[1] The use here of sherd weight for interassemblage comparison of means requires a conversion of sherd weights to a log10 scale. The log10 scale conversion is used because assemblages that are greater than 50 sherds are not normally distributed relative to the variable of sherd weight. They have weight distributions that are skewed to the right. For the entire combined assemblages of all the field houses (N=1804) the deviation from normal is 3.329 (standard error 0.058) for skewness and 19.882 (standard error 0.115) for kurtosis. The weight distributions are skewed to the right because pieces of broken vessels can be several standard deviations larger than the mean and still be analyzed, while sherds several standard deviations smaller than the mean cannot (they are too small to even be identifiable as sherds, or don't have analyzable surfaces)(Baker 1978; Dunnell and Simek 1995). A normal distribution can be achieved by converting weight to a log10 scale (see Shennan 1997:92-101) and removing outliers over 40 grams in size. The results for the combined assemblages (with outliers excluded N = 1801) is a skewness of –0.24 (standard error = 058) and kurtosis of –0.176 (standard error = 0.115). Although they are larger for individual assemblages when the log10 scale is used, the skewness and kurtosis statistics remain below 1.000 for the 16 individual assemblages with over 50 sherds.

[2] This volume of vessel failure and discard is estimated based on an occupation span of approximately 200 years and a maximal population of 100 or more. For comparison, the Pueblo I-era Duckfoot site in southwestern Colorado, was occupied for approximately 25 years and had a population of 14 to 25 persons. Over this period, approximately 475 vessels were discarded at the site (Lightfoot 1994).

[3] I may have also initially misclassified some Santa Fe Black-on-white sherds as Vallecitos Black-on-white, and Vallecitos Black-on-white sherds as Jemez Black-on-white by following the incorrect classificatory principles set out by Reiter (1938) that Vallecitos Black-on-white should be more "Santa Fe-like" than "Jemez-like". See the discussion of Vallecitos Black-on-white attributes in Chapter VII.

[4] It is unlikely that early ceramics at these sites represent earlier occupations. At sites where surface visibility is high and re-occupations are evident, there is relatively good representation of the earlier assemblage relative to the later assemblage, because it would be unlikely, given good surface visibility that discard of entire vessels would result in only a few remaining sherds.

[5] Among the two associations considered here, this variability is primarily in the ratio of Ponderosa Pine to Piñon Pine, One-seed Juniper and Rocky Mountain Juniper, which increases continuously with elevation. On the Jemez mesas, Ponderosa Pine, with Gambel Oak in the under- and mid-story, will eventually completely exclude Piñon Pine and One-Seed Juniper with sufficient elevation. In addition to elevation, exposure is a significant factor determining the ratios of the various overstory species. However, given the consistent south to southwest aspect of the Jemez mesas, elevation is a greater determining factor in overstory vegetation than exposure, except in canyon-bottom settings.

[6] The distribution of sherd weight totals between the 30 study sample sites does not approach normal, even when the values are transformed into a log10 scale (skewness = -1.129, standard error = 0.456; kurtosis = 1.655, standard error = 0.887). Because a normal distribution could not be obtained, the nonparametric Kruskal-Wallace test was substituted for an analysis of variance (ANOVA) between means. This lack of a normal distribution should not be confused with the distribution of weight values within site surface assemblages, which can be normalized by transformation to a log10 scale (see Endnote 1).

[7] The distribution of lithic counts between the 30 study sample sites is normal when converted to a log10 scale (skewness = -0.284, standard error = 0.427; kurtosis = -1.33, standard error = 0.833). See Endnote 1.

[8] Intuitively, the recovery of ceramics through the screening of excavated fill should compensate for the lower weight-to-sherd ratio at lower elevation unexcavated sites, because screening should recover smaller sherds. However, weight data from excavated sites would be necessary to confirm this hunch.

[9] Separate variance rather than pooled variance t-tests are used here because for three of the four tests equality of variances could not be assumed given Levene's Tests for Equality of Variances with a significance value of <0.05. One of the four tests (log10 of lithics, ground visibility 76-99% vs. excavated) registered a Levene's Tests significance value of 0.867 ($F = 0.029$); however, the separate variance t-test results are reported here for comparison to the results of the other three tests.

[10] The sole exception to this is LA 12761, a collection of three structures that were selected for excavation as representative of Jemez Phase field house use (Mackey 1982).

CHAPTER IX

FIELD HOUSE DATA II: ANALYSIS OF VARIABILITY IN FIELD HOUSES THROUGH TIME

The application of occupation ages to the study sample sites, and the mitigation of bias in the study sample, allow for the examination of variability in field house house use across the across the five centuries when the Jemez Plateau saw permanent and significant occupation by early modern Pueblo peoples. Such an analysis allows for the evaluation of issues regard both the timing and the causes of Native population decline during the sixteenth and seventeenth centuries, relative to the prior trajectory of settlement, subsistence and population change over three centuries absent the presence of the Spanish. The results of the analysis indicate that the inclusion of prior population directions are critical to understanding the nature of Pueblo population change during the sixteenth and seventeenth centuries. The analysis reveals that rather than decreasing during the sixteenth and seventeenth centuries, Pueblo populations on the Jemez Plateau remained stable, or actually increased somewhat, and that population decline on the plateau began quite late, probably taking place in a significant fashion around or after A.D. 1650.

This chapter has two objectives. The first is to examine patterning across nine different indicators of field house use intensity in the broad categories of duration of occupation, use group size, and activity diversity. The second is to evaluate the patterning in field house use intensity indicators relative to expectations regarding Pueblo population decline during the sixteenth and seventeenth centuries and relative to other procedural and sociocultural factors that may be responsible for the patterning in use intensity trends. The patterning is then compared to expectations about the various possible forces of Pueblo population change: not only mortality from Old World epidemic diseases, but also fertility, migration from the Jemez Plateau, and the loss of identity as Pueblo peoples.

Analysis of Field House Variability

In Chapter VII, several behavioral domains were identified that can inform on variability in field house use that is relevant to site use intensity, agricultural intensification, and population density. These domains are age of occupation, duration of occupation (periodic and lifetime), use group size, and the diversity of domestic activities. Ceramic data and other information relevant to the age of site occupations has already been examined in the first part of this chapter; however, the formal placement of both study sample sites and excavated sites used in the comparison of artifact assemblages are placed into the study time units for the purposes of the following analyses. Analyses comparing artifact and architectural data relevant to duration of occupation, use group size and the diversity of domestic activities are performed relative to these groupings of sites based on the study time units.

Study Time Unit Assignments for Sites

Based on the ceramic chronology created in an earlier section of this chapter, the distribution of study sample sites into the study time units described in Chapter VII was shown in Table 8.6. However, the weighting of occupation probabilities, along with issues related to biases in the architectural and artifact datasets described in the previous section, can be used to subdivide sites into appropriate categories for different types of analyses (Table 9.1). The distribution of the study sample sites, by study time unit, is shown in Figure 9.1. The distribution of the excavated field house sites used in the analysis by study time unit is shown in Figure 9.2. Note that while there is some clustering of sites with similar ranges of occupation among the study sample sites, the distribution of the more widely scattered excavated sites is more random.

Table 9.1. Study Sample and Excavated Sites by Study Time Unit

Study Time Units					
I: 1200-1325	**II: 1325-1450**	**III: 1450-1525**	**IV: 1525-1625**	**V: 1625-1700**	**VI: 1700-1825**
~~23540~~	~~23540~~	~~23540~~	**12761**	**5688**	~~23540~~
~~23552~~	~~23552~~	~~23552~~	23565	**12761**	23565
23572	23572	~~23672~~	23566	23565	23566
~~23672~~	~~23672~~	~~24574~~	23568	23566	23568
24605	24441	**24595**	~~24526~~	23568	~~24441~~
24628	**24595**	24605	~~24574~~	24503	24503
~~24644~~	24605	**24929**	24639	~~24574~~	~~24526~~
~~24645~~	24628	**55183**	~~24644~~	24639	~~24574~~
56865	*~~24644~~*	56865	~~24645~~	24641	24639
~~70379~~[a]	*~~24645~~*	**68520**	**24925**	~~24644~~	24641
~~70384~~[a]	**24929**	**68522**	**24926**	~~24645~~	24644
~~90370~~	**55183**	23572	**24927**	**24927**	24645
~~90577~~	56865	~~23653~~	**24928**	**24928**	*~~70379~~*
~~23543~~	**68520**	~~24441~~	**68520**	**69562**	*~~70380~~*
23565	**68522**	~~24557~~	**69562**	**84924**	*~~70384~~*
23566	*~~70379~~*[a]	24628	**69563**	~~23540~~	~~74782~~
23568	*~~70384~~*[a]	24639	74782	23572	
~~23653~~	*~~90370~~*	*~~24644~~*	**84924**	~~23653~~	
~~24441~~	~~90577~~	*~~24645~~*	**102677**	~~23672~~	
24503	~~23543~~	*~~70370~~*	~~23540~~	~~24441~~	
~~24557~~	23565	*~~70379~~*	23572	~~24526~~	
24639	23566	*~~70380~~*	~~23653~~	~~24557~~	
~~70370~~[a]	23568	*~~70384~~*	~~23672~~	24605	
~~70380~~[a]	~~23653~~	*~~73233~~*	~~24441~~	56865	
~~73233~~[a]	24503	~~74782~~	~~24557~~	*~~70379~~*	
~~74782~~	~~24557~~	*~~90370~~*	24605	*~~70380~~*	
~~90622~~	24639	~~90577~~	24641	*~~70384~~*	
	~~70370~~[a]	~~90622~~	56865	~~74782~~	
	~~70380~~[a]		*~~70379~~*	~~90577~~	
	~~73233~~[a]		*~~70380~~*		
	~~74782~~		*~~70384~~*		
	~~90622~~		~~90577~~		

Note: Excavated sites are indicated in bold. Sites with probable occupations during a study time unit are shown in black type, while those with only a possible occupation are shown in gray. Sites that have a single strikethrough are excluded from artifact analysis. Sites that have a double strikethrough are excluded from architectural analysis (no excavated sites are included in architectural analysis). Sites that are listed in italics and with a double strikethrough are excluded from both analyses, except where noted.

[a] Excluded only from analysis of masonry shaping.

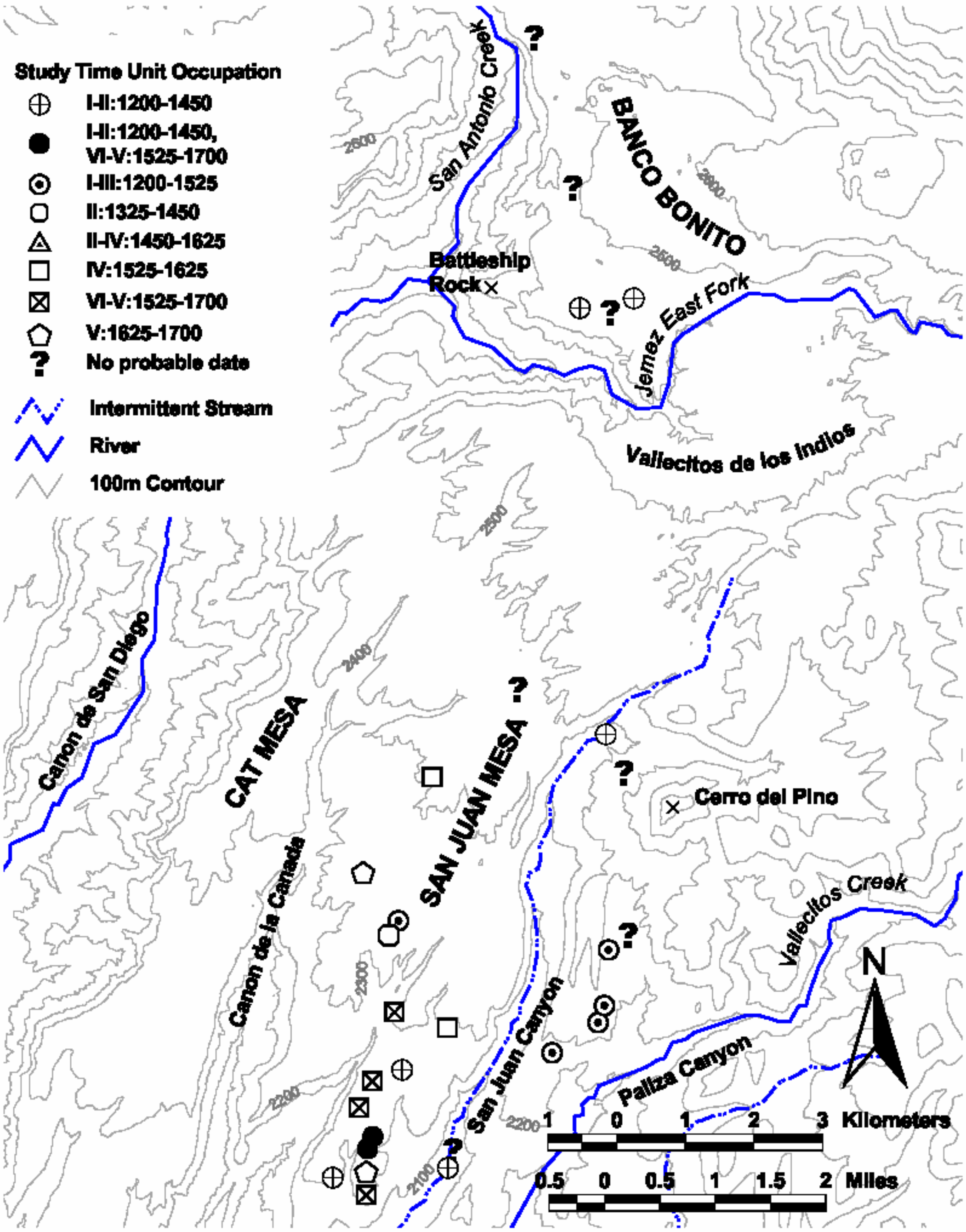


Figure 9.1. The distribution of the 30 study sample sites by study time unit. Only probable occupations, as defined in Table 8.6, are symbolized by time period. Sites lacking a probable occupation are indicated by a question mark.

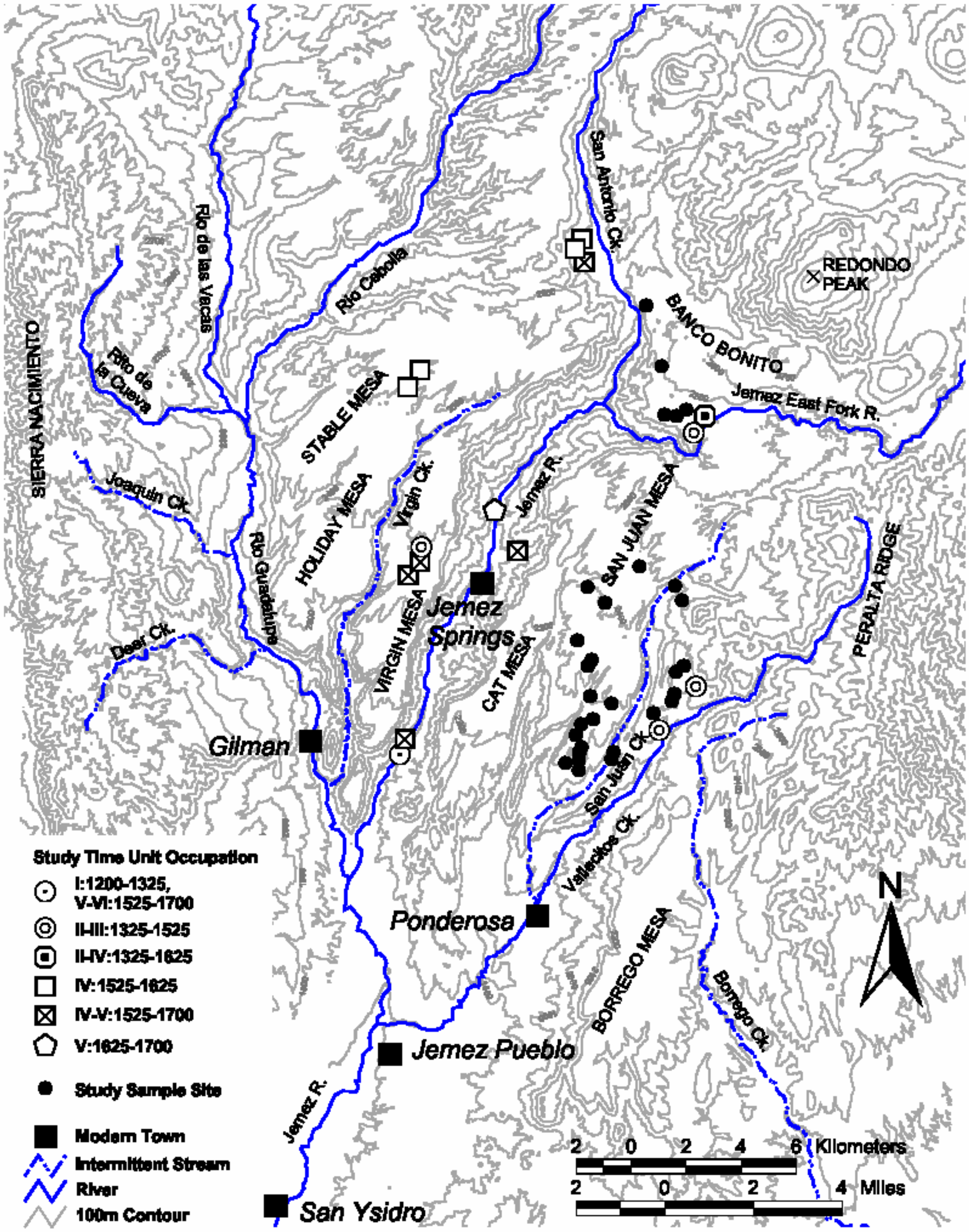


Figure 9.2. The distribution of the 16 excavated field house sites by study time unit, and in comparison to the study sample sites. Note the difference in scale from Figure 9.1. The date assignments here do not conform exactly to the date ranges listed in Table 6.1. A few sites have been shifted slightly from their actual geographic location for greater visibility on the map; the location error is not relevant at this scale.

Overall, there are no strong geographic trends, suggesting the overall site sample is well distributed, if not representative.

As described in the previous section, specific sites have been struck from either the artifact analysis or the analysis of architecture if they appeared to be biased by environmental or post-depositional factors. In addition, all analyses will be confined to those site components that are defined as probable in Table 8.6. As a consequence, seven of the 30 study sample sites are excluded from all analyses, simply because they cannot be reliably be assigned to any of the study time units, rendering their variability incomparable. None of these seven sites could be assigned to one or more study time units, because they lack sufficient ceramic assemblages (and reliable diagnostic ceramics) to allow an assignment. However, these sites were originally selected for field investigation for the very reason that a bias toward sites that have larger ceramic assemblages, reasoning that sites with no or smaller assemblages may represent a distinct range of variability in field house use. Because all seven of the excluded sites fall within areas where ground visibility is low, it is difficult to assess whether these sites truly lack larger ceramic assemblages, or whether they simply have few visible artifacts on the surface. Rather than exclude these sites completely, for architectural variability they will be compared as a class to the other study sample sites later in the chapter to determine whether there is any systematic relationship between the small ceramic assemblages these sites feature and their architectural variability.

Duration of Occupation

Duration of occupation is the amount of time that is spent, in overnight use, at a structure. For field houses, and other periodically used structures, duration of occupation occurs along two axes: duration of periodic use, the number of days the structure is occupied throughout each year, and duration of lifetime occupation, the cumulative number of years the structure is occupied, either continuously or intermittently, prior to abandonment. Both are indicators of intensification, as the former is indicative of direct labor investment, while the latter is consistent with long-term labor and capital investment. It is possible that differences in on-site soil productivity could obtain variability in lifetime duration of occupation independent of investment, but this is unlikely for the areas examined for this study. There are a variety of settings for enhanced productivity on the Jemez: on the Banco Bonito, productive aeolian sediments have accumulated in swales, while on the other mesa tops discontinuous plinian deposits of El Cajete pumice provide settings for enhanced agricultural productivity (see Figure 6.3). The need to enhance the cultivation qualities of plots through visible capital intensification, while present on the Jemez Plateau (see Fliedner 1974, 1975) does not characterize any of the areas surrounding the study sample sites. The few agriculturally related extramural features in association with the study sample sites (see Table 8.12) are likely the hypervisible remains of field clearance (see Stone and Downum 1999), as they are most prevalent on the Banco Bonito and in canyon-bottom settings where stone cobbles are more likely to be part of the surface sediment matrix. Given this consistency in productive settings across the study area, and that the measures of duration of occupation used here are relative in nature, it is not necessary in all cases to distinguish between the two types of occupation duration.

Likewise, archaeological manifestations from which duration of occupation can be inferred take two forms: those that indicate anticipated duration of occupation, the amount of time that the structure is anticipated to be occupied at the time of construction; and actual duration of occupation, which is just that. Concern about use of the former is only necessary if evidence of the latter patterns strongly in an opposite direction. In this study I employ measures of both anticipated and actual duration of occupation, so this is not a concern. The four measures used here are architectural investment, which measures anticipated duration of occupation; and evidence for remodeling and reconstruction, artifact accumulation, and artifact class richness (for monitoring the Clarke Effect), which measure actual duration of occupation.

A central measure of anticipated duration of occupation is architectural investment, observed here in the percentage of shaped masonry blocks and masonry block size percentages. The shaping of the blocks used to construct a structure enhances its reliability, through the properties of overdesign and standardization (see Chapter V). Shaped versus unshaped blocks require less mortar and are more amenable to load stresses. As a consequence, a greater tendency towards the incorporation of shaped blocks into a structure indicates a greater anticipated duration of occupation. Table 9.2 contains the distributions of percent of shaped masonry block classes among 46 components at 20 of the study sample sites. The shaping classes pattern by time period, with decreasing numbers from the earliest to latest study time units of sites with masonry where less than or equal to 50 percent of the blocks are shaped. Despite this patterning however, the differences between the time periods is not significant (where p is less than 0.05), although p values decrease significantly when data classes are reduced. When shaping classes are reduced to just two, less than or equal to 50 percent, and greater than 50 percent, and time units are reduced to just two, between 1200 and 1525 and between 1525 and 1700, the p value is lowest (0.053). That the pattern that is visibly evident in the table data does not produce more unambiguous significance values can be explored by examining the graphical distribution of the shaping classes through time. Figure 9.3 indicates that while the decrease in the number of sites with masonry shaped less than 50 percent decreases each time period, the numbers of sites with percentages of shaped masonry greater than this fluctuates. This may be a product of a small sample of site components (n = 46), or it could be a consequence of temporal misclassification of younger sites, if the temporal pattern of greater masonry shaping through time is correct.

Masonry block size is a second measure of anticipated duration of occupation. Like masonry shaping, block size is an indicator of both overdesign and standardization in construction. Increases in block size are an indicator of greater investment, as larger blocks reduce both the volume of mortar needed for construction, and reduce the number of failure points along a wall. Larger blocks are also indicative of greater selectivity in the quarrying and

Table 9.2. Percentage of Masonry Blocks Shaped by Study Time Unit
a. individual study time units

Component		Shaping Class: 0-50%		Shaping Class: 51-100%		Total
		1-25%	*26-50%*	*51-75%*	*76-99%*	
I:1200-1325	Count	7		3		10
		4	*3*	*1*	*2*	
	Expected Count	5.7		4.3		10.0
		2.8	*2.8*	*1.5*	*2.8*	
II:1325-1450	Count	7		4		11
		4	*3*	*2*	*2*	
	Expected Count	6.2		4.8		11.0
		3.1	*3.1*	*1.7*	*3.1*	
III:1450-1525	Count	5		2		7
		3	*2*	*0*	*2*	
	Expected Count	4.0		3.0		7.0
		2.0	*2.0*	*1.1*	*2.0*	
IV:1525-1625	Count	4		5		9
		1	*3*	*1*	*4*	
	Expected Count	5.1		3.9		9.0
		2.5	*2.5*	*1.4*	*2.5*	
V:1625-1700	Count	3		6		9
		1	*2*	*3*	*3*	
	Expected Count	5.1		3.9		9.0
		2.5	*2.5*	*1.4*	*2.5*	
Total	Count	26		20		46
		13	*13*	*7*	*13*	
	Expected Count	26.0		20.0		46.0
		13.0	*13.0*	*7.0*	*13.0*	

5x2 table: N = 46 $X^2 = 4.102$ df = 4 p = 0.392

Table 9.2. (continued)
b. grouped study time units

Component		Shaping Class 0-50%		Shaping Class 51-100%		Total
		1-25%	26-50%	51-75%	76-99%	
I-III:1200-1525	Count	19		9		28
		11	*8*	*3*	*6*	
	Expected Count	15.8		12.2		28.0
		7.9	*7.9*	*4.3*	*7.9*	
IV-V:1525-1700	Count	7		11		18
		2	*5*	*4*	*7*	
	Expected Count	10.2		7.8		18.0
		5.1	*5.1*	*2.7*	*5.1*	
Total	Count	26		20		46
		13	*13*	*7*	*13*	
	Expected Count	26.0		20.0		46.0
		13.0	*13.0*	*7.0*	*13.0*	

2x4 table: N = 46 $X^2 = 5.215$ df = 3 p = 0.157
2x2 table: N = 46 $X^2 = 3.741$ df = 1 p = 0.053

Note: Statistics calculated based on both the four initial classes of relative shaping frequencies, and the pooling of these classes into two (zero to 50 and 51 to 100 percent). Table data includes 46 components at 20 study sample sites. The 20 sites examined are those that have probable occupations (as defined in Table 8.6) and were not excluded due to geographical effects (see Table 9.1). Part a. shows the distribution of individual and grouped shaping classes to the individual study time units. Part b. shows the distribution of the shaping classes relative to grouped study time units. Neither statistic indicates dependence between the two variables at the less than 0.05 significance level.

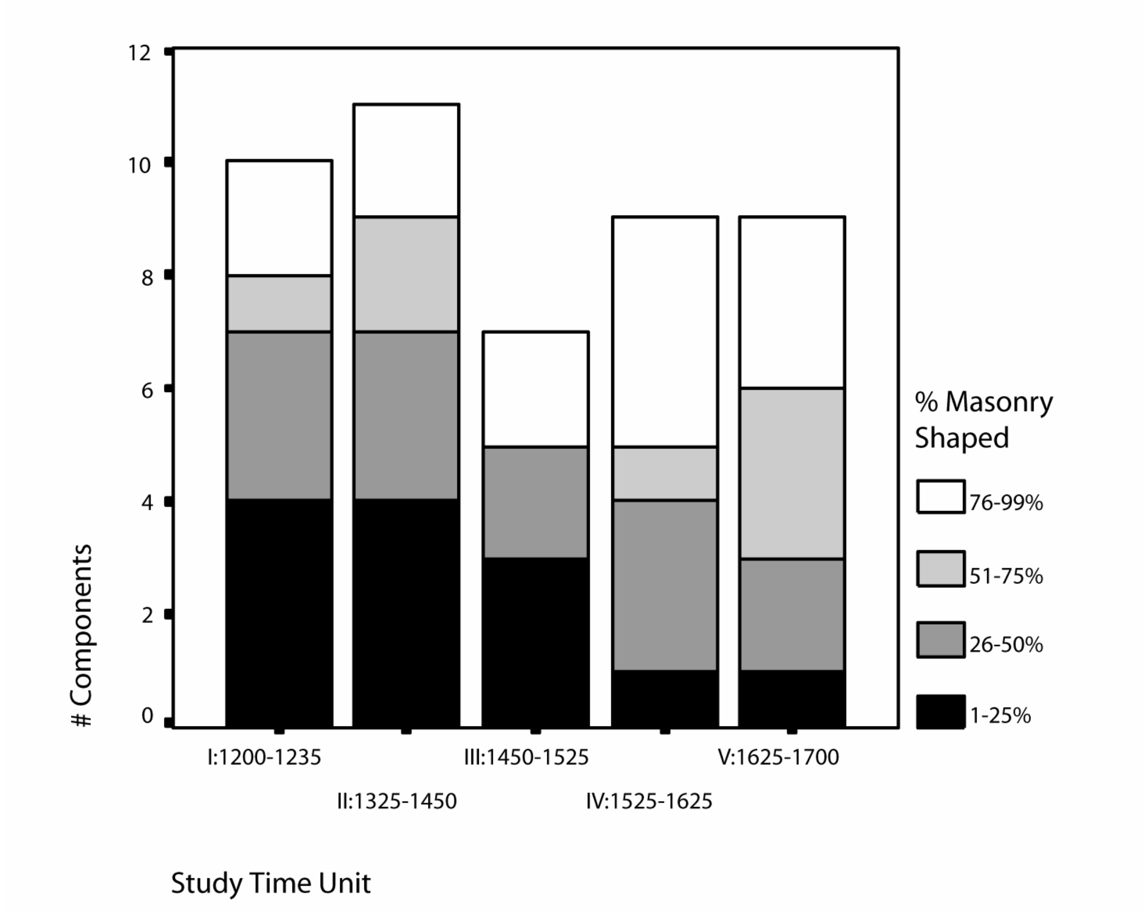


Figure 9.3. Bar chart of the same data displayed in Table 9.2.

collection of building stone, with the assumption, warranted by the discussion of raw material availability in the previous section, that larger material is less available than smaller material. Variability in block size, a measure of standardization, is not a powerful measure of construction investment, because several factors within the construction sequence can affect block size choice. For example, a lack of block shaping can be compensated for by selecting blocks of variable sizes that fit together well.

Table 9.3 shows the distribution of block sizes across the five study time units. Because different class sizes could not be quantified in the field without excavation, relative percentages of each size class visible on the surface were estimated; the use of relative percentages necessitated the use of medians as measures of central tendency. Table 9.3 shows significant increases in the percentage of the largest (greater than 60 centimeters maximum dimension) and smallest (less than 10 centimeters maximum dimension) block sizes. The increase in the largest class of block size indicate increasing investment in construction during study time units IV and V, after A.D. 1525. From a qualitative perspective, the increase in the smallest block size also likely supports increasing investment, but cannot be demonstrated, because almost all of the masonry remains examined are at collapsed structures. At the one site, LA 24574, where there are walls standing greater than approximately 50 centimeters, and there is a significant percentage of large blocks incorporated into the walls (20 percent), small stones are used as chinking between large blocks as a method for minimizing mortar between blocks. The increasing percentages of small blocks at other later sites may be an indicator of this chinking practice, and an additional marker of increased construction investment. Together, patterns in masonry shaping and the size of masonry blocks indicate that there is an increase in construction investment, and anticipated duration of construction from earlier to later periods. For both measures, that increase takes place most significantly after A.D. 1525, in the transition between study time units III and IV.

Table 9.3. Masonry Block Size Category Percentages by Study Time Unit

Masonry Block Size	Study Time Unit									
	I		II		III		IV		V	
	%	Count	%	Count	%	Count	%	Count	%	Count
< 10 cm	0	00	0	00	0		0		0	
	0	555**5**55	0	5555**5**5	0	555	0	5	0	5
	1	00	1	000	1	**0**0	1	000	1	00
	1		1		1		1	**5**	1	5
	2		2		2		2	000	2	**0**00
	2	5	2	5	2	5	2	5	2	55
	3	0	3	0	3	0	3		3	
n cases		12		13		7		9		9
10 – 30 cm	2	0	2	0	2	0	2	0	2	0
	2		2		2	5	2	55	2	55
	3	000	3	000	3	0	3	0**0**	3	0
	3	5**5**55	3	55**5**5	3	**5**5	3	55	3	**5**5
	4	0	4	00	4		4	0	4	000
	4	55	4	55	4	55	4	5	4	
	5		5		5		5		5	
	5		5		5		5		5	
	6		6		6		6		6	
	6		6		6		6		6	
	7	0	7	0	7		7		7	
n cases		12		13		7		9		9

Table 9.3. (continued)

Masonry Block Size	I %	I Count	II %	II Count	III %	III Count	IV %	IV Count	V %	V Count
	2	55	2	55	2	5	2	5	2	5
	3		3		3		3	00	3	00
	3		3		3		3		3	5
	4		4		4		4	0	4	**0**
30 – 60 cm	4	55	4	555	4	55	4	**5**5	4	55
	5	0**0**0	5	0**0**0	5	**0**0	5	00	5	00
	5		5		5		5	5	5	
	6	00	6	00	6	0	6		6	
	6	55	6	55	6		6		6	
	7	0	7	0	7	0	7		7	
n cases		12		13		7		9		9
	0	00000**0**00	0	000000**0**0	0	000**0**	0	0	0	0
	0	55	0	555	0	55	0	55	0	55
60 cm +	1	0	1	0	1		1	0	1	0
	1	5	1	5	1		1	**5**5	1	**5**5
	2		2		2	0	2	000	2	000
n cases		12		13		7		9		9

Note: The case (component) marked in bold represents the median for each group of cases. The gray trend line shows the change in median across the five time units. Stem and leaf diagrams of Site component masonry block sizes are expressed as percentages of four size classes, for each of the five study time units. Size classes are divided into five percent intervals (00%, 05%, 10%, 15%, etc.). Plot includes 50 components for 24 structures at 22 study sample sites. Only components of those sites with probable occupations (as defined in Table 8.6) are shown; one additional site, and two components each from two sites, have been excluded (see text).

Evidence of intra-structural differences in construction materials is one aspect of construction that informs more directly on actual duration of occupation. Patterning in this variable is difficult to observe, for three reasons. First, field houses are by their nature short-duration occupations, and so the potential for additional construction at these sites is low. Second, most of the sites in the study sample are partially or completely collapsed, and it is difficult to determine where or if additional construction took place. Third, it is impossible to determine whether these episodes of additional construction are representative of different periods from original construction.

Despite these difficulties, it is worthwhile to examine patterns of intra-site variability in masonry shaping and block size at the few sites where it can be observed to see if additional construction patterns follow those of anticipated construction. Eight of the study sample sites show evidence of architectural additions or remodeling (Table 9.4). At only one of the eight sites is there evidence of differences in construction. This is at LA 24574, the site that features high standing walls. At this site, a second room added contains the same percentage of shaped blocks, and the same proportion of block sizes, except that it lacks the stones of less than 10 centimeters in size that are prevalent in the construction of the site's first room. The addition of the room is indicated by bond-abut relationships. At this site, and at two others where there is evidence of added rooms, the volume of masonry in the added rooms is significantly less than in the originally constructed room(s). At these sites, and at others where there are integrated second rooms with lower volumes of masonry, I have interpreted these as ramada areas, that have only masonry foundations or curtain walls, and are either open, or have organic superstructures. This interpretation is supported by the identification of at least three excavated field houses that have added or integrated spaces with less substantial construction methods or only semi-enclosed spaces (Elliott 1991; Peterson et al. 1992). If these spaces are functionally distinct from other rooms (for example, if they are intended to be open to allow for workspace ventilation, or for shaded monitoring of garden plots), investment in the construction of these spaces would be

Table 9.4. Evidence of Additional Construction or Remodeling at Study Sample Sites

LA Number	Study Time Unit Occupations	Addition/ Remodeling	Shaping/Block Size Differences?	Masonry Volume Differences?
23540	I-III	ramada addition	No	Yes
23568	IV-V	ramada addition?	No	No
24526	IV	room addition?	No	No
24557	I-V	room/ramada addition	No	No
24574	III-V	room addition	Yes	Yes
24641	V	ramada addition	No	Yes
24644	IV-V[a]	room addition	No	No
70379	I-II	room/ramada addition?	No	No

Note: The study time units listed for each site are probable occupations, as defined in Table 8.5, except where shown in gray; this is a possible occupation span.

[a] This date range is for the late component of the site only, which the architecture is believed to represent.

expected to be different than that of fully enclosed spaces, independent of the intensity of structure use. Thus, a less substantially constructed ramada added to a substantially constructed field house room would not reflect a downward revision in the anticipated duration of occupation by builders; quite the opposite, it may indicate the desire to diversify activities at the field house by the construction of additional facilities. This may explain, why, for example, that the added room at LA 24574 shows evidence of less architectural investment than the originally constructed room, despite the fact that for the potential range of occupation at this site (study time units III-V), other indicators of architectural investment show a trend of overall greater investment through time. However, this interpretation is confounded by the distribution of floor features at the three excavated field houses that have ramada-like areas. At these sites, the prevalence of hearths and bins, the two floor features commonly found at excavated field houses, are the same in both fully and partially enclosed rooms.

Measures of assemblage variability for examining duration of occupation serve as a balance to measures generated from architectural variability as they reflect disposal rather than construction, and thus reflect actual rather than anticipated duration of occupation. Two aspects of assemblages are examined: ceramic sherd accumulation, and lithic class richness. Accumulation is a measure of actual duration of occupation. Here I follow the convention of using plain ware ceramics as a measure of accumulation. However, I use accumulation here as a relative measure, rather than as a means for estimating actual population, for three reasons. First, intensity in field house occupation can affect the use of ceramics at a field house, so the relationship between occupation size and ceramic discard at field houses is likely non-linear. Second, while it is assumed that the assemblages sizes from the study sample sites used here are comparable to the excavated assemblages, the resolution of this data is not assumed to be great enough for more than a general measure of discard, and is not precise enough to estimate population. And third, it is impossible to distinguish between duration of periodic occupation and duration of lifetime occupation at periodically occupied sites based on accumulation alone;

however, this can be evaluated by comparing accumulation to structure size and to lithic class diversity. Accumulation here is expressed as sherd counts, because of the comparison between excavated and unexcavated assemblages. At eight of the study sample sites, the size of the plain ware assemblage is estimated based on the percentage of the sampled assemblage that is plain ware, and the total size of the assemblage.

The distribution of plain ware assemblages sizes is shown in Figure 9.4. No strong patterning is visible in the distribution of assemblage sizes, other than a difference in the size of assemblages before and after A.D. 1525. This lack of patterning is confirmed by means-comparison statistics. A one-way ANOVA of log10 assemblage sizes[1] from the five study time units yields a significance value of 0.331 (sum of squares = 3.888, df = 4, mean square = 0.972, F = 1.185), not significant at the 0.05 level. When study time units are grouped to reflect the differences seen in the Figure 9.4 box plots, a pooled variance t-test comparing grouped study time units I-III to units IV-V yields a significance value of of 0.064 (t = -2.181, df = 45, mean difference -0.5648, standard error difference 0.2590), still not significant at the 0.05 but much lower than that yielded by the one-way ANOVA comparing the sample size means of each period separately.

While this patterning in plain ware ceramic assemblage accumulation is suggestive, it is not definitive. If the lack of strength in patterning is not a consequence of behavior, it may be due to two problems. First, the class evenness problem that has plagued other uses of ceramics throughout this study is also in operation here. Despite the fact that the study sample and excavated sites used in this analysis have larger ceramic assemblages than field houses overall, they still represent short-term occupations, and the stochastic nature of discard is likely biasing both the size of the total assemblage, and the fraction of the assemblage that is plain ware. Second, utilizing sherd counts versus weights to measure accumulation exacerbates class evenness problems. Even if I assume that in aggregate sherd sizes at lower elevation study sample field houses and excavated field houses should be approximately the same, the stochastic

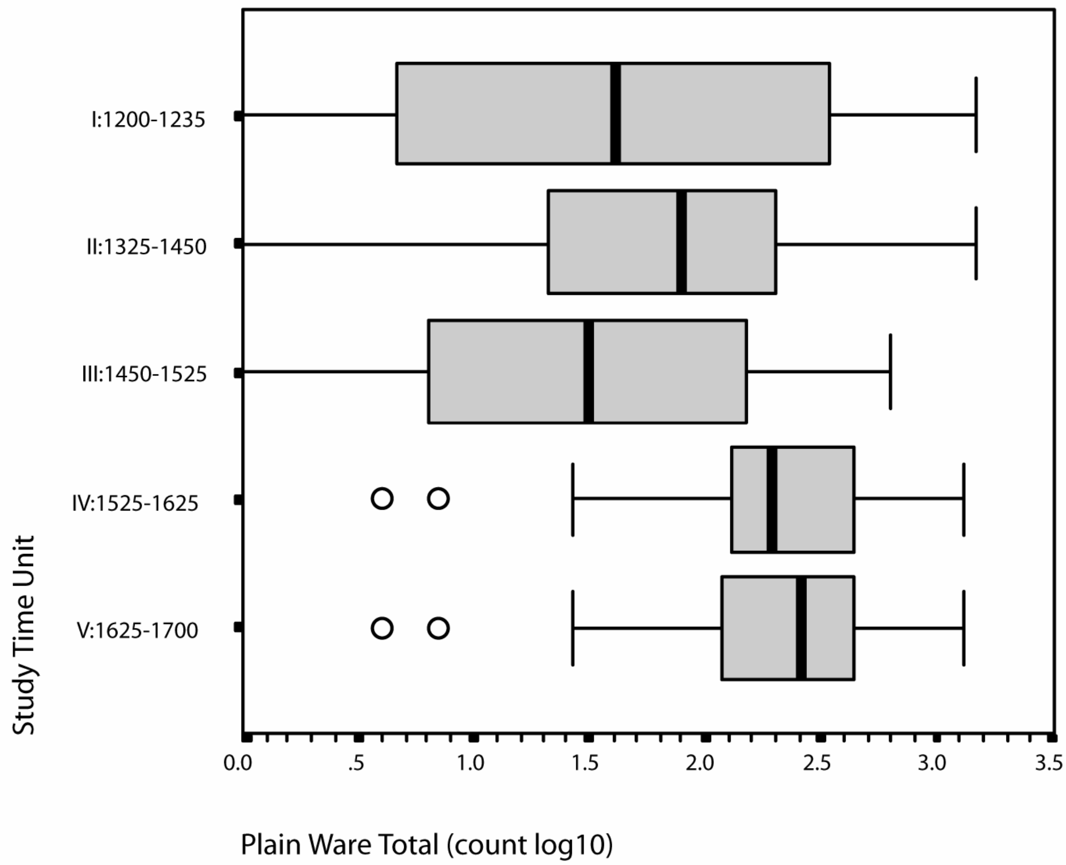


Figure 9.4. Box plots of plain ware assemblage sizes (in log10counts) by study time unit, for 47 components at 25 study sample and excavated sites, the former having greater than 50 percent ground visibility. Open circles in the box plots display outliers.

nature of vessel breakage and post-depositional processes mean that sherd size relative to individual vessels can be quite variable between sites, given small assemblages sizes. These problems, along with those observed in chronology construction, highlight the difficulty of using ceramic sherds in small, short-term occupation site assemblages for generating inferences about past behavior. Fundamentally, it is because the remains (sherds) are the consequence of far fewer discard episodes than the remains themselves. That is to say, hundreds, or even thousands of sherds, can be the product of the discard of just a few vessels. At three sites excavated in the Horseshoe Springs area, between San Antonio Creek and the base of Cebollita Mesa, sherd weights, sherd counts and estimated numbers of whole vessels were calculated for each site (Reed and Goff 1999). With assemblage size ranges of between 191 and 555 total sherds, these are estimated to represent between only eight and 12 vessels of all types. Thus, the relationship of sherds to whole vessels creates a multiplier effect to the already vexing problem of class evenness regarding discard at small assemblage size, short-duration occupations. Overall, in relation to duration of occupation, accumulation of ceramics should be viewed as evidence supporting other patterns of actual occupation duration, rather than as a central indicator of duration lengths.

Class richness is an indicator of actual duration of occupation, as a measure of discard behavior, where class richness is predicted by sample size (the Clarke Effect). Here I examine the comparative richness of functional lithic artifact classes. Class richness contrasts with accumulation as a measure because it is less sensitive to the stochastic effects of discard in short-term occupations because richness is an occurrence-based, rather than a frequency-based measure. Class richness is also suitable for examining small assemblages because it utilizes the accumulation of multiple classes, rather than a single class of material, such as plain ware ceramics. And unlike ceramics, there is a greater concordance between discard episodes and artifact counts with lithics, as lithic artifacts have a greater tendency to remain whole following discard.

For the 25 study sample and excavated sites where lithic assemblages can be classified and quantified, the relationship between class richness and sample size can be assessed. There are two methods appropriate for evaluating the effects of sample size on class richness, the regression method (Jones et al. 1983) and the Monte Carlo simulation method (Kintigh 1984, 1989). I use the regression method here based on four criteria (see Rhode 1988). First, because of the relationship between short-term occupations and discard rates, class evenness among the different artifact classes may not be reflective of actual rates of discard. Class evenness measures do not contribute to the calculation of the regression method; however, they are integral to the Monte Carlo simulation method. Second, because relatively few classes (N = 8) are used in the calculation relative to sample sizes (max. n = 193, mean 28.2, median 12), the model constraints of the regression method are less likely to contribute to the significance of the relationship between richness and sample size. Third, residuals generated from the regression do not increase in value along with increasing sample sizes, an indicator of model constraints contributing to the significance value. And fourth, there are no samples that have mutually exclusive classes; all classes utilized in the classification are present in the samples, and there are no classes present in any sample that are not present in at least one other sample.

Application of the regression method finds that most variability in lithic class richness is explained by sample size, indicating that the Clarke Effect is in action and it can be used as a measure of actual duration of occupation. Calculation of correlation coefficients yields a Pearson's r value of 0.692 (significant at less than 0.001), with sample size explaining approximately 48 percent of the variability in class richness. Figure 9.5 indicates that this figure is not higher due to seven outliers that have residual values greater than one standard deviation from the regression line. These seven sites may be of value in addressing the second diagnostic aspect of class richness, activity diversity and are discussed in more detail below. When the 18 remaining sites that conform more closely to the regression line are plotted relative to study time unit, there is significant patterning relative to time unit (Table 9.5). The smaller sample sizes of

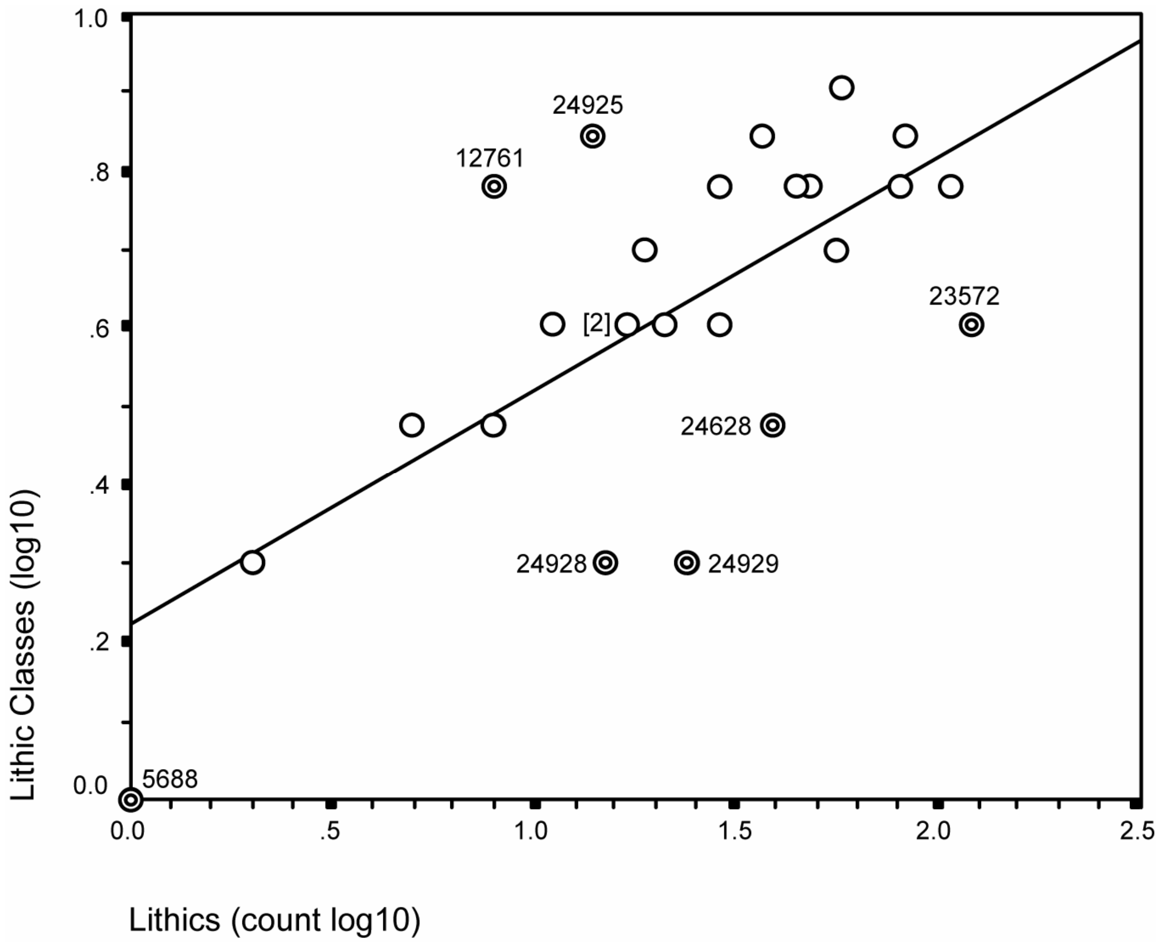


Figure 9.5. Scatterplot displaying the relationship between log10 lithic classes and log10 lithic sample size for 25 sites (study sample and excavated) that have probable occupations (as defined in Table 8.6), have ground visibility greater than 50 percent, and do not have temporally discontinuous multiple components. Open circles are sites with residual values that fall within fall within one standard deviation of the slope. Bulls-eye circles are outliers that are greater than one standard deviation from the slope. Only those sites that are outliers are labeled by LA number. Only 17 open circles are visible as two almost completely overlap (where indicated by [2]).

Table 9.5. Distribution of Lithic Class Frequencies across Study Time Units

Component	n of Lithic Classes				Total
	1-2	3-4	5-6	7-8	
I:1200-1325		2			**2**
II:1325-1450		4	2		**6**
III:1450-1525		4	2		**6**
IV:1525-1625		4	4	3	**11**
V:1625-1700	1	3	4	1	**9**
Total	**1**	**17**	**12**	**4**	**34**

Note: table includes 34 components at 18 sites (study sample and excavated). Only those sites that a) have probable occupations (as defined in Table 8.6), b) have ground visibility greater than 50 percent, c) do not have temporally discontinuous multiple components, and d) have class richness-sample size regression residual values of less than one standard deviation from the regression slope (see Figure 9.5) were included in the analysis.

the components that fall within the three pre-A.D. 1525 time units mean that individually larger samples may be underrepresented simply as a consequence of sampling error, but collectively they suggest that assemblages prior to this time are less rich than post-A.D. 1525 assemblages. Overall, despite the under-representation of the earlier time units, there is a clear trend towards greater class richness through time, with only one site in study time unit V significantly deviating from this pattern by displaying only one or two classes.

Both ceramic accumulation and lithic class richness can be indicators of use group size, in addition to being indicators of duration of occupation. To be valid measures of the former, influence from the latter must be evaluated. Because this evaluation is best conducted in the context of independent measures of use group size, it follows the discussion of those measures in the next section. Likewise, duration of periodic and lifetime occupation have equifinal results for all of the aspects for architecture and assemblages examined in this section. From surface evidence alone, it is impossible to distinguish between the two for all of the variables examined here, except for lithic class richness. Consideration of variability in lithic class richness relative to periodic versus lifetime duration of occupation in made in the context of the diversity of domestic activities and is discussed in that section.

Use Group Size

Use group size is a measure of the size of the number of individuals utilizing a field house on a periodic basis. Use group sizes should increase with increases in the intensity of field cultivation, as more members of a household are called upon to contribute to agricultural labor. Use group size at field houses, can be monitored by a variety of variables, but as discussed in Chapter VII, of those variables available for the study sample sites, only one, size of enclosed area, is independent from occupation duration. At the unexcavated study sample sites, enclosed area itself cannot be measured at most sites because room alignments are buried by rubble. Instead, rubble mound area (the area of continuous collapsed masonry) and number of rooms are used as estimators of enclosed area. Rubble mound area, although an imperfect variable because of effects from a variety of post-depositional variables, is less variable compared to rubble mound volume when affected by processes such as scavenging, assuming that scavenging is a systematic activity targeted at blocks of specific shaping and size criteria, rather than where those blocks originate on the structure. Field measurement attempted to control for volume of masonry, and the definition of "continuous" was modified to take volume as a variable into account.

When variability in rubble mound area and number of rooms is examined across the five study time units, there is little strong patterning in the former, and none in the latter. Figure 9.6 displays the distribution of rubble mound sizes across the five time periods. The only trend apparent is an increase in median rubble mound sizes after A.D. 1525. Means-comparison statistics support these observations: a one-way ANOVA of rubble mound sizes from the five study time units yields a significance value of 0.752 (sum of squares = 1205.848, df = 4, mean square = 301.462, F = 0.477), while a pooled variance t-test comparing grouped study time units I-III to units IV-V yields a significance value of of 0.172 (t = -1.384, df = 50, mean difference – 9.8477, standard error difference 7.1131). While the increase in mean rubble mound size after A.D. 1525 is suggestive, it is not significant at the 0.05 level. But such weak patterns do not even appear in the data for numbers of rooms. Figure 9.7 displays the frequencies of room counts across the five study time units. Accounting for unequal sample sizes between the five study time units, there is no appreciable change in the relative percentages of numbers of rooms, particularly within the more common classes of one room and two room structures.

In addition to measuring duration of occupation, both accumulation and class richness can be indicators of use group size. It is important to distinguish between the effects of population size and length of time a structure is occupied in considering how artifact assemblages formed, both in terms of size and class richness, to determine whether these are valid measures of duration of occupation. A comparison between accumulation and class richness on one hand, and size of enclosed area (using rubble mound size as a proxy) can be used as a check to examine

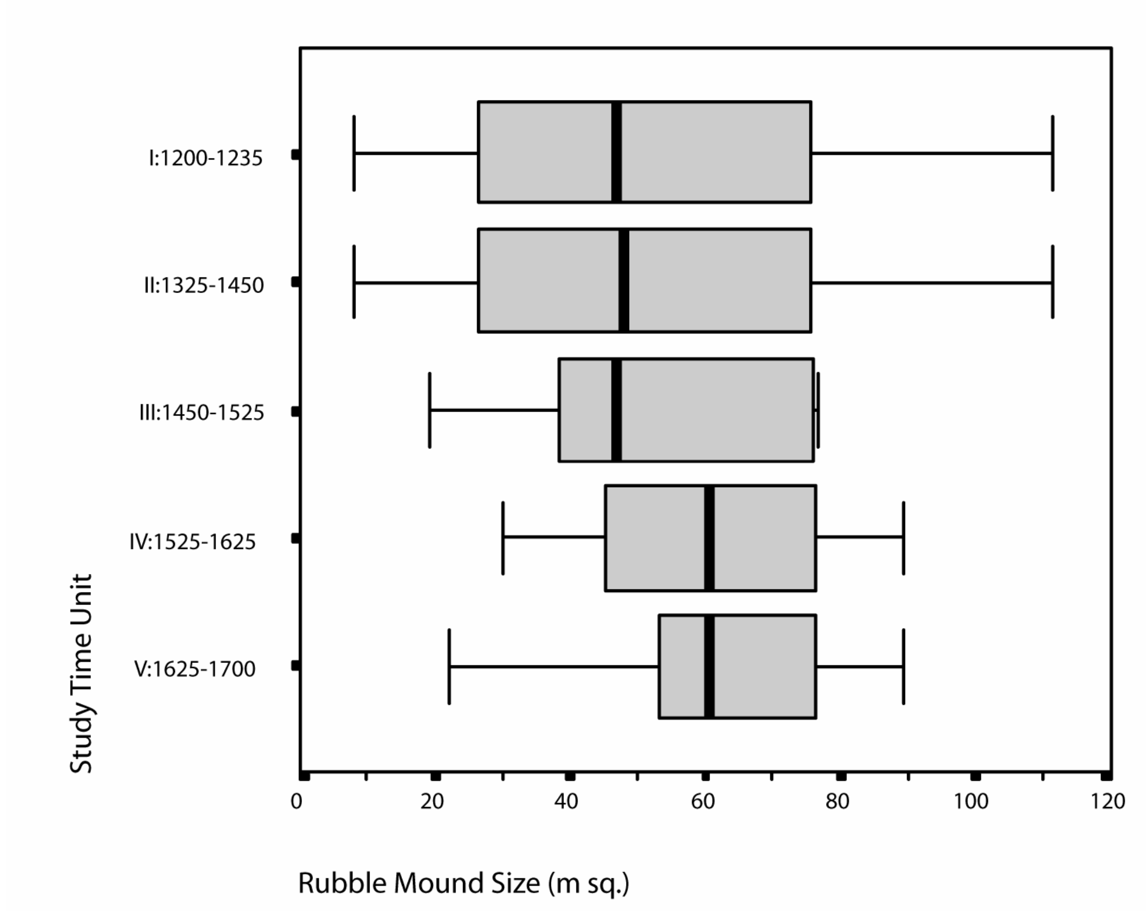


Figure 9.6. Boxplots of rubble mound sizes for 52 components of 25 structures at 23 study sample sites, across the study time units. Only components of those sites with probable occupations (as defined in Table 8.6) are included. Two components each from two sites, have been excluded, because of the superimposition of later component architecture upon earlier component remains.

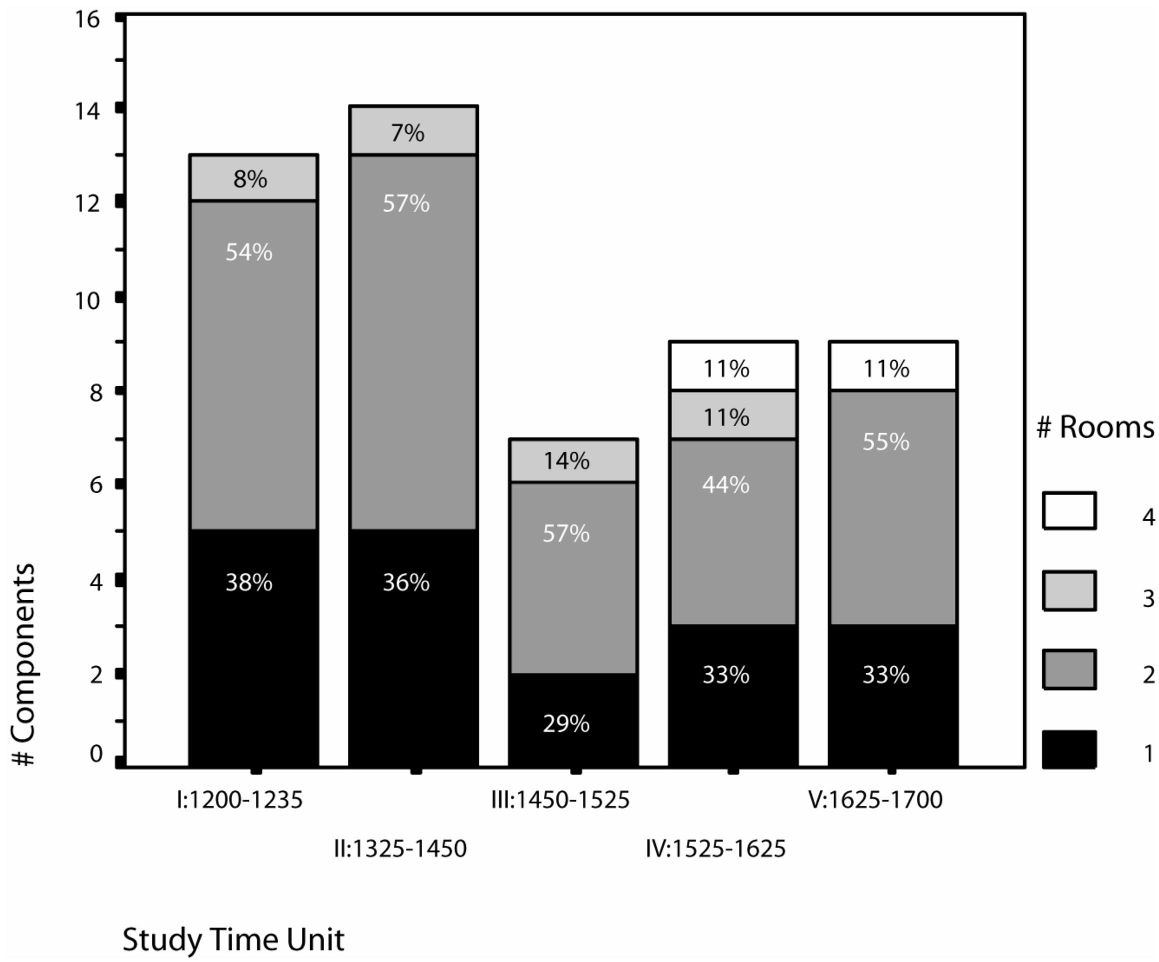


Figure 9.7. Stacked bar chart of field house room counts for 52 components of 25 structures at 23 study sample sites, across the five study time units. The same sites and components left out of Figure 9.6 are also excluded here. The relative percentage of room numbers for each study time unit is shown within bar stack element; for example, the five structure components in study time unit I that have one room are 38 percent of the total structure components for that study time unit. Some stacks do not total to 100 percent, due to rounding.

which factor, use group size or duration of occupation, is responsible for patterning among artifact assemblages. The comparisons are made for the ten study sample sites that are included in analyses for both architecture and assemblage characteristics; summaries of comparative data are listed in Table 9.6.

A mixed picture emerges from the comparison of rubble mound area to assemblage data. Figure 9.8 examines the correlation between these variables for both the study sample sites used in the duration of occupation analyses, and the entire study sample. For the accumulation of plain wares, ceramic counts correlate closely with rubble mound size, with a Pearson's *r* value of 0.818 (significance value 0.004) and rubble mound size (and by implication, use group size) explaining 67 percent of the variability in plain ware sherd counts. Two of the three sites that fall one standard deviation from the regression line are sites where architectural stone has been scavenged, which may have affected the relationship between rubble mound size and enclosed area by removing or dispersing rubble. This close patterning does not hold true for lithic class richness, however. Calculation of the correlation between this value and rubble mound area yield a Kendall's *tau-b* coefficient of only 0.540 (significance value 0.072).[2] A similar lack of patterning extends to examination of all study sample sites. When total ceramic assemblage weights (as opposed to counts) of all 30 study site ceramic assemblages are correlated with rubble mound area, the correlation yields a Pearson's *r* value of only 0.610 (significance value <0.001), with rubble mound area explaining only 37 percent of the variability in assemblage size. Correlation of lithic class richness and rubble mound area across all 30 of the study sample sites yields a Kendall's *tau b* correlation of only 0.433 (significance value 0.001).

It is difficult to explain the close correlation between sherd counts and rubble mound size at the seven sites that do not exhibit scavenging of architectural masonry. Judging from the information presented in Table 9.6, five of the seven sites are similar in age, ground cover, overstory vegetation, and elevation (see alsoTable 8.13), all factors that could affect sherd size and serve as separate independent variables explaining the patterning. Given the data that is

Table 9.6. Enclosed Area and Assemble Data Summary for Study Sample Sites Included in the Analysis of Ceramic Accumulation and Lithic Class Richness

LA Number	Study Time Unit Occupation	Rubble Mound Size (m²)	Number of Rooms	Counts of Plain Ware Sherds	Number of Lithic Classes
23565	IV, V	53.4	2	397	6
23566	IV, V	89.3	1	1317	6
23568	IV, V	61.2	2	523	4
23572	I, II	111.4	2	1468	-[b]
24503	V	21.9 [a]	1	117	2
24605	I, II, III	49.1	1	1	3
24628	I, II	47.0[a]	3	80	-[b]
24639	IV, V	80.3	4	763	7
24641	V	55.0	2	317	6
56865	I, II, III	75.7 [a]	2	21	4

[a] There is evidence for the potential scavenging of architectural stone at this site.

[b] Missing lithic class values for two of the sites reflect the fact that these two sites were excluded from the lithic class richness analysis, because their assemblages were more than one standard deviation from the regression line in that analysis (see Figure 9.5).

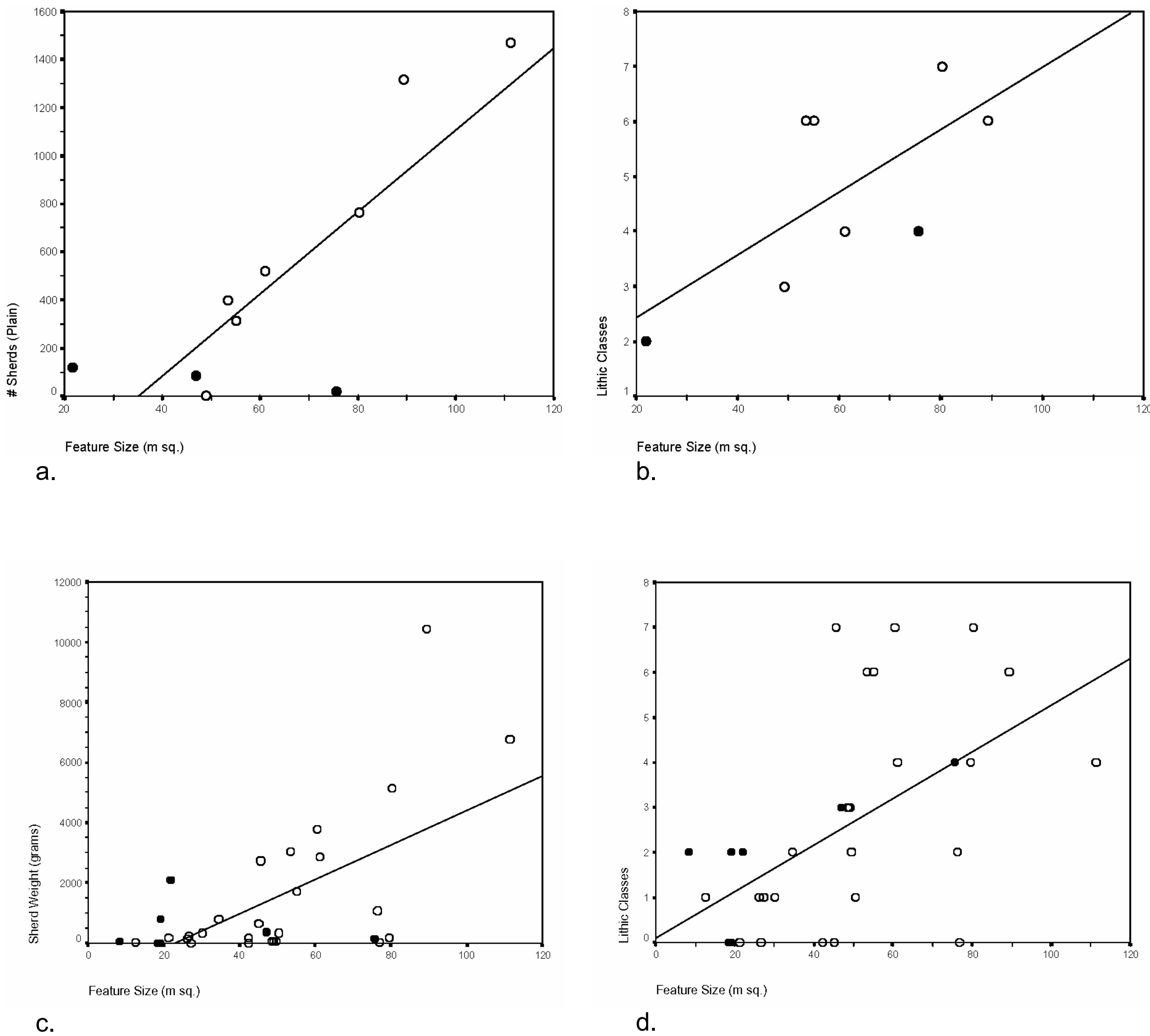


Figure 9.8. Scatterplots of the distribution of: a. assemblage plain ware sherd counts relative to rubble mound area for the ten study sample sites used in the accumulation analysis; b. lithic class frequencies relative to rubble mound area for the 8 study sample sites used in the class richness-sample size analysis; c. total sherd weights relative to rubble mound area for all 30 study sample sites, and; d. lithic class frequencies relative to rubble mound area for all 30 study sample sites. Filled circles represent sites where there is evidence of the scavenging of architectural stone, which can affect feature size.

available, the best hypothesis that can be offered is that ceramic accumulation is more explanatory of use group size during study time units IV and V than it is during earlier periods. Testing such a hypothesis falls beyond the scope of the data available for this study. However, a preliminary evaluation of the idea can be made by examining this pattern in relationship to the diversity of domestic activities, an examination found in the next section. Being able to distinguish between whether patterning in accumulation is a consequence of use group size or duration of occupation, however, is less important, as long as indicators of these two trends agree, which they do.

Diversity of Domestic Activities

The diversity of domestic activities performed at a field house is a measure of the number of different domestic (that is, non-agricultural) tasks that are performed during the duration of periodic occupation. As such, the diversity of domestic activities is an indirect measure of the duration of periodic occupation, but because indicators of activity diversity increase in a non-linear fashion relative to ceramic accumulation and the discard of lithic artifacts it is best treated separately. The diversity of domestic activities is also intertwined with use group size, because both the number of individuals, and their age and sex distributions, will dictate the domestic activities necessary to support their occupation of the structure. Two measures are used here for examining the diversity of domestic activities: lithic class richness and the presence of extramural features.

As discussed previously, where class richness is predicted by sample size, it is an indicator of the duration of occupation. Where richness diverges from sample size, however, it can indicate functional differences between sites (Kintigh 1989; Rhode 1988). The previous analysis of the relationship between the number of lithic functional classes present at a site and the size of that site's lithic assemblage found that of the 25 sites examined, seven had functional class frequencies that were not predicted by assemblage size (see Figure 9.5). Whether these outliers indicate trends the diversity of domestic activities through time can be evaluated by examining the timing of occupations at these seven sites (Figure 9.9). Two of the seven sites have lithic class frequencies that are greater than would be predicted by sample size, while five have lithic class frequencies that are less than would be predicted. Generally, the sites sort according to time period: the two sites with the larger class frequencies date to study time units IV or V, while three of the five sites with smaller class frequencies date to study time units I, II or III. Two of the sites with smaller class frequencies than would be predicted, however, are anomalous, in that they date to study time units IV or V. The first, LA 5688, was excavated in 1961. The lack of screening, and possible collection biases by the excavators, may be responsible for the low number of classes at this site. The use of hardware screen to examine excavated sediments is not mentioned in the excavation report for this site, and no screens are visible in a photograph showing in-progress excavation (Sciscenti 1962:Figure 6). The photo also indicates that excavation was conducted primarily by non-professional, Native American laborers, as was the custom for highway salvage excavations conducted by the Museum of New Mexico (the organization that conducted the excavation) during this time. While many of the Native American laborers employed by the museum were highly talented, knowledgeable, and experienced, it is possible that certain classes of lithic remains, particularly non-tool chipped stone items (debitage, utilized flakes, and cores), were systematically overlooked or discarded. (It is also possible that the decision not to collect lithic remains belonging to these classes was made by the professional supervisory archaeologist, but such an exclusion is not indicated in the excavation report.) The second site dating to study time unit IV or V is LA 24928, excavated in 1985. This site is located within the boundaries of an early twentieth century logging camp, and it was the opinion of the excavators that the historic occupation had been responsible for the general degradation of the site's surface remains (Elliot et al. 1988:100-102). While the collection of artifacts from the site would not have affected buried (and later excavated) remains, subsurface deposits at the site were shallow, and it is telling that the site yielded only non-

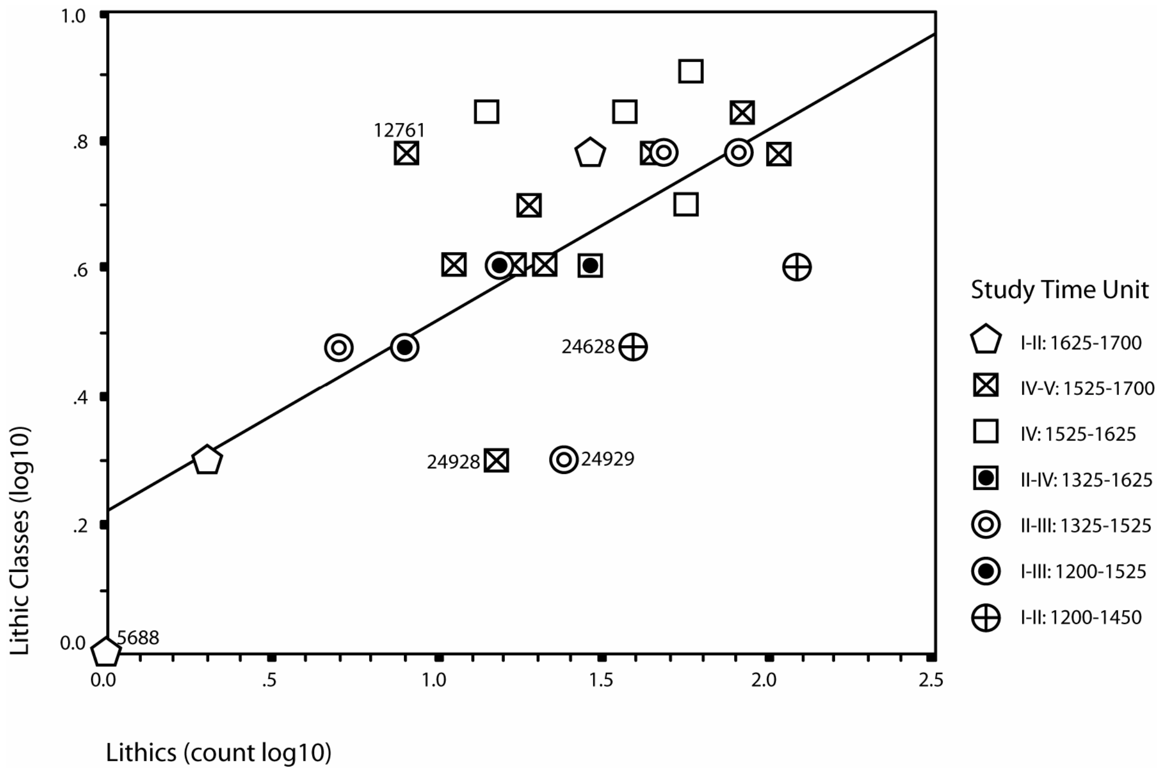


Figure 9.9. Scatterplot of log10 lithic class frequencies relative to log10 sample size and coded according to study time unit occupation spans, for 25 study sample and excavated field house sites. Sites included here are the same as those in Figure 9.5, based on the same criteria stipulated for that figure. The study time unit symbology used in this figure corresponds to that employed in Figures 9.1 and 9.2. The plotted location of a few sites have been shifted slightly for greater visibility, but these shifts do not affect the distribution of data on the plot, and the regression line shown is based upon originally plotted locations. The number accompanying each plot is the LA number of the site at which each lithic assemblage was found. LA numbers shown in bold indicate outliers that fall more than one standard deviation from the regression line.

diagnostic chipped stone debitage, and fragmentary groundstone; it is possible that finished and formal items falling into other functional classes were collected. While the remaining 23 sites included in the examination of lithic class richness have been exposed to a range of excavation techniques and collection pressures, only one other site was subjected to excavation techniques or a collection setting similar to LA 5688 or LA 24928. The site is LA 102677, which was located in a developed group campground where it was subject to intensive non-professional surface collection (Acklen and Railey 1998).

The patterns seen in lithic class richness indicative of greater or lesser degrees of activity diversity can be compared to measures of accumulation to determine whether accumulation is an indicator of periodic or lifetime duration of occupation. If class richness is significantly less than what would be predicted by accumulation, the lifetime duration of occupation of the site should be long relative to periodic duration of occupation, and the use of the site is less intensive than what would be predicted by accumulation alone. However, if class richness is significantly greater than predicted by accumulation, then duration of periodic occupation should be long relative to lifetime duration of occupation, and the use of the site should be more intensive than predicted by accumulation alone. Figure 9.10 plots the distribution of the 25 study sample and excavated field house sites that have both lithic class frequency and plain ware accumulation data. These two variables correlate very poorly with one another, and there is little patterning according time period and the likelihood that artifact discard is a product of lifetime duration of occupation (fewer lithic classes than would be predicted by accumulation) or periodic duration of occupation (more lithic classes than would be predicted by accumulation). While the distribution indicates significant variability, this variability need not be taken into consideration when comparing trends in duration of occupation through time.

The distributions in Figure 9.10 also allow for the initial assessment of the hypothesis forwarded in the last section, that increases in use group size may be partially responsible for increases in accumulation during study time units IV and V. If true, then lithic class frequencies

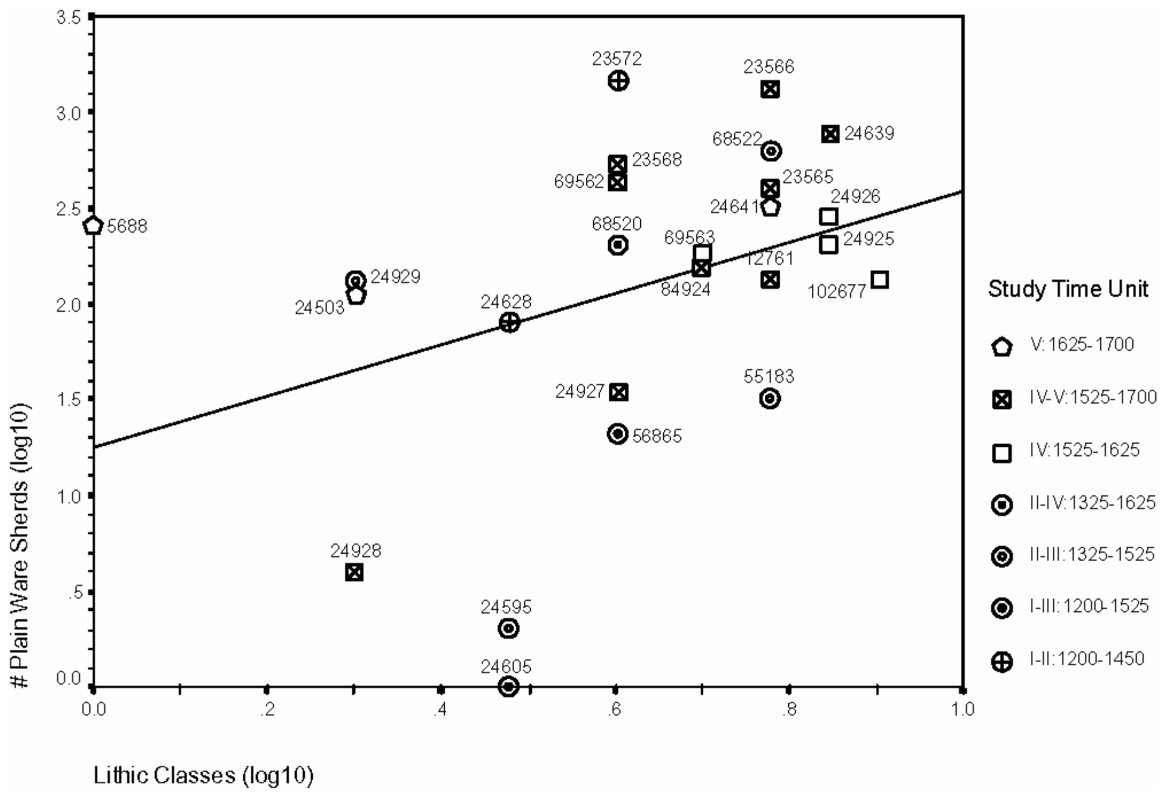


Figure 9.10. Scatterplot of log10 lithic class frequencies relative to log10 plain ware sherd counts and coded according to study time unit occupation spans, for 25 study sample and excavated field house sites. Sites included here are the same as those in Figure 9.5, based on the same criteria stipulated for that figure. The study time unit symbology used in this figure corresponds to that employed in Figures 9.1 and 9.2. The number accompanying each plot is the LA number of the site at which each assemblage was found.

at these sites should be higher than predicted by accumulation. However, this does not hold true for any of the five late sites where group size appears to be predicting accumulation rates, according to rubble mound size. At these sites, the number of lithic classes present are lower than would be predicted by accumulation rates, suggesting that lifetime duration of occupation explained accumulation rates. Higher periodic rates of occupation would be expected if group size explained accumulation. This contradiction between the accumulation data and the structure size data is currently irreconcilable and will need further exploration with additional site data.

The presence of extramural features is also indicative of domestic activity diversity. There is no patterning in the temporal distribution of these remains among the study sample sites. The presence of domestic (non-agricultural) extramural features is listed in Table 8.12. Eleven (11) extramural features were observed at six study sample sites. Of these, three of the features are thermal features (concentrations of ash, charcoal, and/or fire-cracked rock) which must be excluded because of visibility biases. Among the remaining eight features, five are found at three sites dating to study time units IV and V (LA 23566, 24641, and 24645), one is located at a site dating to study time unit I, II, or III (LA 23540), and two at one site that has no probable dated occupation (LA 70380). Furthermore, there is no patterning among feature classes. For example, features formally similar to the horseshoe-shaped masonry bin or cist recorded at the site dating to study time unit I, II, or III were also found at two of the sites dating to study time units IV or V.

Evaluation of Excluded Sites

As stated at the outset of this section, seven study sample sites were excluded from all analyses because they lacked ceramic assemblages sufficient for calculating probable dates of occupation. All seven sites also have very small surface ceramic assemblages, and each has low surface visibility conditions. The exclusion of these sites could be random; they may simply have small, non-datable surface assemblages because of surface visibility conditions. Or it is possible that they represent sites of significantly less use. This latter possibility is rendered less likely by the range in ceramic assemblage size variability seen at excavated sites that also occur in areas of low surface visibility. However, I compare some architectural attributes of these seven sites to the remainder of the study sample sites to see if they represent significantly different patterns in use than those included in the architectural analysis. Comparisons are made on the variables of block size and structure enclosed area. Because three of the seven excluded sites are located on the Banco Bonito, and feature different masonry raw materials from most other sites, comparisons of percentages of shaped blocks is not made.

Both measures of block size and structure enclosed area show that the seven study sample sites with only possible dates are significantly different from the 23 sites with probable dates, with both measures indicating that these seven sites were less intensively used. Table 9.7 compares percentages of categories of block sizes at the two subsets of sites. For the smallest and largest block size categories, less than 10 centimeters and greater than 60 centimeters, median percentages of these categories are five percent less for the possible sites as they are for the probable sites. Higher percentages of these categories are indicators of greater investment. When sites with probable dates are divided into components by study time units, the median percentage category of block size for sites with possible dates compare most closely to sites that date to study time units I, II, and III.

A similar but stronger pattern is seen when rubble mound area, as a proxy for structure enclosed area, is compared between sites with probable dates and sites with possible dates. A pooled variance t-test comparing the two groups of sites yields a significance value of 0.014 ($t = 2.611$, $df = 30$, mean difference 25.545, standard error difference 9.782), demonstrating a significant difference between the probable sites and possible sites. When compared to components of the sites with probable dates that date to each of the five study time units, the sites with possible dates show the most similarity to probable sites with components dating to study time units I and II, while they are significantly different from probable sites with components

Table 9.7. Masonry Block Size Category Percentages for Study Sample Sites with Probable and Possible Occupations

Masonry Block Size							
< 10 cm		10-30 cm		30-60 cm		60 cm+	
%	Count	%	Count	%	Count	%	Count
0	00000	0		0		0	0000000000000[**I-III**]
0	**5**555555555[**I-II**]	0		0		0	55555555
1	000**0**000[**III**]	1		1		1	000
1	55[**IV**]	1		1		1	555[**VI-V**]
2	000[**V**]	2	00	2		2	000
2	555	2	555	2	555	2	
3	0	3	00000[**IV**]	3	000	3	
3		3	55555**5**55[**I-III,V**]	3	5	3	
4		4	**0**00000	4	000[**V**]	4	
4		4	555	4	55555[**IV**]	4	
5		5		5	**0**0**0**000000[**I-III**]	5	
5		5	55	5	5	5	
6		6	0	6	000	6	
6		6		6	55	6	
7		7	0	7	00	7	

Note: Table contains data for 31 field house structures at 29 study sample sites. Size classes are divided into five percent intervals (00%, 05%, 10%, 15%, etc.). Size classes are divided into five percent intervals (00%, 05%, 10%, 15%, etc.). Sites in black characters are study sample sites with occupations to which probable study time unit assignments could be made; sites in gray characters are those to which only possible study time unit assignments could be made. The case (site) marked in bold represents the median for each group of cases (probable and possible). The roman numeral that follows some percentage lines indicate that this line is the median for a particular study time unit (for example, 30% is the median percentage of blocks that fall within the 10 to 30 cm size range at sites with components dating to study time unit IV; see Table 9.3 for the source of these assignments). This table differs from Table 9.3 that each case represents a single site, whereas in Table 9.3 each case represents a site component (for which there may have been more than one for each site).

dating to study time units III, IV, and V. A pooled variance t-test comparing the possible sites with each of the probable site components, yields significance values of 0.069 and 0.058, respectively, for study time units I and II and significance values of 0.025, 0.002 and 0.002 for study time units III, IV, and V, respectively. Although the values for comparisons between the possible sites and the study time unit I and II probable components are not significant at the 0.05 level, they are very low, suggesting that the possible sites are substantially smaller even than the earliest probable sites. These differences yield three possible interpretations. First, the possible sites may represent the least used early sites, a conclusion that is supported by the dating of the two possible sites that lack any ceramics, as discussed in the previous chronology section of this chapter. Second, they could represent a class of less utilized field houses that date to any or all other components. Or third, they may represent small structures that served other uses, and are not field houses; these sites could be the by-catch I refer to in the definition used to identify field houses found in Chapter V. In any case, what these sites is that the least utilized of all the study sample sites appear to have been excluded from the actual pool of studied sites.

Summary of Indicators of Agricultural Intensification at Field Houses

In all, nine indicators of the intensity of field house use across three broad use categories—duration of occupation, use group size, and activity diversity—were examined to measure trends in the intensity of use from approximately A.D. 1200 to A.D. 1700. The degree to which field houses were occupied, both in duration and in the numbers of persons utilizing the structure, is indicative of the amount of labor invested in the fields and gardens adjacent to the field house, and can be used as a measure of changes in agricultural intensification (Kohler 1992; Sullivan and Downum 1991). If trends in the various indicators agree, they should be diagnostic of trends in agricultural intensification on the Jemez Plateau.

Trends in the nine indicators of field house use intensity are shown in Table 9.8. Data was sufficient to examine trends for seven of the nine indicators; for two, remodeling and

Table 9.8. Summary of Trends Among 9 Indicators of Field House Use Intensity

	Study Time Unit (span in years A.D.)			
	II (1325-1450)	**III (1450-1525)**	**IV (1525-1625)**	**V (1625-1700)**
Occupation Duration				
masonry shaping	none	none	increase	none
masonry block size	none	none	increase	increase
structure remodeling	insufficient data			
plain ware accumulation	none	none	increase	none
lithic class diversity (Clark Effect)	none	none	increase	none
Use Group Size				
rubble mound area	none	none	increase	none
number of rooms	none	increase	decrease	none
Activity Diversity				
class diversity	none	none	increase	increase
extramural features	insufficient data			

Note: each field lists the direction of change in use intensity indicated from the previous study time unit. For example, for masonry block size, an indicator of anticipated duration of occupation, there is no change in intensity of use indicated between study time units I and II, and II and III. The indicator indicates an increase in use intensity between study time units III and IV and IV and V.

reconstruction (an indicator of duration of occupation) and extramural features (an indicator of activity diversity), there was data from too few sites to make conclusions regarding the direction of change. Patterning in these indicators indicate any changes in field house use intensity through time. For six of the seven remaining indicators, trends pattern in a single direction. They show relative stability in the use of field houses between study time units I, II and II (between A.D. 1200 and 1525). There is an increase in the intensity of field house use during study time unit IV, and stability in field house use between study time units IV and V (A.D. 1525 and 1700). Overall, data converge on an increase in field house use intensity during the early part of the sixteenth century. None of the trends run counter to this overall patterning. One indicator, masonry shaping, shows the same pattern, but also indicates an increase in use intensity from study time unit IV to V as well. A second, number of rooms, indicates a decrease in use intensity from study time unit II to III, and then an increase from III to IV, indicating no real change its overall trajectory. While the trend in the number of rooms does not support that indicated by the six other indicators, it does not run in the opposite direction (it does not indicate a decrease in use intensity during study time units IV and V). It should be emphasized, however, that the statistical and empirical support for all of these trends is weak. For two of the trends, for example, the percentage of masonry blocks shaped, and rubble mound area, significance values indicating an increase in use intensity, significant values are quite low (0.053 and 0.172, respectively) and very suggestive of change, but are not significant at 0.05 level. The reasons for the weakness in the indicators' trends is discussed in the next section.

Discussion of Analysis Results

The analysis performed on the study sample field house architecture and assemblage characteristics indicates an increase in field house use intensity in the early sixteenth century on the Jemez Plateau. Because of the relationship between field house use intensity, agricultural intensification, and population change, this increase has implications for understanding the causes and direction of Pueblo population change during the sixteenth and seventeenth centuries, the period when the northern Southwest saw exploration and then conquest by agents of the Spanish Empire. To understand what the implications of this increase in field house use intensity might be, three issues need to be reviewed: prior expectations regarding Pueblo population change; the relationship between agricultural intensification and population change; and a consideration of the demographic forces that could have contributed to the direction of Pueblo population changes during the sixteenth and seventeenth centuries. When such a review is conducted, it is clear that Pueblo populations on the Jemez Plateau either remained stable, or increased during the sixteenth and much of the seventeenth centuries, and that this increase appears to be driven by demographic forces arising among Native Americans in the century immediately prior to the arrival of the Spanish in the Pueblo world. At the same time, it does not fundamentally contradict the concept that the Pueblo farmers of the Jemez Plateau suffered significant population decline prior to A.D. 1700.

Prior Expectations of Sixteenth and Seventeenth Century Population Decline

There is general agreement among scholars from various disciplines that Pueblo populations experienced significant declines prior to A.D. 1700. However, there are significant differences of opinion and fact regarding the timing and causes of population decline. These positions have been explored in detail in Chapter III and summarized in Table 3.5; here they are recapitulated to generate expectations for patterns in population decline.

The Dobyns hypothesis, as applied to the Pueblo world, states that depopulation from epidemics of Old World infectious disease, introduced via trade routes from Mexico following the Spanish conquest there or from direct contact with sixteenth century Spanish explorers, resulted in the loss of 50 to 90 percent of the Pueblo population of the northern Southwest prior to end of the sixteenth century (Dobyns 1983, 1990, 1991; Rushforth and Upham 1992; Upham 1986, 1992). At least two, and perhaps many epidemics struck the northern Southwest during the sixteenth century, including one only a few years after Cortes's conquest of central Mexico in 1521, but prior to the arrival of the first Spaniards in the Pueblo world in 1539. Given the Dobyns hypothesis, significant population decline should be seen across the northern Southwest in the sixteenth century. There has been only limited archaeological support for this hypothesis. Surveying region-wide settlement patterns, Lycett finds settlement pattern changes and a reduction in the number of overall settlements that he feels cannot be accounted for by increasing aggregation and subsistence changes. However, he also states that the large settlement record of the northern Southwest displays evidence of much greater population decline during the seventeenth century (Lycett 1995).

In contrast to the Dobyns hypothesis is the idea that population decline among the Pueblos occurred alongside Spanish colonization of the northern Southwest during the seventeenth century, as a consequence of mortality from introduced Old World epidemic diseases, or from other forces driving increased mortality, reduced fertility, migration, and the loss of identity, including warfare, exploitation, and starvation. In general, researchers who subscribe to this position have argued that significant depopulation was initiated between approximately A.D. 1620 and 1640, and resulted in population declines of between 50 and 80 percent (Barrett 1997, 2002; Earls 1992; Schroeder 1992). One researcher, Reff, sees the potential for significant population decline during the first two decades of the seventeenth century, followed by two decades of population recovery, then followed thereafter by depopulation between 1640 and the end of the century (Reff 1991). The expectation generated from this position is that Pueblo populations should remain stable during the sixteenth century, and then experience significant depopulation during the mid- to late seventeenth century. Several researchers have found empirical support for seventeenth century population decline in region-wide archaeological evidence (Barrett 2002; Lycett 1995; Schroeder 1992), and in several sub-areas within the northern Southwest, including the Chama Valley (Ramenofsky 2000; Ramenofsky and Feathers 2002), the Galisteo Basin (Lycett 1995), and the Rio Abajo (Earls

1992). Several researchers have emphasized that population decline, particularly within settlements and areas in the northern and central Rio Grande, may be a consequence not only of mortality, but also of emigration to other regions, particularly to the western Pueblo region (Earls 1992; Palkovich 1985, 1996; Schroeder 1968). Migration to this latter area may explain why the Pueblos there maintained their populations despite potential epidemic episodes during the early- and mid-seventeenth century (Earls 1992).

Evaluation of Results of the Field House Analysis

Comparison of the patterns of population change that can be generated from the analysis of field house data from the Jemez Plateau to the expectations generated by previous research on population decline in the northern Southwest requires the evaluation of those data relative to population change. The evaluation of the current study can be divided into two domains: procedural issues regarding the generation of the data, and substantive issues that connect trends in field house use intensity to intensification and population change. Evaluation of these procedural and substantive issues lead to the conclusion that although there are limitations to the conclusions that can be drawn from the study results regarding population change, the relationship between changes in field house use intensity and population change is real and the population changes observed on the Jemez Plateau are relevant to the issue of Pueblo population change during the early modern era.

Several aspects of the methodology used in this study are responsible for the patterning visible in the trends in field house use intensity, rather than the patterning being solely a consequence of past human behavior. The two major contributing factors are chronology and sample size (number of field houses in the study sample). Despite attempts to minimize bias in the data used to examine trends in field house use intensity through time, there were structural limitations in the data used that could not be overcome. Within the instrument of chronology, units were created that were relevant to monitor changes relevant to the questions of Pueblo population change in the sixteenth and seventeenth centuries. However, the types available for the ranked occurrence seriation almost always required that sites be assigned to multiple study time units, and the ranking resulted in the sites being divided into two almost mutually exclusive groups that are early (study time units I, II, and III, A.D. 1200 to 1525) and late (study time units IV and V, A.D. 1525 to 1700). Of the 23 that have components with probable dates, only three have components that fall within both the early and late groups. A consequence of this grouping has been to obscure variability within the early and late groups, particularly the early group. Among the 12 probable sites within the early group, only one is a single component site; six have two components, and five have three components. Among these sites, multiple components have been assigned to these sites not because they have ceramic assemblages with different diagnostic types that can be assigned to different and distinct study time units, but rather because they feature diagnostic types that can be assigned to more than one time unit. These ceramic types are the early black-on-white ware and plain ware types (see Table 8.6). The situation is not similar, however, for sites that belong to the late group. For the eight probable sites that belong only to the late group, four are single component sites and four are two component sites. Of the latter, three are assigned to both components on the basis of a transitional type, Glaze E-F (Type Late). The white ware and plain ware types used to date early assemblages in general span most or all of two or more study time units; Glaze E-F (Type Late) by contrast, spans only the last 50 years of study time unit IV and the first 25 years of V, meaning that sites that have this type as their first rank order diagnostic type likely really fall within this constricted time period. Overall then, the types used in the ranked occurrence seriation have served to obscure variability between study time units I, II and III. However, this effect is likely significantly less for study time units IV and V, and the continuity between the two units is not a consequence of the ceramic types used. On the other hand, the types used mean that the inference that there continuity in field house use intensity between the two units is strong only for the first third of study time unit V, or until about A.D. 1650.

The small sample of sites that were used in the analysis is likely the primary factor for why the trends that support changes in field house use intensity are so weak. The small number of sites used mean that one or two sites that were potentially misclassified as to study time unit, or otherwise had anomalous architecture or an abnormally large or small assemblage as a consequence of behavioral or post-depositional factors, could substantially affect the distribution of data. For example, in Figure 9.4, which displays the distribution of log10 plain ware sherd counts as a measure of ceramic accumulation, two lower outliers among the study time unit IV and V components depress the median assemblage counts for these two study units. This explains in part the lack of significance seen in the pooled variance t-test that compares the means of these two units to those of study time units I, II, and III. A larger number of components in the test, assuming they would conform to the central tendency and dispersion seen in the existing data, would lessen the effects of the outliers on means comparisons.

Beyond the issue of outlier effects in small samples, there is also the issue of whether the study sample, which encompassed data from only 46 field house sites (30 study sample and 16 excavated) can be representative of the literal thousands of field houses located on the plateau, or even the 1100 recorded sites on the eastern portion of the plateau from which the initial study sample was randomly selected. The study sample was selected to represent a geographically wide range of site locations, but for the most part it includes sites only on the eastern portion of the Jemez Plateau, although the excavated sites included in the analysis of site assemblages are located across the plateau. The potential for bias in the site sample was compounded by the inability to preselect a sample that was uniformly distributed across the study time units, because so few sites had been accurately or precisely dated. The use of an initial random sample mitigated the potential for bias in site age, but lower frequencies of field houses constructed during any of the given study time units could depress the numbers of sites represented. Because there is so little data overall on either functional or temporal variability in Jemez Plateau field houses, it is difficult to assess whether the sample used in this study is truly representative.

However, there is recent qualitative evidence to suggest that it is representative. Intensive pedestrian survey was conducted on the lower portion of Virgin Mesa, on the western part of the plateau, in 2001 and 2002, in geographic, elevational, evironmental, and erosional settings similar to lower San Juan Mesa, were many of the current study's sites are located. The survey identified a record dominated by field houses that date to the Vallecitos, late Jemez and Guadalupe phases and have assemblage and architectural characteristics that are within the same range variability as the study sample sites located on lower San Juan Mesa (Elliott 2002b). It is likely that there are areas within the Jemez Plateau where field houses exhibit attributes and variability not captured within the small sample employed in this study, but the similarity between the lower Virgin and lower San Juan records indicate that the patterning present in the sites included in the study was likely widely distributed across the plateau.

However, the procedural issues regarding chronology and sample size do not preclude two conclusions regarding the field house use intensity data. The first is that there is a substantial increase in field house use intensity between study time units III and IV. The second is that use remains stable between study time unit IV and at least the first portion of V. There is enough variability in the ranked occurrence seriation to allow for these conclusions, and despite the small sample size effect on the statistical analysis applied to any single indicator, the convergence of six of the indicators on these patterns, and none against them, support the results.

There are three substantive considerations that must be evaluated regarding the results of this study to determine its relevance to the issue of Pueblo population decline during the sixteenth and seventeenth century. First, the increases in field house use intensity seen in the study results may not be a consequence of agricultural intensification, but rather a result of a shift from aggregated to dispersed settlement. Second, if the increase in field house use intensity does indicate a change in farming practices, this change may not be driven by increases in population density, but by other economic changes that are stimulating production. And third, if the study results do suggest increases in population density, this change may not be indicative of changes in population size. Reviewing these considerations indicates that increases in field house use intensity on the Jemez Plateau during study time units IV and V is a consequence of agricultural intensification and increases in population density, but not necessarily a result of an increase in the size of Pueblo populations.

Because periodic circulation is a continuum, there is always a potential that in the course of movement between primary and secondary settlements that the primary settlement will be abandoned and that the secondary settlement will be converted into a new primary residence (Stone 1996a). The transformation of field houses from secondary to primary settlements has been documented during the late ancestral Pueblo era (Nelson 1999), and such a transition has been suggested as a response to Spanish colonization in other portions of the northern and central Rio Grande region (Kulisheck 2003a; Mera 1940). This transition from field house to primary settlement in response to Spanish settlement has been suggested for several excavated Jemez Plateau field houses that were intensively used and occupied during the sixteenth and seventeenth centuries (Acklen and Railey 1999; Luebben et al. 1988). Despite the substantial nature of study time unit IV and V field house architecture, and the large size and diversity of the artifact assemblages accompanying these structures, they do not appear to be primary residences. The expectations generated for the transformation of field houses into primary residences suggests that this process takes place in the context of aggregated settlement abandonment, yet on the Jemez, large settlement occupations persist in the sixteenth and seventeenth centuries (Kulisheck 2001a). Furthermore, the transition from field houses to primary residences is typically accompanied by fundamental architectural changes to the structures. In the Post-Classic eastern Mimbres area, the transition to primary residences saw one and two room field houses converted into six to 12 room settlements with features not present in the field houses (Nelson 1999). By contrast, the differences seen between field houses occupied during study time units I, II and III and units IV and V are those of scale, not of kind. Only one known site in the Jemez appears to represent a late dispersed settlement representing a fundamental shift in settlement scale. This site, not included in the current analysis, LA 38962 (also known as Bj74), is a small six room settlement constructed inside of a rock overhang in the canyon of the East Fork of the Jemez, just to the south of the Banco Bonito. An earlier occupational surface in the overhang was used as a field house or perhaps as a shrine. The six-room settlement was constructed atop this surface some time in the sixteenth or early seventeenth century. Excavation of the settlement recovered materials almost never recovered at field houses, including a diverse chipped and ground stone assemblage, along with 13 human burials (Luebben et al. 1988). Although the reasons for the construction of LA 38962 are intriguing, there are no other similar sites known from the Jemez Plateau. And lastly, while the construction of LA 38962 may have been stimulated by the imposition of Spanish rule over the Jemez, the increase in field house use intensity detected by this study took place in the early sixteenth century, approximately 100 years prior to the establishment of missions on the plateau.

Assuming that increases in field house use intensity during study time units IV and V are a consequence of agricultural intensification, it is possible that such intensification was driven by economic forces other than increases in population density. Studies in the Rio Abajo and Salinas areas of the northern and central Rio Grande region have found subsistence changes driven by the imposition of Spanish rule, as new crops and animal domesticates were introduced and missionaries and *encomenderos* demanded tribute from Pueblo farmers (Earls 1985; Graves and Spielmann 2003). This explanation, however, does not fit with the increases in agricultural intensification observed in the Jemez. First, the timing is incorrect; the increase in labor investment in farming practices among Jemez Plateau Pueblo farmers took place early in the sixteenth century, at least 75 years before the Spanish colony in the northern Southwest was established. Second, despite the imposition of an *encomienda* on the Pueblo peoples of the Jemez in 1608 (Snow 1983), there is little historical evidence for tribute collection or other economic exploitation of the farmers of the area, as there is for Pueblo farmers in other areas (see Knaut 1995; Scholes 1930, 1935). The missions that were established on the Jemez apparently relied on irrigation agriculture conducted on the floodplain of the Jemez River, and were often unstaffed (Bloom and Mitchell 1938; Scholes 1938).

The assumption that increases in population density were a consequence of agricultural intensification during the sixteenth and seventeenth century does not automatically lead to an interpretation that the population of the Jemez Plateau actually grew during this period. The density of subsistence farmers can increase if there is a decline in the amount of arable land available, even with population stability or even decline. Such a scenario has been suggested to explain evidence of field house use and agricultural intensification in the north-central Arizona area in the late ancestral Pueblo era (Berger and Sullivan 1990; Sullivan and Downum 1991). It is possible that ecological and anthropogenic forces reduced the areas available for cultivation on the Jemez Plateau after A.D. 1525. There is limited support for this idea, based on the apparent abandonment of some high elevation areas, such as the Banco Bonito, by this time. However, there is no definitive environmental evidence to suggest a downturn in temperatures that would have necessitated the abandonment of higher elevation fields. (At the same time, there is little good data for reconstructing Jemez Plateau temperature data). The known distribution of field houses during study time units IV and V appears to be concentrated in the lower portions of mesas and in drainage bottoms (see Elliott 2002b). This may be an issue of site visibility, as there have been field houses excavated dating to these study time units found at elevations as high as 2500 meters (Gauthier and Elliott 1989). Better data on the distribution of field houses by age of occupation is needed from the Jemez Plateau. However, there is no evidence to support the proposition that Pueblo farmers were required to utilize less overall land during the sixteenth century than they did during the century prior.

Interpretation of Results

The analysis of architectural and assemblage data from the field houses examined in this study indicate a substantial increase in agricultural intensification on the Jemez Plateau after A.D.

1525, and stability in farming practices to at least until 1650. This increase in agricultural intensification indicates that Pueblo populations on the plateau remained stable, or actually increase, after 1525, and there is no evidence for population decline among the plateau's farmers prior to 1650. These results disallow the application of the Dobyns hypothesis to the Jemez Plateau. There is no evidence for rapid depopulation during the sixteenth century, and depopulation of such a magnitude should be apparent in the archaeological record (Milner 1980; Ramenofsky 1987). It should also be evident in the record of agricultural production, as depopulation following epidemics of Old World infectious diseases in places such as Mexico and Peru were followed by the abandonment of intensive farming practices (Denevan 2001; Evans 1990; Whitmore and Turner 2001). The results of this study support researchers who argue that depopulation in the northern Southwest took place during the seventeenth century. Population decline on the Jemez Plateau took place after A.D. 1625, likely after 1650, and in line with the 1640 date that many researchers have supported for the initiation of significant Pueblo depopulation. However, given the data generated for this study, it is possible that Pueblo populations on the Jemez Plateau experienced no significant population decline prior to the Pueblo Revolt of 1680, as the data suggest population stability following A.D. 1650, and there there are no conflicts in indicator trends, such as disagreement between anticipated and actual duration of occupation, that suggest population decline during the period A.D. 1650 to 1700. It is quite clear, though, that there was no significant Pueblo occupation of the Jemez Plateau, beyond the lowermost portion of the Cañon de San Diego and Jemez River valley, after A.D. 1700, and that depopulation must have taken place during the seventeenth century. The resolution of the data used in this study is insufficient to determine when during the latter half of seventeenth century the process of population decline was initiated, or when major episodes of depopulation took place.

The inability to diagnose when during the middle and late seventeenth century Pueblo farmers began to disappear from the Jemez Plateau makes it difficult to identify the demographic variables that contributed to the decline. Changes in mortality, fertility, migration, and identity may have all contributed to the decline. Mortality due to epidemics of Old World infectious diseases has been the major factor implicated in seventeenth century population decline (Barrett 2002; Lycett 1995; Palkovich 1994; Ramenofsky 1996; Reff 1991, 1993). The practice of periodic circulation between large primary settlements and field houses may have lessened the potential for disease morbidity among Pueblo farmers on the Jemez Plateau. Periodic dispersion may have acted as a buffer against infectious diseases, by lessening contact between large numbers of individuals during periods of infection, and breaking the chain of disease transmission (McGrath 1991). Within the Southwest historically, it is documented that the Navajo experienced lower rates of morbidity and mortality from Old World infectious diseases than other Native groups because of a dispersed settlement pattern (Shoemaker 1999). While Pueblo peoples of the Jemez would have been very vulnerable to disease episodes during winter months, during much of the year, diseases would have spread through the area only with difficulty. While it has been difficult to distinguish between duration of periodic occupation and duration of lifetime occupation for field houses in this study, it appears likely that the duration of periodic occupation increased at Jemez field houses during the sixteenth and seventeenth centuries. As such, Pueblo farmers on the Jemez Plateau would have spent more time at their field houses and less in the large settlements where the potential for disease transmission was high, an unintended benefit of increasing agricultural production.

Warfare is a second source of mortality that must be considered, given the history of conflict that characterized relationships between the Pueblo inhabitants of the Jemez and the Spanish in the later part of the seventeenth century, in addition to conflicts with other Pueblo peoples and non-Pueblo Natives. The Pueblo peoples of the Jemez Plateau were active in rebellions and violence against the Spanish through much of the middle and late seventeenth century, were participants in both the 1680 and 1696 Pueblo Revolts, and also offered armed resistance to the reconquest of the New Mexico colony by the Spanish in 1694 (Brugge 2002;

Espinosa 1988; Hackett and Shelby 1942; Hendricks 2002; Kessell et al. 1998; Schaafsma 2002; Scholes 1938). The Pueblo peoples of the Jemez Plateau also engaged in warfare with Pueblo peoples in the lower Jemez River Valley during the years of the Pueblo Revolt (Kessell et al. 1998). Reports of raids by Navajos and other non-Pueblo Native Americans on Pueblo settlements in the Jemez also appear in Spanish documents, but it is doubtful whether significant conflict with non-Pueblo Natives was significant (Brugge 2002; Schaafsma 2002; Wilson 1985). While in a few cases—such as the battle fought in 1694 between Pueblo peoples from the Jemez and Pueblo allies from other areas of the northern and central Rio Grande and the Spanish and their Pueblo allies—mortality from warfare was significant, the effects of violent conflict were likely attritional rather than catastrophic.

Based on historic documents alone, Spanish attempts to appropriate labor from the Pueblo peoples of the Jemez, and intervene in economic practices, were limited. As such, the effects of the imposition of Spanish rule during the seventeenth century on fertility were likely small. Spanish practices of labor appropriation in sixteenth and seventeenth century Florida, for example, were responsible for reducing fertility by removing males from communities and reducing Native unions and births (Worth 1998). Similar appropriations of labor were made from other Pueblo communities in the northern and central Rio Grande region (Knaut 1995), but apparently not the Jemez. Seasonal circulation appears to have allowed many Jemez to escape Spanish awareness altogether. By doing so, they made themselves unavailable for the demands made so often by the Spaniards on the Pueblos for goods and labor, being resident in small numbers at dispersed and remote field houses, rather than at a large settlement. The death of significant numbers of adult males during the violence and conflict of the last two decades of the seventeenth centuries, however, could have had a similar effect by reducing unions and lowered fertility during this period and into the early eighteenth century.

Migration, and a subsequent loss of identity as Pueblo people, may be a significant contributor to population decline on the Jemez Plateau during the latter half of the seventeenth century, as significant or more so than depopulation from Old World infectious diseases. Migration from the Jemez Plateau to other areas, particularly the Dinetah, the area occupied by the Navajo in northwestern New Mexico during their first centuries in the northern Southwest, may have begun as early as the 1620s, and continued through the 1640s as a response to disease introduction and the imposition of the mission system (Brugge 2002). Complete abandonment of the Jemez Plateau came in the wake of the Revolt of 1696, when Pueblo peoples on the plateau fled to the Dinetah, to the Hopi mesas, and to other areas beyond Spanish control (Brugge 2002; Ellis 1956; Espinosa 1988; Kessell et al. 1998; Reiter 1938). Both voluntary and forcible return to the present-day community of Walatowa (Jemez Pueblo) began in 1706, with most refugees returning in the first two decades of the eighteenth century, but the last members and descendents of the late seventeenth century diaspora did not return to Walatowa until 1780, when 40 families were returned from Hopi (Brugge 2002).

At this time, it is impossible to speculate how many individuals emigrated from the Jemez Plateau during the seventeenth century, and of these, what percentage returned to resettle at Walatowa in the eighteenth century. It is probable that Pueblo peoples from the Jemez were assimilated into other Pueblo villages, particularly at Hopi, and into non-Pueblo Native communities, particularly the Navajo. David Brugge believes that a special and close relationship existed between the Pueblo peoples of the Jemez and the Navajos to the north and northwest during the sixteenth, seventeenth and eighteenth centuries (Brugge 2002). Extensive trade between the two groups is indicated both through documentary sources, and from archaeological evidence; of Pueblo ceramics found at sixteenth and seventeenth century Navajo sites, Jemez Black-on-white is the most common (Reed and Reed 1992). Brugge believes that a significant but unknown number of refugees from Jemez were assimilated into the Navajo, based on the oral history of the Coyote Pass (Jemez) Clan, which traces its ancestry to Pueblo refugees from Jemez who found sanctuary among the Navajo following the Revolt of 1696 (Brugge 2002; see also Gutierrez 1991; Sando 1982). Substantial and innovative ethnohistoric, ethnological and archaeological research will be necessary to establish the magnitude of seventeenth century Pueblo emigration and loss of identity as peoples of the Jemez. While loss of identity from transfer of individuals to other Native American groups is likely significant, Pueblo peoples from the Jemez Plateau assuming a Spanish ethnic identity is less likely. Some Pueblo individuals were taken as captives by the Spanish during periods of conflict and were raised in Spanish households (Brugge 2002), but their numbers were likely small compared to individuals from non-Pueblo Native groups, who were much more routinely taken as slaves (Brooks 2002; Gutierrez 1991). Because of its marginal status and limited contact with Spaniards during the seventeenth century, there were probably few unions between Pueblo peoples from the Jemez and Spaniards.

In summary, this study supports that population decline among the Pueblo peoples of the Jemez Plateau took place during the second half of the seventeenth century, culminating in the abandonment of the area for permanent settlement by A.D. 1700. Depopulation of the plateau may have been driven by mortality caused by epidemics of Old World infectious diseases introduced by the Spanish, but mortality from warfare and conflict, as well as significant migration and the subsequent loss of Pueblo identity by the migrants are also likely contributing factors to the decline. The current evidence available from this study cannot distinguish between these causes of population loss. However, the evidence does refute the concept that epidemics of Old World diseases struck the Jemez Plateau in the sixteenth century, prior to the colonization of the northern and central Rio Grande region by the Spanish.

Chapter IX Endnotes

[1] The distribution of plain ware counts between the 25 study sample and excavated sites is normal when converted to a log10 scale (skewness –0.735, standard error 0.347; kurtosis –0.422, stardard error 0.681). See Chapter VIII, Endnote 1.

[2] I use the Kendall's *tau-b* correlation coefficient rather than Pearson's *r* or Spearman's *rho* for examining lithic class richness relative to rubble mound area because class frequencies are ordinal rather than continuous, and within the data set there are several ranking ties (several sites have the same number of

lithic classes) (see Shennan 1997:145-147). It could be argued that Kendall's *tau-b* might be a better measure for examining the correlation between lithic class richness and sample size, but I have retained the use of Pearson's *r* for evaluating that relationship to remain consistent with the methods set forth in Jones, Grayson and Beck (1983).

CHAPTER X

CONCLUSION

This dissertation has examined the demographic history of the Jemez Plateau of north-central New Mexico from an archaeological perspective, and the effects of Spanish colonization and conquest on Pueblo populations there. It has found that populations on the Plateau remained stable, or even increased, during the sixteenth century, and remained stable into the seventeenth century, and that Pueblo population decline in the area did not commence in earnest until A.D. 1650. If Old World infectious diseases did enter the northern Southwest in the sixteenth century, they did not penetrate as far as the Jemez Plateau. The peripheral location of the plateau, and the use of periodic circulation between primary residences and secondary agricultural settlements, may have buffered the Pueblo peoples of the area from the worst biological and socioeconomic effects of the Spanish conquest. The lateness of the decline also requires a serious consideration of migration and loss of identity as a significant force driving population decline on the Jemez.

Evaluation of the Study

This study was conducted under two broad directives that differentiate its approach from previous studies. The first is to conduct research as a contributor to an archaeology of population change; that is, to develop an understanding of Pueblo population change during the sixteenth and seventeenth century that is fundamentally archaeological, and independent from historical data, and the constraints of the historical record and historical time. Although this study considers questions that are raised in part by historical research, it is reliant on archaeological methods, data and timescales, because an archaeological approach is most appropriate to the evaluation of population decline. Second, the research was conducted guided by the methodologies of demographic archaeology, a process of understanding population change within the context of Pueblo settlement and economy.

The research conducted met with mixed success under these two directives. An archaeology of population change requires time units relevant to understanding change, and archaeological phenomena that will reflect such a change. Field houses, as short-duration occupation sites whose variability reflects regional population change, were an appropriate source of data relative to the time units necessary to examine population change during the early modern Pueblo era and the era of Spanish contact and colonization. However, the chronological instrument employed, the ranked occurrence seriation of ceramics found in field house assemblages, was not fully sufficient to assign the field house sites to the study time units. Some of the study sample sites could not be assigned to time units at all, while other had to be assigned to multiple units, obscuring variability in field house use between those units. However, the ranked occurrence seriation did allow for a comparison of field house occupations between the time prior to the potential for effects from the arrival of Old World populations in the Western Hemisphere (through the introduction of new infectious diseases)—the time between about A.D. 1200 and 1500—and the sixteenth and seventeenth centuries. It also allowed, to a limited extent, to distinguish between the potential for decline in the sixteenth century, due to the introduction of disease, and the potential for decline during the seventeenth century, in concert with active colonization of the northern Southwest by the Spanish Empire.

The study was more successful at embedding population change within the context of Pueblo socioeconomic organization, and in light of the full suite of demographic variables, although it was not able in the final analysis to distinguish between the different potential demographic forces that were responsible for the depopulation of the Jemez Plateau. The paradox of what appears to be the pattern of demographic change on the plateau, based on the archaeological record, is that population appears to be stable for so long during the sixteenth and seventeenth centuries, and then arrives at depopulation so quickly. The configuration of settlement and its relationship to subsistence account for the first part of this paradox. The use of periodic circulation as a subsistence strategy, along with the isolation of the Jemez Plateau, relative to other portions of the northern and central Rio Grande region, explain why the effects of disease and exploitation were less pronounced. While a consideration of the potential forces of demographic change can account for rapid depopulation in the latter part of the seventeenth century, this study was unable to identify which of these causes was primary in driving this rapid depopulation. However, the timing and circumstances of the depopulation at a time of revolt and upheaval mean that migration, loss of identity, and mortality due to warfare must be considered alongside mortality as a result of disease as potential driving forces.

The study also achieved mixed results in approaching population change from the perspective of demographic archaeology. One criticism of its opposite, archaeological demography, is that it requires region wide data to identify regional population sizes and regional trends. By linking population change indirectly to the archaeological record through agricultural intensification, this problem was avoided, yet analysis of data relevant to changes in farming practices produced only weak results when subjected to statistical testing. The equivocal results produced dictate that while demographic archaeological methods can employ smaller sample sizes than purely demographic studies, because they identify behavior indicative of population change, the sample sizes must be large enough to account for intra-period variability. Sample sizes were kept small so that detailed analysis of ceramics could yield more refined ceramic chronology and provide better dates for the study sample sites. Less attention to chronology, and more effort towards defining use at a greater number of sites, would have alleviated this problem, but it could not have been known at the outset of the study that such a large investment in chronological construction would have yielded so few results.

Like most dissertations, this study set out with large ambitions and yielded only modest results. And yet, modest results are one of the necessary consequences of working towards an archaeology of population change. The approach proceeds from the proposition that a single phenomenon—the arrival of Old World populations into the Western Hemisphere—could have had demographic effects that were variable at a variety of spatial scales. Such variability was due both to variation in the timing of entry and nature of conquest on the part of Europeans, and differences in the prior social organization of Native North Americans and in their responses to conquest. As a consequence, *a priori*, it was assumed that the study would only provide results that are particular to the Jemez Plateau, and can not be generalized to either the northern Southwest or to Native North America as a whole. However, it does provide an additional piece to understanding the overall course of demographic change in the Pueblo world in the sixteenth and seventeenth centuries.

Summary of the Dissertation

This section is a digest of the contents of each of the dissertation chapters.

Chapter I

In this dissertation, I explore the phenomenon of population decline experienced by the Pueblo population of the Jemez Plateau of north-central New Mexico in the sixteenth and seventeenth centuries. The decline of this population mirrors the experience of Natives throughout North America following the arrival Europeans in the New World just over 500 years ago. The decline of native populations was severe; over the course of five hundred years, Natives went from being the only inhabitants of the continent to a tiny minority in a population dominated by people of Old World descent. But relative survival of Natives across North America was quite variable, both between regions of the continent and within those regions as well. The dissertation departs from the idea that understanding the forces which have determined the differential persistence of Native groups is central to comprehending the process of population decline anywhere in North America.

The process of population decline on the Jemez Plateau is explored through a research framework which examines demographic change through its interaction with the variables of economy and settlement. The framework is designed to establish the links between these variables, and how they can be examined in the archaeological record of the Southwest in general and the Jemez Plateau in particular. This framework stands in contrast to previous investigations of population decline among the Pueblo, which have focused on the enumeration of Pueblo populations from the point of their contact with Europeans onward, with an eye toward identifying the causes of population decline. The departure of this study from previous approaches is threefold; it looks at changes in the structure of variables relevant to demography, rather than counting people; it focuses on settlement use, rather than settlement occupation and abandonment; and it considers the importance of precontact Pueblo demographic organization in understanding the process of decline.

The structure of the dissertation is designed to execute the research framework outlined in this introduction. It proceeds from an explication of the links between the variables demography, economy and settlement, to the archaeological tools for studying those variables, to an examination of relevant data from the late prehistoric and early historic Jemez Plateau. The data provides insight on the potential causes of population decline on the Jemez, and sheds light on the variability seen in population decline among the Pueblo of the Southwest.

Chapter II

This dissertation takes a new approach to Pueblo population change, with a focus on Pueblo social organization as relevant to understanding the process of population decline during the sixteenth and seventeenth centuries. This approach requires new definitions for the terms relevant to population decline, including chronological units, which form the parameters of the study. The term “Pueblo” has cultural, spatial and temporal meanings, and is used with qualifiers indicate its use. “Pueblo peoples” are those inhabitants of the Southwest unified and distinguished from others based on their reliance on subsistence agriculture and residence in compact, aggregated villages, and are the subject of this study. “Pueblo world” refers to the area inhabited by Pueblo peoples and their ancestors, and is synonymous with the northern Southwest. “Ancestral Pueblo” and “modern Pueblo” are eras which reflect differences in the material culture and sociocultural organization of Pueblo peoples through time. The term “Spanish” refers to the explorers and colonists who conquered the northern Southwest during the sixteenth and seventeenth centuries, and incorporates other Europeans, African, Middle Native Americans and others who took part in the conquest.

However, a new approach to population change focused on Pueblo peoples also requires an overview of the nature of the Spanish conquest of the northern Southwest. This conquest can be divided into two phases: exploration during the sixteenth century and colonization during the seventeenth century. The sixteenth century exploration of the Pueblo world was carried out between A.D. 1539 and 1593, by seven different parties that were diverse in their size, make-up, intentions, and activities. However, four commonalities can be identified regarding the phase of exploration. First, the exploration of the region by the Spanish was sporadic in its timing. Second, the exploring parties were mostly small in size. Third, the interaction between the Spanish exploring parties and the Pueblos often devolved into violence. And fourth, the accounts produced by the explorers of the Pueblo world are remarkably consistent in their details regarding settlement, economy, and sociopolitical organization. The seventeenth century colonization of the Pueblo world began in A.D. 1598 with the establishment of the Oñate colony, and asserted control over all of the Pueblos between the 1620s and the Pueblo Revolt of 1680. Three characteristics define the nature of Spanish colonization during the seventeenth century. First, the number of Spanish colonists remained small relative to the Pueblo population throughout the seventeenth century. Second, the Spanish population remained concentrated in the capitol of the colony, Santa Fe. And third, the colony maintained little contact with the rest of colonial Spanish America during the seventeenth century.

Chapter III

The U.S. Southwest lags behind other regions of North America in the study of Native American population decline. While it is clear that population decline took place, there is no agreement between scholars as to when population decline began, its severity, the role of disease, or the uneven patterning of depopulation. The failure of a coherent picture of early historic population decline is due to three factors: a reliance on inappropriate or insufficient evidence, a failure to consider the demographic organization of early modern Pueblo peoples, and neglect of the entire range of demographic forces affecting population change. Instead, I offer an alternative framework for evaluating population change that take these factors into account.

Population decline has been a significant topic for researchers concerned with the last five hundred years of Native North American history. For at least a century, there has been little change in the position that Native populations have declined significantly, and that the majority of causes for the decline—disease, conquest and relocation, increases in mortality and decreases in fertility, warfare—were a consequence of the arrival of Old World populations on the continent. However, the evidence used to examine the process of Native American population decline has expanded from limited ethnographic observations and historic sources to include information from physical anthropology, archaeology, historical demography, epidemiology, ethnohistory, and other fields. More recent research has also given rise to the primacy of Old World infectious disease introduction as the most significant factor in Native population decline, and the hypothesis that significant population from disease epidemics may have preceded face-to-face contact between Old World populations and Native Americans. However, population decline has not been examined from the perspective of general demographic theory, and research to date has created an ad hoc body of ideas about how the process of population decline among Native North Americans took place over the past 500 years.

The earliest research conducted into Native North American population decline, by scholars such as Mooney and Kroeber, emphasized the severity of depopulation and identified the arrival of Old World peoples as its primary cause. In contrast to more recent researchers, however, they held that Native North American populations prior to 1500 were small, and that depopulation was a consequence of face-to-face contact between Natives and Old World populations. This view was challenged in the latter half of the twentieth century by Henry Dobyns, who argued that Old World infectious diseases arrived in North America from the newly conquered areas of Mexico and Caribbean ahead of European explorers. As a consequence, Native North American populations declined precipitously prior to initial face-to-face contact, and the size of the North American population prior to 1500 was far larger than estimated by the first European explorers. Dobyns's ideas were influenced by the devastating effects of infectious disease epidemics on the Native populations of Mesoamerica, and the documented spread of Old World infectious disease from Mexico to Peru after the Spanish conquest of the former, but prior to the arrival of Europeans in the latter. If correct, Dobyns's hypothesis could mean that dramatic population decline took place in North America prior to the arrival of the first Europeans, and that significant culture change brought about by depopulation could have also taken place prior to the first European observations regarding Native North American life. Dobyns's ideas have gained acceptance by many scholars, and have been incorporated into overviews of the European conquest of the New World, despite the fact that prior to 1980, there was little empirical evidence to support the notion of dramatic Native population decline in North America after 1500, but prior to face-to-face contact between Native and Old World peoples. Instead, the hypothesis drew its support from the mathematical and epidemiological possibilities of disease effects, and a few early European descriptions of large Native American populations.

Because by its very nature the Dobyns hypothesis could not be tested using historical data, archaeologists soon began to examine the idea of population collapse in North America after 1500, but prior to European conquest. Studies conducted for several regions of North America indicate that, rather than the monolithic collapse predicted by Dobyns, the effects of infectious Old World diseases was spatially and temporally variable. Significant depopulation took place in the sixteenth century in the U.S. Southeast, and possibly in the Pacific Northwest, as predicted by Dobyns. Significant declines also likely took place in the upper Midwest and the southern Southwest, but in the seventeenth century, prior to face-to-face contact between Old World peoples and Natives, but a century after when epidemics should have been introduced from Mexico and elsewhere. And in other regions, such as the Northeast and Alta California, Native American population declines do not appear to precede European conquest. The variability in Native American demographic responses to disease has given rise to the idea of differential persistence, that differing patterns of population decline are a consequence of regional and local factors population size and density, settlement patterns, and the nature and frequency of interactions between Natives and Old World peoples. Patterns of differential persistence have been documented in historical studies of Native population decline elsewhere in the Americas, including Mexico, Nicaragua, and Ecuador.

Testing of the Dobyns hypothesis by researchers in some regions of North America has allowed a shift in emphasis from confirming population decline to understanding the contexts in which Native American depopulation took place. Recent research in the U.S. Southeast is exemplary of this shift. There, researchers have focused on the demographic conditions that made depopulation or persistence possible, the effects of colonial rule, and the role that European geopolitical policies and actions had in institutionalizing population decline and preventing recovery. Archaeological and ethnohistoric research has established that the domination of Southeastern society by hierarchical chiefdoms likely aided depopulation by concentrating populations and facilitating the spread of disease. At the same time, peripheral, non-hierarchical groups persisted as chiefdoms collapsed. In Florida, which was colonized a century before the interior Southeast, historical and paleoanthropological studies intensified the effects of disease epidemics through warfare, malnutrition and overwork, and discouraged the reproduction necessary for Natives to recover from depopulation. In the interior Southeast, there were no such barriers to population recovery, and an incipient recovery may have been on the way by the seventeenth century. However, historical studies have shown that the global geopolitical policies of France and Britain turned the interior Southeast into a war zone in the late seventeenth and eighteenth centuries. Warfare and slave raiding prevented any possible recovery, and colonization at the end of this period set the stage for the final displacement of Southeastern Natives by Old World populations.

Scholarship on population decline among Pueblo peoples in the early historic era is a consequence of both general intellectual trends, and the demographic evidence that has been available. A wide variety of historic and archaeological sources of evidence have been employed to examine Pueblo population decline, or is available. Historic sources include both documents from Spanish explorers and colonists, and Pueblo oral history. Spanish sources include general accounts, such as reports by explorers and missionaries, and records related to particular events and proceedings, such as legal documents, vital records, tax and tribute documents, letters, and reports on military campaigns. Sources for Pueblo oral history include conventional ethnographies and oral histories, ethnographic evidence submitted in land claims settlement cases, and testimony from Pueblo interviewees themselves. Archaeological evidence relevant to Pueblo population decline in the early historic era includes settlements, landscape scale evidence, human remains, and artifact and ecofact remains.

Previous research into the decline of Pueblo populations in the northern Southwest during the sixteenth and seventeenth centuries has in general followed that for Native North America as a whole, with a shift from understanding depopulation as a process that took place with face-to-face contact, to consideration of the Dobyns hypothesis. However, researchers have not been able to move beyond the question of disease depopulation to that of differential persistence. Most research regarding Southwestern population decline prior to the 1980s supported the idea that depopulation among the Pueblos was a consequence of disease and other factors introduced as part of face-to-face contact between Spaniards and Pueblo peoples. The notion of depopulation from epidemics of Old World infectious diseases following the conquest of Mexico, but prior to the arrival of the Spanish, has emerged in the last twenty-five years. The concept of disease depopulation has been attractive to some Southwestern researchers, given the apparent decline and disappearance of many Native populations across the Southwest in the fifteenth and possibly early sixteenth century. Others have argued for sociopolitical complexity among the Pueblos in the centuries prior to the arrival of the Spanish, a sociopolitical complexity not observed by the earliest explorers in the region. Given minor revisions in chronology, depopulation from disease could be a powerful argument to support hypotheses regarding population decline and sociopolitical de-evolution.

Archaeological and historic research has been conducted to examine the validity of disease depopulation among Pueblo peoples in the sixteenth and seventeenth centuries. These studies have generated three reactions to the Dobyns hypothesis: support, refutation, and evaluation. Studies supporting Pueblo population decline in the sixteenth century, prior to the Spanish colonization of the northern Southwest, are based on epidemiological models of disease spread and effects, and marshall empirical support from a selective examination of historic evidence and archaeological settlement pattern changes. Those who have sought to refute the Dobyns hypothesis have relied primarily on historical evidence suggesting greater population stability in the sixteenth century, and population decline with face-to-face contact during the seventeenth century. In contrast to reviews of existing evidence, new archaeological studies have found both patterning that both supports and runs counter to the notion of sixteenth century population decline. All studies agree that population decline took place among Pueblo peoples during the sixteenth and seventeenth centuries, and that disease was an important, if not the most important factor in that decline. However, facts that remain in dispute are whether population decline took place in the sixteenth or seventeenth century, the severity of population decline, and the relative importance of disease as a cause of depopulation.

That researchers in the Southwest have been unable to resolve basic questions regarding population decline among Pueblo peoples in the sixteenth and seventeenth centuries leads to two major issues that must be addressed for these questions to be answered. First, the failure of existing studies to arrive at resolution of must be diagnosed. And second, new research directions for answering basic questions regarding depopulation among the Pueblos need to be developed. Existing studies have failed because they have relied upon insufficient evidence, and have not taken into account the demographic organization of Pueblo peoples. Alternative strategies for evaluating population decline can be developed in part from elements of existing studies, from recent advances made in other parts of North America, and from general demographic, archaeological and anthropological theory.

The existing historic evidence for Pueblo population changes during the sixteenth and seventeenth centuries is insufficient for assessing population decline during this era for several reasons: population estimates from general accounts cannot be evaluated using demographic techniques; population estimates from different observers are difficult to correlate with one another; not all communities with archaeological evidence of occupation appear to be included in enumerations; and momentary estimates may have failed to take into account the dynamism of mobility patterns among Pueblo peoples. Existing archaeological evidence has also failed to adequately address population changes. Derived primarily from the large village settlement record, studies have been unable to cope with the long and variable settlement of large villages, and have failed to take into account the small settlement record. The reliance on insufficient evidence by research has been a consequence of the approaches taken by most researchers to the issue of sixteenth and seventeenth century Pueblo population decline. Most have divorced the experience of depopulation from long-term demographic trends among Pueblo peoples, initiating consideration of population change in the sixteenth century. Neglect of demographic patterns prior to the sixteenth century has in turn led scholars away from considering the sociocultural context of Pueblo population change, and from the evaluation of responses by Pueblo peoples to the demographic challenges introduced by the Spanish exploration and colonization of the northern Southwest. Instead, debate has focused on the potential effects of differing levels of Spanish entry into the region, and attention has been paid to mortality as a cause of population decline to the neglect of other demographic forces, such as fertility and migration. The direction of study concerning Pueblo population decline in the northern Southwest continues to be framed within the context of the Dobyns hypothesis. While the failure to resolve the fundamental questions posited by Dobyns should not be a barrier to better understanding the context of population decline, the century-and-a-half prior to Spanish colonization are among the most poorly known archaeologically in the northern Southwest. A poor understanding of the archaeological record of the fifteenth and sixteenth centuries provides a significant obstacle to contextualizing Pueblo population decline within the era of the Spanish conquest.

To overcome the barriers of evidence and approach to understanding the process of Pueblo population decline in the sixteenth and seventeenth centuries, researchers will need to construct relevant evidence to the problem, incorporate Pueblo sociocultural organization into understandings of depopulation, and consider all demographic variables when developing ideas regarding population change. For evidence, researchers must look primarily to the archaeological record. There is the potential for the discovery of many new historic documents in libraries and archives. However, historic records most relevant to demographic reconstruction, such as vital records, do not exist or have been destroyed for the period of interest. The potential to develop traditional Pueblo histories regarding the sixteenth and seventeenth centuries is much greater, but there are barriers both to the use of these documents for the development of demographic evidence, and to the creation of the documents themselves. The concerns of oral historians are often different than those of demographers, and traditional historians within the Pueblos are often prevented from or uninterested in sharing traditional history with non-Pueblo researchers. Within the archaeological record, there are aspects of the record that have gone little examined that have the potential to provide evidence relevant to demographic change. At large settlements, human remains and ecological evidence can provide evidence of population decline, but extensive new excavation would be required, and there are legal and attitudinal barriers to the study of skeletal evidence. Alternatives to new excavation include novel analyses of existing excavated materials, or creating occupational sequences for large sites from surface artifacts or exposed architecture. An alternative to examining large sites is to study other portions of the archaeological record such as small structures (the focus of this study), or landscape distributions of artifacts and non-structural features.

New studies of Pueblo population decline will need to incorporate an understanding of sociocultural organization prior to the arrival of the Spanish in the northern Southwest, and use this as a comparative framework for understanding population changes during the sixteenth and seventeenth centuries. The epidemiological, economic and social changes introduced by the Spanish can only be understood within such as framework. Likewise, the strategies of Pueblo peoples for dealing with change developed throughout the centuries must be identified to understand the response of the Pueblos to the Spanish conquest. Ideas for understanding sociocultural change among Pueblo peoples have been well developed for the eras prior to the arrival of the Spanish in the northern Southwest, and can be brought to bear on the research problems of Pueblo population change during the sixteenth and seventeenth centuries.

Future studies must also take into account all potential causes of demographic change. Population change is a consequence of fluctuations in just three variables: fertility, mortality, and migration. When examining change within specific groups, identity is also a critical variable. The primary concern of past studies has been mortality; other variables must also be incorporated into understandings of Pueblo population decline.

Chapter IV

This study examines population change from the perspective of changing settlement and landscape use, beginning in the late ancestral and early modern Pueblo eras, and extending into the first two centuries of Spanish presence in the northern Southwest. This approach is taken from the realm of demographic archaeology, the examination of population change within the context of sociocultural organization and culture change. It contrasts with approaches derived from archaeological demography, which is the enumeration of and description of population and population change using archaeological methods. This latter approach is the one that has most commonly been taken when descriptions of sixteenth and seventeenth century Pueblo population decline have been attempted.

The demographic archaeology approach taken here differs from that of archaeological demography on four critical points. First, it assumes that the variable of population is more easily understood from the vantage of socioeconomic organization, not the other way around. Second, it uses population density, rather than population size, as the central value in measuring population change. Third, it is an examination of population trends, rather than an attempt at enumeration. And fourth, it examines variability, rather than varying frequencies of constants, as a measurement of change. By taking such an approach, I avoid the difficulties inherent in attempting to estimate population sizes from archaeological proxies. At the same time, the approach is appropriate in its use of relative population density as a measure of population change, because this variable is relevant to socioeconomic change, and has been proven useful in other regions in detecting Native American population decline following the arrival of Old World peoples.

The study specifically examines changes in agricultural intensification, as manifested in settlement use, as a measure of population change. Agricultural intensification is used because among subsistence agriculturalists it is related to population change in a regular, uniform and reliable fashion, and because it is manifested in the use and distribution of settlements and utilized landscapes in ways that can be measured through archaeological research.

Agricultural intensification is related to population density because intensification is driven by land scarcity. As more farmers occupy the same limited area of land, and less land is available to each individual farmer, the productivity of smaller plots of land must be increased through the investment of labor, technology, or capital. The relationship between agricultural intensification and population density was first defined by Ester Boserup, and has been verified by a large number of cross-cultural and longitudinal studies of subsistence agricultural economies. However, subsistence farmers also have a variety of alternatives to intensification when faced with increasing population density. These include migration, craft specialization, conflict, and diversification. Intensification can also be driven by factors other than increasing population, such as sociopolitical pressures, but these factors may not be applicable to ancestral and early modern Pueblo peoples. Environmental factors may place absolute limitations on intensification, but on balance population density has been found to be of far more explanatory value than environment when describing variability in intensification practices.

Agricultural intensification is manifested in two aspects of the archaeological record: settlement patterns and landscape modification. Intensification affects settlement patterns according to the proximity-access principle: the greater one's need to access any landscape feature, the greater premium one will place on residing near that feature. Thus, as farmers invest more labor in agricultural production, they will locate their residences closer to their fields to minimize increasing travel times. Landscape modifications appear as durable consequences of capital and labor investment in fields. Archaeological visible landscape modifications include features to improve the physical qualities of fields, such as terraces, borders, retention walls, soil dams and gravel mulches; modifications to soil chemistry through the application of manure and household waste; and improvements in plant care, including canal irrigation, pot watering, predator control and weeding, indicated by physical features, artifact residues, and micro- and macrofloral remains. Landscape-scale features may also be indirect indicators of intensification, as markers of changes in rules of land tenure that are tied to agricultural intensification.

The relationship between population density and agricultural intensification can be explored through the settlement and land use history of ancestral and early modern Pueblo peoples between A.D. 1150 and 1600, directly prior to Spanish colonization of the northern Southwest. Three broad trends characterize this time span: the abandonment of large portions of the region by ancestral Pueblo and other native Southwestern populations, the congregation of peoples into aggregated settlements, and the proliferation of agriculturally related landscape features and landscape modifications.

The abandonment of settlements and regions in the northern Southwest has come to be viewed by archaeologists as a strategy for responding to changing environmental and social conditions, rather than as a consequence of catastrophe or failure. In the mid- A.D. 1100s, ancestral Pueblo populations achieved their maximum distribution across the region. From that century forward, regional abandonment took place in a stepwise fashion, with most regional abandonment taking place between A.D. 1300 and 1450. By A.D. 1500, populations are found only in the greater Rio Grande drainage and in a few refugia on the southern and western margins of the San Juan Basin (Acoma, Zuñi and Hopi). The interest of this study is the demographic consequences of abandonment, not its causes. The abandonments of the late ancestral and early modern eras were a consequence of either population decline or of emigration. There is little support for widespread population decline across the Pueblo world; however, emigration and rising population densities in areas that remained occupied is more strongly supported. Increasing population densities in areas not abandoned is indicated by growth in the number and site of settlements, and by the widespread appearance of landscape features indicative of agricultural intensification, particularly after A.D. 1300.

Concurrent with the process of abandonment is that of settlement aggregation, the congregation of Pueblo populations into fewer and significantly larger settlements than those occupied prior to A.D. 1150. After A.D. 1300, population aggregation is virtually ubiquitous across the northern Southwest, with virtually all early modern Pueblo peoples living in large settlements. Given agricultural intensification in the early modern era, aggregation is an surprising pattern, as population dispersion is the expected pattern under conditions of rising population densities and increasing intensification. However, population decline has never been suggested as a potential cause of aggregation in the Pueblo world, and population growth has figured into almost all explanations of the phenomenon. As with abandonment, it is not the intention of this study to explain aggregation. However, several explanations for aggregation have been offered that run counter to the expectations generated by the relationship between population density, agricultural intensification, and the settlement behavior of subsistence farmers. One explanation is that intensification led to a demand for pooled labor, encouraging aggregated residence. However, ethnographic evidence demonstrates that dispersed intensive farmers are equally capable of pooling labor. A second explanation is that aggregation arose to reduce competition between different communities over arable land; aggregation reduced the spatial distribution of populations and created buffer zones between populations. However, such buffer zones could have just as easily been created between groups of dispersed farmers. It is more plausible that settlement aggregation reduced competition between intensifying farmers by providing a means of defense (the aggregated settlement), and a mechanism for enforcing individual land ownership by the group. At the same time, aggregated residence facilitated social integration, and reducing competition between individual farmers within communities. As such, aggregation should not be seen as an enabler of intensification, but rather as a potential outcome of the process, given an environment of limited resources.

Given the relationship between aggregation and agricultural intensification, it is clear that the former took place not because of, but rather in spite of the latter. Aggregation creates a series of challenges for the subsistence farmer, most important being the increased cost of maintaining intensive farming practices while residing remotely from fields. Both prehistoric and contemporary subsistence agriculturalists have resolved this dilemma by maintaining satellite settlements close to fields, to mitigate travel costs during time periods when labor investment in fields is required. In the northern Southwest, the settlement record indicates that ancestral and early modern Pueblo peoples established satellite settlements adjacent to fields to mitigate the costs of aggregated residence. Broadly, satellite settlements, commonly termed field houses or farmsteads, are found in association with episodes of aggregation, and proliferate after A.D. 1150 with the increasing trend towards aggregation across the Pueblo world.

Chapter V

The relationship between agricultural intensification and the archaeological record is not straightforward, because intensification involves the allocation of the fundamentally intangible qualities of time and labor. There are several archaeological avenues for measuring intensification; in this study, I examine seasonal farming residences known as field houses. This is in contrast with most other studies of intensification in the northern Southwest, which have focused on agricultural field remains. There is no inherent advantage to studying sites rather than fields; I do so here because of the nature of the field and settlement records of the Jemez Plateau, and problems with the relationship between intensification and agricultural field use in the northern Southwest.

Features representing the remnants of agricultural fields proliferate in the archaeological record of the northern Southwest after A.D. 1150. The intensification of fields follows three avenues: improvement of the physical qualities of the field; improvement in the pedological qualities of the field; and improvement in the care delivered to the crops themselves through irrigation and watering, protection, competition reduction, and other methods. Physical improvements to fields offer moisture and heat retention, and protection to crops. However, they are more indicative of capital rather than labor intensification, and may actually represent lower overall inputs of time and effort. Because they are highly visible, the role they play in intensification may be overstated, and they may divert attention from fields more intensively farmed but lacking in resilient features. And many features identified as related to agricultural intensification may have served other functions. Improvements to soils may be a better measure of the intensification of labor, but have been little studied in the northern Southwest. Improvements in crop productivity and survival are better known, but there are disputes as to the importance of irrigation systems during the early modern Pueblo era, and little evidence. Pollen and artifact residues have also been studied to examine plant care, but methods for studying these remains are more difficult to execute on a regional scale.

In this study I examine settlements for evidence of variability in agricultural intensification. Both settlement use and settlement location can be used to examine intensification. The use of settlement location, however, requires uniform distributions of agricultural resources and that the settlements studied are primary residences; neither of these cases hold for the field houses of the Jemez Plateau. It also requires good spatial and chronological information, both of which are lacking for the plateau. Overall, there is no general model for understanding the relationship of secondary agricultural settlements to intensification. By contrast, there are existing models for understanding its relationship to settlement use which can be applied to secondary farming settlements.

Secondary farming settlements are defined by four elements: periodic occupation, task specificity, residence, and mobility. These elements can be operationalized into two broad ideas for understanding the relationship between intensification and field houses: periodic circulation and the field house. Periodic circulation is the movement of peoples from a primary to a secondary residence for a period greater than a day but less than a year. For ancestral and early modern Pueblo peoples, periodic circulation was the movement from aggregated primary residences to secondary agricultural settlement, and was one of several mobility strategies related to agricultural production. As an economic pursuit, periodic circulation can be understood as a form of logistical mobility, moves taken to resolve the spatial incongruity of resource distributions (in the case of secondary agricultural settlements, the incongruity between primary settlements and available agricultural land).

Field houses are one of two types of secondary agricultural settlements that have been identified as used by ancestral and early modern Pueblo farmers. I define field houses as a locality adjacent to a field that serves as a residence during agricultural activities. This is a conceptual definition derived from the residential behavior of subsistence farmers rather than from physical aspects of the archaeological record. The challenge in defining field houses is that the term lies at the intersection of functional concepts and empirical phenomena that do not completely overlap. Thus the term field house is used both to define both loci of behavior and a specific type of archaeological remains that do not necessarily always coincide. Prior efforts at defining field houses have mostly focused on material attributes of field house remains, such as the presence of specific architectural or assemblage attributes, assemblage diversity, and assemblage indicators of duration of occupation. However, a few have emphasized site location as a defining attribute, and it is from these efforts that the definition used here is derived. Most earlier definitions were designed to distinguish field houses from other classes of sites, and by doing so, used the very criteria that are needed to examine variability in field house use as criteria for site definition. Because this study is an examination of intra-class variability, it cannot use such criteria for site definition as they may exclude many relevant sites. By the same token, the definition used in this study may misclassify some non-agricultural sites as field houses.

This study relies on the assumption that field houses represent an economic solution to the conflict in location between aggregated residence and agricultural intensification. However, there are alternative perspectives on field house use that can undermine this assumption. The first is that field houses can occur under any conditions of spatial incongruity between residences and fields, regardless of aggregation. While this is true, empirically it is not the case for the Jemez Plateau, where aggregated primary residence is ubiquitous by A.D. 1350. The second is that field houses are constructed as material indicators of field ownership, regardless of their function as seasonal residences, in response to change rules of land tenure. However, this perspective conflates land use with land tenure. While the conditions leading to land tenure changes and periodic circulation are the same, field houses are a consequence of land use. Land tenure is a system of land allocation rules that do not necessitate material signifiers that will persist in the archaeological record.

Field houses indicate changes in agricultural intensification through changes in the intensity of their use, best expressed as duration of periodic or lifetime occupation. Duration of occupation can be measured by examining characteristics of architecture and assemblages. Architecture reflects duration of occupation through construction, which is an indicator of the anticipated duration of occupation, and remodeling, which can point to the actual duration of occupation. Among artifacts, duration of occupation can be measured through accumulation and diversity. Accumulation is a measure of the discard of artifacts over time. Diversity is a measure of the numbers of artifact classes present at a site. While artifact diversity is typically considered to be an indicator of activity diversity, it can also measure the duration of artifact discard. This is because, due to the stochastic nature of discard, the diversity of artifact classes at a site should increase with occupation duration, a phenomenon known as the Clarke Effect. Both architectural and assemblage characteristics have been successfully employed in previous studies of field houses to measure differences in use intensity, although not in a systematic manner. Variability of construction, remodeling, artifact accumulation and artifact class diversity can all be affected by factors other than duration of occupation, but by measuring these attributes in tandem, effects from these other factors can be identified.

Chapter VI

This study employs the archaeological record of the Jemez Plateau for examining changes in field house use to study changes in agricultural intensification and population during the centuries prior to and following the arrival of the Spanish in the northern Southwest. The

Jemez Plateau is one of the major culture areas of the northern and central Rio Grande region, and locus for significant ancestral and early modern Pueblo settlement between A.D. 1250 and 1700.

The Jemez Plateau is a distinct physiographic province, an upland area of long sloping mesas and deep narrow canyons, watered by three permanent and several intermittent watercourses. The physiography of the plateau was produced primarily by late Tertiary and Quaternary volcanic episodes, in particular the Plio-Pleistocene eruption of the Valles Caldera that produced the ash flows which formed most of the mesas of the area. Geological deposits in the region provided a variety of chipped and ground stone raw materials for the residents of the area. The Jemez Plateau is a source for chipped stone raw materials—obsidian and chert—that are found across a wide area of the northern Southwest and southern Plains. Soils and sediments on the plateau are mostly of alluvial origin, both on the mesa tops and in the canyon bottoms. The deepest and most well-watered soils are located on the mesa tops that would have been suitable for cultivation.

Most ancestral and early modern Pueblo occupation on the Jemez Plateau is found within three vegetation associations: Ponderosa Pine forest, Piñon-Juniper woodland, and the transition zone between the two. These vegetation associations have been significantly modified from their historic conditions over the past 150 years by grazing, fire suppression and logging, resulting in the overstocking of trees and overstory closure in the Ponderosa Pine forest, and understory removal and erosion in the the Piñon-Juniper woodland. The forests and woodlands of the Jemez Plateau are primarily xeric and temperate, with an average of 43 centimeters of annual rainfall and an average of 170 frost-free days at Jemez Springs. Because of their southern aspect, the mesas of the plateau may enjoy more frost-free days than the canyon bottoms, while at the same time receiving greater rainfall due to elevation. Paleoenvironmental reconstruction indicates low variability in rainfall over the period of Pueblo occupation of the plateau, with at least three significant drought episodes. Droughts likely caused mass mortality among overstory vegetation, and the modern boundary between vegetation associations was likely highly mobile in the past due to these mortality episodes.

Previous archaeological research on the Jemez Plateau has emphasized site location through survey and the excavation of small sites, but investigation of large settlements has been limited. As a result settlement patterns are well known, but the chronological sequence of settlement change is much more poorly understood. Early research in the late nineteenth and early twentieth centuries defined the basic settlement pattern of the area, but excavations were mainly conducted to obtain museum specimens. Major excavations conducted by the University of New Mexico and the School of American Research between 1928 and 1949, however, were responsible for defining the basic ceramic chronology for the area, and stimulated related significant historic research on the sixteenth and seventeenth centuries. There was little research on the plateau during the middle part of the twentieth century, other than scattered excavations, and an important survey of agricultural landscapes. Since the 1970s, tens of thousands of hectares have been surveyed as part of heritage preservation work, and two dozen field houses have been partially or completely excavated. Most emphasis of this later work has been site location, but efforts at chronology construction have been made in conjunction with this fieldwork.

Previous research on the archaeological record of the Jemez Plateau itself is insufficient for evaluating the nature of Pueblo population change there during the sixteenth and seventeenth centuries. However, a general sequence of settlement change can be constructed. This study proposes a new phase sequence for describing changes in occupation on the Jemez Plateau by ancestral, early modern, and late modern Pueblo peoples. The area was little occupied during the *San Ysidro Phase*. The first major settlement on the plateau commenced during the *Vallecitos Phase,* when small aggregated settlements, along with field houses and agricultural features appeared in the lower reach of the plateau's canyons. Settlement growth was likely driven by immigration from the southern San Juan Basin, as settlements and ceramics share affinities with those from that region. Many medium-sized and a few very large villages emerged during the *Paliza Phase*. Settlement corresponds to major patterns seen throughout the northern and central Rio Grande region, with large villages featuring well-planned layouts. Settlement during the *Jemez Phase* shifted to very large villages, and many medium-sized settlements were abandoned. The use of field houses during this phase appears to have reached its greatest extent, and field houses show a broad diversity in form and assemblage characteristics. The *Guadalupe Phase* corresponds to the period when the Spanish first asserted control over the Jemez Plateau. Settlement persists only at the largest settlements of the area, although there are also apparent reoccupations of small aggregated sites abandoned during the Vallecitos and Paliza Phases. The use of field houses also continued. Virtually all Pueblo occupation of the Jemez Plateau ceased by the advent of the *Cañon Phase*; most Pueblo peoples moved or resettled at the location of modern-day Jemez Pueblo (Walatowa).

Historic documents provide disparate though significant demographic information on the Pueblo population change during the sixteenth and seventeenth centuries. Spanish exploring parties rarely ventured onto the plateau, and estimates of occupation from the sixteenth century may be second-hand. Spanish control over the area was only asserted in the 1620s, when two missions were established in the area. Missionary efforts were focused on relocating Pueblo populations from settlements on the mesa tops to the mission communities located along the Jemez River. There is little mention of the Jemez Plateau in historic documents during the mid-seventeenth century, and missions in the area may have been unstaffed from time to time. The Pueblo peoples of the plateau participated in the Pueblo Revolts of 1680 and 1696, and most Pueblo peoples of the area fled to other regions. Refugees returned to the region in the early eighteenth century, resettling at modern-day Jemez Pueblo (Walatowa). Overall, historic evidence indicates Pueblo population decline in the area, particularly after 1620. However, this trend fails to fully correspond with the archaeological record of settlement, both at large sites and at field houses.

Chapter VII

Examining Pueblo population decline on the Jemez Plateau during the sixteenth and seventeenth centuries requires two instruments: a temporal scale appropriate for evaluating hypotheses regarding depopulation, and measures that can assess variability in field house use relevant to agricultural intensification and population change. These instruments were developed and applied to 30 field houses located on the eastern portion of the Jemez Plateau. The study sample sites were selected from a population of 1100 recorded potential field house sites on the eastern plateau. Twenty-two of the sites were randomly selected from the population, while eight were systematically selected as sites with potential occupations dating to the seventeenth century. All of the material analyzed for this study were surface phenomena, and were all analyzed in the field. The use of surface remains is based on the concept that surface materials represent a valid fraction of remains at Jemez Plateau field houses. The northern Southwest is a particularly appropriate region for employing surface remains, because there has been little burial of materials, and vegetation rarely obscures surface visibility. These conditions hold for the Jemez Plateau, although surface visibility is a concern for some areas. The analysis of all materials in the field is based on the notion that the examination of artifacts under such conditions is reliable, an idea confirmed by experimental studies. No-collection surface artifact analysis was employed for two pragmatic reasons: opposition to excavation and other disturbing analyses by the descendent community at Jemez Pueblo, and a lack of curation space for collected artifacts.

The study examines four aspects of past human behavior at field houses that is relevant to the intensity of structure use and the degree of agricultural intensification: age of occupation, duration of occupation, use group size, and diversity of domestic activities. Age of occupation is examined through an attribute analysis of diagnostic ceramic types. Duration of occupation is monitored through four phenomena. One, masonry standardization, is a measure of anticipated duration of occupation. Three are measures of actual duration of occupation: remodeling and reconstruction, ceramic assemblage size (accumulation), and lithic class richness. Use group size is measured by estimating enclosed area from rubble mound size and number of rooms. The diversity of domestic activities is monitored by examining lithic class richness that does not conform to the Clarke Effect, and through the occurrence of extramural features.

All study sample sites were recorded, mapped and photographed, with architectural details recorded on supplemental forms. Artifacts associated with sites were located through systematic transects. Where needle litter obscured the surface, organic litter was raked to expose mineral soil. Where ceramic assemblages exceeded 100 sherds, assemblages were systematically sampled to acquire a sample approximately equal to 100. However, the entire surface ceramic assemblage was quantified and rare time-diagnostic sherds not included in the sample were identified, illustrated and photographed to be used in dating the site. All analyzed sherds were weighed and piece-plotted in addition to being subjected to an attribute analysis. Additional attributes were recorded for rim sherds. All surface lithics were tallied according to raw material type, reduction stage (if chipped), inferred function or formal type (if exhibiting inferred use-wear or retouch).

A new chronological framework is necessary for examining ideas regarding Pueblo population decline on the Jemez Plateau. Six chronological units are defined based upon hypotheses regarding changes in population size and density in the northern Southwest between A.D. 1200 and 1825, including the inferred growth of populations prior to the arrival of Old World populations in the northern Southwest, and during the era of Spanish exploration and colonization. The units are of unequal duration, although this is not a complicating factor, as only relative measures of population change are employed.

The assignment of sites to the temporal units defined for this study is based on a ranked occurrence seriation of time-diagnostic ceramic types. The diagnostic types include both established types, and provisional types identified for this study. The typology used is sherd based and relies on ubiquitous surface characteristics, following typological conventions for northern and central Rio Grande ceramic types. A modified type-variety system is used here to classify types, with types treated as intensional units for describing the distribution of ceramics in time, and varieties as units for describing the distribution of ceramics in space. The goal of classification here is to create units of maximal spatial extent and minimal temporal duration, to maximize the resolution dating using occurrence seriation. Types are identified for three major groups: plain wares, white wares, and glaze and matte paint polychrome wares. Plain wares on the Jemez Plateau mirror variability seen across the entire northern and central Rio Grande region, and are classified as varieties of region-wide types. Provisional types of Rio Grande Plain are suggested based on variability in the finishing of closed form interiors. White wares are classified according to ubiquitous surface characteristics, including the presence or absence of attributes such as slip, paint and polish on interior and exterior surfaces (particularly of open forms). One type description, Vallecitos Black-on-white, is significantly modified from earlier definitions. Jemez Black-on-white is subdivided into three provisional types based on surface attributes and the occurrence of European rim forms. Rio Grande glaze wares are classified according to the types defined for areas directly adjacent to the Jemez Plateau, as the majority of glaze wares found on the plateau were likely produced in these areas. All of the types are assigned as indicators of one or more of the study time units based upon their known duration of manufacture.

Chapter VIII

This and the following chapter present the results of the analysis of data from the Jemez Plateau study sample sites relative to field house use intensity, agricultural intensification, and population change. The chapter has two objectives: applying the ceramic chronology from Chapter VII to the study sample sites, and identifying biases in the data resulting from environmental or post-depositional processes.

The data used in the analysis are derived from surface artifact assemblages and exposed architecture at the 30 study sample sites. Aritfact assemblages include lithics (chipped and ground stone) and ceramics. Lithic frequencies are expessed as counts, while ceramics are expressed as weights where possible, to correct for variability in sherd size relative to site elevation. Architectural data includes percentages of shaped masonry blocks, masonry block size, structure site, number of rooms, and the presence of extramural features.

Twenty-eight of the 30 study sample sites are dated using a ranked occurrence seriation. This method is employed for dating sites because ceramics are present at all but two of the study sample sites, the small assemblage sizes and short-duration occupations of the sites are not amenable to frequency seriation, and because occurrence seriation is not dependent upon sample size. The occurrence seriation utilizes provisional types and is compared to frequency seriation. These tasks are facilitated by a preliminary assignment of nine of the study sample sites to early and late categories. Frequency seriation is evaluated because it has been suggested as a method for dating sites on the Jemez Plateau using ceramic assemblages. The ratio of open to closed forms among Jemez Black-on-white is one attribute that has been identified as varying in frequency through time, and is used to evaluate the use of frequency seriation because data relevant to this attribute can be taken from published reports of excavations at large and small sites. The ratio of open to closed Jemez Black-on-white forms does not pattern by time at the nine study sample sites used for preliminary analysis, nor does it pattern for excavated field houses. However, the ratio does pattern for stratified trash middens at the large pueblo of Unshagi, indicating that long-duration assemblages are necessary to even out the stochastic effects of discard on ratios of different vessel forms. These stochastic effects mean that frequency seriation is an invalid method for dating sites such as field houses that are a product of short-duration discard episodes. They also invalidate the utility of some of the provisional types utilized in the ranked occurrence seriation, because these types were identified based on relative frequencies of attributes within existing types.

The assignment of study sample site ceramic assemblages to different study time units based on the ranked occurrence seriation employs types that were the result of a reclassification derived from the diagnostic attributes for each type identified in Chapter VII. The reclassification departs somewhat from the type identifications made in the field, partially because it does not rely on qualitative preconceptions of site age, and partly because the attribute-based reclassification has the potential to "misclassify" poorly finished sherds from later vessels as early. The types created by the reclassification are then ranked based on the duration of their manufacture, and confidence regarding that duration of manufacture, with short-duration, well dated types receiving the highest rank. The two sites without ceramic assemblages are dated by their association with better dated sites from the same locality.

The use of data derived from surface remains and small, short-duration occupation sites has the potential to introduce bias into the structure of data that is independent from variability in field house use intensity. Among assemblage characteristics, artifact class richness and assemblage volume (a measure of accumulation) are strongly affected by surface assemblage size. Site assemblage sizes are largely a product of surface visibility, and sites with little ground cover have large assemblages, while sites that are mostly covered do not. Surface assemblages at sites with high ground visibility correspond closely in lithic class richness and ceramic volume to excavated sites, indicating that these sites have surface assemblages that are representative. Sites with low ground visibility do not. Variability in architecture can be affected by raw material variability, reuse, scavenging, and surface visibility. Available raw materials affects the percentage of shaped blocks present within a field house rubble mound, and masonry block size. Reuse can bias structure size where later structures have been built directly atop earlier ones. Surface visibility affects the ability to identify non-masonry extramural features, but not masonry ones. The effects of scavenging could not be diagnosed. Bias within surface assemblages can be corrected by substituting excavated site assemblage data for data derived from low visibility site assemblages. Because biases in architecture are less prevalent, sites affected by these biases are simply excluded from the relevant analyses.

Chapter IX

Once sites can be dated and biases in data can be mitigated, field house data from the Jemez Plateau can be examined for variability in use through time. The results of this analysis conclude that rather than decreasing during the sixteenth and seventeenth centuries, Pueblo populations on the Jemez Plateau remained stable, or actually increased somewhat, and that population decline on the plateau began quite late, probably taking place in a significant fashion around or after A.D. 1650. Two tasks are undertaken in this chapter: examaining patterning among nine indicators of field house use intensity; and evaluating this patterning in relative to expectations regard Pueblo population change during the sixteenth and seventeenth centuries.

For the analysis of variability in field house use intensity through time, only site components that could be assigned to study time units with probable certainty are used. Components with only possible certainty are excluded, meaning that seven study sample sites were excluded altogether, because they lack any component with probable date. Later evaluation of these sites indicates that they among the least utilized and probably date to study time units I or II. Three areas of site use intensity are examined: duration of occupation, use group size, and activity diversity. Duration of occupation can be divided into anticipated and actual duration of occupation. Architectural investment is a measure of anticipated duration of occupation and can be monitored by examining the percentage of shaped masonry blocks within field house rubble mounds, and masonry block size. Site components dating to study time units IV and V have greater frequencies of shaped masonry blocks than do earlier site components, but the differences are not statistically significant. Likewise, site components belonging to study time units IV and V have greater percentages of blocks that fall within the largest and smallest size categories. Shaped blocks, along with the largest block sizes, are indicators of greater investment because they better handle loads and are resistant to failure. Reuse and remodeling can be an indicator of actual duration of occupation, but there is not enough data on this phenomenon to suggest any trends through time. Ceramic accumulation and lithic class richness are assemblage-based measures of actual duration of occupation. Accumulation of plain wares indicates greater volumes of sherds at components dating to study time units IV and V relative to earlier units, indicating an increase in actual duration of occupation. However, this increase is not statistically significant. Lithic class richness measures actual duration of occupation through the Clarke Effect (the longer a site is occupied, the more diverse its assemblage will be). Study time units IV and V have greater frequencies of site components with greater lithic class richness than do earlier site components.

Use group size can be measured by the size of a structure's enclosed area. Rubble mound size and number of rooms are used as proxies for enclosed area. There is an increase in rubble mound area for site components dating to study time units IV and V from earlier units, but this increase is not statistically significant. There is no significant change in the number of rooms across the five study time units. Ceramic accumulation and lithic class richness, used in this study as measures of occupation duration, can also be indicators of use group size. When compared to rubble mound size, these two assemblage indicators do not appear to correlate with rubble mound size, except for aspects of ceramic volume, suggesting that they better measure duration of occupation than use group size.

Diversity of domestic activities is monitored by examining lithic class richness among site component assemblages that do not conform to sample size expectations (i.e., the Clarke Effect), and by the presence of extramural features. Site components that date to study time units IV and V have lithic class frequencies that are richer than would be predicted by sample size, while earlier site components have frequencies that are less rich. There is not enough data on the presence of extramural features to detect any patterning. In sum, six of the nine indicators show an increase in field house use intensity between study time units III and IV, or after about A.D.

1525. At the same time, five of the nine indicators show that use intensity was stable between study time units IV and V, the period spanning A.D. 1525 to 1700.

The trends in field house use intensity on the Jemez Plateau identified by the analysis can be compared to expectations of Pueblo population decline during the sixteenth and seventeenth centuries, and evaluated relative to procedural and substantive concerns regarding data patterning. The Dobyns hypothesis, which postulates significant mortality from introduced Old World infectious diseases prior to Spanish colonization, stipulates significant depopulation during the sixteenth century. Many other researchers believe that Pueblo population decline to place concurrent with Spanish colonization, and is a mid- to late seventeenth century phenomenon. The patterning in the indicators of field house use intensity for the Jemez Plateau are partially a consequence of the types used in the ranked occurrence seriation that obscure variability during study time units I, II and III. However, the increase in use intensity between study time units III and IV, and the stability in use intensity between units IV and V appear to be real, although such stability can only be assumed through approximately A.D. 1650. The increase in use intensity could be a consequence of the conversion of secondary settlements into primary residences, but the architectural and assemblage characteristics of the field houses, along with continued occupation at large sites, suggest this is not the case. Agricultural intensification indicated by increases in field house use intensity during study time units IV and V could be a result of increased production demands imposed by the Spanish rather than increases in population density, but the timing of the increase predates the establishment of Spanish control over the Jemez Plateau by approximately 100 years. The increase in population density indicated by increasing intensification during study time units IV and V may not translate into larger population sizes for the plateau if the area available for farming shrank during this era, and there is limited evidence to support this contention. Overall, Pueblo populations on the Jemez Plateau remained stable or increased after A.D.1525, and there is no evidence for population decline prior to A.D. 1650. This conclusion refutes the Dobyns hypothesis and supports the notion that Pueblo population decline took place in association with Spanish colonization. Depopulation on the Jemez Plateau may have been driven by mortality from Old World infectious diseases. However, warfare, emigration, and the loss of identity as Pueblo peoples during the second half of the seventeenth century may have also been major contributors to population decline.

APPENDIX A

SUMMARY OF SIZE AND OCCUPATION DATA FOR JEMEZ PLATEAU SITES OVER FIVE ROOMS IN SIZE

The table below contains summary information on all recorded settlements on the Jemez Plateau dating to between A.D. 1200 and 1700 that are reported as greater than four rooms in size. The sites were identified based on a search of New Mexico Cultural Resource Information System and site files at the Archaeological Records Management Section, Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico. The phase assignments are derived from listings and ceramic information in Elliott (1982, 1991), and from ceramic and other chronometric information contained in the files for each site.

Table A.1. Jemez Plateau Sites Over 4 Rooms in Size

			Phase Occupied						
LA No.	Forest Service No.	No. of Rooms	Vallecitos 1200-1350	Paliza 1350-1450	Early Jemez 1450-1525	Late Jemez 1525-1625	Guadalupe 1625-1700	Cañon After 1700	Unknown
96	AR-03-10-03-00005	600	X	X	X	X	X	X	
123	AR-03-10-03-00337	263			X	X			
128	AR-03-10-03-00647	125		X					
130	AR-03-10-03-00571	1300		X					
132	AR-03-10-03-00031	625			X	X	X		
133	AR-03-10-03-00504	325			X	X	X		
134	-	40	X	X					
135	AR-03-10-03-00199	350		X					
136	AR-03-10-03-00002	650	X			X	X		
137	AR-03-10-03-00580	75		X					
189	AR-03-10-03-00572	250		X					
248	-	100	X						
258	-	100	X						
303	AR-03-10-03-00012	1100			X	X	X		
322	AR-03-10-03-00205	12							X
373	-	50		X					
385	AR-03-10-03-00535	50		X					
386	AR-03-10-03-00554	75		X					
395	-	10	X						
403	AR-03-10-03-00689	60	X	X					
478	AR-03-10-03-00400	1400		X					
479	AR-03-10-03-00579	200		X	X	X			
481	AR-03-10-03-00530	1250		X	X	X	X		
482	AR-03-10-03-00011	1250			X	X	X		

Table A.1. (continued)

LA No.	Forest Service No.	No. of Rooms	Phase Occupied: Vallecitos 1200-1350	Paliza 1350-1450	Early Jemez 1450-1525	Late Jemez 1525-1625	Guadalupe 1625-1700	Cañon After 1700	Unknown
483	AR-03-10-03-00007	300		X	X	X			
484	AR-03-10-03-00576	1850			X	X	X		
541	AR-03-10-03-00320	350			X	X			
679	-	350				X	X		
1825	AR-03-10-03-00360	250					X		
5918	AR-03-10-03-00030	375		X	X	X			
5919	-	25							X
5920	AR-03-10-03-00018	350		X					
8860	-	190				X	X	X	
23528	AR-03-10-03-00087	5	X						
23578	AR-03-10-03-00137	5	X						
23648	AR-03-10-03-00207	8	X		X	X			
23649	AR-03-10-03-00208	12	X						
23655	AR-03-10-03-00214	15							X
23662	AR-03-10-03-00221	6	X						
23663	AR-03-10-03-00222	5							X
23712	AR-03-10-03-00317	65					X		
23717	AR-03-10-03-00323	28					X		
23719	AR-03-10-03-00325	160					X		
23720	AR-03-10-03-00326	5					X		
24536	AR-03-10-03-00487	21							X
24553	AR-03-10-03-00505	50		X					
24788	AR-03-10-03-00573	750			X	X			
24789	AR-03-10-03-00574	75		X					

Table A.1. (continued)

LA No.	Forest Service No.	No. of Rooms	Phase Occupied						
			Vallecitos 1200-1350	Paliza 1350-1450	Early Jemez 1450-1525	Late Jemez 1525-1625	Guadalupe 1625-1700	Cañon After 1700	Unknown
24790	AR-03-10-03-00575	100				X			
24792	AR-03-10-03-00578	50		X					
24856	AR-03-10-03-00033	10							X
24958	AR-03-10-03-01606	28			X	X			
25098	AR-03-10-03-01312	10							X
38962	AR-03-10-03-00010	6				X	X		
44000	AR-03-10-03-00003	150			X	X			
44001	AR-03-10-03-00688	75			X	X			
45322	AR-03-10-03-01422	12							
46340	AR-03-10-03-00001	50			X	X			
54423	AR-03-10-03-00954	8					X	X	
54825	AR-03-10-03-00194	40	X	X					
56361	AR-03-10-03-00669	10	X	X					
56522	AR-03-10-03-00760	10	X	X	X				
56859	AR-03-10-03-01729	5							X
61644	AR-03-10-03-01033	6			X	X			
64452	AR-03-10-03-01830	70	X	X	X	X			
65149	AR-03-10-03-01745	6	X						
65153	AR-03-10-03-01749	100	X						
65154	AR-03-10-03-01750	20	X						
65155	AR-03-10-03-01751	100	X						
65156	AR-03-10-03-01752	8	X						
65159	AR-03-10-03-01755	20	X						
65176	AR-03-10-03-01772	16	X						

Table A.1. (continued)

LA No.	Forest Service No.	No. of Rooms	Phase Occupied						
			Vallecitos 1200-1350	Paliza 1350-1450	Early Jemez 1450-1525	Late Jemez 1525-1625	Guadalupe 1625-1700	Cañon After 1700	Unknown
66970	AR-03-10-03-01862	10	X	X	X				
70367	AR-03-10-03-02080	6							X
71604	AR-03-10-03-02118	50	X	X			X	X	
73147	AR-03-10-03-02127	9		X	X				
74764	AR-03-10-03-00184	10		X	X				
75729	AR-03-10-03-02066	5		X	X	X			
90253	AR-03-10-03-02618	15		X	X				
90494	AR-03-10-03-02732	12	X	X	X				
90497	AR-03-10-03-02735	40	X	X					
101628	AR-03-10-03-02119	40	X			X	X		
101629	AR-03-10-03-02120	40	X						
109322	-	60	X						
113062	AR-03-10-03-03104	10		X	X				
132756	AR-03-10-03-03585	20	X						
65176	AR-03-10-03-01772	16	X						

APPENDIX B

TREE RING DATING RESULTS FROM SPECIMENS COLLECTED AT STUDY SAMPLE SITES LA 23566 AND LA 24639

The exceptions to the no collection policy of this study were two tree-ring specimens collected from sites LA 23566 (AR-03-10-03-125) and LA 24639 (AR-03-10-03-619). Both specimens had been exposed by illegal looting at the sites some time prior to 1980 or 1981. The samples were collected to prevent their eventual degradation from exposure. Santa Fe National Forest Archeologist Michael Bremer and Jemez Ranger District Archeologist Rita Skinner were notified when the specimens were collected in 1999 and 2000. The specimens were submitted for tree-ring dating to the Laboratory of Tree-Research at the University of Arizona, Tucson.

This appendix contains the correspondence received from the Laboratory of Tree-Ring Research regarding the results of attempts to date the specimens, and the printout of the dating results. Neither specimen yielded a date and could only be identified as to species, despite the fact that each had enough rings present for dating.

Laboratory of
Tree-Ring Research

THE UNIVERSITY OF
ARIZONA®
TUCSON ARIZONA

P.O. Box 210058
Tucson, Arizona 85721-0058
Phone: (520) 621-6469
FAX: (520) 621-8229

4 April 2000

Jeremy R. Kulisheck
1616 Paseo de la Conquistadora
Santa Fe, New Mexico 87501-2337

Re: Accession A-1478

Dear Jeremy,

Enclosed is a species identification form documenting the results of our analysis of one archaeological tree-ring sample from LA 24639. Although the ponderosa pine sample could not be dated, it has enough dendrochronological potential to be added to our permanent collection for future reference.

If you have any questions about these results, please let me know.

Sincerely,

Jeffrey S. Dean

LA 24639 - Species ID by DOB - Reported 3 April 2000 - Accession A-1478

	FIELD NUMBER	TRLNO	DF	PP	PNN	JUN	S/F	POP	QUER	NONCON
1		NMI-20		1						
			Total:	1						

Laboratory of
Tree-Ring Research

THE UNIVERSITY OF
ARIZONA®
TUCSON ARIZONA

P.O. Box 210058
Tucson, Arizona 85721-0058
Phone: (520) 621-6469
FAX: (520) 621-8229

13 May 2002

Jeremy R. Kulisheck
1702 Paseo de la Conquistadora
Santa Fe, New Mexico 87501-2339

Re: Accession A-1577

Dear Jeremy,

Here are the results of our analysis of one archaeological tree-ring sample from LA 23566 on the Jemez Plateau, New Mexico. Enclosed is a species identification form. Although this sample is somewhat complacent and cannot be dated, it has enough dendrochronological potential to be added to our permanent collection for future reference. Analysis of this sample took so little time that there is no charge for the work.

If you have any questions about these results, please let me know.

Sincerely,

Jeffrey S. Dean

LA 23566 - Species ID by RLW - Reported 11 May 2002 - Accession A-1577

-	FIELD NUMBER	TRLNO	DF	PP	PNN	JUN	S/F	POP	QUER	NONCON	COMMENT
1	001	NMI-24		1							52 rings. Complacent ring series.
			Total:	1							

APPENDIX C

FORMS USED FOR RECORDING ARCHITECTURAL AND CERAMIC ATTRIBUTES

Several generations of forms were used during the fieldwork. The forms included here are the last versions used, and reflect the final format of the data that was utilized in the study's analyses. See Appendix D for the codes used to complete the ceramics form.

LA ____________ FS AR 03-10-03-__________ Rev. 11/97

LA: ____________________ Name: ____________________

FS: AR 03-10-03-__________ Date: ________________

JEMEZ CHRONOLOGY AND POPULATION PROGRAM
FIELD HOUSE ARCHITECTURE DATA SHEET

1. **Structure Mound Area** (m)

_______ _______ _______ _______
N NE E SE

_______ _______ _______ _______
S SW W NW

2. Rubble Scatter Area (m)

_______ _______ _______ _______
N NE E SE

_______ _______ _______ _______
S SW W NW

3. **Structure/Rubble Sketch**

Scale: **N** ↑

4. **Masonry Block Size** (% for each) : _______ _______ _______ _______
<10cm 10-30cm 30-60cm >60cm

5. **Shaping of Masonry:** _______ (0%; 1-25%; 26-50%; 51-75%; 76-99%; 100%)

6. **Number of Rooms:** _______ (none observable [0]; 1-4; >4)

7. **Room Traits**

Room 1

a. Visible Wall (orientation)

_______ _______ _______ _______

b. Length Visible

_______ _______ _______ _______

c. Max. Height (courses)

_______ _______ _______ _______

d. Max. Height (m)

_______ _______ _______ _______

e. Room area _______ m²
based on **2 3 4** walls

Room 2

a. Visible Wall (orientation)

_______ _______ _______ _______

b. Length Visible

_______ _______ _______ _______

c. Max. Height (courses)

_______ _______ _______ _______

d. Max. Height (m)

_______ _______ _______ _______

e. Room area _______ m²
based on **2 3 4** walls

LA ____________ FS AR 03-10-03-__________ Rev. 11/97

FIELD HOUSE DATA SHEET (Back Sheet)

7 **Room Attributes** (con'd.)

Room 3

a. Visible Wall (orientation)

______ ______ ______ ______

b. Length Visible

______ ______ ______ ______

c. Max. Height (courses)

______ ______ ______ ______

d. Max. Height (m)

______ ______ ______ ______

e. Room area ______ m²
based on **2 3 4** walls

Room 4

a. Visible Wall (orientation)

______ ______ ______ ______

b. Length Visible

______ ______ ______ ______

c. Max. Height (courses)

______ ______ ______ ______

d. Max. Height (m)

______ ______ ______ ______

e. Room area ______ m²
based on **2 3 4** walls

8. Structure Interior Dimensions ______ based on **2 3 4** walls

9. Structure Exterior Dimensions ______ based on **2 3 4** walls

10. **Skeleton Sketch of Visible Rooms**

Scale: **N** ↑

11. **Comments** ________________

Page ______ of ______
rev. 10/99

LA ______________ FS AR 03-10-03-______________ Name ________________ Date ___________

Jemez Chronology and Population Program

Ceramic Attribute Coding Form--Short Form

						Int./Ext.					
1. **sherd #**	3. **unit**	5. **weight**	10. **vessel type**	11. **place ment**	12. **rim**	13. **srfce mod**	14. **srfce treat**	15. **slip**	16. **paint**	17. **type**	18. **comments**
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			
						/	/	/			

LA ____________ FS AR 03-10-03-____________ Page _____ of _____
rev. 10/99

Ceramic Attribute Coding Form (back sheet)
Rim Class Extension & Comments

1.	12. **rim**					18.
	a.	b.	c.	d.	e.	
Sherd #	**jnct**	**angle**	**shape**	**thick loc**	**term**	**Comments**

Comments: ____________________

APPENDIX D

CODES FOR CERAMIC ATTRIBUTES

The codes listed below are the ones used to record ceramic attributes on the form in Appendix C. If the term "**no code**" is listed following the attribute, the attribute was entered uncoded. The term in parentheses is the truncated database term used for each attribute in the computer files containing the ceramic data for each site.

0. Site Number (site#) **no code**

1. Sherd Number (sherd#) **no code**

3a. Unit—Distance (unitdist) **no code**

3b. Unit—Angle (unitangl) **no code**

5. Weight (grams and log10 grams) (weight and wght_log) **no code**

10. Vessel Type (vesltype)
    1. Open
    2. Closed
    3. Other

11. Sherd Placement (placment)
    1. Rim
    2. Neck
    3. Body
    4. Base
    5. Rim/Neck
    6. Rim/Neck/Body
    7. Neck/Body
    8. Neck/Body/Base
    9. Body/Base
    10. Whole Vessel/Vessel Fragment
    11. Handle
    12. Other

12. Rim (rim)
    1. Present
    2. Absent

12a. Rim Junction

1 Abrupt Interior
2. Abrupt Exterior
3. Abrupt Both
4. Gradual

12b. Rim Angle
1. Parallel
2. Interior
3. Exterior

12c. Rim Shape
1. Parallel
2. Dual Convex
3. Plano-convex (Convex Interior)
4. Plano-convex (Convex Exterior)
5. Concave Interior
6. Concave Exterior
7. Converging
8. Diverging

12d. Rim Thickness Location
1. Proximal
2. Medial
3. Distal
4. No Thickening

12e. Rim Termination
1. Pointed
2. Convex
3. Flat

13a. Surface Modification—Interior (modint)
1 None
2 Indented Corrugated
3 Smeared Indented Corrugated
4 Incised
5 Plain Corrugated
6 Other

13b. Surface Modification—Exterior (modext)
1 None
2 Indented Corrugated
3 Smeared Indented Corrugated
4 Incised
5 Plain Corrugated
6 Other

14a. Surface Treatment—Interior (treatint)
1. Rough
2. Smooth
3. Polished

14b. Surface Treatment—Exterior (treatext)
1. Rough
2. Smooth
3. Polished

15a. Slip—Interior (slipint)
1. Present
2. Absent

15b. Slip—Exterior (slipext)
1. Present
2. Absent

16a. Paint—Interior (paintint)
1. Present
2. Absent

16b. Paint—Exterior (paintext)
1. Present
2. Absent

17. Type—Established (type)
1. Jemez Plain
2. Jemez IBC
3. Other Plain
4. Jemez B/w
5. Vallecitos B/w
6. Glaze Yellow
7. Glaze Red
8. Glaze A
9. Glaze B
10. Glaze C
11. Glaze D
12. Glaze E
13. Glaze F
14. Unknown White Ware
15. Other/Can't Tell

18. Comments (comments) **no code**

19. New Types (Attribute Based)
1. Rio Grande Plain Type A
2. Rio Grande Plain Type B
3. Rio Grande Corrugated
4. Rio Grande Blind Corrugated
5. Kapo Black
6. Other/Unknown Plain
7. Santa Fe Black-on-white
8. Vallecitos Black-on-white
9. Jemez Black-on-white Type A
10. Jemez Black-on-white Type B
11. Jemez Black-on-white Type C
12. Jemez Black-on-white undifferentiated
13. Other Whiteware
14. Unknown Whiteware
15. Glaze A
16. Glaze C-D
17. Glaze E
18. Glaze E-F
19. Glaze F
20. Glaze Late
21. Glaze Yellow Unknown
22. Glaze Red Unknown
23. Tewa Polychrome
24. Puname Polychrome
25. Ogapoge Polychrome
26. Other Type
27. Unknown Type

APPENDIX E

DEFINITION OF PROVISIONAL SHERD TYPES BASED UPON DATA ATTRIBUTES

The resorting of sherds recorded at field houses conducted in Chapter VIII was accomplished by using surface attributes and inferred vessel forms. Combinations of different attribute modes were identified as corresponding to different types, as identified in Tables 7.4 and 7.5. The attributes and modes for each type are listed below. Attributes are listed as abbreviated names that correspond to the data variable names in the Appendix D database; they are also listed on the Appendix C code forms. Attribute modes are listed as code numbers that correspond to the attribute codes used in the Appendix D database and on the Appendix C code forms.

Assignments for the following 10 types were made solely on the presence of different combinations of surface attributes.

1. Rio Grande Plain Type A: treatint < 3 where vesltype = 2, modext = 1, treatext <3, slipint =2, slipext = 2, paintint =2, paintext = 2

2. Rio Grande Plain Type B: treatint = 3 where vesltype = 2, modext = 1, treatext <3, slipint =2, slipext = 2, paintint =2, paintext = 2

3. Rio Grande Corrugated: modext =2, 5 where vesltype = 2, treatext < 3, slipint =2, slipext = 2, paintint =2, paintext = 2

4. Rio Grande Blind Corrugated: modext = 3 where vesltype = 2, treatext < 3, slipint =2, slipext = 2, paintint =2, paintext = 2

5. Kapo Black: treatext = 3 where vesltype = 2, slipint =2, slipext = 2, paintint =2, paintext = 2

7. Santa Fe Black-on-white: slipext = 2 where vesltype = 1, treatext < 3, paintext = 2

8. Vallecitos Black-on-white: slipext = 1 where vesltype = 1, treatext < 3, paintext = 2 AND treatext < 3 where slipext = 1 vesltype = 1, paintext = 2 (two methods)

9. Jemez Black-on-white Type A: treatext = 3 where slipext = 1, vesltype = 1, paintext = 2 AND paintext = 2 where treatext = 3, slipext = 1, vesltype = 1 (two methods)

10. Jemez Black-on-white Type B: paintext = 1 where treatext = 3, slipext = 1, vesltype = 1

12. Jemez Black-on-white Undifferentiated: vesltype = 2 where treatext = 3, slipext = 1, paintext = 1

These types were identified through sorting based on surface attributes, and through the examination of individual records.

6. Other/Unknown Plain: modext = 4, 6 where slipint =2, slipext = 2, paintint =2, paintext = 2 (attribute-based reclassification); (slipint =2 or slipext = 2), (paintint =2 or paintext = 2) where values for interior or exterior surfaces were missing (records check)

14. Unknown Black-on-white: vesltype = 2 where treatext = 3, slipext = 1, paintext = 2 (attribute-based reclassification); (slipint =1 or slipext = 1), (paintint =2 or paintext = 2) where values for interior or exterior surfaces were missing; all others where slipint =1 or slipext = 1 but did not match any of the patterns listed above (including all vesltype = 3) (records check)

These types were identified through records checks only; many were reclassified from other categories (Types 6-13, 15) based on the attribute-based reclassification.

11. Jemez Black-on-white Type C
15. Glaze A
16. Glaze C-D
17. Glaze E
18. Glaze E-F
19. Glaze F
20. Glaze Late
21. Glaze Yellow Unknown
22. Glaze Red Unknown
27. Unknown Type

REFERENCES CITED

Acklen, John C., and Jim A. Railey

1999 *Ancestral Jemez Archaeology: Excavations at Three Field House Sites at Horseshoe Springs, Sandoval County, New Mexico*. TRC Project 23245. Submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwestern Region, Albuquerque.

Adams, E. Charles

1978 The Function of Limited Activity Sites in the Settlement System of the Lower Piedra District, Colorado. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 83-107. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

1989 Homol'ovi III: A Pueblo Hamlet in the Middle Little Colorado River Valley. *Kiva* 54(3):217-230.

1991 *The Origin and Development of the Pueblo Katsina Cult*. University of Arizona Press, Tucson.

1998 Late Prehistory in the Middle Little Colorado River Area, a Regional Perspective. In *Migration and Reorganization: The Pueblo IV Period in the American Southwest*, edited by Katherine A. Spielmann, pp. 53-63. Arizona State University Anthropological Research Papers 51. Tempe.

Adams, E. Charles (editor)

2001 *Homol'ovi III: A Pueblo Hamlet in the Middle Little Colorado River Valley*. Arizona State Museum Archaeological Series 193. University of Arizona, Tucson.

Adams, Eleanor B., and Angelico Chavez (translators and annotators)

1975 *The Missions of New Mexico, 1776 : A Description by Fray Francisco Atanasio Domínguez, with Other Contemporary Documents*. Reprinted. University of New Mexico Press, Albuquerque. Originally published 1956. University of New Mexico Press, Albuquerque.

Adler, Michael A.

1994 Population Aggregation and the Anasazi Social Landscape: A View from the Four Corners. In *The Ancient Southwestern Community: Models and Methods for the Study of Prehistoric Social Organization*, edited by W.H. Wills and Robert D. Leonard, pp. 85-101. University of New Mexico Press, Albuquerque.

1996a Land Tenure, Archaeology, and the Ancestral Pueblo Social Landscape. *Journal of Anthropological Archaeology* 15(2):337-371.

1996b "The Great Period": The Pueblo World During the Pueblo III Period, A.D. 1150 to 1350. In *The Prehistoric Pueblo World, A.D. 1150-1350*, edited by Michael A. Adler, pp. 1-10. University of Arizona Press, Tucson.

Adler, Michael A. (editor)
1996c *The Prehistoric Pueblo World, A.D. 1150-1350*. University of Arizona Press, Tucson.

Adler, Michael A., Todd Van Pool and Robert D. Leonard
1996 Ancestral Pueblo Population Aggregation and Abandonment in the North American Southwest. *Journal of World Prehistory* 10(3):375-438.

Alexander, Hubert G.
1935 The Excavation of "Jemez Cave": A Preliminary Report. *El Palacio* 38(18-20):97-108.

Alexander, Hubert G., and Paul Reiter
1935 *Report the Excavation of Jemez Cave, New Mexico.* University of New Mexico and School of American Research Monograph 1(3). University of New Mexico Press, Albuquerque.

Allen, Craig D.
1989 *Changes in the Landscape of the Jemez Mountains, New Mexico*. Ph.D. dissertation, University of California, Berkeley. University Microfilms, Ann Arbor.

Allen, Craig D., and David D. Breshears
1998 Drought-induced Shift of a Forest-woodland Ecotone: Rapid Landscape Response to Climate Variation. *Proceedings of the National Academy of Sciences* 95:14839-14842.

Allen, Craig D., Ramzi Touchan, and Thomas W. Swetnam
1996 Overview of Fire History in the Jemez Mountains, New Mexico. In *New Mexico Geological Society Guidebook, 47th Field Conference, Jemez Mountains Region*, pp. 35-36. New Mexico Geological Society, Albuquerque.

Anderson, Bruce A.
1990 Site Types. In *The Wupatki Archeological Inventory Survey Project: Final Report*, edited by Bruce A. Anderson, pp. 2-1—2-26. Southwest Cultural Resources Center Professional Paper 35. Division of Anthropology, Southwest Regional Office, US Department of Interior National Park Service, Santa Fe.

Anderson, H. Allen
1985 The Encomienda in New Mexico, 1598-1680. *New Mexico Historical Review* 60(4):353-377.

Anscheutz, Kurt F.
1995 Saving a Rainy Day: The Integration of Diverse Agricultural Technologies to Harvest and Conserve Water in the Lower Rio Chama Valley, New Mexico. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 25-39. New Mexico Archaeological Council Special Publications 2. Albuquerque.

1998 Not Waiting for the Rain: Integrated Systems of Water Management by Pre-Columbian Pueblo Farmers in North-Central New Mexico. Unpublished Ph.D. dissertation, Department of Anthropology, University of Michigan, Ann Arbor.

Arbolino, Risa Diemond
2001 *Agricultural Strategies and Labor Organization: An Ethnohistoric Approach to the Study of Prehistoric Farming Systems in the Taos Area of Northern New Mexico*. Ph.D. dissertation, Southern Methodist University. University Microfilms, Ann Arbor.

Ayer, Mrs. Edward E. (translator), Frederick Webb Hodge and Charles Fletcher Lummis, (annotators)
1916 *The Memorial of Fray Alonso de Benavides, 1630*. Reprinted 1965. Horn and Wallace, Albuquerque.

Bahr, Donald M., Juan Smith, William S. Allison, and Julian Hayden
1994 *The Short Swift Time of Gods on Earth: The Hohokam Chronicles*. University of California Press, Berkeley.

Baker, Brenda J., and Lisa Kealhofer
1996 Assessing the Impact of European Contact on Aboriginal Populations. In *Bioarchaeology of Native American Adaptation in the Spanish Borderlands*, edited by Brenda J. Baker and Lisa Kealhofer, pp. 1-13. University Press of Florida, Gainesville.

Baker, Charles M.
1978 The Size Effect: An Explanation of Variability in Surface Artifact Assemblage Content. *American Antiquity* 43(2):288-293.

Baker, Ele M. and Joe H. Toulouse, Jr.
1937 Giusewa Excavation Notes, Season May – October, 1937. Unpublished Ms. on file, Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

Baker, Larry L., and Stephen R. Durand (editors)
2003 *Prehistory of the Middle Rio Puerco Valley, Sandoval County, New Mexico*. Archaeological Society of New Mexico Special Publication 3. Scopecraeft Press, Portales, New Mexico.

Baldwin, Stuart J.
1984 A Reconsideration of the Dating of a Seventeenth-Century New Mexican Document. *New Mexico Historical Review* 59(4):411-413.

Bandelier, Adolph F.A.
1890-1892 *Final Report of Investigations Among the Indians of the Southwestern United States, Carried on Mainly in the Years from 1880 to 1885*. 2 vols. Archaeological Institute of America American Series Papers 3 and 4. Archaeological Institute of America, Cambridge.

1910 *Documentary History of the Rio Grande Pueblos of New Mexico*. Papers of the School of American Archaeology 13. Santa Fe.

Banks, Larry D.
1990 *From Mountain Peaks to Alligator Stomachs: A Review of Lithic Sources in the Trans-Mississippi South, the Southern Plains, and Adjacent Southwest*. Oklahoma Anthropological Society Memoir 4. Norman.

Barrett, Elinore M.
1997 *The Geography of Rio Grande Pueblos Revealed by Spanish Explorers, 1540-1598*. Latin American Institute Research Paper Series 30. University of New Mexico, Albuquerque.

2002 *Conquest and Catastrophe: Changing Rio Grande Pueblo Settlement Patterns in the Sixteenth and Seventeenth Centuries*. University of New Mexico Press, Albuquerque.

Baugh, Timothy G.
1997 Economy and Obsidian Exchange in the Southwest. In *OLE Volume III: The Analysis*, edited by John C. Acklen, pp. 241-283. Public Service Company of New Mexico, Albuquerque.

Baugh, Timothy G., and Fred W. Nelson, Jr.
1987 New Mexico Obsidian Sources and Exchange on the Southern Plains. *Journal of Field Archaeology* 14(3):313-329.

Bayman, James M., and M. Guadalupe Sanchez
1998 The Surface Archaeology of Classic Period Hohokam Community Organization. In *Surface Archaeology*, edited by Alan P. Sullivan III, pp. 75-88. University of New Mexico Press, Albuquerque.

Beck, Charlotte, and George T. Jones
1994 On-Site Artifact Analysis as an Alternative to Collection. *American Antiquity* 59(2):304-315.

Beers, Henry Putney
1979 *Spanish and Mexican Records of the American Southwest: A Bibliographic Guide to Archive and Manuscript Sources*. University of Arizona Press, Tucson.

Bender, Barbara
1985 Emergent Tribal Formations in the American Midcontinent. *American Antiquity* 50(1):52-62.

Berger, Kathleen A., and Alan P. Sullivan III
1990 When is a Fieldhouse? Interpretations of Seasonal Sites at Wupatki National Monument. Paper Presented at the 55th Annual Meetings of the Society for American Archaeology, Las Vegas.

Berlin, G. Lennis, J. Richard Ambler, Richard H. Hevly, and Gerald G. Schaber
1977 Identification of a Sinagua Agricultural Field by Aerial Thermography, Soil Chemistry, Pollen/Plant Analysis, and Archaeology. *American Antiquity* 42(4):588-600.

Berlin, G. Lennis, David E. Salas and Phil R. Geib
1990 A Prehistoric Sinagua Agricultural Site in the Ashfall Zone of Sunset Crater, Arizona. *Journal of Field Archaeology* 17(1):1-16.

Bernardini, Wesley
1998 Conflict, Migration, and the Social Environment: Interpreting Architectural Change in Early and Late Pueblo IV Aggregations. In *Migration and Reorganization: The Pueblo IV Period in the American Southwest*, edited by Katherine A. Spielmann, pp. 91-114. Arizona State University Anthropological Research Papers 51. Tempe.

Berry, Michael S.
1982 *Time, Space and Transition in Anasazi Prehistory*. University of Utah Press, Salt Lake City.

Betancourt, Julio L., Elizabeth A Pierson, Kate Aasen Rylander, James A. Fairchild-Parks, and Jeffrey S. Dean
1993 Influence of History and Climate on New Mexico Piñon-Juniper Woodlands. In *Managing Piñon-Juniper Ecosystems for Sustainability and Social Needs*, edited by Earl F. Aldon and Douglas W. Shaw, pp. 42-62. USDA, Forest Service, General Technical Report RM-236. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins.

Bice, Richard A., Phyllis S. Davis, and William M. Sundt
1998 *The AS-8 Pueblo and the Cañada de las Milpas: A Pueblo III Complex in North-Central New Mexico*. Albuquerque Archaeological Society, Albuquerque.

Bice, Richard A., and William M. Sundt
1972 *Prieta Vista: A Small Pueblo III Ruin in North-Central New Mexico*. Albuquerque Archaeological Society, Albuquerque.

Biella, Jan V.
1979 Changing Residential Patterns among the Anasazi, A.D. 750-1525. In *Archeological Investigations in Cochiti Reservoir, New Mexico, Volume 4: Adaptive Change in the Northern Rio Grande Valley*, edited by Jan V. Biella and Richard C. Chapman, pp. 103-144. University of New Mexico Office of Contract Archeology, Albuquerque.

Binford, Lewis R.
1978 Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand. *American Antiquity* 43(3):330-361.

1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.

1983 *In Pursuit of the Past: Decoding the Archaeological Record*. Thames and Hudson, New York.

1990 Mobility, Housing, and Environment: A Comparative Study. *Journal of Anthropological Research* 46(2):119-152.

Binford, Lewis R., and Sally R. Binford
1966 A Preliminary Analysis of Functional Variability in the Mousterian of Levallois Facies. *American Anthropologist* New Series 68(2, II):238-295.

Bintliff, John
2000 The Concepts of 'Site' and 'Offsite' Archaeology in Surface Artefact Survey. In *Non Destructive Techniques Applied to Landscape Archaeology*, edited by Marinella Pasquinucci and Frédéric Trément, pp. 200-215. The Archaeology of Mediterranean Landscapes, Vol. 4, Graeme Barker and David Mattingly, general editors, Oxbow Books, Oxford.

Bintliff, John, and Anthony Snodgrass
1988 Off-site Pottery Distributions: A Regional and Interregional Perspective. *Current Anthropology* 29(3):506-513.

Black, Francis L.
1992 Why Did they Die? *Science* 258:1739-1740.

Blake, Michael, Steven A. LeBlanc, and Paul E. Minnis
1986 Changing Settlement and Population in the Mimbres Valley, SW New Mexico. *Journal of Field Archaeology* 13(4):439-464.

Blaklie, Piers, and H.C. Brookfield
1987 *Land Degradation and Society*. Methuen, London.

Blinman, Eric
2000 The Foundations, Practice, and Limitations of Ceramic Dating in the American Southwest. In *It's About Time: A History of Archaeological Dating in North America*, edited by Stephen E. Nash, pp. 41-59. University of Utah Press, Salt Lake City.

Bloom, Lansing
1923 The Jemez expedition of the School, Summer of 1922. *El Palacio* 14(2):15-20.

Bloom, Lansing B., and Lynn B. Mitchell
1938 The Chapter Elections in 1672. *New Mexico Historical Review* 13(1):85-109.

Borah, Woodrow W.
1964 America as Model: The Demographic Impact of European Expansion upon the Non-European World. In *Actas y Memorias XXXV Congreso Internacional de Americanistas*, pp. 379-387. 3 vols. Editorial Libros de Mexico, Mexico D.F.

1976 The Historical Demography of Aboriginal and Colonial America: An Attempt at Perspective. In *The Native Population of the Americas in 1492*, edited by William M. Denevan, pp. 13-34. University of Wisconsin Press, Madison.

Borah, Woodrow W., and Sherburne F. Cook
1960 *The Population of Central Mexico in 1548: An Analysis of the Suma de Vistas de Pueblos*. University of California Publications Ibero-Americana 43. University of California Press, Berkeley.

Bohrer, Vorsila L.
1960 Zuni Agriculture. *El Palacio* 67(6):188-202.

1982 Appendix A: One Step in the Search for Pueblo Fields on Mesita del Buey. In *Pajarito Plateau Archaeological Surveys and Excavations, II*, by Charlie R. Steen, pp. 57-59. Los Alamos National Laboratory, Los Alamos.

Boone, James L.
2002 Subsistence Strategies and Early Human Population History: An Evolutionary Ecological Perspective. *World Archaeology* 34(1):6-25.

Boserup, Ester
1965 *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. Aldine, Hawthorne.

1981 *Population and Technological Change: A Study of Long-Term Trends*. University of Chicago Press, Chicago.

Boyer, W.W., and Peter Robinson
1956 Obsidian Artifacts of Northwestern New Mexico and their Correlation with Source Material. *El Palacio* 63(11-12):333-345.

Bradfield, Maitland
1971 *The Changing Pattern of Hopi Agriculture*. Royal Anthropological Institute of Great Britain and Ireland Occasional Paper 30. London.

Bradley, Bruce A.
1996 Pitchers to Mugs: Chacoan Revival at Sand Canyon Pueblo. *Kiva* 61(3):241-255.

Brandt, Elizabeth A.
2002 The Climate for Ethnographic/Ethnohistoric Research in the Southwest. In *Traditions, Transitions and Technologies: Themes in Southwestern Archaeology*, edited by Sarah H. Schlanger, pp. 113-126. University Press of Colorado, Boulder.

Bremer, J. Michael
1989 *Walnut Canyon: Settlement and Land Use*. The Arizona Archaeologist 23. Arizona Archaeological Society, Phoenix.

Brookfield, H.C.
1972 Intensification and Disintensification in Pacific Agriculture: A Theoretical Approach. *Pacific Viewpoint* 13(1):30-48.

Broughton, William H.
1993 The History of Seventeenth-Century New Mexico: Is it Time for New Interpretations? *New Mexico Historical Review* 68(1):3-12.

Brown, Paula, and Aaron Podolefsky
1976 Population Density, Agricultural Intensity, Land Tenure and Group Size in the New Guinea Highlands. *Ethnology* 15(3):211-238.

Brugge, David M.
2002 Jemez Pueblo and the Navajos: Relations Prior to 1800. In *Forward into the Past: Papers in Honor of Teddy Lou and Francis Stickney*, edited by Regge N. Wiseman, Thomas C. O'Laughlin and Cordelia T. Snow, pp. 5-16. Papers of the Archaeological Society of New Mexico 28. Albuquerque.

Buge, David E.
1984 Prehistoric Subsistence Strategies in the Ojo Caliente Valley, New Mexico. In *Prehistoric Agricultural Strategies in the Southwest*, edited by Suzanne K. Fish and Paul R. Fish, pp. 27-34. Arizona State University Anthropological Papers 33. Tempe.

Bull, I.D., I.A. Simpson, P.F. van Bergen, and R.P. Evershed
1999 Muck 'n' Molecules: Organic Geochemical Methods for Detecting Ancient Manuring. *Antiquity* 73(279):86-96.

Burnett, Barbara A.
1993 Adaptive Efficiency of Arkansas Populations. In *Caddoan Saltmakers in the Ouachita Valley: The Hardman Site*, edited by Ann M. Early, pp. 187-222. Arkansas Archeological Survey Research Series 43. Arkansas Archeological Survey, Fayetteville.

Butler, William B.
1979 The No-Collection Strategy in Archaeology. *American Antiquity* 44(4):795-799.

Cameron, Catherine M.
1991 Structure Abandonment in Villages. In *Archaeological Method and Theory, Volume 3*, edited by Michael B. Schiffer, pp. 155-194. University of Arizona Press, Tucson.

1995 Migration and the Movement of Southwestern Peoples. *Journal of Anthropological Archaeology* 14(2):104-124.

1999 *Hopi Dwellings: Architectural Change at Orayvi*. University of Arizona Press, Tucson.

Cameron, Catherine M., and S. A. Tomka
1993 *The Abandonment of Settlements and Regions: Ethnoarchaeological and Archaeological Approaches*. Cambridge University Press, Cambridge.

Camilli, Eileen L., James I. Ebert
1992 Aritfact Reuse and Recycling in Continuous Surface Distributions and Implications for Interpreting Land Use Patterns. In *Space, Time and Archaeological Landscapes*, edited by Jacqueline Rossignol and LuAnn Wandsnider, pp. 113-136. Plenum Press, New York.

Campbell, Sarah K.
1990 *PostColumbian Culture History in the Northern Columbia Plateau A.D. 1500-1900*. Garland, New York.

Church, Fermor S., and John T. Hack
1939 An Exhumed Erosion Surface in the Jemez Mountains, New Mexico. *Journal of Geology* 47(6):613-629.

Clark, Jeffery J.
2001 *Tracking Prehistoric Migrations: Pueblo Settlers among the Tonto Basin Hohokam*. University of Arizona Anthropological Papers 65. University of Arizona Press, Tucson.

Clary, Karen H.
1983 Appendix V: The NMAP Farm-Field Pollen Study. *In Economy and Interaction Along the Lower Chaco River: The Navajo Mine Archeological Program, Mining Area III, San Juan County, New Mexico*, edited by Patrick Hogan and Joseph C. Winter, pp. 607-608. Office of Contract Archeology and Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

1987 *Pollen Evidence for the Agricultural Utilization of Late Classic Period (A.D. 1350-1500) Puebloan Gravel Mulch Terrace Gardens, the Rio Chama, in the Vicinity of Medanales, New Mexico*. Castetter Laboratory for Ethnobotanical Studies Technical Series Report 198. Castetter Laboratory, Department of Biology, University of New Mexico, Albuquerque.

Cohen, Mark N.
1977 *The Food Crisis in Prehistory: Overpopulation and the Origins of Agriculture*. Yale University Press, New Haven.

Colton, Harold S.
1960 *Black Sand: Prehistory in Northern Arizona*. University of New Mexico Press, Albuquerque.

Conkey, Margaret W.
1980 The Identification of Prehistoric Hunter-Gatherer Aggregation Sites: The Case of Altamira. *Current Anthropology* 21(5):609-630.

Cook, Noble David
1998 *Born to Die: Disease and New World Conquest, 1492-1650*. Cambridge University Press, New York.

Cook, Sherburne F.
1972 *Prehistoric Demography*. McCaleb Module in Anthropology 16. Addison-Welsey Modular Publications, Reading.

1976 *The Population of the California Indians, 1769-1970*. University of California Press, Berkeley.

Cook, Sherburne F., and Woodrow W. Borah
1960 *The Indian Population of Central Mexico, 1531-1610*. University of California Publications Ibero-Americana 44. University of California Press, Berkeley.

1963 *The Aboriginal Population of Central Mexico on the Eve of the Spanish Conquest*. University of California Publications Ibero-Americana 45. University of California Press, Berkeley.

1971 *Essays in Population History: Mexico and the Caribbean, Volume One*. University of California Press, Berkeley.

Cook, Sherburne F., and Robert F. Heizer
1968 Relationships among Houses, Settlement Areas, and Population in Aboriginal California. In *Settlement Archaeology*, edited by K.C. Chang, pp. 79-116. National Press, Palo Alto, California.

Cook, Sherburne F., and Lesley Byrd Simpson
1948 *The Population of Central Mexico in the Sixteenth Century*. University of California Publications Ibero-Americana 31. University of California Press, Berkeley.

Cordell, Linda S.
1985 Status Differentiation and Social Complexity in the Prehistoric Southwest: A Discussion. In *Status, Structure and Stratification: Current Archaeological Reconstructions*, edited by Marc Thompson, Maria Teresa Garcia and Francois J. Kense, pp. 191-195. Proceedings of the 16th Annual Chacmool Conference, University of Calgary, Calgary.

1989 Northern and Central Rio Grande. In *Dynamics of Southwest Prehistory*, edited by Linda S. Cordell and George J. Gumerman, pp. 293-335. Smithsonian Institution Press, Washington D.C.

1994 Introduction: Community Dynamics of Population Aggregation in the Prehistoric Southwest. In *The Ancient Southwestern Community: Models and Methods for the Study of Prehistoric Social Organization*, edited by W.H. Wills and Robert D. Leonard, pp. 79-83. University of New Mexico Press, Albuquerque.

1995 Tracing Migration Pathways from the Receiving End. *Journal of Anthropological Archaeology* 14(2):203-211.

1996 Big Sites, Big Questions: Pueblos in Transition. In *The Prehistoric Pueblo World, A.D. 1150-1350*, edited by Michael A. Adler, pp. 228-240. University of Arizona Press, Tucson.

1997 *Archaeology of the Southwest*. Second edition. Academic Press, San Diego.

Cordell, Linda S., David E. Doyel and Keith W. Kintigh
1994 Processes of Aggregation in the Prehistoric Southwest. In *Themes in Southwest Prehistory*, edited by George J. Gumerman, pp. 109-133. School of American Research Press, Santa Fe.

Cordell, Linda S., Amy C. Earls, and Martha R. Binford
1984 Subsistence Systems in the Mountainous Settings of the Rio Grande Valley. In *Prehistoric Agricultural Strategies in the Southwest*, edited by Suzanne K. Fish and Paul R. Fish, pp. 233-241. Arizona State University Anthropological Papers 33. Tempe.

Cordell, Linda S., and George J. Gumerman
1989 Cultural Interaction in the Prehistoric Southwest. In *Dynamics of Southwest Prehistory*, edited by Linda S. Cordell and George J. Gumerman, pp. 1-17. Smithsonian Institution Press, Washington D.C.

Cordell, Linda S., and Fred Plog
1979 Escaping the Confines of Normative Thought: A Reevaluation of Puebloan Prehistory. *American Antiquity* 44(3):405-429.

Cordell, Linda S., Steadman Upham, and Sharon L. Brock
1987 Obscuring Cultural Patterns in the Archaeological Record: A Discussion from Southwestern Archaeology. *American Antiquity* 52(3):565-577.

Corruccini, Robert S.
1972 The Biological Relationships of Some Prehistoric and Historic Pueblo Populations. *American Journal of Physical Anthropology* 37(3):373-388.

Costello, Julia, and Phillip L. Walker
1987 Burials from the Santa Barbara Presidio Chapel. *Historical Archaeology* 21(1):3-17.

Covington, W. Wallace, and Margaret M. Moore
1994 Southwestern Ponderosa Pine Forest and Structure and Resource Conditions: Changes Since Euro-American Settlement. *Journal of Forestry* 92(1):39-47.

Covington, W. Wallace, and Leonard F. DeBano
1990 Effects of Fire on Pinyon-Juniper Soils. In *Effects of Fire Management of Southwestern Natural Resources: Proceedings of the Symposium, November 15-17, 1988, Tucson, AZ* , edited by J.S. Krammes, pp. 78-86. USDA, Forest Service General Technical Report RM-191. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins.

Christenson, Andrew L.
1994 A Test of Mean Ceramic Dating Using Well-Dated Kayenta Anasazi Sites. *Kiva* 59(3):297-317.

Cronon, William
1983 *Changes in the Land: Indians, Colonists and the Ecology of New England*. Hill and Wang, New York.

Crosby, Alfred W., Jr.
1967 Conquistador y Pestilencia: The First New World Pandemic and the Fall of the Great Indian Empires. *Hispanic American Historical Review* 47(3):321-327.

1972 *The Columbian Exchange: Biological and Cultural Consequences of 1492*. Greenwood, Westport, Connecticut.

1986 *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*. Cambridge University Press, Cambridge.

Crown, Patricia L.
1983 Field Houses and Farmsteads in South-central Arizona. In *Hohokam Archaeology along the Salt-Gila Aqueduct Central Arizona Project, Volume V: Small Habitation Sites on Queen Creek*, edited by Lynn S. Teague and Patricia L. Crown, pp. 3-22. Arizona State Museum Archaeological Series 150. University of Arizona, Tucson.

1991 Evaluating the Construction Sequence and Population of Pot Creek Pueblo, Northern New Mexico. *American Antiquity* 56(2):291-314.

Crown, Patricia L., Janet D. Orcutt, and Timothy A. Kohler
1996 Pueblo Cultures in Transition: The Northern Rio Grande. In *The Prehistoric Pueblo World, 1150-1300*, edited by Michael A. Adler, pp. 188-204. University of Arizona Press, Tucson.

Cushing, Frank Hamilton
1920 *Zuni Breadstuff*. Indian Notes and Monographs 8. Museum of the American Indian, Heye Foundation, New York.

Damp, Johnathan E., Stephen A. Hall, and Susan J. Smith
Early Irrigation on the Colorado Plateau near Zuni Pueblo, New Mexico. *American Antiquity* 67(4):665-676.

D'Arrigo, Rosanne D., and Gordon C. Jacoby
1991 A 1000-year Record of Winter Precipitation from Northwestern New Mexico, USA: A Reconstruction from Tree-rings and its Relation to El Niño and the Southern Oscillation. *The Holocene* 1(2):95-101.

Davis, Emma Lou, and James H. Winkler
1959 A Late Mesa Verde Site in the Rio Puerco Valley. *El Palacio* 66(2):73-84.

Davis, R.P. Stephen Jr.
2002 The Cultural Landscape of the North Carolina Piedmont at Contact. In *The Transformation of the Southeastern Indians, 1540-1760*, edited by Robbie Ethridge and Charles Hudson, pp. 135-154. University Press of Mississippi, Jackson.

Dean, Glenna
1995 In Search of the Rare: Pollen Evidence of Prehistoric Agriculture. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 353-359. New Mexico Archaeological Council Special Publications 2. Albuquerque.

Dean, Jeffrey S.
1991 Thoughts on Hohokam Chronology. In *Exploring the Hohokam: Prehistoric Desert Peoples of the American Southwest*, edited by George J. Gumerman, pp. 61-150. University of New Mexico Press, Albuquerque.

1994 The Medieval Warm Period on the Southern Colorado Plateau. *Climatic Change* 26(2):225-241.

Dean, Jeffrey S., William H. Doelle, and Janet D. Orcutt
1994 Adaptive Stress: Environment and Demography. In *Themes in Southwest Prehistory*, edited by George J. Gumerman, pp. 53-86. School of American Research Press, Santa Fe.

Dean, Jeffery S., and Alexander J. Lindsay, Jr.
1978 Special Use Sites in Long House Valley, Northeastern Arizonza: An Analysis of the Southwestern Anthropological Research Group File. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 109-117. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

Dean, Jeffrey S., and John C. Ravesloot
1993 The Chronology of Cultural Interaction in the Gran Chichimeca. In *Culture and Contact: Charles C. DiPeso's Gran Chichimeca*, edited by Anne I. Woosley and John C. Ravesloot, pp. 83-103. University of New Mexico Press, Albuquerque.

de Montmollin, Olivier
1989 Land Tenure and Politics in the Late/Terminal Classic Rosario Valley, Chiapas, Mexico. *Journal of Anthropological Research* 45(3):293-314.

Denevan, William M.
1992 Native American Populations in 1492: Recent Research and a Revised Hemispheric Estimate. In *The Native Population of the Americas in 1492*, second edition, edited by William Denevan, pp. xxvii-xxxviii. University of Wisconsin Press, Madison.

2001 *Cultivated Landscapes of Native Amazonia and the Andes*. Oxford University Press, Oxford.

Diamond, Jared
1997 *Guns, Germs and Steel: The Fates of Human Societies*. W.W. Norton, New York.

Dick-Peddie, William A.
1993 *New Mexico Vegetation: Past, Present and Future*. University of New Mexico Press, Albuquerque.

Diehl, Michael W.
1992 Architecture as a Material Correlate of Mobility Strategies: Some Implications for Archeological Interpretation. *Behavior Science Research* 26(1-4):1-35.

1997 Changes in Architecture and Land Use Strategies in the American Southwest: Upland Mogollon Pithouse Dwellers, A.C. 200-1000. *Journal of Field Archaeology* 24(2):179-194.

Diehl, Michael, and Patricia A. Gilman
1996 Implications from the Designs of Different Southwestern Architectural Forms. In *Interpreting Southwestern Diversity: Underlying Principles and Overarching Patterns*, edited by Paul R. Fish and J. Jefferson Reid, pp. 189-193. Arizona State University Anthropological Research Papers 48. Tempe.

Dillehay, Tom D., Patricia J. Netherly, and Jack Rossen
1989 Middle Preceramic Public and Residential Sites on the Forested Slope of the Western Andes, Northern Peru. *American Antiquity* 54(4):733-759.

Dittert, Alfred E., Jr.
1968 Some Factors Affecting Southwestern Populations during the Period A.D. 900-1540. In *Contributions to Southwestern Prehistory, Volume 4: Proceedings, VII Congress, International Association for Quaternary Research*, edited by Cynthia Irwin-Williams, pp. 14-16. Eastern New Mexico University Contributions in Anthropology 1(1). Eastern New Mexico University Press, Portales.

Dobyns, Henry F.
1963a An Outline of Andean Epidemic History to 1720. *Bulletin of the History of Medicine* 37(6):493-515.

1963b Indian Extinction in the Middle Santa Cruz River Valley. *New Mexico Historical Review* 38(2):163-181.

1966 Estimating Aboriginal American Population: An Appraisal of Techniques with a New Hemispheric Estimate. *Current Anthropology* 7(4):395-416.

1981 *From Fire to Flood : Historic Human Destruction of Sonoran Desert Riverine Oases*. Ballena Press Anthropological Paper 20. Ballena Press, Socorro.

1983 *Their Number Become Thinned: Native American Population Dynamics in Eastern North America*. University of Tennessee Press, Knoxville.

1989 Native Historic Epidemiology in the Greater Southwest. *American Anthropologist* 91(1):171-174.

1990 Prehistoric to Historic Transitions: Chronological Considerations. *In Perspectives on Southwest Prehistory*, edited by Paul E. Minnis and Charles L. Redman, pp. 301-307. Westview Press, Boulder.

1991 Native New World: Links between Demographic and Cultural Changes. In *Columbian Consequences, Volume 3: The Spanish Borderlands in Pan-American Perspective*, edited by David Hurst Thomas, pp. 541-559. Smithsonian Institution Press, Washington D.C.

1992 Native American Trade Centers as Disease Foci. In *Disease and Demography in the Americas*, edited by John W. Verano and Douglas H. Ubelaker, pp. 215-222. Smithsonian Institution Press, Washington D.C.

1993 Disease Transfer at Contact. *Annual Review of Anthropology* 22:273-291.

Dodge, William A.

1982 *Archeological Investigations at Jemez Pueblo, New Mexico: Monitoring of Indian Health Service Waterline Trenches*. University of New Mexico Office of Contract Archaeology, Albuquerque.

Dohm, Karen

1990 Effect of Population Nucleation on House Size for Pueblos in the American Southwest. *Journal of Anthropological Archaeology* 9(3):201-239.

Dominguez, Steven

2002 Optimal Gardening Strategies: Maximizing the Input and Retention of Water in Prehistoric Gridded Fields in North Central New Mexico. *World Archaeology* 34(1):131-163.

Doolittle, William E.

1980 Aboriginal Agricultural Development in the Valley of Sonora, Mexico. *Geographical Review* 70(3):328-342.

1985 The Use of Check Dams for Protecting Downstream Agricultural Lands in the Prehistoric Southwest: A Contextual Analysis. *Journal of Anthropological Research* 41(3):279-305.

1988 *Pre-Hispanic Occupance in the Valley of Sonora, Mexico: Archaeological Confirmation of Early Spanish Reports*. University of Arizona Anthropological Papers 48. University of Arizona Press, Tucson.

1990 *Canal Irrigation in Prehistoric Mexico: The Sequence of Technological Change*. University of Texas Press, Austin.

1992 House-Lot Gardens in the Gran Chichimeca: Ethnographic Cause for Archaeological Concern. In *Gardens of Prehistory: The Archaeology of Settlement Agriculture in Greater Mesoamerica*, edited by Thomas W. Killion, pp. 69-91. University of Alabama Press, Tuscaloosa.

2000 *Cultivated Landscapes of Native North America*. Oxford University Press, Oxford.

Doolittle, William E., James A. Neely, and Michael D. Pool

1993 A Method for Distinguishing Between Prehistoric and Recent Water and Soil Control Features. *Kiva* 59(1):7-26.

Dongoske, Kurt E., Michael Yeatts, Roger Anyon, and T.J. Ferguson

1997 Archaeological Cultures and Cultural Affiliation: Hopi and Zuni Perspectives in the American Southwest. *American Antiquity* 62(4):600-608.

Donkin, R.A.

1979 *Agricultural Terracing in the Aboriginal New World*. University of Arizona Press, Tucson.

Downum, Christian E., Gregory Burrell Brown

1998 The Reliability of Surface Artifact Assemblages as Predictors of Subsurface Remains. In *Surface Archaeology*, edited by Alan P. Sullivan III, pp. 111-123. University of New Mexico Press, Albuquerque.

Downum, Christian E., and Alan P. Sullivan III

1990 Settlement Patterns. In *The Wupatki Archeological Inventory Survey Project: Final Report*, edited by Bruce A. Anderson, pp. 5-1—5-90. Southwest Cultural Resources Center Professional Paper 35. Division of Anthropology, Southwest Regional Office, US Department of Interior National Park Service, Santa Fe.

Dozier, Edward P.
1960 The Pueblos of the South-Western United States. *Journal of the Royal Anthropological Institute of Great Britain and Ireland* 90(1):146-160.

1970 *The Pueblo Indians of North America*. Holt, Reinhart and Winston, New York.

Drakos, Paul G., Jay Lazarus, and Christopher Inoué
1996 Holocene Evolution of Canyons and Implications for Contaminant Transport, Pajarito Plateau. In *New Mexico Geological Society Guidebook, 47th Field Conference, Jemez Mountains Region*, pp. 399-406. New Mexico Geological Society, Albuquerque.

Drennan, Robert D.
1988 Household Location and Compact Versus Dispersed Settlement in Prehispanic Mesoamerica. In *Household and Community in the Mesoamerican Past*, edited by Richard R. Wilk and Wendy Ashmore, pp. 273-293. University of New Mexico Press, Albuquerque.

Drèze, Jean, and Amartya Sen
1989 *Hunger and Public Action*. Clarendon Press, Oxford.

Dublin, Susan Ann
1998 Frontier Landscapes, Residential Mobility and the Archaeology of Place at Lower Pescado Village, Zuni, N.M. Unpublished Ph.D. dissertation, Department of Anthropology, Columbia University, New York.

Dunnell, Robert C.
1971 *Systematics in Prehistory*. The Free Press, New York.

1989 Diversity in Archaeology: A Group of Measures in Search of Application? In *Quantifying Diversity in Archaeology*, edited by Robert D. Leonard and George T. Jones, pp. 142-149. Cambridge University Press, Cambridge.

1992 Methodological Impacts of Catastrophic Depopulation on American Archaeology and Ethnology. In *Columbian Consequences, Volume 3: The Spanish Borderlands in Pan-American Perspective*, edited by David Hurst Thomas, pp. 561-580. Smithsonian Institution Press, Washington D.C.

1995 Artifact Size and Plowzone Process. *Journal of Field Archaeology* 22(3):305-319.

Dunnell, Robert C., and William S. Dancey
1983 The Siteless Survey: A Regional Scale Data Collection Strategy. In *Advances in Archaeological Method and Theory, Volume 6*, edited by Michael B. Schiffer, pp. 267-287. Academic Press, New York.

Dunning, Nicholas P., and Timothy Beach
1994 Soil Erosion, Slope Management, and Ancient Terracing in the Maya Lowlands. *Latin American Antiquity* 5(1):51-69.

Duff, Andrew I.
1998 The Process of Migration in the Late Prehistoric Southwest. In *Migration and Reorganization: The Pueblo IV Period in the American Southwest*, edited by Katherine A. Spielmann, pp. 31-52. Arizona State University Anthropological Papers 51. Tempe.

2002 *Western Pueblo Identities: Regional Interaction, Migration, and Transformation*. University of Arizona Press, Tucson.

Duff, Andrew I., and Richard H. Wilshusen
2000 Prehistoric Population Dynamics in the Northern San Juan Region, A.D. 950-1300. *Kiva* 66(1):167-190.

Dye, David H.
2002 Warfare in the Protohistoric Southeast: 1500-1700. In *Between Contacts and Colonies: Archaeological Perspectives on the Protohistoric Southeast*, edited by Cameron B. Wesson and Mark A. Rees, pp. 126-141. University of Alabama Press, Tuscaloosa.

Ebert, James I.
1992 *Distributional Archaeology*. University of New Mexico Press, Albuquerque.

Echo-Hawk, Roger C.
2000 Ancient History in the New World: Integrating Oral Traditions and the Archaeological Record in Deep Time. *American Antiquity* 65(2):267-290.

Eder, James F.
1984 The Impact of Subsistence Change on Mobility and Settlement Pattern in a Tropical Forest Foraging Economy: Some Implications for Archeology. *American Anthropologist* new series 86(4):837-853.

Earls, Amy C.
1985 The Organization of Piro Pueblo Subsistence, A.D. 1300 to 1680. Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

1987 *An Archaeological Assessment of "Las Huertas," Socorro, New Mexico*. Papers of the Maxwell Museum of Anthropology 3. Maxwell Museum of Anthropology, Albuquerque.

1992 Raiding, Trading and Population Reduction among the Piro Pueblos, A.D. 1540-1680. In *Current Research on the Late Prehistory and Early History of New Mexico*, edited by Bradley J. Vierra, pp. 11-19. New Mexico Archaeological Council Special Publication 1. Albuquerque.

Eggan, Fred R.
1950 *Social Organization of the Western Pueblos*. University of Chicago Press, Chicago.

1979 Pueblos: Introduction. In *Southwest*, edited by Alfonso Ortiz, pp. 224-235. Handbook of North American Indians, Vol. 9, William C. Sturtevant, general editor, Smithsonian Institution, Washington D.C.

Elliott, Michael L.
1982 *Large Pueblo Sites Near Jemez Springs, New Mexico*. Cultural Resources Report 3. Santa Fe National Forest, Santa Fe.

1991 *The Jemez Falls Campground Project: Archeological Investigations at Four Small Sites in the Jemez Mountains, New Mexico*. Jemez Mountains Research Center. Submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwest Region, Albuquerque.

1993 *New Mexico State Monument: Jèmez*. Museum of New Mexico Press, Santa Fe.

1994 Jemez Area Ceramics. Manuscript on file, USDA, Forest Service, Santa Fe National Forest, Santa Fe.

1998 Coalition Period Adaptations in the Jemez Region: Origins of the Jemez Phenomenon. Paper presented at the 63rd Annual Meeting of the Society for American Archaeology, Seattle.

2002a Mission and Mesa: Some Thoughts on the Archaeology of Pueblo Revolt Era Sites in the Jemez Region, New Mexico. In *Archaeologies of the Pueblo Revolt: Identity, Meaning and Renewal in the Pueblo World*, edited by Robert W. Preucel, pp. 45-60. University of New Mexico Press, Albuquerque.

2002b *Lower Virgin Mesa Heritage Resources Inventory, Jemez Ranger District, Santa Fe National Forest*. Submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwestern Region, Albuquerque.

Elliott, Michael L., Sandra L. Marshall, and J. Andrew Darling

1988 *Archeological Investigations at Small Sites in the Jemez Mountains, New Mexico*. Cultural Resources Report 6. Santa Fe National Forest, Santa Fe.

Ellis, Florence Hawley

1956 *Anthropology Evidence Supporting the Land Claims of the Pueblos of Zia, Santa Ana and Jemez: 1956*. Native American Bilingual Teacher Education Program, University of Albuquerque, Albuquerque.

1966 Pueblo Boundaries and their Markers. *Plateau* 38(4):97-106.

1974a Anthropological Data Pertaining to the Taos Land Claim. In *American Indian Ethnohistory, Indians of the Southwest: Pueblo Indians I*, edited and compiled by David Agee Horr, pp. 29-150. Garland, New York.

1974b Archaeologic and Ethnologic Data Pertaining to the Acoma and Laguna Land Claims, 1958-1959. In *American Indian Ethnohistory, Indians of the Southwest: Pueblo Indians II*, edited and compiled by David Agee Horr, pp. 9-330. Garland, New York.

1974c Anthropology of Laguna Pueblo Land Claims. In *American Indian Ethnohistory, Indians of the Southwest: Pueblo Indians III*, edited and compiled by David Agee Horr, pp. 9-120. Garland, New York.

1978 Small Structures Used by Historic Pueblo Peoples and their Immediate Ancestors. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 59-68. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

Ellis, Florence H., and Andrea Ellis Dodge

1989a Water and Solar Engineering in the Rio Grande Drainage: Fourteenth-Nineteenth Centuries. In *From Chaco to Chaco: Papers in Honor of Robert H. Lister and Florence C. Lister*, edited by Meliha S. Duran and David T. Kirkpatrick, pp. 35-44. Papers of the Archaeological Society of New Mexico 15. Albuquerque.

1989b The Spread of Chaco/Mesa Verde/McElmo Black-on-white Pottery and the Possible Simultaneous Introduction of Irrigation into the Rio Grande Drainage. *Journal of Anthropological Research* 45(1):47-52.

Elmore, Francis H.

1936 Excavation at Giusewa Pueblo, Jemez Springs, N. Mex., September 1936 – October 1936. Manuscript. on file, Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

Ensey, Michelle M.
1997 The Late Holocene Environment of the Jemez Mountains, New Mexico. Unpublished M.A. thesis, Department of Anthropology, Washington State University, Pullman, Washington.

Espinosa, J. Manuel (editor and translator)
1940 *First Expedition of Vargas into New Mexico, 1692*. University of New Mexico Press, Albuquerque.

1988 *The Pueblo Revolt of 1696 and the Franciscan Missions in New Mexico: Letters of the Missionaries and Related Documents*. University of Oklahoma Press, Norman.

Euler, Robert C.
1988 Demography and Cultural Dynamics on the Colorado Plateaus. In *The Anasazi in a Changing Environment*, edited by George J. Gumerman, pp. 192-229. Cambridge University Press, Cambridge.

Evans, Susan T.
1990 The Productivity of Maguey Terrace Agriculture in Central Mexico during the Aztec Period. *Latin American Antiquity* 1(2):117-132.

Ezzo, Joseph A., Clark M. Johnson, and T. Douglas Price
1997 Analytical Perspectives on Prehistoric Migration: A Case Study from East-Central Arizona. *Journal of Archaeological Science* 24:447-466.

Fallon, Denise, and Karen Wening
1987 *Howiri: Excavation at a Northern Rio Grande Biscuit Ware Site*. Laboratory of Anthropology Note 261b. Museum of New Mexico, Laboratory of Anthropology Research Section, Santa Fe.

Farrington, I.S.
1985 The Wet, the Dry and the Steep: Archaeological Imperatives and the Study of Agricultural Intensification. In *Prehistoric Intensive Agriculture in the Tropics*, Volume 1, edited by I.S. Farrington, pp. 1-9. BAR International Series 232. Oxford.

Feinman, Gary M.
1997 Thoughts on New Approaches to Combining the Archaeological and Historical Records. *Journal of Archaeological Method and Theory* 4(3-4):367-377.

Feinman, Gary M., Kent G. Lightfoot, and Steadman Upham
2000 Political Hierarchies and Organizational Strategies in the Puebloan Southwest. *American Antiquity* 65(3):449-470.

Ferguson, Cheryl
1980 The Analysis of Skeletal Remains. In *Tijeras Canyon: Analyses of the Past*, edited by Linda S. Cordell, pp. 121-148. Maxwell Museum of Anthropology and University of New Mexico Press, Albuquerque.

Fewkes, Jesse Walter
1896 The Prehistoric Culture of Tusayan. *American Anthropologist* 9(5):21-173.

1900 Tusayan Migration Traditions. In *Nineteenth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution*, part. 2, edited by John Wesley Powell, pp. 573-633. U.S. Government Printing Office, Washington, D.C.

Findlow, Frank J. and Marisa Bolognese
1982 Regional Modeling of Obsidian Procurement in the American Southwest. In *Contexts for Prehistoric Exchange*, edited by Jonathan E. Ericson and Timothy K. Earle, pp. 53-81. Academic Press, New York.

Fine-Dare, Kathleen S.
2002 *Grave Injustice: The American Indian Repatriation Movement and NAGPRA*. University of Nebraska Press, Lincoln.

Fish, Paul R., Suzanne K. Fish, George J. Gumerman, and J. Jefferson Reid
1994 Toward an Explanation for Southwestern "Abandonments." In *Themes in Southwest Prehistory*, edited by George J. Gumerman, pp. 136-163. School of American Research Press, Santa Fe.

Fish, Suzanne K.
1983 Pollen Studies from Agricultural Features. In *Hohokam Archaeology Along the Salt-Gila Aqueduct, Central Arizona Project, Volume III: Specialized Activity Sites*, edited by Lynn S. Teague and Patricia L. Crown, pp. 575-604. Arizona State Museum Archaeological Series 150. University of Arizona, Tucson.

1994 Archaeological Palynology of Gardens and Fields. In *The Archaeology of Garden and Field*, edited by Naomi F. Miller and Kathryn L. Gleason, pp. 44-69. University of Pennsylvania Press, Philadelphia.

Fisher, Reginald G.
1930 *The Archaeological Survey of the Pueblo Plateau: Report of the State Archaeological Survey of New Mexico*. University of New Mexico Anthropological Series 1(1). University of New Mexico Press, Albuquerque.

1931 *The Archaeological Survey of the Pueblo Plateau : Santa Fe Sub-Quadrangle A* . University of New Mexico Survey Series 1(1). University of New Mexico Press, Albuquerque.

Fliedner, Dietrich
1974 *Der Aufbau de Vorspanishchen Siedlungs- und Wirtschaftslandschaft im Kulturraum der Pueblo-Indianer: Eine Historisch-Geographische Interpretation Wüstegfallener Ortsstellen und Feldflächen im Jemez-Gebiet, New Mexico (USA)*. Arbeiten aus dem Geographischen Institut der Universität des Saarlandes 19. Selbstverlag des Geographischen Instituts des Universität des Saarlandes, Saarbrücken.

1975 Pre-Spanish Pueblos in New Mexico. *Annals of the Association of American Geographers* 65(3):363-377.

1981 *Society in Space and Time: An Attempt to Provide a Theoretical Foundation from an Historical Geographic Point of View*. Arbeiten aus dem Geographischen Institut der Universität des Saarlandes 20. Selbstverlag des Geographischen Instituts des Universität des Saarlandes, Saarbrücken.

Flint, Richard
1997 "Armas de Tierra": The Mexican Indian Component of Coronado Expedition Material Culture. In *The Coronado Expedition to Tierra Nueva: The 1540-1542 Route Across the Southwest*, edited by Richard Flint and Shirley Cushing Flint, pp. 57-70. University of Colorado Press, Niwot, Colorado.

2002 *Great Cruelties Have Been Reported: The 1544 Investigation of the Coronado Expedition*. Southern Methodist University Press, Dallas.

Flint, Richard, and Shirley Cushing Flint (editors)
1997 *The Coronado Expedition to Tierra Nueva: The 1540-1542 Route Across the Southwest*. University of Colorado Press, Niwot.

2003 *The Coronado Expedition : From the Distance of 460 Years*. University of New Mexico Press, Albuquerque.

Ford, Richard I.
1977 The Technology of Irrigation in a New Mexico Pueblo. In *Material Culture: Styles, Organization and Dynamics of Technology*, edited by Heather Lechtman and Robert S. Merrill, pp. 139-154. 1975 Proceedings of the American Ethnological Society. West, St. Paul.

Ford, Richard I., Albert H. Schroeder, and Stewart L. Peckham
1972 Three Perspectives on Puebloan Prehistory. In *New Perspectives on the Pueblos*, edited by Alfonso Ortiz, pp. 22-40. University of New Mexico Press, Albuquerque.

Forde, C. Daryll
1931 Hopi Agriculture and Land Ownership. *Journal of the Royal Anthropological Institute of Great Britain and Ireland* 61:357-405.

Forrestal, Peter P. (translator and editor)
1954 *Benavides' Memorial of 1630*. Academy of American Franciscan History, Washington D.C.

Fowler, Don D.
2000 *A Laboratory for Anthropology: Science and Romanticism in the American Southwest, 1846-1930*. University of New Mexico Press, Albuquerque.

Gallay, Alan
2002 *The Indian Slave Trade: The Rise of the English Empire in the American South, 1670-1717*. Yale University Press, New Haven.

Galloway, Patricia
1991 The Archaeology of Ethnohistorical Narrative. In *Columbian Consequences, Volume 3: The Spanish Borderlands in Pan-American Perspective*, edited by David Hurst Thomas, pp. 453-469. Smithsonian Institution Press, Washington D.C.

1994 Confederacy as a Solution to Chiefdom Dissolution: Historical Evidence in the Choctaw Case. In *The Forgotten Centuries: Indians and Europeans in the American South, 1521-1704*, edited by Charles Hudson and Carmen Chaves Tesser, pp. 393-420. University of Georgia Press, Athens.

1995 *Choctaw Genesis, 1500-1700*. University of Nebraska Press, Lincoln.

2002 Colonial Period Transformations in the Mississippi Valley: Dis-Integration, Alliance, Confederation, Payoff. In *The Transformation of the Southeastern Indians, 1540-1760*, edited by Robbie Ethridge and Charles Hudson, pp. 225-247. University Press of Mississippi, Jackson.

Gardner, Jamie N., Fraser Goff, Sammy Garcia, and Roland C. Hagan
1986 Stratigraphic Relations and Lithologic Variations in the Jemez Volcanic Field, New Mexico. *Journal of Geophysical Research B* 91(2):1763-1778.

Gauthier, Rory P, and Michael L. Elliott
1989 *Archeological Investigations in the Jemez Mountains, New Mexico, Jemez Ranger District, Santa Fe National Forest*. Cultural Resources Document 5. Santa Fe National Forest, Santa Fe.

Gilman, Patricia A.
1987 Architecture as Artifact: Pit Structures and Pueblos in the American Southwest. *American Antiquity* 52(3):538-564.

1997 *Wandering Villagers: Pit Structures, Mobility and Agriculture in Southeastern Arizona*. Arizona State University Anthropological Research Papers 49. Tempe.

Glass, D.V.

1973 *Numbering the People: The Eighteenth-Century Population Controversy and the Development of Census and Vital Statistics in Britain*. Saxon House, Farnborough.

Glassow, Michael A.
1980 Prehistoric Agricultural Development in the Northern Southwest: A Study in Changing Patterns of Land Use. Ballena Press Anthropological Papers 18. Ballena Press, Socorro, New Mexico.

Glover, Vernon J.
1990 *Jemez Mountains Railroads, Santa Fe National Forest*. Historical Society of New Mexico, Santa Fe. Originally published 1989, New Cultural Resources Report Series 9, USDA, Forest Service, Southwestern Region, Albuquerque.

Goetze, Christine E., and Barbara J. Mills
1993 Ceramic Chronometry. In *Across the Colorado Plateau, Anthropological Studies for the Transwestern Pipeline Expansion Project, Volume XVI: Interpretation of Ceramic Artifacts*, edited by Barbara J. Mills, Christine E. Goetze, and Maria Nieves Zedeño, pp. 87-146. University of New Mexico Office of Contract Archaeology and Maxwell Museum of Anthropology, Albuquerque.

Goodman, Alan H., and Debra L. Martin
2002 Reconstructing Health Profiles from Skeletal Remains. In *The Backbone of History: Health and Nutrition in the Western Hemisphere*, edited by Richard H. Steckel and Jerome C. Rose, pp. 11-60. Cambridge University Press, Cambridge.

Gottfried, Gerald J., Thomas W. Swetnam, Craig D. Allen, Julio L. Betancourt, and Alice L. Chung-MacCoubrey
1995 Pinyon-Juniper Woodlands. In *Ecology, Diversity, and Sustainability of the Middle Rio Grande Basin*, edited by Deborah M. Finch and Joseph A. Tainter, pp. 95-132. USDA, Forest Service General Technical Report RM-GTR-268. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins.

Graves, William M., and Suzanne L. Eckert
1998 Decorated Ceramic Distributions and Ideological Developments in the Northern and Central Rio Grande Valley, New Mexico. In *Migration and Reorganization: the Pueblo IV Period in the American Southwest*, edited by Katherine A.Spielmann, pp. 263-283. Arizona State University Anthropological Research Papers 51. Tempe.

Grayson, Donald K.
1981 The Effects of Sample Size on Some Derived Measures in Vertebrate Faunal Analysis. *Journal of Anthropological Research* 8(1):77-88.

1989 Sample Size and Relative Abundance in Archaeological Analysis: Examples from Spiral Fractures and Seriation. In *Quantifying Diversity in Archaeology*, edited by Robert D. Leonard and George T. Jones, pp. 79-84. Cambridge University Press, Cambridge.

Grayson, Donald K., and Stephen C. Cole
1998 Stone Tool Assemblage Richness during the Middle and Early Upper Palaeolithic in France. *Journal of Archaeological Science* 25(9):927–938.

Green, Roger C., Maryanne Atherton Danfelser, and Gwinn Vivian
1958 Interpretation of Bg 91: A Specialized Largo-Gallina Surface Structure. *El Palacio* 65(2):41-60.

Gregory, David A.
1975 Defining Variability in Prehistoric Settlement Morphology. In *Chapters in the Prehistory of Eastern Arizona*, pp. 40-46. Fieldiana Anthropology 65. Field Museum of Natural History, Chicago.

Greiser, Sally T., and T. Weber Greiser
1995 Prehistoric Irrigation in the Taos Valley. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 221-237. New Mexico Archaeological Council Special Publications 2. Albuquerque.

Greiser, Sally T., and James L. Moore
1995 The Case for Prehistoric Irrigation in the Northern Southwest. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 189-195. New Mexico Archaeological Council Special Publications 2. Albuquerque.

Haas, Jonathan, and Winifred Creamer
1992 Demography of the Protohistoric Pueblos of the Northern Rio Grande, A.D. 1450-1680. In *Current Research on the Late Prehistory and Early History of New Mexico*, edited by Bradley J. Vierra, pp. 21-27. New Mexico Archaeological Council Special Publication 1. Albuquerque.

1993 *Stress and Warfare Among the Prehistoric Kayenta Anasazi of the Thirteenth Century*. Fieldiana Anthropology new series 21. Field Museum of Natural History, Chicago.

1996 The Role of Warfare in the Pueblo III Period. In *The Prehistoric Pueblo World, A.D. 1150-1350*, edited by Michael A. Adler, pp. 205-213. University of Arizona Press, Tucson

Habicht-Mauche, Judith A.
1987 Southwestern Culinary Ceramics on the Southern Plains: A Case Study of Technological Innovation and Cross-Cultural Interaction. *Plains Anthropologist* 32(116):175-189.

1993 *The Pottery from Arroyo Hondo Pueblo, New Mexico: Tribalization and Trade in the Northern Rio Grande*. Arroyo Hondo Archaeological Series 8. School of American Research Press, Santa Fe.

Hack, John T.
1942 *The Changing Physical Environment of the Hopi Indians of Arizona*. Harvard University Peabody Museum of American Archaeology and Ethnology Papers 35(1). Peabody Museum, Cambridge.

Hackett, Charles Wilson (translator and annotator)
1923-1937 *Historical Documents relating to New Mexico, Nueva Vizcaya, and Approaches Thereto, to 1773, Collected by Adolph F.A. Bandelier and Fanny R. Bandelier*. 3 vols. Carnegie Institution of Washington, Washington D.C.

Hackett, Charles Wilson, and Charmion Clair Shelby (editors and translators)
1942 *Revolt of the Pueblo Indians of New Mexico and Otermin's Attempted Reconquest, 1680-1682*. 2 vols. University of New Mexico Press, Albuquerque.

Haecker, Charles M.
1987 Puebloan Limited Activity Sites within the Western Uplands of the Ortiz Mountains. In *Secrets of a City: Papers on Albuquerque Area Archaeology in Honor of Richard A. Bice*, edited by Anne V. Poore and John Montgomery, pp. 99-107. Papers of the Archaeological Society of New Mexico 13. Ancient City Press, Santa Fe.

Hallenbeck, Cleve (editor)
1987 *The Journey of Fray Marcos de Niza*. Southern Methodist University Press, Dallas.

Hammond, George P., and Agapito Rey (editors and translators)
1940 *Narratives of the Coronado Expedition 1540-1542*. University of New Mexico Press, Albuquerque.

1953 *Don Juan de Oñate, Colonizer of New Mexico 1598-1628*. 2 vols. University of New Mexico Press, Albuquerque.

1966 *The Rediscovery of New Mexico 1580-1594: The Explorations of Chamuscado, Espejo, Castaño de Sosa, Morlete, and Leyva de Bonilla and Humana*. University of New Mexico Press, Albuquerque.

Harlow, Francis H.
1973 *Matte-Paint Pottery of the Tewa, Keres and Zuni Pueblos*. Museum of New Mexico Press, Santa Fe.

Harrington, John P.
1916 The Ethnogeography of the Tewa Indians. *Twenty-ninth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution for the Years 1907-1908*, pp. 29-636. U.S. Government Printing Office, Washington D.C.

Hawley, Florence M.
1936 *Field Manual of Prehistoric Southwestern Pottery Types*. University of New Mexico Bulletin Anthropological Series 1(4). University of New Mexico Press, Albuquerque.

Hassan, Fekri A.
1979 Demography and Archaeology. *Annual Review of Anthropology* 8:137-160.

1981 *Demographic Archaeology*. Academic Press, New York.

Haury, Emil W.
1956 Speculations on Prehistoric Settlement Patterns in the Southwest. In *Prehistoric Settlement Patterns in the New World*, edited by Gordon R. Willey, pp. 3-10. Viking Fund Publications in Anthropology 23. Wenner-Gren Foundation for Anthropological Research, New York.

Hayes, P.P.
1991 Models for the Distribution of Pottery around Former Agricultural Settlements. In *Interpreting Artefact Scatters: Contributions to Ploughzone Archaeology*, edited by A.J. Schofield, pp. 81-92. Oxbow Monograph 4. Oxbow Press, Oxford.

Head, Genevieve N.
1999 Lithic artifacts. In *The Bandelier Archeological Survey*, edited by Robert P. Powers and Janet D. Orcutt, pp. 469-549. 2 vols. Intermountain Cultural Resources Management Professional Paper 57. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

2002 Site Typology and Architecture. *From Folsom to Fogelson :The Cultural Resources Inventory Survey of Pecos National Historical Park*, edited by Genevieve N. Head and Janet D. Orcutt, pp. 99-163. 2 vols. Intermountain Cultural Resources Management Professional Paper 66. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Head, Genevieve N., and Janet D. Orcutt (editors)
2002 *From Folsom to Fogelson: The Cultural Resources Inventory Survey of Pecos National Historical Park*. 2 vols. Intermountain Cultural Resources Management Professional Paper 66. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Hendricks, Rick
2002 Pueblo-Spanish Warfare in Seventeenth-Century New Mexico: The Battles of Black Mesa, Kotyiti, and Astialakwa. In *Archaeologies of the Pueblo Revolt: Identity, Meaning and Renewal in the Pueblo World*, edited by Robert W. Preucel, pp. 181-197. University of New Mexico Press, Albuquerque.

Hendricks, Rick, and John P. Wilson (editors, translators, and annotators)
1995 *The Navajos in 1705 : Roque Madrid's Campaign Journal*. University of New Mexico Press, Albuquerque.

Hegmon, Michelle
1989 Risk Reduction and Variation in Agricultural Economies: A Computer Simulation of Hopi Agriculture. *Research in Economic Anthropology* 11:89-121.

1991 The Risks of Sharing and Sharing as Risk Reduction: Interhousehold Food Sharing in Egalitarian Societies. In *Between Bands and States*, edited by Susan A. Gregg, pp. 309-329. Center for Archaeological Investigations Occasional Paper 9. Southern Illinois University Press, Carbondale.

2002 Recent Issues in the Archaeology of the Mimbres Region of the Southwestern United States. *Journal of Archaeological Research* 10(4):307-357.

Hegmon, Michelle, Margaret C. Nelson, Roger Anyon, Darrell Creel, Steven A. LeBlanc, and Harry J. Shafer
1999 Scale and Time-Space Systematics in the Post—A.D. 1100 Mimbres Region of the North American Southwest. *Kiva* 65(2):143-166.

Heiken, Grant, Fraser Goff, Jamie N. Gardner, W.S. Baldridge, J.B. Hulen, Dennis L. Nielson, and David Vaniman
1990 The Valles/Toledo caldera complex, Jemez volcanic field, New Mexico. *Annual Review of Earth and Planetary Sciences* 18:27-53.

Henige, David P.
1982 *Oral Historiography*. Longman, New York.

1990 Their Number Become Thick: Native American Historical Demography as Expiation. In *The Invented Indian: Cultural Fictions and Government Policies*, edited by James A. Clifton, pp. 169-191. Transaction Publishers, New Brunswick.

1998 *Numbers from Nowhere: The Native American Contact Population Debate*. University of Oklahoma Press, Norman.

Herhahn, Cynthia L.
1995 14th Century Dry Farming Features in the Northern Rio Grande Valley, New Mexico. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 77-84. New Mexico Archaeological Council Special Publications 2. Albuquerque.

Herr, Sarah A., and Jeffery J. Clark
1997 Patterns in the Pathways: Early Historic Migrations in the Rio Grande Pueblos. *Kiva* 62(4):365-389.

2002 Mobility and the Organization of Prehispanic Southwest Communities. In *The Archaeology of Tribal Societies*, edited by William A. Parkinson, pp. 123-154. International Monographs in Prehistory Archaeological Series 15. Ann Arbor.

Herrington, LaVerne
1982 Water-Control Systems of the Mimbres Classic Phase. In *Mogollon Archaeology: Proceedings of the 1980 Mogollon Conference*, edited by Patrick H. Beckett, pp. 75-90. Acoma Books, Ramona, California.

Hill, James N.
1970 *Broken K Pueblo: Prehistoric Social Organization in the American Southwest*. University of Arizona Anthropological Papers 18. University of Arizona Press, Tucson.

Hill, James N., and W. Nicholas Trierweiler
1986 Prehistoric Responses to Food Stress on the Pajarito Plateau, New Mexico: Technical Report and Results of the Pajarito Archaeological Research Project, 1977-1985. Pajarito Archaeological Research Project, Department of Anthropology, University of California, Los Angeles. Submitted to the National Science Foundation in partial fulfillment of Grant BNS-78-08118. Copies available from the Archaeological Records Management Section, New Mexico Historic Preservation Division, Laboratory of Anthropology, Museum of Indian Arts and Culture, Museum of New Mexico, Santa Fe.

Hill, J. Brett
1998a Ecological Variability and Agricultural Specialization among the Protohistoric Pueblos of Central New Mexico. *Journal of Field Archaeology* 25(3):275-294.

1998b Agricultural Production and Specialization among the Eastern Anasazi during the Pueblo IV Period. In *Migration and Reorganization: the Pueblo IV Period in the American Southwest*, edited by Katherine A.Spielmann, pp. 209-232. Arizona State University Anthropological Research Papers 51. Tempe.

Hinsley, Curtis M., Jr.
1981 *Savages and Scientists: The Smithsonian Institution and the Development of American Anthropology, 1846-1910*. Smithsonian Institution Press, Washington D.C.

Hodge, Frederick Webb
1918 Administrative Report. *In Thirty-Second Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution for the Years 1910-1911*. U.S. Government Printing Office, Washington D.C.

Hodge, Frederick Webb, George P. Hammond and Agapito Rey (editors and translators)
1945 *Fray Alonso Benavides' Revised Memorial of 1634*. University of New Mexico Press, Albuquerque.

Hollingsworth, T.H.
1969 *Historical Demography*. Cornell University Press, Ithaca.

Holmes, W.H.
1905 Notes on the antiquities of Jemez Valley, New Mexico. *American Anthropologist*, new series 7(2):198-212.

Howell, Todd L.
1994 *Leadership at the Ancestral Zuni Village of Hawikku*. Unpublished Ph.D. dissertation, Department of Anthropology, Arizona State University, Tempe.

1995 Tracking Zuni Gender and Leadership Roles Across the Contact Period. *Journal of Anthropological Research* 51(2):125-147.

Howell, Todd L., and Keith W. Kintigh
1996 Archaeological Identification of Kin Groups Using Mortuary and Biological Data: An Example from the American Southwest. *American Antiquity* 61(3):537-554.

Howell, Todd L., and Tammy Stone (editors)
1994 *Exploring Social, Political and Economic Organization in the Zuni Region*. Arizona State University Anthropological Papers 46. Arizona State University, Tempe.

Hunter-Anderson, Rosalind L.
1979 Explaining Residential Aggregation in the Northern Rio Grande: A Competition Reduction Model. . In *Archeological Investigations in Cochiti Reservoir, New Mexico, Volume 4: Adaptive Change in the Northern Rio Grande Valley*, edited by Jan V. Biella and Richard C. Chapman, pp. 169-175. University of New Mexico Office of Contract Archeology, Albuquerque.

1986 *Prehistoric Adaptation in the American Southwest*. Cambridge University Press, Cambridge.

Hutchinson, Dale L., Clark Spenser Larsen, Margaret J. Schoeninger and Lynette Norr
1998 Regional Variation in the Pattern of Maize Adoption and Use in Florida and Georgia. *American Antiquity* 63(3):397-416.

Hutchinson, Dale L., and Lynette Norr
1994 Late Prehistoric and Early Historic Diet in Gulf Coast Florida. In *In the Wake of Contact: Biological Responses to Contact,* edited by Clark Spenser Larsen and George R. Milner, pp. 9-20. Wiley-Liss, New York.

Indian Claims Commission
1974 Commission Findings on the Pueblo Indians. In *American Indian Ethnohistory, Indians of the Southwest: Pueblo Indians V*, edited and compiled by David Agee Horr, pp. 9-403. Garland, New York

Ivey, James E.
1989 Another Look at Dating the Scholes Manuscript: A Research Note. *New Mexico Historical Review* 64(3):341-347.

Jackson, Robert H.
1985 Demographic Change in Northwestern New Spain. *The Americas* 44(4):462-479.

1994a *Indian Population Decline: the Missions of Northwestern New Spain*. University of New Mexico Press, Albuquerque.

1994b Congregation and Population Change in the Mission Communities of Northern New Spain: Cases from the Californias and Texas. *New Mexico Historical Review* 69(2):163-183.

Jaffe, A.J.
1992 *The First Immigrants from Asia: A Population History of the North American Indians*. Plenum Press, New York.

Jefferies, Richard W.
1982 Debitage as an Indicator of Intraregional Activity Diversity in Northwest Georgia. *Midcontinental Journal of Archaeology* 7(1):99-132.

Jeter, Marvin D.
1989 Protohistoric and Historic Native Americans. In *Archaeology and Bioarchaeology of the Lower Mississippi Valley and Trans-Mississippi South in Arkansas and Louisiana*, by Marvin D. Jeter, Jerome C. Rose, G. Ishmael Williams, Jr., and Anna M. Harmon, pp. 221-248. Arkansas Archeological Survey Research Series 37. Arkansas Archeological Survey, Fayetteville.

2002 From Prehistory through Protohistory to Ethnohistory in and near the Northern Lower Mississippi Valley. In *The Transformation of the Southeastern Indians, 1540-1760*, edited by Robbie Ethridge and Charles Hudson, pp. 177-223. University Press of Mississippi, Jackson.

John, Elizabeth A.H.
1975 Storms Brewed in Other Men's Worlds: The Confrontation of Indians, Spanish and French in the Southwest, 1540-1795. Texas A & M University Press, College Station.

Johnson, Gregory A.
1982 Organizational Structure and Scalar Stress. In *Theory and Explanation in Archaeology: The Southampton Conference*, edited by Colin Renfrew, Michael J. Rowlands, and Barbara Abbott Seagraves, pp. 389-421. Academic Press, New York.

1989 Dynamics of Southwestern Prehistory: Far Outside—Looking In. In *Dynamics of Southwest Prehistory*, edited by Linda S. Cordell and George J. Gumerman, pp. 371-389. Smithsonian Institution Press, Washington D.C.

Jones, Anne Trinkle
1996 Prehistoric Subsistence and Survival at Petrified Forest, Arizona. In *River of Change: Prehistory of the Middle Little Colorado River Valley, Arizona*, edited by E. Charles Adams, pp. 141-161. Arizona State Museum Archaeological Series 185. University of Arizona, Tucson.

Jones, George T., and Robert D. Leonard
1989 The Concept of Diversity: An Introduction. In *Quantifying Diversity in Archaeology*, edited by Robert D. Leonard and George T. Jones, pp. 1-3. Cambridge University Press, Cambridge.

Jones, George T., Donald K. Grayson, and Charlotte Beck
1983 Artifact Class Richness and Sample Size in Archaeological Surface Assemblages. In *Lulu Linear Punctated: Essays in Honor of George Irving Quimby*, edited by Robert C. Dunnell and Donald K. Grayson, pp. 55-73. University of Michigan Museum of Anthropology Anthropological Papers 72. Ann Arbor.

Joralemon, Donald
1982 New World Depopulation and the Case of Disease. *Journal of Anthropological Research* 38(1):108-127

Kane, Allen E.
1986 Prehistory of the Dolores River Valley. In *Dolores Archaeological Program: Final Synthetic Report*, compiled by David A. Breternitz, Christine K. Robinson and G. Timothy Gross, pp. 353-435. US Department of Interior Bureau of Reclamation Engineering and Research Center, Denver.

Kates, Robert W., Goran Hayden, and B.L. Turner II
1993 Theory, Evidence, and Study Design. In *Population Growth and Agricultural Change in Africa*, edited by B.L. Turner II, Goran Hayden and Robert W. Kates, pp. 1-40. University Press of Florida, Gainesville.

Kayser, David W.
1974 A Prehistoric Water System. *El Palacio* 79(3):30-31.

Kealhofer, Lisa
1996 The Evidence for Demographic Collapse in California. In *Bioarchaeology of Native American Adaptations in the Spanish Borderlands*, edited by Brenda J. Baker and Lisa Kealhofer, pp. 56-92. University Press of Florida, Gainesville.

Kelley, Jane H.
1966 The Archaeology of the Sierra Blanca Region of Southwestern New Mexico. Unpublished Ph.D. dissertation, Department of Anthropology, Harvard University, Cambridge.

Kelly, Robert L.
1983 Hunter-gatherer Mobility Strategies. *Journal of Anthropological Research* 37(3)277-306.

1992 Mobility/Sedentism: Concepts, Archaeological Measures, and Effects. *Annual Review of Anthropology* 21:43-66.

Kent, Susan
1991 The Relationship between Mobility Strategies and Site Structure. In *The Interpretation of Archaeological Spatial Patterning*, edited by Ellen M. Kroll and T. Douglas Price, pp. 33-59. Plenum Press, New York.

Kent, Susan, and Helga Vierich
1989 The Myth of Ecological Determinism—Anticipated Mobility and Site Spatial Organization. *Farmers as Hunters: The Implications of Sedentism*, edited by Susan Kent, pp. 96-130. Cambridge University Press, Cambridge.

Kessell, John L.
1987 *Kiva, Cross and Crown: The Pecos Indians and New Mexico, 1540-1840*. Second edition. Southwest Parks and Monuments Association, Tucson.

1991 Did Fray Marcos Lie? Who Cares? In *Spanish Borderlands Sourcebooks, Volume 17: The Spanish Missions of New Mexico I, Before 1680*, edited by John L. Kessell and Rick Hendricks, pp. 17-34. Garland, New York.

2002 *Spain in the Southwest: A Narrative History of Colonial New Mexico, Arizona, Texas, and California*. University of Oklahoma Press, Norman.

Kessell, John L. (editor)
1989 *Remote Beyond Compare: Letters of don Diego de Vargas to His Family from New Spain and New Mexico, 1675-1706*. University of New Mexico Press, Albuquerque.

Kessell, John L., Rick Hendricks, and Meredith D. Dodge (editors)
1992 *By Force of Arms: The Journals of don Diego de Vargas, New Mexico, 1691-93*. University of New Mexico Press, Albuquerque.

1995 *To the Royal Crown Restored: The Journals of don Diego de Vargas, New Mexico, 1692-94*. University of New Mexico Press, Albuquerque.

1998 *Blood on the Boulders: The Journals of don Diego de Vargas, New Mexico, 1694-1697*. 2 vols. University of New Mexico Press, Albuquerque.

Kessell, John L., Rick Hendricks, Meredith D. Dodge and Larry D. Miller (editors)
2000 *That Disturbances Cease: The Journals of don Diego de Vargas, New Mexico, 1697-1700*. University of New Mexico Press, Albuquerque.

2002 *A Settling of Accounts: The Journals of don Diego de Vargas, New Mexico, 1700-1704*. University of New Mexico Press, Albuquerque.

Kidder, Alfred V.
1915 *Pottery of the Pajarito Plateau and Some Adjacent Regions of New Mexico*. American Anthropological Association Memoirs 2(6). Washington.

1927 Southwestern Archaeological Conference. *Science* 66:489-491.

Kidder, Alfred V., and C.A. Amsden
1931 *The Pottery of Pecos, Volume 1: The Dull-Paint Wares*. Papers of the Phillips Academy Southwestern Expedition 5. Yale University Press, New Haven.

Kidder, Alfred V., and Anna O. Shepard
1936 *The Pottery of Pecos, Volume 2: The Culinary, Glaze-Paint and Other Wares, and the Technology of Pecos Pueblo*. Papers of the Phillips Academy Southwestern Expedition 7. Yale University Press, New Haven.

Kintigh, Keith W.
1984 Measuring Archaeological Diversity by Comparison with Simulated Assemblages. *American Antiquity* 49(1):44-54.

1985 *Settlement, Subsistence and Society in Late Zuni Prehistory*. University of Arizona Anthropological Papers 44. University of Arizona Press, Tucson.

1989 Sample Size, Significance, and Measures of Diversity. In *Quantifying Diversity in Archaeology*, edited by Robert D. Leonard and George T. Jones, pp. 25-36. Cambridge University Press, Cambridge.

Kirch, Patrick V.
1990 The Evolution of Sociopolitical Complexity in Prehistoric Hawaii: An Assessment of the Archaeological Evidence. *Journal of World Prehistory* 4(3):311-345.

1994 The Wet and the Dry: Irrigation and Agricultural Intensification in Polynesia. University of Chicago Press, Chicago.

Kite, Michael A.
1988 A Ceramic Sequence from the Chupadera Arroyo Basin, Central New Mexico. Unpublished Master's thesis, Department of Anthropology, Eastern New Mexico University, Portales.

Knaut, Andrew L.
1995 *The Pueblo Revolt: Conquest and Resistance in Seventeenth-Century New Mexico*. University of Oklahoma Press, Norman.

Kohler, Timothy A.

1989 Introduction. In *Bandelier Archaeological Excavation Project: Research Design and Summer 1988 Sampling*, edited by Timothy A. Kohler, pp. 1-12. Washington State University Department of Anthropology Reports of Investigations 61. Pullman, Washington.

1992 Field Houses, Villages, and the Tragedy of the Commons in the Early Northern Anasazi Southwest. *American Antiquity* 57(4):617-635.

1993 News from the Northern American Southwest: Prehistory on the Edge of Chaos. *Journal of Archaeological Research* 1(4):267-321.

Kohler, Timothy A., and Eric Blinman

1987 Solving Mixture Problems in Archaeology: Analysis of Ceramic Materials for Dating and Demographic Reconstruction. *Journal of Anthropological Archaeology* 6(1):1-28.

Kohler, Timothy A., and Michele Gray

1993 Ceramic Materials. In *Papers on the Early Classic Period Prehistory of the Pajarito Plateau, New Mexico*, edited by Timothy A. Kohler and Angela R. Linse, pp. 35-41. Washington State University Department of Anthropology Reports of Investigations 65. Pullman, Washington.

Kohler, Timothy A., and Meredith H. Matthews

1988 Long-term Anasazi Land Use and Forest Reduction: A Case Study from Southwest Colorado. *American Antiquity* 53(3):537-564.

Kohler, Timothy A., Janet D. Orcutt, Eric Blinman and Kenneth L. Petersen

1986 Anasazi Spreadsheets: The Cost of Doing Agricultural Business in Prehistoric Dolores. In *Dolores Archaeological Program: Final Synthetic Report*, compiled by David A. Breternitz, Christine K. Robinson and G. Timothy Gross, pp. 525-538. United States Department of Interior Bureau of Reclamation Engineering and Research Center, Denver.

Kowalewski, Stephen A.

1990 Merits of Full-Coverage Survey: Examples from the Valley of Oaxaca, Mexico. In *The Archaeology of Regions: A Case for Full-Coverage Survey*, edited by Suzanne K. Fish and Stephen A Kowalewski, pp. 33-85. Smithsonian Institution Press, Washington D.C.

Kricher, J.C.

1993 *A Field Guide to the Ecology of Western Forests*. Peterson Field Guide 45. Houghton-Mifflin, Boston.

Kroeber, A.L.

1916 *Zuñi Potsherds*. Anthropological Papers of the American Museum of Natural History 18(1). New York.

1934 Native American Population. *American Anthropologist* 36(1):1-25.

1939 *Cultural and Natural Areas of Native North America*. University of California Publications in American Archaeology and Ethnology 28. University of California, Berkeley.

Kulisheck, Jeremy
2001a Settlement Patterns, Population and Congregacion on the 17th Century Jemez Plateau. In *Following Through: Papers in Honor of Phyllis S. Davis*, edited by Regge N. Wiseman, Thomas C. O'Laughlin, and Cordelia T. Snow, pp. 77-101. Papers of the Archaeological Society of New Mexico 27. Albuquerque.

2001b Seventeenth Century Field Houses on the Jemez Plateau, North-Central New Mexico, U.S.A. Paper accompanying a poster presented at the 66th Annual Meeting of the Society for American Archaeology, New Orleans, Louisiana.

2003a Pueblo Population Movements, Abandonment, and Settlement Change in Sixteenth and Seventeenth Century New Mexico. *Kiva* 69(1):30-54.

2003b VCNP—Banco Bonito Hazardous Fuels Reduction Project Heritage Resources Clearance Report, Santa Fe National Forest, Sandoval County, New Mexico. USDA, Valles Caldera National Preserve. Report submitted to USDA, Forest Service, Santa Fe National Forest. Copies avialable from USDA, Valles Caldera National Preserve, Los Alamos, New Mexico.

Ladd, Edmund J.
1979 Zuni Economy. In *Southwest*, edited by Alfonso Ortiz, pp. 492-498. Handbook of North American Indians, Vol. 9, William C. Sturtevant, general editor, Smithsonian Institution, Washington D.C.

Ladefoged, Thegn N., and Michael W. Graves
2000 Evolutionary Theory and the Historical Development of Dry Land Agriculture in Nirth Kohala, Hawai'i. *American Antiquity* 65(3):423-448.

Lahr, M.M., and J.E. Bowman
1992 Paleopathology of the Kechipawan Site: Health and Disease in a Southwestern Pueblo. *Journal of Archaeological Science* 19(5):639-654.

Lambert, Marjorie F.
1981 Spanish Influences on the Pottery of the San Jose de Los Jemez and Giusewa, Jemez State Monument (LA 679), Jemez Springs, New Mexico. In *Collected Papers in Honor of Erik Kellerman Reed*, edited by Albert H. Schroeder, pp. 215-236. Archaeological Society of New Mexico Papers 6. Albuquerque Archaeological Society Press, Albuquerque.

Lambert, Ruth E.
1998 Ceramic Wares and Types: Assessing H.S. Colton's Ceramic Concepts. In *Unit Issues in Archaeology: Measuring Time, Space, and Material*, edited by Ann F. Ramenofsky and Anastasia Steffen, pp. 147-162. University of Utah Press, Salt Lake City.

Lang, Richard W.
1982 Transformation in White Ware Pottery of the Northern Rio Grande. In *Southwestern Ceramics: A Comparative Review*, edited by Albert H. Schroeder, pp. 153-200. The Arizona Archaeologist 15. Arizona Archaeological Society, Phoenix.

1995 The Fields of San Marcos: Agriculture at a Great Town of the Galisteo Basin, Northern New Mexico. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 41-76. New Mexico Archaeological Council Special Publications 2. Albuquerque.

Lange, Charles H., Carroll L. Riley, and Elizabeth M. Lange (editors and annotators)
1966-1984 *The Southwestern Journals of Adolph F.A. Bandelier*. 4 vols. University of New Mexico Press, Albuquerque.

Lange, Richard C.
1989 A Survey of the Homolovi Ruins State Park. *Kiva* 54(3):195-216.

1996 The Little Colorado River, Farming and Prehistory in the Homol'ovi Area. In *River of Change: Prehistory of the Middle Little Colorado River Valley, Arizona*, edited by E. Charles Adams, pp. 239-258. Arizona State Museum Archaeological Series 185. University of Arizona, Tucson.

Larsen, Clark Spenser
1990 Biocultural Interpretation and the Context for Contact. In *The Archaeology of Mission Santa Catalina de Guale, Volume 2: Biocultural Interpretations of a Population in Transition,* edited by Clark Spenser Larsen, pp. 11-25. American Museum of Natural History Anthropological Papers 68. New York.

1994 In the Wake of Columbus: Native Population Biology in the Post-Contact Americas. *Yearbook of Physical Anthropology* 37:109-154.

2001 Bioarchaeology of Spanish Florida. In *Bioarchaeology of Spanish Florida: The Impact of Colonialism*, edited by Clark Spenser Larsen, pp. 22-51. University Press of Florida, Gainesville.

Larsen, Clark Spenser, Dale L. Hutchinson, Margaret J. Schoeninger, and Lynette Norr
2001 Food and Stable Isotopes in La Florida: Diet and Nutrition Before and After Contact. In *Bioarchaeology of Spanish Florida: The Impact of Colonialism*, edited by Clark Spenser Larsen, pp. 52-81. University Press of Florida, Gainesville.

Larsen, Clark Spenser, and Christopher B. Ruff
1994 The Stresses of Conquest in Spanish Florida: Structural Adaptation and Change before and after Contact. In *In the Wake of Contact: Biological Responses to Contact,* edited by Clark Spenser Larsen and George R. Milner, pp. 21-34. Wiley-Liss, New York.

Larsen, Clark Spenser, Christopher B. Ruff, and Mark C. Griffin
1996 Implications of Changing Biomechanical and Nutritional Environments for Activity and Lifeway in the Eastern Spanish Borderlands. . In *Bioarchaeology of Native Adaptation in the Spanish Borderlands*, edited by Brenda J. Baker and Lisa Kealhofer, pp. 95-125. University Press of Florida, Gainesville.

Larsen, Clark Spenser, Margaret J. Schoeninger, Dale L. Hutchinson, Katherine F. Russell, and Christopher B. Ruff
1990 Beyond Demographic Collapse: Biological Adaptation and Change in Native Populations of La Florida. In *Columbian Consequences, Volume 2: Archaeological and Historical Perspectives on the Spanish Borderlands East,* edited by David Hurst Thomas, pp. 409-428. Smithsonian Institution Press, Washington D.C.

Larsen, Clark Spenser, and George R. Milner (editors)
1994 *In the Wake of Contact: Biological Responses to Contact*. Wiley-Liss, New York.

Larson, Daniel O.
1996 Population Growth, Agricultural Intensification, and Culture Change among the Virgin Branch Anasazi, Nevada. *Journal of Field Archaeology* 23(1):55-76.

Larson, Daniel O., Hector Neff, Donald A. Graybill, Joel Michaelsen, and Elizabeth Ambos
1996 Risk, Climatic Variability, and the Study of Southwestern Prehistory: An Evolutionary Perspective. *American Antiquity* 61(2):217-241.

Leach, Helen M.
1999 Intensification in the Pacific: A Critique of the Archaeological Criteria and their Application. *Current Anthropology* 40(3):311-339.

Lehmer, Donald J.
1948 *The Jornada Branch of the Mogollon*. University of Arizona Bulletin 19(2). Social Science Bulletin 17. University of Arizona Press, Tucson.

Lekson, Stephen H.
1992 The Surface Archaeology of Southwestern New Mexico. *The Artifact* 30(3):1-36.

Lekson, Stephen H., Curtis P. Nepstad-Thornberry, Brian E. Yunker, Toni S. Laumbach, David P. Cain, and Karl W. Laumbach
2002 Migrations in the Southwest: Pinnacle Ruin, Southwestern New Mexico. *Kiva* 68(2):73-101.

Lent, Stephen C., Joan K. Gaunt, and Adisa J. Willmer
1992 *A Study of the Effects of Fire on Archaeological Resources, Phase I: The Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico*. Archaeology Notes 93. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Leonard, Robert D., and Heidi E. Reed
1993 Population Aggregation in the Prehistoric American Southwest: A Selectionist Model. *American Antiquity* 58(4):648-661.

LeTourneau, Phillipe, Scott Aby and Ray Kunselman
1997 Lithic resources of the Jemez Mountains. In *OLE Volume II: Artifacts*, edited by John C. Acklen, pp. 1-29. Public Service Company of New Mexico, Albuquerque.

Levine, Frances
1999 *Our Prayers are in This Place: Pecos Pueblo Identity over the Centuries*. University of New Mexico Press, Albuquerque.

Levine, Frances, and Anna LeBauve
1997 Examining the Complexity of Historic Population Decline: A Case Study of Pecos Pueblo, New Mexico. *Ethnohistory* 44(1):75-112.

Lewarch, D.E., and Michael J. O'Brien
1981 The Expanding Role of Surface Assemblages in Archaeological Research. In *Advances in Archaeological Method and Theory, Volume 4*, edited by Michael B. Schiffer, pp. 297-342. Academic Press, New York.

Liebmann, Matt
2003 Changes in Pueblo Site Planning through the Contact Period: An Investigation of the Spatial Organization of Jemez Villages from the 1500's to Today. Paper presented at the 68th Annual Meeting of the Society for American Archaeology, Milwaukee.

Lightfoot, Dale R.
1990 The Prehistoric Pebble-Mulched Fields of the Galisteo Anasazi: Agricultural Innovation and Adaptation to Environment. Unpublished Ph.D. dissertation, Department of Geography, University of Colorado, Boulder.

Lightfoot, Dale R., and Frank W. Eddy
1995 The Construction and Configuration of Anasazi Pebble-Mulch Gardens in the Northern Rio Grande. *American Antiquity* 60(3):459-470.

Lightfoot, Kent G.
1984 *Prehistoric Political Dynamics: A Case Study from the American Southwest*. Northern Illinois University Press, Dekalb.

1995 Culture Contact Studies: Redefining the Relationship between Prehistoric and Historical Archaeology. *American Antiquity* 60(2):199-217.

Lightfoot, Kent G., and Fred Plog
1984 Intensification along the North Side of the Mogollon Rim. In *Prehistoric Agricultural Strategies in the Southwest*, edited by Suzanne K. Fish and Paul R. Fish, pp. 179-195. Arizona State University Anthropological Papers 33. Tempe.

Lightfoot, Kent G., and Roberta Jewett
1986 The Shift to Sedentary Life: A Consideration of the Occupation Duration of Early Mogollon Pithouse Villages. In *Mogollon Variability*, edited by Charlotte Benson and Steadman Upham, pp. 9-43. New Mexico State University, University Museum Occasional Papers 15. Las Cruces.

Lightfoot, Kent G., and Steadman Upham
1989 Complex Societies in the Prehistoric American Southwest: The Debate. In *The Sociopolitical Structure of Prehistoric Southwestern Societies*, edited by Steadman Upham, Kent G. Lightfoot and Roberta Jewett, pp. 3-32. Westview Press, Boulder.

Lightfoot, Ricky R.
1994 *The Duckfoot Site, Volume 2: Archaeology of the House and Household*. Crow Canyon Archaeological Center Occasional Papers 4. Cortez.

Lindauer, Owen
1984 Sherd Areas as Loci of Subsistence in the Middle Gila. In *Prehistoric Agricultural Strategies in the Southwest*, edited by Suzanne K. Fish and Paul R. Fish, pp. 73-84. Arizona State University Anthropological Research Papers 33. Tempe.

Lindsay, Alexander J., Jr.
1961 The Beaver Creek Agricultural Community on the San Juan River, Utah. *American Antiquity* 27(2):174-187.

Lipe, William D.
1994 Comments on Population Aggregation and Community Organization. In *The Ancient Southwestern Community: Models and Methods for the Study of Prehistoric Social Organization*, edited by W.H. Wills and Robert D. Leonard, pp. 141-143. University of New Mexico Press, Albuquerque.

Livi-Bacci, Massimo
1992 *A Concise History of World Population*, translated by Carl Ipsen. Blackwell, Cambridge.

Longacre, William A.
1966 Changing Patterns of Social Integration: A Prehistoric Example from the American Southwest. *American Anthropologist* 68(1):94-102.

1968 Some Aspects of Prehistoric Society in East-Central Arizona. In *New Perspectives in Archaeology*, edited by Sally R. Binford and Lewis R. Binford, pp. pp. 89-102. Aldine, Chicago.

1970 *Archaeology as Anthropology: A Case Study*. University of Arizona Anthropological Papers 17. University of Arizona Press, Tucson.

Luebben, Ralph A., Leonard W. Blake, Hugh C. Cutler, Joyce Herold and Erik K. Reed
1988 Bj 74: A small rock overhand containing an occupational surface and a small, post-Spanish pueblo, Jemez Mountains, New Mexico. In *Reflections: Papers on Southwestern Culture History in Honor of Charles H. Lange,* edited by Anne Van Arsdale Poore, pp. 91-124. Papers of the Archaeological Society of New Mexico 14. Ancient City Press, Santa Fe.

Lycett, Mark T.
1989 Spanish Contact and Pueblo Organization: Long-Term Implications of European Colonial Expansion in the Rio Grande Valley, New Mexico. In *Columbian Consequences, Volume 1: Archaeological and Historical Perspectives on the Spanish Borderlands West,* edited by David Hurst Thomas, pp. 115-125. Smithsonian Institution Press, Washington D.C.

1995 Archaeological Implications of European Contact: Demography, Settlement, and Land Settlement, and Land Use in the Middle Rio Grande Valley, New Mexico. Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Lyman, R. Lee, Michael J. O'Brien, and Robert C. Dunnell
1997 *The Rise and Fall of Culture History*. Plenum Press, New York.

McAllister, Shirley Powell, and Fred Plog
1978 Small Sites in the Chevelon Drainage. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 17-23. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

McAnany, Patricia A.
1992 Agricultural Tasks and Tools: Patterns of Stone Tool Discard near Prehistoric Maya Residences Bordering Pulltrouser Swamp, Belize. In *Gardens of Prehistory: The Archaeology of Settlement Agriculture in Greater Mesoamerica*, edited by Thomas W. Killion, pp. 184-213. University of Alabama Press, Tuscaloosa.

McCaa, Robert
2000 The Peopling of Mexico from Origins to Revolution. In *A Population History of North America*, edited by Michael R. Haines and Richard H. Steckel, pp. 241-304. Cambridge University Press, New York.

2002 Paleodemography of the Americas: From Ancient Times to Colonialism and Beyond. In *The Backbone of History: Health and Nutrition in the Western Hemisphere*, edited by Richard H. Steckel and Jerome C. Rose, pp. 94-124. Cambridge University Press, Cambridge.

McCartney, Peter H., and Margaret F. Glass
1990 Simulation Models and the Interpretation of Diversity. *American Antiquity* 55(3):521-536.

McEwan, Bonnie G. (editor)
2000 Indians of the Greater Southeast: Historical Archaeology and Ethnohistory. University Press of Florida, Gainesville.

McFadden, Leslie D., Paula Muir Watt, Steven L Reneau, and Eric V. McDonald
1996 General Soil-Landscape Relationships and Soil-Forming Processes in the Pajarito Plateau, Los Alamos National Laboratory Area, New Mexico. In *New Mexico Geological Society Guidebook, 47th Field Conference, Jemez Mountains Region*, pp. 357-365. New Mexico Geological Society, Albuquerque.

McGuire, Randall H., and Dean J. Sattia
1996 Although They Have Petty Capitans, They Obey Them Badly: The Dialectics of Prehispanic Western Pueblo Social Organization. *American Antiquity* 61(2):197-216.

McGuire, Randall H., and Michael B. Schiffer
1983 A Theory of Architectural Design. *Journal of Anthropological Archaeology* 2(3):277-303.

Mackey, James
1982 Vallecitos Pueblo (A Fourteenth Century A.D., Ancestral Jemez Site), and LA 12761 (A Late Prehistoric-Early Historic, Jemez Phase Farm House Site) in New Mexico. *Journal of Intermountain Archeology* 1(2):80-99.

McNeill, William H.
1976 *Plagues and Peoples*. Anchor Press, Garden City.

Mahoney, Nancy M, Michael A. Adler, and James W. Kendrick
2000 The Changing Scale and Configuration of Mesa Verde Communities. *Kiva* 66(1):67-90.

Marshall, Michael P. (compiler)
1984 Place Names of the Pre-Revolt Period: A Summary of the Historical Records. In *Rio Abajo: Prehistory and History of a Rio Grande Province*, by Michael P. Marshall and Henry J. Walt, pp. 245-257. New Mexico Historic Preservation Division, Santa Fe.

Marshall, Michael P., and Henry J. Walt
1984 *Rio Abajo: Prehistory and History of a Rio Grande Province*. New Mexico Historic Preservation Division, Santa Fe.

Mason, Ronald J.
2000 Archaeology and Native American Oral Traditions. *American Antiquity* 65(2):239-266.

Matson, R.G., William D. Lipe, and William R. Haase IV
1988 Adaptational Continuities and Occupational Discontinuities: The Cedar Mesa Anasazi. *Journal of Field Archaeology* 15(3):245-264.

Maxwell, Timothy D.
1995 A Comparative Study of Prehistoric Farming Strategies. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 3-12. New Mexico Archaeological Council Special Publications 2. Albuquerque.

2000 Looking for Adaptations: A Comparative and Engineering Analysis of Prehistoric Agricultural Technologies and Techniques in the Southwest. Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Maxwell, Timothy D., and Kurt F. Anscheutz
1992 The Southwestern Ethnographic Record and Prehistoric Agricultural Diversity. In *Gardens of Prehistory: The Archaeology of Settlement Agriculture in Greater Mesoamerica*, eidted by Thomas W. Killion, pp. 35-68. University of Alabama Press, Tuscaloosa.

Meindl, Richard S., and Katherine F. Russell
1998 Recent Advances in Method and Theory in Paleodemography. *Annual Review of Anthropology* 27:375-399.

Meltzer, David J.
1992 How Columbus Sickened the New World. *New Scientist* 136:38-41.

Meltzer, David J., Robert D. Leonard, and S.K. Stratton
1992 The Relationship between Sample Size and Diversity in Archaeological Assemblages. *Journal of Archaeological Science* 19(3):375-387.

Mera, H.P.
1933 *A Proposed Revision of the Rio Grande Glaze Paint Sequence*. Laboratory of Anthropology Technical Series Bulletin 5. Santa Fe.

1934 *A Survey of the Biscuit Ware Area in Northern New Mexico*. Laboratory of Anthropology Technical Series Bulletin 6. Santa Fe.

1935 *Ceramic Clues to the Prehistory of North Central New Mexico*. Laboratory of Anthropology Technical Series Bulletin 8. Santa Fe.

1940 *Population Changes in the Rio Grande Glaze-Paint Area*. Laboratory of Anthropology Technical Series Bulletin 11. Santa Fe.

Merbs, Charles F.
1989 Patterns of Health and Sickness in the Precontact Southwest. In *Columbian Consequences, Volume 1: Archaeological and Historical Perspectives on the Spanish Borderlands West,* edited by David Hurst Thomas, pp. 41-55. Smithsonian Institution Press, Washington D.C.

1992 A New World of Infectious Disease. *Yearbook of Physical Anthropology* 35:3-42.

Milich, Alicia Ronstadt (translator)
1966 *Relaciones, An Account of Things Seen and Learned by Father Jerónimo de Zárate Salmerón from the Year 1538 to Year 1626*. Horn and Wallace, Albuquerque.

Miller, Elizabeth
1996 The Effect of European Contact on the Health of Indigenous Populations in Texas. . In *Bioarchaeology of Native Adaptation in the Spanish Borderlands*, edited by Brenda J. Baker and Lisa Kealhofer, pp. 126-147. University Press of Florida, Gainesville.

Miller, G., J. Redders, R. Stein, M. Edwards, J. Phillips, V. Andrews, S. Sebring, and C. Vaandrager
1993 *Terrestrial Ecosystem Survey of the Santa Fe National Forest*. USDA, Forest Service, Santa Fe National Forest, Santa Fe.

Miller, Naomi F., and Kathryn L. Gleason
1994 Fertilizer in the Identification and Analysis of Cultivated Soil. In *The Archaeology of Garden and Field*, edited by Naomi F. Miller and Kathryn L. Gleason, pp. 25-43. University of Pennsylvania Press, Philadelphia.

Milner, George R.
1980 Epidemic Disease in the Postcontact Southeast: A Reappraisal. *Mid-Continental Journal of Archaeology* 5(1):39-56.

Mills, Barbara J.
1989 Integrating Functional Analyses of Vessels and Sherds through Models of Ceramic Assemblage Formation. *World Archaeology* 21(1):133-147.

1998 Migration and Pueblo IV Community Reorganization in the Silver Creek Area, East-Central Arizona. In *Migration and Reorganization: The Pueblo IV Period in the American Southwest*, edited by Katherine A. Spielmann, pp. 65-80. Arizona State University Anthropological Research Papers 51. Tempe.

Mills, Barbara J. (editor)
2000 Alternative Leadership Strategies in the Prehispanic Southwest. University of Arizona Press, Tucson.

Mindeleff, Cosmos
1900 Localization of Tusayan. In *Nineteenth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution for the Years 1897-1898*, part. 2, edited by John Wesley Powell, pp. 635-653. U.S. Government Printing Office, Washington, D.C.

Mindeleff, Victor
1891 A Study of Pueblo Architecture in Tusayan and Cibola. In *Eighth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution for the Years 1888-1887*, edited by John Wesley Powell, pp. 3-228. U.S. Government Printing Office, Washington, D.C.

Mooney, James
1910 Population. In *Handbook of American Indians North of Mexico*, edited by Frederick Webb Hodge, pp. 286-287. Bureau of American Ethnology Bulletin 30 (Part 2). Smithsonian Institution, Washington D.C.

1928 *The Aboriginal Population of America North of Mexico*, edited by John R. Swanton. Smithsonian Miscellaneous Collections 80 (Number 7). Smithsonian Institution, Washington D.C.

Moore, Bruce M.
1978 Are Pueblo Field Houses a Function of Urbanization? In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 9-16. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

1980 *Pueblo Isolated Small Structure Sites*. Ph.D. dissertation. Southern Illinois University, Carbondale. University Microfilms, Ann Arbor.

Moore, James L.
1995 Prehistoric Irrigation at Pot Creek Pueblo. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 209-220. New Mexico Archaeological Council Special Publications 2. Albuquerque.

Morley, Selma E.
2002 *Stylistic Variation and Group Self-Identity: Evidence from the Rio Grande Pueblos*. Ph.D. dissertation. University of California, Los Angeles. University Microfilms, Ann Arbor.

Morrison, Kathleen D.
1994 The Intensification of Production: Archaeological Approaches. *Journal of Archaeological Method and Theory* 1(2):111-159.

1996 Typological Schemes and Agricultural Change: Beyond Boserup in Precolonial South India. *Current Anthropology* 37(4):583-608

Morrow, Baker H. (translator and editor)
1996 *A Harvest of Reluctant Souls: The Memorial of Fray Alonso Benavides, 1630*. University Press of Colorado, Niwot.

Naroll, Raoul
1962 Floor Area and Settlement Population. *American Antiquity* 27(4):587-589.

Nelson, Ben A.
1991 Ceramic Frequency and Use-Life: A Highland Mayan Case in Cross-Cultural Perspective. In *Ceramic Ethnoarchaeology*, edited by William A. Longacre, pp. 162-181. University of Arizona Press, Tucson.

Nelson, Ben A., and Roger Anyon
1996 Fallow Valleys: Asynchronous Occupations in Southwestern New Mexico. *Kiva* 61(3):275-294.

Nelson, Ben A., Timothy A. Kohler and Keith W. Kintigh
1994 Demographic Alternatives: Consequences for Current Models of Southwestern Prehistory. In *Understanding Complexity in the Prehistoric Southwest*, edited by George J. Gumerman and Murray Gell-Mann, pp. 113-146. Addison-Wesley, Reading.

Nelson, Ben A., and Steven A. LeBlanc
1986 *Short-Term Sedentism in the American Southwest: The Mimbres Valley Salado*. University of New Mexico Press, Albuquerque.

Nelson, Ben A., Margaret C. Rugge, and Steven A. LeBlanc
1978 LA 12109: A Small Classic Mimbres Ruin, Mimbres Valley. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 191-206. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

Nelson, Margaret C.
1993 Classic Mimbres Land Use in the Eastern Mimbres Region, Southwestern New Mexico. *Kiva* 59(1):27-47.

1999 *Mimbres During the Twelfth Century: Abandonment, Continuity, and Reorganization*. University of Arizona Press, Tucson.

Nelson, Margaret C., and Michelle Hegmon
2001 Abandonment is Not as It Seems: An Approach to the Relationship between Site and Regional Abanonment. *American Antiquity* 66(2):213-235.

Nelson, Margaret C., and Gregson Schachner
2002 Understanding Abandonments in the North American Southwest. *Journal of Archaeological Research* 10(2):167-206.

Nelson, Nels C.
1913 Ruins of Prehistoric New Mexico. *American Museum Journal* 13(2):63-81.

1914 *Pueblo Ruins of the Galisteo Basin*. Anthropological Papers of the American Museum of Natural History 15, part 1. American Museum of Natural History, New York.

Netting, Robert McC.

1981 *Balancing on an Alp: Ecological Change and Continuity in a Swiss Mountain Community*. Cambridge University Press, Cambridge.

1990 Population, Permanent Agriculture and Polities: Unpacking the Evolutionary Portmanteau. In *The Evolution of Political Systems: Sociopolitics in Small-Scale Sedentary Societies*, edited by Steadman Upham, pp. 21-61. Cambridge University Press, Cambridge.

1993 *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*. Stanford University Press, Stanford.

Newman, Jay R., and Roger L. Nielsen

1985 Initial Notes on the X-ray Fluorescence Sourcing of Northern New Mexico Obsidians. *Journal of Field Archaeology* 12(3):377-383.

Newson, Linda A.

1992 Variaciones Regionales en el Impacto del Dominio Colonial Español en las Poblaciones Indígenas de Honduras y Nicaragua. *Mesoamérica* 24:297-312.

1993 Highland-Lowland Contrasts in the Impact of Old World Diseases in Early Colonial Ecuador. *Social Science and Medicine* 36(9):1187-1195.

1995 *Life and Death in Early Colonial Ecuador*. University of Oklahoma Press, Norman.

Nichols, Deborah L.

1987 Risk and Agricultural Intensification during the Formative Period in the Northern Basin of Mexico. *American Anthropologist* 89(3):596-616.

Nichols, Deborah L., and Shirley Powell

1987 Demographic Reconstruction in the American Southwest: Alternative Behavioral Means to the Same Archaeological Ends. *Kiva* 52(1):193-207.

Nielsen, Axel E.

1991 Trampling the Archaeological Record: An Experimental Study. *American Antiquity* 56(3):483-503.

Odell, George H.

1981 The Morphological Express at Function Junction: Searching for Meaning in Lithic Tool Types. *Journal of Anthropological Research* 37(3):319-342.

Orcutt, Janet D.

1986 Modeling Prehistoric Agricultural Ecology in the Dolores Area. In *Dolores Archaeological Program: Supporting Studies: Settlement and Environment*, compiled by Kenneth Lee Peterson and Janet D. Orcutt, pp. 649-677. US Department of Interior Bureau of Reclamation Engineering and Research Center, Denver.

1991 Environmental Variability and Settlement Changes on the Pajarito Plateau, New Mexico. *American Antiquity* 56(2):315-332.

1993 Villages, Field Houses and Land Use on the Southern Pajarito Plateau. In *Papers on the Early Classic Period Prehistory of the Pajarito Plateau, New Mexico*, edited by Timothy A. Kohler and Angela R. Linse, pp. 87-104. Washington State University Department of Anthropology Reports of Investigations 65. Pullman, Washington.

1999a Demography, Settlement and Agriculture. In *The Bandelier Archeological Survey*, edited by Robert P. Powers and Janet D. Orcutt, pp. 219-308. 2 vols. Intermountain Cultural Resources Management Professional Paper 57. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

1999b Chronology. In *The Bandelier Archeological Survey*, edited by Robert P. Powers and Janet D. Orcutt, pp. 85-116. 2 vols. Intermountain Cultural Resources Management Professional Paper 57. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Orcutt, Janet D., Eric Blinman, and Timothy A. Kohler

1990 Explanations of Population Aggregation in the Mesa Verde Region Prior to A.D. 900. In *Perspectives on Southwestern Prehistory*, edited by Paul E. Minnis and Charles L. Redman, pp. 196-212. Westview Press, Boulder.

Ortiz, Alfonso (editor)

1972 *New Perspectives on the Pueblos.* University of New Mexico Press, Albuquerque.

Orton, Clive

1982 Computer Simulation Experiments to Assess the Performance of Measures of Quantity of Pottery. *World Archaeology* 14(1):1-20.

1993 How Many Pots Make Five?—An Historical Review of Pottery Quantification. *Archaeometry* 35(2):169-184.

Owsley, Douglas W.

1992 Demography of Prehistoric and Early Historic Northern Plains Populations. In *Disease and Demography in the Americas*, edited by John W. Verano and Douglas H. Ubelaker, pp. 75-86. Smithsonian Institution Press, Washington D.C.

Paisano, Edna L.

1993 *We, the First Americans*. U.S. Census Bureau, United States Department of Commerce, Washington D.C.

Palkovich, Ann M.

1985 Historic population of the Eastern Pueblos: 1540-1910. *Journal of Anthropological Research* 41(3):401-426.

1994 Historic Epidemics of the American Pueblos. *In the Wake of Contact: Biological Responses to Conquest*, edited by Clark Spenser Larsen and George R. Milner, pp. 87-95. Wiley-Liss, New York.

1996 Historic depopulation in the American Southwest: Issues of interpretation and context-embedded analysis. In *Bioarchaeology of Native Adaptation in the Spanish Borderlands*, edited by Brenda J. Baker and Lisa Kealhofer, pp. 179-197. University Press of Florida, Gainesville.

Parsons, Elsie Clews

1939 *Pueblo Indian Religion*. 2 vols. University of Chicago Press, Chicago.

Pauketat, Timothy R.

1989 Monitoring Mississippian Homestead Occupation Span and Economy using Ceramic Refuse. *American Antiquity* 54(2):288-310.

Perez, Hector

1997 Estimates of the Indigenous Population of Central America (16th to 20th Centuries). In *Demographic Diversity and Change in the Central American Isthmus*, edited by Anne R. Pebley and Luis Rosero-Bixby, pp. 97-115. Rand, Santa Monica.

Perttula, Timothy K.
1991 European Contact and its Effects on Aboriginal Caddoan Populations between A.D. 1520 and A.D. 1680. In *Columbian Consequences, Volume 3: The Spanish Borderlands in Pan-American Perspective*, edited by David Hurst Thomas, pp. 501-518. Smithsonian Institution Press, Washington D.C.

1992 *"The Caddo Nation:" Archaeological and Ethnohistoric Perspectives*. University of Texas Press, Austin.

2002a Social Changes among the Caddo Indians in the Sixteenth and Seventeenth Centuries. In *The Transformation of the Southeastern Indians, 1540-1760*, edited by Robbie Ethridge and Charles Hudson, pp. 249-321. University Press of Mississippi, Jackson.

2002b Caddoan Area Protohistory and Archaeology. In *Between Contacts and Colonies: Archaeological Perspectives on the Protohistoric Southeast*, edited by Cameron B. Wesson and Mark A. Rees, pp. 49-66. University of Alabama Press, Tuscaloosa.

Peterson, John, Christian B. Nightengale, Ada González-Peterson, and Lori Hawthorne
1992 Lower Jemez Data Recovery Project: Sites AR-03-10-03-1806, AR-03-10-03-2055, and AR-03-10-03-2056, Jemez Ranger District, Santa Fe National Forest. New World Consultants, Inc. Report submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwestern Region, Albuquerque.

Phillips, David A. Jr.
1989 The Prehistory of Chihuahua and Sonora, Mexico. *Journal of World Prehistory* 3(4):373-401.

Phillips, David A. Jr., and John P. Carpenter
1999 The Robles Phase of the Casas Grandes Culture. In *The Casas Grandes World*, edited by Curtis Schaafsma and Carroll Riley, pp. 78-83. University of Utah Press, Salt Lake City.

Pieper, Rex D., and Roger D. Wittie
1990 Fire Effects in Southwestern Chaparral and Pinyon-Juniper Vegetation. In *Effects of Fire Management of Southwestern Natural Resources: Proceedings of the Symposium, November 15-17, 1988, Tucson, AZ* , edited by J.S. Krammes, pp. 87-93. USDA, Forest Service General Technical Report RM-191. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins.

Pilles, Peter J., Jr.
1969 Habitation and Field Houses near Winona and Angell, Arizona. *Kiva* 34(2-3):90-102.

1978 The Field House and Sinagua Demography. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 119-133. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

1996 The Pueblo III Period along the Mogollon Rim: The Honaki, Elden, and Turkey Hill Phases of the Sinagua. In *The Prehistoric Pueblo World, A.D. 1150-1350*, edited by Michael A. Adler, pp. 59-72. University of Arizona Press, Tucson.

Plog, Fred
1974 *The Study of Prehistoric Change*. Academic Press, New York.

1975 Demographic Studies in Southwestern Prehistory. In *Archaeology and Physical Anthropology: A Symposium*, edited by Alan C. Swedlund, pp. 94-103. Society for American Archaeology Memoirs 30. Society for American Archaeology, Washington D.C.

1979 Prehistory: Western Anasazi. In *Southwest*, edited by Alfonso Ortiz, pp. 108-130. Handbook of North American Indians, Vol. 9, William C. Sturtevant, general editor, Smithsonian Institution, Washington D.C.

1983 Political and Economic Alliances on the Colorado Plateaus, A.D. 400 to 1450. *Advances in World Archaeology* 2:289-330.

Plog, Fred, and Cheryl K. Garrett
1972 Explaining Variability in Prehistoric Southwestern Water Control Systems. In *Contemporary Archaeology: A Guide to Theory and Contributions*, edited by Mark Leone, pp. 280-288. Southern Illinois University Press, Carbondale.

Plog, Stephen
1986 Patterns of Demographic Growth and Decline. In *Spatial Organization and Exchange: Archaeological Survey on Northern Black Mesa*, edited by Stephen Plog, pp. 224-255. Southern Illinois University Press, Carbondale.

Plog, Stephen, and Michelle Hegmon
1993 The Sample Size-Richness Relation: The Relevance of Research Questions, Sampling Strategies, and Behavioral Variation. *American Antiquity* 58(3):489-496.

Plog, Stephen, Fred Plog, and Walter Wait
1978 Decision Making in Modern Surveys. *Advances in Archaeological Method and Theory, Volume 1*, edited by Michael B. Schiffer, pp. 383-421. Academic Press, New York.

Powell, Melissa
2002 Ceramics. *From Folsom to Fogelson :The Cultural Resources Inventory Survey of Pecos National Historical Park*, edited by Genevieve N. Head and Janet D. Orcutt, pp. 237-304. 2 vols. Intermountain Cultural Resources Management Professional Paper 66. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Powell, Melissa, and Karl K. Benedict
2002 Ceramic Chronology. *From Folsom to Fogelson :The Cultural Resources Inventory Survey of Pecos National Historical Park*, edited by Genevieve N. Head and Janet D. Orcutt, pp. 59-98. 2 vols. Intermountain Cultural Resources Management Professional Paper 66. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Powell, Shirley
1983 *Mobility and Adaptation: The Anasazi of Black Mesa, Arizona*. Southern Illinois University Press, Carbondale.

1988 Anasazi Demographic Patterns and Organizational Responses: Assumptions and Interpretive Difficulties. In *The Anasazi in a Changing Environment*, edited by George J. Gumerman, pp. 168-191. Cambridge University Press, Cambridge.

Powers, Robert P., and Janet D. Orcutt (editors)
1999 *The Bandelier Archeological Survey*. 2 vols. Intermountain Cultural Resources Management Professional Paper 57. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Powers, Robert P., Tineke Van Zandt, James M. Vint, and Genevieve N. Head
1999 Site Typology. In *The Bandelier Archeological Survey*, edited by Robert P. Powers and Janet D. Orcutt, pp. 117-218. 2 vols. Intermountain Cultural Resources Management Professional Paper 57. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Preucel, Robert W., Jr.
1987 Settlement Succession on the Pajarito Plateau, New Mexico. *Kiva* 53(1):3-33.

1990 *Seasonal Circulation and Dual Residence in the Pueblo Southwest*. Garland, New York.

2000 Making Pueblo Communities: Architectural Discourse at Kotyiti, New Mexico. In *The Archaeology of Communities: A New World Perspective*, edited by Marcello-Andrea Canuto and Jason Yaeger, pp. 58-77. Routledge, London.

Preucel, Robert W. Jr., Loa P. Traxler, and Michael V. Wilcox
2002 "Now that the God of the Spaniards is Dead:" Ethnogenesis and Community Formation in the Aftermath of the Pueblo Revolt of 1680. In *Traditions, Transitions, and Technologies: Themes in Southwestern Archaeology*, edited by Sarah H. Schlanger, pp. 71-93. University of Colorado Press, Boulder.

Pryor, Frederic L.
1986 The Adoption of Agriculture: Some Theoretical and Empirical Evidence. *American Anthropologist* 88(4):879-897.

Railey, Jim A.
1999 Enviromental Background. In *Ancestral Jemez Archaeology: Excavations at Three Field House Sites at Horseshoe Springs, Sandoval County, New Mexico*, edited by John C. Acklen and Jim A. Railey, pp. 63-104. TRC Project 23245. Submitted to USDA Forest Service, Santa Fe National Forest. Copies available from USDA Forest Service, Southwestern Region, Albuquerque.

Raish, Carol
1992 *Resurvey of the Area of the Henry Fire Cultural Resource Report, Jemez Ranger District, Santa Fe National Forest*. Santa Fe National Forest Report 1991-10-127B. Submitted to USDA Forest Service, Santa Fe National Forest. Copies available from USDA Forest Service, Southwestern Region, Albuquerque.

Ramenofsky, Ann F.
1987 *Vectors of Death: The Archaeology of European Contact*. University of New Mexico Press, Albuquerque.

1990 Loss of Innocence: Explanations of Differential Persistence in the Sixteenth-Century Southeast. In *Columbian Consequences, Volume 2: Archaeological and Historical Perspectives on the Spanish Borderlands East*, edited by David Hurst Thomas, pp. 31-48. Smithsonian Institution Press, Washington D.C.

1992 Diseases of the Americas, 1492-1700. In *The Cambridge World History of Disease*, edited by Kenneth F. Kiple, pp. 317-327. Cambridge University Press, Cambridge.

1996 The Problem of Introduced Infectious Diseases in New Mexico: AD 1540-1680. *Journal of Anthropological Research* 52(2):161-184.

2000 Decoupling Archaeology from History: Northern New Mexico. In *The Entangled Past: Integrating History and Archaeology,* edited by M. Bond, J.C. Erwin and M. Henrickson, pp. 51-64. Proceedings of the 30th Chacmool Conference, University of Calgary, Calgary.

Ramenofsky, Ann F., and James K. Feathers
2002 Documents, Ceramics, Tree Ring Dates and Luminescence: Estimating Final Native Abandonment of the Lower Rio Chama. *Journal of Anthropological Research* 58(1):121-159.

Ramenofsky, Ann F., and Anastasia Steffen
1998 Units as Tools of Measurement. In *Unit Issues in Archaeology: Measuring Time, Space, and Material*, edited by Ann F. Ramenofsky and Anastasia Steffen, pp. 3-17. University of Utah Press, Salt Lake City.

Redman, Charles L.
1987 Surface Collection, Sampling and Research Design: A Retrospective. *American Antiquity* 52(2):249-265.

Reed, Heidi E., and John R. Stein
1998 Testing the Pecos Classification. In *Unit Issues in Archaeology: Measuring Time, Space and Material*, edited by Ann F. Ramenofsky and Anastasia Steffen, pp. 41-51. University of Utah Press, Salt Lake City.

Reed, Lori Stephens, and Joell Goff
1999 Ceramic Artifacts. In *Ancestral Jemez Archaeology: Excavations at Three Field House Sites at Horseshoe Springs, Sandoval County, New Mexico*, edited by John C. Acklen and Jim A. Railey, pp. 63-104. TRC Project 23245. Submitted to USDA Forest Service, Santa Fe National Forest. Copies available from USDA Forest Service, Southwestern Region, Albuquerque.

Reed, Lori Stephens, and Paul F. Reed
1992 The Protohistoric Navajo: Implications of Interaction, Exchange, and Alliance Formation with the Eastern and Western Pueblos. In *Cultural Diversity and Adaptation: The Archaic, Anasazi and Navajo Occupation of the Upper San Juan Basin*, edited by Lori Stephens Reed and Paul F.Reed, pp. 91-104. USDOI Bureau of Land Management, New Mexico State Office, Santa Fe.

Reff, Daniel T.
1981 The Location of Corazones and Señora: Archaeological Evidence from the Rio Sonora Valley, Mexico. In *The Protohistoric Period in the North American Southwest, AD 1450-1700*, edited by David R. Wilcox and W. Bruce Masse, pp. 94-112. Arizona State University Anthropological Papers 24. Arizona State University, Tempe.

1991 *Disease, Depopulation, and Culture Change in Northwestern New Spain, 1518-1764*. University of Utah Press, Salt Lake City.

1993 An Alternative Explanation of Subsistence Change During the Early Historic Period at Pecos Pueblo. *American Antiquity* 58(3):563-564.

1994 Contextualizing Missionary Discourse: The Benavides *Memorials* of 1630 and 1634. *Journal of Anthropological Research* 60(1):51-67.

Reiter, Paul
1938 *The Jemez Pueblo of Unshagi, New Mexico, with Notes on the Earlier Excavations at "Amoxiumqua" and Guisewa*. Two parts. University of New Mexico and School of American Research Monograph 1(4-5). University of New Mexico Press, Albuquerque.

1939 *Report of Archaeological Excavations on the Santa Fe National Forest*. University of New Mexico. Submitted to the Smithsonian Institution. Copies available from the Bureau of American Ethnology Catalogue of Manuscripts (number 4070), National Museum of Natural History, Smithsonian Institution, Washington D.C.

Reiter, Paul, William T. Mulloy and E.H. Blumenthal Jr.
1940 Preliminary report of the Jemez excavation at Nanishagi, New Mexico. *University of New Mexico Bulletin Anthropological Series* 3(3). University of New Mexico Press, Albuquerque.

Reneau, Steven L., Jamie N. Gardner, and Steven L. Forman
1996 New evidence for the age of the youngest eruptions in the Valles caldera, New Mexico. *Geology* 24(1):7-10.

Riley, Carroll L.
1974 Mesoamerican Indians in the Early Southwest. *Ethnohistory* 21(1):25-36.

1995 *Rio del Norte: People of the Upper Rio Grande from Earliest Times to the Pueblo Revolt*. University of Utah Press, Salt Lake City.

Roberts, Heidi, and Richard V.N. Ahlstrom
1997 Malaria, Microbes and Mechanisms of Change. *Kiva* 63(2):117-135.

Rocek, Thomas R.
1998 Pithouses and Pueblos on Two Continents: Interpretations of Sedentism and Mobility in the Southwestern United States and Southwest Asia. In *Seasonality and Sedentism: Archaeological Perspectives from Old and New World Sites*, edited by Thomas R. Rocek and Ofer Bar-Yosef, pp. 199-216. Peabody Museum Bulletin 6. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge.

Rodning, Christopher B.
2002 Reconstructing the Coalescence of Cherokee Communities in Southern Appalachia. In *The Transformation of the Southeastern Indians, 1540-1760*, edited by Robbie Ethridge and Charles Hudson, pp. 155-175. University Press of Mississippi, Jackson.

Rogers, John Blackwell
1996 The Fluvial Landscape Evolution of San Diego Canyon, Jemez Mountains, New Mexico. Unpublished Master's thesis, Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque.

Rohn, Arthur H.
1963 Prehistoric Soil and Water Conservation on Chapin Mesa, Southwestern Colorado. *American Antiquity* 28(4):441-455.

Roney, John R.
1995 Mesa Verdean Manifestations South of the San Juan River. *Journal of Anthropological Archaeology* 14(2):170-183.

1996 The Pueblo III Period in the Eastern San Juan Basin and Acoma-Laguna Areas. In *The Prehistoric Pueblo World, A.D. 1150-1350*, edited by Michael A. Adler, pp. 145-169. University of Arizona Press, Tucson.

Rose, Martin R., Jeffrey S. Dean, and William J. Robinson
1981 *The Past Climate of Arroyo Hondo, New Mexico, Reconstructed from Tree Rings*. Arroyo Hondo Archaeological Series 4. School of American Research Press, Santa Fe.

Rothschild, Nan A., Barbara J. Mills, T.J. Ferguson, and Susan Dublin

1993 Abandonment in Zuni Farming Villages. In *Abandonment of Settlements ad Regions: Archaeological and Ethnoarchaeological Approaches*, edited by Catherine M. Cameron and S.A. Tomka, pp. 123-137. Cambridge University Press, New York.

Ruff, Christopher B., and Clark Spenser Larsen

1990 Postcranial Biomechanical Adaptations to Subsistence Strategy Changes on the Georgia Coast. In *Biocultural Interpretations of a Population in Transition*, edited by Clark Spenser Larsen, pp. 94-120. Archaeology of Mission Santa Catalina de Guale 2. American Museum of Natural History Anthropological Papers 68. American Museum of Natural History, New York.

2001 Reconstructing Behavior in Spanish Florida: The Biomechanical Evidence. *Bioarchaeology of Spanish Florida: The Impact of Colonialism*, edited by Clark Spenser Larsen, pp. 113-145. University Press of Florida, Gainesville.

Ruscavage-Barz, Samantha M.

2002a Classic Period Small Structure Function and Variability on the Pajarito Plateau. In *Forward into the Past: Papers in Honor of Teddy Lou and Francis Stickney*, edited by Regge N. Wiseman, Thomas C. O'Laughlin and Cordelia T. Snow, pp. 81-92. Archaeological Society of New Mexico Papers 28. Albuquerque.

2002b Understanding Santa Fe Black-on-white Style and Technology: An Example from the Pajarito Plateau, New Mexico. *Kiva* 67(3):249-268.

Rushforth, Scott, and Steadman Upham

1992 *A Hopi Social History: Anthropological Perspectives on Sociocultural Persistence and Change*. University of Texas Press, Austin.

Sale, Kirkpatrick

1990 The Conquest of Paradise: Christopher Columbus and the Columbian Legacy. Penguin, New York.

Sallade, Jane K., and David P. Braun

1982 Spatial Organization of Peasant Agricultural Subsistence Territories: Distance Factors and Crop Location. In *Ethnography by Archaeologists: 1978 Proceedings of the American Ethnological Society*, edited by Elisabeth Tooker, pp. 19-41. American Ethnological Society, Washington D.C.

Salzer, Matthew W.

2000 Temperature Variability and the Northern Anasazi: Possible Implications for Regional Abandonment. *Kiva* 65:295-318.

Sanders, William T. and Thomas W. Killion

1992 Factors Affecting Settlement Agriculture in the Ethnographic and Historic Record of Mesoamerica. In *Gardens of Prehistory: The Archaeology of Settlement Agriculture in Greater Mesoamerica*, edited by Thomas W. Killion, pp. 14-31. University of Alabama Press, Tuscaloosa.

Sando, Joe S.

1979 Jemez Pueblo. In *Southwest*, edited by Alfonso Ortiz, pp. 418-429. Handbook of North American Indians, Vol. 9, William C. Sturtevant, general editor, Smithsonian Institution, Washington D.C.

1982 *Nee Hemish: A History of Jemez Pueblo*. University of New Mexico Press, Albuquerque.

1992 *Pueblo Nations: Eight Centuries of Pueblo Indian History*. Clear Light, Santa Fe.

Sandor, Jonathan A.

1992 Long-Term Effects of Prehistoric Agriculture on Soils: Examples from New Mexico and Peru. In *Soils in Archaeology: Landscape Evolution and Human Occupation*, edited Vance T. Holliday, pp. 217-245. Smithsonian Institution Press, Washington D.C.

1995 Searching Soil for Clues About Southwest Prehistoric Agriculture. In *Soil, Water, Biology and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 119-143. New Mexico Archaeological Council Special Publications 2. Albuquerque.

Sandor, J.A., P.L. Gersper, and J.W. Hawley

1990 Prehistoric Agricultural Terraces and Soils in the Mimbres Area, New Mexico. *World Archaeology* 22(1):70-86.

Santley, Robert S.

1992 A Consideration of the Olmec Phenomenon in the Tuxtlas: Early Formative Settlement Pattern, Land Use, and Refuse Disposal at Matacapan, Veracruz, Mexico. In *Gardens of Prehistory: The Archaeology of Settlement Agriculture in Greater Mesoamerica*, edited by Thomas W. Killion, pp. 150-183. University of Alabama Press, Tuscaloosa.

Savage, Melissa

1991 Structural Dynamics of a Southwestern Pine Forest under Chronic Human Influence. *Annals of the Association of American Geographers* 81(2):271-289.

Schaafsma, Curtis F.

2002 Pueblo and Apachean Alliance Formation in the Seventeenth Century. In *Archaeologies of the Pueblo Revolt: Identity, Meaning and Renewal in the Pueblo World*, edited by Robert W. Preucel, pp. 198-211. University of New Mexico Press, Albuquerque.

Schacht, Robert M.

1981 Estimating Past Population Trends. *Annual Review of Anthropology* 10:119-140.

1984 The Contemporaneity Problem. *American Antiquity* 49(4):678-695.

Schiffer, Michael B.

1987 *Formation Processes of the Archaeological Record*. University of New Mexico Press, Albuquerque.

Schlanger, Sarah H.

1986 Population Studies. In *Dolores Archaeological Program: Final Synthetic Report*, compiled by David A. Breternitz, Christine K. Robinson and G. Timothy Gross, pp. 493-523. United States Department of Interior Bureau of Reclamation Engineering and Research Center, Denver.

1988 Patterns of Population Movement and Long-Term Population Growth in Southwestern Colorado. *American Antiquity* 53(4):773-793.

1990 Artifact Assemblage Composition and Site Occupation Duration. In *Perspectives on Southwestern Prehistory*, edited by Paul E. Minnis and Charles L. Redman, pp. 103-121. Westview Press, Boulder.

1991 On Manos, Metates and the History of Site Occupations. *American Antiquity* 56(3):460-474.

1992 Recognizing Persistent Places in Anasazi Settlement Systems. In *Space, Time and Archaeological Landscapes*, edited by Jacqueline Rossignol and LuAnn Wandsnider, pp. 91-112. Plenum Press, New York.

Schlanger, Sarah H., and Janet D. Orcutt
1986 Site Surface Characteristics and Functional Inferences. *American Antiquity* 51(2):296-312.

Schmader, Matthew F.
1986 *Testing and Evaluation of LA 55183, A Small Special Activity Site near Ponderosa, NM*. University of New Mexico Office of Contract Archeology Proposal 185-303. Report submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwestern Region, Albuquerque.

Schoenwetter, James, and Alfred E. Dittert, Jr.
1968 An Ecological Interpretation of Anasazi Settlement Patterns. In *Anthropological Archeology in the Americas*, edited by Betty J. Meggers, pp. 41-66. Anthropological Society of Washington, Washington D.C.

Scholes, France V.
1929 Documents for the History of the New Mexican Missions in the Seventeenth Century. *New Mexico Historical Review* 4(1):45-58, 4(2):195-201.

1930 The Supply Service of the New Mexico Missions in the Seventeenth Century. *New Mexico Historical Review* 5(1):93-115.

1932 Problems in the Early Ecclesiastical History of New Mexico. *New Mexico Historical Review* 7(1):32-74.

1935 Civil Government and Society in New Mexico in the Seventeenth Century. *New Mexico Historical Review* 10(2):77-113.

1936-1937 Church and State in New Mexico, 1610-1650. *New Mexico Historical Review* 11(1):9-76, 11(2):145-178, 11(3):283-294, 11(4):297-349, 12(1):78-106.

1937-1941 Troublous Times in New Mexico, 1659-1670. *New Mexico Historical Review* 12(2):134-174, 12(4):380-452, 13(1):63-84, 15(3):249-268, 16(1):15-40, 16(2):184-205; 16(3):313-327.

1938 Notes on the Jemez Missions in the Seventeenth Century. *El Palacio* 44(7-9):61-71, 44(13-15):93-102.

1944 Correction. *New Mexico Historical Review* 19(3):243-246.

Scholes, France V., and Lansing B. Bloom
1944-1945 Friar Personnel and Mission Chronology, 1598-1629. *New Mexico Historical Review* 19(4):319-336, 20(1):58-82.

Schroeder, Albert H.
1963 Navajo and Apache Relationships West of the Rio Grande. *El Palacio* 70(3):5-23.

1967-1968 An Archeological Survey Adjacent to Hovenweep National Monument. *Southwestern Lore* 33(3-4):61-94.

1968 Shifting for Survival in the Spanish Southwest. *New Mexico Historical Review* 43(4):291-310.

1979 Pueblos Abandoned in Historic Times. In *Southwest*, edited by Alfonso Ortiz, pp. 236-254. Handbook of North American Indians, Vol. 9, William C. Sturtevant, general editor, Smithsonian Institution, Washington D.C.

1992 Protohistoric Pueblo Demographic Changes. In *Current Research on the Late Prehistory and Early History of New Mexico*, edited by Bradley J. Vierra, pp. 29-35. New Mexico Archaeological Council Special Publication 1. Albuquerque.

Schultz, Michael, Clark Spenser Larsen, and Kerstin Kreutz
2001 Disease in Spanish Florida: Microscopy of Porotic Hyperostosis and Cribra Orbitalia. In *Bioarchaeology of Spanish Florida: The Impact of Colonialism*, edited by Clark Spenser Larsen, pp. 207-225. University Press of Florida, Gainesville.

Schwartz, Douglas W.
1960 Archaeological Investigations in the Shinumo Area of Grand Canyon, Arizona. *Plateau* 32(1):61-67.

Sciscenti, James V.
1962 *The Cañon de San Diego Ruin: Salvage Excavations at LA 5688*. Laboratory of Anthropology Note 12. Santa Fe.

Scurlock, Dan
1981 Euro-American History of the Study Area. In *High Altitude Adaptations Along Redondo Creek: The Baca Geothermal Anthropological Project*, edited by Craig Baker and Joseph C. Winter, pp. 131-160. Office of Contract Archeology, University of New Mexico, Albuquerque.

Sebastian, Lynne
1983 Anasazi Site Typology and Chronology. In *Economy and Interaction along the Lower Chaco River: The Navajo Mine Archaeological Program, Mining Area III, San Juan County, New Mexico, edited by Patrick Hogan and Joseph C. Winter*, pp. 403-419. Office of Contract Archeology and the Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

Self, Stephen, Fraser Goff, Jamie N. Gardner, John V. Wright and William M. Kite
1986 Explosive Rhyolitic Volcanism in the Jemez Mountains: Vent Locations, Caldera Development and Relation to Regional Structure. *Journal of Geophysical Research B* 91(2):1779-1798.

Self, Stephen, Grant Heiken, Martha L. Sykes, Kenneth Wohletz, Richard V. Fisher, and David P. Dethier
1996 *Field Excursions to the Jemez Mountains, New Mexico*. New Mexico Bureau of Mines and Mineral Resources Bulletin 134. New Mexico Institute of Mining and Technology, Socorro.

Sen, Amartya
1981 *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford University Press, New York.

Shennan, Stephen
1997 *Quantifying Archaeology*. Second edition. University of Iowa Press, Iowa City.

2000 Population, Culture History, and the Dynamics of Culture Change. *Current Anthropology* 41(5):811-835.

2001 Demography and Cultural Innovation: A Model and its Implications for the Emergence of Modern Human Culture. *Cambridge Archaeological Journal* 11(1):5-16.

Shepard, Anna O.
1938 Appendix VI: Technological Notes on the Pottery from Unshagi. In *The Jemez Pueblo of Unshagi, New Mexico, with Notes on the Earlier Excavations at "Amoxiumqua" and Guisewa*, by Paul Reiter, pp. 205-211. University of New Mexico and School of American Research Monograph 1(4-5). 2 parts. University of New Mexico Press, Albuquerque.

1942 *Rio Grande Glaze Paint Ware: A Study Illustrating the Place of Ceramic Technological Analysis in Archaeological Research*. Carnegie Institution Contributions to American Anthropology and History 39, pp. 132-262. Carnegie Institution of Washington, Washington D.C.

1956 *Ceramics for the Archaeologist*. Carnegie Institution of Washington Publication 609. Carnegie Institution of Washington, Washington D.C.

Shoemaker, Nancy
1999 *American Indian Population Recovery in the Twentieth Century*. University of New Mexico Press, Albuquerque.

Shott, Michael J.
1989a Diversity, Organization and Behavior in the Material Record: Ethnographic and Archaeological Examples. *Current Anthropology* 30(3):283-315.

1989b On Tool-Class Use Lives and the Formation of Archaeological Assemblages. *American Antiquity* 54(1):9-30.

1996 Mortal Pots: On Use Life and Vessel Size in the Formation of Ceramic Assemblages. *American Antiquity* 61(1):463-482.

Simmons, Alan H.
1998 Exposed Fragments, Buried Hippos: Assessing Surface Archaeology. In *Surface Archaeology*, edited by Alan P. Sullivan III, pp. 159-167. University of New Mexico Press, Albuquerque.

Simmons, Marc
1964 Tlascalans in the Spanish Borderlands. *New Mexico Historical Review* 39(2):101-110.

1969 Settlement Patterns and Village Plans in Colonial New Mexico. *Journal of the West* 8(1):7-21.

1979 History of Pueblo-Spanish Relations to 1821. In *Southwest*, edited by Alfonso Ortiz, pp. 178-193. Handbook of North American Indians, Vol. 9, William C. Sturtevant, general editor, Smithsonian Institution, Washington. D.C.

Skibo, James M., Michael B. Schiffer, and Kenneth C. Reid
1989 Organic-tempered Pottery: An Experimental Study. *American Antiquity* 54(1):122-146.

Skinner, S. Alan
1965 A Survey of Field Houses at Sapawe, North Central New Mexico. *Southwestern Lore* 31(1):18-24.

Smith, Marvin T.
1987 *Archaeology of Aboriginal Culture Change in the Interior Southeast: Depopulation During the Early Historic Period*. University Press of Florida, Gainesville.

1989 Aboriginal Population Movements in the Early Historic Period Interior Southeast. In *Powatan's Mantle: Indians in the Colonial Southeast*, edited by Peter H. Wood, Gregory A. Waselkov, and M. Thomas Hatley, pp. 21-34. University of Nebraska Press, Lincoln.

1994 Aboriginal Depopulation in the Postcontact Southeast. In *The Forgotten Centuries: Indians and Europeans in the American South, 1521-1704*, edited by Charles Hudson and Carmen Chaves Tesser, pp. 257-275. University of Georgia Press, Athens.

2000 *Coosa : The Rise and Fall of a Southeastern Mississippian Chiefdom*. University Press of Florida, Gainseville.

Smith, Michael E., and T. Jeffrey Price
1994 Aztec-Period Agricultural Terraces in Morelos, Mexico: Evidence for Household-level Agricultural Intensification. *Journal of Field Archaeology* 21(2):169-179.

Smith, R.L., R.A. Bailey and C.S. Ross
1970 *Geologic Map of the Jemez Mountains*. Miscellaneous Investigations Series Map I-571. U.S. Geological Survey, Denver.

Snead, James E.
1995 Beyond Pueblo Walls: Community and Competition in the Northern Rio Grande, A.D. 1300-1400. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

2001 *Ruins and Rivals: The Making of Southwest Archaeology*. University of Arizona Press, Tucson.

Snow, Cordelia Thomas
1974 A Brief History of the Palace of the Governors and a Preliminary Report on the 1974 Excavation. *El Palacio* 80(1):1-22.

1979 The Evolution of a Frontier: An Historical Interpretation of Archeological Sites. In *Archeological Investigations in Cochiti Reservoir, New Mexico, Volume 4: Adaptive Change in the Northern Rio Grande Valley*, edited by Jan V. Biella and Richard C. Chapman, pp. 217-234. University of New Mexico Office of Contract Archeology, Albuquerque.

Snow, David H.
1982 The Rio Grande Glaze, Matte-Paint, and Plainware Tradition. In *Southwestern Ceramics: A Comparative Review*, edited by Albert H. Schroeder, pp. 235-278. The Arizona Archaeologist 15. Arizona Archaeological Society, Phoenix.

1983 A Note on Encomienda Economics in Seventeenth-Century New Mexico. In *E. Boyd, Pioneer Scholar of Spanish Colonial Culture in the Southwest*, edited by Marta Weigle, pp. 347-357. University of New Mexico Press, Albuquerque.

Snow, Dean R.
1995 Microchronology and Demographic Evidence Relating to the Size of Pre-Columbian North American Indian Populations. *Science* 268:1601-1604

1996 Mohawk Demography and the Effects of Exogenous Epidemics on American Indian Populations. *Journal of Anthropological Archaeology* 15(2):160-182.

Snow, Dean R., and Kim M. Lanphear
1988 European Contact and Indian Depopulation in the Northeast: The Timing of the First Epidemics. *Ethnohistory* 35(1):15-33.

Snow, Dean R. and William A. Starna
1989 Sixteenth-Century Depopulation: A View from the Mohawk Valley. *American Anthropologist* 91(1):142-149.

Spielmann, Katherine A.
1989 Colonists, Hunters, and Farmers: Plains-Pueblo Interaction in the Seventeenth Century. In *Columbian Consequences, Volume 1: Archaeological and Historical Perspectives on the Spanish Borderlands West,* edited by David Hurst Thomas, pp. 101-113. Smithsonian Institution Press, Washington D.C.

Spielmann, Katherine, Margaret Schoeninger, and Karen Moore
1990 Plains-Pueblo Interdependence and Human Diet at Pecos Pueblo, New Mexico. *American Antiquity* 55(4):745-766.

Stannard, David E.
1992 *American Holocaust: Columbus and the Conquest of the New World*. Oxford University Press, New York.

Statistics Canada
1996 Population by Aboriginal Group, 1996 Census. Statistics Canada, Ottawa. Electronic document, http:www.statcan.ca/English/Pgdb/People/Population/demo39a.htm. Accessed April 14, 2002.

Stearns, Thomas B.
1981 Palynological Evidence of the Prehistoric Effective Environment. In *High Altitude Adaptations Along Redondo Creek: The Baca Geothermal Anthropological Project*, edited by Craig Baker and Joseph C. Winter, pp. 25-39. Office of Contract Archeology, University of New Mexico, Albuquerque.

Steele, Ian K.
1994 *Warpaths: Invasions of North America*. Oxford University Press, New York.

Stewart, Guy R.
1940 Conservation in Pueblo Agriculture. *Scientific Monthly* 51(3):201-220, 51(4):329-340.

Stewart, Guy R., and Maurice Donnelly
1943 Soil and Water Economy in the Pueblo Southwest. *Scientific Monthly* 56(1):31-44, 56(2):134-144.

Stodder, Ann L.W.
1990 Paleoepidemiology of Eastern and Western Pueblo Communities in Protohistoric New Mexico. Unpublished Ph.D. dissertation, Department of Anthropology, University of Colorado, Boulder.

1996 Paleoepidemiology of Eastern and Western Pueblo Communities in Protohistoric and Early Historic New Mexico. In *Bioarchaeology of Native Adaptation in the Spanish Borderlands*, edited by Brenda J. Baker and Lisa Kealhofer, pp. 148-176. University Press of Florida, Gainesville.

Stodder, Ann L.W., and Debra L. Martin
1992 Native Health and Disease in the Southwest before and after Spanish Contact. In *Disease and Demography in the Americas*, edited by John W. Verano and Douglas H. Ubelaker, pp. 55-74. Smithsonian Institution Press, Washington D.C.

Stone, Glenn Davis
1991 Agricultural Territories in a Dispersed Settlement System. *Current Anthropology* 32(3):343-353.

1994 Agricultural Intensification and Perimetrics: Ethnoarchaeological Evidence from Nigeria. *Current Anthropology* 35(3):317-324.

1996a *Settlement Ecology: The Social and Spatial Organization of Kofyar Agriculture*. University of Arizona Press.

1996b Comments on "Typological Schemes and Agricultural Change: Beyond Boserup in Precolonial South India," by Kathleen D. Morrison. *Current Anthropology* 37(4):600-601.

1998 Settlement Concentration and Dispersal among the Kofyar. In *Rural Settlement Structure and African Development*, edited by Marilyn Silberfein, pp. 75-97. Westview Press, Boulder.

Stone, Glenn Davis, and Christian E. Downum
1999 Non-Boserupian Ecology and Agricultural Risk: Ethnic Politics and Land Control in the Arid Southwest. *American Anthropologist* 101(1):113-128.

Stone, Glenn Davis, Robert McC. Netting and M. Priscilla Stone
1990 Seasonality, Labor Scheduling and Agricultural Intensification in the Nigerian Savanna. *American Anthropologist* 92(1):7-23.

Stone, Tammy
1993 Small Site Function and Duration of Occupation in the Hohokam Northern Periphery. *Kiva* 59(1):65-82.

Sullivan, Alan P., III
1984 Sinagua Agricultural Strategies and Sunset Crater Volcanism. In *Prehistoric Agricultural Strategies in the Southwest*, edited by Suzanne K. Fish and Paul R. Fish, pp. 85-100. Arizona State University Anthropological Research Papers 33. Tempe.

1987 Artifact Scatters, Adaptive Diversity, and Southwestern Abandonment: The Upham Hypothesis Reconsidered. *Journal of Anthropological Research* 43(4):345-360.

1994 Frontiers, Barriers and Crises Today: Colton's Methods and the Wupatki Survey Data. In *The Ancient Southwestern Community: Models and Methods for the Study of Prehistoric Social Organization*, edited by W.H. Wills and Robert D. Leonard, pp. 191-207. University of New Mexico Press, Albuquerque.

1995 Artifact Scatters and Subsistence Organization. *Journal of Field Archaeology* 22(1):49-64.

1998 Preface: Surface Phenomena in Archaeological Research. In *Surface Archaeology*, edited by Alan P. Sullivan III, pp. xi-xiii. University of New Mexico Press, Albuquerque.

Sullivan, Alan P., III, and Christian E. Downum
1991 Aridity, Activity and Volcanic Ash Agriculture: A Study of Short-Term Prehistoric Cultural-Ecological Dynamics. *World Archaeology* 22(3):271-287.

Sullivan, Alan P., III, and Anthony S. Tolonen
1998 Evaluating Assemblage Diversity Measures with Surface Archaeological Data. In *Surface Archaeology*, edited by Alan P. Sullivan III, pp. 143-155. University of New Mexico Press, Albuquerque.

Sullivan, Lynne P., and S. Terry Childs
2003 *Curating Archaeological Collections: From the Field to the Repository*. Archaeologist's Toolkit Vol. 6, Larry J. Zimmerman and William Green, general editors. Altamira Press, Walnut Creek, CA.

Sundt, William M.
1987 Pottery of Central New Mexico and its Role as Key to both Time and Space. In *Secrets of a City: Papers on Albuquerque Area Archaeology in Honor of Richard A. Bice*, edited by Anne V. Poore and John Montgomery, pp. 116-147. Archaeological Society of New Mexico Papers 13. Ancient City Press, Santa Fe.

1991 Migration Clues? Local Varieties of Foreign Pottery Types in the Jemez Mountain Country. In *Puebloan Past and Present: Papers in Honor of Stewart Peckham*, edited by Meliha S. Duran and David T. Kirkpatrick, pp. 165-176. Archaeological Society of New Mexico Papers 17. Albuquerque.

Sutton, Mark Q.
1977 The Archeological Concept of Field House. Unpublished Master's thesis, Department of Anthropology, California State University, Sacramento.

Swedlund, Alan C.
1994 Issues in Demography and Health. In *Understanding Complexity in the Prehistoric Southwest*, edited by George J. Gumerman and Murray Gell-Mann, pp. 39-58. Addison-Wesley, Reading, Massachusetts.

Swedlund, Alan C., and Steven E. Sessions
1976 A Developmental Model of Prehistoric Population Growth on Black Mesa, Northeastern Arizona. In *Papers on the Archaeology of Black Mesa, Arizona*, edited by George C. Gumerman and Robert C. Euler, pp. 136-148. Southern Illinois University Press, Carbondale.

Swetnam, Thomas W.
1990 Fire History and Climate in the Southwestern United States. In *Effects of Fire Management of Southwestern Natural Resources: Proceedings of the Symposium, November 15-17, 1988, Tucson, AZ* , edited by J.S. Krammes, pp. 6-17. USDA, Forest Service General Technical Report RM-191. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins.

Swetnam, Thomas W., and Christian H. Baisan
1996 Historical Fire Regimes in the Southwestern United States Since A.D. 1700. In Fire Effects in Southwestern Forests: Proceedings of the Second La Mesa Fire Symposium, Los Alamos, New Mexico, March 29-31, 1994, edited by Craig D. Allen, pp. 11-32. USDA, Forest Service General Technical Report RM-GTR-286. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins.

Swetnam, Thomas W., and Julio L. Betancourt
1998 Mesoscale Disturbance and Ecological Response to Decadal Climatic Variability in the American Southwest. *Journal of Climate* 11(12):3128-3147.

Teague, Lynne S.
1993 Prehistory and the Traditions of the O'Odham and Hopi. *Kiva* 58(4):435-454.

Thomas, David Hurst
1983 *The Archaeology of Monitor Valley 2: Gatecliff Shelter*. American Museum of Natural History Anthropological Papers 59(1). New York.

Thornton, Russell
1987 American Indian Holocaust and Survival: A Population History Since 1492. University of Oklahoma Press, Norman.

2000 Population History of Native North Americans. In *A Population History of North America*, edited by Michael R. Haines and Richard H. Steckel, pp. 9-50. Cambridge University Press, Cambridge.

Titiev, Mischa
1944 *Old Oraibi, A Study of the Hopi Indians of Third Mesa*. Papers of the Peabody Museum, Harvard University 22(1). Cambridge.

Touchan, Ramzi, Craig D. Allen, and Thomas W. Swetnam
1996 Fire History and Climatic Patterns in Ponderosa Pine and Mixed Conifer Forests of the Jemez Mountains, Northern New Mexico. In *Fire Effects in Southwestern Forests: Proceedings of the Second La Mesa Fire Symposium, Los Alamos, New Mexico, March 29-31, 1994*, edited by Craig D. Allen, pp. 33-46. USDA, Forest Service General Technical Report RM-GTR-286. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins.

Toulouse, Joseph H., Jr.
1937a Excavations at San Diego Mission, New Mexico. *New Mexico Anthropologist* 2(1):16-18.

1937b Two artifacts from Jemez. *El Palacio* 43(19-21):107-108.

1945 Early Water Systems at Gran Quivira National Monument. *American Antiquity* 10(4):362-372.

1949 *The Mission of San Gregorio de Abó; A Report on the Excavation and Repair of a Seventeenth-Century New Mexico Mission*. University of New Mexico Press, Albuquerque.

Toulouse, Joseph H., and Robert L. Stephenson
1960 *Excavations at Pueblo Pardo, Central New Mexico*. Museum of New Mexico Papers in Anthropology 2. Santa Fe.

Trigger, Bruce G.
1989 *A History of Archaeological Thought*. Cambridge University Press, Cambridge.

Tuggle, H. David, J. Jefferson Reid, and Robert C. Cole, Jr.
1984 Fourteenth Century Mogollon Agriculture in the Grasshopper Region of Arizona. In *Prehistoric Agricultural Strategies in the Southwest*, edited by Suzanne K. Fish and Paul R. Fish, pp. 101-110. Arizona State University Anthropological Papers 33. Tempe.

Turner, B.L. II, Robert Q. Hanham, and Anthony V. Portararo
1977 Population Pressure and Agricultural Intensity. *Annals of the Association of American Geographers* 67(3):384-396.

Turner, Frederick
1983 *Beyond Geography: The Western Spirit Against the Wilderness*. Rutgers University Press, New Brunswick.

Tyler, Daniel
1986 Dating the Caño Ditch: Detective Work in the Pojoaque Valley. *New Mexico Historical Review* 61(1):14-25.

Ubelaker, Douglas H.
1976 The Sources and Methodology for Mooney's Estimates of North American Indian Populations. In *The Native Population of the Americas in 1492*, edited by William M. Denevan, pp. 243-288. University of Wisconsin Press, Madison.

1988 North American Indian Population Size, A.D. 1500 to 1985. *American Journal of Physical Anthropology* 77( ):289-294

1992 North American Indian Population Size: Changing Perspectives. In *Disease and Demography in the Americas*, edited by John W. Verano and Douglas H. Ubelaker, pp. 169-176. Smithsonian Institution Press, Washington D.C.

2000 Patterns of Disease in Early North American Populations. In *A Population History of North America*, edited by Michael R. Haines and Richard H. Steckel, pp. 51-97. Cambridge University Press, Cambridge.

Upham, Steadman
1982 *Polities and Power: An Economic and Political History of the Western Pueblo*. Academic Press, New York.

1984 Adaptive Diversity and Southwestern Abandonment. *Journal of Anthropological Research* 40(2):235-256.

1986 Smallpox and Climate in the American Southwest. *American Anthropologist* 88(1):115-128.

1988 Archaeological Visibility and the Underclass of Southwestern Prehistory. *American Antiquity* 53(2):245-261.

1992 Population and Spanish Contact in the Southwest. In *Disease and Demography in the Americas*, edited by John W. Verano and Douglas H. Ubelaker, pp. 223-236. Smithsonian Institution Press, Washington D.C.

Upham, Steadman, Kent. G. Lightfoot, and Gary M. Feinman
1981 Explaining Socially Determined Ceramic Distributions in the Prehistoric Plateau Southwest. *American Antiquity* 46(4):822-833.

Upham, Steadman, and Fred Plog
1986 The Interpretation of Prehistoric Political Complexity in the Central and Northern Southwest: Toward a Mending of the Models. *Journal of Field Archaeology* 13(2):223-238.

U.S. Census Bureau
2000 Census 2000 Summary File (SF 1) 100-Percent Data. U.S. Census Bureau, United States Department of Commerce, Washington D.C. Electronic document, http://factfinder.census.gov/bf/_lang=en_vt_name=DEC_2000_SF1_U_DP1_geo_id=01000US.html. Accessed April 14, 2002.

Vansina, Jan
1985 *Oral Tradition as History*. University of Wisconsin Press, Madison.

van de Westeringh, W.
1988 Man-made Soils in the Netherlands, Especially in Sandy Areas ("Plaggen Soils"). In *Man-Made Soils*, edited by W. Groenman-van Waateringe and M. Robinson, pp. 5-19. Symposia of the Association for Environmental Archaeology No. 6. BAR International Series 410. Oxford.

Van Dyke, Ruth M.

1997 The Andrews Great House Community: A Ceramic Chronometric Perspective. *Kiva* 63(2):137-154.

Van West, Carla R.

1994 *Modeling Prehistoric Agricultural Productivity in Southwestern Colorado: A GIS Approach*. Washington State University Reports of Investigations 67. Pullman, Washington.

1996 Agricultural Potential and Carrying Capacity in Southwestern Colorado, A.D. 901 to 1300. In *The Prehistoric Pueblo World, A.D. 1150-1350*, edited by Michael A. Adler, pp. 214-227. University of Arizona Press, Tucson.

Van West, Carla R., and Jeffery S. Dean

2000 Environmental Characteristics of the A.D. 900-1300 Period in the Central Mesa Verde Region. *Kiva* 66(1):19-44.

Van Zandt, Tineke

1999 Architecture and Site Structure. In *The Bandelier Archeological Survey*, edited by Robert P. Powers and Janet D. Orcutt, pp. 309-388. 2 vols. Intermountain Cultural Resources Management Professional Paper 57. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Varien, Mark D.

1999 *Sedentism and Mobility in a Social Landscape: Mesa Verde and Beyond*. University of Arizona Press, Tucson.

2002 Persistent Communities and Mobile Households: Population Movement in the Central Mesa Verde Region, A.D. 950 to 1290. In *Seeking the Center Place: Archaeology and Ancient Communities in the Mesa Verde Region*, edited by Mark D. Varien and Richard H. Wilshusen, pp. 163-184. University of Utah Press, Salt Lake City.

Varien, Mark D., Barbara J. Mills

1997 Accumulations Research: Problems and Prospects for Estimating Site Occupation Span. *Journal of Archaeological Method and Theory* 4(2):141-191.

Varien, Mark D., and James M. Potter

1997 Unpacking the Discard Equation: Simulating the Accumulation of Artifacts in the Archaeological Record. *American Antiquity* 62(2):194-213.

Varien, Mark D., Carla R. Van West and G. Stuart Patterson

2000 Competition, Cooperation and Conflict: Agricultural Production and Community Catchments in the Central Mesa Verde Region. *Kiva* 66(1):45-65.

Verano, John W., and Douglas H. Ubelaker, editors

1992 *Disease and Demography in the Americas*. Smithsonian Institution Press, Washington D.C.

Vetancurt, Augustín de

1960-1961 [1698] Teatro Mexicano: Descripcion Breve de Los Sucessos Exemplares de la Nueva España en el Neuvo Mundo Occidental de las Indias. 4 vols. Privately published, Madrid. 1960-1961 facsimile ed., Jose Porrua Turanzas, Madrid.

Viklund, Lonyta

1988 Bonito Diversity Survey—A Cultural Resource Survye in Jemez Ranger District, Santa Fe National Forest. Southwest Archaeological Consultants, Inc. Report submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwestern Region, Albuquerque.

Vint, James N.

1999 Ceramic Artifacts. In *The Bandelier Archeological Survey*, edited by Robert P. Powers and Janet D. Orcutt, pp. 389-467. 2 vols. Intermountain Cultural Resources Management Professional Paper 57. US Department of the Interior National Park Service, Intermountain Region, Santa Fe.

Vivian, Gordon

1964 *Excavations in a 17th-Century Jumano Pueblo: Gran Quivira*. Archeological Research Series 8. National Park Service, U.S. Deparment of the Interior, Washington D.C.

Vivian, R. Gwinn

1974 Conservation and Diversion: Water-Control Systems in the Anasazi Southwest. In *Irrigation's Impact on Society*, edited by Theodore E. Downing and McGuire Gibson, pp. 95-112. University of Arizona Anthropological Papers 25. University of Arizona, Tucson.

1990 The Chacoan Prehistory of the San Juan Basin. Academic Press, San Diego.

Walker, Phillip L.

2001 A Spanish Borderlands Perspective on La Florida Bioarchaeology. In *Bioarchaeology of Spanish Florida: The Impact of Colonialism*, edited by Clark Spenser Larsen, pp. 274-307. University Press of Florida, Gainesville.

Walker, Phillip L., and J.R. Johnson

1992 The Effects of European Contact on the Chumash Indians. In *Disease and Demography in the Americas*, edited by John W. Verano and Douglas H. Ubelaker, pp. 127-139. Smithsonian Institution Press, Washington D.C.

Walker, Phillip L., Patricia M. Lambert, and M. DeNiro

1989 The Effects of European Contact on the Health of the California Indians. In *Columbian Consequences, Volume 1: Archaeological and Historical Perspectives on the Spanish Borderlands West*, edited by David Hurst Thomas, pp. 429-448. Smithsonian Institution Press, Washington.

Walsh, Michael R.

1998 Lines in the Sand: Competition and Stone Selection on the Pajarito Plateau, New Mexico. *American Antiquity* 63(4):573-593.

2000 Material Evidence for Social Boundaries on the Pajarito Plateau, New Mexico. *Kiva* 65(3):197-213.

Wandsnider, LuAnn, and Eileen L. Camilli

1992 The Character of Surface Archaeological Deposits and its Influence on Survey Accuracy. *Journal of Field Archaeology* 19(2):169-188.

Ward, Albert E.

1978 Sinagua Farmers Before the "Black Sand" Fell: An Example from Wupatki National Monument. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 135-146. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

Warren, A. Helene

1974 The Ancient Mineral Industries of Cerro Pedernal, Rio Arriba County, New Mexico. In *New Mexico Geological Society Guidebook, 25th Field Conference, Central-Northern New Mexico Region*, pp. 87-93. New Mexico Geological Society, Albuquerque.

1977a Geology and Mineral Resources: White Rock Canyon and Cochiti Study Area, Sandoval County, New Mexico. In *Archeological Investigations in Cochiti Reservoir, New Mexico, Volume 1: A Survey of Regional Variability*, edited by Jan V. Biella and Richard C. Chapman, pp. 15-30. University of New Mexico Office of Contract Archeology, Albuquerque.

1977b Ceramic Studies in Cochiti Reservoir, 1976-1977. In *Archeological Investigations in Cochiti Reservoir, New Mexico, Volume 3: 1976-1977 Field Seasons*, edited by Jan V. Biella, pp. 27-39. University of New Mexico Office of Contract Archeology, Albuquerque.

1979a Geological and Mineral Resources of the Cochiti Reservoir Area. In *Archeological Investigations in Cochiti Reservoir, New Mexico, Volume 4: Adaptive Change in the Northern Rio Grande Valley*, edited by Jan V. Biella and Richard C. Chapman, pp. 47-58. University of New Mexico Office of Contract Archeology, Albuquerque.

1979b The Glaze Paint Wares of the Upper Middle Rio Grande. In *Archeological Investigations in Cochiti Reservoir, New Mexico, Volume 4: Adaptive Change in the Northern Rio Grande Valley*, edited by Jan V. Biella and Richard C. Chapman, pp. 187-216. University of New Mexico Office of Contract Archeology, Albuquerque.

Watson, Patty Jo, Steven A. LeBlanc and Charles L. Redman

1971 *Explanation in Archaeology: An Explicitly Scientific Approach*. Colombia University Press, New York.

1980 Aspects of Zuni Prehistory: Preliminary Research on Excavations and Survey in the El Morro Valley of New Mexico. *Journal of Field Archaeology* 7(2):201-218.

Weber, David J.

1987 Introduction. In *The Journey of Fray Marcos de Niza*, edited by Cleve Hallenbeck, pp. xx-xx. Southern Methodist University Press, Dallas.

1992 *The Spanish Frontier in North America*. Yale University Press, New Haven.

Wendorf, Fred, and Erik K. Reed

1955 An Alternative Reconstruction of Rio Grande Prehistory. *El Palacio* 62(5-6):131-173.

Wesson, Cameron B., and Mark A. Rees

2002 Protohistory and Archaeology: An Overview. In *Between Contacts and Colonies: Archaeological Perspectives on the Protohistoric Southeast*, edited by Cameron B. Wesson and Mark A. Rees, pp. 1-11. University of Alabama Press, Tuscaloosa.

Whitely, Peter M.

2002a Archaeology and Oral Tradition: The Scientific Importance of Dialogue. *American Antiquity* 67(3):405-415.

2002b Re-imagining Awat'ovi. In *Archaeologies of the Pueblo Revolt: Identity, Meaning and Renewal in the Pueblo World*, edited by Robert W. Preucel, pp. 147-166. University of New Mexico Press, Albuquerque.

Whitmore, Thomas M., and B.L. Turner II
2001 *Cultivated Landscapes of Middle America on the Eve of Conquest*. Oxford University Press, Oxford.

Wiessner, Polly
1974 A Functional Estimator of Population from Floor Area. *American Antiquity* 39(2):343-350.

Wilcox, David R.
1978 The Theoretical Significance of Field Houses. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 25-32. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

1996 Pueblo III People and Polity in Relational Context. In *The Prehistoric Pueblo World, A.D. 1150-1350*, edited by Michael A. Adler, pp. 241-254. University of Arizona Press, Tucson.

Wilcox, David R., and W. Bruce Masse
1981 A History of Protohistoric Studies in the North American Southwest. In *The Protohistoric Period in the North American Southwest, AD 1450-1700*, edited by David R. Wilcox and W. Bruce Masse, pp. 1-27. Arizona State University Anthropological Research Papers 24. Tempe.

Wilcox, David R., and W. Bruce Masse (editors)
1981 *The Protohistoric Period in the North American Southwest, AD 1450-1700*. Arizona State University Anthropological Research Papers 24. Tempe.

Wilk, Richard
1996 Comments on "Typological Schemes and Agricultural Change: Beyond Boserup in Precolonial South India," by Kathleen D. Morrison. *Current Anthropology* 37(4):601-602.

Willigan, J. Dennis, and Katherine Lynch
1982 *Sources and Methods of Historical Demography*. Academic Press, New York.

Wills, W.H., Thomas A. Baker, and Lee A. Baker
1990 Aerial Perspectives on Prehistoric Agricultural Fields of the Middle Rio Grande Valley, New Mexico. In *Clues to the Past: Papers in Honor of William M. Sundt*, edited by Meliha S. Duran and David T. Kirkpatrick, pp. 315-332. Papers of the Archaeological Society of New Mexico 16. Albuquerque.

Wills, W.H., and Thomas C. Windes
1989 Evidence for Population Aggregation and Dispersal During the Basketmaker III Period in Chaco Canyon, New Mexico. *American Antiquity* 54(2):347-369.

Wilshusen, Richard C.
2002 Estimating Population in the Central Mesa Verde Region. In *Seeking the Center Place: Archaeology and Ancient Communities in the Mesa Verde Region*, edited by Mark D. Varien and Richard H. Wilshusen, pp. 101-120. University of Utah Press, Salt Lake City.

Wilshusen, Richard C., and Eric Blinman
1992 Pueblo I Village Formation: A Reevaluation of Sites Recorded by Earl Morris on Ute Mountain Ute Tribal Lands. *Kiva* 57(3):251-269.

Wilshusen, Richard C., and Scott G. Ortman
1999 Rethinking the Pueblo I Period in the San Juan Drainage: Aggregation, Migration and Cultural Diversity. *Kiva* 64(3):369-399.

Wilson, John P.
1985 Before the Pueblo Revolt: Population Trends, Apache Relations, and Pueblo Abandonments in Seventeenth Century New Mexico. In *Prehistory and History in the Southwest: Collected Papers in Honor of Alden C. Hayes*, edited by Nancy Fox, pp. 113-120. Papers of the Archaeological Society of New Mexico 11. Ancient City Press, Santa Fe.

1992 The Flyaway Histories of New Mexico. In *Current Research on the Late Prehistory and Early History of New Mexico*, edited by Bradley J. Vierra, pp. 245-249. New Mexico Archaeological Council Special Publication 1. Albuquerque.

Winter, Joseph C.
1978 Anasazi Agriculture at Hovenweep, I: Field Systems. In *Limited Activity and Occupation Sites: A Collection of Conference Papers*, edited by Albert E. Ward, pp. 83-97. Contributions to Anthropological Studies 1. Center for Anthropological Studies, Albuquerque.

1981 Energy and Power along Redondo Creek: II—A Cultural Framework. In *High Altitude Adaptations Along Redondo Creek: The Baca Geothermal Anthropological Project*, edited by Craig Baker and Joseph C. Winter, pp. 173-189. University of New Mexico Office of Contract Archeology, Albuquerque.

1983 Jemez Mountain Obsidian Exchange: A View from Redondo Valley. In *High-Altitude Adaptations in the Southwest*, edited by Joseph C. Winter, pp. 91-107. USDA Forest Service Southwestern Region Cultural Resource Management Report 2. Albuquerque.

Winterhalder, Bruce
1990 Open Field, Common Pot: Harvest Variability and Risk Avoidance in Agricultural and Foraging Societies. In *Risk and Uncertainty in Tribal and Peasant Economies*, edited by Elizabeth Cashdan, pp. 67-87. Westview Press, Boulder.

1996 Social Foraging and the Behavioral Ecology of Intragroup Resource Transfers. *Evolutionary Anthropology* 5(1):46-47.

2001 The Behavioural Ecology of Hunter-Gatherers. In *Hunter-Gatherers: an Interdisciplinary Perspective*, edited by Catherine Panter-Brick, Robert H. Layton, and Peter Rowley-Conwy, pp. 12-38. Cambridge University Press, Cambridge.

Wittfogel, Karl A., and Esther S. Goldfrank
1943 Some Aspects of Pueblo Mythology and Society. *Journal of American Folklore* 56(219):17-30.

Wolff, J.A.., and J.N. Gardner
1995 Is the Valles Caldera Entering a New Cycle of Activity? *Geology* 23(5):411-414.

Wolfman, Daniel
1994 *Jemez Mountains Chronology Study*. Office of Archaeological Studies, Museum of New Mexico. Submitted to USDA, Forest Service, Santa Fe National Forest. Copies available from USDA, Forest Service, Southwestern Region, Albuquerque.

Wood, Peter H.
1989 The Changing Population of the Colonial South: An Overview by Race and Region, 1685-1790. In *Powatan's Mantle: Indians in the Colonial Southeast*, edited by Peter H. Wood, Gregory A. Waselkov, and M. Thomas Hatley, pp. 35-103. University of Nebraska Press, Lincoln.

Wood, W. Raymond
1990 Ethnohistory and Historical Method. In *Archaeological Method and Theory, Volume 2*, edited by Michael B. Schiffer, pp. 81-109. University of Arizona Press, Tucson.

Woodbury, Richard B.
1961 *Prehistoric Agriculture at Point of Pines, Arizona*. Memoirs of the Society for American Archaeology 17. Society for American Archaeology, Washington D.C.

Woodson, M. Kyle
1999 Migrations in Late Anasazi Prehistory: The Evidence from the Goat Hill Site. *Kiva* 65(1):63-84.

Woodward, Lee A.
1987 *Geology and Mineral Resources of Sierra Nacimiento and Vicinity, New Mexico*. New Mexico Bureau of Mines and Mineral Resources Memoir 42. New Mexico Institute of Mining and Technology, Socorro.

Woosley, Anne I.
1980 Agricultural Diversity in the Prehistoric Southwest. *Kiva* 45(4):317-335.

1986 Puebloan Prehistory of the Northern Rio Grande: Settlement, Population and Subsistence. *Kiva* 51(3):143-160.

1988 Population Aggregation and the Role of Large Pueblos in the Northern Rio Grande. Paper presented at the 53rd Annual Meeting of the Society for American Archaeology, Phoenix.

Wright, J. Leitch
1981 *The Only Land They Knew: The Tragic Story of the American Indians in the Old South*. Free Press, New York.

Yellen, John
1977 *Archaeological Approaches to the Present: Models for Reconstructing the Past*. Academic Press, New York.

Zubrow, Ezra B.W.
1990 The Depopulation of Native America. *Antiquity* 64:754-765.

Zubrow, Ezra B.W. (editor)
1976 *Demographic Anthropology: Quantitative Approaches*. University of New Mexico Press, Albuquerque.

Zumwalt, Rosemary Lévy
1992 *Wealth and Rebellion: Elsie Clews Parsons, Anthropologist and Folklorist*. University of Illinois Press, Urbana.