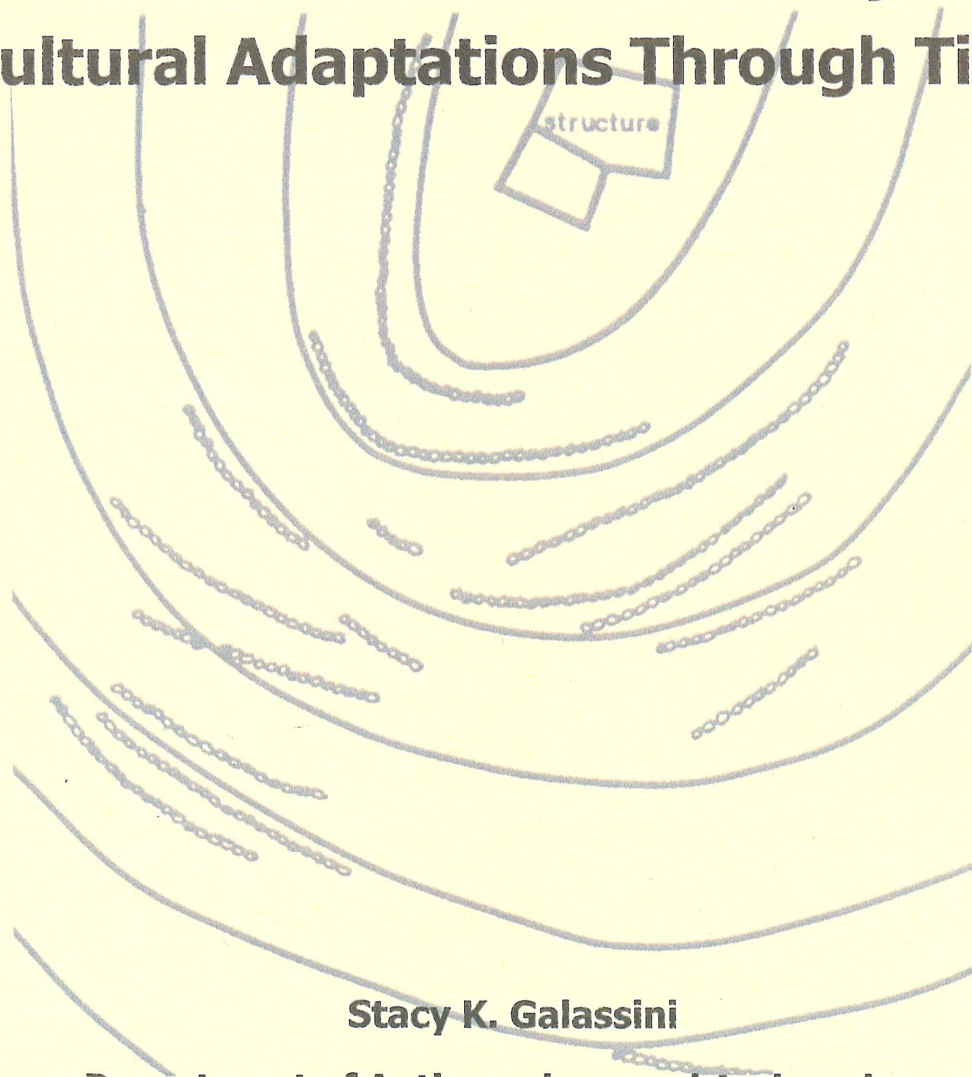


Water Control in the Middle Rio Puerco Valley: Cultural Adaptations Through Time



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CHAPTER 1: INTRODUCTION

Since the inception of agricultural practices in the American Southwest (ca. AD 500), the limiting or encouraging factors in food-producing strategies at all levels are primarily environmental, based on the variables of topography, climate, and effective moisture. Prehistoric Anasazi subsistence adaptations through time are seen largely as responses to environmental stress and population-resource imbalances (Irwin-Williams 2003:1). As an increasingly sedentary people began to intensify agricultural practices, more technologically diverse techniques were incorporated to maximize this strategy in a marginal environment (see Moore 1981; Buge 1984; Vivian 1984; Anschultz 1998). Subsequent historic populations with differing economies, technology, and most importantly, culture, came with their own strategies to cope in this remote valley.

Co-occurring with shifts in agricultural productivity were the distribution of sites, or settlement patterns, reflected in periods of dispersed, aggregated, and nucleated populations (Irwin-Williams 1977). These patterns are thought of as adaptive states and are assumed to be concomitant with favorable micro-environments, availability of water, and arable land. Although many factors may contribute to the movement of people from one place to another and abandonments on all scales (e.g., population growth, lack of game, disease, and internal or external strife), the underlying cultural mechanisms of a society also provide an impetus for adapting (or mal-adapting) within an environment. Specifically, how a society manages subsistence technology “define[s] the functional potentials and constraints of the effective environment, and likewise the potentials, constraints, and demographic structural

requirements for the resident population” (Irwin-Williams 2003).

Water control technology was implemented by all who practiced agriculture in the middle Rio Puerco valley. At one time flood-water farming was possible before the Rio Puerco became so deeply entrenched. Fluctuating environmental conditions made it necessary for the prehistoric occupants to expand their techniques to take advantage of slope and drainage runoff, a practice common throughout the prehistoric southwest. The number and diversity of prehistoric water control devices in the valley testify to the fact that this adaptation was critical to the success of crop production. In contrast, Spanish populations, assumedly more sophisticated, practiced a more technologically (or conceptually) constrained agriculture, one determined on controlling the often violent Rio Puerco. Their economy was also divided with raising livestock, a practice that while it provided them with an alternative food supply, contributed to the deterioration of local environmental conditions, and ultimately the abandonment of the area.

Underpinning issues of differential adaptation are the concepts of landscape and land use and how geography, historical processes, and culture intersect to bring the human-environment interaction to light. Specifically, one’s cultural background has much to do with determining one’s environmental aptitude and learning curve in adapting to adverse conditions.

First, a theoretical perspective from which to discuss human-environment relationships will be outlined. Chapter 3 will discuss the nature of prehistoric agricultural techniques in the American Southwest. The following three chapters will give the archaeological, physical, and cultural history of the middle Rio Puerco valley. Chapter 7 outlines research methodology of

re-evaluating the dating of tested water control devices, while the last two chapter discusses results and the nature of the human manipulation of landscape and resources from a cultural adaptation perspective.

CHAPTER 2: THEORETICAL FRAMEWORK

Since the theme of this work is at its most basic about how different cultures adapt to similar environments, it is necessary to define certain concepts of culture and what anthropologists mean when they use the term, for it is not always in the same context. Anthropology has developed many definitions for culture and has always been concerned with why and how it changes. Indeed, the definitions and perceptions of what exactly culture is seem to parallel current social and political events. Anthropology itself has divided up into this school and that school, reflective of the attitudes and biases of individuals instilled with the baggage of their own times and culture projecting those onto past or foreign societies.

Harris (1985:114) simply defines culture as “the total socially acquired life-style of a group of people including patterned, repetitive ways of thinking, feeling, and acting.” The way it was defined by Tylor (1871:1), the founder of academic anthropology, still holds:

Culture...taken in its wide ethnographic sense is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society. The condition of culture among the various societies of mankind, in so far as it is capable of being investigated on general principles, is a subject apt for the study of laws of human thought and action.

These definitions hold for synchronic snapshots of a society, but as history proves, things change. Processes of enculturation, where information and customs are passed on to younger generations for them to replicate, are meant to sustain the culture and its identity. But each generation faces its own set of conditions that the physical environment metes out. To pass on culture, that is, to reproduce genetically and ideologically, a culture must successfully cope with the changing environmental conditions and ensure a predictable means of subsistence.

In this way, humans can be considered part of the ecosystem. Human ecology “concentrates on the ecological relationships among human beings and their cultures and the rest of the organic and inorganic environment” (Harris 1985:204). In the prehistoric American Southwest, and in all societies, it is the articulation with the natural world and the selective adaptations made to exist in it that allow a culture to continue. This is just basic Darwinian evolution. The most selectively fit organisms beget the most offspring and transmit their genes (and ideas) to future generations. Culture is the social and ideological mechanism that provides an organization, a metaphysical reason, to human adaptive responses not only to the environment, but to other humans.

CHAPTER 3: AGRICULTURAL TECHNIQUES IN THE PREHISTORIC SOUTHWEST

Definitions

Technological water control devices used across the prehistoric Southwest are morphologically similar though may not have similar functions or construction styles. For example, the device may be considered as having primarily a conservation function or a diversionary function, or the same type of feature might be constructed from masonry or from brush. Also, the entire system may use a combination of features that act interdependently, though appear independent, according to the level of archaeological visibility. Consequently, typologies and terminologies have been used that may or may not apply to all parts of the Southwest. Obviously, not every type of agricultural strategy is possible in all parts of the Greater Southwest, or even the Colorado Plateau. Therefore, each study must include the operating definitions of terms under consideration. The following definitions are largely adapted from Vivian (1974) unless otherwise cited. Vivian characterizes these features as used for either conservation or diversion. Conservation systems use water in place, as in border gardens, check dams, and contour terraces. These are dependent on rainfall and runoff resulting from rainfall. Diversion systems use collected water for transport to another location, as in ditches and diversion dams.

Water control: the myriad of techniques and practices used to capture, conserve and use water resources for domestic and agricultural purposes.

Water control system: a feature or combination of features that provide water for farming or domestic use.

Bordered or grid garden: small area enclosed by low earth or stone borders that

contains and conserves moisture.

Check dam: consists of low rough stone walls built across small intermittent drainages retaining both water and soil, frequently occurring in ravines or narrow valleys.

Contour terrace: consists of long rows of low stone walls built across hillsides, talus slopes, or concentrically around small knolls; designed to capture slope wash rather than the intermittent drainage of ravines and stream beds; terracing also commonly functioned to create level planting areas that trapped soil and conserved moisture (Doolittle 1992, 2000).

Ditch: a narrow shallow cut in the earth for carrying water, typically less than one meter in width and depth.

Diversion dam: a stone or earthen dam designed to temporarily restrict the flow of water for diversion into a ditch.

These represent the broad typological definitions traditionally used. However, recent studies have provided for a more diverse interpretation of water control systems as more complex than simply an either/or proposition both functionally and adaptively (e.g., Woosley 1980, Anschuetz 1998, Maxwell 2000). Anschuetz (1998:136) feels this classification is based too heavily on “the identification of readily visible structures that work to control the flow, storage and distribution of water” and ignore other “potentially significant components of a comprehensive water management system,” such as the manipulation of soils and the development of seed stock for deep planting.

The practice of agriculture indeed requires the management of many things, water being perhaps the most crucial. As Anschuetz commented however, other manipulations of

the environment were just as significant in the production of a successful harvest. As discussed later, a group's agricultural success depended not only on the climate, but also on the selection of farming techniques that maximized crop production. Indigenous populations understood very well that diversity in field location and plant preparation and protection were also important. The following are descriptions of some of those techniques.

Field locations

Akchin fields were planted to take advantage of the alluvial fans at the mouths of drainages or arroyos where water and sediments could spread across a low-gradient field naturally with little artificial diversion. Hack's (1942) seminal work on Hopi agriculture describes this as the most common location of fields in that area. Fields located along the terraces of arroyos or within the arroyo also utilized water from stream floods. Obviously, fields located in these areas were also subject to devastation should the flood be too violent. More artificial diversion, such as dams and spreaders, was required to protect from crop damage in these fields, thus involving more labor. The agricultural potential of these areas though likely countered the environmental risk. The nature of *akchin* farming, that is, planting in different locations around the waterways, probably ensured a certain amount of success the population could predict and rely on. By their very nature flood-plain fields are ephemeral and difficult to detect archaeologically, particularly if there were no extensive artificial features associated with them (Maxwell 2000:180). In the middle Puerco valley the stream channel has become so eroded since Puebloan times that no fields have been located around the arroyo, with the exception of the Salado Creek area where Nials (1975) reported a large field visible only from the air. However, before the Rio Puerco entrenched it is almost certain the

inhabitants would have practiced flood-water farming.

Dry farming relies solely on rainfall and in arid environments requires soil that is permeable that overlies a less pervious soil that retains the moisture. Hack (1942) reported extensive sand dune fields in the Hopi area where it buffered against the continued entrenchment of arroyos and watershed loss. Dry farming was undoubtedly practiced by all groups across the Southwest. Before active human agency in crop production, observation of the location and physical properties of where native plants thrived would not have escaped the local population. Active human manipulation of native plants, then domesticated cultigens likely began in locations and soils that maximized precipitation, therefore, dry farming was not a big leap in agricultural innovation. Again, this is an archaeologically obscured feature but well documented ethnographically.

Runoff, or slope wash fields, were perhaps the most utilized method of controlling water in areas with otherwise unreliable sources of irrigation. These were located at or below the break in slope of a valley or mesa side (Hack 1942). Water diversion devices, such as terraces and check dams, were built upslope and in drainages to slow and direct runoff. As seen in Figures 3 and 4 the slopes of Guadalupe Mesa would have presented adequate conditions for controlling water to fields below. In Chaco Canyon the main method of water capture was diverting runoff from small watersheds into ditches that then went into headgates that distributed water to fields (Vivian 1974). This method also captured water for domestic use (Lagasse et al. 1984:187).

Another method of field manipulation was the use of gravel-mulches (Lightfoot 1990). Maxwell (2000:166) defines this as "any nontranspiring barrier placed over the soil surface for the purpose of reducing soil evaporation, increasing filtration by protecting the surface, and

reducing weed growth.” Experimenting with gravel or rock mulches in the Galisteo Basin, Lightfoot (1990) found that the mulch promoted much more plant life and retained soil moisture up to 3.5 times more than non-gravel mulched areas.

By a suite of methods using strategic planting, water control, and field location and manipulation, native Americans extracted the most the land could provide with what is often considered “simple technology.” With an abundant lithic supply, a digging stick, a bag of seeds, and, most importantly, intimate knowledge of the potential and limitation of the physical environment, indigenous groups were able to buffer against environmental stress for many centuries.

CHAPTER 4: ARCHAEOLOGICAL BACKGROUND

The area known as the middle Rio Puerco of the East was the center of an eleven year project started by Cynthia Irwin-Williams in 1970. The Rio Puerco Valley Project (RPVP) was first organized around delineating the local cultural sequence and settlement patterns, beginning in Archaic times and progressing up to the first signs of what is known as the Anasazi culture, the ancestors of the modern Pueblo Indians (Baker 2003:5). The valley was occupied from around AD 600 - 1300 and, therefore, offered a large temporal and cultural background from which to extract archaeological data. In addition, the valley saw occupation from populations of Navajo, Apache, Spanish, and Anglo-Americans up through the 20th century.

After the project began it was obvious the valley had much to be discovered and a new research design was implemented to encompass larger goals. Three of the new goals relevant to this project were: 1) to investigate the large-scale relationship between site location and specific natural and cultural resources; 2) to evaluate the effects of environmental stress on human population size and distribution; and 3) to examine the development of water control devices and their effects on the environment (Irwin Williams 1977a:2). These concerns were also extended to the historic settlements, mainly the Europeans, as they too were subject to the same environmental stress the prehistoric occupants of the valley experienced (Baker 2003:8).

Through grants from the National Geographic Society, Eastern New Mexico University, the National Institute of Health, and private endowments, the middle Rio Puerco valley is one of the most studied areas in southwestern archaeology. Home to the Eastern New

Mexico University archaeological field school for several summers and the subject of many master's theses and dissertations, the Rio Puerco valley has produced important contributions to anthropological knowledge, particularly concerning peripheral communities and their adaptive strategies in a harsh and isolated environment. Most of the valley has been surveyed resulting in the recording of 1,232 individual sites and the analysis of over 230,000 ceramic sherds, providing for the chronologically detailed database (Baker 2003:19)

Following Irwin-Williams' research goals some of the projects included: Fritz's (1973) thesis on settlement patterning in the valley noted that the prehistoric inhabitants constructed water control devices, did not place sites on prime farm land, and also did not practice a very intensive type of agriculture; Haecker's (1976) study explored strategies employed by the first Spanish settlers; Terrel (1979) did a thesis on architectural attributes of the great house on Guadalupe Mesa; Moore (1981) dated and tested several water control devices; Pippin (1987) has perhaps the most comprehensive study of the area in his dissertation on the paleoecology of Guadalupe Ruin; Durand and Hurst (1991) refined ceramic dating through seriation; Roler (1999) undertook a faunal analysis of Eleanor Ruin, the second largest site in the valley; Rooke (2000) indexed arable land and agricultural productivity around the river channel; Proper (2001) excavated Eleanor Ruin to further explore occupations by indigenous and immigrant populations; and, finally, a synthesis of the prehistory of the middle Rio Puerco valley was published by the Archaeological Society of New Mexico (Baker and Durand 2003). These works represent a broad and detailed view of the prehistoric and historic occupations of the middle Rio Puerco. Yet, there is still much to be learned from the area as archaeological method and theory ever progresses.

The Guadalupe Community

First, it is necessary to define the relationship between a small dispersed community like Guadalupe (and many others) and the monumental architectural wonder of Chaco Canyon some 100 km away (Figure 1). The large settlement patterns in Chaco Canyon represent the center of a regionally integrated system that began developing in the 10th century (Cordell 1997:305). Eventually encompassing 65,000 square kilometers of the San Juan Basin, the Chacoan system included “outliers,” communities smaller than those at Chaco but possessing many of the same material attributes and practices, including the settlement patterning and masonry style of great houses and unit pueblos, participation in an exchange network, and evidence of a regional road network spoking out from Chaco Canyon (Cordell 1997:306). There are also similarities in the timing and method of agricultural intensification as much of the Colorado Plateau experienced the same fluctuating climatic conditions. The nature and degree to which the outlying communities were in direct association (or control) of the center has been debated for decades, as has the extent of the social and political complexity of the Chaco Canyon community itself (e.g., see the essays in Crown and Judge 1991 and Durand and Durand 2000). At the very least, there is a baseline cultural affiliation happening in the San Juan Basin with the Chaco community representing the hallmarks of that culture as seen in settlement patterns, architecture, and ceramics.

The archaeological hub of the Rio Puerco valley is the great house on Guadalupe Mesa and known as Guadalupe Ruin. In the vocabulary of southwest archaeology, the term “great house” roughly denotes a larger multi-room pueblo with an associated kiva surrounded by smaller unit pueblos. Taken together this configuration is termed a “community,” specifically, a Chacoan type community (Lekson 1991:32) (Figure 2).

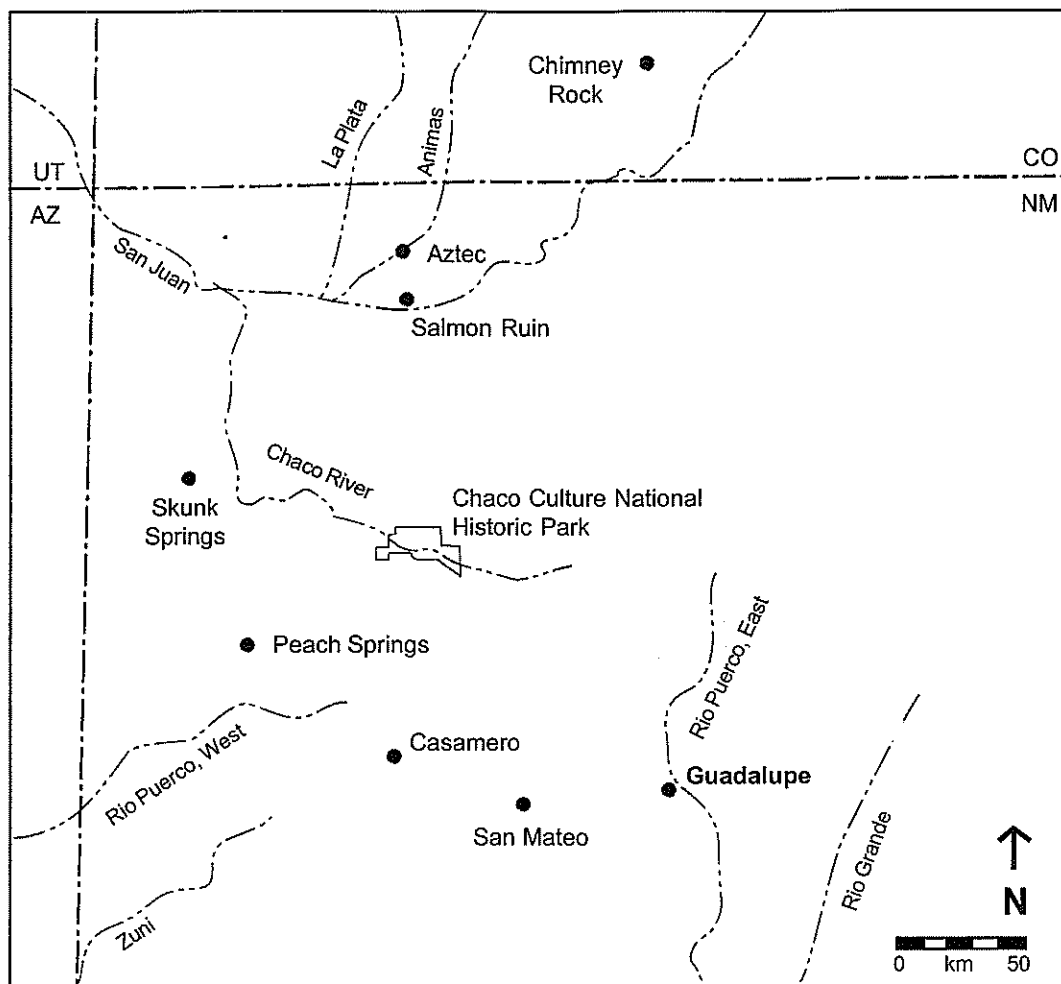


Figure 1. Regional map of several Chacoan outlier communities (adapted from Durand and Durand 2000:102).

The great house on Guadalupe Mesa is a single-story 54 room masonry pueblo built 300 feet above the valley floor (Figure 3 and Figure 4). The construction of the Guadalupe great house began around AD 960 and is the only outlying great house with the same style of masonry construction used in Chaco Canyon around the same time (Durand and Durand 2000:103). Some of the structures below the mesa, including the large site of Eleanor Ruin, date earlier than the great house. Construction progressed through the 11th century with occupation continuous until the 1100s, known as the Chacoan era (Pippin 1987). Beginning in the early 12th century (AD 1130-1220) the post-Chaco, or San Juan-Mesa Verde period, is evidenced by extensive remodeling of the great house, Eleanor Ruin, and smaller sites within the valley. As occurred throughout the Colorado Plateau, people were moving about and repopulating areas, putting their own architectural stamp on existing buildings.

Fulfilling one of the early research goals of the RPVP, James Moore (1981) identified 45 water and soil conservation systems, 36 of which were contour terraces (Figure 5 and 6). One feature was a major diversion dam-ditch-field system located in the southern part of the middle Rio Puerco where Salado Creek meets the main channel. Although Nials (1975) was the first to describe this fairly extensive system, it was from an aerial perspective and to date has not been traced on the ground, a common problem of ancient agricultural features. Moore tested nine of the contour terraces for construction type (based on complexity and energy input) and chronology based on ceramics either found within the terrace, or from the nearest associated structure or feature (Figure 7). Much of the dating is tentative and is exclusively assigned to the AD 1100s, a fairly late date for the initial use of water control devices on the Colorado Plateau.

Charles Haecker (1976) produced a study on historic Spanish subsistence patterns in



Figure 3. View from atop Guadalupe Mesa looking southeast with pueblo walls in the foreground. Canon Tapia, a tributary of the Rio Puerco channel is in the background.



Figure 4. View from below and looking northwest at the slopes of Guadalupe Mesa.

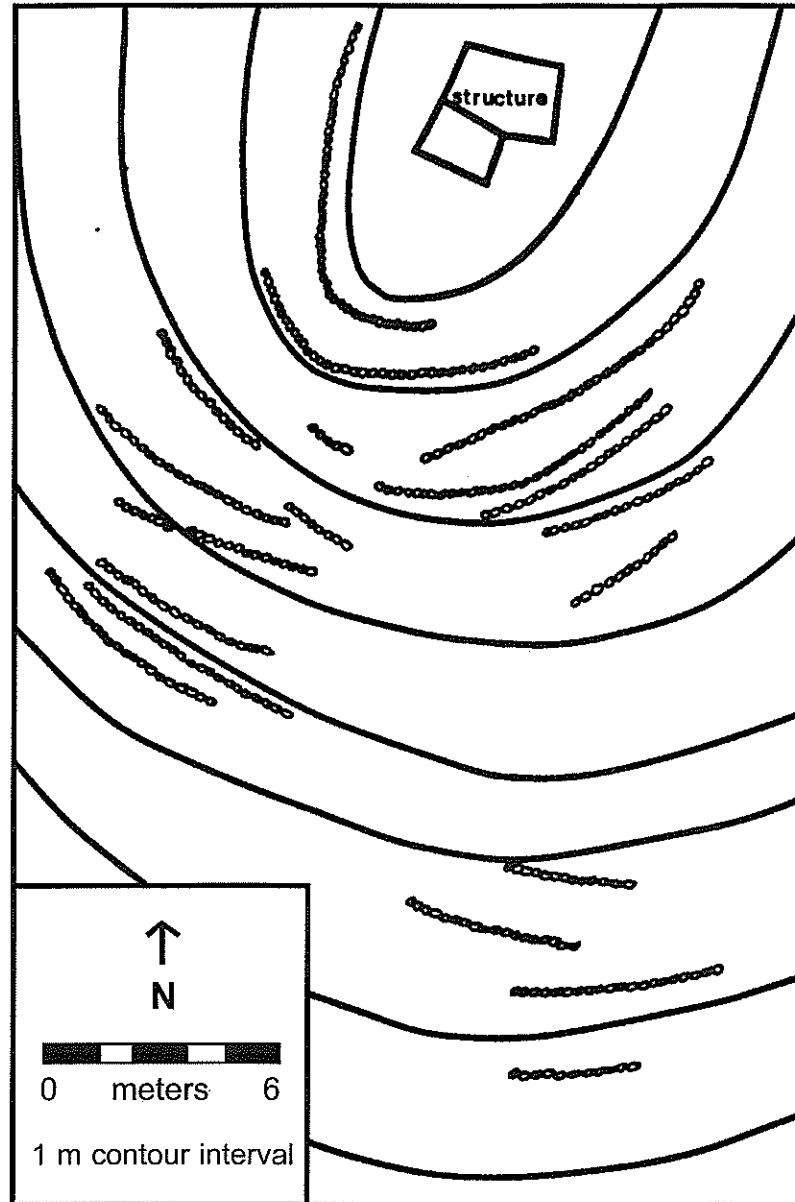


Figure 5. A representative contour terrace system associated with ENM 880 (adapted from Moore 1981:113).

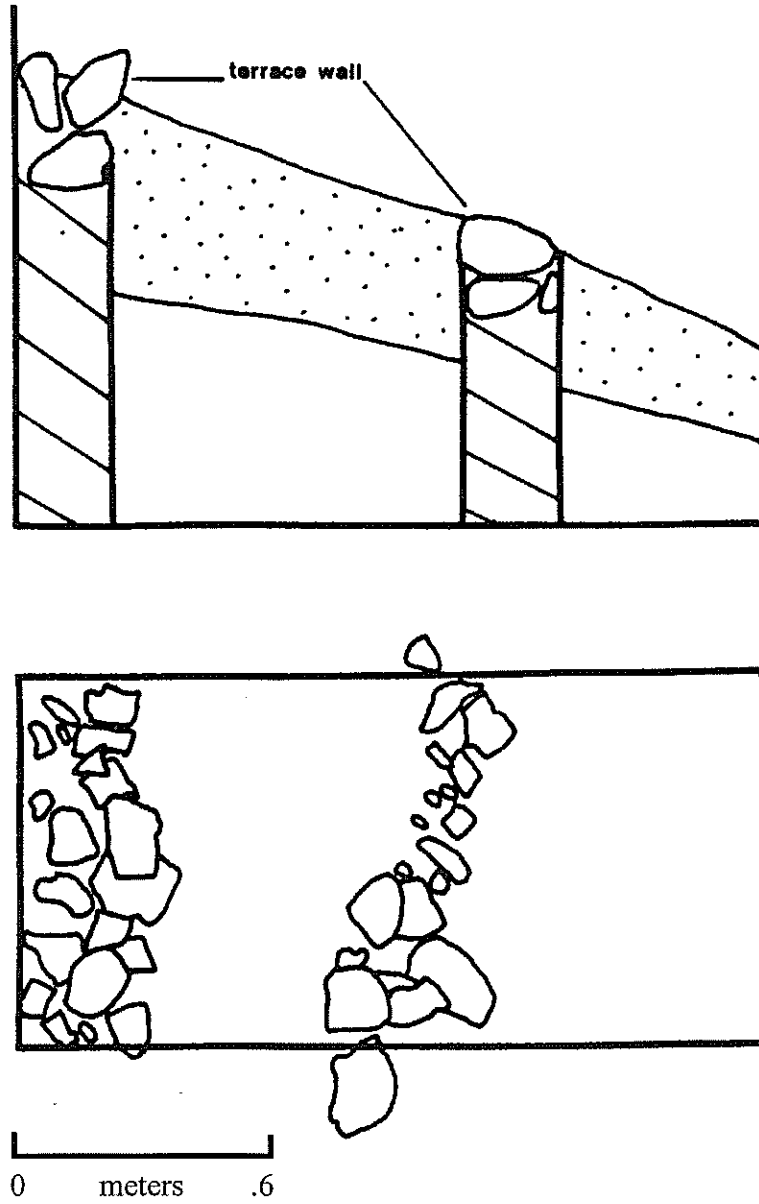


Figure 6. Typical contour terrace, profile and planview (adapted from Moore 1981:143).

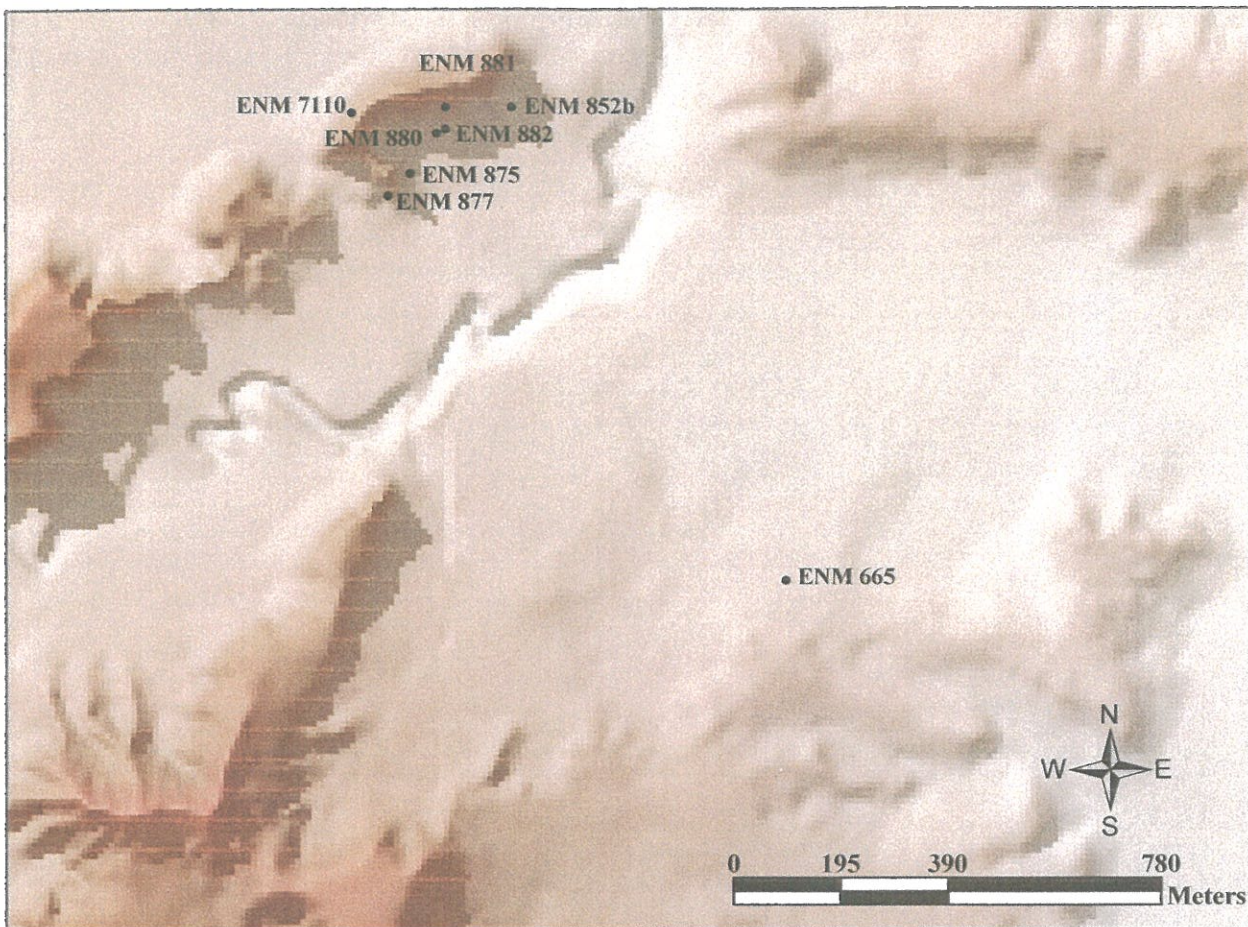


Figure 7. Map of eight of the contour terraces Moore (1981) tested around the slopes of Guadalupe Mesa and southeast of there.

the valley. After survey, he tested four 18th century sites and one late 19th century site, collecting all artifacts and bone and extracting paleobotanical material for pollen analysis. One of the 18th century sites was from Navajo occupation. Haecker concludes the settlers adapted to some extent to the harshness of the valley, exchanging goods with the indigenous population and supplementing dietary staples with the same wild plants the natives harvested. However, there is little discussion of farming techniques. Widdison's (1958) historical geography of the area provides much information on the natural environment, as well as the historical population, but suffers somewhat from an ethnocentric point of view.

In concert with each other, archaeological and geographical accounts of the middle Rio Puerco valley can help discern the processes, cultural and environmental, that shaped the prehistoric and historic adaptations. Periodic re-evaluations of past studies are necessary as ideas about culture change.

CHAPTER 5: PHYSICAL ENVIRONMENT

Geology

The middle Rio Puerco valley is located in Sandoval County, New Mexico, approximately 45 miles northwest of Albuquerque (Figure 8). This area is within the Datil section of the Colorado Plateau physiographic province and proximal to the Southern Rocky Mountains and Basin and Range provinces. Largely characterized by volcanic activity from the late Pliocene-Pleistocene epochs, the geology of the valley consists of Upper Jurassic and Cretaceous sandstones and shales with volcanic necks of basalt and andesite prevalent throughout (Nials 2003:21). The valley is dissected by the semi-continuous Rio Puerco channel and bounded by the basalt capped formations of Mesa Chivato in the west and Mesa Prieta in the east. Successive erosional events have left pediment surfaces and gravel-capped river terraces at differing elevations (Bryan and McCann 1936). The most extensive is the Ortiz surface on Mesa Prieta, formed in the early Pleistocene with late Pleistocene terraces occurring within 35 meters above the river (Moore 1981:58). Alternating strata of permeable sandstone and impermeable shale and clay beds has shaped the topography of the valley and determined locations of springs which influenced the placement of sites and agricultural features by local populations (Nials 2003).

Representing the main northwest tributary of the Rio Grande the Rio Puerco heads in the Nacimiento Mountains, runs southeast for 142 miles and drains an area of approximately 5,860 square miles (Moore 1981:57). Meaning "dirty river" in Spanish, the Rio Puerco contributes 45% of the sediment load to the Rio Grande but only 3% of the water above Elephant Butte Dam (Dorignac 1963). Winter precipitation in the Nacimientos can increase

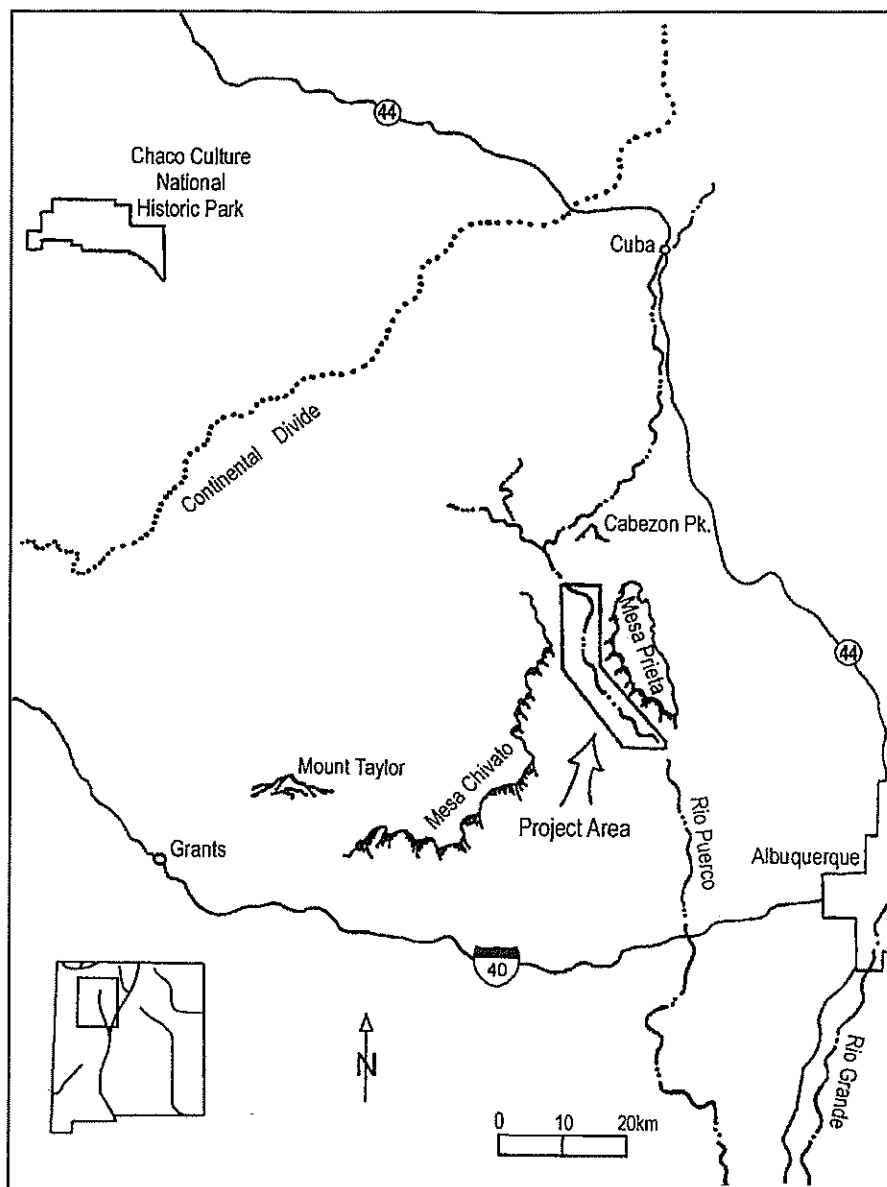


Figure 8. Location of the Rio Puerco Valley, New Mexico (Baker and Durand 2003:6).

the waterflow in the middle and lower parts of the valley. However, most channel activity is due to local runoff from the surrounding slopes and tributaries (Widdison 1958; Moore 1981).

The flanks of Mesa Chivato slope to the Puerco over 10 miles and contain the tributaries with the greatest length and discharge while Mesa Prieta rises sharply to 1100 feet just two miles from the channel and contains less than a dozen large tributaries carrying runoff (Nials 2003:24) (Figure 9). Early settlements practicing horticulture were located along the tributaries originating from Mesa Chivato (Irwin Williams and Haynes 1970). Moore (1981:60) noted that “the highly dissected nature of the region has resulted in the formation of many small colluvial fans adjacent to areas draining the mesa top,” creating agricultural fields. Where the floodplain meets the colluvial slope Pippin (1987:14) noted possible “temporary ponding with increased infiltration of runoff water,” a feature of natural water retention that would have been conducive for early farming.

A large porportion of the valley floor was a broad floodplain until the mid to late 19th century (Widdison 1958:12). Flood water farming would have been possible and predictably productive in the long-term. Since at least the 1880s the channel has become a large arroyo, incised up to 50 feet in some places, with the largest flash floods incapable of reaching the banks (Widdison 1958:12). Widdison (1958:18) also documented the varying width of the channel as between 20 and 100 feet with meander necks being cut off in just a few decades. Nials and Durand (2003:35) report that arroyo-cutting will “lower water tables, reduce base flow and vegetation cover, and erode sediments and soil that has taken thousands of years to accumulate. Piping vents adjacent to the arroyos make many valley bottoms not only dryer, but unsafe for livestock and humans, and impossible for agriculture.”

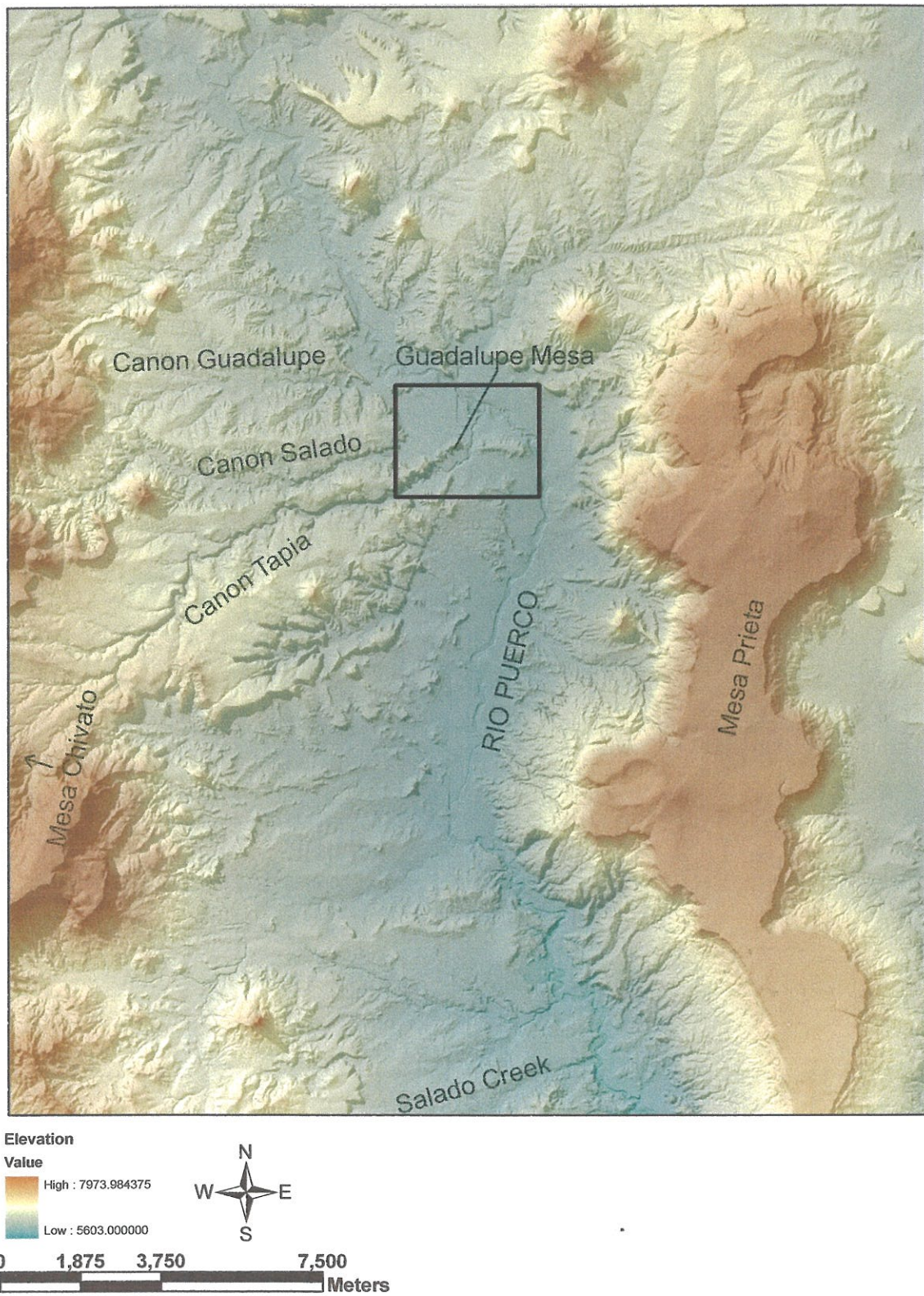


Figure 9. Map of the middle Rio Puerco valley illustrating the heavy dissection and varied topography.

Episodes of cyclic down cutting and sedimentation in parts of the valley since the end of the Pueblo II period (AD 1100) would have required a major flooding event to overflow the banks to water the agricultural fields on the floodplain and replenish soil nutrients (Moore 1981:183). The unpredictability of a critical water source would have reduced the amount of arable land and forced the inhabitants to relocate to more productive areas (Rooke 2000:11). In addition, other methods to increase water conservation and diversion from slope runoff would have been instituted or intensified to mitigate any loss of valley floor farming.

Climate

The climate in the Puerco valley is semi-arid with an average annual precipitation of 10 inches (Tuan et al. 1973). Over half of this amount comes in the violent convectonal thunderstorms of late summer contributing to the erosion of the main channel (Widdison 1958). Winters are cold and dry but often provide more effective moisture through, less evapotranspiration, and more penetration and conservation in the sandy soil. The spring months can produce high intensity duststorms affecting the topsoil and health of early seedlings. The average growing season is 140-150 frost-free days with killing frosts occurring as late as May and as early as October (Pippin 1987:14).

Vegetation

Biotic communities in the Puerco valley are Saltbush Grassland, Juniper-Cholla Grassland, Pinyon-Juniper Woodland, and Ponderosa Pine and Oak Forest. Vegetation includes semi-desert grasses and shrubs covering the valley floor and the adjacent uplands. These include grama grass, Indian rice grass, greasewood, sagebrush, salt bush, rabbit brush,

snakeweed, bee weed, and jimson weed. Cacti species include cholla and prickly pear. A pinyon-juniper woodland occurs on the mesa tops with Ponderosa pine present in the higher altitudes of Mesa Chivato. Salt cedar and cottonwoods grow near springs and in the arroyo bottoms (Pippin 1987). Inhabitants of the early 19th century reported large stands of cottonwoods, willows, and tall grasses along the river banks, all of which disappeared by the middle of the 20th century (Widdison 1958:33). In terms of human land use, Widdison (1958:33) goes on to say:

The streams, climate, topography, soils, and vegetation of the Rio Puerco valley all combine to create a natural landscape in which human settlement can barely exist. Even the most complete and ingenious use of the valley's resources cannot raise occupance above a subsistence level, a level at which poverty and hardship are characteristics of everyday life...The inherent paucity of resources has made it impossible for a large population to live in the valley, and will probably continue to make it impossible.

CHAPTER 6: CULTURE HISTORY AND LAND USE

Theoretical Background

Transformation of societies from simple to complex, or small-scale to large-scale has been an accepted process documented cross-culturally throughout the world. Nineteenth century anthropologists, such as Edward Tylor and Louis Henry Morgan, were the original purveyors of the idea that culture inexorably evolved through a series of stages (Barrett 1996:49-50). In this unilineal and unbroken line, societies began in savagery and predictably progressed through barbarism and, finally, attained civilization, the apex of culture with the concomitant moral and intellectual traits one would find in modern polite society. Many non-European societies were characterized as “stuck” in a lower stage, bereft of the intellectual tools to progress. These evolutionary models of human progress were derived from racist and ethnocentric views and perpetuated as the natural world order through the colonial efforts of many European countries, as well as the United States.

Over the next several decades the discipline moved away from these ideas, but by the 1950s evolutionary applications to culture were reorganized into schemes that were still comprised of developmental stages but based more on modes of production and energy input and output. The work of early archaeologists concerned with “when” had provided an undeniable chronology of material remains clearly revealing that culture did indeed change, although there were many mechanisms, both human and environmental, impacting the trajectory, timing, and history of a society. For example, it could be argued that the inception of sedentary agriculture in any society is accompanied by changes to that society necessary to cope with the increase and change in land use, food production, and population. Indeed,

questions of culture change have very much been tied up with methods of subsistence (Green 1980:313). The archaeologists of the last half of the 20th century were more interested in revising the old models to more reflect concerns with the “how” and “why” questions, i.e., techno-economic relationships, adaptation to the environment (cultural ecology), control of resources, and areal syntheses of settlement patterns (e.g., Steward 1938,1949; Willey and Phillips 1958; White 1959). Willey and Sabloff (1993:208) summarize it as “history being expanded from its minimal archaeological definition of a chronicle of potsherds, artifacts, and buildings to a definition embracing social behavior and cultural institutions...” The basic cultural evolution framework of human society has persisted and is still in use in one form or another, specific to each geographically or culturally circumscribed area. However, it is no longer assumed that culture change is unilineal, inexorable, irreversible, or even inherently good.

In most developmental schemes the trend is toward generalization and regional synthesis. This “normative” perspective has been criticized as representing only the strong patterns in what is an incomplete archaeological record, therefore obscuring variability within and between regions and local areas (Cordell and Plog 1979; Gumerman and Gell-Mann 1994). In other words, the Chaco Canyons of the Southwest disproportionately represent the knowledge of indigenous culture, while the much more numerous and geographically variable hamlets consisting of small, scattered residences contribute little to the overall view of cultural evolution in the northern Southwest. However, through Cultural Resource Management mandates and ongoing academic studies, the knowledge and detail of prehistoric cultures in local “backwaters” of the Anasazi world continues to build. This study concerns one of those localities, apart from but associated with the larger Anasazi cultural tradition.

The Pecos Classification

As ancestors of the modern Pueblo Indians the cultural traits of the Anasazi are framed in such an evolutionary scheme, denoted by temporal periods and based on developments in architecture, material culture, food gathering or production, settlement patterning, and social and political organization. Instituted in 1927 at the first Pecos (New Mexico) Conference, these parameters served to streamline the data compiled by archaeologists working in different areas in the Southwest so as to compare culture traits and develop a consistent chronology and terminology of culture development (Kidder 1927). Known as the Pecos Classification, this framework has amazingly persisted and been only slightly amended over the years. Vivian (1990:169) notes that while the traditional 200 year intervals for Pecos classification periods apply to broad regional patterns, “subregional variation in levels of complexity and rates of change have produced temporal modifications for the period.” However, for consistent units of time between regions and clarity of general patterns over time throughout the relevant areas, the broad temporal units are used here.

The classification is intended as a temporal developmental guideline for the northern Southwest and does not represent an umbrella chronology for all indigenous cultural practices in North America, although such a classification is useful for cross-cultural comparisons. The following phases are represented by recorded sites in the Rio Puerco valley and are pertinent to the discussion of prehistoric agriculture. The Archaic in whole is not represented in the Pecos Classification but is important as the precursor to the indigenous development of Pueblo life in the valley.

The Archaic period (6,000 BC - AD 200) denotes the stage characterized by environmental conditions approaching those of today with a largely mobile hunting and gathering

lifestyle practiced by peoples in what Cordell (1997:102) refers to as a “world-wide post-Pleistocene pattern.” This is usually described as a switch in emphasis from the hunting of large game to a more broad-spectrum pattern of small game and the processing of wild plant foods. Projectile points become less specialized and milling tools are in use. Generally, population increases and habitation sites become larger throughout the Archaic, consisting of small clusters of pithouses reflecting short-term stays or seasonal reoccupation (Cordell 1997:119). By the end of the Archaic maize and squash become incorporated into the diet and the earliest ceramics occur. The appearance of ceramics in the replacement of baskets as containers and cooking vessels indicate a more sedentary population with increased investment in food-production and processing (Crown and Wills 1995:174).

The Basketmaker III period (AD 400 - 700) is described as “the emergent Pueblo culture” (Cordell 1997:249). At this time the three big traditions of the Southwest begin to emerge out of the Archaic period: the Hohokam, the Mogollon, and the Anasazi. While part of the tool kit carries over from the Archaic, the most significant transition is from spears and darts to the bow and arrow around AD 500. Social organization continues to be largely dispersed with small hamlets cropping up in some parts of the Southwest. By AD 550 - 650 the typical residence was a round or square shallow pithouse with consistent floor features including a hearth, ash pit, and storage cists (Cordell 1997:239). Locations generally move from high eminences to alluvial terraces suggesting an increased association with agricultural practices, and also indicates continued reduction in mobility (Cordell 1997:241). Anasazi ceramics throughout the Colorado Plateau shared uniform attributes, simply decorated though technically sophisticated (Gumerman and Gell-Mann 1994).

Another factor influencing the dynamics of culture change is the climate. Across the

Colorado Plateau during this period there was an increase in regional moisture, rising water tables, and soil deposition (Vivian 1990:112). Lower temperatures might also explain the move to lower elevations in order to extend the growing season. Increased moisture would also make otherwise agriculturally marginal areas more attractive. Overall, a relatively stress-free environment contributes to the trends of increasing sedentism and agriculture and a concomitant rise in population.

In the Pueblo I period (AD 700 - 900) there is an increase in village size with pithouses giving way to above-ground multi-room masonry dwellings. There are many proposed explanations for this shift in architecture. Some of these are: a shift in the need and use of space as storage solutions for an increasing agricultural surplus (Gilman 1983, 1987); a general trend of population growth and social complexity (Plog 1974); and a result in the change of ceremonial practices (Shafer 1993). Pithouses continued in use, though probably for seasonal habitation or ceremony and not primarily for the day to day tasks of an increasingly sedentary group. The general trends are those toward an increase in population, technology, economics, and even cosmology. However, villages remained rather dynamic and did not sustain an aggregated state for much more than a generation, fluctuating between occupation and abandonment (Lightfoot 1992). Architecture, settlement patterns, and ceramic styles continued to depart from regional homogeneity and developed into local variations (Cordell 1997:259).

The climate deteriorated during this time, with the favorable conditions in the previous centuries reversing. Drier conditions commencing around AD 700, and culminating in a major drought period from AD 850 - 900, resulted in the drop of water tables and the down-cutting of arroyos, a major factor affecting flood-plain agriculture. Across much of the Colorado

Plateau, water control devices become prevalent around AD 900 in intensified efforts to sustain agriculture (Fritz 1973:24; Vivian 1990:168; Cordell 1997:264).

It would appear counter-intuitive that agriculture became so precarious, yet settlement patterns indicate an ever increasing commitment to it. Vivian (1990:136) explains, “these long-term climatic trends prompted gradual cultural adjustments, but more immediate adaptational responses were stimulated by short-term fluctuations in rainfall variance and periodicity.” While environmental conditions over 200 years generally deteriorated, “these long-term but low-frequency processes were, in a sense, slightly mitigated by short-term, high-frequency fluctuations in precipitation that about half of the time improved (though temporarily) conditions for farming” (Vivian 1990:164).

During Pueblo II (AD 900 - 1100) the trend of cultural variability continued. With increased population and regional expansion, local styles in ceramics and architecture developed. In the San Juan Basin the Chacoan system floresced. Villages became more aggregated, consisting of several pueblo units, kivas, and field houses near the arable plots of land. These architectural features suggest an increasingly integrated community with a larger labor pool capable of implementing more extensive farming technology (Proper 2001:18). Agriculture became the main mode of subsistence with corn, squash, and beans as the important staples. Climatic conditions improved rather dramatically from the previous period. In the study area, the construction of the great house on Guadalupe Mesa began. This settlement is considered a Chacoan “outlier” based on architectural and other cultural attributes associated with those prevalent in the Chaco Canyon community in the San Juan Basin (Pippin 1987).

Pueblo III (AD 1100-1300) is characterized by abandonment of smaller local sites and aggregation into larger villages, particularly in the northern Rio Grande, around AD 1200.

Abandonment of previously highly aggregated areas, such as Chaco Canyon, also occurred in this period. Mesa Verde floresced and declined within this period with populations from that area moving into the San Juan Basin and the Puerco valley. A sudden change in ceramics and architectural style in the late 1200s indicate a brief replacement by groups from the Mesa Verde area (Pippin 1987). The Puerco population reaches its zenith around AD 1200 but begins another dispersal of settlements cycle over the next 100 years (Baker 2003:195).

During this period paleoenvironmental reconstruction indicates that successive droughts occurred across the Colorado Plateau (Dean 1985). Systems dependent on rainfall would have been easily upset by even short-term droughts. Eventually, only areas capable of sustaining agricultural production with gravity-fed irrigation remained populated while many other areas in the southwest were abandoned (Cordell 1997:395). Such areas likely attracted populations with which trade and social ties had been established over the centuries. A larger labor pool also would have contributed to a larger land use system of irrigated agriculture around the major rivers. Many factors likely contributed to this shift in settlement patterning including degrading environmental conditions, internal and external strife, population outstripping carrying capacity, and disease (Cordell 1997:365-397; Baker 2003:195).

Pueblo IV -V(AD 1300 - 1500) saw increased growth of the Rio Grande Pueblos, as well as the Hopi, Acoma-Laguna, and Zuni Pueblos in the west (Gumerman and Gell-Mann 1994; Cordell 1997). In the Puerco valley only four sites date to this period (Baker 2003:19). The major cultural event during this time is the arrival of the Athabascan populations from the Mackenzie Basin region of Canada, the Navajo and the Apache peoples (Cordell 1997:19). The Athabascan relationship with the pueblos was mainly that of raiding and trading. While the Apaches continued a largely nomadic hunting and gathering lifestyle, the Navajos had

adopted farming practices from the pueblos by the time of the Spanish Entrada (1539-1546).

In the Puerco valley over 140 Navajo sites have been recorded (Baker 2003:19).

The Europeans and Americans (1539-the present)

By the end of the 15th century the pueblos were in a general state of prosperity. Of course, the colonization by the invading Europeans put an end to that.

The major villages along the Rio Grande had been there for perhaps no more than 200 years when the Spaniards entered the Southwest...This concentration of population appears to be correlated with the development of irrigated farming on the Rio Grande and suggests as well a developing social and political organization commensurate with the demands of the incipient waterworks society. The Rio Grande Pueblos were well on the road toward economic surpluses and the development of a complex society [Dozier 1970:39-40].

The arrival of the Spanish expeditions out of Mexico changed the pueblo landscape forever, both culturally and physically. The history of Spanish-Native relations is notoriously contentious and rife with many instances of atrocities committed against the indigenous population (for example, see Dozier 1970:40-88). These have been well documented and will not be discussed in detail here. The underlying theme of the conflict was that of extreme cultural differences, socially, economically, technologically, and religiously.

By 1700 there were no colonial settlements outside of the Rio Grande valley, though remote areas such as the Rio Puerco had been explored by the Spanish. According to Widdison (1958:50) a population pressure must have forced out Rio Grande settlers into a comparatively marginal region (as well as "hostilely" occupied), most likely a need for more rangeland. Arable land would also have been a necessity. Through land grants provided by the Spanish crown, settlers began to occupy the land around the Rio Puerco by 1753 (Table 1). These grants were awarded only after a survey of the area and after the colonists agreed

Table 1. Original Land Grants in the Rio Puerco Valley, New Mexico*

Grant Name	Date Granted	Recipient
Nuestra Senora de la Luz de San Fernando y San Blas	1753	Bernabe M. Montano
Nuestra Senora de la Luz de las Lagunitas	1762	Antonio Baca
M. and S. Montoya (Bosque Grande)	1766	Miguel and Santiago Montoya
Lagunitas del Rio Puerco, or Mestas	1768	Joaquin Mestas
Agua Salada, or Jaramillo	1769	Luis Jaramillo
Canada de los Apaches, or Antonio Sedillo	1769	Antonio Sedillo
Ignacio Chavez		
Canada de los Alamos		
Ojo del Espiritu Santo		

*adapted from Widdison 1958:52.

to found permanent settlements with certain architectural requirements (for defense purposes) (Haecker 1976:6). The new population made attempts to co-exist with the native population, though their differences created problems. For example, the Navajo/Apache practice of planting small crop plots and then coming back to them at a later date appeared to the colonists as an abandonment of their fields, over which the settlers herds would eventually roam and destroy (Haecker 1976:8). While the wild grasses and vegetation provided well for the stock animals, the Rio Puerco did not provide for the type of acequia irrigation farming with which colonists were familiar. Any dams and canals built by the settlers were easily destroyed by flash floods. There is no indication that the European settlers used other means of water control, such as those used on the steep slopes and drainages to manage runoff to fields. Also, Haecker (1976:10) notes that even the settlers on the Rio Grande were quite "poor": "they had only stone hammers and axes, with wooden pins taking the place of nails. They made their own vessels, furniture and clothing, ground their corn on a metate and use forked oak sticks for plows." Extended to the Rio Puerco settlers, these conditions sound quite similar to prehistoric and historic indigenous populations.

By 1768 the settlers wrote a plaintive petition to the governor stating that it was impossible to make a living on this land and requested permission to abandon it (Haecker 1976:10). Increasing conflict with the Navajos and Apaches, overgrazing by a growing livestock population, and mainly, a drought in the 1770s, all conspired to drive out the Spanish by 1774. Widdison (1958:58) comments that other areas were also affected by this time: "Not only were the villages of the Puerco abandoned, but others nearer the Rio Grande valley were evacuated, and even some within that valley itself had to be deserted." He goes on to explain the overall abandonment process in the Puerco:

This historical reason for the abandonment of the Puerco valley was the result of geographic factors, specifically the harsh physical environment. It was impossible in the Puerco environment for a sedentary population to grow that was capable of resisting the Indians. Even with the Spanish-Americans' greater ability to make the valley productive, the population necessarily remained small. It remained too small, and was neither large enough nor strong enough to withstand the Navajo. The environment thus influenced not only the characteristics of settlement but the very existence of settlement.

The valley remained abandoned, save for dispersed Navajo and Apache groups, until the United States Army led expeditions into the area in 1846 and 1849. Reports were less than glowing concerning the environment, noting that the arroyo was entrenched up to 30 feet in places, the timber was depleted, and the water was brackish (Haecker 1976:14-15). Nonetheless, by the 1870s villages began to again sprout up, often where the old one had been and by descendants of the original colonists (Widdison 1958:62). This time there was a noticeable lack of native presence. Widdison (1958:62) blithely comments:

“In the 1860s the government captured all the Navajo Indians and transported them to a reservation in eastern New Mexico. With the Navajo gone, there was little to keep the Spanish-Americans from expanding once again into the Puerco valley - and the Indians unknowingly encouraged it. Because it was necessary to feed the captive Indians...there was more than an ordinary incentive for the Spanish-Americans again to take up livestock raising in the Puerco valley.”

This second attempt at making a living in the Puerco also necessarily involved establishing successful agricultural techniques. The new settlers devised more serious attempts at diverting flood waters from the Rio Puerco, including an engineered plan to construct reservoirs, acequias, canals, and pipelines for irrigation (Widdison 1958; Haecker 1976). After some initial success the plan succumbed to the violence of the flood waters. Some areas managed to produce bountiful harvests for a few good years, but once again water control and conservation were unsustainable for the second group of settlers. The channel continued to

entrench further, water tables lowered, and livestock overgrazed the land again, causing further erosion. By the 1880s and 90s the valley was once again mostly abandoned.

A few families remained into the 19th century and continued to eke out a living raising subsistence crops, sheep, and cattle. By the 1930s government agencies began intervening and limiting grazing rights. Many families had to rely on government assistance, including welfare, WPA projects, and Farm Security Administration grants. Widdison (1958:127) predicted complete loss of population by the end of the 1950s: "The middle valley is located in the western parts of Sandoval and Bernalillo counties...these counties, with an orientation toward centers of population along the Rio Grande, can spare little attention to such remote and slightly populated areas as the middle Puerco valley. In short, the middle valley has lost all influence in New Mexico, just as it will probably soon lose the last of its inhabitants."

In conclusion, complexity and success are relative terms in the middle Rio Puerco valley. The prehistoric populations managed to occupy it continuously for several centuries through a combination of many adaptive strategies, including shifting settlement patterns and land use. The European populations barely managed for a generation at a time. The root of these divergent adaptations will be discussed later.

CHAPTER 7: METHODOLOGY

Moore (1981) assumed that the contour terraces were partially constructed with fill from trash deposits, or middens, which consisted of organic waste, including ceramic sherds. Although the overall amount of temporally diagnostic sherds was limited this was still the best way to date the features (Table 2, Table 4). Moore further (1981:116) assumed that the latest dated sherd found in a feature would necessarily be the best feature date:

“it can be proposed that the later sherds in the sequence represent either the minimum date for the construction of the system, or the period during which it was used. This would be dependent both upon the question of whether trash continued to be dumped on the system following construction, and whether the builders were using their own middens, the middens of earlier occupations, or a combination of both.”

This also brings up issues of the nature of ancient agricultural features and how their construction history is difficult to determine. In other words, what Doolittle (1984) terms as an “incremental process” is often obscured in the archaeological record. Prehistoric technological artifacts rarely remain in their original states, but undergo periods of maintenance and repair, remodeling and refilling (see Schiffer 1980). This continuum of transformation processes is difficult to parse and so the available diagnostic artifacts are taken as the most reliable means of relative dating.

To determine whether the water control features Moore identified around Guadalupe Mesa were dated correctly, or reduced down to the most precise dates possible, his method of relative dating using ceramics was compared to a later seriation technique that refined the dates of ceramics in the valley (Durand and Hurst 1991). In this method a total of 17 ceramic groups with temporal periods of 30+ years spanned the years ca. AD 800 - 1258+ (Table 3).

While the full technique employing multidimensional scaling is rather complicated and mathematical, the basic concept is that “chronological inference using seriation assumes that the seriated groups function as cultural historic, stylistic classes. By definition, stylistic classes are unimodal and continuous in time. These attributes of stylistic classes are the theoretical principles by which one infers chronological significance” (Durand and Hurst 2003:119).

By comparing the two sets of data, it was hypothesized, the tested features might produce more specific (and earlier) dates when the more refined chronology was applied. These revised dates could then be compared to known climatic conditions which in turn influenced settlement patterns and agricultural intensification. This could be compared cross-culturally or geographically to determine whether the Rio Puerco populations were invoking similar adaptive techniques in similar conditions as other prehistoric native populations.

Secondly, these prehistoric adaptive strategies are compared to strategies the subsequent European populations employed. Since agriculture was a crucial endeavor to both populations, their relative success can be compared by way of occupation time and preferred methods of diverting and conserving the limited precipitation available in an arid environment. This relative success is a function of not only the variability of the physical environment, but of the unique suite of cultural practices each population inherently relies on, for better or for worse.

Table 2. Moore's Ceramic Dates for the Middle Rio Puerco Valley.

Type	Pecos Classification	Estimated Period
Kana'a Grey	BMIII-PI	725-950
Red Mesa B/W	I	875-1050
Puerco B/W	I-II	975-1125
Gallup B/W	I-II	1000-1125
Chaco B/W	I-II	1000-1150
Wingate B/R	I-II	1050-1200
Socorro B/W	I-II	1050-1250
McElmo B/W	I-II	1075-1275
Kwahe'e B/W	II	1125-1200
Santa Fe B/W	II	1175-1300
St. John's Polychrome	II	1200-1300

Table 3. Durand and Hurst Ceramic Seriation Groups for the Middle Rio Puerco Valley.

Group	Pecos Classification	Estimated Period
1	I	?-828
2	I	829-863
3	I	864-903
4	II	904-937
5	II	948-950
6	II	951-968
7	II	969-990
8	II	991-1016
9	II	1017-1055
10	II	1056-1091
11	III	1092-1126
12	III	1127-1164
13	III	1165-1194
14	III	1195-1216
15	III	1217-1238
16	III	1239-1257
17	III	1258-?

Table 4. Vital Statistics for 9 Contour Terraces in the Middle Rio Puerco Valley, Moore (1981).

Site No.	Masonry Type	Slope (deg.)	Associated Structure	Ceramic Type	Unit	Date (A.D.)
ENM 665	5	18	No	Chaco Whiteware	1	1100+
				Wingate B/R	1,2	1125+
				Kwahe'e B/W	1,2	1125+
ENM 852b	1	16	Yes	St. John's Polychrome	4	1200+
				Kana'a Grey Red Mesa B/W Gallup B/W Puerco B/W McElmo B/W	*	pre 1125 1125+
ENM 875	1	21	Yes	Gallup B/W	1	1000+
				Puerco B/W		1000+
				Kwahe'e B/W		1175+
				Santa Fe B/W		1175+
ENM 877	5	20	Yes	St. John's Polychrome	1	1200+
				Santa Fe B/W	2	1175+
ENM 880	1,2,3	18	Yes	Kwahe'e B/W	**	1125+
ENM 881	2	20	Yes	Kwahe'e B/W	2,3	1125+
				Santa Fe B/W		1175+
				Socorro B/W		1175+
				Santa Fe B/W	6,7	1175+
				Wingate B/R	7	1125+
				Red Mesa B/W		1000+
				Gallup B/W		1000+
				Puerco B/W		1000+

Table 4. Vital Statistics for 9 Contour Terraces in the Middle Rio Puerco Valley, Moore (1981), cont.

Site No.	Masonry Type	Slope (deg.)	Associated Structure	Ceramic Type	Unit	Date (A.D.)
ENM 882	2	11	Yes	Kwahe'e B/W Santa Fe B/W	1	1175+ 1175+
ENM 7110	1,2	20	No	Gallup B/W	1	1000+

*Ceramics were collected from associated structure and trash deposits.

**Ceramics were collected from the surface of the terrace.

CHAPTER 8: RESULTS

There were no significant differences in the ceramic dates, especially in the broad scheme of archaeological periods. Moore's assumption that the latest date for a sherd is the best date for a feature, though somewhat unsatisfactory, is the safest conclusion to make. One problem with ceramic dating is the potentially long period a particular type might endure. The mean dates in Table 5 are dates of either the duration of a type (Moore), or a combination of duration/height of popularity taken from the other data. Another problem is that Moore's types are singular with no early and late styles, or subtypes, as the Durand and Hurst scheme offers. Thus, while the Moore category of Red Mesa Black-on-White is assigned the period of AD 875 - 1050, the Durand and Hurst method lists many periods of the same type spanning AD 850 - 1150. The collected ceramics by Moore would have to be re-analyzed to be placed into the other scheme more definitively.

Ceramic dating is relative, and, therefore, a particularly imprecise method to date the use of a morphologically dynamic feature. Habitation structures can be more confidently dated through time as people, of course, occupy and reoccupy a pueblo and their day to day activities are marked by material goods with stylistic markers that change through time. In fact, Moore extrapolated the dates of nearby structures to the terraces where there was no ceramics to date. The water control features were partially constructed with fill from elsewhere, often trash from previous occupations including sherds of pottery. One would assume that as this feature is maintained, refilled and remodeled, the fill becomes increasingly amalgamated with cultural debris from the handiest location. Even the masonry type Moore employs, using level of labor involved, cannot be seen as an evolution in technology and time

Table 5. Ceramic Dating Comparison

Type	Moore's Mean Date	Seriation Mean Date
Kana'a Grey	838	876
Red Mesa B/W	963	929
Puerco B/W	1050	1077
Gallup B/W	1063	982
Chaco B/W	1025	1147
Wingate B/R	1125	1207
Socorro B/W	1150	1147
McElmo B/W	1175	1147
Kwahe'e B/W	1163	1147
Santa Fe B/W	1238	1235
St. John's Polychrome	1250	1181

as the topography and constant maintenance would also mix these types. As the area was occupied over such a long period, it is virtually impossible to confidently assign any date but the latest one.

Ultimately, Móore's dates of the AD 1100s have to be accepted and in the larger backdrop of Pueblo culture history, events such as the intensification of water control technology have to remain relative to other larger phenomena, such as settlement patterns and climatic patterns. As climatic conditions dictated, populations that were unwilling or unable to expand into other areas, yet continued to grow, would intensify their efforts to produce crops in their own locale. And finally, what was the end result for the different cultural groups that tried to make a living in the middle Rio Puerco valley?

The Occupations

The Chaco era of Guadalupe Mesa occurred ca. AD 960 - 1130 and was the height of the community. Though there had always been some occupation of the valley and there were structures around the mesa, the construction of the great house marks a kind of florescence for the isolated area. It is estimated that about 21 buildings were occupied with an average of 16 rooms per structure. Also, the south side of the mesa begins to fill up with habitation. Considering the slope, aspect, and the abundance of sandy colluvium, the presence of water control features fits as this landscape would have had a high agricultural potential. Habitation structures were most commonly situated on the shale bedrock as was noted in other parts of the valley (Fritz 1973, Durand and Durand 2000).

The post-Chacoan era (AD 1130 - 1220) witnessed a reduced number of habitations. Durand and Durand (2000:106) report only 4 structures at the base of the mesa with more

than 10 rooms was occupied. The great house was largely abandoned as were many other structures. Again, this trend of periodic abandonments and population movement in the Guadalupe community was concurrent with trends across the Chacoan San Juan Basin. Movement to more distant arable land was the likely trend.

The final occupation (AD 1220 - 1300) by Puebloan peoples is one of an immigrating San Juan-Mesa Verde population. As noted before, the Mesa Verde region floresced and was abandoned in a fairly short time. As Chacoan groups moved out of the Puerco, these groups reoccupied it. While structures around the base of the mesa remained the same, the great house and Eleanor Ruin were heavily remodeled by subdividing the rooms (Durand and Durand 2000:107), creating a larger room count, though not necessarily a larger population. Eventually, this population left the valley by AD 1300 and aggregation into the large Rio Grande pueblos was the final settlement patterning for prehistoric New Mexico. Aggregation is an adaptive strategy when there is more population than the peripheral marginal regions can carry. While agriculture intensification would continue to increase, it did so in the most arable and well-watered regions. A growing population increases the labor needed for this intensification, and it is likely that through previous communication and exchange networks, social ties had been formed between distant populations. The Puerco region remained largely unoccupied until the Athabaskan populations, with a non-agricultural and nomadic lifestyle, immigrated in just before the Spanish entrada.

The environmental patterns on the Colorado Plateau physiographic province have been well documented (e.g., Bryan 1941, Dean et al. 1985). In the Puerco region, much of this information has come from periods of erosion and sedimentation from the arroyo itself (Bryan 1925, 1928, Nials and Durand 2003). In the 10th century, there was a period of effective

moisture that would have made flood-water farming around the tributaries and parts of the channel itself more favorable. Runoff agriculture would have been minimal, but likely existed in some form. The 11th century was characterized by ineffective moisture, therefore, violent summer rainstorms would cut into the channel, making akchin farming precarious. However, capturing runoff from slopes would have been intensified and features and sites would be clustered in these areas. Nials and Durand (2003:53) report that “an increase in site frequency occurs during the eleventh century, while mean distance to nearest site also increases. Settlement is thus dispersed over a wider area, possibly utilizing the larger number, but smaller size, of areas favorable for farming in a regime of ineffective precipitation.” So, the water control features Moore tested seem to generally be a century off from this trend, though some sherds dating from the 1000s were within some of the terraces. However, climatic fluctuations and agricultural intensification might involve some lag time in technology proliferation. In other words, environmental perturbations largely effect subsistence gradually, therefore, responses to these perturbations are not necessarily concurrent with them. Anschuetz (1998:40-42)

comments:

“In responding to perceived risk, individuals and populations try to maintain long-term flexibility such that they neither make excessive nor unnecessary commitments in responding to perturbations...and individuals or populations that either under - or over - responds to a particular fluctuation, compromises its resiliency for coping with future perturbation.”

In light of this, a long-term agricultural existence in a highly marginal environment was possible for the prehistoric group whose culture consisted of constant adaptations to fluctuating conditions.

But, even a highly adaptive culture could not sustain in an environment that continued to deteriorate. A widespread drought in the Chaco-San Juan area between AD 1275 - 1300

led to widespread abandonments across the entire area (Wendorf 1956). By this time, social upheaval in the way of internal and external strife was likely occurring, due to the constriction of good land and resources. Arroyo-cutting throughout the plateau greatly limited agricultural land. Also, though the exact dates are unknown, the arrival of the Athabaskans might have driven pueblo communities together, not only for resource sharing, but for defensive purposes (Cordell 1997).

By the time the Spanish settlers received their first land grants in the Puerco valley in 1753, contact between Indians and Europeans had been head to head for 200 years with cultural identity and practices in direct conflict. One of those differences concerned agriculture. As Spicer (1962:540-41) comments:

For the Eastern and Western Pueblos the raising of corn, beans, and squash had been fundamental for centuries, and farming was therefore knit intricately into their lives. It was in a sense their religion, since their major ceremonials were directly or indirectly agricultural rites, and the central values of their religious view were expressions of the agricultural way of life. To raise a field of corn annually was to live.

The Spanish, on the other hand, while they certainly practiced agriculture, did not rely so heavily on it or base their world-view on it. And though they possessed metal tools and plows, these tools were only slowly accepted by the Indians.

There is no record that Eastern Pueblo standard of living increased during the Spanish period, or that agricultural production increased in any degree. The addition of new crops brought by the Spaniards was also without revolutionary effect...The basic pattern of subsistence agriculture of the Eastern Pueblos was not altered [Spicer 1962:542].

While one might think that cultural traits were rapidly passing back and forth among the two cultures, historical accounts say otherwise. Diffusion, the concept of borrowing

cultural traits, and once thought to be the impetus for culture change, seemed to be met with some resistance. Indeed, when the Spanish arrived the pueblo mode of production was vital and sophisticated. The 1582 expedition of Antonio de Espejo recorded the following sights:

“Passing through these settlements, we estimated that they contained more than twelve thousand people, including men, women, and children.

As we crossed this province the inhabitants of each town came out to meet us, took us to their pueblos, and gave us quantities of turkeys, corn, beans, and tortillas...

They have fields planted with corn, beans, calabashes, and tobacco in abundance. These crops are seasonal, dependent on rainfall, or they are irrigated by means of good ditches.” [in Dozier 1970:40].

Clearly, the pueblos along the Rio Grande were thriving and the Spanish sound almost admiring of the abundances.

After the Spanish fully colonized the Rio Grande region they too began facing population pressures. The first families to settle in the Puerco claimed inability to make a living from their land around Albuquerque, and had even become field laborers for the Indians:

“...we are crowded and needy, for however much we may labor in the fields, and in the cultivation of our lands, we are unable to support ourselves, nor always obtain even sufficient for our maintenance from day to day, and we are obliged to go out, among the nearest Indian Pueblos, to work for them, sometimes weeding their fields, and sometimes bringing firewood from the mountains, for the small compensation of the few ears of corn with which they pay for this and other very laborious work...” [Land Grant 1753:8, in Haecker 1976:5].

Unfortunately, they were somewhat led astray by the governor’s surveyors and assurances of good farm and grazing land. As noted before, they came in relative poverty to an equally impoverished area. Their adaptive responses to the hardships they faced fell short of getting them through 20 years of occupation, with the harrassment of the Navajos the final blow to their stay. Equally causal in their failure to make a go of it was the chronic lack of

water and unsuccessful efforts to irrigate from the unruly channel. It is unknown whether slope runoff was ever used, but there is no evidence that it was. The land could not provide for and agricultural and pastoral people. By the time they left the valley there was 10,000 head of cattle, enough to destroy the one resource left, causing further erosion (Haecker 1976:9). Unbelievably, more groups came in later, but met with the same result. The Rio Puerco could no longer sustain an agricultural way of life. Something the indigenous population found out by AD 1300.

A group whose existence is so closely tied to the land and what it produces will have a culture that reinforces that relationship and so be very aware of the available choices, the selective adaptations, that will best support that lifestyle. This may come through water control intensification, differential planting, and settlement patterns. As strangers in a strange land, the Europeans were less equipped to adapt to dry farming, and focussed instead on taming the wild Rio Puerco with woefully inadequate irrigation methods, but a technology with which they were familiar. The point is not that one group is inherently better, or smarter, than the other. The point is that some groups are better equipped to adapt to lifestyle changes in certain environments, and that this ability comes largely through their culture.

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