Suyanisqatsi / Koyaanisqatsi

Creating Balance in a Land of Little Water and Burning Rock

Cooperation, Competition, and Climate in the Flagstaff Region of the U.S. Southwest

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by

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ABSTRACT

Environmental change has often been cited as affecting choices made whether to pursue cooperative or competitive strategies. The Flagstaff region provides a unique opportunity to address how environmental changes may affect choices made between competition and cooperation. Part of the region was a prehistoric frontier zone between three archaeological cultures and these groups had to contend with a marginal and highly variable climate for agriculture. These regional patterns of climatic variation are well documented and further the eruption of Sunset Crater Volcano in the midst of this frontier zone devastated local environments and reshaped the landscape. As groups re-colonized the frontier zone, they actively sought to negotiate new boundaries using both competitive and cooperative strategies that can be discerned archaeologically, including intergroup violence and the construction and use of communal ritual architecture. Dendroclimatological data is used to identify periods of environmental change and expectations for cooperative and competitive responses to these changes are developed based on anthropological theory and ethnographic case studies. These expectations are then tested against the archaeological record. Three lines of evidence are used to assess changes in levels of competition: (1) use of defensive sites, (2) presence of skeletal trauma, and (3) emergence of specialized social roles and weapons technologies. Two lines of evidence are used to assess changes in levels of cooperation (1) use of communal ritual architecture and (2) patterns of exchange. In some cases the expected relationships between favorable conditions and evidence of increased cooperation and between unfavorable conditions and evidence of increased competition are found. However, in other cases the expectations are not supported, with local historical and cultural contingencies appearing to override environmental influences. Contrasts between patterns of cooperation and competition found in the culturally diverse frontier zone versus the patterns found in the more culturally homogenous heartland are identified that suggest greater likelihood of the emergence of conflict in settings with pre-existing contexts of social differences.

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First and foremost are family. My parents, Fred and Linda O'Hara, always sought to provide me the most interesting and enriching educational and cultural experiences. They have steadfastly supported the choices I have made in my life's journey, celebrating my successes, encouraging my aspirations, and picking me up when I've stumbled. They also applied their professional talents as editors to this document, reading everything included in these pages (and then more). My siblings Laura, Eoin, and Keiran travelled the early stages of my path together, shared many inspirational experiences at museums and historic sites, and tolerated me rambling on about my latest interests. My father's sisters, my godmother Lois and her older sister Marie, have always been a rock of stability I could depend upon for encouragement, assistance, and prayers. My mother's parents, Joseph and Frances Maier, and her younger brother, my godfather Michael, encouraged a love of art, something I hope shines through in the graphics I have made for this study.

Since she encouraged me to return to school, my wife Beth has suffered trials that have tested her devotion. She has put up with delays, missed deadlines, me spending

more time in front of the computer than with her, and a myriad of other unintentional deficiencies and slights. It hasn't always been smooth, but she's been my compass guiding me forward, sometimes offering carrots, other times wielding the stick. If this process has seemed like a lifetime to her, it's because it has been two lifetimes: those of our children Millie and Miles. Millie arrived soon after my prospectus was approved and the first chapters were written during her first few months of life. The final chapters were written during Mile's first year, and I often wondered if I was going to make it. Seemingly equal parts angel and devil, these two little dynamos are as inspiring and exhilarating as they are exasperating and exhausting. While Miles is just learning to talk, and "book" is one of his favorite words, Millie often expresses her opinion, including about my work. She says my books are boring because they are just "words, words, words," but she adds "that's okay, because you like boring things." Hopefully, as she and her brother grow up I will be able to instill the same curiosity about the past in them as my parents did in me and they won't find Daddy's work so boring. Since Beth and I married, my in-laws Harold and Carolyn Moser have been as supportive as parents. Like my parents, Carolyn is a professional editor, and she also applied her talents to some chapters. Both sets of grandparents were of great assistance when Millie and Miles first arrived, and without their help with diapers, feeding, burping, bathing, and general baby and toddler wrangling during those times this project would never have come to fruition.

My quest for knowledge and understanding of the past has been a long and cumulative path I could not have journeyed without assistance by many along the way, and throughout my life I have been lucky to have great teachers who guided and inspired me, and. In many Hopi and Navajo myths, when the heroes are lost, overwhelmed, and at

their lowest, Spider Woman intercedes on their behalf, providing knowledge and power that assures success. My advisor and committee chair Michelle Hegmon was like my Spider Woman, nurturing my ideas in classes and office discussions, and assuring support from teaching and research assistantships and a dissertation completion fellowship. My other committee members, Keith Kintigh and David Abbott, also supported and encouraged me through the classes they taught and work opportunities they provided. Barbara Stark was on the committee that approved my prospectus and guided its preparation in her proposal writing class. Others in the School of Human Evolution and Social deserving thanks include John Martin, Kate Spielmann, Betsy Brandt, Chris Carr, Michael Barton, Chelle Brooks, and Georgiana Miller. Chris Downum and David Wilcox introduced me to the great diversity of the archaeological record of the Flagstaff region in the 1996 Museum of Northern Arizona/Northern Arizona University field school. While at Northern Arizona, Chris was my advisor, thesis committee chair, and boss, and others who provided guidance and support include Kelley Hays-Gilpin, Jim Wilce, Kim Smiley, Wolf Gumerman, and Bob Trotter. Earlier, Jerry Levy and Jeff Reid at the University of Arizona encouraged me to pursue my interests in anthropology.

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CHAPTER 1 – CREATING AND LOSING BALANCE

In Hopi philosophy human existence can be characterized as having two possible alternate states of being: *suyanisqatsi* and *koyaanisqatsi*. Suyanisqatsi combines suyan- (clear, bright, sure, or certain) with qatsi (life, existence, or way of life) to describe "life of harmony and tranquility, lack of confusion, utopian existence" (Hill et al. 1998:559). In contrast, koyaanisqatsi combines koyaan- (chaotic or corrupted) with qatsi to refer to "life of moral corruption and turmoil (re: life of a group), life out of balance" (Hill et al. 1998:154). Oral traditions of Hopi clan migrations present histories that cycle between these states (Courlander 1970, 1971; Fewkes 1900; Lomatumay'ma et al. 1993; Nequatewa 1936; Voth 1905). There are times and places when clans came together in harmonious co-existence, but these cooperative relations deteriorated and the loss of balance led to the dissolution and dispersal of the community. The cycle then began anew as clans migrated and either established or joined new communities in cooperation with other clans, some that had followed the same pathways and others that came from different backgrounds.

Like Hopi clan migration traditions, archaeological reconstructions of the prehistory of the U.S. Southwest also identify cycles of change, with periods of cultural stability punctuated by episodes of reorganization leading to new stable cultural formations. The challenges presented to the prehistoric inhabitants of the region by the marginal and variable conditions for the practice of agriculture led archaeologists to emphasize the challenges and limitations imposed by the environment and how these shaped trajectories of cultural adaptation and change (Dean et al. 1985; Dean et al. 1994; Gumerman 1988). The primary adaptation that populations made to the region's aridity was the development of a diverse array of agricultural technologies and strategies well-suited to specific environmental settings and conditions (Fish and Fish 1984, 1994; Minnis 2000; Toll 1995), but other adaptive social processes were employed as well. These include the storage and sharing of food supplies (Hegmon 1996); production and exchange of craft goods (Bayman 1999; Harry 2005); manipulation of political structures, ritual practices, and labor organization (Feinman et al. 2000; Potter 2000; Potter and Perry 2000; Schachner 2001, 2010); intergroup conflict and violence (LeBlanc 1999; Wilcox and Haas 1994); and mobility and migration (Cameron 1995; Clark 2002).

Just as Hopi clan migration traditions make contrasts between periods of harmony characterized by social cooperation and periods of disorder beset by conflict and competition, these adaptive social processes can also be characterized and contrasted as being either cooperative or competitive. While sharing and exchange are cooperative processes and intergroup conflict is competitive, the arenas of politics and ritual may involve both cooperation and competition. In small-scale societies, the social contexts for cooperation, like the sharing of food and exchange of resources, are often associated with and thus mediated and structured by communal ritual practices that define community membership and social identity, sanctify the social order, and organize production and consumption (Bell 1992, 1997; Rappaport 1971, 1999). Such cooperative use of communal ritual often plays a crucial role in organizing and structuring relationships within and among communities. But communal ritual can also be an arena for competitive distinction within and among communities since sponsorship of or participation in communal ritual can confer prestige and social capital that can be converted into political influence or power (Potter 1997; Rosman and Rubel 1971; Ware

2014). Competition and cooperation are not binary opposites, but rather complementary and inter-related social processes. Yet despite this complexity, a straightforward association between changing environmental conditions and choices between cooperative and competitive adaptations has often been presumed, such that unfavorable conditions are thought to lead to competition and favorable ones to cooperation.

Previous research on intergroup conflict and violence in the U.S. Southwest has proposed a causal relationship between intensification of conflict and periods of environmental stress (Haas and Creamer 1993; LeBlanc 1999), a proposition supported by cross-cultural research on resource unpredictability and intergroup comflict (Ember and Ember 1992). Conversely, other research has suggested favorable and productive climate conditions that provided food surpluses enabled the construction and use of new forms of communal ritual architecture (Vivian et al. 2006). The interplay between environmental conditions and choices between cooperative and competitive social strategies would seem straightforward, in that the shortages created by unfavorable conditions should lead to competition and conflict while the surpluses produced during favorable periods should lead to cooperation and investments in communal ritual that facilitated sharing and exchange. However, ethnohistorical studies of the River Yuman groups in the U.S. Southwest have questioned a direct relationship between intergroup conflict and subsistence stress, finding that cooperative social networks that cross-cut boundaries provide greater benefits than competition or conflict (C. Kroeber 1980). Similarly, the construction and use of new forms of communal ritual architecture has also been interpreted as a response to crises created by climate change, migration, and population aggregation (Adams 1990).

Thus the expected straightforward relationship between unfavorable conditions and competition on the one hand, and between favorable conditions and cooperation on the other, may not be warranted. Rather, it is more useful to ask when these relationships do and do not hold: Why do some periods of environmental stress lead to increased competition and conflict while others do not? An understanding of how environmental stress can be met with peaceful and cooperative social relationships has great relevance in the 21st century time of climate change.

The Flagstaff region of the U.S. Southwest provides a unique case for examining how and why environmental changes may lead to competition or cooperation for four reasons. (1) Like much of the U.S. Southwest, the Flagstaff region presents a marginal and highly variable environment for the practice of agriculture, and the regional patterns of climatic variation are well documented. (2) The region encompasses a prehistoric frontier zone between three archaeological cultures, and the contexts for both competition and cooperation are intensified in the cultural interactions that characterize frontier settings. (3) The eruption of Sunset Crater Volcano in the midst of this frontier zone devastated local environments and reshaped the landscape. Also, unlike climatic variability, the eruption was an event beyond memory and experience and thus presented unique challenges to the affected populations. (4) As groups re-colonized the frontier zone, they actively sought to negotiate new boundaries using both competitive and cooperative strategies that can be discerned archaeologically, including intergroup conflict and the construction and use of communal ritual architecture.

GETTING TO THE QUESTION

The Flagstaff region was also chosen for this study because of my own personal experiences encountering the region's archaeology and being subject to its variable climate. You could say this all started during the winter break of my senior year of college. My father was in Phoenix for business and I flew out to meet him for a weekend trip to the Grand Canyon. On the way back to Phoenix, we drove through Wupatki National Monument, and the Citadel was the first archaeological site I visited in the U.S. Southwest. My parents had always sought enriching historical experiences for me and my siblings during our vacation trips, and in my youth I had climbed one of the Mississippian mounds at Etowah, been to innumerable Civil War battlefields, and visited various colonial and frontier era forts, but none was as striking as the experience I had at the Citadel.

There the remnants of a 50+ room, multistory pueblo built from red sandstone rise from the top of an outcrop of black volcanic rock and tower over the surrounding area (Figure 1-1). Flat plains stretch off to the east, and to the north, south, and to west is broken terrain of white limestone and red sandstone escarpments with mesas capped by dark volcanic rock. Looking around from the top of the Citadel, I could see that on top of almost every nearby rise was another pueblo of red sandstone precariously perched near the edge of a sheer black cliff. It hardly fit the my image of the peaceful Pueblo peoples. The place had a tense and nervous feeling of a people on edge and fearful. But fearful of whom? Their immediate neighbors? Everyone seemed to have a watchful eye on one another. Or, was it some unknown enemy lurking beyond the horizon or hiding behind the hills?

Figure 1-1. The Citadel in Wupatki National Monument

Another obvious question was what was worth fighting over? It was a stark and harsh landscape that had an alien allure of the exotic and inspired an unsettling feeling of loss. I grew up in the lush green hills of East Tennessee where a creek flowed through our backyard and my parent's small vegetable garden produced more green beans than my siblings and I cared to eat. I had since relocated to the somewhat less verdant, but equally balmy and bountiful hills of Southern California, which was a desert, but a very productive one. In an anthropology class I had learned how the indigenous Cahuilla peoples had been able to live comfortably foraging for the desert's bounty. But the area around the Citadel was different. It was January and a biting cold wind was bringing snow from the San Francisco Peaks to the southwest. On the plains to the east there was patchy grass and a few shrubs; in the broken ground to the north, south, and west scattered shrubby juniper trees and lots of bare, broken rock, joined the patches of grass. It hardly looked like a landscape conducive to agriculture, and it seemed to me that the struggles of trying to wrest a living from such a harsh landscape would likely lead to conflict over scarce resources.

As we arrived in Phoenix later that day, news came over the radio that Operation Desert Shield had progressed into Operation Desert Storm and U.S. troops were attacking Iraqi forces in Kuwait and Iraq. In another desert land, struggle for control over a scarce resource, one vital to the functioning of the developed world's economy, had escalated from a stalemate to an open conflict that would result in devastating loss of life and lasting damage to the environment. Thinking back to those moments on top of the Citadel earlier in the day I wondered if anything ever changed. Had and would people always fight for the fat on top of the table or the scraps underneath? It seemed a bleak assessment, but unfortunately it also appeared to be supported by the dark and bloody course of much of human history.

I returned to the Citadel and Wupatki National Monument five years later when I began graduate school at Northern Arizona University (NAU) and participated in an archaeological field school co-directed by Chris Downum and David Wilcox. Our first weekend we went on field trip to Wupatki and sites on the Coconino National Forest nearby. While Wilcox was a strong proponent of the role of conflict in the prehistory of the region, Downum was more skeptical and offered counter arguments and examples of cooperation and interaction. When I had visited earlier with my father, snow had prevented us from going down to the ballcourt at Wupatki, but on this field trip we went to it and to the Second Sink and Juniper Terrace ballcourts just south of the monument.

To me these ballcourts were a counterpoint to foreboding fortified sites like the Citadel. They were places where people came together to compete, but within a rule-bound arena that limited violence. While both players and onlookers took sides during the game, before and after the game both sides were brought together in a spirit of shared camaraderie.

For the next ten years I lived in Flagstaff and experienced the variable and unpredictable climate: four feet of snow on April Fool's Day, summer deluges that resulted in flooding, or dry years that turned the vegetation into a tinderbox. My attempts at gardening were very disheartening. Elevation and temperature were equally as challenging as precipitation. With water from the hose supplementing the unpredictable rains lettuce, cabbage, and chard grew fine, but while I could get squash, tomatoes, and peppers to grow and flower, they rarely produced fruit. One year my yield was two jalapeño peppers. While my gardening foibles were bemusingly disappointing, I knew that if I were trying to make a living as a farmer, I would be in a perpetual state of crisis. In contrast to the dry years, the wet years fueled bountiful vegetation. One summer I worked in the backcountry at Wupatki, and the wet winter and spring resulted in lush growth of grass in those grasslands east of the Citadel that had seemed so sparse the first time I saw them. While my attempts at growing food had limited success, experienced prehistoric farmers would have been able to turn those favorable years into bountiful yields.

I learned more about traditional agricultural practices from times when Miguel Vasquez, another one of my professors at NAU, took students to Hopi to help Leigh Kuwanwisiwma, director of the Hopi Cultural Preservation Office, plant corn in the spring and harvest it in the fall. The produce of these fields was used for ceremonies or provided to elderly Hopi who could no longer farm themselves. Vasquez wanted us students to learn about reciprocity and giving back to the communities that we as anthropologists studied. I also learned a lot about Hopi agricultural methods by seeing how generations of knowledge could be applied to create a rich harvest from a sandy field. One year, however, I got a stark reminder of the challenges faced in the region when spring planting was cancelled because there had been insufficient winter precipitation to allow germination. The word was that no Hopi farmers planted that year; the seed corn was going to be saved until the next spring. In today's world the Hopi could go shopping in Flagstaff and farming corn was done more to maintain their culture and support the needs of traditional ceremonies than to provide for daily subsistence. Still, I could imagine that in the past dry winters would have led to long and stressful years of rationing stored food reserves and offering prayers for rain and snow for the following winter.

Over the years and through these experiences the questions I seek to answer in this dissertation began to crystallize. How did the variability in environmental conditions interact with competitive strategies that drove the investment in fortified sites like the Citadel and with cooperative strategies that motivated the construction and use of ballcourts to peacefully mediate relations? While the details are specific to the Flagstaff region, the basic underlying question of how environmental variability and change interact with competitive and cooperative social responses has broader implications for understanding the influences of changing environmental conditions on human behavior both for archaeological interpretations of the past and for planning for future impacts from climate change.

Organization of Research

This dissertation is organized into four parts: (I) setting, (II) perspectives, (III) expectations and evidence, and (IV) weaving the warp and weft together. In Part I the stage is set in two chapters, the first presenting the environmental setting of the Flagstaff region and the second the archaeological setting. The environmental setting describes the geology, soils, ecology, and climate of the region; provides details about the timing and impacts of the eruption of Sunset Crater; and uses paleoclimatic reconstructions to identify specific periods that would have been favorable or unfavorable to agricultural success. The archaeological setting reviews the previous research that has identified the archaeological cultures of the region, the cultural-historical sequence of occupation, and the material culture correlates of these cultural and temporal units. The role of the region as a frontier zone among different cultures is highlighted and contextualized theoretically. Cultural interaction in frontier zones provides opportunities for innovation and transformation through cooperation, but also has the potential to create or intensify competition and conflict.

Part II provides an anthropological perspective on the problem in three chapters on cultural responses to environmental disturbances (Chapter 4), practices of intergroup conflict (Chapter 5), and the use of communal ritual architecture (Chapter 6). Such perspective is needed to interpret and understand the archaeological record. In these chapters it is provided by first reviewing anthropological theory and then presenting ethnographic case studies of small-scale societies with subsistence levels of production from the U.S. Southwest, East Africa, Papau New Guinea and other parts of the Pacific, and Paricutín, Mexico, where a volcanic eruption similar to that of Sunset Crater affected local Tarascan Indian communities.

Chapter 4 on cultural responses to environmental disturbances first looks at such events, their impacts, and the responses to them in terms of hazards, risk, and vulnerability. Then a series of dimensions are developed to assess the severity of impacts from environmental disturbances and the effectiveness of social responses to mitigate these impacts. These responses are understood as progressing through a series of escalating stages depending upon the nature of the impacts and the efficacy of the responses. The ethnographic case studies include different types of environmental disturbances that vary in their magnitude, frequency, duration, areal extent, and spatial dispersion. The different environmental disturbances include extreme dry periods and volcanic eruptions such as those experienced in the study area, as well as severe storms and frosts.

Intergroup conflict is examined from an anthropological perspective in Chapter 5, beginning with a review of types or levels of conflict differentiated by the social scale of the conflict, the motivation of the participants, and the goals and objectives of the exercise of violence. Then the structural contexts under which intergroup conflict is likely to emerge in nonstate societies are explored to understand resource competition as a factor in the emergence of conflict as a form of strategic interaction among politically autonomous local groups. Next, a series of dimensions of conflict are developed that can be used archaeologically to measure changes in the nature and intensity of the conflict.

These guide a review of the ethnographic case studies, which include: (1) comparison of intergroup conflict among the Hopi, River Yumans, and Navajo of the U.S. Southwest; (2) discussion of the relationships between territorial competition and environmental stress in East Africa; (3) examination of the inter-relationships among conflict over land, inter-regional exchange, and the emergence of specialized leadership in Papua New Guinea, focusing in particular on the Enga; and (4) exploration of the variation in conflict within and between Tarahumara communities after the eruption of Paricutín Volcano in Mexico.

Chapter 6 examines communal ritual architecture from the perspective of these forms being "structuring structures" (Bourdieu 1977:72) that generate and reproduce social practices through the way their physical construction of space organizes and constrains the activities pursued within and around them. This theoretical perspective is used in a discussion of the architectural forms, cultural meanings, and social roles of Mesoamerican ballcourts and Hopi kivas. Communal rituals provide a means of transmitting vital cultural information, especially information about responses to low-frequency environmental disturbances, and two examples of the encoding of critical information about environmental conditions in Hopi communal rituals are presented and analyzed. Ritual practices may also embed mechanisms, such as food sharing, that are needed to prepare for and contend with the impacts of environmental disturbances. The relationship between communal ritual and food sharing is explored using the Hopi as an example of how robust mechanisms for institutionalized food sharing can be embedded in a ritual system.

These perspectives developed in Part II are used to develop expectations for the archaeological record in the first chapter of Part III. The basic assumption to be tested is whether there is a direct relationship between unfavorable environmental periods and increased competition through intergroup conflict on the one hand, and between favorable periods and cooperation shown through the construction and use of communal ritual architecture on the other. Since I expect that there is a relationship, albeit not direct and simple, I develop a model of social responses to favorable and unfavorable conditions within the framework of the stages of response identified in Chapter 4. In this model, alarm stage responses have the potential to mitigate the impacts of unfavorable conditions and prevent escalation to resistance or exhaustion stage responses like increased conflict or regional abandonment. However, the model predicts that increased conflict is likely to occur under certain conditions and circumstances that can be identified in reference to the paleoclimatic reconstruction done in Chapter 2 and the dimensions of environmental disturbances and affected societies developed in Chapter 4. During favorable periods, investments would be made in communal ritual architecture, creating and strengthening social and exchange relations that could be activated for assistance as an alarm stage response during a subsequent unfavorable period.

The remainder of Part III presents the archaeological evidence of competition and cooperation in the Flagstaff region. I use three different lines of evidence to evaluate the nature of intergroup conflict and its temporal and spatial patterning in the region: (1) the construction and use of defensive sites (Chapter 8); (2) the presence of skeletal trauma (Chapter 9); and (3) the emergence of specialized social roles and weapons technologies (Chapter 10). In each chapter, comparisons are made and contrasts drawn between the heartland of the region where there was greater cultural homogeneity and the frontier zone where there was greater heterogeneity as the result of interaction and among groups from different cultural backgrounds. I develop indices to assess the rate and frequency of skeletal trauma and defensive site construction and use, then use these measures to assess changes in the nature and organization of intergroup conflict in reference to the dimensions developed in Chapter 5.

The following two chapters present two different but related lines of evidence to evaluate cooperation: the construction and use of communal ritual architecture (Chapter 11), and patterns of extraregional exchange for pottery and exotic materials like marine shell and various minerals (Chapter 12). In Chapter 11, the chronology of construction and use of ballcourts and great kivas in the region is reviewed and evaluated in relation to environmental conditions and the expectation that their construction and use should be associated with favorable periods. I use the plainware pottery assemblages from these features and associated habitation sites to examine the social homogeneity or heterogeneity of the gatherings held within them. Finally, the construction and use of ballcourts and great kivas in the region is examined in the context of the larger regional systems with which these features were associated, the Hohokam ballcourt network and the Chaco regional system, and comparisons are drawn between these features' histories of use in the heartland and frontier zone.

In Chapter 4 intensified exchange was found to be an initial alarm-stage response to environmental stress, one that has the potential to mitigate the impacts of unfavorable conditions. Chapter 12 explores this possibility by tracing patterns of extraregional exchange for pottery and exotic materials like marine shell, turquoise, argillite, and other minerals. These exotic materials are important not just as markers of exchange outside the local region, but also for their use as socially valued goods used to seal transactions like betrothals, marriages, initiations, or alliances and as personal ornaments to mark social identities, roles, and statuses. Thus, I begin by relating an indigenous tradition about a female deity who controlled these materials in order to provide perspective on how exchange networks would connect populations in different regions. Chapter 11 had documented, changing patterns of exotic material exchange associated with the ballcourt. These 11 are explored further with a focus on what changes in the materials and forms reveal about changing extra-regional relations and the local emergence of new social identities and alliances. I examine and analyze the changing patterns of exchange for non-locally produced plain and decorated pottery next, focusing on Little Colorado White Ware, Prescott Gray Ware, and White Mountain Red Ware. Their changing patterns of exchange are analyzed in relation to environmental disturbances, and comparisons between the heartland and frontier zone indicate that populations in the two areas were engaged in different yet overlapping exchange networks.

In Part IV, the concluding chapter, I weave these all together into a tapestry of the historic dynamics of climate, cooperation, and competition in the Flagstaff region. The setting, perspectives, and expectations are the warp, the non-moving elements that act as the foundation of a textile. The varied lines of evidence presented are the weft, the active elements of a textile that are woven through the warp to create patterns. For each temporal period, I evaluate the correspondences between the expectations and the different lines of evidence drawn from the archaeological record. At some times the expectations are met, at other times not. I explore these cases when the expectations are not met to provide greater insight into and understanding of the dynamics of interaction between changing environmental conditions and processes of competition and cooperation. In conclusion, I compare my findings to other recent research on the causes of intergroup conflict on a theoretical level (Turchin 2005; Turchin and Korotayev 2006) and to another regional case study in the U.S. Southwest (Kohler et al. 2006; Kohler et al. 2014) and explore the large implications of my findings.

CHAPTER 2 – ENVIRONMENTAL SETTING

The Flagstaff region of the American Southwest is located in north central Arizona around the San Francisco Peaks, which include the highest point in the state. This physiographic setting leads to a range of elevations within the region, from ca. 4200 feet (1280 m) along the Little Colorado River to 12,637 feet (3852 m) at the top of Humphreys Peak. Because of the range of elevations found in the region, there is great ecological diversity, from desertscrub at the lowest elevations to alpine tundra at the highest. The region has an arid climate with biseasonal precipitation that varies based on elevation and may also have substantial inter-annual variability. The environmental variability and diversity found in the Flagstaff region presented both great challenges and opportunities to the region's prehistoric inhabitants.

Descriptions of the environmental setting in this chapter create a context for understanding the challenges and opportunities faced by prehistoric subsistence farmers in the arid, high-elevation environment of the region. The physiographic and ecological setting is described, with an emphasis on conditions that would have affected agriculture, including the eruption of Sunset Crater Volcano. Next, previous research on the climate of the region is reviewed, including dendroclimatological reconstructions of regional precipitation and temperature. This paleoclimatic record is used to identify favorable and unfavorable periods for maize agriculture.

PHYSIOGRAPHIC AND ECOLOGICAL SETTING

For this study, the Flagstaff region is defined as the area encompassed by the drainages that head on the San Francisco Peaks and its hilly flanks and drain into the Little Colorado River to the east (Figure 2-1). This area largely consists of two major drainage systems, their tributaries, and an area of internal drainage between them. On the south is the Rio de Flag and its tributaries, and to the north is Deadman Wash and its tributaries. Between the two is the Coconino Divide, an area east of the San Francisco Peaks. The hilly volcanic landscape in this area has created many small internal drainages centered on open basins known locally as "parks;" these receive all of the local runoff.

When naturalist C. Hart Merriam conducted a biological survey of the Flagstaff region in 1889 he described climbing from the Little Colorado River to the top of the San Francisco Peaks as akin to travelling from Central Mexico to the Arctic. As elevation increases, so does effective precipitation, while concurrently temperatures decrease. These changes in precipitation and temperature create a series of "life zones" composed of different plant and animal communities (Merriam 1890). Six distinctive biotic communities stratified by elevation are present in the Flagstaff region (Table 2-1), from lowest to highest these are Great Basin desertscrub, Plains grassland, Great Basin conifer woodland, Rocky Mountain montane conifer forest, Rocky Mountain subalpine conifer forest, and alpine tundra (Brown 1994; Brown and Lowe 1982).

The Great Basin conifer woodland and Rocky Mountain montane conifer forest communities would have provided the most productive environments for agricultural

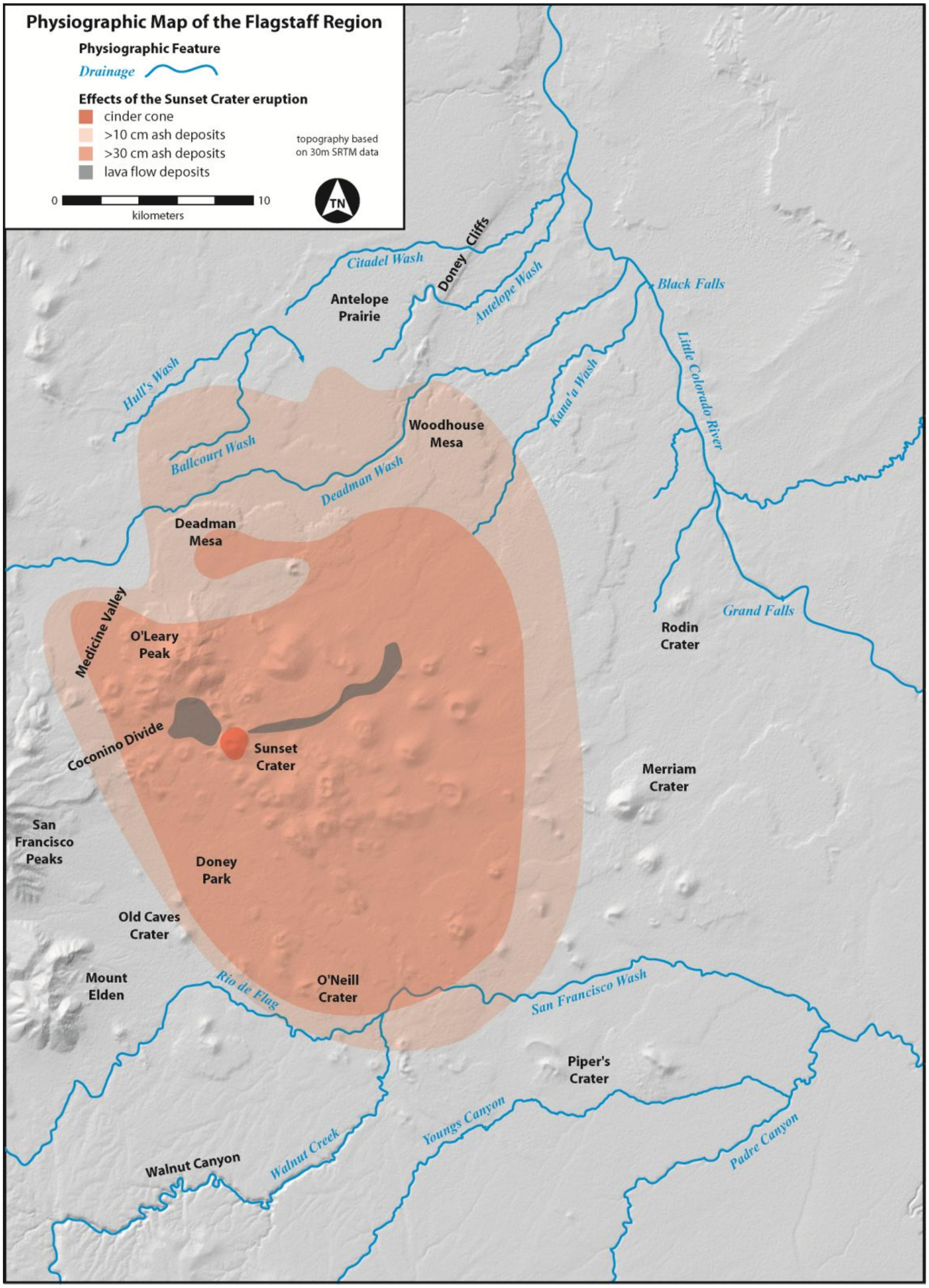


Figure 2-1. Physiographic map of the Flagstaff region.

Table 2-1. Biotic communities of the Flagstaff region (Brown 1982)

Biotic Community	Elevation Range	Characteristic Plants
Great Basin Desertscrub	< 1500 m	saltbush and sagebrush
Plains Grassland	1500 – 1700 m	bunch grasses and cacti
Great Basin Conifer Woodland	1500 – 2300 m	pinyon and juniper
Rocky Mountain Montane Conifer Forest	2000 – 2600 m	ponderosa pine and oak
Rocky Mountain Subalpine Conifer Forest	2500 – 3500 m	spruce, fir, and aspen
Alpine Tundra	> 3500 m	grasses, sedges, and lichens

pursuits and human exploitation of wild plants and animals, especially the Great Basin conifer woodland communities. The lower elevation desertscrub and grassland communities would have provided less secure opportunities for both foraging and agriculture because these lower-elevation areas receive less effective precipitation, have less biotic diversity and density, and have soil characteristics that are generally not favorable (see below). The higher-elevation subalpine and alpine communities are beyond the range of agriculture because of the short growing season and support fewer edible plants and animals for human exploitation. However, these biomes would have been sources of important medicinal plants not found at lower elevations.

The change in elevation from the Little Colorado River to the top of the San Francisco Peaks is also accompanied by dramatic changes in geology that have almost as much an influence on regional ecology as the changes in elevation. From the heights of the San Francisco Peaks, the landscape descends in a series of terraces to the Little Colorado River Valley to the east. These terraces begin with San Francisco Volcanic Field surrounding the peaks, a rough and broken landscape of cinder cones, lava flows, and ash fields. Features of the volcanic field extend to the Little Colorado Valley, with cinder cones on its edge and lava flows continuing to the river. The lava flows of the volcanic field terrace down to flat limestone plains dissected by narrow canyons. These plains then descend into the shale and sandstone badlands of the Little Colorado River Valley (Billingsley et al. 2007; Moore and Wolfe 1987).

The San Francisco Volcanic Field dominates the region and is characterized by Quaternary-aged volcanic deposits (Colton 1937; Priest et al. 2001; Robinson 1913). The volcanic substrates of the field are porous and well-drained, leading to limited availability of groundwater and earning the appellation of "Sierra Sin Agua" from early Spanish explorers. Drainages in the volcanic field only carry water during major precipitation events, although in some areas natural "tanks" have been created where the drainages have cut through lava flows. Turkey Tanks and Grass Tanks along San Francisco Wash often hold water throughout the year and had substantial prehistoric settlement around them. Springs are found around the flanks of the San Francisco Peaks, but most are at elevations too high to have supported prehistoric habitations nearby.

Soils in the volcanic field are well-drained sandy loams created by chemical and mechanical erosion of fine-grained volcanic tephra (Hendricks 1985). These soils may result from in situ pedogenesis of ash and lapilli deposits or from alluvial deposition of erosional products along drainage terraces and in parks. These volcanic soils possess many favorable characteristics for agriculture, having excellent permeability, moisture retention, and root penetration, although some are too deep and excessively drained. The presence of underlying aquacludes like bedrock and carbonate horizons at appropriate depths can help improve the moisture availability of the overlying soils (Edwards 2007).

Northeast and southeast of the volcanic field are flat plains underlain by the Permian-aged Kaibab formation, which has been incised with deep and narrow canyons. Antelope Prairie in Wupatki National Monument and Walnut Canyon are typical of these physiographic features. The Kaibab formation is composed of a sandy and cherty dolomitic limestone that can be resistant to water infiltration, leading to localized runoff and the potential for surface water accumulations. Dolomitic limestone bedrock may also form an aquaclude below accumulated soils. While the clayey loams that accumulate above the Kaibab bedrock are generally rather shallow, the presence of an underlying bedrock aquaclude improves soil moisture retention capacities where deeper deposits are present (Hendricks 1985; Levine 1987).

Along the Little Colorado River, the Triassic-aged Moenkopi formation creates a picturesque landscape of dramatic red mesas like that found surrounding Wupatki Pueblo. The sweeping vistas and bright colors are enhanced by the relative scarcity of vegetation in the associated desertscrub biotic community. The uppermost sandstones of the Wupatki member of the Moenkopi formation are a local groundwater aquifer, accumulating water that percolates through the overlying permeable volcanic deposits to the west. This groundwater moves horizontally upon contacting the underlying impermeable mudstone layers, emerging as a series of reliable springs in the vicinity of Wupatki Pueblo (Cosner 1962). Soils in the Little Colorado River Valley are coarse and gravelly sandy loams derived from erosion of the Moenkopi formation and consist of colluvial and alluvial deposits. These soils often overlie bedrock shallowly and have low permeability, which limits agricultural use (Hendricks 1985). Dunes of fine volcanic ash redeposited by eolian action are found in some areas, especially near Wupatki Pueblo (Billingsley et al. 2007). The lower elevations found in the Little Colorado River Valley allow a longer potential growing season, but with less and more widely scattered rainfall.

This diversity of biotic communities and soil types, the variable lengths of growing seasons and reliability of rainfall depending on elevation, and the limited availability of surface water presented a mosaic of challenges and opportunities to the region's prehistoric inhabitants. However, what may have been the greatest challenges and opportunities were presented after the eruption of Sunset Crater in the late 1000s.

THE ERUPTION OF SUNSET CRATER VOLCANO AND ITS EFFECTS

In 1930, archaeologists from the Museum of Northern Arizona (MNA) excavated prehistoric pit houses at a series of sites along Bonito Terrace west of Sunset Crater. These pit houses had been buried beneath the ashfall from the eruption. This discovery confirmed that the latest volcanic feature in the San Francisco Mountain volcanic field had erupted during the human occupation of the region (Colton 1932; Downum 1988). This discovery also raised two important questions that are still the focus of research: (1) When did Sunset Crater erupt? and, (2) How did the eruption affect local human populations?

Early estimations of the eruption date were made on the basis of ceramics associated with the pit houses buried by the Sunset Crater ash and those associated with sites stratigraphically on top of the ash. Despite concerted efforts in 1931 and 1932 to obtain tree-ring samples that would assist dating the eruption, the targeted sites failed to recover datable samples (Downum 1988). Based on the data available to them at the time, Colton (1932) placed the eruption between 700 and 875, while McGregor (1936a) suggested that it occurred between 860 and 910. On the basis of new tree-ring samples and refinements made to the seriation of local ceramic assemblages, Colton (1945) later revised the eruption date to 1066.

Re-analysis of tree-ring samples from Wupatki Pueblo led Smiley (1958) to propose an eruption date of 1064. Six specimens from the site were found to have suppressed rings after 1065, which Smiley interpreted as resulting from the stripping of the tree's limbs and needles by ashfall from the eruption. Smiley suggested that the eruption must have initiated in the winter of 1064-1065. Later re-analysis of these same specimens revealed that some were duplicate samples from the same construction beams, and that the six specimens represented only three individual trees (Ort et al. 2007; Robinson et al. 1975).

Smiley's research established the date of 1064 as the onset of the eruption in the archaeological and geological literature. However, this pattern of ring suppression, found in the three individual trees identified by Smiley, has not been seen in any other tree-ring specimens from Wupatki Pueblo or from the greater Flagstaff region. The limited distribution of this pattern suggests that the individual trees were affected by some other localized growth-retarding event (Boston 1995; Ort et al. 2007).

Paleomagnetic dating provides another line of evidence. Research by Shoemaker and Champion (1977) suggested an eruption sequence lasting between 100 and 200 years. These early efforts were hampered by the limitations of the science at the time, and more recent studies (Ort et al. 2007) have provided more accurate assessments. The estimates of Shoemaker and Champion, however, were influential in subsequent interpretations of the eruption's timing. Using Smiley's beginning date of 1064, the range of dates suggested by the early paleomagnetic studies, and observations made on the relationships among the various eruptive features, several researchers proposed eruptive sequences that began in 1064 and lasted through 1200 to 1250 (Amos 1986; Holm and Moore 1987; Pilles 1979). These long sequences are extremely unlikely, however, based on known recent cinder cone eruptions: 95 percent last less than one year and 50 percent last less than 30 days (Vesperman and Schmincke 2000).

The length of the eruptive event is an important question to resolve, because, as is discussed in Chapter 4, the scale and magnitude of an environmental disturbance influence the social responses made by affected populations. If eruptive action persisted for up to 200 years, these disturbances would have affected several generations of the region’s population. In contrast, a brief eruptive event would have long-term impacts from the deposition of lava and ash, but the severe disturbances engendered by an active eruption would have been of shorter duration. Recent research associated with cultural resource management excavations along U.S. Highway 89 has provided important new data to help resolve the long-standing question of the eruption’s duration.

Examination of tephra deposits has confirmed earlier observations made by Amos (1986) that individual fallout units of volcanic ash can be discerned, but there is no evidence – such as soil formation or extensive eolian reworking of surficial deposits – of lengthy periods between fallout events. (Hooton and Ort 2007; Ort et al. 2007). These observations suggest that the eruptive event spanned a relatively short period of time. New paleomagnetic samples analyzed in reference to the contemporary secular variation curve (Lengyel and Eighmy 2002) indicate that the eruption occurred between 1040 and 1100 (Ort et al. 2007).

Tree rings have also been used in recent attempts to pinpoint the date of the eruption. Following the supposition made by Smiley (1958) that ash fall stripped foliage from the trees and suppressed tree growth, the tree-ring record of the region was re-examined in search of a widespread pattern of ring suppression not associated with patterns of regional precipitation (Elson et al. 2009). These studies suggest that a regional pattern of ring suppression between 1085 and 1090 could be associated with the eruption. Additional analyses of elemental concentrations in tree rings have also been conducted. Trees that were growing during eruptive events at Paricutín Volcano in Mexico and Mount Lassen in California exhibit distinctive elemental concentrations in growth rings added during eruptions, having elevated concentrations of sulfur, phosphorous, and sodium. Similar elevated concentrations of these elements were identified in samples from the Flagstaff region, also corresponding to the period between 1085 and 1090 (Elson et al. 2011). These new tree-ring data support the geological evidence of a relatively brief rather than multi-decadal eruptive event, and this eruptive period of 1085 to 1090 fits within the date range identified by the paleomagnetic studies.

The eruption covered approximately 900 square miles (2,330 km^2) with volcanic tephra that altered local ecosystems tremendously (Figure 2-1). However, the effects of the eruption were not homogenous across the impact zone. Areas closer to Sunset Crater were buried under lava flows or deep deposits of ash, while areas around the periphery had less ash deposition and were unaffected by surface flows of lava. Fine ash deposits were reworked and redeposited by eolian action, and some areas unaffected by the primary ashfall from the eruption received ash that was secondarily redeposited by wind. Within the ashfall zone, contemporary deposits that have been altered by centuries of eolian and fluvial action range in depth from greater than 10 m close to Sunset Crater to less than 5 cm in peripheral areas (Amos 1986; Hooten and Ort 2007).

While those areas with deep ash or deposits of lava were rendered uninhabitable, areas with thinner ash deposits were found to have experienced in prehistoric population growth following the eruption. Colton (1932, 1936) first proposed that the deposition of these thinner layers of ash may have actually been beneficial, providing a mulch that improved the moisture retention characteristics of the underlying soil. Hopi dry-farming technologies were used as an analogy, and in the 1930s Colton (1965) conducted a series of experiments using Hopi maize varieties grown in plots near Wupatki Pueblo and Sunset Crater. These plots had different depths of ash overlying the soils.

Similar experiments have since been conducted by the National Park Service (Maule 1963) and researchers associated with the U.S. Highway 89 archaeological project

(Waring 2007). All of these studies have demonstrated a positive correlation between ash mulch and greater rates of germination success. However, the presence of too deep a mulch (greater than 15 cm) was found to impede the emergence of maize shoots. In all the experiments, the ideal depth of the ash mulch was found to be between 2.5 and 10 cm. Waring also and found that, in addition to improving moisture retention capacities of the underlying soils, the ash mulch increased soil temperatures. At higher-elevation plots, this increase in soil temperature was found to be beneficial, as it effectively increased the length of the growing season.

While some previously arable land became unproductive because it was deeply buried, the productive potential of other arable land improved. Additionally, some land that had previously been marginal or non-arable was made potentially productive as the result of the ash deposition, especially locations on the limestone plains, where soil of sufficient depth could be found overlying a bedrock aquaclude. Research by Edwards (2003, 2007) has demonstrated that prehistoric farmers preferentially chose locations with specific soil characteristics, including the presence of an ash mulch and an underlying aquaclude.

Colton (1932, 1936, 1946, 1960) proposed that the improved agricultural opportunities created by the ash mulch created a prehistoric "land rush," as local populations re-colonized the ashfall zone and were joined in this process by immigrants from outside the region. While the initial shock and displacement caused by the eruption were detrimental, Colton saw the eruption as beneficial, allowing greater agricultural productivity and population growth. However, he recognized that local soils were easily exhausted of nutrients and that the fine fraction of the ash mulch was depleted over time by eolian action. He also recognized the importance of climatic variation, especially seasonal and inter-annual variability in precipitation.

The Regional Climate Record

The Flagstaff region has an arid climate with warm summers and cold winters that presented many challenges to prehistoric subsistence farmers, especially variability in precipitation (Colton 1958). Data on regional climate can be drawn from two sources: (1) historic climate records from weather observation stations, and (2) paleoclimatic reconstructions derived from tree rings. The historic series provide fine-grained measurements on a daily, monthly, and annual basis. They were used in the paleoclimatic reconstructions to calibrate measured ring width with amounts of precipitation and average annual temperature, although these proxy measures are statistical estimates of past conditions, and thus less accurate than the historic records. A brief examination of the historic record follows in order to investigate patterns of variability that are masked in the reconstructions, especially interseasonal variation and differences based on elevation. Then the paleoclimatic reconstructions are interpreted to identify periods when environmental conditions would have been either detrimental or beneficial to agricultural production.

Historic climate data from National Weather Service recording stations at Sunset Crater and Wupatki National Monuments are available from the Western Regional Climate Center (2011a, 2011b). The Sunset Crater recording station is at an elevation of

6980 feet (2127 m), and data are based upon the period 1969–2010. The Wupatki recording station is at an elevation of 4910 feet (1497 m), and data are based upon the period 1940–2010. The data from these stations demonstrate the differences in effective precipitation based on elevation, with Wupatki receiving an average of 20 cm of precipitation annually while Sunset Crater receives an annual average of 42 cm.

There is a marked biseasonal precipitation pattern (Figure 2-2), with peaks of precipitation in the late summer and in the winter. The warm-season rainfall is part of the well-known monsoon pattern in which a seasonal shift in high-pressure systems and

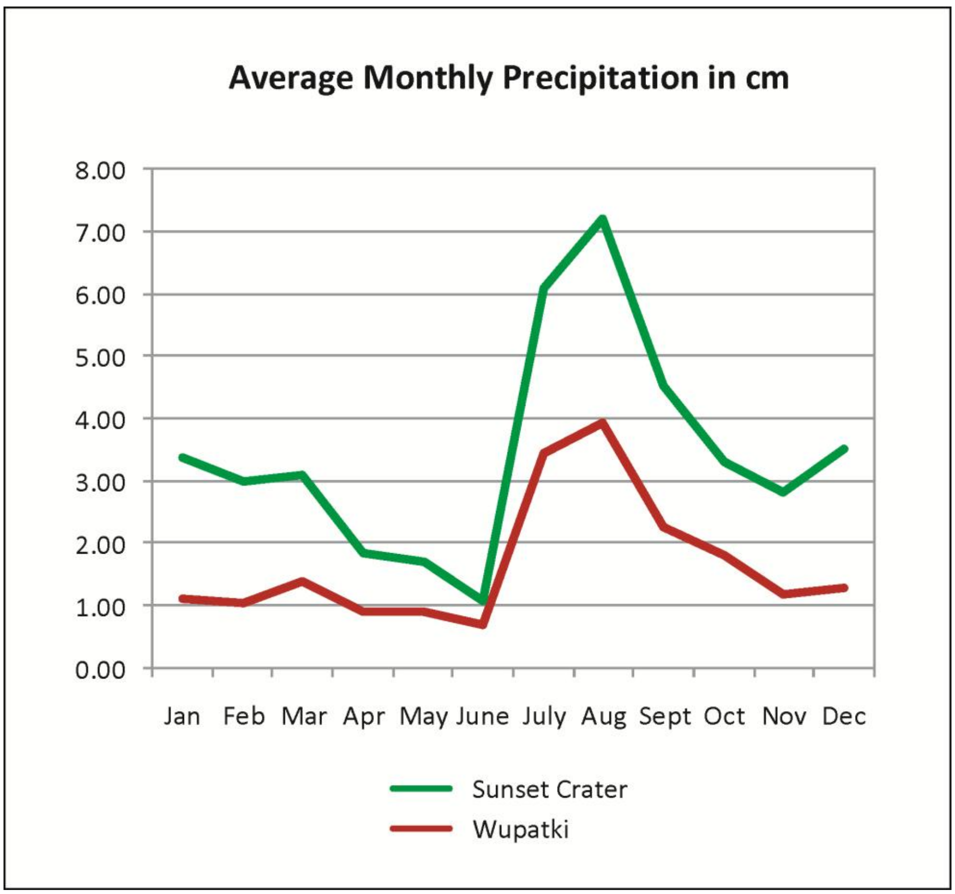


Fig 2-2. Historical average monthly precipitation at Wupatki and Sunset Crater

upper-level air circulation patterns draws subtropical moisture from the Gulf of California and eastern Pacific Ocean into the Southwest (Douglas et al. 1993; Adams and Comrie 1997). These monsoon rains provide 43 to 48 percent of the annual precipitation during the end of the growing season between July and September. Winter precipitationis influenced by two large-scale climate patterns, the El Niño–Southern Oscillation and the Pacific Decadal Oscillation, the interaction of which can create pronounced interannual reversals in the abundance of winter precipitation (Ni et al. 2002).

Because of this seasonal precipitation pattern, the amount of cool-season precipitation is very important for agriculture. Because of the relative dryness of the spring months, the amount of available soil moisture from winter precipitation is critical for spring germination. Maize, the staple crop of prehistoric Puebloan peoples, requires a minimum of 25 cm of annual precipitation and 15 cm of growing-season precipitation (Muenchrath and Salvador 1995). Wupatki receives an average of 20 cm of annual precipitation and 11.3 cm of precipitation between April and September, while Sunset Crater receives an average of 41.9 cm of annual precipitation and 20.7 cm of growing season precipitation.

These averages would suggest that the Wupatki area is marginal for agriculture, because, on average. it receives insufficient precipitation. However, there is a wide range between the recorded maximum and minimum amounts of annual precipitation (Figure 2-3). At Wupatki, some years *do* receive enough total rainfall, but having sufficient rainfall during *both* the cool *and* warm seasons is necessary for agricultural success (Table 2-2). Over the period of record, only 8% of years received enough rainfall during both the cool and warm seasons to allow successful maize agriculture at Wupatki. In

Table 2-2. Climatic conditions in relation to the needs of maize agriculture and their frequency of occurrence at different elevations based on historic weather records

Climatic Conditions in Relation to Needs of Maize Agriculture	Frequency of Occurrence	
	Wupatki (71 years)	Sunset Crater (42 years)
Sufficient cool season precipitation	32	93
High probability of late spring frosts when there is sufficient cool season precipitation	-	28
Sufficient cool and warm season precipitation	8	72
High probability of late spring frosts when there is sufficient cool and warm season precipitation	-	32
Insufficient warm season precipitation after sufficient cool season precipitation	74	22
Insufficient cool season precipitation	68	7

comparison, higher-elevation areas around Sunset Crater usually receive sufficient, if not ample, precipitation; 78% of years received enough rainfall during both the cool and warm seasons.

However, available moisture is not the only limiting factor affecting agriculture in the Flagstaff region. As elevation increases, the length of the growing season, as defined by late spring and early fall frosts, decreases. Southwestern varieties of maize require a freeze-free period of 80 to 120 days to reach full maturity (Muenchrath and Salvador 1995). At Wupatki, the freeze-free period averages 134 days, and the shortest recorded period is 112 days (Figure 2-3). At Sunset Crater, the freeze-free period averages 84 days, and the shortest recorded period is 41 days. There is a 44% probability that the growing season will be less than 80 days, and an 83% probability that it will be less than

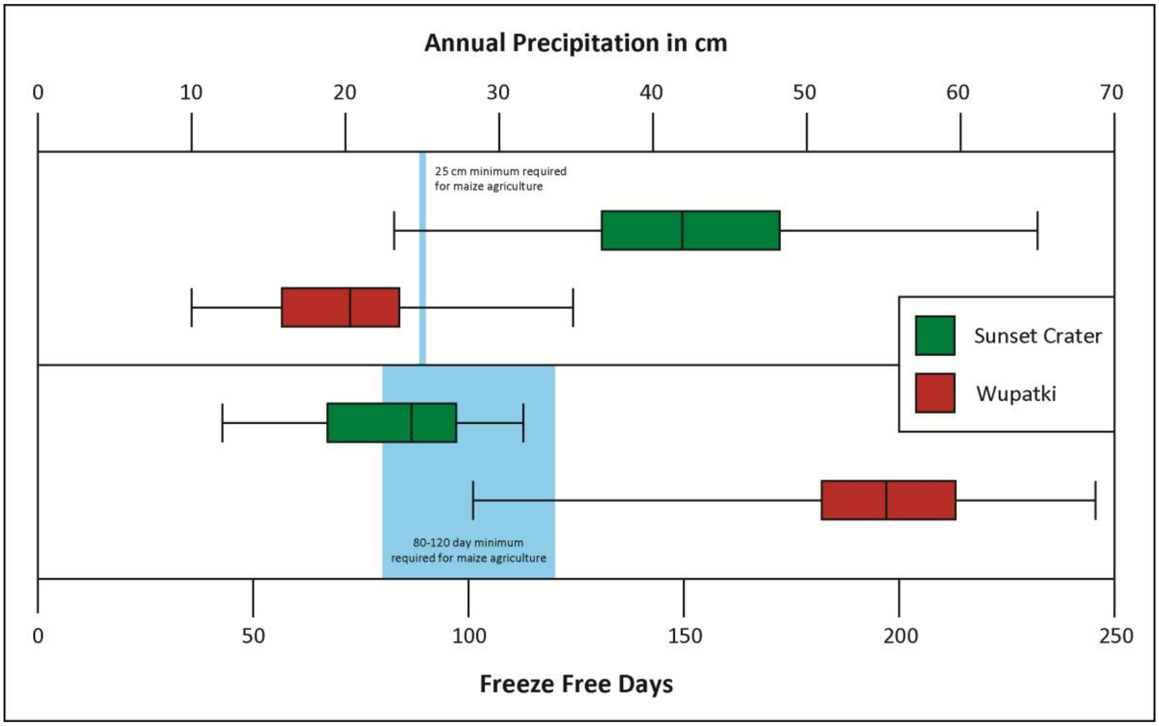


Fig 2-3. Boxplots of the historical amounts of annual precipitation and number of freeze free days at Wupatki and Sunset Crater shown in relation to the growing requirements for maize.

100 days. Cold temperatures and risks of growing season frosts were not a problem in the Wupatki area, but in areas above 6000 feet, like at Sunset Crater, cold temperatures could be a significant problem. Late spring freezes could potentially prevent germination and kill emerging seedlings, and early fall frosts could potentially retard kernel maturation and reduce crop yields. The average daily low temperature during May was used as a predictor of high probability of late spring frosts that could affect germination and seedlings. Of those years that received sufficient precipitation in both the cool season precipitation to foster germination, 37% could have been affected by late spring frosts. The average daily low temperature during September was used as a predictor of high

probability of early fall frosts that could reduce crop yields. Such early fall frosts appear not to have been as problematic as late spring freezes, as they affected only 4% of those years that received sufficient cool season precipitation, had not suffered from spring frosts, and received sufficient warm season precipitation. Thus cumulatively, only 50% of years received sufficient precipitation during both the cool and warm seasons and were free from potential the damages of spring and fall frosts.

These precipitation and temperature data indicate that, while higher elevation areas are more likely to receive sufficient precipitation to practice maize agriculture, they are also more susceptible to freeze-shortened growing seasons. Conversely, lower elevation areas rarely suffered from shortened growing seasons but were more deficient in necessary precipitation. Strategies used by prehistoric farmers of the region to contend with this variation were probably like those practiced historically by Hopi farmers and included placing plots in locations that concentrated runoff from adjacent areas, maintaining multiple plots across different microenvironments, and selecting suitable varieties of maize for planting at different elevations (Bradfield 1971; Forde 1931a; Hack 1942). The post-1085 deposition of Sunset Crater ash may also have ameliorated some of the challenges presented by precipitation and temperature variability. As found by Waring (2007), the beneficial effects of the ash mulch in increasing soil temperature and radiating heat that was absorbed from the sun during day can lengthen the growing season in higher-elevation settings. And in lower-elevation settings, the presence of a suitable ash mulch may have been significant in conserving the critical soil moisture from winter precipitation needed for the spring germination of crop seeds. The ash mulch may even have permitted agricultural success during years with less-than-optimal conditions.

This review of historic climate data is useful for understanding the range of variability, interannually and interseasonally, that could be expected in the region. In contrast, the paleoclimatic reconstructions derived from tree-rings provide a longer-term perspective and allow the identification of multi-annual periods of above- or below-average precipitation or temperature. Recent research associated with the U.S. Highway 89 archaeological project has produced a reconstruction of annual precipitation and temperature for the region (Salzer and Dean 2007; Salzer and Kipfmueller 2005). This research identified several different measures of significant deviation from long-term averages, including extreme dry, wet, cool, and warm intervals, and combinations of the precipitation and temperature reconstructions distinguishing significantly warm/dry, warm/wet, cool/dry, and cool/wet intervals (Tables 2-3 and 2-4).

Each of these periods of extreme departure from long-term averages has implications for prehistoric agricultural success. Extreme dry periods present obvious challenges, with decreased productivity and increased risk of crop failure. Conversely, extreme wet periods have the potential benefit of increased productivity. Cool periods would increase agricultural risk in high-elevation locations, while warm periods would increase chances of success in these locations. The impacts of temperature variability would be opposite at lower elevations, where cool temperatures would be beneficial and warm temperatures could be detrimental if excessive. Temperatures > 38° C (100° F) in lowland areas during June, which is both the driest part of the year and when corn is starting to tassel, can lead

Table 2-3. Extreme wet, dry, warm, and cool intervals, with range of calendar years A.D. and the length of the intervals in years in parentheses (Salzer and Dean 2007).

Extreme Dry Intervals	Extreme Wet Intervals
1033 – 1041 (9) 1090 – 1101 (12) 1131 – 1140 (10) 1215 – 1221 (7) 1292 – 1300 (9)	1047 – 1066 (20) 1077 – 1084 (8) 1162 – 1167 (6) 1268 – 1275 (8)
Extreme Warm Intervals	**Extreme Cool Intervals**
1067 – 1091 (25) 1146 – 1155 (10)	1094 – 1120 (27) 1195 – 1219 (25) 1225 –1245 (21) 1258 – 1271 (14)

Table 2-4. Cool/dry, cool/wet, warm/dry, and warm/wet intervals, with range of calendar years A.D.and the length of the intervals in years in parentheses (Salzer and Dean 2007).

	Cool	Warm
Dry	1094 – 1101 (8) 1215 – 1219 (5)	1090 – 1091 (2)
Wet	1268 – 1271 (4)	1077 – 1084 (8)

to low rates of pollination and kernel formation. Combining temperature and precipitation serves to further refine these basic trends. Periods that were warm/dry could be worse than periods that were cool/dry, as the increase in temperature may exacerbate the impacts from decreased precipitation.

These dendroclimatological data on periods of extreme departures from long-term averages can be used to determine periods of relative success and failure of agriculture efforts in the region. When the duration and impact of an environmental disruption exceeds the capacity of a society to buffer against food shortages, leading to diminished or depleted food reserves. Puebloan societies ideally maintained two to four years of stored foods as a buffer against poor harvests or total crop failure (Levy 1992:107-108). In such a setting, environmental disturbances lasting five years or more would deplete accumulated food reserves. Conversely, ameliorative conditions would allow the accumulation of surpluses. If the reconstructed precipitation amounts could be used to create an index to measure the potential productivity of maize agriculture and the ability of households to accumulate or deplete stored food reserves, these propositions could be tested archaeologically.

However, the paleoclimatic data must be used cautiously. While robust statistical techniques calibrated to historical records were used to create the reconstructed precipitation and temperature values, there are some qualifications as to the representativeness of some of the data, particularly the reconstructed precipitation amounts. Because the conifer species used for the reconstruction complete most of their annual growth by the end of July, the variation in ring width represents not the amount of precipitation over a calendar year, but rather over a tree's growth period from October through the following July, and the reconstructed precipitation amounts only represent that interval. Additionally, the reconstruction is for an idealized elevation of 7000 feet (Salzer and Dean 2007:104-105). The issue of elevation can easily be addressed by applying standardized lapse rates for decline in precipitation and increase in temperature as elevation decreases (Colton 1958; Dean and Salzer 2007). The problem of the intervals represented by the reconstructed precipitation values presents greater challenges to using these values to directly infer the effects of precipitation on agriculture.

While the tree-ring reconstructions present the cumulative precipitation between October and the following July, historic climate records indicate that on average 30% of the annual rainfall total falls in August and September, the months not accounted for in the tree-ring reconstructions. These are also months when precipitation is most crucial for the final maturation of maize (Muenchrath and Salvador 1995). Additionally, since the meteorological mechanisms that create cool-season and warm-season precipitation in the region are independent, the amount of cool-season precipitation is not predictive of the amount of warm-season precipitation. Comparisons of tree-ring width with monthly precipitation records has shown that variation in ring width is strongly correlated with cool-season precipitation, but correlation with warm season precipitation is weak (Benson 2010). Methods to reconstruct warm season precipitation using tree rings from other species are under development (Meko and Baisan 2001; Stahle et al. 2009) but have not been applied to samples from the study area.

When analyzing dendroclimatological data for long-term trends, analysts usually smooth the data, express it in terms of standard deviation units, and identify periods that are departures of more than one standard deviation from the long-term average (Dean and Robinson 1977). This statistical technique has proven to be an extremely useful approach, but if the goal is reconstructing or modeling prehistoric agricultural productivity, the utility of tree-ring data is somewhat limited . Benson (2011a, 2011b) has made an ambitious study of the factors contributing to maize productivity on the southern

Colorado Plateau, but the methods were not designed to reconstruct productivity for specific years in the prehistoric past. The study examined various factors of precipitation, temperature, and soil chemistry and concluded that effective soil moisture was the most important variable in determining maize productivity.

While inferring that periods with significant negative departures from the long-term average precipitation that would be deleterious to agricultural pursuits is useful, directly measuring productivity and the ability to build up or need to draw from a surplus would be ideal for the current research. If the tree-ring reconstructions of precipitation were for full annual years, one could index the deviation from the minimum precipitation needs of maize rather than seeking periods in the climatological record that deviate from the long-term average. This process would identify those years when maize production would have been favorable versus those when it likely would have failed. Because the reconstructed precipitation only covers the period between October and July, this index cannot be constructed directly.

The historic climate records indicate that on average 70% of annual precipitation falls during the October-July period, including winter precipitation that is vital for spring germination. Therefore, the reconstructed precipitation amounts can be indexed to 70% of the minimum precipitation requirements for maize (17.5 cm) to determine if the reconstructed October-July precipitation is more or less than this required amount. This index measures *potential* maize productivity by determining which years were likely to have sufficient cool season precipitation to allow successful germination and early plant growth; unfortunately, however, it cannot account for final crop maturation in August and

September because of the nature of the data. Importantly, although the index may not be able to predict agricultural success with a high degree of accuracy, it should predict most periods of agricultural failure and thus can be used to identify when environmental conditions would have challenged agricultural pursuits.

The departures from 17.5 cm were expressed in standard deviation units and then adjusted for different elevations with standardized lapse rates for decline in amounts of precipitation with decrease in elevation (Figure 2-4). This figure also shows the relationships with the distribution of biotic communities and important archaeological sites of the region. The archaeological sites are arranged by elevation. This analysis demonstrates that sufficient moisture was almost always available at 6000 ft and higher, but lower elevations often lacked sufficient precipitation to initiate crop growth (Table 2-5). However, agriculture at higher elevations was challenged by cool periods, and much of the 1200s was extremely cool, increasing risks of shortened growing seasons. When these cool periods coincided with dry periods, the opportunity to buffer lower-elevation agricultural failures with plots at higher elevations presented additional risks rather than rewards. This situation parallels the observation made by Peterson (1986) for the Dolores region of southwestern Colorado, where he found that different ranges of elevation become more or less suited for agriculture as climatic conditions change. In the Flagstaff region, prehistoric occupation appears to have focused on elevations between 5500 and

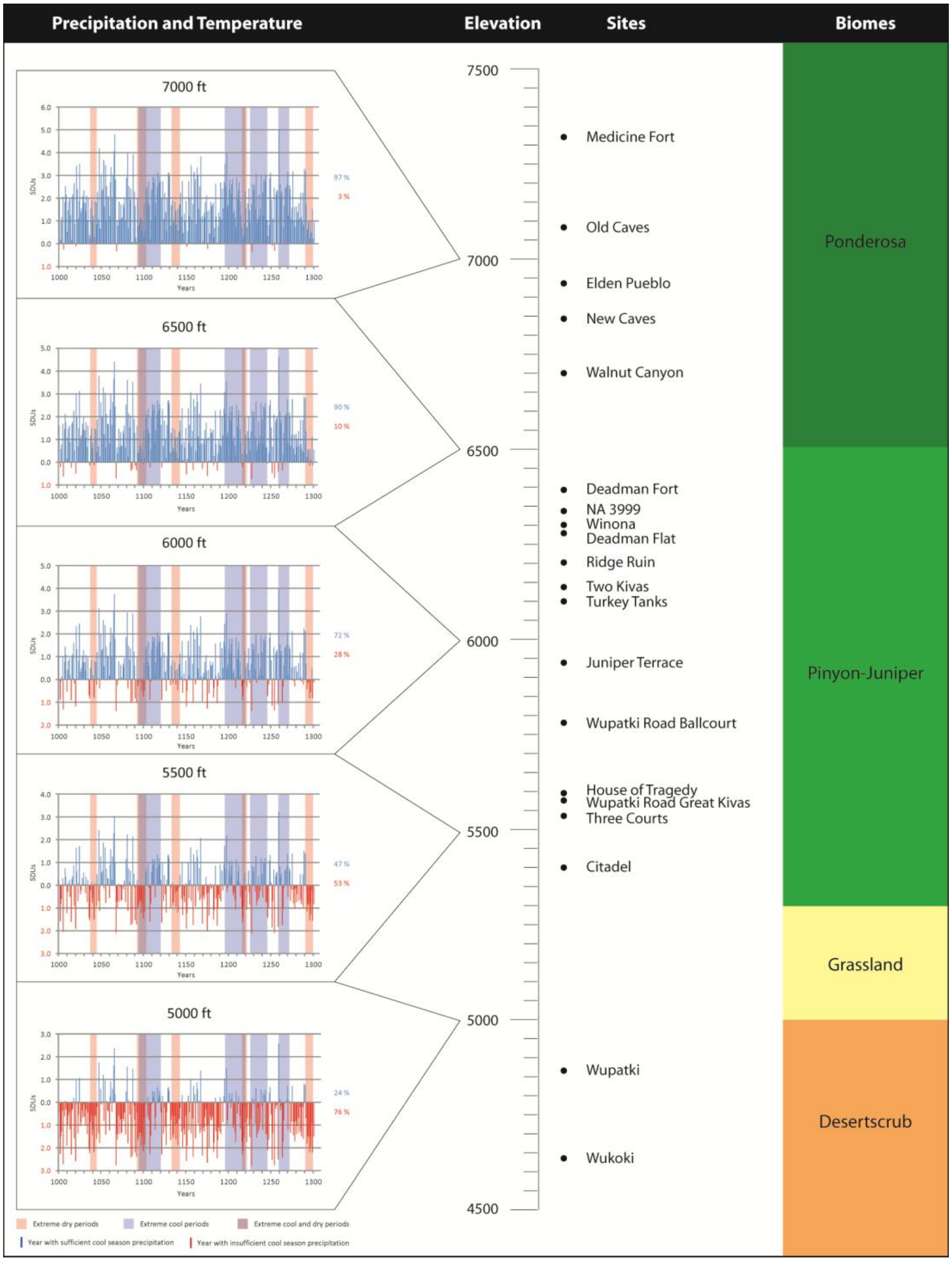


Figure 2-4. Departures of reconstructed precipitation values from 70% of the annual requirements of maize (October through July) expressed in standard deviation units and broken down by elevation; also shown in relation to biotic communities and the elevations of significant archaeological sites in the region.

Table 2-5. Climatic conditions in relation to the needs of maize agriculture and their frequency of occurrence at different elevations (in feet) based on reconstructed precipitation amounts

Climatic Conditions in Relation to Needs of Maize Agriculture	Frequency of Occurrence between A.D. 1000 and 1300				
	5000	5500	6000	6500	7000
Sufficient cool season precipitation	24	47	72	90	97
Insufficient cool season precipitation	76	53	28	10	3

6500 feet, but higher- and lower-elevation areas were used as well, perhaps in response to particularly advantageous climate conditions (Pilles 1979, Downum 1992).

Climate scientists have recently used tree-ring data from across the western U.S. to reconstruct warm season Palmer Drought Severity Index (PDSI) values for the past 2000 years (Cook et al. 1999, 2004). The PDSI is a cumulative measure of precipitation andtemperature that is widely used by meteorologists to determine the initiation, intensity, and termination of drought conditions (Palmer 1965). The index is most sensitive to long-term trends, but has limitations in how it handles evapotranspiration, runoff, and precipitation that falls as snow (Alley 1984). The PDSI reconstructions are for grid points 2.5 degrees apart in latitude and longitude across the western U.S. The closest grid point to the Flagstaff region is 61 miles (99 km) to the west-southwest at an elevation of 5436 feet (1657 m). These reconstructions, while more coarse-grained than the Salzer and Dean (2007) reconstructions, provide measures for the regional effects of climatic variability. The reconstructed values from this nearest grid point (Figure 2-5) suggest that 18% of the years between 1000 and 1300 suffered severe to extreme drought conditions, and another 14% experienced moderate drought conditions. Only 41% of years had near normal or wet conditions.

Other researchers have used these reconstructions to identify "megadroughts" that affected the entire U.S. Southwest (Benson and Berry 2009; Benson et al. 2007). Megadroughts are defined as dry periods spanning more than 20 years that have PDSI values of less than or equal to −1 for at least 60% of the years in the period and at least two periods of more than three consecutive years with PDSI values of less than or equal to −1. Two of these megadroughts fall within the period of interest, one between 1130 and 1177, and a second between 1273 and 1297.

These different methods of reconstructing past climate can each be used to identify periods of five years or longer of adverse or beneficial climatic conditions. The periods

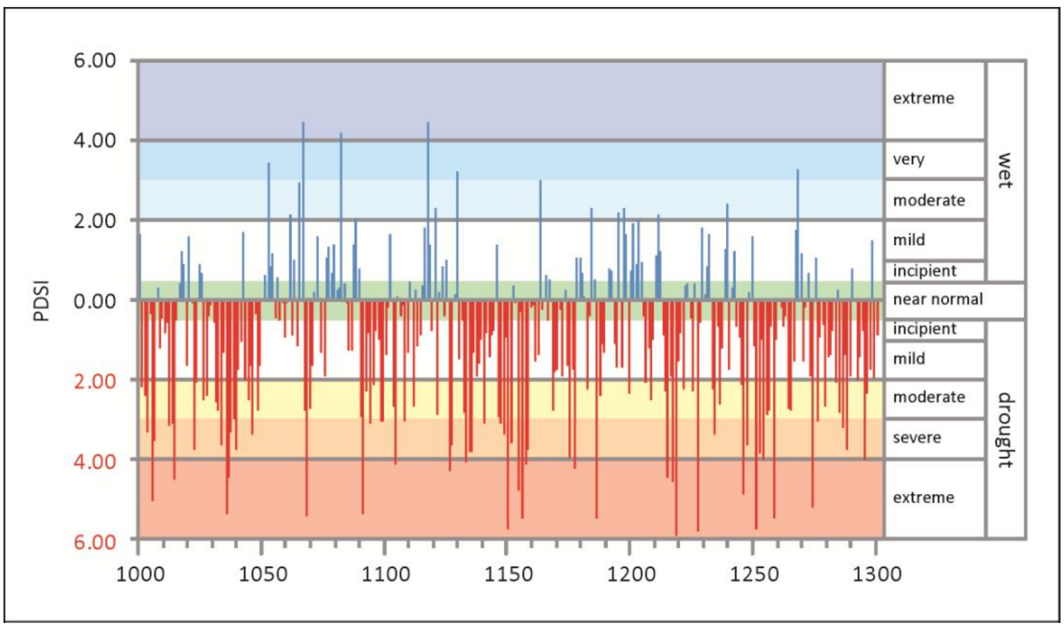


Figure 2-5. Reconstructed PDSI values for the nearest grid point to the Flagstaff region (all dates A.D.).

defined using the different methods can then be compared to find consensus on the duration and severity of particular periods (Figure 2-6). Using this process, I have defined five periods between A.D. 1000 and 1300 (Figure 2-7) during which environmental conditions would have had negative effects on agriculture (Table 2-6) and five periods during which conditions would have had beneficial effects (Table 2-7). These periods vary in their characteristics (Table 2-8), and these differences may have elicited different adaptive responses from the region's prehistoric agriculturalists. In Chapter 7, these periods are used to develop expectations for cooperative and competitive social responses that can be tested against the archaeological record of the region.

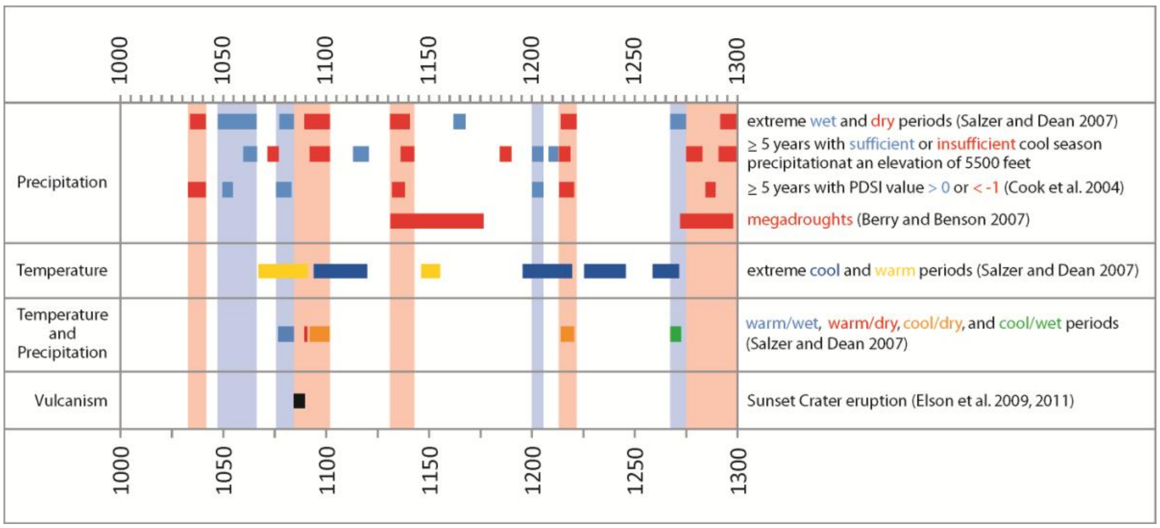


Figure 2-6. Sources of prehistoric climatic variation in the Flagstaff region reconstructed from various sources. Shaded red and blue bars indicate the consensus periods used in this research (all dates A.D.).

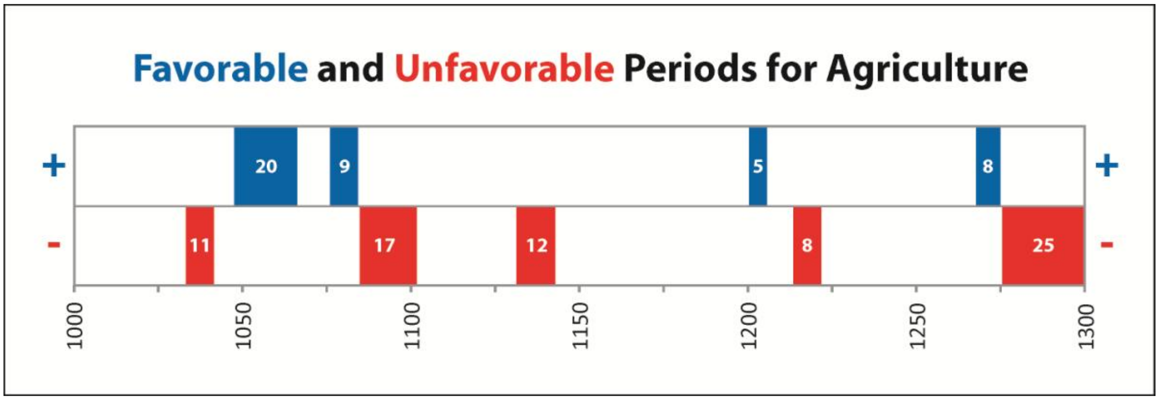


Figure 2-7. Consensus periods used in this research (all dates A.D.).

Summary

The environment of the Flagstaff region has great diversity, and the region's climate has tremendous variability, both annually and seasonally. Agriculture was a risky proposition in the Flagstaff region, and given the potential annual, seasonal, and spatial variability in precipitation, overall success may have been achievable only about half of the time. The eruption of Sunset Crater between 1085 and 1090 transformed the environment, devastating some areas but also creating new contexts for agriculture. These environmental data have been used to define periods during which conditions were likely to have either benefited or negatively impacted agricultural production. The following chapter examines how prehistoric human populations interacted with this dynamic landscape. These prehistoric populations were as diverse as the region they inhabited, and Chapter 3 will focus on the sequence of prehistoric cultural development in the region.

Table 2-6. Comparison of different periods of environmental disturbances expected to have negatively impacted agriculture. Intervals shown in red have significant overlap across the left five columns and were used to define the consensus periods in the far right column (all dates A.D.).

Extreme Dry	Warm/Dry or Cool/Dry	Insufficient Cool Season Precipitation	PDSI < -1	Megadroughts and Vulcanism	Consensus Periods
1033 – 1041			1031 – 1041		**1031 – 1041**
		1071 – 1076			
1090 – 1101	1090 – 1091 1094 – 1101	1093 – 1101		1085 – 1090	**1085 – 1101**
1131 – 1140		1137 – 1142	1132 – 1138	1130 – 1177	**1131 – 1142**
		1185 – 1189			
1215 – 1221	1215 – 1219	1214 – 1218	1214 – 1219		**1214 – 1221**
1292 – 1300		1276 – 1283 1291 – 1300	1285 – 1289	1273 – 1297	**1276 – 1300**

Table 2-7. Comparison of different periods with environmental conditions expected to have benefited agriculture. Intervals shown in red have significant overlap across the left four columns and were used to define the consensus periods in the far right column (all dates A.D.).

Extreme Wet	Warm/Wet or Cool/Wet	Sufficient Cool Season Precipitation	PDSI > 0	Consensus Periods
1047 – 1066		1060 – 1066	1050 – 1054	**1047 – 1066**
1077 – 1084	1077 – 1084		1076 – 1083	**1076 – 1084**
		1114 – 1120		
1162 – 1167				
		1200 – 1204	1200 – 1204	**1200 – 1204**
		1209 – 1213		
1268 – 1275	1268 – 1271			**1268 – 1275**

Table 2-8. Consensus periods with environmental conditions that were either conducive (blue) or detrimental (red) to agriculture, and the specific characteristics of each period. Consensus periods have the range of calendar years A.D. and the length of the intervals in years in parentheses.

Consensus Periods	Characteristics
1031 – 1041 (11)	Since this dry period did not also have cool temperatures, higher elevation areas with greater amounts of precipitation could have been used to buffer lower elevation crop failures.
1047 – 1066 (20)	This 20-year-long wet period could have fueled population growth and allowed the accumulation of surpluses.
1076 – 1084 (9)	This warm/wet period would have allowed reliable agricultural production at higher elevations and would have benefited lower elevations as well. Could have allowed the accumulation of surpluses.
1085 – 1101 (17)	Begins with the eruption of Sunset Crater from 1085 to 1090. This followed by an extreme dry interval that began with warm/dry period from 1090 to 1091 and ended with a cool/dry period from 1094 to 1101. This cool/dry period would have affected attempts to buffer lower elevation crop failures with higher elevation production. Surpluses accumulated during the previous warm/wet period may have buffered the initial impacts of this period.
1131 – 1142 (12)	Found across all the different reconstructions of precipitation, this period also overlaps with the beginning of a regional megadrought.
1200 – 1204 (5)	This wet period was during a longer extreme cold interval that would have limited the agricultural potential of higher elevations.
1214 – 1221 (8)	The middle part of this period, 1215 to 1219, was cool/dry, which would have affected attempts to buffer lower elevation crop failures with higher elevation production.
1268 – 1275 (8)	The beginning of this period, 1268 to 1271, was cool/wet. While limiting higher elevation agriculture, this period would have made lower elevation agriculture more reliable and productive.
1276 – 1300 (25)	This 25-year-long dry period overlaps with a regional megadrought. Surpluses accumulated during the previous cool/wet period may have buffered the initial impacts of this period, but the length of this period would have challenged the sustainability of agricultural activities.

CHAPTER 3 – ARCHAEOLOGICAL SETTING

The previous chapter described the environmental setting of the Flagstaff region − its physiography, geology, ecology, and climate − creating a context for understanding the potential possibilities of and limitations on prehistoric subsistence agriculture in the region. This chapter describes the archaeological setting of the region (Figure 3-1) − the spatial and temporal patterning of the material remains of the past and the interpretations that have been made of these patterns − creating a context for understanding the relationships between climatic conditions and social strategies of cooperation and competition. Material culture evidence of three archaeological "cultures" − the Sinagua, Cohonina, and Kayenta − is found in the Flagstaff region. The southern part of the region is considered the heartland of the Sinagua, while the northern part, an area of overlap among the material culture patterns used to define the archaeological cultures of the region, has been described as a frontier zone. On a larger scale, the Flagstaff region was on the frontiers of two larger regional systems − the Hohokam ballcourt network and the Chaco regional system. To contextualize these frontiers, I begin with a discussion of contemporary perspectives on the dynamic nature of frontier zone interactions. Then I present a general outline of the material culture characteristics and chronological sequences of development as defined by previous research. This outline includes the archaeological cultures of the region and the larger regional systems in which they participated, discussing each within the context of its frontier settings.

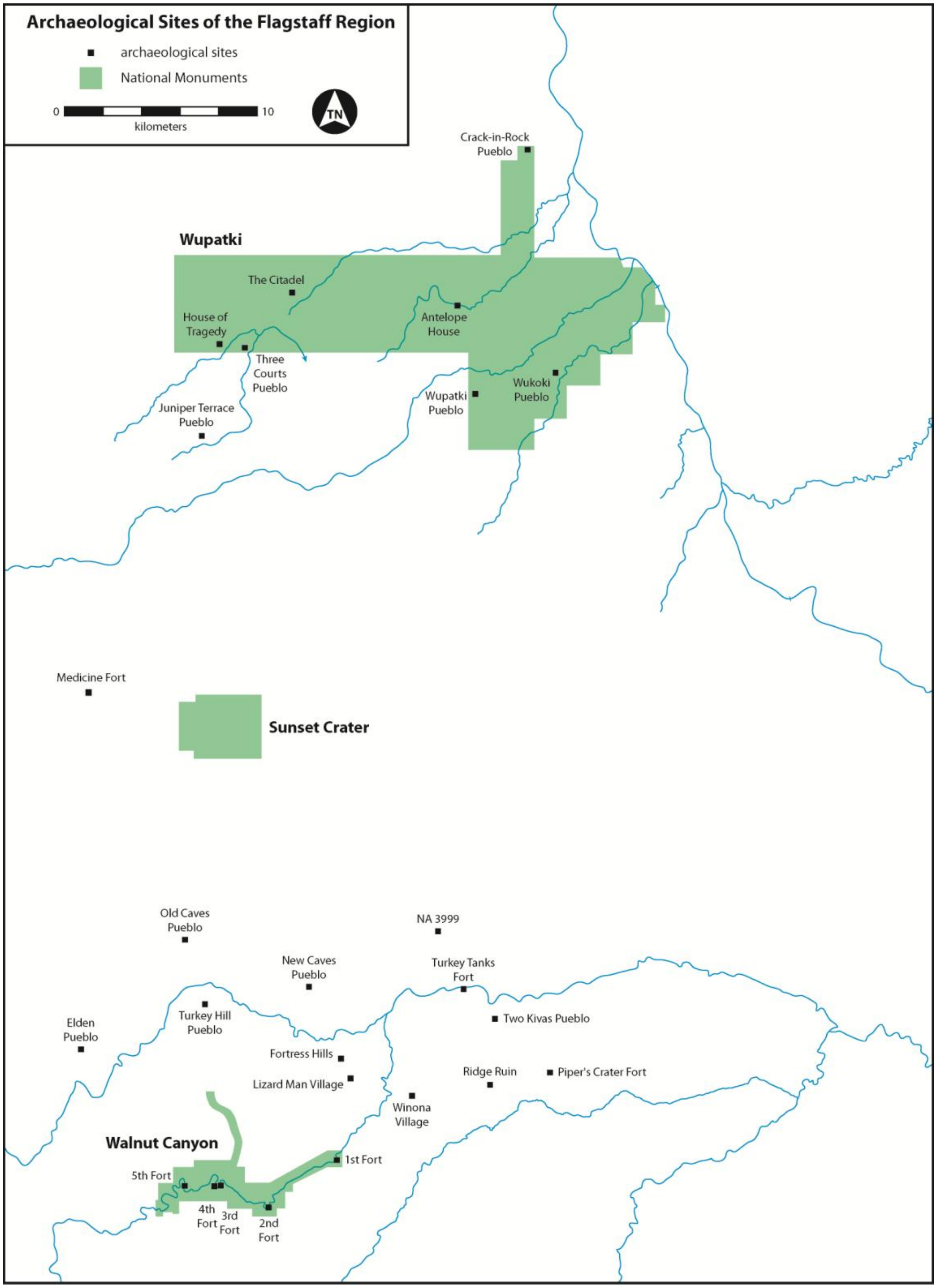


Figure 3-1. Locations of selected archaeological sites in the Flagstaff region and Wupatki, Sunset Crater, and Walnut Canyon National Monuments.

FRONTIER DYNAMICS

Frontiers are those interstitial areas between more politically and economically integrated social units where boundaries may be overlapping and are often contested. Historians and anthropologists have long seen frontiers as dynamic areas where different social, political, and economic networks interacted with and crosscut one another in a socially charged arena of cultural innovation and transformation (Donnan and Wilson 1994; Kopytoff 1987; Lightfoot and Martinez 1994). Settlers of frontier zones may be only loosely integrated into the social, political, and economic networks of their own culture and may therefore be more receptive to or even dependent on interaction with neighboring groups. The asymmetries of power between a cultural core and its frontier may encourage the residents of the periphery to be open to outside influences and willing to adapt cultural traditions to meet frontier conditions.

Cultural interaction in a frontier zone may be a catalyst for the transformation and innovation of technological methods, artistic styles, concepts of social and economic organization, and ideas about cosmology and ritual practice. Frontier interactions between groups create and maintain social boundaries that are often not discretely delineated. Rather, there may be multiple and overlapping boundaries, with different boundaries activated in interactions of different types or of different scales (Bashkow 2004). These varied conceptual boundaries are often mapped onto physical features of the landscape, constructs that may either be shared or be contested by the parties on either side of the boundary (Green and Perlman 1985). Of particular significance to my research, the heightened interaction in a frontier zone, may enhance competitive and cooperative social responses to environmental disturbances.

Archaeologists have traditionally used patterned and spatially distinct distributions of material culture to define archaeological cultures that are often presumed to have some relationship to ethnic or other forms of social identity (Jones 1997; Shennan 1989). Archaeologically defined boundaries between cultures, where “weak” patterns of material culture distribution contrast with “strong” ones (Herr 2001:1-5), have the characteristics of frontier zones where continuous social interaction and movement created multiple, overlapping boundaries. In the Flagstaff region, three mostly spatially distinct sets of material culture have been defined by archaeologists as different cultural units. Where these patterns overlap, there is evidence of interaction, exchange, and perhaps even co-residence as indicated by sites with mixed material cultural assemblages. Colton (1946, 1968) called this zone with mixed assemblages a frontier, and the interactions in this area do appear to have fueled processes of cultural innovation and transformation.

CULTURAL-HISTORICAL UNITS OF ANALYSIS

The three archaeological cultures found in the Flagstaff region − Sinagua, Cohonina, and Kayenta − were distinguished largely on the basis of differences in the technological styles of plain ware pottery produced, although differences also exist in architectural forms, projectile point styles, and mortuary practices (Colton 1939, 1946; Cameron 1999; Horn-Wilson 1997; Justice 2002; Stanislawski 1963a). These cultural-historical units were defined during the 1920s and 1930s through the work of archaeologists at MNA (Colton 1939, 1946), and while some of the assumptions underlying these classificatory units as representing social units have been questioned (Elson 2011:199-202, 207, 210-211; Herr and Van Keuren 2007:197-201; Wilson 1969), the terms Sinagua, Cohonina, and Kayenta have continued to be used as a significant means of describing the nature of variation in archaeological assemblages and patterns of interaction within and among regions.

Each of the so-called "cultures" has been associated with one of three distinctive plainware pottery traditions: Sinagua with Alameda Brown Ware, Cohonina with San Francisco Mountain Gray Ware, and Kayenta with Tusayan Gray Ware (Figure 3-2). These wares were made from geologically different materials indicative of different

Figure 3-2. The plainware pottery traditions of the Flagstaff region.

production locales. They can also be distinguished based on different technological styles used in their manufacture; each has a distinctive constellation of attributes based onchoices made during the processes of material selection, vessel forming, surface finishing, and vessel firing.

The following sections present a discussion of the traditional interpretations of archaeological cultures of the Flagstaff region that were developed by Colton (1939, 1946) and continue to influence archaeological practice in the region today, outlining the material culture determinants, spatial distributions, and chronological sequences of development for the Sinagua, Cohonina, and Kayenta archaeological cultures (Table 3-1). The spatial distribution of material culture, particularly plain ware pottery, suggests that the heartland of the Sinagua archaeological culture is in the southern half of the Flagstaff region, and a frontier zone with the neighboring Cohonina and Kayenta archaeological cultures is in the northern half (Figure 3-3).

Sinagua and Alameda Brown Ware

The Sinagua archaeological culture was defined largely based on the distribution of Alameda Brown Ware pottery and the practice of extended inhumation (Colton 1946). Alameda Brown Ware was formed using the paddle-and-anvil method; fired in an oxidizing atmosphere; and often polished, slipped, and smudged (Colton 1958; Colton and Hargrave 1937). More rarely it was painted with red-on-buff or white-on-red decorations. Pre-eruption Alameda Brown Ware consisted of a single type, Rio de Flag Brown, which was manufactured using self-tempered alluvial clays and exhibited a limited range of vessel forms. After the eruption, different types with unique tempering

Table 3-1. Flagstaff region phase chronology and characteristics

Pre-eruption Sinagua phases
Cinder Park (400–825) introduction of agriculture, dispersed clusters of pit houses **Sunset** (825–1000) evidence of increasing trade with the north (Puebloans) and the south (Hohokam), greater diversity of agricultural strategies **Rio de Flag** (1000–1080) earliest Hohokam-style ballcourts built, increased emphasis on dry farming
Post-eruption Sinagua phases
Angell-Winona-Padre (1085–1130) locally produced Hohokam-like red-on-buff and shell jewelry, cremation, shift in ceramic production to more specialized vessel forms and paste/temper recipes; increasing use of masonry architecture, shift in whiteware exchange patterns, end of ballcourt use towards the end of this phase **Elden** (1130–1220) shift to multi-room aboveground masonry pueblos, most with 8–12 rooms, few with 25+ rooms, proliferation of field houses and rock alignments **Turkey Hill** (1220–1300) aggregation into fewer and larger (30–100 room) pueblos, abandonment of Flagstaff area at end of this phase **Clear Creek** (1300–1450) aggregation into four remaining 80 to 1000+ room pueblos at the eastern end of Anderson Mesa
Cohonina phases
Coconino (700–900) seasonal mobility, jacal houses in pinyon-juniper, deep pit houses and jacal storage structures in ponderosa **Medicine Valley** (900–1100) forts and other uses of masonry, first Hohokam-like ballcourts **Hull** (1100–1150) shift to unit pueblos (6–20 rooms); abandonment of the “heartland” and shift to the “periphery” in the Wupatki, Sycamore Canyon, and Upper Basin areas; end of San Francisco Mountain Gray Ware production
Kayenta phases
Lino (Basketmaker III, 500–700) small clusters of pit houses along Little Colorado River **Marsh Pass** (Pueblo I, 700–900) small jacal pueblos without kivas **Black Mesa** (Pueblo II, 900–1130) masonry pithouses and small masonry pueblos **Klethla** (Early Pueblo III, 1130–1200) expansion of sites into the frontier zone around Wupatki, the Citadel, and Crack-in-Rock, 10–50 room masonry pueblos **Tsegi** (Late Pueblo III, 1200–1300) withdrawal from the frontier, aggregation into large sites of 50+ rooms, especially after 1250

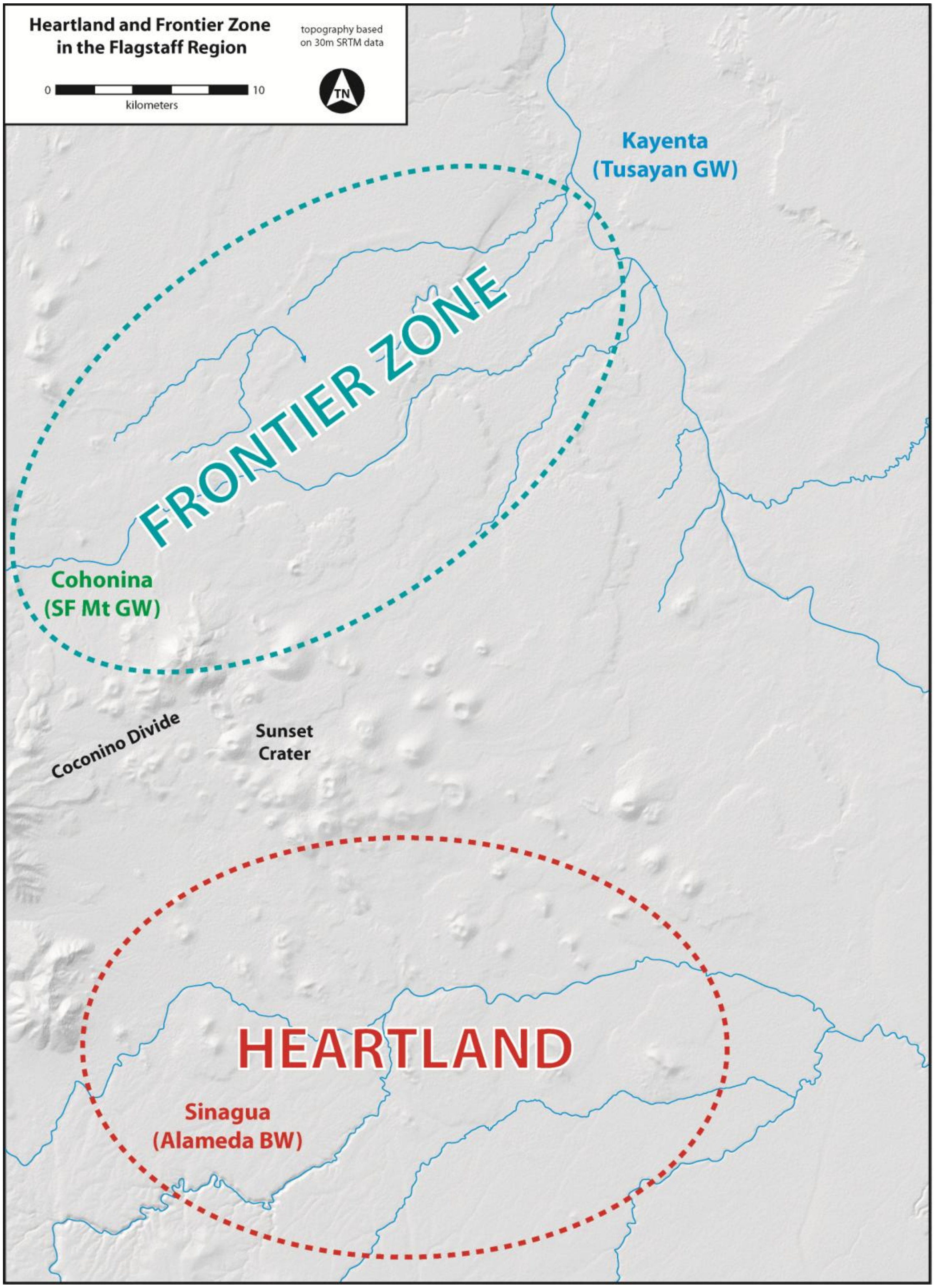


Figure 3-3. The Sinagua heartland and the frontier zone in the Flagstaff region.

materials were manufactured. These types had a variety of surface treatments, including the presence or absence of a red slip or a smudged interior, and they were manufactured in a wider range of vessel forms. After 1150, two different styles of corrugated surface finishing were introduced: Elden Corrugated exhibited vertical indentations like Mogollon corrugated types found to the southeast, while Sunset (or Black Falls) Corrugated had oblique indentations like Puebloan corrugated types found to the north and east.

The Sinagua phase sequence is separated into pre-eruption and post-eruption periods. The pre-eruption phases, which mark the introduction and adaptation of agriculture to the region, are the Cinder Park (400–825), Sunset (825–1000) and Rio de Flag (1000–1085) phases (Downum 1992; Pilles 1988a, 1988b, 1988c). Pottery and agriculture were introduced at the beginning of the Cinder Park phase; and throughout the pre-eruption period local populations lived in dispersed clusters of pit houses near arable lands. Duringthe Cinder Park and Sunset phases, agriculture was focused on the cultivation of small plots where ephemeral drainages entered open parks within the forest. During the Rio de Flag phase, a greater diversity of agricultural strategies was employed as settlements expanded along drainages and alluvial terraces were cultivated. Also, dry farming strategies were introduced, perhaps in response to increased moisture between 1047 and 1066 (see Chapter 2). Evidence of an expansion of interregional trade appears beginning in the Sunset phase and continuing into the Rio de Flag phase in the form of increasing frequencies of Puebloan and Hohokam decorated pottery types.

After the eruption, there were significant shifts in settlement patterns and architectural styles, possibly in response to changing environments. The post-eruption period consists of the Angell-Winona-Padre (1085–1130), Elden (1130–1220), Turkey Hill (1220–1300), and Clear Creek (1300–1425) phases. The Angell-Winona-Padre phase marks a transitional period of adjustments made in the aftermath of the eruption (Downum 1992; Pilles 1988d, 1988e, 1988f). Angell, Winona, and Padre were initially conceived of as three separate yet contemporaneous "foci" representing the local population and different coresident immigrant groups (Colton 1938, 1946; McGregor 1937a, 1937b, 1937c, 1941). However, later re-analysis of associated tree-ring dates by Wilcox (1986) suggests that the masonry-lined Padre form of pit house is somewhat later than the earlier timber Angell and Winona forms. Rather than representing different co-resident ethnic groups, the variability in pit house architecture may be a manifestation of the transitional nature of the time, and the masonry used in Padre style structures presaging the subsequent shift to surface masonry architecture in the Elden phase.

The Angell-Winona-Padre phase began with the eruption of Sunset Crater in 1085, and, in response, populations concentrated in a refugium along the southern edge of the ash fall zone (Figure 3-4), where surveys indicate dense populations during the immediate post-eruptive period in this area south of San Francisco Wash (Bryce et al. 2012a). Excavations at Winona Village, a site within the refugium, recovered six beams from a single pit house dating to 1086 (Robinson et al. 1975:88-90), suggesting initial settlement immediately following the eruption of Sunset Crater.

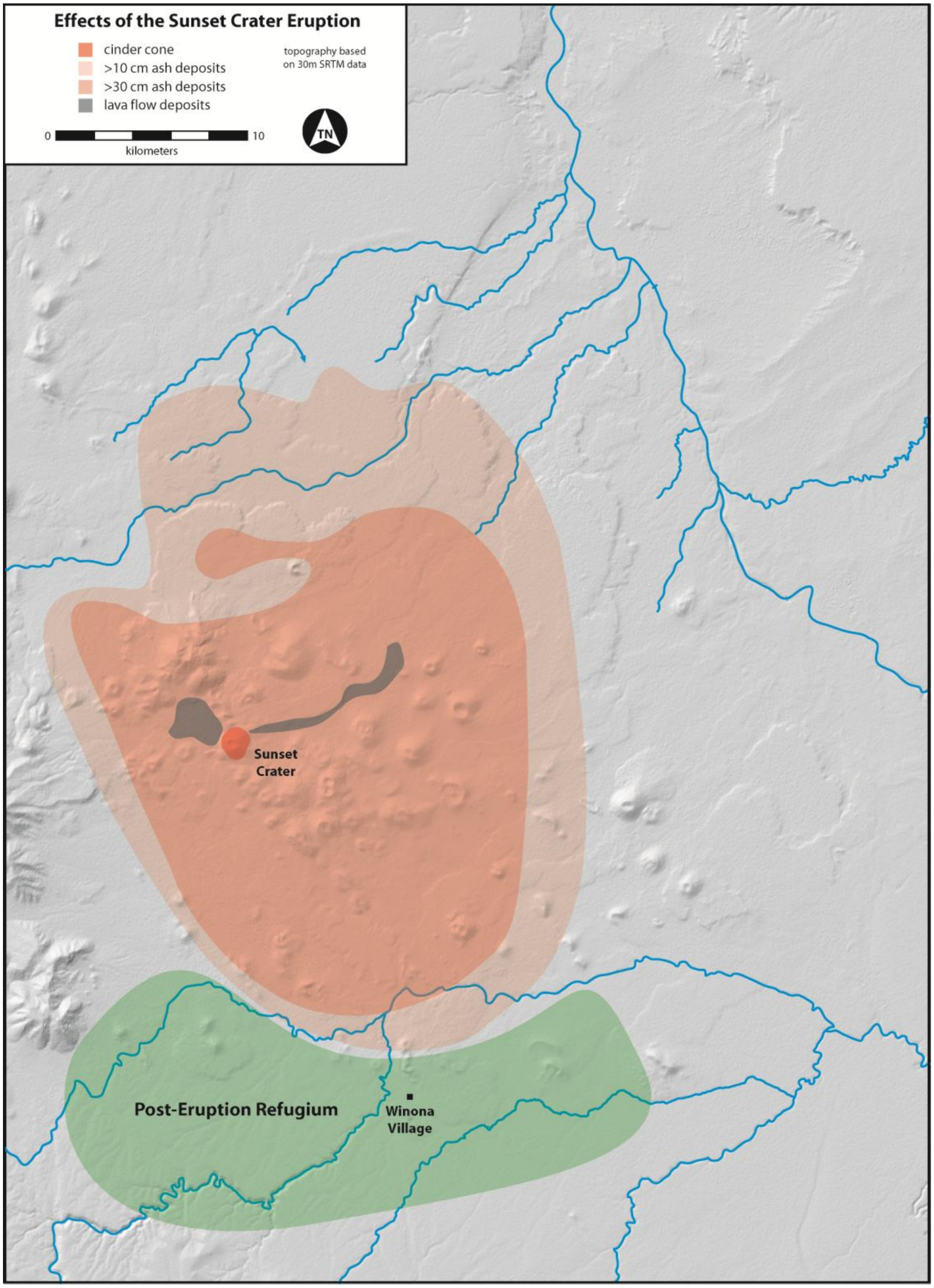


Figure 3-4. The extent of the Sunset Crater ashfall zone and the location of the post-eruption refugium.

The following Elden phase was marked by a transition from pit house to pueblo architecture, family-sized unit pueblos were dispersed widely across the landscape and increased investments were made in dry farming (Downum 1992; Pilles 1988g). Ceramic group dating, which assigns sites to temporal periods based on the co-occurrence of different temporally sensitive pottery types in pottery assemblages (Colton 1946), allows the separation of the Elden phase into an early period (1130-1160) characterized by assemblages with Sosi and Dogoszhi styles and a late period (1160-1220) with Flagstaff style (see Appendix A on Ceramic Dating for more details about ceramic group dating).

Settlement pattern changes from the Elden to Turkey Hill phase were characterized by increasing population aggregation into fewer and larger sites (Downum 1992; Pilles 1988h, 1996), although some smaller habitations (Garcia et al. 2010) and possible seasonal farmsteads (Tsouras 2008) continued to be used. Defensive sites on top of natural landforms were constructed in the Sinagua area during the Elden and Turkey Hill phases (Colton 1946; Kamp and Whittaker 2009). While many sites like New Caves, Piper's Crater Fort, and Turkey Tanks Fort were defensive, other large and long-lived habitations like Elden Pueblo, Turkey Hill Pueblo, and Two Kivas Pueblo were not. The Flagstaff region was de-populated at the end of the Turkey Hill phase as populations moved to the southeast and aggregated into even larger pueblos near reliable springs at the eastern end of Anderson Mesa like Chavez Pass, Grapevine, and Kinnikinnick during the Clear Creek phase (Bernardini and Brown 2004; Downum 1992; Pilles 1988i).

These traditionally defined cultural historical phases are blocks of time characterized by certain spatial and stylistic patterns of material culture. In addition to the introduction of new pottery types or architectural forms, changes in settlement and land use patterns also occurred during these transitions between cultural-historical periods. These transitions between phases identified by archaeologists were created by changing social contexts of production and consumption and changes in articulation within and between social groups and between human populations and the environment. Certain environmental disturbances defined in Chapter 2 (the Sunset Crater eruption, the 1130s megadrought, and the 1214-1221 cool/dry period) appear to correspond well to the timing of phase changes in the Sinagua cultural historical sequence (Figure 3-5), suggesting that these periods of environmental disturbance played some role in the changing contexts of human occupation of the region.

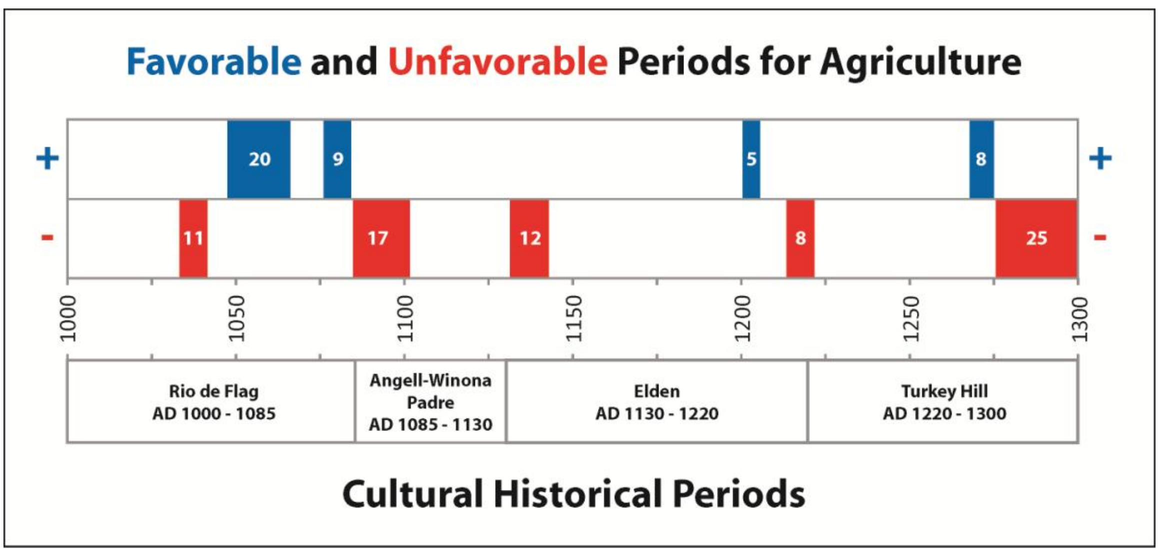


Figure 3-5. Relationships between environmental conditions and cultural historical phase transitions in the Flagstaff region.

Cohonina and San Francisco Mountain Gray Ware

The Cohonina archaeological culture was defined on the basis of the distribution of San Francisco Mountain Gray Ware throughout the region west of Flagstaff − from the San Francisco Peaks on the east to the Aubrey Cliffs on the west, with the Mogollon Rim on the south and the Grand Canyon on the north. This pattern was initially defined through work done by MNA in both the heartland near Williams and Ash Fork (Hargrave 1937, 1938; McGregor 1951, 1967) and on the eastern frontier zone on the north side of the San Francisco Peaks (Colton 1946; Hargrave 1933; Spicer 1934). More recent research by MNA, Kaibab National Forest archaeologists, and students from Northern Arizona University has continued to refine understanding and interpretation of the prehistoric occupation of this area (Bone 2002; Cartledge 1979; Samples 1992; Weintraub et al. 2006; Wilcox 1996; Wilcox et al. 1996).

San Francisco Mountain Gray Ware was formed using the paddle-and-anvil method, fired in a reducing atmosphere, and often polished or finished with a fugitive red surface treatment. Bowls were occasionally decorated with black-on-gray designs that appear to be simplified copies of Tusayan White Ware designs. Pre-eruptive jars were neck-banded like contemporary Tusayan Gray Ware types, while later post-eruptive jars were polished and often finished with a fugitive red surface treatment. The temper of all San Francisco Mountain Gray Ware types predominantly consists of quartz sand with small amounts of mica and feldspar, indicating production in the heartland of the Cohonina territory where Coconino sandstone and sands derived from it and low-iron clays from the Kaibab formation were both available (Colton 1958; Colton and Hargrave 1937; Heidke et al.

2007; Roberts 2001). The high-quality obsidian available within the region was also utilized (Shackley 2005:29-36), and triangular, serrated points were produced from these materials using a distinctive manufacturing strategy (Horn-Wilson 1997; Justice 2000:270-272).

The Cohonina phase sequence developed by Colton (1946:17) was largely shaped by his interpretations of the dynamics of frontier interactions and consisted of the Coconino (750–950), Medicine Valley (950–1100), and Hull (1100–1150) phases. The Coconino phase represented the establishment of agricultural populations in the region, and data from excavations in the heartland were used to define the material culture characteristics of this phase. Sites consist of small clusters of shallow pit houses and ramada-like structures. While maize agriculture was practiced, there was still considerable seasonal mobility. The subsequent Medicine Valley phase was largely defined on the basis of excavations in the frontier zone on the north side of the San Francisco Peaks (Colton 1946; Parry 1981). However, more recent research in the Sitgreaves Mountain area of the heartland (Cartledge 1976; Samples 1992) has added to the darabase of sites from this time period and revealed important aspects of social and economic organization.

Seasonal mobility continued to be an important aspect of Cohonina subsistence economy during the Medicine Valley phase, and different types of sites appear to have been occupied during different seasons and used for different purposes. Growing-season farmsteads with small clusters of shallow pit houses and ramada-like structures were like Coconino phase sites. These farmsteads were widely dispersed through the lower-elevation pinyon-juniper biotic communities near plots used for dry farming. Non-growing-season habitations consisting of groups of deep pit houses with associated surface granaries were built in higher-elevation pine-oak forests on the flanks of the prominent mountains of the region (Cartledge 1976; Samples 1992). In the Cohonina area, reliable springs are only found around the flanks of the large mountains, with the lower-elevation areas being largely devoid of surface water except during the summer monsoon. Thus, it appears that these higher-elevation areas were used for non-growing-season habitation sites during the Medicine Valley phase. These locales likely provided access to more reliable sources of water and wood for fuel and construction.

During the early to mid 1100s, the Cohonina heartland was depopulated as the inhabitants moved to the east, northeast, and south. The 1130s megadrought likely adversely affected dry farming in the region, leading to this abandonment. Colton's Hull phase was defined on the basis of survey and excavation in the frontier zone along Deadman's Wash (Colton 1946; Smith 1952a), and the developments described, the shift to surface masonry unit pueblos and increased exchange with neighboring Kayenta populations, appear to be particular to that area. During the same time period, other people from the Cohonina area were moving to the northeast into the Upper Basin near the Grand Canyon and to the south into the Sycamore Canyon area between the Mogollon Rim and the Verde River (Weintraub et al. 2006).

During this period of abandonment and settlement reorganization, San Francisco Mountain Gray Ware, the key material signature of the Cohonina culture, ceased to be produced (Sorrell 2005). Petrographic studies suggest that it had been produced in that heartland region and that the distinctive constellation of materials used was unavailable elsewhere (Heidke et al. 2007; Roberts 2001). Thus, any Cohonina immigrants on the Flagstaff frontier would have lost access to this crafted good and, in response, perhaps shifted to consuming plain ware pottery produced by neighboring potters in the Kayenta and Sinagua regions. This change in the pattern of plain ware acquisition in the frontier zone would have stimulated the establishment of new social networks for the reciprocal exchange of plain wares and other goods, with these new social relationships perhaps leading to the creation of new social identities.

Kayenta and Tusayan Gray Ware

The area north and east of the Little Colorado River has been interpreted as the territory of a branch of Puebloan culture best known from the Black Mesa, Navajo Mountain, and Tsegi Canyon regions, the Kayenta archaeological culture. The early work of the Rainbow Bridge–Monument Valley Expedition was important in defining this archaeological culture (Beals et al. 1945). More recently, the cultural resource management work on Black Mesa added to and refined interpretations of cultural adaptations and chronology in the Kayenta heartland (Powell and Gumerman 1987; Powell and Smiley 2002).

Tusayan Gray Ware was the utilitarian plain ware produced and used in the Kayenta region. It was fired in a reducing atmosphere and tempered with angular, coarse-grained quartz. Constructed by coiling, the earliest types were finished by scraping and sometimes polishing, while later types maintained the coil structure as part of the final surface finish through neck banding or all-over corrugation. Neck-banded types were produced between 850 and 1100; and around 1050, all-over corrugated surface finishes were introduced (Colton 1955; Colton and Hargrave 1937; Hays-Gilpin and van Hartesveldt 1998).

Potters in the Kayenta region also produced two distinctive decorated wares, Tusayan White Ware and Tsegi Orange Ware. Tusayan White Ware has a paste similar to that used in Tusayan Gray Ware, but with a finer-grained quartz sand for temper. The surfaces are polished and painted with black geometric designs. The stylistic developments of these decorations have been well-studied and used to create a series of distinctive types that have been dated through associations with tree-ring specimens (Brennan 2003; Breternitz 1966; Colton 1955; Colton and Hargrave 1937). Tsegi Orange Ware was manufactured with the same clays, but was tempered with crushed sherds and fired in an oxidizing atmosphere. The surfaces were red-slipped, polished, and painted with black or polychrome designs that are also well dated (Breternitz 1966; Colton 1956; Colton and Hargrave 1937). These plain and decorated Kayenta wares are frequently found in significant proportions in pottery assemblages from sites in the Sinagua and Cohonina regions, suggesting extensive production and exchange of these Kayenta wares. In contrast, except for in the frontier zone along the Little Colorado River, Alameda Brown Ware and San Francisco Mountain Gray Ware, which were produced in the Sinagua and Cohonina regions, are wholly absent from pottery assemblages in the Kayenta heartland.

Colton (1939:52-59; 1946:17) defined the following phase sequence for the Kayenta region, which broadly corresponds to the Pecos Classification (Kidder 1927): Lino (500–700, Basketmaker III), Marsh Pass (700–900, Pueblo I), Black Mesa (900–1120, Pueblo

II), Klethla (1120–1200, Early Pueblo III), and Tsegi (1200–1300, Late Pueblo III). While these phases were defined on the basis of data from the work of the Rainbow Bridge–Monument Valley Expedition in the Kayenta heartland, MNA explorations in the Flagstaff region provided archaeological evidence that sites with Kayenta pottery and architecture were present along the Little Colorado River as early as the Lino phase (Colton 1946:99-102).

Colton's interpretation of Kayenta, which had a major impact on Flagstaff archaeology, was based on his belief that during the Klethla phase, after the eruption of Sunset Crater had deposited the beneficial ash mulch, populations from the Kayenta region expanded into the frontier zone west of the river to colonize these newly arable lands (Colton 1946:261-266). The Citadel, Crack-in-Rock Pueblo, Wupatki Pueblo, and other sites around them in modern Wupatki National Monument are characteristic sites viewed as evidence of this proposed colonization, and the defensive nature of many of these sites suggest intrusion into the area and competition for land. Colton's argument relied not only on the presence of high proportions of Kayenta plain ware types at sites in this area but also the distinctive masonry architecture and the practice of flexed inhumation (Colton 1946:275, 294-295).

While Colton characterized Klethla phase settlement as expanding into the frontier zone, he saw Tsegi phase settlement in the frontier zone as withdrawing back across the Little Colorado River. This withdrawal was indicated by the abandonment in the early- to mid-1200s of the Citadel, Crack-in-Rock Pueblo, and other sites surrounding these large defensive sites (Colton 1946, 1968). In the greater Kayenta region, the Tsegi phase was associated with increasing aggregation at larger and larger sites, mostly in the Tsegi Canyon and Navajo Mountain areas in the northern part of the region, and culminated with the abandonment of the region during the late 1200s megadrought (Dean 1996; Lindsay 1969).

Frontier Dynamics in the Flagstaff Region

The Deadman's Wash area from the north side of the San Francisco Peaks to the Wupatki area near the Little Colorado River has been defined as a frontier zone among the Sinagua, Cohonina, and Kayenta (Colton 1946, 1968) (Figure 3-2). Prior to the eruption of Sunset Crater, much of this area appears to have been largely uninhabited (Colton 1946; Downum and Sullivan 1990; Sullivan and Downum 1991). Much of the eastern part of the frontier zone has shallow soils derived from the Kaibab and Moenkopi formations with limited agricultural potential (see Chapter 2). Yet there are small pockets of arable land that may have been used seasonally. Lambert's (2006) excavations of a sample of eight field houses in the Citadel area suggests that two of these may have been used on a limited seasonal basis before the eruption, and that after the eruption this pattern of use resumed.

In the higher-elevation western end of the frontier zone, pre-eruption sites have mixed plain ware assemblages, and excavations have revealed sites with both Sinagua and Cohonina architectural forms (Cameron 1999; Colton 1946; Parry 1981). Recent GIS analyses of plain ware distributions from surveys and excavations reveal a distinct boundary in the area of the Coconino Divide with greater frequencies of San Francisco

Mountain Gray Wares north of the divide and greater frequencies of Alameda Brown Ware to the south (Garcia 2004). Further, there is a decrease in frequency of San Francisco Mountain Gray Ware with increasing distance from Deadman's Wash, a primary travel corridor through the area leading to the production locations of the pottery farther to the west (Heidke et al. 2007). These settled areas in the higher elevation western end of the frontier zone are close to Sunset Crater (Medicine Valley is approximately 8 km from the volcano) and were within the ashfall zone of the eruption.

The initial post-eruptive resettlement of the frontier zone was characterized by the establishment of dispersed field houses, some of which appear to have grown into seasonal farmsteads and then full-time habitations. Based on her research on the early field houses and their flaked and ground stone assemblages, Schofer (2006) found evidence of different mobility strategies employed by Sinagua, Cohonina, and Kayenta colonists in the period before 1160. Specifically, she concluded that Cohonina colonists practiced a strategy of residential mobility with temporary relocation of households to locations near critical resources, Sinagua colonists practiced a strategy of short-term circulation with daily and overnight mobility from a nearby home base, and Kayenta colonists a strategy of seasonal circulation with temporary growing-season occupations tethered to a more distant home.

These colonists would have faced much-changed environmental conditions and likely experimented with new agricultural techniques. Lambert (2006) suggests that the use of field houses shifted during the process of recolonization. Initially, field houses were seasonally occupied during the growing season with permanent habitation at more distant sites. This shifted to day use of field houses with habitation at nearby sites that were beginning to emerge on the landscape. As favorable agricultural locations were identified and practices developed, those field houses near productive lands grew into full-time habitations. These habitations were characteristically small unit pueblos, suggesting individual family groups as the basic unit of colonization. This pattern of dispersed, family-sized settlements interspersed with field houses and other agricultural features was followed by increasing population aggregation and settlement reorganization after 1160 (Sullivan and Downum 1991).

Field houses were logistically important in agricultural activities. They provided a location to rest or prepare food during planting, weeding, and harvest, and harvested crops could be staged at the field house in preparation for transport back to the primary habitation. Field houses may also have played a role in marking and validating land use rights, especially in a context of competition for land and limited institutional means of validating and enforcing land use claims (Kohler 1992). Other agricultural features include fields demarcated by rock alignments, piles, and pads; terraced slopes; and ridge-and-swale cinder dune fields (Berlin et al. 1977, 1990; Brown 1996; Hasbargen 1997; McNutt 2001; Travis 1990). The prehistoric farmers of the region appear to have recognized advantageous edaphic characteristics related to cinder depth and the underlying subsoils, and selected these microenvironments for agricultural development while not using adjacent areas lacking these characteristics (Edwards 2007).

The proliferation of such features suggest that changing land use patterns associated with the resettlement of the frontier zone increased competition for arable lands. Previous studies of prehistoric agriculture in the region (Sullivan 1984:100; Travis 1990:53) have suggested that the presence of abundant agricultural features indicates a response of agricultural intensification to population pressure where additional units of labor are invested in each unit of land to increase production (sensu Boserup 1965). Researchers in other regions of the U.S. Southwest have similarly suggested that evidence of aggregation into larger pueblos indicated the consolidation of populations to meet the labor demands of agricultural intensification (Cordell et al. 1994; Leonard 1989). However, Stone and Downum (1999) argue that the ecological conditions in the frontier zone would not permit agricultural intensification because such practices would increase risk rather than increase productive capacity. In what they call a non-Boserupian situation, in order to minimize risk, strategies of extensive land use were pursued rather than intensification. They show that features indicative of intensification are relatively infrequent and associated with specific topographic and soil conditions. Rather, most of the agricultural features identified archaeologically required little labor investment and may be "hypervisible" remains of limited activities rather than evidence of intensification, or they may have served other functions altogether unrelated to intensification, such as being "perimetric features" used to identify claims to use rights (Stone and Downum 1999:119).

Instead of pursuing intensification, farmers in the Flagstaff region practiced extensive agriculture, expanding rather than narrowing the range of land into which labor was invested. However, increasing population density in the frontier zone as it was colonized would have made this strategy more difficult. Maintaining access to the needed extensive land base required political strategies that included aggregation into groups that could enforce and protect both individual and group claims to land. Stone and Downum suggest that consolidation into larger political entities capable of enforcing group land claims was a response to population pressure and land shortages. Immigrants may have been recruited as part of this process. Even though the incorporation of migrants into the group added increased agricultural risk, it would have also provided added strength in numbers for asserting and defending land claims. Evidence for such a competitive social environment includes defensive sites and skeletal evidence of interpersonal violence in the frontier zone in the periods after the eruption (see Chapters 8 and 9). But there is also evidence of mediation and cooperation with ballcourts and great kivas (see Chapter 11). These different forms of communal ritual architecture may have been important contexts for intergroup mediation in a competitive environment.

Archaeological Cultures and Frontiers

The three archaeological cultures identified in the Flagstaff region were distinct in many ways, but there was also considerable interaction among them, including the exchange of pottery, obsidian, and likely many perishable products, as well as ideas and probably even spouses. In addition to this cooperative interaction, there are also indications of competition and conflict. Over time, the common developmental trajectory of shifting from pit houses to unit pueblos and then into larger, aggregated pueblos lessened some of the differences in architectural forms and settlement organization, and perhaps differences in social and economic organization as well. By 1150, the heartland of the Cohonina region was depopulated, and with this abandonment also came the end of

San Francisco Mountain Gray Ware production. The material culture patterning that archaeologists identify as Cohonina faded from the archaeological record, but the people who produced it did not disappear. The colonists from the Cohonina region who settled in the frontier zone following the eruption absorbed additional migrants as the Cohonina heartland was abandoned. Some migrants moved to the northeast into the Upper Basin near the Grand Canyon, while others moved to the south into the Sycamore Canyon area between the Mogollon Rim and the Verde River (Weintraub et al. 2006). For those in the Flagstaff region, the social dynamics of the frontier zone would have provided opportunities to reformulate and shift cultural identities. Different land use strategies may have been initially employed by colonists from different cultural backgrounds, but the ecological conditions of the frontier zone encouraged cooperation to assure access to an extensive land base and competition to exclude others, possibly those considered outsiders, to prevent fragmentation or decrease of an extensive land base.

REGIONAL SYSTEMS

In addition to these interactions in the frontier zone, at different times both before and after the eruption of Sunset Crater, the creation of cultural identities in the Flagstaff region was also influenced by larger regional systems. At different times and places in the prehistoric U.S. Southwest, large-scale systems of economic and cultural integration arose that brought populations in different regions into large-scale economic, political, and ritual relationships. These regional systems organized the production, consumption, and exchange of agricultural and craft goods across different regions. They both mediated and defined social identities, creating a large-scale sense of inclusive membership and communitas using communal ritual to sanctify and naturalize these relationships. The Flagstaff region was on the frontiers of two of these larger regional systems − the Hohokam ballcourt network to the south and the Chaco great house system to the east − and this frontier is evidenced by the construction and use of Hohokam-style ballcourts and Chaco-style great houses and great kivas in the region.

The Hohokam Ballcourt Network

The Hohokam archaeological culture of the Sonoran Desert of Southern Arizona has been defined on the basis of the distribution of red-on-buff pottery, canal irrigation, cremation, ballcourts, and mounds. A widespread network of ballcourts built during the Colonial (750–950) and Sedentary periods (950–1150) defines the extent of the Hohokam regional system (Wilcox 1979, 1991; Wilcox and Sternberg 1983). Centered in the Salt-Gila Basin, the center of Hohokam irrigation agriculture, this network of ballcourts extended along the major drainages that fed into and led out of the basin: west to Gila Bend, south to the Tucson Basin, east to the Safford Basin, and north along the Verde River and above the Mogollon Rim (Figure 3-6). This distribution includes four ballcourts along the Mogollon Rim in the Cohonina region and twelve in the Flagstaff region (Marshall 2001; Morales 1994; Wilcox 1991; Wilcox and Sternberg 1983; Wilcox et al. 1996).

This regional system facilitated the exchange of goods and resources across environmental zones, allowing complementary systems of production to thrive and

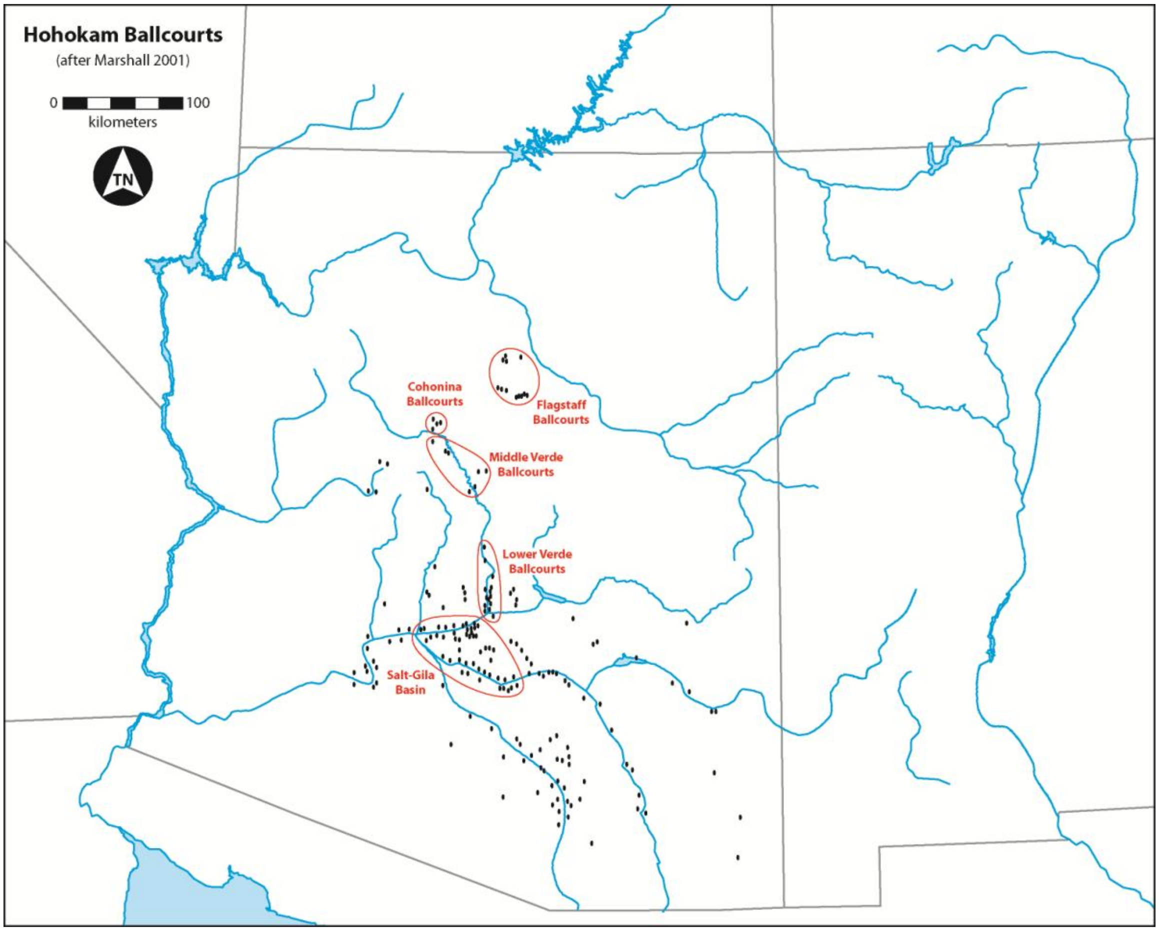


Figure 3-6. Map of all known Hohokam-style ballcourts in the U.S. Southwest (after Marshall 2001).

expand. Agricultural products from canal systems along the main rivers were exchanged for various wild subsistence resources and raw materials from the surrounding uplands, and craft goods made in both areas were also traded (Abbott et al. 2007; Crown 1991; Doyel 1991; Wilcox 1979). The Hohokam regional system has been proposed to have been a multi-ethnic and multi-lingual phenomenon (Shaul and Andresen 1989; Shaul and Hill 1998), and ballcourts were facilities for a game that pitted two sides against each other in a rule-delimited competition. As such, ballcourts would be ideal for bringing different groups together in mediated relationships. The associated system of beliefs attached to the ballgame and itscosmological meanings would have granted supernatural sanction to the activities and provided a shared sense of communal identity for participants regardless of their ethnic or cultural background. The ballcourt system is believed to have facilitated widespread exchange relations that led to specialized production of subsistence and craft goods (Abbott 2006; Abbott et al. 2007).

This ballcourt system appears to have abruptly collapsed at the end of the Sacaton phase in the middle Sedentary period ca. 1070 (Abbott 2006; Abbott et al. 2007; Doyel 2000). Ballcourts ceased to be used, peripheral areas north of the Salt-Gila core were abandoned by Hohokam populations, and these populations contracted to the core area. The reasons for this dramatic shift are unclear, but changing flow regimes and streambed morphology in the Salt and Gila Rivers may have had negative consequences on the reliability and productivity of irrigation agriculture (Graybill et al. 2006; Waters and Ravesloot 2000, 2001). The ballcourt system depended on the high productivity of irrigation agriculture in the core to underwrite productive specialization of nonirrigated subsistence products (especially wild foods), lithic raw materials and other minerals, and craft goods. Any significant perturbation in agricultural productivity might have thrown the whole system out of balance. The presence of ballcourts suggests a need for mediated interaction and a possibility of existing underlying social tensions. Finely manufactured projectile points found as mortuary offerings have been suggested to be associated with military sodality membership, and regional styles of these points further suggest regionalized groups with distinct social identities (Hoffman 1997). The ballcourt system would have crosscut and integrated various social and possibly ethnic groups and the diverse productive ecosystems these groups inhabited.

Abbott's (2000, 2002, 2009) studies of the patterns of pottery production and distribution in the Salt-Gila Basin provides insights into the nature and socioeconomic consequences of the collapse. During the Colonial and Sedentary periods when ballcourts were in use, pottery production was specialized and highly concentrated geographically. Potters in villages at the tail ends of different irrigation systems specialized in the production of different vessel forms. For households throughout the region to have full sets of domestic pottery, exchange with each of the producing groups was necessary. These exchanges were facilitated by the predictable timing and location of ballgames that allowed the establishment of efficient marketplaces (Abbott et al. 2007). This led to a pattern of distribution that created interdependent relationships among producers and consumers across all the different irrigation communities. This pattern of specialized production and widespread distribution and consumption ended with the collapse of the ballcourt system. During the subsequent Classic period, the production and distribution of pottery became balkanized as each irrigation community produced and consumed its own pottery, reducing connectivity between different groups and limiting other opportunities for other exchange.

In summary, between 750 and 1070, a network of Hohokam ballcourts developed that was centered on the irrigation communities of the Salt-Gila Basin. This network spread throughout central Arizona and up the Verde River into the Flagstaff region. Communities with ballcourts were located in different environmental zones and also likely in communities with different linguistic and cultural backgrounds. Ballcourts and the games played within them provided a context of mediated interaction that could decrease tensions and facilitate exchange. Ballgames provided opportunities for intergroup competition to occur within a rule-bound arena that would limit the escalation of violence. They could facilitate exchange in two ways. First, by providing specific locations where large numbers of potential trading partners could congregate at predictable times, allowing the establishment of efficient markets. Secondly, by providing the foundations for a moral community with shared values and identities, trusted exchange partners were also created. This network of ballcourts integrated communities across different regions and allowed the emergence of specialized production of a variety of goods. This complex system of specialized production and exchange underwritten by ritual collapsed rapidly around 1070, perhaps as the result of decreased production from irrigated lands caused by changing streamflow characteristics of the Salt and Gila Rivers.

The Chaco Great House System

In the late 800s, Puebloan populations living in Chaco Canyon in the San Juan Basin of northwestern New Mexico began to construct a series of "great houses" that differed from ordinary Puebloan habitations in terms of size, internal spatial organization, and quality of workmanship marked by distinctive styles of masonry (Lekson 1984, 2007). Great houses often had associated great kivas and roads. Great kivas were larger than the ordinary kivas associated with smaller unit pueblos and had different internal spatial configurations (Van Dyke 2002; Vivian and Reiter 1960). The roads are cleared and flattened surfaces with raised berms on either side that formally defined linear approaches and entry ways to great houses. Some roads connect great houses, while others simply point in the direction of another great house from which a road extends, but without any connecting road in between. These features suggest the roads were primarily significant for their ritual use and cosmological design rather than for transportation of economic resources (Marshall 1997; Roney 1992; Sofaer et al. 1989; Stein and Lekson 1992).

In the late 900s, great houses, great kivas, and roads began to be built outside of the canyon, eventually coming to be widely distributed across the Four Corners region of northwestern New Mexico, southwestern Colorado, southeastern Utah, and northeastern Arizona (Fowler and Stein 1992; Kantner and Mahoney 2000) (Figure 3-7). While many of these outlier great houses were not nearly as large as the great houses in Chaco Canyon, they were still large and impressive in their local contexts. Like the great houses of Chaco Canyon, outlier great houses were surrounded by dispersed communities of unitpueblo "small houses." Through this expansion, clusters of great-house-centered communities were established throughout the region (Gilpin 2003).

From the initial great house construction efforts in the late 860s, the erection and expansion of great houses proceeded in intermittent but relatively constant pulses of construction activity until around 1130. After that date, construction in the canyon decreased substantially, and the organizational nature of the entire regional system changed, with apparently independent developments in those areas to the north (Reed 2008) and to the south and west (Kintigh 1996; Kintigh et al.1996) of Chaco Canyon. This post-Chaco reorganization continued to reference the power and meaning of

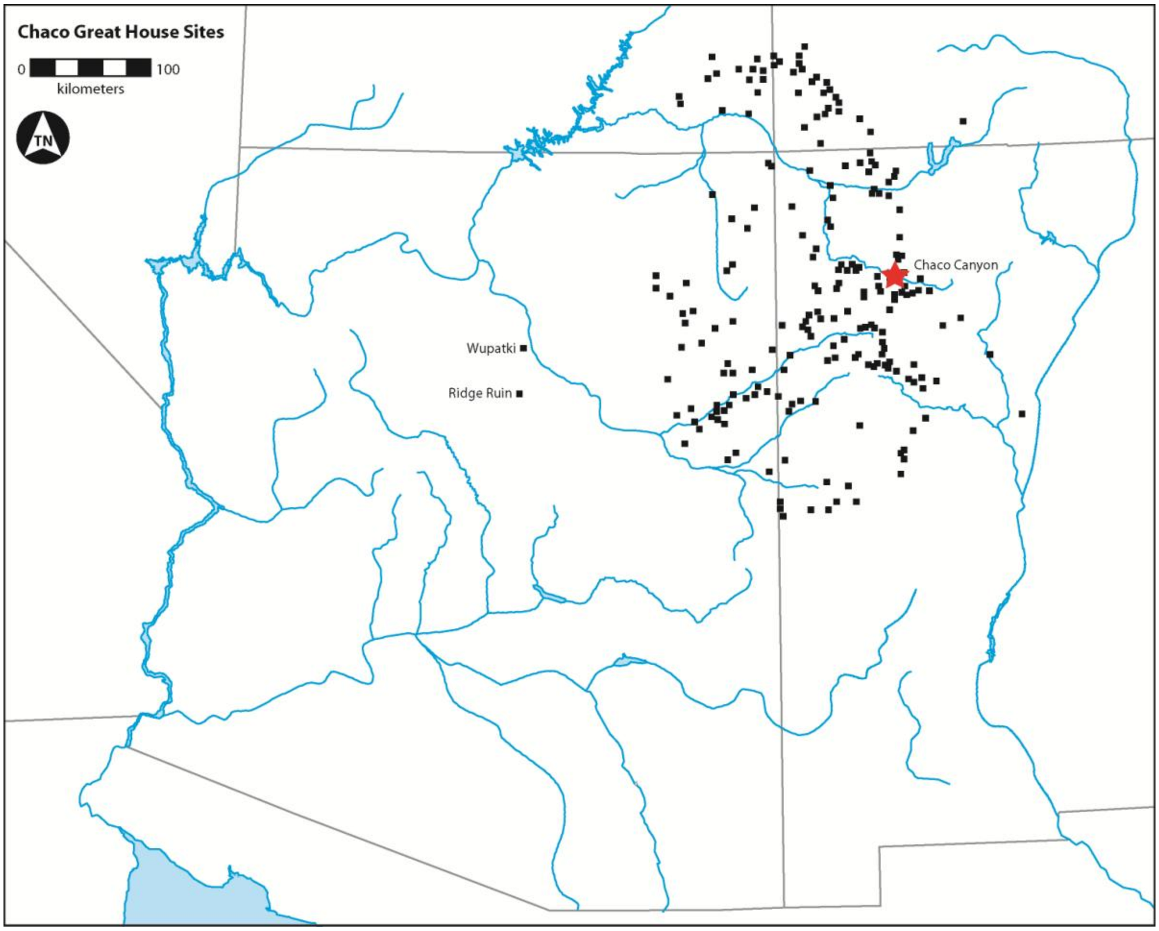


Figure 3-7. Distribution of Chaco great houses 860-1130 (after Kantner 2003).

Chaco Canyon and its distinctive great houses, great kivas, and roads, but these architectural features were re-interpreted within new local contexts (Fowler and Stein 1992; Stein and Lekson 1992).

On the western frontier of the Chaco great house system, typical great houses and associated communities dating to the late 1000s and early 1100s are found along the Puerco River and Pueblo Colorado Wash and in the Low Mountain area on the eastern side of Black Mesa (Gilpin 1989; Fowler and Stein 1992). Also included in Fowler and Stein's compendium of great houses are Wupatki Pueblo and Ridge Ruin in the Flagstaff region. The initial construction at both of these sites used Chaco-style masonry (Fisher Motz 1933:91; McGregor 1941:136-157), and the associated tree-ring dates indicate that the Chaco-style cores of both sites were constructed around or just before 1120 (Downum 1988:418-422; Downum et al. 1999), or only shortly before the decline of the center and re-organization of the system. Neither is as large as any of the great houses of Chaco Canyon or even many of the outlier great houses. However, each is "great" in its own local context and each is at the center of a dispersed community.

During the post-Chaco period of re-organization between 1130 and 1250, unroofed great kivas were constructed at several sites in the Little Colorado River Valley and adjacent areas, such as the Hinkson Site (Kintigh et al. 1996), McCreery Pueblo (Burton 1993), NA 8014 (Olson 1971), Site 143 (McGimsey 1980), the Sundown Site (Gumerman 1988; Gumerman and Skinner 1968), and the Flagstaff region where one has been excavated at Wupatki Pueblo (Colton 1946) and others are known from survey. These unroofed great kivas were less restrictive of access than the earlier roofed great kivas and may indicate changes in the scale of community participation in the performances held in these features.

In summary, between 860 and 1130, a network of great houses, great kivas, and roads emerged in the Four Corners region that was centered in Chaco Canyon, where the earliest and largest great houses and other architectural features are found. Two great houses in the Flagstaff region, Ridge Ruin and Wupatki Pueblo, represent the far western frontier of the distribution of great houses and were built ca. 1120 during the tail end of the regional system's expansion. After 1130, the center declined and the network of outliers reorganized spatially on both inter- and intra-site scales. The architectural forms of the new post-Chaco sites referenced the past power and mystery of Chaco Canyon but re-interpreted these forms in reference to the needs of the local community.

ARCHAEOLOGICAL CULTURES, REGIONAL SYSTEMS, AND FRONTIERS

The frontier nature of the cultural setting in the Flagstaff region, with it being a frontier among three archaeological cultures as well as on the frontiers of two larger regional systems, created a dynamic zone of interaction where different cooperative and competitive strategies were pursued. The use of communal ritual architecture like ballcourts and great kivas indicates cooperative strategies mediating across social boundaries, while evidence of intergroup violence and the use of defensive sites indicates competitive strategies used to create or contest social boundaries. Like other researchers in the U.S. Southwest, Colton emphasized the constraints placed on the prehistoric populations of the Flagstaff region by the environment when developing his interpretations of the region's archaeology, and disturbances like the eruption of Sunset Crater and the megadrought of the late 1200s were seen as key factors driving cultural adaptations and interactions. The following chapter explores theoretical perspectives on the creation of risk and vulnerability to environmental disturbances, develops dimensions to evaluate the scalar nature of disturbances and their impacts, and presents ethnographic case studies of how cultures adapt and interact in the face of environmental disturbances.

CHAPTER 4 – ANTHROPOLOGICAL PERSPECTIVES ON SOCIAL RESPONSES TO ENVIRONMENTAL DISTURBANCES

The U.S. Southwest has an arid environment with considerable temporal and spatial variability in precipitation. These baseline conditions would have presented significant challenges to prehistoric agriculturalists of the region. However, when environmental disturbances like periods of diminished precipitation occurred, these challenges would be even greater. Assessing how human populations adapted to these challenging conditions and responded to adverse periods has long been an interest of archaeological research in the region (Douglass 1929; Dean and Doyel 2006). Significant adaptations to the region's aridity include employing diverse agricultural strategies and technologies (Fish and Fish 1994); developing strategies for storing and sharing food (Hegmon 1996); producing and exchanging craft goods (Bayman 1999; Harry 2005); and re-organizing communities, communal ritual, and labor resources (Feinman et al. 2000; Potter and Perry 2000; Schachner 2001, 2010). Environmental disturbances, however, may overwhelm the abilities of these adaptations, leading to additional responses like intergroup conflict (LeBlanc 1999) and extraregional migration (Cameron 1995). Some of these adaptations − like food sharing, exchange, and communal ritual − employ cooperative strategies. However, some researchers have emphasized competitive strategies like intergroup conflict in response to environmental adversity (Haas and Creamer 1993; LeBlanc 1999).

Assessing the impacts of past environmental disturbances has been an important topic of research in the Flagstaff region (Colton 1936, 1960; Kelly 1971; Elson et al. 2007), where extreme dry periods and a volcanic eruption presented hazards with which the region's prehistoric inhabitants had to contend. The archaeological record of the region provides evidence of both cooperative and competitive strategies, including the presence of communal ritual architecture and evidence of intergroup conflict. The fine-grained climatological record of the region allows for the potential of evaluating the relationships among climatic conditions and these competitive and cooperative responses. In this chapter, I examine anthropological theories about and ethnographic cases of social responses to environmental disturbances. Through this review I identify key dimensions of these phenomena and variables of these dimensions that can be measured and assessed with archaeological data. Key to this discussion is the perspective that environmental disturbances are not simply stochastic natural events outside the control of humans. Rather, the hazards and risks engendered by such disturbances are created by the interaction among natural, human, and technological systems, and vulnerabilities to disturbances may also be created by human actions and technological choices (Wisner et al. 2004).

I first examine social responses to environmental disturbances from a contemporary perspective that identifies hazards and their attendant risks and vulnerabilities that differentially affect impacted populations. A series of dimensions that identify and measure the scale and magnitude of environmental disturbances are defined, as well as dimensions related to the social and economic structure of the affected populations that influence responses. As the impacts of an environmental disturbance unfold, affected populations often move through different stages of response, which are defined along with the various response strategies employed during these stages. Examples from ethnography of the impacts of and social responses to extreme dry periods, volcanic eruptions, severe storms, cold periods, and frosts are then presented to illustrate how the dimensions of disturbances may influence strategies of response. In the final part, I discuss how stages and strategies of responses can be identified and measured archaeologically.

ENVIRONMENTAL DISTURBANCES

The environment creates certain constraints to which human societies must adapt, and adaptations are made to an expected range of conditions that come to be seen as "normal." Environmental disturbances are periods of significant departure from these perceived normal conditions or of deviation from long-term average conditions and the expected range of variation around that average. Disturbances are potentially disruptive, especially to subsistence activities, and, as such, constitute a hazard. Environmental disturbances further impact people by disrupting routines of everyday life, destabilizing social structures and adaptations and thus challenging worldviews and systems of meaning.

Environmental disturbances differ depending on the expected normal pattern of variation and how it is disrupted. Climate-induced environmental disturbances include dry periods, freezes, periods of increased or decreased temperature, sudden storms, and floods. In geologic time, the earth's surface is an active and dynamic component of the environment. From the shortened perspective of a human life, the earth's surface is perceived to have a substantial degree of stability, and disruptions of this perception by geologic events include volcanic eruptions, earthquakes, landslides, and erosion.

Hazards, Risk, and Vulnerability

Contemporary perspectives suggest that the hazards of environmental disturbances and the attendant risks and vulnerabilities of human societies are not only a result of the vicissitudes of nature. There is nothing "natural" about disasters; rather they are primarily social phenomena (Oliver-Smith 1996, 1999, 2002; Wisner et al. 2004). While the environment creates contexts for change, the agency for change lies in the nature of the social responses made to mitigate the impacts of an environmental disturbance.

The potential impacts of environmental disturbances on human societies are assessed in terms of risks of and vulnerabilities to hazards created by the disturbance (Cutter 1994, 1996; Eakins and Luers 2006; Wisner et al. 2004). A hazard is a danger to persons or property resulting from the departure from expected conditions. Risk and vulnerability are inter-related – risk is a measure of the probability of loss of or damage to persons or property resulting from a natural hazard, while vulnerability is a measure of the exposure that persons or property have to risks. Therefore, risks and vulnerabilities are constructed by the interaction among natural, human, and technological systems. Recurrent hazards and risks may be identified and planned for; at the same time, vulnerabilities to environmental disturbances may also be created by human actions and technological choices. Additionally, risk and vulnerability to hazards are often not equally distributed within a society. This differential distribution of risk and vulnerability is often socially created by differential access to resources, opportunities, and power.

For example, in the U.S. Southwest, a recurrent hazard is extreme dry periods that have the potential to impact subsistence activities by reducing ecosystem productivity. By adopting agriculture, prehistoric Southwestern societies increased productivity per unit of land, allowing population growth and greater sedentism. However, the adoption of agriculture increased the risks of and vulnerabilities to extreme dry periods. The probability of extreme dry periods occurring did not change, but the adoption of agriculture and concomitant population growth also created a dependency on these high-yield subsistence activities, making populations more vulnerable to the impacts of extreme dry periods. Shifting to increased use of wild resources in the face of agricultural failure was not an option that would provide for the needs of large populations. Additionally, vulnerability to the effects of the impacts was likely differentially distributed within prehistoric Southwestern societies. Some segments of society had greater access to better quality land, to social networks that facilitated extra-regional exchange or migration, or to political power that was validated by ritual knowledge, all of which would have reduced the vulnerability of some people.

Dimensions of Environmental Disturbances and Affected Societies

Several researchers have assessed the severity of impacts and the effectiveness of social responses to mitigate these impacts in terms of a series of dimensions (Burton et al. 1978; White 1974; Smithers and Smits 1997). Environmental disturbances vary along three different scales – temporal, spatial, and intensity (Halstead and O’Shea 1989). In an archaeological case study, Reycraft (1998) developed dimensions to consider variation in environmental disturbances and affected societies that influence the severity of impacts and the effectiveness of social responses. These dimensions are useful because they provide a framework for developing expectations for the range of responses made by societies with specific characteristics to environmental disturbances of different types, and thus are developed below.

Dimensions of Environmental Disturbances

Reycraft (1998) identified eight dimensions of environmental disturbances – magnitude, frequency, periodicity, duration, speed of onset, time of onset, areal extent, and spatial dispersion. These dimensions expand upon the three scales of variation identified by Halstead and O'Shea. Magnitude is a measure of the intensity of the disturbance. Frequency, periodicity, duration, speed of onset, and time of onset all relate to the temporal scale of variability. Areal extent and spatial dispersion relate to the spatial scale of variability.

Magnitude is the power of an environmental disturbance measured in relation to its degree of departure from ordinary conditions. The magnitude of a disturbance often directly correlates with the severity of impacts. The greater the magnitude of an environmental disturbance, the greater its potential damage and the more limited the ability of existing institutions and technologies to mitigate impacts. The volcanic eruptions of the Mediterranean island of Thera (Freidrich 2000) and of Sunset Crater (Hooton and Ort 2007) within the study area differed in the magnitude of the disturbances and thus in the extent of the impacts. The Thera eruption destroyed island settlements and spawned tsunamis that wreaked devastation on Crete and other nearby islands, and may have contributed to the collapse of Minoan civilization. Sunset Crater, while locally devastating, was considerably smaller in scale and had a much more restricted range of impacts.

Frequency is how often an environmental disturbance of a given magnitude may be expected to occur. ***Periodicity*** refers to whether environmental disturbances are random occurrences or are seasonal and/or cyclical in nature. Together they define the intervals between disturbances. The frequency and periodicity of disturbances may allow established social or technological responses to mitigate the risks of and vulnerabilities to potential impacts. When more frequent, disturbances come to be expected by people, and past experiences with these more frequent disturbances provide knowledge of measures to mitigate impacts. Periodicity affects predictability, and more predictable environmental disturbances can be more easily planned for and mitigated.

In discussing variation in Southwestern climate, Dean (1988) distinguished between high- and low-frequency environmental processes. High-frequency processes (HFPs), such as interannual and interseasonal variation in precipitation and temperature, operate on seasonal or annual scales. In contrast, low-frequency processes (LFPs), such as extreme dry periods, lowering of the water table, and arroyo cutting, operate on multidecadal scales. Dean suggests that adaptive responses to these processes differ, and the longer-term effects of LFPs may be greater. People could plan for and test responses to HFPs but not to the extreme deviations from long-term norms created by LFPs, which might have caused disruptions leading to population re-organization, migration, or collapse. Volcanic eruptions were not considered by Dean, but would also be considered LFPs, as their interval of occurrence is even greater than multi-decadal. However, volcanic eruptions differ from many other LFPs, particularly in the speed of onset and the spatial extent and distribution of impacts, and thus may trigger different responses.

The effectiveness of mitigation efforts may be affected by an environmental disturbance's ***duration*** or its ***speed of onset***. Duration is the length of time over which an environmental disturbance persists. Speed of onset is the length of time between the first appearance of an environmental disturbance and its peak. Longer-lasting disturbances and those with rapid onsets have a greater potential to strain the capabilities of social and technological responses. While the impacts of shorter disturbances may be overcome through a variety of response mechanisms, longer disturbances may overwhelm mitigation attempts because of the continuous and cumulative effects of strain. Speed of onset affects the ability to plan responses to mitigate the potential impacts of a disturbance. Those disturbances with rapid onsets have the potential to catch affected populations unaware and unprepared.

Time of onset is the point during the year that an environmental disturbance occurs. The impacts of an environmental disturbance may be different depending on when during in the agricultural cycle it happens. Those occurring before planting or harvest may be more damaging than those occurring after harvest, because they may lead to the loss of an entire year of production and an immediate subsistence shortfall.

The effects of an environmental disturbance vary based on its ***areal extent*** and ***spatial dispersion***. The areal extent of a disturbance can be geographically widespread or restricted. Within an affected area, the spatial dispersion of the impacts can be homogenous or heterogeneous. Such spatial variation affects the potential number of people impacted by a disturbance and whether or not there are places and populations that may provide refuge or other support to impacted populations. The larger the area affected by an environmental disturbance, the greater the number of people potentially impacted by its effects. Further, a homogenous distribution of the effects of an environmental disturbance would impact a greater number of people, while a heterogeneous distribution would leave some areas intact and impact fewer people.

When they struck, extreme dry periods affected wide areas of the U.S. Southwest, providing few potential refugia for affected populations. The effects of volcanic eruptions, like that of Sunset Crater, are more spatially restricted, and within the affected area, the nature and severity of the impacts vary. As was discussed in Chapter 2, the eruption of Sunset Crater buried some productive agricultural lands under lava and ash deposits, but the agricultural potential of other areas was apparently improved by the deposition of the volcanic ash.

Dimensions of Affected Societies

Dimensions of the scale and complexity of affected societies also influence responses to environmental disturbances. These social dimensions include population density, level of resource use, capital investment in resource exploitation, type of economic system, technological capacity, level of sociopolitical complexity, areal extent of affected polities, presence or absence of social inequalities, and experience with past disturbances.

Population density is the number of people living within an affected area in relation to the size of the area. The greater the population density in an affected area, the greater the number of people potentially impacted. Also, prior to the onset of environmental disturbances, increased population densities often force more people into areas with greater risks − more marginal lands for agriculture or grazing, floodplain areas subject to inundation, foothill or mountainous locations prone to landslides, and other risky locations – thus increasing their vulnerability.

The ***level of resource use*** refers to how the exploitation of natural and productive resources is organized. Foragers, shifting horticulturalists, and intensive agriculturalists have different levels of residential mobility and flexibility that affect potential responses to environmental disturbances. Whether the resources upon which groups depend are dispersed or concentrated can affect how damaging the effects of an environmental disturbance may be, as concentrated resources have greater potential to suffer more losses than dispersed resources.

Capital investment in resource exploitation is the amount of labor and material invested in infrastructure to support resource extraction, production, processing, and/or storage. The amount of investment in resource exploitation directly affects potential for damage, with greater investments of capital creating a greater potential for loss because productive facilities may suffer damage.

The ***type of economic system*** an affected society has refers to how that society organizes labor and resources, particularly the economic independence or interdependence of the smallest units of production and the degree of productive differentiation and specialization. The greater the levels of specialized production, the greater the potential for economic disruption of not just the activities of various units of production but also, more importantly, of distribution networks and markets that connected these different productive units. Household-level subsistence production may provide greater flexibility in the event of environmental disturbances, because such systems often have built-in buffering mechanisms to withstand short-term impacts.

The ability to develop and deploy technological solutions to the challenges of environmental disturbances varies depending upon a society's ***technological capacity***. More advanced technologies, especially those related to communication and transportation, may allow a greater capacity for response. However, some technological adaptations can also create greater vulnerabilities to environmental disturbances. For example, while the development of irrigation technologies may allow greater productivity in arid lands, such technologies also increase vulnerabilities to extreme dry periods that reduce water availability and to flood events that could destroy irrigation features (Nelson et al. 2010).

The ***level of sociopolitical complexity*** of an affected society is the type and nature of existing political institutions at the time of a disturbance. This determines the political capacity of labor and resource mobilization that can be applied to mitigation and relief efforts. The ability of state-level societies to mobilize labor and resources in response to an environmental disturbance dwarfs that of smaller band-level societies. However, more complex societies also have greater differences in the distribution of and access to material wealth, political power, economic resources, and technological knowledge within a sociopolitical system, which may render some segments of the population more vulnerable. .

The ***areal extent of the affected society*** may or may not correspond to that of the environmental disturbance. If only a portion of a society's area is affected, then the unaffected areas may be able supply labor and resources to assist those within the zone of impact. This ability to mobilize labor and resources from adjacent unaffected areas is, however, dependent on the level of sociopolitical complexity.

Experience with past disturbances is related to the frequency and periodicity of environmental disturbances and increases the potential to identify and plan for risks, reduce vulnerabilities, and prepare mitigation responses. Knowledge of past events and responses can be encoded in oral traditions or written records, and this multigenerational time depth of knowledge provides greater understanding of the parameters of potential environmental disturbances and their impacts. The depth and detail of experiential knowledge may provide advantages to planning for mitigation and relief efforts in advance and to deploying responses in the aftermath of a disturbance.

Sheets (1999, 2008) investigated cultural responses to volcanic activity in Mesoamerica and found that while small-scale populations of village horticulturalists practicing shifting cultivation could adjust to the impacts of an eruption, similar events affecting larger, more complex states often led to collapse of the economic systems that supported political complexity. The greater population densities and investments in productive facilities of more politically and economically complex societies may place limits on the ability to shift settlements or subsistence practices, creating different levels of risk and vulnerability to severe environmental disturbances.

Application of the Dimensions

My research is primarily concerned with two specific forms of environmental disturbances, one climatic – recurrent extreme dry periods – and the second geological – the eruption of Sunset Crater Volcano. Differences between these two can be conceptualized in terms of the dimensions developed above. In terms of the degree of departure from ordinary conditions, the magnitude of the Sunset Crater eruption was greater than that of extreme dry periods. Extreme dry periods have a slow onset, their effects are spatially widespread and homogeneous in their distribution, and they were frequent and predictable events to which planned mitigation measures could be applied. In contrast, volcanic eruptions have a rapid onset, their effects are more spatially restricted and heterogeneous, and they are infrequent and unpredictable events. In the case considered here, the two compounded each other in that the eruption of Sunset Crater was followed by an extreme dry period.

The prehistoric occupants of the Flagstaff region were subsistence farmers who grew corn, beans, and squash and lived in relatively small-scale societies. While these populations had past experience with extreme dry periods that allowed the development of planned mitigation measures, volcanic eruptions were beyond their realm of experience. In general, the complexity and scale of the prehistoric cultures of the region increased over time in terms of the social dimensions defined above. Population growth led to increased population density. There was increasing capital investment in resource exploitation with the development of extensive dry farming field systems following the eruption. Economic organization increased in scale and complexity as shown by increased evidence of inter-regional and emergent small-scale craft specialization of pottery and jewelry. Levels of social complexity and social inequality also seem to increase with increasing differentiation between sites in terms of access to exotic materials and ritual architecture, and mortuary practices and assemblages indicating the emergence of new social roles and identities. While some of these changes may have reduced risks and vulnerabilities, others likely increased them, especially commitment to extensive dry farming during the re-colonization of the frontier zone after the eruption. In the remainder of this chapter, I first review the different response and buffering strategies employed to mitigate the impacts of environmental disturbances, and the stages through which these responses may progress depending upon the severity of the disturbance and the effectiveness of mitigative measures. Then a series of ethnographic cases of responses to environmental disturbances are presented and analyzed in relation to the dimensions, strategies, and stages.

Response Strategies, Buffering Mechanisms, and Stages of Response

As an environmental disturbance begins to affect people, they may respond with a variety of different strategies, and these different response strategies can then be further conceptualized as belonging to a series of escalating stages of response. Based on ethnographic cases, Torry (1979) identified five general strategies that impacted populations employ in response to environmental disturbances: dispersal, interethnic economic exchange, retrenchment of social activity, ritual regulation, and intertribal raiding. The dynamics of some of these responses can be interrelated. For example, dispersal through migration often leads to the development of new networks of social and economic interactions in the new location. While environmental disturbances may trigger social changes, they more often accelerate changes that were already underway prior to the disturbance (Oliver-Smith 1996). And while changes are often unintended or unforeseen, sometimes they are deliberately adopted choices made in response to the impacts of an environmental disturbance.

In contrast to Torry's study of responses that are reactive to the environmental disturbance, archaeologists Halstead and O’Shea (1989) suggest that societies faced with environmental variability and uncertainty develop planned mechanisms to buffer against shortfalls created by variation. These buffering mechanisms can be placed into four broad categories: mobility, diversification, storage, and exchange. Some of these do broadly correspond to response strategies identified by Torry. Mobility takes advantage of the spatial and temporal structure of an environmental disturbance to move away from scarcity and dispersal (one of Torry’s strategies) is a form of mobility. For Halstead and O’Shea, exchange includes both relationships of positive reciprocity, like trade and sharing, and negative reciprocity, like raiding and theft, and thus encompasses the strategies reorganization of exchange networks and increased intergroup conflict.

Storage is a buffering mechanism identified by Halstead and O'Shea that was not considered as a response by Torry. Storage is not a response to a specific environmental disturbance currently affecting a population, rather it is a response to past experiences and a planned means to withstand expected impacts. Storage strategies may also encourage production beyond immediate subsistence needs in order to create surpluses to store for future consumption during periods of diminished productivity.

The greatest impact of environmental disturbances on human populations is disruption of food production and distribution, leading first to food shortages and then to famine. Famine does not always simply result from a decline in the availability of food, but also may develop from declining food entitlements as the social and economic networks that define rights to access and obligations to provide food become more restrictive (Sen 1981, 1985). Dirks (1980) has reviewed social responses to food shortages and famine, drawing on data from and studies of 19 episodes of famine in the 19th and 20th century caused by both environmental disturbances and the social disruptions of war. He suggests that system-level responses proceed through a series of escalating stages – alarm, resistance, and exhaustion – as a crisis emerges and increases in severity.

The alarm stage begins when an impending food shortage is recognized. In the case of slow-onset environmental disturbances, recognition may emerge gradually, unlike the often immediate recognition with a rapid-onset event. During the alarm stage there is intensified social interaction, and responses to the crisis are coordinated in most institutional spheres of activity. Exchange relations are activated, and the range of positive reciprocity is extended. Economic activities are diversified to meet the shortfalls of standard modes of production. The greater the frequency and periodicity of disturbances, the more likely a society will develop well-organized alarm stage responses, including intensification of exchange networks and the diversification of economic production.

While the range of positive reciprocity is extended during the alarm stage, it becomes more restricted in the subsequent resistance stage. As resource deficits increase, social interaction decreases and social ties erode, more restrictions are placed on resource sharing and cooperative group actions, and the effective social range of sharing and reciprocity reduces to family units. In addition to declines in the availability of food, there are also declining entitlements to food. Negative reciprocity increases and intergroup conflict to gain or defend access to resources becomes more pronounced. In the exhaustion stage, the final semblances of social stability break down as families cease to function as productive and redistributive entities, and individuals resort to fending for themselves. This societal breakdown, or even fears of impending collapse, may lead to migration as a response. Dramatic transformations of social and political organization often accompany the exhaustion stage. While some changes are unintended consequences, others are deliberate choices that were enacted through the agency of the survivors. As alarm stage responses have the potential to mitigate the impacts of environmental disturbances before the emergence of resistance and exhaustion, these later stages may be reached only during disturbances with long durations, large areal extents, and homogenous distribution of impacts within affected areas.

The responses to environmental disturbances defined by Torry and the buffering mechanisms identified by Halstead and O'Shea fit neatly into Dirks's three stages of response (Table 4-1). The alarm stage may include responses of dispersal, interethnic economic exchange, and ritual regulation. The resistance stage may include responses of retrenchment of social activity and intertribal raiding, and also may correspond to when the effectiveness of the various buffering mechanisms, especially storage, fails. Complete failure of the buffering mechanisms and response strategies would subsequently lead to the exhaustion stage, most likely only in the event of extensive and homogenous disturbances of long duration.

Table 4-1. Relationships among stages of response, response strategies, and buffering mechanisms

<table>
<tr><th>Stages of Response
(Dirks 1980)</th><th>Response Strategies
(Torry 1979)</th><th>Buffering Mechanisms
(Halstead an O'Shea 1989)</th></tr>
<tr><td rowspan="3">Alarm</td><td>Dispersal</td><td>Mobility</td></tr>
<tr><td>Interethnic economic exchange</td><td>Exchange</td></tr>
<tr><td>Ritual regulation</td><td>Diversification</td></tr>
<tr><td rowspan="2">Resistance</td><td>Retrenchment of social activity</td><td rowspan="2">Storage</td></tr>
<tr><td>Intertribal raiding</td></tr>
<tr><td>Exhaustion</td><td colspan="2">Failure of response strategies and buffering mechanisms</td></tr>
</table>

Ethnography of Social Responses to Environmental Disturbances

In the following sections, I present several ethnographic case studies of social responses to environmental disturbances to illustrate the interplay of these dimensions and some of the social processes involved, focusing on societies with subsistence levels of production responding to different types of environmental disturbances − extreme dry periods in East Africa and the U.S. Southwest; volcanic eruptions in the U.S. Southwest, Mexico, the Philippines, and Papua New Guinea; severe storms in Polynesia; and frosts in Papua New Guinea. While these disturbances vary in their magnitude, frequency, periodicity, duration, speed of onset, time of onset, areal extent, and spatial dispersion, some commonalities in response strategies pursued can be identified.

Social Responses to Extreme Dry Periods in East Africa

In East Africa, the Lake Turkana Basin and adjacent Omo River Valley at its northern end are occupied by several ethnic groups differentiated by language and subsistence practices, which include a continuum of mixed agricultural and pastoral adaptations. Extreme dry periods are recurrent hazards in the region, and differential vulnerabilities to these dry periods have been created by variability in the quality of agricultural and pastoral lands. Among the Mursi, who practiced a mixture of floodplain agriculture, dry farming, and stock raising, Turton (1977) documented the following specific responses to extreme dry periods: (1) intensifying production of hunting, fishing, and gathering as an alternative to agricultural failure, (2) activating social networks established through marriage and stock partnerships, (3) increasing exchange with groups in the adjacent Ethiopian Highlands, and (4) more livestock raiding against neighboring groups.

These responses were preferentially pursued in the order presented. The first three responses are characteristic of alarm stage responses to food shortages, when social interaction and economic production and exchange are intensified. The fourth, however, is characteristic of the resistance stage when positive reciprocity and exchange decrease and conflict becomes more pronounced. The activation of social networks established through marriage and stock partnerships could be used to facilitate either exchange for subsistence goods or migration outside the affected area. Turton (1977, 1997) also noted an increase in formalized dispute settlement contests that mediated intra-ethnic conflicts and limited escalation of violence to lethal levels. These contests were refereed duels between agonists armed with long sword-like wooden poles. The dueling disputants represented different localized kin groups, but belonged to the same age grade.

Among the nearby Pokot, Bollig (1993) found that during periods of resource scarcity, local leaders sought to avoid inter-ethnic conflict because it disrupted social and exchange networks across ethnic boundaries that were built on stock partnerships. Such intensification of social interaction and economic production and exchange are characteristic alarm stage responses. Exchange relations across ethnic boundaries were often further strengthened through intermarriage and ritual initiations.

Such marital and ritual relations facilitated more than just intensification of economic exchange among the Gabbra and Rendille. Schlee (1989) found that these relations allowed the migration of families from one of the groups to the other during extreme dry periods. Migrant families often adopted the social identity of their hosts, and succeeding generations would be seen as naturalized members of the host group. The continued maintenance of social relations with their source group, however, allowed the possibility of return and re-integration into their group of origin, resulting in multi-generational shifts in the expressed social identities of families. In this example, migration leads to the re-organization of political and social units, and provides a flexible means of doing so in response to adverse conditions in different regions.

The previous examples have shown different alarm and resistance stage responses, and resistance lapsing into exhaustion is seen in Turnbull's (1972, 1978) ethnography of the Ik, who live in the mountains to the west of the Turkana Basin. Families, the cooperative units of production and redistribution, collapsed after two years of famine, and the young and old were left to fend for themselves. Children self-organized into age-graded foraging bands, while the elderly starved. Livestock raiding and other thievery from neighboring groups increased, as did poaching in a restricted game preserve. While Turnbull suggests that the Ik had only recently adopted agriculture and that this was partly to blame for the famine, other researchers (Heine 1985) show that this was not the case, arguing that the Ik had been noted as dedicated agriculturalists by the earliest European explorers.

These East African ethnographies provide examples of different response strategies, including migration, social transformation, re-organization and intensification of production and exchange, and increased intergroup conflict. They also illustrate the interactions among such strategies, such as the suppression of conflict to allow greater exchange (as in the case of the Pokot) or the initiation of social transformations by migration (as in the case of the Gabbra and Rendille). These case studies also provide examples of all the different stages of response and show that there may be progression through the stages as environmental or social conditions worsen.

Social Responses to Extreme Dry Periods in the U.S. Southwest

Similar responses to extreme dry periods are seen in ethnographies and oral histories of people in the US Southwest. I focus on examples from Hopi ethnography and oral history, because the Hopi are the most geographically proximate Puebloan culture to the research area and occupy an environment with similar challenges, specifically an arid, high elevation setting with a patchy distribution of arable land. During extreme dry periods in the 1770s and 1860s, small segments of Hopi villages separated and independently migrated to and sought refuge among the neighboring Zuni, Navajo, and Havasupai (Eggan 1950; Levy 1992). Migrations to Zuni were facilitated by clan and ritual relations; those to the Navajo by clan relations, intermarriage, and stock partnerships; and those to the Havasupai through exchange partners. Levy (1992) suggests that social segments lacking access to prime arable land, ritual knowledge, and political power were those that were forced to emigrate during times of privation. Those politically and economically marginal segments of the population were thus more vulnerable to the effects of extreme dry periods and the possibility of residential relocation.

Because arid conditions and uneven distribution of precipitation characterized the Hopi region, agricultural practices combined methods that maximized and conserved moisture with a strategy of maintaining multiple plots across different microenvironments (Bradfield 1971; Forde 1931a; Hack 1942). Additionally, there was a robust set of social adaptations that institutionalized reciprocity and food sharing within an elaborate cycle of communal rituals that emphasized rain-making and agricultural fertility (Bradfield 1973; Titiev 1944); these are discussed in more detail in Chapter 6. However, the primary means of withstanding periods of food shortage resulting from extreme dry periods was food storage. Hopi households sought to maintain two to three years worth of corn in reserve to provide food when crops failed (Levy 1992:107-108).

Surprisingly, Hopi mythology and oral history do not often mention or emphasize extreme dry periods (see Courlander 1971; Nequatewa 1936; Stephen 1929; Voth 1905). Minc has suggested that oral traditions may play an important role in preserving and transmitting information about the potential impacts and occurrences of environmental disturbances and what responses may be taken to mediate the effects (Minc 1986; Minc and Smith 1989). Cohen (1990) offers another explanation for the dearth of mention of dry periods in mythology and oral history. He suggests that frequent or chronic environmental stresses would not be directly recounted, but rather would be disguised through a theme of victimhood of capricious aggressive behavior. Such a theme is common in Hopi coyote tales, in which iisaw is either the victim of capricious aggressive behavior or directs capricious aggressive behavior at other characters (Malotki and Lomatuway'ma 1984).

The contrasting conclusions may be a byproduct of the different media that were the foci of research. Specifically, Cohen focuses on folktales as opposed to myth, while Minc's focus is on myths as recounted in the context of ritual. Folktales are fictive narratives told for entertainment and to transmit social values and norms. In contrast, although often similarly fantastic in plot and actions, myths present what are held to be truthful historic accounts of creation, origins, migrations, and other cultural traditions (Bascom 1984). Cohen proposes that as forms of entertainment, folktales provide a context for the psychological mastery of anxiety-inducing or threatening experiences. Minc suggests that the important context within which oral traditions would transmit information is ritual performances rather than simply through storytelling. While storytellers may vary the content of the story in response to the composition of the audience, their reactions, or other social contexts, ritual performances are ideally invariable and reduce the ambiguity of the intended message, creating an ideal context for the transmission of information to a large number of participants (Laughlin and Brady 1979; Rappaport 1979, 1999; Turner 1969). The role of ritual in transmitting information about potential environmental disturbances is discussed in more detail Chapter 6.

While Hopi oral traditions generally do not feature extreme dry periods as plot elements, there are some exceptions. In most of these stories, the lack of rain and resulting crop failures are simply the background that creates the need to establish proper relations with supernatural deities through ritual, and social responses to the extreme dry period are not noted (Courlander 1971:90-91, 96-97; Voth 1905:77-81). There are two historical tales in which the effects of environmental disturbances and social responses made to them are noted. The first relates the effects of an extreme dry period at Oraibi, and it not only presents information about potential social responses to the crisis, it also encodes specific information about wild plant use.

A Famine at Oraibi
(adapted from Malotki and Gary 2001:240-246)

> After years of successful crops preceded by the performance of the proper ceremonies and rituals, the Hopi at Oraibi first began to suffer from diminished yields, and then from complete crop failure. The people knew that they had done something wrong to cause these failures. As stored food supplies were exhausted families left the village, dispersing across the landscape to where they could find wild foods. One couple abandoned their young children when they departed, leaving the older brother and his younger sister alone in the abandoned village. The children gleaned the fields for corn and dug through the refuse dump looking for beans. Soon they were joined by another orphaned pair of children, an older sister and her younger brother.
>
> The children were saved through the supernatural intervention of the deity Maasaw, who took pity upon them and fed them. As the older boy matured, Maasaw taught him agricultural methods and provided him with seed corn. As he became a young man, word of his agricultural success and bounty spread and the former village residents returned. He welcomed them back to the village and provided them seed corn to start their own fields. However, when his own parents returned, he provided them with seed corn but they were not allowed to settle in the village.

In this case, crop failure and subsequent depletion of food reserves eventually led to the exhaustion stage and the complete collapse of the social order. Families broke apart, leaving children to fend for themselves. Before this collapse, the people abandoned agricultural pursuits, and followed alarm stage strategies of dispersal and diversification by foraging for wild foods. Notably however, when the crisis first emerged as the crop yields declined and then failed, the Hopi did not blame the unpredictability of nature, but rather what they believed to have been their own failings in the proper performance of rituals.

The story also include includes information on several wild plant foods that could be utilized during times of trouble or privation. In the story, named wild plant foods are used to create a metaphoric relationship between the long-term famine described and the seasonal food stress regularly experienced. As the famine causes people to disperse, they gather two named wild plants – wild potatoes (*Solanum jamesii*) and Jerusalem artichokes (*Helianthus tuberosus*). Both are plants that produce tubers that were collected and used in the winter, and their use symbolically marks the beginning of the period of privation in the story. When Maasaw comes to provide the children sustenance, the cooked greens of beeweed (*Cleome serrulata*) and saltbush (*Atriplex canescens*) are identified as the first foods that he provides. The early spring foliage of both plants is some of the first wild plant food available to Hopi who have been dependent upon stored foods through the winter, and the consumption of these greens marks the end of the period of privation in the story.

Specific techniques for the preparation of one of these plants are also provided. Wild potatoes contain a poisonous compound that can cause vomiting, diarrhea, and stomach cramps. In order to counteract the effects of the poison, the Hopi would add a specific type of yellow, salty clay called tumöntsöqa (literally "potato clay") when cooking wild potatoes (Hill et al. 1998:665; Moerman 1998). The clay's colloidal properties act to adsorb the poisonous solanine, preventing its adverse effects (Rowland 2002), and the clay needed and the preparation techniques used are described in the story (Malotki and Gary 2001:240-241).

There is another historical tale in which the impacts of and social responses to environmental disturbances play a major role, and this story features an extreme dry period that was preceded by a volcanic eruption:

Earth Fire: A Hopi Legend of the Sunset Crater Eruption
(adapted from Malotki and Lomatuway'ma 1987:15-103)

> The Ka'nas katsinam who resided in the San Francisco Peaks were offended when, after performing rituals for and sharing food with their Hopi in-laws, trickery was used to compel the wife of a Ka'nas man to commit adultery with a Hopi man. Magical powers were then used to initiate the volcanic eruption, a resulting firestorm, and a subsequent dry period. After surviving the firestorm, the Hopi did not recognize the onset of the dry period until the second year. Initial intensification of ritual activity seeking rain was gradually replaced with restricted sharing and begging. A variety of climatological calamities struck – failure of summer rains, failure of winter snows, devastating hail, excessive heat, and tremendous winds and erosion.
>
> Over the course of four years, stored food reserves and supplies of seed corn were exhausted, and various famine foods were resorted to, including small rodents, insects, cactus pads, yucca, and even leather drum skins. Some people migrated to live among neighboring groups. Social interactions among those who remained reduced because people were too occupied with efforts to find food. While others starved, the family of the Ka'nas katsina that initiated the eruption and drought held food reserves that they consumed in secret. One of their neighbors discovered their hidden stores, and stole from it. Hunger led to the breakdown of the social order, and individuals fought over any morsels of food that could be found. After extensive suffering and the deaths of those responsible for the adultery, the Ka'nas katsinam reversed the curse, ending the drought. They also called in the support of other katsinam to provide food for the needy Hopi.

In this account, the alarm stage is marked by intensified production of prayer offerings and associated ritual activity. Resistance and exhaustion develop through the restriction of sharing, reduced social interaction, and breakdown of the social order with resulting theft and conflict. Specific responses include migration outside the region and intensification of alternative sources of food production through uses of famine foods. This Hopi account of the Sunset Crater eruption suggests that an extreme dry period that followed the eruption and lasted more than four years had greater effect than the eruption itself. As detailed in Chapter 2, this sequence of the eruption being followed by a lengthy extreme dry period is borne out in the geological and climatological record. While this account emphasizes the impacts of the subsequent drought, volcanic eruptions have their own substantial impacts, with destructive lava and ash deposits that permanently transform the landscape, as the following examples from Mexico, the Philippines, and Papua New Guinea illustrate.

Social Responses to Volcanic Eruptions – Paricutín, Mexico

The direct impacts of such lava and ash deposits is known from the 1943–1952 eruption of Paricutín Volcano in Michoacán, Mexico, accounts of which provide an opportunity to examine the effects of a volcanic eruption in an environment similar to that of the study area and occupied by subsistence farmers largely dependent upon maize agriculture. The eruptive event was also similar to that of Sunset Crater (Foshag and González Reyna 1956). The impacts of the eruption on the local Tarascan villagers, and the resulting changes in their political and economic organization that are summarized below have been documented by Nolan (1972, 1979) and Rees (1970).

Most of the eruptive activity occurred during the first two years, and led to the relocation of several Tarascan Indian villages. One rumor about the cause of the eruption suggested that a land dispute between the villages of Paricutín and San Juan Parangaricutiro led God to send the eruption to destroy the contested land so none could use it. Initial responses to the eruption involved intensified ritual activity to appease an angry God, but relocation efforts were commenced when it became clear that the two villages would be enveloped by advancing lava flows. Three other nearby villages were affected by ashfall and were wholly or partially evacuated.

While volcanic eruptions can be violent, the Paricutín eruption directly resulted in only three deaths, all from lightning created by the dense ash clouds. Following the eruption, however, mortality in relocated communities increased, as disease and hunger struck the refugees. The eruption began in February, the beginning of the agricultural season, and relocations began the following summer; thus two years or more of agricultural production were lost. While areas covered with lava or deep ash deposits were rendered unsuitable for agriculture, including approximately 4200 hectares of previously cultivated land, other areas with 15 cm or less of ash could still be used for agriculture and grazing, and former residents began to return to the area to establish farmsteads as early as 1945. The eruption had reshaped the landscape and obscured former boundaries between the villages, leading to competition for arable land that played out in court cases and violent confrontations through the 1960s.

Many of the refugees became dependent on new agricultural lands developed near the relocated communities. These developments were accompanied by a shift from communal land tenure administered locally and following Tarascan traditions to adoption of the ejido system, where the federal government rather than the village holds the title to communal land. Other responses to the eruption included intensification of non-subsistence-related activities, such as exploitation of forest products and short-term participation in migrant labor through the American bracero program.

The eruption elicited typical responses to environmental disturbances, including migration and intensification of non-subsistence activities. However, in the Paricutín case, relocation was often facilitated by the Mexican government, which moved whole communities. In the other cases discussed, migration was at the scale of individual family units who had established social relations with potential hosts. Also, the nonagricultural economic activities pursued were embedded in larger regional market systems. In fact, the eruption led to dramatic social and economic transformation of the local Tarascan communities, which became more integrated into the national market economy and even into transnational labor markets after the eruption. These changes in social and economic organization were part of the transformation of agricultural land tenure from communal village lands with traditional usufruct rights to the modern ejido system sponsored by the state. Post-eruption conflicts over land were often addressed through the courts, but violence sometimes escalated, leading to murders and burned farmsteads (discussed in more detail in Chapter 5).

Social Responses to Volcanic Eruptions – Philippines and Papua New Guinea

Another example of the impacts of volcanism on traditional societies that affected systems of land tenure and led to competition for land is the 1991 eruption of Mount Pinatubo and the Aeta, an Austro-Melanesian ethnic minority in the Philippines (Gaillard 2002, 2006; Gaillard and Le Masson 2007). Like in the case of Paricutín, the modern state was involved in the evacuation of Aeta communities and their resettlement outside the impact zone. Unlike at Paricutín, these evacuations preceded the eruptive event, because advanced seismology provided warning. During the eruption, pyroclastic ash flows covered much of the evacuated area; and after the eruption, tropical rains led to massive mudslides and debris flows of the unconsolidated tephra. Resettlement camps brought many of the upland Aeta into greater contact with state institutions, the modern market economy, and the neighboring lowland Kapampangan, an Austronesian ethnic group physically and culturally distinct from the Aeta and more integrated into the modern market economy. Increased interaction with outside influences in the aftermath of the evacuation led to accelerated cultural change among the Aeta, as traditional forms of religion, medicine, leadership, housing, and clothing were transformed in response to markets, missionaries, and state relief and development efforts.

The lack of access to adequate lands for traditional swidden farming near the resettlement camps led many Aeta to return to those areas near former villages that had not been impacted by the eruption. Swidden farmsteads were re-established on the lower slopes of Pinatubo, but residences were maintained in the resettlement camps to assure access to markets and state services. While traditional multihousehold cooperative units remained the basis of production and food sharing, the pattern of land tenure was transformed. There was a shift from open communal lands without discrete boundaries to the formal demarcation of boundaries. These boundaries were also marked at different social levels, both between individual Aeta productive units and between the Aeta and the expanding population of their Kapampangan neighbors.

Similar transformation of land-tenure systems was found among the Orokaiva of Papua New Guinea who survived the 1951 eruption of Mount Lamington (Belshaw 1951; Keesing 1952; Schwimmer 1969). Lacking advanced warning, several thousand Orokaiva were killed in the eruption, and the survivors were displaced to neighboring areas unaffected by the eruption. Increased competition for land both within refugee communities and with the local groups who were hosting the refugees led to a transformation from communal to sole ownership of agricultural land. The abandonment of ancestral lands in the aftermath of the eruption also led to the loss of rituals attached to specific landmarks and features, most of which had been destroyed by the eruption. This destruction led to separation from ancestral spirits believed to have inhabited the mountain and landforms on its slopes. Mortuary and birth rituals performed in agricultural fields on the slopes of the mountains to join the living to the ancestors were also abandoned after the eruption and resettlement. The eruption created other contexts for religious change, as Christian missionaries increased efforts to convert the Orokaiva and fostered indigenous sentiment that the eruption was caused by God's anger over the failure to build Christian churches and their betrayal of Christian missionaries to the Japanese during World War II.

Like at Paricutín, both the Aeta and Orokaiva experienced transformations of land-tenure systems in the aftermath of volcanic eruptions. Such transformations led to increasing restrictions on and demarcation of land use, suggesting an early stage resistance response. Also notable is the transformation of religion. In the both cases, this transformation was affected by increased contact with Christian missionaries involved in aid efforts. For the Orokaiva, however, religious changes also resulted from the loss of rituals associated with landmarks on ancestral lands destroyed by the eruption. Thus the transformation of the landscape by the eruption led to changes in Orokaiva ritual practices.

Social Responses to Severe Storms, Cold Periods, and Frosts

Severe storms and extreme cold periods can have effects similar to volcanic eruptions and dry periods and can provide additional examples of the types of social responses that may be made. Like volcanic eruptions, severe storms have a rapid onset, with the effects of the impacts continuing to be felt long after the storm has ended. The Polynesian island of Tikopia was struck by two devastating typhoons in 1952 and 1953, with the resulting destruction of crops and wild resources leading to a period of famine. Raymond Firth, who had long worked on the island, and one of his graduate students were present to observe the impacts of the typhoons and the resulting social responses (Firth 1959; Spillius 1957). As part of the efforts to restore the damaged agricultural infrastructure, reforms were implemented by officers of the chief to more clearly define use rights to and boundaries of agricultural plots. Fallow periods were shortened in order to rapidly increase agricultural production. Increased tensions over theft of fruits from orchards led to the formalization of public assemblies for the purpose of redressing and mediating grievances. Ceremonies that required large food prestations, especially marriages and mortuary rites, were delayed or abbreviated. The increased restrictions on use rights to land and increased thievery that led to the transformation of social institutions represent resistance stage responses.

Like dry periods, the impacts and effects of cold periods and associated frosts may be slow to emerge. In parts of highland Papua New Guinea, frosts can be extremely damaging to the staple sweet potato crops. While the occurrence of occasional frosts happens most years, widespread cold periods with severe killing frosts occur in multidecadal intervals. In 1972, severe cold affected nearly 150,000 people, resulting in widespread population dislocations and requiring outside food assistance. In the wake of this disaster, Waddell (1975) examined traditional mechanisms that the Fringe Enga of the Central Highlands used to manage the risk of frost, identifying three different levels of responses – local, intraregional, and extraregional.

The local level of response consisted of those everyday practices used by farmers to ameliorate the impacts of frosts, including mulched and mounded plantings, covering plants with grass at night prior to threats of frost, and maintaining gardens in different ecological niches with different exposures to frost risks. In the latter strategy, farmers strove to have a diversified portfolio of garden plots in both the fertile but frost-prone valley bottoms and on the less fertile but also less frost-prone hill slopes.

The intraregional level of response was the practice of maintaining widely dispersed gardens within the local group territory, some more than a day's walk apart. This spatial dispersion served to reduce risk of complete loss in the event of a localized frost. These first two levels were preventative and acted to minimize the damaging effects of frost before it occurred. However, they were not always sufficient, and in the aftermath of severe crop losses, the extra-regional level response of migration would be pursued. Migration outside of the affected area was facilitated by widely dispersed networks of phratry and clan relations. Refugees would settle temporarily among kin while awaiting the recovery of their gardens. These periods of refuge could last as little as six months, or could extend as long as three years. The availability of cuttings for transplantation to re-establish gardens was often one of the factors that limited the rate of return.

The agricultural efforts of the Wola of the Southern Highlands were also vulnerable to frost damage, and they used many of the same strategies employed by the Enga at the local and intraregional levels. Sillitoe (1993) documented specific ritual activities in response to frost that were activated at different scales of community participation depending upon the severity of the frost impacts. These rituals made offerings to appease the deity held responsible for the adverse conditions and were held adjacent to sacred water pools associated with the deity's mythic history.

At the lowest scale of community participation, individuals may make offerings at one of these sacred locations when their gardens were affected by frost or other climatic perturbations. In the event of a large-scale damaging frost, the highest level of ritual activity was initiated that required the joint participation of all Wola communities. Each community sent a pair of ritual specialists to the principle sacred spot associated with the deity. There, a special structure was built by the closest community, which sponsored this event. The specialists held sequestered prayer offerings within the structure and then performed a public dance. This was then followed by a pilgrimage of the specialists to ten other sacred spots associated with the deity, where the ceremony was repeated under the sponsorship of the community closest to each of the sacred spots. This ritual requirement for region-wide cooperation in the face of food shortages and hunger limited the potential for conflict over access to land or other resources among the different participating communities. The series of ceremonial performances also created multiple contexts for food sharing between communities and spread the burdens of sponsorship among many communities across the region.

Summary of Social Responses to Environmental Disturbances

Some of the common social responses to environmental disturbances found in these examples include migration, transformation of social and economic organization, and intergroup conflict. Prior to the advent of state intervention and large-scale relief efforts, migration out of an area affected by an environmental disturbance was done by small social segments, usually individual families, and established social connections within the host community were needed. Changes in social and economic organization included reformulation of land-tenure rules to more strictly define use rights and boundaries. Social transformations also resulted from increased interaction with outside groups, as in the cases of the Aeta and Paricutín Tarascans, who came to be integrated into their respective national economies and became more subject to state institutions. Changes in religious practices are also common, but may be the result of different factors, like the loss of access to sacred sites among the Orokaiva, the unsupportable resource demands of ceremonial activities in Tikopia, intensified practices to supplicate the angered forces that caused the disturbance among the Hopi and Paricutín Tarascans, or even increased proselytizing efforts of Christian missionaries among the Aeta and Orokaiva.

Migration and changes to social and economic organization that intensify interaction and production are characteristic of alarm stage responses. Often, the mobilization of resources and people organized by alarm stage responses mitigates the impacts of disturbances and prevents further deterioration of the situation. Increased intergroup conflict and changes to social and economic organization that restrict interaction are resistance stage responses. In addition to conflict, resistance responses include restrictions on the social range sharing, reduction of ceremonial activity dependent on food sharing, and the institution of more restrictive definitions of land ownership and use rights. By the exhaustion stage, social responses have been overwhelmed by the magnitude, duration, or extent of a disturbance, resulting in the collapse of fundamental social institutions.

While the exhaustion stage was rarely reached in the above examples, the emergence of intergroup conflict as a resistance stage response was common. There are also cases where increased competition with neighboring groups or internal tensions over thefts did not escalate into violent conflict – among the Mursi, intragroup conflict among localized kin groups was mediated through refereed, non-lethal competitions; on Tikopia, conflict over thievery led to the formalization of public assemblies to mediate grievances; and among the Pokot, conflict was often avoided in order not to disrupt social and economic networks activated during the alarm stage. However, restrictions on sharing that may be instituted as a resistance response may disrupt such networks, leading to grievances that may then be used to justify conflict. The exhaustion stage can be said to have been reached when an environmental disturbance leads to population dislocation and the temporary abandonment of affected areas. The dislocation and dispersal of the local population could potentially result in the collapse of fundamental social institutions, which is characteristic of the exhaustion stage.

There may be constraints on the resettlement of an abandoned area after an environmental disturbance has waned. In the case of the Fringe Enga in highland Papua New Guinea, who were dislocated by severe frosts, limitations on the availability of capital needed to re-establish gardens – transplantable sweet potato vine cuttings – could delay resettlement efforts. In the Hopi historical tale where children were abandoned during the exhaustion stage, vital capital needed – seed corn and agricultural knowledge – was first provided to the story's hero through divine intercession, and then gifted by him to the former village residents as they returned to the village. In the U.S. Southwest, the availability of seed corn may have been limited after prolonged dry periods when robust stores of seed corn would have been difficult to maintain, given the pressures of consumption. Other challenges could also arise during resettlement efforts, including the potential for competition and conflict with other claimants to the land, as will be discussed in Chapter 5.

IDENTIFYING RESPONSE STAGES AND STRATEGIES ARCHAEOLOGICALLY

Some of the stages of response and the strategies employed can be identified archaeologically. Intensified social interaction – characteristic of an alarm stage response – can often be discerned archaeologically through changing patterns of consumption and exchange, and where chronological control is good, it can be interpreted as a response to a specific environmental disturbance. Similarly, resistance stage responses of decreased social interaction and increased restrictions on sharing can also be identifiable through changing patterns of consumption and exchange. The nature of the changing patterns need to be interpreted and contextualized in order to determine the relationship to intensified or decreased social interaction. In the Hohokam region of the U.S. Southwest a shift in the patterns of pottery production and exchange between the Sedentary and Classic periods indicates a change in the nature of social interaction among the irrigation communities that lived along different canal systems (Abbott 2000). As mentioned in Chapter 3, during the Sedentary period pottery production was extremely concentrated and there was widespread exchange among canal systems indicating intensive social interaction. After a period of environmental disturbance in the late A.D. 1000s that would have disrupted irrigation agriculture, this pattern of interaction became more restricted. During the Classic period, pottery production was widespread and there was little exchange among canal systems. In Chapter 9, the changing patterns of extra-regional exchange for non-locally produced pottery and exotic raw materials like marine shell, argillite, and turquoise in the Flagstaff area will be evaluated in relation to environmental conditions and social strategies of competition and cooperation.

Exhaustion stage responses indicative of the breakdown of fundamental social institutions would be marked by dramatic transformations of material culture and lifeways or by migration and regional abandonments. The regional megadroughts that affected the U.S. Southwest in the 1130s and from 1275 to 1300 (see Chapter 2) were followed by widespread abandonments, population relocations, and transformations of material culture and lifeways. In the Mimbres region of southwestern New Mexico, the 1130s megadrought was followed by population dispersal and changes in settlement and land use patterns (Nelson 1999). Further, the hallmark tradition of decorated pottery ended, and the social and ritual ideology expressed through this media must have been radically transformed. The later regional megadrought from A.D. 1275 to 1300 was followed by the abandonment of the Flagstaff region and much of the northern U.S. Southwest. In the Mesa Verde region of southwest Colorado increased intergroup conflict preceded abandonment and population re-location to the northern Rio Grande. This population movement was accompanied by transformations of architectural forms of communal integration and decorated pottery styles (Ortman 2012).

The escalation of intergroup conflict as a resistance stage response should also be identifiable archaeologically through the presence of fortified sites, changes in settlement patterns, and skeletal evidence of interpersonal violence. Researchers in the U.S. Southwest have used such evidence to suggest correlations between such occurrences and periods of environmental disturbances (Haas and Creamer 1993; LeBlanc 1999). The following chapter examines the relationships between increased intergroup conflict and environmental disturbances, and means for the archaeological identification of intergroup conflict are discussed further.

CHAPTER 5 – ANTHROPOLOGICAL PERSPECTIVES ON INTERGROUP CONFLICT

This chapter presents an overview of anthropological perspectives on intergroup conflict to provide contexts for evaluating prehistoric evidence of conflict in the Flagstaff region. Intergroup conflict has been well-studied anthropologically, and I begin by examining some of the established theoretical perspectives in the field. First I review definitions and typologies of intergroup conflict that have been developed by previous researchers, identifying how the motivations and goals of the antagonists, as well as the social scale of the conflict, can be applied to measuring changes in the levels of conflict. Then structural contexts for the emergence of intergroup conflict are identified, and the relationship these structural contexts may have to competition for resources and environmental disturbances is evaluated. I then discuss the types of evidence used to identify conflict archaeologically and develop dimensions that allow the assessment of changes in the intensity of conflict. The chapter concludes with ethnographic case studies from the U.S. Southwest, East Africa, Papua New Guinea, and Mexico that illustrate and explore the dynamics of these dimensions of conflict and their relationships to resource competition, environmental disturbances, and exchange.

DEFINITIONS AND TYPOLOGIES

Intergroup conflict is the hostile interaction between two social units, as opposed to individuals, involving violence that may escalate to lethal levels. It is a nearly ubiquitous social practice in human history (Keegan 1993; Keeley 1996), and anthropologists and other social scientists have long theorized and debated the origins and causes of what is often seen as a destructive and destabilizing practice (Kelly 2000; Nettleship et al. 1974; Otterbein 1985, 1999; Ross 1993). Types or levels of intergroup conflict can be differentiated on the basis of the social scale of the conflict, the basic motivation of the participants, and the goals and objectives of the exercise of violence. These types or levels of intergroup conflict include feuding, warfare, and raiding.

Feuding is conducted on the scale of family groups, participants are motivated by a sense of obligation and honor towards their kin group, and the goal is revenge for real or perceived insult or injury to one's kin group. Feuding often involves tit-for-tat killings, with each then requiring revenge by the victim's group against the offender's, creating, in some cases, seemingly endless cycles of violence. Such revenge killings employ the principle of social substitution, where the actual killer need not be killed to exact revenge but rather any member of the killer's social group is a legitimate target of violence (Black-Michaud 1985; Boehm 1984). ***Warfare***, in contrast, is conducted on the scale of larger political units. While the motivations of individual participants may vary, the choice to conduct war is motivated by the political concerns of the larger group and the decisions as to when and whom to engage are made through political processes. The goals and objectives of warfare are inspired by political and economic concerns and are focused on the control of territory and resources through the defense or seizure, including the subjugation and incorporation, of other political units to control their productive and reproductive capacities (Ferguson 1984; Otterbein 1985). ***Raiding*** refers to intergroup conflict where the goal is securing booty and individual participation is motivated by the potential for economic gain. The necessity to easily transport the seized booty while fleeing potential pursuers often limits what can be sought by raiding parties. Bulky subsistence goods like agricultural stores were, therefore, not usually targeted; rather easily moved livestock and/or human captives were preferred targets. Raiding parties may be organized at varied scales − by kindred, age cohort, local group, etc. − depending upon the size of the party needed to assure success considering the nature of the enemy and the desired goals. While raiding may be employed as a tactic in warfare between larger political units, it often is engaged in at smaller scales and decisions regarding its prosecution made independent of larger-scale political decision-making processes (Cohen 1984; Turney-High 1949).

Rather than discrete categories, this feuding/warfare/raiding typology has overlaps and reflects a continuum along different axes of scale and motivation. Raiding parties may also attempt to kill enemies in the process of obtaining booty as expressions of feud-based sensibilities of vengeance and payback. The moral opprobrium of aggrieved kin groups can be channeled into political arguments to unite diverse social segments, providing a shared sense of identity and solidarity in preparation for war. Raiding practices may aggravate competing interests within a society because raiding parties acting independently of the political process can undercut the constituted political authorities and destabilize inter- and intragroup relations. Regardless of the scale, motivation, and goals involved, all occurrences of intergroup conflict exist within particular social and historical contexts that recursively define the motivations of the participants, the goals of the exercise of violence, the groups that may legitimately be targeted, and the cultural practices employed. This typology, which takes into account both the social scale of action and the individual and collective motivations, will be used when evaluating changes in the scale and motivations of prehistoric intergroup conflict in the Flagstaff region.

THE STRUCTURAL CONTEXTS OF INTERGROUP CONFLICT

Many researchers have proposed interpretations of the origins or ultimate causes of intergroup conflict in nonstate societies, and these can be grouped into three broad categories: (1) sociobiological theories rooted in selection for aggressive behavior through the reproductive fitness of successful combatants (Chagnon 1988, 1990; Tooby and Cosmides 1988; van der Dennan 2002; Wrangham 1999), (2) cultural theories of male status and socialization for conflict (Divale and Harris 1976; Robarcek 1989; Robarcek and Robarcek 1992; Ross 1986), and (3) political theories of the absence of superordinate authority and enforceable modes of mediation and adjudication (Hobbes 1996 [1651]; Koch 1974a, 1974b; Sahlins 1968). Helbling (2006) argues that these searches for origins or ultimate causes may be futile, for instead of being ultimate causes of conflict, each of these different mechanisms is actually a consequence of it, because each theory presupposes the existence of a conflict-ridden social environment. Additionally, these mechanisms have the strong likelihood of acting as positive feedback cycles that further reify the existence of or even escalate intergroup conflict.

Helbling (1999, 2006) suggests that defining the structural contexts under which conflict is likely to emerge in nonstate societies is more productive than seeking the origins of conflict. Building on the Hobbesian dilemma of the absence of superordinate authority, Helbling suggests that the presence of politically autonomous local groups in multicentric anarchic systems is one structural context necessary for the emergence of conflict. On its own, this is not, however, sufficient. If these local groups are small, mobile foraging bands, the option of movement is present and provides the possibility of conflict avoidance. If these local groups are dependent on locally concentrated resources and cannot move to avoid conflict with neighbors, the second structural context necessary for the emergence of conflict is present. Intergroup conflict emerges as an important form of strategic interaction among these politically autonomous local groups in competition for the control or assurance of access to these locally concentrated resources upon which they are dependent.

This leads to an iterated prisoner's dilemma as described in game theory (Chess 1988). Each of these local groups pursues its own self interests in interactions with other groups; and while peaceful and cooperative relations with one's neighbors are desired, there are limitations on the trust that can be extended to out-group members. Because of the mistrust of out-groups and lack of assurances that bilateral agreements will be upheld by the either of the parties, any peaceful entreaties would be unilateral, risky, and perhaps perceived as weakness. Rather than resulting from an innate aggressiveness, the adoption of a bellicose posture and the willingness to preemptively attack one's neighbors develops from a strategic calculation that reduces potential risks and maximizes potential rewards in the near term. These structural conditions lead to a situation where survival of local groups depends upon their ability to maximize military strength through increased group size and the formation of reliable alliances.

The basic prisoner's dilemma is a zero-sum equation, where the gains of the victor are offset by the losses of the defeated. The incorporation of cooperative alliance formation transforms this into a nonzero-sum equation, where the benefits derived by one group correspond to those derived by cooperating groups, creating contexts that encourage the calculus of cooperation. Mauss first proposed that gift exchange, a central feature of alliance formation, acts socially as the structural equivalent and antipode of intergroup conflict (Mauss 1990 [1925]; see also Corbey 2006). Ad hoc alliances based on short-term goals and perceptions of self-interest are unstable and prone to defection of allies as goals and perceptions shift. Alliances may be stabilized through exchange mechanisms like gifting, feasting, and intermarriage that create contexts of shared goals and interest in maintaining these exchange relations. Therefore, the structural contexts under which conflict is likely to emerge also create a need to establish and maintain alliances, competition and cooperation are dynamically intertwined.

INTERGROUP CONFLICT AND COMPETITION OVER RESOURCES

In considering resource scarcity or resource competition as a cause of intergroup conflict (Harris 1984; Vayda 1974, 1976), Helbling (2006:118-119, 125-126) contends that such conditions are often economically created by the productive demands of alliance formation and maintenance or are the result of population pressure created by internal growth driven by a desire to maximize military strength through increased group size. Thus resource scarcity and resource competition are consequences of intergroup conflict, not causes. However, Helbling does not consider the possible effects of environmental disturbances that disrupt the productivity of the locally concentrated resources upon which politically autonomous local groups depend. Such disruptions may affect the ability of local groups to finance the creation and maintenance of alliances, shift the perceptions of self-interest of local groups engaged in alliances, and change the goals of local groups in relation to their neighbors. While environmental disturbances may not be the ultimate cause of intergroup conflict as a social practice, in many cases environmental disturbances create contexts that may trigger specific conflicts between affected groups. Such a relationship is confirmed by Carol and Melvin Ember's (1992) cross-cultural study of 186 societies that found a significant association between resource unpredictability and the occurrence of intergroup conflict.

While intergroup conflict is often seen as symptomatic of the social disorder and chaos that accompanies periods of environmental stress or degradation, it can be socially constitutive, especially since it often promotes cooperation for offensive or defensive success. Intergroup conflict can be important in the achievement of social roles and status, especially among males, and warrior status earned in intergroup conflict is often culturally valued. Intergroup violence can be institutionalized, socially sanctioned, and legitimized through ritual (Abbink 1998; Ellis 1951; Redmond 2002). It also may play a significant role in the formation and maintenance, as well as transformation, of group identity, both symbolically and physically (Elwert 2002; Harrison 1989, 1995; Schlee 2004). As a social practice, it may be manipulated for varied purposes within cooperating groups and between competing antagonists (Bosson 2006; Colson 2007; Reyna 1994).

These social practices of conflict and violence are often embedded in spheres of activity unrelated to and independent of subsistence economics, and such relationships caution against making direct causal associations between environmental disturbances and intergroup violence without examining the full cultural context of the conflict.

Previous research on conflict and violence in the U.S. Southwest has proposed a causal relationship between environmental disturbances and the intensification of conflict (Haas and Creamer 1993; LeBlanc 1999). In contrast, other ethnohistorical studies in the region have questioned a direct relationship between intergroup conflict and subsistence stress. Clifton Kroeber (1980) examined the occurrences of extreme dry periods and intergroup conflict among the Yuman-speaking groups of the Lower Colorado River Valley. Intergroup conflict was endemic and extreme dry periods occurred frequently, but there was no apparent causal relationship. Rather, among Yuman-speaking groups, intergroup conflict was embedded in other spheres of social activity. It was an important avenue for male status achievement and was used to reinforce and mark group identity. Further, cultural beliefs about ghost sickness and foreign contamination limited potential economic gain from raiding for booty or captives (Fathauer 1954; Kroeber and Fontana 1986; Stewart 1947).

The Yuman case illustrates what was described in the previous chapter for the Pokot of East Africa: that during environmental disturbances, cooperative social networks that cross-cut boundaries may provide greater benefits than competition through conflict and violence. The contexts for the emergence of intergroup conflict in nonstate societies identified by Helbling (1999, 2006) – the presence of politically autonomous local groups in a multi-centric anarchic system and dependence on locally concentrated resources – were present in the U.S. Southwest and East Africa. However, such contexts also created incentives for alliance formation and exchange as well. The question is thus, under what conditions or circumstances do environmental disturbances trigger competitive rather than cooperative responses?

Evaluating the relationship between environmental disturbances and intergroup conflict and assessing correlations between the two requires more than simply identifying specific periods affected by environmental disturbances and correlating these to the occurrence of intergroup conflict identifiable archaeologically. In addition, the environmental disturbances should lead to increasing intensity of or some changing context for the practice of intergroup conflict. The following section develops dimensions of intergroup conflict that will allow assessment of increasing intensity or changing contexts of violence using archaeological data.

IDENTIFYING AND MEASURING INTERGROUP CONFLICT ARCHAEOLOGICALLY

While various archaeological data may directly or indirectly provide evidence of the intergroup conflict (Vencl 1984), the presence of fortified sites and conflict-related skeletal trauma provide the most direct archaeological evidence of the occurrence of intergroup conflict. Changes in settlement patterns, especially in relation to use of fortified sites, may also allow inferences about the occurrence of intergroup conflict. Previous archaeological research in the U.S. Southwest has used the presence of fortified sites and associated settlement patterns (Haas and Creamer 1993; LeBlanc 1999; Towner

2003; Wilcox et al. 2001a, 2001b) or evidence of skeletal trauma (Martin et al. 2001; Turner and Turner 1999) to identify the occurrence of intergroup conflict. Other archaeological evidence includes the institutionalization of warrior roles and iconographic expressions of these institutions and roles (Dye 2004; Vandkilde 2006a, 2006b). Such institutions and iconography come to act as structures that shape individual and group identity and may be manipulated by self-interested agents. Iconography may also provide insights into cosmological and ideological beliefs that motivated and gave cultural meaning to intergroup violence. Evidence of warrior iconography and institutional roles has been found in the U.S. Southwest largely in the form of rock art and kiva murals (Crotty 2001; Schaafsma 2000), and, to a lesser extent, through mortuary studies where weapons and other artifacts have been used to identify warrior roles (Howell 2001; McGregor 1943; Morris 1924).

Five dimensions of intergroup conflict and violence (Table 5.1) have been identified by Solometo (2001:27-34) for a study in the Chevelon Creek region of the U.S. Southwest, immediately east of the current study area. These dimensions can be used archaeologically to measure changes in the nature and intensity of the conflict and consist of the tactics and goals employed; the social distance between antagonists; and the frequency and predictability, duration, and social scale of intergroup conflict.

Tactics and goals include methods used and the intentions that motivated their use. Tactics and goals may be revealed by patterns in what or who was targeted for destruction or death and in what military technologies were employed. Houses, food stores, or ritual structures could be targeted for or spared from destruction; killings could

Table 5.1. Dimensions of intergroup conflict (after Solometo 2005)

Dimension	Description	Implications
Tactics and Goals	Weapons and strategies employed against selected targets during hostilities	Restrictions on tactics and goals may limit violence against noncombatants or destruction of property
Social Distance	The strength of relationships between social groups engaged in hostilities measured in terms shared of kinship, affinity, ethnicity, etc.	Close relationships may prevent or limit conflict; with greater social distance, there are fewer shared interests that may provide grounds to prevent hostilities or limit tactics and goals
Frequency and Predictability	How often do attacks occur or can be expected to occur	Frequent and predictable conflict may motivate greater investment in both offensive and defensive capabilities, with specialized training and organization of warriors and fortified architecture
Duration	The length of periods characterized by persistent intergroup conflict	Longer periods of hostilities create and reinforce greater social distances
Social Scale	The size of the social groups engaged in hostilities and how alliances within and between groups are created and maintained	Directly relates to the size of combat forces that may be fielded; larger combat forces require specialized leadership; alliances may be fragile and limit the ability to sustain large forces

be limited to adult males or could also include women, children, and other noncombatants. These tactical variables may be related to perceptions of the social distance between antagonists. They may also accompany different goals, with limits to what may be legitimate targets for violence and destruction in tit-for-tat feuding, as opposed to more unlimited "scorched earth" tactics when conquest or expulsion of the enemy was the goal. As will be discussed below, in highland Papua New Guinea, different tactics were employed when different goals were involved. Sneak attacks on habitations, burning of structures, and indiscriminate killing were tactics employed when clans sought to dispossess their neighbors of land. In contrast, the Great Ceremonial Wars developed to limit fatalities while continuing to allow men to accumulate war honors and prestige and establish the contexts for the creation of new exchange ties through peace-making reparations (Meggitt 1977; Wiessner and Tumu 1998).

The ***social distance*** between antagonists is expected to have a relationship to the tactics employed and the duration of episodes of conflict. More socially distant antagonists are expected to engage in more deadly tactics, including the destruction of food stores, the killing of women and children, and trophy taking and other peri- or post-mortem mutilation. Mutilation dehumanized the defeated enemy, perhaps also incapacitating them in the afterworld; but most important was the social signal such an act transmitted – the great distance between the social groups involved. Among the Enga of Papua New Guinea, post-mortem mutilation was done to indicate social distance between groups, often being used to formally signal the rupturing of social ties (Meggitt 1977). Socially close antagonists have other compelling interests and obligations (kinship, trade, and ritual, for example) that may limit not only the deadliness, but also the duration of episodes of conflict. Meggitt's Enga consultants told him that "we marry the people we fight" (1977:42), and close relationships like these could limit the escalation of conflicts and lead to reciprocal reparation payments to re-establish peaceful relations. However, these relationships could also establish contexts (or pretexts) for conflict when expected social obligations were not fulfilled.

The ***frequency and predictability*** of episodes of conflict influence the use of military technologies, such as specialized weapons and fortified architecture, and the development of institutionalized roles. If episodes of conflict were frequent and predictable, investments in specialized weapons and fortifications and the development of military institutions would be expected. Most archaeologically visible would be fortifications. Investments in fortifications include not just the initial investment of labor in their construction, but the time then invested in the additional travel between the fortified site (often on a hill or other prominence) and agricultural fields or other productive facilities, as well as the additional time and effort invested in transporting food, water, and other resources to the fortified site.

The ***duration*** of periods of conflict may be measured by the use-length of fortified sites, estimated primarily by the accumulations of domestic refuse. The duration of individual engagements is unlikely to be identifiable archaeologically, but periods of chronic intergroup violence may be identified by patterns in architectural and skeletal data. Like frequent and predictable episodes, longer duration periods of conflict would also be expected to result in investments in specialized weapons and fortifications and the development of military institutions to manage defense.

Social scale of conflict refers to the size and organization of the competing groups. That scale may be measured in the size of cooperative units cohabitating sites and engaged in alliances as evidence by clustering and/or networks of inter-visibility. Larger fortified sites and larger or more integrated networks or clusters of sites would suggest a greater social scale of conflict. Increasing social scale would also be expected to be accompanied by the emergence of military institutions and new social roles to organize and direct defense, offense, and negotiations. War-related iconography in various media may also be developed to reinforce ideologies of conflict, motivate participation, and celebrate achievements (Harrison 1993).

Changes in these dimensions can be identified archaeologically by examining settlement patterns and the distribution of fortified sites, skeletal trauma and other indications of violence, and evidence for the presence of warrior institutions and iconography. In her case study, Solometo (2001) used architectural and settlement pattern data to demonstrate that an increasing intensity of conflict preceded the regional abandonment of the Chevelon Creek region.

In the remainder of this chapter, I present an overview of ethnographic accounts of intergroup conflict in small-scale societies to provide examples of and insights into the relationships among intergroup conflict, environmental disturbances, and other spheres of social action. I begin with an overview of the social structure and practice of intergroup conflict in the U.S. Southwest drawn from ethnographic accounts and oral histories of the Hopi, Navajo, and River Yumans. These data are analyzed in the context of the dimensions of conflict outlined above. Additional ethnographic accounts of intergroup conflict drawn from East Africa and Papua New Guinea illustrate the relationships that intergroup conflict has with environmental disturbances and competition for land and resources, as well as ways in which it is embedded in spheres of social activity independent of subsistence economics. The emergence of conflict within and between villages in the aftermath of the Paricutín eruption and its relation to competition for land provides insights into how and why different communities came into conflict.

INTERGROUP CONFLICT IN THE U.S. SOUTHWEST

Despite often being characterized as peaceful, the ethnographically known Puebloan cultures of the U.S. Southwest have a well-documented history of participation in intergroup conflict and a robust set of social institutions and cultural practices related to it (Ellis 1951; Haas and Creamer 1997). Puebloan cultures resisted the Spanish conquest, struggled with the neighboring Navajos and Apaches, and even fought among themselves. In this section, I focus on intergroup conflict as a social practice among the Hopi, who are the most proximate contemporary group to the study area and are believed to have cultural affiliation with the prehistoric cultures of the region (Pilles 1996). Data drawn from Navajo and River Yuman ethnography will be presented to compare and contrast with the Hopi. The Navajo and River Yumans lived in dispersed settlements, while the Hopi lived in aggregated villages. In the study area, population aggregation into larger settlements and settlement clusters increased over time, but dispersed settlements were more characteristic throughout most of the prehistoric occupation of the region.

Intergroup Conflict among the Hopi

While their autonym Hopitu translates as "one who is mannered, civilized, peaceable, polite" (Hill et al. 1998), the Hopi have institutional social roles and rituals related to the management and prosecution of intergroup conflict (Beaglehole and Beaglehole 1935; Titiev 1944) as well as oral histories of intergroup conflict among Puebloan communities prior to the arrival of the Spanish (Courlander 1971; Lomatumay’ma et al. 1993; Nequatewa 1936, 1955; Voth 1905). Currently, the Hopi live in ten villages on a series of three adjacent mesas in northeastern Arizona. Two other villages to the northwest along Moenkopi Wash developed from agricultural colonies. Each mesa is politically independent of the others, and the villages on each mesa, while related though history and sometimes continued ritual relations, are also politically independent (Levy 1992; Whiteley 1988). This emphasis on community autonomy continues to this day, as only four of the twelve villages participate in the overarching tribal government created under the auspices of the Bureau of Indian Affairs in 1936 (Hopi Tribe 2010).

The following account of Hopi social organization prior to the twentieth -century transformation of their society is drawn primarily from descriptions of Third Mesa by Mischa Titiev (1944), Maitland Bradfield (1973), Peter Whiteley (1988), and Jerrold Levy (1992), with additional information from First Mesa (Stephen 1936) and Second Mesa (Beaglehole and Beaglehole 1935; Connolly 1979). Each village was composed of multiple matrilineal clans that co-resided in communal houses. Ideally, each of these clans controlled rituals and ritual paraphernalia that were employed for the benefit of the entire community. The use rights to certain prime agricultural lands near the village were underwritten by these ritual performances. These prime lands were largely used to grow produce used to finance the feasts that accompanied the clan's ritual performances Not all clans, however, controlled rituals or had access to prime agricultural lands. By controlling a ritual, a clan was responsible not only for the care of associated ritual paraphernalia but also for the provision of officers for the sodality that organized the performances of the clan's ritual. Membership in these sodalities was not limited to members of the controlling clan but rather was drawn from the wider community and crosscut clan membership. The ritual and political importance of the sodalities and associated clans were ranked relative to one another, but these relationships were not hierarchical. Instead, they were heterarchical in that each was an autonomous unit with specific roles and responsibilities in relation to each other and the whole community (sensu Crumley 1995).

Initiation into these sodalities marked the progress of an individual through their life. In the following description, emphasis will be given to the initiatory life cycle of Hopi boys and men, as it is associated with different institutionalized roles related to intergroup conflict. Between the ages of 8 and 12, all Hopi boys and girls were initiated into the Katsina sodality. This initiation marked the first step of the initiates ritual maturation, and gave the boys the right (and responsibility) to personify katsinam during communal dances. Shortly after puberty, all boys were also initiated into one of four "manhood" sodalities − One Horn, Two Horn, Singers, and Wuwutcim (an archaic word often glossed as "Manhood"). This initiation marked their transition from childhood to adulthood and their assumption of more significant ritual responsibilities. All Hopi sodalities have some association with weather control and fertility, but the One Horn and Two Horn sodalities also have associations with the management of intergroup conflict and were seen as the outer wall of defense of the village. They also were responsible for rooting out and punishing witches within the community.

After initiation into one of the manhood sodalities, a young man could be, and most were, initiated into the Mòmtsit warrior sodality. While the roles of the One Horn and Two Horn sodalities were defensive, the Mòmtsit sodality managed and prosecuted offensive actions against outside enemies, and its name reflects this. Mòmtsit is derived from from mots which conceptually means "to stick out" and is the root for words like mosta (needle) and motski (yucca). Within the Mòmtsit society were two additional sub-orders of greater distinction: the Nasotanwimkya, or stick swallowers, and the Pas Qalèetaqt, or real warriors. During the public portion of the Mòmtsit initiation, members of the Nasotanwimkya conducted stick swallowing performances akin to modern day sword swallowing. One did not join the Nasotanwimkya by choice; any existing Mòmtsit member could be forcibly initiated into the Nasotanwimkya as the result of inadvertent trespass on ceremonial activities of the group. Membership in the Pas Qalèetaqt was achieved through the actual killing of an enemy and required another initiation procedure that cleansed the killer and protected them from the potentially malevolent ghost of their victim.

Demonstrable proof of the death of an enemy was obtained through trophy taking, and this trophy was integral in the purification rites of the Pas Qalèetaqt initiation. Scalping was done in historic time, but myths and oral histories also refer to the taking of whole heads. When enemy scalps were brought into the village, rituals were performed to adopt, incorporate, and both neutralize and co-opt the power of the enemy. The warrior who took the scalp kept it, referred to it as a son, and periodically washed and fed it. Scalping and other forms of trophy taking deliberately desecrate the sanctity of the deceased enemy's body and are an overt expression of social distance. The elaborate rituals to adopt and incorporate the enemy scalp into to the scalp taker's home community even further emphasize this social distance, as a piece of the distant enemy comes to be transformed into a kinsman.

Also after initiation into one of the manhood sodalities, men could seek membership in the Snake, Antelope, Blue Flute, and Grey Flute sodalities. Like the four manhood sodalities, membership in these four sodalities was mutually exclusive. Also like the manhood sodalities, there were two complementary pairs that cooperated with one another to perform rituals to benefit the entire community. The Snake and Antelope sodalities cooperated in the performance of their respective rites, and the two flute sodalities also cooperated in their performances. Each pair alternated these annual performances with the other, so in one year the Snake and Antelope sodalities would perform their rituals, and in the following year the Blue and Grey Flute sodalities would perform theirs. While primarily associated with the creation of clouds and rain in the late summer, the Snake and Antelope sodalities also had associations with intergroup conflict. Their members were seen as elder warriors, who encouraged the younger warriors and made prayers and other offerings on their behalf both before and during military actions.

The Hopi villages were in defensible, mesa-top positions, and the Hopi claimed to fight only in defense. However, retaliatory raids against the Navajo were undertaken in which livestock were stolen, hogans burned, and the inhabitants sometimes killed. If the village was warned of an approaching enemy party, the warrior societies would be rallied, and the leaders of the One Horn and Two Horn sodalities would ritually block the enemy by laying a line of corn meal across their path while chanting protective incantations. This sacrosanct line in the sand was then backed by the ranks of Hopi warriors. Bows and arrows were used to engage the enemy at a distance before beginning hand-to-hand combat. Wooden clubs and stone axes were the primary weapons for hand-to-hand combat, with later addition of Spanish-style lances that were shortened and used as thrusting spears. Crooked sticks were used to catch enemy combatants for clubbing, and rawhide shields were used to deflect arrows and ward off blows from clubs (Beaglehole and Beaglehole 1935).

In summary, the Hopi had a variety of institutional roles associated with the management and prosecution of intergroup conflict that were specialized in their functions: the One Horn and Two Horn sodalities were responsible for local defense and protection of the community from witchcraft, the Mòmtsit sodality directed external military activities against the community's enemies, and the Snake and Antelope sodalities provided guidance and ritual protection to the warriors. The development of such warrior sodalities provides formal and institutionalized avenues of male status achievement that are directed toward socially desired goals. In the Hopi case, the goals include defense against outside enemies and internal threats of witchcraft.

In communities consisting of diverse kin groups with potentially competing interests, the right to use force against other community members is often monopolized by warrior sodalities (Tefft and Reinhard 1974). In Hopi villages, during certain periods of ritual activity, members of the One Horn and Two Horn sodalities had the authority to kill anyone violating established rules and orders. Warrior sodalities also provided a cultural context for the exercise of violence against non-group members, both by defining who are legitimate and illegitimate targets of violence, and by providing rewards and status for the successful exercise of violence against legitimate targets. Through the monopolization of the use of force within the community and the definition of legitimate targets of violence as non-group members, violence and conflict are projected outside of the community.

In addition to developing institutionalized social roles for the management of conflict, the Hopi made investments in fortified sites, developed specialized weaponry, and used trophy taking as means of expressing social distance. Regarding the expectations developed by Solometo (2001), the institutionalization of roles, use of fortified sites, and development of specialized weapons can be seen as responses to the frequent and predictable nature of conflict with the Navajo and others prior to the establishment of peace during the reservation era. The institutionalization of roles also relates to the social scale of the intergroup conflict, with larger social groups needing more specialized leaderships roles to organize and direct members of diverse kin groups and other social segments or political factions. Tactics and goals were largely oriented towards village defense, but livestock raids and retaliatory attacks were mounted against the Navajo, whose social distance was reinforced by the practice of scalping. These data present the descriptions made by outside ethnographers based on consultant memories of historic period conflicts. The following section will use Hopi oral histories to explore the emic interpretations of what motivated conflict between prehistoric Puebloan villages.

Hopi Oral Traditions of Intergroup Conflict

During the late-nineteenth century period observed by early ethnographers and reconstructed by later ethnologists, Hopi conflict with other groups had largely been suppressed by the United States government. Recently recalled history emphasized conflicts with neighboring Native American groups, particularly the Navajo, and with the Spanish and New Mexicans, all of whom raided the Hopi for livestock and captives to be sold into slavery (Aitken 1931; Courlander 1971; Nequatewa 1944; Voth 1905). Hopi oral histories of earlier periods recall a time before the arrival of the Spanish and Navajo when ancestral Hopi villages fought amongst themselves (Courlander 1971; Curtis 1922; Lomatumay’ma at al.1993; Nequatewa 1936, 1955; Voth 1905). These accounts provide insights into the motivations that drove the antagonists to engage in violence. The repetition and reification of these motivations in each re-telling of the story provided them cultural legitimacy. These motivations include violations of kinship or ritual obligations, failures to fulfill promised marriage exchanges, competition over a potential spouse, accusations of witchcraft, and disputes over resources. One story relates to the study area, as it involves the destruction of a well-known site.

The Destruction of Hovi'itstuyqa, or Elden Pueblo
(adapted from Lomatumay’ma et al. 1993:205-273; and Nequatewa 1955).

> A beautiful young girl living at Hovi'itstuyqa established a series of impossible tasks for potential suitors to complete. A homely young man who was a social outcast from the village of Tupats'ovi near Chavez Pass to the southeast was able to achieve these impossible tasks through the intervention of the deity Old Spider Woman, who pitied him and provided magical assistance. After agreeing to marry the young man, the girl and her family employed various stalling tactics to delay the promised exchange. Her brothers were deliberately slow weaving her wedding garment, and she only half-heartedly ground corn for her future in-laws at Tupats'ovi to fulfill the marriage contract.
>
> After the completion of the marriage, the girl rebuffed her husband's advances and refused to consummate the union. A rival suitor from Hovi'itstuyqa, whom the girl secretly desired, came to Tupats'ovi, where he first seduced and then

> abducted the girl, taking her back home to Hovi'itstuyqa. After this insult, the spurned husband recruited warriors from the Kisispaya, Yavapai from the Verde Valley area to the southwest, to assist him in an attack on Hovi'itstuyqa. In the surprise attack, he killed his rival and his allies killed all the other men and boys. The Kisispaya took all the women and girls, including the estranged wife, as payment for their help. Afterwards, the young man felt remorse for the extent of the killings and shamefully left Tupats'ovi.

The story uses the common theme of the pitied outcast as protagonist and it delivers a moral about the socially disruptive nature of infidelity, the story also has another message encoded symbolically. The name of the protagonist is Pitsinsivostiyo, or Cottonseed Boy. He lives in the Chavez Pass area, along an important trade route to the south, a significant source of cotton and cotton textiles needed for ritual purposes. The social rupture between the villages of Tupats'ovi and Hovi'itstuyqa caused by the failed marriage and abduction would have also resulted in the disruption of exchange relations that the people of Hovi'itstuyqa would have needed to acquire ritually important cotton. This was critical because cotton cannot be grown in the higher elevations of the Flagstaff region, like at the base of Mount Elden where Hovi'itstuyqa was located. At the story's end, after Pitsinsivostiyo leaves in shame, the narrator notes that with his departure access to cotton was lost. The people realize that he "had actually owned the cotton. When he left, he took it with him" (Lomatumay’ma at al. 1993:273). But the rupture of exchange relations meant more than just the material loss of cotton products. The loss of this regional exchange alliance also exposed Hovi'itstuyqa to attack by foreign enemies, the Kisispaya, leading to the death of the men and boys and the dispersal of the women and girls as captives among the foreigners.

In this and other accounts, the motivation for conflict is rooted in the perceived failure to fulfill important social obligations and violation of social norms. Neither resource competition nor the effects of environmental disturbances are emphasized in most accounts of inter-village conflict, but resource competition is a theme in some versions of the demise of the village of Sikyatki near First Mesa. Most accounts say that the conflict arose as the result of competition for a potential spouse that led to assaults and murders that required vengeance, resulted in the disruption of ceremonies, and escalated to the use of witchcraft (Courlander 1982; Curtis 1922; Lomatumay'ma et al. 1993; Parsons 1926; Waters 1963; Voth 1905). In some accounts, however, the conflict initially resulted from disputes over resources, either use rights to agricultural land (Mindeleff 1891), access to springs (Fewkes 1898), or rights to gather firewood (Courlander 1982). These disputes over resources then led to the aforementioned violent and antisocial acts. Some accounts say that Sikyatki was destroyed by an attack and most of its inhabitants killed either by warriors from a single community (Lomatumay'ma et al. 1993; Voth 1905) or from an alliance of multiple villages (Parsons 1926). In contrast, others say it was not destroyed but rather was abandoned by its inhabitants as relations with their neighbors deteriorated and became intolerable (Courlander 1982, 1984; Waters 1963).

These accounts reveal that while conflicts may have resulted from resource competition, what was more significant to the disputants was the cultural validation of the opposing side as legitimate targets for violence as the result of their failure to fulfill important social obligations or adhere to acceptable social norms. These failings placed the opposing side outside the social world of proper humans and sanctioned violent acts towards them. For example, witchcraft was the most antisocial act possible, as witches used their powers to drain the life forces of their neighbors and even relatives, leaving them ill or dead. Witches even had the ability draw rain to only their own fields and repel it from the fields of others. People who practiced witchcraft were so far outside the realm of human society, the Hopi referred to them as kwitavit or kwitam, meaning excrement people (Malotki and Gary 2001; Titiev 1942). As such, witches were legitimate targets of violence, and violent acts towards them were not only sanctioned but were to some degree obligated, especially for members of warrior sodalities.

While the Hopi have demonstrable cultural affiliation with the prehistoric Puebloan cultures of the study area (Pilles 1996), there are significant differences of scale between the ethnographically known Hopi villages and prehistoric communities of the study area. While Hopi villages are large population aggregations with multiple co-resident kin groups, throughout most of the prehistoric occupation of the study area, much of the population lived in dispersed independent households. To consider whether there might have been the same social institutions in such dispersed communities, I next review intergroup conflict among the Navajo and River Yumans. These peoples lived in dispersed communities, had high levels of intergroup conflict, and had developed elaborate cultural practices that accompanied intergroup conflict; however, neither had warrior sodalities.

Intergroup Conflict among the Navajo

In comparison to the aggregated villages of the Hopi, during the 18th and 19th centuries the Navajo lived in dispersed homesteads similar to those found during the prehistoric occupation of the study area. Intergroup conflict was an important means of male status achievement among the Navajo (Hill 1936), and they were faced with various military threats from the Spanish, Mexicans, Utes, and Comanches (McNitt 1972). While the frequency and predictability of conflict led to the construction of fortified sites at times (Towner 2003), the Navajo did not have warrior sodalities.

Although a young man's first expedition against an enemy was marked by special initiatory practices, there were no formally named institutions that organized these expeditions or the initiatory practices. Rather, ad hoc parties of kinsmen, affines, and sometimes members of neighboring kin groups organized parties to conduct livestock raids or retaliatory attacks on neighboring enemies. The novitiate warrior was required to use a scratching stick to touch himself, had restrictions on food and water, and was obligated to perform certain tasks in camp for the experienced warriors. These behavioral restrictions and labor obligations were enforced by all of the party members as part of creating a shared experience of transition from youth to manhood (Hill 1936). Leadership was based on past achievements and personal qualities; it was not a formally constituted and named social role. A variety of war names could be applied to men who distinguished themselves. These war names describe the man in various ways as running, speaking/orating, or being fierce/determined (Young and Morgan 1951). The Enemyway and other rituals provided returning combatants with purification and protection from enemy ghosts and facilitated their re-integration into the community. Scalps that had been taken were symbolically killed and washed with ashes during these rites. Scalps were used to co-opt the power of the enemy and protect the scalper during future engagements. The scalp taker kept his trophies, and they were stored with other ritual paraphernalia (Haile 1938; Hill 1936; Oakes et al. 1943; Reichard 1950).

During the historic period, the dynamics of intergroup conflict among the Navajo were driven by the transforming contexts of Spanish, Mexican, and American colonization and conquest. The Navajo were subject to livestock and slave raiding by New Mexicans, Utes, and Comanches, and they mounted their own retaliatory attacks against these enemies, seeking livestock and captives as well (McNitt 1972). Navajo raiders largely fought from horseback, using bows and arrows and long lances to engage opposing riders or enemy on foot. Clubs and knives were used in hand-to-hand combat, and rawhide shields adorned with protective amulets were used to deflect arrows and ward off blows (Hill 1936).

Navajo raiding activities were suppressed after the American conquest, but conflict did not disappear. During the reservation period, internal feuding between individual kin groups and larger localized groups continued. These feuds were usually initiated by witchcraft accusations, but were fomented in the context of adjustments to confinement on the reservation, suppression of raiding, and increasing integration into the national and even global economy, all of which increased internal social tensions. These feuds could encompass large areas and mobilize many potential combatants, as was the case of a feud between Navajos from the Ganado area and others from the Chinle area in 1878. During this feud, several accused witches were killed on both sides, but, more dramatically, a ceremony being performed by one community was disrupted by warriors from the rival community seeking to kill the Hatathli, or singer, directing the ceremony. Rising tensions led to mediation by the trader Lorenzo Hubbell and threats of intervention by the U.S. military (Blue 1988; Kluckhohn 1944).

Frequency and predictability of conflict led to investments in defensive Pueblitos during certain phases of Navajo history. Post-mortem mutilation and trophy taking was used to express social distance and co-opt the power of the enemy. Raiding by small groups organized along kinship lines was the primary focus of Navajo intergroup conflict, although formerly large-scale attacks had been mounted by most of the tribe's warriors after the periodic Naachid ceremony that brought local group leaders from across Navajo territory together to reaffirm alliances and relationships. With confinement upon the reservation and suppression of raiding, feuding within and between local groups increased. While largely fueled by increasing social tensions resulting from the changing economic and political situation, conflict was expressed through witchcraft accusations and executions, which led to retaliatory killings.

Intergroup Conflict among the River Yumans

Like the Navajo, the Yuman-speaking groups of the Lower Colorado River lived in dispersed communities and did not have warrior sodalities despite having high levels of intergroup conflict and elaborate cultural practices related to intergroup conflict. As mentioned earlier, the Yuman-speaking groups of the Lower Colorado River are notable for the cultural importance placed on intergroup conflict for both male status achievement and the creation and reinforcement of group identities and social boundaries. The River Yumans lived in dispersed rancherias and also had high levels of seasonal mobility that allowed exploitation of both desert and riverine resources. While there were very formalized ritual practices conducted by combatants before and after conflicts to counteract the potentially adverse effects of foreign contamination and ghost sickness, there were no formally named institutions that organized these practices (Fathauer 1954; Forde 1931b; Kroeber and Fontana 1986; Spier 1933; Stewart 1947).

During the early historic period between ca. 1700 to 1850, high levels of intergroup conflict led to a series of population displacements, migrations, and the creation of unoccupied buffer zones between agonists (Forbes 1965; Spier 1933; White 1974). An alliance that included the Mohave and Quechan expelled their Xalchidoma and Kohuana neighbors from the Lower Colorado River. These displaced migrants settled with their Maricopa and Kaveltcadom allies along the Lower Gila River to the east. Continued conflict with the Mohave-Quechan alliance subsequently pushed the migrants eastward towards Gila Bend, and then beyond to the Middle Gila, where they settled adjacent to their Pimic-speaking O'odham allies.

Need for agricultural lands did not motivate this conflict, for when the Mohave displaced the Xalchidoma from the Parker Valley, a prime area for floodplain agriculture, it was not immediately occupied by the victors. After about two generations, the vacant land came to be slowly settled by Mohave colonists (C. Kroeber 1980; Stewart 1969a). Some land in the captured Parker Valley, as well as some in the Mohave Valley homeland, was given to some of their Numic-speaking Chemehuevi allies and trading partners from the Mojave Desert to the west who sought the agricultural opportunities afforded by access to such lands (A. Kroeber 1925). After the expulsion of the displaced migrants and their hosts from the Lower Gila Valley, this area was not re-occupied and remained a buffer zone between the hostile groups (Spier 1933). The Lower Gila, however, did not have as reliable or productive potential for floodplain agriculture as did the Parker Valley on the Lower Colorado.

Combat was regimented, with organized formations and use of different specialized weapons by different ranks of combatants. The advanced ranks fought in close quarters with small clubs that were also sharpened at one end for stabbing. They were followed by combatants armed with longer, sword-like clubs to dispatch the wounded as their compatriots advanced against the enemy. These ranks of hand-to-hand specialists were flanked on either side by archers, who hemmed in the enemy and funneled their ranks in towards the fury of club fighting. Cavalry forces were included as the introduced horse became more common, and were used to further flank the enemy, attempting to drive around the rear of the enemy forces. Experienced warriors were known as kwanani, or brave ones. Those kwanami who had demonstrated their abilities in previous engagements led in these engagements by their persuasive abilities, strong personalities, examples of bravery and daring, and the reputed power of their dreams. A successful career as a kwanami demonstrated possession of supernatural power through dreaming and provided an avenue to political leadership as a kwoxot, an orator and organizer of community events.

Tactics involved attempting to sneak up on the outskirts of an enemy rancheria before dawn. If the assembled attacking force was a small party from a single member of a larger alliance, a hit-and-run assault was mounted where houses were attacked, the sleeping occupants killed, and the buildings burned, followed by a rapid retreat before reinforcements from nearby rancherias could respond. If the attacking force was large, consisting of most of a group's warriors and including the participation of allies, the attacking force established ranks on the outskirts of the sleeping rancheria and then called out the surprised enemy. The rallied forces of the challenged rancheria and allies from neighboring rancherias who arrived as the alarm spread formed ranks against the opponents, and challenges and insults were hurled back and forth. Sometimes individual bouts of hand-to-hand combat between champions from either side were fought before the event precipitated into a general melee. If the attackers were able to win the day, they would push into the rancheria where they would burn houses and stores. Fear of foreign contamination largely precluded plundering attacked communities. These same fears also limited the taking of captives, although females were sometimes taken to be given to elderly shamans with the supernatural power to withstand foreign contamination. If the defenders held strong and repelled the attack, they might also pursue the retreating attackers if their ranks were in disarray or greatly outnumbered (Kroeber and Fontana 1986; Spier 1933; Stewart 1947). Upon returning home, the attacking combatants were required to undergo purification rites outside the rancheria prior to their reintegration into the community after their physically and spiritually perilous adventures (Fathauer 1951, 1954; Forde 1931b; Spier 1933).

Scalping of victims was performed; but because of fears of foreign contamination and ghost sickness, it was attended by ritual purification of the scalp and scalper, and the scalper must have been empowered by a dream to perform such a dangerous act. The ritually purified scalps preceded the returning warriors into the community, because the purification rites of the warriors lasted longer. Enemy scalps were ritually integrated into the victorious community through a scalp dance in which women dressed in the battle costume of kwanami while dancing around a pole tied with the newly taken scalps. As they danced, these female kwanami recounted the group's military accomplishments and insulted the enemy. The scalps were then kept and stored by the community's kwoxot who would periodically wash and then re-dress the scalps in the manner of a kwanami's hairstyle. Scalps were brought out during harvest time and were associated with enhanced fertility. They were also used in rituals prior to attacking the enemy to empower the kwanami for the fight and draw strength away from the enemy. The scalps could provide warning to the kwoxot of impending enemy attacks by making their own war cries (Forde 1931b, Stewart 1969b).

Indigenous concepts held that the power dreams of the kwanami drove decisions as to when and whom to attack. These dreams were discussed and interpreted publicly among the kwanami and kwoxot, allowing consensus among different interpretations or even among different dreams. Grievances and vengeance for past wrongs were also powerful motivations (Forde 1931b; Kelly 1977; Spier 1933; Stewart 1947). In contrast to these indigenous beliefs, Graham (1975) and Stone (1981) have proposed that conflict was largely driven by ecological factors. Graham suggests that population pressure and limitations on land that could be farmed using the flood-recession methods of the Yumans led to competition for land. Stone presents a more complex interpretation based on two observations about River Yuman agriculture. First, the methods employed were dependent on the annual flooding of the Colorado River, which varied every year, leading to significant interannual variability in agricultural productivity. Further, the use of flood-recession farming methods limited the potential to intensify agricultural production. These limits on agricultural productivity needed to be balanced through assured access to wild resources, particularly productive stands of mesquite trees. Therefore, territories and the resources they contained needed to be defended and expanded through seizure of adjacent territories. The interpretations of both Graham and Stone presume that shortages of land and resources led to intergroup conflict.

Kroeber and Fontana (1986; C. Kroeber 1980) have questioned this assumption of ecological pressures driving conflict because there is no evidence of limitations on the availability of or access to arable floodplain lands; in fact not all potential agricultural lands were under production. Indeed, enough land was available to reward allies from neighboring desert areas with access to floodplain fields. The Mohave allowed the Chemehuevi to farm within their territory, and the Quechan allowed the Southwestern Yavapai the same privileges. Further, territory from which enemies had been expelled were either only slowly occupied or left abandoned.

The River Yumans had well-developed cultural practices related to intergroup conflict, including formal social roles, the kwanami, although they lacked warrior sodalities. Success as a kwanami provided social recognition, demonstrated possession of powerful dreams, and could be an avenue to local leadership. Indigenous beliefs held that the dreams of the kwanami determined the timing of hostilities. Rather than raiding or simple feuding, intergroup conflict among the River Yumans was at the scale of warfare, as it was conducted between regional alliances of political units and sometimes resulted in the expulsion of defeated groups from their lands. Conflict does not appear to have been driven by the need to acquire additional lands, as vacated lands were not always re-occupied, were re-occupied slowly, or were even used to reward allies. Instead of material causes of conflict, Kroeber and Fontana (1996) propose that intergroup conflict was most important among the River Yumans for the role it played in the creation and reinforcement of group identities, the formation of group solidarity in the face of enemy threats, and the maintenance of social boundaries between groups.

Summary of Intergroup Conflict in the U.S. Southwest

The cultural traditions of intergroup conflict among the Hopi, Navajo, and River Yumans shows a diversity of social practices and a variety of motivations. Among the Hopi, warrior status was institutionalized in a variety of specialized roles that provided for offense, defense, protection from witchcraft, and maintenance of the social order. In contrast, while intergroup conflict was an important avenue of male status achievement among both the Navajo and River Yumans, there were no formalized warrior societies, although warriors did have a named status role among the River Yumans. All of the groups discussed practiced trophy taking with attendant rituals that emphasized the social distance of the defeated enemy.

Motivations varied depending on the context of the intergroup conflict. Among the Hopi, oral traditions about inter-village conflict prior to the modern era indicate a variety of motivations, including failure to fulfill social obligations; violations of social norms; rivalries among men for spouses; and competition for resources like land, water, and firewood. Even when resource competition may have been a factor in intergroup conflict, oral traditions still emphasized aspects that legitimized the enemy as a target of violence for their social failings. Navajo intergroup conflict was largely motivated by the economic rewards of raiding for livestock and captives. After confinement on the reservation and suppression of raiding, increased feuding emerged within Navajo society and was played out through witchcraft accusations and executions. River Yuman intergroup conflict was motivated by the dreams of warriors in the emic view. While some etic analysts have proposed ecological causes, others have emphasized social factors, especially the relationship between intergroup conflict and the formation and maintenance of group identity.

These specific findings can be interpreted in terms of the five dimensions of conflict developed by Solometo (2001). The frequency and predictability of intergroup conflict influenced the tactics and goals employed. All the groups developed specialized weapons adapted to their combat tactics; but, more specifically, the Hopi and Navajo invested in defensive habitation sites: the Hopi in mesa-top villages and the Navajo in smaller fortified pueblitos. A similar relationship between these two dimensions was not seen among the River Yumans. Despite the frequency and predictability of intergroup conflict, no effort was made to fortify habitations or occupy defensive locations like mesa tops.

The high levels of seasonal mobility among the River Yumans may have contributed to a lack of investment in fortifications.

The role of the social scale of conflict is evident in the development of specialized institutions to manage conflict. Only the Hopi created such specialized institutions; the Navajo and River Yumans lacked such formal warrior societies but did have high status social roles for warriors. The Navajo and River Yuman examples suggest that formalized warrior institutions do not develop simply as a response to frequent and predictable conflict. Such institutions more likely result from differing social scales of conflict and needs for internal conflict management found in societies with dispersed versus aggregated communities.

Social distance between groups and duration of enmities were also important factors in the structuring of conflict. While social and economic interaction and exchange occurred between the Navajo and Hopi, each holds the other to be their traditional enemies from time immemorial, a social fact engrained in oral traditions of intergroup conflict (Hill 1936; Nequatewa 1955). Similarly, various Yuman-speaking groups like the Quechan and Mojave were embroiled in long-standing conflicts that acted to define differences between groups. The duration of these conflicts served to reinforce the social distances between antagonists. Social distance between antagonists was also marked and emphasized through trophy-taking practices.

The typology of feuding, raiding, and warfare can also be examined in relation to these dimensions and the ethnography of conflict in the U.S. Southwest. As discussed above, feuding, raiding, and warfare employ different tactics, have different goals, and are organized at different social scales. There are also differences in their frequency, predictability, and duration and in the social distances between antagonists. Antagonists engaged in feuding or raiding relationships have an expectation of frequent and predictable episodes of conflict. While each individual episode may be of short duration, the underlying structure of the conflict is enduring and provides contexts for future actions. Because of the larger social scales of involvement, warfare may be less frequent but still predictable. In contrast to feuds and raids, the duration of the state of conflict in wars are often more prolonged. While social distance between antagonists is usually high, those groups engaged in feuds often have an underlying relationship that has been breached, leading to the state of hostility, and suggesting that the abrogation of social closeness and the creation of social distance is a fundamental aspect of feuding. Further, the creation and maintenance of social distance is essential to legitimize targets of violence towards persons or property through acts of both raiding and warfare.

The ethnography of conflict in the U.S. Southwest suggests that warfare as a means of interaction between large political units was characteristic of the Hopi, Navajo, and Yumans. After the introduction of livestock by the Spanish, the Navajo practiced raiding as an important economic activity, and the Hopi were often targeted by them and responded with reprisal efforts to recover lost stock. All of the Southwestern groups were victimized by slave raids during the colonial period, and the Navajo and Yumans sometimes participated as suppliers of captives. Raiding was less likely to have occurred prehistorically in the U.S. Southwest because bulky subsistence goods were not usually targeted and easily moved livestock were lacking. However, human captives may have been sought, and some archaeological evidence has been suggested to indicate that the raiding for and enslavement of female captives occurred in the Mesa Verde and La Plata regions of Colorado and New Mexico (Kohler and Turner 2006; Martin et al. 2008).

Internal feuding between kin groups was suppressed among the Hopi, not mentioned in the literature on the Yumans, and appears to have emerged among the Navajo only after confinement upon the reservation and the suppression of external conflict which had acted as a means of projecting hostilities and creating internal group solidarity. As previously mentioned, this typology of feuding, raiding, and warfare has overlaps and reflects a continuum along different axes of social scale and individual motivation. The Hopi oral histories of prehistoric intervillage conflict demonstrate how the sentiments and emotions that inspire feuding kin groups can be directed into political arguments to unite diverse social segments of larger villages in preparation for war. The differences in the tactics and goals; social scale and distance; and frequency, predictability, and duration between feuding and warfare lead to different expectations regarding investments in fortifications and the development of institutional roles for the management and prosecution of conflict. As conflict escalates from feuding between kin groups to warfare between larger political units, greater investment in fortifications to protect persons and property would likely be made and formal roles and institutions to manage conflict would likely emerge. The institutionalization of managerial roles may, however, be most influenced by social scale and the needs of maintaining internal solidarity and peace.

In the following sections, examples from East Africa, Papua New Guinea, and Paricutín Mexico will be used to further illustrate the dynamics of what motivates intergroup conflict in nonstate-level societies, the interplay between resource competition and intergroup conflict, the relationship between intergroup conflict and exchange, and the organization of intergroup conflict at a community level. These examples will be further analyzed in the context of the identified dimensions of conflict.

INTERGROUP CONFLICT IN EAST AFRICA

In the preceding chapter on social responses to environmental disturbances, the responses to droughts made by the Mursi, who practiced a mixture of agriculture and stock raising, were described. The response of last resort was increased livestock raiding against their neighbors, often the Bodi to the north (Turton 1977). Turton (1978, 1979, 1988, 1994) has also documented the history of Mursi territorial expansion made at the expense of the Bodi, especially the social and ritual aspects of converting land contested through intergroup conflict into annexed territory incorporated into the Mursi sphere. Relations between the Mursi and Bodi alternated between periods of peace and hostilities. During peaceful periods Mursi and Bodi farmers and herders cooperatively engaged in economic activities, contracting stock partnerships and even occasionally working fields jointly. During hostilities, both groups raided each other for livestock, often as a means of supplementing subsistence resources during environmental disturbances. Both sides also engaged in destructive attacks upon settlements and random killings of travelers, farmers, and herders caught away from settlements as acts of revenge and intimidation.

Over several generations, the Mursi, seeking better quality arable lands and grazing lands free of the Tsetse fly, expanded their territorial control from the west side of the

Omo Valley to the east side and continued to move northward at the expense of the Bodi. While Mursi accounts suggest the most recent episode of northward expansion was associated with the growth and segmentation of a territorial section on the northern frontier, Turton has demonstrated that the population increase within this section was not simply through internal growth. Rather, this section grew largely by the recruitment through marriage of Mursi from territorial sections further south, and from the neighboring Chai ethnic group to the west, who shared linguistic, cultural, and historical ties with the Mursi. In contrast to these recruited allies, the Bodi spoke an unrelated language and had different cultural and historical traditions.

Over the course of this expansion, Turton distinguishes between de facto and de jure Mursi occupation of what were formerly Bodi lands. Occurring continually over the course of the expansion, de facto occupation was still a contested social fact to which the Bodi were not necessarily willing to concede. In contrast, de jure occupation was achieved at the end of different stages of expansion through ritual boundary marking activities that restored peaceful relations between the two groups. These rituals were performed by both sides within what was at the cessation of the hostilities recognized as each group's respective territory. Each group's ritual was attended by representatives of the other side to acknowledge not only the establishment of peace, but also the new arrangement of territorial possession and associated boundaries. Each successive Mursi boundary-marking ritual was conducted in what had previously been Bodi territory.

Outbreaks of hostilities were often triggered by adverse environmental conditions, including drought, flood, or livestock disease, and led to Bodi dispossession and Mursi de facto occupation. The timing of the formalization of de jure occupation was unrelated to environmental conditions but rather was linked to the periodic age set initiations of Mursi territorial sections. This association allowed the initiated age set of unmarried men seeking social renown to be recognized for their contributions to the achievement of the de jure occupation.

This Mursi example demonstrates that intergroup conflict and competition for resources like land need to be situated in both their historical and cultural contexts. Conflict with the Bodi was punctuated and gradually led to Mursi expansion. While environmental disturbances could trigger specific outbursts of violence and Mursi dispossession of Bodi lands, what was most important was the conversion of these contested lands into exclusive Mursi holdings through boundary marking rituals conducted jointly with the Bodi and timed to coincide with Mursi age set initiations.

In the previous chapter on social responses to environmental disturbances, it was also described how local leaders among the Pokot sought to avoid inter-ethnic conflict during periods of resource scarcity because it disrupted social and exchange networks across ethnic boundaries (Bollig 1993). These exchange relations were often based on stock partnerships in which partners from different regions, and often from different ethnic groups, exchanged livestock that were not owned by the recipient of the transfer but rather was taken under his care and raised for the partner's benefit. These partnerships allowed a livestock owner to spread segments of his herds across different areas to diversify risk of loss from drought, disease, wildlife, and theft. Thus, local leaders sought to preserve the social and physical capital that was invested in and created by these exchange networks, and preserve the ability to activate obligations within these networks during times of crisis.

In contrast, escalation of intergroup conflict was sought by other segments of Pokot society, namely younger men in search of economic advancement and social renown through livestock raiding. These younger men without investments in exchange relations of stock partnerships wanted to create their own social and physical capital by building herds through theft and earning the esteemed reputation of a warrior. It was through such activities that the older local leaders had initially created their own wealth and social position. While livestock raids of the young men brought them benefits in the form of wealth and status, they had the potential to disrupt the relationships older leaders had worked hard to establish. Disruptions created by conflict endangered the ability of leaders to use such relations to provide supplementary resources during environmental disturbances, or potentially provide avenues for migration, as was described previously for the Gabbra and Rendille (Schlee 1989).

This Pokot example illustrates how motivations for cooperation and competition in intergroup relations vary within a community in relation to the individual's social status and perceptions of individual benefits. As a group action, the decision to choose to follow a path of cooperation or competition must be negotiated among various interests within the group, some of which may potentially be in conflict. In the following section, examples from Papua New Guinea will be used to further explore what motivates intergroup conflict, the relationships between intergroup conflict and exchange, and how conflicts over resources or territorial control must be understood within their historic contexts.

INTERGROUP CONFLICT IN PAPUA NEW GUINEA

The indigenous cultures of Papua New Guinea have provided anthropologists with considerable grist to theorize upon the origins, effects, and cultural meanings of intergroup conflict (Brandt 2002, 2006; Knauft 1990; Stewart and Strathern 2002). Ecological interpretations have suggested that intergroup conflict in Papua New Guinea emerged as a response to land shortages created by population growth (Rappoport 1968; Vayda 1967, 1971). Using data from 26 Papuan cultures, Sillitoe (1977) examined the relationship between population density and the likelihood that conflict occurred to achieve territorial gains. Sillitoe demonstrated that population density varied and land shortages were infrequent within his sample, yet intergroup conflict was a constant and often was motivated by reasons other than winning territory. He thus concluded that there was little direct relationship between intergroup conflict and competition for land.

However, Ember (1982) re-examined Sillitoe's data and demonstrated that there was, in fact, a statistically significant relationship between the conflict and competition for land, and that, as population density increased, the occurrence of intergroup conflict to gain territory increased. While Ember's analysis may put Sillitoe's final conclusions in doubt, Sillitoe made another important observation, suggesting that there is no straightforward relationship between population density and land shortages. Varied environmental and ecological settings, as well as differences in agricultural technologies, create different contexts for the cultural construction and perception of both density of populations and shortages of land (Sillitoe 1977:74-75). Further, all perceptions of shortage and need are culturally constructed and not constant across different societies. In fact, shortages and need may be created as much by social networks of production and distribution as by limitations on ecological capacity.

As an illustration, Sillitoe (1977:75) discusses salt springs in the Enga area (see also Meggitt 1958). These springs are valuable resources that are not equally distributed across the landscape, and groups having one within their territory are able to produce salt for exchange. The springs are sometimes targets of seizure by groups lacking such resources, but the motivation of such actions is not simply to gain access to a limited resource; other social factors are often more important. Those seeking to capture and control a salt spring may be motivated by the ambitions of a big man to improve his position within regional exchange networks, or they may be dissatisfied with the arrangements and social relations within the exchange network that provides them access to salt.

The remainder of this section will further examine intergroup conflict among the Enga for three reasons. First, Meggitt (1977) has contended that competition for land was the primary reason for intergroup conflict among the Enga. Second, he and other researchers (Wiessner and Tumu 1998) have also shown how intergroup conflict was closely connected to the dynamics of intergroup exchange. And third, Wiessner and Tumu have reconstructed the history of Enga growth and migration over multiple generations, and this diachronic view reveals the development of the cultural-ecological contexts under which competition for land emerged and how it played out in the development of elaborate military alliances and exchange networks (Wiessner 2002, 2006; Wiessner and Tumu 1998).

Meggitt collected data on 71 intergroup conflicts that he interpreted to have occurred between ca. 1900 and 1950 and on another 60 that occurred between 1961 and 1973. Of the earlier set of conflicts, accounts indicated that a majority (58%) were fought for the aggressor to gain land. Other motivations included other property disputes (24%), particularly over pigs and other valuable items involved in ceremonial gift exchanges, or revenge for the homicide (16%) or sexual assault (3%) of a group member. The groups involved in these conflicts encompassed different levels of social distance and included subclans of the same clan, clans of the same tribe, and clans of different tribes. Regardless of the motivations, conflicts were more likely to occur between the more socially distant clans of different tribes than between the more closely related groups; 62% of the documented conflicts occurred between clans of different tribes, 28% between clans of the same tribe, and 10% between subclans of the same clan (Meggitt 1977:13).

Different tactics and goals were employed depending on the social distance between the antagonist groups. When fighting occurred between related clans, attacks were limited to the daytime, some warning was given, non-combatants were not targeted, property like houses and crops were not destroyed, and combatants that were killed were not mutilated. In contrast, when fighting occurred between unrelated clans, surprise nocturnal raids were favored, non-combatants were considered legitimate targets, houses and crops were destroyed, and enemy victims were mutilated if possible. Post-mortem mutilation marked social distance between groups; it was performed as an insult to the kin group of the deceased and sometimes as a provocative signal to formally indicate the rupture of social relations. Bows and arrows and throwing spears were used to engage the enemy at a distance, and stone axes were used in hand-to-hand combat. Most of the stone blades of these axes were manufactured outside of the region and obtained through exchange. Such axes were not just weapons, but important symbols of male status that were often ritually presented or exchanged during ceremonies.

Enga men strove to achieve the honor of being called a "man-killer" or "constant-striker," but these sobriquets were achieved statuses, not formally institutionalized social roles. Similarly, leadership in intergroup conflict as a "belly-stirrer" was assumed on an ad hoc basis and achieved through demonstrable qualities of bravery, self-confidence, and oration. Enga leadership positions were achieved through the abilities and accomplishments of the individual and were not permanent; leaders lost influence if their abilities faded in light of more charismatic and successful contenders. Leadership of clans and tribes was held by big men, kamongo, whose social importance and power came through their management of exchange relations and intergroup diplomacy. While not directly leaders in the arena of intergroup conflict, kamongo played vital roles in the financing of war reparations that were paid to allies and enemies with whom peace was to be established.

Meggitt studied the outcomes of land conflicts in order to assess the success of conflict in securing land as the result of conflict. In most cases, the aggressor succeeded in the acquisition of new lands: 18% of the documented conflicts resulted in the complete eviction of the losers from the contested lands and 56% resulted in the aggressor gaining some lands (Meggitt 1977:14). Success was not universal, though; as 26% of conflicts resulted in a stalemate with no changes in boundaries between the groups. However, the high rate of success documented would likely encourage those who sought to use force to obtain new lands, because nearly three out of four attempts resulted in territorial gains.

During the 1950s, Australian colonial authorities largely suppressed intergroup conflict among the Enga, but Meggitt observed that there was a subsequent increase in conflict during the 1960s and early 1970s. Several factors may have contributed to the resurgence of conflict, but Meggitt emphasized population growth that had resulted from the suppression of conflict and improved access to modern medicine as creating shortages in agricultural land. At the same time, however, increased cultivation of cash crops and the introduction of cattle had created new pressures on the land base, perhaps contributing more to perceived land shortages and disputes over use rights than population growth. During this later period, 73% of conflicts were fought over land (Meggitt 1977:178), a significant increase from the earlier period. There were also changes in the social distance between antagonists, as later conflicts more frequently pitted closely related clans against one another. During the earlier period, only 38% of conflicts were between clans of the same tribe or between subclans of the same clan; during the later period, intraclan and intratribal conflict increased to the point where 50% of conflicts were between closely related clans (Meggitt 1977:179).

While Meggitt emphasized that the units of competition among the Enga were kin groups, this does not mean that antagonists in conflicts were unrelated. In fact, Meggitt was told by his consultants that "we marry the people we fight" (Meggitt 1977:42). Conflicts inevitably arose between neighboring clans whose lands abutted on one another, creating a context for disputed claims over use rights. These neighboring clans were also, however, groups that frequently intermarried, creating affinal ties between them. In a sample of 331 recorded marriages, Meggitt found that 53% were between neighboring clans (Meggitt 1977:42), groups that were likely to be involved in disputes over land claims along their boundaries. These cross-cutting kinship ties did not necessarily decrease conflict. In fact, they often had the potential of creating new contexts for disputes that might lead to conflict, particularly the perceived failure of one party to fulfill bride price payments or complete ceremonial gift exchanges in a timely or sufficiently generous manner.

The dimensions of conflict developed by Solometo (2001) that Meggitt's analysis most directly speaks to are the tactics and goals employed, the social distances between antagonists, and the social scale of conflict. The social distance between antagonists and the tactics and goals employed are directly related. Restrictions on tactics and goals lessened as social distance increased, resulting in the application of greater violence and destruction, including post-mortem mutilation of defeated enemies that was used both to signal and reinforce social distance between antagonists. The social scale of the conflict was also related to social distance and the tactics and goals employed. The web of clan, phratry, and affinal ties that defined the relationships between involved parties could be narrow or expansive, creating feelings of social distance that either restrained violent tactics or encouraged their use. The increasing social scale of alliances also created additional potential contexts for disputes that might rise to open conflict.

Meggitt's analysis of pre- and post-colonial contexts of conflict demonstrates the need for a diachronic rather than a synchronic view of intergroup conflict. More recent research by Wiessner and Tumu (1998; Wiessner 2002, 2006) has provided additional time depth and nuance to the history of intergroup conflict in the Enga region. Their findings have led them to reassess some of Meggitt's assumptions and conclusions. In the course of recording the oral histories of the migrations of different Enga clans and tribes, Wiessner and Tumu collected data on 153 different episodes of intergroup conflict. Not only is this data set larger than Meggitt's, it was gathered from a wider range of sources and has greater time depth and more accurate assessments of when certain events occurred. Wiessner and Tumu chronologically arranged recorded events into periods defined by the number of generations before the present. Analysis of the data show that the motivations that inspired conflict changed over time.

During the earliest recorded period, from the founding generation when the cultivation of sweet potatoes was introduced ca. 250 to 400 years ago to the eighth generation before the present, disputes over agricultural land played no role in triggering conflicts. Most intergroup conflicts resulted from disputes over possessions or sharing of work (45%) or disputes over hunting, trapping, or the sharing of meat (39%). Disputes over homicides, women, pigs, and fruit trees initiated the remaining conflicts (16%). The prevalence of conflict over hunting suggests that even when the density of Enga populations was low and agricultural lands were plentiful, there was a desire to maintain exclusive access to undeveloped areas for hunting, and conflict was used as a means of affirming and defending boundaries.

During the seventh through fourth generations before the present, disputes over hunting, trapping, meat sharing, possessions, and work sharing continued to result in conflicts, but their frequency of occurrence decreased in relation to other causes like homicides and disputes over agricultural land, which became a significant source of conflict. Disputes over land accounted for 10% of intergroup conflicts during the period six to seven generations before the present, and this figure nearly tripled to 28% during the period four to five generations before present. As the frequency of land disputes leading to conflicts rose, however, the number of defeated clans that were wholly expelled from their lands declined rather than increased. Further, the average distance that migrating defeated clans moved decreased. As open areas for potential displaced migrants filled up, the ability for conflicts to end by one group migrating became limited. New options were needed that would allow the losers to remain on their land while re-establishing peaceful relations between groups that were formerly in conflict.

The Enga created a solution to this problem by extending the range of recipients of war reparations. These payments of food and valuables had formerly only been given to allies and relatives in compensation for group members lost in a conflict. During the fifth and fourth generations before the present the payment of war reparations came to be extended to defeated enemies, as well, to re-establish peaceful relations. As new lands were not acquired, these could not be used to reward allies, who now had to be compensated with pigs and other valuables. These changing contexts for compensating both allies and enemies created new economic pressures on agricultural production, particularly of pigs and pig fodder, and on the acquisition of valuables through extra-regional exchange. The existing Tee cycle of ceremonial exchange that had originally developed to facilitate the accumulation and distribution of bridewealth payments was tapped into to finance war reparation payments.

Over the past two to three generations before the present, disputes over agricultural land became the most frequent cause of intergroup conflict, instigating 58% of all conflicts during this period. Defeated groups could no longer migrate as large units to establish independent communities because large tracts of unoccupied land were no longer available. In cases of total defeat, the surviving segments of vanquished clans dispersed to different destinations, seeking refuge among various relatives and allies and ceasing to operate as an integrated social unit.

While these data are in accord with Meggitt's data and his interpretation that conflict over land increased over time, Wiessner and Tumu dispute Meggitt's assertion that increasing population and resulting land shortages caused these disputes. They argue instead that it was labor to work agricultural land that was in short supply rather the land itself. During early periods, more land was acquired after expelling the defeated enemy than could be occupied by the victor, let alone be put into agricultural production given the limitations on labor availability. These newly acquired lands were often given to allies or relatives as rewards for their support and participation in the conflict. Wiessner and Tumu suggest that the displacement of neighboring groups was often motivated by a desire to expel quarrelsome neighboring groups and replace them with more friendly allies and relatives.

Implicit in Meggitt's argument is that an imbalance of power existed between larger clans needing land and their smaller neighbors who could be dispossessed of their holdings. Sociobiological interpretations of conflict have proposed that such imbalances of power facilitate the predatory acquisition of resources through dominance of larger and stronger groups (Manson and Wrangham 1991). In contrast, Wiessner (2006) argues that rather than exploiting imbalances of power to seize resources, intergroup conflict in nonstate societies seeks to re-establish balances of power between groups. Conflicts between groups often result from and cause insult or injury requiring revenge to re-establish balance between the groups. In addition to retaliating for past injuries and/or insults, acts of revenge deter future aggressive actions and affirm a group's reputation and its capacity to hold territory. Establishing balance and equality between groups is essential for the creation of reciprocal bonds of trust that allow exchange to flow. Contrary to Meggitt's assertion that land was the object of conflict, often the wanted resources were ones that could not be taken through force, like exchange relationships, and could only be accessed through the re-establishment of balance between groups.

If imbalances of power and need for land drove conflict, then, Wiessner argues, over time it should be expected that more-effective tactics or institutions for engaging in conflict would develop, but this was not the case. The Enga do not have warrior societies or other formal institutions for organizing and directing the conduct of conflict. Bachelor cults instilled cultural values, created integrated and loyal age cohorts, and subjected young men to the moral direction and molding of their elders, but they were not used to plan, direct, or train young men for conflict. Rather than developing institutions that would increase the effectiveness of conflict to seize land, the Enga developed more-elaborate institutional means to contain conflict and re-establish the peaceful balance of power needed for exchange to move between groups. The Great Ceremonial Wars that emerged among the central Enga in the fifth and sixth generations before present characterize such developments.

While conventional conflicts often erupted spontaneously from simmering social tensions, Great Ceremonial Wars were carefully arranged and choreographed episodes in which the exchanges made among allies on both sides were the ultimate goal, not the death or expulsion of enemies. Conventional conflicts usually involved individual competing clans, each with a small set of allies. In contrast, participation in a Great Ceremonial War unified all of the clans in a tribe and their allies in other tribes. The principal opposing groups in a Great War were referred to as the "owners of the fight" (Wiessner and Tumu 1998:268), and big men from each owner of the fight worked to organize their allies and coordinate with their opponents through formal challenges or prearranged provocations.

Great Ceremonial Wars were not fought on the common boundaries between the owners of the fight. Rather, each owner of the fight entreated an ally to host the war. As such, no territory was being contested through the conflict. During the course of the war, the hosts provided housing and sustenance for the owners of the fight and the other assembled allies. Deep feelings of camaraderie were engendered by this period of cohabitation, as the assembled warriors lived together in the men's houses of the host's community. The relationship of reciprocity between the hosts and the owners of the fight were sealed through a series of gift exchanges, food prestations, and feasts that occurred before, during, and after the war. The relationships forged on the battlefield, in the men's houses, and through the formal exchanges continued after the war, creating widespread networks of exchange connecting the owners of the fight, the hosts, and all of the participating allies.

The initiation of a Great Ceremonial War was formalized and accompanied by great fanfare as hundreds of warriors in ceremonial costume made displays of strength towards their opponents and before crowds of spectators from both sides. Leaders from the opposing sides met and exchanged embraces, challenges, and weapons. Limitations were placed on the tactics employed, and rules forbade the exercise of violence outside the context of the formal field of battle. There were no attacks upon settlements or destruction of property; non-combatants were not legitimate targets of violence; and warriors who were killed in battle were not mutilated, and their kin were allowed to retrieve their bodies unmolested.

The increasing managerial demands of the Great Ceremonial Wars led to the emergence of a new social role − the watenge, or Great War leader. Great War leaders possessed all the skills and abilities and held all the roles and responsibilities of a big man. They were responsible for making all the arrangements needed for a Great Ceremonial War, including contacting the opposing owners of the fight and potential hosts and allies, organizing and financing gifts and exchanges throughout the war, and negotiating the end of hostilities and re-establishment of peace. Great War leaders also played a role on the battlefield rallying troops and directing their movements. During battle, Great War leaders were targets of the opposing side, but only to capture and humiliate them; killing a Great War leader was not allowed. The role of Great War leader also came to be an inherited rather than achieved role. The sons or nephews of a successful Great War leader were expected to assume the mantle provided they displayed the requisite competence. The fixing of this role within particular families contrasts with ordinary big men, whose status was wholly achieved and not transferable. The preference for the inheritance of the role of Great War leader resulted from the need to have mastery of an extensive network of exchange relations which could be facilitated by and built upon family connections.

The Great Ceremonial Wars provided all of the benefits of intergroup conflict while limiting or preventing many negative consequences. Great Ceremonial Wars reinforced group solidarity, provided a means of male status achievement, and established the contexts for extending exchange relations, while limiting deaths and preventing the destruction of property and loss of land. While the Great Ceremonial Wars involved an increase in the social scale of intergroup conflict among the Enga, they did not mark an increase in the intensity of conflict, because rules limited the exercise of violence, preventing the loss of land and destruction of property, as well as reducing casualties. The Great Ceremonial Wars developed as a means of conflict management through mediated, rule-bound competition.

The Enga provide many insights into the relationships that intergroup conflict has with competition for land and with exchange. Meggitt has argued that the Enga primarily fought to secure access to land, and that conflict over land increased through time, fueled by a growing population and imbalances of power. Alternatively, Wiessner and Tumu argue that agricultural lands have never been in short supply, and that labor is the limited resource. While conflicts were fought over land and could lead to the expulsion of the defeated group from their lands, these newly opened lands were usually granted to allies or relatives rather than occupied by the victor. As Enga populations grew, open tracts of land that could be settled by displaced losers filled up, limiting the ability of defeated groups to move away from their antagonists. New social practices developed that allowed defeated groups to remain on their lands and enter into reciprocal exchange with the victor to re-establish peace. In intractable cases, however, the defeated were forced out, and the lack of areas for them to settle as a group led to their fragmentation and absorption into other groups.

Wiessner argues that rather than imbalances of power leading to conflict, with larger, land-hungry clans preying upon their smaller neighbors in order to seize their land, conflict was initiated to create balance between groups and allow the establishment of exchange relations between equals. The development of the Great Ceremonial Wars exemplifies creation of balance through conflict. These ritualized and mediated conflicts allowed groups and individuals to accrue many of the positive benefits of intergroup conflict while avoiding negative consequences. The goals of Great Ceremonial Wars did not include the displacement and dispossession of vexing neighbors, nor did they include seeking revenge killings or post-mortem mutilation. Rather, the primary goal was the creation and extension of exchange relations among allied groups. The extensive exchange networks realized by the Great Ceremonial Wars created increased management needs and led to the emergence of a new social role that came to be an inherited rather than achieved leadership position.

Weissner and Tumu's analysis of intergroup conflict among the Enga sheds additional light on the role of social scale as a dimension of conflict. The social scale of conflict among the Enga increased dramatically as the Great Ceremonial Wars complex emerged. In conjunction with this increasing social scale of conflict was the development of institutionalized roles related to the management of the needed political alliances and economic exchange networks. Weissner and Tumu's discussion of the limitations created by labor availability on the resettlement of land from which defeated clans had been expelled by the victors and their allies can also be applied to cases where land had been vacated as the result of an environmental disturbance. In the previous chapter, the Orokaiva example highlighted limitations on resettlement of abandoned areas were created by a lack of capital to invest in the re-establishment of agriculture. Limitations on the availability of labor in the aftermath of an environmental disturbance could be as much of an impediment to the resettlement of abandoned areas as lack of planting stocks. In the following example from Paricutín, efforts to resettle areas were sometimes limited by other factors – competition and conflict with other settlers.

INTERGROUP CONFLICT IN THE AFTERMATH OF THE PARICUTÍN ERUPTION

In the previous chapter, the responses of Tarascan Indians affected by the eruption of Paricutín Volcano in Michoacán, Mexico, were shown to include ritual activity, migration, economic diversification, and the transformation of traditional systems of land tenure. Competition and conflict also developed after the eruption, as the transformation of the environment by the eruption exacerbated a pre-existing land dispute between the villages of Paricutín and San Juan Parangaricutiro and created new disputes among established communities and new communities founded by refugees. As farmers from these various communities returned to the affected area seeking potential fields, they found that many landscape features that had been used to define boundaries between the communities had been obliterated or obscured by the effects of the eruption. Reflecting the increasing incorporation of the local Tarascan population into the national economy, disputes were first taken to court, thus submitting to a superordinate authority. Some disputes, however, erupted into violence. Crops and farmsteads were burned; livestock killed; and people intimidated, beaten, or killed.

As refugees from the villages of Paricutín and San Juan Parangaricutiro returned to the affected area, conflicts over land emerged over the locations of pre-eruption boundaries between the two. Conflict also emerged between the village of Zacán and the smaller rancho of Las Palmas, as well as between the villages of Nuevo San Juan Parangaricutiro and Caltzontzin. While the dispute between the former residents of Paricutín and San Juan Parangaricutiro contested boundaries and use rights that had been established by generations of use, the other two disputes pitted either long-term claimants against interlopers, as in the case of Zacán and Las Palmas, or new refugee communities against one another as they sought to establish new use rights and boundaries in relation to each other, as in the case of Nuevo San Juan Parangaricutiro and Caltzontzin.

The village of Zacán was on the edge of the ashfall zone of the volcano and was thus only lightly affected by the eruption. Conflict began after 1946, when refugees from the eruption established the rancho of Las Palmas and encroached on Zacán's traditional lands. The annexation of Las Palmas by Zacán in 1957 created new institutional contexts whereby the civic leaders of Zacán could use the power of the state to quash the dispute and assert the traditional use rights of the villagers over those new use rights claimed by the interlopers.

The most violent confrontations were between the newly established refugee communities of Nuevo San Juan Parangaricutiro and Caltzontzin. In their new locations, each sought to create new use rights to arable lands and establish boundaries between the communities. Competition for arable land led to court battles over this resource in the early 1950s. Failures to achieve desired results in court led some to take matters in their own hands, with the first reported incidences of violence in 1959 and 1960. The conflict escalated, and hired gunmen were brought in to reinforce the combatants on each side. Farmers at isolated ranchos were physically intimidated, beaten, or even killed. Crops were destroyed, livestock killed, and buildings burned. This escalation led to the intervention of the Mexican state in 1967, and the eventual establishment of boundaries sanctioned by the state in 1969.

Disputes even arose within communities. Like Zacán, the village of Zirosto was on the edge of the area affected by the eruption but suffered greater damage to the village and to its agricultural lands. The village men fought among themselves over the limited lands and other resources available. The community fractured over the Mexican government's proposed relocation of the village. The decision of some to emigrate to the government-sponsored community of Zirosto Nuevo led to an irreparable schism that split families and larger kin groups.

The Paricutín eruption provides examples of the processes by which communities came into conflict over arable land in the aftermath of a severe environmental disturbance. In addition to the eruption obscuring landscape features that had been used to define the boundaries between communities, the reformulation of community structure in the aftermath of the eruption also obscured the validity of use rights to lands and led to contested claims. Those affected by the eruption could either remain in their old villages or move to new villages, but there was diversity in choices made by individuals and households within each village. The original villages were often split, as some residents remained and others emigrated. Those that emigrated did not always relocate as a community or reconstitute the structure of the old community in the new location. The social institutions within and relationships between communities that had underwritten the legitimacy of land claims and provided means to validate or contest them without resorting to force were restructured as old villages were transformed and new villages were established. Occasionally, this restructuring involved exercises of force when competing claims were contested.

SUMMARY OF INTERGROUP CONFLICT

This review has shown that intergroup conflict is a complex cultural practice that is embedded in historical developments and infused with cultural values, in addition to being influenced by ecological contexts and environmental conditions. As such, straightforward assertions that episodes of intergroup conflict are caused by environmental disturbances merit more thorough analyses to determine the cultural, historical, and ecological contexts involved. While this review confirms many of the expected relationships between social responses and the different dimensions of conflict identified by Solometo (2001), some expectations require caveats.

The tactics and goals employed do have a clear relationship to the social distance between the antagonists, with greater limitations on the exercise of violence when the competing groups are socially close. Post-mortem mutilation, trophy taking, targeting of noncombatants, destruction of houses and stores, and the use of ambush and surprise nocturnal attacks are only engaged in when the competing groups are socially distant. Some of these acts, especially post-mortem mutilation and trophy taking, are used to signal or establish this distance.

The expectation that increased frequency and predictability of conflict should encourage investments in fortifications and the institutionalization of warrior roles is not always met. Other factors may be important in the interplay between the dimensions of conflict and the responses made. Settlement patterns and their relation to subsistence practices may work to limit investments in fortifications. In the case of the River Yumans, a flexible subsistence strategy that emphasized seasonal mobility to exploit riverine and desert resources worked against the establishment of fortifications in fixed locations. The River Yumans also did not have warrior roles formalized into institutionalized leadership positions. There was a formally recognized title and social status for warriors, kwanami, but a kwanami's power as a leader was limited to the sphere of conflict and was adopted and exercised on an ad hoc basis.

Among the Hopi, there were institutionalized leadership roles associated with warrior status, and these were attached to sodalities. However, the emergence of these institutions and associated leadership roles may not have been in response to the frequency and predictability of conflict. Rather, the origins of these institutions may have been influenced as much by changes in social scale, especially the changing scale of interaction within Hopi society and the needs of internal social control, as by conflict with outside groups. Aggregation into the large villages found historically among the Hopi changed the social scale of conflict both internally, as previously independent kin groups needed to develop cooperative strategies to facilitate peaceful cohabitation, and externally, as this larger political unit defined other political units as competitors and legitimate targets of violence.

The social scale of conflict may have a greater influence on the structure of leadership roles related to management of conflict than the frequency or predictability of conflict. Among the Enga, the increased social scale of conflict that emerged with the Great Ceremonial Wars led to the development of new leadership roles to manage the increasingly large and complex networks of alliance and exchange. The increased demands on production and exchange created by the Great Ceremonial Wars also require consideration of Helbling's (2006) contention that the demands on production generated by the obligations of alliances have the potential to create new contexts of resource scarcity and competition. As Sillitoe (1977) observed, scarcity and need are not constants but rather are culturally constructed based on dynamic ecological and social contexts.

The Enga case also highlights the interdependent nature of conflict and exchange, as exchange was used both to seal alliances and heal social ruptures. In non-state societies, intergroup exchange is often embedded in and mediated through communal ritual. The following chapter examines communal ritual and focuses on two aspects. First, I explore the role played by architectural spaces used in communal rituals in guiding and structuring group relations. Then I seek to elucidate the relationships among communal ritual, exchange, and the mediation of intergroup conflict, especially in the context of environmental disturbances.

CHAPTER 6 – ANTHROPOLOGICAL PERSPECTIVES ON COMMUNAL RITUAL AND ARCHITECTURE

Cooperation among groups in noncentralized societies is often mediated and structured by communal rituals. These communal rituals define community membership and social identity, sanctify the social order, and organize production and consumption (Bell 1992, 1997; Rappaport 1971, 1999). Ritual often plays a crucial role organizing and structuring relationships within and among communities. By creating an inclusive moral community of trusted members, communal rituals are a social nexus for sharing and exchange. Like intergroup conflict, communal ritual as a social practice was a resource that could be manipulated for varied purposes, especially as a resource for the construction and affirmation of social identities. However, communal rituals can also be an arena for competitive distinction within and among communities (Potter 1997; Rosman and Rubel 1971).

Communal rituals are often performed within specific architectural spaces that may be exclusively dedicated to ritual use. Architecture is a particularly concrete "structuring structure" (Bourdieu 1977:72) that guides the generation and reproduction of social practices and representations through its physical construction of space and the way this constructed space organizes and constrains the activities pursued within and around it (Rapoport 1982, 1990). Architecture is often imbued with meaning, providing models of the structure of the cosmos or the social order. Communal ritual architecture provides a physical context for the expression and affirmation of group membership and provides an avenue to understand the integration of households into larger communities (Adler and Wilshusen 1990).

In this chapter, I provide a context for the interpretation of ballcourts and great kivas in the Flagstaff region. First, I provide greater elaboration about communal ritual and architecture as structuring structures. In this context, I then present data on and interpretations of the architectural forms, cultural meanings, and social roles of Mesoamerican ballcourts and Hopi kivas. Several theorists have proposed that rituals provide a means of transmitting vital cultural information (Rappaport 1971, 1999; Turner 1969), especially information about responses to low-frequency environmental disturbances (Halstead and O'Shea 1989). Two examples of the encoding of critical information about environmental conditions in Hopi rituals are presented and analyzed. In addition to encoding information about the potential effects of low-frequency events, ritual practices may embed mechanisms needed to prepare for and contend with the impacts of such events. Rituals provide an important context for food sharing, which can be an essential mechanism for buffering variability in production on an annual and interannual basis, as well as in the face of environmental disturbances. I explore the relationship between communal ritual and food sharing using the Hopi as an example of how robust mechanisms for institutionalized food sharing can be embedded in a ritual system.

COMMUNAL RITUAL AND ARCHITECTURE

Ritual refers to a conventionalized or formulaic set of practices performed with the intention of achieving a desired effect (Rappaport 1999:24-26). Rituals may be enacted at different social scales, they may be performed by individuals and not witnessed by other people, or they may be performed by large groups. For example, Hopi ritual practices may be done by individuals or large congregations. As an individual, a traditional Hopi would greet the rising sun each day with an offering of corn meal and a formulaic prayer thanking Tawa, the sun deity, for his life-giving gifts of light and heat and requesting continuance of his beneficence. This offering is done without any witnesses other than Tawa, the object of the devotion. Throughout the year, this same individual will participate in numerous communal rituals tied to agricultural and celestial cycles as either an audience member or a performer. These rituals engage the whole community in a common purpose, creating and maintaining cooperative social bonds. Offerings are choreographed performances of multiple individuals and are witnessed by the entire community as well as by the ancestors and supernaturals to whom the offerings are made. Such communal rituals serve political functions by creating a context for the definition of community membership and the establishment and affirmation of social identities (Bell 1992, 1997; Rappaport 1971, 1999). As such, rituals and the architectural units that may host their performances, are "structuring structures" (Bourdieu 1977:72). In practice theory, "structures" are objective and external rules and resources that dialectically interact with social practices through the everyday actions of individual agents. "Structuring structures" are those structures that act to generate and reproduce social practices and representations, like systems of kinship terms that define networks of consanguinal and affinal relationships or ritual activities that define cosmological and social relationships.

Communal rituals provide supernatural sanction for the social and political order, reinforcing established social roles and statuses. Combined with their role in defining group membership and creating identity, communal rituals are a resource that may be manipulated to consolidate social and political power. Robert Netting (1972) has examined the role communal ritual may play in the centralization of political power, especially through internal and voluntary means. He suggests that, because belief systems are often expressed in shared symbols and cosmology that transcend local group and kin divisions, leaders who can manipulate these beliefs can also transcend these divisions. Population pressures on circumscribed resources often encourage the organization of leadership around the control of communal rituals focused on renewal or fertility, sanctified mediation, and peaceful inter-regional exchange.

Communal rituals are often held in specialized architectural spaces, and architecture is a particularly concrete form of structuring structure that guides and constrains the activities conducted within and around the spaces defined through its construction. Amos Rapoport (1982, 1990) has argued that architecture creates a built environment that not only organizes space, but imposes order on time, meaning, and communication as well. Through physical cues, architecture communicates various social meanings and appropriate behavioral responses to those that interact with it. The built environment does not simply define individual spaces in isolation; rather, architecture defines a system of spaces that are linked through systems of activity. Rapoport also argues that the built environment consists not only of the fixed features typically considered in architectural analyses, the walls, floor, ceiling, doors, windows, etc. of an architectural unit, but also includes semifixed and nonfixed features that are essential components of the communicative role of the built environment. Semifixed features include furnishings and decorations that can be moved or changed, altering the system of space and providing different communicative cues for social behavior. Nonfixed features refers to people and their activities, and in the context of the use of communal ritual architecture, the actions of other users provide important social cues and imbue the space with meaning. Following Rapoport's insights, Hegmon (1989) argues that architecture spatially and symbolically reinforces processes of social and cultural integration through interaction between structures and users.

Michael Adler (1989; Adler and Wilshusen 1990) has conducted a cross-cultural comparison of communal ritual architecture using a worldwide sample. On the basis of this sample, he distinguishes between low-level and high-level integrative facilities as determined by the level of community integration they provide. Low-level facilities integrate only a specified subset of the community, while high-level facilities integrate the whole community or even multiple communities. This distinction also structures other activities; Adler found that low-level facilities were more likely to have a wider range of activities undertaken within them in addition to ritual. These other activities include cooking, socializing, sleeping, and craft production. High-level integrative facilities were more likely to only have a specialized role related to the performance of rituals, with other nonritual activities excluded. In addition to restrictions on use, many specialized ritual structures also have restrictions on access, with rights to enter the structure limited to individuals of specific social roles or statuses.

Architecture may construct a model of the cosmos or the social order. Bourdieu (1977:89-92) demonstrates how the structure of Kabyle houses and villages in North

Africa expresses a set of symbolic oppositions and hierarchies that order social divisions based on the segregated roles of men and women. These meanings encoded in the space come to be embodied by actors through their physical interactions with the spaces. Similarly, Navajo hogans are divided into male and female zones of activity that define the complementary sexual division of labor. These zones guide and constrain the activities of the hogan's inhabitants and structure interactions with guests. Further, Navajo hogans provide a model of the cosmos, as they are constructed according the plan of the first hogan built by First Man in the first world and encoded in songs of the Blessingway, with each of the four primary support posts seen as symbolizing one of the four sacred mountains that define the boundaries of Navajo lands (Jett and Spencer 1981; Kluckhohn and Leighton 1946; Wyman 1970). While these examples are both of residential structures, communal ritual architecture is also often constructed following similar principles. Adler and Wilshusen (1990:137) suggest that high-level integrative facilities with specialized ritual use are typically built as the physical expression of the cosmological order. As will be detailed below, ballcourts and kivas also define a model of the cosmos, being points of communication with and access to the underworld.

Specialized ritual structures are typically built through the contributed efforts of the entire community. In some cases, the construction of communal ritual architecture can provide a referential model of social relations and economic rights within a community. Among the Wegeva of Melanesia, the contribution of labor and materials to the construction of communal ritual architecture in the village provided a right to use certain village lands and was used as a physical marker and reminder of those rights (Hogbin

1939). All Wegeva villages were centered on a niabwa, or communal men's house, which was used for men's ceremonial activities, for the storage of sacred objects, and as a residence for bachelors. The niabwa was like an ordinary house, but larger and more carefully constructed. During construction, the contribution and placement of a rafter beam by man from the village secured rights for that man to specific agricultural plots. The arrangement of rafters provided a map, so to speak, of the village's lands and who had the rights to use them. In discussions, the rafters would be referred to as a form of title by the land owner, whether they be the original man who placed the rafter or his son or other heir, to the use rights of that land.

Communal ritual architecture has great potential as a type of structuring structure to create and recreate the social and cosmological order and to naturalize the constitution of that order to participants through ritual practice. The remainder of this section will present perspectives on how communal ritual architecture in the U.S. Southwest, particularly kivas and ballcourts, acted as structuring structures.

COMMUNAL RITUAL ARCHITECTURE IN THE U.S. SOUTHWEST

The importance of communal rites of intensification that were focused on weather control and fertility among the indigenous peoples of the U.S. Southwest has long been noted by ethnologists (Underhill 1948). Among Puebloan groups, communal rituals are performed in the village plazas and in the kivas contained within the plazas. Archaeologists have seen the emergence and use of communal ritual architecture like plazas and kivas in the U.S. Southwest as either being enabled by favorable and productive climate conditions that provided surplus food to finance communal rituals

(Vivian et al. 2006), or as responding to crises created by climate change, migration, and population aggregation (Adams 1991).

My research is concerned with the ballcourts and great kivas in the Flagstaff region and the potential associations their construction and use may have with environmental periods that were favorable to agriculture. Before trying to interpret the relationships between communal ritual architecture and environmental conditions, more fundamental understanding must be developed of the architectural forms and cultural meanings of ballcourts and great kivas.

The ballcourts of the U.S Southwest were only used prehistorically. Thus, the best evidence about the use and meaning of ballcourts is from Mesoamerican data drawn from codices, mythologies, and ethnologies. Like the ballcourts, great kivas are an archaeological phenomenon. While not as large as the prehistoric great kivas, the kivas of contemporary Puebloan groups still provide insights into the cosmological associations of the architectural form, the means by which kiva architecture guides and structures social interactions, and the roles played by kivas in the formation and maintenance of group identity. Data on Hopi kiva use is presented to illustrate these points.

Ballcourts

Ritualized games and sports can provide contexts for mediated competition between groups that allow the release of tensions while limiting the escalation of violence (Cornell and Allen 1997). Various ritual ballgames were played throughout the Americas, and the most widespread variants used a solid rubber ball and were usually played within a formally constructed ballcourt. The ballgame originated in Mesoamerica, and then spread to northern parts of South America, the Caribbean, Northwest Mexico, and the U.S. Southwest (Stern 1949).

In Mesoamerican cosmologies and mythologies, the ballcourt is seen as a portal to the underworld, providing access to the ancestors and the gods of the underworld, and serving as a nexus for creation (Miller 2001; Schele and Freidel 1991; Schele and Miller 1986; van Bussel 1991). For example, in the Quiché Maya creation myth, the Popol Vuh, an episode centered on the ballgame leads the Hero Twins to defeat the gods of the underworld, allowing them to resurrect their father, who is reborn on the earth-surface world as the Young Maize God. In doing so, they create a balance between life and death, and bring agriculture to humans (Freidel et al. 1993:345-350; Tedlock 1985:91-142).

Ballcourts are polysemic and multivalent, having many different levels of meaning and an ability to interact with many spheres of social activity. In addition to being a portal to the underworld used to access the ancestors and the powers of creation, the ballcourt has many other meanings, including dualism, balanced complementarity, and the separation of a whole into parts. Such concepts associate the ballcourt with not just the dualistic upperworld/underworld relationship, but also with other dualisms like day/night, sun/moon, and light/dark, as well as with the periodicity of seasonal and celestial cycles. Ballcourts also extend the concepts of complementarity and the separation of a whole into parts into the social sphere by mediating and marking divisions between and within various social segments − polities, villages, clans, moieties, sodalities, and social classes. Ballcourts were used to both celebrate victories in war and to restore peaceful relations and seal alliances after conflicts (Fox 1996; Gillespie 1991; Guttierez 1990; Uriarte 2001).

Ballcourts created a context for peaceful exchange relations to connect social groups. Whether winners or losers of particular matches, those groups that participated in ballgames were brought into a balanced relationship that was sanctioned by the supernatural. This relationship produced an inclusive community of members sharing the same moral values who could be trusted to reciprocate exchanges. Within the context of ballgames, several modes of exchange could potentially occur, with gifting between members of opposing sides and the hosting of feasts for the opponents as the most prominent reciprocal exchanges (Day 2001; Fox 1996). The scheduled and predictable time and place of ballgames provided opportunities for the trade and barter of craft goods, agricultural produce, and raw materials in adjacent markets (Hill and Clark 2001).

Wagering was also a significant mechanism of exchange; and as a form of negative reciprocity, it could be used to create social debts and obligations in addition to material transfers. Hill and Clark (2001) argue that ballcourts provided several avenues for the consolidation of social power and the emergence of social ranking, and one of these is gambling and the ability use it to accrue social debts and obligations. In addition to consolidating social power through gambling, individuals could achieve status and distinction either through playing the game or by sponsoring the construction and use of ballcourts. On a group level, these organized competitions created a nexus for the formation and reinforcement of community identity, which could come to be embodied by those who were outstanding players or who played central roles as the sponsors of facilities and activities.

Throughout most of Mesoamerica, prehistoric ballcourts were elaborately constructed features with fine masonry and associated bas relief sculptures that depicted sacred and historic themes. The basic form of a ballcourt has two parallel platforms that defined the playing field and provided elevated surfaces from which the assembled audience could view the game. The open ends were the goals and often were enclosed by additional platforms that formed a backstop. The playing field was marked with a central stone set flush with the playing surface that divided the court into two sides. Similar end markers were set to mark the goal lines (Taladoire 2001).

As such, the ballcourt structures the interactions of participants. The players and the audience are separated and occupy distinctive zones, with the players on the floor of the ballcourt and the audience on the platforms on either side of the playing field. The players have symbolically entered the underworld, with the audience viewing their actions from the upperworld. The center marker divides the playing field and separates the two teams of players. The audience is also physically separated on the platforms on either side of the playing field. As such, the ballgame marks two sides as engaged in mediated competition, but the architectural form also marks them as balanced and equal. Because ballcourts define a sacred space, an axis mundi that connects the upper and lower dimensions of the cosmos, they structure the interactions not only between the living participants, but also among the living, the dead, and the supernatural. While such interaction may not seem tangible, the control of access to ancestors and the supernatural may provide a means of consolidating social power (Helms 1998).

In the U.S. Southwest, including the study area, ballcourts were less elaborate in their methods of construction and finishing, consisting of parallel earthen berms that curved inward towards each other at both ends. The berms and the playing surface they enclosed were plastered with a thick clay surface. Center and end markers placed like those found in Mesoamerican courts were also present but were not decorated with carvings like their Mesoamerican counterparts (Wilcox and Sternberg 1983). While less elaborate in their construction methods and materials, the ballcourts of the U.S. Southwest were no less monumental in scale when placed in the context of the size of the communities that built and used them. Their architectural form also marked the same distinctions between the players and the audience, between the two teams of players, and between the two sides of the audience. Ballcourts in the U.S. Southwest may also have been associated with markets that facilitated productive specialization and regional exchange (Abbott et al. 2007).

Ballcourts were symbolic portals to the underworld that provided access to ancestral spirits, deities, and both supernatural and (possibly) social power. They mediated and marked boundaries between groups at different levels. The architectural form marked the separate identities of the competing sides, both among the players and the spectators. While this competitive distinction was marked, use of the ballcourt also indicated that the competition was mediated and that the two sides were engaged in a balanced and complementary relationship. Ballcourts were used to both celebrate war and restore peace, and they created contexts for several modes of exchange at different social scales. Reciprocal gifting and feasting established and reinforced relationships between leaders and high-status individuals of the opposing social groups. Trade, barter, and market exchanges were facilitated by the predictable timing and locations of ballgames, as well as by the balanced relationship of peace and trust they established between communities. Finally, ballcourts also provided several potential avenues to social power: the creation of social debts and obligations through gambling; the achievement of status and distinction as a player; the sponsorship of ballcourt construction and use; influence over community identity and sentiment; and the control of access to ancestors, deities, and supernatural power.

Hopi Kivas

Kiva is a Hopi word describing a subterranean or semi-subterranean building (Hill et al. 1998). The term has come to be applied to similar structures built and used by all Puebloan groups in the U.S. Southwest, as well as to analogous archaeological features found in the northern Southwest (Lekson 1988; Smith 1952a:154-165). Kiva use was similar across the Puebloan Southwest, and the Hopi will be used as an example to illustrate three points about kivas and their uses. First, that they were multi-purpose structures primarily used for ritual activities. Second, their architectural form created sanctified space that structured and guided social interactions during rituals. Third, how kivas helped create and maintain the densely interwoven social fabric of Hopi communities. The following discussion is largely synthesized from data presented by Alexander Stephen (1936), Mischa Titiev (1944), and Peter Whiteley (1988, 2008).

Among the Hopi, kivas were built, maintained, and used by the various ritual sodalities in each village. Kivas would most often be referred to by the name of the sodality that "owned" it (although kivas may be shared by different sodalities); however, they could also be referred to by the name of the clan that sponsored the most recent renovation of the structure. Kivas were multipurpose structures used for the private ritual activities of the owning sodality; to host public ritual activities during the spring katsina dance season; and as a place for sodality members to socialize, sleep, and work on craft production.

The primary purpose of kivas was for use as an exclusive location for certain sodality ritual activities, especially private initiation rites. All ceremonies had public and private rites. The private rites were performed in the controlling sodality's kiva and were attended only by sodality members. During the warmer months of the summer and fall, public rites were performed outside in the village plaza. During the colder months of the winter and spring, public rites were performed in all of the kivas of the village, with the performers rotating among the various kivas and repeating elements of the performance for the different segments of the village assembled within each kiva.

In addition to these ritual purposes, kivas were also a private place for sodality members to gather. Here they could socialize about village life, plan ritual activities, and share the sodality's lore, creating a sense of shared identity and reinforcing group camaraderie. For the male sodalities, the kivas also provided a location for members to sleep. In a matrilineal and matrilocal society like Hopi, postpubescent unmarried men existed in a liminal state between their natal household and their future status as a married man in the household of their wife's mother. Married men can also be seen as being in a liminal state, never fully integrated into the household of their wife (and her mothers and sisters) and still responsible for ritual and economic activities organized by their matrilineal kin. A man could retreat to one of several kivas to which he had access through sodality memberships and there commiserate with fellow sodality members about the pressures of living with his in-laws if married, or if younger and unmarried, problems with efforts to court a particular maana, a marriage-eligible young woman. In kivas, social ties between men of different kin groups were forged and strengthened.

Kivas were also a locus for craft production, particularly of objects needed for the ritual activities of the sodality. Weaving of the garments worn by sodality members during ritual performances was done in kivas as was the manufacture of masks and other ritual paraphernalia. The range of materials used in craft production included textiles, leather, feathers, wood and other plant materials, pigments for painting and dying, stone and shell for lapidary work, bone, antler, horn, and turtle shell. Raw materials, tools, and finished craft goods were stored in the kivas.

The architectural form of Hopi kivas created an idealized sacred space for ritual activities that structured and guided the interactions among participants in these rituals. Kivas in historic and modern Hopi villages are rectangular subterranean structures built into the plazas of villages. Inside, kivas have a raised platform at one end, benches around the other three sides, and a sunken central floor. Entry is gained via a hatchway in the roof and a ladder. A ventilator shaft enters under the platform to provide fresh air, while smoke exits through the entry hatch. Within the floor is a hearth protected from the ventilator shaft's airflow by a deflector, an associated ashpit, and a small hole used for making offerings called a sipapu. The sipapu was no mere hole in the floor, but was a point of communication with the underworld and its inhabitants, the ancestral spirits, the katsinam, and other deities. The Hopi were dependent upon these denizens of the underworld for rain, fertility, health, and prosperity, and had entered into a reciprocal arrangement where the living and the dead performed complementary and mutually beneficial rituals that were mediated by the katsinam (Wright 1986). Corn pollen, corn meal, and hard goods like shell, turquoise, and other minerals were placed in sipapus as offerings to the ancestors and katsinam. But more important than these physical offerings were the spoken prayers and ritual formulas that initiated communication with the underworld.

While a kiva contains a sipapu within its floor, the kiva itself is a symbolic sipapu − a point of access to and communication with the underworld. In fact, there is an architectural nesting of sipapus that create different levels of interaction and communication at different social scales (Hieb 1994). There is the sipapu in the kiva floor, at which an individual may make offerings. This is nested within the kiva itself, which is a sipapu within the plaza that contains it. Within the kiva, sodality members gather to prepare for ritual activities, which, like the offerings done by an individual at the smaller sipapu, are communicative acts with the ancestors and katsinam, but these are rituals performed by a group. The public parts of these rituals are often performed in the plaza, an open space defined by the bordering blocks of residential rooms, which is a sipapu within the village, a place where the entire community gathers to participate in public parts of rituals, providing an audience, interacting with the performers when cued, partaking in the sharing of food and other gifts, and communing with the ancestors and katsinam. The sipapu within the kiva is a point of communication at the scale of an individual, the kiva within the plaza is a point of communication at the scale of the sodality, and the plaza within the village is a point of communication at the scale of the entire community. The sipapu, kiva, and plaza thus designate a nested series of sacred spaces defined by the structural idiom of an opening within a whole that allows access to that which is below − the sipapu is an opening in a whole kiva floor, the kiva an opening in a whole plaza, and a plaza is an opening within a whole village. Each is used for communication through ritual acts of making offerings and staging performances at the scale of individuals, small groups (sodalities), and the whole community.

The architectural form of a kiva itself structures and guides the interaction of participants. Access is limited by the single hatchway, and when ceremonial activities are underway, the entryway is symbolically closed by placing a bow standard across the ladder projecting from the hatch up into the plaza. Inside the kiva, the platform, benches, and floor create different zones of activity that organize the interactions among participants, identifying them as performers or audience members, as initiates or the initiated, or as junior or senior sodality members. This principle of separation is demonstrated in the initiation rites of the Momtcit sodality when the initiates, dressed in special costume and mimicking the actions of young helpless birds, are restricted to the benches on the east and south walls, while the initiated members may move freely about (Titiev 1944:133). Initiation into the Nakyawimi, the sword-swallowers order of the Momtcit, resulted from trespass of a non-member into space sanctified through its use by the Nakyawimi. For example, if the Nakyawimi were using the floor of the kiva for a preparatory rite prior to their public sword-swallowing performances, all nonmembers were restricted to the benches and platform. If a nonmember inadvertently (or accidentally on purpose) entered this space, they were required to be initiated into this order (Titiev 1944:157).

In addition to the structuring of activities within them, kivas provided a nexus for the creation of social relationships within the community. The concept of kiva groups among the Hopi illustrates the means by which this was achieved. Between the ages of 8 and 12 years of age, every Hopi girl and boy is initiated into the Katsina sodality. In this initiation, it is revealed to them that the katsinam they have seen dancing in the kivas and plazas are actually their male family members and neighbors in costume. After this revelation, all the initiated males have the right and responsibility to personify katsinam themselves during public rituals. Also, as a result of initiation, one becomes a member of a specific kiva group on the basis of the kiva within which they were initiated. These kiva groups form the basis of sponsorship for the spring and summer katsina dances, providing performers and mobilizing the labor and resources needed to support the undertaking. Kiva groups also cooperated in the katsina initiation rites and in the maintenance of their kivas.

Membership in kiva groups crosscuts clan memberships, lays the foundation for lifelong relationships, and intertwines the social fabric of the community. The relationships created by kiva-group membership crosscut not only clan membership, but also generations. Cohorts initiated together form a bond through this shared experience, creating informal age-graded units within kiva groups. Initiates are sponsored by older initiated members who are not clan relatives, and through the initiation, the sponsor ceremonially adopts the initiate as their child. Upon completion of the initiation, the new initiate is given a name that metaphorically refers to the clan name of their sponsor (Whiteley 1992). This name would then be used whenever someone wanted to activate a kiva group relationship. The relationship between sponsors and initiates crosscuts generations, and through the course of a Hopi individual's lifetime, an individual would not only be an initiate, which creates a relationship with a ceremonial mother or father, but also would later likely become a sponsor of a ceremonial child or children of their own.

Among the Hopi, and generally across all Southwestern Pueblos, kivas were multipurpose structures. They were used primarily for ritual activities, both public and private performances. But kivas were also used for more mundane social functions and craft production. While some of the female sodalities owned kivas and all female katsina sodality initiates had access to the kivas of their kiva group, kivas were largely male spaces, providing a place to socialize, sleep, and escape from the labor demands placed on them by the natal and affinal households controlled by their mothers and mothers-in-law. Through their architectural form, kivas created a sanctified space for communication with the underworld, ancestral spirits, and the katsinam. The architectural features of a kiva structured and guided the interactions of participants in the rituals held within, spatially identifying the social statuses and roles of those within in varied ways, depending upon the circumstances at hand. Kivas also serve as a physical nexus of social relationships within Hopi communities, creating durable ties that crosscut kin groups and generations.

Comparing Ballcourts and Kivas

Both ballcourts and kivas created sanctified social spaces to communicate with the underworld and its inhabitants, the ancestors, deities, and other supernaturals. The architectural forms of both emphasize their sunken interiors that physically symbolize this connection with the underworld. Both also create contexts for the exchange of information and resources. Ballcourts were used to mediate relations both within and between communities, and their physical structure re-affirmed the respective identities of the two sides engaged in the mediated competition. The use of kivas integrated the various social segments within a community, bringing different unilineal kin groups together and masking the distinctions among them. While the benches, platform, and sunken floor of a kiva often defined distinctions between performers and the audience, or between relative ritual status, the differences in kin group identity were not marked, all were kindred when inside a kiva. Ballcourts also provided opportunities for individuals to consolidate social power. Several potential avenues to power were present: creating of social debts and obligations through gambling; achieving social status and distinction on the field of play; sponsoring games and associated activities, exerting influence over community identity; and controlling access to ancestors, deities, and supernatural power.

The most significant differences between ballcourts and kivas center on their different potentials for the creation of social distinctions. Ballcourts have the potential to mark and maintain social differences and boundaries between the competing sides. The social contexts of ballcourt use are overtly competitive, albeit mediated so as to prevent escalation to lethal levels. In contrast, the use of kivas emphasizes cooperation, and the social differences among participants in kiva rituals are masked. The distinctions that are made relate to relative ritual status, like the distinctions made between performers and the audience or between initiates and the initiated. However, competition is not wholly absent from kiva activities. Kiva groups and ritual sodalities strove to sponsor public ceremonies enjoyed by the community for both the aesthetic qualities of the performance − the songs, dances, costumes, and other paraphernalia − and for the bounty of food and other gifts that reflected the generosity and prosperity of the sponsoring group. The qualities of a ceremony were judged by the community members relative to other successful performances. Therefore groups competed to present the most enjoyable, aesthetically pleasing, bountiful, and memorable ritual performances. In contrast to competition in ballcourts, this competition was not head-to-head.

Ballcourts also presented opportunities to consolidate social power that were not possible with kivas. One means was through social debts and obligations accrued through gambling. In Hopi oral histories, gambling in kivas is specified as a cause of moral laxity leading to the shirking of ritual responsibilities, loss of reciprocal relations with the ancestors and supernaturals, and social disorder and conflict that cause community collapse (Courlander 1971:133-138; Lomatumay'ma at al. 1993:75-115). In Navajo oral histories, Nááhwíiłbįįhí, He Always Wins, of Chaco Canyon used his skills at wagering, as well as trickery and magic, to amass such tremendous social debts and obligations that he wound up controlling not just everyone's material possessions, but their labor as well (Matthews 1897:82-87). In both the Hopi and Navajo cases, the stories are examples of the undesirable consequences of gambling, with the Navajo myth specifically critiquing its potential to create power differentials, and they serve as admonitions against gambling, particularly in inappropriate contexts like in kivas.

In short, ballcourts and great kivas were structuring structures that produced, reproduced, and naturalized the social and cosmological order through ritual practices performed within them. They also provide a context for other social practices, forging a sense of solidarity and communitas as well as vying for prestige and creation of social debts and obligations. Communal ritual architecture has other potential uses, including the transmission of vital cultural knowledge and facilitating systematized food sharing, which are discussed in the following sections.

TRANSMISSION OF ENVIRONMENTAL KNOWLEDGE THROUGH RITUAL

Communal ritual architecture has greater potential than just integration, it may also be the locus for the transmission of important cultural knowledge, including knowledge about and responses to environmental disturbances. Roy Rappoport (1971, 1999) and Victor Turner (1969) have suggested that rituals provide an ideal context for the transmission of vital cultural knowledge in that characteristics of invariance of and redundancy in performances may assure the fidelity of transmitted information. Halstead and O'Shea (1989) have more specifically suggested that knowledge regarding low-frequency severe environmental disturbances and the buffering measures needed to prepare for and contend with their impacts will often become embedded in annual ritual practices. Two specific buffering measures are often embedded in ritual practices. First is the dedicated production of subsistence goods for storage and communal feasting. Second is the establishment of long-distance exchange relations to acquire rare resources used in ritual paraphernalia. In times of need, these exchange relations can be activated to provide subsistence goods or opportunities for migration. While perhaps costly to maintain in terms of the labor and resources invested in production and storage and the social capital invested in the maintenance of long-distance exchange relations, these ritual practices assure preparedness for the worst possible conditions. If knowledge about low-frequency events and appropriate buffering mechanisms were not embedded in annual rituals, ad hoc attempts to prepare and deploy the costly responses needed to contend with the impacts of a severe disturbance may fail.

Such encoding of information about low-frequency environmental disturbances has been demonstrated among the Nunamiut and Tareumiut of the Alaskan Arctic (Minc 1986; Minc and Smith 1989). There, relationships between long-term climatic cycles and the inverse correlation between the availability and abundance of terrestrial and marine resources are encoded in rituals, mythology, and cosmology. These beliefs and practices explained long-term fluctuations in resource variability, preserved and transmitted information about past patterns of variation across multiple generations, and provided a context for the creation and maintenance of exchange relations across ecotones and cultural boundaries to buffer unpredictable variability. Similar encoding of vital information about cultural responses to environmental disturbances through ritual practices is found among the Hopi. There, information about the challenges of practicing agriculture in an arid and unpredictable region is transmitted via the Powamuy ceremony, and the ritual performances of the Paalölöqangw puppets provide practical and esoteric knowledge about how to contend with low-frequency destructive floods.

The Powamuy Ceremony

Held in mid-February, the Powamuy ceremony uses ritual mimesis to assist the initiation of the agricultural season (Bradfield 1973:69-95; Titiev 1944:114-120; Voth 1901). In all the kivas of the village, fires are kept blazing in order to force the germination of individual "plots" of beans planted by all the men of the community. Because of this, the Powamuy is often called the Bean Dance. Despite this name, corn plants are also sprouted by selected men. The men carefully tend their plots and officers of the Powamuy sodality circulate among the kivas, inspecting the crops, because the success of these efforts is believed to portend the results of the coming agricultural season.

During these periods of tending their plots in the kivas, the men offer songs and prayers for the crops, make prayersticks, and construct sand paintings and altars with symbols of plants, clouds, and various katsinam and other supernaturals. The songs and prayers of the Powamuy recite information about the natural order of the world and the associations among plants, animals, and places. One of the songs presented by Voth (1901:149-152) contains information about the sequence of the northward moving sunrise and sunset in relation to landmarks on the horizon that was used to time the planting of different crops in different locations (Titiev 1938). The ritual activities of the Powamuy provide Hopi farmers a context for sharing information about agricultural practices, the needs of specific plants and plant varieties in terms of soils and water, the potential spatial and temporal variation of rainfall, and individual plans for the coming season. Other resources could be exchanged as well, like seed varieties and promises of labor to assist in planting or preparing new lands for cultivation. The information shared was not simply practical matters related to cultivation, but also included information about the proper rituals, prayers, and offerings that should accompany all of the stages of agricultural activities from before planting to after harvest.

Also during Powamuy, the village's mamant, the marriage-eligible young women, cooperate in applying a new layer of whitewash plaster to the interior walls of the kivas, and this action is seen as a prayer for rain to moisten and renew the earth (Mindeleff 1891:129; Parsons 1939: 316, 488; Stephen 1936:198, 209). Through the year, different paintings are added to communicate specific details pertinent to the rituals being performed. Just as Powamuy celebrates the coming agricultural renewal of the world, the walls of the kivas are renewed and prepared for the growth of the new year's ritual imagery. Excavations of numerous prehistoric kivas in the U.S. Southwest, most notably those from the ancestral Hopi village of Awatovi, have revealed multiple layers of paintings with intervening whitewashed layers representing the cumulative result of repeated cycles of ritual renewal and use (Smith 1952b:10-11, 16-21).

The Paalölöqangw Puppets

Following the Powamuy, a series of ritual puppet shows were performed that transmitted knowledge about the damaging effects of floods, which had a low frequency of occurrence, but could be devastating. In Hopi and other Puebloan cosmologies, flooding is caused by giant horned and feathered serpents that reside underground and are associated with the control of terrestrial waters and earthquakes (Parsons 1939:184-185). The Hopi call these giant supernatural serpents Paalölöqangw. The actions of the flood-causing Paalölöqangw are re-enacted during spring equinox ceremonies in late March that involve the use of elaborate puppets (Fewkes 1920:504-509; Fewkes and Stephen 1893; Geertz and Lomatuway'ma 1987:217-252; Titiev 1944:121-123). In four different performances, Paalölöqangw puppets are manipulated in re-enactments that recognize the power of the Paalölöqangw to both produce and destroy crops. In one performance, several Paalölöqangw puppets extend from a screen behind which the puppeteers manipulate their movements. Mock fields of corn sprouts set in small mounds of soil are arranged before the screen, and the undulating Paalölöqangw threaten destruction of the fields before being placated by a performer personifying Haha'i Wuhti, mother of the katsinam, who feeds them sacred corn meal and suckles them like children. In a following performance, the Paalölöqangw puppets rise from jars, again threatening a mock field of corn sprouts before them. The Koyemsi, the Mudhead Clowns, intercede in this performance, grappling with the writhing Paalölöqangw and forcing them to withdraw.

These puppet performances transmit both practical and esoteric knowledge about the potential destructive magnitude of low-frequency flood events. This information is practically applied through the development of an understanding of the types of risky planting contexts to avoid and the technological means available to reduce vulnerability to flooding in risky locations, like the construction of brush and stone weirs and diversion dams. Without the rituals to reinforce this knowledge and to transmit it across generations, the low-frequency occurrence of destructive floods may result in the loss of recognition of high-risk locations and a lack of investment in mitigation measures to reduce vulnerabilities. The performances also present esoteric knowledge about the proper supernaturals to whom offerings must be made − to the Paalölöqangw to appease their wrath, to Haha'i Wuhti to intervene and tame the Paalölöqangw with offerings of sustenance, or to the Koyemsi who may be needed to wrestle the unruly and unappeased Paalölöqangw into submission.

Information Transfer in Hopi Rituals

Both the Powamuy rituals and the Paalölöqangw puppet performances transmit information critical for agricultural success in a variable and unpredictable environment. While both are performed in kivas, unfixed features like altars, sand paintings, prayersticks, puppet screens, and mock fields are used in the performances to create the specific ritual contexts and totransmit the vital knowledge. The knowledge transmitted allows preventative measures to be employed in order to avoid disasters. Powamuy provides a context for the preservation and transmission of practical knowledge of farming in a setting of mock cultivation. The Paalölöqangw puppet shows preserve knowledge about low-frequency destructive floods, creating an awareness of the risks and vulnerabilities created by their possible occurrence. Neither, however, provides specific practical means with which to mitigate the effects of agricultural failure caused by climatic variability or severe flooding. Both, however, do have food sharing as important associated activities, with feasting and gifting of food occurring at every stage of the rituals.

FOOD SHARING IN HOPI COMMUNAL RITUAL

Food sharing is one of the most important aspects of communal ritual among the Hopi, and it occurs at several different social scales during the preparations for and performances of every communal ritual. The spring nighttime katsina dances held in the kivas and the summer daytime katsina dances held in the plazas are examples of different social scales of food sharing associated with the preparation for and performance of communal rituals. The communal rituals held in the prehistoric ballcourts and great kivas of the Flagstaff region likely involved similar patterns of food sharing at several different social scales.

These spring nighttime and summer daytime katsina dances are not associated with specific sodality performances like the Soyal, Powamuy, and Niman ceremonies and may be sponsored by any man of good standing in the village. Upon receiving the scheduling approval of the village chief, the sponsor would enlist the members of his kiva group and clan relatives to assist him in the undertaking (Titiev 1944:112, 126). Securing sufficient food resources to finance the performance was critical, and the combined social networks of the sponsor, his clan relatives, and his fellow kiva group members, especially his adoptive father, would be used to gather the needed resources.

Most important was the presentation of food to the assembled audience. During each public performance of the ceremony, food prepared in households related to the sponsor would be distributed among the gathered onlookers. Any leftover food would be packaged and distributed to the audience members to take home. At this scale, food resources were mobilized from a large network and redistributed within the entire community. At a smaller scale, food was prepared by the sponsor’s household to support preparatory activities, like work sessions to manufacture and assemble needed ritual paraphernalia and rehearsal sessions to practice songs and dances to be performed. At this scale, resources mobilized by the sponsor's household were redistributed to the active participants in the endeavor to perform the ceremony.

Often special foods are prepared and consumed during communal rituals. These may employ special, costly preparation techniques or engage the gathered congregants in communal productive activities (Hayden 2001). Among the Hopi, a special feasting food is piki bread − paper-thin, pastry-like rolls of a thin batter of finely ground corn meal cooked on a hot, oiled stone griddle. Preparing piki bread is time consuming, because the corn meal requires extra preparation and the cooking process necessitates careful attention and constant deft movements to prevent burning either the piki or the cook's hands (Kavena 1980). For the Soyal ceremony that marks the winter solstice and the seasonal arrival of the katsinam from the underworld, large amounts of a special rabbit stew are prepared. The rabbits are acquired in communal hunts conducted by the men of each kiva, and a hunting ban on rabbits is enforced in the month prior to the solstice to provide large stocks of rabbits for harvesting (Beaglehole 1936:12; Dorsey and Voth 1901:58; Stephen 1936:387; Titiev 1944:144).

Rather than embedding costly mitigation responses to food shortages in a single ritual, the Hopi distributed this function across all ceremonies that were performed throughout the year. This spread the burdens of producing for storage and communal feasting and created a robust set of food-sharing mechanisms that provided the ability to ameliorate food shortages at any time of year. To support these efforts, specific fields were dedicated to the production of foods to finance certain rituals. Their use and produce was controlled by clan leaders and sodality officers, and clan and sodality members were recruited to provide labor for the cultivation of these fields (Bradfield 1971; Forde 1931a; Whiteley 1988, 2008). Food sharing in the context of rituals not only provided a mechanism for redistribution to mitigate spatial and temporal variation and unpredictability, but also established and reinforced reciprocal bonds within the community.

COMMUNAL RITUAL ARCHITECTURE AND SOCIAL PRACTICES

Communal ritual architecture not only integrates social groups but also acts as a powerful structuring structure that produces and reproduces fundamental relationships of the social and cosmological order. Two forms of communal ritual architecture that were used prehistorically in the U.S. Southwest, ballcourts and kivas, have been shown to have similarities in their basic functions as structuring structures but differences in the specifics of the resulting social relationships created. Kivas facilitated integration and identity as a single group while ballcourts marked and mediated social differences while allowing for the establishment of further distinctions through the creation of social debts and obligations.

On a practical level, communal ritual may provide a context for the transmission of vital cultural knowledge and the creation of robust institutional buffering mechanisms guiding the production, storage, and redistribution of surplus. Rituals that emphasize invariant performance provide an ideal arena for the communication of important information across generations, especially knowledge about the effects of and mitigation measures for low-frequency environmental disturbances. Communal ritual also creates institutionalized contexts for food sharing that allow variations in productivity within a community and between seasons and years to be evened out.

In the following chapter, the ethnographic possibilities explored in Chapters 4, 5, and 6 will be used to develop expectations that can be tested against archaeological data from the Flagstaff region and used to evaluate relationships between climate and processes of competition and cooperation. The adverse and beneficial periods identified in Chapter 2 will be used to define specific expectations for the timing and patterning of archaeological data related competition (defensive sites, skeletal trauma, and social and technological specialization) and cooperation (communal ritual architecture and exchange).

CHAPTER 7 – DEVELOPING EXPECTATIONS FOR THE ARCHAEOLOGICAL RECORD

The previous chapters described the environmental and cultural setting of the Flagstaff region and provided theoretical perspectives on and ethnographic accounts of social responses to environmental disturbances, intergroup conflict, and communal ritual. This material provides the basis for developing a model that addresses the diachronic and cumulative nature of social responses to environmental processes. In the first part of this chapter, I outline the sequences of social responses to deviations from the expected normal range of climatic variability. I then consider the lagging nature of responses, as well as the cumulative effects of both impacts and responses. This model results in a set of general expectations for competitive and cooperative responses to environmental disturbances and favorable conditions. These general expectations are then used to develop a series of specific expectations to be tested against the archaeological record.

GENERAL MODEL OF SOCIAL RESPONSES

Figure 7.1 visualizes as a flow chart a general model of the sequences of social responses made given some variation from normal conditions. In response to unfavorable environmental conditions that lead to decreased agricultural productivity and increased subsistence stress, three stages of response may be adopted depending upon the length and severity of the environmental disturbance and the effectiveness of initial efforts to buffer shortfalls and mitigate the impacts of the disturbance (Dirks 1980). These stages

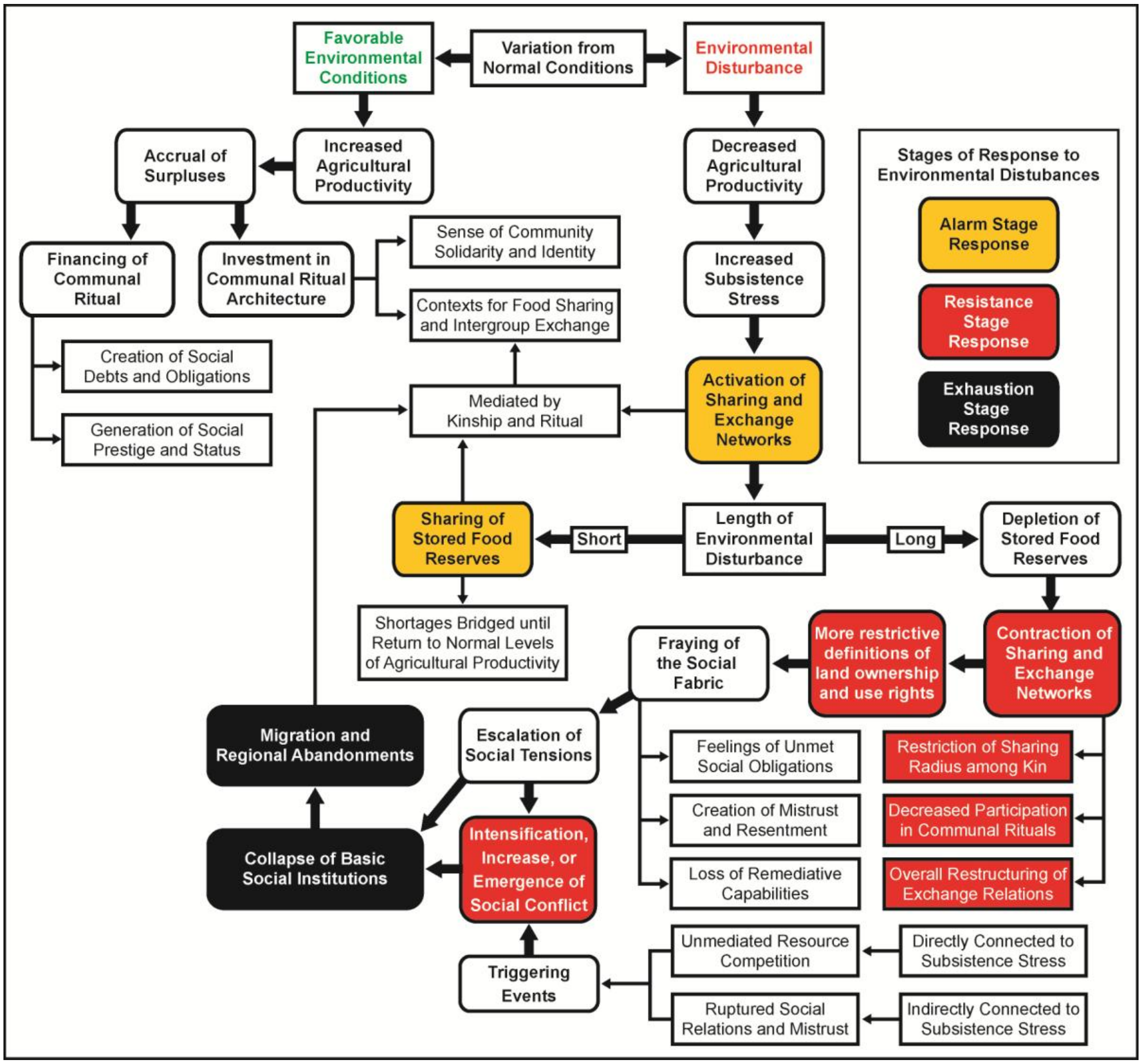


Figure 7-1. Generalized model outlining sequences of social responses to variation from normal environmental conditions.

are shown in different colors in Figure 7.1: alarm as yellow, resistance as red, and exhaustion as black.

The material developed in Chapters 4 and 5 shows that environmental disturbances may lead to conflict involving previously peaceful groups or the escalation of existing social tensions. Conflict, however, is not the first response in the face of environmental disturbances. During shorter environmental disturbances, stored food reserves may bridge shortages until agricultural productivity recovers; but during longer disturbances, the most characteristic initial alarm stage response is intensified interaction within social networks that facilitate sharing and exchange of resources. This includes the activation of local, regional, and extraregional networks mediated by kinship, as well as ritual activity that builds upon relationships created during times of plenty. Sharing and exchange are often embedded in ritual activities, and these activities are institutionalized to promote stability and continuity that allows for preparedness. Alarm stage responses should be visible archaeologically through changing patterns of exchange. Extraregional exchange may provide access to resources to supplement stored food reserves and allow shortages to be bridged. It is generally during the subsequent resistance stage, if it is reached, that intergroup conflict becomes a more common response.

The resistance stage begins as food reserves are depleted and there is little or nothing to share. Increased restrictions on social interaction emerge, and there is little sharing except with a few close kin, reduced participation in other social activities, and curtailment of large-scale activities that require many resources, such as communal rituals. These restrictions on social interaction lead to feelings of unmet social obligations, the development of mistrust and resentment, and, perhaps most importantly, the loss of potential means of social mediation. More restrictive definitions of land ownership and use rights may also be instituted, perhaps further exacerbating tensions. This fraying of the social fabric and associated escalation of social tensions creates contexts for conflict to emerge, increase, or intensify. Conflict may be triggered by events directly related to subsistence stress, such as unmediated competition for access to or control of resources. Resource competition may escalate to conflict since the corrosion of social relations leads to the deterioration of potential means of mediation between disputing parties. Further, newly instituted and more restrictive definitions of land use rights may also be contested. Conflict may also be triggered by events indirectly related to subsistence stress, as ruptured social relations create feelings of unmet social obligations, mistrust, and resentment. Resistance stage responses should be visible archaeologically through the use of defensive sites and the presence of skeletal trauma from violence. The increased social tensions and conflict of the resistance stage may lead to the exhaustion stage, marked by the collapse of social institutions and often resulting in regional abandonments. The intensification of extraregional trade during the alarm stage may provide more than just access to needed resources. The social connections created and maintained by exchange also provide relationships that may be necessary if the exhaustion stage response of abandonment and migration out of the region is required for survival.

In contrast to these stages of response to environmental disturbances, favorable environmental conditions that generate increased agricultural productivity and it is assumed that the accrual of surpluses may allow the financing of communal ritual and investment in the construction of architectural forms to host these gatherings. Communal rituals are shared social experiences that create a sense of community solidarity and identity, and the architectural forms that contain them embody these shared experiences for individuals and groups through their construction, use, and maintenance. Communal ritual also creates social contexts for food sharing and economic exchange, building relationships that may be activated as an alarm stage response during times of need. Financing or directing these activities provides individuals and groups opportunities to convert food surpluses into social capital through the creation of social debts and obligations and the generation of social prestige and status. As such, they may be an arena for social competition as well as cooperation within and between communities. Responses to favorable and unfavorable environmental conditions are also intertwined, as the local and interregional bonds created through communal ritual activity provide potential sharing and exchange partners during alarm stage responses and possible pathways for migration if the exhaustion stage is reached.

Lagging Responses and Cumulative Effects

Responses to periods of environmental disturbances and periods with favorable conditions may not be immediate. Rather, responses may be deployed as the impacts of disturbances or the benefits of favorable conditions become manifest, often with some time lag between the onset of variation from normal conditions and the activation of a response. This is particularly the case with slow onset environmental disturbances like extreme dry periods. The escalation through different levels of response (alarm, resistance, and exhaustion) would also lag the onset of the event, meaning that resistance stage responses like increases in intergroup conflict and exhaustion stage responses like regional abandonments would likely only be activated during environmental disturbances of longer durations. The outcomes of responses made to the effects of the impacts of disturbances and the benefits of favorable periods may lag the end of the conditions that initially triggered the responses and persist into subsequent periods.

The impacts of disturbances and the benefits of favorable conditions may also be cumulative. There may be additive effects from repeated impacts or the interaction among the different effects of an impact may compound and intensify the overall effect. The impacts from frequent or periodic disturbances may be cumulative, increasing in severity incrementally as disturbances re-occur, especially if the interval between disturbances does not allow recuperation from earlier impacts. In the case of long duration disturbances, the severity of the impacts may also increase cumulatively as the effects of a disturbance persist. The effects of social responses may also be cumulative. Social ties created during favorable periods could be strengthened when activated during an alarm stage response and subsequently increase even more in importance. Similarly, the loss and grief from repeated or persistent hostilities during unfavorable periods may persist into subsequent periods, fueling animosities and maintaining social distances.

The lagging nature of intergroup conflict as a response has been explored by ecologist Peter Turchin and anthropologist Andrey Korotayev (Turchin 2005; Turchin and Korotayev 2006). Their research investigates the relationship between internal warfare and population levels in agrarian states and has shown how dynamic feedbacks create coupled oscillations of these variables with a lagged phase shift similar to classic ecological models of the relationships between predator and prey population densities (Figure 7-2a). In Turchin and Korotayev’s interpretation, population pressures create political instability that leads to social conflict, and in a self-corrective way, periods of

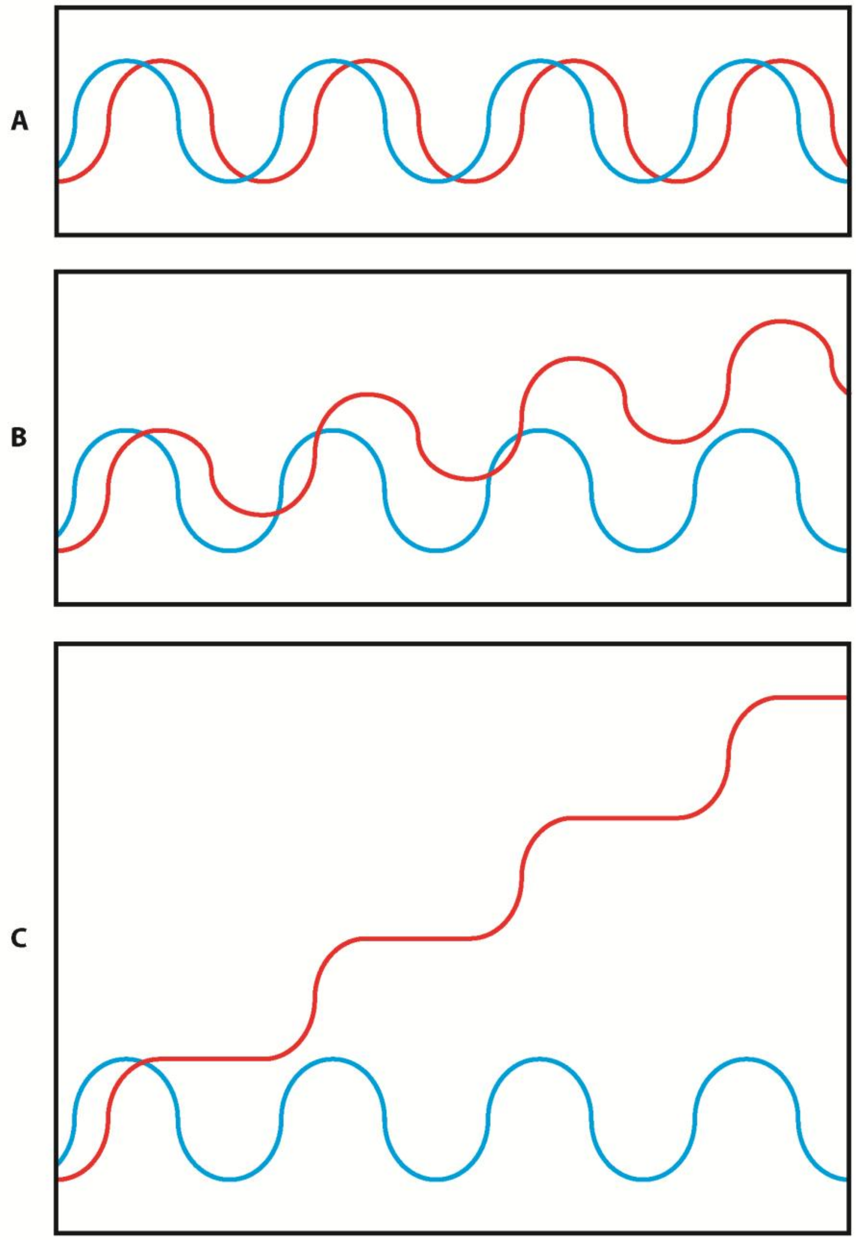


Figure 7-2. Idealized dynamic feedback relationships between two variables with a lagging phase shift. Graph A represents the classic ecological model of relationships between population levels of predator (red) and prey (blue) species. In Turchin and Korotayev's model, these variables are the population levels of agrarian states (blue) and internal warfare (red), or they could also represent environmental conditions (blue) and levels of intergroup conflict (red). In Graphs B and C, the lagging variable increases in each successive cycle, either cycling upward as it escalates more than it de-escalates in each cycle (B) or increasing in a stepwise manner if there were no de-escalation.

conflict reduce population. I suggest there should be a similar lagging relationship between intergroup conflict and environmental disturbances, as well as between investment in and use of communal ritual architecture and favorable periods. There would not, however, be a dynamic feedback relationship in that environmental conditions are independent of the levels of intergroup conflict and use of communal ritual architecture.

The effects of responses may also continue beyond immediate periods of environmental stress or beneficial climate. After environmental disturbances, diminished social mechanisms for conflict resolution and mediation may take time to be restored. As noted by Turchin, the onset of conflict may be rapid, but the return of stability and peace may occur more slowly. I suggest that this would affect the interactions between variables, and the intensity of competition and conflict may ratchet up with each successive disturbance, either cycling upwards as the intensity of competition and conflict escalates more than it de-escalates in each cycle (Figure 7-2b) or increasing in a stepwise manner if there were no de-escalation (Figure 7-2c). Both patterns would cumulatively lead to a near constant state of social tension and conflict.

These idealized relations should also hold true for responses made to favorable conditions, with increasing investment in and financing of communal ritual increasing with but lagging behind the onset of favorable conditions. Decrease in such outlays may also lag declining environmental conditions as social commitments made during favorable times would continue through initial alarm stage responses and not be curtailed until the onset of the resistance stage. Just as it may be easier to escalate than de-escalate conflict, the sense of communitas and shared identity forged through ritual practice during favorable periods may endure and continue through the onset of environmental disturbances, providing relationships for alarm stage sharing and exchange and perhaps mediating social tensions to delay or prevent altogether the onset of resistance stage responses like conflict. In some cases, such periods of stress and challenge could even strengthen these relationships and the exchange they facilitate may cumulatively increase in importance. The idealized behaviors of and interactions between the two variables in Figure 7-2 are depicted as very regular in phase interval and cycle amplitude. In reality, however, the occurrence of favorable and unfavorable environmental conditions is stochastic, varying in both interval and amplitude; such stochastic variation would likely affect the interactions between the two variables, perhaps leading to the types of escalating trends depicted in Figures 7-2b and 7-2c.

EXPECTATIONS

The general hypothesis is that adverse environmental conditions lead to the emergence or intensification of intergroup conflict while favorable environmental conditions lead to increased investment in communal ritual architecture. The following sections develop expectations that can be tested against the archaeological record in order to assess the relationships among cooperation, competition, and environmental conditions.

Expectations for Competitive Responses

In this analysis, intergroup conflict is expected to be the primary competitive response deployed during the resistance stage. Four lines of archaeological evidence will be assessed to examine the emergence or intensification of conflict in relation to environmental disturbances: (1) the occurrence and patterning of skeletal trauma, (2) the construction and use of fortifications, (3) the emergence of formal warrior roles and institutions, and (4) the development of specialized weapons technologies. Below I develop expectations for each using the dimensions of conflict discussed in Chapter 5, particularly the frequency and predictability of conflict, the tactics employed and goals sought, the social distance between antagonists, and the social scale of the conflict. The ethnographic data reviewed in Chapter 4 revealed another potentially competitive resistance stage response: the implementation of more restrictive systems of land tenure made in the face of increased competition for access to or control of resources.

Skeletal Trauma

While indications of skeletal trauma from violence present the most direct evidence of intergroup conflict, such trauma provides more information than simply the presence or absence of conflict. The age and sex of victims and their treatment have the potential to provide insights into the tactics and goals employed and the social distance between the antagonists. In a social environment of mistrust and resentment that is part of the resistance stage, the social distance between groups is expected to increase. Social distance may be expressed through interpersonal violence, whether there are restrictions upon who is or is not consider legitimate targets of violence or what tactics may be employed in conflict. Socially close groups may limit violence to certain categories of persons, perhaps excluding children, women, or the elderly from attack; limitations may also be placed the tactics employed or goals sought, placing limitations on the rules of engagement and the destruction or seizure of property. Changes in who or what may be targeted by violence are expected as conflict increases or intensifies. Practices of peri- and postmortem mutilation and trophy taking are expected to increase as social distances become greater, as such acts are often used to formally signal the rupture of social relations, to reinforce social distance, or to dehumanize the enemy and legitimize violent acts. If continued escalation of tensions lead to a state of near constant hostility, the social distance between the antagonists may become a nearly unbridgeable chasm.

Defensive Sites

With the emergence, increase, or intensification of intergroup conflict, means may be taken to protect persons and property from death or destruction through the construction of defensive sites. If conflict becomes more frequent and predictable, the costs of investing in fortifying sites come to be offset by the risks of not preparing defensively. The costs of fortification involve not just the materials and labor invested in construction, but also increased travel times and transport costs between a defensive site and resources such as agricultural fields and sources of water and firewood. Defensive sites are more likely to be used when the resources that groups are dependent upon are locally concentrated and mobility is not an option for conflict avoidance. If mobility is part of a group's subsistence strategy, defensive sites may not be invested in regardless of the frequency of predictability of conflict.

Two different types of defensive sites can be distinguished: *fortified refuges* and *fortified habitations* (Solometo 2006). The first are defensible locations to which dispersed local populations may withdraw during crises, and such sites lack evidence of full-time habitation and storage features. The second have full-time habitation and significant storage facilities in order to provide greater security for people and accumulated food stores. If conflict is emergent and population densities are low, initial investments in fortifications are expected to be in the construction of fortified retreats. If an existing state of conflict increases in frequency or scale, or if the exercise of violence intensifies with fewer restrictions on who or what are considered legitimate targets, investments are expected to be made in fortified habitations. Fortified sites may be organized into larger networks of defense and integrated through line-of-sight relationships that may have allowed the communication and coordination of defensive actions. The development of line-of-sight networks of fortified sites indicates the integration of multiple social units into mutual defense and is expected to occur in association with increasing social scale of conflict.

Specialized Social Roles and Institutions

If intergroup conflict is frequent and predictable, it may encourage investment in not just material defenses like defensive sites, but also in personnel through the specialized training and organization of warriors. Increases in the social scale of conflict resulting in greater numbers of allied communities and their warriors is likely to require specialized leadership and the emergence of formalized leadership roles and the creation of institutions like warrior sodalities. However, I argued in Chapter 5 that in some cases the formal institutionalization of such roles may be more related to internal needs for social control and cohesion than to external needs for the management of defensive and offensive capabilities. While internal group solidarity and identity would be reinforced by the creation of institutions that maintain internal order through the monopolization of the use of force, such institutions also project tensions and hostilities outside of the community onto "others" – those non-group members who have been defined as legitimate targets of violence. Further, as the Great Ceremonial Wars of the Enga reveal, the emergence of specialized roles may not be limited to the leaders of warriors engaged in battle, but also specialized leaders who conducted negotiations with both allies and enemies and arranged the financing for feasts and other activities conducted before, during, and after a Great Ceremonial War (Wiessner and Tumu 1998).

Identifying the formalization of warrior roles and status in the archaeological record is difficult but can pursued with three lines of evidence: (1) the interpretation of social roles and identities expressed in mortuary assemblages, (2) the emergence and use of warrior iconography in art, and (3) practices of trophy taking. In addition to signaling social distance, as discussed above, trophy taking practices like scalping are often embedded in the social creation and validation of warriors, and may indicate the emergence of warrior roles. If intergroup conflict increases in its frequency and predictability or, perhaps more importantly, in its social scale, evidence of warrior roles in the mortuary record, artistic iconography related to warriors, and trophy-taking behavior are expected to emerge or increase in frequency.

Specialized Weapons Technologies

Associated with the emergence of warrior roles is the development of weapons technologies specially designed for use in intergroup conflict rather than for more mundane purposes like hunting game or cutting wood. The design of such weapons is sometimes intended to increase their lethality, like the different types of specialized clubs wielded by different ranks of warriors among the River Yumans (Stewart 1947). Specialized weapons may also come to be associated with warrior roles and identities and used to symbolize them. They may be manufactured from exotic or symbolically powerful materials or may have high levels of labor invested in their manufacture. The polished stone axes of the Enga and other groups in New Guinea are an example of such a specialized weapon technology, they were manufactured from exotic types of stone through a laborious process, used to symbolize male status, and exchanged widely as alliance-building gifts (Burton 1989; Wiessner and Tumu 1998). Specialized weapons technologies may also be defensive, like shields. In addition to warding off projectiles and blows, shields also provide a canvas upon which to communicate individual or group identity, and they may also be used to symbolize warrior roles and identities (McCoy 1984; Schaafsma 2000; Wright 1976). If intergroup conflict is frequent and predicable or if the social scale of conflict increases, it is expected to lead to the development of specialized weapons technologies.

More Restrictive Systems of Land Tenure

Another response to environmental disturbances noted in the ethnographic review in Chapter 4 is the increased formalization and demarcation of systems of land tenure. This appears to have been a resistance stage response to increased competition for access to or control of resources in the face of diminishing formal institutional means of social mediation. Following Kohler (1992) and Stone and Downum (1999), archaeological evidence of the increasing formalization and demarcation of systems of land tenure would include the use of field houses and perimetric features like rock alignments and piles. Such evidence of more restrictive land tenure systems is expected as an early resistance stage response to environmental disturbances, that would most likely precede and perhaps even act to provoke intergroup conflict.

Expectations for Cooperative Responses

Investment in and use of communal ritual architecture is the primary cooperative response to favorable environmental conditions that will be measured in this analysis. In addition to the chronology of their use, two other aspects of communal ritual architecture are of interest: how these features structure the interactions of the users and their locations in relation to the heartland and frontier zone. Communal ritual created contexts for the establishment and affirmation of social and exchange relations.

Communal Ritual Architecture

Investments in communal ritual architecture are archaeologically identifiable through dateable episodes of construction, use, and maintenance, allowing expected relationships with periods of favorable environmental conditions to be assessed. In addition to evidence of the construction and use of communal ritual architecture, it is expected that there will also be corresponding lack of evidence of intergroup conflict because the use of communal ritual architecture implies high levels of community integration that reduced social distances between groups and functioning means of social mediation that should help suppress conflict. However, if intergroup conflicts escalate to a permanent state of hostility as was discussed above, use of communal ritual architecture may be associated with the formation and maintenance of within-group solidarity to more effectively engage in intergroup conflict.

Structuring Structures and Their Locations

In Chapter 6, I discussed how forms of communal ritual architecture are designed to structure the interactions of users and the creation of community identities. I noted that the architectural forms of great kivas and ballcourts structure the interactions of their users in different ways. Ballcourts mark and maintain social differences and boundaries between participating groups. In contrast, great kivas do not mark or structure the social differences among participants in kiva rituals, other than marking ritual status. Forms of communal ritual architecture not only structure spaces, but they are also structured by space on a landscape scale in terms of their locations relative to other sites, especially others that also have communal ritual architecture, and to other natural and social features of the landscape. In the this research, the locations of communal ritual architecture in relation to the heartland and the frontier zone is of great interest as it has the potential to reveal the nature of the interactions among the different cultural traditions of the region. In general, it is expected that forms of communal ritual architecture marking differences should be located in the frontier zone.

Interpreting Changing Patterns of Exchange

Both favorable and unfavorable environmental conditions are likely to result in changing patterns of exchange including change in degree or access to new or different materials and/or sources of materials. Interpreting changing exchange patterns in relation to environmental conditions may reveal more details about processes of cooperation and competition. While exchange is primarily a cooperative social activity, it may also be related to processes of competition. Exchange is an essential component of forming and maintaining alliances among different social groups that allow the allies to compete more effectively against common threats, and exchange may also be an important aspect of making peace and ending episodes of conflict.

In response to environmental disturbances, alarm stage activation of social networks would likely lead to increased exchange, but resistance stage contraction of social networks would diminish trade. In the wake of resistance stage retrenchment of social activities, the rupturing of social relations may later lead to the re-structuring of exchange networks with new partners. The changing types and frequencies of exchange items associated with such re-structuring should be identifiable in the archaeological record, and allow the relationships between changes in exchange networks and environmental disturbances to be assessed.

The use of communal ritual during favorable environmental periods would also lead to increased exchange, likely at a much greater volume than alarm stage responses to disturbances. The adoption of new ritual practices may stimulate exchange for new materials and objects associated with the expression of identities defined by participation in communal rituals, and such changes in exchange patterns and material culture should be archaeologically visible.

In the study area, two types of exchange items have great potential to reveal how changes in patterns of exchange relate to changing environmental conditions and processes of cooperation and competition: non-local pottery and exotic preciosities like marine shell, turquoise, and argillite. As discussed in Chapter 3, Alameda Brown Ware was produced and consumed in the Flagstaff region and other plain and decorated pottery wares were imported from adjacent regions. Changes in the patterns of non-local pottery acquisition can provide insights into how social relations with neighboring groups were structured and changed in relation to environmental disturbances.

Marine shell and other "hard substances" (Hopi huru'yngwa, Navajo ntł'iz) like turquoise and argillite were valued for their purity of essence and enduring qualities (Hill et al. 1998; Young and Morgan 1987). Unlike food, clothing, baskets, or pottery, objects made of these materials could be consumed (worn or displayed, gifted and regifted) without losing value; they may actually have gained value through their use. These materials and objects made from them were important in the purposes they played signifying social roles, statuses, and identities. Also, as socially valued goods they were exchanged to seal social transactions like betrothals, marriages, and initiations. Because of these uses, in addition to providing insights into patterns of exchange relations with neighboring groups from whom the materials were acquired, these hard substances and the contexts within which they were used also reveal changing social and political developments within the local community.

Changing patterns of exchange for non-local pottery and hard substances have the potential to provide insights into the development of both extra- and intra-regional social relations, and allow the assessment of the relationship between these developments and periods of favorable or unfavorable environmental conditions, the occurrence of intergroup conflict, and the use of communal ritual architecture. In general, it is expected that environmental disturbances and intergroup conflict would be followed by the re-structuring of exchange relations, and that the adoption and use of new forms of communal ritual architecture would be accompanied by increased exchange, especially for hard substances like marine shell, turquoise, and argillite that were used to seal social transactions and signal social roles, statuses, and identities.

The creation of new exchange relations as an alarm stage response to an environmental disturbance may have cumulative effects that continue after the end of the disturbance. The interaction and exchange between partners is unlikely to diminish after normal conditions return as maintaining such relationships through better times assures continued access to exchanged resources and maintains open pathways for potential migration if the exhaustion stage is reached. Rather than cycling up and down like the variables depicted in Figures 7-2a and 7-2b, the importance or frequency of exchange items may increase stepwise in the manner of the red line in Figure 7-2c, with each successive environmental disturbance leading to the increases in the amount and importance of exchange between partners.

EXPECTATIONS FOR SPECIFIC TEMPORAL PERIODS

In Chapter 2, I identified five periods between 1000 and 1300 that would have been unfavorable for agricultural production and four periods that would have been favorable for agricultural production (Table 7-1). The unfavorable periods range in length from 8 to 25 years with an average of 14.6 years. These lengthy periods would have likely lead to

Table 7-1. Favorable (blue) and unfavorable (red) periods defined in Chapter 2 with the range of calendar years A.D. and the length of the period in years in parentheses.

Favorable / Unfavorable
1031 – 1041 (11)
1047 – 1066 (20)
1076 – 1084 (9)
1085 – 1101 (17)
1131 – 1142 (12)
1200 – 1204 (5)
1214 – 1221 (8)
1268 – 1275 (8)
1276 – 1300 (25)

the depletion of food reserves and the activation of resistance stage responses including increased intergroup conflict. The favorable periods range in length from 5 to 20 years with an average of 10.5 years and would have likely allowed the accumulation of surpluses, some of which could be dedicated to the financing of communal ritual and associated architectural venues.

While the occupational chronology of some sites can be very accurately ascertained from tree-ring dates or temporally diagnostic ceramics, in most cases the chronological resolution of site use is more coarse with sites assigned to one or more of the temporal periods defined by the cultural-historical phase sequence in Chapter 3 (methods of ceramic dating are described in detail in Appendix A). In Chapter 3, I noted that the transitions between several of these periods correlate with environmental disturbances (Figure 7-3): the 1085-1130 period begins with the eruption of Sunset Crater and subsequent dry period, the 1131-1142 megadrought is at the beginning of the 1130-1160 period, the transition around 1220 follows the 1214-1221 cool/dry period, and the final abandonment of the region occurred during the 1276-1300 megadrought. These temporal periods identified by archaeologists are blocks of time characterized by certain spatial

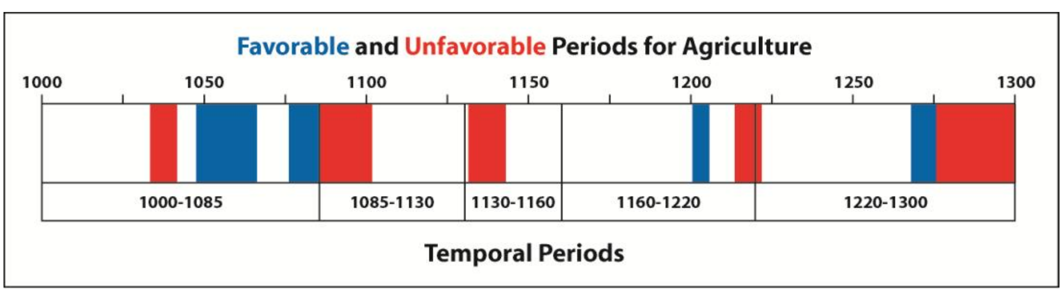


Figure 7-3. Favorable and unfavorable periods defined in Chapter 2 showing correlation of unfavorable periods with transitions between temporal periods.

and stylistic patterns of material culture, with changes in settlement and land use patterns occurring during the transitions between them. These transitions are marked by changing social contexts of production and consumption and changes in articulation within and between social groups and between human populations and the environment. The correlation of these transitions in the cultural historical sequence of the region with periods of environmental disturbance suggests that these events influenced the changing contexts of human occupation of the region.

In the following chapters, I use these five temporal periods (1000-1085, 1085-1130, 1130-1160, 1160-1220, and 1220-1300) to measure changes in levels of competition and cooperation. Using these periods allows the expectation that the impacts of major environmental disturbances affect social responses and adaptations in the temporal periods that follow. In the remainder of this chapter I develop archaeological testable expectations for interpreting changes in levels of competition and cooperation during each of the temporal periods.

Expectations for the 1000-1085 Period

The middle of this temporal period is marked by an 11-year-long extreme dry period, the latter half has two lengthy periods with favorable conditions, and the period ends with the eruption of Sunset Crater. Evidence of increased competition and intergroup conflict is expected to be associated with the 1031-1041 extreme dry period, as it would have greatly exceeded the buffering capacity of stored foods and initial alarm stage responses would have been unable to mitigate the effects of decreased agricultural productivity. In the low population densities characteristic of the region before the eruption, investments in fortifications are expected to have taken the form of fortified retreats to which the dispersed populations could withdraw in times of trouble.

Overall, the 38-year-long period from 1047 to 1084 was characterized by normal or greater than normal precipitation. A remarkable 20-year-long favorable period from 1047 to 1066 would have provided extremely productive agricultural returns for nearly a generation. After an eight-year-long interval of return to normal conditions following the earlier multi-decadal wet period, sustained favorable conditions again returned for nine years. For about a generation and a half these favorable environmental conditions would have allowed high levels of agricultural productivity not only because of the higher levels of precipitation, but also because this lengthy wet period favored dry farming practices and facilitated the expansion of agricultural production into areas that had not been previously used for farming. Much of this expansion, however, was into marginal zones, creating potential vulnerabilities to future environmental disturbances. Individuals born at the beginning of this period would have reached adulthood without experiencing any severe food shortages or unfavorable environmental conditions. Their lack of experience with environmental disturbances, along with expansion of agricultural production into marginal zones allowed by the favorable conditions, would have further increased potential vulnerabilities to future environmental disturbances.

Some of the surpluses produced during these favorable years could be invested in communal ritual architecture, which could have provided contexts for the preservation and transmission of knowledge about environmental variability and the adaptations that could be made in the face of adversity. During this temporal period, sites with communal ritual architecture are expected to have been built and used during the latter half when favorable conditions predominated and are expected to be located in areas marking boundaries between groups where their use could facilitate interaction.

Expectations for the 1085-1130 Period

This period is unique in that it began with five years of volcanic eruption, an cataclysmic event unknown in the history of human occupation of the region. This unforeseen disaster was then followed by 12 years of diminished precipitation. This calamitous period, however, immediately followed a multi-decadal period of high agricultural potential, and surpluses accumulated during this preceding favorable period may have been able to buffer the initial impacts of the eruption. Some segments of the population would have been extremely vulnerable to extreme dry conditions, especially those who were dependent upon dry farming or using more marginal lands. The destruction wrought by the eruption would have led to localized abandonment of those areas affected by deposition of ash and lava and resettlement in unaffected areas. The volcanic eruption was unlike anything the local population had ever experienced. In addition, the lengthy preceding ameliorative period may have reduced the local experiential knowledge about how to respond to extreme dry conditions. The drastic differences between the 1047-1084 interval and the 1085-1101 interval likely imparted a serious shock to local communities and strained the capacity to mitigate both the loss of lands to the eruption and the diminished agricultural returns from deteriorating climatic conditions.

Like the surpluses accrued during the preceding favorable period, the sense of community solidarity engendered by the use of communal ritual architecture could have helped mitigate the initial effects of the eruption and resulting population dislocations by supporting formal means of mediating social tensions. But the ethnographic review suggests that resistance stage responses can include the abandonment of communal ritual practices that consumed large quantities of resources, as these levels of consumption may become unsustainable given diminished productivity and dwindling food reserves. This would be accompanied by the contraction of sharing networks that would create feelings of mistrust and resentment over unmet social obligations, leading to a reduced capacity for social remediation and setting the stage for intergroup conflict to emerge. Increase in the frequency and predictability of conflict is expected to lead to increased investment in defensive sites. If the social distance between antagonists increased and the tactics and goals of conflict changed, then use of defensive sites is expected to shift from fortified retreats to fortified habitations.

One of the primary alarm stage responses made to environmental disturbances is to intensify interaction that facilitates sharing and exchange of resources by activating local, regional, and extra-regional social networks mediated by kinship and ritual. The localized nature of the eruption's disruptive effects is expected to have prompted major changes in patterns of extra-regional exchange, as ties with groups outside of the affected area were likely activated to provide access to resources needed to bridge the shortfalls created by local losses of productivity.

Expectations for the 1130-1160 Period

The beginning of this period was affected by a 12-year-long megadrought that impacted the entire U.S. Southwest. As the effects of this drought emerged, populations in the Chaco and Mimbres regions reorganized at a large-scale across the landscape. In the Flagstaff region, this period corresponds to the beginning of the Elden phase, which is characterized by a shift from pit house to pueblo architecture and increasing population aggregation. These changes in domestic architecture indicate changes in the organization and articulation of domestic units of production and consumption. The widespread extent of this environmental disturbance may have limited the ability of local populations to mitigate its effects through the activation of long-distance exchange networks, and there were likely major changes in patterns of extra-regional exchange. While the loss of access to certain resources is expected, exchange for some resources may have increased in importance as relationships created during earlier periods could grow in strength when faced by new challenges.

The length and severity of this environmental disturbance is expected to lead to resistance stage responses with greater levels of intergroup conflict and increased investment in defensive sites. If the social ruptures created by the earlier 1085-1101 environmental disturbance had not been fully mended, this severe megadrought may have escalated existing hostilities, increasing social distances between antagonists. Greater social distances are expected to be marked by reduced limitations of the exercise of violence and increased occurrence of peri- and post-mortem mutilation and trophy taking. This increased social distance and changes in tactics and goals are also expected to have prompted significant investments in fortified habitations. The social scale of conflict may also have increased, leading to the integration of fortified habitations into line-of-sight networks for mutual defense. Increased frequency and predictability of conflict is expected to lead to the development of specialized warrior roles and institutions for the management of conflict and specialized weapons technologies. The declines in agricultural productivity would have limited the ability to accrue surpluses that could be invested in communal ritual activity, and it is expected that resistance stage responses would also include the abandonment of communal ritual architecture.

Expectations for the 1160-1220 Period

There is a relatively brief five-year-long interval with favorable conditions during this temporal period, but no unfavorable intervals until the transition to the following temporal period. In general, the 1160-1220 period is a long stretch of relatively normal conditions that may have allowed lingering social tensions to subside. It is expected that the more reliable productivity during this period could have stimulated investment in and use of communal ritual architecture, perhaps including the introduction of new forms. Conversely, as the frequency and predictability of conflict is expected to have declined, there should be less evidence of the use of defensive sites and of skeletal trauma. Communal ritual architecture built during this time period is expected to be located in the frontier zone where their use could facilitate interactions among different groups.

Expectations for the 1220-1300 Period

The transition from the preceding temporal period was associated with an eight-year-long cool/dry interval that would have limited the ability to use higher elevation areas to buffer lower elevation crop failures. This transition corresponds to the end of the Elden phase in the Flagstaff region, and the following Turkey Hill phase was characterized by increasing aggregation into fewer and larger sites. The end of this period was associated with a regional megadrought that affected the entire U.S. Southwest and was followed by large-scale abandonments of and migrations from the Mesa Verde and Kayenta regions. In the study area, this megadrought corresponds with the terminal occupation of the region as the exhaustion stage response of abandonment and migration was made between 1275 and 1300 and populations moved to the southeast, aggregating into large pueblos near reliable water sources at the eastern end of Anderson Mesa (Bernardini and Brown 2004; Pilles 1996). As with responses to earlier unfavorable conditions, the adoption of resistance stage responses is expected to increase the frequency, predictability, and social scale of conflict, as well as creating greater social distances between antagonists. Increases in the frequency, predictability, and social scale of conflict should lead to greater investment in and use of larger fortified habitations connected in line-of-sight networks, while greater social distances should be marked by peri- or post-mortem mutilation.

SUMMARY OF EXPECTATIONS

This chapter has developed a model of the possible sequences of social responses to environmental conditions that accounts for their diachronic and cumulative nature. This model was then used to develop expectations for competitive and cooperative responses in general and more specifically for each temporal period in the study area between 1000 and 1300 (Table 7-2). In these expectations, responses to favorable environmental conditions are cooperative and involve investments in communal ritual architecture, while responses to unfavorable environmental conditions are competitive and lead to the emergence or escalation of intergroup conflict. Responses to deviations from normal conditions likely lag the onset of the change, especially in the case of slow onset events like periods with diminished precipitation. The effects of favorable and unfavorable periods and the responses made to them are also likely cumulative. These expectations may then be tested using different types of archaeological evidence from the region, and the following five chapters present the data needed to evaluate these expectations. Chapters 8-10 examine evidences for competition from defensive sites, skeletal trauma, and the specialization of social roles and weapons technologies, then Chapters 11 and 12 examine evidence for cooperation from communal ritual architecture and exchange.

Table 7-2. Expectations for different temporal periods.

Temporal Period	Expectations: Competition	Expectations: Cooperation
1000-1085	• evidence of conflict should be associated with the 1030-1041 extreme dry period • use of fortified retreats	• use of communal ritual architecture should be associated with the 1047-1084 favorable period • communal ritual architecture should be located in the frontier zone
1085-1130	• evidence of conflict should be associated with the 1085-1101 eruption and subsequent dry period • shift from use of fortified retreats to use of fortified habitations	• no use of communal ritual architecture during the 1085-1101 eruption and subsequent dry period • changing patterns of extra-regional exchange following the Sunset Crater eruption
1130-1160	• evidence of conflict should be associated with the 1131-1142 megadrought • increased use of fortified habitations • greater social scale indicated by line-of-sight networks of fortified habitations • increased social distance indicated by peri- and post-mortem mutilation • emergence of specialized social roles and institutions and development of specialized weapons technologies	• no use of communal ritual architecture during the 1131-1142 megadrought • changing patterns of extra-regional exchange following the 1131-1142 megadrought
1160-1220	• decreased use of defensive sites • reduced social distance indicated by restrictions on the exercise of violence	• establishment of new sites with communal ritual architecture in the frontier zone • maintenance of extra-regional exchange relations established following environmental disturbances
1220-1300	• increased use of defensive sites following the cool/dry period 1214-1221 • greater social scale indicated by line-of-sight networks of larger fortified habitations • increased social distance indicated by peri- and post-mortem mutilation	• changing patterns of extra-regional exchange following the cool/dry period 1214-1221

CHAPTER 8 – EVIDENCE OF COMPETITION: DEFENSIVE SITES

Intergroup conflict may result from the escalation of competition to levels that may employ destructive force against people or property. While violent conflict is often perceived as being symptomatic of social disorder associated with resource stress or degradation, it can also be instrumental, used not only to pursue goals related to resource access or control, but also to achieve social status and re-affirm group identity. As such, it cannot simply be assumed that evidence of violence is indicative of resource competition. One must carefully examine the archaeological contexts and the chronological associations with environmental disturbances. In this and the following chapters, the archaeological evidence for competition through intergroup conflict in the Flagstaff region is surveyed; specifically, I present data on and discuss the spatial and temporal associations of defensive sites (this chapter), sites with skeletal evidence of violence (Chapter 9), and the specialization of social roles and weapon technologies (Chapter 10).

This evidence can be used to understand several dimensions of intergroup conflict identified in Chapter 5, including the tactics and goals; the social distance between the antagonists; and the frequency, predictability, and social scale of conflict (Solometo 2004, 2006). Identified patterns can be evaluated in light of these dimensions to further our understanding of the changing contexts of intergroup conflict in the Flagstaff region. Changes in some of these dimensions, particularly tactics and goals, social distance, and social scale will be further evaluated in light of the typology of feuding, raiding, and warfare to understand changes in the scale of intergroup violence as social and political practice.

In this chapter, I examine the spatial and temporal patterning of defensive sites in relation to two expectations developed in Chapter 7: (1) environmental disturbances identified in Chapter 2 will lead to greater investment in and use of defensive sites, and (2) because there is more potential for competitive interaction in the frontier zone than in the heartland, there will be more investment in and use of defensive sites in the frontier zone. These expectations relate to the dimensions of the frequency and predictability of conflict and the tactics employed and goals sought. If conflict is frequent and predictable or if tactics and goals have few limitations on legitimate targets for violence or destruction, then greater levels of investments in defensive sites should be present to provide increased security for persons and property.

First, I define two types of defensive sites, fortified refuges and fortified habitations, and present some examples of each type to illustrate the general characteristics of defensive sites and to explore aspects of strategic site placement. Then, I present and analyze data on the spatial and temporal distributions of defensive sites in terms of their density, frequency, and rate of occurrence. Using these data, I develop an index that combines both the frequency and rate of defensive site use by time periods to evaluate changes in the intensity of intergroup conflict and to assess differences between the Sinagua heartland and the frontier zone. Trends in the index are then considered in relation to the environmental data developed in Chapter 2 in order to evaluate expectations.

DEFINING DEFENSIVE SITES

In a study of the neighboring East Clear Creek region about 90 km southeast of Flagstaff, Solometo (2004, 2006) developed a typology of defensive sites that differentiates fortified refuges and fortified habitations on the basis of the presence or absence of full-time residential occupation. Fortified refuges are simply secure locations to which surrounding dispersed populations may retreat in times of danger; they are not used for residential use full time and lack associated habitation rooms, storage features, and domestic refuse deposits. In contrast, fortified habitations were used full time as residences and thus have associated habitation rooms and storage features as well as abundant refuse. Rather than simply being retreats used in times of danger, fortified habitations provide greater security for persons and property all the time. Colton made similar distinctions for sites that he dubbed "forts" in the Flagstaff region, some were seen as refuges resorted to during times of trouble and otherwise not inhabited while others were permanent habitations (Colton 1946:268, 1960:61, 62).

These different types of defensive sites indicate different levels of investment and use. Populations using fortified retreats can be dispersed and reside near their agricultural fields. Those living in fortified habitations are concentrated and have increased travel times and transport costs between the fortified habitation and resources like agricultural fields and sources of water and firewood. Solometo (2004, 2006) interprets these different levels of investment as influenced by both the tactics of intergroup conflict and its frequency and predictability. If conflict were infrequent and the tactics limited legitimate targets of violence, fortified retreats would be sufficient to assure group security. However, if conflict were frequent and there were fewer limitations on the exercise of violence, fortified habitations that provide greater security for persons and property would become necessary. In her case study, Solometo (2006) found a shift over time from the use of fortified refuges to the use of fortified habitations; she interpreted this as an indication of increasingly intense conflict, which occurred in the period just prior to the abandonment of the region.

Both fortified refuges and fortified habitations use natural landforms and/or constructed walls to limit access and give defenders the advantage of height over any attackers. For my analysis, I use a conservative approach to identifying defensive sites: they must be defended on *all* sides or approaches by walls and/or natural features that would impede access for attackers and provide defenders a height advantage of 1 m or more. I have excluded cliff dwellings from consideration as defensive sites for two reasons. First, this special habitation type is limited in its distribution in the region, largely being restricted to a geologically unique location in the heartland at Walnut Canyon. There, they are associated with five forts built on finger ridges extending into the canyon (Baldwin and Bremer 1986; Colton 1932; Neff and Spurr 2004). Secondly, Harper (1993) has proposed that the cliff dwellings in Walnut Canyon were primarily used for storage and cold-season habitation, while growing-season settlement focused on the use of small, undefended farmsteads on the arable flatlands adjacent to the canyon rims.

The following sections present examples of both fortified refuges and fortified habitations from the Flagstaff region to illustrate the general characteristics of defensive sites and to explore related aspects of strategic site placement, such as locations that allowed monitoring of travel corridors, proximity to water sources, and intervisibility with nearby defensive sites and other evidence of mutual defense. Examples will also be used to discuss how changing site use may affect this typology of fortified refuge versus habitation and some challenges dating fortified refuges that had only limited use. This information is then used to track the density, frequency, and rate of occurrence of defensive sites and to assess the expectations regarding the effect of environmental disturbance and the heartland-frontier differences.

Fortified Refuges

The Fortress Hills and Medicine Fort sites are examples of fortified refuges. They provide a context for examining issues regarding dating, the relationships between fortified refuges and surrounding dispersed populations, and the nature of their strategic locations. The Fortress Hills site in the heartland exemplifies a challenge often associated with fortified retreats: the limited nature of their use results in low rates of artifact deposition and the presence of few temporally diagnostic ones. In contrast, excavations at Medicine Fort in the frontier zone recovered tree-ring specimens and robust pottery assemblages, allowing a more refined understanding of the timing of its use.

The Fortress Hills site is located in the heartland near where the Rio de Flag, San Francisco Wash, and Walnut Canyon drainages join; the hills overlook high quality agricultural lands to the east and west, including an area along the Rio de Flag known as Gourd Flat (Colton 1918). The hills are the remnants of a cinder cone volcano and consist of four rises, one with a fortified refuge that has walls defending access to the summit and a one-room structure on top with three low walls built against an outcrop (Figure 8-1). Very few artifacts were found associated with the site either by the Coltons when the

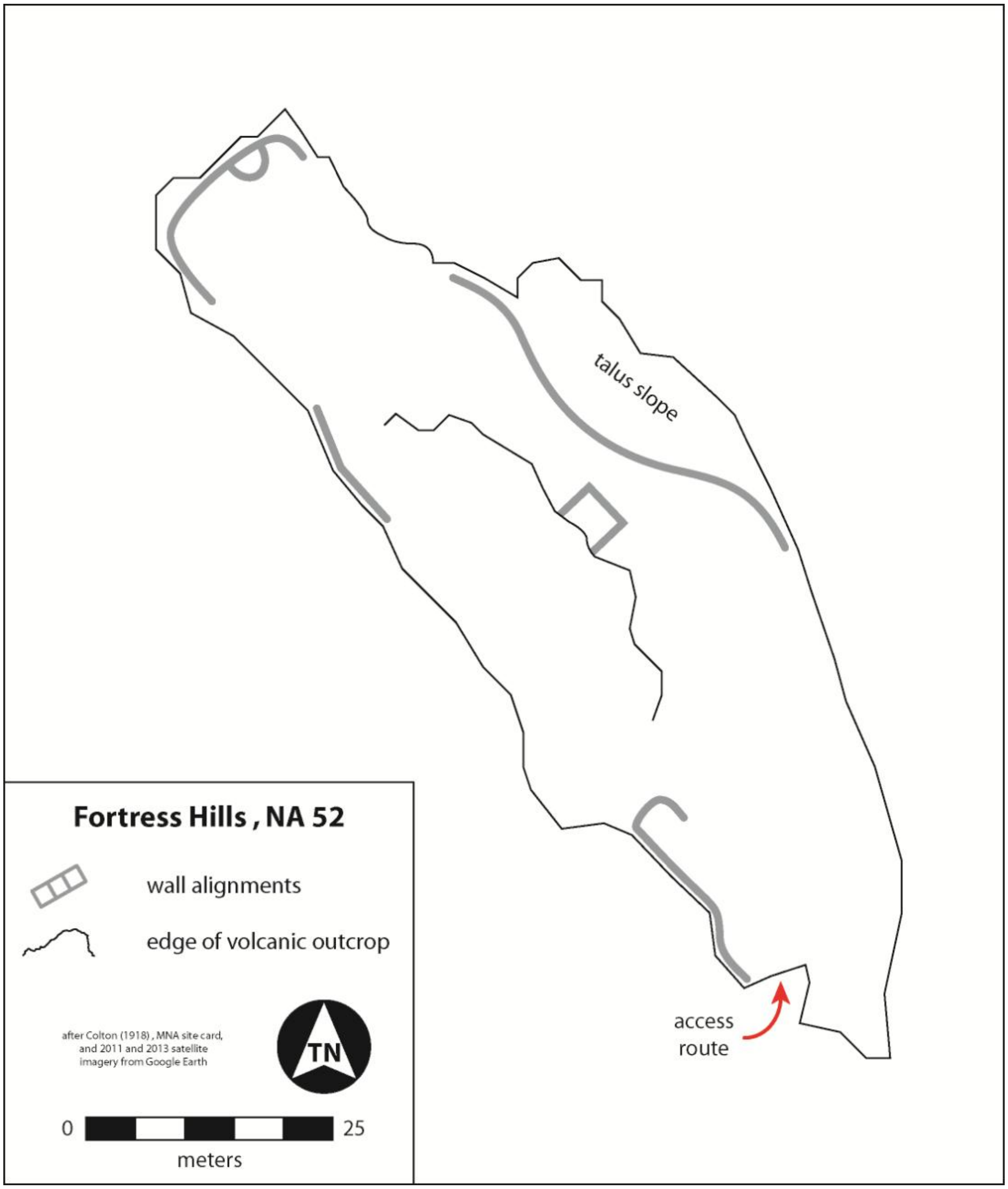


Figure 8-1. Map of NA 52 in the Fortress Hills.

site was first recorded in 1916 or by Forest Service archaeologists in 1978 (Colton and Colton 1918; MNA site card); therefore, there are some challenges to interpreting its period or periods of use.

Black-on-white types present include Black Mesa, Holbrook A, and Sosi, while Alameda Brown Ware types include Rio de Flag, Winona, and Sunset. This limited assemblage (18 sherds collected by Colton in 1916 and 3 types noted by Pilles in 1978) suggests use between 1000 and 1160. The fortified hilltop retreat is surrounded by pit house and pueblo settlements on the flanks of the cinder cone (Figure 8-2), and data from sites within a 1 km radius of the fort can be used to assess the size of local populations that could have retreated to it during times of trouble (Figure 8-3). Population in the

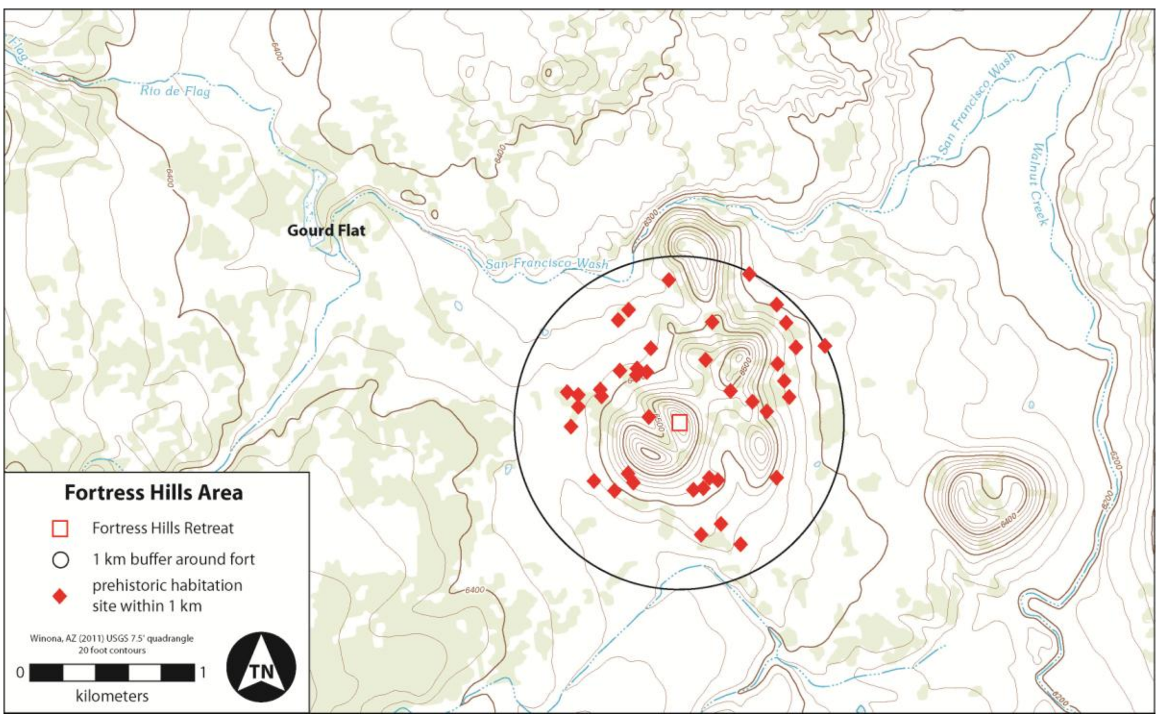
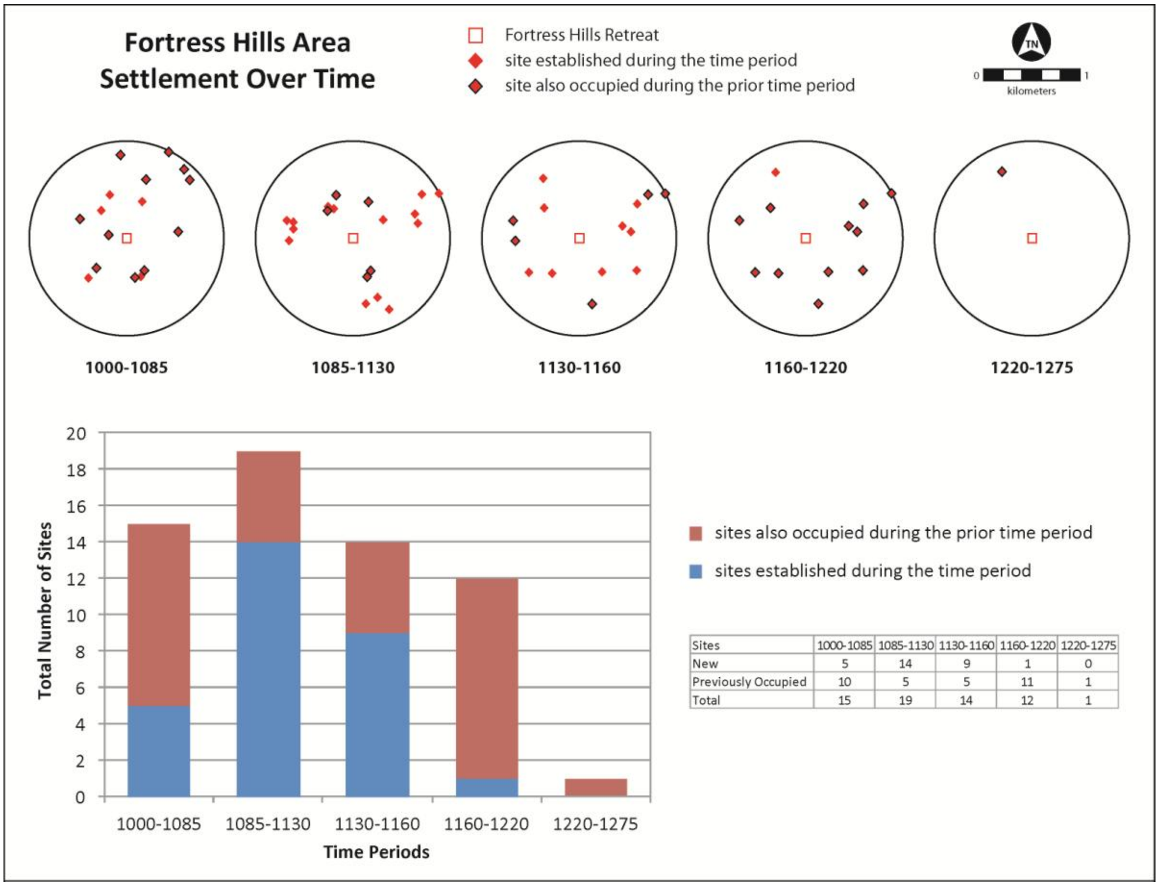


Figure 8-2. Map of the Fortress Hills area.



Sites	1000-1085	1085-1130	1130-1160	1160-1220	1220-1275
New	5	14	9	1	0
Previously Occupied	10	5	5	11	1
Total	15	19	14	12	1

Figure 8-3. Fortress Hills area settlement over time.

Fortress Hills area was greatest during the 1085-1130 time period, especially when measured by the number of new sites established during that time period, but significant numbers of people were also present in the preceding 1000-1085 period and following 1130-1160 period. Population declined after 1160 and dropped precipitously after 1220. These settlement data support the inference that the fort was used by local populations beginning in the 1000-1085 period and continuing through the 1130-1160 period.

In contrast, Medicine Fort can be more securely dated. It is also a more substantial structure that may have undergone changes in use over its period of occupation. The fort consists of one large room measuring 16.5 by 8.2 m with three smaller rooms appended along the eastern side (Figure 8-4). The walls of the large room are 1 m or more in thickness and stood greater than 2 m high. The site is on a narrow ridge on the north side of a pass in the Coconino Divide where it could be used to monitor travel through the pass, which connects the frontier zone in the Medicine Valley just to the north with the heartland to the south; this route is now followed by US Highway 89. A dispersed community of pit house clusters surrounds the site, and directly associated with it are a pit house and a cave with habitation and storage features (Colton 1946; Parry 1981; MNA site files, O'Leary Peak USGS quadrangle) (Figures 8-5 and 8-6).

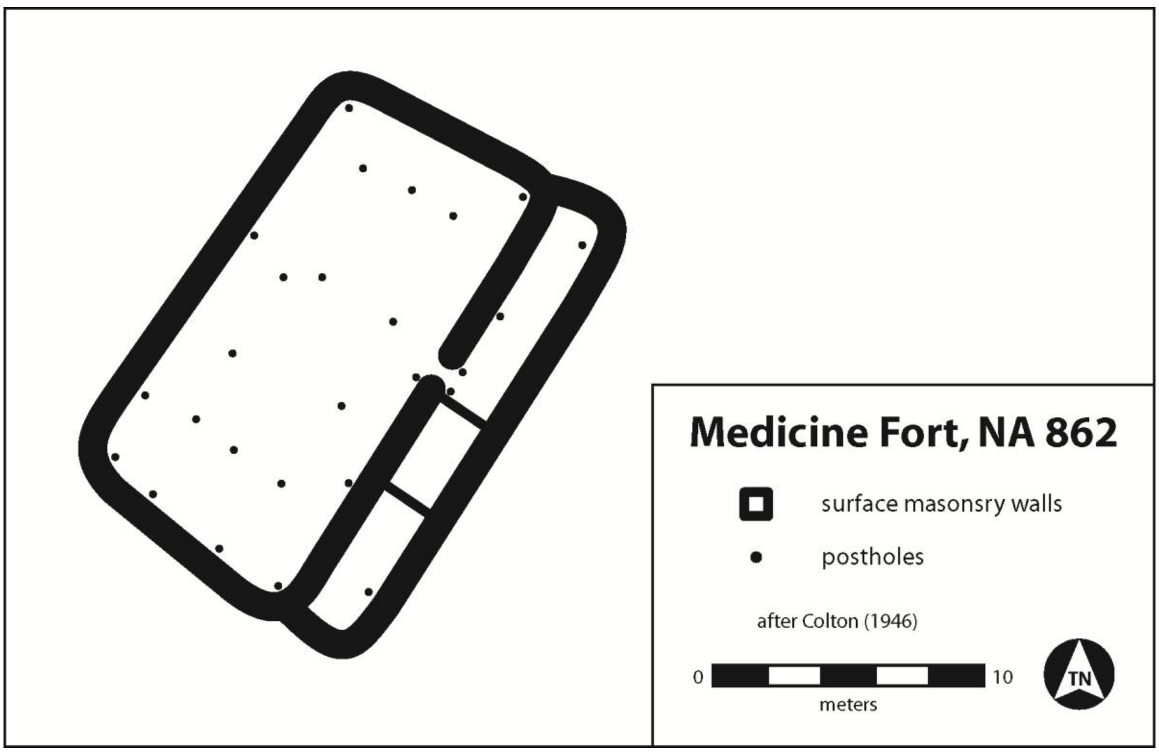


Figure 8-4. Map of Medicine Fort, a fortified refuge.

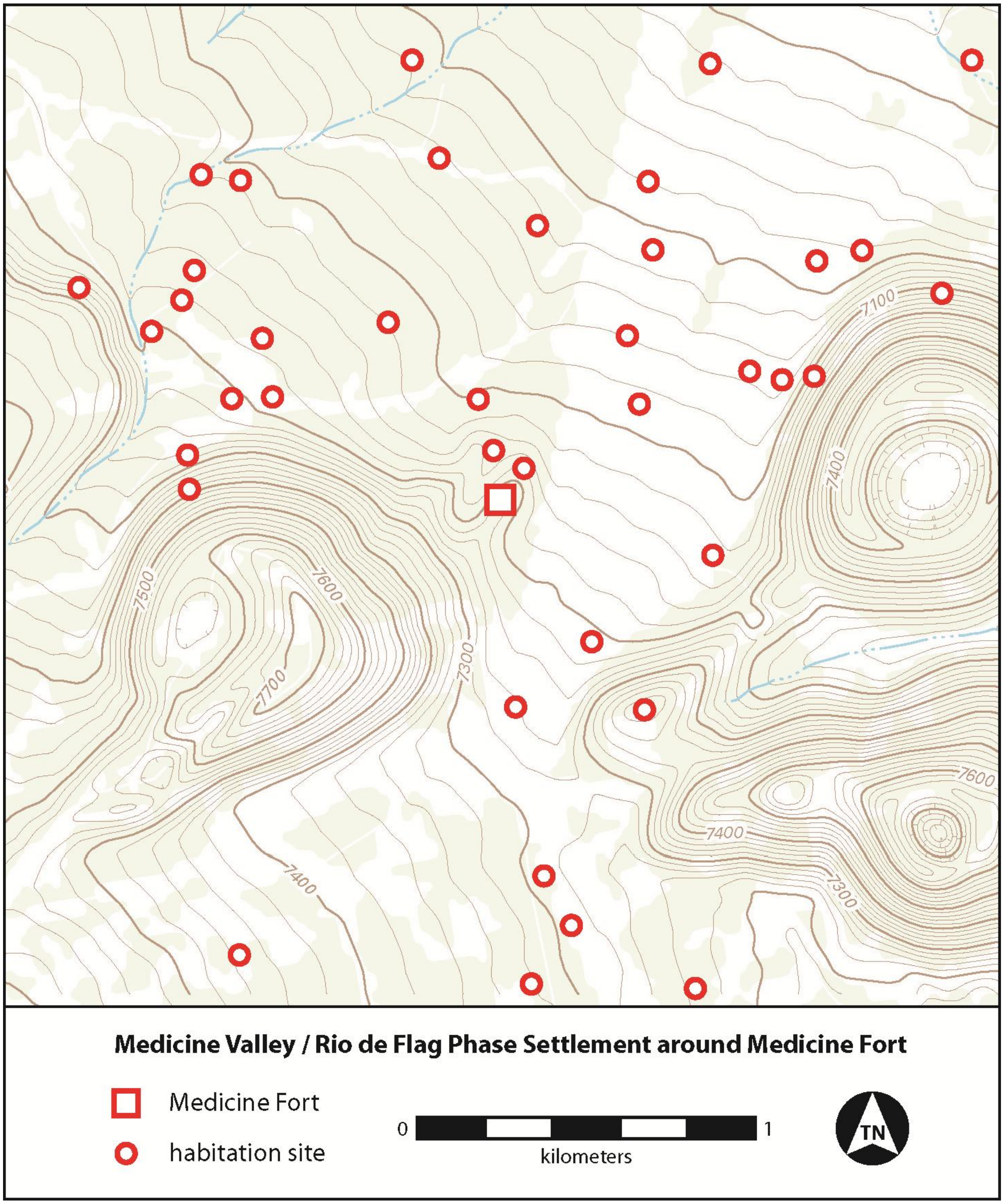


Figure 8-5. Map of the dispersed community surrounding Medicine Fort.

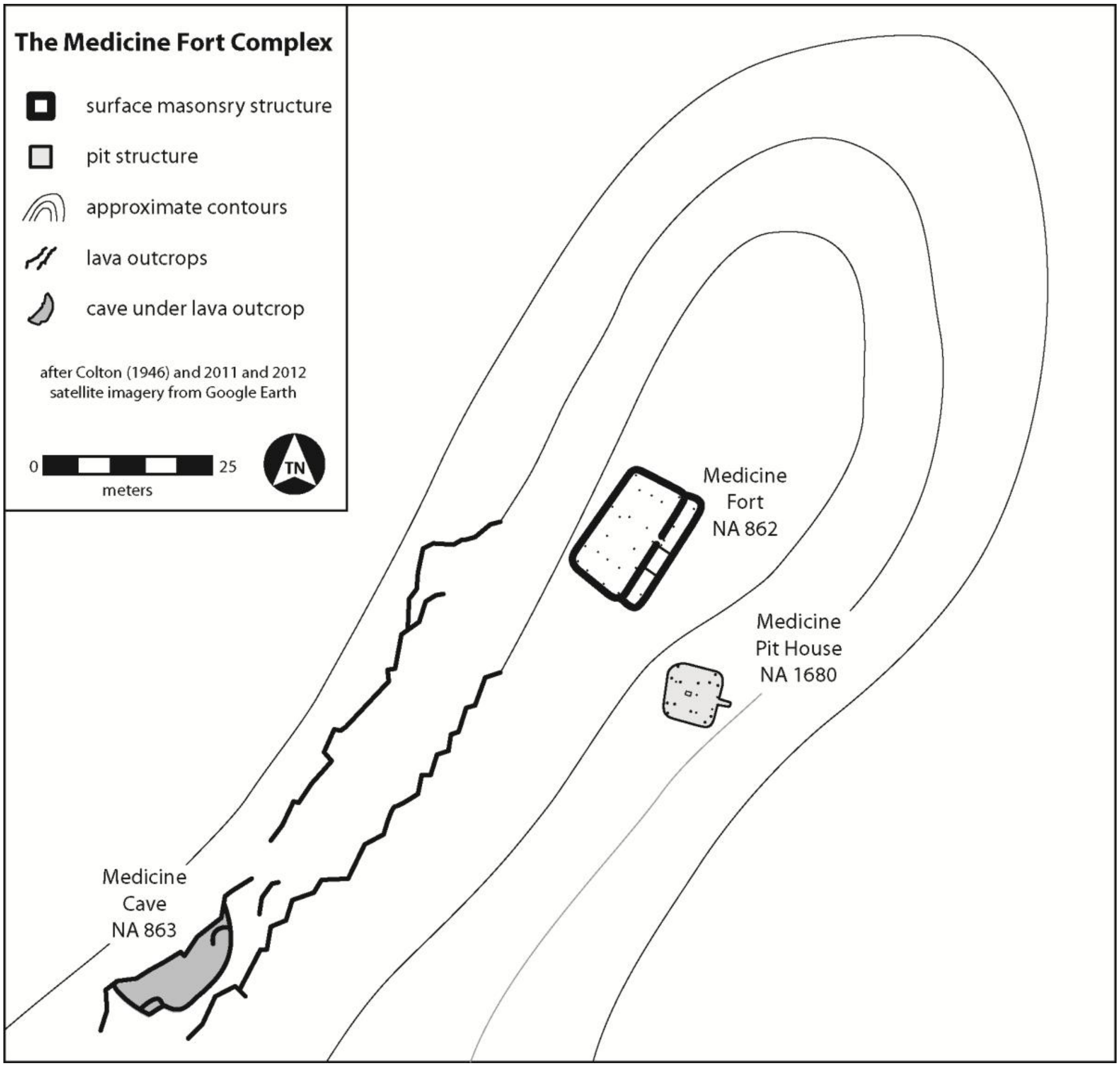


Figure 8-6. Map of the complex of features associated with Medicine Fort.

The site had burned and numerous tree-ring specimens were recovered during the 1930 MNA excavation of the site (Colton 1946; Hargrave 1933). Downum (1988:389-396) interprets the dates to indicate initial construction of the large room ca. 1050, episodes of renovation and expansion that added the three storage rooms ca. 1060, and burning and abandonment of the site sometime after 1065. The black-on-white pottery assemblage is all Black Mesa and lacks Sosi and Dogoszhi, indicating abandonment before 1075. Patterns of postholes and associated burned structural elements inside the large room indicate the presence of a portales roof around the interior walls with an open center. Hargrave (1933:49-50) believed that a parapet wall extended above this portales roof, allowing defenders to be stationed in protected positions within the fort.

Medicine Fort began as a large single room and would have been ideal refuge for the inhabitants of neighboring habitation sites, which were small and vulnerable to attack. However, this role as a fortified refuge appears to have changed when a row of storage rooms was added during the ca. 1060 construction episode, indicating a need to defend food as well as people and thus for longer-term defense. When the site was burned, the storage rooms were full (excavations recovered large numbers of pots and baskets, as well as charred corn, beans, and grass seeds), suggesting that the food stores were targeted for destruction rather than theft during an attack.

Fortified Habitations

The shift towards secured storage seen at Medicine Fort is one characteristic that differentiates fortified habitations from fortified refuges. It is possible that site use changed over time like at Medicine Fort, and many fortified habitations may have begun as fortified refuges. In order to examine this possibility, and to consider strategic locations in relation to travel corridors, water sources, and other resources, as well as in relation to needs for mutual defense, I describe a series of fortified habitation sites.

Crack-in-Rock Pueblo

Named for the need to climb through one of two fissures in a mesa in order to access the rooms on top, this well-preserved pueblo evokes a haunting need for security. It has two defensive walls restrict access via a fissure that has a ramp and stairway allowing entrance to the mesa top. These walls created defense in depth by providing a secondary line of defense to which defenders could retreat from a forward defensive position (Figure 8-7). If defenders retreated from the first wall to the second, attackers would have had to cross a kill zone, an open area without any protective cover, in order to assault the secondary line of defense. Loopholes in the secondary wall would have allowed archers in protected positions to fire upon attackers crossing this zone.

A series of rooms were built at the base of the mesa at the top of a steep talus slope that would have been difficult for attackers to ascend, and the other crack in the rock originates near the western rooms and provided access into the roomblock above. Excavations revealed a distinctive D-shaped kiva like those found in the Kayenta region to the northeast (Smith 1952a); other defensive sites in the Crack-in-Rock area like Middle Mesa, Horseshoe Mesa,and Antelope House also have these features. Limited trash deposition at the site suggests only a short occupation, and NPS archaeologists who stabilized the site and conducted limited excavations suggested that the lower rooms were earlier than the roomblock on top of the mesa (Voll and Mayer 1964). If this was the case, it indicates increasing investment in fortifications and a perceived need for greater security.

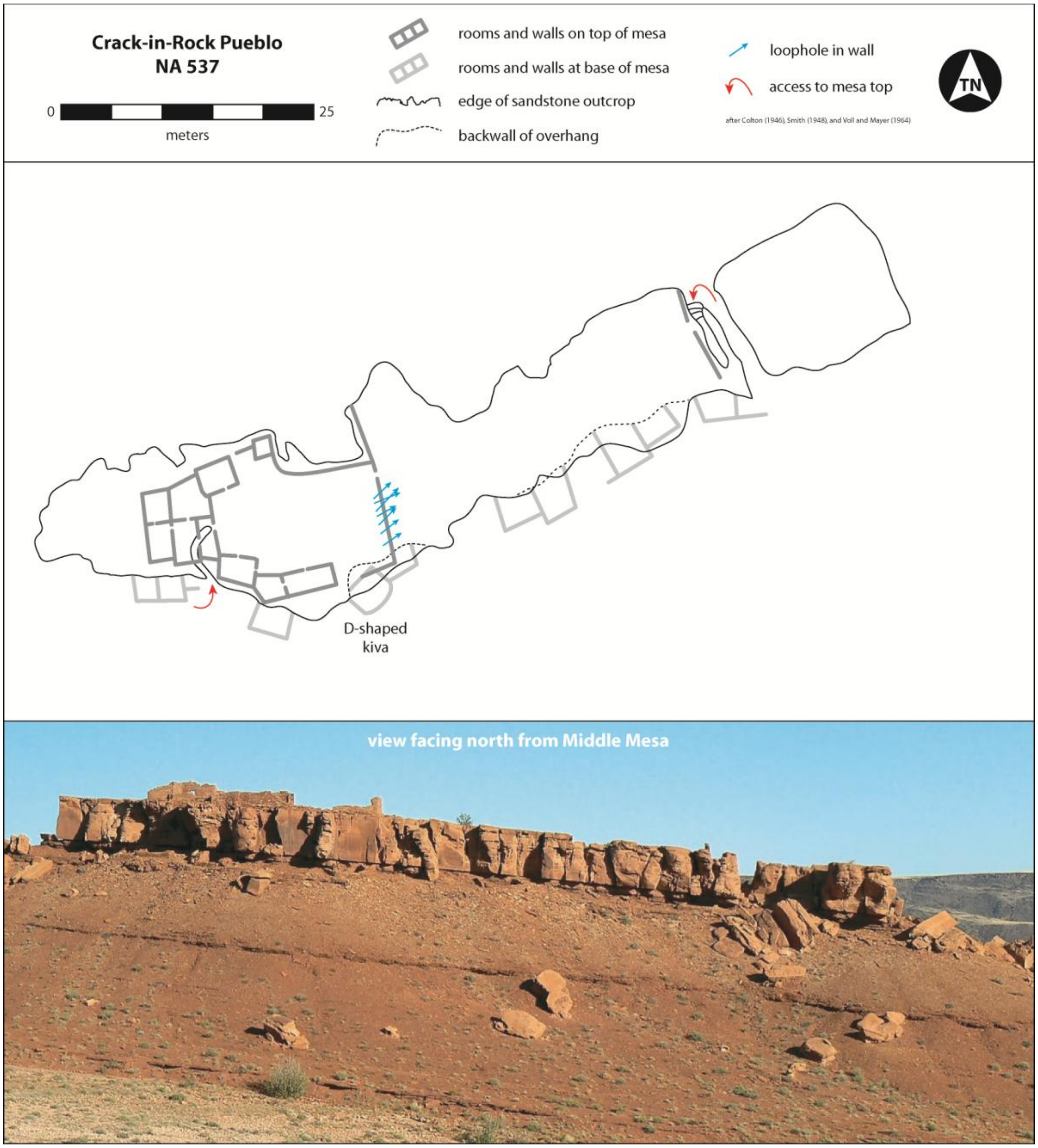


Figure 8-7. Map and photo of Crack-in-Rock Pueblo.

Wukoki Pueblo

First noted by Lieutenant Lorenzo Sitgreaves of the U.S. Army Corps of Topographical Engineers during an 1851 survey for potential transportation routes through the region (Sitgreaves 1854:8-9), Wukoki Pueblo has an impressive three-story tower still standing on the top of a small mesa (Figure 8-8). The buildings and a wall around the perimeter of the mesa top restricts access. The tower allows a line-of-sight connection with Heiser Ruin, another similar tower-like pueblo 2.4 km to the south, and with Wupatki Pueblo and other nearby sites. Crack-in-Rock also has line-of-site connections with other proximate sites, and while the two sites are not intervisible, the

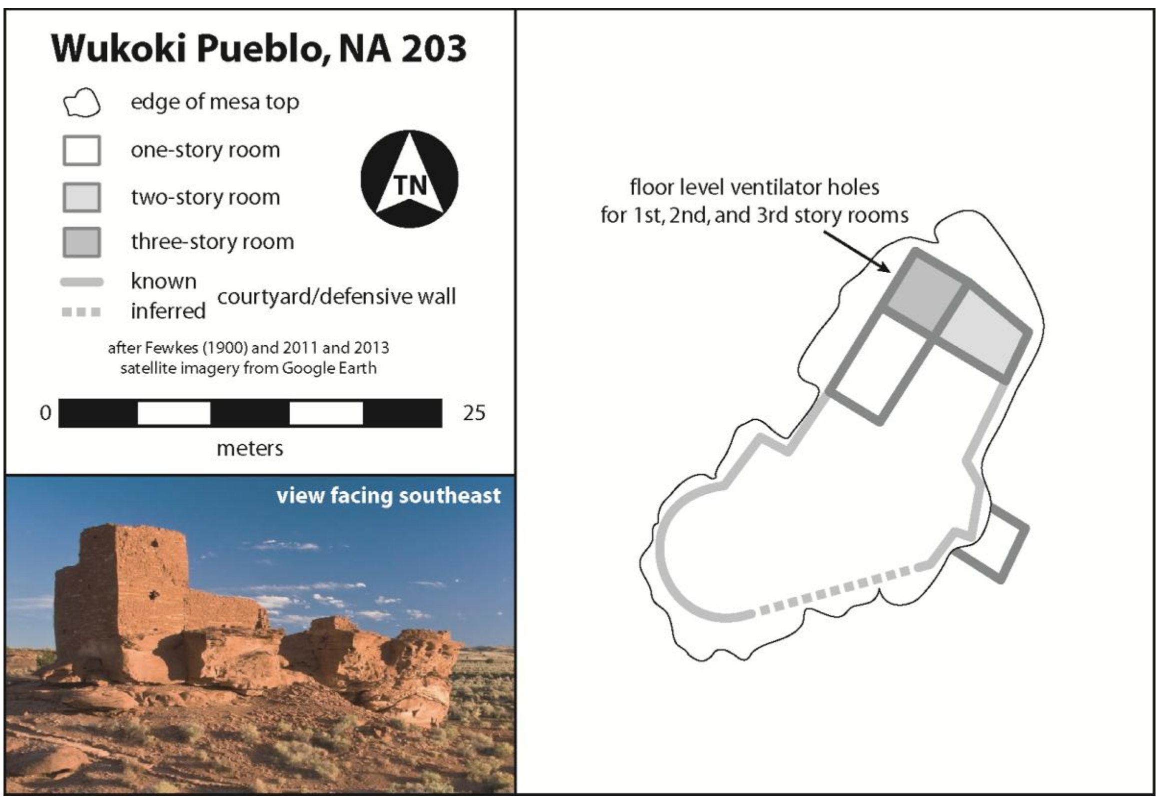


Figure 8-8. Map and photo of Wukoki Pueblo.

network of connecting sites between them could have allowed communication. The emergence of these networks of line-of-sight connectivity suggests the development of alliances for mutual defense and increasing social scale of conflict. Wukoki, Heiser, and other sites in the Wupatki area are well-situated to monitor movements along Deadman's Wash and Kana'a Wash, routes that led to the Black Falls crossing on the Little Colorado River and continued to be used into historic times by the Hopi when travelling from the Hopi Mesas to the San Francisco Peaks (Colton 1964; Ferguson and Loma'omvaya 2011).

Defensive Sites in the Citadel area

The Citadel area in Wupatki National Monument has one of the densest concentrations of defensive sites in the region (Figure 8-9). They are almost all inter-visible, which, along with their proximity suggests that the occupants were members of an allied community. Other aspects of site locations in the Citadel area also indicate that social units cooperated for mutual defense. North of and visible from the Citadel are two groups of defensive sites occupying the prominent ends of lava-capped mesas. On each mesa, two or three roomblocks, each representing distinct co-residential social units, are arranged together to block access and provide mutual support (Figures 8-10 and 8-11). Like in the nearby Crack-in-Rock and Wupatki areas, the emergence of networks of line-of-sight connections and these groupings for mutual defense indicate increasing social scale of conflict.

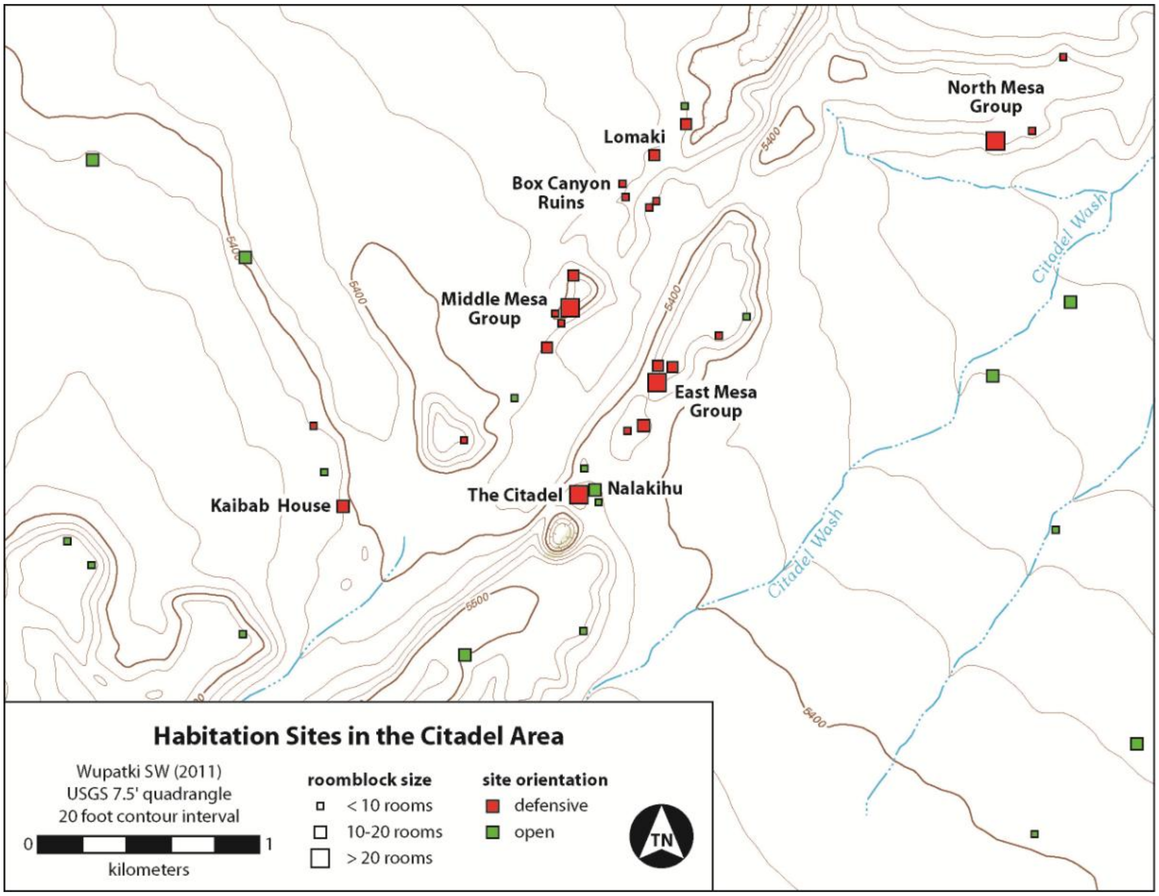


Figure 8-9. Map of habitation sites in the Citadel area.

Turkey Tanks Fort

This site is built on a narrow outcrop where San Francisco Wash cuts through a lava flow creating a series of tanks in the water-resistant basalt that catch runoff in the wet periods and holds water through subsequent dry periods (Figure 8-12). Two walls across the narrow outcrop block access to the rooms at the end and create defense in depth. Three excavated rooms at the end all had hearths and were used for habitation. The site directly overlooks a natural water source and the residents likely controlled access to this limited and critical resource. Petroglyphs of Hopi clan symbols in the canyon above and

Figure 8-10. Grouping of defensive sites on East Mesa in the Citadel area.

below the tanks and the fort may have expressed the identity of the site's occupants and proclaimed their control ofthe water. Other fortified habitations, particularly in the lower-elevation Wupatki and Roden Basins, are also located near water sources (Table 8-1). Controlling access to these water sources may have been an important strategic goal that guided the placement of these sites; if so, this suggests competition for resources after the eruption.

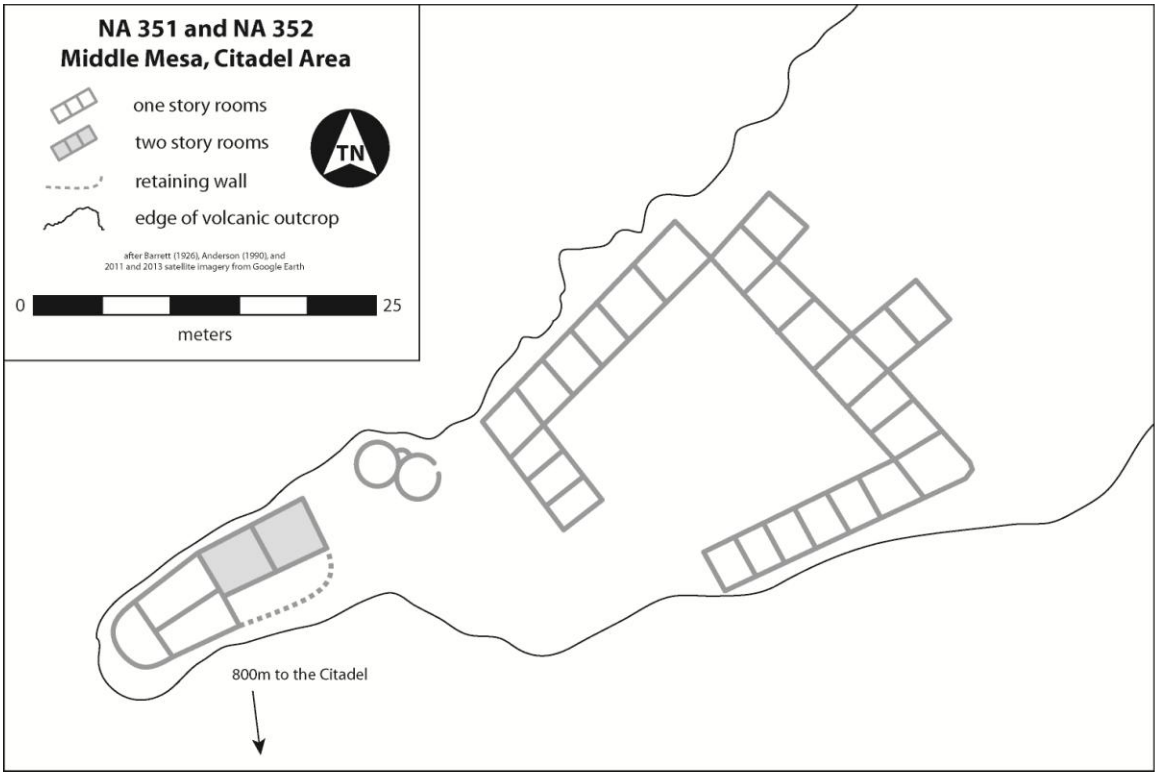


Figure 8-11. Grouping of defensive sites on Middle Mesa in the Citadel area.

Table 8-1. Distances between fortified habitations and associated water sources

Fortified Habitation	Water Source	Distance in Meters
Heiser Pueblo (NA 202)	Peshlakai Spring	1930
	Heiser Spring	1330
The Eyrie (NA 474)	Grass Tank	950
Wupatki Pueblo (NA 405)	Wupatki Spring	290
NA 920	Roden Spring	55
NA 720		40
NA 715	Little Roden Spring	15

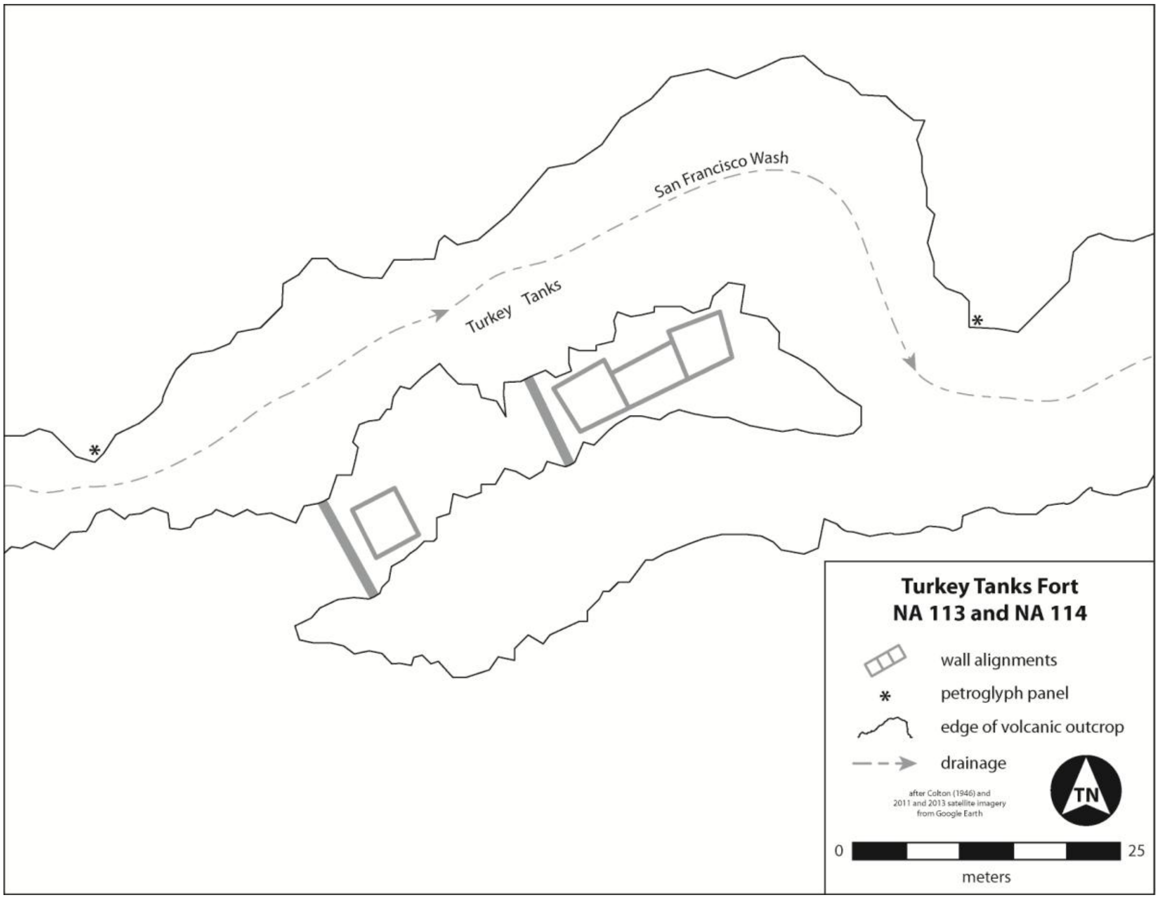


Figure 8-12. Map of Turkey Tanks Fort.

Piper's Crater Fort

Located on the top of a cinder cone more than 120 m above the surrounding area (Figure 8-13), Piper's Crater Fort is far removed from the necessities of daily life and required substantial costs in time and effort to transport food, water, and firewood to the site. The limited ceramic assemblage indicates a post-1220 occupation, and the site has one of the latest tree-ring dates for the region, a non-cutting date of 1246 (Robinson et al. 1975). Like Piper's Crater Fort, other post-1220 fortified habitations like New Caves and Old Caves are also located on the top of cinder cones more than 100 m in height. Both of

Figure 8-13. Map and photo of Piper's Crater Fort.

these sites also have numerous cavates and excavated cellars in rooms creating substantial secured storage (Colton 1946; Kamp and Whittaker 2009) indicating intensifying conflict and a greater need to protect food stores resulting from changing tactics and goals.

Petroglyphs and Fortified Habitations

Petroglyph panels with recognizable Hopi clan symbols that may have identified the social identities of the inhabitants are found associated with some fortified habitation sites (Figure 8-14), including sites in the Crack-in-Rock and Citadel areas in the frontier zone and in the heartland at Turkey Tanks Fort and NA 3999. At Crack-in-Rock Pueblo, one panel not only has clan symbols, but also a possible depiction of a sodality leader or member (Figure 8-15), suggesting that new sodalities were being developed in order to integrate emergent unilineal descent groups. How rock art in the Flagstaff region may relate to expressing social identities and signifying social boundaries remains to be systematically examined, but the association of known Hopi clan symbols with fortified sites suggests that localized kin groups had begun organizing for mutual defense as Stone and Downum (1999) suggest happened in order to gain and defend access to the extensive land holdings needed to practice agriculture in the region.

Figure 8-14. Petroglyph panel below a fortified room at Middle Mesa (WS-833) with Young Corn (Piikyasngyam) clan symbols in the center of the photo.

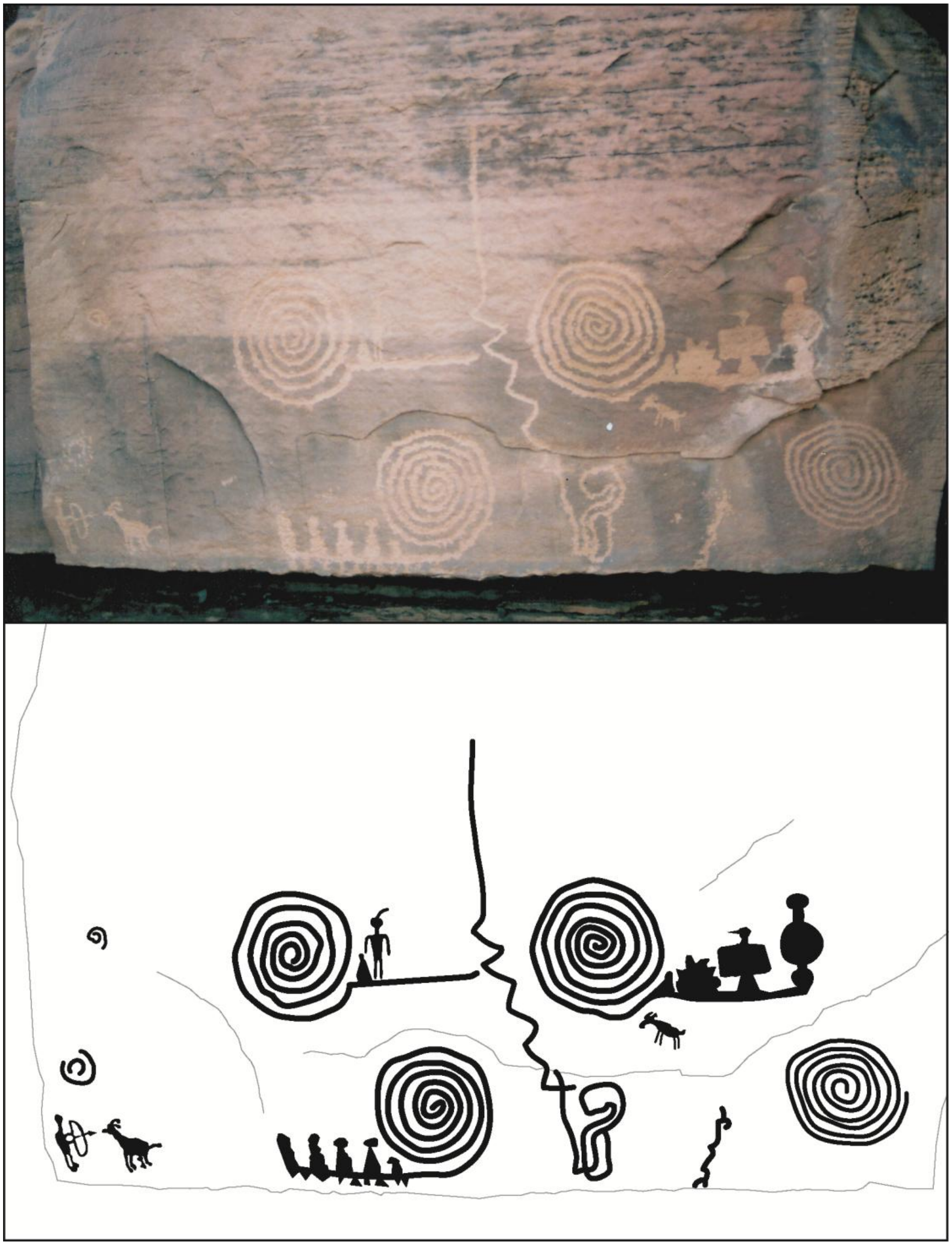


Figure 8-15. Petroglyph panel at Crack-in-Rock Pueblo with Hopi clan and sodality symbols. On the line leading from the upper spiral on the right are Sun Forehead (Qalngyam) and Eagle (Kwangyam) clan symbols, and on the line leading from the upper spiral on the left is a member of the One Horn sodality (Kwaakwant).

SPATIAL AND TEMPORAL DISTRIBUTIONS OF DEFENSIVE SITES

The previous descriptions of different defensive types alluded to some spatial and temporal variation in their distributions. The two expectations developed at the beginning of the chapter included one for temporal changes in defensive site use and one for spatial variation. Temporally, the increasing frequency and predictability of conflict following environmental disturbances should lead to increased use of defensive sites and shifts from the use of fortified refuges to fortified habitations. Spatially, use of defensive sites should be higher in the beginning of the chapter included one for temporal changes in defensive site use and one for spatial variation. Temporally, the increasing frequency and predictability of conflict following environmental disturbances should lead to increased use of defensive sites and shifts from the use of fortified refuges to fortified habitations. Spatially, use of defensive sites should be higher in the frontier zone than in the heartland because of the greater potential for competitive interaction in the frontier zone.

My research has identified a total of 133 defensive sites (Table 8-2; Figure 8-16) in the region based on review of the published archaeological literature on the region; survey of site records from MNA, the Coconino National Forest, and Wupatki National Monument; personal visits to many of the identified sites either when field directing a site monitoring program at Wupatki from 1996 to 1998 (O'Hara and Johnson 1998), exploring on forest lands while hiking or woodcutting from 1998 to 2006, or working for EcoPlan Associates on the Northern Arizona Shooting Range project in 2009 (Bryce et al. 2012a, 2012b); and use of satellite imagery available on Google Earth (http://earth.google.com). Google Earth was initially used to "revisit" known sites, obtain

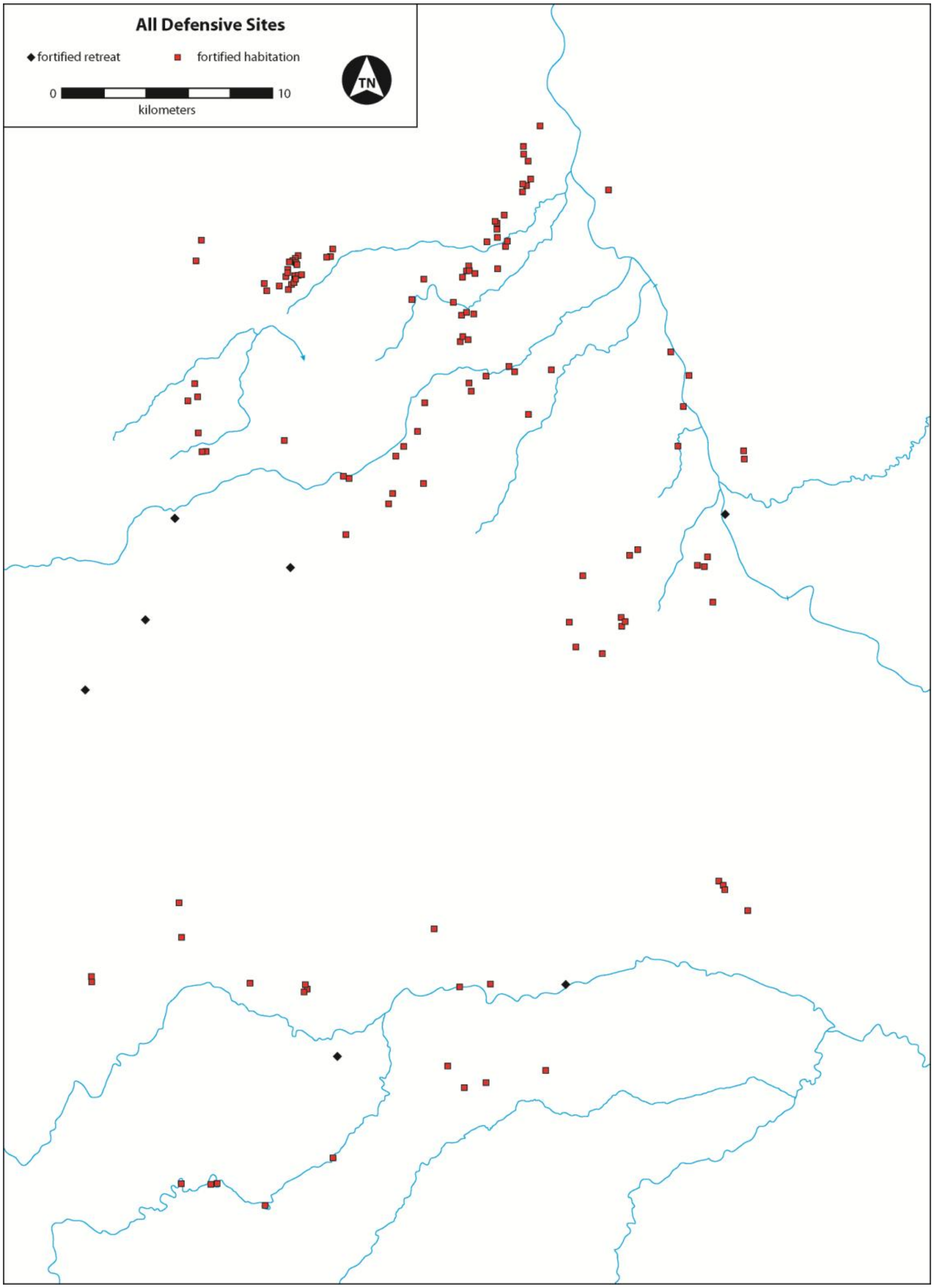


Figure 8-16. Map of all defensive sites in the Flagstaff region.

Table 8-2. Defensive sites identified in the Flagstaff region

Site Numbers	Site Names	Site Type	Pre-1085	1085-1130	1130-1160	1160-1220	1220-1275	MCD
Pre-Eruption Frontier Forts (3)								
NA 862	Medicine Fort	R	X					
NA 1539	O'Leary Mesa Fort	R	X					
NA 1765A	Deadman's Fort	R	X					
Crack-in-Rock / Antelope House Cluster (28)								
NA 537	Crack-in-Rock Pueblo	H				X		1186 ± 11
NA 538-545 / WS-833	Middle Mesa	H			X	X	X	
NA 546-554 / WS-834	Horseshoe Mesa	H			X	X	X	
NA 557		H				X	X	1194 ± 13
NA 625 / WS-355	Antelope House	H		X	X	X		1139 ± 10
NA 633-635 / WS-1027		H				X	X	1196 ± 12
NA 636 / WS-1043		H				X	X	1198 ± 15
NA 637 / WS-323		H		X	X	X		
NA 754 / WS-1807		H				X		
NA 755 / WS-1806		H				X		
NA 790 / WS-839	Cinnamon Mesa	H			X	X		
NA 791		H				X		
NA 792 / WS-840		H		X	X	X	X	1146 ± 14
NA 795 / WS-1801		H				X		1207 ± 28
NA 796 / WS-807		H				X		1181 ± 18
WS-329		H			X	X	X	
WS-404		H		X	X	X	X	1191 ± 13
WS-804		H				X		
WS-1466		H		X	X	X		
WS-1759		H			X	X	X	
WS-1762		H		X	X	X	X	
WS-1770		H			X	X	X	1183 ± 10
WS-2371		H			X	X	X	1174 ± 15
WS-2377		H			X	X	X	1165 ± 21
WS-2378		H			X	X	X	1200 ± 8
WS-2424		H			X	X	X	1189 ± 7
WS-2430		H			X	X	X	
-	CO Bar 1	H						
Wupatki Cluster (7)								
NA 202 / WS-2286	Heiser Ruin	H			X	X		1175 ± 16
NA 203	Wukoki	H			X	X		1172 ± 9
NA 405	Wupatki Pueblo	H		X	X	X	X	
NA 407 / WS-1395		H				X		1200 ± 18
NA 2222 / WS-1494	Campground Ruin	H		X	X	X	X	1181 ± 12
WS-746		H			X	X		
WS-751		H				X		
Antelope Canyon Cluster (3)								
WS-1067		H				X	X	1237 ± 12
WS-2000		H		X	X	X		1162 ± 9
WS-2002		H				X		
Citadel Cluster (23)								
NA 342 / WS-136	Kaibab House	H				X		
NA 343/WS-157	Magnetic Mesa	H			X	X	X	1175 ±21
NA 345-349/WS-1744 & 1748		H				X		1188 ± 0
NA 350 / WS-1743		H				X		
NA 351 / WS-1736		H				X		
NA 352 / WS-1723		H		X	X	X		
NA-353 / WS-1717 & 1718		H			X	X	X	1180 ± 12
NA 354A / WS-1685		H			X	X		
NA 354B / WS-1688		H				X		
NA 355	The Citadel	H			X	X	X	1161 ± 6
NA 359 / WS-82		H				X	X	
NA 360 & 361 / WS-1634 & 1635		H			X	X	X	
NA 368 / WS-1645		H				X	X	
NA 372 / WS-1638		H		X	X	X	X	
NA 373 / WS-1636		H		X	X	X	X	1184 ± 15
NA 374 / WS-1637		H			X	X	X	
NA 377 & NA 378/ WS-1695	Box Canyon Ruins	H				X	X	1197 ± 23
NA 379/WS-1692	Lomaki	H			X	X		
NA 384/WS-1679		H				X	X	
NA 656 / WS-1556	North Mesa	H			X	X		
NA 2932 / WS-1553		H				X		
NA 2934		H				X		
WS-1213		H				X		
Western Terraces Cluster (9)								
NA 201		H			X	X	X	1183 ± 27
NA 457		H			X	X		1160 ± 23
NA 459		H		X	X	X		1125 ± 11
NA 577		H			X	X		
NA 584		H			X	X		
NA 586		H			X	X		
NA 1814	Juniper Terrace	H			X	X	X	1165 ± 4
WS-2176		H			X	X		1149 ± 15
-	CO Bar 2	H						

R = Defensive Refuge, H = Fortified Habitation

Table 8-2. Defensive sites identified in the Flagstaff region (cont.)

Site Numbers	Site Names	Site Type	Pre-1085	1085-1130	1130-1160	1160-1220	1220-1275	MCD
Deadman Wash Cluster (12)								
NA 803	Strawberry Crater Fort	R		?	?			
NA 1591		H			X	X	X	1191 ± 27
NA 1592		H			X	X	X	1179 ± 27
NA 1597		H			X	X		
NA 1598		H			X	X		
NA 1599		H			X	X	X	1190 ± 25
NA 2110		H		X	X	X		1148 ± 10
NA 2217	Strawberry Crater Flow Fort	H			X	X		1170 ± 9
NA 2218		H			X	X	X	1197 ± 20
NA 29325		H				X	X	
-	South of NA 2218	H						
-	East of NA 2217	H						
Roden Basin / Little Colorado Cluster (22)								
NA 580	Long Fort	R						
NA 701		H						
NA 702		H						
NA 703		H						
NA 715	Little Roden Spring	H						
NA 720	Roden Spring A	H						
NA 750		H						
NA 920	Roden Spring B	H						
NA 979		H						
NA 2465		H						
-	SW of Little Roden Spring	H						
-	N of Roden Spring	H						
-	Roden Great Kiva	H						
-	Section 2	H						
-	Section 3	H						
-	Section 34	H						
-	Little Colorado 1	H						
-	Little Colorado 2	H						
-	Little Colorado 3	H						
-	Navajo Nation 1	H						
-	Navajo Nation 2	H						
-	Navajo Nation 3	H						
Sheba Crater Cluster (4)								
-	Sheba Crater 1	H						
-	Sheba Crater 2	H						
-	Sheba Crater 3	H						
-	Sheba Crater 4	H						
Sinagua Heartland (22)								
NA 52	Fortress Hills	R	?	X	X	X		
NA 72	Old Caves Pueblo	H					X	
NA 113 & 114	Turkey Tanks Fort	H				X	X	1177 ± 23
NA 262	First Fort	H				X		
NA 295	Fifth Fort	H				X		
NA 316	Fourth Fort	H				X		
NA 393	Second Fort	H				X		
NA 474	The Eyrie	H		X	X	X		
NA 481-484	New Caves South	H				X	X	
NA 485	New Caves Lava Plug	H						
NA 486-503, 723-733	New Caves North	H				X	X	
NA 507 / NA 10720A	Robber's Roost South	H				X		
NA 508 / NA 10720B	Robber's Roost North	H				X		
NA 534	Piper Crater Fort	H				X	X	
NA 735	Third Fort	H				X		
NA 1785	Ridge Ruin	H		X	X	X		
NA 3285		H				X		
NA 3999		H				X		
NA 16387	Sunset Pueblo	H			X	X		
NA 18461		H				X		
NA 27384		R				X		
AR-03-04-02-4992						X		

R = Defensive Refuge, H = Fortified Habitation locational information, and measure intersite distances, but the high resolution of much of the recent imagery also allowed the identification of additional sites, some of which could then be associated with recorded data at MNA. However, 22 of the sites identified with Google Earth have not been recorded and lack chronometric data that would allow assignment to particular time periods (Figure 8-17). The remaining 111 sites have data on the presence/absence or frequency of temporally diagnostic pottery types that allow them to be assigned to one or more occupational periods using the ceramic group dating method developed by Colton (1946) (Figures 8-18 through 8-22). For the sites with frequency data either from excavations, surface collections, or surface inventories, mean ceramic dates with 95% confidence intervals were calculated following methods developed by South (1977) if there were 20 or more sherds of temporally diagnostic types. Details on these dating methods are presented in Appendix A. The post-eruption sites in Table 8-1 are grouped into nine clusters (Figure 8-23) based on aspects of geography, networks of site intervisibility, and patterns of similarities and differences in the plainware assemblages within and between clusters. I examine the clear temporal and spatial trends visible in the maps in terms of the *density* of the distribution of defensive sites and their *frequency* and *rate* of occurrence, and these latter two measures are then used to create an index of defensive site use.

Density

Across all time periods defensive sites are more prevalent and more densely distributed in the frontier zone than in the Sinagua heartland, which is expected given the

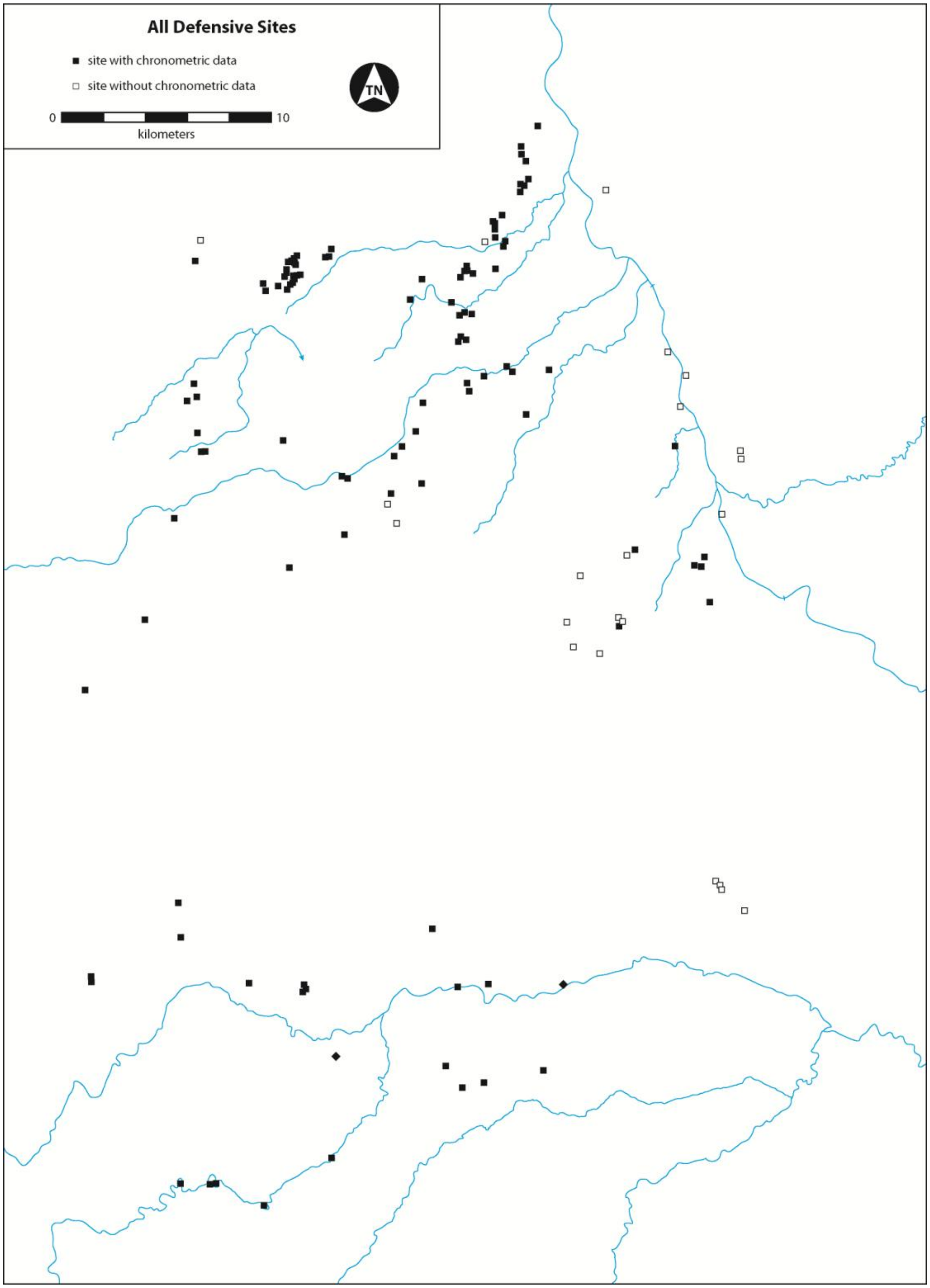


Figure 8-17. Map showing the presence or absence of chronometric data for defensive sites.

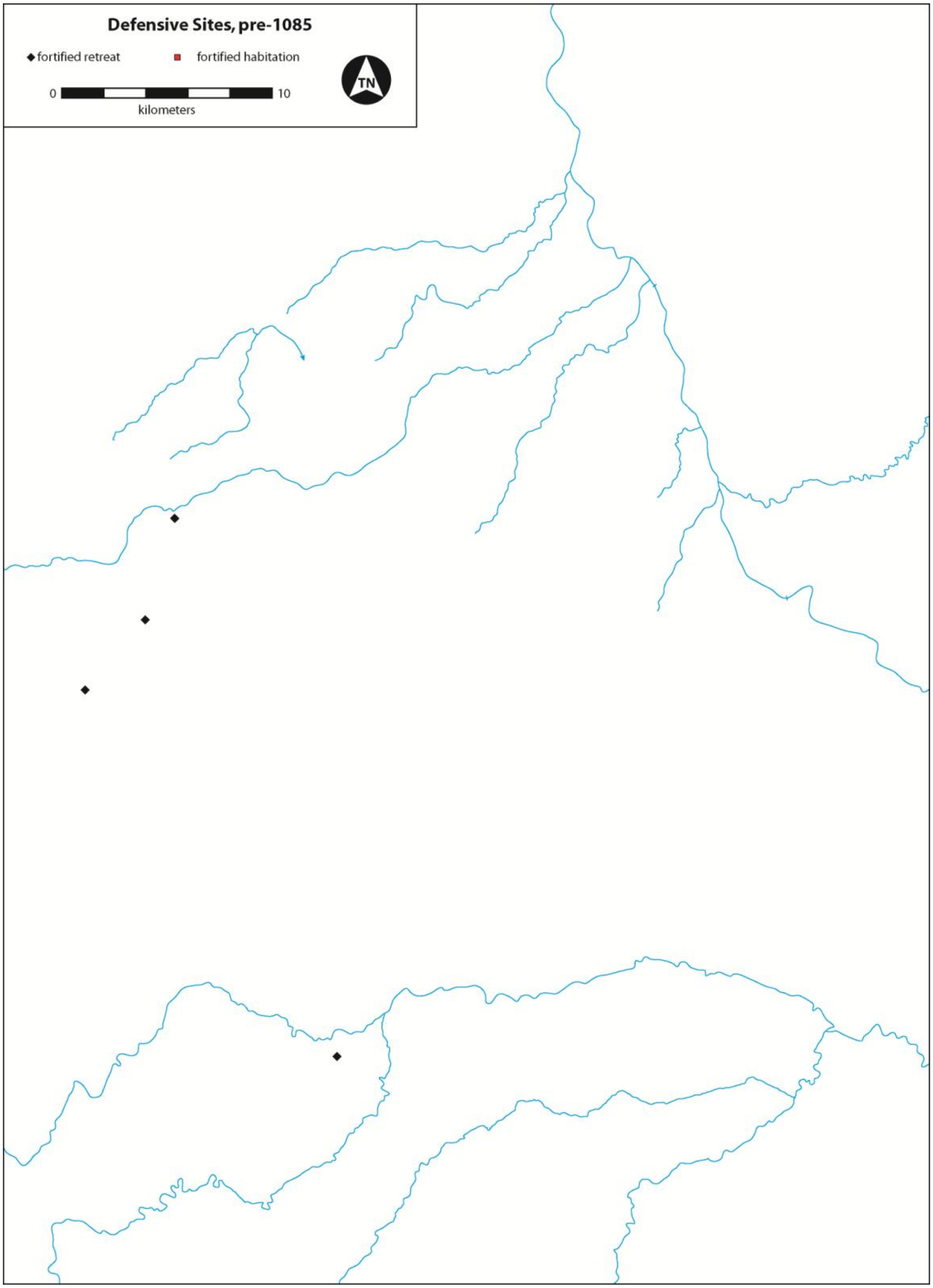


Figure 8-18. Map of defensive sites, pre-1085 (n = 4).

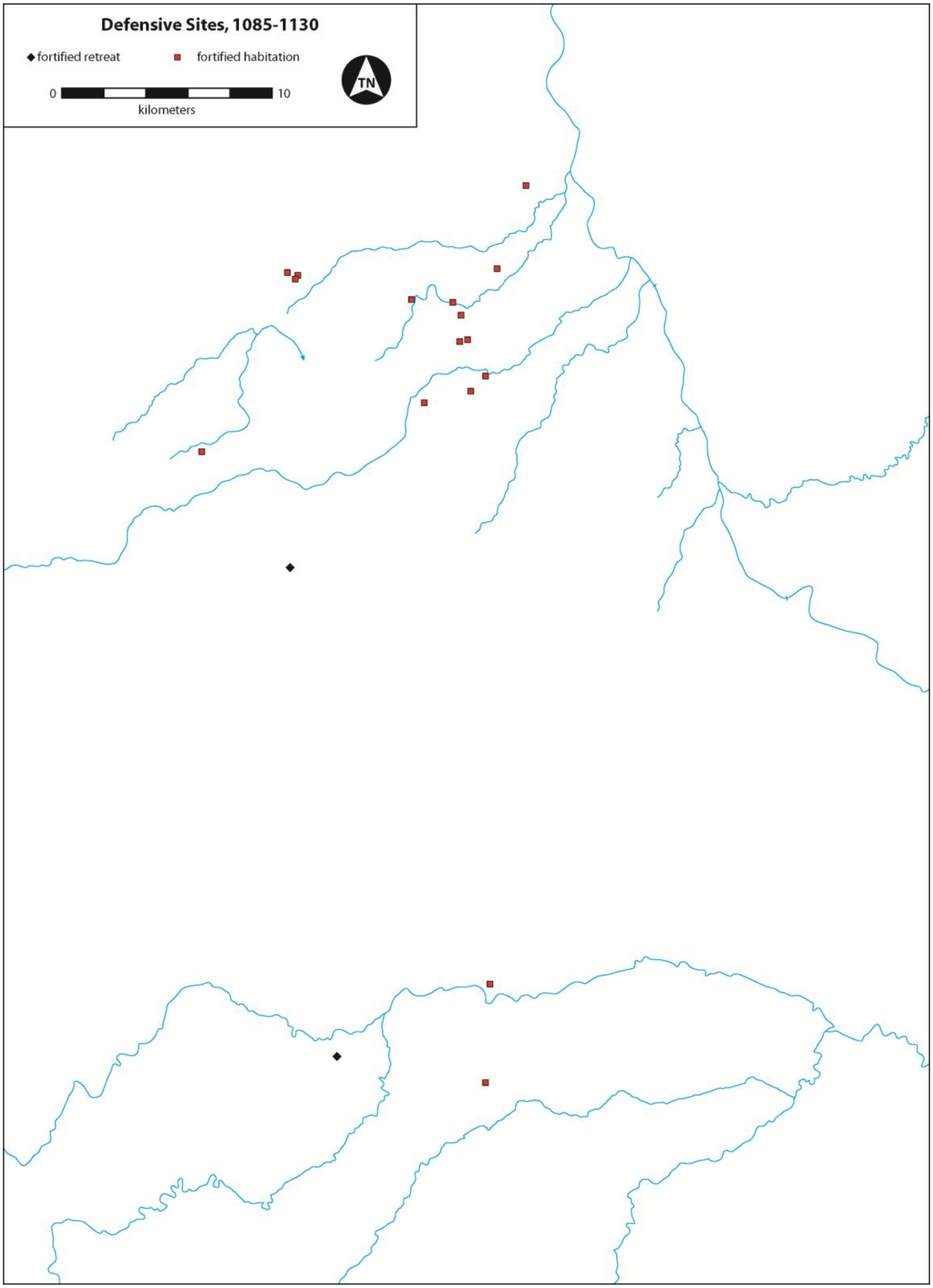


Figure 8-19. Map of defensive sites, 1085-1130 (n = 18).

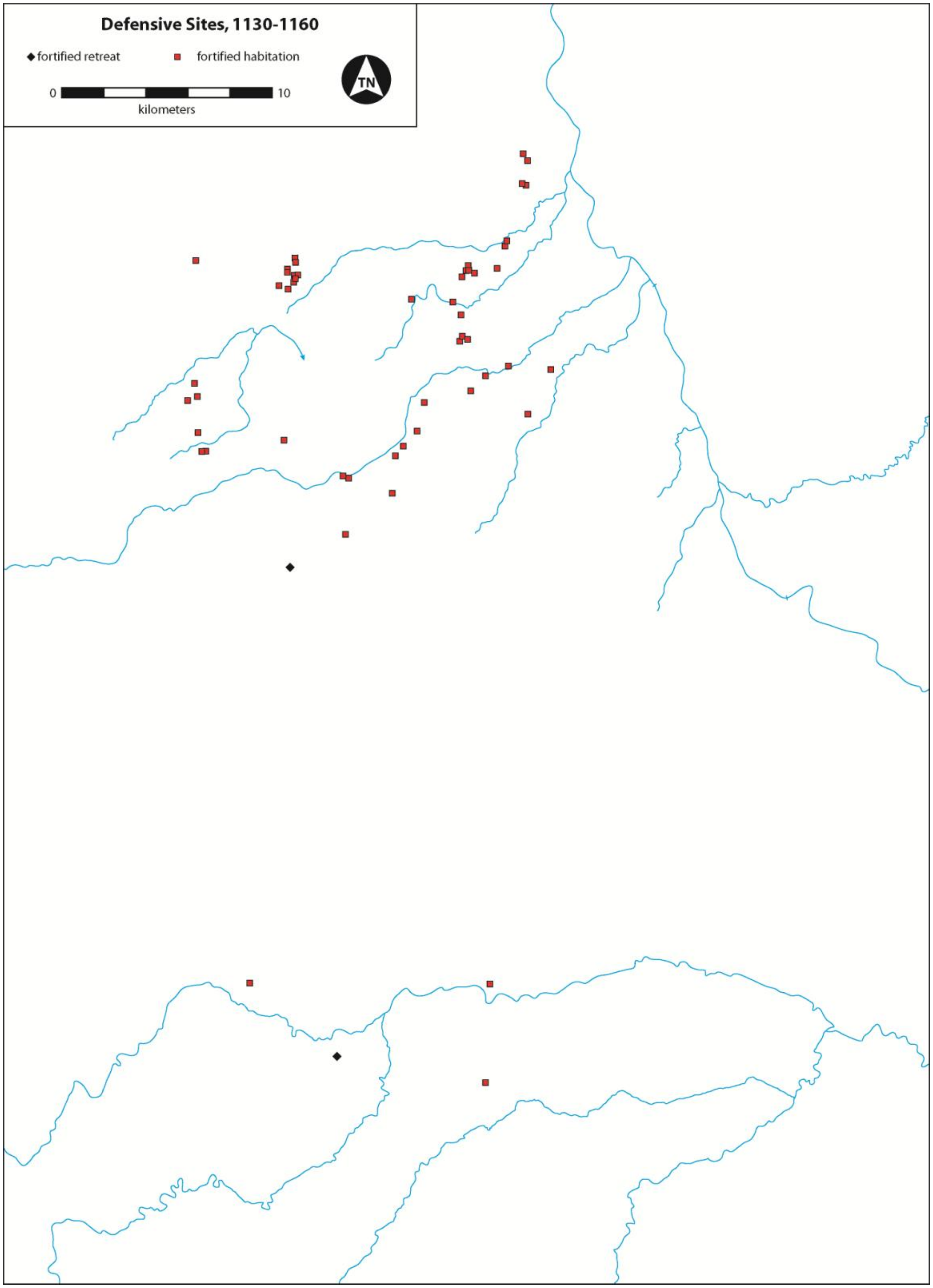


Figure 8-20. Map of defensive sites, 1130-1160 (n = 54).

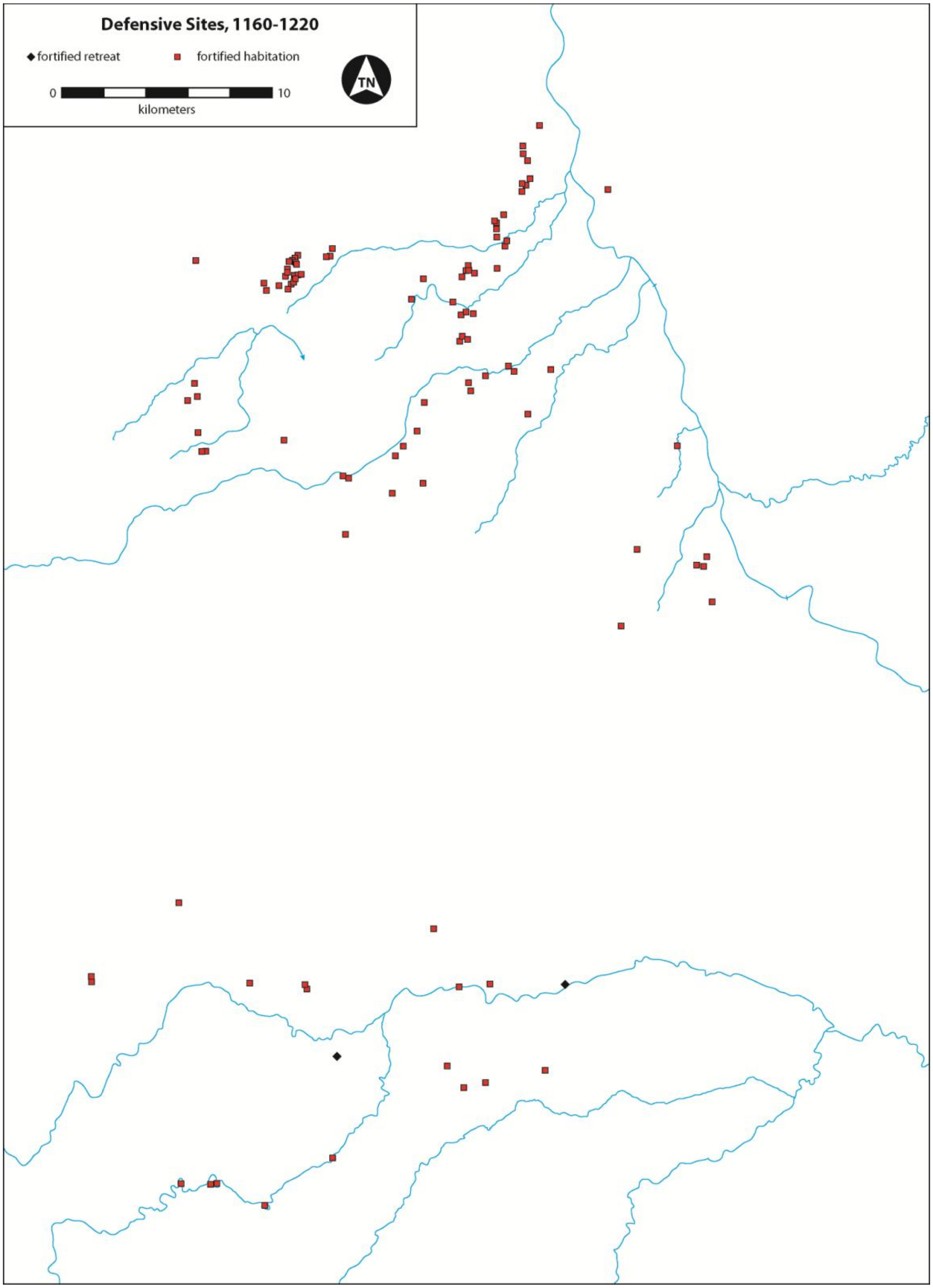


Figure 8-21. Map of defensive sites, 1160-1220 (n = 103).

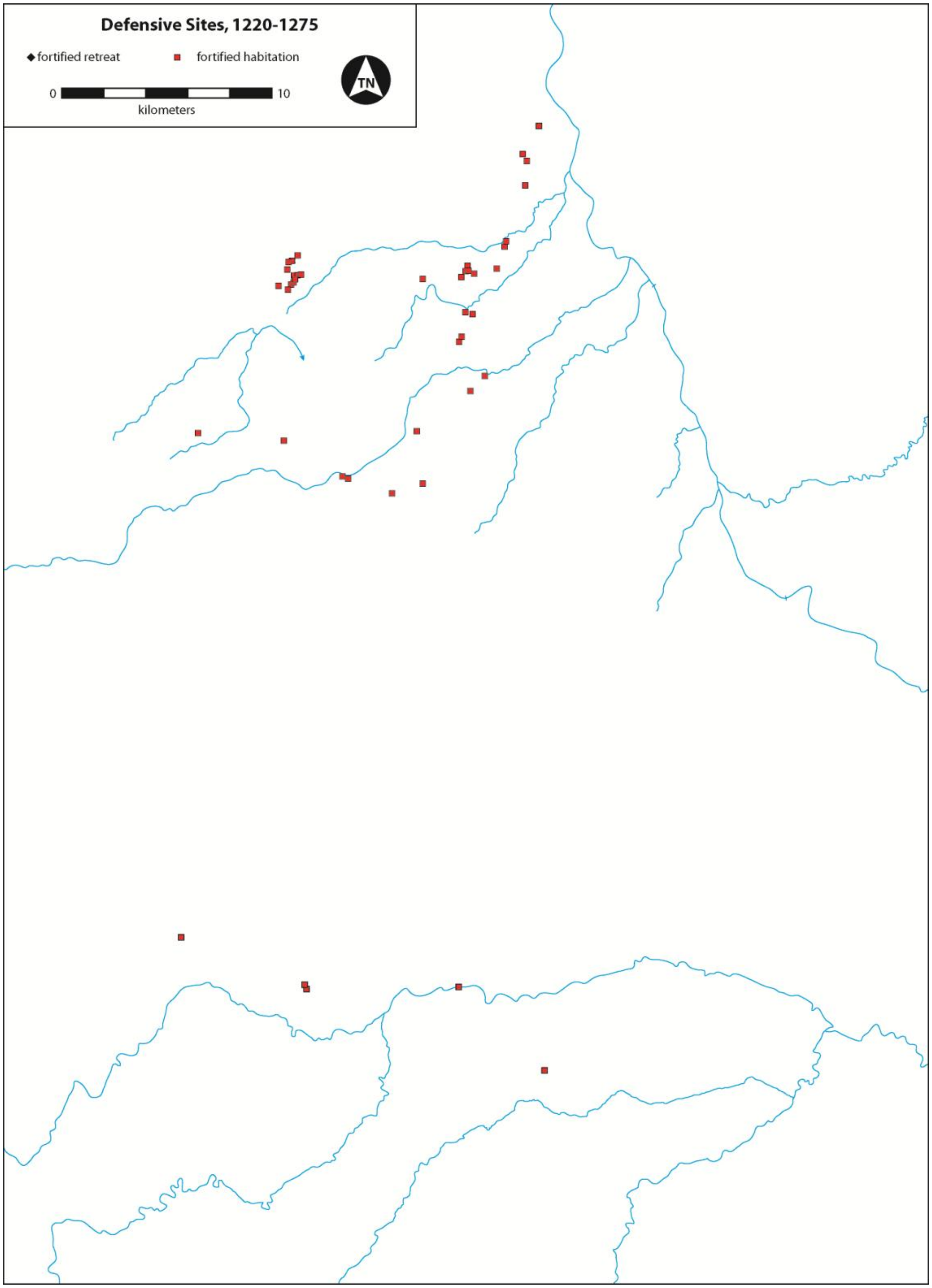


Figure 8-22. Map of defensive sites, 1220-1275 (n = 43).

Figure 8-23. Map of defensive site clusters.

greater potential for competitive interaction in the frontier zone. Greater density of defensive sites as well as evidence of inter-site visibility discussed above suggest greater cooperation and coordination for mutual defense. In order to compare the frontier zone and heartland more systematically, the distances between all defensive sites were measured for a group of sites from each area: (1) the dense Citadel cluster in the frontier zone where one of the densest distribution of defensive sites is found, and (2) the five forts along Walnut Canyon in the southern part of the Sinagua Heartland cluster (Figure 3-1) that were contemporaneous with one another and part of an integrated settlement system.

For each cluster the minimum, mean, and maximum values are plotted for the distances to the next closest contemporaneous defensive site and for the distances between all defensive sites in the cluster (Figure 8-24).The defensive sites in the frontier

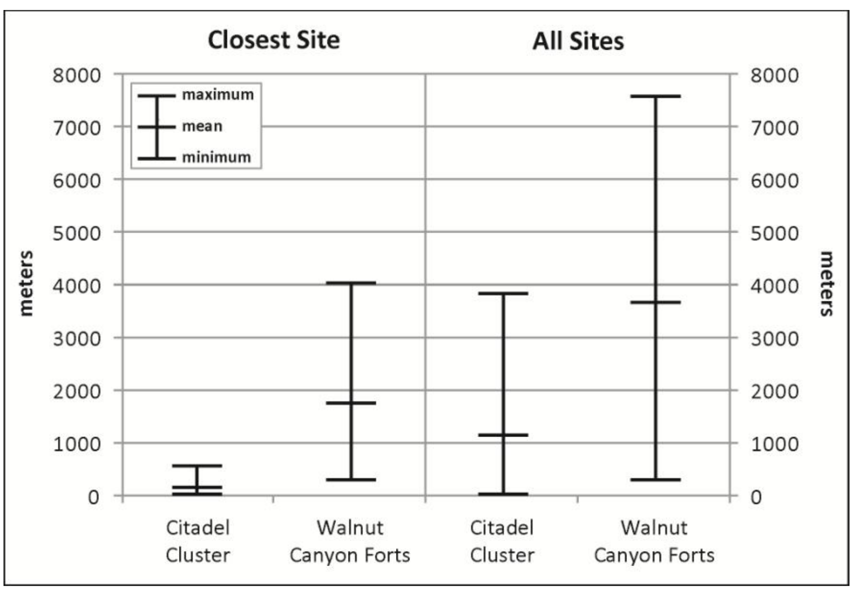


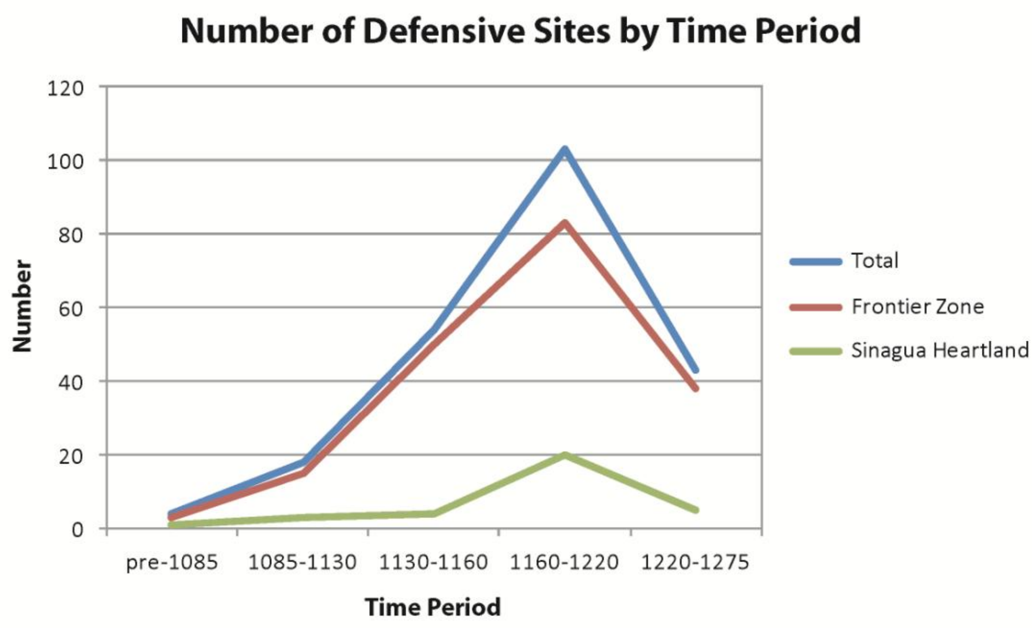
Figure 8-24. Distances between defensive sites in the Sinagua Heartland and the frontier zone.

zone are closer together and more densely packed than those in the Sinagua heartland indicating higher levels of cooperation and coordination for mutual defense in frontier zone communities. However, these frontier zone defensive sites were likely joined into several networks, indicated by distinct clusters with differences in the associated plainware assemblages.

Frequency

The distribution of defensive sites across time and space is assessed in terms of several measures: (1) count per time periods (the effects of different period lengths is considered below in the subsection on “Rates;” (2) relative proportions of the two types of defensive sites, fortified refuges versus fortified habitations; (3) the relative proportions of defensive sites in the Sinagua heartland versus those in the frontier zone; and (4) the percentage of all habitation sites that are defensive. The number of defensive sites increased from the pre-1085 period through the 1160-1220 period and then declined thereafter (Figure 8-25).

This pattern of growth and decline in the overall numbers of defensive sites matches the general population trends for the region (Colton 1946; Downum 1992). Using sites from within Wupatki National Monument where the total population of all sites is known from intensive survey, linear regression of the number of defensive habitation sites by time period against the number of non-defensive habitation sites by time period finds a strong correlation between the two (r^2 = 0.9641).



	Pre-1085	1085-1130	1130-1160	1160-1220	1220-1275
Total	4	18	54	103	43
Frontier Zone	3	15	50	83	38
Sinagua Heartland	1	3	4	20	5

Figure 8-25. Numbers of defensive sites by time period and location.

Solometo (2004, 2006) proposed that a shift from use of fortified refuges to use of fortified habitations indicates greater intensity of intergroup conflict with more frequent attacks, fewer limitations on legitimate targets of violence, and greater social distance between antagonists. In the Flagstaff region as a whole, there is a major shift in the types of defensive sites. Before the eruption, only fortified retreats were used; all four of the pre-eruption defensive sites are fortified refuges. After the eruption, a vast majority of defensive sites (96.8 %) are fortified habitations. Like in Solometo's study area, changes in the defensive site types used indicates increasing intensity of conflict in the region over time. Overall, and in all time periods, a far greater proportion of defensive sites are located in the frontier zone (Table 8-3). As mentioned above, such a distribution is expected given the greater potential for competition among the culturally diverse settlers of the frontier zone.

The frequency of defensive sites can also be assessed by calculating the percentage of all habitation sites that are defensive by time period and by area. Survey data from Wupatki National Monument and the Medicine Valley area are used for the frontier zone. The monument has been intensively surveyed recording a total of 2,668 archaeological sites including 896 datable prehistoric habitation sites (Anderson 1990a; Sullivan and Downum 1991) and it is likely that all sites within its boundaries have been recorded. In contrast, adjacent areas in the frontier zone have more discontinuous and less thorough and intensive survey. However, only one site pre-eruption site was identified in the Wupatki survey, as settlement before the eruption was focused in higher elevation areas west and southwest of the monument. To calculate pre-eruption values for the frequency and rate of defensive sites, a sample of habitation sites dating to the 1000-1085 time period recorded within a 1-km radius of Medicine Fort was compiled (21 sites including Medicine Fort). Like the Wupatki survey data, it is likely that all sites within in this well-

Table 8-3. Proportions of all defensive sites by time periods

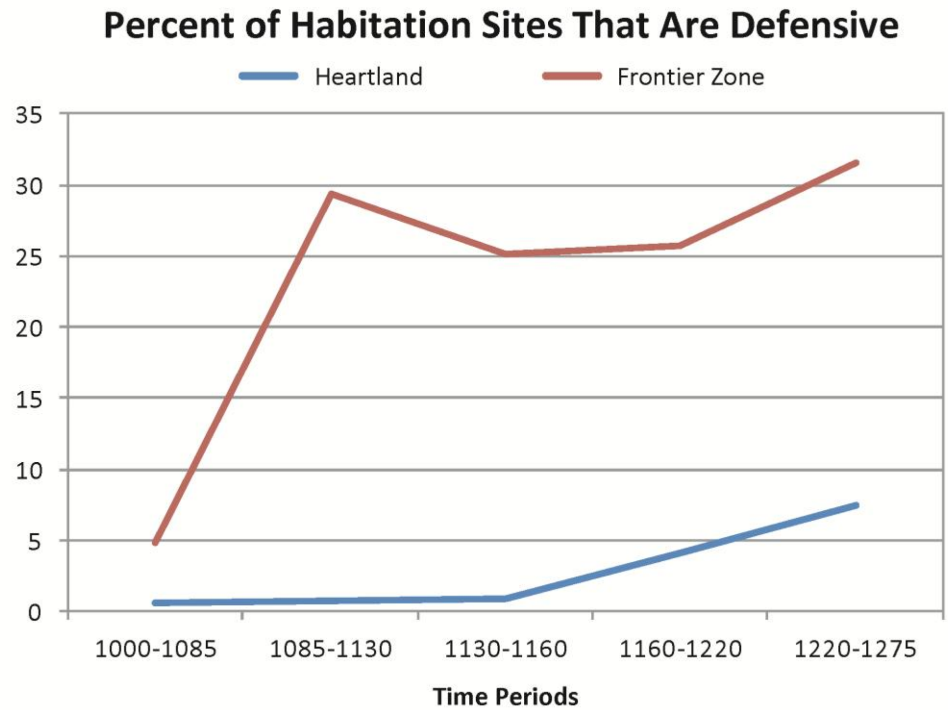
Location	Time Periods					All Time Periods
	pre-1085	1085-1130	1130-1160	1160-1220	1220-1275	
Frontier Zone	75.0	83.3	92.6	80.6	88.4	85.1
Sinagua Heartland	25.0	16.7	7.4	19.4	11.6	14.9
Whole Region	1.8	8.1	24.3	46.4	19.3	-

studied area have been recorded (Colton 1946; Parry 1981; MNA site files, O'Leary Peak USGS quadrangle).

In the Sinagua heartland survey coverage is discontinuous and varies in both the intensity of survey efforts and the nature of site data recording. To calculate the percentage of defensive sites in the heartland, a sample of 891 habitation sites with 1,368 temporal components was compiled, using survey data from the Coconino National Forest and Walnut Canyon National Monument. As this sample from the heartland is not a complete record of all habitation sites from the area, the percentage calculated using this sample was adjusted with empirical Bayesian methods to provide a more meaningful estimate. The details of this method are presented in Appendix B with other information about calculating the indices used. As expected, the percentage of habitation sites that are defensive is much higher in the frontier zone than it is in the heartland (Figure 8-26).

Rate

The analyses above demonstrate general trends across time and space in the distribution and frequency of defensive sites. As noted above, they generally follow overall trends in population. In this subsection I refine these measures by taking into account the variable lengths of time periods and accounting for population more systematically. When investigating the population trends at Wupatki, Sullivan and Downum (1991) recognized these issues and calculated an annualized rate of room construction by time period using the data from the intensive survey of the monument. The total number of rooms added during a time period was divided by the number of



Time Periods	Heartland				Frontier Zone		
	Defensive	Total	%	Bayes %	Defensive	Total	%
1000-1085	1	103	0.97	0.54	1	21	4.76
1085-1130	3	370	0.80	0.67	17	58	29.31
1130-1160	4	387	1.04	0.91	33	131	25.19
1160-1220	20	459	4.37	4.15	56	218	25.69
1220-1275	5	48	10.87	7.52	30	95	31.58

Figure 8-26. Percentage of defensive sites among all habitation sites.

years in that time period to get a rooms per year measure (Figure 8-27). This measure provides an approximation of the rates of population growth.

Similar annualized rates of site construction were calculated for the heartland and frontier zone (Figure 8-28). These measures show that the rate of fortified site

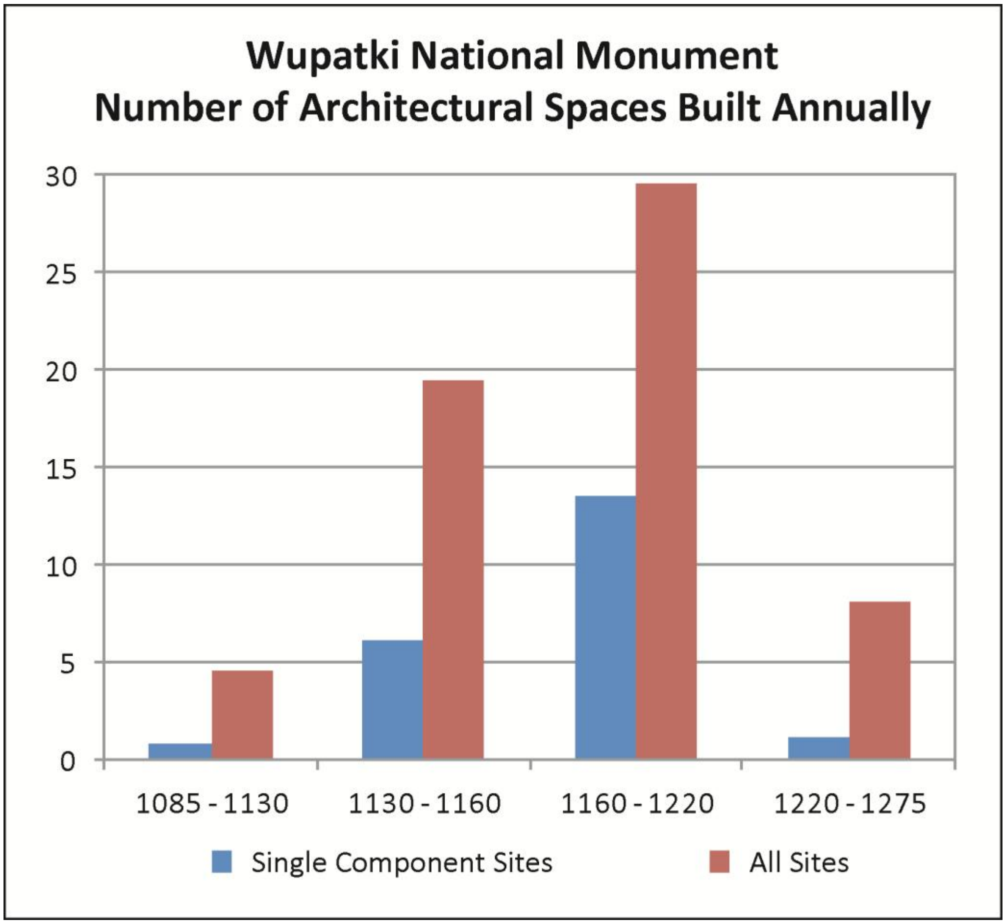
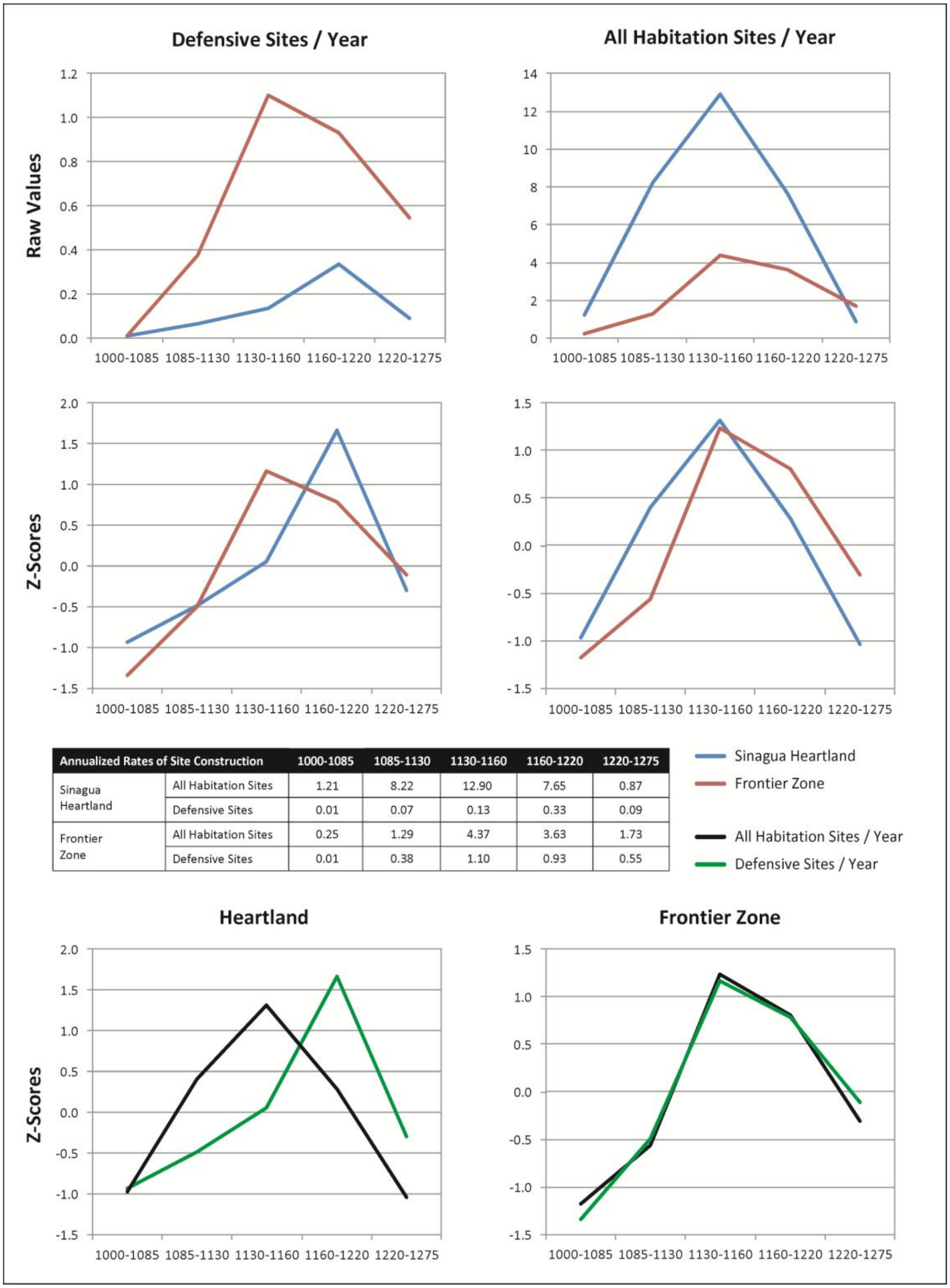


Figure 8-27. Annualized rates of room construction at Wupatki National Monument by time period (after Sullivan and Downum 1991).

construction in the frontier zone greatly exceeds that in the heartland. It peaks during the 1130-1160 period in the frontier zone while the peak in the heartland is during the subsequent 1160-1220 period. When the raw values of the rates are standardized as z-scores, the peak in the heartland is slightly more significant in terms of its standardized deviation from the mean than the earlier peak in the frontier zone. The peak in the rate of defensive site construction in the frontier zone corresponds to the peak in rate of overall site construction for the area, while in the heartland the peak in the rate of defensive site



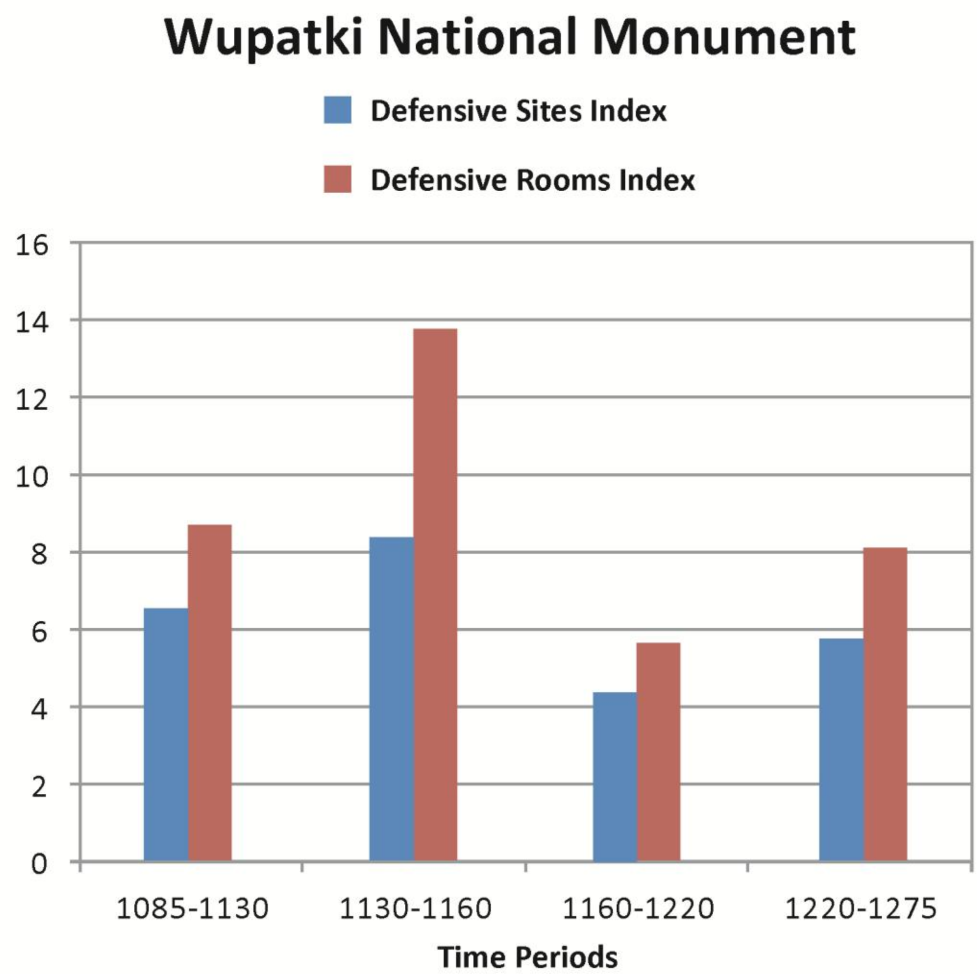
Annualized Rates of Site Construction		1000-1085	1085-1130	1130-1160	1160-1220	1220-1275
Sinagua Heartland	All Habitation Sites	1.21	8.22	12.90	7.65	0.87
	Defensive Sites	0.01	0.07	0.13	0.33	0.09
Frontier Zone	All Habitation Sites	0.25	1.29	4.37	3.63	1.73
	Defensive Sites	0.01	0.38	1.10	0.93	0.55

Figure 8-28. Comparison of the annualized rates of construction for all habitation sites and defensive sites.

construction follows the peak in rate of overall site construction. In both areas, the overall rate of site construction peaks during the 1130-1160, and since the sample sizes of sites are greatly different, these rates are best compared as z-scores, which indicate different trajectories of growth and decline about the peak, with more rapid growth and slower decline in the frontier zone compared to the heartland.

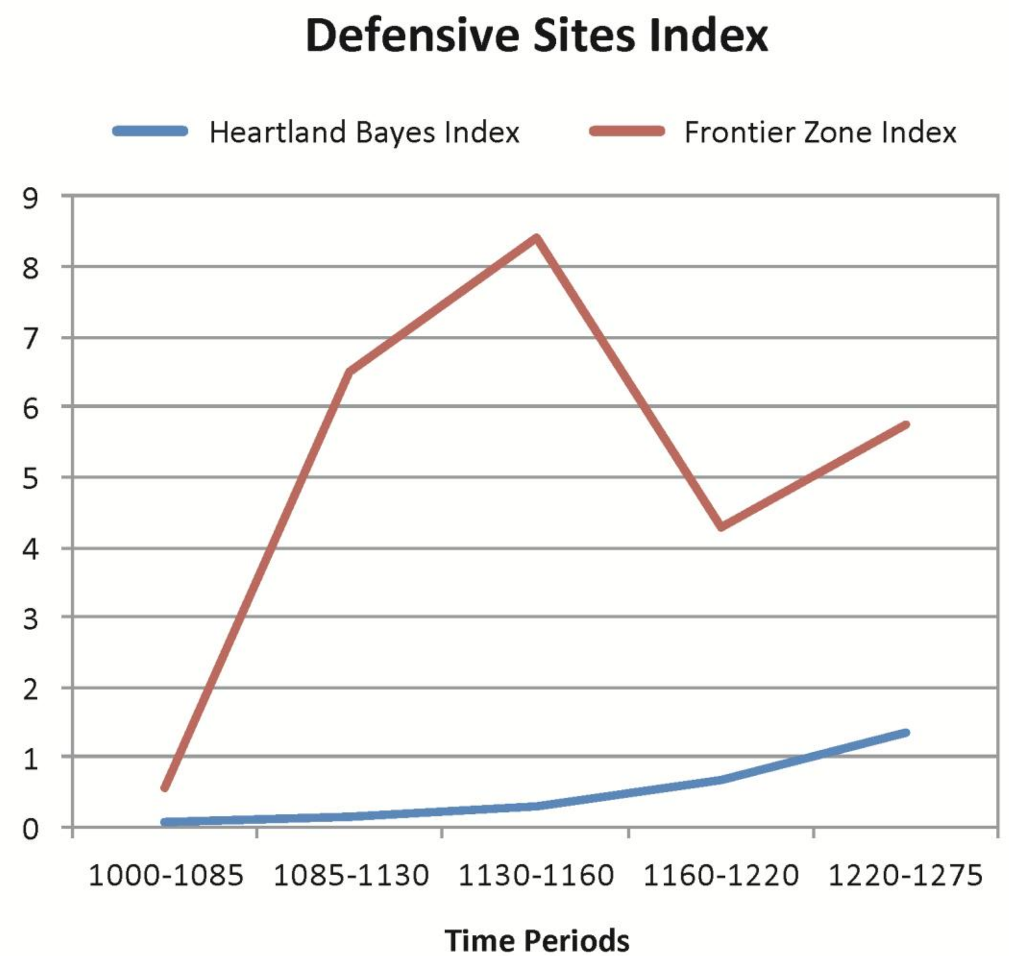
Indexing Frequency and Rate

Building on these methods, I developed an index of defensive site and room use that measures both the frequency of defensive sites in the overall population of habitation sites and the annualized of rate of their construction. This allows me to consider trends in relation to environmental variables, and thus to evaluate the expectation that defensive site use will increase following environmental disturbances. For the frontier zone, the data from the Wupatki survey allowed the calculation of a defensive room index as well (Figure 8-29). Lack of sufficient comparable data on room counts for the heartland sample, however, precluded the calculation of a defensive rooms index for that area. Details of how these indices were calculated are presented in Appendix B. In general, the frontier zone has much higher (up to 43.4 times higher) index values than the heartland (Table 8-4) and the index has a more varied trajectory over time (Figure 8-30). In the concluding section, these trends are compared with data on the changing environment and in relation to the expectations.



Time Periods	1085-1130	1130-1160	1160-1220	1220-1275
Total Habitation Sites	58	131	218	95
Defensive Sites	17	33	56	30
Total Habitation Rooms/Period	183.66	508.33	969.33	326.67
Defensive Rooms/Period	73.08	208.76	327.6	144.93
Sites Index	6.51	8.40	4.28	5.74
Rooms Index	8.84	13.69	5.63	8.07

Figure 8-29. Defensive sites and rooms indices for Wupatki National Monument subset of the frontier zone sample.



Time Period	Heartland		Frontier Zone Index
	Raw Index	Bayes Index	
1000-1085	0.11	0.06	0.56
1085-1130	0.18	0.15	6.51
1130-1160	0.35	0.30	8.40
1160-1220	0.73	0.69	4.28
1220-1275	1.98	1.37	5.74

Figure 8-30. Comparison of defensive sites index values between the heartland and frontier zone.

Table 8-4. Frontier zone index values divided by heartland index values by time period

Time Period	Frontier Zone Index / Heartland Index
1000-1085	8.9
1085-1130	43.4
1130-1160	27.8
1160-1220	6.2
1220-1275	4.2

RESULTS AND CONCLUSIONS: ENVIRONMENTAL DISTURBANCES AND DIMENSIONS OF CONFLICT

The expectations developed in Chapter 7 proposed that environmental disturbances should lead to greater investment in and use of defensive sites and that the greater potential for competitive interaction in the frontier zone will result in greater investment in and use of defensive sites than in the heartland. These expectations can be assessed by considering the index developed in this chapter in relation to the environmental trends developed in Chapter 2. The effects of three environmental disturbances are important: the 1085-1101 eruption of Sunset Crater and subsequent drought, the 1131-1142 megadrought, and the cool/dry period from 1214 to 1221. The first and second occurred at the beginning of the 1085-1130 and 1130-1160 periods respectively, and effects of these environmental disturbances should be seen in rising index values for those periods. The third occurred just before the transition between periods around 1220, and its effects should be seen in rising index values for the following 1220-1275 period.

While index values increased after 1085, the establishment of new defensive sites during the 1085-1130 period did not immediately follow the eruption of Sunset Crater as expected. In the heartland, sites established immediately after the eruption, like Winona

Village and the pit house village component of Ridge Ruin, were not defensive. The Fortress Hills site appears to have continued in use from before the eruption, but other defensive sites, like the pueblo component of Ridge Ruin, were not established until around 1120. In the frontier zone, construction at Wupatki Pueblo began at about the same as at Ridge Ruin, and both share distinctive Chaco-style masonry (see Chapter 11 for more details about the initial construction at these sites).

Other defensive sites in the frontier zone assigned to 1085-1130 time period on the basis of the presence of Black Mesa style sherds often have very few in relation to later types. These sites may have only been used seasonally during this period by groups seeking new opportunities who later established more substantial permanent settlements. Antelope House and NA 792 are two sites that have substantial early components in their inventoried surface assemblages that suggest they were established as full time residences ca. 1120, about the same time as Wupatki Pueblo. Wupatki is located along Deadman's Wash, an important travel corridor, and both Antelope House and NA 792 are located along the next two major drainages to the north: Antelope Wash and Citadel Wash. Both are also at the base of the Doney Cliffs where these drainages exit narrow canyons, strategic locations where travel became restricted. While the effects of the eruption and subsequent extreme dry period had subsided, the initial post-eruption settlement of the frontier zone in the early 1100s faced challenges of an environment transformed by the eruption. The high proportions of Tusayan Gray Ware and distinctive architectural styles including D-shaped kivas and use of fine ashlar masonry indicate that these settlers at Wupatki, Antelope House, and NA 792 came from the Kayenta region across the Little

Colorado River to the northeast, and they seem to have anticipated conflict when establishing defensive sites along key travel corridors in the frontier zone.

As predicted, defensive sites were more prevalent and densely distributed in the frontier zone, but the index indicates that use of defensive sites did not always conform to the expectations regarding environmental disturbances. The relationship between defensive site use in the frontier zone and environmental conditions conforms to the stated expectations. The value for the frontier zone defensive site index increases during the 1130-1160 period when the impacts of the megadrought would have been felt, falls during the 1160-1220 period when climate was more amenable, and then increases again after 1220 in the aftermath of the cool/dry period. The frontier zone defensive room index shows that the 1130-1160 time period has the highest measure of rooms per defensive site and the highest ratio value of the defensive rooms index to the defensives sites index (Table 8-5), indicating that larger defensive sites were being established during and after the 1131-1142 megadrought. A different pattern is found in the heartland that does not conform to the expectations. The heartland defensive site index increases steadily over time and not in apparent response to environmental disturbances. From each time period to the next, the heartland index values nearly or more than double (Table 8-6), and the heartland index increases during the 1160-1220 period while the frontier zone index decreases. The greatest increase in the heartland index follows the 1214-1221 cool/dry period.

Table 8-5. Increase factor of heartland index values from the preceding time period

Time Period	Heartland Index	Increase Factor from Preceding Period
1085-1130	0.16	-
1130-1160	0.31	1.9
1160-1220	0.70	2.3
1220-1275	1.83	2.6

Table 8-6. Rooms per defensive site and the ratio of the room and site indices for the frontier zone

Time Period	Rooms per Defensive Site	Ratio of Room to Site Indices
1085-1130	4.30	1.36
1130-1160	6.33	1.63
1160-1220	5.85	1.32
1220-1275	4.83	1.41

The shift from the use of fortified refuges before the eruption to fortified habitations afterwards indicates increasing intensity of conflict with greater need to secure persons and property. In terms of the dimension of conflict outlined in Chapter 5, the evidence from defensive site use suggests that intergroup conflict became more frequent and predictable, employed different tactics and goals, and increased in social scale after the eruption and particularly during the 1130-1160 and 1220-1275 time periods that followed environmental disturbances. The following chapter on evidence of skeletal trauma presents evidence of the types of violent interactions that motivated these investments in defensive sites and speak to increasing social distance between the antagonists.

CHAPTER 9 – EVIDENCE OF COMPETITION: SKELETAL TRAUMA

During certain periods, the prehistoric inhabitants of the Flagstaff region invested considerable effort constructing defensive sites, efforts likely motivated by events that caused people to fear for the security of themselves, their families, and their property. While the architectural and settlement data on defensive sites discussed in the previous chapter is indirect evidence of intergroup conflict, skeletal evidence provides more direct evidence, and such evidence is found at nine sites in the region (Figure 9-1, Table 9-1). These sites include mass killings with dismemberment, burning, and other disrespectful treatment (Smith 1952a; Swartz and Elson 2006a; Turner and Turner 1999) that meet Kuckelman et al.'s (2000) characterization of "extreme processing events." Lekson (2002) has suggested that such events occurred during periods when violence was escalated and deliberately employed to create a climate of fear. There is also evidence of scalping (Stanislawski 1963a; Turner and Turner 1999), violent raids upon settlements (Bartlett 1934; Colton 1946; Landis 1993), and even possible ritual sacrifice or execution and burial (Swartz 2006). Like the data on fortified architecture, the evidence suggests a ratcheting up of social tensions and violent conflict in the post-eruptive period.

In this chapter I first examine the skeletal evidence of violence by temporal periods and then develop indices of skeletal violence that are compared to the similar indices of defensive site use. This evidence is used to evaluate some general expectations developed in Chapter 7: (1) environmental disturbances will lead to increased levels of conflict, (2) because of the greater social distance between groups there is more potential for

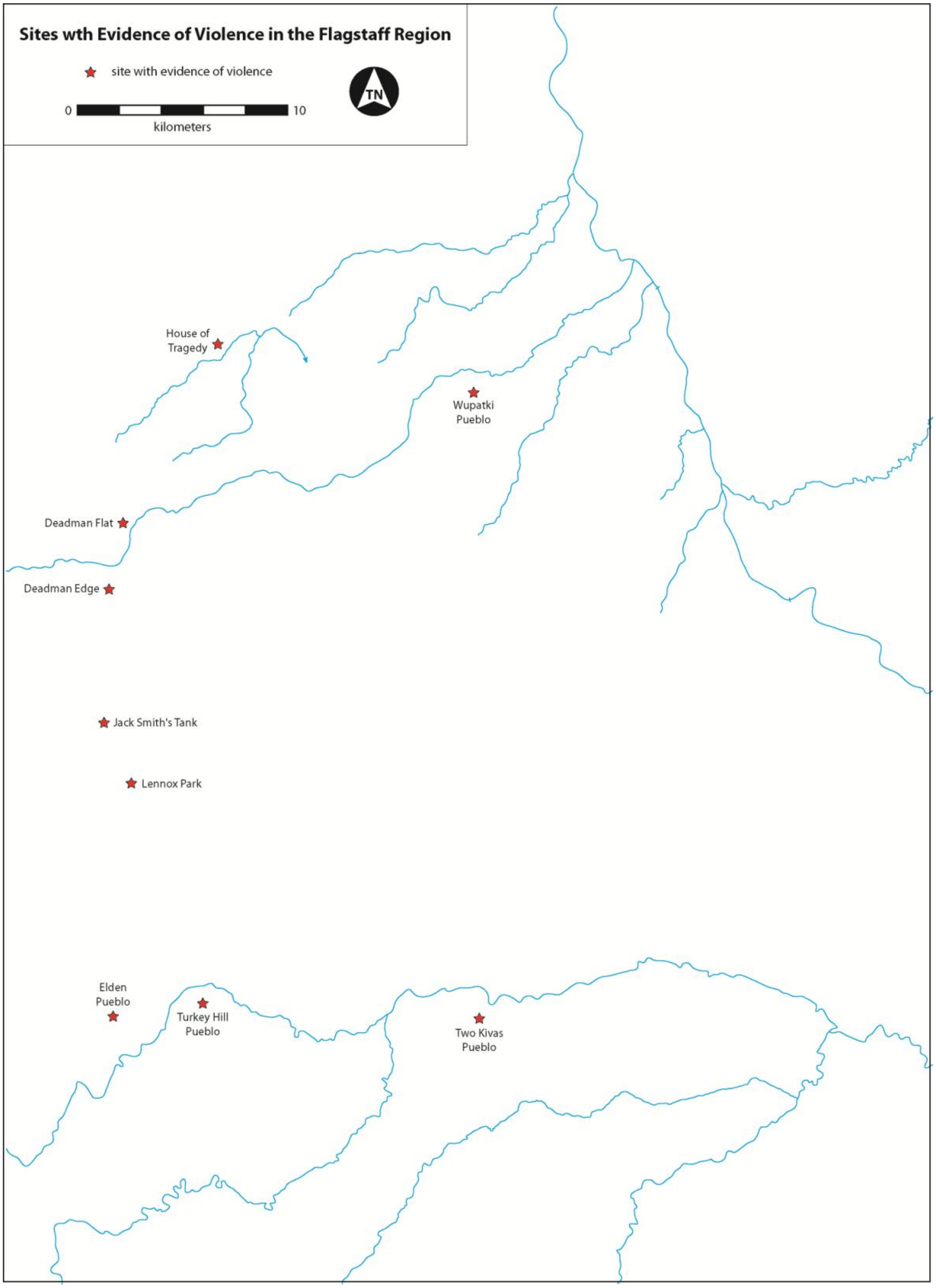


Figure 9-1. Sites in the Flagstaff region with skeletal evidence of violence.

Table 9-1. Sites with skeletal evidence of intergroup violence

Site Name	Site Numbers	Designation	Age	Sex	Description	Dates	References
Lenox Park	NA 20700	Feature 10	35-40	female	articulated remains splayed face down; evidence of burning and weathering on the bones, but no direct evidence of violence like cut marks or impact breakage	850-950	Landis 1993 Swartz and Elson 2006b
Jack Smith's Tank	NA 408, NA 409, NA 1295, and NA 1554	NA 408A.B1	middle-aged adult	male	both described as on the floors of burned pit houses, although the positioning of the bodies is unknown; only the cranium from NA 1295A was curated and shows evidence of burning but no direct evidence of violence like cut marks or impact breakage	1050-1085	Bartlett 1934 Colton 1946 Hargrave 1933 Turner and Turner 1999
		NA 1295A.B1	elderly adult	female			
Deadman's Edge	NA 420	Inhumation Feature 18	11-12	indeterminate	found below and within the burned roof fall next to a primary roof-support post, may have been upright; partially disturbed by backhoe trench; largely disarticulated and heavily burned; possibly bound to roof-support post; presence of rodent chewing suggests partial postmortem surface exposure	1130-1160	Spurr and Bailey 2006 Swartz and Elson 2006a
		Inhumation Feature 19	35-40	female	lying on back on the floor with legs tightly flexed and knees spread apart; arms against the sides of the torso, right flexed upward and left extended downward; perimortem bone breakage attributed to collapsing superstructure; heavy burning to upper left side where fallen roof beam crushed the cranium; cranium exhibits evidence of mild criba orbitalia indicating nutritional stress; possibly a victim of sexual assault		
		Inhumation Feature 21	12-14	indeterminate	Lower half of body in subfloor pit, head and right arm on floor outside of pit; burning and perimortem trauma to cranium; some perimortem bone breakage attributed to collapsing superstructure; appears to have been clutching a large obsidian flake in the right hand defensively		
		Inhumation Feature 22	25-30	female	contorted with legs twisted together and left arm wrapped around body; on the floor next to a primary roof-support post, feet by post, possibly bound; perimortem fracture of left radius and ulna; patchy burning; cranium exhibits evidence of mild porotic hyperostosis indicating nutritional stress		
		Inhumation Feature 23	15-17	indeterminate	face down in subfloor pit next to a primary roof-support post, feet by post, possibly bound; burning limited to upper body, only ribs heavily burned; presence of rodent chewing suggests partial postmortem surface exposure		
Deadman's Flat	NA 25764	Inhumation Feature 7	20-25	male	face down on pit house floor with arms flexed upwards at sides and legs crossed at ankles; buried in pile of Sunset Crater ash; cranium exhibits evidence of mild porotic hyperostosis indicating nutritional stress	1130-1160	Spurr and Bailey 2006 Swartz 2006
House of Tragedy	NA 618	Burial 1	young to middle-aged adult	male	two partially articulated legs with perimortem cut marks, anvil abrasions, impact breakage, and burning found in an unburned surface room	1130-1160	Smith 1952a Turner and Turner 1990 Turner and Turner 1999
		Burial 2	young adult	male	disarticulated remains scattered on the floor of the kiva; defensive parry break of radius and ulna, and other breakage of maxilla, mandible, ribs, scapulae, vertebrae, and pelvis suggestive of a violent beating; no cutmarks, anvil abrasions, or burning		
		Burial 3	young adult	female	mostly articulated remains on the floor of the kiva; only disarticulation at the left hip, where the head of the femur was 20 cm from the acetabulum, yet the remainder of the leg, ankle, and foot bones remained articulated; one broken rib; no cut marks, anvil abrasions, or burning		
		Burial 4	-	-	disarticulated, fragmented, and incomplete co-mingled remains of two adults in an extra-mural pit; no cutmarks, anvil abrasions, or burning		

Table 9-1. Sites with skeletal evidence of intergroup violence (cont.)

Site Name	Site Numbers	Designation	Age	Sex	Description	Dates	References
Wupatki Pueblo	NA 405	MNA20	adult	male	disarticulated secondary burial with perimortem breakage of six teeth that had been deposited in a rock crevice	1160-1275	Lincoln 1961 Turner and Turner 1990 Turner and Turner 1999
		MNA34	6-7	indeterminate	broken jaw, buried in Room 32 with no offerings	1160-1275	
		NPS1	adult	male	lethal perimortem cranial trauma to left side and cut marks indicating scalping, buried in Room 25 with 3/4 groove axe, bone awls, shell disc beads, *Conus* shell tinklers, pigment, ground stone	1160-1220	
		NPS2	adult	male	partially disarticulated burial that had been disturbed prehistorically, one-third complete, lacking cranium and mandible, both femurs had perimortem midshaft percussion breakage, also in Room 25	1160-1220	
		NPS-x	6	indeterminate	broken jaw, percussion fracture to right parietal; broken clavicle, humerus, and radius; buried in Room 73 with no offerings	1160-1275	
		MNA35.1	young adult	female	lethal perimortem percussion fracture to center of frontal bone as well as a broken nose; healed depression fracture to the posterior of the frontal bone; Grade 2 porotic hyperostosis present; only cranium and appendicular elements present, no thoracic elements present; buried in Room 59 stratigraphically above floor contact bone bed	1220-1275	
		MNA35	-	-	disarticulated and partially articulated remains of a minimum of 19 individuals (based on right scapulae); only 1 cranium and 17 mandibles present, many elements under-represented, especially vertebrae; abundant carnivore chewing, but no cut mark, anvil abrasions, or perimortem breakage as would be expected from violence; demographic profile reasonably approximates normal age and sex distribution in a populationre-deposited on floor of Room 59	1220-1275	
		Trench L	-	-	isolated elements with perimortem damage found in midden deposits: long bone fragment with anvil abrasions; adolescent male femur with cut marks, anvil abrasions, and carnivore chewing; humerus with cut marks; and cranium (possibly male) with broken occipital and squamosal bones	1160-1275	
Two Kivas	NA 700	Burial 2	21	male	lethal perimortem cranial trauma to left side and cutmarks indicating scalping, buried in Room M with no offerings	ca. 1185	McGregor n.d. Turner and Turner 1999
Turkey Hill Pueblo	NA 660	Burial 15	adult	male	lethal perimortem cranial trauma and cutmarks indicating scalping; burial context unknown	1160-1275	Turner and Turner 1999
Elden Pueblo	NA 142	-	adult	male	all have cut marks indicating scalping but presence of additional trauma and burial context unknown	1160-1275	Peter Pilles, personal communication 2013
		-	adult	male			
		-	adult	male			

competitive interaction in the frontier zone than in the heartland, there will be more evidence of skeletal trauma in the frontier zone, and (3) the cumulative escalation of hostilities will lead to changes in tactics and goals and increased social distances between groups.

PRE-ERUPTION EVIDENCE OF VIOLENCE

Burned pit houses with bodies inside them have been found at two sites occupied before the eruption, the Lenox Park and Jack Smith Tank sites. Both of these are located in the frontier zone near the Coconino Divide. The skeletal remains at both sites had no direct evidence of violence, yet their treatment and disposition appears disrespectful and other evidence, as discussed below, suggests intergroup conflict led to these deaths.

Lenox Park

Three portions of the Lenox Park site (NA 20700) have been excavated for two cultural resource management projects (Landis 1993; Swartz and Elson 2006b), resulting in the complete excavation of all identified habitation features. Four of the eight excavated pit houses at the site were burnt, one with the burned body of an adult female between 35 and 45 years of age unceremoniously splayed on the floor (Figure 9-2). While the skeleton showed no evidence of peri- or post-mortem damage, the burning and post-depositional weathering of the bone may have made any traces difficult to identify (Spurr and Bailey 2006:220). While the excavator of the feature believed the woman was trapped in an accidental fire, dying while trying to retrieve her personal belongings

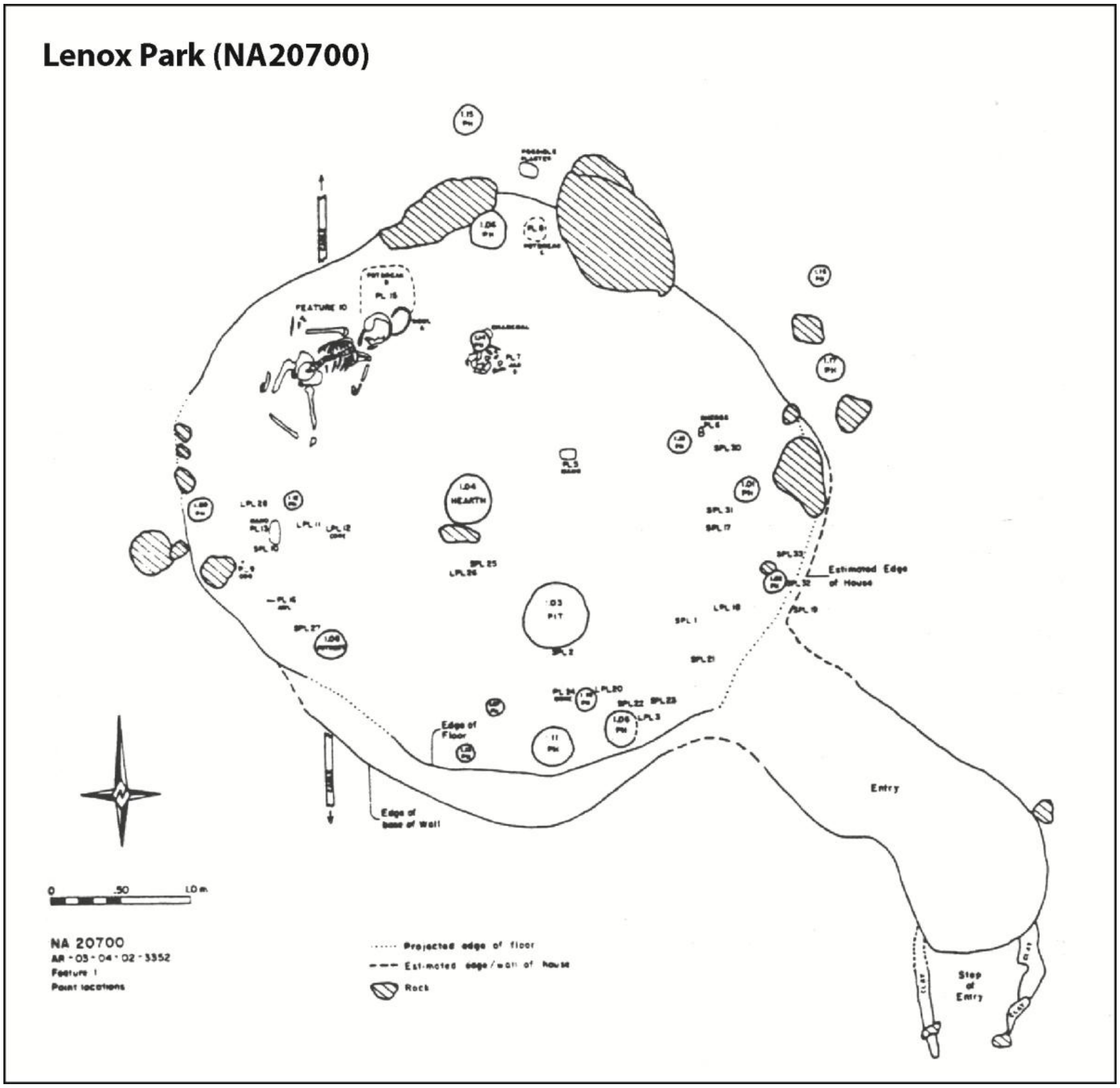


Figure 9-2. Feature 1 at the Lenox Park Site (NA 20700) with the remains of a woman splayed face down on the floor (after Landis 1993:405)

(Landis 1993), the circumstances and apparent disrespectful treatment suggest intergroup conflict. While the burned pit houses had floor assemblages of domestic artifacts, the unburned pit houses had almost no floor assemblages, with only inverted metates on the floors of three (Landis 1993; Swartz and Elson 2006b). This evidence could be interpreted as indicating an attack upon the site during which half of the settlement was destroyed and a victim of the attack was burned in one of the houses. After the attack, the survivors salvaged what they could and abandoned the site. The plainware assemblage at the site was predominantly Alameda Brown Ware (86%), suggesting that the occupants were socially and economically connected to populations to the south in the Sinagua heartland. Decorated ceramics at the Lenox Site indicate occupation between 850 and 950, and tree-ring dates indicate that one of the pit houses (although not the one containing the human remains) was built shortly after 918.

Jack Smith Tank

Several contemporaneous clusters of pit houses and associated granaries (NA408, NA409, NA1295, and NA1554) around Jack Smith Tank were excavated by MNA in 1931 and 1932. These excavations were not as well documented as later excavations, and not all of the skeletal material was curated. Five of the nine excavated pit houses had burned, two with burned human remains on the floors − a possible adult male from NA408A and an elderly female from NA1295A (Bartlett 1934; Colton 1946; Turner and Turner 1999). Only the female's cranium was available for re-analysis, and it showed evidence of burning but no other trauma. The pottery assemblages indicate occupation between 1050 and 1085. The plainware assemblages from the different structures were mixed and varied, although Alameda Brown Ware was the dominant ware in all, ranging from 39 to 72% of the assemblages. The proportions of San Francisco Mountain Gray Ware ranged from 23 to 40%, and a set of five obsidian projectile points of a serrated form typically associated with the Cohonina region (Justice 2002; Horn-Wilson 1997) were recovered from NA408A. The pottery and flaked stone suggest there was considerable interaction among people from different cultural backgrounds in the frontier zone. The evidence at the Jack Smith Tank sites could be interpreted similarly to that from Lenox Park – a small, defenseless settlement was attacked and partially destroyed with the victims burned inside destroyed houses.

Patterns of Pre-Eruption Violence

The evidence from Lenox Park and Jack Smith Tanks is somewhat ambiguous because no direct evidence of skeletal trauma is present. It could be argued that these cases represent a form of mortuary ritual where the house of the deceased was abandoned and burned with the deceased inside. However, there is a lack of patterning of this practice in other excavated pre-eruption sites. The standard pre-eruptive mortuary practice was extended inhumation in abandoned, trash-filled pit houses (Colton 1946; Hohmann 1983). Examples of formal burials following this standard practice were recovered from both Lenox Park and the Jack Smith Tank sites, including a later intrusive formal burial into the NA1295A pit house that also contained one of the sets of burned human remains (Bartlett 1934; Swartz and Elson 2006b). Further, the splayed, face-down positioning of the female at Lenox Park does not suggest respectful treatment of the deceased.

These were both small, defenseless habitation sites in the frontier zone that appear to have suffered attacks during which about half of each settlement was destroyed and victims of the attacks, including women who were presumably non-combatants, were burned inside some of the houses that were destroyed. Personal property – houses and their contents – was targeted for destruction. The conflict may have been related to contested social boundaries in the frontier zone because the Coconino Divide marks a boundary between the distributions of Alameda Brown Ware and San Francisco Mountain Gray Ware (Colton 1946, 1968; Garcia 2004).

POST-ERUPTION EVIDENCE OF VIOLENCE

More post-eruption sites with evidence of violence have been excavated, and, in most cases, the violence is of an entirely different and generally non-ambiguous character than what is suggested by the pre-eruption evidence. Three sites in the frontier zone – House of Tragedy, Deadman's Edge, and Deadman's Flat – have victims unceremoniously deposited on the floors of pit structures. Another four sites have formal burials that had been scalped and suffered other trauma, and one of these sites, Wupatki Pueblo, has additional skeletal evidence of social violence.

House of Tragedy

House of Tragedy (NA 682) is a small, unfortified unit pueblo (Figure 9-3) in the frontier zone that was excavated by MNA (Smith 1952a:51-69; Turner and Turner 1999:160-167). The predominance of Tusayan Gray Ware at the site (76% of the plainware assemblage) and the presence of a benched kiva suggest the occupants were socially and economically connected to populations to the northeast in the Kayenta region. The name of the site was given by its excavator, Watson Smith, and refers to

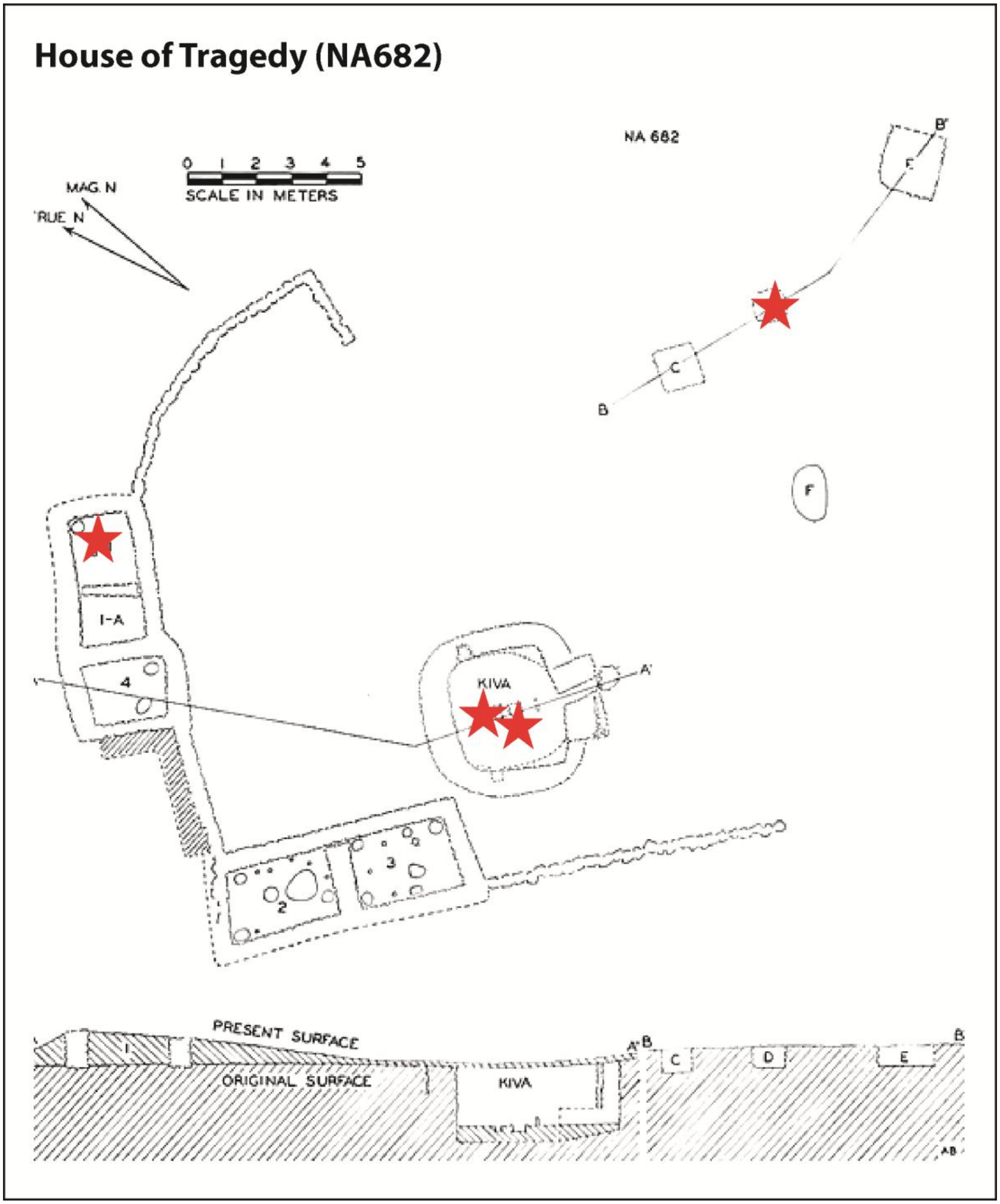


Figure 9-3. Plan view and cross section the House of Tragedy (NA 682) after Smith (1952a:52); red stars indicate locations of human remains with evidence of violence.

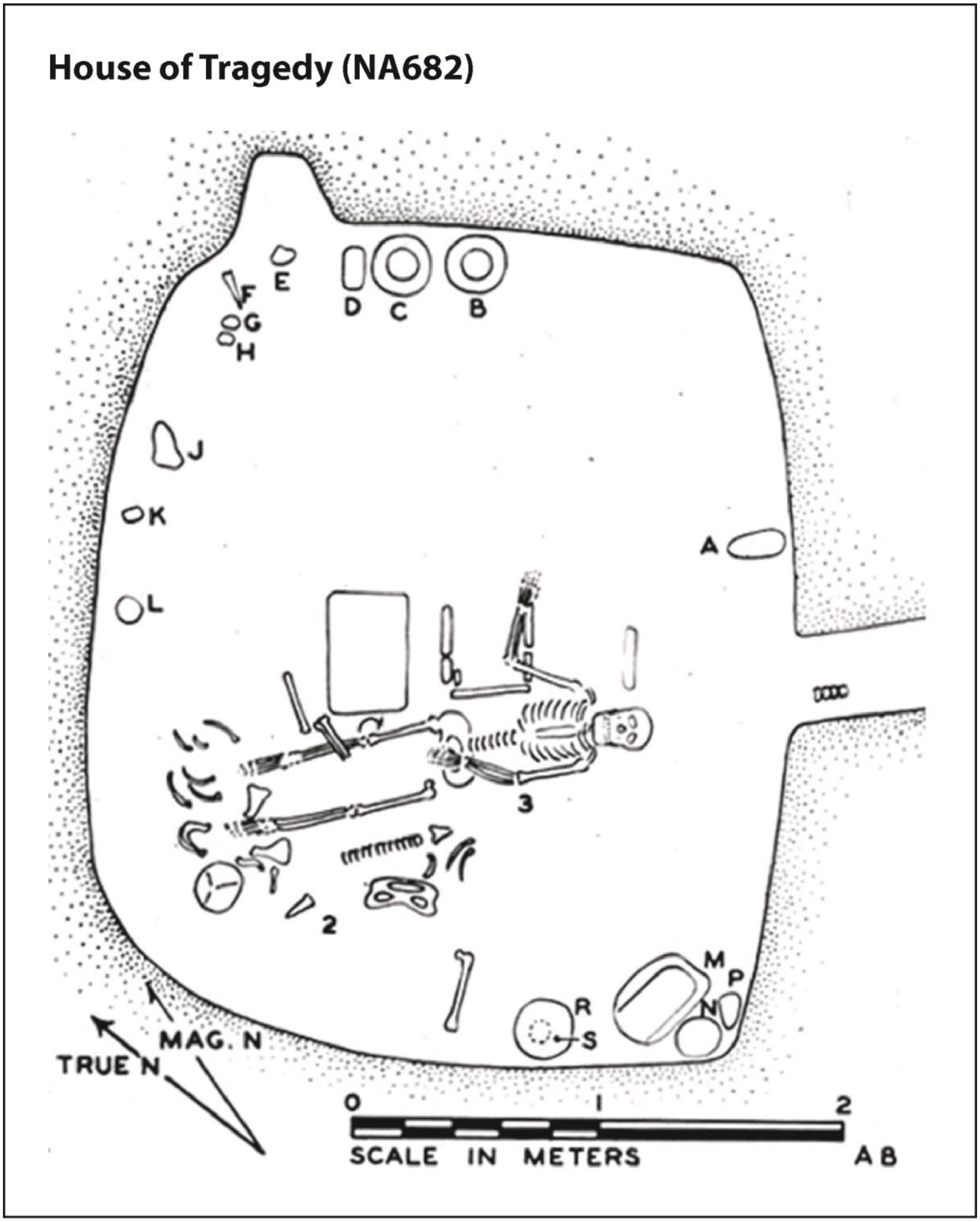


Figure 9-4. Plan view of the kiva at the House of Tragedy (NA 682) showing Burial 2, the disarticulated male, and Burial 3, the mostly articulated female; after Smith (1952a:61).

evidence found of a savage attack that led to the abandonment of the site. The brutalized remains of a young adult female and a young adult male were found on the floor of the site's kiva (Figure 9-4). Evidence from the kiva indicates that the site had been previously abandoned and then re-occupied. The original floor was overlain by eolian and water-lain fill, and the later floor of packed clay was 50 to 55 cm above the original. This later floor surface was resurfaced at least once with a layer of clay 2 to 5 cm thick. Smith (1952a:54, 60) believed the site to have been abandoned a short time and also interpreted the patterns of postholes as resulting from later braces added to support a sagging superstructure. The abandonment floor assemblage included whole vessels, manos, hammerstones, a metate, stone hoe, bone awl, and jet mirror (button).

The female victim was laid on her back roughly in the center of the floor, one arm splayed out over the hearth. The body of the male victim was dismembered and scattered on the floor around the female, with four of the lumbar vertebrae, still articulated, stuffed into the ventilator shaft. Of the skeletal elements of the male, 20.6% suffered impact fractures, including the maxilla and mandible, five ribs, the sternum, and pelvis; another 17.6% of the skeletal elements were fragmentary. While there was this abundant evidence of impact fractures, there were no cut marks found on the bones. The female had one broken rib, but no other direct skeletal evidence of violence. However, although the entire left leg, ankle, and foot were fully articulated, with even the patella present, the head of the left femur was displaced 20 cm from the acetabulum. No cut marks or rodent chewing was found on the femoral head or pelvis, indicating the leg had not been cut or chewed off. Christy Turner (personal communication 1998) suggested that the most likely way for a femur to be dislocated in such a manner would be to force the femur up laterally and perpendicular to the body. I suggest that the female's left leg was dislocated at the hip, wrested from its socket in a violent struggle, perhaps during a sexual assault. After the victims were deposited on the floor, the kiva was not burned and slowly accumulated eolian fill. Both sets of remains had evidence of rodent chewing on the bones, suggesting that the remains had been left exposed on the floor of the open, abandoned kiva for some time.

In addition to the two victims in the kiva, the articulated portions of the legs of a young to middle-aged adult, possibly male, were found on the floor in an unburned habitation room of the pueblo, and the bones from at least two individuals (one adult female and one old adult of indeterminate sex) were found in an extramural storage pit. Both the legs in the room had been broken mid-femur, were missing the proximal ends, and had fully articulated knees. Below the knees, the tibia and fibula of the left leg were complete with a partially articulated foot, while the right leg consisted of a partial tibia and complete fibula with no foot elements. Cut marks, impact breaks, and anvil abrasions were present on the femurs, and, while the room had not burned, the distal ends of both femurs had evidence of burning. A flaked stone knife was found on the room floor between the two legs, perhaps an instrument used in their dismemberment. A masonry-lined storage pit east of the pueblo contained 152 whole and fragmentary skeletal elements that had been deliberately covered with stone slabs. The remains were wholly disarticulated, but no cut marks, burning, or other perimortem damage was identified. Almost every skeletal element is present in the assemblage, representing the remains of at least two individuals. The origin and nature of these deposits is uncertain, but these remains may have been collected and deposited by relatives of the deceased at a later point after hostilities had subsided.

Deadman's Edge

The site of Deadman's Edge (NA 420) is a small cluster of pit houses and surface masonry rooms in the frontier zone. Four pit houses within the U.S. Highway 89 right-of-way were excavated by Desert Archaeology, and four surface rooms and at least five other pit depressions remain unexcavated outside the right-of-way (Swartz and Elson 2006a:97-121). The predominance of San Francisco Mountain Gray Ware at the site (68% of the plainware assemblage) suggests the occupants were socially and economically connected to populations to the west in the Cohonina region. Two of the four excavated pit houses had been burned, and the unburned pit houses had almost no floor assemblages, with only an inverted metate on the floor of one. Five individuals were found inside one of the burned pit houses (Figure 9-5). Four were on the floor and had been disrespectfully treated, either splayed on the floor or partially stuffed into storage pits in the floor, while the fifth was disarticulated within the burned roof fall near one of the primary roof support posts (Figure 9-6). Two of the victims were adult females; the other three were subadults of indeterminate sex. None of the victims were adult males.

All of the victims had skeletal elements that bore evidence of burning, and some had evidence of trauma, including crushed crania and broken rib and arm bones. Some of this damage, however, could have resulted from the collapse of the burning superstructure,

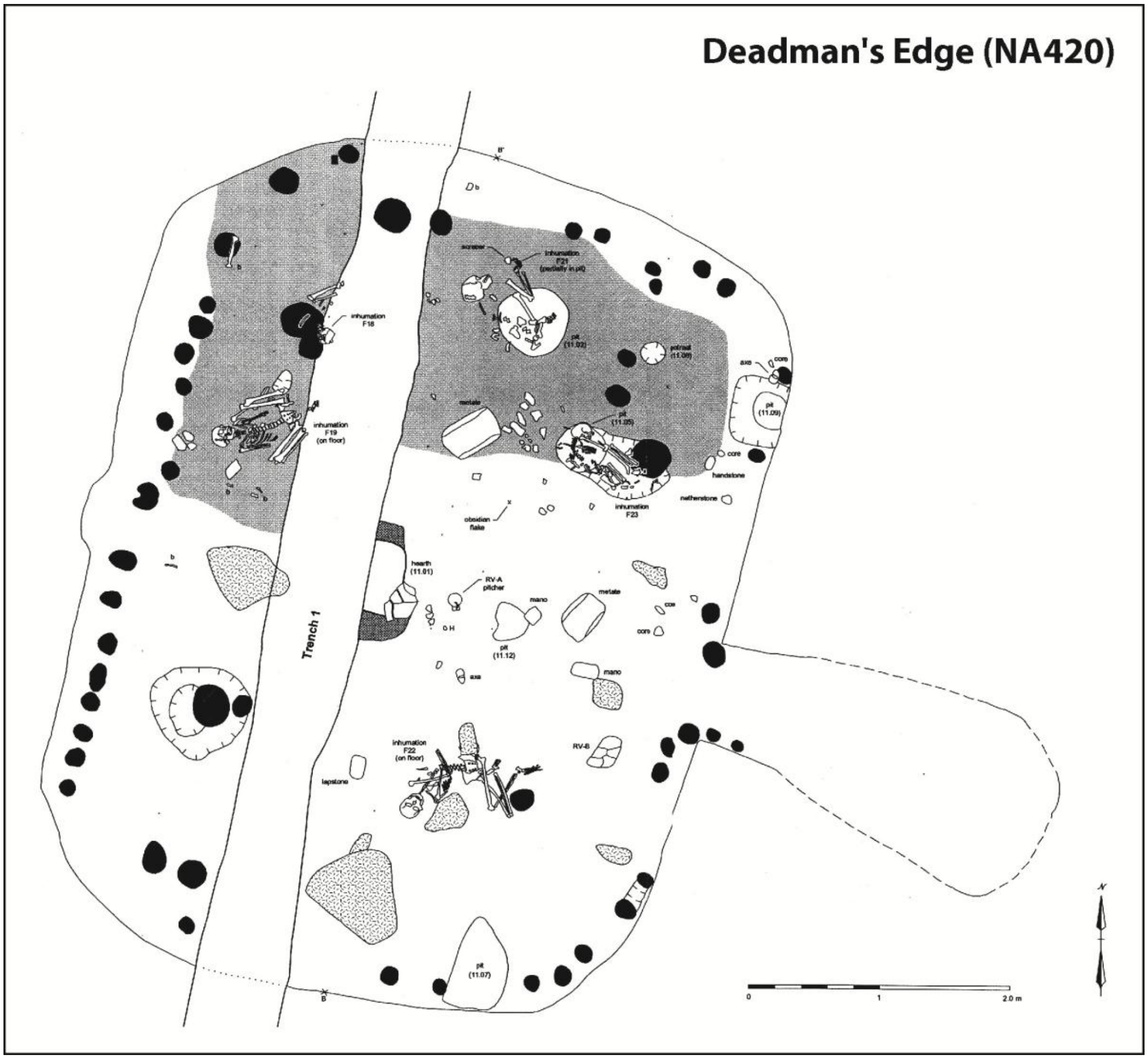


Figure 9-5. Plan view map of Feature 1 at Deadman's Edge (NA 420) showing the locations of the victims on the floor, after Swartz and Elson (2006a:107).

and other damage is difficult to assess. For example, the right, upward-facing side of the cranium of Inhumation 21 was crushed and heavily burned, likely by a falling roof beam, but a depression fracture on the left temple does not show evidence of burning. It is unclear whether this fracture resulted from a blow to the head before the structure was burned, or if it occurred at the same time as the crushing of the other side, with the left

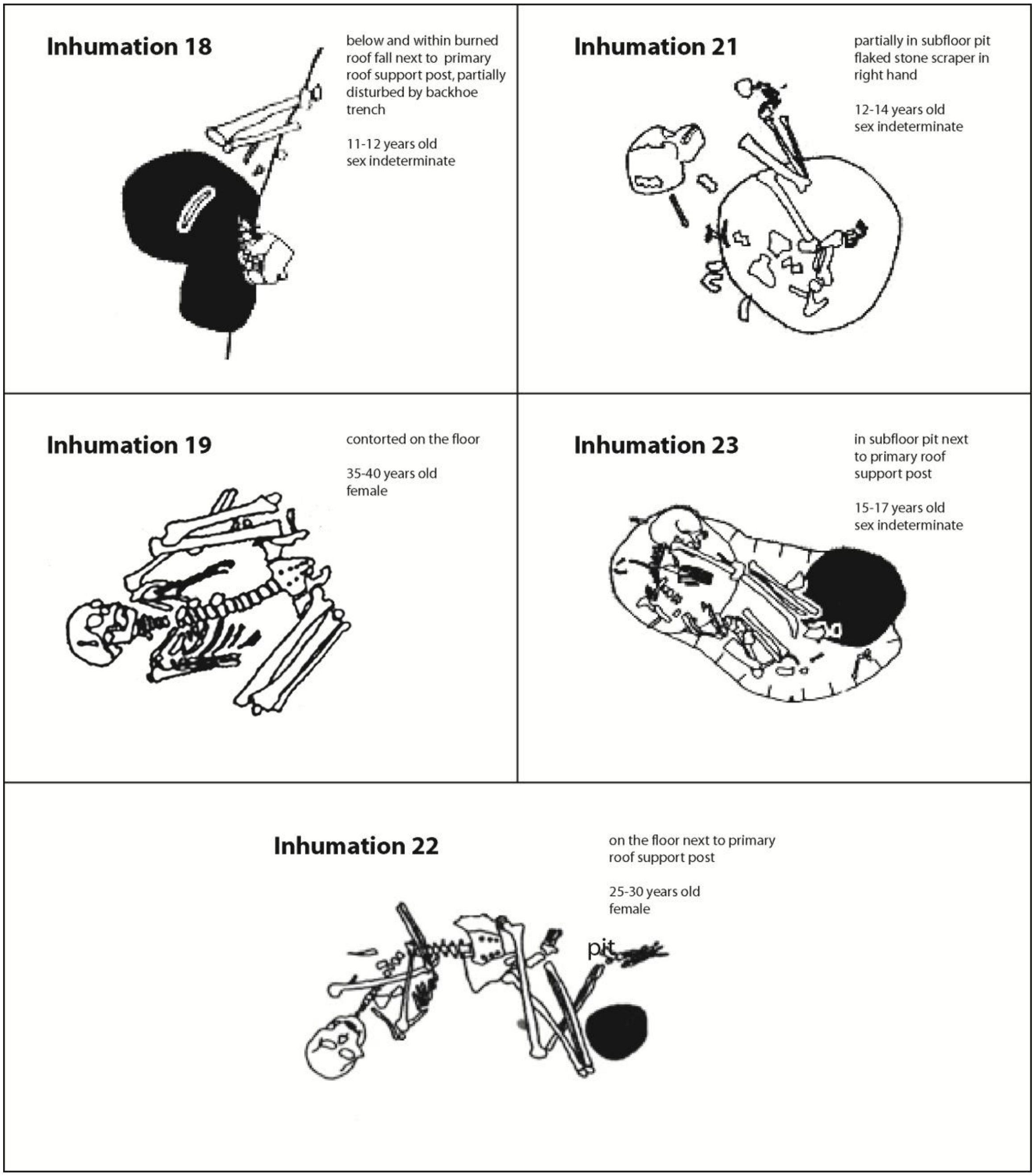


Figure 9-6. Details of the skeletal remains from Feature 11 at Deadman's Edge (NA 420); Swartz and Elson (2006a:107).

side of the skull impacting the floor when the falling beam hit the opposite side. Also, the broken ribs of Inhumation 22 were believed by the analysts not to have the patterning expected from a beating, where adjacent ribs would be fractured in the same general locations (Spurr and Bailey 2006:209).

Despite the ambiguous nature of some of the skeletal trauma, the placement of the bodies and the burning of the pit house with a complete domestic floor assemblage of manos, metates, axes, awls, and whole pots suggests foul play. Three of the five victims (Inhumations 18, 22, and 23) were found directly associated with primary roof support posts of the pit house. Inhumation 18, which was immediately below and within the burned roof fall, may have been upright when the structure burned (Swartz and Elson 2006a:114), perhaps bound to the post. The unusual positioning of Inhumation 19 also suggests binding and perhaps even sexual assault of the victim, and was said by the analysts not to have resulted from the shrinking and flexing of muscles and tendons during the burning process that can result in a characteristic pugilist posture (Bass 1984:160-161; Spurr and Bailey 2006:204). Inhumation 21 was partially in a subfloor pit and was believed by the excavators to be clutching a large flake defensively. Hopi consultants felt that a terrible tragedy occurred at the site and believed the site's occupants died defending themselves. The treatment of the victims suggested to the Hopi consultants that the perpetrators of the violence were from another ethnic group and were not culturally related to the victims (Ferguson and Loma'omvaya 2011:175-176).

Deadman's Flat

Just 3.6 km to the north of Deadman's Edge is the site of Deadman's Flat (NA 25764), which was also partially excavated by Desert Archaeology (Swartz 2006). A pit house and a one-room field house within the highway right-of-way were excavated, while a masonry roomblock with an associated pit depression outside the right-of-way were not excavated. Like the nearby site of Deadman's Edge, the plainware pottery assemblage was predominantly San Francisco Mountain Gray Ware (86%), again suggesting that the site's occupants were socially and economically connected to populations in the Cohonina region to the west. The excavated pit house had the body of a relatively robust male 20 to 25 years of age placed face down on the floor (Figure 9-7). While the arms were splayed out, the legs met at the ankles as though bound together (Figure 9-8), and the body had been intentionally buried in a pile of Sunset Crater ash. Although there was no skeletal evidence of peri- or postmortem damage, the disrespectful treatment and unusual body covering suggests something abnormal about this event, perhaps ritual sacrifice or execution.

In addition to the body on the floor, there was a large floor assemblage of artifacts, including whole pots, raw materials and tools for flaked stone production, and ground stone tools for pigment processing and lapidary work. A sub-floor pit also contained a diverse assemblage of tools, including a projectile point, a flaked stone core, a hammerstone, a ground stone ball, a ground stone cylinder, and a bone awl. The nature of these assemblages, like that in the burned pit house at Deadman's Edge, suggests that the abandonment of the structure was sudden and not planned.

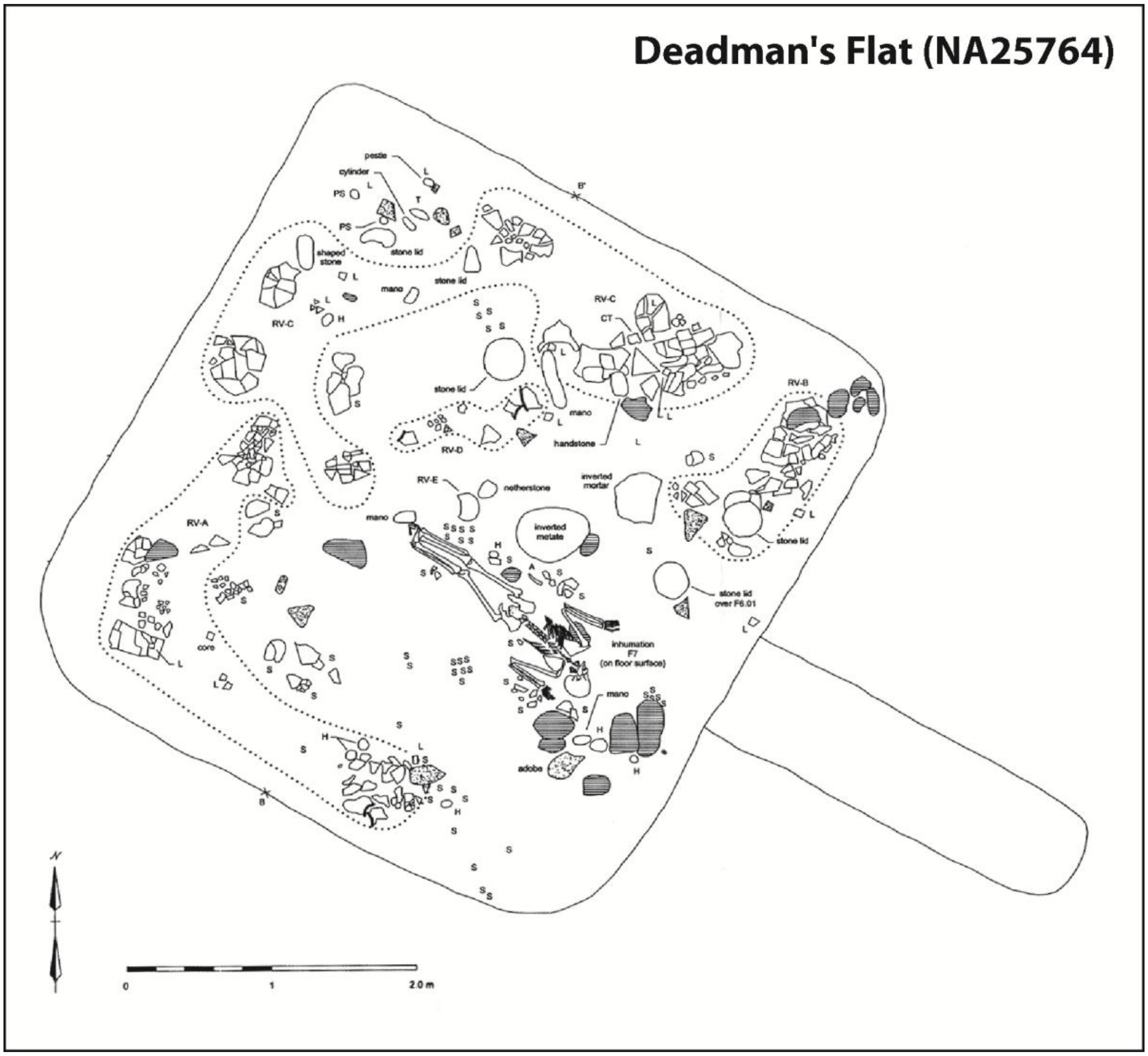


Figure 9-7. Plan view map of Feature 6 at Deadman's Flat (NA 25764) showing floor assemblage of crushed whole vessels and other objects and the skeletal remains; after Swartz (2006:85).

Another unusual aspect of the pit house is a set of floor features in the western half of the structure (Figure 9-9). The pit house had been excavated into heavily caliche-cemented soils, resulting in excellent preservation of the floor and its various features, like postholes, storage pits, pot rests, and a hearth. Four similarly sized and shaped pits in the western half are arranged to define a rectangle. Unlike other pits in the floor they had

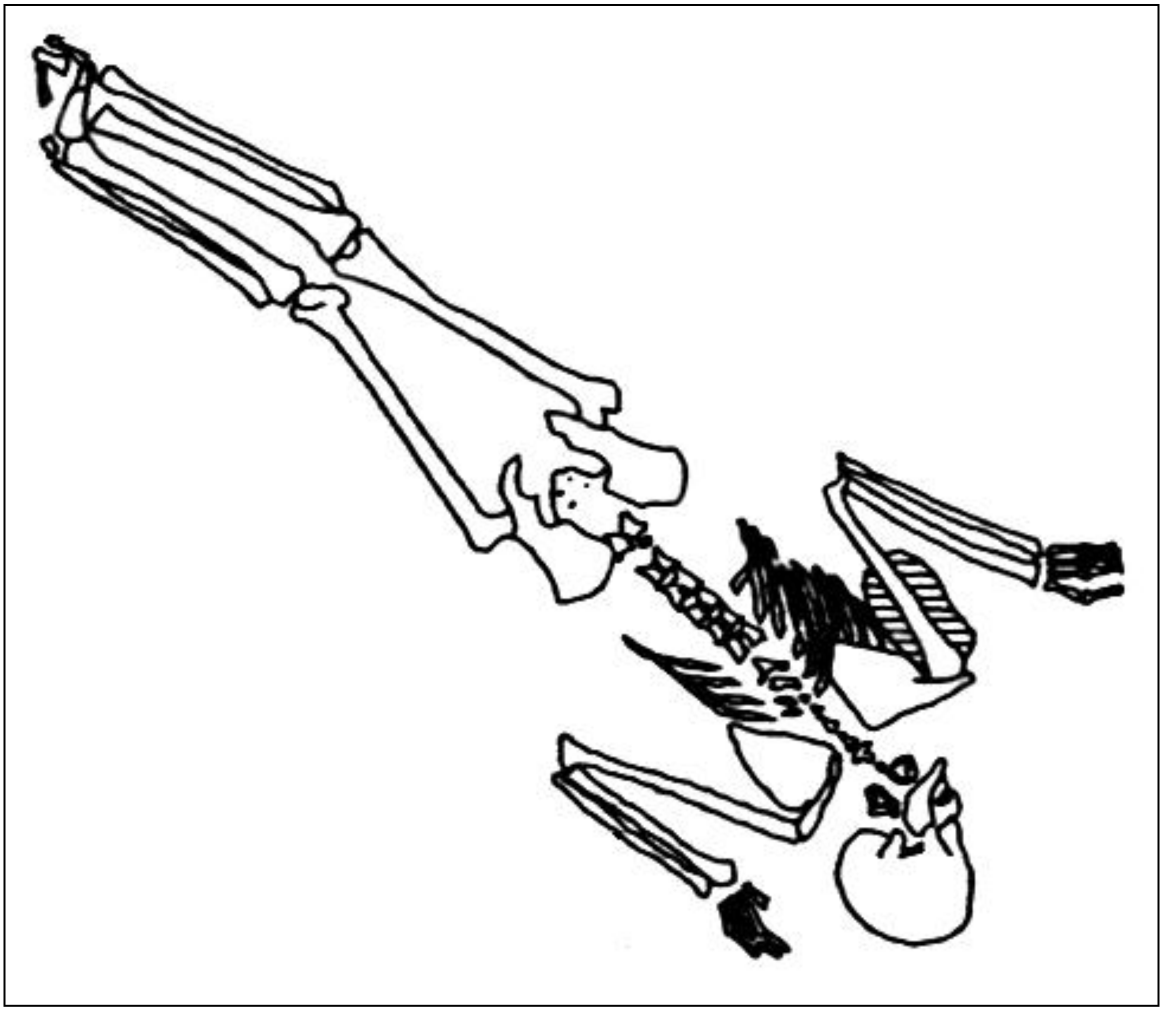


Figure 9-8. Detailed view of Inhumation Feature 7 at Deadman's Flat (NA 25764) showing the unusual body positioning; after Swartz (2006:85).

been deliberately filled with an orange silty soil that contained no charcoal, artifacts, or other inclusions. Because of their arrangement and shared special treatment, they were likely used together. The special treatment upon the cessation of their use may indicate that they may have had some ritual function (Wilshusen 1989), and Hopi consultants suggested that they were supports for tabular, painted-wood altar pieces or perhaps loom

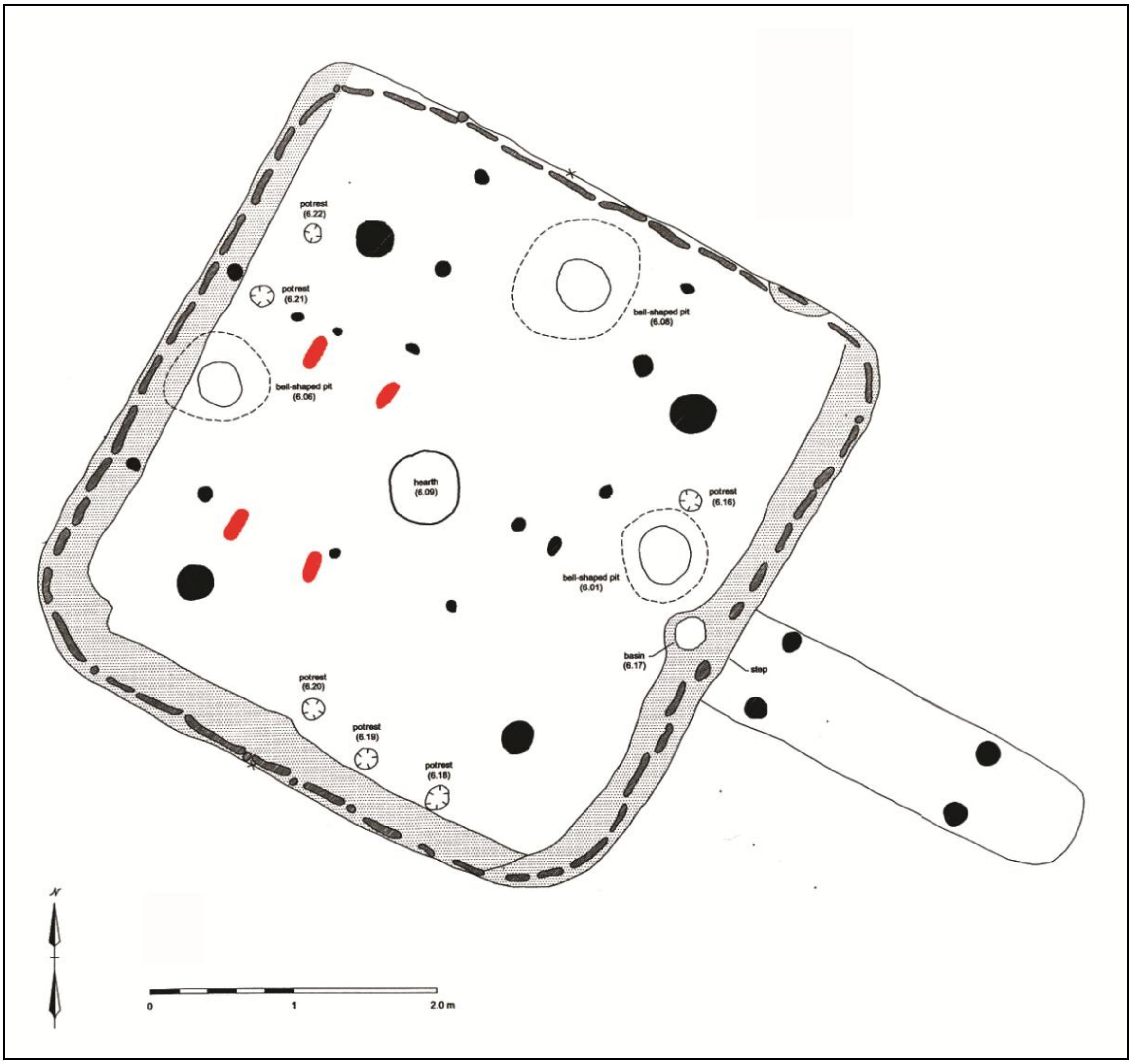


Figure 9-9. Plan-view map of Feature 6 at Deadman's Flat (NA 25764) showing floor features; possible altar piece support holes shown in red; after Swartz (2006:81).

anchor holes (Ferguson and Loma'omvaya 2011:175-176). The Hopi constructed elaborate altars in kivas that used painted-wood elements, stones, minerals, shell, feathers, plants, feathers, and colored sand paintings to create cosmic models that were interacted with through various rites (Fewkes 1926; Geertz 1987). Also, among the Hopi, weaving was a male task performed in kivas with much of the production focused on ceremonial costumes. The Hopi consultants further believed the pit house to be a specialized ritual structure and that the individual on the floor died an unnatural death.

Evidence of Scalping

Evidence of scalping has been identified on the skulls of six formal burials excavated at four large post-eruptive sites with long and complex occupation histories – Elden Pueblo (ca. 1150-1275), Turkey Hill Pueblo (ca. 1150-1275), Two Kivas Pueblo (ca. 1175-1275), and Wupatki (ca. 1120-1275). Scalped individuals have been found in both the heartland (Elden, Turkey Hill, and Two Kivas) and frontier zone (Wupatki). All were adult males, at least three of whom (Turkey Hills, Two Kivas, and Wupatki) had suffered severe cranial trauma prior to being scalped. The example from Wupatki had been killed by severe blunt-force trauma to head and face prior to scalping that removed the ears in addition to the scalp on the top of the head (Turner and Turner 1999:341, 345-346). When buried within an abandoned room, he was accompanied by a polished stone axe, bone awls, shell beads, and *Conus* shell tinklers (Richert and Mathew 1952). Despite having been violently killed and mutilated after death, the body of this individual was retrieved and afforded formal burial accompanied by offerings of weapons and symbols of his social and ritual status. In contrast, the example from Two Kivas, who also suffered severe head trauma, had been retrieved from where he had fallen but was buried without any offerings (McGregor n.d.), perhaps reflecting his relative youth (estimated to have been in his early 20s at time of death) and lack of social achievement.

Other Evidence from Wupatki Pueblo

In addition to the burial of a scalped body, other evidence of social violence is present in the skeletal assemblage from Wupatki. In their review of the evidence for violence in the skeletal assemblage from the site, Christy and Jacqueline Turner state that "we know of no comparable frequency data for random, isolated perimortem damage in another large archaeological site, our experience with large skeletal collections ... leads us to believe that the Wupatki taphonomic situation as a whole indeed signals substantial conflict or maltreatment" (Turner and Turner 1999:341). Perimortem damage suggestive of violence was found on crania, mandibles, and long bones, and the victims include women and children in addition to adult men. Some incidences are undeniably the result of intergroup violence, like the scalped burial of an adult male discussed above and the isolated remains found in the midden deposits that are suggestive of postmortem mutilation and trophy taking. Others are more difficult to interpret, like the two young children. Both had broken mandibles, and one had lethal cranial trauma as well as a broken clavicle, humerus, and radius. These children could have been killed by enemies, or may have been victims of severe child abuse or accidental falls. Both were buried in abandoned rooms without offerings.

Most problematic for interpretation are a large set of comingled human remains on the floor Room 59 that have been analyzed and reported on by Turner and Turner (1990, 1999). A minimum number of 19 individuals are present in the deposit based on the number of right scapulae present. However, not all skeletal elements are equally represented in the deposit; most unusual is the presence of a single cranium with 16 mandibles. The remains were mostly disarticulated, but some of the appendicular elements, including hands and feet, appear to have been articulated. None of the bones had any evidence of cutmarks, anvil abrasions, or burning, but there was abundant evidence of canid chewing and even a possible perforation of a scapula caused by a vulture's beak. The demographic profile of the assemblage reasonably approximates the normal age and sex distribution of known archaeological cemetery populations, with roughly equal numbers of identifiable males and females represented and with all age categories from infant to elderly present.

Turner and Turner suggested that the remains represent the victims of a sudden catastrophic morbidity event like a disease epidemic or the sharing of contaminated food. A catastrophic event that Turner and Turner did not consider is starvation, which could result during the exhaustion stage of social responses to a long-term environmental disturbance. Like a population suffering from the effects of disease or poisoning, a group of starving individuals would be weakened and unable to properly dispose of the remains of their deceased compatriots. Lacking proper burial, the remains were left exposed and then scavenged by canids before later being gathered and deposited on the floor of Room 59 by some unknown individual or group. The lack of sun-induced bleaching or other weathering of the bones suggested to Turner and Turner that the remains were interred within a matter of a few weeks. Observations suggest that canid scavengers may take 3 to 10 weeks to effect disarticulation of a human body (Haglund 1997; Haglund et al. 1989), so the partial disarticulation would suggest at the lower end of this range, or also within a few weeks.

What happened to the crania is unclear. Cervical vertebrae and hyoids were under-represented in the assemblage, suggesting they may have been removed at the same time. The recovered cervical vertebrae had no evidence of cut marks indicating decapitation, and the lack of any other evidence of perimortem violence would suggest that trophy taking was not the cause of the missing crania. While canid chewing is present on many elements, it is unlikely that dogs or coyotes dragged the heads away, as observations of canid scavenging effects found crania to be one of the few remaining whole elements after 5 or more months (Haglund 1997; Haglund et al. 1989). The crania are missing from the deposit because of some unknown decision made by those who collected and deposited the remains of this catastrophic event. What motivated this and where the crania were ultimately deposited will likely never be known. This deposit does not, however, appear to have resulted from intergroup violence, although it does inform upon the precarious nature of group survival in the lower-elevation areas of the frontier zone, where the effects of an extreme dry period would be more pronounced.

While Turner and Turner (1990) suggest this deposit to be one of the terminal events in the occupation of Wupatki Pueblo, another burial was found stratigraphically above and separate from this deposit (Brewer and Brewer 1934; Turner and Turner 1999:339, 348). Room 59 was excavated by NPS custodians Jimmy and Sallie Brewer after the MNA excavations were completed in the fall of 1934. Human remains were visible on the surface in the room along what was being developed as an interpretive trail around the pueblo. Prior to encountering the co-mingled deposits on the floor, the partial skeleton of a female was excavated. The cranium, mandible, and the appendicular elements were present, but all thoracic elements were missing, perhaps weathered from exposure. The arm and leg bones were undamaged, but the cranium had a lethal perimortem percussion fracture to the center of the frontal bone as well as an unhealed broken nose. There was a healed depression fracture to the posterior of the frontal bone, indicating that the woman had suffered previous violence. In addition to suffering physical violence, the woman also suffered from malnutrition, as evidenced by the fact that the crania exhibits evidence of porotic hyperostosis.

This example suggests a systemic pattern of violence that may indicate another dimension of intergroup conflict. This woman was killed by a severe blow to the forehead after having her nose broken and had a healed cranial fracture suggesting she had been the victim of previous episodes of violence. She suffered from nutritional deficiencies in life, and was unceremoniously deposited in an abandoned room after death. Similar evidence from other parts of the U.S. Southwest has been used to argue that female captives were taken from socially distant groups and exploited by their captors for their productive and reproductive potential (Martin 1997, 2008; Martin and Akins 2001; Martin et al. 2008, 2010). Raiding for female captives may have become important in the competitive recolonization of the frontier zone after the eruption, as the availability of labor was an important factor that could limit success when attempting to develop the extensive agricultural holdings that Downum and Stone (1999) suggest would have been necessary. Women's labor in the production, processing, and preparation of food was vital, and capturing women from competing groups also transferred their reproductive potential. Ethnographic accounts of warfare in non-state societies indicate that children were also targeted as captives, so it is possible that the children who suffered from violence at Wupatki Pueblo were captives.

Dating These Incidences of Violence

Tree-ring dates and associated pottery types provide means to estimate when the violence occurred. The pit house at Deadman's Edge in which the victims were burned yielded 17 datable tree-ring specimens, four of which were cutting dates, all from the year 1129 (Dean 2006:587), indicating construction ca. 1130 or shortly thereafter. The pottery assemblages and other non-cutting tree-ring dates suggest contemporaneity of the four excavated features at the site. The similarity in the ceramic assemblages between Deadman's Edge and Deadman's Flat suggest the two sites were contemporaneous (Figure 9-10). The biggest difference in the assemblages is the greater frequency of Dogoszhi-style whitewares at Deadman's Flat. The proposed specialized ritual function of the excavated feature may account for this, as the hachured Dogoszhi style is thought to be symbolically associated with the Chacoan regional system (Neitzel et al. 2002) and turquoise (Plog 2003), and is found in significantly higher frequencies at sites with kivas (Plog 1990). Given the proximity and contemporaneity of the two sites and the similarity in the unusual and disrespectful treatment of the dead, it is easy to imagine that both incidences were related and perpetrated by the same group of aggressors. None of the structures at House of Tragedy had burned and no tree-ring specimens were recovered, but the decorated ceramic assemblage indicates occupation of the site during Ceramic Group 2, between 1130 and 1160 (Smith 1952a:104). The presence of predominantly

Flagstaff Black-on-white with lesser amounts of Black Mesa, Sosi, and Dogoszhi Black-on-whites, and the presence of San Francisco Mountain Gray Ware, would suggest a date around 1150, and the mean ceramic date of the assemblage is 1160 ± 6. The assemblage from House of Tragedy is distinctly different from the more similar assemblages from Deadman's Edge and Deadman's Flat (Figure 9-10), which were likely contemporaneous and earlier than the occupation of House of Tragedy.

The evidence from all three of these sites suggest occupation during the period between 1130 and 1160 when colonists from different cultural backgrounds had come to the frontier zone, were attempting to wrest a living from a landscape still recovering from the eruption, and were competing for access to the better-quality lands. None of the sites is defensively oriented or fortified, they are all in open and vulnerable locations. The violence at Deadman's Edge and Deadman's Flat likely occurred during the 1130s megadrought, while that at House of Tragedy happened in the aftermath of that environmental disturbance when social ties may have still been frayed and perhaps antagonisms inflamed by the social memory of the earlier incidences of violence. Further, it was also attacked when the site was re-occupied after a period of abandonment, perhaps a message being sent to certain social groups about such efforts to re-establish a presence in this contested frontier zone. The evidence from these sites suggests high levels of violence between 1130 and 1160.

All of the incidences of scalping appear to postdate 1160, though some are more securely dated than others. The individual from Wupatki was buried in a room that was added to the original core of Chaco-style rooms and has a single non-cutting date of

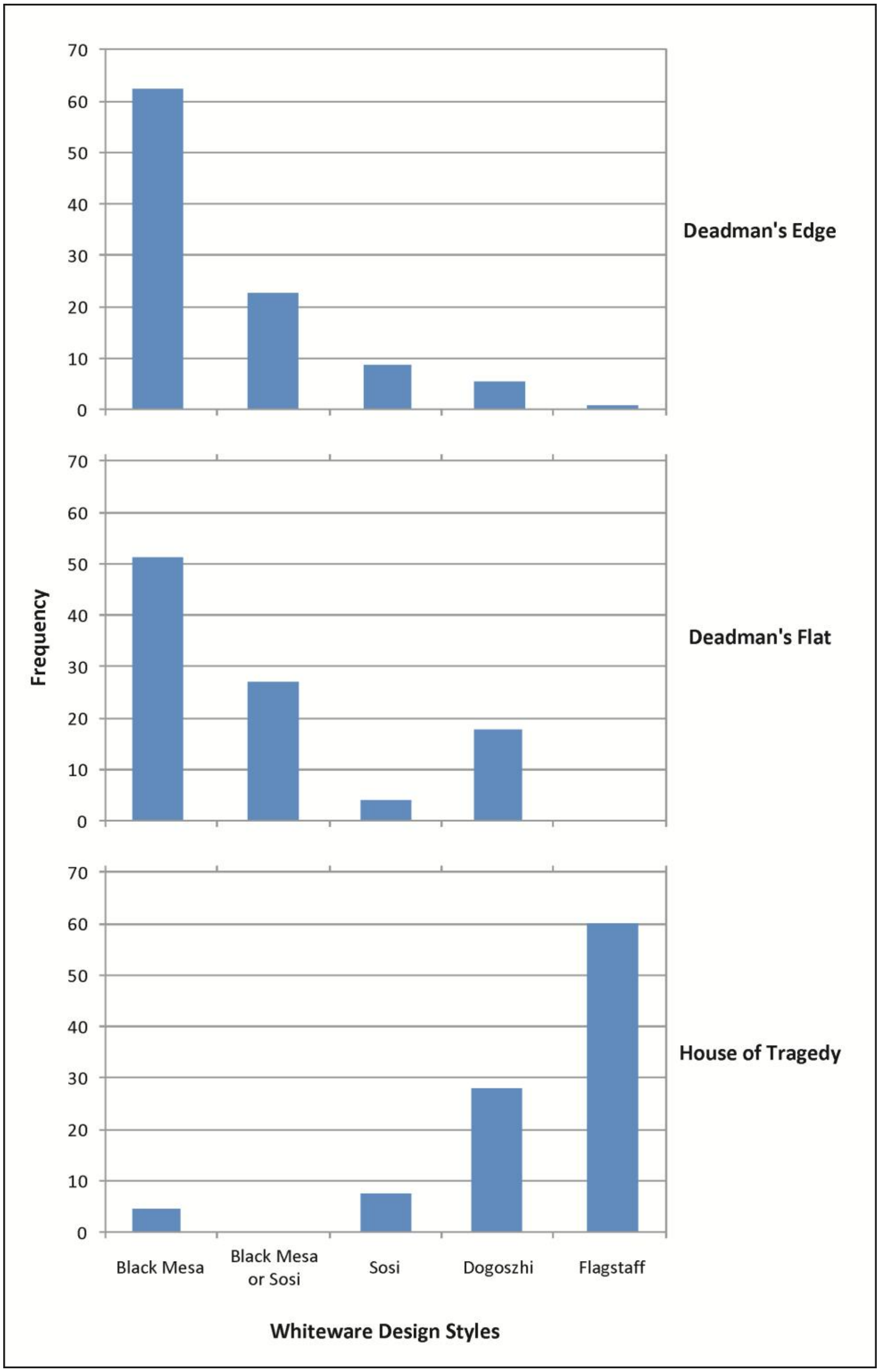


Figure 9-10. Comparative seriations of whiteware design styles at Deadman's Edge, Deadman's Flat, and House of Tragedy.

1140. Other adjacent rooms from this expansion have cutting dates of 1145, 1147, 1160, 1168, and 1173, suggesting initial construction just prior to 1150 with renovations or expansion in the 1160s and 1170s. Trenching in this part of the pueblo prior to roomexcavation recovered tree-ring specimens with cutting dates in the 1190s and as late as 1211, indicating continued renovation and expansion. Expansion episodes built upwards, filling lower-story rooms with trash and fill, and the black-on-white pottery in the trash deposits is dominated by Flagstaff-style sherds, suggesting the rooms were filled with trash between 1150 and 1220. The burial with evidence of scalping and the individual with two broken femurs were interred in the trash of one of these lower level rooms, most likely during early to middle part of the period from 1160 to 1220.

The individual with evidence of scalping from Two Kivas Pueblo was found on the floor of Room M, which had been abandoned and begun to accumulate refuse. After the burial, more trash accumulated before the roof beams were scavenged, leaving a layer of clay and roof closing materials that was then overlain by additional trash deposits. The room was built and used early during the occupation of the pueblo, and has a single non-cutting tree-ring date of 1172. The black-on-white pottery in the trash deposits is dominated by Flagstaff-style sherds with very little Tusayan and no Kayenta style, suggesting the room was filled with trash prior to 1220, and the mean ceramic date on the decorated sherds from the lower trash fill is 1184 ± 6. This individual was buried during the 1160-1220 time period, likely in the mid-1180s.

The mortuary remains and associated funerary objects from Turkey Hill Pueblo have been recently re-examined as part of the Coconino National Forest's repatriation program.

Unfortunately, associations between the human remains and offerings could not be securely reconstructed based on the available field notes, reports, and cataloging data. Thus, the scalped individual from Turkey Hill Pueblo cannot be associated with any temporally diagnostic offerings. The scalped burials at Elden Pueblo also cannot be dated because they did not have associated decorated ceramics either (Peter Pilles, personal communication 2014). Therefore, these burials cannot be securely dated other than to the full occupation spans of the sites ca. 1150-1275.

Patterns of Post-Eruption Violence

In contrast to the pre-eruption period, incidences of violence from the post-eruption period display levels of peri- and postmortem damage suggestive of intent to degrade and dehumanize the deceased while striking fear and terror in the hearts of survivors, and trophy taking that provided symbols of victory and power. While pre-eruptive violence appears to have targeted both males and females, post-eruptive violence included subadults as victims as well. This evidence suggests changes from the pre-eruptive to post-eruptive periods in two of the dimensions of intergroup conflict developed in Chapter 5: (1) greater social distances emerged between antagonists, and (2) implementation of new tactics and goals that did not exclude subadults from lethal force. Further, there appear to be differences between the 1130-1160 and post-1160 periods and between the heartland and frontier zone. The extreme processing events are temporally restricted to the 1130-1160 period and spatially restricted to the frontier zone.

Darling (1998) and Walker (1998) have suggested that some extreme processing events may have resulted from witchcraft executions. Ethnography of Puebloan beliefs about and documented cases of witchcraft trials and punishment indicate that accused witches were tortured and abused, and, upon execution, their deceased bodies were often dismembered and burned to fully destroy them. Additionally, witchcraft powers were believed to run in families, and were often thought to be latent and yet unexpressed by children. Thus, witchcraft punishments might target not only the accused witch but entire families, children included. Interpretations of warfare and witchcraft are not mutually exclusive but rather mutually reinforcing interpretations. Witchcraft accusations are a culturally framed means of defining targets of violence as outside the realm of human society. Southwestern ethnographies suggest that enemies were often accused of being witches (Parsons 1939), and these perceptions motivated conflict and the ill-treatment of vanquished enemies. The period from 1130 to 1160 includes the 1131-1142 megadrought, the effects of which may have precipitated the deadly events at Deadman's Edge and Deadman's Flat as alarm stage responses ratcheted up to resistance stage responses in the early 1130s. Later, the return of settlers to the frontier zone after the drought may have been contested, as at House of Tragedy, and ill will seated in the events of the past may have motivated the harsh treatment of the victims there. All seem to have been deliberate expressions of social distance between aggressors and their victims that might also have signaled boundaries between groups.

Sexual assaults may have been part of the violence at Deadman's Edge and House of Tragedy. In Hopi myth, rape is symptomatic of the social disorder and chaos brought on by social and ritual failings (Courlander 1982:17; Lomatumay'ma et al. 1993:80) or is associated with witchcraft practices (Malotki 1978:85; Talayesva 1942:428-429; Titiev 1972:113-114); it is not mentioned in relation to intergroup conflict (Beaglehole 1935). Data from New Guinea indicate that rape could both be a provocation precipitating conflict (Meggitt 1977:13-14; Newton 1983:495) as well as its inevitable result (Pospisil 1958:91); it could also be a tactic deliberately employed to provoke a group against which grievances were held (Meggitt 1977:23, 192). As such, it would appear to be an act done against socially distant groups and can be seen as signaling social distance or the rupture of social relations.

Scalping and other perimortem mutilation could also be used to signal social distance. All the incidences of scalping are post-1160, and the victims were adult males who were formally buried. The incidences of trophy taking evidenced by the scalped burials suggest an increasing importance for individuals to demonstrate achievements in the arena of conflict, perhaps related to the formalization and institutionalization of warrior roles and statuses. At least three died from cranial trauma suggestive of close hand-to-hand combat using clubs, perhaps in formal engagements between armed males as described for the Hopi, Yuman, and Enga in Chapter 5. Other than these scalped adult males, the evidence of post-1160 violence includes the possible captive woman and the two beaten children from Wupatki Pueblo.

From 1130 to 1160, isolated and defenseless households appear to have been targeted for overwhelming and ruthless application of force, and women and subadults were considered legitimate targets of horrific violence, including torture and possibly sexual assault. After 1160, the exercise of violence was more limited in that it was more restricted to adult males engaged in combat. The scalped individuals from Wupatki and Two Kivas were both killed by blows to the left side of the head, presumably while facing their right-handed, club-wielding opponents.

INDEXING SKELETAL VIOLENCE

The frequency and rate of the occurrence of skeletal violence can be indexed as was the use of defensive and fortified sites in the previous chapter allowing changes in the intensity of conflict to be assessed. Details on the calculation of the index and the Bayesian transformation of the data are presented in Appendix B. Frequency is measured as the percentage of burials with evidence skeletal trauma, and its rate of occurrence as the average number of incidences of violence per year (Figure 9-11). Frequency reveals how often violence occurred at a population level, while rates reveal how often violence occurred on a temporal scale. Higher frequencies and rates not only indicate higher levels of violence, but also would have created greater fears and anxieties among the affected populations. In general, the index is calculated by dividing the number of incidences of violence per time period by the total number of excavated burials from that period, with the result then being divided by the number of years in the period. However, different periods are used for this index than for the defensive site index.

Most burials lack decorated ceramics that would allow temporal placement, and many have no offerings at all. Some burials lacking decorated ceramics can be contextually dated in relation to other data, or at minimum to the period that the site from which the

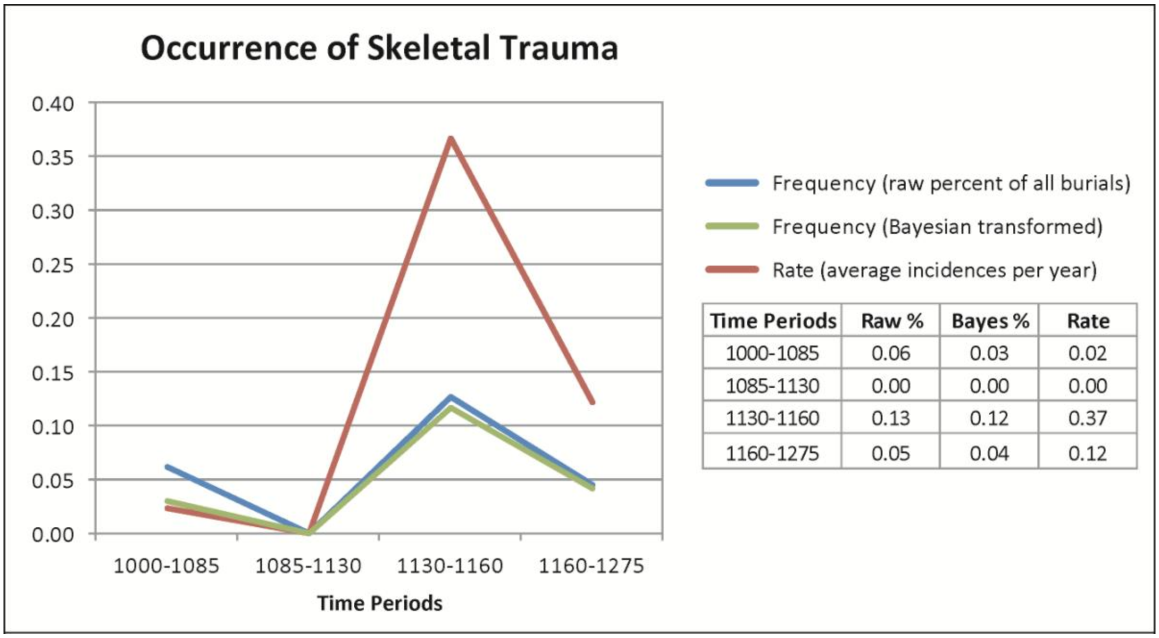
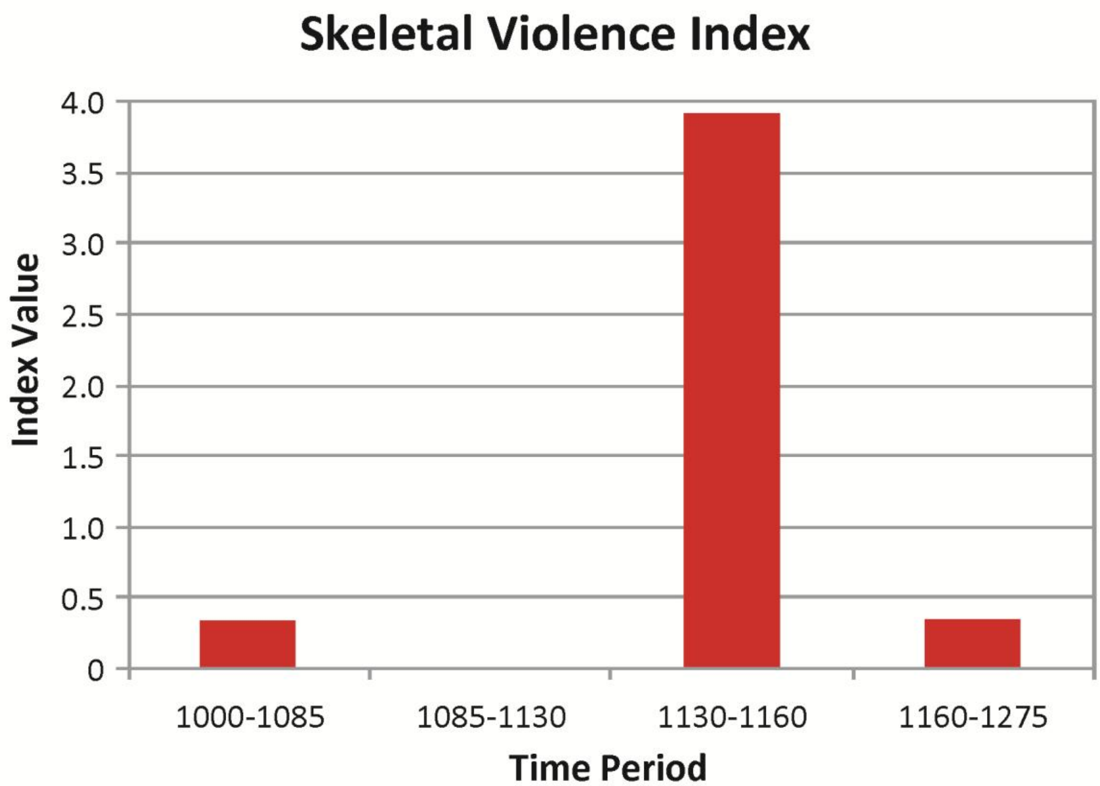


Figure 9-11. The frequency and rate of occurrence of skeletal trauma.

burial was recovered was occupied. There are large, excavated sites occupied both before and after 1220 that have substantial mortuary assemblages, like Elden Pueblo (n = 143), Turkey Hill Pueblo (n = 44), Two Kivas Pueblo (n = 13), and Wupatki Pueblo (n = 40). Separating burials in these assemblages into time periods is problematic. For example, of the 40 burials from Wupatki Pueblo (which does not include the 19 individuals from the Room 59 comingled deposit), only 9 have decorated ceramics as offerings: 6 have only Flagstaff-style ceramics (indicating inhumation between 1150 and 1220), and 3 have only Tusayan-style ceramics (indicating post-1220 inhumation). Securely Securely differentiating between the two periods is difficult as most burials lack associated temporally diagnostic decorated pottery; and while most likely pre-date 1220, some are probably later. Therefore, the two periods were combined for this analysis.

The resulting index (Figure 9-12) indicates that the time of the most extreme violence (1130-1160) also had the greatest frequency and rate of violence. The index value for that period is 10.8 times higher than for the earlier 1000-1085 period and 10.7 times higher than for the following 1160-1220 period. There is no evidence of violence from the 1085-1130 period, which begins with the Sunset Crater eruption and includes the subsequent extreme dry period. This period has a large sample of burials (n = 271) and the highest number of burials per year of all periods (Figure 9-11), indicating that this pattern is not a result of sampling issues.   However, all but three of the burials are from sites in the heartland, and 42.8% of the burials from this period are cremations (which are included in the calculation of the frequency values). The frontier zone could be seen as underrepresented in this sample, but that area appears to have been only lightly populated (Sullivan and Downum 1991) during that time period, and Lambert (2006) and Schofer (2006) suggest that initial post-eruption populations may have been seasonally mobile.

The effects of cremation generally prevent identification of skeletal trauma that may have resulted from violence, and it is possible that victims of violence were preferentially cremated. However, adult males, who would presumably be more frequent victims of intergroup violence, are not significantly under-represented in the inhumations from this period. A total 62 adult inhumations were recovered from five sites that also have many cremations (Winona Village, Ridge Ruin, the Piper Site, NA 10803, and NA 10806); 55 of these 62 inhumations could be assigned a sex: 26 were male and 29 were female (Bartlett 1941; Bliss 1956; Hudgens 1974). Therefore, it seems unlikely that the absence



Time Period	# Burials	# Violence	% Violence	Bayes %	# Years	Violence/Year	Burials/Year	Index
1000-1085	32	2	0.0625	0.0308	85	0.02	0.38	0.36
1085-1130	271	0	0.0000	0.0000	45	0.00	6.02	0.00
1130-1160	87	11	0.1264	0.1175	30	0.37	2.90	3.92
1160-1275	309	14	0.0453	0.0421	115	0.12	2.69	0.37

Figure 9-12. Skeletal violence index by time periods with table of values used to calculate the index.

of evidence for violence during the 1085-1130 period is a result of the victims having been cremated; rather, it seems to have been a period of general peace.

Interpreting the Evidence

Skeletal evidence of intergroup conflict is found both before and after the eruption of Sunset Crater, but the violence is of a different character during different periods. Before the eruption, intergroup conflict was characterized by hit-and-run raids on small settlements in the frontier zone during which pit houses and their contents were burned, sometimes including the deceased occupants. The three victims from this period include one male and two females, and one of these females was elderly. Other than burning, there was no evidence of perimortem damage and no evidence of trophy taking, mutilation, or torture. The skeletal violence index, which measures the rate and frequency of violence within the mortuary population, is low for this period.

Immediately following the eruption, during the 1085-1130 period, there is no evidence of violence. In the subsequent 1130-1160 period violence peaks in its rate and frequency. The exercise of violence during this period is also of a completely different nature, suggesting changes in the tactics and goals of intergroup conflict. The aggressors likely attacked in force that allowed them the security to torture and otherwise dehumanize their victims while either preventing or repelling any immediate counterattack. The presence of women and the elderly in the pre-eruption sample suggests there were few limitations on who was considered a legitimate target of violence, and the presence of children and juveniles at Deadman's Edge indicate perhaps even fewer limitations were present during the 1130-1160 period. At Deadman's Edge, a group of related women and children were tortured, possibly sexually assaulted, and burned to death in their home. Similarly, at House of Tragedy, a young couple were defiled and killed in what was likely their own kiva, and other possible family members were also butchered and killed.

The index for the post-1160 period decreases substantially but still remains much higher than the pre-1130 values. The post-1160 violence also is of a different character; most of the victims are adult males who were killed, scalped, and then buried. Three of these men were killed by blows to the head, two of them by blows to the left side of the head. These injuries and the scalping suggest face-to-face, hand-to-hand combat between adversaries who filled social roles and had social statuses that were relatively equal. The scalping may indicate the need for the victors to obtain a symbol of their triumph in order to gain social recognition and prestige, and it could also be an expression of social distance between the communities of the victors and the victims. Despite suffering defeat and humiliation on the battlefield, these scalped men were formally buried, indicating that they were respected and valued by their home communities. All of this suggests an increasing formalization of conflict between social groups and perhaps increased specialization of social roles related to conflict: warriors who fight the enemy, leaders who direct the warriors in offensive or defensive actions, and mediators who broker peace sealed by exchange between the former adversaries.

Such tactics of formal battle between specialist warriors are unlike the preceding period when violence was directed asymmetrically against defenseless women and children rather than between warrior equals. Women and children did not escape the brunt of violence after 1160; however the context of the violence was different. Rather than being tortured and killed, perhaps as accused witches as may have been the case during the 1130-1160 period, after 1160 there is evidence that women and children suffered domestic abuse in the context of captivity. The young female at Wupatki who was killed by a blow to the head also suffered a broken nose in the same assault, had a healed skull fracture indicating a pattern of abuse, and suffered from nutritional deficiencies. While her abuse, and that of the two children who had broken jaws and other injuries, could be dismissed as domestic violence rather than intergroup violence, if these individuals were captives from other groups who were exploited and subject to maltreatment and deprivation, then the violence must be understood in the context of intergroup competition.

During the historic period in the U.S. Southwest, intertribal raiding for captives was inextricably entangled with the colonial era slave trade, which supplied workers for the mines of northern Mexico. More traditional patterns of captivity persisted as well. Native American women and children captives were often incorporated into households in the New Mexican frontier to provide additional domestic, agricultural, or pastoral labor (Bailey 1966; Brooks 2002). Across North America and throughout the world, many cultural groups captured individuals, particularly women and children, from neighboring groups during periods of conflict to control and exploit their productive and reproductive abilities (Cameron 2011, 2013; Carocci and Pratt 2012; Snyder 2010). While captives could be subject to deprivation and violence, they could also be adopted as family members or even come to found their own descent groups within their adoptive communities. Captives could also introduce new crafting skills, technological innovations, or ritual knowledge and practices.

Ethnologists working in Africa have developed the concept of "wealth in people" to describe social systems in which established and aspiring leaders use systems of kinship, marriage, and clientage, including slavery, to create networks of dependencies and obligations allowing them to control the productive labor of a group (Bledsoe 1980:46-80; Goody 1971; Guyer 1993). In such systems, the control of social dependents creates material wealth and maintains the status and security of both leaders and their group. Nyerges (1992) has argued that in frontier settings, where there are low population densities and high levels of mobility, labor is a key resource that group leaders compete to control. As diverse social groups resettled the prehistoric frontier zone of the Flagstaff region after the eruption of Sunset Crater, aspiring leaders likely sought to build wealth in people by activating their kinship networks, engaging in strategic marriages, and creating clientage through political alliances, ritual initiations, and economic exchanges. Some may have also sought to bolster their numbers through the capture of members from rival groups, especially women whose labor was essential to the production, processing, and preparation of food and whose reproductive potential could be controlled.

The skeletal evidence indicates that changes in intergroup violence were characterized by different tactics and goals as well as by increasing social distance between groups. Intergroup conflict before the eruption appears to have been characterized by hit-and-run raids against small settlements with few limitations regarding who was considered legitimate targets of violence, as both adult men and women, including the elderly, were victims. The conflict occurred in the frontier zone where people from different cultural traditions were coming together, and plainware assemblages from sites in this area indicate considerable interaction. While some interaction was peaceful, allowing exchange and perhaps even ethnic coresidence at some sites, other interaction was competitive. Conflict during this period may have been associated with the contesting of boundaries between groups and does not appear to have been associated with environmental disturbances. Rather, the incident at Jack Smith's Tank occurred and the nearby fortified retreats of Medicine Fort, O'Leary Mesa Fort, and Deadman's Fort were in use during times that were favorable for agriculture. As demonstrated in Chapter 2, the 38-year-long interval from 1047 until the eruption of Sunset Crater in 1085 had no unfavorable periods, and 76% of the years had greater-than-normal levels of precipitation.

The lack of evidence of violence in the period following the eruption also does not conform to the expectation that such an environmental disturbance (five years of volcanic activity followed by an 11-year-long extreme dry period) would likely lead to the resistance stage response of increased intergroup conflict. Responses to the megadought of the 1130s, however, do conform to the expectation that severe environmental disturbances lead to greater conflict. The tremendous increase in the rate and frequency of violence during the 1130-1160 period and the increasingly brutal nature of that violence indicate an increase in the social distance between groups. Like during the pre-eruption period, the evidence of this violence is restricted to the frontier zone. The index of defensive site use developed in the previous chapter also indicated peak investment in defensive and fortified sites in the frontier zone during this time period.

After 1160, the skeletal evidence suggests another change in the social context of violence with greater formalization and perhaps institutionalization of intergroup conflict. Adult or juvenile men comprise 76.9% of the victims of violence, and 66.7% of these individuals had been scalped. While scalping and other post-mortem mutilation may be used to express the social distance between victor and the victim, they may also be associated with status- and prestige-seeking behavior. The high incidence of scalping is accompanied by cranial trauma, suggesting formal battle between warriors and reverential mortuary treatment of men who had fallen in combat and been mutilated. Taken together, this evidence suggests an increasing formalization of conflict between social groups and the emergence of specialized of social roles related to conflict. Solometo (2001) proposed that increasing frequency and predictability of conflict should motivate increased investment not only in defensive and fortified sites (as discussed in the previous chapter) but also in specialized training and organization of warriors and specialized weapons to arm them. The following chapter examines evidence from the Flagstaff region for the post-1160 emergence of specialized social roles related to the prosecution and management of conflict and development of specialized weapon technologies intended for intergroup conflict.

CHAPTER 10 – EVIDENCE OF COMPETITION: SPECIALIZED SOCIAL ROLES AND WEAPONS TECHNOLOGY

The expectations developed in Chapter 7 suggest that increased frequency, predictability, and social scale of conflict should motivate certain social and technological responses: (1) the development of specialized social roles and institutions for making war and mediating peace, and (2) development of weapons technologies specially designed for use in intergroup conflict. If environmental disturbances lead to increased frequency and predictability of conflict, then initial evidence of these social and technological responses should be expected in the 1085-1130 period following the eruption and subsequent drought, and greater evidence of these responses in the 1130-1160 period during and after the 1130s megadrought. Increasing social scale of conflict is also expected to affect the development of specialized social roles and institutions. However, the ethnographic data reviewed in Chapter 5, suggested the caveat that specialized social roles and institutions related to the management of conflict may be influenced as much by internal needs for social control and identity formation as communities grow as by external needs for defense. In this chapter, I first present two lines of evidence for the development of specialized warrior roles and institutions: (1) an ornament form used to signal warrior identity and (2) ritual paraphernalia used in warrior initiations. Then, I examine a distinctive projectile point form that developed locally after the eruption as an example of the emergence of specialized weapons technologies.

Specialized Social Roles and Institutions

In the Rio Grande and Four Corners regions, the iconography of warrior figures, shields, and shield-bearing figures in rock art and kiva murals has been used to investigate the emergence after 1250 of specialized warrior roles and institutions (Crotty 2001; Schaafsma 2000). While the rock art of the Flagstaff region has not received such systematic scrutiny, the documented iconography (Anderson 1990b; Colton 1946; Colton and Colton 1931; D'Amico 1977; Hays-Gilpin and Weaver 2012; Schaafsma 1987) does not appear to contain unambiguous depictions of either warriors or shields. This iconography of warriors and shields largely developed after the prehistoric abandonment of the study area, so its absence is not unusual. However, two other lines of evidence do suggest that specialized warrior roles and institutions developed in the Flagstaff region after the eruption of Sunset Crater. Comparative study of Sinagua mortuary assemblages indicates that greater social differentiation emerged and a larger number of social roles developed in the periods that followed the eruption of Sunset Crater (Hohmann 1983). Various material forms were used to mark roles and statuses, including painted armbands (Whittaker and Kamp 1992), painted staffs (King 1949), and personal ornaments (Murphy 2000). One form of personal ornament, nose plugs, were introduced to the region after the eruption and I argue that they were used to signal the wearer’s warrior identity. While these ornaments indicate an individual’s warrior identity, other ritual paraphernalia provides evidence of the organization of warriors into formal institutions. I argue that swallowing sticks, which have been recovered from post-eruption mortuary and non-mortuary contexts, were used in warrior sodality initiations.

Nose Plugs

Nose plugs (Figure 10-1) are straight or slightly curved stone tubes most commonly made from argillite, but also from limestone, quartzite, siltstone, steatite, and other unidentified minerals (Jernigan 1978:74, 76-77, 129, 133-135). Some are more elaborate, with pieces of turquoise inlay on the ends. These ornaments were made to be inserted into a perforation in the nasal septum and have been found *in situ* with male inhumations (Haury et al. 1950; McGregor 1943). McGregor (1941:206) noted that specimens found with cremations at Winona Village had staining around the center as would be left by burning of the septum had they been worn during the cremation process. Some straight specimens have notches in the center that likely assisted their being secured in the nasal perforation. Worn on the face, nose plugs would have been very conspicuous and a particularly effective means of signaling an individual's social identity, role, or status.

Nose plugs have been found in the Hohokam region to the South dating from the Pioneer through Classic periods (Jernigan 1978:74, 76-77). They were introduced to the Flagstaff region after the Sunset Crater eruption as part of a suite of Hohokam material culture and ritual practice (see Chapter 11). The Flagstaff region is the only place where nose plugs have been found north of the Mogollon Rim. Nose plugs have not been found from Puebloan sites on the Colorado Plateau and nasal piercing was not practiced among ethnographically-known Puebloan cultures. Ethnographies indicate that nasal piercing was practiced by O'odham and Yuman speakers of the Sonoran Desert and Lower Colorado River Valley to the south and west, and only males in these cultures had their septums pierced. The act of piercing and the bone, stone, or shell ornaments then

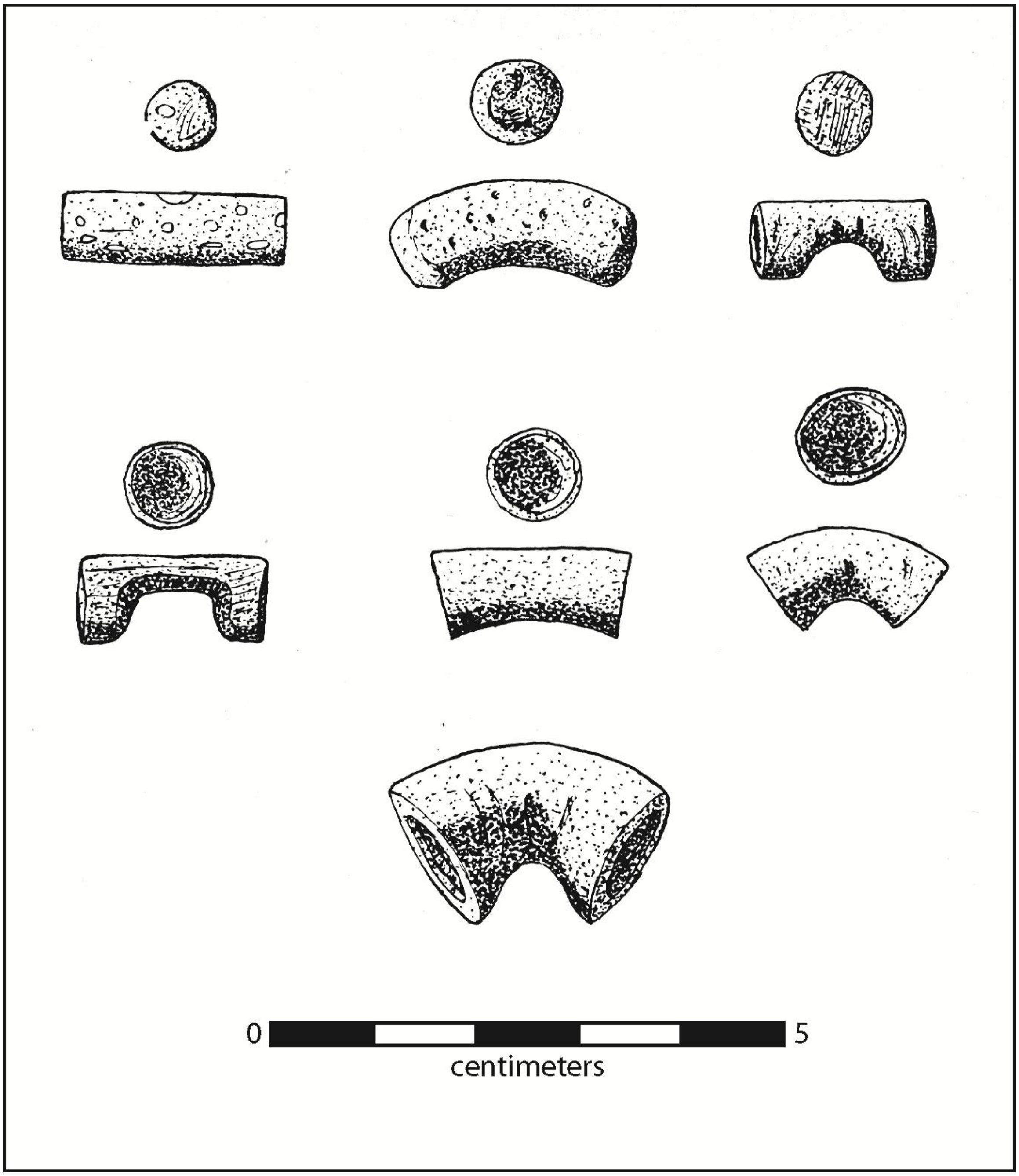


Figure 10-1. Nose plugs from Winona Village and Ridge Ruin (after McGregor 1941:207).

displayed signified an individual’s bravery and status as a warrior (Gifford 1936:276; Kniffen et al. 1935:110; Russell 1908:163; Spier 1933:102). The piercing could be done at puberty to mark transition to manhood or later in life to signify achievements in war.

In the Flagstaff region, nose plugs have been found at post-eruption sites in both the heartland and frontier zone. In the heartland, they are found at large sites like Ridge Ruin (McGregor 1941, 1943), small sites like Lizard Man Village (Kamp and Whittaker 1999:132, 133), earlier sites with ballcourts like Winona Village (McGregor 1941), and later sites without ballcourts like Two Kivas Pueblo (McGregor n.d.). Similarly, in the frontier zone, nose plugs have been found at large sites with communal ritual architecture like Wupatki Pueblo (Stanislawski 1963b:167-169) and at small sites like Ant Hill (Adams 2006:108). Assuming the validity of the ethnographic analogy that nasal piercing and adornment indicates an individual's bravery and their status as a warrior, this wide distribution of nose plugs in the region suggests social roles that signaled warrior status and personal bravery were valued and important. The distribution of nose plugs at both large sites with communal ritual architecture and small habitation sites further suggests that these roles were not restricted to privileged members of the community, but rather could be achieved by many. Their presence in both the heartland and frontier zone indicates that this social role crosscut communities engaged in different social and economic networks and likely with different cultural backgrounds, which perhaps underscores the importance of specialist warriors for community success in the region. While introduced after the Sunset Crater with other aspects of Hohokam material culture and ritual practice like the use of cremation and the local manufacture of red-on-buff pottery, nose plugs continued to be used after these other practices were abandoned, again suggesting the importance of specialist warriors in the constitution of regional communities.

Ritual Paraphernalia

While nose plugs clearly signaled an individual's social role and identity, whether this role was organized into a formal institution like a warrior sodality that managed and directed the activities of those that held the role is not clear. There is, however, a certain form of ritual paraphernalia found in the Flagstaff region that was likely used in the initiation rites of a warrior sodality. These swallowing sticks are similar to those that were formerly used in initiation rites of the Hopi Mòmtsit warrior sodality, and archaeological specimens have been recovered from both mortuary and non-mortuary contexts. The mortuary contexts present further information about the ritual and political organization of prehistoric communities in the Flagstaff region.

The swallowing sticks recovered from mortuary contexts were all found with the burial of the Magician of Ridge Ruin (Figure 10-2). This tall, physically robust man who died in his mid-40s was buried ca. 1175 accompanied by a rich and varied assemblage consisting of several distinct sets of paraphernalia (Table 10-1) for the performance of symbolically and functionally differentiated rituals (McGregor 1943; O'Hara 2008). Many of these rituals can be associated with curing and weather control, but some can be linked to male initiation rites related to warrior status; to mediation, arbitration, and conflict resolution; and to divinatory powers used in hunting, warfare, and combating

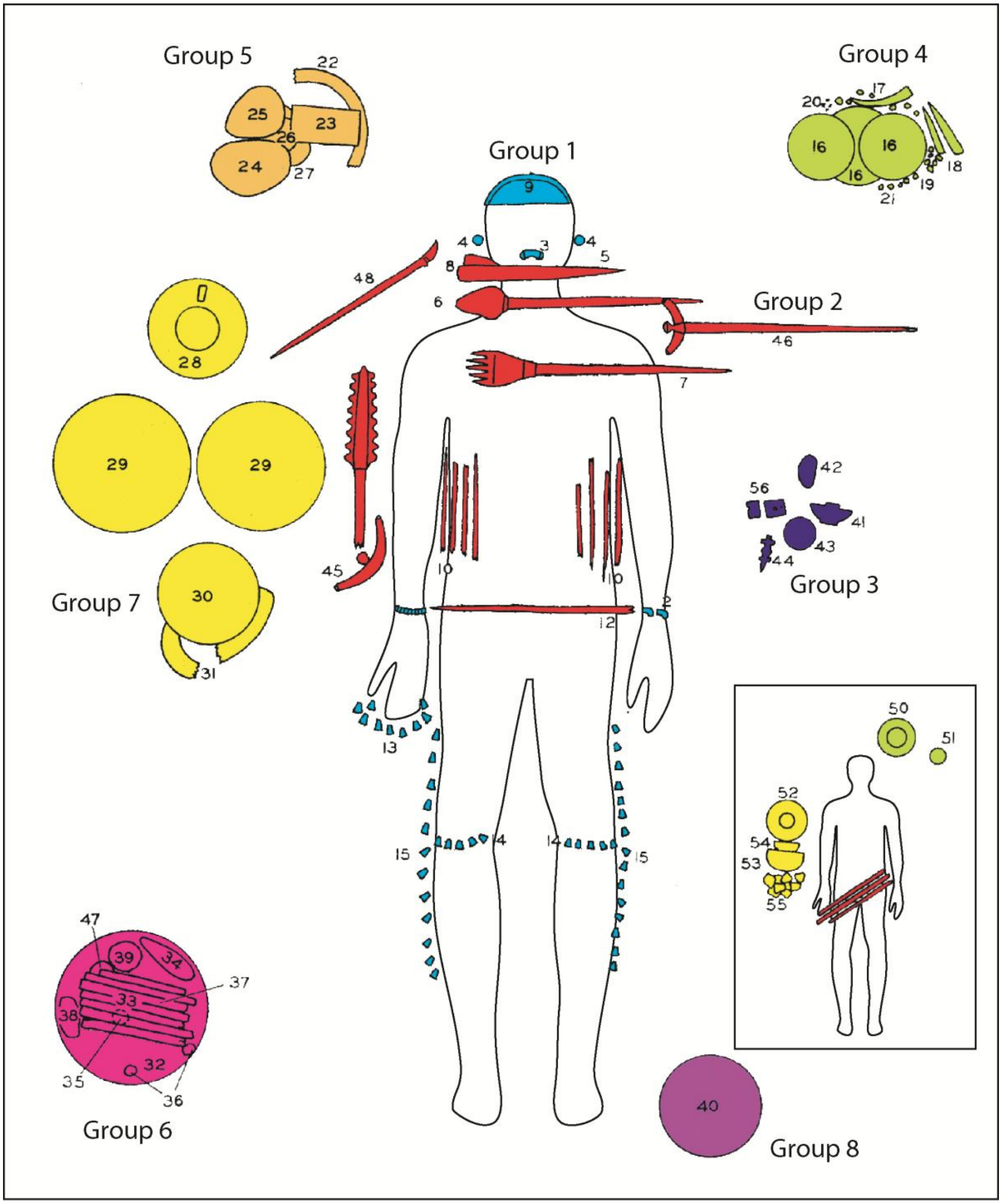


Figure 10-2. The Magician burial with associated artifacts identified in situ and designated as Groups 1-8, after McGregor (1943). See Table 1 for descriptions of items in the groups of offerings.

Table 10-1. Groups of offerings identified in the Magician burial with their locations in the grave and their contents.

Group	Location in Grave	Contents*
1	worn as clothing or ornament	(1) turquoise bead bracelet on right wrist, (2) mosaic bead bracelet on left wrist, (3) argillite and turquoise noseplug, (4) turquoise and shell earrings, (9) stone and shell bead cap, and (13-15) conus shell tinklers along sides of legs, at knees, and in right
2	above and along side body, from pelvis to jaw	(5) large decorated bone awl, (6) wooden swallowing sword with whole *Galeodea* shell on handle, (7) wooden swallowing sword with carved hand handle, (8) obsidian knife blade, (10) eight blue-painted swallowing swords, (11) swallowing sword with painted agave effigy handle, (12) red-painted swallowing sword, (45) turquoise and shell mosaic crescent, (46) swallowing sword with turquoise and shell mosaic crescent handle, (48) swallowing sword with carved deer/sheep hoof handle, and (49) three swallowing swords – one with carved hand handle, another with a carved deer/sheep hoof handle
3	on the left side of the body	(41) bird-shaped mosaic, (42) ear-shaped mosaic, (43) round mosaic, (44) lizard-shaped shell pendant, and (56) two square calcite pendants painted green
4	on the left side of the head	(16) three Flagstaff Black-on-white seed jars, (17) rim of large shell, (18) jasper and chalcedony knife blades, (19) two cut out shell pendants [in seed jar], (20) specular hematite crystals, (21) malachite fragments, (50) Dogoszhi Black-on-white jar, and (51) black-on-white bowl
5	on the right side of the head	(22) painted basket, (23) mosaic basket tube, (24) abalone shell, (25) three nested *Cardium* shells, (26) bird-shaped mosaic shell bracelet, and (27) shell and turquoise pendant
6	on the right side of the feet	(32) coiled basket, (33) reeds filled with azurite pigment, (34) azurite pigment in a gourd, (35) cinnabar pigment in small leather sacks, (36) fragments of hematite, (37) claws and teeth of mountain lion, (38) mass of hair, (39) mass of [cotton?] yarn, (47) lignite button
7	on the right side of the body	(28) Sunset Red pitcher, (29) two Citadel Polychrome bowls, (30) Walnut Black-on-white bowl, (31) painted basket, (52) Sunset Red jar, (53) black-on-white bowl, (54) black-on-white bowl, and (55) crushed black-on-white bowl
8	on the left side of the feet	(40) black-on-white bowl
9	placed over the body and offering Group 2	painted arrowshafts, miniature painted bows
–	objects with unknown grave locations	painted wooden cup, "several" quartz crystals, shaped calcite rod, rectangular turquoise pendant, triangular turquoise pendant, lizard-shaped shell pendant, pair of abalone shell earrings, two mosaic pieces (one round and one ovular), two whole *Carduim* shells, *Turitella* shell pendants, pigment-stained abalone shell fragments, decorated bone awl, three plain bone awls, bone spatula, bone tube, trapdoor spider nest and cocoon rattles, and 11 ceramic vessels (including one Turkey Hill Red bowl, one Tusayan Polychrome pitcher, and nine black-on-white bowls)

* numbers in parentheses keyed to Figure 10-6

witchcraft (Table 10-2). The Magician was buried wearing a nose plug, indicating his identity as a warrior, and central to the offerings is a set of 13 swallowing sticks that were placed directly above him. Southwestern ethnographies indicate that such items were used by Puebloans and other groups in shamanic demonstrations of power in weather control, curing, and male initiation rites, including initiations into warrior sodalities (Table 10-3). Among the Hopi, stick swallowing performances were exclusively associated with the ritual activities of the Nasotanwimkya suborder of the Mòmtsit warrior sodality discussed in Chapter 5 (see also Titiev 1944:156-159).

The set of swallowing sticks found with the Magician had handles decorated with representations of agave leaves, hands, hooves, and crescents (Figure 10-3). In the

Table 10-2. General and specific ritual roles represented in the Magician burial and the artifacts that mark those roles.

General Ritual Roles	Marker Artifacts	Other Associated Artifacts	Offering Group
male initiation curing war winter weather control	swallowing swords	decorated bone awl obsidian knife	2
weather control	whole cardium and abalone shells	mosaic basket tube painted basket bird-shaped mosaic shell bracelet	5
curing combating witchcraft	red and white knives	black and green pigments marine shell decorated seed jars	4
combating witchcraft divination hunting war	nite mirror necklace of mountain lion teeth and claws	red and blue pigments human hair cotton yarn	6
curing divination	quartz crystals	unknown	–
curing	bone tube		

Table 10-3. Southwestern cultures that practiced sword swallowing with data on the presence of a controlling ritual sodality, the season of the year that sword-swallowing rites were performed, and what associations the ritual possessed.

Culture	Sodality	Season	Associations							References
			Fire	Cold	War	Fertility	Weather	Curing	Lightning	
Acoma	Y	Winter	X					X		White 1932
Hopi	Y	Winter			X				?	Stephen 1936 Titiev 1944
Jemez	Y	Spring	X					X		Parsons 1925
Laguna	Y	Winter			X					Boas 1928 Parsons 1920
Navajo	N	Winter	X			X	X	X		Matthews 1887
Santa Ana	Y	unknown			X			X	?	White 1942
Tohono O'odham	N	unknown	X		?		X			Underhill 1946
Zia	Y	Winter	X		X			X		White 1962
Zuni	N	Winter	X	X	X	X	X	X		Simpson 1948 Stevenson 1904

X = strong association   ? = possible or uncertain association

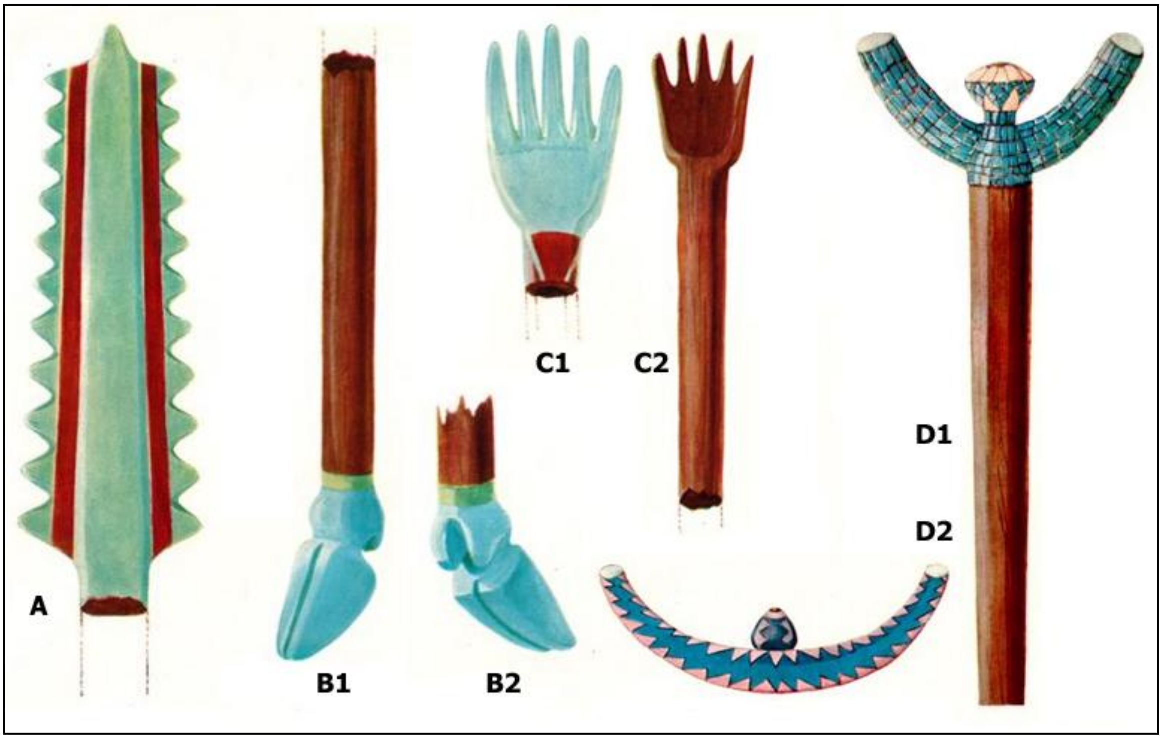


Figure 10-3. Decorated handles of swallowing sticks from the Magician burial: (A) agave leaves, (B) hooves, (C) hands, and (D) crescents; from McGregor (1943). There were three of each of these forms.

Flagstaff region, two other swallowing sticks have been recovered from non-mortuary contexts: one from Wupatki Pueblo (Fewkes 1926:105) and the other from Tse Tlani, a small site 12 km southeast of Ridge Ruin (Ward 1969). The exact context of the Wupatki specimen is uncertain, but the one from Tse Tlani was recovered from the fill of a probable kiva, perhaps deposited as part of an abandonment ritual for the structure or deposited later with the old kiva acting as a special location for the retirement of a charged piece of ritual paraphernalia. Both swallowing sticks from Wupatki and Tse Tlani had carved hooves for handles indicating probable use in the same ritual as the set found with the Magician, suggesting the adoption throughout the region of male initiation rites linked to the achievement of warrior status. Other swallowing sticks have been found at later sites in the Verde Valley and in the Upper Little Colorado River Valley, and include a pair carved from slate with hand and hoof handles (Dixon 1956:52-53; McGregor 1943:297).

I have previously proposed that the varied offering groups found with the Magician indicate the segregation of ritual powers into complementary sodalities and the emergence of more formally constituted leadership positions (O'Hara 2008). The offerings should not be seen as personal wealth, but rather as sets of inalienable ritual paraphernalia that were decommissioned as an affirmation of the nature of social and political relations in the community at an important social transition. The evidence suggests that these complementary sodalities were similar to later arrangements found at Hopi and other Pueblos, some concerned with weather control, fertility, and curing, and others with war and other aspects of social conflict like combating witchcraft. The act of the burial with the placement of the offerings created a sociogram outlining the constitution of the local community. The central presence of the swallowing sticks in that sociogram suggests the importance of male initiation rites linked to the achievement of warrior status, the formal social institutions that performed these rites, and the social roles achieved by those who underwent initiation.

Evidence for Warrior Roles and Institutions

Nose plugs and swallowing sticks suggest the presence of specialized social roles related to intergroup conflict, formal institutions to organize and manage warriors, and leadership roles within these institutions. Ethnographic analogy suggests that nose plugs, like that worn by the Magician, were likely symbols of warrior status and a specialized social role related to intergroup conflict. Their wide distribution underscores the importance of specialist warriors in regional social and political organization. While iconographic evidence in rock art for weapon- or shield-bearing warriors is absent, the association of known Hopi clan and sodality symbols at defensive sites (see Chapter 8) suggests that localized kin groups integrated by sodalities had begun to organize for mutual defense. Evidence of such sodalities is present in the offerings found with the burial of the Magician, and rituals related to male initiation and warfare appear to be primary to the arrangement of ritual paraphernalia in the grave. This arrangement of decommissioned inalienable ritual paraphernalia can be interpreted as a sociogram describing the ritual and political organization of the community with leadership associated with the male initiation and warfare at the center.

While the sample size of these special artifacts is low, the available evidence suggests that the development of specialized roles associated with warriors that were organized into formal institutions occurred after the eruption of Sunset Crater. Nose plugs first appeared in the region immediately following the eruption and continued to be used throughout the 1100s and into the 1200s. The organization of warriors into formal institutions appears to have been later, as swallowing sticks have only been recovered from post-1160 contexts. The burial of the Magician occurred ca. 1175 and the mean ceramic date for Tse Tlani is 1177. The swallowing stick from Wupatki lacks context that would allow dating its deposition, but the peak occupation for the site as a whole was during the 1160-1220 period.

While some of the sample sizes are low, the available evidence seems to suggest two dimensional changes from the pre-eruptive to post-eruptive periods: increases in (1) the frequency and predictability and (2) the social scale of intergroup violence. Increased frequency and predictability of intergroup violence would encourage and even select for the institutionalization of warrior roles, as groups possessing formal institutions that trained warriors and organized them into fighting units would likely have greater success when competing against groups that lacked such institutions. Increases in the social scale of intergroup conflict occur in two related ways: (1) the size of the local community organized for mutual purposes, and (2) the scale at the regional level of those communities engaged in hostilities. Increased social scale of intergroup conflict would require the formalization and institutionalization of warrior roles to more effectively organize and deploy larger numbers of combatants, as well as integrate larger communities for mutual defense and offense. However, as the size of local communities increased, internal needs for social control and identity formation may also have influenced the institutionalization of warrior roles. The evidence from the Magician burial indicates that multiple complementary institutions developed during the late Elden phase (1160-1220) as local populations grew, household organization was transformed by the adoption of unit pueblo architecture, and these social units aggregated into clusters.

SPECIALIZED WEAPONS TECHNOLOGIES

Intensification of intergroup conflict may lead to technological adaptations like the development of specialized weapons technology for use in war, which can have two aspects. First, design features can increase the lethality of the weapon to provide those bearing such weapons a competitive advantage over their opponents. Secondly, the materials used or workmanship invested may increase the value of the weapon as a symbol of power, status, and authority, which relates back to the development of specialized warrior roles and institutions.

LeBlanc (1997, 1999) has discussed the development of specialized weapons technology associated with intergroup conflict in the U.S. Southwest at length, focusing on the adoption and spread of bow-and-arrow technologies; the role of shields; and the evidence for wooden swords and fending sticks, other clubs, and specialized axes and knives. LeBlanc suggests the trends in technological developments, their adoption, and spread indicate increased intergroup conflict region-wide after 1200. I suggest that in the Flagstaff region changes in projectile point technology indicate that some of these developments occurred in the aftermath of the 1130s megadrought and the associated episodes of extreme violence that accompanied intergroup conflict.

For a knapper making a projectile point from cryptocrystalline stone, a problem to consider in the design is not if the point will break, but rather how it will break when it does. For example, in an investigation into Folsom point technology, Ahler and Geib (2000) suggested that the fluting of Folsom points was part of an overall hafting system that was intended to control breakage to the tip, allowing a sizeable portion to be easily re-sharpened into a new point that could be re-hafted, and providing multiple cycles of use and re-use until the remaining basal fragment was too small for resharpening and rehafting. The fluting allowed the foreshaft elements to cover most of the point and focus any bending and twisting forces of impact at the tip where breakage would then be most likely to occur. This overall design was to provide a reliable and maintainable hunting system that was lightweight and allowed the user to be distant from sources of quality toolstone while pursuing game. Geib (1995) has further suggested that Late Archaic and Basketmaker II period corner- and side-notched points of the Colorado Plateau were similarly designed to control breakage in order to provide a large piece that could be easily re-fashioned into a new point. In this case, however, the notching not only facilitated hafting, but also created a pre-weakened area for breakage that would leave a large triangular distal fragment needing only basal trimming and renotching to be rehafted and re-used.

After 1150, a new projectile point style, which I refer to generically as "high-side-notched," was developed in the Flagstaff region, and it later spread along and below the Mogollon Rim after 1250 (Justice 2002:292-293, 302-306) (Figure 10-4). These points were expertly pressure flaked from bifacially prepared blanks, resulting in a thin cross section, they have a basal indentation that creates barbed ears, and they are notched near the midpoint of blade (Figure 10-5). Points of this type have been variously called Ridge Ruin, Walnut Canyon, and Point of Pines Side-Notched (Justice 2002:292-293, 302-306), High Notched Small Triangular (Kamp and Whittaker 1999), Ridge Ruin and Elden Side-Notched (Whittaker, Kamp, and Bryce 2013), Classic Side-Notched (Sliva 1997), Middle

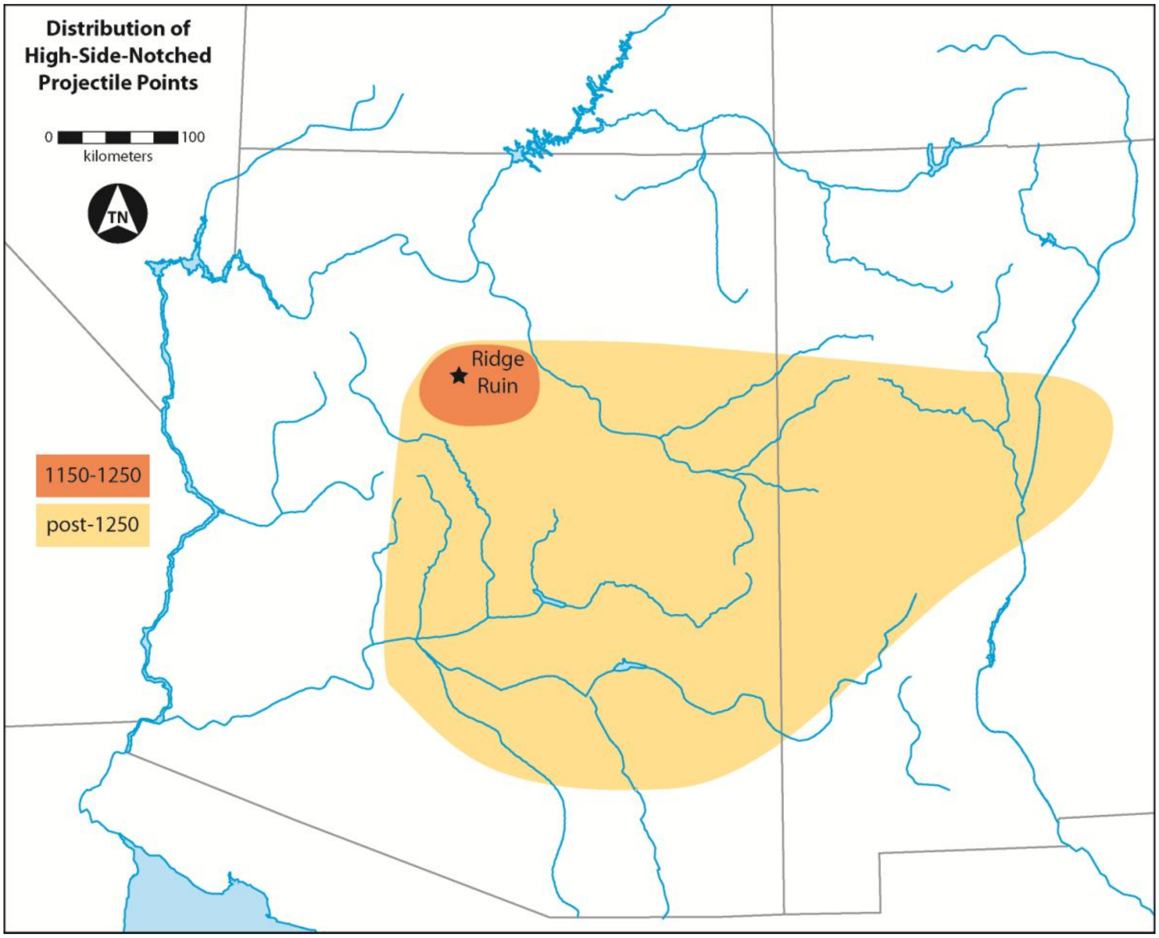


Figure 10-4. Map of the distribution of high-side-notched projectile points (after Justice 2002:304-306).

Side-Notched and High Side-Notched (Loendorf and Rice 2002), and Kahorsho Center-Notched (Rondeau 1979), as well as the less descriptive Type N (McGregor 1941) and Type 2a (Anderson and McDonald 1990). Some of the morphological differences among named types relate to characteristics of the blade margins, whether they are straight, concave, or taper in towards the base to become roughly parallel.

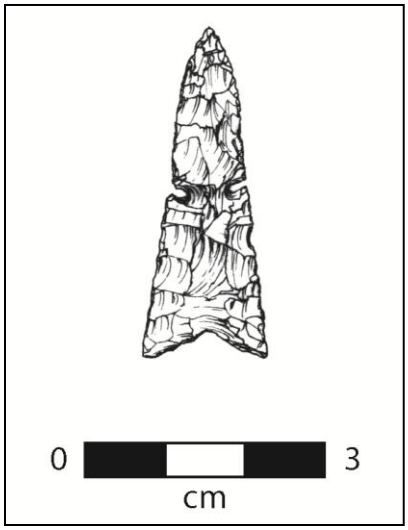


Figure 10-5. High-side-notched point from the Magician burial at Ridge Ruin (Justice 2002:292).

The notching near the midpoint, while functional for hafting, results in a long hafting element and creates a weak point where breakage upon impact would be highly likely if not certain. In fact, the final production stage of notching likely had a high risk of breaking the point preform before it was finished. Like the high rate of failure found in the fluting stage of Folsom point production (Ahler andGeib 2000), incorporation of this design feature despite the high likelihood of failure and the loss of invested labor and materials indicates that this feature was considered essential to achieve the desired performance characteristics in the finished product.

Unlike the aforementioned systems that controlled breakage in order to leave a large enough fragment to be reworked into a serviceable point, this notching method would not leave any fragment that could be easily re-worked into a suitable point. However, if the intent was to increase the lethality of the point rather than provide a reliable and maintainable hunting system, this notching would be ideal, as the broken tip of the point would remain in the body of the target even if the barbed base were removed, increasing the likelihood of infection and death, especially if the tip was poisoned in ways documented among some Southwestern cultures (Ellis 1997; Gifford 1932, 1936, 1940). Further, the long hafting element would require the distal end of the arrowshaft to be split more deeply than would be needed if the notches were closer to the base, and the shaft would then be more likely to split and splinter further upon impact, perhaps resulting in a more severe wound and creating more difficulty for extraction (William Bryce, personal communication 2013). A projectile point designed for big-game hunting should maximize penetration to increase the probability of a quick kill shot in the chest cavity (Ahler and Geib 2000). The design of the high-side-notched system with the notching encouraging breakage on impact and the deeply split hafting element increasing haft drag, maximizes damage over penetration. In total, these design characteristics seem to have been intended to increase the lethality of the projectile. Much like modern hollowpoint bullets like the Winchester Black Talon (Carter 2002:64-65), these high-side-notched points were designed to maximize damage upon impact to increase the potential lethality of the inflicted wound.

While first appearing in the archaeological record in the Flagstaff area after 1150, these high-side-notched forms were never a predominant point form in lithic assemblages. At the site of Lizard Man Village, where 261 projectile points were found, the high-notched form only comprised 13% of the assemblage of small triangular points, while low-notched, un-notched, and serrated forms each accounted for 24% of the assemblage. While the high-side-notched forms were finely pressure flaked from bifacially prepared preforms, most of the un-notched points are described as thick, poorly flaked, and more typical of local projectile point production (Kamp and Whittaker 1999:83-85). Further indicating the relative rarity of this form, high-side-notched points accounted for only 1.2% of the assemblage of 163 projectile points recovered during the archaeological survey of Wupatki National Monument (Anderson and McDonald 1990).

There is one context, however, where the assemblage is dominated by these points: the burial of the Magician. The final depositional event in the elaborate ritual that accompanied the burial was the placement of 426 projectile points, some of which retained hafting and shaft elements (including nocked distal ends) indicating that whole arrows were placed, as well as an unknown number of miniature bows. The high-side-notched form accounted for 64% of the assemblage, and other side-, corner-, and un-notched forms comprised the remainder. Recent documentation of the point assemblage prior to repatriation noted that many of the points were similar in form, size, notch characteristics, and/or material; these traits marked sets that were perhaps manufactured by a single knapper (Whittaker, Kamp, and Bryce 2013). A total of 44 of these sets were identified, although this represents a minimum number as not all of the 426 points could be placed within such sets. These may represent 44 individual offerings of arrow bundles placed by 44 different mourners present at the burial ceremony, perhaps as a final affirmation of their political and military allegiance to the Magician.

The high-side-notched projectile point form that developed in the Flagstaff region appears to have been designed to maximize the potential lethality of the wound inflicted. These points were expertly made and had greater amounts of labor and skill invested in them than the more typical rudimentarily fashioned points found in the region. The interpretation that the high-side-notched points found with the Magician were in sets made by different individuals reveals that the basic form was replicated by an expert group of knappers in the community who shared a common vision of not just how the completed point should look, but also how it should function and to what ends it should be used. The workmanship invested in these points indicates the importance placed on the purpose for which they were used and may have increased the symbolic value of the weapon in its association with intergroup conflict.

While projectile points are small and not highly visible, Wiessner (1983) has shown how different projectile point forms made and used by the !Kung San transmitted information about the group affiliation or identity of the manufacturer. In the Flagstaff region, the high-side-notched form may have been a symbol of warrior identity and associated with that social role; the skill needed to manufacture these points may have been requisite for recognition as a specialist warrior. The large numbers of this point form that were placed as offerings with the Magician, an important local leader who likely oversaw rituals related to male initiation and warfare, supports the inference that this form was associated with intergroup conflict and signaled the warrior identity of those who used arrows tipped with these points.

All together, these factors suggest that this point form was developed as a specialized weapon for use in intergroup conflict. The design of the point maximizes the damage inflicted upon the target and increases the lethality of the wound inflicted. The skilled workmanship displayed sets them apart from the more rudimentary points more commonly found in the region and signals both the identity of the user as a warrior and the intent of their use to kill another human.

SUMMARY OF EVIDENCE FOR COMPETITION

This and the previous two chapters have presented three complementary lines of evidence that indicate increasing intensity and changing contexts of intergroup conflict in the Flagstaff region: (1) investments made in defensive sites , (2) the presence and nature of skeletal trauma, and (3) specialization of social roles and weapons technologies. Some of these changes correlate with periods of environmental stress as the developed expectations predict, but some of the expectations developed are not met.

Prior to the eruption of Sunset Crater, levels of violence were low and limited to what appear to have been hit-and-run attacks on small settlements in the frontier zone where plainware pottery assemblages indicate considerable cultural diversity and interaction. Three fortified retreats were built in the frontier zone in the mid-1000s, two of which are in locations that can monitor key travel routes, and another fortified retreat was built in the heartland. While evidence for attacks on settlements is limited to the frontier zone, the need for secure refuge was apparently also felt in the heartland. There were no environmental disturbances in the decades prior to the eruption, instead it was a sustained period of conditions favorable for agriculture. During this favorable period, populations from the west expanded into the frontier zone, creating contexts for interaction and cooperation seen in the mixed plainware pottery assemblages as well as competition evidenced by the attacks upon the Lenox Park and Jack Smith Tanks sites and the construction of the fortified retreats.

The expectations predict that the 5 years of eruptive activity and subsequent 11-year-long extreme dry period should lead to an increase in intergroup conflict as alarm stage responses would not be sufficient to meet the challenges faced leading to resistance stage responses like increased conflict. However, evidence for intergroup conflict during this period is largely absent. There is no skeletal evidence of violence, but the nose plug, an ornament that was likely associated with warrior status, was introduced along with other aspects of Hohokam material culture and ritual practice. The fortified retreat at the Fortress Hills in the heartland was still accessible and may have been in use, but no other defensive sites were present until the construction ca. 1120 of the great house components of Ridge Ruin and Wupatki.

Other defensive sites were established in the frontier zone in the 1120s, but the defensive site use index indicates that the peak period of investment in and use of defensive sites in the frontier zone was during the 1130 to 1160 time period, during and following the 1131 to 1142 megadrought. The skeletal violence index also peaks dramatically during this period, and the character of the violence changes as well, with whole families killed in their homes and evidence of peri- and postmortem mutilation and possible sexual assault. The model predicts such increase in conflict during and after the 1131 to 1142 megadrought, and the nature of the violence suggests changing tactics and goals as well as increased social distance between those groups engaging in hostilities.

After 1160, the skeletal violence index decreases, but remains much higher than the levels before the peak. The character of the violence changes again, with the most frequent targets of violence being adult men who were killed in face-to-face hand-to-hand combat, scalped, and then formally buried, suggesting increased formalization and institutionalization of conflict. The evidence for the emergence of specialized warrior roles and institutions suggests that by the time of the Magician's burial, ca. 1175, social and ritual power was distributed among complementary sodalities and that one related to male initiation and warfare was central to the constitution of the local community. The offerings found with the Magician included a large number of points in a form unique to the region. This high-side-notched form that developed after 1150 was designed to maximize its lethality suggesting they were specialized for intergroup conflict. Further, the levels of expert craftsmanship invested in their production may indicate their symbolic value associated with war and warrior status. Defensive site use decreased in the frontier zone during the 1160 to 1220 time period, but in the heartland this period saw increasing investment in defensive sites. After 1220, defensive site use increased in both areas, and in most of the latest sites occupied were defensive.

Conflict before the eruption seems to have been related to contested boundaries in the frontier zone, and some of this competition was during favorable periods, not during environmental disturbances. During the devastating aftermath of the eruption there is almost no evidence of conflict at all, contra the expectations that such an unexpected disaster followed by an extreme dry period should lead groups to resort to violence as resistance stage responses came to be deployed. As expected, the megadrought of 1131-1142 did trigger conflict and the incidences of violence are all in the frontier zone where competition for land during the post-eruption colonization of this area had already likely increased tensions between groups. Increased social distance is indicated by the extreme nature of the violence, and the tactics and goals shifted from small-scale hit-and-run attacks to larger scale attacks seeking the annihilation of the targeted settlement. Investment in and use of defensive sites was also greater in the frontier zone, indicating that the frequency and predictability of conflict was high.

After 1160, conflict decreased from the peak of the previous period but remained higher than it had been during earlier periods. The nature of the violence changed again suggesting greater formalization and institutionalization of conflict. A majority of the victims were scalped adult men who were likely killed in formal combat. The offerings found with the burial of the Magician indicate that a heterarchical arrangement of complementary ritual sodalities emerged during this time period with a sodality related to male initiation and warfare playing a central role in the constitution of the local community. This emergence of specialized social roles and institutions related to intergroup conflict was accompanied by the development of a projectile point form designed for increased lethality. There were changes in the tactics and goals, continued marking of social distance between groups, and probably increased social scale at the community and regional level. Petroglyphs of Hopi clan symbols are found associated with many defensive sites suggesting that localized kin groups had begun organizing for mutual defense. Intergroup conflict may have become an important mechanism for defining group identities and boundaries as has been described in New Guinea (Harrison 1989, 2006) and among the River Yumans (Fathauer 1954; Kroeber and Fontana 1986; Stewart 1947). In respect to the typology of conflict discussed in Chapter 5, these changes in the social scale of conflict indicate a shift from smaller scale conflict between socially close groups (feuding) to larger scale conflict between socially distant and distinct communities (warfare). The greater formalization and institutionalization of conflict after 1160 was likely a response to the extreme nature of the violent events that occurred during the 1130 to 1160 period that sought to control cycles of violence, limit their effects, and prevent their escalation in ways similar to the Enga development of the Great Ceremonial Wars described in Chapter 5. Such cooperation will be examined in the following two chapters by looking at the construction and use of different forms of communal ritual architecture and changing patterns of exchange.

CHAPTER 11 – EVIDENCE OF COOPERATION: COMMUNAL RITUAL ARCHITECTURE

In the next two chapters, two related lines of evidence will be used to evaluate expectations about how cooperative social processes were associated with either favorable or unfavorable environmental conditions: (1) the construction and use of communal ritual architecture and (2) exchange for nonlocal resources and craft goods. Periods with environmental conditions favorable to agriculture may allow the production of surpluses that can be used to finance communal ritual architecture by providing food for workers during construction and maintenance activities and, perhaps more importantly, for feasting events that accompanied ritual activities. The social gatherings hosted at these features also could facilitate the exchange of resources and craft items among the diverse groups assembled. In this chapter I examine the temporal and spatial distributions of two forms of communal ritual architecture used prehistorically in the Flagstaff region: ballcourts and great kivas. In the following chapter I examine exchange for non-locally produced pottery and exotic materials like marine shell, turquoise, argillite, and other minerals.

Examination of the temporal and spatial distributions of ballcourts and great kivas allows the evaluation of two expectations: (1) their temporal association with favorable environmental conditions, and (2) their spatial association with the frontier zone. The productivity during favorable periods provides resources for investment in the use of communal ritual activities and associated architectural feature. Decreased productivity during unfavorable periods, however, has the potential to trigger resistance stage responses like increased restrictions on social interaction, reduced participation in social activities, and curtailment of large-scale activities like communal rituals that require many resources. Thus, the construction and use of these communal ritual facilities – ballcourts and great kivas – is expected to be associated with favorable environmental conditions, while unfavorable conditions should conversely be accompanied by cessation of their use.

Secondly, the frontier zone is an area where populations from different cultural traditions interacted, and, since communal ritual is often used to integrate diverse community segments, I expect that architectural features supporting communal ritual should be found spatially associated with the frontier zone. Ballcourts in particular should be found in the frontier zone, as the architectural form of these features structure interactions between participating groups by marking and maintaining social differences and boundaries. Further, the use of ballcourts should correspond to periods when social distances between groups were pronounced. The architectural form of great kivas, in contrast, does not structure interactions to mark social differences among participants but instead expresses a common social identity. Their use is expected when social distances between groups were low and a common identity was expressed.

The architectural forms of ballcourts and great kivas did not originate in the Flagstaff region, rather they are each associated with larger regional systems described in Chapter 3: ballcourts with the Hohokam regional system centered in the Salt-Gila basin to the south and great kivas with the Chaco regional system centered in the San Juan basin to the east. The gatherings at these features were likely important contexts for creating and maintaining extraregional exchange relations that would have facilitated the movements of the materials discussed in Chapter 12. Determining the chronology of their use in the Flagstaff region is necessary to understanding the nature of their introduction to the region and their use in relation to these larger regional systems.

First, I present chronological and spatial data for the known ballcourts and great kivas of the region and evaluate expected patterns related to environmental conditions and the frontier zone. I then use data on plainware assemblages to examine the nature of group participation in the activities associated with these features, assessing whether they were used to bring together diverse groups or to express a common identity. In light of these chronological data and analyses of the plainware assemblages, I assess the use of ballcourts and great kivas in relation to the larger Chaco and Hohokam regional systems, the local heartland and frontier zone communities, and environmental conditions. In conclusion, I synthesize these data to show how local populations adapted these non-local forms to meet their own needs to mediate social tensions, create a common social identity, and create contexts where sharing and exchange were encouraged.

BALLCOURTS

Twelve Hohokam-style ballcourts have been identified in the Flagstaff region (Figure 11-1) (Table 11-1), and their periods of use dated through the analysis of associated pottery from excavated contexts and surface surveys and by relating the ballcourts with nearby habitation sites (Morales 1994; Wilcox 1991; Wilcox and Sternberg 1983). Three ballcourts were built and used before the eruption of Sunset Crater, one of which

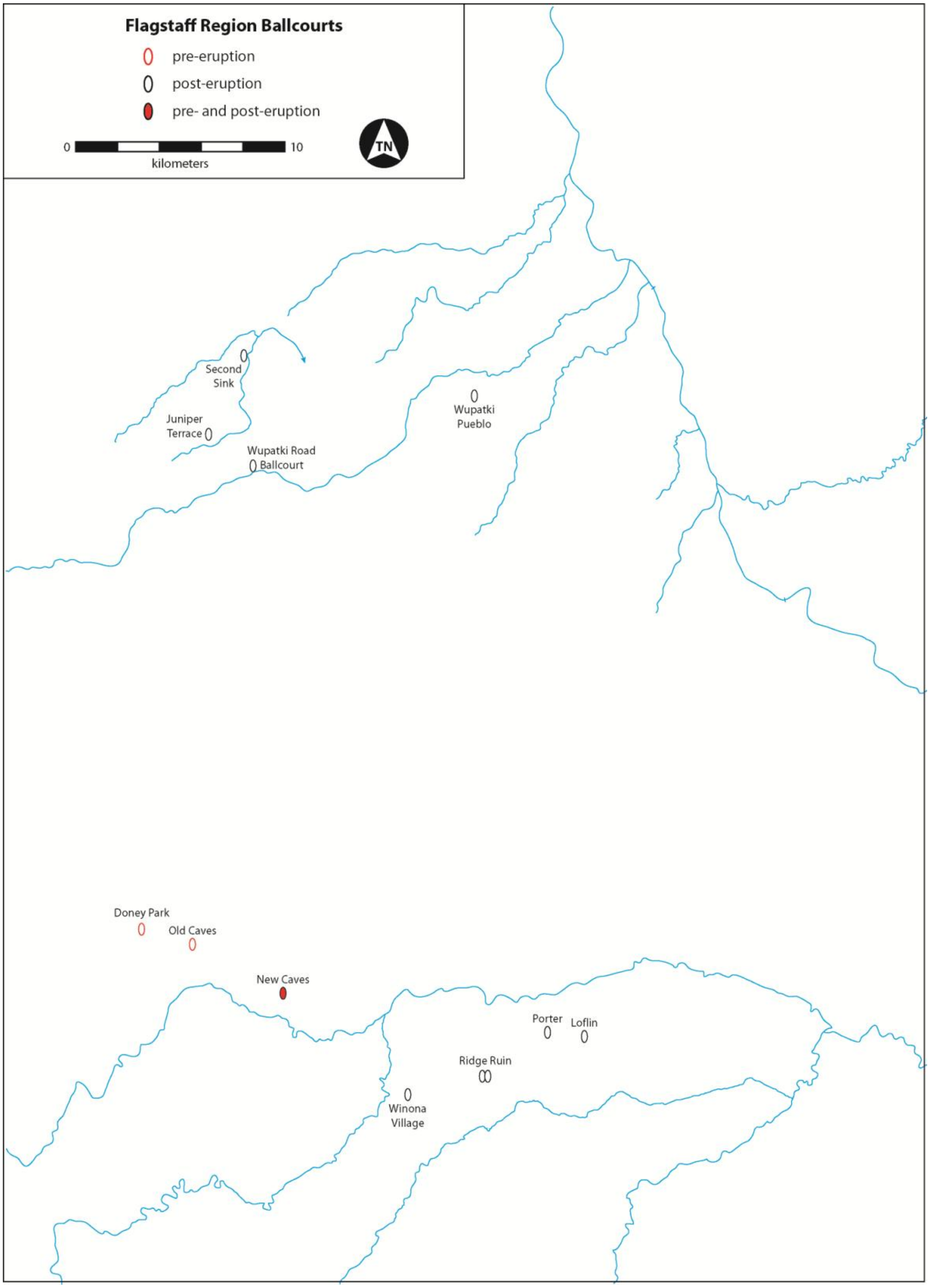


Figure 11-1. Ballcourts in the Flagstaff region.

Table 11-1. Hohokam-style ballcourts in the Flagstaff region.

Period & Area	Ballcourt Name	Wilcox (1991)	Morales (1994)	Number of Decorated Sherds *	Mean Ceramic Date **	Periods Used in This Study
Pre-Eruption	Doney Park	1000-1100	825/1025-1100	0	–	1000-1085
	Old Caves	1150-1250	825/1025-1100	6	1055	
	New Caves	1070-1150	825/1025-1100	12	1093	
Post-Eruption Heartland	Winona	1066-1100	–	237	1094	1085-1130
	Ridge Ruin West	1070-1120	1064-1100	8	1096	
	Ridge Ruin East	1070-1120	1064-1130	25	1106	
	Loflin	1070-1150	–	33	1120 †	
	Porter	–	–	–	–	
Post-Eruption Frontier zone	Second Sink	1070-1150	1080-1120	25	1094	
	Wupatki Road	1066-1100	1130-1200	18	1138	1130-1160
	Juniper Terrace	1130-1200	1130-1200	29	1162	
	Wupatki Pueblo	1130-1200	–	2	–	

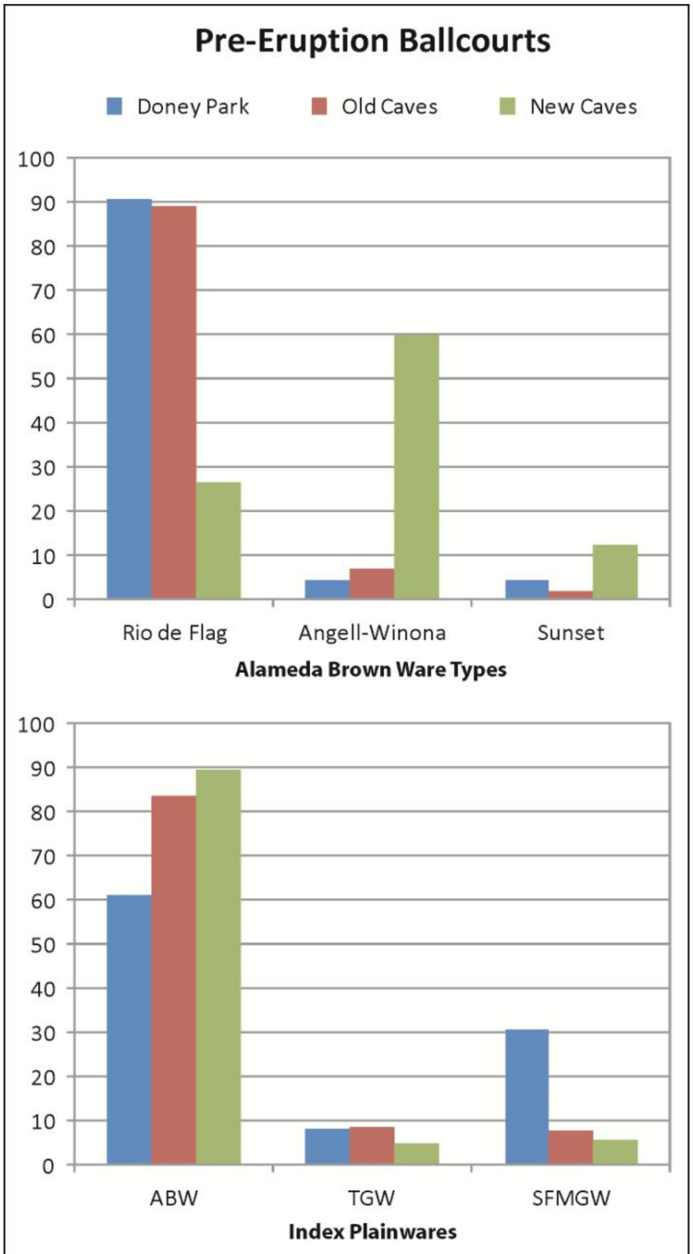
* source data is Morales (1994:36) for all except Winona (Colton 1946:185) and Loflin (MNA site card)
** some dates calculated using fewer than the preferred 20 or more sherds
† sherds used for Loflin MCD are from the whole site, all others are from the ballcourt only

continued to be used after the eruption, and another nine were built and used after the eruption. All of the pre-eruption ballcourts were in the heartland, while post-eruption ballcourts are found in both the heartland and the frontier zone. In the following sections, I present data on the chronology of construction and use for the pre-eruption, post-eruption heartland, and post-eruption frontier zone ballcourts and evaluate the expectations regarding their use in relation to environmental conditions.

Pre-Eruption Ballcourts

The Doney Park, Old Caves, and New Caves ballcourts were all built and used during 1000-1085 period before the eruption, but they probably were not all used at the same time. Seriation of the ceramic assemblages associated with these ballcourts (Morales 1994:36) based on the proportions of the index plainwares, the proportions of the Alameda Brown Ware types present, and the black-on-white styles present supports this inference (Figure 11-2). This seriation suggests the Doney Park ballcourt was built and used first, perhaps before 1050; the Old Caves ballcourt was in use next, between 1050 and 1075; and the New Caves ballcourt was the latest of the three, postdating 1075 with use continuing after the 1085 eruption.

This chronology suggests that the Old Caves and New Caves ballcourts were used during a lengthy interval before the eruption that was favorable for agriculture (see Chapter 2). This interval consisted of a 20-year-long favorable period from 1047 to 1066 that was followed by a 11-year-long favorable period from 1076 to 1084. This conforms to the expectation that use of communal ritual architecture should be associated with



Decorated Styles Present	Doney Park	Old Caves	New Caves
Kana'a		X	
Black Mesa		X	X
Sosi		X	X
Dogoszhi			X

Figure 11-2. Seriation of the pre-eruption ballcourts based on Alameda Brown Ware types, index plainwares, and black-on-white styles.

favorable environmental conditions. However, if the earlier Doney Park ballcourt was pre-1050, it may have been in use during the 1031-1041 unfavorable period contrary to the expectations.

Post-Eruption Ballcourts in the Heartland

In the wake of the physical devastation of the eruption and the social trauma created by population relocation, five new ballcourts were constructed in the heartland: one each at Winona Village, Porter, and Loflin, and two at Ridge Ruin. While the pre-eruption ballcourts were north of the Rio de Flag/San Francisco Wash drainage, the five new ballcourts built after the eruption were to the south in the post-eruption refugium (see Figure 3-3). This shift also matches a general shift in settlement to lower elevations after the eruption (Pilles 1979).

These post-eruption ballcourts in the heartland were associated with newly established communities consisting of dispersed clusters of pit houses, and the occupational histories of these sites can provide insights into the timing of ballcourt use. Best documented is the site of Winona Village (Figure 11-3); work by MNA resulted in the excavation of 20 pit houses and the recovery of 101 tree-ring specimens (McGregor 1941; Robinson et al. 1975). At Winona Village there is a distinctive Hohokam-style pit house (NA 2133A) that has a cluster of six tree-ring cutting dates from 1086 indicating construction soon after the eruption, and it is likely that the ballcourt at the site was built at the same time. Tree-ring dates and decorated pottery types present suggest that Winona Village began to decline after 1100 (Table 11-2). The pit house cluster at NA 2133 appears to have been abandoned soon after 1100, and the Hohokam-style pit house was

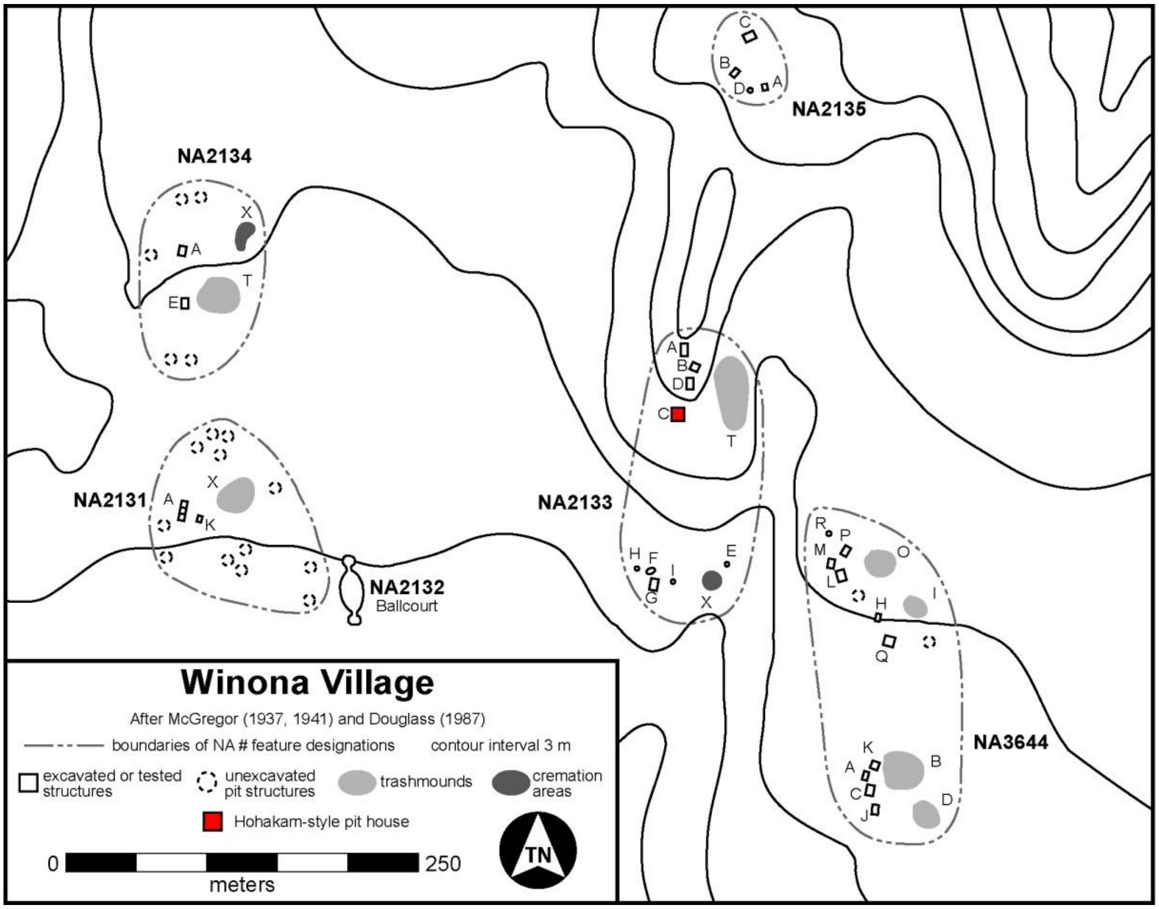


Figure 11-3. Map of Winona Village.

burned with a large floor assemblage of 25 whole pottery vessels. While there is evidence of limited occupation of the site through the early 1140s, most construction activity and pottery discard appears to have ended in the early 1100s.

The five post-eruption ballcourts (Table 11.1) were roughly contemporaneous, indicated by seriation using the pottery from the excavations of the Winona Village ballcourt and the systematic survey recording of the Ridge Ruin ballcourts (Figure 11-4). This conclusion is supported by the mean ceramic dates (Table 11-1) except for the Loflin ballcourt. However, the 1120 date for Loflin was calculated using sherds recorded

Table 11-2. Mean ceramic dates and tree-ring dates from Winona Village.

Winona Village NA Site #	Mean Ceramic Date (≥25 decorated)	Tree Ring Dates Cutting	Tree Ring Dates Latest Non-Cutting
2131A	1098		
2131T	1096		
2133A	1095	1086	1095
2133B	1088		1082
2133C	1088		
2133D	1090		1101
2133G			1082
2134A	1091		1140
2134B			1090
2134E	1095		1086
2134T	1092		1076
2135A	1091		
2135C	1091	1087	1096
3644A	1102		976
3644B	1093		
3644C	1115	1120	1117
3644H	1107		
3644J	1109		1093
3644K	1103	1076	
3644L	1090		
3644M	1091	1097, 1104	1096
3644P		1107	1107
3644Q			1070

from the whole site rather than just those associated with the ballcourt, as is the case for the others. Loflin has later Flagstaff-style black-on-white pottery present, which affects calculation of the mean ceramic date. The whiteware assemblage from Loflin is predominantly (84.4%) Black Mesa and Sosi styles, the same styles that account for all of the whiteware sherds at the Winona and Ridge Ruin ballcourts.

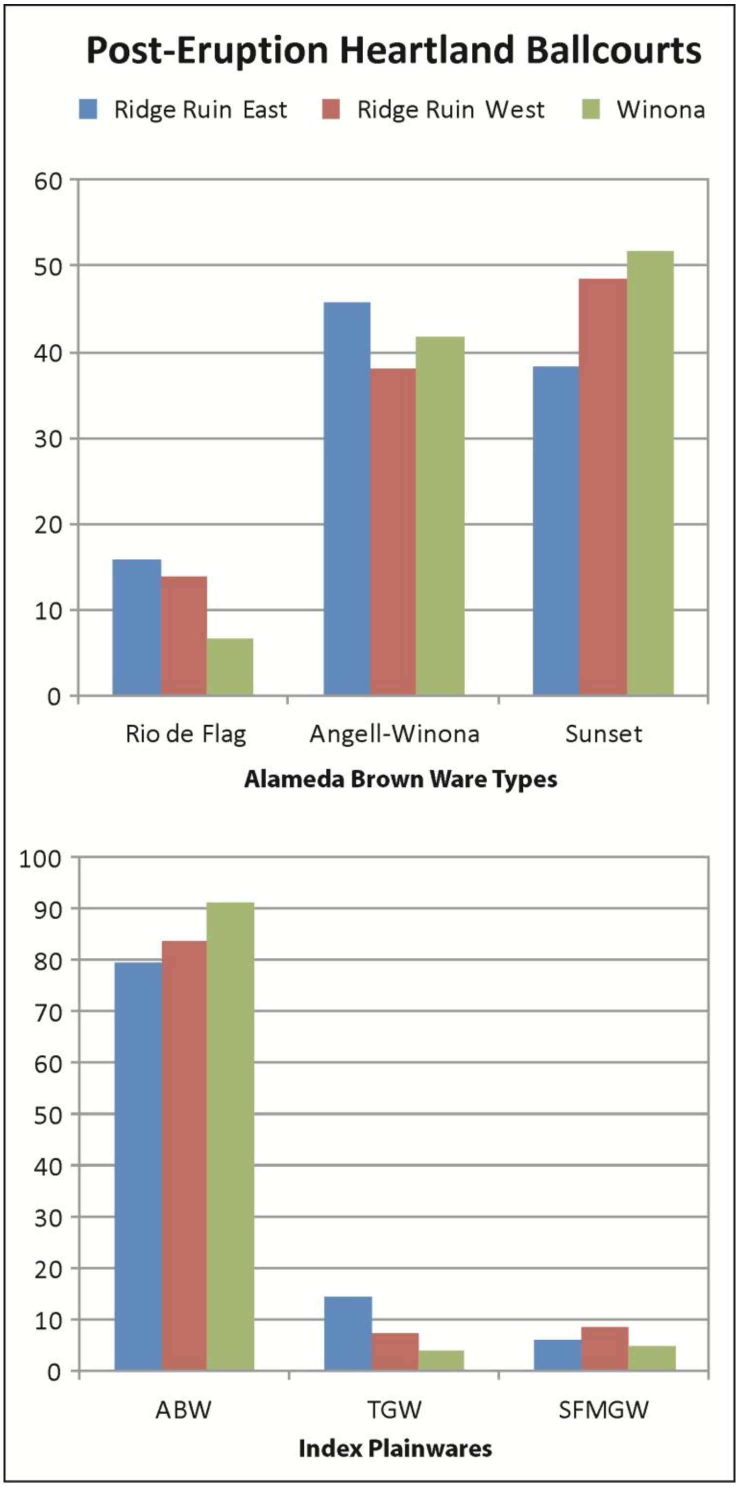


Figure 11-4. Seriations of the post-eruption heartland ballcourts based on Alameda Brown Ware types and index plainwares

The available evidence suggests that the post-eruptive heartland ballcourts were used for a relatively short time from immediately following the eruption to shortly after 1100, and that their use was likely contemporaneous. This would place their use not during a favorable period, but rather during an environmental disturbance. Specifically, these ballcourts were built and used shortly after the 1085 eruption, during the five-year-long period of volcanic activity and the subsequent 11-year-long dry period. This is contrary to the expectation that such a devastating period would lead to resistance stage responses like the contraction of sharing and the suspension of large-scale communal activities.

Post-Eruption Ballcourts in the Frontier Zone

Following the eruption, four new ballcourts were also constructed in the frontier zone: Second Sink, Juniper Terrace, Wupatki Road, and Wupatki Pueblo. Analysis of the systematically recorded surface assemblages of pottery at Second Sink, Wupatki Road, and Juniper Terrace (Morales 1994) suggest that these three ballcourts were in use at different times. The proportions of decorated black-on-white styles and Alameda Brown Ware types seriate the ballcourts with Second Sink as the earliest, Juniper Terrace as the latest, and Wupatki Road between the two (Figure 11-5). The mean ceramic dates of the decorated assemblages (Table 11-1) support this seriation, although the numbers of decorated sherds from each ballcourt is small. While the ballcourt at Wupatki was excavated, the results were not fully reported (Lindsay 1965). The field notes at MNA indicate that only two decorated sherds were recovered, both Flagstaff-style, which could suggest post-1150 use. However, one of these was recovered from water-lain clay in one

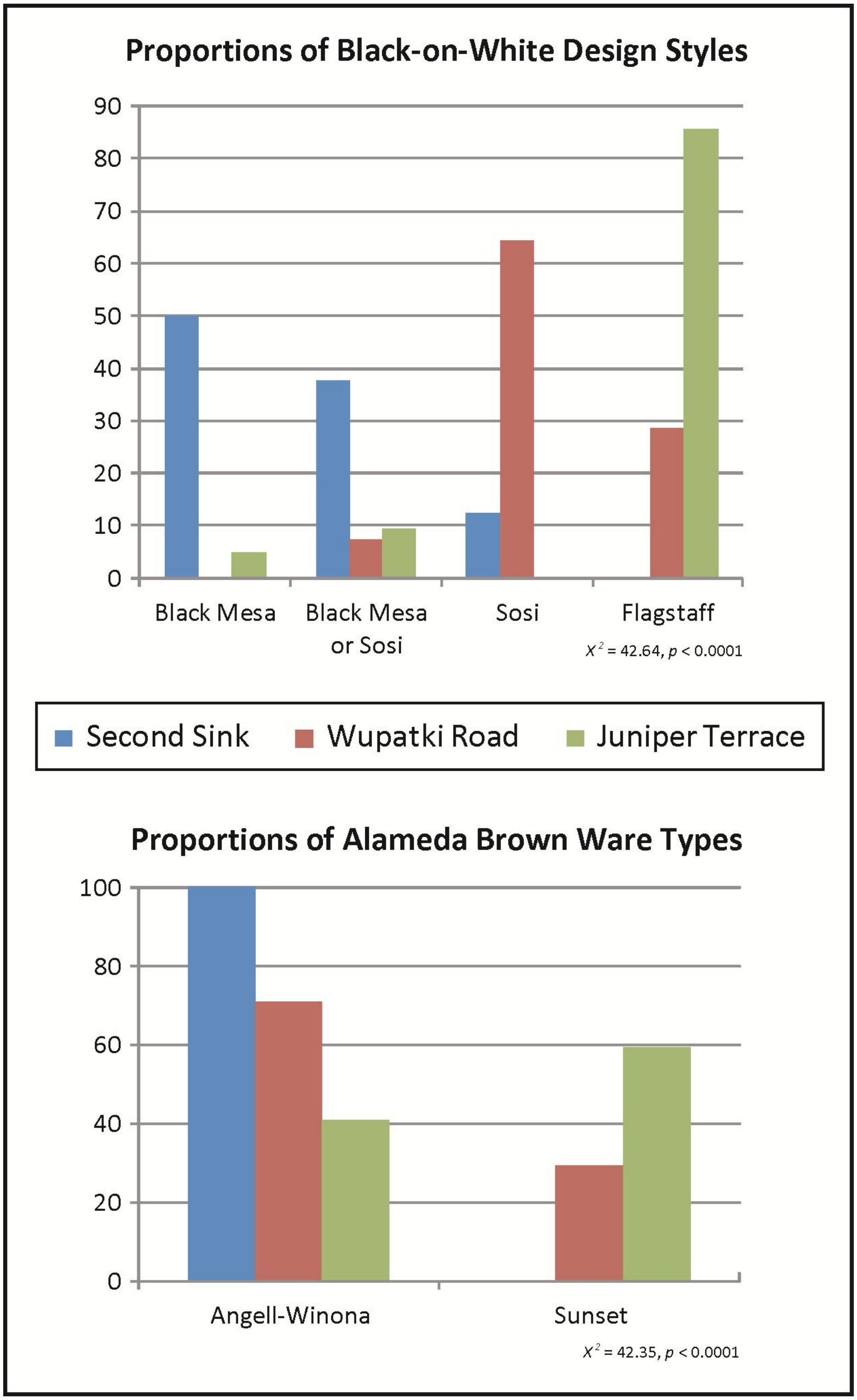


Figure 11-5. Seriations of the frontier zone ballcourts based on black-on-white design styles and Alameda Brown Ware types.

of the ballcourt entrances, indicating that it was deposited after the ballcourt fell out of use. I suggest that the Wupatki ballcourt was in use during the same time period as the Juniper Terrace and Wupatki Road ballcourts, between 1130 and 1160.

Excavation data from habitation sites associated with the Second Sink and Juniper Terrace ballcourts provide additional insights into the timing of these ballcourts' use. The ballcourt at Second Sink is associated with Three Courts Pueblo where excavations revealed a Hohokam-style pit house (NA 618X) like the one found at Winona Village. No datable tree-ring specimens were recovered during the excavations, despite the structure having been burned. The decorated pottery types present indicate occupation during the 1085-1130 period, and the excavator believed the site to have been occupied "shortly after 1100" (Smith 1952:102). The individual pit houses and pueblo rooms lack sufficient numbers of decorated sherds to allow relative dating of these features, but mean ceramic dates for the composite assemblage of whiteware sherds from the whole site is 1106 ± 6. The pottery from Second Sink ballcourt and Three Courts Pueblo suggest the ballcourt was used from the 1090s until shortly after 1100, at about the same time as the post-eruption ballcourts in the heartland.

Excavations at Juniper Terrace Pueblo also revealed a Hohokam-style pit house (NA 1814C) which had a masonry-lined kiva (NA 1814E) built next to it. Tree-ring dates suggest that these two structures were constructed and used sequentially (Downum 1988:382-389). Eight tree-ring specimens with 1129 cutting dates were recovered from the Hohokam-style pit house, indicating its construction in 1130 or soon thereafter. It was burned upon abandonment and then slowly filled with trash deposits. The adjacent masonry-lined kiva has a cluster of seven cutting dates ranging from 1135 to 1139, indicating its construction around 1140. The kiva blocks the lateral entryway of Hohokam-style pit house, which suggest that the kiva was built after the earlier structure had fallen out of use. The kiva may have replaced the Hohokam-style pit house as the ritually focused pit structure at the site. If use of the Juniper Terrace ballcourt was associated with the Hohokam-style pit house, then its use would be bracketed to between 1130 and 1140, earlier than the mean ceramic date of 1162 indicated by the pottery associated with the ballcourt.

The available evidence indicates that the Second Sink ballcourt was built and used shortly after the 1085 eruption while the other frontier zone ballcourts at Juniper Terrace, Wupatki Road, and Wupatki Pueblo were built and used later during the 1130-1160 period. The Second Sink ballcourt was likely in use at the same time as the post-eruption ballcourts in the heartland, but, by the time the later frontier zone ballcourts were built, the heartland ballcourts had fallen out of use. Contrary to expectations, the frontier zone ballcourts were used during environmental disturbances, not during favorable periods. The Second Sink ballcourt was used following the eruption and during the subsequent dry period, and the other three frontier zone ballcourts were used during or following the 1131-1142 megadrought.

Summary of Ballcourt Chronology

Three ballcourts were built and used in the heartland before the eruption; Doney Park was likely in use before 1050, Old Caves between 1050 and 1075, and New Caves after 1075. After the eruption of Sunset Crater in 1085, New Caves continued in use and five new ballcourts were built in the heartland (Winona, Ridge Ruin East and West, Porter, and Loflin) and another (Second Sink) in the frontier zone. These ballcourts appear to have been roughly contemporaneous and were in use from 1085 until shortly after 1100. Finally, during the 1130-1160 period three new ballcourts were built in the frontier zone at Juniper Terrace, Wupatki Road, and Wupatki Pueblo. Excavation data from Juniper terrace suggests that these ballcourts may have been in use only during the decade of the 1130s. The Old Caves and New Caves ballcourts were in use during a lengthy period of favorable environmental conditions as expected, but, contrary to the expectations, all of the post-eruption ballcourts were used during periods of increased environmental stress. The Winona, Ridge Ruin East and West, Porter, Loflin, and Second Sink ballcourts were all built and used immediately following the eruption and during the subsequent period of drought, and the Juniper Terrace, Wupatki Road, and Wupatki Pueblo were built and used during the 1103s megadrought. The implications of the construction and use of new ballcourts during periods of environmental stress contrary to the expectations will be discussed more later.

GREAT KIVAS

Great kivas in the Flagstaff region are not as well-documented as ballcourts and most have only recently been recognized. Only the great kiva at Wupatki Pueblo has been excavated (Colton 1946), but eight other possible great kivas in the region are known from survey (Figure 11-6). The Wupatki Pueblo great kiva measures 17 m in diameter, has no postholes to support a roof, and is benched with an opening to the northeast (Figure 11-7). Because of this lack of a roof, Colton referred to it as an amphitheater (1946:56-57). The other possible great kivas in the region are large, circular depressions

16 to 18 m in diameter sometimes surrounded by a berm of the fill excavated from the depression. While untested through excavation, the surface indications suggest that these features are similar to the excavated great kiva at Wupatki Pueblo. I assess the chronology of use of these features using excavation data from the Wupatki Pueblo great kiva and surface data from habitation sites in the communities surrounding the Wupatki Pueblo, Wupatki Road, and Magnetic Mesa great kivas.

Excavation of the Wupatki great kiva revealed four stratigraphic levels: (1) trash deposits prior to the construction of the great kiva, (2) fill associated with the construction of the first floor of the great kiva, (3) fill associated with the construction of the second floor of the great kiva, and (4) trash deposited in the great kiva after it fell out of use. The mean ceramic dates on the decorated pottery assemblages associated with these strata allow the use of the great kiva to be bracketed between 1170 and 1200, with the narrowest estimate of use being between just 1180 and 1190 (Figure 11-8).

None of the other possible great kivas have been excavated, and detailed inventories of associated artifacts are unavailable. However, pottery assemblages from habitation sites associated with these possible great kivas allows assessment of when they were used, and sufficient data are available for habitations sites associated with the Magnetic Mesa and Wupatki Road great kivas. The Magnetic Mesa great kiva is located in the Citadel area about 100 m northwest of the closest habitation site, NA 343, a small unit pueblo (Figures 11-9 and 11-10). The possible great kiva was first identified by Colton (1932:34), who believed it to be a reservoir and discussed it with other reservoirs in the area, but its location on top of a basalt mesa without any significant catchment to provide

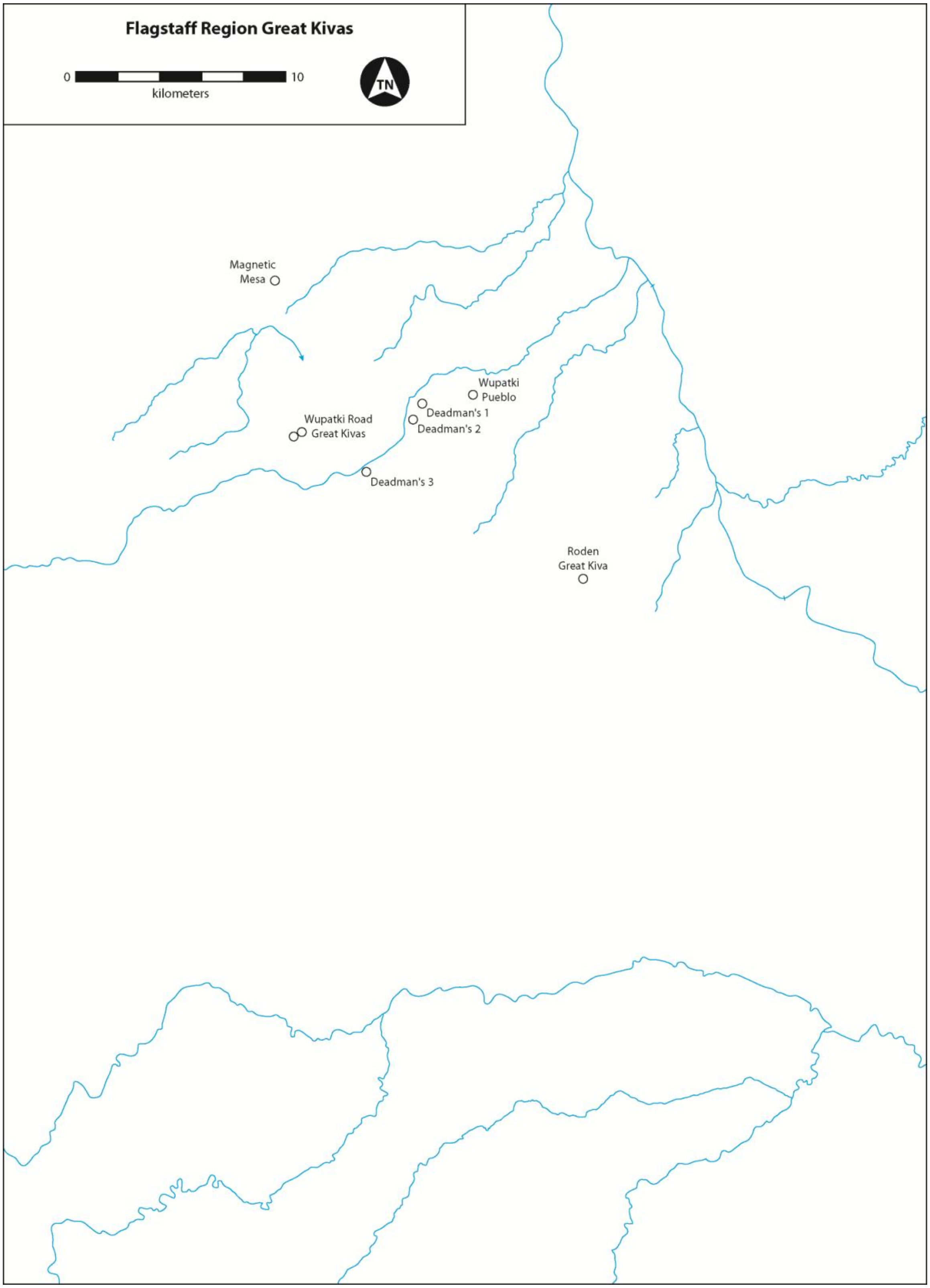


Figure 11-6. Map of great kivas in the Flagstaff region.

Figure 11-7. Overview of the unroofed great kiva at Wupatki Pueblo with 37 schoolchildren and teachers visible sitting on the bench.

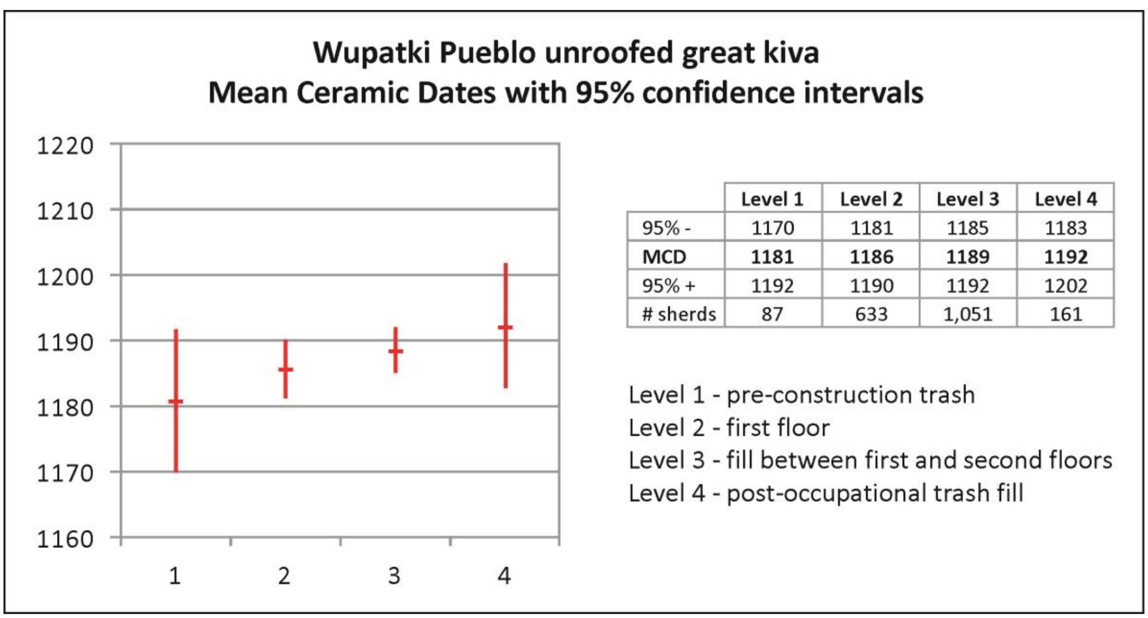


Figure 11-8. Seriation of excavated levels from Wupatki great kiva by mean ceramic date.

runoff would argue against its serving as a reservoir. Other documented reservoirs in the area are along drainages, and two (WS-165 and WS-224) have been archaeologically tested, confirming their function (Ritterbush 1984).

The Wupatki Road great kivas are located 120 m apart at the center of a dispersed community of 13 pueblo roomblocks (Figure 11-11). The 1994 NAU field school used a total station to collect data used to create a 10-cm contour map of the area around the depressions and demonstrated that they could not have collected runoff and acted as reservoirs (Chris Downum, personal communication 1998). MNA conducted test excavations at the largest roomblock in the Wupatki Road great kiva community, NA 1586, in 1932 (Colton 1946), and I used the decorated pottery from these excavations to calculate the mean ceramic date for the site. Mean ceramic dates were also calculated

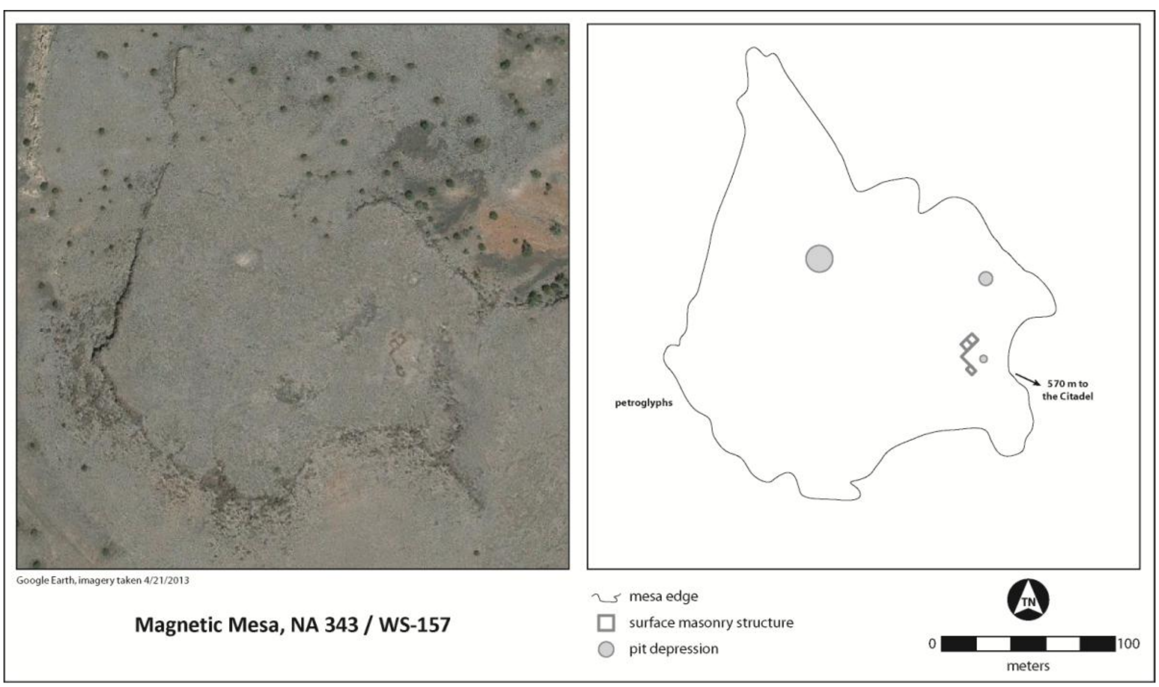


Figure 11-9. The Magnetic Mesa great kiva and Site NA 343.

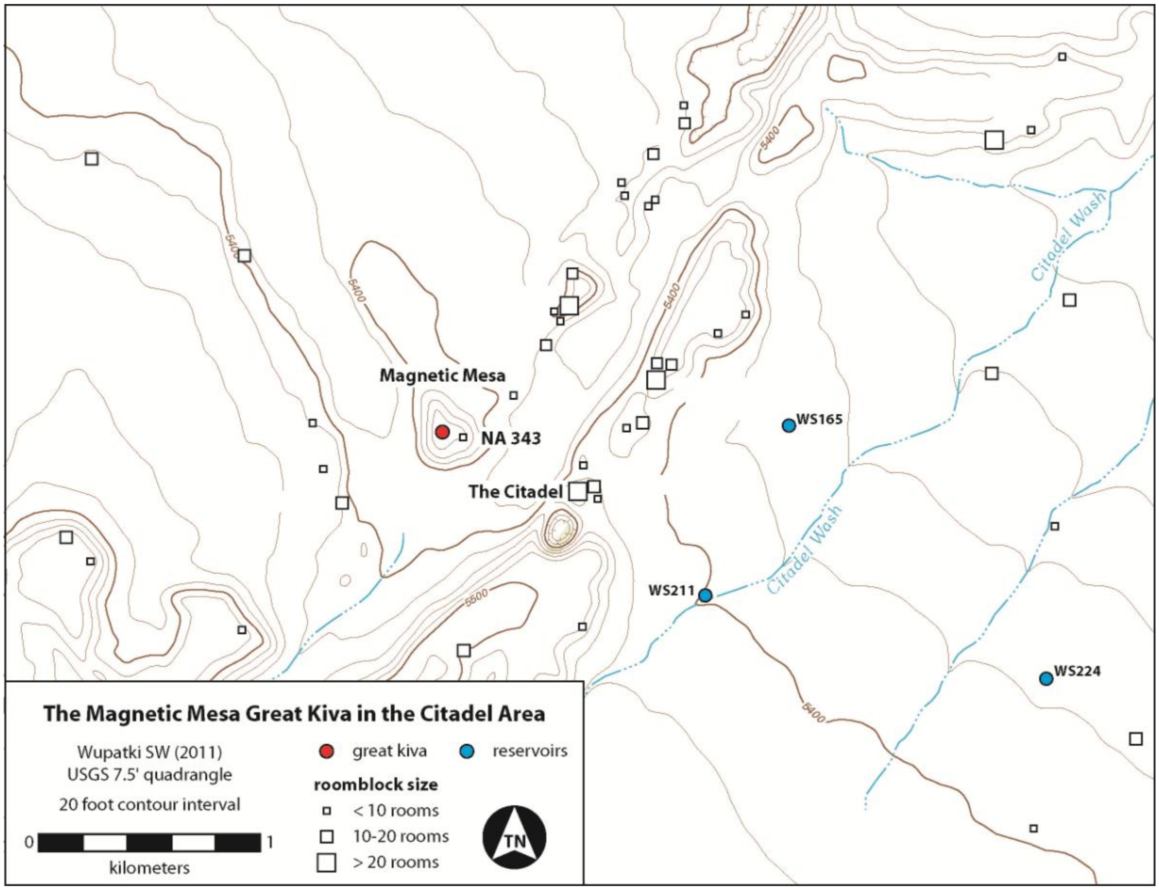


Figure 11-10. Location of the Magnetic Mesa great kiva and prehistoric reservoirs in the Citadel area.

using counts of surface for collections from NA 1586, three other sites in the Wupatki Road great kiva community, and NA 343 on Magnetic Mesa. The mean ceramic dates suggest that these sites were occupied during the same 1170 to 1200 period that the Wupatki Pueblo great kiva was in use, suggesting that all of these great kivas were contemporaneous (Figure 11-12).

Three other possible great kivas have been located recently by an avocational archaeologist; they are along Deadman's Wash about halfway between Wupatki Pueblo

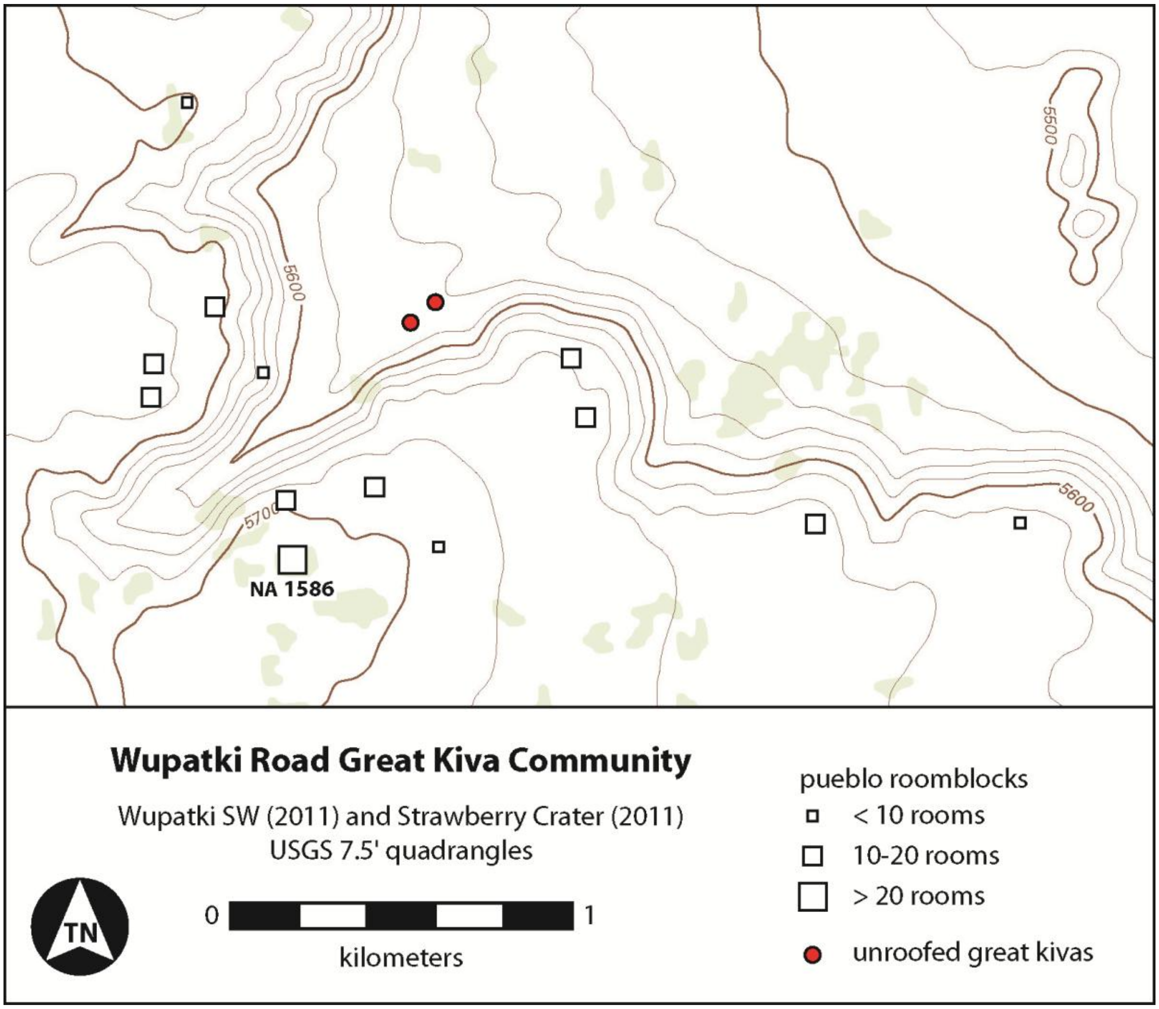
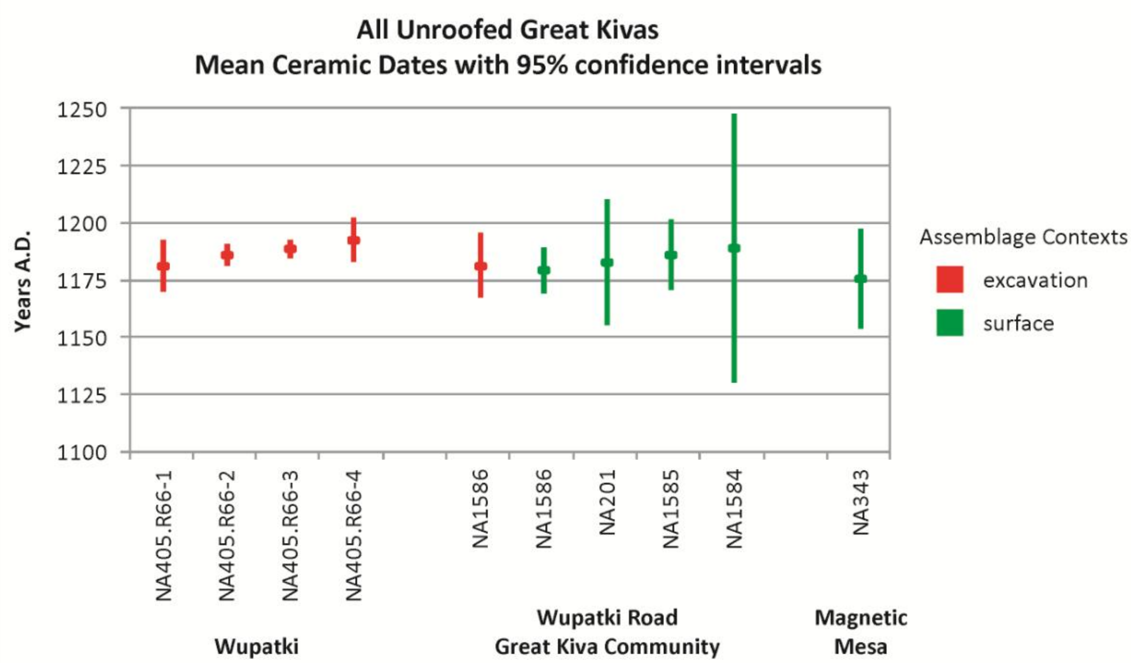


Figure 11-11. The Wupatki Road great kiva community.

and the Wupatki Road great kivas (Peter Pilles, personal communication 2013). These possible great kivas are associated with a cluster of defensive and open sites along the south side of Deadman's Wash (Figure 8-23), and the available evidence suggests that these sites were primarily occupied during the 1160 to 1220 time period. The final possible great kiva was located with GoogleEarth satellite imagery on private land west of Roden Crater. This area has not been surveyed, so no data is available on the chronology of it or nearby habitation sites.



Site #	NA405.R66-1	NA405.R66-2	NA405.R66-3	NA405.R66-4	NA1586-Ex	NA1586-S	NA201	NA1585	NA1584	NA343
95%-	1170	1181	1185	1183	1168	1169	1155	1171	1130	1154
MCD	1181	1186	1189	1192	1181	1179	1183	1186	1189	1175
95%+	1192	1190	1192	1202	1195	1189	1210	1201	1248	1197
# of sherds	87	633	1051	161	38	73	50	44	29	22

Figure 11-12. Seriation of sites associated with unroofed great kivas.

The available data suggests that great kivas in the Flagstaff region were used between 1170 and 1200, and perhaps only during the 1180s. This interval does not include any of the periods favorable for agriculture that were defined in Chapter 2, but neither is it a time of sustained dry intervals. Based on the precipitation reconstructions for different elevations, only six years between 1170 and 1200 (19.4%) would have lacked sufficient rainfall for successful agriculture at an elevation of 6,000 feet and there were never more than two successive years of low precipitation. While not a strong fit with the expectation that the construction and use of communal ritual architecture should be associated with favorable periods, the construction and use of great kivas between 1170 and 1200 does not contradict the expectation.

PLAINWARE POTTERY AND PARTICIPATION IN COMMUNAL RITUAL

The architectural forms of ballcourts and great kivas structure the interactions of participants in different ways. As discussed in Chapter 6, ballcourts mark and maintain social differences between participating groups, while great kivas express the shared social identity of those assembled. The nature of social participation at the ballcourts and great kivas of the Flagstaff region can be investigated by examining the presence of the three predominant plainwares of the region: Alameda Brown Ware, San Francisco Mountain Gray Ware, and Tusayan Gray Ware. The different proportions associated with these features can be seen as representing the participation levels of peoples from the Sinagua, Cohonina, and Kayenta regions in the ritual activities held at ballcourts and great kivas, as well as their participation in other attendant activities like feasting and exchange. I assess the social diversity of those who gathered at the ballcourts and great kivas using the proportions of these plainwares and a diversity index for the plainware assemblages, with more diverse assemblages indicating gatherings of peoples from different cultural backgrounds and less diverse assemblages indicating gatherings of more socially close groups with a common shared identity.

To visualize the nature of group participation in ballcourt activities (Figure 11-13), I use a ternary plot commonly used in soil sciences to show the proportions of sand, silt, and clay as components of a soil. In this case, I plotted the proportions of the three index

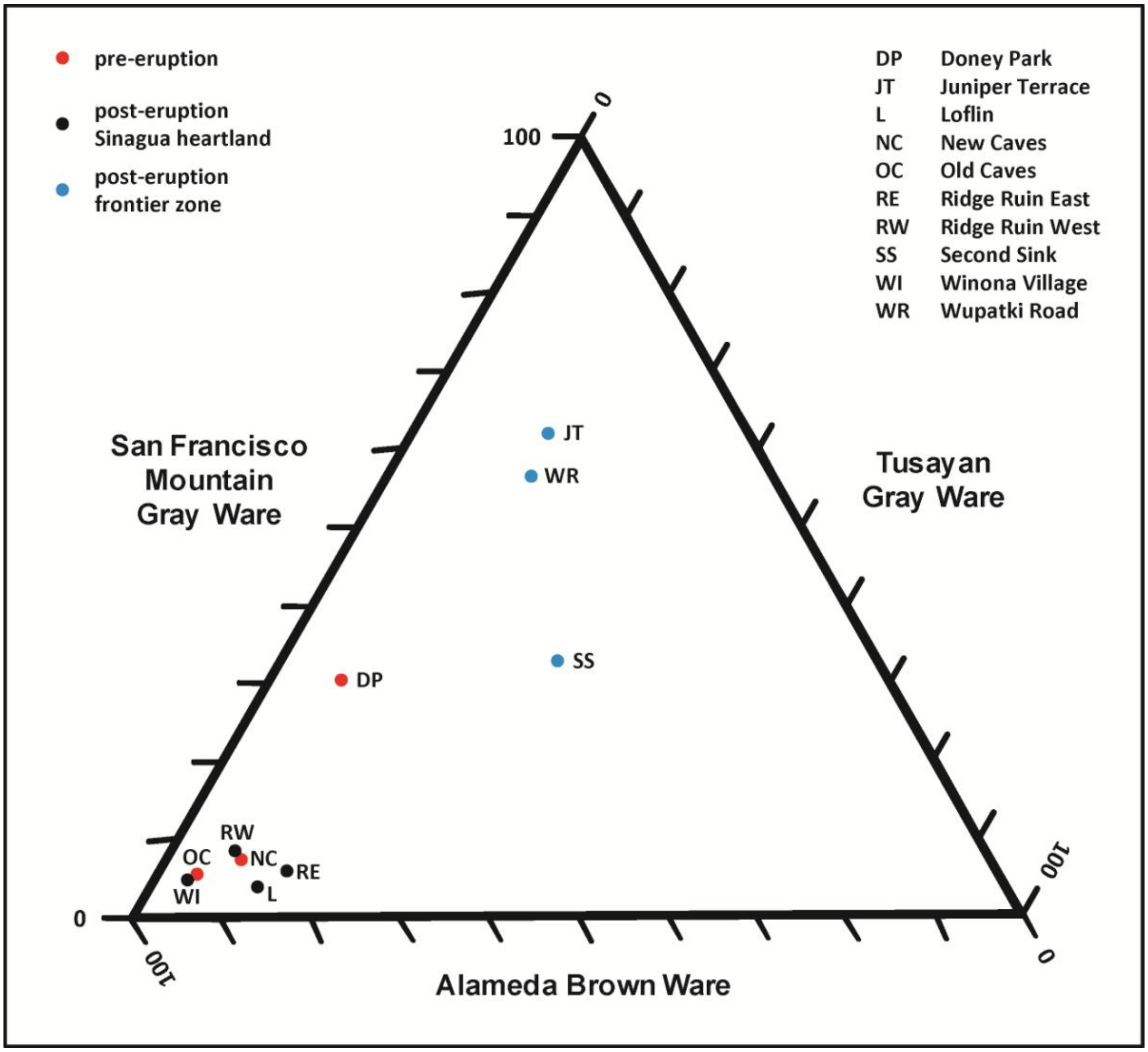
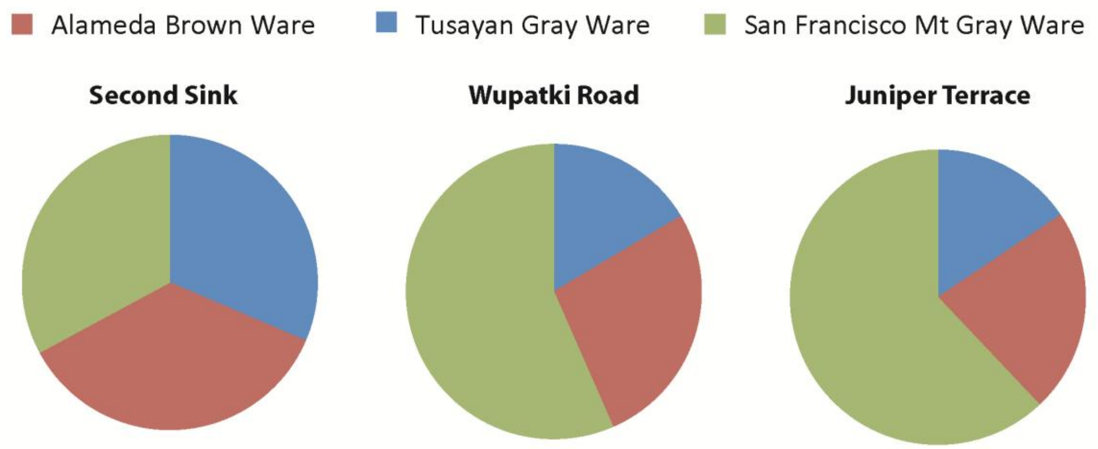


Figure 11-13. Tenery plot of the proportions of index plainwares from ballcourts in the Flagstaff region.

plainwares for the nine ballcourts that have sufficient data. The plainware assemblage from the Doney Park ballcourt is much different from the other two pre-eruption ballcourts at Old Caves and New Caves, suggesting that more-diverse gatherings occurred at it than at the later pre-eruption ballcourts. The high frequencies of Alameda Brown Ware (61.6%) and San Francisco Mountain Gray Ware (30.6%) suggest that the activities at the Doney Park ballcourt brought together Sinagua and Cohonina populations. The two later pre-eruption ballcourts at Old Caves and New Caves have plainware assemblages more similar to the post-eruption ballcourts from the Sinagua heartland at Winona, Ridge Ruin East and West, and Loflin with less San Francisco Mountain Gray Ware and more Alameda Brown Ware and. These ballcourts all have plainware assemblages that are 79.3 to 91.0% Alameda Brown Ware, indicating more-limited participation in the activities at these ballcourts by people from outside the local area.

The plainware assemblages from the post-eruption ballcourts in the frontier zone are very different from those in the heartland and vary among themselves as well (Figure 11-14). Second Sink, the earliest frontier-zone ballcourt established during the initial post-eruption resettlement, has nearly equal proportions of the three plainwares. In contrast, the two later ballcourts in the frontier zone have lesser amounts of Alameda Brown Ware and Tusayan Gray Ware and greater amounts of San Francisco Mountain Gray Ware. The social diversity of the groups integrated at the Second Sink ballcourt was quite different from that of the later two ballcourts. Second Sink appears to have brought all the cultural traditions together equally, while the later ballcourts appear to have had greater use by participants from the Cohonina cultural tradition. These later ballcourts were in use during and after the 1130s megadrought when populations were abandoning the Cohonina heartland to the west. Many of these migrants moved into the frontier zone (Weintraub et al. 2006) and the ballcourts at Wupatki Road and Juniper Terrace may have facilitated the integration of these newly arrived migrants into frontier zone communities.



Frontier Zone Ballcourts	Relative Proportions of Index Plainwares		
	Alameda BW	Tusayan GW	SF Mt GW
Second Sink	35.7	31.4	32.9
Wupatki Road	26.9	16.5	56.6
Juniper Terrace	22.3	15.6	62.1

Figure 11-14. Proportions of plainwares at frontier zone post-eruption ballcourts.

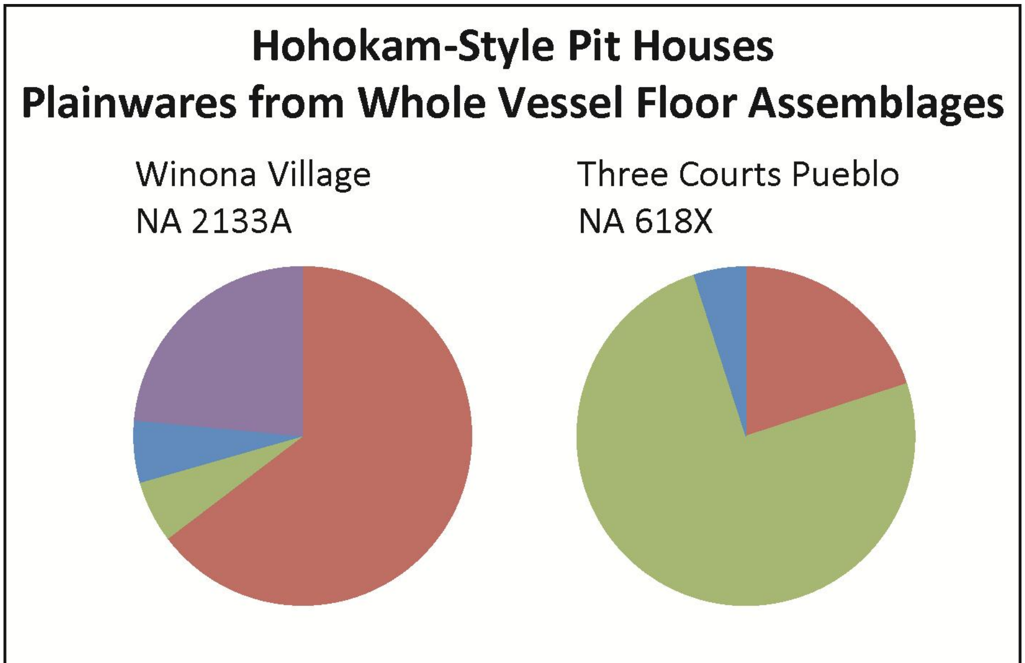
The diversity of these plainware assemblages from ballcourts can be measured using the Gini-Simpson Diversity Index (Table 11-3), which is often used in ecology as a comparative measure of species diversity between sampling units (Hurlbert 1971). In this case, the measure expresses the probability that two sherds chosen at random from an assemblage would be different plainwares, with a higher probability indicating an assemblage with a more diverse composition. This measure indicates that the frontier zone ballcourts attracted diverse groups of participants as expected, and the earliest ballcourt at Second Sink has a somewhat more diverse plainware assemblage than the later ballcourts at Wupatki Road and Juniper Terrace. In the heartland, however, only the

Table 11-3. Gini-Simpson Diversity Index values for plainware assemblages from heartland and frontier zone ballcourts

Ballcourts		Gini-Simpson Diversity Index
Heartland	Doney Park	0.54
	Old Caves	0.19
	New Caves	0.29
	Winona	0.17
	Ridge Ruin East	0.36
	Ridge Ruin West	0.33
	Loflin	0.29
Frontier Zone	Second Sink	0.69
	Wupatki Road	0.61
	Juniper Terrace	0.58

earliest ballcourt at DoneyPark has indications of diverse social gatherings. The later ballcourts in the heartland, both pre-eruption (Old Caves and New Caves) and post-eruption (Winona, Ridge Ruin, and Loflin), all have less diverse assemblages that were dominated by Alameda Brown Ware, indicating that most participants in activities at these later ballcourts in the heartland shared a common social identity.

Two of the excavated Hohokam-style pit house at ballcourt sites had large floor assemblages of whole pots, and the plainwares in these assemblages can inform about the social and economic relations of those that sponsored and directed ballcourt activities (Figure 11-15). The assemblage from NA 2133A at Winona Village in the heartland is dominated by Alameda Brown Ware (68.8%), while that from NA 618X at Three Courts Pueblo in the frontier zone is dominated by San Francisco Mountain Gray Ware (75.0%).



Plainwares	NA 2133A	NA 618X
Alameda Brown Ware	11	4
San Francisco Mt Gray Ware	1	15
Tusayan Gray Ware	1	1
Mogollon Brown Ware	4	0

Figure 11-15. Whole vessel floor assemblages from Hohokam-style pit houses at Winona Village and Three Courts Pueblo

Each has lesser amounts of the other regional plainwares, and nonlocally produced Mogollon Brown Wares comprise 25% of the assemblage from Winona Village. The ballcourts associated with these two Hohokam-style pit houses were roughly contemporaneous, but the floor assemblages suggest that the sponsors of ballcourt-related events in the heartland and frontier were engaged in different local and regional social and economic networks. Further, the contrast between the assemblages from the Hohokam-style pit house at Three Courts Pueblo and the associated ballcourt at Second Sink reveal differences between the composition of the participants in ballcourt activities (all plainwares equally represented) and the social and economic relations of the sponsor (plainware assemblage 75% San Francisco Mountain Gray Ware).

As with the ballcourts, the nature of group participation in the great kivas can also be assessed by examining the frequencies of the associated index plainwares from the region. I use plainware assemblages from two different contexts for this assessment: (1) the excavation of the great kiva at Wupatki Pueblo, and (2) surface inventories of habitation sites in the communities associated with the great kivas at Wupatki Pueblo, Wupatki Road, and Magnetic Mesa. The assemblages from the Wupatki Pueblo great kiva are predominantly Alameda Brown Ware and the proportions of this ware increased over time from before the construction of the great kiva (51% in Level 1) to after its abandonment (79% in Level 4) (Figure 11-16). The mean ceramic dates associated with these levels suggest that this change occurred rapidly, perhaps over little more than a decade. This increase in the amounts of Alameda Brown Ware indicates that frontier zone populations at Wupatki Pueblo had increasing social and economic relations with populations in the heartland production zone of Alameda Brown Ware, and that these changes occurred during the time that the great kiva was in use. The assemblages from the Wupatki Pueblo great kiva have much less San Francisco Mountain Gray Ware than the earlier ballcourts because this ware fell out of production after 1150 when its production area was abandoned.

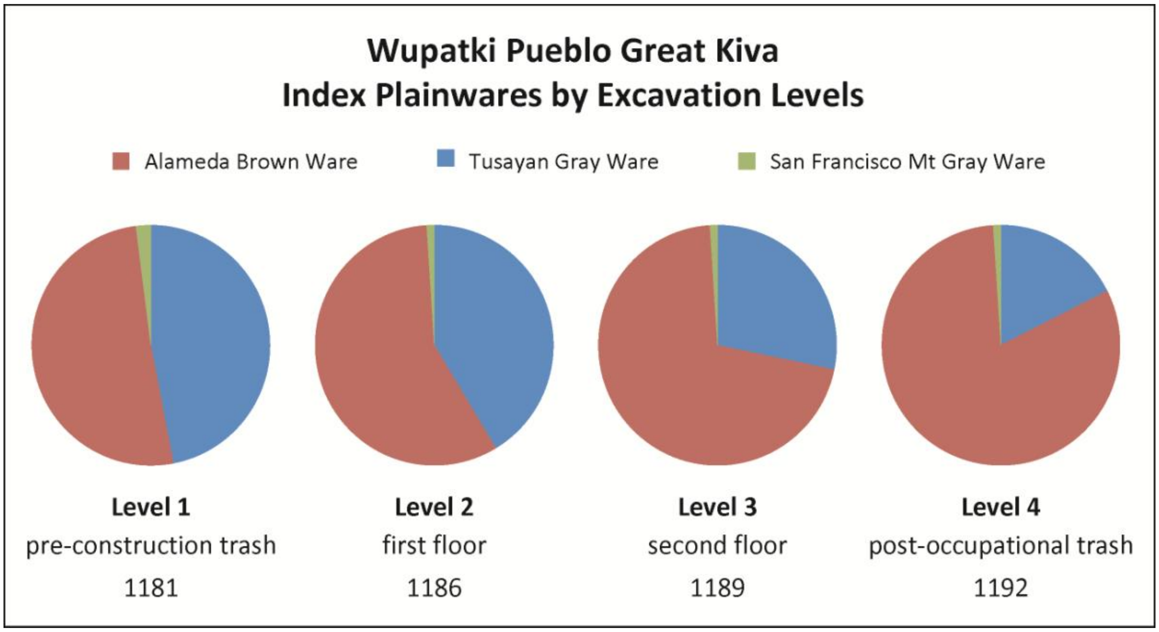
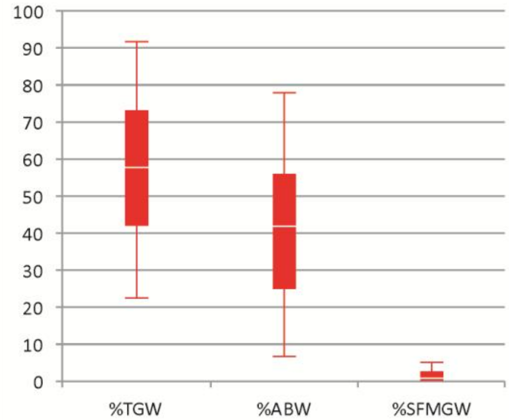


Figure 11-16. Proportions of index plainwares recovered from the Wupatki great kiva by stratigraphic levels.

Comparison of surface assemblages from habitation sites in the communities that surround great kivas reveal differences among them. Figure 11-17 shows the variation within these communities by plotting the maximum, minimum, and median values of the plainware proportions at habitation sites. While the plainware assemblages from the Wupatki great kiva are predominantly Alameda Brown Ware, sites in the surrounding community have greater proportions of Tusayan Gray Ware. Sites in the Citadel area, where the Magnetic Mesa great kiva is located, have even greater proportions of Tusayan Gray Ware. The wide spreads of maximum and minimum proportions of Alameda Brown Ware and Tusayan Gray Ware indicate substantial intersite variability in the compositions of the plainware assemblages in these two communities. In contrast, sites in the Wupatki Road great kiva community have predominantly Alameda Brown Ware and there is little intersite variability in the compositions of the plainware assemblages. There

Percentages of Index Plainwares

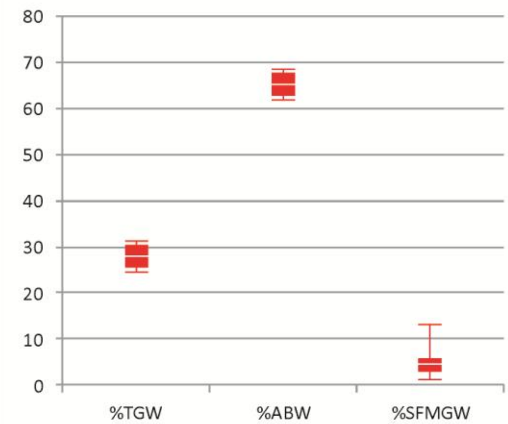
Wupatki Area



	%TGW	%ABW	%SFMGW
Maximum	91.5	77.6	4.8
3rd Quartile	72.9	56.9	1.9
Median	58.1	41.6	0.2
1st Quartile	41.9	24.7	0.0
Minimum	22.4	6.4	0.0

number of sites = 16

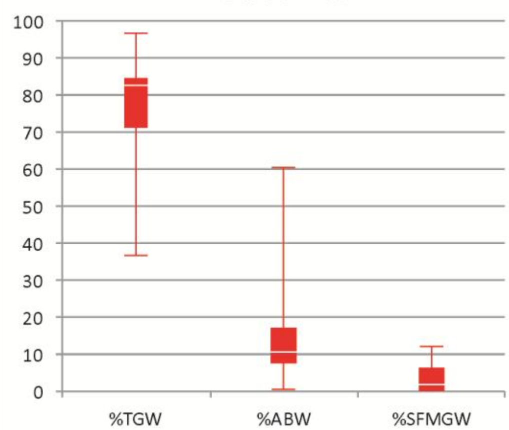
Wupatki Road Great Kiva Community



	%TGW	%ABW	%SFMGW
Maximum	31.0	75.0	13.2
3rd Quartile	30.6	67.4	5.6
Median	27.9	65.5	4.7
1st Quartile	24.5	63.9	3.4
Minimum	23.6	62.3	1.4

number of sites = 4

Citadel Area



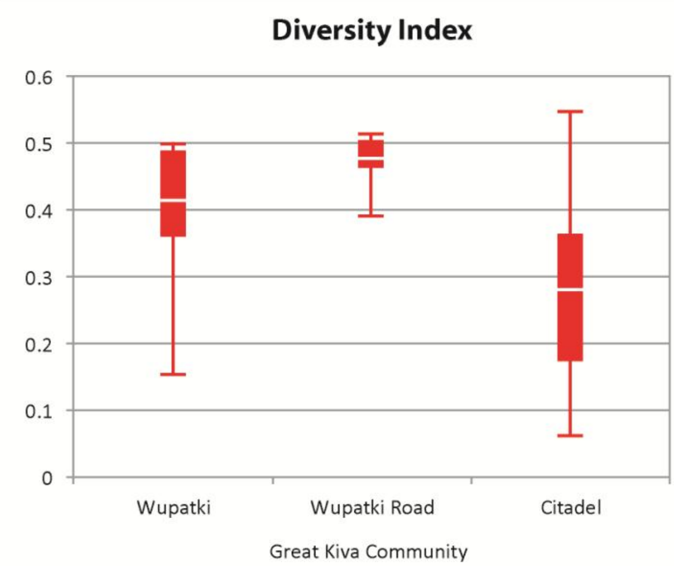
	%TGW	%ABW	%SFMGW
Maximum	96.8	60.1	12.2
3rd Quartile	84.6	16.9	6.0
Median	83.0	10.9	2.1
1st Quartile	70.6	8.0	0.0
Minimum	36.8	0.0	0.0

number of sites = 17

Figure 11-17. Comparison of the proportions of index plainwares at habitation sites in the Wupatki area, the Wupatki Road great kiva community, and the Citadel area.

are, however, fewer sites in the sample for the Wupatki Road great kiva community than for either of the others. Regardless, the differences in the predominant plainwares present in these communities suggest that the use of great kivas crossed social boundaries that existed in the frontier zone between groups that had greater social and economic connections to populations in the heartland and groups with greater connections with populations in the Kayenta region across the Little Colorado River to the northeast.

Diversity index values were calculated for the habitation sites in these great kiva communities and the maximum, minimum, and mean values for each community are plotted in Figure 11-18. The sites in the Citadel area have the lowest diversity, and the average diversity index values for all of the great kiva communities are lower than the values for the earlier ballcourts in the frontier zone (Figure 11-19), suggesting that the groups that used great kivas were less socially diverse and perhaps shared a greater sense



	Wupatki	Wupatki Road	Citadel
Maximum	0.50	0.53	0.55
3rd Quartile	0.48	0.50	0.36
Median	0.42	0.47	0.28
1st Quartile	0.36	0.46	0.17
Minimum	0.15	0.39	0.06

Figure 11-18. Diversity index values for the habitation sites in the Wupatki area, the Wupatki Road great kiva community, and the Citadel area.

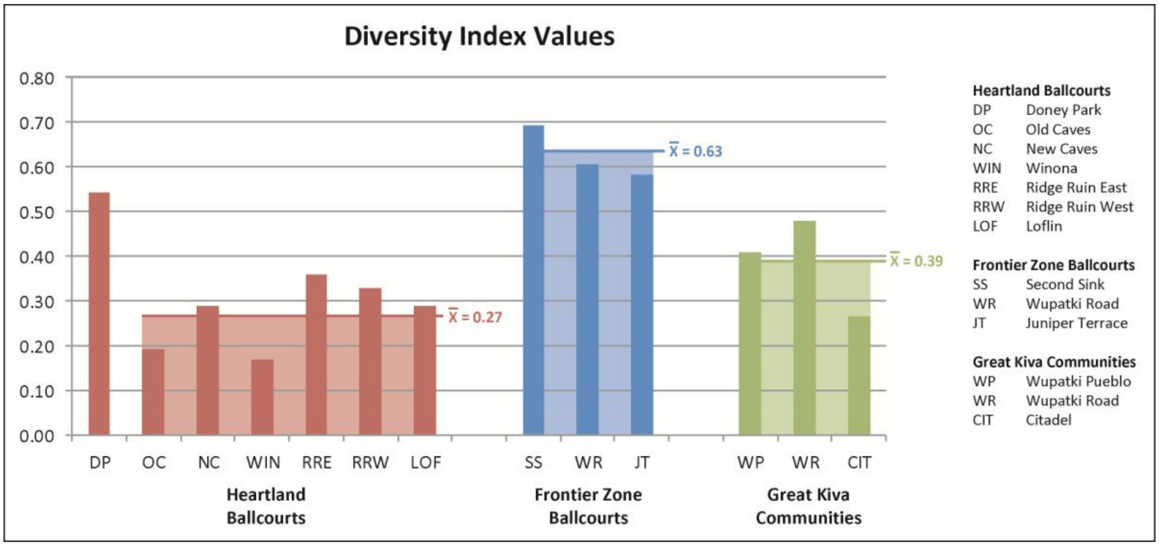


Figure 11-19. Diversity Index values for ballcourts and great kiva communities.

of common identity than those that had gathered at the earlier ballcourts. The diversity index values for the great kiva communities, however, are not as low as those of the later pre-eruption (Old Caves and New Caves) and post-eruption ballcourts in the heartland (Winona Ridge Ruin East and West, and Loflin).

The Doney Park ballcourt and the post-eruptive frontier zone ballcourts have plainware assemblages that indicate, as expected, that these ballcourts hosted socially diverse gatherings, likely marking sides and mediating tensions. In contrast, the other ballcourts, all in the heartland, have plainware assemblages dominated by Alameda Brown Ware that suggest most of the participants in activities at these ballcourts shared a common social identity. The plainware assemblages from the great kiva communities have lower diversity scores than the earlier frontier zone ballcourts, suggesting that there was a greater sense of shared identity in these communities than among the groups that participated in the earlier ballcourt activities. However, both the Wupatki Pueblo and

Citadel great kiva communities have substantial intrasite variation in the composition plainware assemblages, suggesting that new identities were being forged in communities that brought together groups from diverse backgrounds. Further, the differences in the plainware assemblages between the three great kiva communities indicate that the construction and use of great kivas crossed social boundaries that were found in the frontier zone.

RELATIONSHIPS WITH REGIONAL SYSTEMS

The architectural forms of ballcourts and great kivas originated outside the Flagstaff region, and the ritual practices that accompanied their use likely did as well. Both forms are associated with different larger regional systems, ballcourts with the Hohokam to the south and great kivas with Chaco to the east. The Flagstaff region is on the frontiers of both these regional systems, and the local users of ballcourts and great kivas may not have been strongly integrated into either of these regional systems. In fact, the timing of the use of ballcourts and great kivas discussed above would suggest most were used after these two larger regional systems had declined. The ballcourts and great kivas of the Flagstaff region were not just in a spatial frontier, but a temporal one as well, as they were temporally peripheral to the regional systems that inspired their construction and use. This frontier setting of the Flagstaff region may present some explanation for the construction and use of ballcourts during periods of environmental stress contrary to expectations as it provided an arena for cultural innovation and transformation.

Ballcourts and the Hohokam

The initial discovery of Hohokam-style ballcourts associated with other evidence of Hohokam material culture in the Flagstaff region led Colton (1938, 1946, 1960) to propose that migrants from the Hohokam region came to the Flagstaff region following the eruption of Sunset Crater. Later researchers have downplayed the possibility of large-scale, long-distance migrations, proposing instead that exchange relations between the Flagstaff and Hohokam regions increased and became more formalized after the eruption of Sunset Crater (Fish et al. 1980:1611-174; Pilles 1979:472). These interpretations have presumed that all the ballcourts in the Flagstaff region were contemporary with the larger network of ballcourts centered in the Salt-Gila Basin to the south (Figure 3-5). As discussed earlier, more recent research on ballcourts in both regions has shown that some of the Flagstaff ballcourts were used before the eruption (Morales 1994) and, more importantly, the larger regional system and the complex network of specialized production and exchange it facilitated had collapsed by the time of the eruption (Abbott 2006) (see Chapter 3).

Only the two earlier pre-eruption ballcourts at Doney Park and Old Caves would have been in use while the large-scale Hohokam regional system integrated by ballcourt use was still operational. These ballcourts in the Flagstaff region were the farthest north of all the ballcourts in the system, and as such were peripheral and isolated with large spatial gaps between clusters of ballcourts and the center (Figure 3-5). They would have been contemporaneous with four ballcourts on the Mogollon Rim some 65 to 85 km to the southwest (Bone 2002; Wilcox et al. 1996) and seven other ballcourts in the Middle Verde River some 85 to 100 km (Wilcox and Sternberg 1983; Marshall 2001). It is about another 75 km from the ballcourts in the Middle Verde to the next group in the Lower Verde, which were tightly integrated into the dense distribution of ballcourts in the Salt-Gila Basin at the core of the system (Wilcox and Sternberg 1983:104).

In this peripheral setting, the ballcourts of the Flagstaff region may not have been strongly integrated into the Hohokam regional system, and little material evidence of exchange is present before the eruption, just small amounts of Hohokam pottery and *Glycymeris* shell bracelets. Being on the periphery of the network may have allowed local groups to use these ballcourts more to meet their own needs rather than to achieve the goals of actors at the core of the ballcourt network. Old Caves and New Caves may have been built and used as the larger system was collapsing, and the increasing insular nature of their plainware assemblages compared to the earlier Doney Park ballcourt suggests the use of ballcourts was shifting towards meeting local needs. Regardless of the level of integration with the center of the system, the pre-eruption use of ballcourts in the Flagstaff region likely mediated intra- and intergroup tensions, engendered a strong sense of communitas and shared identity, and provided contexts for sharing and exchange, both locally and extraregionally.

All of the post-eruption ballcourts were built and used after the larger network had collapsed. The activities that occurred in these ballcourts were not integrated into or peripheral to this larger network, they were a smaller network unto themselves. However, as noted by Colton (1938, 1946) and McGregor (1937a, 1937b, 1937c, 1941), use of the post-eruption ballcourts in the heartland was accompanied by other aspects of Hohokam material culture and ritual practice, like the local production of shell ornaments and red-on-buff pottery using Hohokam styles and forms, adoption of a cremation death ritual, and construction of Hohokam-style pit houses.

Before the eruption, shell ornaments were rare and limited in form and species; after the eruption, a wider range of finished forms were present using a greater variety of shell species (Colton 1946:314). This diversification of forms and materials is also accompanied by evidence of the manufacture of shell jewelry and the practice of other lapidary crafts, with unworked raw materials, debitage, finished products, and specialized ground and flaked stone tools. This is particularly evident at Winona Village and comparative analysis of the shell assemblage from the site with assemblages from Hohokam sites from the Salt-Gila and Tucson Basins has revealed overall similarities in the forms and styles used and in the frequencies of different forms and species present in the assemblages (Murphy 2000:126-129). The production and consumption of shell in the Flagstaff region appears to have been centered on sites with ballcourts, because these sites have significantly higher ratio values of shell to sherds than contemporaneous sites that did not have ballcourts (Hedquist 2007:49; Murphy 2000:131-133).

Beginning in the 800s, small quantities of Hohokam red-on-buff are found in some excavated pottery assemblages from the Flagstaff region. After the eruption, in addition to imported Hohokam pottery, red-on-buff pottery with Hohokam-style painted designs and vessel forms was produced locally (Colton and Hargrave 1937:178-183; O'Hara 1998). Distinctive Hohokam vessel forms like jars with Gila shoulders and heavy-walled censers were used for both painted red-on-buff vessels and plain Alameda Brown Ware vessels (Colton 1958). Heavy-walled censers are found in Hohokam pottery assemblages from the Pioneer through Sedentary periods, and their association with cremations and palettes indicates their use in cremation death rituals (Haury 1976:226-228).

Prior to the eruption, the standard mode of disposal of the dead was extended inhumation, often in the fill of abandoned pit houses. After the eruption, the practice of cremation was adopted by a segment of the population. During the 1085-1130 period, cremations accounted 40.4% of all burials (Table 11.4). The practice of cremation abruptly ended after 1130, with only one cremation representing just 0.3% of all excavated burials. Significant intra- and intersite differences in the proportions of cremations and inhumations at sites and the number and types of funerary offerings with cremations and inhumations suggest that mortuary rites were used to contest the social order and restructure social relations following the eruption of Sunset Crater (O'Hara 2011, 2012).

As previously mentioned, three examples of Hohokam-style pit houses have been excavated (Figure 11-20). These structures are subrectangular with a lateral entryway, a single central gable along the long axis of the room, and a groove around the perimeter of the floor into which wall posts were set. They are typical of the Type S-1 Sedentary

Table 11-4. Mortuary practices by time period.

Temporal Period	Inhumations	Cremations	Total
Pre-Eruption			
Cinder Park/Sunset/Rio de Flag AD 550-1085	33	0	33
Post-Eruption			
Angell/Winona/Padre AD 1085-1130	171	116	287
Elden/Turkey Hill AD 1130-1300	292	1	293
Totals	506	117	623

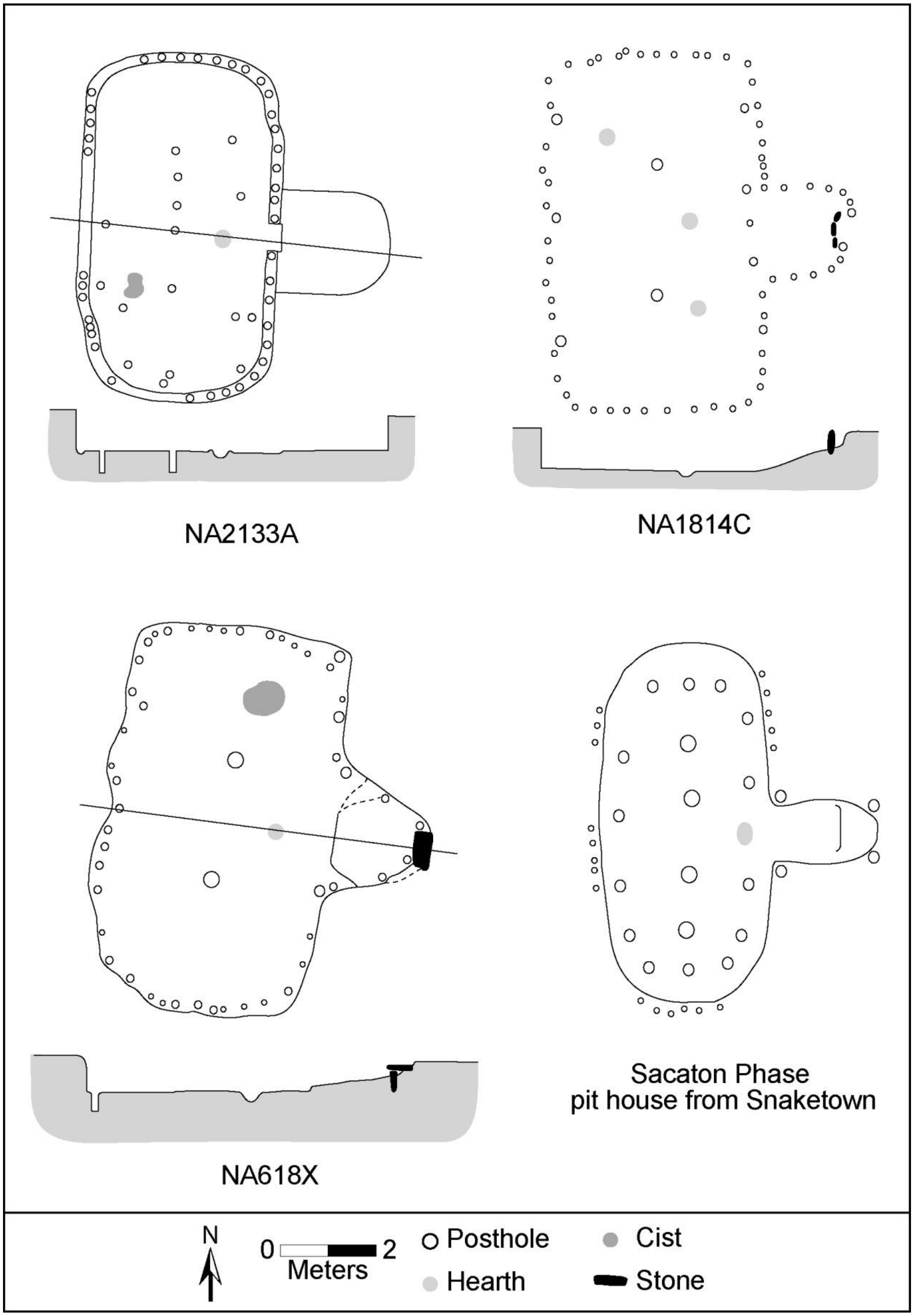


Figure 11-20. Excavated Hohokam-style pit houses in the Flagstaff region and Haury's (1976) Type S-1 pit house from Snaketown.

period pit house defined from excavations at Snaketown (Haury 1976:53-57), also shown in Figure 11-20. McGregor (1941:89) described the structure at Winona Village as such: "NA 2133A might be known as the Hohokam house, for in all particulars it is typical of a Sedentary Hohokam house, the only house in fact found anywhere in this work which might be so considered." Cutting dates indicate its construction immediately following the beginning of the eruption and it had greater amounts of red-on-buff pottery and shell artifacts than other structures at the site (Murphy 2000; O'Hara 1998).

Colton (1938; 1946; 1960) interpreted the presence of Hohokam-style pit houses as one piece of evidence of migration into the Flagstaff region following the eruption of Sunset Crater by diverse ethnic groups, including migrants from the Hohokam region to the south. However, three pit houses seems scant evidence of migration, and there is only one at each site where they are found. At Winona Village, where 20 pit houses were fully excavated, only one had the architectural characteristics of a Hohokam-style pit house. The ones at Winona and Three Courts were likely contemporaneous in the 1090s, but tree-ring dates indicate theone at Juniper Terrace was built much later, after 1129. Further, the evidence of locally-produced red-on-buff pottery and use of a cremation death ritual is largely restricted to the post-eruptive refugium in the heartland; excavations in the frontier zone have recovered only three sherds of locally-produced red-on-buff from three sites and found the single post-1130 cremation.

An alternate interpretation to migration proposes that these were the houses of resident Hohokam traders, built with the ballcourts as exchange relations between the Flagstaff and Hohokam regions increased and became formalized after the eruption of Sunset Crater (Fish et al. 1980:1611-174; Pilles 1979:472). However, exchange is fundamentally embedded in communal ritual activity in small-scale, non-state societies, and ballcourts were not simply a venue for a game, but rather were sanctified spaces that provided access to the supernatural. Therefore, it is likely that the occupants of these Hohokam-style pit houses were not simply prehistoric businessmen but were ritual specialists who directed activities in the ballcourts and provided access to extraregional exchange networks mediated through ritual practice (O'Hara 1998). These Hohokam-style pit houses were probably not ordinary residences, but were specialized features used for certain more-exclusive rituals related to ballcourt use, such as preparing the contestants beforehand or purifying them afterwards. Each of the three known excavated Hohokam-style pit houses was burned, and those at Winona and Three Courts had large floor assemblages with 20 or more whole vessels. Some of the vessels from Three Courts had corn, seeds, and other vegetal material in them (Smith 1952a), suggesting the storage of food for use in ballcourt-related activities.

Rather than resulting from migration, I interpret the suite of Hohokam-style material culture and ritual practices centered on the use of ballcourts as evidence of local populations expressing new social identities. Emerging immediately in the aftermath of the Sunset Crater eruption, it is hard to imagine that these changes were not connected. The eruption would not only have physically devastated the landscape, but also emotionally devastated the local populations not just through the stress of the destruction and displacement but also by challenging their worldview, their comprehension of the natural and supernatural, and their understanding of humanity's place in the world. The social and environmental context of devastation and loss that likely followed the eruption would have been a fertile bed for the emergence of a revitalization movement.

Revitalization movements are intentional, organized efforts to re-establish a balanced existence that emerge in cultures undergoing transformation as a result of a period of increased stress and cultural distortion (Linton 1943; Wallace 1956). Two different strategies for creating a renewed sense of community identity have been identified in revitalization movements: (1) revival strategies that seek a return to the traditional values and practices of an idealized past, and (2) importation strategies that seek the introduction of new cultural values and mechanisms; however, both strategies might also be combined.

The violence of the eruption may have challenged the conceptual relation between the earth's surface and the underworld and between the living and the dead. In Mesoamerican cosmology, the ballcourt is a sipapu-like portal to the underworld allowing access to ancestors, deities, and the powers of creation. Combining revival and importation strategies, the re-definition of the ballgame and the adoption of associated ritual behaviors like cremation and signifying objects of material culture like red-on-buff pottery and specific forms of shell jewelry may have been an intentional effort to establish a new means of communicating with and relating to the underworld and the powers therein that had been disturbed. If this was a revitalization movement, it seems to have lost its impetus and traction within the community soon after 1100, as ballcourts fell out of use, locally produced red-on-buff stopped being made, and the practice of cremation abruptly ended.

These changes after the eruption likely accelerated ones that were already occurring. The increasing proportions of Alameda Brown Ware over time at the pre-eruption ballcourts suggests that as the larger system was collapsing, the use of ballcourts was re-focused towards the needs of heartland populations with less participation by outside groups. This more insular nature of ballcourt use and participation appears to have continued after the eruption when refugees from the areas affected by lava flows and heavy ash fall re-settled in the post-eruption refugium. Surveys in the refugium indicate growth in population following the eruption, with exceptionally dense settlement in the areas surrounding and between the ballcourts at Winona Village and Ridge Ruin (Bryce et al. 2012a). Social tensions between refugees and their hosts may have been high, especially given the environmental challenges local populations faced with the eruption and subsequent drought. The use of ballcourts associated with a revitalization movement may have been an important means of mediating these tensions and creating a shared sense of identity.

Since the post-eruption ballcourts were used after the larger regional system collapsed, loss of access to resources obtained by exchange through the system, like marine shell, might be expected. However, there was an increase in the presence of shell after the eruption that included access to a new source: the Pacific Coast. As the larger regional system collapsed, it appears that populations on the peripheral frontier did not passively accept these economic changes, new long-distance exchange relationships were forged in the aftermath of the eruption that will be discussed in greater detail in the following chapter.

The later frontier zone ballcourts were even more isolated in space and time from the regional system that inspired them. The chronology of ballcourts indicated by pottery types found with the ballcourts and the ceramic and tree-dating of associated habitation features suggests a lapse in their use for about a generation, from around 1100 when the post-eruption ballcourts in the heartland and the Second Sink ballcourt in the frontier zone fell out of use until about 1130 when the Juniper Terrace, Wupatki Road, and Wupatki Pueblo ballcourts were built. This revival of ballcourt use occurred as the abandonment of the Cohonina region to the west began with the onset of the 1130s megadrought, leading to increased movement into the frontier zone. Similar to the earlier situation in the post-eruptive refugium, the need to mediate social tensions between the new migrants and already established frontier zone populations, both of whom faced environmental stresses, may have inspired the revival of ballcourt use. While the earlier Second Sink ballcourt, which was contemporaneous with ballcourts in the heartland, had relatively equal proportions of the index plainwares of the region, the later Juniper Terrace and Wupatki Road ballcourts have greater amounts of San Francisco Mountain Gray Ware, suggesting changed composition of the participating groups.

The plainware assemblages indicte that ballcourts in the heartland were used by more homogenous groups of participants. While there may have been tensions between refugees and hosts, the social distances among ballcourt participants appear to be small as a common social identity was expressed. The plainware assemblages from frontier zone ballcourts indicate greater social diversity in participation with likely greater social distances between participating groups. The later frontier zone ballcourts were also used during the 1130-1160 period that the indices developed in Chapters 8 and 9 indicate increasing inter-group conflict and use of defensive sites, and the nature of the violence during this period, with the killing of whole family units and disrespectful treatment of the victims, indicates increasing and marked social distances between groups.

The local re-interpretation of ballcourts in the Flagstaff region following the collapse of the larger Hohokam regional system is characteristic of frontier dynamics of innovation and transformation. The basic ideas and values that provided the foundation for the success of the larger system – supernaturally sanctified meditated competition to reduce inter- or intra-group tensions and to facilitate exchange – were given new local meanings by populations facing social and environmental crises that emerged first following the eruption of Sunset Crater and the movement of refugees into the post-eruption refugium and again later with the 1130s megadrought and movement of migrants from the Cohonina region into the frontier zone.

Great Kivas and Chaco

In addition to influences from the south and the Hohokam, the presence of great kivas suggests influences from the east and Chaco Canyon. Great kivas are often associated with great houses, and, as mentioned in Chapter 3, there are two sites in the Flagstaff region where the initial construction used Chaco-style masonry, one of which is Wupatki Pueblo. However, the great house and great kiva at Wupatki were not contemporaneous, the great house component was earlier. The initial great house component at Wupatki Pueblo was built ca. 1120 during the later years of the Chaco regional system's era of expansion, and being located so far from the center at Chaco Canyon, which is some 300 km distant, it may not have been strongly integrated into the system. Expansion of Wupatki Pueblo after 1135 did not use the distinctive Chaco-style masonry of the initial construction episodes. The first episodes of construction that expanded upon the great house core occurred during the 1130s megadrought and as the center of the regional system declined and its peripheries re-organized. The changes in construction styles may indicate a local rejection of the external influences of Chaco during this period of environmental stress. Even after the great house was transformed, Wupatki continued to be an important local community center. While the construction and use of the Wupatki ballcourt is not well dated, it appears to have been used during the 1130-1160 period and its construction may have accompanied the expansion of the pueblo after 1135 that seems to have marked changes in the relationship to Chaco.

The Wupatki great kiva was unlike those found in the core of the Chaco regional system as it was unroofed. Other unroofed great kivas have been dentified at several sites in the Little Colorado River Valley and adjacent areas (Figure 11-21). Like the Wupatki great kiva, these other unroofed great kivas post-date the decline of the center and are associated with the re-organization of the southwestern periphery of the Chaco regional system between 1130 and 1250 (Kintigh 1996; Kintigh et al.1996). Herr's (2001) study of great kivas in the Silver Creek region some 150 km to the southeast has suggested that they were used to integrate diverse groups of migrants arriving in the region into new communities. Some of the great kivas were roofed like the earlier Chaco-era great kivas, but others were only partially roofed or were unroofed, like that at Site AZ P:16:160 (ASM). Rather than being a part of the Chaco regional system, these great kivas gave the new communities a sense of legitimacy that referenced but was not directed by or strongly integrated into Chaco. The Flagstaff-region great kivas were likely used in a similar manner. They are not found in the heartland, only in the frontier zone, where migrants from diverse backgrounds were establishing new communities and boundaries.

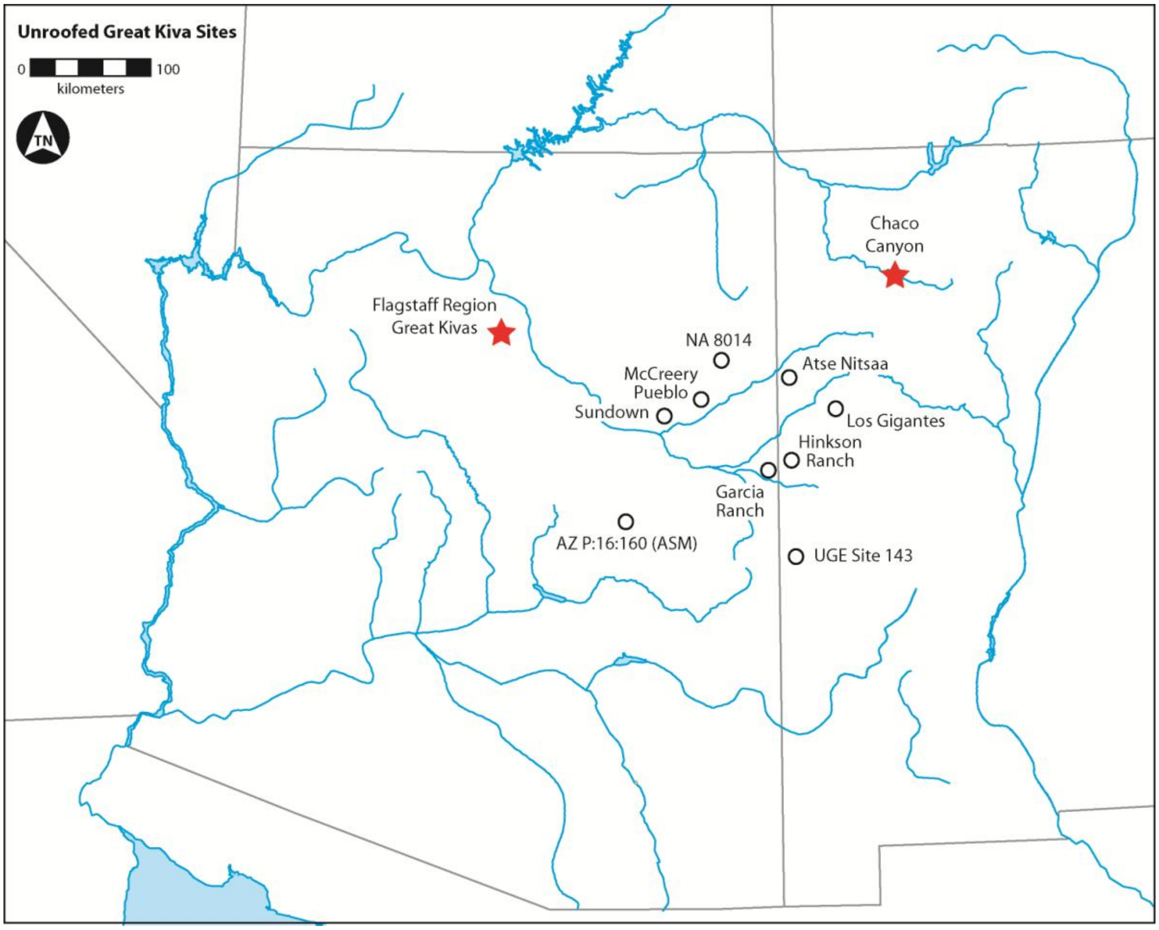


Figure 11-21. Known sites with unroofed great kivas.

Herr (2001:93-94) also suggested that in a frontier zone rich in open land yet poor in available labor these newly established communities needed to attract migrants for the labor they could contribute. Great kivas and the communal activities held within them aided in the recruitment of newcomers, building a community's wealth in people (see discussion of this concept in Chapter 8). The frontier zone of the Flagstaff region was land rich and labor poor immediately following the eruption, but, by the time that great kivas were built more than 80 years after the eruption, the area was densely settled. Labor was undoubtedly an important resource to assure community success, but creating and maintaining alliances to assist in the enforcement and protection of individual and group claims to land was probably more important (Stone and Downum 1999).

Like the great kivas in Herr's study area, those of the Flagstaff region were local developments independent of the Chaco regional system, which had already undergone re-organization as the center declined after 1130. The great kivas in the Flagstaff region may have been inspired by other unroofed great kivas that were built as part of the re-organization of the southwestern periphery of the former regional system, but they were not integrated into any large scale system of great kivas, instead they developed in response to local social needs.

Summary and Results: Communal Ritual Architecture

According to the expectations developed in Chapter 7, the construction and use of ballcourts in the Flagstaff region should be associated with favorable environmental periods. The history of these structures presented in the first parts of this chapter shows that this general expectation is not always met. Similarly, the expectation that sites with communal ritual architecture should be found spatially associated with the frontier zone where populations from different cultural traditions interacted is also only partially met, as are the expectations related to the use ballcourts by socially distant groups and great kivas by socially close groups. Those cases contrary to these expectations reveal how local populations adapted the use of ballcourts and great kivas to meet local needs and contingencies, as is revealed by the analyses of their chronologies and their associated plainware assemblages

The pre-eruption ballcourts were used during a long period of favorable conditions that ended with the eruption at around 1085. This supports the expectation that sustained productivity during favorable periods provides resources for investment in the use of communal ritual activities and associated architectural features. However, new ballcourts were built soon after beginning of the eruption in 1085 and were used through the eruption and the 11-year-long dry period that followed, and additional ballcourts were later built and used during the 1131-1142 megadrought. These episodes of ballcourt construction and use are contrary to the expectation that decreased productivity during unfavorable periods is likely to trigger resistance stage responses that would include curtailment of large-scale activities that require many resources like communal rituals. The interval between 1170 and 1200 when the great kivas were used had no highly productive favorable periods, but also had no lengthy environmental disturbances, which only weakly supports the expectations.

All the great kivas and four of the nine ballcourts built after the eruption are located in the frontier zone, but all the pre-eruption ballcourts and five of nine post-eruption ballcourts are in the heartland. The earliest pre-eruption ballcourt at Doney Park was in use while the Hohokam larger regional system of ballcourts was operational, and it was on the far frontier of that system. The later pre-eruption ballcourts at Old Caves and New Caves were used during and after the collapse of this larger system around 1070. The plainware assemblages associated with these pre-eruption ballcourts indicate changes in the social composition of the groups participating in ballcourt activities before and after the collapse of the larger system. Gatherings at the earlier Doney Park ballcourt were more socially diverse with greater participation by peoples from neighboring regions than those at the later ballcourts at Old Caves and New Caves. Rather than abandoning ballcourts after the collapse of the larger regional system, populations in the Flagstaff region adapted their use to meeting local needs and the gatherings became increasingly insular with most participants drawn from the local region.

After the eruption of Sunset Crater in 1085, five more ballcourts were built in the heartland, and their associated plainware assemblages indicate that the gatherings continued to be largely local affairs. This is in contrast with the contemporary Second Sink ballcourt in the frontier zone where the associated plainware assemblage indicates relatively equal participation by all the cultural traditions that were beginning to colonize the area after the eruption. The challenges created by the eruption and its impacts did not lead populations in the heartland to abandon the use of ballcourts, instead new investments were made in ballcourts. Further, sites associated with the post-eruption heartland ballcourts also have new forms of material culture and evidence of new ritual practices that I interpret as indicating the development of a revitalization movement in the heartland. The crisis created by the eruption accelerated changes that had begun after the collapse of the larger Hohokam regional system and the local continuation of ballcourt use. As discussed in Chapter 4, while environmental disasters may trigger social change, more often they accelerate changes that were already underway (Oliver-Smith 1996). When faced with devastation of the environment, dislocation of affected populations, and loss of agricultural production from the eruption, heartland populations increased their investment in ballcourts as a means of mediating social tensions, creating a shared sense of identity, and providing contexts for sharing and exchange.

The construction and use of the later ballcourts in the frontier zone also indicates investment in new communal ritual architecture during a period of environmental stress, contrary to expectations. Investing in ballcourts was one way frontier zone populations responded to the challenges of the megadrought and an influx of migrants from the neighboring Cohonina region to the west. The use of ballcourts could have mediated social tensions both among people from different cultural traditions that had colonized the frontier zone after the eruption and between these initial colonists and later migrants, creating a new shared identity among these socially diverse groups and providing opportunities for sharing and exchange. Another response to the megadrought was increased intergroup conflict as indicated by the defensive site and skeletal violence indices developed in Chapters 8 and 9. These increased levels of conflict indicate that social distances in the frontier zone were high during the 1130-1160 period, and the plainware assemblages also indicate that diverse gatherings of socially distant groups were held at these later frontier zone ballcourts.

As expected and indicated by the ceramic analysis, the post-eruption frontier zone ballcourts structured interactions between socially distant groups and were used when social distances were pronounced. In contrast, the post-eruption heartland ballcourts were primarily used by groups from the same cultural tradition that would presumably have been socially close. However, in the period following the eruption the dislocation and resettlement of refugees from impacted areas likely created social tensions within the community. As described in Chapters 4 and 5, the dislocation of refugees following the eruptions of Mount Lamington in Papua New Guinea and Paricutín in Mexico led to tensions over land use rights between resettled refugees and their new neighbors, and in the Paricutín area these tensions sometimes escalated into violence.

Unlike ballcourts, great kivas do not structure interactions to mark social differences among participants but instead express a common social identity is expressed. The plainware assemblages from communities with great kivas have lower diversity measures than the earlier frontier zone ballcourts, and differences in the composition of the plainware assemblages between communities indicates that the use of great kivas crossed social boundaries in the frontier zone. The indices of skeletal violence and defensive sites are much lower when great kivas were in use than they were in the preceding period when ballcourts were in use, further suggesting that social distances had decreased.

When the temporal and spatial patterns of communal ritual architecture did not conform to the expectations, as in the construction and use of new ballcourts in the heartland following the eruption and again in the frontier zone during the 1130s megadrought, these cases reveal how local populations adapted these non-local forms to meet their own needs to mediate social tensions, create a common social identity, and create contexts where sharing and exchange were encouraged. While changing patterns of exchange for marine shell related to ballcourt use were briefly discussed above, the following chapter further examines the relationships among exchange, environmental disturbances, and use of communal ritual architecture.

CHAPTER 12 – EVIDENCE OF COOPERATION: EXCHANGE

In small scale societies, the exchange of craft goods like pottery and exotic raw materials like marine shell, turquoise, and other minerals was not done in formal markets using standardized mediums of exchange. Rather, exchange transactions were governed by principles of social reciprocity and took place in the context of social events like the types of communal rituals and associated feasts that would have been practiced at the ballcourt and great kiva sites of the Flagstaff region. The activation of sharing and exchange networks was identified as an important alarm stage response to periods of environmental disturbance, and often this response may provide support allowing the crisis to be bridged without resorting to more socially disruptive resistance or exhaustion stage responses like social conflict or regional abandonment (see Chapter 4).

Following the expectation that environmental disturbances should lead to the activation of exchange networks, in this chapter I examine patterns of exchange for two important types of resources that moved long distances: (1) "hard substances" like marine shell, turquoise, argillite, and other minerals, and (2) non-locally produced pottery. The patterns of exchange for these resources are examined not only in relation to environmental disturbances, but also to the use of communal ritual architecture and to potential differences between the heartland and frontier zone. I expect that the evidence for exchange of hard substances and non-locally produced pottery should increase following environmental disturbances, as relationships forged during times of need were likely subsequently maintained and could even increase in importance again following later environmental disturbances. Changes in exchange will be measured in relation to the three environmental disturbances that also appear to have been critical hinge points regional culture history: (1) the 1085-1101 eruption and subsequent drought, (2) the 1130s megadrought, and (3) the 1214-1221 cool/dry period. These exchange relations are expected to have built upon relationships initially established through the use of communal ritual architecture, and populations in the heartland and frontier zone are expected to have participated in different networks of extra-regional exchange resulting in different patterns.

HARD SUBSTANCES

Marine shell and minerals like turquoise, argillite, and jet were called "hard substances" by the Hopi (huru'yngwa, Hill et al. 1998) and Navajo (ntł'iz, Young and Morgan 1987), and these materials were valued for their purity of essence and enduring qualities. Unlike more perishable and mundane items of everyday life like food, clothing, baskets, or pottery, objects made of these hard substances could be used without their losing value. They could be worn or displayed, gifted and regifted without diminishing their value, and they could even gain value through their use and exchange.

These materials were rare, usually locally unavailable, and often acquired from great distances. As such they inform on the nature of long-distance exchange relations and social networks that provided connections between and across regions. But perhaps even more importantly, their social uses also provide information on the nature of local social and political relationships. The objects made from these hard substances were important for signifying various types of social roles, statuses, and identities, including group membership, political or ritual roles, age grades, marital status, and others. As socially valued goods (Spielmann 2002) objects made from hard substances were exchanged to seal social transactions like betrothals, marriages, initiations, or alliances.

Few artifacts manufactured from these materials were present in the Flagstaff region prior to the eruption of Sunset Crater. As was mentioned in Chapter 11, the amount of shell and other hard substances increased substantially after the eruption, and the new sites associated with post-eruption ballcourts appear to have been primary loci for the production and consumption of these materials. After the eruption, a fine shell and lapidary crafting tradition emerged, and this tradition and the exchange relations that provided the needed raw materials were maintained until the abandonment of the region.

Over time, however, the manufactured forms and external stylistic influences changed. In addition, there is an indigenous tradition about a female deity associated with these hard substance, her creation of new clans that were given these substances, and the migration of these clans from the western ocean to join other Puebloan peoples in the Southwest, with the Flagstaff region of the post-eruption period specified as their point of entry into the Puebloan social world. First, I present an overview of this myth and interpret its meaning, then I discuss the archaeological evidence of the local acquisition and transformation of hard substance

Hard Substances in Myth

In both Hopi and Navajo mythology, there is a powerful and creative female deity associated with shell and other hard substances: the Hopi Huru'ingwùuti (Hard Substances Woman) and the Navajo 'Asdzą́ą́ Nádleehé or Yoołgai 'Asdzą́ą́ (Changing

Woman or White Shell Woman). In both Hopi and Navajo traditions, after the emergence of people onto the present earth surface world and the defeat of the monsters by the Hero Twins, this deity withdraws to an island located either off the Pacific Coast or in the Gulf of California where she lives in a house made of hard substances. There she creates new groups of people by rubbing skin from different parts of her body. These groups then migrate to the Colorado Plateau to join their relatives, the descendants of those who had emerged from the underworld. The available Navajo versions (Fishler 1953; Matthews 1890, 1897; Wyman 1970) provide more details about the migration than the more abbreviated available Hopi versions (Talayesva 1942; Voth 1905). In the Navajo accounts, each of the groups created was given a wand and a basket made of a hard substance: abalone shell, white shell, turquoise, black stone, and red stone. When the challenges of hunger or thirst were faced in the course of their migration, the baskets provided food and the wands were used to create springs, and the different groups received clan names when the wands were used. Social relations of exchange and intermarriage were established with some groups met along the way, with these groups joining the migration and also receiving clan names. Encounters with other groups resulted in failed attempts to establish proper social relations, sometimes leading to conflict.

The migration myth describes the Flagstaff region as the point of entry into the Southwestern social world, and the San Francisco Peaks (Dook'o'osłííd, Light Shines From It) and Sunset Crater (Dził Bílátah Łitsoi. Yellow-Topped Mountain) are mentioned. The name of the San Francisco Peaks refers to its association with iridescent abalone from the Pacific Ocean. The migrants had hostile interactions with the some of the Arrow People (K'aa'dine'é) who lived in the area west of the San Francisco Peaks, and the migration continued to the northeast through the Kayenta region to the Chaco region with various mountains and other landforms, springs, streams, and Puebloan villages mentioned. While the different accounts all detail this northeastern route, one account mentions that this is the "female story" with another undescribed "male story" of migration to the east along the Little Colorado River (Fishler 1953:94-95).

This mythic migration may symbolically represent an enchained network of exchange and marital alliances that connected Puebloan groups in the Southwest to other groups living near sources of marine shell on the Pacific Coast and Gulf of California, as well as other hard substances like turquoise and argillite found in the areas in between. Such long-distance exchange relations and marital alliances would also provide pathways for migration in times of trouble. The mention of the San Francisco Peaks and Sunset Crater do not just establish the location of part of the migration event/exchange network, the presence of Sunset Crater on the landscape also places emergence of this exchange network after the eruption. The springs created by the wands of hard substances in the myth may describe actual places along a well-traveled prehistoric and historic exchange route that connected the Flagstaff region to the Pacific Coast (Brand 1938; Colton 1941).

For example, during the migration, just prior to the arrival of the migrants at the San Francisco Peaks, the last wand was used to create a spring. This was the wand of red stone, which may reference the large prehistoric argillite mine near Del Rio Springs in the Chino Valley north of Prescott and southwest of the Peaks (Bartlett 1939). Argillite objects recovered from sites in the Flagstaff region, including Winona Village and other post-eruption sites, have been sourced to this mine using x-ray fluorescence of artifacts and geologic samples (Elson and Gunderson 1992). The Prescott region is located along the documented route used for trade and travel, and some excavated sites in the Williamson Valley close to this trail have large quantities of turquoise from local sources and from other sources to the west and northwest, as well as substantial amounts of argillite from the Del Rio source and marine shell from both the Pacific and Gulf of California (Barnett 1970, 1978). These various hard substances were present in both raw, unworked forms and as finished beads, pendants, and other ornaments, and lapidary tools were present in the ground and flaked stone assemblages.

While framed as a migration myth, I believe this episode describes the development of an exchange network connecting the Puebloan Southwest with sources of shell and other hard substances from sources to the west and south: the Pacific Coast, the Gulf of California, and other points in between, like the Halloran Springs turquoise source in the Mojave Desert (Leonard and Drover 1980) and the previously mentioned Del Rio Springs argillite source. This exchange network connected with the Puebloan social world in the Flagstaff region, and the description of Sunset Crater in the myth indicates that this network emerged after its eruption. Indeed, as mentioned in Chapter 11 and discussed further below, the amount of hard substances in the Flagstaff region increased tremendously after the eruption. The myth further describes populations in the Chaco region being connected to western sources of hard substances through the Flagstaff region. In addition to gaining access to greater amounts and more diverse assemblages of hard substances like marine shell, argillite, and turquoise, the social relationships forged through exchange and intermarriage would have provided access to resources other than just hard substances, like subsistence stores needed during alarm stage responses to environmental disturbances. They also may have provided pathways for migration in the event of exhaustion stage abandonments.

Hard Substances in the Flagstaff Region

As discussed in Chapter 11, hard substances were rare in the Flagstaff region before the eruption, but after the eruption a wide range of materials were present. In the case of marine shell, only shell from the Gulf of California was used before the eruption, while Pacific Coast shell also came to be included after the eruption. Pre-eruption shell was limited to a single species (*Glycymeris*) worked into a single form (bracelets), while post-eruption shell assemblages have a greater diversity of species and forms present. Post-eruption assemblages also have evidence of the local manufacture of shell jewelry and the practice of other lapidary crafts. Shell assemblages at initial post-eruption sites like Winona Village have characteristic Hohokam forms like *Glycymeris* bracelets and pendant cutouts (Figure 12-1).

While the initial post-eruption use of hard substances was characterized by Hohokam-style forms, later post-1130 assemblages include elaborate mosaics using turquoise, argillite, jet, and other materials, as well as new species of shell and forms used (Jernigan 1978; McGregor 1943, n.d.; Stanislawski 1963b). These increases in the amount of shell

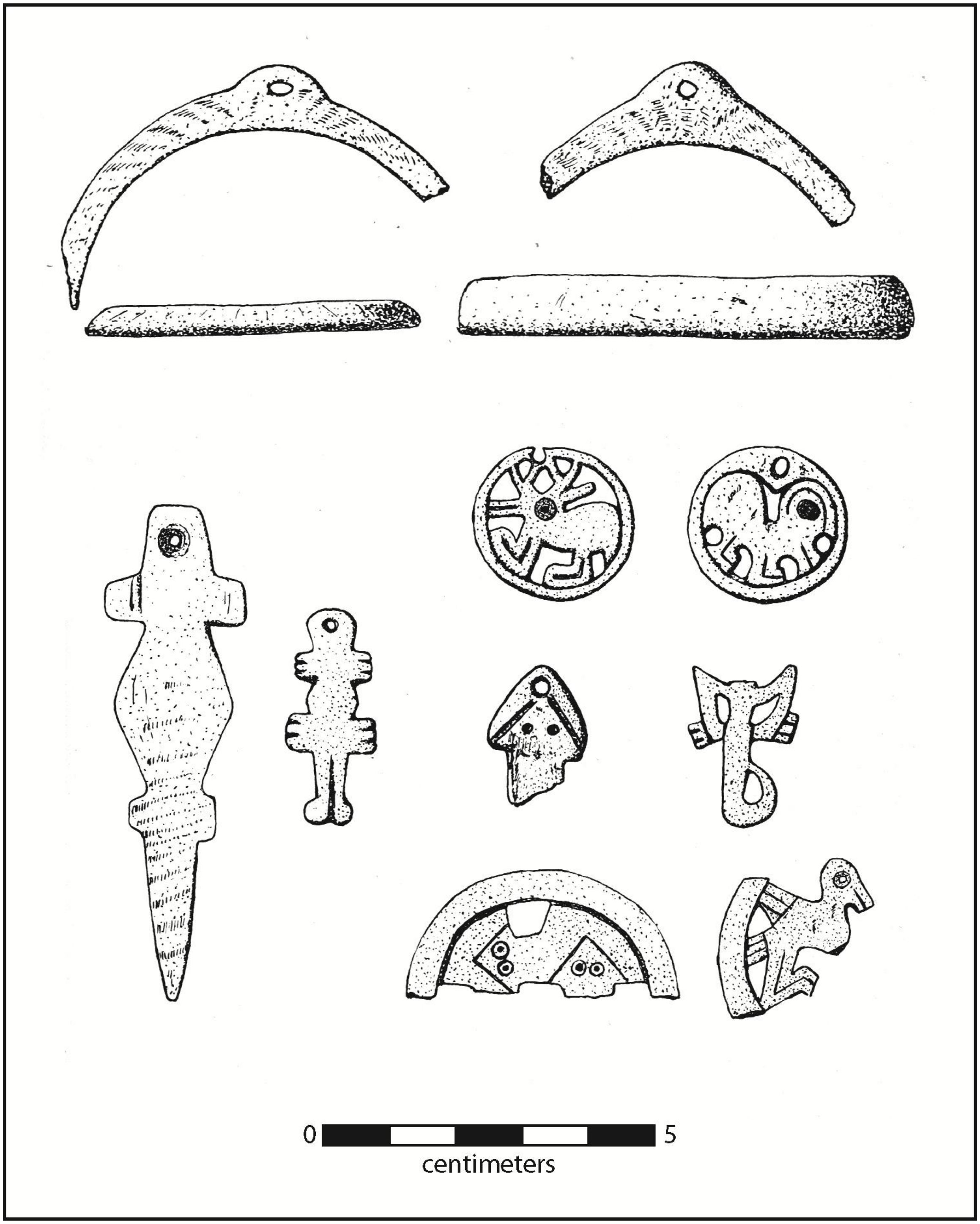


Figure 12-1. Hohokam-style shell bracelets and pendants from Winona Village (McGregor 1941:205, 223)

obtained as well as the diversity of species used and the number of sources from which it came indicates expansion of the trade networks to which residents of the Flagstaff region had access. But these changes indicate more than just new exchange relations and potential external influences, they also indicate changes in social relations and the structure of the local community, and the adoption of new social roles and ritual practices. Three particular forms indicate shifting exchange relations and the adoption of new social roles and ritual practices after 1130: (1) *Conus* shell tinklers, (2) fine mosaic work, and (3) jet buttons or mirrors.

Shell Tinklers

One of the new forms of shell jewelry made from a species not used earlier is tinklers made from *Conus* shell (Figure 12-2). The burial of the Magician (McGregor 1943) indicates that such tinklers were worn and used as part of a ceremonial costume, as tinklers were found along his legs as though sewn onto a kilt or leggings and he held a rattle of *Conus* tinklers in his right hand (Figure 10-2). *Conus* tinklers were used similarly in ethnographically known Puebloan ceremonial costume (Roediger 1941:139, 175) and *Conus* shell rattles were said to evoke the sound of ocean or the waters of emergence (Parson 1939:704: Stephen 1936:1253). The Magician burial, which dates to ca. 1175, is one of the earliest contexts from which *Conus* tinklers have been recovered, only a few sites in the Chaco and Mimbres regions may be earlier (O'Hara 2009). After 1250, the use of *Conus* tinklers became widespread and they have been found at coalescent Pueblo communities along and below the Mogollon Rim and at Classic period Hohokam and

Figure 12-2. *Conus* shell artifacts from the Phoenix Museum of History: beads (left), with the tip of the spire ground off to make a small hole; tinklers (right), with the entire spire removed and a hole for suspension abraded at the other end.

Salado sites further south. In mortuary contexts, they are found almost exclusively with adult men and have been proposed to mark membership in a male sodality at the Grasshopper Pueblo (Whittlesey and Reid 2001). The *Conus* tinklers may have been associated with the stick-swallowing ritual also represented in the Magician's offerings, and Zuni lore suggests that such rites originated in Chaco Canyon (Frazier 1986:211-212). Other influences from Chaco evident in the post-eruption assemblages of hard goods include fine mosaics and jet objects usually called buttons.

Fine Mosaic Work

Fine mosaic work from the Flagstaff region is perhaps best known from the offerings found with the Magician (McGregor 1943), which included mosaic pendants, earrings, swallowing stick handles, a bracelet, and a basketry tube (Figure 12-3), but evidence of other mosaic work has been found at numerous other sites in the region, including both large one like Wupatki Pueblo (Stanislawski 1963b) and smaller ones like Lizard Man Village (Kamp and Whittaker 1999). The only stylistic and technological antecedents for

Figure 12-3. Select artifacts with fine mosaic work found with the Magician burial (McGregor 1943:Plates I and II). Upper row: basketry tube covered with turquoise, argillite, jet, and rodent tooth mosaic work (8.5 × 12 cm) and raptor mosaic of turquoise, shell, and pyrite (70 × 42 mm) that was attached to a Glycymeris bracelet. Lower row: raptor mosaic of shell and turquoise (70 × 40 mm) and circular mosaic pendant or brooch of turquoise, shell, and pyrite (23 mm diameter).

this craftwork in the U.S. Southwest are found in the Bonito phase (850-1140) of Chaco Canyon (Jernigan 1978; Mathien 1997; Pepper 1920).

When worn or displayed, mosaic objects signal the value of the hard goods invested in their manufacture and the crafting labor and skill invested, as well as information about the bearer's social role, status, or identity. The mosaics found with the Magician include two raptorial bird forms, and similar objects have also been found in the Flagstaff region at the Pollock Site, Two Kivas Pueblo, and Wupatki Pueblo ((McGregor n.d.; Stanislawski 1963b:171). Raptor mosaics have also been found at later sites along and below the Mogollon Rim like Chavez Pass, Montezuma Castle, Tuzigoot, and Casa Grande (Jernigan 1978; McGregor n.d.) indicating that the social role or identity associated with this symbol persisted and spread. In the Flagstaff region, they have been found in mortuary contexts with an adult man (Ridge Ruin), an elderly woman (the Pollock Site), and a child (Two Kivas Pueblo), suggesting that whatever social role or identity expressed with this form was not restricted to any specific age or gender.

Jet Buttons or Mirrors

Flat, discoidal or rectangular objects made of jet (lignite) with one or more perforated ridges on one side (Figure 12-4) have been commonly called "buttons" in the archaeological literature of the U.S. Southwest because of the oversized button-like appearance (Jernigan 1978:193), although it is hardly likely that they functioned as such and Jernigan alternatively calls these objects “plaques” (1978:144, 193). While McGregor (1941:195, 1943:281) initially referred to one found with the Magician as a

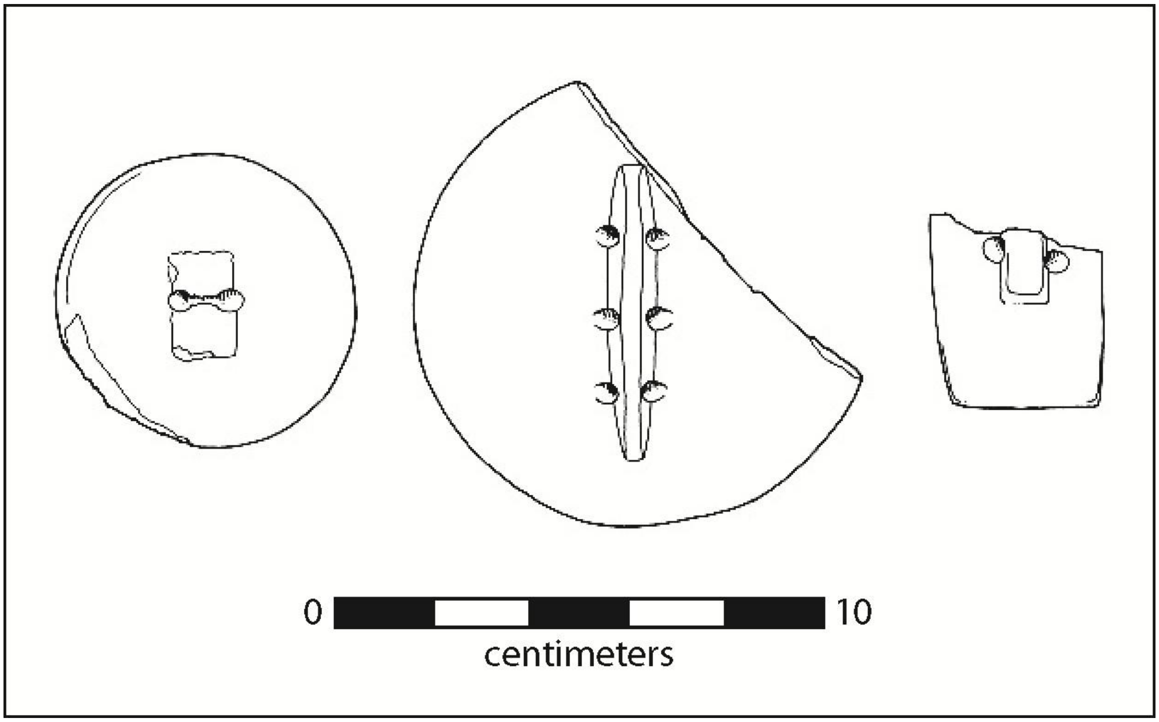


Figure 12-4. Jet mirrors from the Flagstaff region (Jernigan 1978:148), specimen on left from the Magician burial.

button, he later called it a “mirror” (1943:297) and noted similarities in the button-like means of attachment on the back to that found on Hohokam and West Mexican sandstone-backed pyrite mirrors (Eckholm 1945). Throughout Mesoamerica mirrors were used by shamanic practitioners in trance-inducing rituals; their reflective surfaces were believed to represent the waters of the underworld and the mirrors facilitated shamanic journeys to that realm (Miller and Taube 1993; Saunders 1988). While McGregor (1943:297) and later Jernigan (1978:87-90, 147) noted these formal similarities, neither built upon this observation to suggest use of these black, hand-sized mirrors by shamanic practitioners either as an extra-dimensional portal, as in the Mesoamerican example, or as a scrying device used in divination activities. Scrying refers to the practices of intensive staring into reflective (mirrors), translucent (crystals), or luminescent (fire) objects or substances to receive visions or insights for divinitory purposes (Eliade 1964; Lyon 2004). Puebloan ethnographies indicate that other materials, like crystals and the reflective surfaces of liquids in a medicine bowls, were used as a scrying devices (Parsons 1939:330, 719).

In addition to the example found with the offerings of the Magician at Ridge Ruin, other jet mirrors have been recovered from the House of Tragedy and Three Courts Pueblo (Smith 1952a:143-144), Nalakihu (King 1949:94-95), Two Kivas Pueblo (McGregor n.d.), and the Young's Canyon site (Fewkes 1926:7). The example from Three Courts Pueblo is from the earliest context, likely between 1100 and 1115, and the others all appear to post date 1150. Those from Ridge Ruin and the Young's Canyon site were offerings with burials. While that from Ridge Ruin was with the Magician, an adult man, the one from the Young's Canyon site was with an elderly woman, suggesting that the ritual practices associated with these objects were not restricted to a single gender. That with the Magician was found on a coiled basket with a necklace made from mountain lion teeth and claws, a bundle of cotton yarn, a bundle of human hair, and three different pigments: azurite, cinnabar, and hematite (McGregor 1943). Based on comparative Puebloan ethnography, I have previously proposed that this group of objects with the Magician is a set of ritual paraphernalia used for divination in hunting, war, and combating witchcraft (O'Hara 2008). Three of the others jet mirrors were recovered from floor contexts in rooms that were likely used for rituals: the Hohokam-style pit house at

Three Courts Pueblo, the kiva at House of Tragedy, and Room 4 at Nalakihu, which had loom holes in the floor suggesting that it functioned as a kiva (King 1949:30-36).

The temporal and spatial distribution of jet mirrors indicate that the form originated in the Chaco region during the Bonito phase (850-1140), with examples recovered from both great houses (Pepper 1920; Judd 1959) and small houses (Brand et al. 1937; Mathien 1992). Further connecting these items to the Chaco region is the fact that the jet is from Cretaceous Menefee formation exposed in Chaco Canyon and other parts of the San Juan Basin (Molenaar 1983). After 1150, jet mirrors are found at sites in the Flagstaff and Kayenta regions (Judd 1930; Kidder and Guernsey 1919), and after 1250 at sites along and below the Mogollon Rim (Jernigan 1978; Rinaldo 1964). Like *Conus* shell tinklers and objects using fine mosaic work, jet buttons appear to have been a piece of ritual paraphernalia that originated in the Chaco region, most likely in Chaco Canyon itself, and then spread to the west after 1150 and then along and below the Mogollon Rim after 1250.

Interpreting the Use and Exchange of Hard Substances

Prior to the eruption, hard substances and objects made from them were rare, but following the eruption, not only did the amount of hard substances increase, but they were increasingly used as important means of signaling social identities and roles. Hard substances were imported to the region and transformed by local artisans into forms inspired by non-local sources. Following the eruption, during the 1085-1130 period, the use of hard substances was characterized by Hohokam-style forms while after 1130 new forms, styles, and techniques were introduced from the Chaco Canyon region and an even wider range of raw materials were used. This influence from Chaco likely began ca. 1120 when the great house components of Wupatki and Ridge Ruin were established, but these forms, styles, and techniques became locally rooted and continued to be used after the great houses were transformed and rebuilt during the 1130s megadrought. Fine mosaic work, *Conus* shell tinklers, and jet mirrors are characteristic of late Elden phase (1160-1220) assemblages; this follows the decline of Chaco Canyon indicating that the social roles and ritual practices associated with these objects had become important locally and not just as a reference to connections to a distant center.

The spread of these three different forms of ritual paraphernalia together suggests a dispersal of a set of ritual practices that originated in Chaco Canyon and spread to the Flagstaff region in the mid-1100s. At the same time these ritual practices and associated paraphernalia were arriving in the Flagstaff region from the east, an increasing amount and more diverse assemblages of shell were coming into the region from the west and south, a shift in inter-regional exchange relations described in myth. An exchange network providing access to hard substances and sealed through marriage alliances and kinship connected the Pacific coast and Chaco Canyon via the Flagstaff region, and later these relationships provided migration pathways.

As expected, these changes in patterns of exchange for hard substances follow environmental disturbances. The initial surge of hard substances acquisition and emergence of a local crafting tradition using Hohokam styles followed the eruption of Sunset Crater. The later expansion of the sources and types of hard substances and shift to styles, forms, and techniques influenced by Chaco followed the 1130s megadrought during the decline of the center and re-organization of the Chaco regional system. However, the 1214-1221 cool/dry period does not seem to have affected patterns of hard substances exchange, as post-1220 Turkey Hill phase assemblages are similar to earlier Elden phase (1130-1220) ones.

While hard substances are found at both large and small sites in the Flagstaff region, when the presence of hard substances is measured as a ratio value to the site's ceramic assemblage they are found in greater quantities at sites like Juniper Terrace, Ridge Ruin, Winona Village, and Wupatki Pueblo that have communal ritual architecture than at contemporary sites that lack communal ritual architecture (Hedquist 2007). This indicates that such sites were, as expected, the primary loci for the acquisition, production, and use of these symbolically and socially charged materials. There is little difference, however, between the patterns of hard substances acquisition and use in the heartland and frontier zone. The initial post-eruption surge in Hohokam-style forms is best represented at sites in the heartland, but more sites from the 1085-1130 period have been excavated in the heartland and frontier zone populations were smaller and more mobile during this period of the initial resettlement of areas directly affected by tephra deposition from the eruption.

NON-LOCAL POTTERY

While Alameda Brown Ware was locally produced, all other pottery found in the Flagstaff region was produced elsewhere and imported. In the absence of formal markets, the movement of these pots was most likely facilitated by social relations established through ceremonial and ritual interactions between groups. Throughout the prehistoric occupation of the region, pottery manufactured in the neighboring Cohonina and Kayenta regions was a common component of household assemblages, especially in the frontier zone. These included various types of San Francisco Mountain Gray Ware, Tusayan Gray and White Wares, and Tsegi Orange Ware. The presence of other types and wares, often in smaller amounts and less commonly found, indicate social and economic relations with other areas (Figure 12-5). These include the Hohokam Buff Ware previously mentioned in Chapter 11, as well as Wingfield Plain, Mogollon Brown Ware, Cibola White Ware, Little Colorado White Ware, Prescott Gray Ware, and White Mountain Red Ware. In the following sections I evaluate the patterns of acquisition and use of the latter three wares in relation to the expectations that changes should follow environmental disturbances, be associated with the use of communal ritual architecture, and be different in the heartland and frontier zone.

Little Colorado White Ware

Aside from the extremely small amounts of red-on-buff and white-on-red varieties of Alameda Brown Ware that were locally produced, all of the decorated pottery used in the Flagstaff region was imported. Throughout the prehistoric occupation of the region, a majority of this imported decorated pottery was various black-on-white types of Tusayan White Ware produced in the Kayenta region more than 150 km to the northeast. The presence of Lino Black-on-gray at Cinder Park phase sites indicate that the initial farming

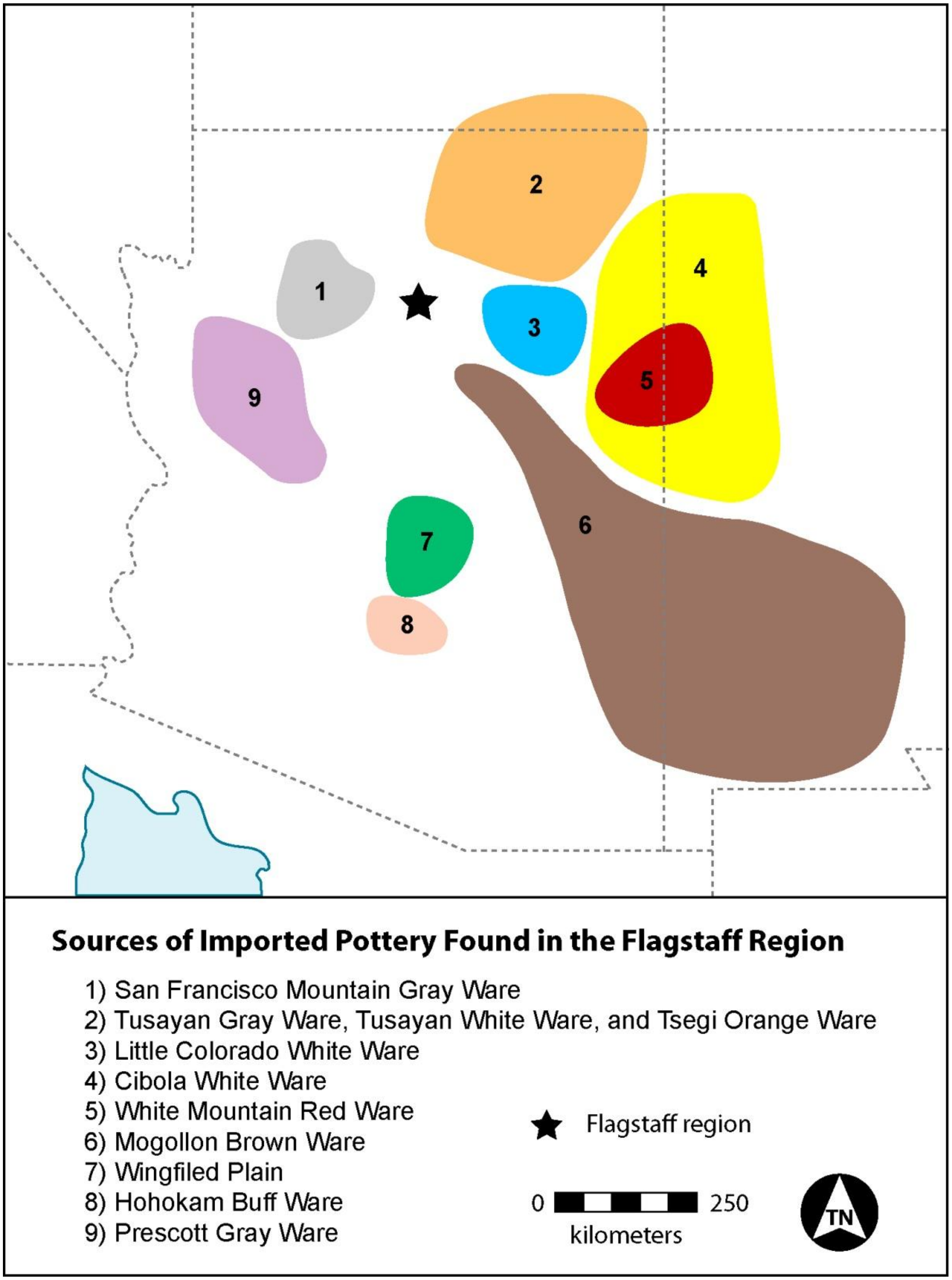


Figure 12-5. Sources of imported pottery found in the Flagstaff region.

populations of the Flagstaff region had established social and economic relations with populations in the Kayenta area, and the continued occurrence of Tusayan White Ware types throughout the prehistoric occupation of the region indicates that these relations were enduring and maintained over many generations.

Tusayan White Ware is just one of several white ware traditions that was manufactured by prehistoric Puebloan populations in the U.S. Southwest (Abel 1955; Breternitz et al. 1974; Colton 1952, 1955; Colton and Hargrave 1937; Gladwin and Gladwin 1931; Hawley 1936; Hays-Gilpin and Van Hartesveldt 1998). These different white wares often share analogous design styles but differ in the materials used in their manufacture reflecting the local geologies of their different production locales. Little Colorado White Ware was manufactured in the Hopi Buttes region between Black Mesa on the north and the Little Colorado River on the south. Like other white wares, it was formed using the coil-and-scrape method and fired in a reducing atmosphere. It was made from a high iron clay tempered with crushed sherds. The surfaces were heavily coated with a chalky white slip and decorated with organic paint, and the types defined by these painted designs are generally analogous in style to Tusayan White Ware types (Colton 1955; Douglass 1987).

Prior to the eruption of Sunset Crater, Little Colorado White Ware was not used in the Flagstaff region. It is completely absent from excavated pottery assemblages recovered from 80 pre-eruption sites in the Flagstaff region, both in the Sinagua heartland and the frontier zone (Table 12-1). Two notable exceptions from survey observations are the ballcourts at Old Caves and New Caves, which were in use just before the eruption.

Table 12-1. Excavated pre-eruption sites with no Little Colorado White Ware.

Site Numbers	# of SItes	Reference
NA4375 NA5903	2	Breternitz 1957a
NA5971 NA5947	2	Breternitz 1957b
NA6589 NA6873	2	Breternitz 1959
NA1125 NA1904	2	Breternitz 1963
NA74 NA152 NA192 NA194 NA283 NA408 NA409 NA860 NA862 NA863 NA1121 NA1122 NA1123 NA1237 NA1238 NA1239 NA1244 NA1295 NA1296 NA1297 NA1524 NA1531 NA1554 NA1570 NA1571 NA1608 NA1625 NA1633 NA1653 NA1676 NA1680 NA1907 NA1914 NA1918 NA 1919 NA 1920 NA 1922 NA1925 NA 1926 NA 1927 NA 1959 NA1975 NA2000 NA2001 NA2002 NA2003 NA2004 NA2055 NA2056 NA2057 NA2058 NA2060 NA2797 NA2798 NA2799 NA2800 NA3024 NA3028 NA3029 NA3056 NA3996	61	Colton 1946
NA10754	1	De Boer 1976
AR-03-04-02-2564 AR-03-04-02-2567	2	Dosh 1998
NA20700		Landis 1993
NA18417 NA18680 NA20700 NA21087 NA25751 NA25767 NA25779	7	Van Keuren and Herr 2007
NA5700	1	Vivian 1956
Total Number of Sites	80	

While the white ware assemblage from the Old Caves ballcourt consists of only 15 sherds, it is 26.7% Little Colorado White Ware. The New Caves ballcourt white ware assemblage is a little larger (n=27) and is 22.2% Little Colorado White Ware (Morales 1994). This may indicate that in the decades before the eruption ritual and ceremonial interactions at the ballcourts were the context for the initial creation of social and economic relations between the populations of the Flagstaff region and the producers of Little Colorado White Ware from the Hopi Buttes region.

After the eruption, Little Colorado White Ware became a common component of pottery assemblages from excavated sites in the region, although there appear to be differences in the patterns of occurrence between the Sinagua heartland and the frontier zone. To measure the nature of this shift in white ware acquisition and use, I compiled a sample of excavated components with 25 or more decorated sherds from 32 sites (64 components) in the Sinagua heartland and 19 sites (38 components) in the frontier zone. The proportions of Tusayan and Little Colorado White Wares relative to one another and the mean ceramic dates based on the decorated white ware, red ware, and orange ware sherds were calculated for of these components. The samples were then seriated by the mean ceramic dates and the proportions of Little Colorado and Tusayan White Wares were visually represented with stacked histograms to show the pattern of temporal variation in the occurrence of these wares in both the Sinagua heartland (Figure 12-6) and the frontier zone (Figure 12-7).

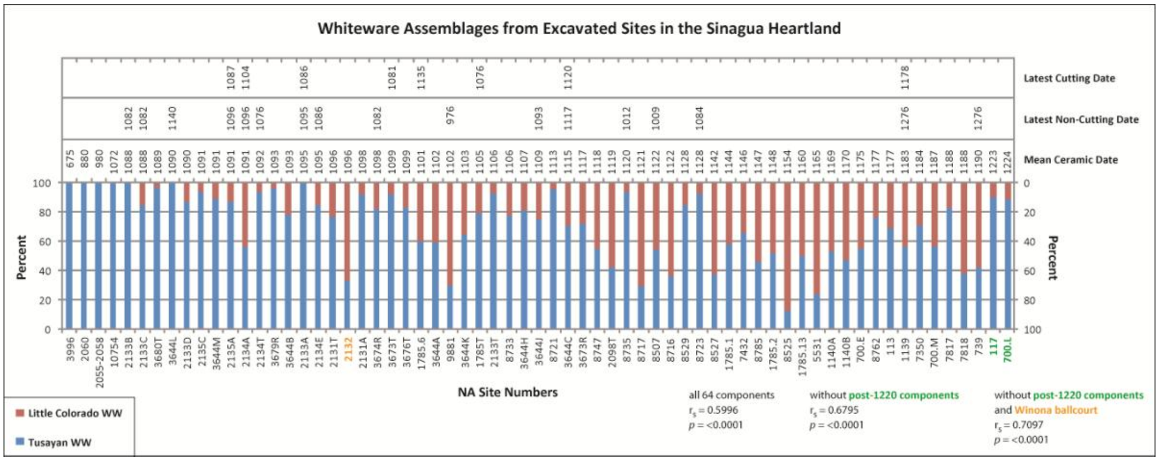


Figure 12-6. Percentages of Little Colorado and Tusayan White Wares from excavated sites in the Sinagua heartland seriated by mean ceramic date and shown with associated tree-ring dates.

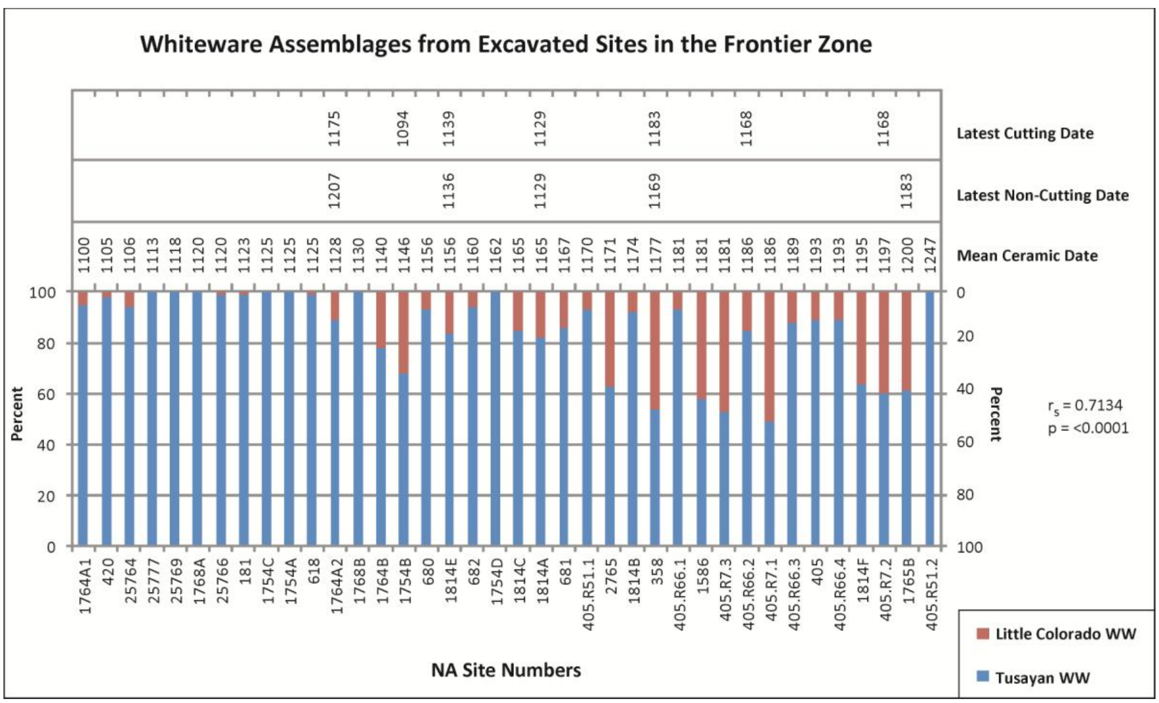


Figure 12-7. Percentages of Little Colorado and Tusayan White Wares from excavated sites in the frontier zone seriated by mean ceramic date and shown with associated tree-ring dates.

Little Colorado White Ware in the Heartland

The increasing amount of Little Colorado White Ware in the heartland after the eruption is apparent in Figure 12-6, as is the variation among the white ware assemblages from the different components, even different components from the same site. Spearman's rank order correlation can be used to identify whether two ranked variables, like the mean ceramic dates and the increasing proportions of Little Colorado White Ware in these samples, have a monotonic association and, if so, the strength of that association. It provides a measure, Spearman's rho (r_s), that can range from -1 to +1, where -1 is a perfect negative association (as one variable increases, the other decreases), 0 is no association, and +1 is a perfect positive association (as one variable increases, the other does as well). The significance of the r_s value can then be evaluated using the Student's *t*-distribution. For the sample of excavated components $r_s = 0.5996$ with a one-tailed $p < 0.0001$, indicating a moderate association between time and increasing amounts of Little Colorado White Ware.

However, two sites contribute 28 of the 64 components, Winona Village with 21 components (16 pit houses, 1 roomblock, 3 trash mounds, and 1 ballcourt) and the pit house village at Ridge Ruin with 7 components (3 pit houses and 4 trash mounds), and it is useful to examine each on its own. Tree ring dates suggest that Winona Village was established around 1086, immediately after the Sunset Crater eruption began (Robinson et al. 1975). In general, the components with early mean ceramic dates have lower proportions of Little Colorado White Ware, with NA 2134A as a notable exception (Figure 12-8). The structure is a masonry-lined pit house and this style of architecture

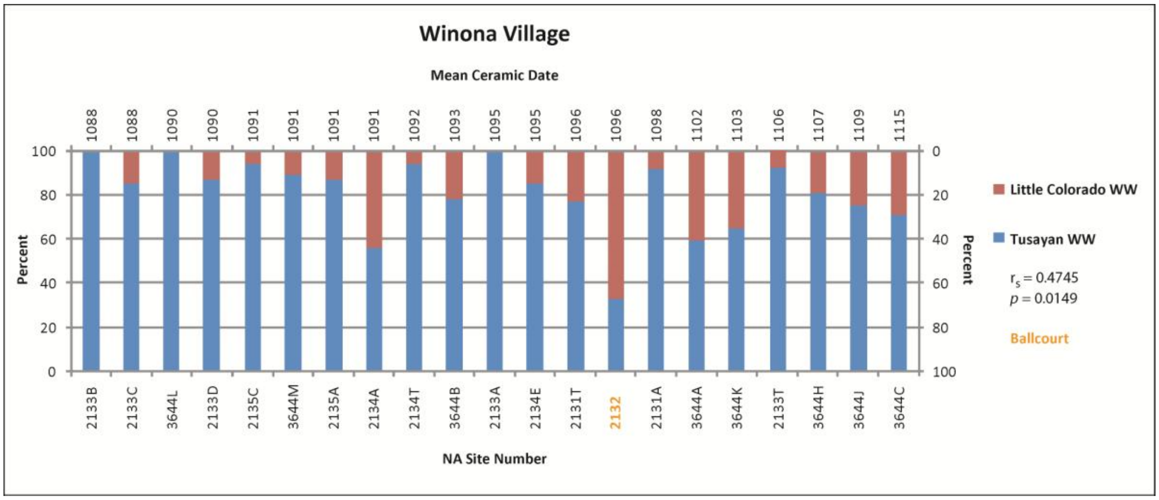


Figure 12-8. Percentages of Little Colorado and Tusayan White Wares from Winona Village.

would suggest that it post-dates 1100, at least a decade later than the mean ceramic date. Another outlier is the high proportion of Little Colorado White Ware from the ballcourt, NA 2132, which is the only component at the site with more than 50% Little Colorado White Ware and where the proportion of 66.7% is 3.5 times greater than the sample mean and 2.9 standard deviations above it. The ballcourt was obviously an important location for the introduction of Little Colorado White Ware into the community.

Testing the association between mean ceramic date and increasing amounts of Little Colorado White Ware in the sample from Winona Village yields r_s = 0.4745 (p = 0.0149), suggesting only a weak association. Much of the variation among the differentcomponents both at Winona Village and in the region as a whole is likely due to the households represented by the pottery assemblages having been embedded in different social networks, with some having greater social and economic relations with populations in the Hopi Buttes region than others. These differences were likely more pronounced during the early stages of the development of these inter-regional relationships, as appears to have been the case at Winona Village in the immediate aftermath of the eruption.

Like before the eruption, the ritual and ceremonial interactions at ballcourts served as the primary context for the creation of social and economic relations between the populations of the Flagstaff and Hopi Buttes regions, and appear to have facilitated the expansion of those relations. In addition to the excavated assemblage from the Winona ballcourt, surface sherds associated with the two ballcourts at Ridge Ruin also include Little Colorado White Ware, although in differing amounts. The east ballcourt, which appears to have been used earlier, has only 7% Little Colorado White Ware, while the later west ballcourt has 29% (Morales 1994). The significance of this difference must be assessed cautiously, for while 44 white ware sherds were identified at the east ballcourt, only 14 were identified at the west ballcourt (Fisher's exact test $p = 0.0541$). However, when the seven excavated components from the pit house village occupation at Ridge Ruin are examined on their own (Figure 12-9), the proportions of Little Colorado White Ware increase from the earlier components to the later components, with $r_s = 0.8829$ ($p < 0.05$) suggesting a strong association.

To understand the nature of this variation and more general trends over time, I grouped the sites into four time periods corresponding to the traditional cultural-historical phases for the region: pre-1085, 1085-1130, 1130-1220, and 1220-1275. The first period has four components, none of which have any Little ColoradoWhite Wares. There are eight other excavated pre-eruptive sites in the Sinagua heartland not included in this

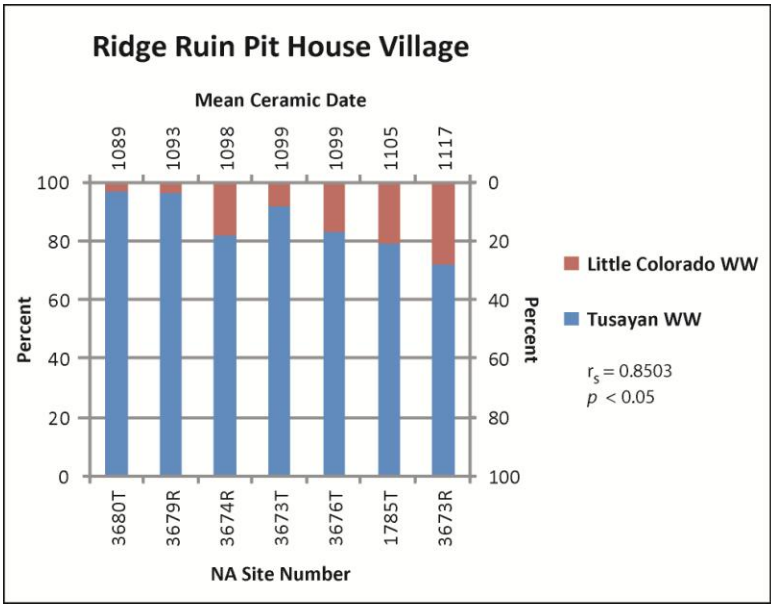


Figure 12-9. Percentages of Little Colorado and Tusayan White Wares from the pit house village component of Ridge Ruin.

sample because they lacked the sufficient number of decorated sherds to allow mean ceramic dating, however, none have Little Colorado White Ware present. The final period has only two components, both of which have relatively low proportions of LittleColorado White Ware, Turkey Tanks Caves (NA 117) with 10% and the late component at Two Kivas (NA 700) with 11.5%. The Two Kivas assemblages will be considered in more detail later to discuss the changing nature of white ware acquisition after 1220.

The 1085-1130 and 1130-1220 periods have 39 and 19 components respectively, allowing the variation within and between the two periods to be compared using box plots showing the maximum, minimum, first and third quartiles, and median values of the white ware proportions for each time period (Figure 12-10). Assemblages from the 1085-

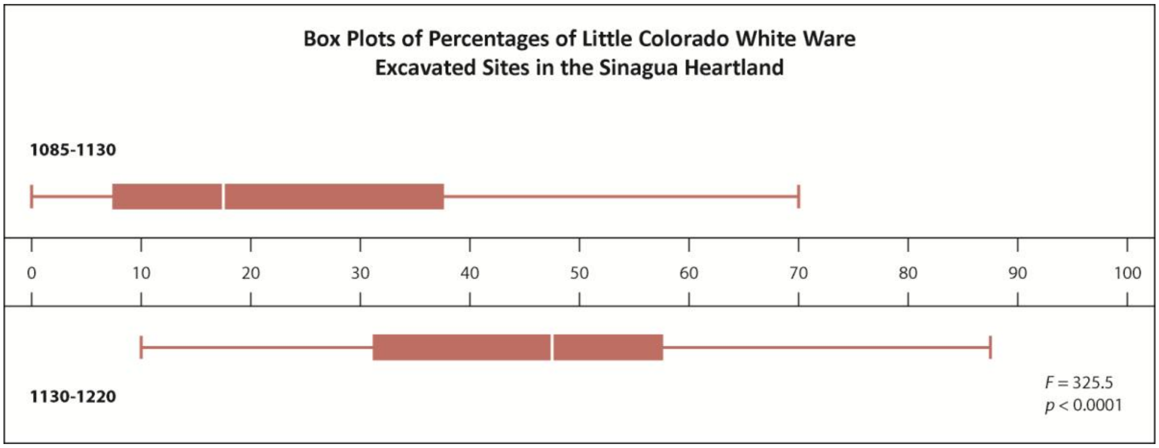


Figure 12-10. Box plots of the percentages of Little Colorado White Ware from excavated sites in the Sinagua heartland.

1130 period have from 0 to 70.4% Little Colorado White Ware, with a median of 18.0%, a mean of 24.1%. This increase from no Little Colorado White Ware in excavated assemblages prior to the eruption to a mean of 24.1% in the period following the eruption indicates major expansion of the social and economic relations between populations in the Sinagua heartland and those in the Hopi Buttes region. These relationships were also widely shared within the community, as 92% of excavated components have Little Colorado White Ware present.

In the following 1130-1220 period, these relationships appear to have become even more important when assemblages have from 10.0 to 87.3% Little Colorado White Ware, with a median of 47.5% and a mean of 46.0%. The mean nearly doubled after 1130, and all excavated components have Little Colorado White Ware present. The statistical significance of these readily apparent differences can be assessed be using the *F*-test to measure whether the between group variability greater than within group variability, the higher the *F* value, the greater the significance of the between group variability. When comparing the changes in the amounts of Little Colorado White Ware between the 1085-1130 and 1130-1085 periods, $F = 325.5$ with $p < 0.0001$, indicating that the variability between the groups is much more significant than that within each group.

These patterns of change reveal expected increases inter-regional exchange following environmental disturbances that affected populations in the Flagstaff region. The amount of Little Colorado White Ware increased after the eruption of Sunset Crater, and this increase continued after the 1130s regional megadrought. The initial creation of social and economic relationships between the Flagstaff and Hopi Buttes region occurred before the eruption in the context of ballcourt use, and the post-eruption expansion of exchange also appears associated with ballcourts.

A limited number of post-1220 components are available for analysis, but the assemblages from Two Kivas Pueblo, which tree-rings indicate was built in the early 1170s, had major construction during the 1190s, and was occupied until after the 1240s (Robinson et al. 1975), provide some insights into the patterns of white ware acquisition during this period. The various rooms and other excavation units have been divided into early, middle, and late components based on the construction sequence, associated tree-ring dates and decorated pottery, and patterns of abandonment and use for trash deposition (McGregor n.d.). The frequencies of the decorated types associated with these components provide a mean ceramic date of 1175 for the early component, 1190 for the middle component, and 1224 for the late component. In the early and late components, Little Colorado White Ware accounts for 45.4% and 44.4% of the white ware assemblage respectively, but in the late component this drops to only 11.5%. This sharp decrease after 1220 and after the 1214-1221 cool/dry period is contrary to the expectation that levels of exchange should increase following environmental disturbances. However, the Hopi Buttes region where Little Colorado White Wares were produced was rapidly depopulated between 1200 and 1250 (Gumerman 1988; Hays-Gilpin and van Hartesveldt 1998). The decreasing proportions of Little Colorado White Ware in pottery Flagstaff region assemblages from the post-1220 period likely resulted from the depopulation of the source region and the ware's declining production and eventual end after 1250.

The general trend revealed is that Little Colorado White Ware first appeared in excavated pottery assemblages in the Sinagua heartland after the eruption of Sunset Crater and on average accounted for 24.1% of whiteware assemblages; its acquisition continued to increase following 1130, nearly doubling in amount; but after 1220, its proportions declined precipitously. This decline after 1220 should be expected as the ware fell out of production as its source area was being abandoned. If the post-1220 components are excluded from the sample of excavated components when evaluating the rank order correlation the r_s value increases from 0.5996 to 0.6795; further, if those at the Winona ballcourt are excluded as well the r_s value increases again to 0.7097 (both with a one-tailed $p < 0.0001$). Excluding late and anomalously high early contexts strengthens the association between time and increasing amounts of Little Colorado White Ware in the heartland.

The social and economic relationships that facilitated the movement of pottery from the Hopi Buttes region to the Sinagua heartland were first established in the in the decades preceding the eruption of Sunset Crater and expanded dramatically in the aftermath of the eruption and during the subsequent extreme dry period. Evidence indicates that these initial connections were mediated through ballcourt ceremonialism. The acquisition of Little Colorado White Ware continued to increase following the 1131-1142 megadrought suggesting that this period of environmental stress increased the importance of these inter-regional social and economic relationships. These social and economic ties may not have been able to help overcome the challenges presented to populations of the Hopi Buttes region in the early 1200s, and the presence of Little Colorado White Ware in the Sinagua heartland declined precipitously after 1220 as the production locale was depopulated and the ware fell out of production.

Little Colorado White Ware in the Frontier Zone

In the frontier zone, Little Colorado White Ware also first appeared as a component of excavated assemblages after the eruption of Sunset Crater, although initially in much lower frequencies and at a lower proportion of excavated components than in the Sinagua heartland (Figure 12-7). There is a great increase in Little Colorado White Ware frequency after 1130, again similar to the pattern found in the heartland. For the sample of frontier zone excavated components $r_s = 0.7134$ with a one-tailed $p < 0.0001$, indicating a strong association between time and amounts of Little Colorado White Ware.

The frontier zone excavated components were assigned to the same temporal periods as those in the heartland based on their mean ceramic dates. A total of 65 pre-eruption sites have been excavated in the frontier zone, none of which have any Little Colorado White Ware and were not included in the analyzed sample. The 1085-1130 period has 13 components from 10 sites, the 1130-1220 period has 24 components from 11 sites, and there is only one post-1220 component. Like with the heartland sample, the variation within and between the 1085-1130 and 1130-1220 periods can be compared using box plots (Figure 12-11).

Between 1085 and 1130, Little Colorado White Ware is present in very low proportions, suggesting that interactions with the producers in the Hopi Buttes region may have been limited, or perhaps mediated through populations in the Sinagua heartland. Not only are the proportions low, but 38% of the excavated components from the time period have no Little Colorado White Ware. These limited and perhaps mediated interactions increased during the following 1130-1220 period. The mean increased more than tenfold after 1130, from 2.1% to 22.5%. Further, 96% of excavated components in the 1130-1220 period have Little Colorado White Ware present, indicating that these relationships had become more widely shared within the frontier zone community. Like in the heartland, the variability between the two time periods is more significant than that within either of the periods ($F = 253.9$ with $p < 0.0001$).

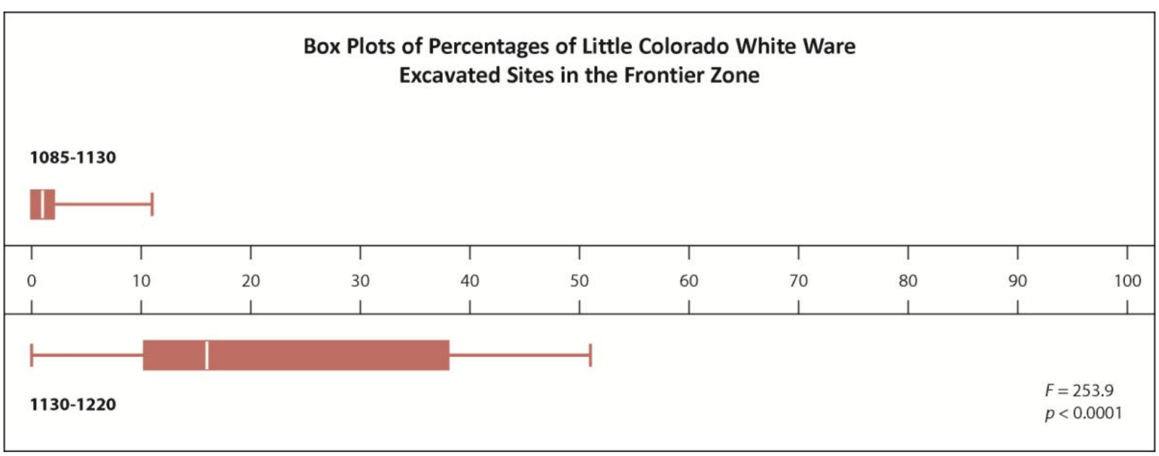


Figure 12-11. Box plots of the percentages of Little Colorado White Ware from excavated sites in the frontier zone.

The one post-1220 component comes from a late deposit at Wupatki Pueblo, the trash-filled second story of Room 51, and contains no Little Colorado White Ware. This component has a mean ceramic date of 1247, which would suggest that it dates to when the production of Little Colorado White Ware was ending, so its absence is not surprising. The trash fill below the first story floor of Room 51 is stratigraphically earlier, has a mean ceramic date of 1170, and Little Colorado White Ware accounts for 7.0% of the white wares, still relatively low compared to the mean for the 1130-1220 period. Colton's merged reporting of 84 excavation components from Wupatki Pueblo (Colton 1946:59) reveals that the overall proportion of Little Colorado White Ware at the site is 10.7%, and other specific contexts also reveal relatively low proportions of Little Colorado White Wares at Wupatki Pueblo.

The assemblages from Room 7 in the northern part of the pueblo stand out for their higher proportions of Little Colorado White Ware (Table 12-2). A single cutting date of 1168 is associated with the first-story roof of this two story room (Reed 1938; Robinson et al. 1975), and the stratigraphic sequence of Room 7 and the associated tree-ring date

Table 12-2. Stratigraphic sequence from Room 7 at Wupatki Pueblo.

Level	Depositional Context	% LCWW	Mean Ceramic Date	# of Decorated Sherds
1	trash deposits above fallen first-story roof	51.3	1186	3,358
2	floor fill of first-story room	40.0	1197	574
3	sub-floor	49.4	1181	109

suggest the room was built ca. 1170, and the first- and second-story rooms were abandoned and began to fill with trash after the mid-1180s. The proportions of Little Colorado White Ware from the Room 7 deposits are 1.7 to 2.2 times higher than the mean for the 1130-1220 period and more than seven times higher than contemporaneous deposits from Room 51. Room 7 is in the northern part of the pueblo, while Room 51 is in the southern part. These differences in deposits from the same period suggest that the different households that comprised Wupatki Pueblo may have had differential access to Little Colorado White Wares, likely because of differences in the various households' social networks that extended beyond the community and had been created and maintained through ritual, inter-marriage, and exchange of resources like pottery.

One final context from Wupatki deserves additional attention, that from the unroofed great kiva (Table 12-3). As previously discussed, the sherds recovered from a test unit in the center of the great kiva were separated by the different depositional units – trash deposits prior to the construction of the great kiva, fill associated with the construction of the first floor of the great kiva, fill associated with the construction of the second floor of the great kiva, and trash deposited in the great kiva after it fell out of use. The proportion of Little Colorado White wares from the trash deposits before the great kiva was built is 6.8%, while the deposits associated with the first floor and the initial construction of the great kiva have 15.3%, a significant increase (χ^2 = 4.26, p = 0.0390). The higher proportions of Little Colorado White Ware continue in the succeeding depositional units, including in the fill associated with the great kiva's renovation. The higher proportions of Little Colorado White associated with the great kiva's construction and use suggest that

Table 12-3. Stratigraphic sequence from the unroofed great kiva (Room 66) at Wupatki Pueblo.

Level	Depositional Context	LCWW		TWW		Mean Ceramic Date	Total # of Decorated Sherds
		#	%	#	%		
4	trash deposits from after great kiva use ended	14	11.7	109	88.3	1192	183
3	fill associated with construction of second great kiva floor	106	11.5	819	88.5	1189	1,267
2	fill associated with construction of first great kiva floor	80	15.3	444	84.7	1186	845
1	pre-construction trash deposits	5	6.8	72	93.2	1181	87
-	sterile soil	-	-	-	-	-	-

this communal ritual structure may have involved greater activation of the social networks in the community that engaged populations in the Hopi Buttes region. It should not be surprising that the construction and use of the great kiva might have indications of greater engagement with populations to the east in the Little Colorado River Valley, as other post-Chaco unroofed great kivas are found in that region.

More evidence of the association between great kiva use and greater social and economic ties with the Little Colorado River Valley is found in the Wupatki Road great kiva community. The proportions of Little Colorado White Ware in the excavated assemblage from NA 1586, the largest site in the community, is 41.9%, 1.8 times higher than the mean for excavated components in the frontier zone. The surface collections from NA 1586 and other sites in the community also have high proportions of Little

Colorado White Ware, ranging from 38.1 to 60.7% (Table 12-4). Great kivas may have been an important context of interaction that facilitated the movement of Little Colorado. White Ware, and their use in the 1180s may be a factor accounting for the increased proportions of the Little Colorado White Ware in the frontier zone during the 1130-1220 period

Ballcourts, which were used earlier than the great kivas, appear to have been important contexts for the introduction of Little Colorado White Wares in the frontier zone. Evidence discussed in the previous chapter indicates that the Second Sink ballcourt was the first one built and used in the frontier zone and Juniper Terrace ballcourt was the latest. Examination of the whiteware assemblages associated with these two ballcourts and the nearby excavated host communities of Three Courts and Juniper Terrace Pueblos reveals an interesting pattern. Surface observations at Second Sink ballcourt found that Little Colorado White Ware accounted for 11 of the 30 whiteware sherds present, or a36.6% proportion (Morales 1994). In contrast, the excavated assemblage from Three Courts Pueblo has considerably less Little Colorado White Ware present, with only a

Table 12-4. Percentages of Little Colorado White Ware from sites in the Wupatki Road great kiva community.

Context	Site	% LCWW	# WW sherds	Mean Ceramic Date
Excavation	NA 1586	41.9	31	1181
Surface	NA 201	38.1	42	1183
	NA 1584	60.7	28	1189
	NA 1585	51.4	37	1186
	NA 1586	47.5	59	1179

single sherd recovered compared to 286 Tusayan White Ware sherds (Smith1952a:89). This results in a proportion of 0.3%, lower than the mean of 2.1% for excavated frontier zone components from the 1085-1130 time period.

The 1935 excavations at the Juniper Terrace ballcourt recovered only 32 total sherds and just 12 white wares, all of which were Little Colorado White Ware (McGregor 1937a:18; Colton 1946:76-77). More recent surface observations at the ballcourt documented a larger number of white wares (n = 41) and found that Little Colorado White Ware accounted for 56.1% of them (Morales 1994). Merged together, the excavated and surface white ware assemblages have 66.0% Little Colorado White Ware. All of these proportions are much higher than the 22.5% mean for the sample of post-1130 excavated sites in the frontier zone. The proportions of Little Colorado White Ware from the five excavated components at Juniper Terrace Pueblo range from 13.4 to 36.0% (Table 12-5). Like at Three Courts Pueblo and Second Sink Ballcourt, at Juniper Terrace there is more Little Colorado White Ware associated with the ballcourt than with the

Table 12-5. Percentages of Little Colorado White Ware from excavated components at Juniper Terrace Pueblo.

Excavated Components at Juniper Terrace Pueblo	% LCWW	# WW sherds	Mean Ceramic Date
NA 1814E, large masonry kiva	16.8	196	1155
NA 1814C, Hohokam-style pit house	14.8	209	1165
NA 1814A, pueblo roomblock	18.1	1,752	1171
NA 1814B, pueblo roomblock	13.4	359	1180
NA 1814F, small masonry kiva	36.0	22	1192
All components merged	17.2	2,538	1170

pueblo. This pattern of higher proportions of Little Colorado White Ware at the ballcourts than at the host communities suggests that ballcourts played a key role in changing patterns of interregional exchange and were important contexts for the creation and maintenance of social and economic relations that facilitated the movement of Little Colorado White Ware vessels into the frontier zone.

Comparing the Two Areas

While Little Colorado White Ware first appears in both the Sinagua heartland and the frontier zone after the eruption of Sunset Crater, there are significant differences in the proportions of Little Colorado White Ware that suggest the populations in the two areas were embedded in different social and economic networks. During the 1085-1130 period following the eruption, excavated components in the Sinagua heartland have significantly higher proportions of Little Colorado White Ware than excavated components from the frontier zone (Figure 12-12). Components from the Sinagua heartland have a median of 18.0% and mean of 24.1%, but those from the frontier zone have a median of 0.003% and mean of 2.1%. While populations in both areas first became engaged in social networks that provided access to Little Colorado White Wares during the 1085-1130 period, those in the Sinagua heartland received greater amounts of Little Colorado White Ware and may have been directly interacting with the producers in the Hopi Buttes region to the east. The lower amounts of Little Colorado White Ware found in the frontier zone indicate that the primary social and economic relationships for acquiring whiteware remained with populations in the Kayenta region to the northeast, as they had been before

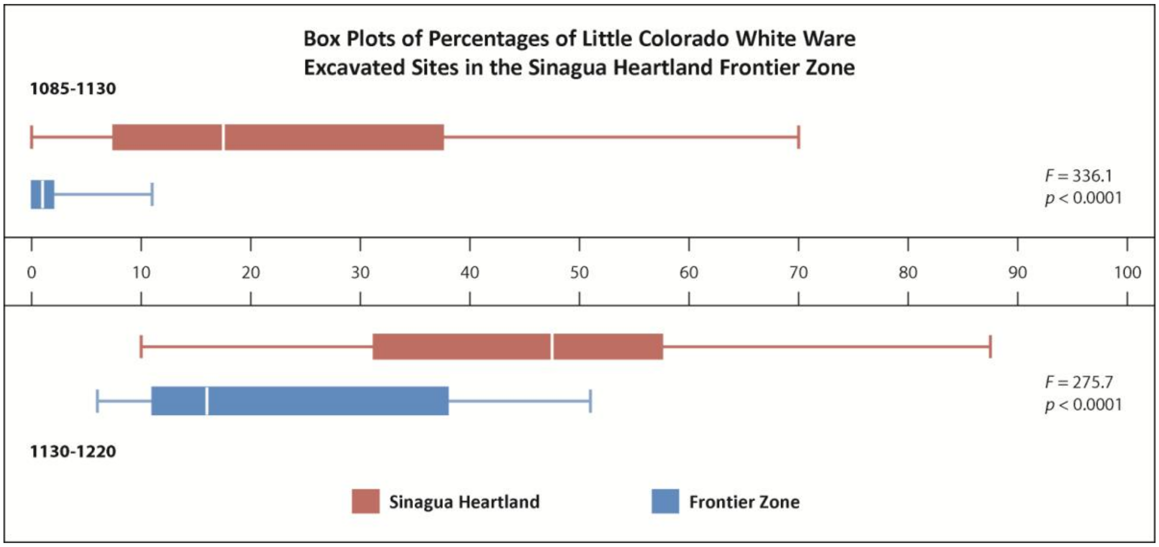


Figure 12-12. Comparison of box plots of the percentages of Little Colorado White Ware from excavated sites in the Sinagua heartland and the frontier zone.

the eruption. The lower frequencies in the frontier zone than in the Sinagua heartland may also suggest that frontier zone access to Little Colorado White Ware was mediated through the Sinagua heartland and that frontier zone populations may not have been directly interacting with the producers in the Hopi Buttes region.

The evidence indicates that in the aftermath of the eruption of Sunset Crater, populations in the Sinagua heartland established substantial new social and economic relationships with populations to the east in the Hopi Buttes region. The much lower proportions of Little Colorado White Ware in the frontier zone indicates that the groups in that area were not as engaged in these new exchange relations. In the Sinagua heartland 92% of the excavated components from the 1085-1130 period have Little Colorado White Ware while only 62% of those in the frontier zone do. These differences in access to Little Colorado White Ware indicate that the social ties facilitating inter-regional exchange were more widespread within the local community in the Sinagua heartland than they were in the frontier zone.

During the subsequent 1130-1220 period, the proportions of Little Colorado White Ware increased substantially in both areas, but overall they still remained higher in the Sinagua heartland than in the frontier zone. While components from the Sinagua heartland have a median of 47.5% and a mean of 46.1%, those from the frontier zone have the median value of 15.5% and mean of 22.5%. The percentage increases of the means for each region are about the same, +22.0% for the Sinagua heartland and +20.4% for the frontier zone, but the proportional increases are tremendously different. In the Sinagua heartland, the mean nearly doubled from the 1085-1130 period to the 1120-1220 period. This is a major increase, but the change was even more dramatic in the frontier zone, where the mean increased more than tenfold. Further, during the 1130-1220 period Little Colorado White Ware is nearly ubiquitous in all excavated components from both regions. This was only a minor increase (+8%) for the Sinagua heartland, but it was a major increase in the frontier zone (+34%) indicating expansion of access to social networks that reached beyond the local community. However, the continued pattern of lower proportions in the frontier zone than in the Sinagua heartland may indicate that frontier zone access to Little Colorado White Ware was still largely mediated through the Sinagua heartland rather than primarily involving direct interaction with the producers in the Hopi Buttes region.

Limited data is available on the nature of interaction in the 1220-1275 period, but steep declines in the proportions of Little Colorado White Ware are apparent. The late component at Two Kivas in the Sinagua heartland has a proportion of only 11.5%, a 75% decrease from the mean of the preceding period. The only securely post-1220 excavated component from the frontier zone data set has no Little Colorado White Ware. However, the population in the production area for Little Colorado White Ware was declining rapidly between 1200 and 1250, and the ware phased out of production by 1250 as the Hopi Buttes region was abandoned.

The evidence also suggests that ballcourts and great kivas were contexts for the creation and maintenance of the social and economic ties that facilitated the movement of Little Colorado White Ware into the region. In the heartland, the earliest presence of Little Colorado White Ware is at late pre-eruption ballcourts, and in the frontier zone, ballcourts have greater proportions of Little Colorado White Ware than contemporaneous host communities and the mean of the excavated sample for the area. The proportions of Little Colorado White Ware double after the construction of the great kiva at Wupatki Pueblo, and sites in the Wupatki Road great kiva community have much higher proportions of Little Colorado White Ware than the mean of the sample of excavated sites for the area.

In small-scale societies without centralized markets, communal ceremonial and ritual events like those held in the ballcourts and great kivas of the Flagstaff region provide a context for interaction and exchange among different participating social groups. While such contexts often favor the exchange of higher valued decorated wares like Little Colorado White Ware, the following section examines a plainware that had large jars transported great distances contrary to the general expectation that smaller vessels with lower transportation costs are usually the object of long-distance exchange.

Prescott Gray Ware

Another non-local pottery ware that provides evidence of changing external social and economic relations following environmental disturbances, particularly in the frontier zone, is Prescott Gray Ware. This ware was manufactured using the paddle-and-anvil method and was tempered with coarse arkosic sands containing abundant mica particles that indicate the ware's origins in the granitic geology of the Prescott area some 140 km to the southwest. The firing atmosphere was generally reducing, but control could be poor resulting in having both reduced and oxidized portions of vessels, or fully oxidized vessels. These differences in firing atmosphere created variations in color leading to the distinction made by analysts between Prescott (or Verde) Gray and Aquarius Orange. Some vessels were decorated with crudely executed black designs using an organic paint and are known as Prescott (or Verde) Black-on-gray and Aquarius Black-on-orange (Colton 1958).

Prescott Gray Wares are found in small amounts at a few pre-eruption sites in the frontier zone. The Medicine Valley area just north of the Coconino Divide was a center of pre-eruption occupation that has been the focus intensive archaeological research first by MNA in the 1930s (Colton 1946; Parry 1981) and more recently for the US89 project (Elson 2006). A total of 28 sites with 44 habitation features have been excavated that date between 950 and 1085. Prescott Gray Ware is present in small amounts at 10.7% of these sites, ranging from 0.2 to 2.2% of the total plainware assemblages, and was recovered from 6.8% of the habitation features (Table 12-6). While present only at a few sites and in very limited quantities, the presence of Prescott Gray Ware suggests the existence of social and economic relations between the occupants of the frontier zone and populations in the Prescott region.

Colton (1946) first made the observation that after the eruption of Sunset Crater the frequency of Prescott Gray Ware occurrence in the frontier zone increased, and he and others (Downum and Sullivan 1990; King 1949; Lambert 1998) have further suggested that Prescott Gray Ware is found mostly along Deadman's Wash and in the western part of Wupatki National Monument around the Citadel, where Prescott Gray Ware accounts

Table 12-6. Presence and absence of Prescott Gray Ware sherds in excavated components from the Medicine Valley.

Excavated Components with Prescott Gray Ware			
Site	**# PGW**	**% PGW**	**Total Plainwares**
NA 1295B	1	0.2	438
NA 1625B	1	2.2	45
NA 21087	22	0.8	2893
Excavated Components without Prescott Gray Ware			
NA 860A	NA 1297A		NA 1907A
NA 860B	NA 1297B		NA 1907B
NA 860C	NA 1297C		NA 1914A
NA 860D	NA 1297E		NA 1914B
NA 862	NA 1524B		NA 2000
NA 863	NA 1524C		NA 2001A
NA 1121	NA 1554A		NA 2002A
NA 1122	NA 1554B		NA 2002B
NA 1123	NA 1554C		NA 2003
NA 1237A	NA 1554D		NA 2004A
NA 1238	NA 1608B		NA 2004B
NA 1239	NA 1625A		NA 18680
NA 1244B	NA 1625C		NA 25751
NA 1296	NA 1680		

for 37.7% of the plainware assemblage from the excavated site of Nalakihu (King 1949). Building upon these observations and Lambert's (1998) initial analysis of sites around the Citadel, I examine the temporal and spatial patterning of this increase using both survey and excavation data.

Prescott Gray Ware is present at 10.8% of the sites recorded on survey at Wupatki National Monument for which detailed pottery presence/absence or counts were recorded (n=1,969). To examine the spatial distribution across the monument, I looked at the percentage of sites with Prescott Gray Ware in four areas: (1) Lambert's 7 km^2 study area around the Citadel, (2) west of the Citadel, (3) east of the Citadel to the Doney Cliffs, which separate the higher elevation grasslands and juniper savannah to the west from the lower elevation desertscrub to the east, and (4) east of the Doney Cliffs (Figure 12-13). These survey data confirm Colton's initial impressions that greater amounts of Prescott Gray Ware are found in the frontier zone after the eruption and appear more frequently in the area around the Citadel.

The frequency of sites with Prescott Gray Ware in the monument also varies over time (Figure 12-14). About one in five sites occupied during the 1085-1130 period has Prescott Gray Ware present. During the 1130-1160 period, the frequency of sites with Prescott Gray Wares decreased, but then increased again through the next two time periods. The sharp decrease during the 1130-1160 time period is most notable when considering just the single-component sites. The early part of this period includes the

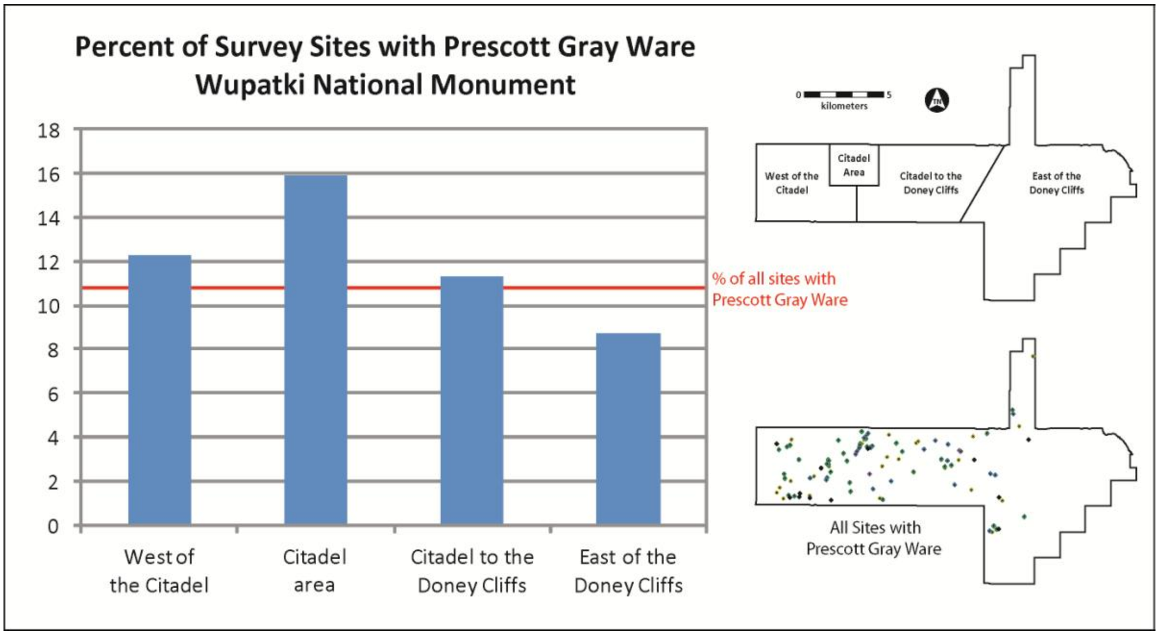


Figure 12-13. Percentage of survey sites with Prescott Gray Ware at Wupatki National Monument by area.

1131-1142 megadrought, and the disruption of social and exchange relations created by the stresses of this environmental disturbance may account for the decreased frequency of sites with Prescott Gray Ware.

This pattern contrasts with the reconstructed settlement demography for the area as measured by an annualized rate of room construction (Sullivan and Downum 1991) (Figure 8-27). Settlement increased during the 1130-1160 period and peaked during the 1160-1220 period while the percentage of sites with Prescott Gray Ware decreased from the initial post-eruption period. It may be that the increase in population brought more households into the frontier zone that were engaged in different long distance exchange networks and lacked connections to the Prescott region. During the 1220-1275 period, the percentage of sites with Prescott Gray Ware increased while the overall number of

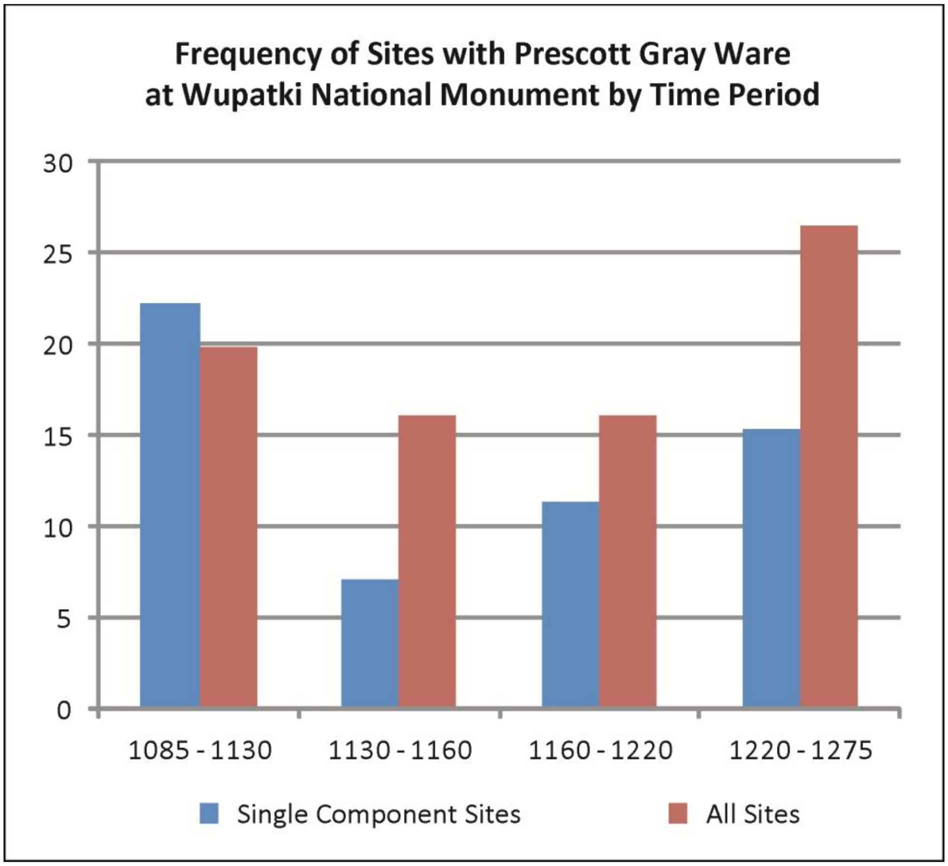


Figure 12-14. Percentage of sites with Prescott Gray Ware at Wupatki National Monument by time period.

architectural spaces decreased, perhaps indicating greater importance of long-distance exchange ties to the west during the final period of occupation.

These analyses so far have been based only on the presence or absence of Prescott Gray Ware, not the amounts found. In order to examine the quantities of Prescott Gray Ware found at sites in the frontier zone, I compiled more detailed data from both survey and excavation. For the survey sample, I used data from Wupatki National Monument and adjacent CNF lands to the south to create a subset of 39 sites that in addition to having Prescott Gray Ware present also have 100 or more plainware sherds and 25 or more decorated sherds recorded. For the excavation sample, the same set of 38 excavated components from 19 sites used in the Little Colorado White Ware analysis was used.

For each site the percentage of the plainware assemblage comprised by Prescott Gray Ware was calculated and the sites were seriated based on their mean ceramic dates. These data on Prescott Gray Ware are compared to the percentages in the same plainware assemblages of San Francisco Mountain Gray Ware and to the proportions of whitewares (Figures 12-15 and 12-16). These comparisons reveal that as the proportions of Prescott Gray Ware increased in the plainware assemblages, those of San Francisco Mountain Gray Ware decreased. Also, as the amounts of Prescott Gray Ware increased, the proportions of Little Colorado White Ware increased relative to Tusayan White Ware. As with the whitewares, Spearman's rank order correlation was used to measure the strength of association between two ranked variables, in these cases between the mean ceramic dates (time) and both the increasing percentages of Prescott Gray Ware and the decreasing percentages of San Francisco Mountain Gray Ware. While there is a strong association with decreasing amounts of San Francisco Mountain Gray Ware in both the survey and excavation samples, the association with increasing amounts of Prescott Gray Ware are only moderate. The decrease in the presence of San Francisco Mountain Gray Ware is related to the abandonment of the ware's production zone following the 1130s megadrought, and changes in the amounts of Prescott Gray Ware may indicate that loss of access to San Francisco Mountain Gray Ware was supplemented by increased long-distance exchange with the Prescott region.

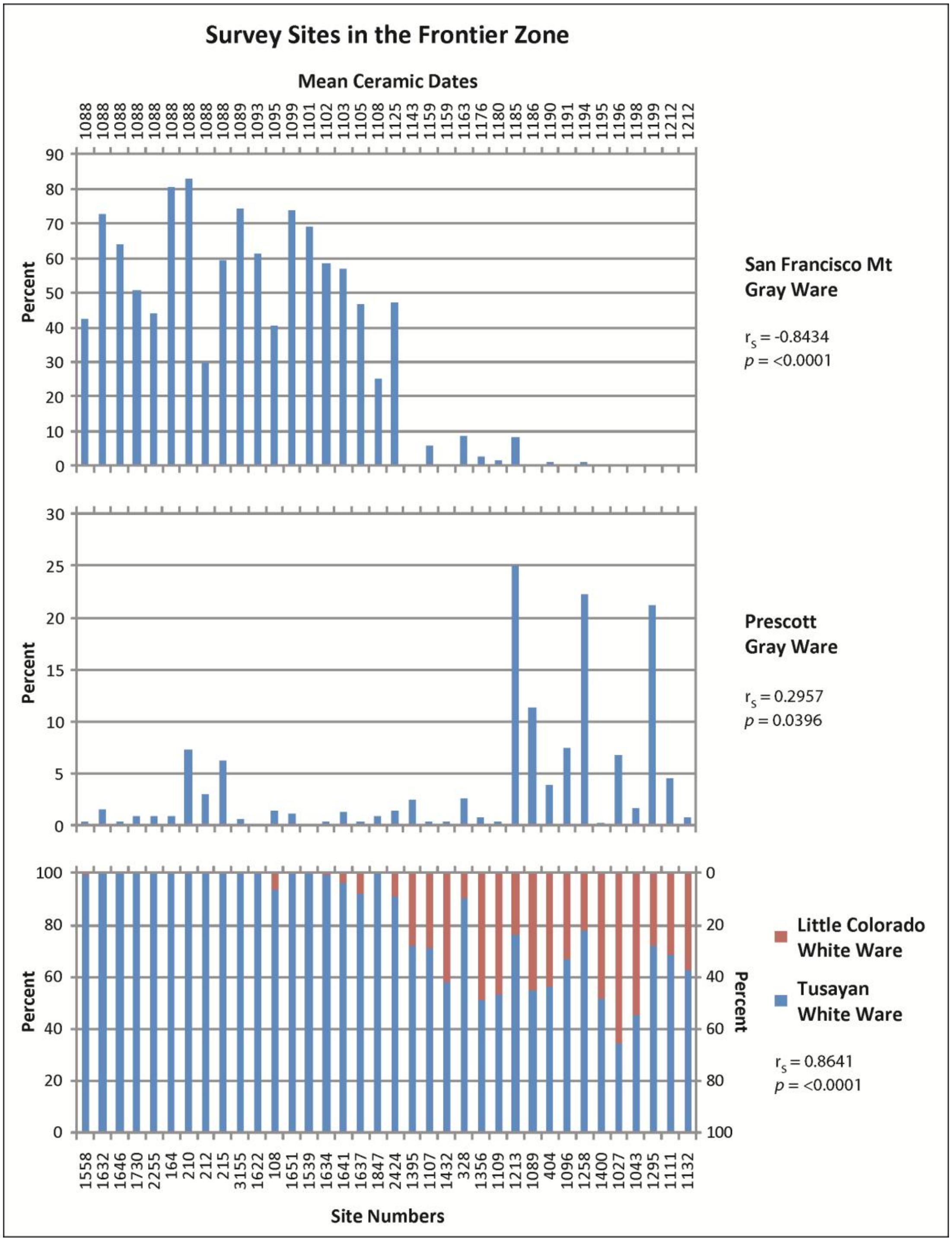


Figure 12-15. Comparison of changing percentages of Prescott Gray Ware with those of San Francisco Mountain Gray Ware and the percentages of whitewares for 39 sites in the frontier zone recorded on survey.

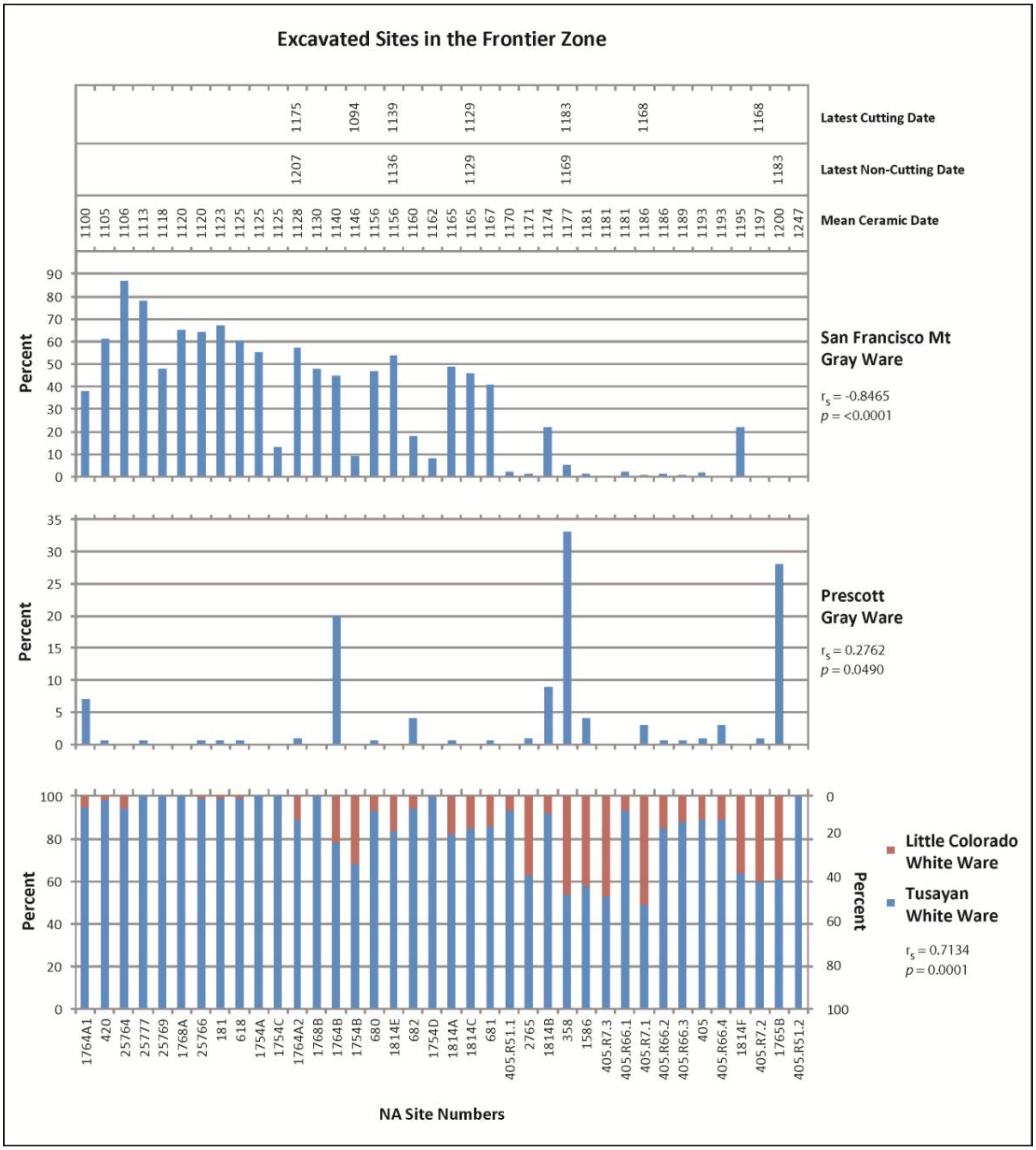


Figure 12-16. Comparison of changing percentages of Prescott Gray Ware with those of San Francisco Mountain Gray Ware and the percentages of whitewares for 38 excavated components in the frontier zone.

When separated into time periods, the gradual increase in both the amount of Prescott Gray Ware present and its availability within frontier zone communities is readily evident (Figure 12-17). The percentage of excavated sites with Prescott Gray Ware increases greatly from one period to next, going from being relatively limited in its distribution during the 1000-1085 time period (present at only 10.7% of sites) to being nearly ubiquitous during the 1130-1220 time period (present at 91.6% of sites). In these excavated assemblages, the maximum percentage of Prescott Gray Ware in the plainware assemblages from each time period also increases from 2.2% to 37.7%.

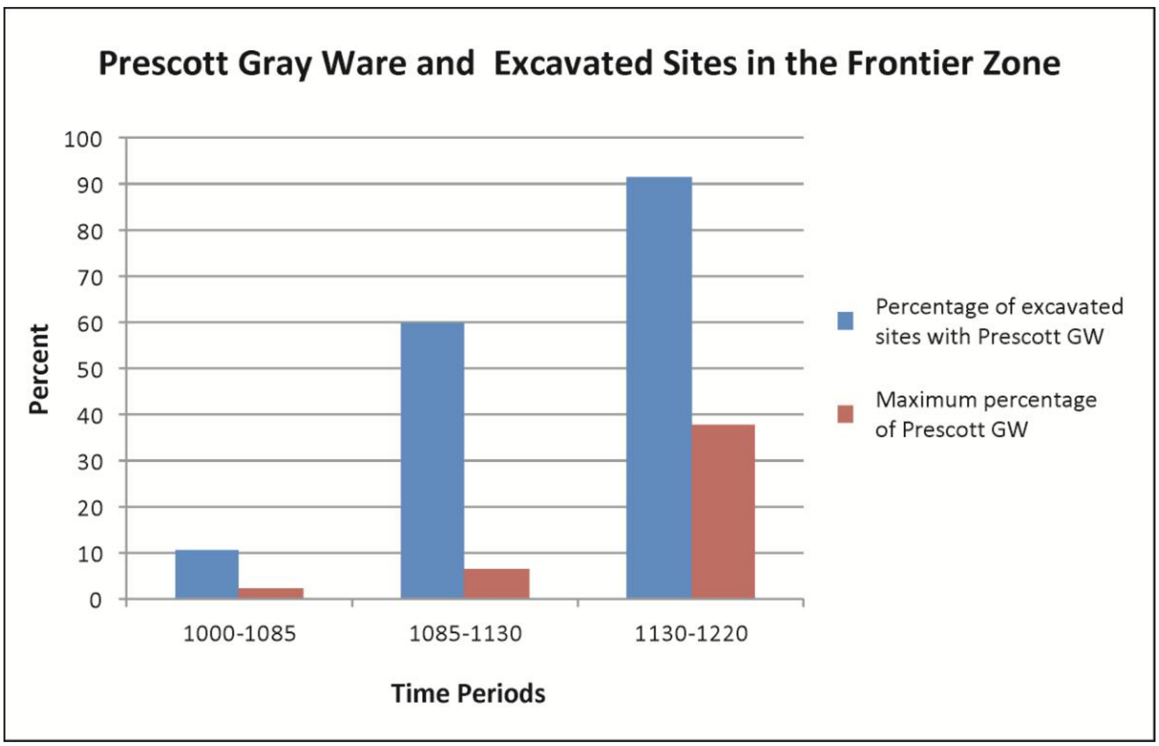


Figure 12-17. Percentage of excavated sites in the frontier zone with Prescott Gray Ware and maximum percentage of that ware in plainware assemblages by time period.

While Prescott Gray Ware is relatively common in the frontier zone, it is much rarer in the Sinagua heartland. In a sample of 676 sites recorded on survey south of the Coconino Divide that have either pottery presence/absence or counts recorded, only seven sites, 0.74% of the total, have Prescott Gray Ware present. In comparison, in the frontier zone 10.8% of the sites recorded on survey at Wupatki have Prescott Gray Ware present. Of 74 excavated sites in the Sinagua heartland, only five, 6.8% of the total, have Prescott Gray Ware present, and it is found in extremely low frequencies (Table 12-7). Again, Prescott Gray Ware is much more common in the frontier zone where 40% of excavated sites have Prescott Gray Ware present.

In both the frontier zone and the heartland, small amounts of Prescott Gray Ware are found associated with ballcourts and great kivas. In the heartland, Prescott Gray Ware is at both the east and west ballcourts at Ridge Ruin but is not found at any of the other ballcourts in the heartland. In the frontier zone, Prescott Gray Ware is present at Wupatki Road, Second Sink, and Juniper Terrace, as well as being present in the great kiva at Wupatki, at sites in the Wupatki Road great kiva community, and at NA 343 associated with the Magnetic Mesa great kiva (Colton 1946:69, 115; Morales 1994).

Table 12-7. Excavated sites in the Sinagua heartland with Prescott Gray Ware

Site	# of PGW sherds	Total # of Plainware Sherds	PGW as % of Total Plainware Assemblage
Two Kivas Pueblo	1	44,257	0.002
NA 8721	1	8,419	0.012
AZ I:10:30 (ASM)	6	6,754	0.089
Lizard Man Village	139	107,703	0.129
Elden Pueblo	present	-	-

These differences in the distribution of Prescott Gray Ware between the frontier zone and the heartland, as well as the differences in the amounts of Little Colorado White Ware, indicate that the populations in these two areas were engaged in very different networks of interregional exchange. While the frontier zone exhibits stronger connections with the Prescott region to the west, the heartland has stronger connections with the Hopi Buttes region to the east. As the Hopi Buttes region was abandoned in the early 1200s, Little Colorado White Ware fell out of production, but another ware from further to the east provides insights into changing patterns of interregional exchange.

White Mountain Red Ware

The diagnostic pottery types indicating sites with post-1220 occupation are Tusayan and Kayenta Black-on-white; but also found at late sites, albeit in small amounts, are White Mountain Red Ware types, particularly St. Johns Black-on-red and St. Johns Polychrome. Pots of the White Mountain Red Ware tradition were manufactured just above the Mogollon Rim along the upper reaches of the Little Colorado River and its drainages some 200 to 250 km southeast of the Flagstaff region. In addition to having decorated interiors, bowls often had painted designs on the exterior walls that have been suggested as being an important means of signaling during communal feasting events (Van Keuren 2004). The St. Johns types were both produced between 1175 and 1300, and were some of the most widely distributed decorated types in the prehistoric U.S. Southwest, found from the U.S Four Corners on the north to the International Four Corners on the south, and from the Verde Valley on the west to the Rio Grande Valley on the east (Carlson 1970). Other White Mountain Red Ware types found in the Flagstaff region include Puerco Black-on-red, Wingate Black-on-red, Springerville Polychrome, and Pinedale Polychrome.

Three other wares that are technologically and stylistically related to White Mountain Red Ware also occur infrequently in pottery assemblages in the Flagstaff region – Puerco Valley Red Ware, Kin Tiel-Klagetoh Orange Ware, and Zuni Glaze Ware. All three of these wares were initially considered different "Series" of White Mountain Red Ware in Colton and Hargrave's (1937) initial synthesis of Southwestern pottery wares and types, but have since come to be recognized as related but distinct traditions (Hays-Gilpin and van Hartesveldt 1998; Woodbury and Woodbury 1966). Puerco Valley Red Ware was made along the Puerco River north of the areas of White Mountain Red Ware production, and Kin-Tiel Klagetoh Orange Ware was made in the Wide Ruins and Ganado area north of the Puerco Valley. Zuni Glaze Ware was made in the Zuni region east of the areas of White Mountain Red Ware production.

Fifteen excavated sites have sherds of White Mountain Red Ware or related wares (Table 12-8), with Showlow Black-on-red being most frequent (12 sites) and the St. Johns types the next most frequent (6 sites). Two Kivas Pueblo has the largest and most diverse assemblage of White Mountain Red Ware and related types, with 94 sherds of 7 different types, making it amenable to analysis for changes in patterns of acquisition and use. I measured changes in the presence of White Mountain Red Ware across the three occupational periods of the site two ways: (1) as a percentage of all redwares and orangewares (primarily Tsegi Orange Ware but also including small amounts of San Juan

Table 12-8. Excavated sites with White Mountain Red Wares or other related wares present.

Excavated Sites with Sherds of WMRW or Other Related Wares	Time Period	White Mountain Red Ware Types						Types in Other Related Wares			Total # of Sherds of WMRW and Related Wares	WMRW as % of All Red and Orange Wares	WMRW as % of All Decorated Sherds
		Puerco B/r (1030-1150)	Wingate/Houck B/r or Poly (1100-1200)	St. Johns B/r or Poly (1175-1250)	Springerville Poly (1250-1300)	Pinedale B/r or Poly (1275-1325)	Indeterminate WMRR	Showlow B/r (1030-1200)	Kin Tiel-Klagetoh B/o or Poly (1250-1300)	Pinawa B/r (1200-1250)			
NA8721	1085-1130							1			1	3.7	0.3
NA8744								1			1	50.0	6.7
NA10803						1		1			2		
NA739	1130-1220							3			3	30.0	5.5
NA8527								7			7	46.7	2.3
Beale's Saddle (NA7350)			6	8							14	55.6	6.5
Deadman's Edge (NA420)							2				2	0.004	0.002
Juniper Terrace (NA1814)								2			2	0.3	0.1
Tse Tlani (NA8762)								3			3	30.0	1.1
Turkey Tanks Fort (NA113)								1			1	100.0	2.6
Elden Pueblo* (NA142)	1130-1275			X							-	-	-
Turkey Hill Pueblo* (NA 660)				X				X	X		-	-	-
Turkey Tanks Caves (NA117)				2				1			3	23.1	3.4
Two Kivas (NA700)		1		42	5	2		30	3	11	94	16.4	2.0
Wupatki Pueblo (NA405)				14				78			92	9.7	1.3
Total # of Sites	-	1	1	6	1	1	1	10	2	1	-	-	-

* - presence only, no counts

Red Ware, Winslow Orange Ware, and Jeddito Orange Ware), and (2) as a percentage of the whole decorated assemblage (Figure 12-18). According to both measures, the proportions of White Mountain Red Ware increased substantially from one period to the next indicating growing social and economic connections with populations in the Upper Little Colorado region. After 1220, the increasing amounts of White Mountain Red Ware accompany decreasing amounts of Little Colorado White Ware, which was falling out of production as the Hopi Buttes region was rapidly depopulated between 1200 and 1250. Following the 1214-1221 cool/dry period that affected the Flagstaff region, social and economic connections to the east in the Hopi Buttes region faded and new ones emerged with groups further away in the Upper Little Colorado region.

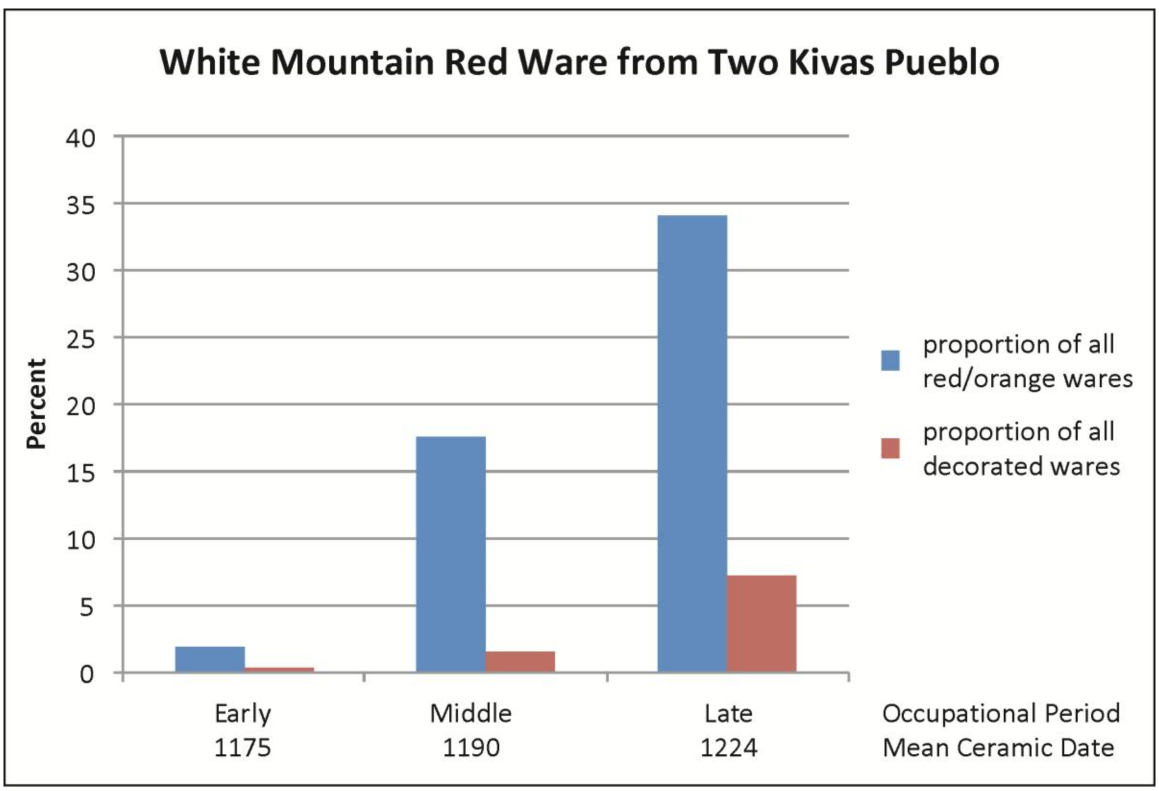


Figure 12-18. Percentages of White Mountain Red Ware from Two Kivas Pueblo.

In the mid- to late-1200s, large plaza-centered pueblo communities were established in the Upper Little Colorado region (Duff 2002), many apparently growing through in-migration from other regions, perhaps including some groups from the Hopi Buttes region. As these pueblos grew, a new social and religious system foundational to the Kachina religion of contemporary Puebloan groups like the Hopi and Zuni emerged to integrate these new socially diverse communities (Adams 1991). The social connections indicated by the presence of White Mountain Red Ware in ceramic assemblages might have provided migration pathways to the growing pueblo communities in the Upper Little Colorado region and near Chavez Pass as the Flagstaff region was abandoned after 1275.

RESULTS AND CONCLUSIONS : EXCHANGE FOR HARD SUBSTANCES AND NON-LOCALLY PRODUCE POTTERY

The varied lines of evidence about exchange for hard substances and non-locally produced pottery are complementary, revealing changes in exchange patterns following environmental disturbances, the changing dynamics of interregional relationships and cultural influences, differences in patterns of exchange between the heartland and frontier zone, and the important role that ballcourts and great kivas played in facilitating exchange. The activation of long-distance exchange relations was identified as a common alarm stage response to environmental disturbances, and changes in patterns of exchange for hard substances and non-local pottery follow disturbances as expected. The eruption of Sunset Crater and the subsequent extreme dry period was followed by a sudden increase in the amounts of hard substances and Little Colorado White Wares in the heartland, both of which had been rare to absent before the eruption. Following the 1130s megadrought, amounts of Little Colorado White Ware continued to increase and the was greater diversity of raw materials acquired and new styles, forms, and manufacturing techniques used.

Similarly, in the frontier zone, the eruption and the 1130s megadrought were followed by continuing increases in the amounts of both Little Colorado White Ware and Prescott Gray Ware. However, the amounts of Little Colorado White Ware in the frontier zone are less than in the heartland, and Prescott Gray Ware is largely absent in the heartland. These patterns indicate that the populations in the two areas were engaged in different, yet overlapping long-distance exchange networks. One area of overlap was hard substances, where similar patterns of increasing amounts and changing styles, forms, and manufacturing techniques are found in both areas. A myth about a female deity who controls hard substances suggests the emergence of enchained relations of exchange and intermarriage connecting populations in the Four Corners region with populations to the west south near sources of marine shell, turquoise, and argillite occurred after the eruption of Sunset Crater and that the Flagstaff region was a key node in exchange relations that provided Puebloan populations in the Kayenta and Chaco regions access to these resources. In both the heartland and frontier zone, more hard substances like marine shell, turquoise, and argillite are found at sites with communal ritual architecture, and ballcourts in both areas appear to have been the loci for the introduction of Little Colorado White Wares.

Increasing amounts of White Mountain Red Ware in the post-1220 period indicate the expansion of long-distance exchange relations with populations in the Upper Little Colorado region following the 1214-1221 cool/dry period. These relationships may have drawn populations from the Flagstaff region into the emerging Kachina religion and provided pathways for migration during the post-1275 abandonment of the region. After 1220, the amounts of White Mountain Red Ware increased while the amounts of Little Colorado White Ware decreased as the Hopi Buttes region where it was produced was abandoned. Similarly, in the frontier zone, the amounts of Prescott Gray Ware increased after the 1130s megadrought while the amounts of San Francisco Mountain Gray Ware decreased rapidly as its production area in the Cohonina region was abandoned as well. In both cases, the loss of more proximate exchange partners through abandonments related to environmental disturbances was supplemented and to some degree replaced by expansion of exchange with more distant partners.

CHAPTER 13 - WEAVING THE LINES OF EVIDENCE TOGETHER

In the introduction I used a weaving analogy to explain the structure of this research. The setting and perspectives used to develop the expectations were described as the warp, the fixed and unmoving foundational threads of a textile. The different lines of evidence then marshaled to test these expectations were described as the weft, the active threads that move through the warp and interact with each other to create the textile's design. In the preceding chapters, several different line of evidence have been presented to evaluate the expected relationships between environmental conditions and the pursuit of cooperative or competitive strategies, and here they all are woven together into a cohesive whole. In most cases the expectations were found to be either fully or partially supported, but in other key cases the expectations were found to be unmet. Varied historical or cultural contingencies came into play and had greater influence over choices made between cooperation and competition than environmental conditions in these latter cases.

In this conclusion, I first review the expectations developed in Chapter 7, discussing which were met, partially met, or unmet in the examination of the archaeological data. Synthesis and interpretation of the different data for each time period follows and explores in greater detail when and why expected cooperative or competitive social responses were or were not found. Contrasts found between the heartland and frontier zone allow the nature of the historical or cultural contingencies that led to unexpected cooperative or competitive responses to be examined further. This case study of the Flagstaff region is then used to evaluate the proposal that intergroup conflict and population levels are coupled in a dynamic feedback relationship (Turchin 2005; Turchin and Korotayev 2006) and compared to case studies from different regions in the U.S. Southwest (Kohler et al. 2009, 2014). Finally, I present some ruminations on what can be learned from this case study about how cooperative strategies may succeed or fail in the face of environmental challenges.

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Evaluating Expectations

The expectations developed in Chapter 7 for cooperative and competitive responses to environmental conditions (Table 13-1) were either fully or partially supported in most cases. For example, the increase in defensive site index values for the 1130-1160 period in both the heartland and frontier zone, an extremely high skeletal violence index value for that period, and evidence for great social distance between antagonists found in the treatment of victims conforms to the expectations for greater competition following the 1130s megadrought. At the same time, increased exchange for Little Colorado White Ware in the heartland and for both Little Colorado White Ware and Prescott Gray Ware in the frontier zone indicates the activation of cooperative alarm stage responses to the challenges of the megadrought.

But in other cases, the expectations were not met. The evidence indicates no increase in competition following the eruption of Sunset Crater contrary to the expectations. During the 1085-1130 period, there is no evidence of conflict and the values for the skeletal violence and defensive site indexes are at their lowest. Rather than stoking competition and conflict, the unparalleled physical destruction and social devastation

Table 13-1. Expectations for different temporal periods developed in Chapter 7 designated by color as met, partially met, and unmet.

Temporal Period	Expectations: Competition	Expectations: Cooperation
1000-1085	• evidence of conflict should be associated with the 1030-1041 extreme dry period • use of fortified retreats	• use of communal ritual architecture should be associated with the 1047-1084 favorable period • communal ritual architecture should be located in the frontier zone
1085-1130	• evidence of conflict should be associated with the 1085-1101 eruption and subsequent dry period • shift from use of fortified retreats to use of fortified habitations	• no use of communal ritual architecture during the 1085-1101 eruption and subsequent dry period • changing patterns of extra-regional exchange following the Sunset Crater eruption
1130-1160	• evidence of conflict should be associated with the 1131-1142 megadrought • increased use of fortified habitations • greater social scale indicated by line-of-sight networks of fortified habitations • increased social distance indicated by peri- and post-mortem mutilation • emergence of specialized social roles and institutions and development of specialized weapons technologies	• no use of communal ritual architecture during the 1131-1142 megadrought • changing patterns of extra-regional exchange following the 1131-1142 megadrought
1160-1220	• decreased use of defensive sites • reduced social distance indicated by restrictions on the exercise of violence	• establishment of new sites with communal ritual architecture in the frontier zone • maintenance of extra-regional exchange relations established following environmental disturbances
1220-1300	• increased use of defensive sites following the cool/dry period 1214-1221 • greater social scale indicated by line-of-sight networks of larger fortified habitations • increased social distance indicated by peri- and post-mortem mutilation	• changing patterns of extra-regional exchange following the cool/dry period 1214-1221

wrought by the eruption led to new levels of cooperation. The investment in new ballcourts and the creation of a renewed sense of community identity through the adoption of a revitalization movement in the heartland indicate this cooperation. Increased exchange for pottery and hard substances following the eruption indicate the activation of alarm stage responses that may have helped prevent the escalation to resistance stage responses like increased conflict.

Another case that does not conform to the expectations is the construction and use of new ballcourts in the frontier zone during the 1130s megadrought. The period when these frontier zone ballcourts were in use was characterized by high levels of conflict, unlike the peaceful conditions that accompanied the use of the earlier post-eruption ballcourts. This more discordant social setting later may have been because the frontier zone ballcourts brought socially distant groups together as expected, while gatherings held at the earlier heartland ballcourts were less socially diverse. The cultural homogeneity in the heartland versus the cultural heterogeneity in the frontier zone appear to be factors that contribute to when responses to changing environmental conditions follow expected or unexpected paths, and these factors will be explored further as the different lines of evidence from each time period are woven together.

SYNTHESIS AND INTERPRETATION OF THE DATA

The following synthesis and interpretation of the archaeological record of the Flagstaff region presents an analytical overview of the patterns created by the weft threads of the evidence moving through the warp threads of the setting, perspectives, and expectations, as well as by the interactions among the different lines of evidence. In the preceding chapters, these different lines of evidence have been presented separately, here they are integrated and stitched together organized by the time periods and associated changes in environmental conditions. All the spatial data are integrated in maps for each of these time periods that present together the distributions of sites with evidence of violence, sites with ballcourts or great kivas, and defensive sites. Each map also has several pie charts that show the relative proportions of the index plainwares of the region for selected sites to visually represent the differences in the social and economic networks within which the occupants of these different sites were engaged.

Before the Eruption (Figure 13-1)

Corn agriculturalists began to settle in the Flagstaff region in the mid-400s, bringing with them a tradition of paddle-and-anvil brownware pottery that developed into Alameda Brown Ware. In the 900s, migrants from the Cohonina region to the west began to settle in the Medicine Valley and Deadman's Flat areas in the frontier zone. These settlements have a distinctive grayware pottery, San Francisco Mountain Gray Ware, with paste and tempering materials that indicate manufacture to the west in the Cohonina region. The earliest evidence of intergroup conflict is from during this initial period of colonization of the frontier zone by populations from the west. An attack upon the Lennox Park site resulted in burned structures, one with an adult woman within, and the subsequent abandonment of the unburned structures. The plainware assemblage at the site is dominated by Alameda Brown Ware and the incident may have resulted from

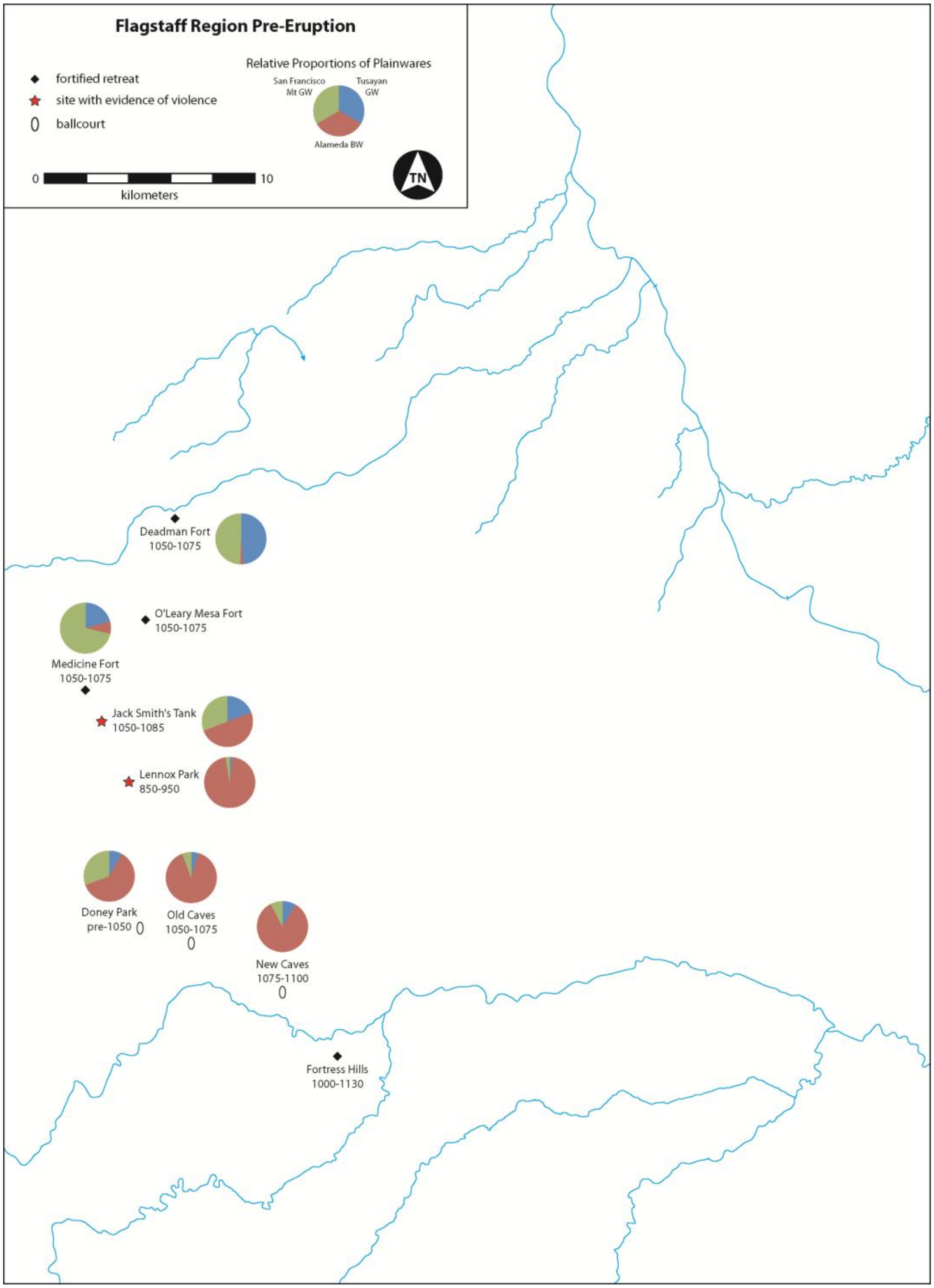


Figure 13-1. Distribution of defensive sites, sites with evidence of violence, and ballcourts before the eruption of Sunset Crater with proportions of index plainwares shown for selected sites.

interethnic tensions in the frontier zone between local populations and migrants and the contesting of the boundaries between these groups. These conflicts were probably similar to the small-scale hit-and-run raids of the River Yumans and Enga described in Chapter 5 that were used to define boundaries, contest the control of and access to resources, and create and reinforce group identities.

The construction and use of the earliest ballcourt at Doney Park in the early 1000s followed this period of tension between locals and migrants. It is located near the boundary between the heartland and frontier zone, partially meeting the stated expectation regarding the location of communal ritual architecture in the frontier zone. This ballcourt was contemporaneous with the larger Hohokam regional system of ballcourts, including four ballcourts to the west along the Mogollon Rim in the Cohonina region. The plainware assemblage associated with this ballcourt indicates participation by both local heartland populations and groups that had social and economic ties with the Cohonina region, indicating that the ballcourt mediated tensions between these groups in the frontier zone.

The two later pre-eruption ballcourts at Old Caves and New Caves were built and used during and after the collapse of the larger Hohokam regional system, and the plainware assemblages associated with these ballcourts indicate more limited participation by groups from outside the heartland. Rather than abandoning ballcourts with the collapse of the larger system, heartland populations adapted their use to meet local needs. Unlike the earlier Doney Park ballcourt, they were not used to integrate local heartland populations with neighboring ones, rather they mediated tensions within the local community and created a shared sense of identity.

Three defensive sites in the frontier zone were contemporaneous with the Old Caves and New Caves ballcourts and were built in locations that allowed travel corridors and areas settled by migrant populations in the Medicine Valley and Deadman's Flat area to be monitored (Figure 13-2). These defensive sites and the habitation sites around them have plainware assemblages that are predominantly San Francisco Mountain Gray Ware, in contrast with the contemporary ballcourts and habitation sites surrounding them, which have predominantly Alameda Brown Ware. The locations of the ballcourts and defensive sites correspond to boundaries in the distributions of these two wares defined using GIS; sites within these boundaries have a 90% likelihood of having ≥50% of the specified plainware (Garcia 2004). These boundaries in the distribution of material culture were likely associated with social boundaries between groups in the frontier zone as well.

As expected, these earliest defensive sites are all fortified refuges. However, while Medicine Fort appears to have begun as a fortified refuge it came to have storage facilities added later, perhaps indicating increased levels and changing contexts of conflict. Fortified refuges where surrounding dispersed populations could retreat when threatened mark one side of the boundary between groups indicated by the plainware distributions, and ballcourts where local populations gathered to mediate social tensions and create a shared identity marked the other side. There was interaction across this boundary, much of it peaceful exchange of pottery, obsidian, and likely other resources as well, but some of the interaction was violent.

Evidence of intergroup conflict at Jack Smith's Tank dates to when these ballcourts and defensive sites, which appear to have organized and integrated different groups in opposition to one another, were in use. The nature of the violence at Jack Smith Tank is

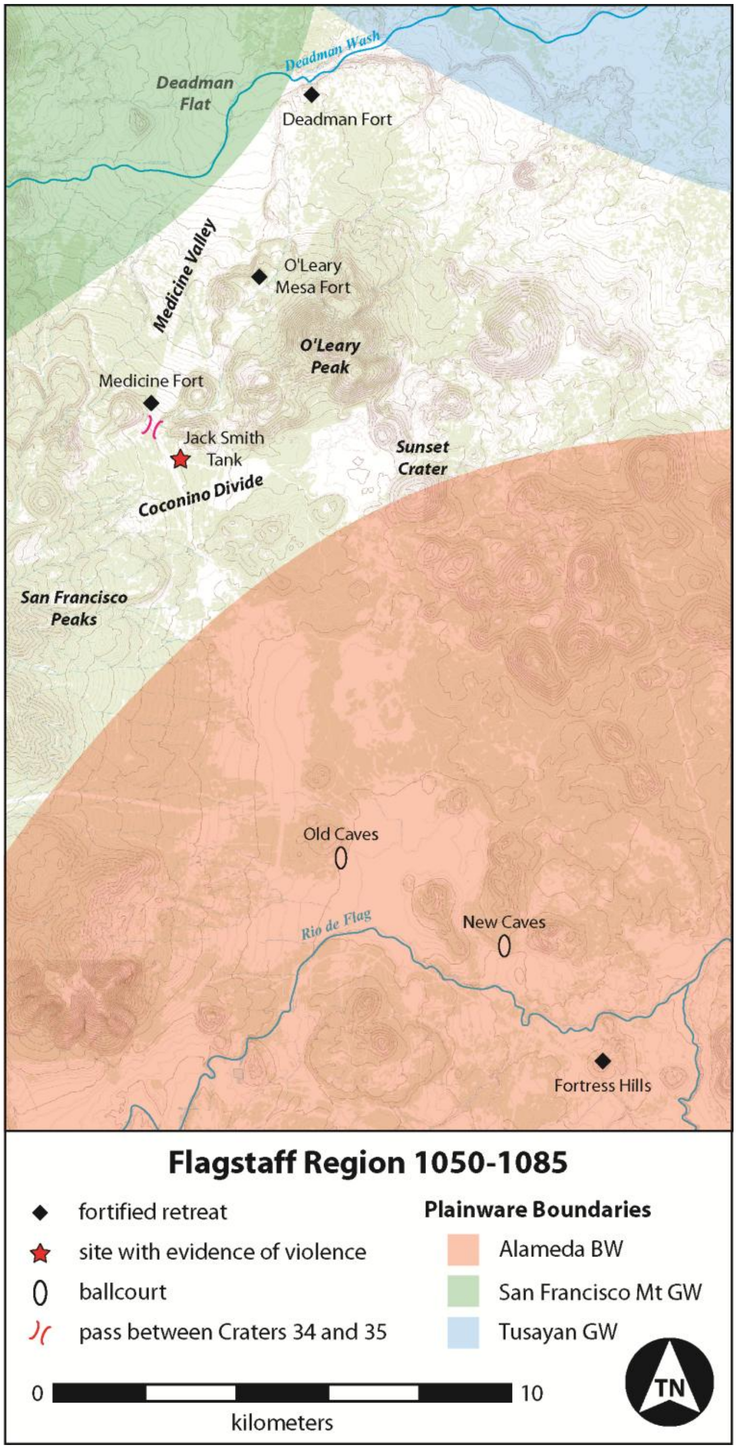


Figure 13-2. Detail of frontier zone showing relationships between plainware boundaries and the locations of defensive sites, sites with evidence of violence, and ballcourts between 1050 and 1085.

similar to what occurred at the earlier Lennox Park Site, with a hit-and-run raid resulting in burned structures, two with victims within them. The more diverse plainware assemblages found at Jack Smith Tank than at Lennox Park indicate the occupants of the later site had greater levels of interaction with migrant groups in the frontier zone than the occupants of the earlier site, but similar tactics were employed to define boundaries, contest the control of and access to resources, and create and reinforce group identities.

The two later pre-eruption ballcourts at Old Caves and New Caves, the defensive sites in the frontier zone, and the attack upon the Jack Smith Tank settlement all occurred during a lengthy period between 1047 and 1084 that was highly favorable for agricultural production. The construction and use of communal ritual architecture like ballcourts is expected during favorable periods, but ballcourts are expected to bring socially distant groups together. Evidence of intergroup conflict like burned bodies in structures and the use of defensive sites, however, is not expected during favorable environmental periods. The failure to meet the expectations regarding the use of ballcourts to integrate socially distant groups and the association of intergroup conflict with favorable period suggests that environmental conditions do not influence competitive and cooperative social processes independent of other historical contingencies, in this case the collapse of the larger regional system and the history of tensions between migrants in the frontier zone and heartland populations.

The Old Caves and New Caves ballcourts and the defensive sites in the frontier zone were built and used during the re-organization of inter-regional relations that followed the collapse of the Hohokam regional system. Populations on the peripheral frontier of the regional system did not passively accept the changes that the collapse of the system would bring. Old Caves and New Caves were built and used as the larger system collapsed, and the increasing insular nature of their plainware assemblages compared to the earlier Doney Park ballcourt suggests the use of ballcourts shifted towards meeting the needs of local populations in the heartland. The basics of ballcourt use learned from participation in the larger regional system - mediating social tensions, creating a shared sense of identity, and providing contexts for sharing and exchange - were reconfigured inwardly. The defensive sites in the frontier zone were established about the same time the social composition of ballcourt gatherings in the heartland changed, and the violence from Jack Smith Tanks provides further evidence of increasing tensions between heartland and frontier zone populations following the abandonment of the Doney Park ballcourt and the collapse of the larger Hohokam regional system.

Before the eruption, exchange was limited, with heartland populations having access to pottery and obsidian from the neighboring Cohonina region and other plain and decorated pottery from the Kayenta region to the northeast. Exchange with the Hohokam region was restricted to small amounts of red-on-buff pottery and finished *Glycymeris* shell bracelets. Some households in frontier zone settlements had exchange relations with the Prescott region to the southwest. Just before the eruption, evidence of new exchange relations with populations in the Hopi Buttes region to the east appeared with the presence of small amounts of Little Colorado White Ware in the assemblages associated with the Old Caves and New Caves ballcourts, presaging great changes to come. Another change that would have significant impacts in later times was the adoption and expansion of dry farming during the favorable decades that preceded the eruption. While adopting dry-farming methods expanded the amount of potential arable land available and allowed for increased agricultural production, it also increased vulnerabilities to dry periods.

After the Eruption, 1085-1130 (Figure 13-3)

Sunset Crater began to erupt in 1085 with volcanic activity over the next five years that covered approximately 900 square miles (2,330 km^2) with deposits of lava and ash. Populations in the heartland were concentrated in a post-eruption refugium south of the area affected by ashfall. Here refugees displaced by the eruption joined existing residents and created new communities. The eruption was then followed by an 11-year-long period of drought. While the prehistoric cultures of the region were generally aware of and experienced with the unpredictable interannual variability in rainfall and the high probability of extended periods of drought, the decades before the eruption were a sustained period with above average precipitation and direct experience with such hazards could have been lowered. Such specialized knowledge about low-frequency environmental processes can be maintained and transmitted in ritual settings, as described in Chapter 6. Further, such rituals often institutionalize buffering mechanisms based on sharing and storage in order to respond to known and expected hazards like spatial and temporal variability in precipitation. The embedding of these buffering mechanisms in ritual institutions formalized them and assured their continuity as established and not ad hoc responses (Halstead and O'Shea 1989).

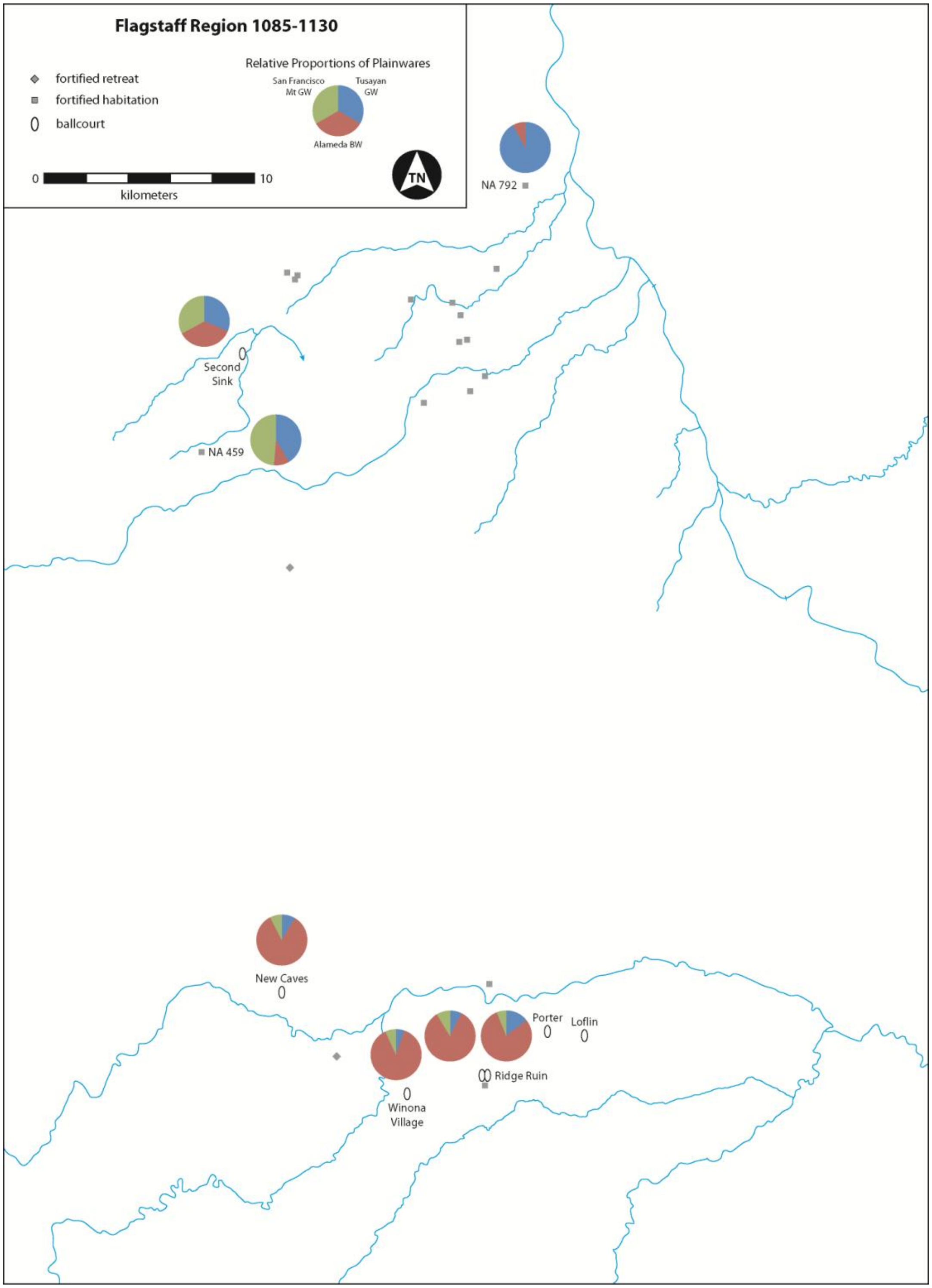


Figure 13-3. Distribution of defensive sites and ballcourts during the 1085-1130 period with proportions of index plainwares shown for selected sites.

The eruption of Sunset Crater, however, was a type of environmental disturbance with which local populations had no prior experience. The eruption differed from droughts with which local populations were familiar in several dimensions, particularly its magnitude, speed of onset, areal extent, and spatial dispersion. In terms of magnitude, the effects and impacts of the eruption were more severe and long-lasting than drought. While a period of drought may diminish productivity, affected areas have the potential to rebound with changing environmental conditions. In contrast, the eruption utterly destroyed many acres of previously arable land and left some areas uninhabitable. Droughts have a slow speed of onset, as recognition of a sustained long-term departure from average environmental conditions and productivity may take several seasons. The eruption of Sunset Crater likely happened rapidly and recognition of its devastating effects would have been immediate. The initial eruption of Paricutín Volcano in Mexico was witnessed by a Tarahumara couple working in a corn field, the cinder cone grew more than 15 m in the first week, raining ash down across a wide area (Luhr and Simkin 1993). While the eruption's effects were devastating, their areal extent was more restricted and their spatial dispersion more concentrated than the effects of a severe drought, which would be more widespread.

Local populations may have been more vulnerable to the effects of a drought following the devastation of the eruption that triggered forced relocations and possible loss of crops and stored resources by the displaced refugees. Despite these challenging conditions, there is no skeletal evidence of conflict during this time period and limited evidence for use of defensive sites, contrary to the expectation that environmental stress increases intergroup conflict. But most unexpected is that six new ballcourts were built immediately following the eruption, five in heartland and one in the frontier zone. The favorable years preceding the eruption likely allowed the accumulation of substantial stored resources that would have assisted local populations during this time of crisis. Further, the institutional means of integration, mediation, and sharing provided by ballcourt use also likely played a significant role in assisting affected populations adjust to the impacts of loss of productive lands and the resettlement of refugees.

The plainware assemblages associated with the new post-eruption ballcourts in the heartland indicate that participation by peoples from outside the local area was still limited. There was, however, an increase in the amounts of hard substances, particularly marine shell, at sites dating to this time period indicating long-distance exchange with peoples to the west and south. The post-eruption use of ballcourts in heartland was associated with a suite of Hohokam material culture and ritual practices that I suggest resulted from the development of a revitalization movement. Such intentional, organized efforts to re-establish a balanced existence and create a renewed sense of community identity emerge in cultures undergoing transformation resulting from increased stress (Linton 1943; Wallace 1956). Religious changes have been documented among traditional cultures displaced by volcanic eruptions like the Orokaiva in New Guinea and the Aeta in the Philippines (see Chapter 4). Among the Orokaiva in particular, the loss of sacred locations following the destructive eruption led to end of traditional birth and mortuary rites that had been associated with former landforms.

This proposed post-eruption revitalization movement may have combined a revival strategy seeking a return to the traditional values and practices of an idealized past with an importation strategy introducing new cultural values and mechanisms. The construction and use of new ballcourts, which hearken back to the peaceful and prosperous glory days of the Hohokam regional system as well as the environmentally stable period before the eruption, embody the traditional values and practices of an idealized past as part of a revival strategy. Association with this idealized past provided legitimacy to the movement's beliefs and practices. In addition to ballcourt use, other evidence of this revitalization movement includes the adoption of a cremation death ritual and the local production of shell ornaments and red-on-buff pottery. These newly introduced cultural values and mechanisms created a renewed sense of community identity as part of an importation strategy, and reinforced the idealized values and practices of the revival strategy. The red-on-buff pottery and shell ornaments signaled new local identities that were legitimized by their association with the idealized past. The distribution of these forms of signifying material culture indicates that their production and consumption was associated with ballcourt sites in the heartland (Murphy 2000, O'Hara 1998). The adoption of cremation marked a significant change in mortuary practice, but it was not adopted by all segments of the community and the practice of inhumation persisted. Significant intra- and inter-site differences in the relative proportions of cremations and inhumations and the number and types of funerary offerings associated with each mode suggest that mortuary rites were used to contest the social order and restructure social relations during this period with those cremated representing adherents of the revitalization movement.

The abandonment of ballcourt use, the practice of cremation, and the production of red-on-buff pottery, as well as the burning of the Hohokam-style pit house at Winona Village, indicate that shortly after 1100 this revitalization movement lost its sway over populations in the heartland. What led to the loss of faith in this revitalization movement among the region's adherents is uncertain, although historically and ethnographically known revitalization movements, like the Ghost Dance (Kehoe 1989; Mooney 1896) and many cargo cults (Worsley 1957), have been short-lived, abandoned when their practices failed to deliver the prophesized benefits. While ballcourts, cremation, and local production of red-on-buff pottery ended, changes in patterns of exchange persisted. Increased exchange for hard substances like marine shell from the west and south continued, although the stylistic influences and social uses would change in later periods.

Just before the eruption, evidence of incipient exchange relations with populations in the Hopi Buttes region to the east had appeared with small amounts of Little Colorado White Ware in the assemblages associated with the Old Caves and New Caves ballcourts. This relationship grew considerably following the eruption, suggesting that activation and expansion of these newly established exchange relations as an alarm stage response to the eruption and following period of drought led to the creation of stronger and more lasting bonds between populations in the heartland and the Hopi Buttes region. Little Colorado White Ware is absent in excavated contexts from habitation sites occupied before the eruption, it then becomes nearly ubiquitous in heartland contexts following the eruption.

The ballcourt at Second Sink in the frontier zone was contemporaneous with the post-eruption ballcourts in the heartland, but the plainware assemblage associated with it is unlike those found with the heartland ballcourts. While the heartland ballcourts have predominantly Alameda Brown Ware indicating little participation by groups outside the local area, the mixed assemblage at Second Sink indicates equal participation by peoples from all of the cultural groups that were moving into the frontier zone following the eruption. Second Sink is located near the intersection of the GIS-defined plainware distributions (Figure 13-4), and these material culture boundaries were likely associated with social boundaries between groups in the frontier zone as well.

The plainwares found in the whole pot floor assemblages from the Hohokam pit houses at Winona Village in the heartland and Three Courts Pueblo in the frontier zone are also very different; the assemblage from Winona Village is dominated by Alameda Brown Ware and also includes Mogollon Brown Ware, while that from Three Courts

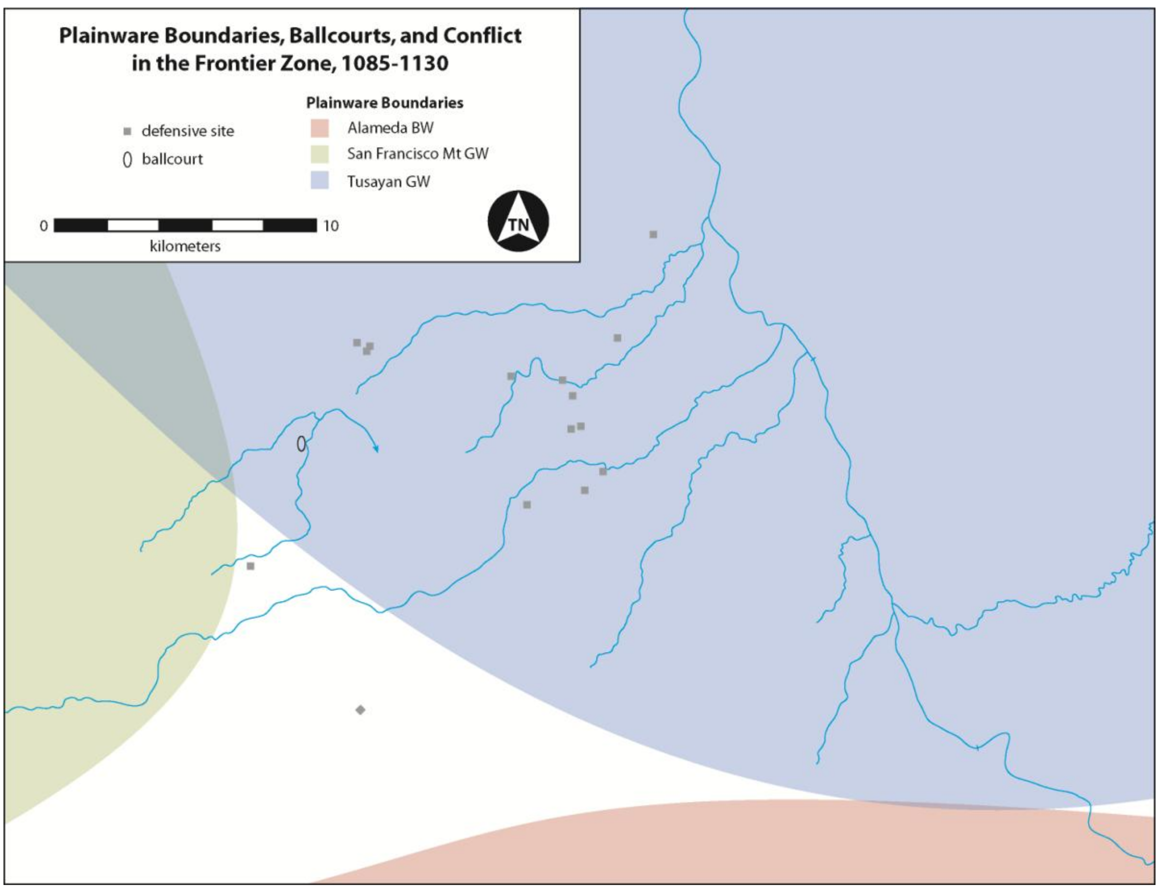


Figure 13-4. Detail of frontier zone showing relationships between plainware boundaries and the locations of defensive sites and ballcourts during the 1085-1130 period.

Pueblo is dominated by San Francisco Mountain Gray Ware. These assemblages indicate that despite shared ritual practices those who sponsored and directed ballcourt activities were embedded in very different social and exchange networks. Differences in the amounts of Little Colorado White Ware and Prescott Gray Wares in the frontier zone compared to the heartland also indicate that populations in these two different areas were engaged in different social and exchange networks. Like in the heartland, no Little Colorado White Ware was present in the frontier zone before the eruption. This ware first appears after the eruption, but in much lower frequencies than found in the heartland. In contrast, the occurrence of Prescott Gary Ware in the frontier zone increases after the eruption while this ware is almost absent in the heartland.

While a ballcourt and an associated site with a Hohokam-style pit house are present in the frontier zone, the suite of Hohokam material culture and ritual practice found in the heartland that I suggest were associated with the emergence of a revitalization movement is not found in the frontier zone. The only excavated cremation from the frontier zone dates to the following 1160-1220 time period (King 1949). While Three Courts Pueblo has a Hohokam-style pit house, only a single sherd of locally produced red-on-buff pottery was recovered and the site lacks the evidence for the manufacture of Hohokam-style shell ornaments that is present at Winona Village in the heartland, where unworked shell, debitage, finished ornaments, and specialized tools were found (McGregor 1941; Smith 1952a). The post-eruption ballcourts in the heartland and frontier zone were used in different ways by different groups of participants. I suggest that the use of the ballcourts in the heartland was associated with a revitalization movement that brought local populations impacted by the eruption together to create a renewed sense of community identity and the associated plainware assemblages indicate that outside participation in the gatherings was limited. In contrast, the use of the Second Sink ballcourt in the frontier zone brought peoples from different cultural traditions together to mediate relations among the culturally diverse migrants settling the frontier zone following the eruption. Like the heartland ballcourts, that at Second Sink was built soon after the eruption and fell out of use shortly after 1100. The temporal associations between the post-eruption ballcourts in the heartland and frontier zone suggest that while they were used in different ways by different groups of participants the use of these ballcourts was still linked.

Defensive sites from this period were not established immediately following the eruption, rather most appear to have been built around 1120 and after, and most are in the frontier zone. All of the defensive sites assigned to this time period were also occupied in following periods and most have more substantial evidence of later occupation, particularly during the 1160-1220 period when populations in the frontier zone peaked. Many of these defensive sites with evidence of occupation in the 1120s may have begun as fortified retreats for surrounding seasonally occupied farmsteads and field houses established by migrants that later grew to become fortified habitations settlement became more permanent.

Two of these early defensive sites are the great house components at Ridge Ruin and Wupatki Pueblo. Both sites were established around 1120 and initially built using Chaco-style masonry. Ridge Ruin was built on a lava outcrop overlooking the two ballcourts associated with the earlier pit house village. While both of these ballcourts had fallen out of use by the time the great house began construction, they still marked the location as a powerful place on the ceremonial landscape. Wupatki Pueblo and other defensive sites in the Wupatki Basin that were established at about the same time, like Antelope House and NA 792, are located in strategic positions along major drainages east of the Doney Cliffs that allowed the occupants to monitor important travel corridors. The plainware assemblages associated with these sites indicate that these settlers came from the Kayenta region across the Little Colorado River to the northeast. When establishing defensive sites along key travel corridors in the frontier zone these migrants seem to have anticipated conflict. To the west, on a mesa overlooking Ballcourt Wash and the head of the Citadel Wash drainage system, NA 459 was established in the 1120s with a plainware assemblage indicating strong connections with the Cohonina region to the west.

This apparent rise in tensions occurred not immediately following the eruption, but rather some 30 years later. Tensions within and between Tarascan villages did not escalate to violence until 10 to 20 years after the eruption of Paricutín and accompanied the movement of settlers back into the affected area as post-eruption ecological succession allowed farming and grazing to resume. When mediation between communities in the courts failed, competition for access to arable and grazable lands escalated into conflicts where farmers were beaten or killed and their crops destroyed, livestock killed, and buildings burned. Not only does the evidence of rising tensions during the end of the 1085-1130 period lag the eruptive event and subsequent drought, it also follows the end of ballcourt use at Second Sink and the loss of the potential for mediation that communal ritual may provide. These pre-existing tensions in the frontier zone would erupt into violent conflict during the following period.

The Megadrought and Its Aftermath, 1130-1160 (Figure 13-5)

The 1130-1160 period began with the 1131-1142 megadrought and the impacts of this event, particularly the deterioration of social relations, likely continued to be felt even after its end and a return to more normal environmental conditions. The Cohonina region to the west was abandoned during this time of environmental stress, with some portions of the region's population following earlier migrants into the frontier zone (Weintraub et al. 2006). There is evidence of both competition and cooperation in the frontier zone during and after the megadrought, with defensive sites and incidences of violence as well as three new ballcourts. The defensive site and skeletal violence indexes both increase dramatically from the previous period and have their highest values during the 1130-1160 period. Ballcourts and sites with evidence of violence are found in a boundary area defined by the distribution of plainware pottery (Figure 13-6), and there was likely competition and conflict among migrants from different cultural backgrounds.

The types of defensive sites and nature of the violence indicate changes in the tactics and goals pursued in intergroup conflict. Defensive sites are almost exclusively fortified habitations, showing a greater perceived need to secure persons from death or capture and property against destruction. The victims of violence during this period include women and subadults who were subject to peri- and post-mortem abuse. At Deadman's Flat and the House of Tragedy whole family units appear to have been killed and either burned or mutilated. Examples of peri- and post-mortem mutilation reviewed in Chapter 5 indicate that such treatment signals social distance between the antagonists in the conflict. The appearance of such treatment during the escalation of conflict that accompanied and followed the megadrought appears to mark a major rupture in regional social relations.

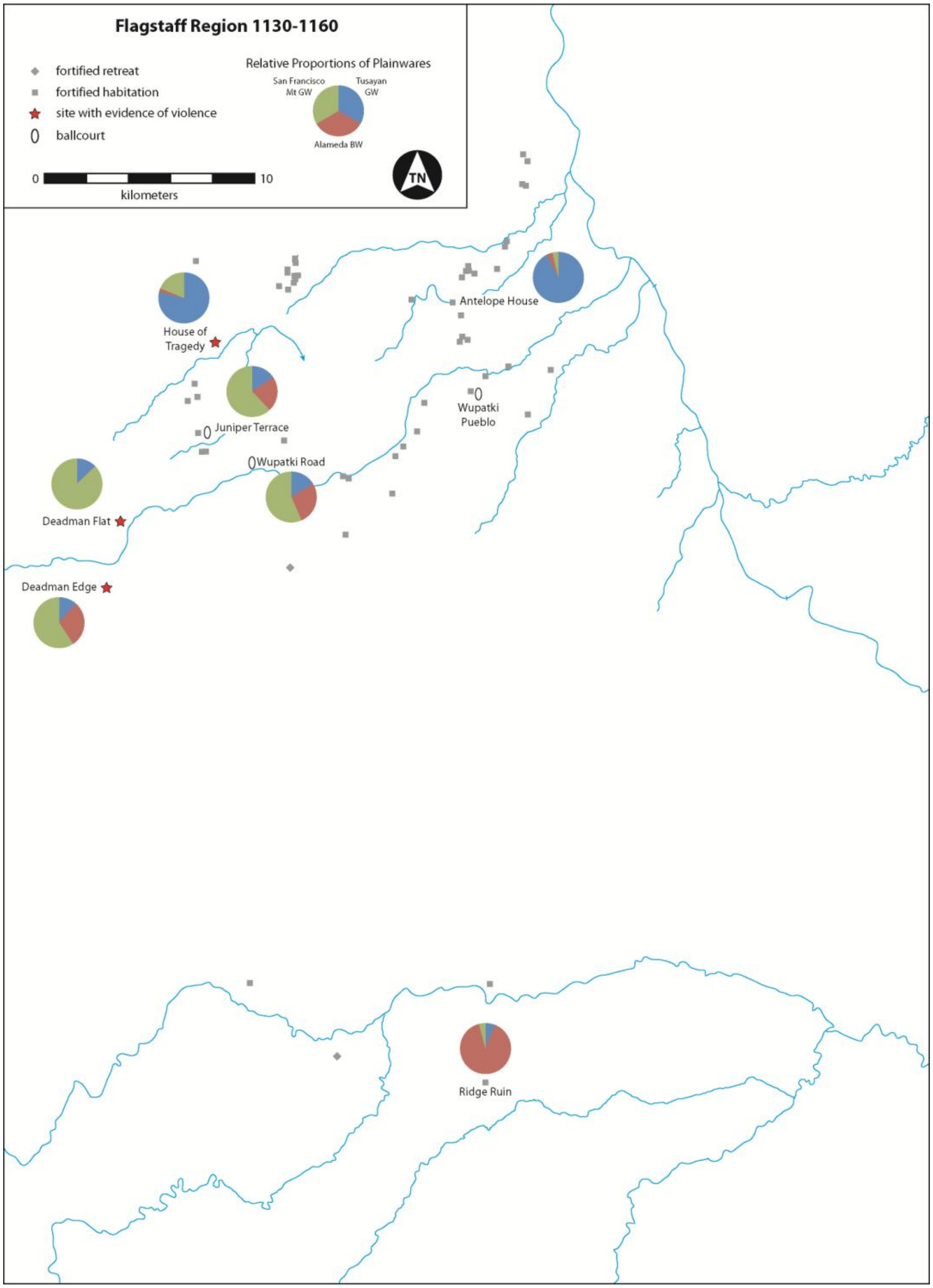


Figure 13-5. Distribution of defensive sites, sites with evidence of violence, and ballcourts during the 1130-1160 period with proportions of index plainwares shown for selected sites.

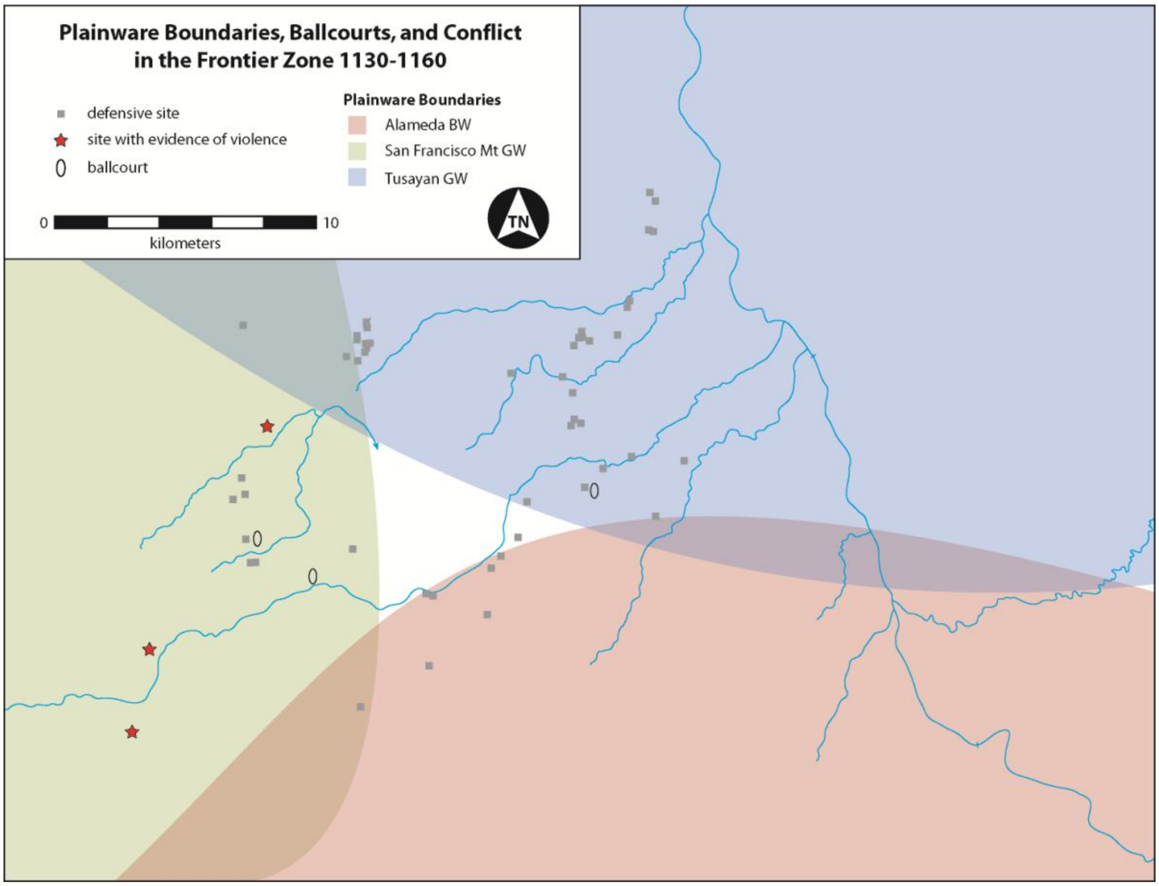


Figure 13-6. Detail of frontier zone showing relationships between plainware boundaries and the locations of defensive sites, sites with evidence of violence, and ballcourts during the 1130-1160 period.

Hopi myths related to the demise of Sikyatki discussed in Chapter 5 indicate that while resource competition may initiate tensions between communities, the escalation to violence is given moral authority by associating its need with a failure by one side to fulfill important social obligations or adhere to acceptable social norms. Such breakdowns in social relations may result from failure to fulfill promised marriage exchanges or ritual obligations, ill treatment of kin or affines, or, perhaps most seriously, the practice of witchcraft. Social failings of these types lead to loss of balance, the peaceful state of suyanisqatsi degenerates into the chaotic state of koyaanisqatsi, and violence between groups emerges.

Among the Hopi and other indigenous groups of the U.S. Southwest, witches were believed to cause illness or death and even had the ability draw rain to only their own fields and repel it from the fields of others. Witchcraft was the most antisocial act possible, and those who practiced it were outside the realm of human society. Therefore, witches were legitimate targets of violence towards whom violent acts were not only sanctioned but were to some degree obligated. Review of historic cases of Zuni witchcraft (Smith and Roberts 1954) reveal that torture was often used to extract confessions from accused witches before their execution, and that whole families could be targeted. Darling (1998) has suggested that the violent treatment of some prehistoric remains in the U.S. Southwest, including dismemberment and burning, resulted from ritual practices used following the execution of witches that were intended to utterly destroy their nefarious powers.

The severe treatment of the victims at Deadman's Edge, Deadman's Flat, and the House of Tragedy suggests the possible torture and execution of witches. At Deadman's Edge, an adult man was splayed face down, possibly partially bound, on the floor of a kiva and then deliberately buried in a pile of black volcanic ash; five women and subadults were bound, tortured, and one possibly sexually assaulted before being burned inside their home at Deadman's Flat; and on the floor of the kiva at the aptly named House of Tragedy was the body of a woman who was possibly sexually assaulted surrounded by the disarticulated remains of a man, perhaps her husband. Rape, murder, and witchcraft are antisocial behaviors characteristic of the chaos of koyaanisqatsi, and such social disorder appears to have characterized the 1130-1160 period in the frontier zone.

Associated ceramic assemblages and tree-ring dates indicate that Deadman's Flat and Deadmans's Edge were contemporaneous and were attacked in the early to mid 1130s during the megadrought. The attack on the House of Tragedy was later, after the megadrought had ended, but while its impacts on social relations were still felt. This undefended unit pueblo had been established after 1130 and then abandoned for a period of time before being later re-occupied and having the kiva renovated and rebuilt. This re-occupation was then violently contested when the site was catastrophically attacked sometime between 1150 and 1160. While the plainware assemblages at Deadman's Flat and Deadmans's Edge were predominantly San Francisco Mountain Gray Ware (87% and 61% respectively), that at House of Tragedy was predominantly Tusayan Gray Ware (79%). The sites are all located near the plainware boundaries (Figure 13-6) and the differences in the assemblages suggest the possibility of tit-for-tat revenge attacks across a social boundary. In a review of witchcraft from Africa, New Guinea, and Medieval Europe, Stewart and Strathern (2004) suggest that outsiders on the margins of a community are frequently targeted by witchcraft accusations. In a frontier setting, the socially distant neighbors on just the other side of the boundary are outsiders on the margins of the community.

The expectations anticipated increased levels of conflict in the frontier zone during and after the megadrought, but not the construction and use of new ballcourts during this same period. Like the incidences of violence, the ballcourts at Juniper Terrace and Wupatki Road are located near the plainware boundaries, in fact just on either side of the

San Francisco Mountain Gray Ware and Tusayan Gray Ware boundaries (Figure 13-6). The plainware assemblages associated with these ballcourts indicate that they hosted less socially diverse gatherings than the earlier ballcourt at Second Sink had, but socially distant groups were still brought together to mediate tensions, create a shared sense of identity, and facilitate sharing and exchange. The high levels of violence and use of defensive sites indicate that these efforts at mediation were not always successful. As Herr (2001) suggested regarding great kivas in a different frontier setting, communal ritual architecture may be used by established communities to attract and integrate migrants. These late post-eruption ballcourts in the frontier zone may also have attracted migrants coming from the Cohonina region to the west as it was abandoned during the megadrought. Use of ballcourts then integrated these migrants into communities that had been established by earlier settlers who had arrived from the same cultural homeland during the initial post-eruption period of migration into the frontier zone.

The situation in the heartland is quite different. All of the sites with evidence of violence that contribute to the extraordinarily high skeletal violence index value for this period are located in the frontier zone and there is no skeletal evidence of violence from sites in the heartland. The defensive site index for the heartland does increase, but it is much lower than that for the frontier zone. Levels of competition and conflict in the heartland appear to have been much lower than those in the frontier zone. Ballcourt use was not revived in the heartland during the megadrought as it was in the frontier zone, perhaps because of the lower levels of competition and the greater levels of cultural homogeneity present.

Changing patterns of exchange for Little Colorado White Ware and Prescott Gray Ware following the megadrought and continuing into the next period suggest activation of the alarm stage response of intensified interaction and exchange, just like before following the eruption of Sunset Crater. As expected and discussed in Chapter 7, these changes in exchange were cumulative, building upon and strengthening the bonds initially created during a previous period of environmental stress. Like the changes that followed the eruption, the changes in patterns of exchange for Little Colorado White Ware and Prescott Gray Ware were different in the heartland and frontier zone, indicating the two areas were engaged in different yet overlapping social and economic networks.

A Period of Stability and Growth, 1160-1220 (Figure 13-7)

Environmental conditions improved during this period, and while there were not any sustained periods of high productivity there were also no sustained periods with low precipitation and diminished productivity. As expected given these improved environmental conditions, the values for the skeletal violence index and defensive site index for the frontier zone decrease. The value of the defensive site index for the heartland, however, increases from the preceding period and more skeletal evidence of violence is found at sites in the heartland. Also from the heartland is the burial of the Magician and the evidence it presents of the emergence of specialized complementary sodalities central of which was one associated with male initiation and warfare. Swallowing sticks used in these male initiation and warfare rites have been recovered from sites in both the heartland and frontier zone, indicating that this sodality was adopted throughout the region. Some fortified habitations from this time period in both

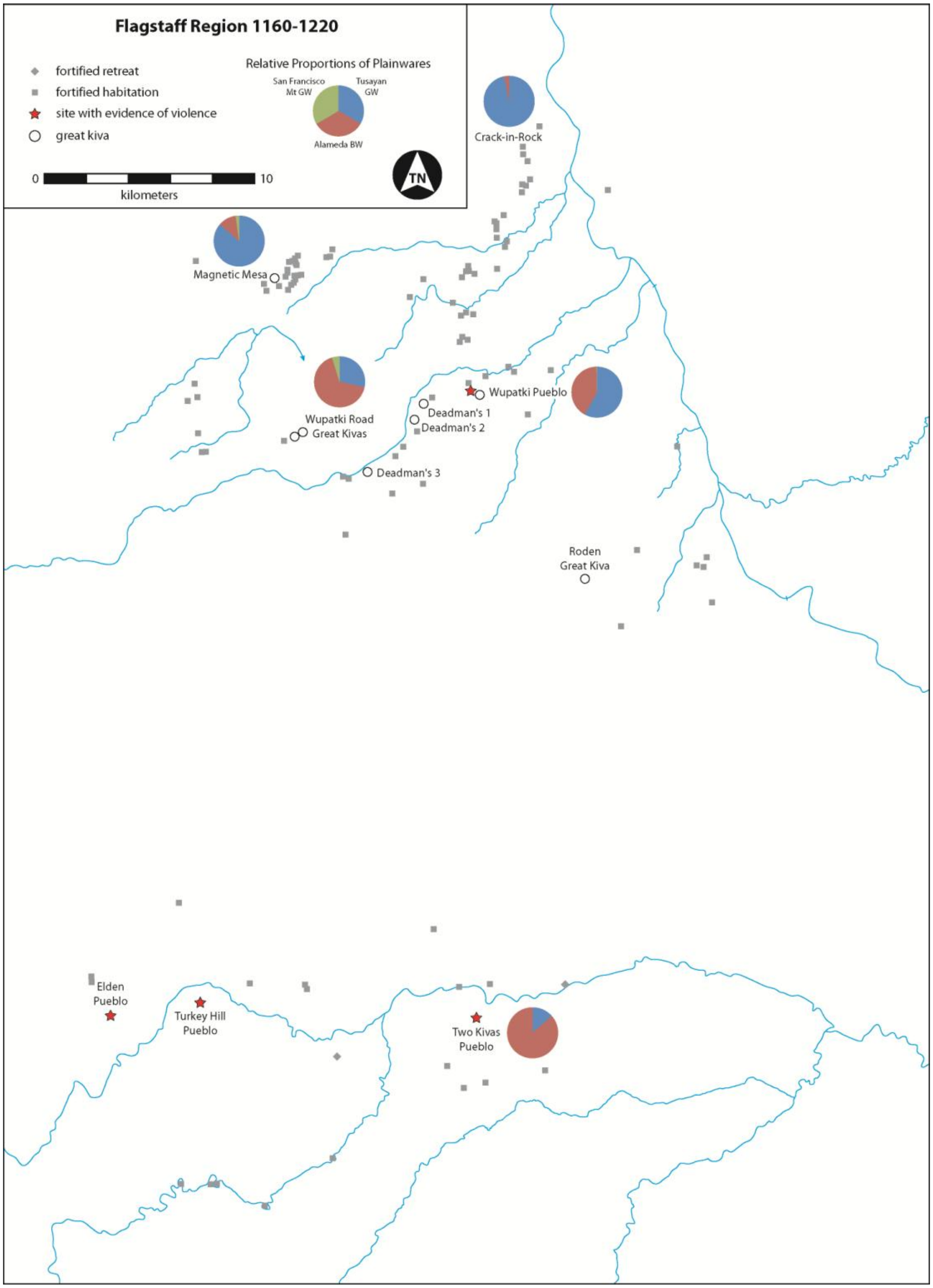


Figure 13-7. Distribution of defensive sites, sites with evidence of violence, and great kivas during the 1160-1220 period with proportions of index plainwares shown for selected sites.

the heartland and frontier zone have associated petroglyphs of known Hopi clan and sodality symbols, and most fortified habitations are in well-connected networks of intervisible sites. These different lines of evidence indicate that emergent localized kin groups had begun to organize for mutual defense as Stone and Downum (1999) suggest happened in order to gain and defend access to the extensive land holdings needed to practice agriculture in the region.

While levels of conflict are generally lower than during the preceding period, there is an increased formalization and institutionalization of the political organization of intergroup conflict during this period. These changes suggest a shift from the raiding and feuding of earlier periods to what may more properly be considered as war: conflict between larger social units where decisions to escalate conflict are motivated by political considerations and made collectively through political processes. While the levels of violence decreased compared to the horrific acts that followed the megadrought, the social scale of conflict increased. This increase in the social scale of conflict was accompanied by limitations on violence that formalized and institutionalized its use. During the 1160-1220 period and the following 1220-1275 period a vast majority of the victims of violence are adult males, most of whom were killed by blows to the head, scalped, and then formally buried. This contrasts to the more unlimited exercise of violence during the preceding period when women and subadults constituted the majority of victims and torture, sexual assault, and high levels of mutilation were practiced. Still, scalping is a form of post-mortem mutilation of a vanquished enemy's body that signals social distance, and conflict continued to be between socially distant groups. However, as a trophy-taking behavior, scalping is also associated with demonstrating achievement in the arena of conflict and related to the formalization and institutionalization of warrior roles and statuses.

This pattern of increasing social scale of conflict accompanied by its formalization and institutionalization with limitations on the exercise of violence that still allowed the accumulation of war honors and status parallels some of the developments of the Great Ceremonial Wars of the Enga described in Chapter 5. In both cases, institutional means were developed to control and limit the destructive nature of conflict while still encouraging the beneficial aspects created through alliance formation and status achievement. Lethal violence was much more restricted in the Enga case and episodes of conflict were elaborately staged and choreographed. After 1160 in the Flagstaff region, limitations on the exercise of violence defined only adult men as legitimate targets. These men were killed in formal face-to-face combat as indicated by blows to the left side of the head by a presumably right-handed attacker. After death the victors scalped the vanquished to both signal social distance and gain a trophy that embodied their triumph. Not all killing was done at close quarters, as the high-side-notched projectile point style that developed after 1150 was intended to increase the lethality of bow-and-arrow weapons technology.

During this period of more ameliorative environmental conditions a new form of communal ritual architecture, the unroofed great kiva, was introduced in the frontier zone. Like the earlier ballcourts in the frontier zone, these great kivas are located near the plainware boundaries (Figure 13-8). These post-1160 boundaries reflect the end of manufacture and use of San Francisco Mountain Gray Ware as its production zone in the heartland of the Cohonina region was abandoned following the megadrought. The people

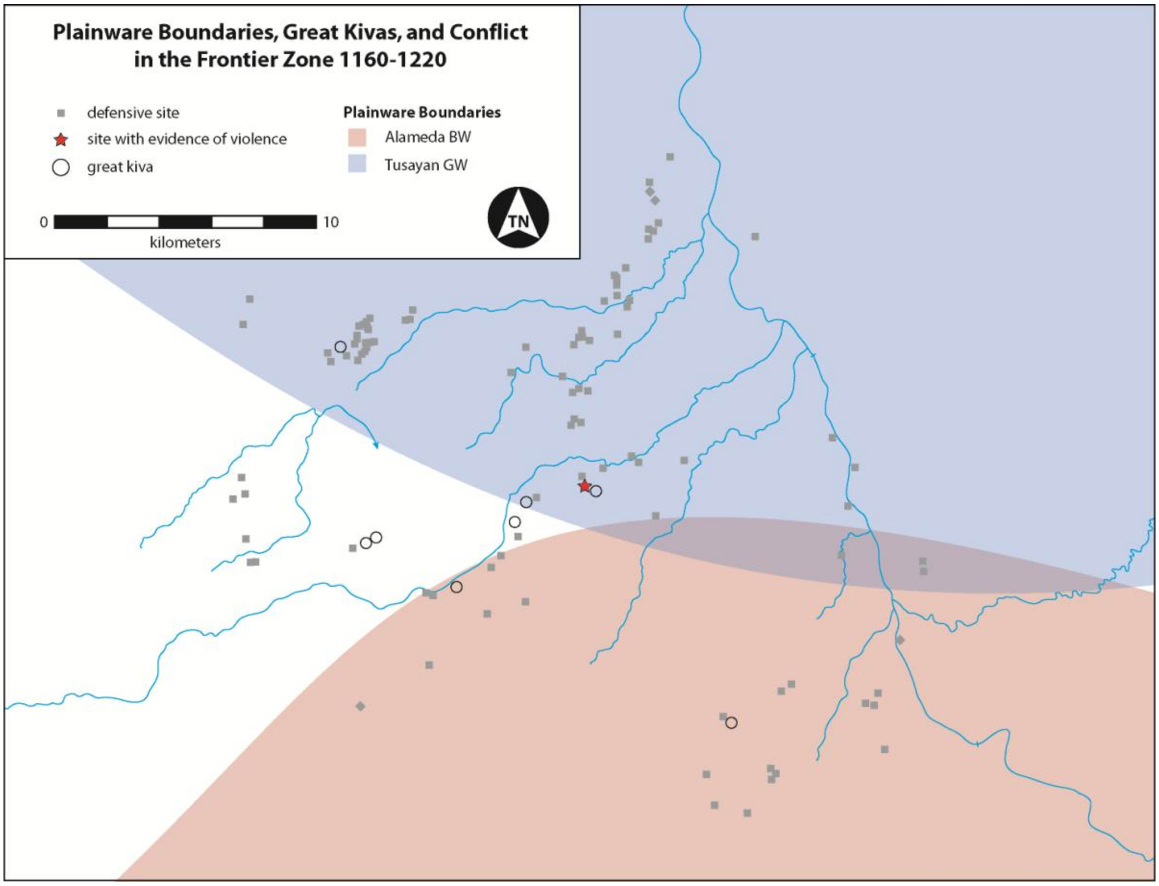


Figure 13-8. Detail of frontier zone showing relationships between plainware boundaries and the locations of defensive sites, sites with evidence of violence, and great kivas during the 1160-1220 period.

who formerly made and used this ware did not disappear, they and their descendents developed new social and economic relationships in the frontier zone that were accompanied by changes in social identities. Chapter 4 recounted multigenerational shifts in claims of social identity among the Gabbra and Rendille of East Africa that were made in response to localized adverse environmental conditions and facilitated by kinship, ritual, and stock partnerships. Like the ballcourts of the preceding period, the great kivas continued to attract and integrate shifting populations in the frontier zone creating a new shared sense of social identity. The plainware assemblages associated with great kiva communities have lower diversity than the earlier ballcourts indicating use by socially close groups. Differences between the plainware assemblages from different great kiva communities, however, indicate that the use of great kivas crosscut social boundaries in the frontier zone.

As discussed for the previous period, exchange for non-locally produced pottery increased cumulatively following the megadrought and continuing into the 1160-1220 period. The burial of the Magician and other contexts from the 1160-1220 period indicate that exchange for hard substances continued to be important not just as a means of maintaining long-distance relationships to acquire these materials, but also for their local use signaling social roles and identities that were linked to these external relations. The styles and technique used in the creation of ornaments from hard substances during the 1160-1220 period, with fine mosaic work, jet buttons, and *Conus* shell tinklers, reflect the lasting influence of the brief interlude of Chaco great houses in the region. Like the earlier suite of Hohokam material culture and ritual practices, these ornaments appear to be part of a suite of Chaco-derived material culture and ritual practices that also included painted baskets and swallowing sticks, and the entirety of this suite of materials and associated practices are found together with the burial of the Magician. This same suite of materials (minus swallowing sticks) have been found in contemporaneous contexts in the Kayenta region, all part of a westward diaspora of Chaco ritual knowledge and associated material culture during the post 1130 re-organization of the regional system.

The new social roles and identities linked to these objects and their associated ritual practices played a key role in the transformation of communities in the Flagstaff region during the 1160-1220 period and led to increased scale of sociopolitical organization in the region. By analogy to ethnographically known Puebloan cultures, the burial of the Magician reveals the existence of multiple complementary sodalities concerned with weather control, curing, combating witchcraft, warfare, and male initiation. I have proposed that the arrangement of offerings in the burial represents a sociogram defining the ritual and political constitution of the community (O'Hara 2008). The central placement of the swallowing sticks in this sociogram indicates the important role that conflict played in creating local identities both on the individual level of male initiates into a warrior sodality and on the community level as a shared sense of a group that faced outside challengers together. While the expectations suggest that increased social scale of conflict leads to greater specialization of social roles and institutions to organize and direct offensive and defensive actions, I suggested in Chapter 5 that such institutions also serve to exert internal social control as the social scale of the community increases. The increased limitations on and the formalized exercise of violence after 1160 indicate that the emergence of warrior sodalities was associated with internal social controls that strictly defined legitimate targets for violence and directed hostilities outside the local community.

Decline and Abandonment, 1220-1275 (Figure 13-9)

Population reconstructions for both the heartland and frontier zone indicate a sharp drop in population from the height of the preceding period (Figure 13-10). The decline in regional population follows the 1214-1221 cool/dry period, suggesting that the impacts of

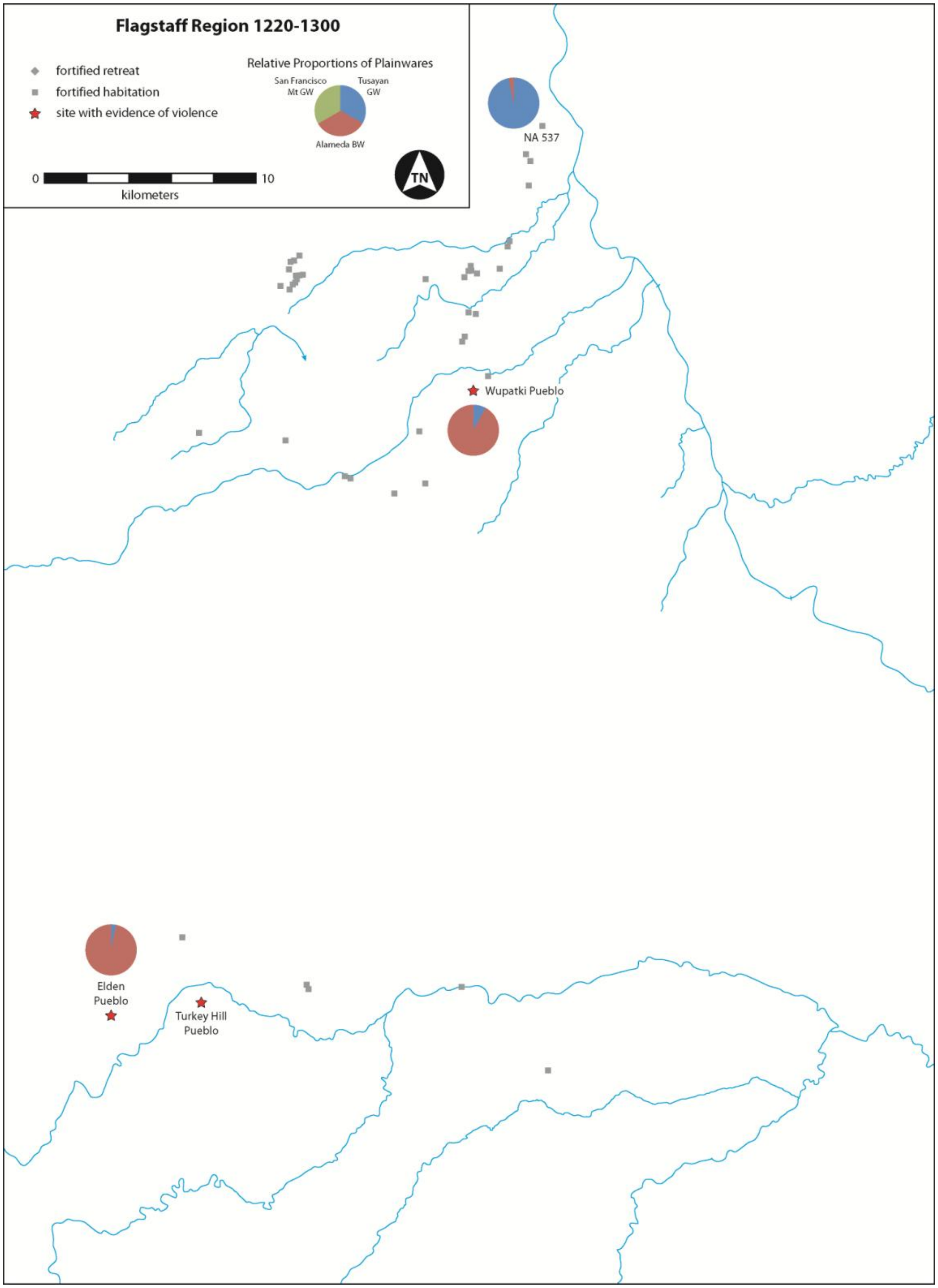


Figure 13-9. Distribution of defensive sites and sites with evidence of violence during the 1220-1300 period with proportions of index plainwares shown for selected sites.

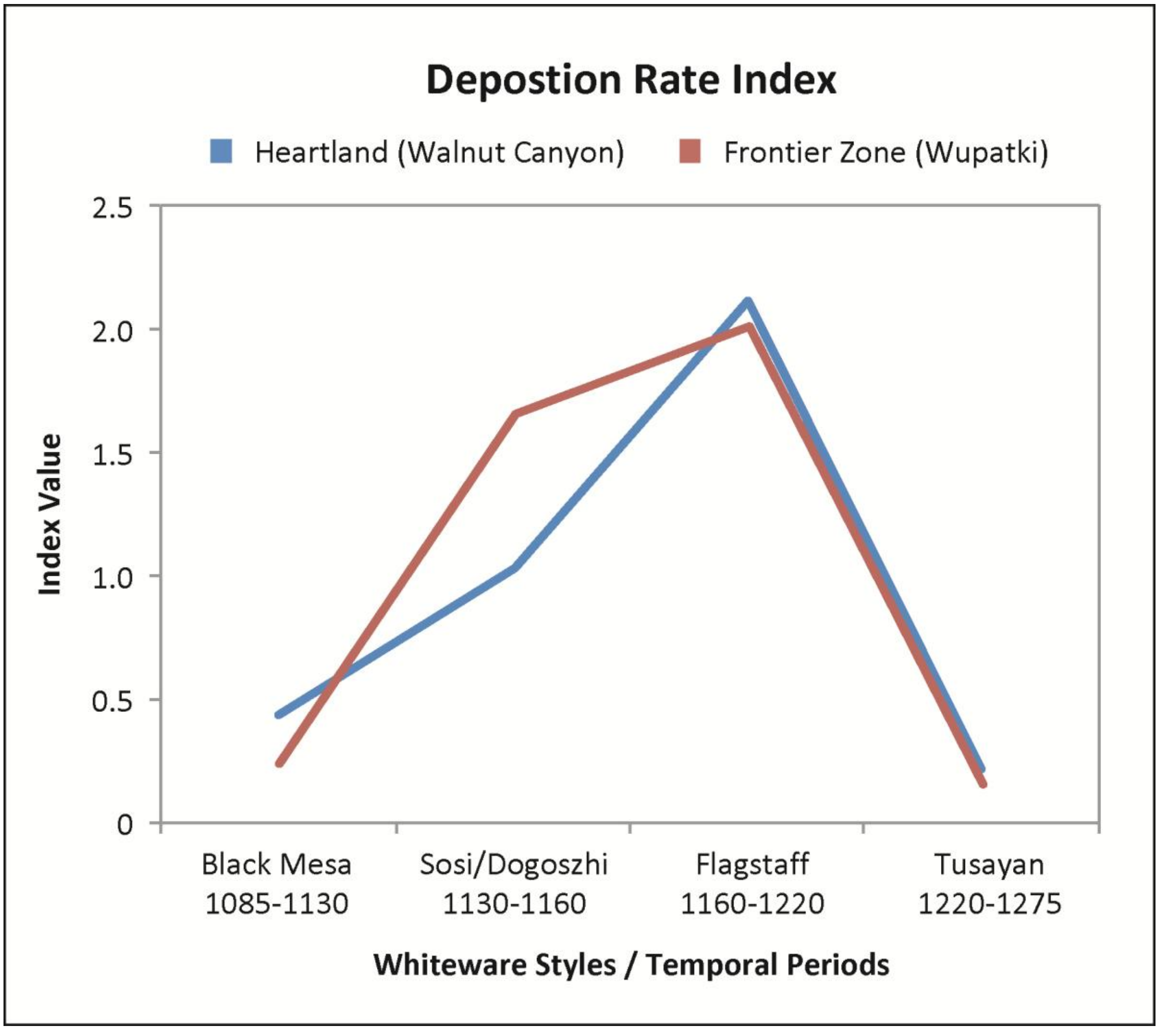


Figure 13-10. Whiteware deposition rate index values for Walnut Canyon and Wupatki National Monuments as a proxy for population trends in the heartland and frontier zone (see Appendix B).

this environmental disturbance had lasting effects. The defensive site index values for both the heartland and frontier zone increase following this environmental disturbance. While most post-1160 incidences of violence cannot be differentiated between the 1160-1220 and 1220-1275 periods, one that can is the beaten and abused woman from Wupatki Pueblo whose treatment in life and death matches the criteria used in another region of the U.S. Southwest to identify female captives taken from socially distant groups (Martin

1997, 2008; Martin and Akins 2001; Martin et al. 2008, 2010). As discussed in Chapter 9, many Native American groups took females and children as captives to co-opt their productive and reproductive potential. In the Navajo myth of the migration of Western Waters clans recounted in Chapter 12, after entering the Flagstaff region the migrants came into conflict with a group of people who lived locally and two children taken captive during these hostilities founded a new clan among the migrants. As environmental conditions declined and populations shrank, the limitations on violence enacted during the previous period may have been relaxed in response to the need to bolster group size and productive potential, perhaps by any means necessary including abduction and captivity.

Great kivas had fallen out of use before the beginning of this period and no new great kivas or ballcourts were built. Changing patterns of exchange indicate that local populations both built on existing relationships and sought to create new ones following the 1214-1221 cool/dry period. In the frontier zone, the frequency of sites with Prescott Gray Ware and the amounts present increased again, indicating the continued importance of long distance relations as an alarm stage response to environmental stress. While the amount of Little Colorado White ware had cumulatively increased following two previous environmental disturbances, its presence in local pottery assemblages dropped precipitously after 1220 as the source region for this ware underwent a dramatic decrease in population that led to the abandonment of the Hopi Buttes region by 1250. With abandonment of the production zone, Little Colorado White Ware fell out of production and became unavailable. Data from Two Kivas Pueblo indicates that as the availability of Little Colorado White from the Hopi Buttes region decreased, increasing amounts of

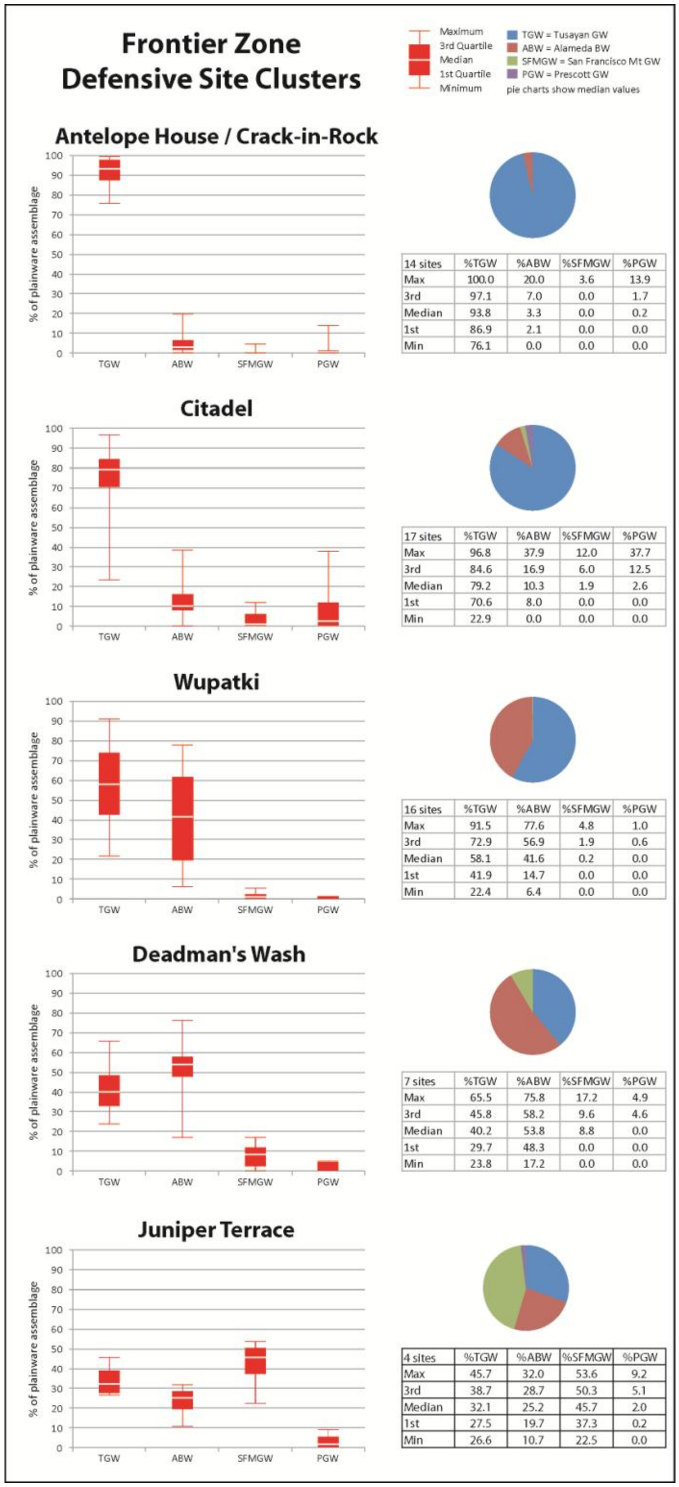
White Mountain Red Ware were acquired from producers in the adjacent but more distant Upper Little Colorado region. This extension of long-distance exchange created new relationships and also possible pathways for migration when the Flagstaff region was abandoned after 1275.

The increased use of defensive sites in both the heartland and frontier zone indicate that the decline in population during this period was accompanied by increased levels of conflict, and many of the latest known occupied sites in the region, like New Caves Pueblo, Old Caves Pueblo, and Piper's Crater Fort, were perched in difficult to access defensive locations that imposed additional transportation costs for food, water, firewood, and construction materials. The acceptance of these burdens by the occupants of these sites indicates a strong perceived need for such defensive measures and high levels of social tensions during the terminal occupation of the region. These high tensions and the lack of forms of communal ritual architecture to promote large-scale social integration created greater vulnerability to the impacts of an environmental disturbance and set the stage for the rapid adoption of the exhaustion stage response of abandonment as the most severe period of drought during the prehistoric occupation of the region began in 1275.

Cooperation and Competition among Frontier Zone Clusters

The preceding synthesis reveals great differences between the heartland and the frontier zone in the ways that cooperative and competitive strategies were employed. I believe that some difference result from the presence of greater cultural homogeneity in the heartland as opposed to the presence of greater cultural heterogeneity in the frontier zone, with greater homogeneity fostering cooperation and greater heterogeneity leading to more competition. Most of the incidences of violence are located in the frontier zone, and the defensive site index values for the frontier zone are significantly higher than those for the heartland. The composition of plainware assemblages in the different areas provides a measure of homogeneity versus heterogeneity. Plainware assemblages from sites in the heartland are uniformly dominated (>75%) by Alameda Brown Ware, indicating the presence of a culturally homogenous population that likely had shared traditions and values. In contrast, plainware assemblages from sites in the frontier are more variable in their composition, and there are also differences among the defensive site clusters in the frontier zone (Figure 13-11). The diversity of the compositions of the plainware assemblages in the different frontier zone defensive clusters can also be assessed using the Gini-Simpson diversity index (Figure 13-12).

These differences in plainware assemblages indicate that the occupants of these clusters were engaged in different yet overlapping social and economic networks. Plainware assemblages from the two northern clusters (Citadel and Crack-in-Rock/Antelope House) indicate greater social connectivity with the Kayenta region northeast of the Little Colorado River, but there are differences between the two clusters. The Crack-in-Rock/Antelope House cluster assemblages are more uniformly dominated by Tusayan Gray Ware and have low diversity index values In contrast, the Citadel cluster assemblages are more diverse with greater amounts of Alameda Brown Ware and Prescott Gray Ware, indicating more social connectivity to the south and west. The diversity index values for the Crack-in-Rock/Antelope House cluster are nearly as low as those found in the heartland.



14 sites	%TGW	%ABW	%SFMGW	%PGW
Max	100.0	20.0	3.6	13.9
3rd	97.1	7.0	0.0	1.7
Median	93.8	3.3	0.0	0.2
1st	86.9	2.1	0.0	0.0
Min	76.1	0.0	0.0	0.0

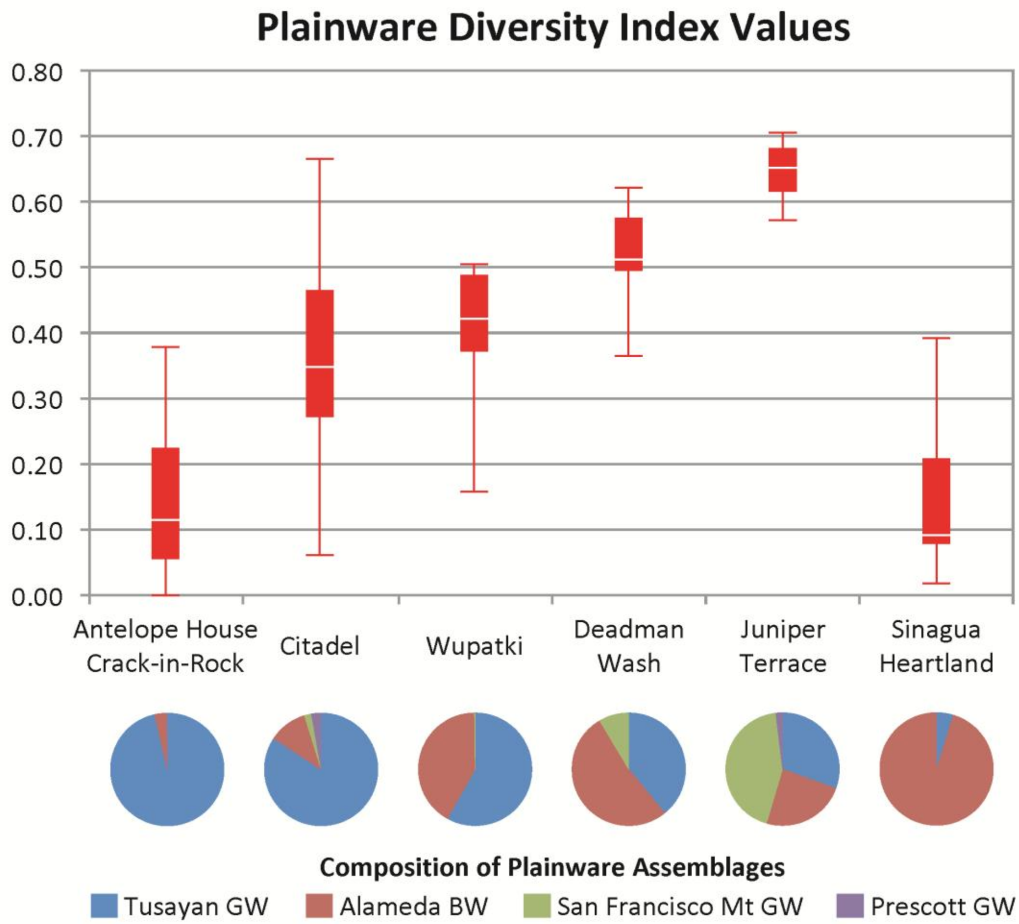
17 sites	%TGW	%ABW	%SFMGW	%PGW
Max	96.8	37.9	12.0	37.7
3rd	84.6	16.9	6.0	12.5
Median	79.2	10.3	1.9	2.6
1st	70.6	8.0	0.0	0.0
Min	22.9	0.0	0.0	0.0

16 sites	%TGW	%ABW	%SFMGW	%PGW
Max	91.5	77.6	4.8	1.0
3rd	72.9	56.9	1.9	0.6
Median	58.1	41.6	0.2	0.0
1st	41.9	14.7	0.0	0.0
Min	22.4	6.4	0.0	0.0

7 sites	%TGW	%ABW	%SFMGW	%PGW
Max	65.5	75.8	17.2	4.9
3rd	45.8	58.2	9.6	4.6
Median	40.2	53.8	8.8	0.0
1st	29.7	48.3	0.0	0.0
Min	23.8	17.2	0.0	0.0

4 sites	%TGW	%ABW	%SFMGW	%PGW
Max	45.7	32.0	53.6	9.2
3rd	38.7	28.7	50.3	5.1
Median	32.1	25.2	45.7	2.0
1st	27.5	19.7	37.3	0.2
Min	26.6	10.7	22.5	0.0

Figure 13-11. Percentages of plainwares from sites in different frontier zone defensive site clusters.



	AH/CIR	CIT	WUPA	DMW	JT	SH
Maximum	0.38	0.66	0.51	0.62	0.71	0.39
3rd Quartile	0.23	0.47	0.49	0.57	0.68	0.21
Median	0.12	0.35	0.42	0.51	0.65	0.09
1st Quartile	0.06	0.27	0.37	0.50	0.62	0.08
Minimum	0.00	0.06	0.16	0.37	0.57	0.02
TGW%	93.8	79.2	58.1	40.2	32.1	4.8
ABW%	3.3	10.3	41.6	53.8	25.2	95.2
SFMGW%	0.0	1.9	0.2	8.8	45.7	0.0
PGW%	0.2	2.3	0.0	0.0	2.0	0.0
median % of plainware at sites in cluster						

Figure 13-12. Gini-Simpson Diversity Index values for and compositions of the plainware assemblages from frontier zone defensive site clusters and a sample of heartland sites.

The plainware assemblages from the two southern clusters (Wupatki and Deadman Wash) are more diverse with considerably more Alameda Brown Wares than the northern clusters, indicating much stronger relations with heartland populations. There are differences between these two clusters as well, with the Deadman Wash cluster having more Alameda Brown Ware and San Francisco Mountain Gray Ware. The plainware assemblages from the western Juniper Terrace cluster have the most diverse composition and indicate strong relationships with populations in the Cohonina and Kayenta regions as well as with groups in the heartland. The spatial and material culture distinctions among these clusters suggest that there were differences in the social identities of the occupants of the clusters as well.

The distribution of plainwares suggest that the Deadman Wash drainage may have been a boundary between the northern and southern clusters (Figure 13-13), with the clusters south of Deadman Wash having greater social connectivity with populations in the heartland. Differences in elevation form a boundary between clusters in the lowlands of the Wupatki Basin to the east and in the upland pinyon-juniper woodlands to the west. The Doney Cliffs separate the Citadel and Crack-in-Rock/Antelope House clusters, and the Woodhouse Mesa escarpment separates the Deadman Wash and Wupatki clusters. The upland and lowland clusters differed not just in elevation, but also in associated precipitation and temperature regimes, biotic communities, and available resources, particularly arable lands of different characteristics.

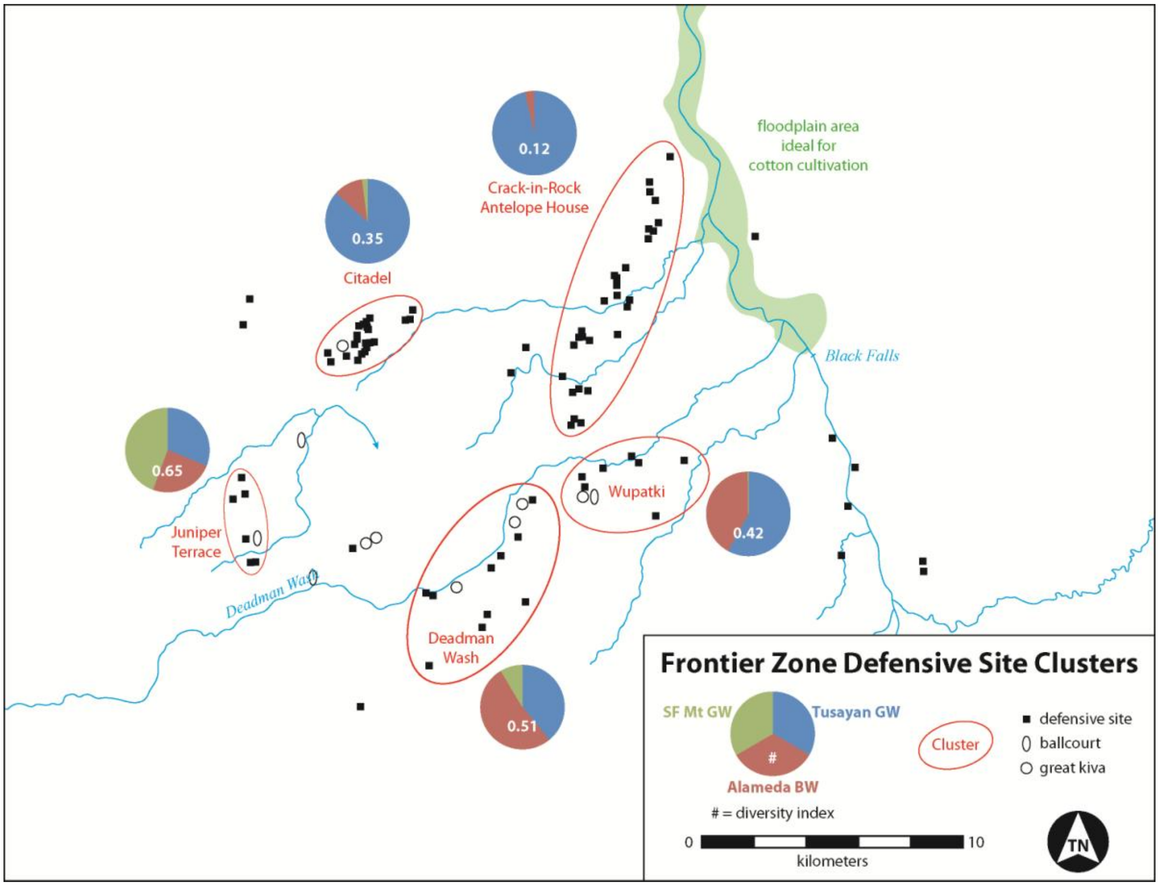


Figure 13-13. Proportions of plainwares and diversity index values for different frontier zone defensive site clusters.

While dry farming in the lowlands was riskier and more vulnerable to insufficient precipitation, the floodplain of the Little Colorado River below Black Falls was ideal for cotton cultivation, being below 5,200 feet in elevation and having more reliable soil moisture from spring flooding and a high water table. Upstream of Black Falls the river is in a narrow canyon with limited available arable land. The excavation of Wupatki Pueblo found abundant evidence of cotton cultivation, with recovery of fibers, seeds, unprocessed bolls, and even plant stems (Stanislawski 1963b). Prior to 1100 most cotton in the U.S. Southwest was produced in irrigated fields in the Hohokam region; cotton production expanded to the Colorado Plateau after 1100, but remained limited until after 1300 (Kent 1957). The occupation of these frontier zone clusters was during this period when cotton was introduced and land suitable for cotton cultivation was likely a prized resource to be defended. The occupants of the lowland Wupatki and Crack-in-Rock/Antelope House clusters may have been in competition with each other for control of these floodplain areas to which they had the best access.

The occupants of these lowland clusters may also have been in competition with those of the upland clusters, preventing these groups from gaining access to plots on the floodplain. Such competitive exclusion would create dependencies between the occupants of the upland clusters who desired cotton that they could not grow themselves and the producers of cotton in the lowland clusters. Loom holes in the floor of the latest kiva at Juniper Terrace Pueblo (mean ceramic date of 1192 ± 19) indicate that cotton was woven at the site. But cotton could not have been grown in the immediate vicinity of the site and had to have been acquired through exchange with the occupants of lowland clusters to the east. The Hopi myth of the destruction of Elden Pueblo recounted in Chapter 5 showed that cotton was a valued and limited resource and conflict had the potential of rupturing the social relations needed to acquire it.

The Crack-in-Rock/Antelope House cluster stands apart from the other clusters in the frontier zone. The plainware assemblages from sites in this cluster are very uniformly dominated by Tusayan Gray Ware and indicate strong social connections with populations in the Kayenta region and little interaction with others. Further reinforcing this isolation from the other frontier zone clusters is the fact that no ballcourts or great kivas were ever built and used in the Crack-in-Rock/Antelope House cluster, unlike the other frontier zone clusters, all of which had either ballcourts, great kivas, or both at some point during their occupational histories. While no ballcourts or great kivas are present, Crack-in-Rock Pueblo, Antelope House, and other sites in the cluster have smaller D-shaped kivas that are distinctive forms of household ritual architecture found in the Kayenta region. These data indicate that the occupants of the Crack-in-Rock Pueblo/Antelope House cluster had strong cultural connections to the Kayenta region as well as a corresponding lack of participation in the types of communal ritual activities that crosscut the other frontier zone clusters.

The frontier zone was occupied by diverse social groups that were entwined in both cooperative and competitive relationships. The contexts of interaction among these diverse groups led to higher levels of conflict in the frontier zone than was found among contemporary heartland populations that were more culturally homogenous. These differing dynamics of conflict in the heartland and frontier zone are examined further in the next section.

USING THE TURCHIN AND KOROTAYEV MODEL T\O COMPARE THE HEARTLAND AND FRONTIER ZONE

As discussed in Chapter 7, ecologist Peter Turchin and anthropologist Andrey Korotayev have modeled relationships between internal warfare and population in agrarian states to demonstrate that dynamic feedbacks between these variables create coupled oscillations with a lagged phase shift similar to classic ecological models of the relationships between predator and prey population densities (Turchin 2005; Turchin and Korotayev 2006). In this model, population pressures create political instability that leads to social conflict, and in a self-corrective way, periods of conflict reduce population. To assess the fit between data and the model, population levels are plotted against levels of political instability /conflict and the temporal trajectory through phase space is expected to circulate in a counterclockwise direction (Figure 13-14). Deviation from this expected trajectory indicates a lack of fit with the model, perhaps as the result of the intervention of external forces into a closed local political system and population base through migration or military invasion (Turchin and Korotayev 2006).

This model has recently been used to evaluate the occurrence of intergroup conflict in other parts of the U.S. Southwest using data from the central Mesa Verde and northern

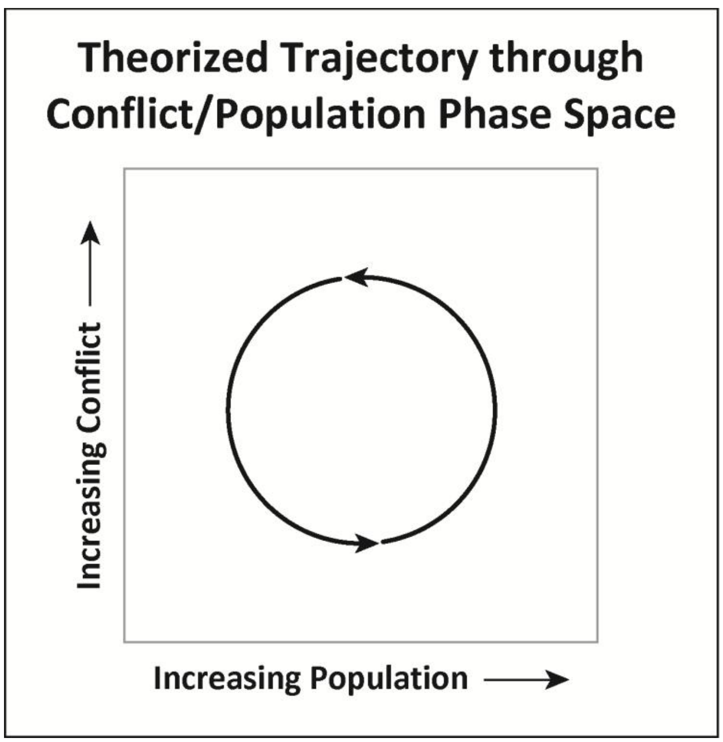
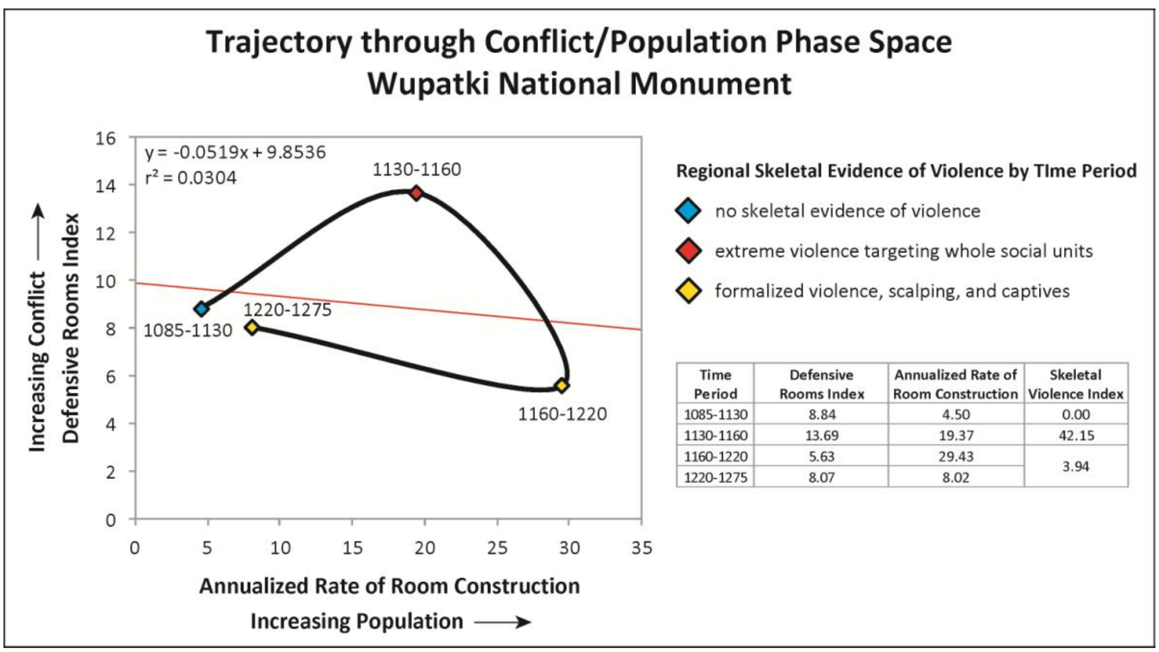


Figure 13-14. The trajectory through conflict/population phase space predicted by Turchin and Korotayev moves in a counter-clockwise direction over time.

Rio Grande regions (Kohler et al. 2009, 2014). Like the heartland and frontier zone of the Flagstaff region, these two case studies have different histories of conflict, with the central Mesa Verde region having higher levels of violence than the northern Rio Grande region. The central Mesa Verde region case study demonstrates fit with the model early during its historical trajectory, but deviates later as the external dynamics of the expansion and re-organization of the Chaco regional system affected the region. In contrast, the northern Rio Grande region case study does not conform to the model's expectations, as levels of conflict remained low even as population grew. The relationships between levels of conflict and various measures of agricultural productivity revealed additional interesting contrasts between the two regions. Levels of conflict in the central Mesa Verde region have a only a weak tendency to increase with declining productivity, while levels of conflict in the northern Rio Grande region decrease with declining productivity. These patterns are contrary to the general assumption that resource stress leads to increased competition and conflict, and Kohler et al. (2014) suggest that the stabilizing influences of ritual and political institutions and interdependencies created though exchange helped limit the emergence of conflict.

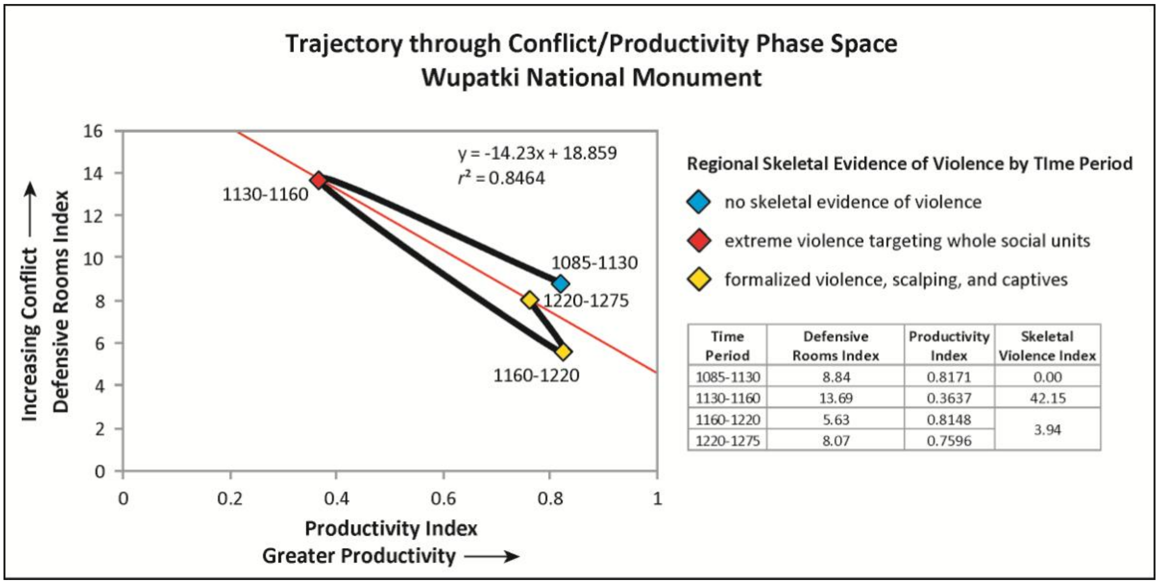
I use the Turchin and Korotayev model to examine data from the heartland and frontier zone and assess their fit with the expectations for a relationship between levels of conflict and cycles of population growth and decline and compare these results to my expectation of a relationship between levels of conflict and cycles of favorable and unfavorable environmental conditions. For the frontier zone, I used the annualized rate of room construction for Wupatki National Monument (Sullivan and Downum 1991) as a measure of population and the corresponding defensive room index calculated in Chapter

8 as a measure of conflict. When these variables are plotted against each other in phase space the trajectory follows a clockwise course (Figure 13-15), contrary to the expectations of Turchin and Korotayev's model. Regression of levels of conflict (the defensive room index) as the dependent variable on population levels (the annualized rate of room construction) as the independent variable results in a low R-squared value (0.0304) that indicates a lack of linear relationship between the levels of conflict and population levels. In contrast, when the defensive rooms index is plotted against the values for a productivity index for each time period derived from reconstructed PDSI values (see Appendix B) (Figure 13-16), the trajectory moves in the expected counter-clockwise direction and regression indicates a strong linear relationship between levels of conflict and productivity (r^2 = 0.8464), although the number of cases is low (n = 4).



Time Period	Defensive Rooms Index	Annualized Rate of Room Construction	Skeletal Violence Index
1085-1130	8.84	4.50	0.00
1130-1160	13.69	19.37	42.15
1160-1220	5.63	29.43	3.94
1220-1275	8.07	8.02	

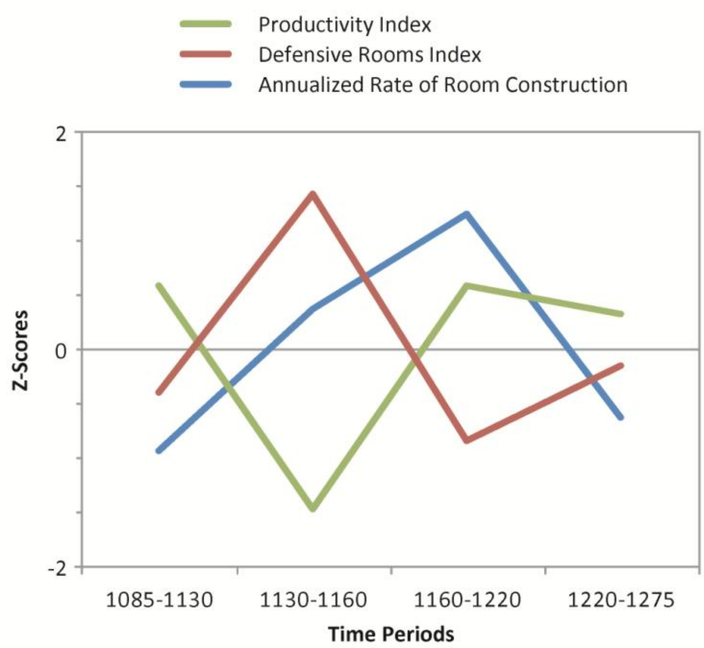
Figure 13-15. Frontier zone trajectory through conflict/population phase space with regression of conflict on population. Trajectory moves in a clockwise direction contra the expectations of Turchin and Korotayev.



Time Period	Defensive Rooms Index	Productivity Index	Skeletal Violence Index
1085-1130	8.84	0.8171	0.00
1130-1160	13.69	0.3637	42.15
1160-1220	5.63	0.8148	3.94
1220-1275	8.07	0.7596	

Figure 13-16. Frontier zone trajectory through conflict/productivity phase space with regression of conflict on productivity. Trajectory moves in a counter-clockwise direction as suggested by Turchin and Korotayev (2006).

When the raw scores of the productivity index, defensive room index, and annualized rate of room construction are standardized as z-scores and plotted together against time (Figure 13-17) the trajectories of levels conflict and changing environmental conditions can be seen as having an almost perfect linear relationship. When the relationships between population and conflict are viewed in this manner, growth in population between the 1085-1130 and 1130-1160 periods corresponds with an increase in levels of conflict, then lower levels of conflict in the following 1160-1220 period are accompanied by population growth, and subsequent increase in levels of conflict in the 1220-1275 period is associated with a dramatic decrease in population. This pattern could be seen as very weakly conforming to the expectations of the Turchin and Korotayev model, although the length of the cycle is brief (only four time periods) and population levels were influenced



Time Period	Raw Scores PI	Raw Scores DRI	Raw Scores ARRC	Z-Scores PI	Z-Scores DRI	Z-Scores ARRC
1085-1130	0.82	7.23	4.50	0.59	-0.41	-0.95
1130-1160	0.36	13.69	19.37	-1.48	1.44	0.36
1160-1220	0.81	5.63	29.43	0.58	-0.86	1.24
1220-1275	0.76	8.07	8.02	0.32	-0.16	-0.64

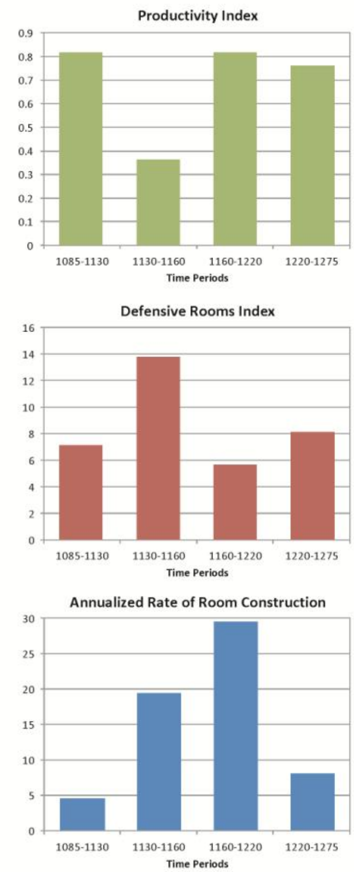


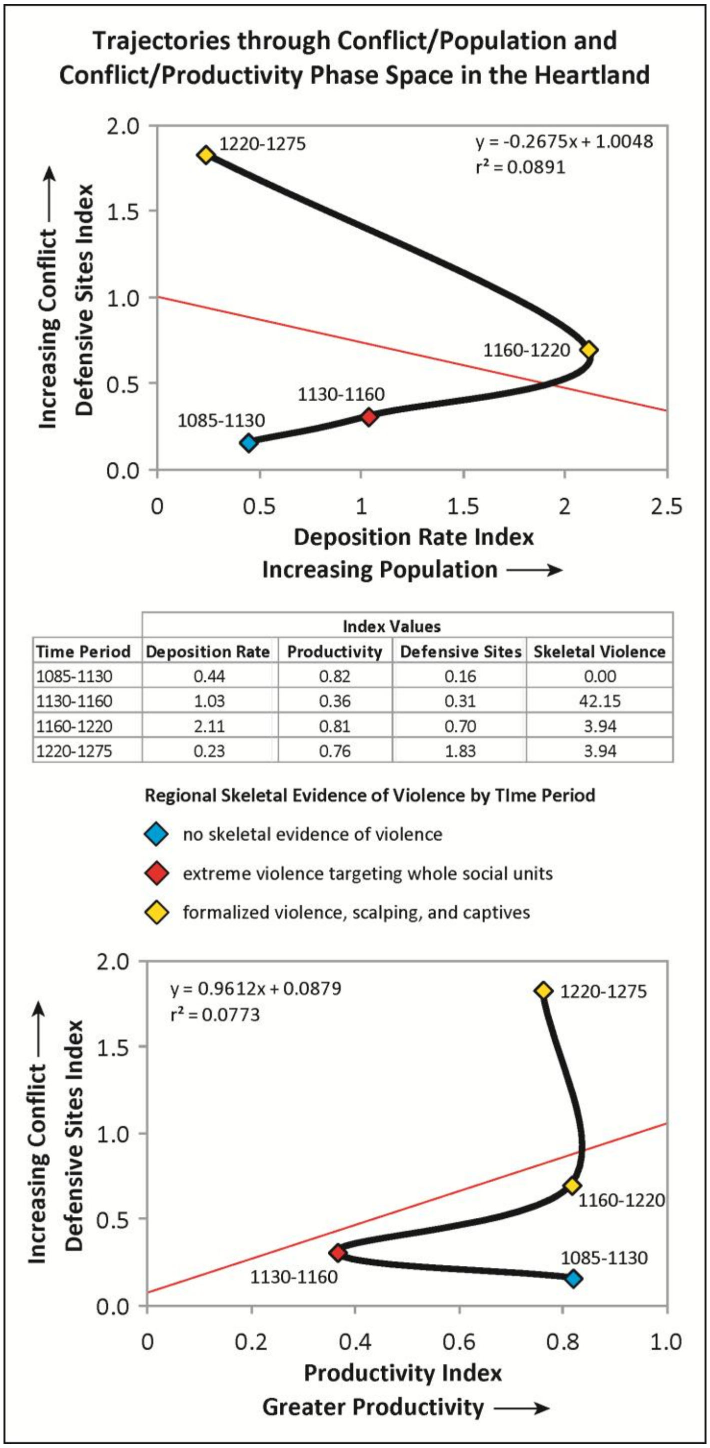
Figure 13-17. Relationships among productivity, population, and conflict for the frontier zone.

by external factors of in migration during the first three periods and out migration during the final period. Regardless, the relationship with changing environmental conditions has greater explanatory significance for levels of conflict in the frontier zone.

Slightly different but comparable data sets were used for the heartland analyses. The survey data from the heartland does not allow the fine-grained site- and room-based population estimates that are available for the frontier zone, therefore I use a deposition rate index for temporally diagnostic whiteware styles (see Appendix B) with data collected in Walnut Canyon National Monument (Acord 2005) as a proxy measure of population. The defensive site index for the heartland calculated in Chapter 8 is used as a measure of conflict and the same productivity index is used as a measure of changing environmental conditions.

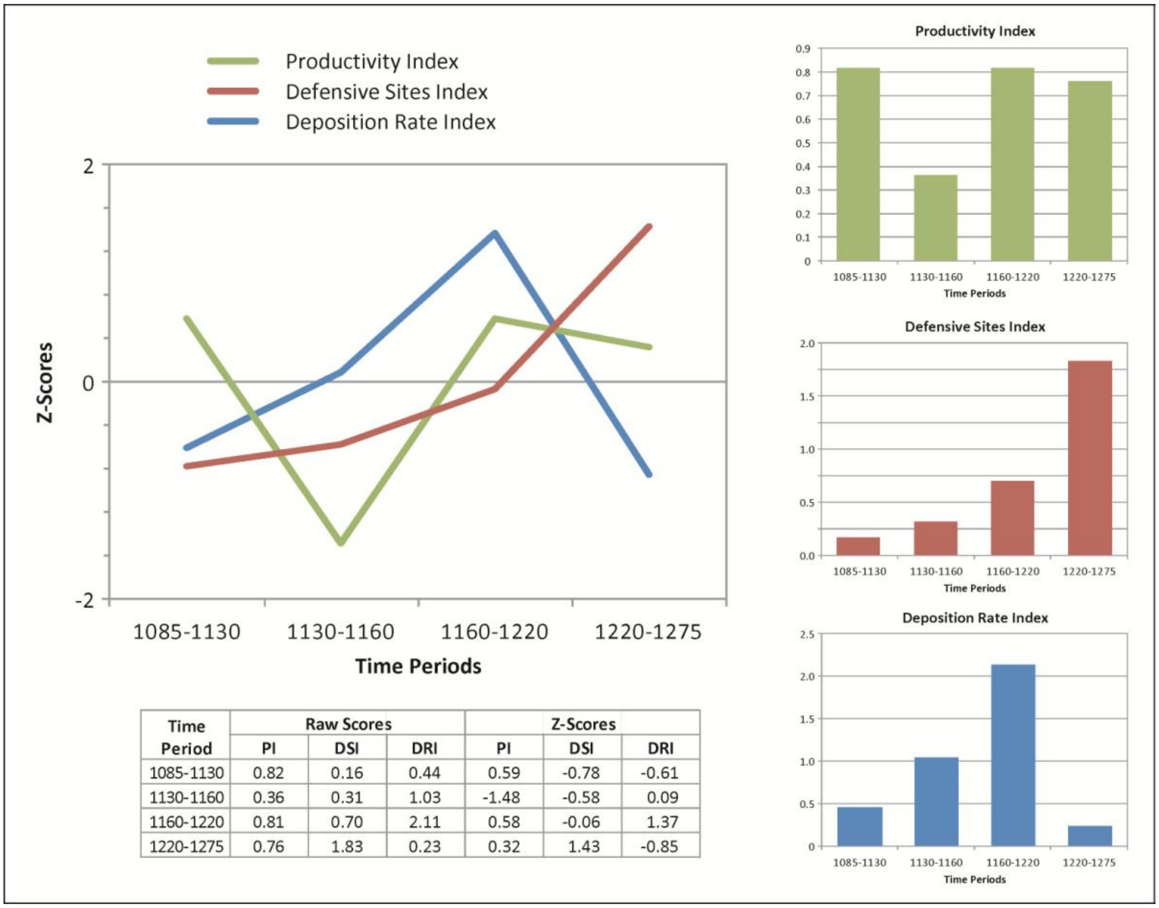
When conflict is plotted against both population and productivity in phase space neither trajectory conforms to the expected counter-clockwise cycle (Figure 13-18). Regression results in low R-squared values for both pairs indicating that little of the variance in the levels of conflict can be explained by either population or environmental conditions. Like with the frontier zone data, I standardized the raw scores of the productivity index, defensive site index, and deposition rate index as z-scores and plotted them together against time (Figure 13-19). Increases in population from the 1085-1130 period through the 1160-1220 period are tracked by smaller increases in levels of conflict. In the final period, dramatic increase in conflict is matched by a similarly dramatic decline in population. As was seen in the frontier zone, this pattern weakly conforms to the expectations of the Turchin and Korotayev model, though again the length of the cycle is brief and population levels are influenced by external factors of out migration during the final period. Conflict and productivity show little correspondence, as levels of conflict increase regardless of whether conditions are favorable or unfavorable. This progressive ratcheting up of levels of conflict is particularly evident in the histogram of heartland defensive site index (Figure 13-19, right center in red).

In Chapter 7, I proposed the possibility of such cumulative increase in a stepwise manner as diminished social mechanisms for conflict resolution and mediation may limit the return of peaceful relations. I also suggested that such a pattern of cumulative increase in a stepwise manner should not be limited to levels of conflict, but should also



	Index Values			
Time Period	Deposition Rate	Productivity	Defensive Sites	Skeletal Violence
1085-1130	0.44	0.82	0.16	0.00
1130-1160	1.03	0.36	0.31	42.15
1160-1220	2.11	0.81	0.70	3.94
1220-1275	0.23	0.76	1.83	3.94

Figure 13-18. Heartland trajectories through conflict/population and conflict/productivity phase spaces with regressions. Neither trajectory conforms to the counter-clockwise direction predicted by Turchin and Korotayev (2006).



Time Period	Raw Scores PI	Raw Scores DSI	Raw Scores DRI	Z-Scores PI	Z-Scores DSI	Z-Scores DRI
1085-1130	0.82	0.16	0.44	0.59	-0.78	-0.61
1130-1160	0.36	0.31	1.03	-1.48	-0.58	0.09
1160-1220	0.81	0.70	2.11	0.58	-0.06	1.37
1220-1275	0.76	1.83	0.23	0.32	1.43	-0.85

Figure 13-19. Relationships among productivity, population, and conflict for the heartland.

apply to cooperative processes like exchange activated as an alarm stage response. Just as enmity bred in conflict may be slow to fade and progressively increase, the bonds created through exchange may strengthen over time and increase in importance. The evidence presented in Chapter 12 indicates that the importance of exchange for non-locally produced pottery increased in a cumulative, stepwise manner as well (Figure 13-20).

Assuming a linear relationship, the regression analyses indicate that little of the variance in levels of conflict in the heartland can be explained by corresponding variance in either population and productivity. What accounts for and explains the progressive

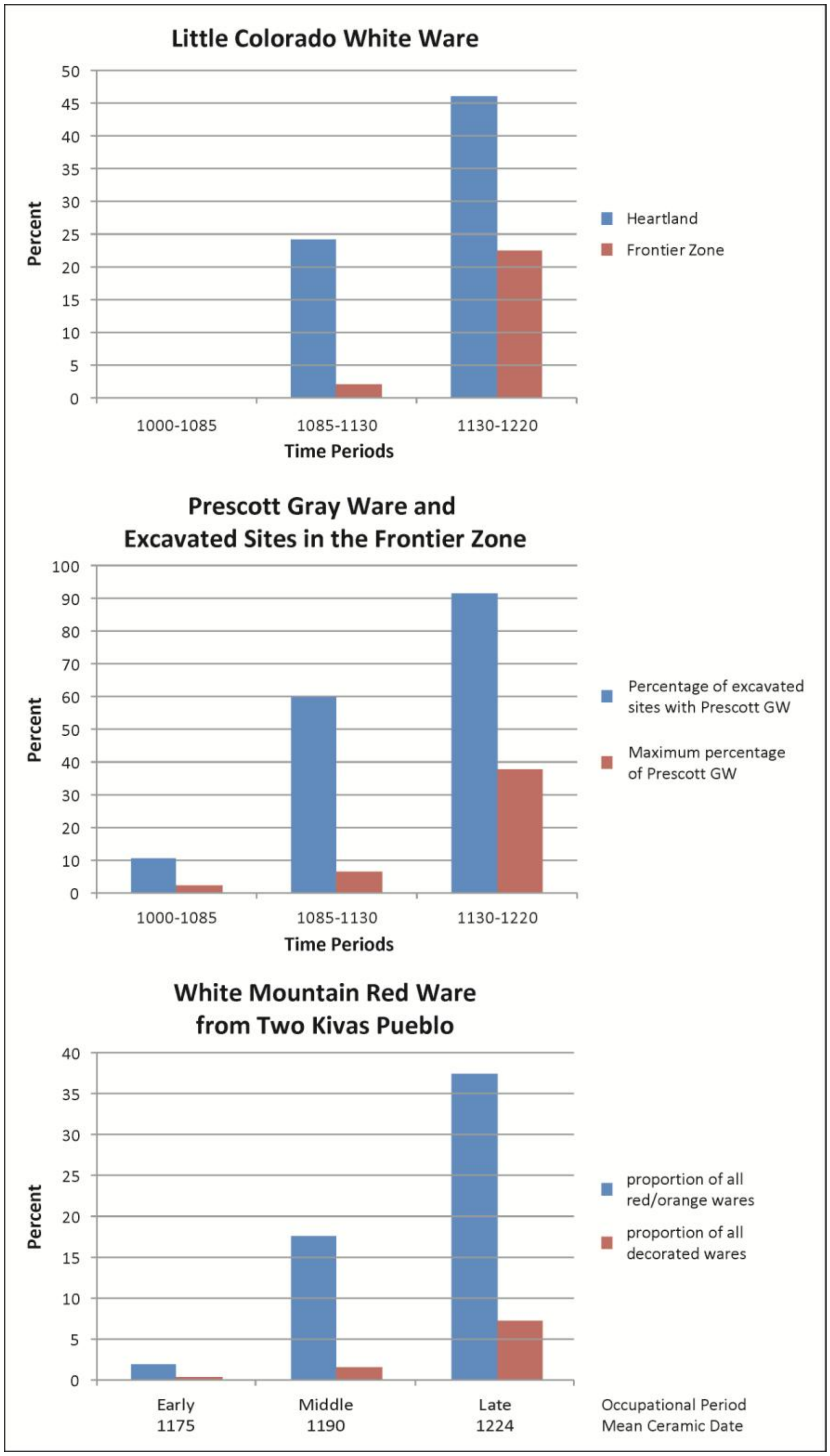


Figure 13-20. Stepwise increase in the importance of exchange relations shown through increasing percentages of non-locally produced pottery by time periods.

increase in the levels of conflict in the culturally homogenous heartland? I believe that this pattern resulted from the increasing entanglement of heartland populations in the conflicts among frontier zone groups, allying with those that they shared cultural traditions with and fighting against those with whom there was greater social distance. A majority of the conflict in the frontier zone was likely between the different groups that lived in in this area, with declining environmental conditions increasing competition between these groups for access to or control of critical resources like arable land and leading to conflict. In contrast, conflict in the heartland was more likely with socially distant groups from the frontier zone rather than among local heartland populations that shared cultural traditions and values. Plainware assemblages indicate that some frontier zone groups maintained strong relationships with populations in the heartland, and alliances with these groups likely drew heartland populations into frontier zone conflicts with more socially distant groups.

Two other points bear further examination in relation to this discussion. First, the decrease in levels of conflict in the frontier zone as populations reached peak levels during the 1160-1220 period contrary to the expectations of Tuchin and Korotayev model. Second, the absence of conflict immediately following the eruption of Sunset Crater contrary to the expectations I developed. Kohler at al.'s proposal that the emergence or escalation of conflict may be limited by the stabilizing influences of ritual and political institutions and interdependencies created though exchange provides an explanation for both of these deviations from expected patterns. Instead of increasing conflict following the eruption, both communal ritual activity and exchange increased. Ballcourt use from before the eruption provide a template for ritual and political institutions that prevented the emergence of conflict through mediation, the creation of a shared identity, and the furtherance of sharing and exchange.

The defensive site and room indexes and the skeletal violence index indicate that the height of conflict in the frontier zone was during the 1130-1160 period, but the following period had population growth rather than decline and levels of conflict declined rather than increased. New ritual and political institutions emerged that prevented the escalation of conflict allowing greater security and population growth. The burial of the Magician indicates the emergence of specialized sodalities with powers distributed among them. Central in this arrangement was a sodality related to warfare and male initiation, and such sodalities have the ability to limit the exercise of violence by deciding the tactics and goals used and defining who were legitimate targets. Violence did not end, but reduced in its frequency and rate and came to be largely restricted to adult males. The construction and use of great kivas in the frontier zone also indicate the emergence of new ritual and political institutions that crosscut the boundaries between different frontier zone clusters and provided institutional means of mediation and integration. The types of hard substances present and the forms of ornaments made from them crosscut not only the boundaries between frontier zone clusters, but also boundaries between the frontier zone heartland areas and even between larger regions. The distribution of hard substances, the sources of the varied materials, the different forms manufactured, and the myth described in Chapter 12 indicate the emergence of enchained exchange relationships that connected the Pacific Coast and the northern U.S Southwest with the Flagstaff region as an important nexus. Similar to the Great Ceremonial Wars of the Enga discussed in Chapter 5, ritual and political institutions emerged that reined in the destructive impacts of conflict and facilitated the beneficial effects of exchange to form alliances and make peaceful reparations while still providing pathways for male status achievement and the expression of intergroup aggression.

COMMUNAL RITUAL ARCHITECTURE AND CLIMATE

While increased levels of conflict in the frontier zone are strongly associated with unfavorable environmental conditions, no such association is found for the heartland. Thus the expected association between increased conflict and unfavorable environmental conditions is only partially met. With the other side of the equation, the expectation that the construction and use of communal ritual architecture should be associated with favorable environmental conditions, the expected association is only partially met again. The construction and use of communal ritual architecture occurred during both favorable and unfavorable periods (Figure 13-21), and more often during the latter, contrary to the expectations. The Old Caves and New Caves ballcourts were associated with the lengthy favorable period of before the eruption, but then five new ones were built and used after the eruption in both the heartland (Winona, Ridge Ruin East and West, Porter, and Loftin) and the frontier zone (Second Sink), and three more new ballcourts (Juniper Terrace, Wupatki Road, and Wupatki Pueblo) were built in the frontier zone during the 1130s megadrought. Great kivas were built and used during a period that was neither highly favorable nor unfavorable, but conditions were improved in comparison to the earlier meagadrought.

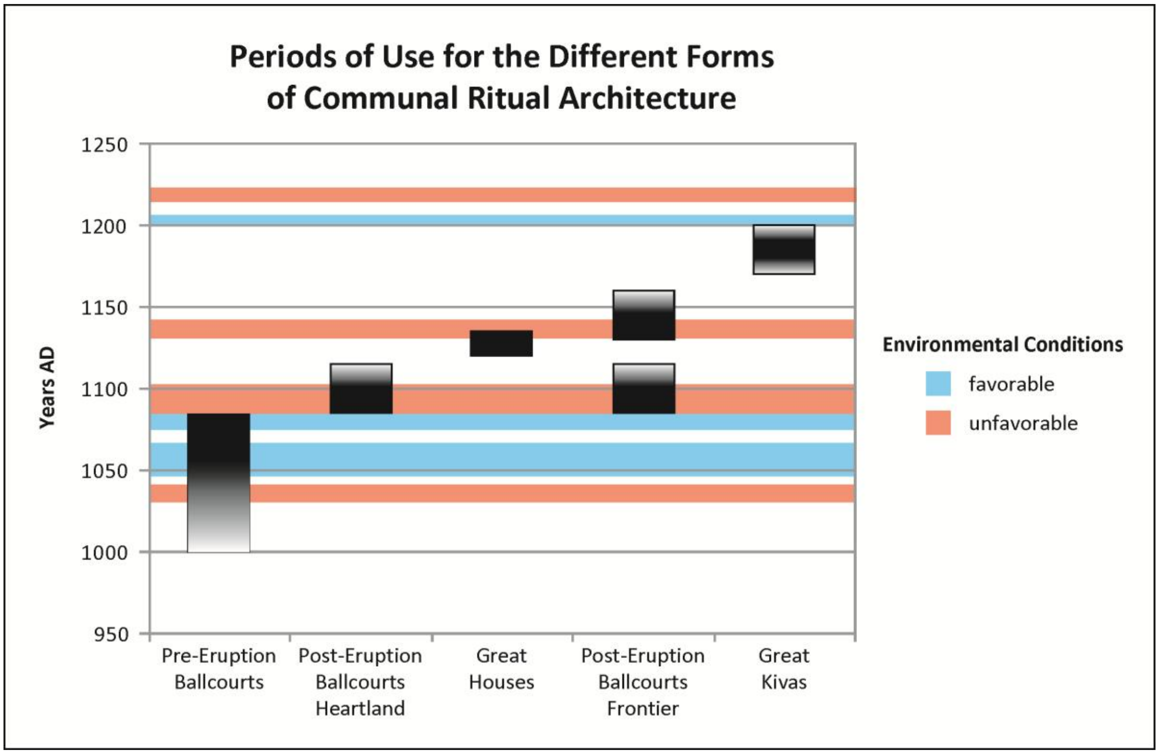


Figure 13-21. Comparison of the periods of use for different forms of communal architecture with periods having favorable or unfavorable environmental conditions

Following the eruption, rather than abandoning use of ballcourts as a resistance stage response of reducing contraction sharing and other social activities in the face of shortages, populations in the heartland increased their use of ballcourts and adopted other associated ritual practices and material culture. Ballcourt use also expanded into the frontier zone where migrants from diverse cultural backgrounds were brought together. Facing the devastating aftermath of the eruption, the affected groups chose to actively engage in cooperative actions that meditated relations, created a shared sense of identity, and facilitated contexts for sharing and exchange. Also following the eruption there was peace instead of increased conflict, indicating that the use of communal ritual succeeded in meditating tensions within and between groups. These ballcourts fell out of use as the crisis created by the eruption and subsequent period drought faded with the return of more normal patterns of precipitation and the beginnings of socioecological succession on the margins of the impacted area as plants and people found new ways of life among the volcanic cinders.

Ballcourts were again built and used during the 1130s megadrought, although all three were in the frontier zone which was still occupied by culturally diverse groups and continued to receive migrants, particularly from the Cohonina region to the west that was abandoned during the megadrought. Like following the eruption, cooperation was again the response to environmental change, not resistance. The communal ritual activities at ballcourts attracted and integrated migrants into existing communities of previous migrants and their descendants. Ballcourt use was revived for its abilities to meditate tensions, create shared community identity, and promote sharing and exchange, but unlike the earlier period of ballcourt use immediately after the eruption, these goals were not fully achieved. The skeletal violence index and the frontier zone defensive site and room indexes all have their highest values during the 1130-1160 period when these ballcourts were in use indicating high levels of competition and conflict.

Between these two periods of ballcourt use, around 1120, two Chaco great houses were built, Ridge Ruin in the heartland and Wupatki Pueblo in the frontier zone. After the beginning of the megadrought, as the center of the Chaco regional system began to decline and the peripheries re-organize, both were built over, with the new construction not using Chaco-style masonry and enclosing and obscuring the initial great house core of both structures. While these great house components did not last long, probably 15 years or less, the ritual practices and the social roles and institutions associated with them and introduced from Chaco transformed local communities in the decades that followed the end of the great houses, as indicated by the burial of the Magician and the evidence of the ritual practices and sodalities present. The unroofed great kivas indicate additional influence from Chaco, although from the re-organizing southwestern periphery of the regional systems, not its former center. While the occurrence of great kivas only weakly meets the expectation of construction and use during a favorable period, the skeletal violence index and the frontier zone defensive site and room indexes all decrease during the period when great kivas were in use. Great kiva use crosscut frontier zone communities that likely had different social identities and created contexts for mediation and integration.

Lessons Learned

This case study shows that there is not always a direct association between environmental stress and increasing levels of competition and conflict, nor is there always an association between favorable environmental conditions and the construction and use of communal ritual architecture. In the frontier zone, there is a strong association between environmental conditions and levels of conflict, but this relationship does not hold true in the heartland where levels of conflict increased steadily from period to period following the eruption independent of environmental conditions. The cultural diversity of the frontier zone created contexts for competition among socially distant groups as migrants settled the area following the eruption and sought to establish claims of resource access and control. These existing competitive relationships are more likely to escalate to conflict and violence if stressed by changing environmental conditions and declining productivity. The greater cultural homogeneity of heartland populations created contexts for cooperation among groups with shared backgrounds, traditions, and values leading to lower levels of conflict in the heartland compared to the frontier zone. Conflict and violence was not absent in the heartland, however, and increased over time as heartland populations were increasingly entangled in the patterns of conflict of the frontier zone through alliances and exchange. These differences between the heartland and frontier zone suggest that unfavorable environmental conditions are more likely to lead to increased conflict in settings with higher levels of cultural diversity that create contexts for pre-existing competition among groups that may easily escalate when stressed to resistance stage responses like conflict.

The construction and use of communal ritual architecture in the region does not support the expectation of a strong association with favorable environmental conditions, but the cases that deviate from this expectation provide insights into factors that contributed to the success or failure of communal ritual to mediate tensions and prevent or limit the escalation of conflict. Contrary to the expectations, the two episodes of ballcourt use after the eruption both occurred during environmental disturbances, the first immediately following the eruption and during a subsequent period of drought and the second during the 1130s megadrought. The expectations suggest that these two periods of environmental stress should have led to increased levels of conflict. The period immediately following the eruption has no evidence of conflict, while the megadrought was accompanied by a tremendous increase in the occurrence and intensity of violence.

The ritual and political institutions associated with ballcourt use in the period immediately after the eruption successfully mediated relations and prevented the emergence of conflict during this period of environmental stress and population dislocation. The construction and use of ballcourts following the eruption built upon an existing tradition of ballcourt use in the heartland that was several decades old. Ballcourts were initially introduced to the Flagstaff region before the eruption when the larger Hohokam regional system of ballcourts was operational, but after this system collapsed ballcourts continued to be built and used, re-adapted to local needs. Instead of abandoning ballcourts after the eruption, heartland populations built upon the foundation of this local tradition and increased their use, also adopting other new forms of material culture and ritual practice associated with ballcourts. The use of ballcourts immediately after the eruption was associated with strong, well-established social institutions that were able to exert a stabilizing influence during this period of crisis and successfully prevent conflict.

In contrast, the later ritual and political institutions associated with ballcourt use during the megadrought brought together diverse groups in the frontier zone but were not able to successfully mediate relations and prevent the escalation of conflict. The use of ballcourts was revived after 15 to 20 years of inactivity not in the heartland where eight ballcourts had previously been built and a strong past tradition of their use existed, but rather in the frontier zone where only one earlier ballcourt had been built and used. The use of these later frontier zone ballcourts was not associated with existing and well-established social institutions as the earlier ballcourts had been and frontier zone populations did not have strong past traditions of ballcourt use to build upon. Lacking the same institutional continuity in ballcourt use found in the heartland at the time of the eruption, the institutions associated with this later period of ballcourt use in the frontier may have been more ad hoc arrangements. Without a strong foundation for the tradition among the groups brought together at the ballcourts these ad hoc institutions were unable to exert a stabilizing influence during the megadrought and conflict among the diverse groups that occupied the frontier zone escalated. These differences indicate that successfully limiting the emergence or escalation of conflict during periods of environmental stress depends on the presence of well-established institutions with strong foundations in the community and that more ad hoc institutional responses to crises are less likely to succeed.

The basic assumption that environmental conditions directly control the choices made between cooperation and competition posits that such choices are largely determined by forces external to cultural agency. This case study, however, has shown that agency is important. Rather than blindly reacting to external stimuli with some kind of pre-programmed, one-size-fits-all response, choices between cooperation and competition were structured by local circumstances and contingencies. Rather than responding with violence in the wake of the unparalleled devastation unleashed by the eruption, local populations built upon an existing cultural template of cooperation and prevented the emergence of conflict during this period of population dislocation and resettlement. Such attempts were not always successful, as the construction and use of later ballcourts was unable to mediate intergroup tensions and the environmental stress of the 1130s megadrought did lead to the expected escalation of conflict in the frontier zone where cultural differences between social groups had the potential to exacerbate tensions. The horrors of this period conflict, however, created the social and historical contexts for the later emergence of institutions that limited the exercise of violence and reduced levels of conflict.

Cultural agency is paramount in the Hopi understanding of the states of suyanisqatsi and koyaanisqatsi. Peace and harmony in a community require the active participation of all and the proper fulfillment of social and ritual responsibilities. Such fulfillment of responsibilities creates not just balance among community members, but also balance between the community and the natural world leading to favorable environmental conditions and bountiful harvests. The chaos and disorder of koyaanisqatsi, on the other hand, are created by failures in the community to properly fulfill these social and ritual responsibilities. Again, this loss of balance does not just effect social relations in the community, but relations with the natural world as well. Detrimental environmental changes are not simply natural stochastic events in the Hopi worldview, but rather they result from the social and ritual failings that created the state of koyaanisqatsi. In a sense, the Hopi perspective suggests that the deprivation and want that follows declining productivity, as well as rising tensions and conflict, are not caused by challenging environmental conditions, but rather by social failings to properly cooperate in the face of adversity. Human actions can create balance and harmony or chaos and disorder. This Hopi view of koyaanisqatsi parallels in some ways contemporary perspectives on hazards, risk, and vulnerability that there is nothing "natural" about disasters; rather they are social phenomena, as risk and vulnerability to hazards are constructed by social choices made governing the interaction among natural and cultural systems. Given the risks and vulnerabilities contemporary societies in the U.S. Southwest have created and the likelihood of increasing temperatures and decreasing precipitation with global climate change, this case study provides hope and promise that environmental stress does not lead inexorably to social conflict, rather cooperative social institutions with strong community foundations have the potential to manage alarm stage responses and prevent escalation to resistance stage responses. Conflict is likely to arise where social differences and tensions already exist, and ad hoc responses to emerging challenges have a less chance of success, so the creation and maintenance of cooperative social institutions that mediate and integrate potential competitors in such settings must precede and plan for such challenges.

REFERENCES

Abel, Leland J.

1955 *Pottery Types of the Southwest: Wares 5A, 10A, 10B, 12A; San Juan Red Ware, Mesa Verde Gray and White Ware, San Juan White Ware*. Museum of Northern Arizona Ceramic Series No. 3B. Northern Arizona Society for Science and Art, Flagstaff.

Abbink, Jon

1998 Ritual and Political Forms of Violent Practice among the Suri of Southern Ethiopia. *Cahiers d'Études Africaines* 38:271-295.

Abbott, David R.

2000 *Ceramics and Community Organization among the Hohokam*. University of Arizona Press, Tucson.

2006 Hohokam Ritual and Economic Transformation: Ceramic Evidence from the Phoenix Basin, Arizona. *North American Archaeologist* 27:285-310.

2002 Ceramic Markers of Ancient Irrigation Communities. In *Intersections: Pathways Through Time*, compiled by Brenda L. Shears, Glen E. Rice, Peggy Lindauer, Harue Yoshida. Anthropological Field Studies No. 44. Arizona State University, Tempe.

2009 Extensive and Long-Term Specialization: Hohokam Ceramic Production in the Phoenix Basin, Arizona. *American Antiquity* 74:531-557.

Abbott, David R., Alexa M. Smith, and Emiliano Gallaga

2007 Ballcourts and Ceramics: The Case for Hohokam Marketplaces in the Arizona Desert. *American Antiquity* 72:461-484.

Acord, Kenny

2005 *A Ceramic Inventory and Chronological Analysis of Sinagua Settlement at Walnut Canyon National Monument*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Adams, E. Charles

1991 *The Origin and Development of the Pueblo Katsina Cult*. University of Arizona Press, Tucson.

Adams, Jenny L.

2006 The Development of Grinding Technology in the Flagstaff Area. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Stone, Shell, Bone, and Mortuary Analyses*, edited by Mark D. Elson, pp. 65-128. Anthropological Papers No. 31. Center for Desert Archaeology, Tucson.

Adams , David K., and Andrew C. Comrie
1997 The North American Monsoon. *Bulletin of the American Meteorological Society* 78:2197-2213.

Adler, Michael J.
1989 Ritual Facilities and Social Integration in Nonranked Societies. In *The Archaeology of Social Integration in the Prehistoric Pueblos*, edited by William Lipe and Michelle Hegmon, pp. 35-52. Occasional Paper No. 1. Crow Canyon Archaeology Center, Cortez, Colorado.

Adler, Michael J., and Richard H. Wilshusen
1992 Large-Scale Integrative Facilities in Tribal Societies: Cross-Cultural and Southwestern US Examples. *World Archaeology* 22:133-146.

Ahler, Stanley A., and Phil R. Geib
2000 Why Flute? Folsom Point Design and Adaptation. *Journal of Archaeological Science* 27:799-820.

Aitken, Barbara
1931 Folk History and its Raw Material; White Men's Raids on the Hopi Villages. *New Mexico Historical Review* 6:376-382.

Alley, William M.
1984 The Palmer Drought Severity Index: limitations and assumptions. Journal of Climate and Applied Meteorology 23:1100-1109.

Amos, Robert C.
1986 *Sunset Crater, Arizona: Evidence for a Large Magnitude Strombolian Eruption.* Master’s thesis, Department of Geology, Arizona State University, Tempe.

Anderson, Bruce A.
1990a *The Wupatki Archaeological Inventory Survey Project: Final Report* (editor). Southwest Cultural Resources Center Professional Paper No. 35. Division of Anthropology, National Park Service, Santa Fe.
1990b Rock Art. In *The Wupatki Archaeological Inventory Survey Project: Final Report,* edited by Bruce A. Anderson, Chapter 9, pp. 1-33. Southwest Cultural Resources Center Professional Paper No. 35. Division of Anthropology, National Park Service, Santa Fe.

Anderson, Bruce A., and Stan A. McDonald
1990 Material Culture Perspectives. In *The Wupatki Archaeological Inventory* Survey *Project: Final Report,* edited by Bruce A. Anderson, Chapter 7, pp. 1-62. Southwest Cultural Resources Center Professional Paper No. 35. Division of Anthropology, National Park Service, Santa Fe.

Bailey, L. R.
1966 *Indian Slave Trade in the Southwest: A Study of Slave-Taking and the Traffic of Indian Captives*. Westernlore Press, Los Angeles.

Baldwin, Anne R., and J. Michael Bremer
1986 *Walnut Canyon National Monument: An Archeological Survey*. Publications in Anthropology No. 39. National Park Service, Western Archeological and Conservation Center, Tucson.

Barnett, Franklin
1970 *Matli Ranch Ruins: A Report of Excavation of Five Small Prehistoric Indian Ruins of the Prescott Culture in Arizona*. Museum of Northern Arizona Technical Series No. 10. Northern Arizona Society of Science and Art, Flagstaff, AZ.
1978 *Las Vegas Ranch Ruin-East and Las Vegas Ranch Ruin-Rest*: T*wo Small Prehistoric Prescott Indian Culture Ruins in West Central Arizona*. Museum of Northern Arizona Bulletin No. 18. Northern Arizona Society of Science and Art, Flagstaff, AZ**.**

Barrett, S. A.
1926 Reconnaissance of the Citadel Group of Ruins in Arizona. *Yearbook of the Public Museum of Milwaukee* 6:7-58.

Bartlett, Katharine A.
1934 *Material Culture of Pueblo II in the San Francisco Mountains, Arizona*. Museum of Northern Arizona Bulletin 7. Northern Arizona Society for Science and Art, Flagstaff.
1939 A Prehistoric “Mine” of Red Argillite, Resembling Pipestone, near Del Rio, Arizona. Museum Notes 11(12):75-78.
1941 Skeletal Material from Winona and the Ridge Ruin. In *Winona and Ridge Ruin Part I, Architecture and Material Culture*, pp. 300-305. Museum of Northern Arizona Bulletin No. 18. Northern Arizona Society of Science and Art, Flagstaff, AZ.

Bascom, William
1984 The Forms of Folklore: Prose Narratives. In *Sacred Narrative: Readings in the Theory of Myth*, edited by Alan Dundes, pp. 5–29. University of California Press, Berkeley.

Bashkow, Ira
2004 A Neo-Boasian Conception of Cultural Boundaries. *American Anthropologist* 106:443-458.

Bass, William M.

1984 Is It Possible to Consume a Body Completely in a Fire? *In Human Identification: Case Studies in Forensic Anthropology*, edited by T.A. Rathbun and J.E. Buikstra, pp. 159-167. Charles C. Thomas, Springfield, Illinois.

Bayman, James M.

1999 Craft Economies in the North American Southwest. *Journal of Archaeological Research* 7:249-99.

Beaglehole, Ernest

1935 Notes on Hopi Warfare. In *The Hopi of Second Mesa*, pp. 17-24. Memoirs of the American Anthropological Association, No. 44. Menasha, Wisconsin.

1936 *Hopi Hunting and Hunting Ritual*. Yale University Publications in Anthropology, No. 4. New Haven, Connecticut.

Beaglehole, Ernest, and Pearl Beaglehole

1935 *The Hopi of Second Mesa*. Memoirs of the American Anthropological Association, No. 44. Menasha, Wisconsin.

Beals, Ralph L., George W. Brainerd, and Watson Smith

1945 *Archaeological Studies in Northeast Arizona : A Report on the Archaeological Work of the Rainbow Bridge-Monument Valley Expedition.* University of California Press, Berkeley.

Bell, Catherine M.

1992 *Ritual Theory, Ritual Practice*. Oxford University Press, New York.

1997 *Ritual: Perspectives and Dimensions*. Oxford University Press, New York.

Belshaw, Cyril S.

1951 Social Consequences of the Mount Lamington Eruption. *Oceania* 21:241–52.

Benson, Larry V.

2011a Factors Controlling Pre-Columbian and Early Historic Maize Productivity in the American Southwest, Part 1: The Southern Colorado Plateau and Rio Grande Regions. *Journal of Archaeological Method and Theory* 18: 1-60.

2011b Factors Controlling Pre-Columbian and Early Historic Maize Productivity in the American Southwest, Part 2: The Chaco Halo, Mesa Verde, Pajarito Plateau/Bandelier, and Zuni Archaeological Regions. *Journal of Archaeological Method and Theory* 18: 61-109.

Benson, Larry V., and Michael S. Berry

2009 Climate Change and Cultural Response in the Prehistoric American Southwest. *Kiva* 75:89-117.

Benson, Larry V., Michael S. Berry, Edward A. Jolie, Jerry D. Spangler, David W. Stahle, and Eugene M. Hattori

2007 Possible Impacts of Early-11th-, Middle-12th-, and Late-13th-Century Droughts on Western Native Americans and the Mississippian Cahokians. *Quaternary Science Reviews* 26:336-350.

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* 42:588-600.

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* 17:1-16.

Bernardini, Wesley, and Gary M. Brown

2004 The Formation of Settlement Clusters on Anderson Mesa. In *The Protohistoric Pueblo World, A.D. 1275-1600*, edited by E. Charles Adams and Andrew Duff, pp. 108-118. University of Arizona Press, Tucson.

Billingsley, George H., Susan S. Priest, and Tracey J. Felger

2007 *Geologic Map of Wupatki National Monument and Vicinity, Coconino County, Northern Arizona*. U.S. Geological Survey Scientific Investigations Map 2958. Government Printing Office, Washington, DC.

Black-Michaud, Jacob

1985 *Feuding Societies*. Basil Blackwell, New York.

Bledsoe, Caroline H.

1980 *Women and Marriage in Kpelle Society.* Stanford University Press, Stanford, California.

Bliss, Wesley L.

1956 Burials. In *Pipeline Archaeology: Reports of Salvage Operations in the Southwest on El Paso Natural Gas Company Projects, 1950-1953*, edited by Fred Wendorf, Nancy Fox, and Orian L. Lewis, pp. 133-135. Laboratory of Anthropology, Santa Fe; Museum of Northern Arizona, Flagstaff.

Blue, Martha

1988 *The Witch* Purge *of 1878: Oral and Documentary History in the early Navajo Reservation Years*. Navajo Oral History Monograph Series No. 1. Navajo Community College Press, Tsaile, AZ.

Boas, Franz

1928 *Keresan Texts*. Publications of the American Ethnological Society, Vol.VIII, Part I. New York.

Boehm, Christopher

1984 The Anthropology of Feuding in Montenegro and Other Tribal Societies. University Press of Kansas, Lawrence.

Bollig , Michael

1993 Intra- and Interethnic Conflict in Northwest Kenya: A Multicausal Analysis of Conflict Behaviour. *Anthropos* 88:176-84.

Bone, Travis S.

2002 *An Examination of Cohonina Social Organization through an Analysis of Public Space*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Boserup, Ester

1965 *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. Allen & Unwin, London.

Bosson, Claus

2006 War as Practice, Power, and Processor: A Framework for the Analysis of War and Social Structure Change. In *Warfare and Society: Archaeological and Ethnographic Perspectives*, edited by Ton Otto, Henrik Thrane, and Helle Vandkilde, pp. 89-111. Aarhus University Press, Oakville, CT.

Boston, Richard L.

1995 *Electron Microprobe Sourcing of Volcanic Ash Temper in Sunset Red Ceramics*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Bourdieu, Pierre

1977 *Outline of a Theory of Practice*. Cambridge University Press, New York.

Bradfield, Richard Maitland

1971 *The Changing Pattern of Hopi Agriculture*. Occasional Paper No. 30. Royal Anthropological Institute, London.

Bradfield, Richard Maitland

1973 *A Natural History of Associations: A Study in the Meaning of Community*. International Universities Press, New York.

Brand, Donald D.
1938 Aboriginal Trade Routes for Sea Shells in the Southwest. *Yearbook of the Association of Pacific Coast Geographers* 4:3-10.

Brand, Donald D., Florence M. Hawley, and Frank C. Hibben
1937 *Tseh So, a Small House Ruin, Chaco Canyon, New Mexico*. University of New Mexico Bulletin No. 308, Anthropological Series 2(2). Albuquerque.

Brennan, Ellen
2003 *The Flagstaff Ceramic Taxonomy and Chronology: A Reevaluation***.** Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Breternitz, David A.
1957a 1956 Excavations near Flagstaff, Part I. *Plateau* 30:22-30.
1957b 1956 Excavations near Flagstaff, Part II. *Plateau* 30:43-54.
1959 Excavations at Two Cinder Park Phase Sites. *Plateau* 31:66-72.
1963 Excavation of Some Pre-Eruption Pithouses near Flagstaff, Arizona. *Plateau* 34:135-143.
1966 *An Appraisal of Tree-Ring Dated Pottery in the Southwest*. Anthropological Papers of the University of Arizona No. 10. University of Arizona Press, Tucson.

Breternitz, David A., Arthur H. Rohm. Jr., and Elizabeth A. Morris
1974 *Prehistoric Ceramics of the Mesa Verde Region*. Museum of Northern Arizona Ceramic Series No. 5. Northern Arizona Society for Science and Art, Flagstaff.

Brewer, Sallie P., and Jim W. Brewer
1934 Excavation of Wupatki Room 59 Human Remains. Manuscript on file Museum of Northern Arizona, Department of Anthropology, Archaeological Site Files.

Brooks, James F.
2002 *Captives and Cousins*: *Slavery, Kinship, and Community in the Southwest Borderlands*. University of North Carolina Press, Chapel Hill.

Brown, Gregory B.
1996 *Direct Crop Production Evidence from Prehistoric Agricultural Fields***.** Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Brown, David E., (editor)
1994 *Biotic Communities: Southwestern United States and Northwestern Mexico*. University of Utah Press, Salt Lake City.

Brown, David E., and Charles H. Lowe
1982 *Biotic Communities of the Southwest*. Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-78. United States Forest Service, Fort Collins, Colorado

Bryce, William D., Jason Sperinck, Christine Stephenson, Kimberly A. Ryan, and Dan Garcia
2012a *Winona: Archaeological Survey for a Proposed Northern Arizona Shooting Range East of Flagstaff, Coconino County, Arizona*. Cultural Resource Survey Report No. 09-291001-B. EcoPlan Associates, Mesa, Arizona.

Bryce, William D., Jason Sperinck, F. Michael O'Hara, Christine Stephenson, Kimberly A. Ryan, and Dan Garcia
2012b *Cochrane Hill: Archaeological Survey for a Proposed Northern Arizona Shooting Range East of Flagstaff, Coconino County, Arizona*. Cultural Resource Survey Report No. 09-291001-A. EcoPlan Associates, Mesa, Arizona.

Burton, John
1989 Repeng and the Salt-Makers: 'Ecological Trade' and Stone Axe Production in the Papua New Guinea Highlands. *Man* 24:255-272.

Burton, Jeffery F.
1993 *When is a Great Kiva? Excavations at McCreery Pueblo*. Publications in Anthropology No. 63. Western Archeological and Conservation Center, Tucson, Arizona.

Burton, Ian, Robert W. Kates, and Gilbert F. White
1978 *The Environment as Hazard*. Oxford University Press, New York.

Cameron Catherine M.
1995 Migration and the Movement of Southwestern Peoples. *Journal of Anthropological Archaeology* 14:104-124.
2011 Captives and Culture Change: Implications for Archaeologists. *Current Anthropology* 52:169-209.
2013 How People Moved among Ancient Societies: Broadening the View. *American Anthropologist* 115:218-231.

Cameron, Erica L.
1999 *Examining Ethnicity through Architecture: The Sunset Crater Ashfall Area, A.D. 1050-1150*. Master’s thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Carlson, Roy L.

1970 *White Mountain Redware: A Pottery Tradition of East-Central Arizona and Western New Mexico*. Anthropological Papers of the University of Arizona, No. 19. University of Arizona, Tucson.

Carocci, Max, and Stephanie Pratt, eds.

2012 Native American Adoption, Captivity, and Slavery in Changing Contexts. Palgrave, New York.

Carter, Gregg Lee, ed.

2002 *Guns in American Society: An Encyclopedia of History, Politics, Culture, and the Law*. ABC-CLIO, Santa Barbara, California.

Cartledge, Thomas R.

1979 Cohonina Adaptation to the Coconino Plateau: A Re-Evaluation. *Kiva* 44:297-317.

Chagnon, Napoleon A.

1990 Reproductive and Somatic Conflicts of Interest in the Genesis of Violence and Warfare among Tribesmen. In *The Anthropology of War*, edited by Jonathan Haas, pp. 77-104. Cambridge University Press, New York.

1988 Life Histories, Blood Revenge, and Warfare in a Tribal Population. *Science* 239:985–992

Chess, David M.

1988 Simulating the Evolution of Behavior: The Iterated Prisoners' Dilemma Problem. *Complex Systems* **2**:663–670.

Christenson, Andrew L.

1994 A Test of Mean Ceramic Dating Using Well-Dated Kayenta Anasazi Sites. *Kiva* 59:297-317.

Cohen, Ronald

1984 Warfare and State Formation: Wars Make States and States Made Wars. In *Warfare, Culture, and Environment*, edited by R. Brian Ferguson, pp. 329-58. Academic Press, New York.

Cohen, Alex

1990 A Cross-Cultural Study of the Effects of Environmental Unpredictability on Aggression in Folktales. *American Anthropologist* 92:474-481.

Colson, Elizabeth

2007 Introduction - The Practice of War. In *The Practice of War*, edited by Aparna Rao, Michael Bollig, and Monika Bock, pp 1-19. Berghahn Books, New York.

Colton, Harold S.
1918 Geography of certain ruins near the San Francisco Mountains, Arizona. *Bulletin of the* Geographical *Society of Philadelphia* 16:37-60.
1932 The Effects of a Volcanic Eruption on an Ancient Pueblo People. The *Geographical Review* 32:582-590.
1936 The Rise and Fall of the Prehistoric Population of Northern Arizona. *Science* 82:337-343.
1937 *The B*asaltic Cinder *Cones and Lava Flows of the San Francisco Mountain Volcanic Field*. Museum of Northern Arizona Bulletin 10. Northern Arizona Society for Science and Art, Flagstaff.
1938 Economic Geography of the Winona Phase. *Southwestern Lore* 3(4):64-66.
1939 *Prehistoric Culture Units and Their Relationships in Northern Arizona*. Museum of Northern Arizona Bulletin 17. Northern Arizona Society for Science and Art, Flagstaff.
1941 Prehistoric Trade in the Southwest. *Scientific Monthly* 52:308-319.
1945 A Revision of the Date of the Eruption of Sunset Crater. *Southwestern Journal of Anthropology* 1:345-355.
1946 *The Sinagua: A Summary of the Archaeology of the Region of Flagstaff, Arizona*. Museum of Northern Arizona Bulletin 22. Northern Arizona Society for Science and Art, Flagstaff.
1952 *Pottery Types of the Arizona Strip and Adjacent Areas of Utah and Nevada*. Museum of Northern Arizona Ceramic Series No. 1. Northern Arizona Society for Science and Art, Flagstaff.
1955 *Pottery Types of the Southwest: Wares 8A, 8B, 9A, 9B; Tusayan Gray and White Ware, Little Colorado Gray and White Ware*. Museum of Northern Arizona Ceramic Series No. 3A. Northern Arizona Society for Science and Art, Flagstaff.
1956 *Pottery Types of the Southwest: Wares 5A, 5B, 6A, 6B, 7A, 7B, 7C; San Juan Red Ware, Tsegi Orange Ware, Homolovi Orange Ware, Winslow Orange Ware, Awatovi Yellow Ware, Jeddito Yellow Ware, Sichomovi Red Ware*. Museum of Northern Arizona Ceramic Series No. 3C. Northern Arizona Society for Science and Art, Flagstaff.
1958 *Pottery Types of the Southwest: Wares 14, 15, 16, 17, 18; Revised Descriptions Alameda Brown Ware, Tizon Brown Ware, Lower Colorado Buff Ware, Prescott Gray Ware, San Francisco Mt. Gray Ware*. Museum of Northern Arizona Ceramic Series No. 3D. Northern Arizona Society for Science and Art, Flagstaff.
1960 *Black Sand: Prehistory in Northern Arizona*. University of New Mexico Press, Albuquerque.
1964 Principal Hopi Trails. *Plateau* 36:91-94.
1965 Experiments in Raising Corn in the Sunset Crater Ashfall Area East of Flagstaff, Arizona. *Plateau* 37(3):77-79.

Colton, Harold S.
1968 Frontiers of the Sinagua. In *Collected Papers in Honor of Lyndon Lane Hargrave,* edited by Albert H. Schroeder, pp. 9-15. Papers of the Archaeological Society of New Mexico No. 1. Museum of New Mexico Press, Santa Fe.

Colton, Mary-Russell F., and Harold S. Colton
1918 The Little Known Small House Ruins in the Coconino Forest. *Memoirs of the American Anthropological Association* 5(4):101-126.
1931 Petroglyphs, the Record of a Great Adventure. *American Anthropologist* 33:32-37.

Colton, Harold S., and Lyndon L. Hargrave
1937 *Handbook of Northern Arizona Pottery Wares*. Museum of Northern Arizona Bulletin No. 11. Northern Arizona Society of Science and Art, Flagstaff, AZ.

Cook, Edward R., David M. Meko, David W. Stahle, and Malcolm K.Cleaveland
1999 Drought Reconstructions for the Continental United States. *Journal of Climate* 12: 1145–1162.

Cook, Edward R., Connie Woodhouse, C. Mark Eakin, David M. Meko, and David W. Stahle
2004 Longterm Aridity Changes in the Western United States. *Science* 306:1015–1018.

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, New Mexico.

Cornell, Tim J., and Thomas B. Allen
2002 *War and Games*. Center for the Interdisciplinary Research on Social Stress. The Boydell Press, Rochester, New York.

Cosner, Oliver J.
1962 *Ground Water in the* Wupatki *and Sunset Crater National Monuments, Coconino County, Arizona*. U.S. Geological Survey Water Supply Paper 1475-J. Government Printing Office, Washington, DC.

Courlander, Harold
1970 *People of the Short Blue Corn: Tales and Legends of the Hopi Indians*. Harcourt Brace Jovanovich, New York.
1971 *The Fourth World of the Hopi: The Epic Story of the Hopi Indians Preserved in Their Legends and Traditions*. Crown Publishers, New York.

Courlander, Harold

1982 *Hopi Voices: Recollections, Traditions, and Narratives of the Hopi Indians*. University of New Mexico Press, Albuquerque.

Crotty, Helen K.

2001 Shields, Shield Bearers, and Warfare Imagery in Anasazi Art, 1200-1500. In *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare*, Rice, Glen E., and Steven A. LeBlanc, pp. 65-83. University of Utah Press, Salt Lake City.

Crown, Patricia L.

1991 The Role of Exchange and Interaction in Salt-Gila Basin Hohokam Prehistory. In *Exploring the Hohokam: Prehistoric Dwellers of the American Southwest*, edited by George Gumerman, pp. 383-415. Albuquerque: University of New Mexico Press.

Crumley, Carole L.

1995 Heterarchy and the Analysis of Complex Societies. *Archeological Papers of the American Anthropological Association* 6 (1): 1–5.

Curtis, Edward S.

1922 *The North American Indian, Vol. 12*. The University Press, Cambridge, Massachusetts.

Cutter, Susan L.

1994 *Environmental Risks and Hazards* (ed.). Prentice-Hall, Englewood Cliffs, New Jersey.

1996 Vulnerability to Environmental Hazards. *Progress in Human Geography* 20:529-539.

D'Amico, Diane H.

1977 *Rock Art of the Northern Sinagua Area*. Master’s thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Darling, J. Andrew

1998 Mass Inhumation and the Execution of Witches in the American Southwest. *American Anthropologist* 100:732–752.

Day, Jane Stevenson

2001 Unity in Duality: The Practice and Symbols of the Mesoamerican Ballgame. In *The Sport of Life and Death: The Mesoamerican Ballgame*, edited by E. Michael Whittington, pp. 65-77. Thames and Hudson, New York.

Dean, Jeffrey S.

1988 A Model of Anasazi Behavioral Adaptation. In *The Anasazi in a Changing Environment*, edited by George J. Gumerman, pp. 25-44. Cambridge University Press, New York.

1996 Demography, Environment and Subsistence Stress. In *Evolving Complexity and Environmental Risk in the Prehistoric Southwest*, edited by Joseph. A. Tainter and Bonnie B. Tainter, pp. 25-56. Addison-Wesley, Reading, MA.

2006 Subsistence Stress and Food Storage at Kiet Siel, Northeastern Arizona In *Environmental Change and Human Adaptation in the Ancient American Southwest*, edited by David E. Doyel and Jeffrey S. Dean, pp. 160-179. University of Utah Press, Salt Lake City.

Dean, Jeffrey S., and David E. Doyel

2006 Culture, Environment, and Adaptation: Perspectives from the Ancient Southwest. In *Environmental Change and Human Adaptation in the Ancient American Southwest*, edited by David E. Doyel and Jeffrey S. Dean, pp. 1-9. University of Utah Press, Salt Lake City.

Dean, Jeffrey S., and William J. Robinson

1977 *Dendroclimatic Variability in the American Southwest. A.D. 680 to 1970*. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

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, NM

Dean, Jeffrey S., Robert E. Euler, George J. Gumerman, Fred Plog, Richard H. Hevly, and Thor N. V. Karlstrom

1985 Human Behavior, Demography, and Paleoenvironment on the Colorado Plateau. *American Antiquity* 50:537-554.

De Boer, Warren R.

1976 *Archaeological Explorations in Northern Arizona: NA 10754, a Sinagua Settlement of the Rio de Flag Phase*. Queens College Publications in Anthropology, No. 1. Queens College Press, Flushing, New York.

Dirks, Robert

1980 Social Responses During Severe Food Shortages and Famines. *Current Anthropology* 21:21-44.

Divale, William Tulio, and Marvin Harris

1976 Population, Warfare, and the Male Supremacist Complex. *American Anthropologist* 78:521-538.

Dixon , Keith A.
1956 *Hidden House: A Cliff Ruin in Sycamore Canyon, Central Arizona*. Museum of Northern Arizona Bulletin No. 29. Northern Arizona Society of Science and Art, Flagstaff.

Donnan, Hastings, and Thomas M. Wilson
1994 An Anthropology of Frontiers. In *Border Approaches: Anthropological Perspectives on Frontiers*, edited by Hastings Donnan and Thomas M. Wilson, pp. 1-14. University Press of America, Lanham, MD.

Dorsey, George A., and H. R. Voth
1901 *The Oraibi Powamu Ceremony*. Fieldiana Anthropology, Vol. 3, No. 2. Field Museum of Anthropology, Chicago.

Dosh, Steven G.
1998 *Medicine Jar and Medicine Bowl: Cohonina and Northern Sinagu Living Side-by-Side in Medicine Valley***.** Technical Report 98-25. Northland Research, Flagstaff.

Douglass, Amy A.
1987 *Prehistoric Exchange and Sociopolitcal Development: The Little Colorado White Ware Production-Distribution System*. Doctoral dissertation, Department of Anthropology, Arizona State University, Tempe.

Douglas, M. W., R. Maddox, K. Howard, and S. Reyes 1993
1993 The Mexican Monsoon. *Journal of Climate* 6:1665-1667.

Downum, Christian E.
1988 *"One Grand History": A Critical Review of Flagstaff Archaeology, 1851-1988***.** Doctoral dissertation, Department of Anthropology, University of Arizona, Tucson.
1992 The Sinagua. *Plateau* 63(1):1-33.

Downum, Christian E,. and Alan P. Sullivan III
1990 Settlement Patterns. In *The Wupatki Archaeological Inventory Survey Project: Final Report*, edited by Bruce A. Anderson, Chapter 5, pp. 1-90. Southwest Cultural Resources Center Professional Paper No. 35. Division of Anthropology, National Park Service, Santa Fe.

Downum, Christian E., Ellen Brennan, and James P. Holmlund
1999 *An Architectural Study of Wupatki Pueblo (NA 405)***.** Archaeological Report No. 1175. Northern Arizona University Anthropology Laboratories, Flagstaff.

Doyel, David E.

1991 Hohokam Exchange and Interaction. In *Chaco and Hohokam: Prehistoric Regional Systems in the American Southwest*, edited by Patrician L. Crown and W. James Judge, pp. 225-252. School of American Research Press, Santa Fe, NM.

2000 The Santan Phase in the Phoenix Basin. In *The Hohokam Village Revisited*, edited by David Doyel, Suzanne K. Fish, and Paul R. Fish, pp. 221-244. Southwestern and Rocky Mountain Division of the American Association of Science, Fort Collins, CO.

Duff, Andrew I.

2002 *Western Pueblo Identities: Regional Interaction, Migration, and Transformation*. University of Arizona Press, Tucson.

Dye, David H.

2004 Art, Ritual, and Chiefly Warfare in the Mississippian World. In *Hero Hawk and Open Hand: American Indian Art of the Ancient Midwest and South*, edited by Richard F. Townsend, pp. 191-205. University of Tennessee Press, Knoxville.

Eakins, Hallie, and Amy Lynd Luers

2006 Assessing the Vulnerability of Social-Environmental Systems. *Annual Review of Environment and Resources* 31:365-394

Eckholm, Gordon F.

1945 *Excavations at Guasave, Sinaloa, Mexico*. Anthropological Papers of the American Museum of Natural History, Vol. 38, Pt. 2. New York.

Edwards, Joshua S.

2003 *Soil Fertility and Prehistoric Agriculture near Sunset Crater, Arizona*. Master's thesis, Quaternary Studies Program, Northern Arizona University, Flagstaff.

2007 Soil Fertility and Prehistoric Agriculture in the Sunset Crater Area. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Environmental Analyses*, edited by Mark D. Elson, pp. 37-58. Anthropological Papers No. 33. Center for Desert Archaeology, Tucson.

Eggan, Fred

1950 Social Organization of the Western Pueblos. University of Chicago Press.

Eliade, Mircea

1964 *Shamanism: Archaic Techniques of Ecstasy*, translated by Willard R. Trask. Princeton University Press, Princeton, NJ.

Ellis, Florence Hawley
1951 Patterns of Aggression and the War Cult in Southwestern Pueblos. *Southwestern Journal of Anthropology* 7:177-201.

Ellis, Christopher J.
1997 Factors Influencing the Use of Stone Projectile Tips: An Ethnographic Perspective. In *Projectile Technology*, edited by Heidi Knecht, pp. 37-74. Plenum Press, New York.

Elson, Mark D., editor
2006 *Sunset Crater Archaeology: The History of a Volcanic Landscape, Introduction and Site Descriptions*. Anthropological Papers No. 30. Center for Desert Archaeology, Tucson.

Elson, Mark D., and James N. Gunderson
1992 The Mineralogy and Sourcing of Argillite Artifacts: A Preliminary Examination of Procurement, Production, and Distribution Systems. In *The Rye Creek Project: Archaeology in the Upper Tonto Basin*, vol. 2, edited by Mark D. Elson and Douglas Craig, Center for Desert Archaeology Anthropological Papers No. 11,.

Elson, Mark D., Michael H. Ort, Paul R. Sheppard, Terry L. Samples, Kirk C. Anderson, Elizabeth M. May, and David J. Street
2011 Sunset Crater Volcano. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Prehistoric Settlement in the Shadow of the Volcano*, edited by Mark D. Elson, pp. 103-129. Anthropological Papers No. 37. Center for Desert Archaeology, Tucson.

Elson, Mark D., David J. Street, Jeffrey S. Dean, and Michael H. Ort
2009 *A.D. 1064? A Pilot Study of Archaeological Tree-Ring Samples to Search for Visible Evidence of the Eruption of Sunset Crater Volcano, Northern Arizona*. Technical Report No. 2005-10. Desert Archaeology, Tucson.

Elson, Mark D., Michael H. Ort, Kirk C. Anderson, and James M. Heidke
2007 Living with the Volcano: The 11th Century AD Eruption of Sunset Crater. In *Living Under the Shadow, the Cultural Impacts of Volcanic Eruptions*, edited by John Grattan and Robin Torrence, pp. 107-132. Left Coast Press, Walnut Creek, California

Elwert, Georg
2002 Switching Identity Discourses: Primordial Emotions and the Social Construction of We-Groups. In *Imagined Differences: Hatred and the Construction of Identity*, edited by Günther Schlee, pp. 33-54. Palgrave, New York.

Ember, Carol R., and Melvin Ember
1992 Resource Unpredictability, Mistrust, and War: A Cross-Cultural Study. *Journal of Conflict Resolution* 36:242-262.

Ember, Melvin

1982 Statistical Evidence for an Ecological Explanation of Warfare. *American Anthropologist* 84:645-649.

Fathauer, George H.

1951 The Mohave Ghost Doctor. *American Anthropologist* 53: 605-607.

1954 The Structure and Causation of Mohave Warfare. *Southwestern Journal of Anthropology* 10(1): 97-118.

Feinman, Gary N., Kent G. Lightfoot, and Steadman Upham

2000 Political Hierarchies and Organizational Strategies in the Puebloan Southwest. *American Antiquity* 65:449-470

Ferguson, R. Brian, editor

1984 *Warfare, Culture, and Environment*. Academic Press, Orlando, Florida.

Ferguson, T. J., and Micah Loma'omvaya

2011 Nuvatukya'ovi, Palatsmo Niqw Wupatki: Hopi History, Culture, and Landscape. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Prehistoric Settlement in the Shadow of the Volcano*, edited by Mark D. Elson, pp. 143-186. Anthropological Papers No. 37. Center for Desert Archaeology, Tucson.

Fewkes, Jesse Walter

1898 Archaeological Expedition to Arizona in 1895. In *The Seventeenth Annual Report of the Bureau of American Ethnology*, Part 2, pp.519-744. Government Printing Office, Washington, DC.

1900 Tusayan Migration Legends. In *The Nineteenth Annual Report of the Bureau of American Ethnology*, pp. 573-633. Government Printing Office, Washington, D.C.

1904 Two Summers Work in Pueblo Ruins. In *The Twenty-Second Annual Report of the Bureau of American Ethnology*, pp 3-195. Government Printing Office, Washington, D.C.

1920 Sun Worship of the Hopi Indians. In *Annual Report of the Board of Regents of the Smithsonian Institution, 1918*, pp. 493-526. Government Printing Office, Washington, DC.

1926 An Archeological Collection from Young's Canyon, Near Flagstaff, Arizona. *Smithsonian Miscellaneous Collections* 77(10):1-15.

Fewkes, J. Walter, and Alexander M. Stephen

1893 The Pá-lü-lü-koñ-ti: A Tusayan Ceremony. ***Journal of American Folklore*** 6:269-282.

Firth, Raymond

1959 *Social Change in Tikopia.* Allen & Unwin, London.

Fish, Suzanne K., and Paul R. Fish

1984 *Prehistoric Agricultural Strategies in the Southwest* (editors). Anthropological Research Papers No. 33. Arizona State University, Tempe.

1994 Prehistoric Desert Farmers of the Southwest. *Annual Review of Anthropology*. 23 83-108.

Fish, Paul R., Peter J. Pilles Jr., and Suzanne K. Fish

1980 Colonies, Traders, and Traits: The Hohokam in the North. In *Current Issues in Hohokam Prehistory: Proceedings of a Symposium*, edited by David Doyel and Fred Plog, pp. 151-175. Anthropological Research Papers 23. Arizona State University, Tempe.

Fisher Motz, J. C.

1933 Notes on Wupatki Architecture. In Scientific Report on the Excavation of Wupatki, F-68 CWA Work Project No. 10, Wupatki National Monument, by Harold S. Colton, L.L. Hargrave, J.W. Brewer Jr., Ten Broeck Williamson, Richard Vam Valkenburgh, and J.C. Fisher Motz. Museum of Northern Arizona Department of Anthropology, Flagstaff.

Fishler, Stanley A.

1953 *In the Beginning: A Navajo Creation Myth*. University of Utah Anthropological Papers No. 13. Salt Lake City.

Forbes, Jack D.

1965 *Warriors of the Colorado: The Yumas of the Quechan Nation and Their Neighbors*. Civilization of the American Indian Series. Norman: University of Oklahoma Press.

Forde, C. Daryll

1931a Hopi Agriculture and Land Ownership. *Journal of the Royal Anthropological Institute* 61:357-404.

1931b Ethnography of the Yuma Indians. *University of California Publications in American Archaeology and Ethnology* 28(4): 83-273.

Foshag, William F., and Jenaro Gonzalez-Reyna

1956 *Birth and Development of Paricutin Volcano*. U.S. Geological Survey Bulletin 965-D. Government Printing Office, Washington, DC.

Fowler, Andrew P. and John R. Stein

1992 The Anasazi Great House in Space, Time, and Paradigm. In *Anasazi Regional Organization and the Chaco System*, edited by David E Doyel, pp.101-122. Maxwell Museum of Anthropology Anthropological Papers 5. University of New Mexico, Albuquerque.

Fox, John G.
1996 Playing with Power: Ballcourts and Political Ritual in Southern Mesoamerica. *Current Anthropology* 37:483-509.

Frazier, Kendrick
1986 *People of Chaco: A Canyon and Its Culture*. W.W. Norton, New York.

Freidel, David A., Linda Schele, and Joy Parker
1993 *Maya Cosmos: Three Thousand Years on the Shaman's Path*. W. Morrow, New York.

Friedrich, Walter
2000 *Fire in the Sea: The Santorini Volcano: Natural History and the Legend of Atlantis*. Cambridge University Press, New York.

Gaillard, Jean-Christophe
2002 Territorial Conflicts Following Volcanic Disasters. *Philippine Geographical Journal* 46:3-17.
2006 Traditional Societies in the Face of Natural Hazards: The 1991 Mt. Pinatubo Eruption and the Aetas of the Philippines. *International Journal of Mass Emergencies and Disasters* 24:5-43.

Gaillard, Jean-Christophe, and Virginie Le Masson
2002 Traditional Societies' Response to Volcanic Hazards in the Philippines. *Mountain Research and Development* 27:313-317.

Garcia, Daniel
2004 *Prehistoric Ceramic Boundaries in the Flagstaff Region, Northern Arizona*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Geertz, Armin W.
1987 *Hopi Indian Altar Iconography*. Iconography of Religions. Section X, North America, Fascicle 5. E. J. Brill, Leiden.

Geertz, Armin W., and Michael Lomatuway'ma
1987 *Children of Cottonwood: Piety and Ceremonialism in Hopi Indian Puppetry*. American Indian Tribal Religions, Vol. 12. University of Nebraska Press, Lincoln.

Geib, Phil R.
1996 *Glen Canyon Revisited*. Anthropological Papers No. 119. University of Utah Press, Salt Lake City.

Gifford, Edward W.
1932 *The Southeastern Yavapai*. University of California Publications in American Archaeology and Ethnology v. 29, no. 3. University of California Press, Berkeley.
1936 *Northeastern and Western Yavapai*. University of California Publications in American Archaeology and Ethnology v. 34, no. 4. University of California Press, Berkeley.
1940 *Culture Element Distributions XII, Apache-Pueblo*. Anthropological Records, Vol. 4, No. 1. University of California Press, Berkeley.

Gillespie, Susan D.
1991 Ballgames and Boundaries. In *The Mesoamerican Ballgame*, edited by Vernon L. Scarborough and David R, Wilcox, pp. 317-345. University of Arizona Press, Tucson.

Gilpin, Denis
1989 Great Houses and Pueblos in Northeastern Arizona. Paper presented at the 1989 Pecos Conference, Bandelier National Monument, Los Alamos, New Mexico.
2003 Chaco-Era Site Clustering and the Concept of Communities. *Kiva* 69:171-205.

Gladwin, Winifred, and Harold S. Gladwin
1931 *Some Southwestern Pottery Types, Series II*. Medallion Papers 10. Gila Pueblo, Globe, Arizona.

Goody, Jack
1971 *Technology, Tradition, and the State in Africa*. Oxford University Press, New York.

Graham, Edward E.
1975 Yuman Warfare: An Analysis of Ecological Factors from Ethnohistorical Sources. In *War, Its Causes and Correlates*, edited by Martin A. Nettleship, R. Dale Givens, and Anderson Nettleship, pp. 451-462. World Anthropology Series. The Hague: Mouton Publishers.

Graybill, Donald A., David A. Gregory, Gary S. Funkhouser, and Fred L. Nials
2006 Long-Term Streamflow Reconstructions, River Channel Morphology, and Aboriginal Irrigation Systems along the Salt and Gila Rivers. In *Environmental Change and Human Adaptation in the Ancient American Southwest*, edited by David E. Doyel and Jeffrey S. Dean, pp. 69-123. University of Utah Press, Salt Lake City.

Green, Stanton W., and Stephen M. Perlman
1985 Frontiers, Boundaries, and Open Social Systems. In *The Archaeology of Frontiers and Boundaries*, edited by Stanton W. Green and Stephen M. Perlman, pp. 145-183. Academic Press, Orlando, FL.

Gumerman, George J.
1988 *The Archaeology of the Hopi Buttes District, Arizona*. Research Paper No. 49. Center for Archaeological Investigations, Southern Illinois University at Carbondale.

Gumerman, George J., and S. Alan Skinner
1968 A Synthesis of the Prehistory of the Central Little Colorado Valley, Arizona. *American Antiquity* 33:185-199.

Guttierez, Mary Ellen
1990 The Maya Ballgame as a Metaphor for Warfare. *Mexicon* 12(6):105-108

Guyer, Jane I.
1993 Wealth in People and Self-Realization in Equatorial Africa. *Man* 28:243-265.

Hass, Jonathan, and Winifred Creamer
1993 *Stress and Warfare among the Kayenta Anasazi of the 13th Century A.D.* Fieldiana Anthropology, New Series, No. 21. Field Museum of Natural History, Chicago.
1997 Warfare among the Pueblos: Myth, History, and Ethnography. *Ethnohistory* 44:235-261.

Hack, John T.
1942 *The Changing Physical Environment of the* Hopi *Indians of Arizona*. Papers of the Peabody Museum of American Archaeology and Ethnology, Vol. 35, No. 1. Harvard University, Cambridge

Haglund, William D.
1997 Dogs and Coyotes: Postmortem Involvement with Human Remains. In *Forensic Taphonomy: The Postmortem Fate of Human Remains*, edited by William D. Haglund and Marcella H. Sorg, pp. 367-379. CRC Press, Boca Raton, Florida.

Haglund, W. D., Donald T. Reay and Daris R. Swindler
1989 Canid Scavenging/ Disarticulation Sequence of Human Remains in the Pacific Northwest. *Journal of Forensic Sciences* 34:587-606.

Haile, Berard
1938 *Origin Legend of the Navajo Enemy Way*. Yale University Publications in Anthropology, No. 17. Yale University Press, New Haven, Connecticut.

Halstead, Paul, and John O'Shea
1989 Introduction: Cultural Responses to Risk and Uncertainty. In *Bad Year Economics: Cultural Responses to Risk and Uncertainty*, edited by Paul Halstead and John O'Shea, pp. 1-7. New Directions in Archaeology. Cambridge University Press, New York.

Hargrave, Lyndon Lane
1933 *Pueblo II Houses of the San Francisco Mountains, Arizona*. Museum of Northern Arizona Bulletin 4. Northern Arizona Society for Science and Art, Flagstaff.
1937 A New Sub-Culture in Arizona. *Southwestern Lore* 3:54-57.
1938 Results of a Study of the Cohonina Branch of the Patayan Culture in 1938. *Museum Notes* 11:43-50.

Harper , Christopher L.
1993 *Seasons and Settlement Patterns at Walnut Canyon National Monument, Arizona*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Harris, Marvin
1984 A Cultural Materialist Theory of Band and Village Warfare: The Yanomamo Test. In *Warfare, Culture, and Environment*, edited by R. Brian Ferguson, 111-140. Academic Press, Orlando, Florida.

Harrison, Simon
1989 The Symbolic Construction of Aggression and War in a Sepik River Society. *Man* 24:583-599.
1993 *The Mask of War: Violence, Ritual and the Self in Melanesia*. *Manchester* University Press, New York.
1995 Transformations of Identity in Sepik Warfare. In: *Shifting Contexts: Transformations in Anthropological Knowledge*, edited by Marilyn Strathern, pp. 81-98. Routledge, New York.

Harry, Karen G.
2005 Ceramic Specialization and Agricultural Marginality: Do Ethnographic Models Explain the Development of Specialized Pottery Production in the Prehistoric American Southwest? *American Antiquity* 70:295-319.

Hasbargen, Jim
1997 *Identification of Prehistoric Fields through Palynological Evidence*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Haury, Emil W.
1976 *The Hohokam, Desert Farmers & Craftsmen: Excavations at Snaketown, 1964-1965*. University of Arizona Press, Tucson.

Haury, Emil W., Kirk Bryan, Edwin H. Colbert, Norman Gabel, Clara Lee Tanner, and T.E. Buehrer
1950 *The Stratigraphy and Archaeology of Ventana Cave, Arizona*. University of Arizona Press, Tucson.

Hawley, Florence
1936 *Field Manual of Prehistoric Southwestern Pottery Types*. University of New Mexico Bulletin, Anthropological Series 1(4). University of New Mexico Press, Albuquerque.

Hays-Gilpin, Kelley, and Donald E. Weaver, Jr.
2012 Marks on the Land: Rock Art of the Sierra Sin Agua. In *Hisat'sinom: Ancient Peoples in a Land without Water*, edited by Christian E. Downum, pp. 16-25. School for Advanced Research Press, Santa Fe.

Hays-Gilpin, Kelley, and Eric van Hartesveldt (editors)
1998 *Prehistoric Ceramics of the Puerco Valley: The 1995 Chambers-Sanders Trust Lands Ceramic Conference*. Museum of Northern Arizona Ceramic Series No. 7. Flagstaff.

Hedquist, Saul L.
2007 *Inferring Social Complexity: An Examination of the Quantity and Distribution of Exotic Material Goods* . Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Hegmon, Michelle
1989 Social Integration and Architecture. In *The Architecture of Social Integration in Prehistoric Pueblos*, edited by William D. Lipe and Michelle Hegmon, pp. 5-14. Occasional Paper No. 1. Crow Canyon Archaeology Center, Cortez, CO.
1996 Variability in Food Production, Strategies of Storage and Sharing, and the Pit House to Pueblo Transition in the Northern Southwest. In *Evolving Complexity and Environmental Risk in the Prehistoric Southwest*, edited by Joseph. A. Tainter and Bonnie B. Tainter, pp. 223-250. Addison-Wesley, Reading, MA.

Heidke, James M., Susan C, Leary, Sarah A. Herr, and Mark D. Elson
2007 Alameda Brown Ware and San Francisco Mountain Gray Ware Technology and Economics. In *Sunset Crater Archaeology: The History of a Volcanic Landscape – Ceramic Technology, Distribution, and Use,* edited by Scott Van Keuren, Mark D. Elson, and Sarah A. Herr, pp. 145-183. Anthropological Papers No. 32. Center for Desert Archaeology, Tucson.

Heine, Bernd
1985 The Mountain People: Some Notes on the Ik of North-Eastern Uganda. *Africa: Journal of the International African Institute* 55:3–16.

Helbling, Jürg
1999 The dynamics of War and Alliance among the Yanomami. In *Dynamics of Violence: Processes of Escalation and Deescalation of Violent Group Conflicts*, edited by Georg Elwert, Stephen Feuchtwang, and Dieter Neubert, pp. 103-116. Dunker & Humblot, Berlin.
2006 War and Peace in Societies without Central Power: Theories and Perspectives. In *Warfare and Society: Archaeological and Ethnographic Perspectives*, Ton Otto, Henrik Thrane, and Helle Vandkilde, pp. 89-111. Aarhus University Press, Oakville, CT.

Helms, Mary W.
1998 *Access to Origins: Affines, Ancestors, and Aristocrats*. University of Texas Press, Austin.

Hendricks, David M., editor
1985 *Arizona Soils*. College of Agriculture, University of Arizona, Tucson.

Herr, Sarah A.
2001 *Beyond Chaco: Great Kiva Communities on the Mogollon Rim Frontier*. Anthropological Papers of the University of Arizona No. 66. University of Arizona Press, Tucson.

Herr, Sarah A., and Scott Van Keuren
2007 Ceramic Economy and Cultural Identity in the Sunset Crater Landscape. In *Sunset Crater Archaeology: The History of a Volcanic Landscape – Ceramic Technology, Distribution, and Use,* edited by Scott Van Keuren, Mark D. Elson, and Sarah A. Herr, pp. 185-203. Anthropological Papers No. 32. Center for Desert Archaeology, Tucson.

Herr, Sarah A., and Jeffery J. Clark
2002 Mobility and the Organization of Prehispanic Southwest Communities. In *The Archaeology of Tribal Societies*, edited by William A. Parkinson, pp. 123-154. Archaeological Series 15, International Monographs in Prehistory, Ann Arbor.

Hieb, Louis
1994 Hopi Thought and Archaeological Theory: The Sipapu Reconsidered. *American Indian Religions* 1:17-36.

Hill, W. W.
1936 *Navajo Warfare*. Yale University Publications in Anthropology, No. 5. Yale University Press, New Haven, Connecticut.

Hill, Kenneth C., Emory Sekaquaptewa, Mary Black, and Ekkehart Malotki, eds.
1998 *Hopi Dictionary = Hopìikwa Lavàytutuveni: A Hopi-English Dictionary of the Third Mesa Dialect*. University of Arizona Press, Tucson.

Hill, Warren D., and John E. Clark
2001 Sports Gambling and Government: America's First Social Compact? *American Anthropologist* 103:331-345.

Hobbes, Thomas
1996 [1651] *Leviathan*, edited with an introduction by J.C.A. Gaskin. Oxford UNiversity Press, New York.

Hoffman, Charles Marshall
1997 *Alliance Formation and Social Interaction during the Sedentary Period: A Stylistic Analysis of Hohokam Arrowpoints*. Doctoral dissertation, Department of Anthropology, Arizona State University, Tempe.

Hogbin, H. Ian
1939 Native Land Tenure in New Guinea. *Oceania* 10:113-165.

Hohmann, John W.
1983 *Sinagua Social Differentiation: Inferences Based on Prehistoric Mortuary Practices*. Arizona Archaeologist No. 17. Arizona Archaeological Society, Phoenix.

Holm, Richard F., and Richard B. Moore
1987 Holocene Scoria Cone and Lava at Sunset Crater, Northern Arizona. *In Rocky Mountain Section of the Geological Society of America Centennial Field Guide*, vol. 2, edited by Stanley S. Beus, pp. 393-397.Geoogical Society of America, Boulder.

Hooton, Jason A., and Michael H. Ort
2007 Sunset Crater Tephra Mapping Project. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Environmental Analyses*, edited by Mark D. Elson, pp. 87-93. Anthropological Papers No. 33. Center for Desert Archaeology, Tucson.

Horn-Wilson, Amy
1997 *Projectile Points of the Cohonina: A Pilot Study*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Howell, Todd L.
2001 Foundations of Political Power in Ancestral Zuni Society. In *Ancient Burial Practices in the American Southwest: Archaeology, Physical Anthropology, and Native American Perspectives*, edited by Duglas R. Mitchell and Judy L. Brunson-Hadley, pp. 149-166. University of New Mexico Press, Albuquerque.

Hudgens, Bruce R.
1974 The Turkey Hills Community: A Sinagua Settlement Pattern Study. Manuscript on file, Museum of Northern Arizona, Flagstaff.

Hurlbert, Stuart H.
1971 The Nonconcept of Species Diversity: A Critique and Alternative Parameters. *Ecology* **52**:577-586.

Jernigan, E. Wesley
1978 *Jewelry of the Prehistoric Southwest*. School of American Research, Santa Fe; University of New Mexico Press, Albuquerque.

Jett, Stephen C., and Virginia E. Spencer
1981 *Navajo Architecture: Forms, History, Distributions*. University of Arizona Press, Tucson.

Jones, Siân
1997 The Archaeology of Ethnicity: Constructing Identities in the Past and Present. Routledge Press, New York.

Judd, Neil M.
1930 *The Excavation and Repair of Betatakin*. Proceedings of the U.S. National Museum, No. 77. Smithsonian Institution, Washington, DC.
1959 *Pueblo del Arroyo, Chaco Canyon, New Mexico*. Smithsonian Miscellaneous Collections, Vol. 135, No. 1. Smithsonian Institution, Washington, DC.

Justice, Noel D.
2002 *Stone Age Spear and Arrow Points of the Southwestern United States*. University of Indian Press, Bloomington.

Kamp, Kathryn A., and John C. Whittaker
1999 *Surviving Adversity: The Sinagua of Lizard Man Village*. University of Utah Anthropological Papers No. 120. University of Utah Press, Salt Lake City.
2009 An Acropolis of the Sinagua: Architectural Adaptation at New Caves, Arizona. *Kiva* 74:281-304.

Kantner, John, and Nancy M. Mahoney, editors
2000 *Great House Communities across the Chacoan Landscape*. Anthropological Papers of the University of Arizona, No. 64. University of Arizona Press, Tucson.

Kantner, John
2003 Preface: The Chaco World. *Kiva* 69:83–92

Keegan, John
1993 *A History of Warfare*. Hutchinson, London.

Keeley, Lawrence H.
1996 *War Before Civilization*. Oxford University Press, New York.

Keesing, Felix M.,
1952 The Papuan Orokaiva vs Mt. Lamington: Cultural Shock and its Aftermath. *Human Organization* 2:16–22.

Kehoe, Alice B.
1989 *The Ghost Dance: Ethnohistory and Revitalization. Case Studies in Cultural Anthropology*. Holt, Rinehart, and Winston, Fort Worth, Texas.

Kelly, Roger E.
1971 *Diminishing Returns: Twelfth and Thirteenth Century Sinagua Environmental Adaptation in North Central Arizona*. Doctoral dissertation, Department of Anthropology, University of Arizona, Tucson.

Kelly, William H.
1977 *Cocopa Ethnography*. Anthropological Papers of the University of Arizona, No. 29. University of Arizona Press, Tucson.

Kelly, Raymond C.
2000 *Warless Societies and the Origin of War*. University of Michigan Press, Ann Arbor.

Kent, Kate Peck
1957 *The Cultivation and Weaving of Cotton in the Prehistoric Southwestern United States*. Transactions of the American Philosophical Society, Vol. 47, Pt. 3. Philadelphia.

Kidder, Alfred Vincent
1924 *An Introduction to the Study of Southwestern Archaeology with a Preliminary Account of the Excavations at Pecos*. Yale University Press, New Haven, Connecticut.

Kidder, Alfred Vincent, and Samuel J. Guernsey
1919 *Archeological Explorations in Northeastern Arizona*. Bureau of American Ethnology Bulletin 65. Government Printing Office, Washington, DC.

King, Dale S.
1949 *Nalakihu: Excavations at a Pueblo III Site on Wupatki National Monument, Arizona*. Museum of Northern Arizona Bulletin 23. Northern Arizona Society for Science and Art, Flagstaff.

Kintigh, Keith W
1996 The Cibola Region in the Post-Chacoan Era. In *The Prehistoric Pueblo World, A.D 1150-1350*, Michael A. Adler, ed., pp. 131-144. University of Arizona Press, Tucson.

Kintigh, Keith W., Todd L. Howell, and Andrew I. Duff
1996 Post-Chacoan Social Integration at the Hinkson Site, New Mexico. *Kiva* 61:257-274.

Kluckhohn, Clyde
1944 *Navaho Witchcraft*. Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University. v. 22, no. 2. Cambridge, Massachusetts.

Kluckhohn, Clyde, and Dorothea Leighton
1946 *The Navajo*. Harvard University Press, Cambridge, Massachusetts.

Kniffen, Fred, Gordon MacGregor, Robert McKennan, Scudder Mekeel, and Maurice Mook
1935 *Walapai Ethnography*. Memoirs of the American Anthropological Association, No. 42. Menasha, Wisconsin.

Koch, Klaus-Friedrich
1974a *The Anthropology of Warfare*. Addison-Wesley Module in Anthropology, No. 52. Reading, Massachusetts.
1974b War *and Peace in Jalemo: The Management of* Conflict *in Highland New Guinea*. Harvard University Press, Cambridge, Massachusetts.

Kohler, Timothy A.
1992 Field Houses, Villages, and the Tragedy of the Commons in the Early Northern Anasazi Southwest. *American Antiquity* 57:617-635.

Kohler, Timothy A., and Kathryn Kramer Turner
2006 Raiding for Women in the Prehispanic Northern Puebloan Southwest? A Pilot Examination. *Current Anthropology* 47:1035-1045.

Kohler, Timothy A., Sarah Cole, and Stanca Ciupe
2009 Population and Warfare: A Test of the Turchin Model in Pueblo Societies. In *Pattern and Process in Cultural Evolution*, edited by S. Shennan, pp. 277-295. University of California Press, Berkeley.

Kohler, Timothy A., Scott G. Ortman, Katie E. Grundtisch, Carly M. Fitzpatrick, and Sarah M. Cole
2014 The Better Angels of Their Nature: Declining Violence Through Time among Prehispanic Farmers of the Pueblo Southwest. *American Antiquity* 79:444–464.

Kopytoff, Igor
1987 The Internal African Frontier: The Making of African Political Culture. In *Pathways to Complexity: An African Perspective*, edited by Igor Kopytoff, pp. 3-84. Indiana University Press, Bloomington.

Kroeber, Alfred L.
1925 *Handbook of Indians of California*. Bureau of American Ethnology Bulletin No. 78. Government Printing Office, Washington, DC.

Kroeber, Clifton B.
1980 Lower Colorado River Peoples: Hostilities and Hunger, 1850-1857. *Journal of California and Great Basin Anthropology* 2: 87-98.

Kroeber, Clifton B., and Bernard L. Fontana
1986 *Massacre on the Gila: An Account of the Last Major Battle Between American Indians, with Reflections on the Origin of War*. Tucson: University of Arizona Press.

Kuckelman, Kristin A., Ricky A. Lightfoot, and Debra L. Martin
2000 Changing Patterns of Violence in the Northern San Juan Region. *Kiva* 66:147-165.

Lambert, Ruth Ellen
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.
2006 *Investigations of Small Structures in the Citadel District of Wupatki National Monument*. Doctoral dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Landis, Daniel G.
1993 A Pre-Eruption Sinagua Settlement on the Frontier. In *Life on the Line: Archaic, Cohonina, and Sinagua Settlements in Western Arizona*. pp. 377-411. Publications in Archaeology No. 19. Soil Systems, Phoenix.

Laughlin, Charles D., and Ivan Brady, eds.
1978 *Extinction and Survival in Human Populations*. Columbia University Press, New York.

LeBlanc, Steven A.
1997 Modeling Warfare in Southwestern Prehistory. *North American Archaeologist* 18:235-276.
1999 *Prehistoric Warfare in the American Southwest*. University of Utah Press, Salt Lake City.

Lekson, Steven H.
1984 *Great Pueblo Architecture of Chaco Canyon, New Mexico*. National Park Service, Santa Fe.
1988 The Idea of the Kiva in Anasazi Archaeology. *Kiva* 53:213-234.

Lekson, Steven H.
2002 War in the Southwest, War in the World. *American Antiquity* 67:607-454.
2007 *The Architecture of Chaco Canyon*. University of Utah Press, Salt Lake City.

Lengyel. Stacey N., and Jeffrey L. Eighmy
2002 A Revision to the U.S. Southwest Archaeomagnetic Master Curve. *Journal of Archaeological Science* 29:1423-1433.

Leonard, N. Nelson, III, and Christopher E. Drover.
1980 Prehistoric Turquoise Mining in the Halloran Springs District, San Bernardino County, California. *Journal of California and Great Basin Anthropology* 2:245-256.

Leonard, Robert D.
1989 Resource Specialization, Population Growth, and Agricultural Production in the American Southwest. *American Antiquity* 54:491-503.

Levine, Steven J.
1987 *Genesis of Soils Derived from the Kaibab Formation of the Colorado Plateau, Arizona*. Doctoral dissertation, Department of Soil and Water Science, University of Arizona, Tucson.

Levy, Jerrold E.
1992 *Orayvi Revisited: Social Stratification in an "Egalitarian" Society*. School of American Research Press, Santa Fe.

Lightfoot, Kent G., and Antoinette Martinez
1994 Frontiers and Boundaries in Archaeological Perspective. *Annual Review of Anthropology* 24:471-492.

Lincoln, Edward P.
1961 *A Comparative Study of Present and Past Mammalian Fauna of the Sunset Crater and Wupatki Areas of Northern Arizona*. Master's thesis, Department of Zoology, University of Arizona, Tucson.

Lindsay, Alexander J., Jr.
1965 Preliminary Report on the Excavations at Wupatki Ballcourt, Wupatki National Monument. Manuscript on file, Museum of Northern Arizona, Flagstaff.
1969 *The Tsegi Phase of the Kayenta Cultural Tradition in Northeastern Arizona*. Doctoral dissertation, Department of Anthropology, University of Arizona, Tucson.

Linton, Ralph
1943 Nativistic Movements. *American Anthropologist* 45:230-240.

Loendorf, Chris, and Glen E. Rice
2002 *Projectile Point Typology, Gila River Indian Community, Arizona*. Anthropological Research Papers No. 2. Gila River Indian Community, Sacaton, Arizona

Lomatumay'ma, Michael, Lorena Lomatumay'ma¸ and Sidney Namigha, Jr.
1993 *Hopi Ruin Legends = Kiqötutuwutsi*, collected, translated, and edited by Ekkehart Malotki. University of Nebraska Press, Lincoln.

Luhr, James F., and Tom Simkin, editors
1993 *Paricutin: A Volcano Born in a Mexican Cornfield*. Geoscience Press, Phoenix.

Lyon, William S.
2004 Divination in North American Indian Shamanic. In *Healing in Divination and Healing: Potent Vision*, edited by Michael Winkelman and Philip M. Peek, pp. 121-138. University of Arizona Press, Tucson.

McCoy, Ronald
1984 Circles of Power: American Indian Shields of the Southwest and Great Plains. *Plateau* 55(4):1-32.

McGimsey, Charles R.
1980 *Mariana Mesa: Seven Prehistoric Sites in West-Central New Mexico*. Papers of the Peabody Museum of Archaeology and Ethnology No. 72. Harvard University, Cambridge.

McGregor, John C.
1936a Dating the Eruption of Sunset Crater, Arizona. *American Antiquity* 2:15-26.
1936b Ball Courts in Northern Arizona? *Museum Notes* 8:55-58.
1937a *Winona Village: A XIIth Century Settlement with a Ball Court near Flagstaff, Arizona*. Museum of Northern Arizona Bulletin 12. Northern Arizona Society for Science and Art, Flagstaff.
1937b Winona Village: A Prehistoric Site Showing Hohokam Influence in the Flagstaff Area. *Museum Notes* 9:39-42
1937c A Small Island of Culture near Flagstaff, Arizona. *Southwestern Lore* 3:28-32.
1941 *Winona and Ridge Ruin, Part I: Architecture and Material Culture*. Museum of Northern Arizona Bulletin 18. Northern Arizona Society for Science and Art, Flagstaff.
1943 Burial of an Early American Magician. *Proceedings of the American Philosophical Society* 86(2):270-298.
1951 *The Cohonina Culture of Northwestern Arizona*. University of Illinois Press, Urbana.
1967 *The Cohonina Culture of Mount Floyd, Arizona*. University of Kentucky Press, Lexington.

McGregor, John C.
n.d. Three Sinagua Sites East of Flagstaff, Arizona. Manuscript on file, Museum of Northern Arizona, Flagstaff.

McNitt, Frank
1972 *Navajo Wars: Military Campaigns, Slave Raids, and Reprisals*. University of New Mexico Press, Albuquerque.

McNutt, Joshua H.
2001 *Determining Functions and Dates of Prehistoric Terrace Features through the Analysis and Mapping of Surface Remains*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Malotki, Ekkehart
1978 *Hopitutuwutsi = Hopi Tales: A Bilingual Collection of Hopi Indian Stories*.. Museum of Northern Arizona Press, Flagstaff

Malotki, Ekkehart, and Ken Gary
2001 *Hopi Stories of Witchcraft, Shamanism, and Magic.* University of Nebraska Press, Lincoln.

Malotki, Ekkehart, and Michael Lomatuway'ma
1984 *Hopi Coyote Tales = Istutuwutsi*. University of Nebraska Press, Lincoln.
1987 *Earth Fire: A Hopi Legend of the Sunset Crater Eruption*. Northland Press, Flagstaff.

Manson, Joseph H., and Richard W. Wrangham
1991 Intergroup Aggression in Chimpanzees and Humans. *Current Anthropology* 32:369–390

Marshall, Michael P.
1997 The Chacoan Roads: A Cosmological Interpretation. In *Anasazi Architecture and American Design*, edited by. Baker H. Morrow and V. B. Price, pp. 62-74. University of New Mexico Press, Albuquerque.

Marshall, John T.
2001 Appendix J: Hohokam Regional Ballcourt Data. In *The Grewe Archaeological Research Project, Volume 1: Project Background and Feature Descriptions*, edited by Douglas B. Craig, pp.571-585. Anthropological Papers No. 99-1. Northland Research, Flagstaff, Arizona.

Martin, Debra L.
1997 Violence Against Women in a Southwestern Series (AD 1000-1300). In: *Troubled Times: Violence and Warfare in the Past*, edited by Debra L. Martin and David W. Frayer, pp. 45-75. Gordon and Breach, New York.

Martin, Debra L.
2008 Reanalysis of Trauma in the La Plata Valley (900-1300): Strategic Social Violence and the Bioarchaeology of Captivity. In: *Reanalysis and Reinterpretation in Southwestern Bioarchaeology*, edited by Anne L. W. Stodder, pp. 167-184. Anthropological Research Papers No. 59. Arizona State University Tempe.

Martin, Debra L., and Nancy J. Akins
2001 Unequal Treatment in Life as in Death: Trauma and Mortuary Behavior at La Plata (AD 1000-1300). *Ancient Burial Practices in the American Southwest*, edited by Douglas R. Mitchell and Judith L. Brunson-Hadley, pp. 223-248. Albuquerque: University of New Mexico Press.

Martin, Debra L., Nancy J. Akins, Bradley J. Crenshaw, and Pamela K. Stone
2008 Inscribed on the Body, Written in the Bones: The Consequences of Social Violence at La Plata. In: *Social Violence in the Prehispanic American Southwest*, edited by Deborah L. Nichols and Patricia L. Crown, pp. 98-122. University of Arizona Press, Tucson.

Martin, Debra L., Ryan Harrod, and Misty Fields
2010 Beaten Down and Worked to the Bone: Bioarchaeological Investigations of Women and Violence in the Ancient Southwest. *Landscapes of Violence* 1:1-19.

Mathien, Frances Joan
1992 *Excavations at 29SJ627, Chaco Canyon, New Mexico*. Reports of the Chaco Center, No. 11. Branch of Cultural Research, U.S. Department of the Interior, National Park Service, Santa Fe, New Mexico
1997 Ornaments of the Chaco Anasazi. In *Ceramics, Lithics, and Ornaments of Chaco Canyon, Analyses of Artifacts from the Chaco Project, 1971-1978: Volume III. Lithics and Ornaments*, edited by Frances Joan Mathien, pp. 1119-1219. National Park Service, Santa Fe, NM.

Matthews, Washington
1887 The Mountain Chant, a Navajo Ceremony. In *The Fifth Annual Report of the U.S. Bureau of American Ethnology*, pp. 3-85. Government Printing Office, Washington, D.C.
1890 The Gentile System of the Navajo Indians. *Journal of American Folklore* 3:89-110.
1897 *Navaho Legends*. American Folklore Society, Boston.

Maule, Stuart H.
1963 Corn Growing at Wupatki. *Plateau* 36(1):29-32.

Mauss, Marcel
1990 [1925] *The Gift: The Form and Reason for Exchange in Archaic Societies*, translated by W. D. Halls. Routledge, New York.

Meggitt, Mervyn
1958 Salt Manufacture and Trading in the Western Highlands of New Guinea. *Australian Museum Magazine* 12:309-313.
1977 *Blood is their Argument: Warfare among the Mae Enga Tribesmen of the New Guinea Highlands*. Mayfield Publishing, Palo Alto, CA.

Meko, David M., and Christopher H. Baisan
2001 Pilot Study of Latewood Width of Conifers as an Indicator of Variability of Summer Rainfall in the North American Monsoon Region. *International Journal of Climatology* 21:697-708.

Merriam, C. Hart
1890 Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado, Arizona. North American Fauna, No. 3. Government Printing Office, Washington, DC.

Miller, Mary
2001 The Maya Ballgame: Rebirth in the Court of Life and Death. In *The Sport of Life and Death: The Mesoamerican Ballgame*, edited by E. Michael Whittington, pp. 78-87. Thames and Hudson, New York.

Miller, Mary, and Karl Taube
1993 Mirrors. In *An Illustrated Dictionary of the Gods and Symbols of Ancient Mexico and the Maya*, pp. 114-115. Thames & Hudson.

Minc, Leah D.
1986 Scarcity and Survival: The Role of Oral Tradition in Mediating Subsistence Crises. *Journal of Anthropological Archaeology* 5:39-113.

Minc, Leah D., and Kevin P. Smith
1989 The Spirit of Survival: Cultural Responses to Resource Variability in North Alaska. In *Bad Year Economics: Cultural Responses to Risk and Uncertainty*, edited by Paul Halstead and John O'Shea, pp. 8-39. New Directions in Archaeology. Cambridge University Press, New York.

Mindeleff, Victor
1891 A Study of Pueblo Architecture in Tusayan and Cibola. In *The Eighth Annual report of the Bureau of American Ethnology*, pp. 3-228. Government Printing Office, Washington, DC.

Moerman, Daniel E.
1998 *Native American Ethnobotany*. Timber Press, Portland, Oregon.

Molenaar, Cornelius M.,

1983 Major Depositional Cycles and Regional Correlations of Upper Cretaceous Rocks, Southern Colorado Plateau and Adjacent Areas. In *Mesozoic Geology of the West-Central United States Rocky Mountain Paleogeography Symposium 2*, edited by Mitchell W. Reynolds and Edward D. Dolly, pp. 201-224. Rocky Mountain Section, Society of Economic Paleontologists and Mineralogists, Denver.

Mooney, James

1896 The Ghost-Dance Religion and the Sioux Outbreak of 1890. In *The Fourteenth Annual Report of the Bureau of Ethnology*, Part 2, pp. 641-1136. Government Printing Office, Washington, DC.

Moore, Richard B., and Edward W. Wolfe

1987 *Geologic map of the east part of the San Francisco volcanic field, north-central Arizona*. Miscellaneous Field Studies, Map MF-1960. U.S. Geological Survey, Reston, Virginia.

Morales, Michael, Jr.

1994 *Prehistoric Ballcourts in Northern Arizona*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Morris, Earl H.

1924 *Burials in the Aztec Ruin*. Anthropological Papers of the American Museum of Natural History, Vol. 26, Pt. 3. New York.

Muenchrath, Deborah A., and Ricardo J. Salvador

1995 Maize Productivity and Agroecology: Effects of Environment and Agricultural Practices on the Biology of Maize. In *Soil, Water, Biology, and Belief in Prehistoric and Traditional Southwestern Agriculture*, edited by H. Wolcott Toll, pp. 303–333. Special Publication No. 2. New Mexico Archaeological Council, Albuquerque.

Murphy, Tracy L.

2000 *Ornamentation and Social Affinity: Shell Ornaments and the Hohokam Influence at Winona Village*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Neff, L. Theodore, and Kimberly Spurr

2004 *An Intensive Archaeological Inventory Survey of Walnut Canyon National Monument New Lands*. Navajo Nation Archaeology Department Project No. 01-143. Northern Arizona University, Flagstaff.

Neitzel, Jill, Hector Neff, Michael Glascock, and Ronald Bishop

2002 Chaco and the Production of Dogoszhi-Style Pottery. In *Ceramic Production and Circulation in the Greater Southwest: Source Determination by INAA and Complementary Mineralogical Investigations*, edited by Donna Glowacki and Hector Neff, pp. 47-65. The Cotsen Institute of Archaeology, Los Angeles.

Nelson, Margaret C.

1999 *Mimbres During the 12th Century: Abandonment, Continuity, and Reorganization*. University of Arizona Press, Tucson.

Nelson, Margaret C., Keith W. Kintigh, David R. Abbott, and John M. Anderies

2010 The Cross-Scale Interplay between Social and Biophysical Context and the Vulnerability of Irrigation-Dependent Societies: Archaeology's Long-Term Perspective. *Ecology and Society* 15(3):Art. 31. [online] URL: http://www.ecologyandsociety.org/vol15/iss3/art31/

Nequatewa, Edmund

1936 *Truth of a Hopi and Other Clan Stories of Shung-Opovi*. Museum of Northern Arizona Bulletin 8. Northern Arizona Society for Science and Art, Flagstaff.

1944 A Mexican Raid on the Pueblo of Oraibi. *Plateau* 16(3):44-52.

1955 The Destruction of Elden Pueblo, A Hopi Story. *Plateau* 28(2): 37-44.

Netting, Robert McC.

1972 Sacred Power and Centralization: Aspects of Political Adaptation in Africa. In *Population Growth: Anthropological Implications*, edited by Brian Spooner, pp. 219-244. MIT Press, Cambridge.

Nettleship, Martin A., R. Dale Givens, and Anderson Nettleship, editors

1975 *War, Its Causes and Correlates*. World Anthropology Series. The Hague: Mouton Publishers.

Newton, Janice

1983 Orokaive Warfare and Production. *Journal of the Polynesian Society* 92:487-507.

Ni, Fenbiao, Tereza Cavazos, Malcom K. Hughes, Andrew C. Comrie, and Gary Funkhauser

2002 Cool-Season Precipitation in the Southwestern USA since AD 1000. Comparison of Linear and Nonlnear Techniques for Reconstruction. *International Journal of Climatology* 22:1645-1662.

Nolan, Mary Lee

1972 *The Towns of the Volcano: A Study of the Human Consequences of the Eruption of Paricutín Volcano*. Doctoral dissertation, Department of Geography, Texas A&M University, College Station.

Nolan, Mary Lee
1979 Impact of Paricutin on five communities. In *Volcanic Activity and Human Ecology*, edited by Payson D. Sheets and Donald K..Grayson, pp. 293-338. Academic Press, New York.

Nyerges, A. Endre
1992 The Ecology of Wealth in People: Agriculture, Settlement, and Society on the Perpetual Frontier. *American Anthropologist* 94:1992.

Oakes, Maud, Jeff King, and Joseph Campbell
1943 *Where the Two Came to Their Father, a Navaho War Ceremonial*. The Bollingen Series, No. 1. Pantheon Books, New York.

Odegaard, Nancy, and Kelley Hays-Gilpin
2002 Technology of the Sacred: Pained Basketry in the Southwest. In *Traditions, Transitions, and Technologies: Themes in Southwestern Archaeology*, edited by Sarah H. Schlanger, pp. 307-331. University Press of Colorado, Boulder.

O'Hara, F. Michael, III
1998 *Red-on-Buff North of the Mogollon Rim: A Comparative Analysis and Cultural Assessment***.** Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.
2008 The Magician of Ridge Ruin: An Interpretation of the Social, Political, and Ritual Roles Represented. Paper presented at the Society for American Archaeology 73rd Annual Meeting, Vancouver, Canada, March 28.
2009 Metaphor, Material Culture, Ritual, and Community Formation. Poster presented at the Society for American Archaeology 74th Annual Meeting, Atlanta, Georgia, April 23.
2011 Creating Local and Regional Contexts for Understanding Sinagua Mortuary Practice. Paper presented in the symposium "Mortuary Practices in the American Southwest: Meta-Data Issues in the Development of a Regional Database," at the Society for American Archaeology 76th Annual Meeting, Sacramento, California.
2012 Creating Ancestors, Creating Katsinam, Creating Rain: Interpreting Sinagua Mortuary Practices. Paper presented in the symposium "Mortuary Practices in the American Southwest: Patterns and Inferences from Regional Databases," at the Society for American Archaeology 77th Annual Meeting, Memphis, Tennessee.

O'Hara, F. Michael, III, and Craig J. Johnson
1998 *Archaeological Site Monitoring at Wupatki National Monument*. Northern Arizona University Anthropology Laboratories Report No. 1192a. Flagstaff.

Oliver-Smith, Anthony
1996 Anthropological Research on Hazards and Disasters. *Annual Review of Anthropology* 25:303-328.
1999 "What is a Disaster?": Anthropological Perspectives on a Persistent Question. In *The Angry Earth: Disaster in Anthropological Perspective*, edited by Anthony Oliver-Smith and Susanna M. Hoffman, pp. 18-34. Routledge, New York.
2002 Theorizing Disasters: Nature, Power, and Culture. In *Catastrophe & Culture: The Anthropology of Disaster*, edited by Susanna M. Hoffman and Anthony Oliver-Smith, pp. 23-47. School of American Research Press, Santa Fe, New Mexico.

Olson, Alan P.
1971 *Archaeology of the Arizona Public Service Company 345kv Line*. Museum of Northern Arizona Bulletin No. 46. Northern Arizona Society for Science and Art, Flagstaff.

Otterbein, Keith F.
1985 *The Evolution of War: A Cross Cultural Study*, 2nd edition. Human Relations Area Files Press, New Haven.
1999 A History of Research on Warfare in Anthropology. *American Anthropologist* 101:794-805.

Ort, Michael H., Mark D. Elson, and Duane E. Champaign
2007 A Paleomagnetic Study of Sunset Crater Volcano. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Environmental Analyses*, edited by Mark D. Elson, pp. 95-102. Anthropological Papers No. 33. Center for Desert Archaeology, Tucson.

Ortman, Scott G.
2012 Winds from the North: Tewa Origins and Historical Anthropology. University of Utah Press, Salt Lake City.

Palmer, Wayne
1965 *Meteorological Drought*. Research Paper No. 45. U.S. Department of Cmmerce Weather Bureau, Washington, D.C.

Parry, Thomas E.
1981 *Cultural Dynamics on a Prehistoric Frontier: A Study of Culturally Mixed Sites in Medicine Valley, Northern Arizona***.** Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Parsons, Elsie Clews
1920 *Notes on Ceremonialism at Laguna*. Anthropological Papers of the American Museum of Natural History, Vol.XIX, Part IV. New York.
1925 *The Pueblo of Jemez*. Department of Archaeology, Phillips Academy, Andover, MA; Yale University Press, New Haven.
1926 *Tewa Tales.* Memoirs of the American Folklore Society, No. 19. Washington, DC.
1939 *Pueblo Indian Religion*. University of Chicago Press.

Pepper, George H.
1920 *Pueblo Bonito*. Anthropological Papers of the American Museum of Natural History Vol. 27. New York.

Peterson, Kenneth L.
1986 Climatic Reconstruction for the Dolores Project. In *Dolores Archaeological Program: Final Synthetic Report*, compiled by David A. Breternitz, Christine K. Robinson, and G. Timothy Gross, pp. 312-325. U.S. Bureau of Reclamation, Engineering and Research Center, Denver.

Pilles, Peter J., Jr.
1979 Sunset Crater and the Sinagua: A New Interpretation. In *Volcanic Activity and Human Ecology,* edited by Payson D. Sheets and Donald K. Grayson, pp. 459-485. Academic Press, New York.
1988a Cinder Park Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, pp. 99-100. Greenwood Press, New York.
1988b Sunset Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, p. 410. Greenwood Press, New York.
1988c Rio de Flag Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, p. 410. Greenwood Press, New York.
1988d Angell Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, pp. 15-16. Greenwood Press, New York.
1988e Winona Focus. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, pp. 533-534. Greenwood Press, New York.
1988f Padre Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, pp. 357-358. Greenwood Press, New York.
1988g Elden Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, pp. 149-150. Greenwood Press, New York.

Pilles, Peter J., Jr.

1988h Turkey Hill Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, pp. 498-499. Greenwood Press, New York.

1988i Clear Creek Phase. In *Historical Dictionary of North American Archaeology*, edited by Edward B. Jelks and Juliet C. Jelks, pp. 103-104. Greenwood Press, New York.

1996 The Pueblo III Period along the Mogollon Rim: The Honanki, Elden, and Turkey Hill Phases of the Sinagua. In *The Prehistoric Pueblo World, A.D 1150-1350*, Michael A. Adler, ed., pp. 59-72. University of Arizona Press, Tucson.

Plog, Stephen

1990 Sociopolitical Implications of Southwestern Stylistic Variation in the American Southwest. In *The Uses of Style in Archaeology*, edited by Margaret W. Conkey and Chritine Hastorf, pp. 61-72. Cambridge University Press, New York.

2003 Exploring the Ubiquitous through the Unusual: Color Symbolism in Pueblo Black-on-White Pottery. *American Antiquity* 68:665-695.

Pospisil, Leopold J.

1958 *Kapauku Papuans and Their Law*. Yale University Publications in Anthropology, No. 54. New Haven, Connecticut.

Potter, James M.

1997 Communal Ritual and Faunal Remains: An Example for the Dolores Anasazi. *Journal of Field Archaeology* 24:353-364.

2000 Pots, Parties, and Politics: Communal Feasting int he American Southwest. *American Antiquity* 65:471-492.

Potter, James M., and Elizabeth M. Perry

2000 Ritual as a Power Resource in the American Southwest. In *Alternative Leadership Strategies in the Prehistoric Southwest*, edited by Barbara J. Mills, pp. 60-78. University of Arizona Press, Tucson.

Powell, Shirley, and George J. Gumerman

1987 *People of the Mesa: The Archaeology of Black Mesa, Arizona*. Southern Illinois University Press, Carbondale.

Powell, Shirley, and Francis E. Smiley, editors

2002 *Prehistoric Culture Change on the Colorado Plateau: Ten Thousand Years on Black Mesa*. University of Arizona Press, Tucson.

Priest, Susan S., Wendell A. Duffield, Karen Malis-Clark, James W. Hendley II, and Peter H. Stauffer

2001 *The San Francisco Volcanic Field, Arizona***.** U.S. Geological Survey Fact Sheet 017-01. Flagstaff, Arizona.

Rapoport, Amos

1982 *The Meaning of the Built Environment: A Nonverbal Communication Approach*. Sage Publications, Beverly Hills, California.

1990 Systems of activities and systems of settings. In *Domestic Architecture and the Use of Space: An Interdisciplinary Cross-Cultural Study*, edited by Susan Kent pp. 9-20. Cambridge University Press, New York.

Rappaport, Roy A.

1968 *Pigs for the Ancestors*. Yale University Press, New Haven, Connecticut.

1971 Ritual, Sanctity, and Cybernetics. *American Anthropologist* 73:59-76.

1979 *Ecology, Meaning and Religion*. North Atlantic Books, Richmond, Virginia.

1999 *Ritual and Religion in the Making of Humanity*. Cambridge University Press, New York.

Redmond, Elsa M.

2002 The Long and the Short of a War Leader's Arena. In *The Archaeology of Tribal Societies*, edited by William A. Parkinson, pp. 53-73. Archaeological Series 15, International Monographs in Prehistory, Ann Arbor.

Reed, Erik K.

1938 *The Excavation of Room 7, Wupatki*. Southwestern Monuments Special Report, National Park Service, Santa Fe.

Reed, Paul F.

2008 *Chaco's Northern Prodigies: Salmon, Aztec, and the Ascendancy of the Middle San Juan Region after AD 1100*. University of Utah Press, Salt Lake City.

Rees, J. D.

1970 Parícutin Revisited: A Review of Man's Attempts to Adapt to Ecological Changes Resulting from Volcanic Catastrophe. *Geoforum* 4:7-25.

Reichard, Gladys A.

1950 *Navaho Religion, a Study of Symbolism*. Pantheon Books, New York.

Reycraft, Richard Martin

1998 The Terminal Chiribaya Project: The Archaeology of Human Response to Natural Disaster in South Coastal Peru. Doctoral dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Reyna, S. P.
1994 A Mode of Domination Approach to Organized Violence. In *Studying War: Anthropological Perspectives*, edited by S. P. Reyna and R. E. Downs, pp. 29-65. War and Society, Vol. 2. Gordon and Breach, Langhorne, PA.

Richert, Roland
1952 1952 Excavations at Wupatki. Manuscript on file, Flagstaff Area National Monuments.

Rinaldo, John B.
1964 Artifacts. In *Chapters in the Prehistory of Eastern Arizona, II*, pp. 63-109. Fieldiana Anthropology Vol. 55. Chicago Natural History Museum.

Ritterbush, Laura
1984 *Prehistoric Water Collection on Antelope Prairie, Wupatki National Monument*. Master's thesis, Department of Anthropology, University of Kansas, Lawrence.

Robarchek, Clayton
1989 Primitive Warfare and the Ratomorphic Image of Mankind. *American Anthropologist* 91:903-920.

Robarcek, Clayton A., and Carole J. Robarcek
1992 Cultures of War and Peace: A Comparative Study of Waorani and Semai. In *Aggression and Peacefulness in Humans and Other Primates*, edited by James Silverberg and J. Patrick Gray, pp.189-213. Oxford University Press, New York.

Roberts, Susan Carroll
2001 *Exploring Prehistoric Cohonina Social Identity through San Francisco Mountain Gray Ware Production*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Robinson, Henry Hollister
1913 *The San Franciscan Volcanic Field, Arizona*. U.S. Geological Survey Professional Paper, No. 76. Government Printing Office, Washington, DC.

Robinson, William J., Bruce G. Harrill, and Richard L. Warren
1975 *Tree-Ring Dates from Arizona H-I, Flagstaff Area*. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

Roediger, Virginia More
1941 *Ceremonial Costumes of the Pueblo Indians: Their Evolution, Fabrication, and Significance in the Prayer Drama*. University of California Press, Berkeley.

Rondeau, Michael F.
1979 *Projectile Point Analysis for the Kahorsho Site: NA 10937, Central Arizona*. Master's thesis, Department of Anthropology, California State University, Sacramento.

Roney, John R.
1992 Prehistoric Roads and Regional Integration in the Chacoan System. In *Anasazi Regional Organization and the Chaco System*, edited by David E. Doyel, pp. 123-131. Maxwell Museum of Anthropology Anthropological Papers No. 5. University of New Mexico, Albuquerque.

Rosman, Abraham, and Paula Rubel
1971 *Feasting With Mine Enemy: Rank and Exchange among Northwest Coast Societies*. Columbiua University Press, New York.

Ross, Marc Howard
1986 The Limits to Social Structure: Social Structural and Psychocultural Explanations for Political Conflict and Violence. *Anthropological Quarterly* 59:171-204.
1993 *The Culture of Conflict: Interpretations and Interests in Comparative Perspective*. Yale University Press, New Haven, Connecticut.

Russell, Frank
1908 The Pima Indians. In *Twenty-Sixth Annual Report of the Bureau of Ethnology*, pp. 3-389. Government Printing Office, Washington, DC.

Sahlins, Marshall
1968 *Tribesmen*. Foundations of Modern Anthropology Series. Prentice-Hall, Englewood Cliffs, New Jersey.

Salzer, Matthew W., and Jeffrey S. Dean
2007 Dendroclimatic Reconstructions and Paleoenvironmental Analyses for the U.S. 89 Project Area. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Environmental Analyses*, edited by Mark D. Elson, pp. 103-131. Anthropological Papers No. 33. Center for Desert Archaeology, Tucson.

Salzer, Matthew W., and Kurt F. Kipfmueller
2005 Reconstructed Temperature and Precipitation on a Millenial Time Scale from Tree Rings in the Southern Colorado Plateau, U.S.A. *Climate Change* 70:465-487.

Samples, Terry
1992 *Cohonina Archaeology: The View from Sitgreaves Mountain*. Master’s thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Saunders, Nicholas J.
1988 *Chatoyer*: Anthropological Reflections on Archaeological Mirrors. In *Recent Studies in Pre-Columbian Archaeology*, edited by N. J. Saunders and Olivier de Montmollin, pp. 1–40. B.A.R. International Series, 421. British Archaeological Reports, Oxford.

Schaafsma, Polly
1987 Rock art at Wupatki. In*: Wupatki and Walnut Canyon: New Perspectives on History, Prehistory, Rock Art*, edited by David Grant Noble, pp. 21-27. School of American Research, Santa Fe.
2000 *Warrior, Shield, and Star: Imagery and Ideology of Puebloan Warfare*. Western Edge Press, Santa Fe.

Schachner, Gregson
2001 Ritual Control and Transformation in Middle-Range Societies: An Example from the American Southwest. *Journal of Anthropological Archaeology* 20:168-194.
2010 Corporate Group Formation and Differentiation in Early Puebloan Villages of the American Southwest. *American Antiquity* 75:473-496.

Schele, Linda, and David Freidel
1991 The Courts of Creation: Ballcourts, Ballgames, and Portals to the Maya Otherworld. In *The Mesoamerican Ballgame*, edited by Vernon L. Scarborough and David R. Wilcox, pp. 289-315. University of Arizona Press, Tucson.

Schele, Linda, and Mary Ellen Miller
1986 *Blood of Kings: Dynasty and Ritual in Maya Art*. George Braziller, New York.

Schlee, Günther
1989 *Identities on the Move: Clanship and Pastoralism in Northern Kenya*. Manchester University Press.
2004 Taking Sides and Constructing Identities. *Journal of the Royal Anthropological Institute* (n.s.) 10:135-156.

Schofer, Jeannne Stevens
2006 *Foundations of Cultural Landscape: Mobility and Settlement Strategies at Wupatki National Monument, A.D. 1065-1160*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Schwimmer, Erik

1969 *Cultural Consequences of a Volcanic Eruption Experienced by the Mount Lamington Orokaiva*. Comparative Study of Cultural Change and Stability in Displaced Communities in the Pacific, Report 9, Department of Anthropology, University of Oregon, Eugene.

Sen, Amartya

1981 *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford University Press, New York.

1985 *Commodities and Capabilities*. Elsevier Science Publishing, New York..

Shackley, M. Steven

2005 *Obsidian: Geology and Archaeology in the North American Southwest*.. University of Arizona Press, Tucson.

Shaul, David Leedom, and John M. Andresen

1989 A Case for Yuman Participation in the Hohokam Regional System. *Kiva* 54:105-126.

Shaul, David Leedom, and Jane H. Hill

1998 Tepimans,Yumans, and other Hohokam. *American Antiquity* 63:375-96.

Sheets, Payson

1999 The Effects of Explosive Volcanism on Ancient Egalitarian, Ranked, and Stratified Societies in Middle America. In *The Angry Earth: Disaster in Anthropological Perspective*, edited by Anthony Oliver-Smith and Susanna M. Hoffman, pp. 18-34. Routledge, New York.

2008 Armageddon to the Garden of Eden: Explosive Volcanic Eruptions and Societal Resilience in Ancient Middle America. in *El Niño, Catastrophism, and Culture Change in Ancient America*, edited by Daniel H. Sandweiss and Jeffrey Quilter, pp. 36-58. Dunbarton Oaks, Washington, DC.

Shennan, Stephen

1989 Introduction: Archaeological Approaches to Cultural Identity. In *Archaeological Approaches to Ethnic Identity*, edited by Stephen J. Shennan, pp. 1-32. Unwin Hyman, London.

Shoemaker, Eugene M., and Duane E. Champion

1977 Eruption History of Sunset Crater, Arizona. Investigator's annual report, manuscript on file, Katharine Bartlett Learning Center, Museum of Northern Arizona, Flagstaff.

Sillitoe, Paul

1977 Land Shortage and War in New Guinea. *Ethnology* 16:71-81.

1993 A Ritual Response to Climatic Perturbations in the Highlands of Papua New Guinea. *Ethnology* 32:169-185.

Simpson, Ruth De Ette
1948 An Ancient Custom in Modern Zuñi – A Sword-Swallowing Ceremony. *The Masterkey* 22:102-104.

Sitgreaves, Lorenzo
1854 *Report of an Expedition down the Zuni and Colorado Rivers*. R. Armstrong, Washington, D.C.

Sliva, R. Jane
1997 An Introduction to the Study and Analysis of Flaked Stone Artifacts and Lithic Technology. Center for Desert Archaeology, Tucson.

Smiley, Terrah L.
1958 The Geology and Dating of Sunset Crater, Flagstaff, Arizona. In *Guidebook of the Black Mesa Basin, Northerastern Arizona*, edited by Roger Y. Anderson and John W. Harshbarger, pp186-190. New Mexico Geological Society, Ninth Field Conference. Albuquerque.

Smith, Watson
1952a *Excavations in Big Hawk Valley, Wupatki National Monument, Arizona*. Museum of Northern Arizona Bulletin 24. Northern Arizona Society for Science and Art, Flagstaff.
1952b Kiva Mural Decorations at Awatovi and Kawaika-a, with a Survey of Other Wall Paintings in the Pueblo Southwest, Papers of the Peabody Museum of American Archaeology and Ethnology, Vol. 37. Cambridge, MA.

Smith, Watson, and John M. Roberts
1954 *Zuni Law: A Field of Values*. Papers of the Peabody Museum of American Archaeology and Ethnology, Vol.43, No. 1. Cambridge, MA.

Smithers, John, and Barry Smit
1997 Human Adaptation to Climatic Variability and Change. *Global Environmental Change* 7:129-146.

Snyder, Christina
2010 *Slavery in Indian Country: The Changing Face of Captivity in Early America*. Harvard University Press, Cambridge, Massachusetts.

Sofaer, Anna, Michael P. Marshall, and Rolf M. Sinclair
1989 The Great North Road: a Cosmographic Expression of the Chaco Culture of New Mexico. In *World Archaeoastronomy*, edited by A. F. Aveni, pp. 365-376. Cambridge University Press, New York.

Solometo, Julie

2001 Tactical Sites of the Chevelon and Clear Creek Drainages. In *The Archaeology of Ancient Tactical Sites*, edited by John R. Welch and Todd W. Bostwick, pp. 21-36. Arizona Archaeologist, No. 32. Arizona Archaeological Society, Phoenix.

2004 *The Conduct and Consequences of War: Dimensions of Conflict in East-Central Arizona*. Doctoral dissertation, Department of Anthropology, University of Michigan, Ann Arbor.

2006 The Dimensions of War: Conflict and Culture Change in East-Central Arizona. In *The Archaeology of Warfare: Prehistories of Raiding and Conquest*, edited by Elizabeth N. Arkush and Mark W. Allen, pp. 23-65 University Press of Florida, Gainesville.

Sorrell, Daniel H.

2005 *Temporal Significance of Attribute Variation in San Francisco Mountain Gray Ware*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

South, Stanley A.

1977 Method and Theory in Historical Archaeology. Academic Press, Orlando, New York.

Spicer, Edward H.

1934 Some Pueblo I Structures in the San Francisco Mountains, Arizona. *Museum Notes* 7:17-20.

Spier, Leslie

1933 *Yuman Tribes of the Gila River*. Chicago: University of Chicago Press.

Spillius, James

1957 Natural Disaster and Political Crisis in a Polynesian Society. *Human Organization* 10:3-27, 113-125.

Spurr, Kimberly, and Shara E. Bailey

2006 Life and Death on the Frontier: Human Remains from the U.S. 89 Fernwood-to-Wupatki Archaeological Project. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Stone, Shell, Bone, and Mortuary Analyses*, edited by Mark D. Elson, pp. 193-253. Anthropological Papers No. 31. Center for Desert Archaeology, Tucson.

Stahle, D.W., M.K. Cleaveland, H.D. Grissino-Mayer, R.D. Griffin, F.K. Fye, M.D. Therrell, D.J. Burnette, D.M. Meko, and J. Villanueva Diaz

2009 Cool- and Warm-Season Precipitation Reconstructions over Western New Mexico. *Journal of Climate* 22:3729-3750.

Stanislawski, Michael B.
1963a Extended Burials in the Prehistoric Southwest. *American Antiquity* 28:308-319.
1963b *Wupatki Pueblo: A Study in Cultural Fusion and Change in Sinagua and Hopi Prehistory*. Doctoral dissertation, Department of Anthropology, University of Arizona, Tucson.

Stein, John R., and Stephen H. Lekson
1992 Anasazi Ritual Landscapes. In *Anasazi Regional Organization and the Chaco System*, edited by David E Doyel, pp. 87-100. Maxwell Museum of Anthropology Anthropological Papers 5. University of New Mexico, Albuquerque.

Stephen, Alexander M.
1929 Hopi Tales. *Journal of American Folklore* 42:1-72.
1936 *The Hopi Journal of Alexander M. Stephen*, edited by Elsie Clews Parsons. Contributions to Anthropology, Vol. 23. Columbia University Press, New York.

Stern, Theodore
1949 *The* Rubber-Ball *Game of the Americas*. Monographs of the American Ethnological Society, No. 17. New York.

Stevenson, Matilda Coxe
1904 *The Zuñi Indians: Their Mythology, Esoteric Fraternities, and Ceremonies*. Twenty-Third Annual Report of the Bureau of American Ethnology, pp. 3-634. Government Printing Office, Washington, D.C.

Stewart, Kenneth M.
1947 Mohave Warfare. Southwestern Journal of Anthropology 3: 257-278.
1969a The Aboriginal Territory of the Mohave Indians. *Ethnohistory* 16: 257-276.
1969b Scalps and Scalpers in Mohave Indian Culture. *El Palacio* 76(2): 25-30.

Stewart, Pamela J., and Andrew Strathern
2004 *Witchcraft, Sorcery, Rumors, and Gossip*. Cambridge University Press, New York.

Stone, Connie L.
1981 Economy and Warfare Along the Lower Colorado River. In. *The Protohistoric Period in the American Southwest, AD 1450-1700*, edited by David R. Wilcox and W. Bruce Masse, pp. 183-197. Anthropological Research Papers No. 24. Tempe: Arizona State University, Department of Anthropology.

Stone, Glenn D., and Christian E. Downum
1999 Non-Bosrupian Ecology and Agricultural Risk: Ethnic politics and Land Control in the Arid Southwest. *American Anthropologist* 101:113-128.

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. Anthropological Research Papers No. 33. Arizona State University, Tempe.

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* 22:271-287.

Swartz, Deborah L.
2006 The Deadman Flat Site, NA 25,764 [AR-03-04-02-3675(CNF)]. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Introduction and Site Descriptions, Part 1*, edited by Mark D. Elson, pp. 73-91. Anthropological Papers No. 30. Center for Desert Archaeology, Tucson.

Swartz, Deborah L., and Mark D. Elson
2006a The Deadman's Edge Site, NA 420 [AR-03-04-02-2258(CNF)]. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Introduction and Site Descriptions, Part 1*, edited by Mark D. Elson, pp. 97-121. Anthropological Papers No. 30. Center for Desert Archaeology, Tucson.
2006b The Lenox Park Site, NA 20,700 [AR-03-04-02-3352(CNF)]. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Introduction and Site Descriptions, Part 2*, edited by Mark D. Elson, pp. 467-517. Anthropological Papers No. 30. Center for Desert Archaeology, Tucson.

Taladoire, Eric
2001 The Architectural Background of the Pre-Hispanic Ballgame: An Evolutionary Perspective. In *The Sport of Life and Death: The Mesoamerican Ballgame*, edited by E. Michael Whittington, pp. 96-115. Thames and Hudson, New York.

Talayesva, Don C.
1942 *Sun Chief: The Autobiography of a Hopi Indian*, edited by Leo W. Simmons. Yale University Press, New Haven, CT..

Tedlock, Dennis (translator)
1985 *Popol Vuh: The Mayan Book of the Dawn of Life and the Glories of Gods and Kings*. Simon and Schuster, New York.

Tefft, Stanton K., and Douglas Reinhard

1974 Warfare Regulation: A Cross-Cultural Test of Hypotheses Among Tribal Peoples. *Cross-Cultural Research* 9:151-172.

Titiev, Mischa

1938 Dates of Planting at the Hopi Indian Pueblo of Oraibi. *Museum Notes* 11(5):39-42.

1942 Notes on Hopi Witchcraft. *Papers of the Michigan Academy of Science, Arts, and Letters* 28:549-557.

1944 *Old Oraibi: A Study of the Hopi Indians of Oraibi*. Papers of the Peabody Museum of American Archaeology and Ethnology, Vol.22, No. 1. Cambridge, MA.

1972 *Hopi Indians of Old Oraibi: Change and Continuity*. University of Michigan Press, Ann Arbor.

Toll, H. Wolcott, editor

1995 *Soil, Water, Biology, and Belief in Prehistoric and Traditional Southwestern Agriculture*. New Mexico Archeological Council, Albuquerque.

Tooby, John, and Leda Cosmides

1988 The Evolution of War and Its Cognitive Foundations. Institute for Evolutionary Studies Technical Report #88-1. Palo Alto, California.

Torry, William I.

1979 Anthropological Studies in Hazardous Environments: Past Trends and New Horizons. *Current Anthropology* 20:517-540.

Towner, Ronald H.

2003 *Defending the Dinétah: Pueblitos in the Ancestral Navajo Homeland*. University of Utah Press, Salt Lake City.

Travis, Scott E.

1990 The Prehistoric Agricultural Landscape. In *The Wupatki Archeological Inventory Survey Project: Final Report*, edited by Bruce A. Anderson, Chapter 4, pp. 1-54. Southwest Cultural Resources Center Professional Paper No. 35. National Park Service, Division of Anthropology, Santa Fe.

Tsouras, Theodore P.

2008 *A Chronological and Spatial Analysis of Prehistoric Settlement at Merrill Crater Ranches*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Turchin, Peter

2005 Dynamical Feedbacks between Population Growth and Sociopolitical Instability in Agrarian States. *Structure and Dynamics* 1:1-19.

Turchin, Peter, and Andrey Korotayev
2006 Population Dynamics and Internal Warfare: A Reconsideration. *Social Evolution & History* 5:112–147.

Turnbull, Herbert Westren, editor
1959 *The Correspondence of Isaac Newton: Volume I, 1661-1675*. Cambridge University Press, Cambridge.

Turner, Victor
1969 *The Ritual Process: Structure and Anti-Structure*. Aldine, Chicago.

Turner, Christy G., II, and Jacqueline A. Turner
1990 Perimortem Damage to Human Skeletal Remains from Wupatki National Monument, Northern Arizona. *Kiva* 55:187-212.
1999 *Man Corn: Cannibalism and Violence in the American Southwest*. University of Utah Press, Salt Lake City.

Turney-High, Harry Holbert
1949 *Primitive War; Its Practice and Concepts*. University of South Carolina Press, Columbia.

Turton, David
1977 Response to Drought: the Mursi of South West Ethiopia. In *Segmentary Lineages Reconsidered*, edited by Ladislav Holy, pp. 119-143. Department of Social Anthropology, Queen's University, Belfast.
1978 Territorial Organisation and Age among the Mursi. In *Age, Generation and Time: Some Features of East African Age Organisations*, edited by P.T.W. Baxter & U. Almagor, pp. 95-130. Hurst, London.
1979 A Journey Made Them: Territorial Segmentation and Ethnic Identity among the Mursi. In *Human Ecology in the Tropics: Symposia of the Society for the Study of Human Biology, Volume XVI*, edited by J.P. Garlic & R.W.J. Keay pp. 165-192. Taylor & Francis, London.
1988 Looking for a Cool Place: The Mursi, 1890s-1980s. In *The Ecology of Survival: Case Studies from Northeast African History*, edited by D. Anderson and D. Johnson, pp. 261-282. Westview Press, Boulder.
1994 Mursi Political Identity and Warfare: The Survival of an Idea. In *Ethnicity and Conflict in the Horn*, edited by K. Fukui and J. Makarkis, pp. 15-32. James Currey, London.
1997 War and ethnicity: Global Connections and Local Violence in North East Africa and Former Yugoslavia. *Oxford Development Studies* 25:77-94.

Underhill, Ruth M.
1948 *Ceremonial Patterns in the Greater Southwest*. Monographs of the American Ethnological Society 13. J. J. Augustin, New York.

Uriarte, María Teresa
2001 Unity in Duality: The Practice and Symbols of the Mesoamerican Ballgame. In *The Sport of Life and Death: The Mesoamerican Ballgame*, edited by E. Michael Whittington, pp. 41-49. Thames and Hudson, New York.

van Bussel, Gerard W.
1991 Balls and Openings: The Maya Ballgame as Intermediary. In *The Mesoamerican Ball Game*, edited by Gerard W. van Bussel, Paul van Dongen, and Ted. J. J. Leyenaar, pp. 245-258-125. Rijksmuseum voor Volkenkunde, Leiden.

van der Dennen, Johan M. G.
2002 *The Origin of War: The Evolution of a Male-Coalitional Reproductive Strategy*. Origin Press, Groningen, Netherlands.

Van Dyke, Ruth M.
2002 The Chacoan Great Kiva in Outlier Communities: Investigating Integrative Spaces across the San Juan Basin. *Kiva* 67:231-247.

Van Keuren, Scott
2006 Feasting and Crafts in the Prehispanic Southwest. *In Identity, Feasting, and the Archaeology of the Greater Southwest*, edited by Barbara J. Mills, pp. 192-209. University Press of Colorado, Boulder.

Vandkilde, Helle
2006a Warfare, Weaponry, and Material Culture: An Introduction. In *Warfare and Society: Archaeological and Ethnographic Perspectives*, edited by Ton Otto, Henrik Thrane, and Helle Vandkilde, pp. 483-490. Aarhus University Press, Oakville, CT.
2006b Warriors and Warrior Institutions in Copper Age Europe. In *Warfare and Society: Archaeological and Ethnographic Perspectives*, edited by Ton Otto, Henrik Thrane, and Helle Vandkilde, pp. 393-422. Aarhus University Press, Oakville, CT.

Vayda, Andrew P.
1967 Warfare in Ecological Perspective. *Annual Review of Ecology and Systematics* 5:183-193.
1971 Phases of the Process of War and Peace among the Marings of New Guinea. *Oceania* 42:1-24.
1974 Warfare in Ecological Perspective. *Annual Review of Ecology and Systematics* 5:183-193.
1976 *War in Ecological Perspective*. Plenum Press, New York.

Vencl, Slavomil
1984 War and Warfare in Archaeology. *Journal of Anthropological Archaeology* 3:16-132.

Vesperman,D., and H.-U. Schmincke

2000 Scoria cones and tuff rings. In *Encyclopedia of Volcanoes*, edited by H. Sigurdsson, pp. 683-694. Academic Press, San Diego.

Vivian, Gordon

1956 Alcove House at NA 5700. *Plateau* 29:6-11.

Vivian, Gordon, and Paul Reiter

1960 *The Great Kivas of Chaco Canyon and Their Relationships*. Monographs of the School of American Research and the Museum of New Mexico, No. 22. School of American Research, Santa Fe.

Vivian, R. Gwinn, Carla R. Van West, Jeffrey S. Dean, Nancy J. Akins, Mollie S. Toll, and Thomas C. Windes

2006 Ecology and Economy. In *The Archaeology of Chaco Canyon: An Eleventh-Century Pueblo Regional Center*, edited by Stephen H. Lekson, pp. 45-65. School of American Research Press, Santa Fe.

Voll, Charles B., and Martin T. Mayer

1964 Stabilization Report 1964, Crack-in-Rock Ruin, NA 537, Wupatki National Monument, Arizona. Southwest Archeological Center, Globe, Arizona.

Voth, H. R.

1905 *Traditions of the Hopi*. Field Museum of Natural History Anthropological Series Vol. 8. Chicago.

Waddell, Eric

1975 How the Enga Cope with Frost: Responses to Climatic Perturbations in the Central Highlands of New Guinea. *Human Ecology* 3:249-273.

Walker, William H.

1998 Where are the Witches of Prehistory? *Journal of Archaeological Method and Theory* 5:245-308.

Wallace, Anthony F. C.

1956 Revitalization Movements. *American Anthropologist* 58:264-281.

Ward, Albert E.

1969 Tse Tlani: A 12th Century Sinagua Village. *Plateau* 41:77-104.

Ware, John

2014 *A Pueblo Social History: Kinship, Sodality, and Community in the Northern Southwest*. School for Advanced Research Press, Santa Fe.

Waring, Gwendolyn
2007 Hopi Corn and Volcanic Cinders: A Test of the Relationship between Tephra and Agriculture in Northern Arizona. In *Sunset Crater Archaeology: The History of a Volcanic Landscape, Environmental Analyses*, edited by Mark D. Elson, pp. 59-70. Anthropological Papers No. 33. Center for Desert Archaeology, Tucson.

Waters, Frank
1963 *Book of the Hopi*. Viking Books, New York.

Waters, Michael R., and John C. Ravesloot
2000 Late Quaternary Geology of the Middle Gila River, Gila River INdian Reservation, Arizona. *Quaternary Research* 54:49-57.
2001 Landscape Change and the Cultural Evolution of the Hohokam along the Middle Gila River and Other River Valleys in South-Central Arizona. *American Antiquity* 66:285-299.

Weintraub, Neil S., Daniel Sorrell, and John Hanson
2005 A GIS Model for Late Pueblo II/Cohonina Multi-Directional Abandonment of the Coconino Plateau. Paper presented at the 70th Annual Meeting for the Society for American Archaeology, Salt Lake City, Utah.

Western Regional Climate Center
2011a Sunset Crater NM, Arizona (028329) - Historic Climate Summary. Online at http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?az8329 (accessed Oct.2, 2011).
2011b Wupatki NM, Arizona (029542) - Historic Climate Summary. Online at http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?az9542 (accessed Oct.2, 2011).

White, Leslie A.
1932 *The Acoma Indians*. Forty-Seventh Annual Report of the Bureau of American Ethnology, pp. 17-192. Government Printing Office, Washington, D.C.
1942 *The Pueblo of Santa Ana, New Mexico*. Memoirs of the American Anthropological Association, No. 60. Menasha, WI.
1962 *The Pueblo of Sia, New Mexico*. Bureau of American Ethnology, Bulletin 184. Government Printing Office, Washington, D.C.

White, Gilbert F., editor
1974 *Natural Hazards: Local, National, Global*. Oxford Univeristy Press, New York.

Whiteley, Peter M.
1988 *Deliberate Acts: Changing Culture through the Oraibi Split*. University of New Mexico Press, Albuquerque.

Whiteley, Peter M.
1992 Hopitutungwni: 'Hopi Names' as Literature. In *On the Translation of Native American Literatures*, edited by Brian Swann, pp. 208-227. Smithsonian Institution Press, Washington, DC.
2008 *The Orayvi Split: A Hopi Transformation*. Anthropological Papers of the American Museum of Natural History, No. 87. New York.

Whittaker, John C., and Kathryn Kamp
1992 Sinagua Painted Armbands. *Kiva* 58:177-188.

Whittaker, John C., Kathryn Kamp, and William Bryce
2013 Projectile Points from the Magician Burial. Poster presented at 78th Annual Meeting of the Society for American Archaeology, Honolulu, Hawaii.

Whittlesey, Stephanie, and J. Jefferson Reid 2001
2001 In *Ancient Burial Practices in the American Southwest*, edited by Douglas R. Mitchell and Judy L. Brunson-Hadley, pp.68-96. University of New Mexico Press, Albuquerque.

Wiessner, Polly
1983 Style and Social Information in Kalahari San Projectile Points. *American Antiquity* 49:253-276.
2002 The Vines of Complexity: Egalitarian Structures and the Institutionalization of Inequality among the Enga. *Current Anthropology* 43:233-269.
2006 From Spears to M-16s: Testing the Imbalance of Power Hypothesis among the Enga. *Journal of Anthropological Research* 62:165-191.

Wiessner, Polly, and Akii Tumu
1998 *Historical Vines: Enga Networks of Exchange, Ritual and Warfare in Papua New Guinea*. Smithsonian Institution Press, Washington, DC.

Wilcox, David R.
1979 The Hohokam Regional System. In *An Archaeological Test of Sites in the Gila Butte-Santan Region, South-Central Arizona*, edited by Glen E. Rice, David R. Wilcox, Kevin Rafferty, and James Schoenwetter, pp. 77-116. Anthropological Research Papers No. 18. Arizona State University, Tempe.
1986 Excavations of Three Sites on Bottomless Pits Mesa, Flagstaff, Arizona. Manuscript on file, Museum of Northern Arizona, Flagstaff.
1991 The Mesoamerican Ballgame in the American Southwest. In *The Mesoamerican Ballgame*, edited by Vernon L. Scarborough and David R. Wilcox, pp. 101-125. University of Arizona Press, Tucson.
1993 The Evolution of the Chacoan Polity. In *The Chimney Rock Archaeological Symposium*, edited by J. M. Malville and G. Matlock, pp. 76-90.: Rocky Mountain Forest and Range Experiment Station.

Wilcox, David R.
1996 Work Plan for the 1996 NAU/MNA Archaeological Field School with the Verde Valley Archaeology Society. Museum of Northern Arizona Department of Anthropology, Flagstaff

Wilcox, David R., and Jonathan Haas
1994 The Scream of the Butterfly: Competition and Conflict in the Prehistoric Southwest. In *Themes in Southwest Prehistory*, edited by George J. Gumerman, pp. 211-238. School of American Research Press, Santa Fe, NM.

Wilcox, David R., and Charles Sternberg
1983 *Hohokam Ballcourts and Their Interpretation*. Archaeological Series No. 160. Arizona State Museum, Tucson.

Wilcox, David R., Gerald Robertson, Jr., and J. Scott Wood
2001a Antecedents to Perry Mesa: Early Pueblo III Defensive Refuge Systems in West-Central Arizona. In *Deadly landscapes : Case Studies in Prehistoric Southwestern Warfare*, edited by Glen E. Rice and Steven A. LeBlanc, pp.109-140. University of Utah Press, Salt Lake City.
2001b Organized for War: The Perry Mesa Settlement System and Its Central Arizona Neighbors. In *Deadly landscapes : Case Studies in Prehistoric Southwestern Warfare*, edited by Glen E. Rice and Steven A. LeBlanc, pp. 141-194. University of Utah Press, Salt Lake City.

Wilcox, David R., Terry Samples, Donald Keller, and Maria Laughner
1996 The Wagner Ballcourt Community and Other Cohonina Sites. *Kiva* 61:433-456.

Wilshusen, Richard S.
1989 Unstuffing the Estufa: Ritual Floor Features in Anasazi Pit Structures and Pueblo Kivas. In *The Archaeology of Social Integration in the Prehistoric Pueblos*, edited by William Lipe and Michelle Hegmon, pp. 89-111. Occasional Paper No. 1. Crow Canyon Archaeology Center, Cortez, CO

Wisner, Ben, Piers Blaikie, Terry Cannon, and Ian Davis
2004 *At Risk: Natural Hazards, People's Vulnerability and Disasters*, 2nd edition. Routledge. New York.

Woodbury, Richard B., and Nathalie F. S. Woodbury
1966 Appendix II: Decorated Pottery of the Zuni Area. In *The Excavation of Hawikuh by Frederick Webb Hodge: Report of the Hendricks-Hodge Expedition, 1917-1923*, edited by Watson Smith, Richard B. Woodbury, and Nathalie F. S. Woodbury, pp. 302-326. Contributions from the Museum of the American Indian, Vol. 20. Heye Foundation, New York.

Worsley , Peter
1957 *The Trumpet Shall Sound: A Study of "Cargo" Cults in Melanesia*. MacGibbon & Kee, London.

Wrangham, Richard W.
1999 The Evolution of Coalitionary Killing. *Yearbook of Physical Anthropology* 42:1-30.

Wright, Barton
1976 *Pueblo Shields from the Fred Harvey Fine Arts Collection*. Northland Press, Flagstaff, Arizona
1986 *Pueblo Cultures*. Iconography of Religions, Section X: North America, Fascicle 4. E. J. Brill, Leiden.

Wyman, Leland C.
1970 *Blessingway*. University of Arizona Press, Tucson.

Young, Robert W., and William Morgan, Sr.
1951 *A Vocabulary of Colloquial Navajo*. U.S. Indian Service, Phoenix.
1987 *The Navajo Language: A Grammar and Colloquial Dictionary*. University of New Mexico Press, Albuquerque.

APPENDIX A

CERAMIC DATING METHODS

CERAMIC DATING METHODS

Two methods of ceramic dating are used to establish the chronology of site occupations: identifying ceramic groups and calculating mean ceramic dates. Ceramic group dating assigns sites to temporal periods based on the co-occurrence of different temporally sensitive pottery types (Figure A-1) in pottery assemblages, and was developed in the Flagstaff region by Colton (1946) and refined by Smith (1952) and Downum (1988). Six ceramic groups with corresponding temporal periods have been defined (Table A-1).

The mean ceramic dating method was originally developed by South (1977) using historic ceramics with well-established dates of production and use, and has been applied to prehistoric ceramic assemblages in the U.S. Southwest (Christenson 1994) where dates of production and use have been determined through associations with tree-ring dated features (Breternitz 1966). For an assemblage with a number (*n*) of different ceramic types (*k*), the method estimates a point in time for assemblage formation/site occupation by multiplying the median dates (*m*) of the types present by their frequency of occurrence (*f*), summing these products, and then dividing by the total number of sherds present (Equation 1). The resulting number is rounded to the nearest integer to provide a calendar year estimate for assemblage formation/site occupation.

$$(1) \qquad \mathrm{MCD} = \frac{\sum_{k=1}^{n} m_k f_k}{\sum_{k=1}^{n} f_k}$$

For the purposes of mean ceramic dating, the numbers of sherds of Tusayan and Little Colorado White Ware types with analogous design styles and equivalent production and use date ranges are summed (Table A-2). The production and use date ranges of decorated whiteware, redware, and orangeware types commonly found in the Flagstaff region are presented in Table A-3 along with the median values of these date ranges. Christenson (1994) proposed that different types could be weighted in order for more temporally sensitive to have a greater contribution to the calculation of the mean ceramic date. Downum (personal communication, 2003) developed the weighting factors for types in the Flagstaff region shown in Table A-3. Like Christenson, these weighting factors were based objectively on the lengths of the type date ranges, but then they were adjusted based on subjective assessments of the rarity and importance of some types and refined by through testing assemblages from key tree-ring dated contexts. The frequency of each type present in the assemblage is multiplied by the weighting factor (Equation 2).

$$(2) \qquad \mathrm{MCD} = \frac{\sum_{k=1}^{n} m_k f_k w_k}{\sum_{k=1}^{n} f_k w_k}$$

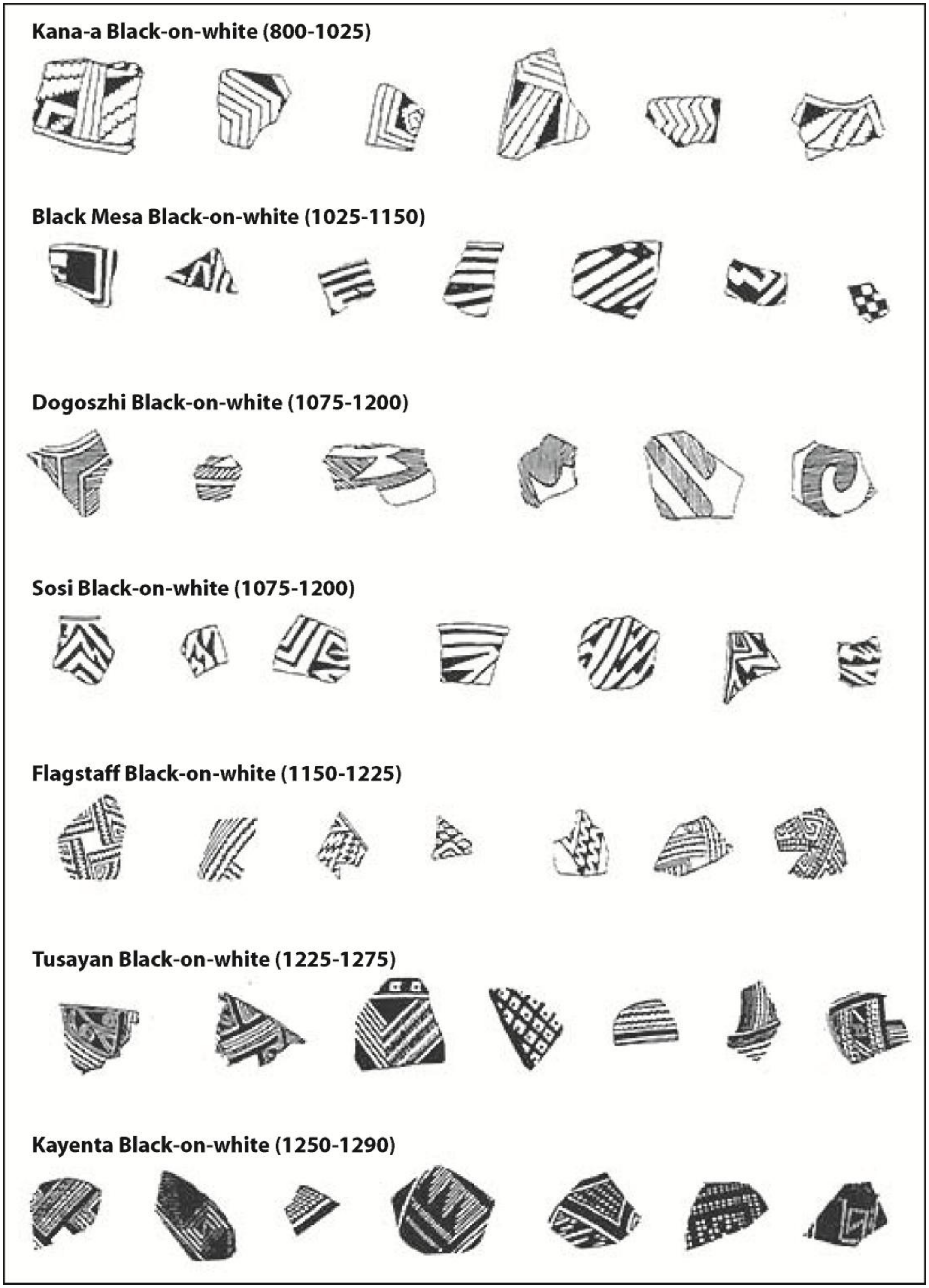


Figure A-1. Representative sherds of the black-on-white design styles [from Beals et al. (1945) compiled by Chris Downum].

Table A-1. Ceramic group dating for the Flagstaff region

Period	Dates	Decorated Pottery Types	Plainware Pottery Types
1	pre-1085	Lino B/g, Kana-a B/w, or Deadman's B/r	Lino Gray, Kana-a Gray, Medicine Gray, Coconino Gray, Floyd Gray, or Rio de Flag Brown
2	1085-1130	Black Mesa B/w, Holbrook A B/w	Tusayan Corrugated, Deadman's Gray, or Angell/Winona Brown
3	1130-1160	Sosi B/w, Holbrook B B/w, Dogoszhi B/w, Padre B/w, or Cameron Polychrome	Tusayan Corrugated and Moenkopi Corrugated
4	1160-1220	Flagstaff B/w, Walnut B/w, Citadel Polychrome, or Tusayan Polychrome	Moenkopi Corrugated, Sunset Red/Brown, or Turkey Hill Red
5	1220-1275	Tusayan B/w or Leupp B/w	Kiet Siel Gray, Moenkopi Corrugated, Sunset Red/Brown, or Turkey Hill Red
6	1275-1300	Kayenta B/w, Tsegi Polychrome, or St. John's Polychrome	Kiet Siel Gray or Jeddito/Winslow Orange Ware

Table A-2. Analogous whiteware design styles and types.

Tusayan White Ware	Little Colorado White Ware
Lino B/g	none
Kana'a B/w	St. Joseph B/w
Black Mesa B/w	Holbrook A B/w
Sosi B/w	Holbrook B B/w
Dogoszhi B/w	Padre B/w
Flagstaff B/w	Walnut B/w
Tusayan B/w	Leupp B/w
Kayenta B/w	none

Table A-3. Production and use date ranges, median dates, and weighting factors for decorated ceramic types

Types	Production and Use Date Range	Median Date	Weighting Factor
Lino B/G	500 – 850	675	1
Kana a B/W	800 – 1025	912.5	1.25
Black Mesa - Holbrook A B/w	1025 – 1150	1087.5	2.25
Sosi - Holbrook B B/w	1075 – 1200	1125	2
"Broadline" (Black Mesa or Sosi) - Holbrook B/w	1025 – 1200	1112.5	1
Dogoszhi - Padre B/w	1075 – 1200	1125	2
Flagstaff - Walnut B/w	1150 – 1225	1187.5	2.75
Tusayan - Leupp B/w	1225 – 1275	1250	3
Kayenta B/w	1250 – 1290	1270	3.1
Deadmans B/r	800 – 1090	945	1.1
Medicine B/r	1050 – 1125	1087.5	2.75
Tusayan B/r	1065 – 1200	1132.5	2.15
Cameron Polychrome	1075 – 1150	1112.5	3.25
Citadel - Tusayan Polychrome	1125 – 1275	1200	2
Kiet Siel - Kayenta Polychrome	1250 – 1290	1270	3.1

Confidence intervals around a MCD can be calculated by dividing the standard deviation (σ) of the median dates for the types present in the assemblage by the square root of the total number of sherds present in the assemblage and multiplying this by the critical value of 1.96 for a 95% confidence interval (Equation 3). Like the MCD, the resulting confidence interval is rounded to the nearest integer for full calendar years.

$$(3) \qquad \text{MCD} = \frac{\sum_{k=1}^{n} m_k f_k w_k}{\sum_{k=1}^{n} f_k w_k} \pm \left[1.96 \left(\frac{\sigma_{mk}}{\sqrt{\sum_{k=1}^{n} f_k}} \right) \right]$$

APPENDIX B

DESCRIPTIONS OF INDEXES

DESCRIPTIONS OF INDEXES

For this research I developed four indexes to measure change by temporal periods:

- ***Defensive Site Index*** **–** the rate and frequency of defensive site use (see Chapter 8),
- ***Skeletal Violence Index*** **–** the rate and frequency of violence-related skeletal trauma (see Chapter 9),
- ***Productivity Index*** **–** potential agricultural productivity (see Chapter 13),
- ***Deposition Rate Index*** **–** the rate of deposition of temporally sensitive white ware types as a proxy for population (see Chapter 13).

Separate values for the defensive site and deposition rate indexes were calculated for the heartland and frontier zone while single values for the whole region were calculated for the skeletal violence and productivity indices. The following sections present the details of the methods used to calculate these measures. Calculation of the skeletal violence index and the defensive site index for the heartland involved Bayesian transformation of the source data and are described first. The data available for the frontier zone did not require Bayesian transformation and allowed the calculation of a defensive room index in addition to a defensive site index, both of which are described separately from the heartland defensive site index. The productivity index uses reconstructed Palmer Drought Severity Index (PDSI) values for the region and is detailed next. Finally, the deposition rate index uses survey data on the frequencies of decorated whiteware styles from Walnut Canyon National Monument in the heartland and Wupatki National Monument in the frontier zone to examine population trends on a landscape scale

SKELETAL VIOLENCE INDEX

An index of skeletal violence (SVI) was developed using data on the total number of excavated burials (n) from the region and the number of remains with evidence of violence (x). However, the excavated sample of burials compiled for this analysis is obviously not a complete record of the true population of all prehistoric burials from the region, and like the conflict index of Cole (2007) and Kohler et al. (2014) the percentage of remains with evidence of violence was adjusted using empirical Bayesian methods to provide a more meaningful estimate for the entire region. These methods are detailed in Cole (2007:85-89) and involve calculating estimates of the unknown population proportion (π) from the observed sample proportion ($p = x/n$). Constants a and b are derived using the mean (μ') and variance (σ'^2) of the prior distribution, which is the proportion for each site in the dataset rather than each temporal period (Equations 1a,b). Then the mean of the posterior distribution (μ'') is derived using these constants and the number of excavated burials and the number of remains with violence for each temporal period (Equation 2). Finally, the most probable value or peak of the posterior distribution [$f(\pi)_{max}$] is calculated for each time period (Equation 3).

$$(1a,b) \qquad a = \mu' \left[\frac{\mu' (1 - \mu')}{\sigma'^2} - 1 \right] \qquad b = (1 - \mu') \left[\frac{\mu' (1 - \mu')}{\sigma'^2} - 1 \right]$$

$$(2) \qquad \mu'' = \frac{x + a}{n + a + b}$$

$$(3) \qquad f(\pi)_{max} = \frac{(x + a + 1)(n + b + a)}{(x + a)(n + b + a - 2)} \mu''$$

The value of $f(\pi)_{max}$, the Bayesian adjusted frequency of occurrence, is the conflict index of Cole (2007) and Kohler et al. (2014). I also calculated the values of *p* and $f(\pi)_{max}$ for each temporal period (*t*); further, I calculated the rate (*r*) at which violence occurred by dividing the number of remains with evidence of violence (*x*) per time period by the length of the temporal period in years (*y*), so $r = x/y$. The final index annualized the frequency of violence by dividing it by *y* and multiplying the result by the constant 1,000 so the final index value was not a small decimal. For comparative purposes, the SVI was calculated using both the observed sample proportion *p* and the estimated unknown population proportion $f(\pi)_{max}$ (Equations 4a,b)

$$(4a,b) \qquad SVI_p = (p_t / y_t) \times 1{,}000 \qquad SVI_\pi = (f(\pi)_{max\,t} / y_t) \times 1{,}000$$

Table B-1 presents the values for *x*, *n*, *p*, *a*, *b*, μ", $f(\pi)_{max}$, *y*, *r*, SVI_p, and SVI_π, and a series of graphs in Figure B-1explore the relationships between values derived from the observed sample proportion and those derived from estimates of the unknown population proportion. The top two graphs compare the prior (*p* and SVI_p) and posterior observations [$f(\pi)_{max}$ and SVI_π] showing that the Bayesian correction had limited effect except regarding the frequency of violence during in the earliest time period which has the smallest sample size ($n = 32$, $x = 2$). The bottom graph compares standardized z-scores of the values of $f(\pi)_{max}$, which is the conflict index of Cole (2007) and Kohler et al. (2014) that measures the frequency of violence only, with SVI_π, my index that combines the frequency and rate.

Table B-1. The skeletal violence index and its components

Time Period	x	n	p	a	b	μ''	$f(\pi)_{max}$	y	r	SVI_p	SVI_π
1000-1085	2	32	0.0625	-0.1001	-0.6441	0.0608	0.0308	85	0.02	0.74	0.36
1085-1130	0	271	0.0000	-0.1001	-0.6441	-0.0004	0.0000	45	0.00	0.00	0.00
1130-1160	11	87	0.1264	-0.1001	-0.6441	0.1264	0.1175	30	0.37	4.21	3.92
1160-1275	14	309	0.0453	-0.1001	-0.6441	0.0451	0.0421	115	0.12	0.39	0.37

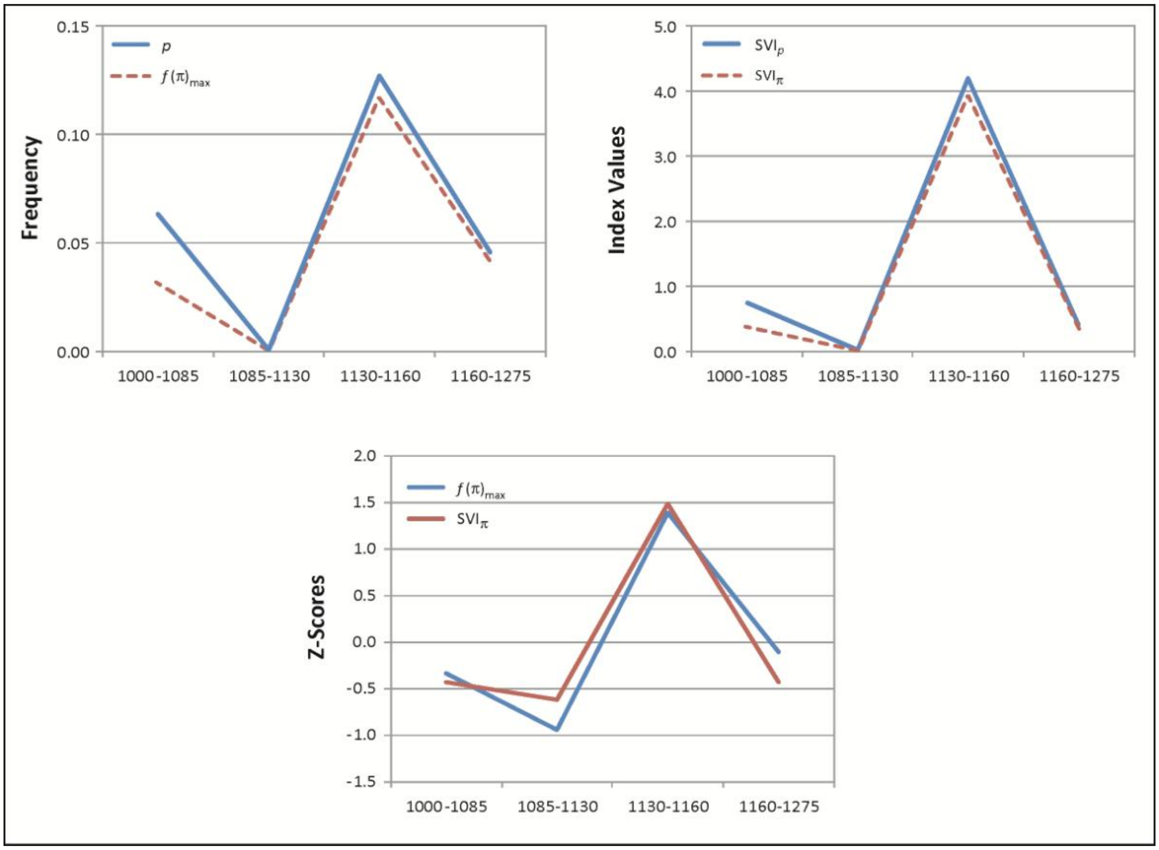


Figure B-1. Graphical comparisons of the skeletal violence index and its components.

Defensive Site Indexes

A defensive site index (DI) was developed to measure the frequency and rate of defensive site use during different time periods. Separate index values were calculated for different datasets from the heartland and the frontier zone. These two datasets differ in the levels and intensity of survey coverage and site recording. The primary component of the frontier zone dataset is from the full coverage survey of Wupatki National Monument (Anderson 1991), but since only one site was occupied in the monument before the eruption, data from the intensively surveyed Medicine Valley area (Colton 1946; Parry 1981) which was occupied before the eruption and includes a fortified retreat. For the purposes of this analysis, the results of these surveys are considered to be the complete population of sites within the monument and in the Medicine Valley area. In contrast, the survey coverage in the heartland is discontinuous and varies in both the intensity of survey efforts and the nature of site data recording. So, like the sample of burials from the region, this sample of sites is also not a complete record of the true population of all prehistoric sites in the heartland and the percentage of defensive sites was adjusted using empirical Bayesian methods to provide a more meaningful estimate. The more straightforward calculation of frontier zone index is discussed first, then the heartland index.

Frontier Zone Defensive Site and Room Indexes

The consistent nature of the site recording and data coding for the sites in the monument allowed the assessment of the number of rooms associated with defensive sites, and using these data two separate indices were calculated, one for defensive sites (DI_s) and the other for rooms at defensive sites (DI_r). No rooms index was calculated for the 1000-1085 period using the Medicine Valley survey data as most of the associated habitation sites consist of pit house clusters and without excavation accurate room counts cannot be made. These indices were derived from the following variables: the number of defensive sites (d_s) and rooms (d_r), the total number of sites (n_s) and rooms (n_r) for each time period (t), and the length in years of each time period (y_t). The means of calculating the number of rooms per period follows the methods used by Sullivan and Downum (1991) in their study of population trends. For sites occupied during a single time period, all the rooms were assigned to that time period; but for sites occupied across more than one time period, the number of rooms were divided equally among the periods.

From these variables two basic measures of defensive site and room use can be calculated: (1) the percentage of defensive sites and rooms in the population of all habitation sites ($p_s = d_s/n_s$ and $p_r = d_r/n_r$), and (2) the annual rate of construction of defensive sites and rooms ($c_s = d_s/y_t$ and $c_r = d_r/y_t$). To create an index expressing both the frequency and rate of use of defensive sites and rooms the frequencies were divided by the length in years of each time period and transformed into an integer greater than zero by multiplying it by 1,000 as shown in Equations 5 and 6.

$$DI_s = (p_s / y_t) * 1{,}000 \quad (5)$$

$$DI_r = (p_r / y_t) * 1{,}000 \quad (6)$$

The values for the variables and the calculated frequencies, rates, and indices for sites and rooms are presented in Table B-2 and compared in a series of graphs both as raw scores and standardized z-scores (Figure B-2).

The frequency of defensive sites and rooms follow slightly different trajectories with the differences in the 1130-1160 period being the most remarkable, for as the frequency of defensive sites decreased, the frequency of defensive rooms increased. This period was marked by a major increase in population from the preceding period (Sullivan and Downum 1991; see also section below on the deposition rate index) with more sites being built in opem, undefended locations. At the same time, however, the defensive sites that were being established were larger and had more rooms. The annual rate of defensive site and room construction also peaks during this period. These rates and the frequency of defensive rooms fall during the subsequent 1160-1220 period while the frequency of

Table B-2. The defensive site and room indexes for the frontier zone and their components

Time Periods	d_s	n_s	p_s	c_s	DI_s	d_r	n_r	p_r	c_r	DI_r
1000-1085	1	21	0.0476	0.01	0.56	-	-	-	-	-
1085-1130	17	58	0.2931	0.38	6.51	73.08	183.66	0.3979	1.62	8.84
1130-1160	33	131	0.2519	1.10	8.40	208.76	508.33	0.4107	6.96	13.69
1160-1220	56	218	0.2569	0.93	4.28	327.6	969.33	0.3380	5.46	5.63
1220-1275	30	95	0.3158	0.55	5.74	144.93	326.67	0.4437	2.64	8.07

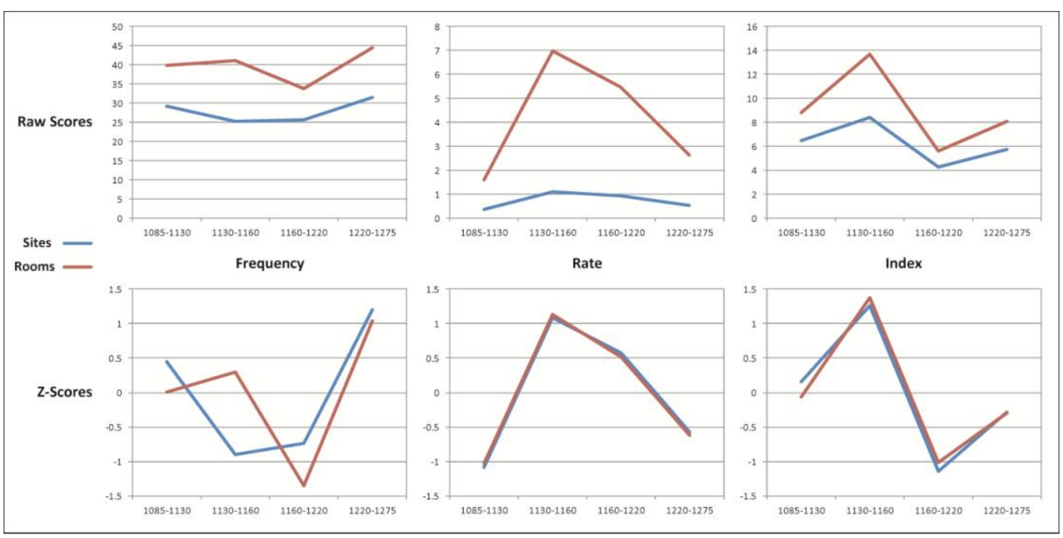


Figure B-2. Graphical comparisons of the sites and rooms index values.

defensive sites remains about the same. During the terminal period of occupation, the rate of defensive site construction decreased as population decreased, yet the frequency of defensive site use increased, indicating increasing competition among the groups that remained. The combined index amplifies these trends increasing in the 1130-1160 period, falling in the following 1160-1220 period, and then rising again during the final period.

Heartland Defensive Site Index

To calculate the index for defensive sites in the heartland, a sample of 819 habitation sites with 1,257 temporal components was compiled using survey data from the Coconino National Forest and Walnut Canyon National Monument. Unlike the full-coverage inventory of Wupatki National Monument, survey coverage in the heartland is discontinuous and this sample of sites is not a complete record of the true population. Methods of site recording and data coding in the heartland site sample are not as consistent as the frontier zone sample, so a comparable defensive room index could not be calculated. Because the sample is not a complete record of the true population, as discussed above, calculation of the percentage of defensive sites in the heartland used empirical Bayesian methods to provide a more meaningful estimate. First, the number of sites and defensive sites per time period (n_s and d_s) were used to calculate the percentage of defensive sites for each time period ($p = d_s/n_s$). Using the same Bayesian methods described for the skeletal violence index (Equations 1, 2, and 3), the most probable value or peak of the posterior distribution [$f(\pi)_{max}$] of the percentage of defensive sites in the heartland was calculated for each time period. The values of p and $f(\pi)_{max}$ were used to calculate defensive site index values for both the known percentage (DI_p) and for the Bayesian adjusted percentage (DI_π) as shown in Equations 7 and 8 respectively. Table B-3 presents the values for d_s, n_s, p, a, b, μ'', $f(\pi)_{max}$, DI_p, and DI_π. Figure B-3 compares the values of p with $f(\pi)_{max}$ and DI_p with DI_π showing the posterior estimate as slightly lower than the prior distribution in all time periods, particularly the final period .

$$DI_p = (p / y) * 1{,}000 \tag{7}$$

$$DI_\pi = (f(\pi)_{max} / y) * 1{,}000 \tag{8}$$

Table B-3. The defensive site index for the heartland and its components

Time Period	d_s	n_s	p	a	b	μ''	$f(\pi)_{max}$	DI_p	DI_π
1000-1085	1	103	0.0097	0.6355	16.9761	0.0136	0.0054	0.11	0.06
1085-1130	3	370	0.0080	0.6355	16.9761	0.0093	0.0067	0.18	0.15
1130-1160	4	387	0.0104	0.6355	16.9761	0.0115	0.0091	0.35	0.30
1160-1220	20	459	0.0437	0.6355	16.9761	0.0434	0.0415	0.73	0.69
1220-1275	5	48	0.1087	0.6355	16.9761	0.0886	0.075	1.98	1.37

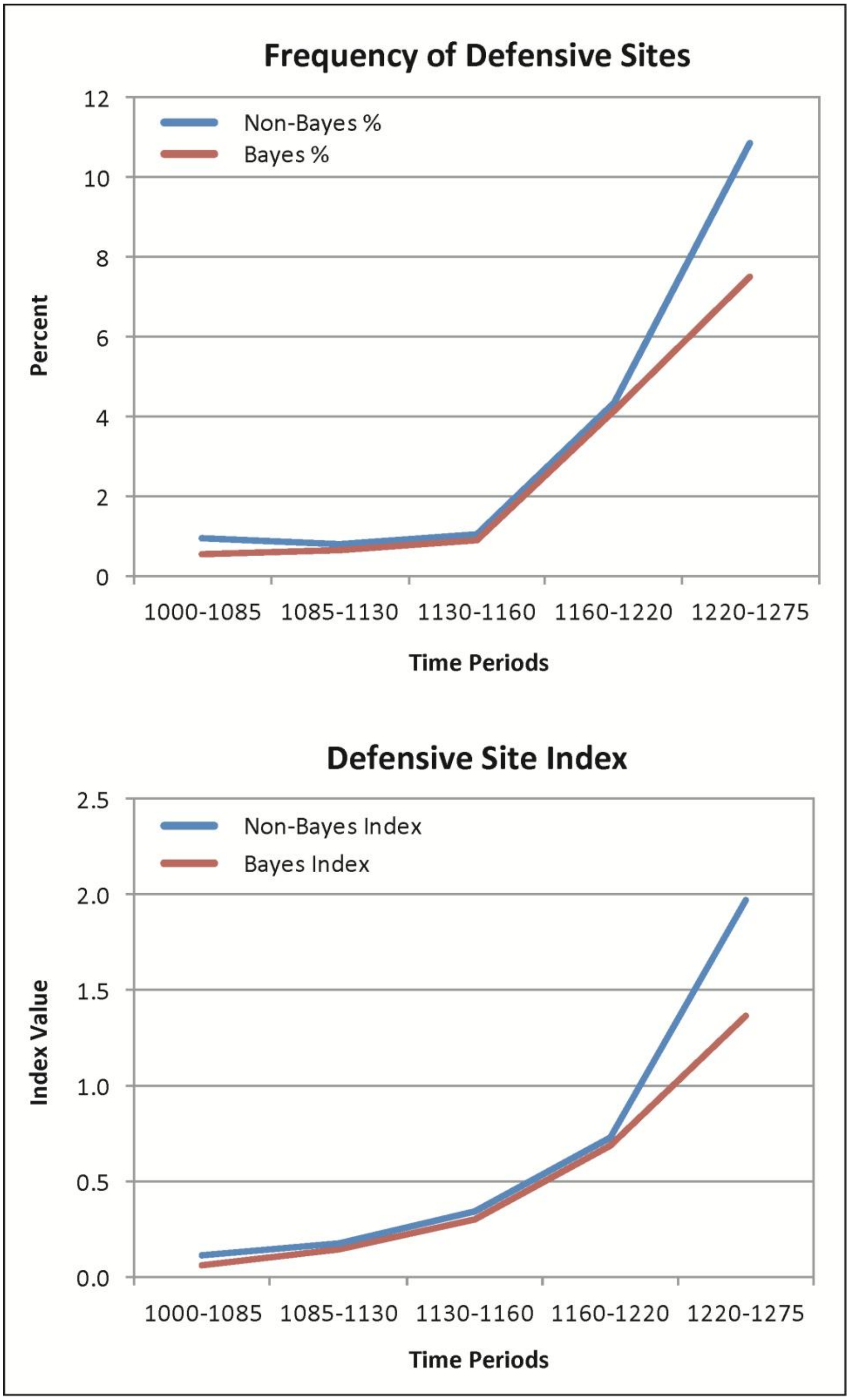


Figure B-3. Graphical comparisons of the Bayesian adjusted and non-adjusted values of the heartland defensive site index and components.

PRODUCTIVITY INDEX

An index of agricultural productivity for the region (PI) was developed using the reconstructed regional values of the Palmer Drought Severity Index (PDSI) (Cook et al. 1999, 2004). This measure was used rather than the reconstructed precipitation record because PDSI accounts for both moisture and temperature and is a cumulative measure. For each of the temporal periods (t), the mean (μ_t) and the variance (σ_t^2) of the reconstructed annual PDSI values were determined and the mean was divided by the variance. In general, if the mean were high and variance low, creating ideal conditions for productive agriculture across the temporal period in question, the index value would be high; conversely, if the mean were low and variance high, creating challenging conditions for agricultural production, the index value would be low. Since all of the PDSI mean values for the different temporal periods are negative numbers, the resulting quotient is negative as well, so this value was added to 1 to create a positive number for the index value for each period (PI_t), as shown in Equation 9.

$$(9) \quad PI_t = (\mu_t / \sigma_t^2) + 1$$

Higher PI values indicate greater potential sustained productivity across the period, while lower PI values indicate less amenable conditions and diminished productive potential. Table B-4 presents the raw scores and standardized z-scores for mean PDSI, variance, and productivity index for each temporal period and Figure B-4 graphically represents the relationships between the component values and the resulting index values both as raw scores and z-scores. The 1130-1160 period that includes the 1130s megadrought has the lowest value and the greatest departure from the median value as well.

Table B-4. The productivity index and its components

Temporal Periods	Raw Scores (Z-Scores)		
	Mean PDSI	Variance	Productivity Index
1000-1085	-0.88 (0.43)	4.33 (0.46)	0.80 (0.44)
1085-1130	-0.79 (0.58)	4.33 (0.45)	0.82 (0.54)
1130-1160	-2.14 (-1.74)	3.36 (-1.59)	0.36 (-1.78)
1160-1220	-0.73 (0.68)	3.96 (-0.32)	0.82 (0.53)
1220-1275	-1.10 (0.05)	4.58 (0.98)	0.76 (0.25)

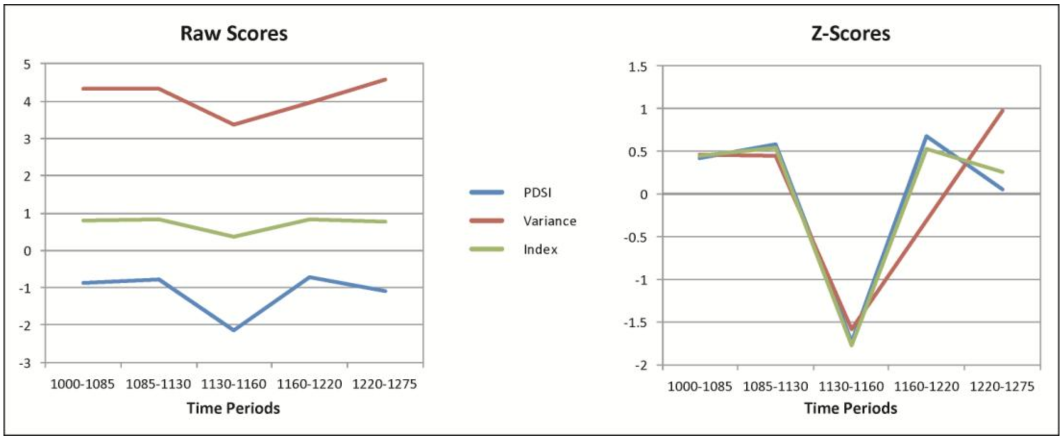


Figure B-4. Graphic representations of the relationships among the Productivity Index and its components.

Deposition Rate Index

To look at general population trends at a landscape level I developed an index to measure the rate of deposition of temporally sensitive whiteware styles using counts compiled from survey data for Walnut Canyon and Wupatki National Monuments, with the former representing the heartland and the latter the frontier zone. The Wupatki dataset consists of the merged assemblages from all sites recorded during the survey (Anderson 1990) for which complete inventories of ceramics were made (n = 14,751). The Walnut Canyon dataset consists of the merged assemblages from all surface collections from previous surveys (n = 614) re-analyzed by Acord (2005).

This index combines the concepts of frequency seriation, ceramic group dating (see Appendix A), and rates of assemblage formation. Like in ceramic group dating, different temporally sensitive whiteware design styles are associated with different time periods (Table B-5) and the assemblages are seriated by these periods like in a typical frequency seriation. But, as noted before, each time period is of different length. So for an assemblage containing different decorated styles (k) associated with time periods (t) of different lengths in years (y), the deposition rate index (DRI) for each time period is calculated (Equation 10) by dividing the number of whiteware sherds (w) of a particular style by the number of years in the associated time period to get a sherds per year measure of deposition for the time period. This measure is then standardized by dividing it by the overall deposition rate for the whole assemblage, the sum of all sherds divided by the total number of years in all periods.

$$(10) \qquad \mathrm{DRI} = (w_k / y_t) / \left(\sum_{k=1}^{n} w_k / \sum_{t=1}^{n} y_t\right)$$

Table B-5. Time periods and associated whiteware styles

Time Period	Whiteware Design Styles (Tusayan WW / Little Colorado WW)
1085-1130	Black Mesa / Holbrook A
1130-1160	Sosi and Dogoszhi / Holbrook B and Padre
1160-1220	Flagstaff / Walnut
1220-1275	Tusayan and Kayenta / Leupp

The final value of the index (Table B-6) thus expresses the rate of deposition for each time period as above (>1) or below (<1) the rate of deposition for the whole assemblage. This rate of deposition is a proxy measure of population as more households and people leave more broken pottery than fewer households and people do, thus increases or decreases in the deposition rate index indicate corresponding increases or decreases in population levels. The index does not directly measure population, but rather indicates trends in changing population levels from period to period. Standardization of the index allows assemblages of different sizes, like the survey data from Wupatki and Walnut Canyon, to be compared in terms of relative population trends.

Figure B-5 compares the deposition rate indexes for Walnut Canyon and Wupatki with the frequency seriation data from which they are derived, showing the general trend is for increased values in the shorter 1130-1160 period and decreased values in the other longer periods. The deposition rate index compares favorably to another assessment of population, Sullivan and Downum's (1991) annual rate of room construction for Wupatki National Monument (Figure B-6). However, when calculating the annual rate of room construction, the rooms at multicomponent sites were equally divided among the time period during which the site was occupied. The proportional distribution represented by the deposition rate index suggests that the annual rate of room construction may slightly underestimate the first two time periods and slightly overestimate the latter two. Comparison of the deposition rate indexes for Walnut Canyon and Wupatki (Figure B-7) suggest some differences in population dynamics in the two areas. The index indicates that populations increased in both areas through the 1160-1220 period and declined thereafter, but the change in the 1130-1160 period was different in the two areas, with a greater increase from the preceding period at Wupatki than at Walnut Canyon. This difference likely results from the greater influence of migration on population dynamics in the frontier zone, especially during the 1130-1160 period.

Table B-6. Deposition rate index values and source data

Area	Whiteware Styles	Time Period	#	%	Sherds/Yr	Index
Wupatki	Black Mesa	1085-1130	834	5.65	18.53	0.24
	Sosi/Dogoszhi	1130-1160	3,873	26.26	129.10	1.66
	Flagstaff	1160-1220	9,368	63.51	156.13	2.01
	Tusayan	1220-1275	676	4.58	12.29	0.16
	Total		14,751		77.63	
Walnut Canyon	Black Mesa	1085-1130	64	10.42	1.42	0.44
	Sosi/Dogoszhi	1130-1160	100	16.29	3.33	1.03
	Flagstaff	1160-1220	410	66.78	6.83	2.11
	Tusayan	1220-1275	40	6.51	0.72	0.22
	Total		614		3.23	

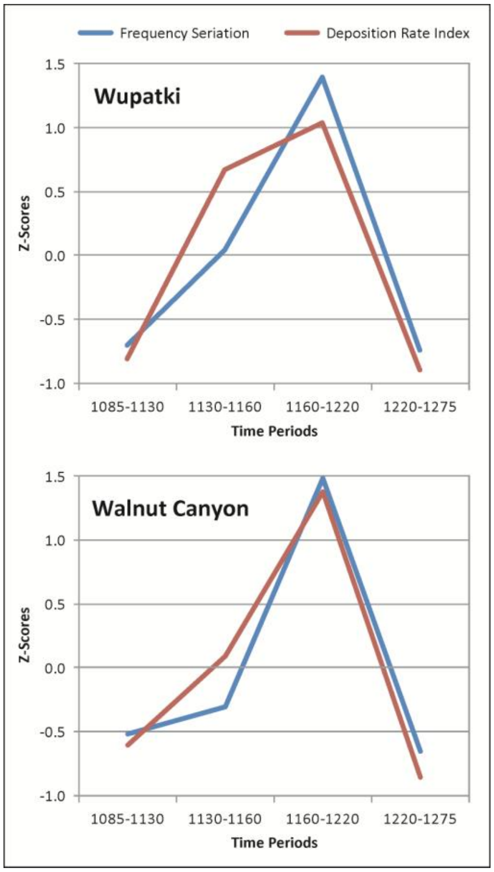


Figure B-5. Comparisons of the Z-scores of the deposition rate index with the frequency seriation source data for Walnut Canyon and Wupatki.

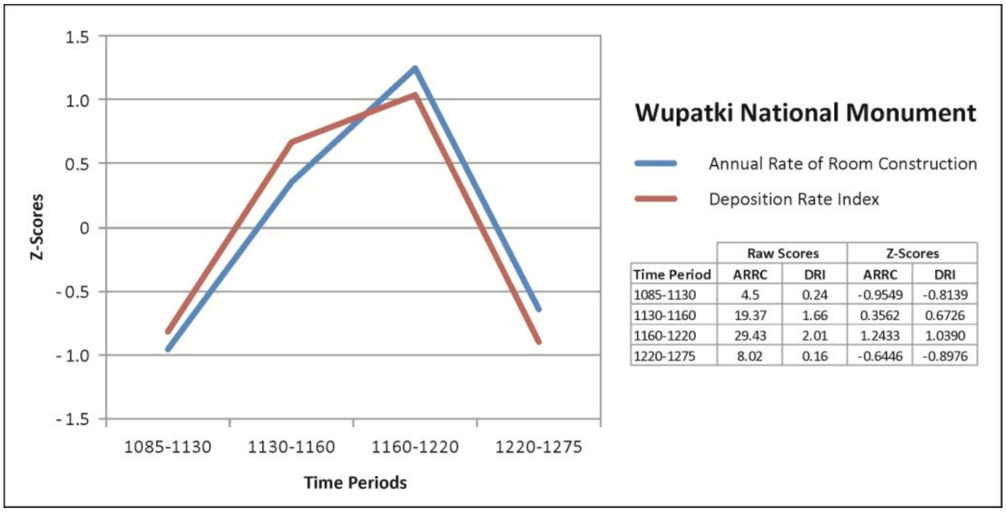


Figure B-6. Comparison of the Z-scores for the annual rate of room construction (Sullivan and Downum 1991) and the deposition rate index for Wupatki.

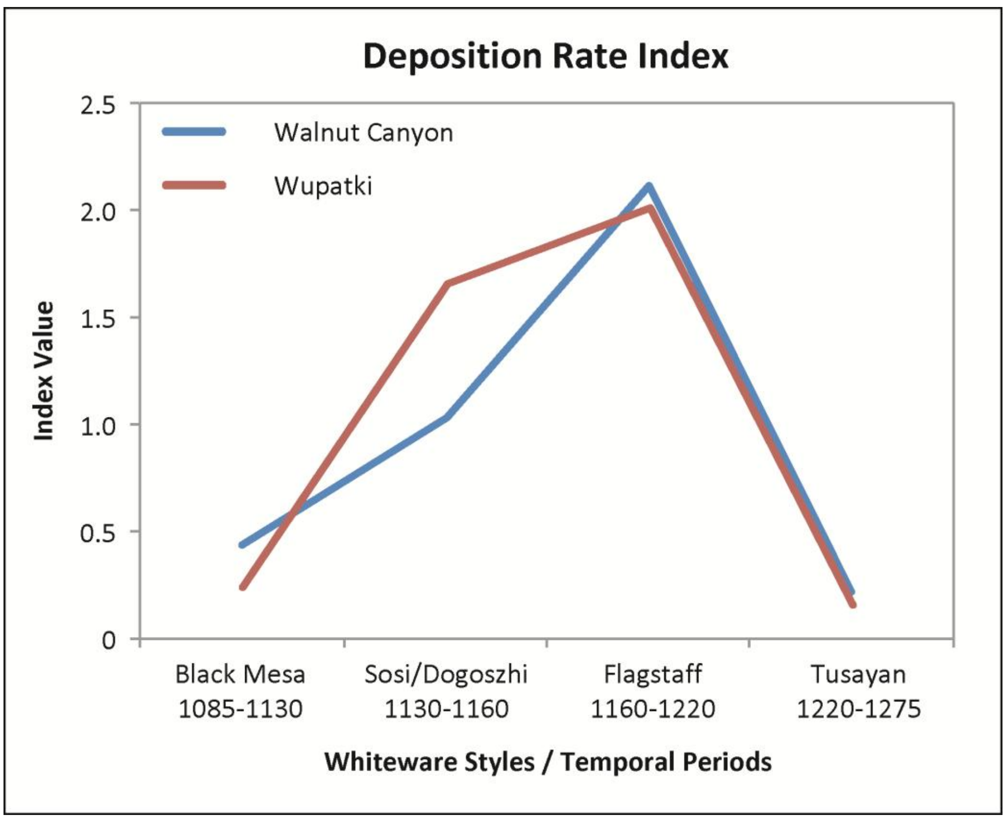


Figure B-7. Comparison of deposition rate indexes for Walnut Canyon and Wupatki.