

Riverine settlement in the evolution of prehistoric land-use systems in the Middle Rio Grande Valley, New Mexico

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Abstract.-Ecosystem management should be based on the fullest possible knowledge of ecological structures and processes. In prehistoric North America, the involvement of Indian populations in ecosystem processes ranged from inadvertent alteration of the distribution and abundance of species to large-scale management of landscapes. The knowledge needed to manage ecosystems today is incomplete without understanding past human involvement in ecological processes, and the adjustments of ecosystems to human components. This paper describes changes in prehistoric land use in part of the Middle Rio Grande Valley, New Mexico. Processes of economic change, land-use intensification, and regional abandonment suggest that there were periods of significant prehistoric disturbance to both upland and valley ecosystems.

INTRODUCTION: HISTORICAL SCIENCE IN ECOSYSTEM RESEARCH

One advantage of the growing role of social scientists in Forest Service research is the opportunity for both social and biophysical scientists to offer fresh perspectives on each other's assumptions and approaches. Every scientist and every manager works with a set of professional assumptions that, on a daily basis, usually remains implicit. To a scientist from another field these assumptions can take on fresh meanings, and perhaps yield different perspectives.

An emerging research topic that promises fruitful collaboration between social and biophysical scientists is understanding the human role in the evolution of North American ecosystems. The

early notion of North American Indians as low-density dwellers in a primordial garden is giving way to a more realistic view. The prehistoric occupants of this continent lived at times in dense, concentrated populations. In some places they modified landscapes to increase production of the resources that they needed. In other places they manipulated vegetation to select for early seral stages and to increase the abundance of particular prey species (Lewis 1973; Cronon 1983; Kay 1995; Sullivan 1995). It is no longer possible to think of North America as a pristine wilderness at the time of European contact. It now seems clear that what Europeans encountered in this continent were ecosystems that had been changing for millennia along with, and in response to, American Indian populations that grew many times in size and density, and whose societies came to be increasingly complex and to require higher and higher levels of resources (e.g., Tainter 1988: 178-187; 1995).

Viewing the prehistory of North American ecosystems in this way leads to significant questions about environmental conditions today. At a fairly obvious level it leads one to ask what is

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meant by terms such as *reference conditions*, *restoration*, or *range of natural (or historic) variation* (e.g., Wright, Chapman, and Jimerson 1995), and whether these terms are thought to apply to ecosystems without human involvement. At a more subtle level, if ecosystem management involves managing with a knowledge of the structures and processes of ecosystems, that knowledge must remain significantly incomplete without an understanding of the past human role in ecosystem processes. Indeed, one might assert that we lack much fundamental knowledge of how North American ecosystems functioned before A.D. 1500 (cf. Cartledge and Propper 1993). If we are to understand reference conditions, we need to know how ecosystems have functioned with human components that ranged from low-density foragers to high-intensity occupations by people who deliberately manipulated their environments, and who retained and transmitted environmental knowledge through myth, ritual, and oral traditions (cf. Gunn 1994).

Although we can pose such queries, we cannot yet say definitively what their implications are.

Though we know that American Indians in prehistory were integral parts of ecosystems, the investigation of cultural-ecological processes in the past is only coming to be recognized as important. In this paper we will discuss the prehistory of an area that witnessed dramatic transformations in the patterns of its human occupation over a period of more than 7,000 years. The patterns of this occupation have important implications for the evolution of local ecosystems, including disturbance processes.

PREHISTORIC LAND USE IN THE MIDDLE RIO GRANDE VALLEY

The area of this study extends from the Rio Grande Valley on the east to the Rio Puerco on the west, and from about the confluence of the Rio Jemez and the Rio Grande on the north to just south of Albuquerque on the south (fig. 1). Lying between the Rio Grande and Rio Puerco basins is a broad, eroded tableland known colloquially as the West Mesa (and called more properly the *Llano de*

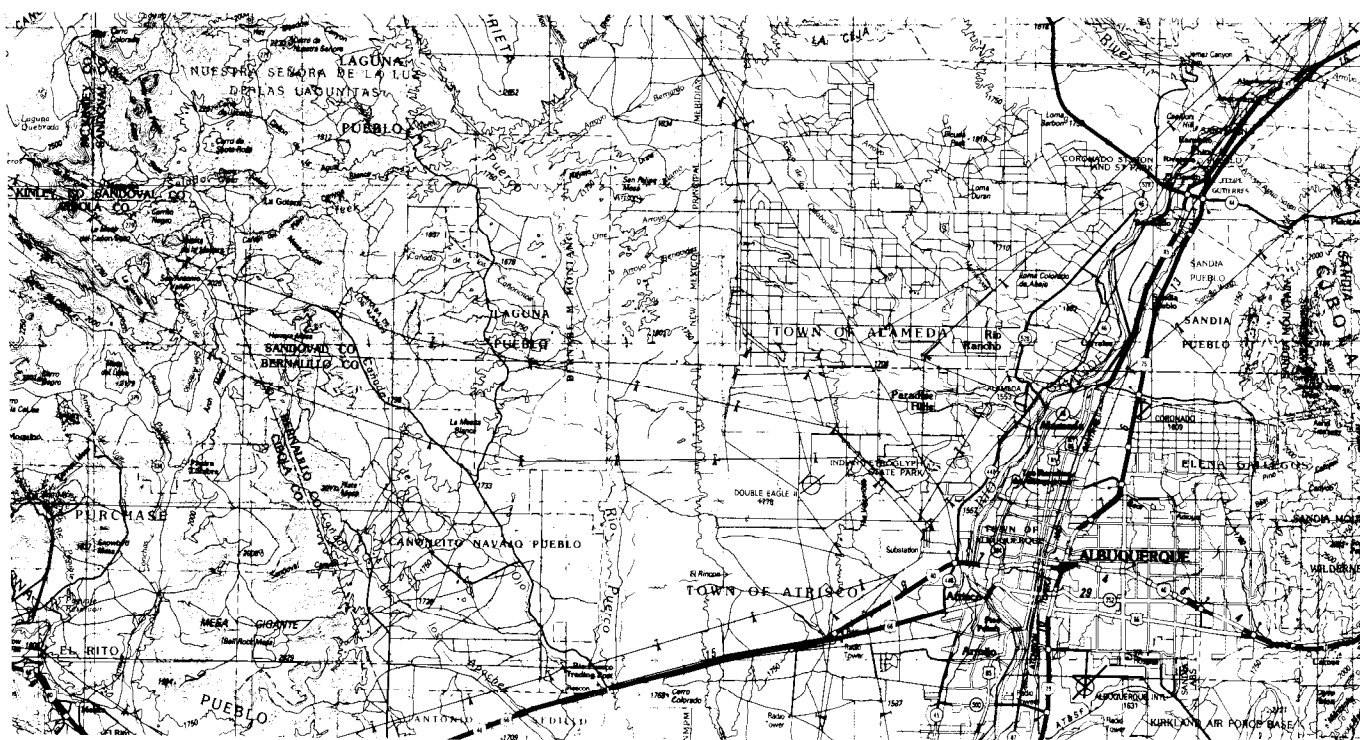


Figure 1. The Middle Rio Grande study area.

Albuquerque). It is a low feature, rising no more than about 225 m. above the floodplains. The Albuquerque West Mesa is a desert grassland containing riverine gravels and erosional remnants of the ancestral Rio Grande. It is devoid of flowing surface water, and the 19th century historian and explorer Adolph Bandelier even described it as "...waterless, bleak, and bare" (1892: 309).

To Euro-Americans, the most desirable landscapes within this area are the fertile river valleys. These are where Hispanic and Anglo-American farmers settled first. It is therefore surprising to learn that in perhaps 12,000 years of occupation by American Indians, the Rio Grande and Rio Puerco valleys are where aboriginal populations came to settle *last*. The early Native American use of this region appears actually to have clustered in precisely those areas that, in a Euro-American view, are most marginal. This apparent paradox illustrates the inherent variability in cultural perceptions of landscapes, and the flexibility of human involvement in landscape processes.

The long time span from about 5500 B.C. to 0 A.D. is called by archaeologists the Archaic period. The mode of subsistence throughout this time was hunting and gathering. Some time in the last millennium B.C. small amounts of maize were added to the diet, but people did not come to depend on agriculture until after about 500 A.D. (Glassow 1972; Hegmon 1995). If is in the context of a hunting and gathering economy that we can understand the early prehistoric landscape preferences.

The hunting and gathering populations of the Archaic period appear to have concentrated initially for at least part of the year on the upper reaches of the Arroyo Cuervo, which is a tributary of the Rio Puerco (fig. 2). Among the reasons for choosing this area are the occurrence of very reliable sources of water in the form of seeps at the heads of side canyons (Irwin-Williams 1973), and the fact that the Arroyo Cuervo has some of the highest topographic diversity in the region.

The topographic diversity in particular helps to explain why early foragers preferred this area to

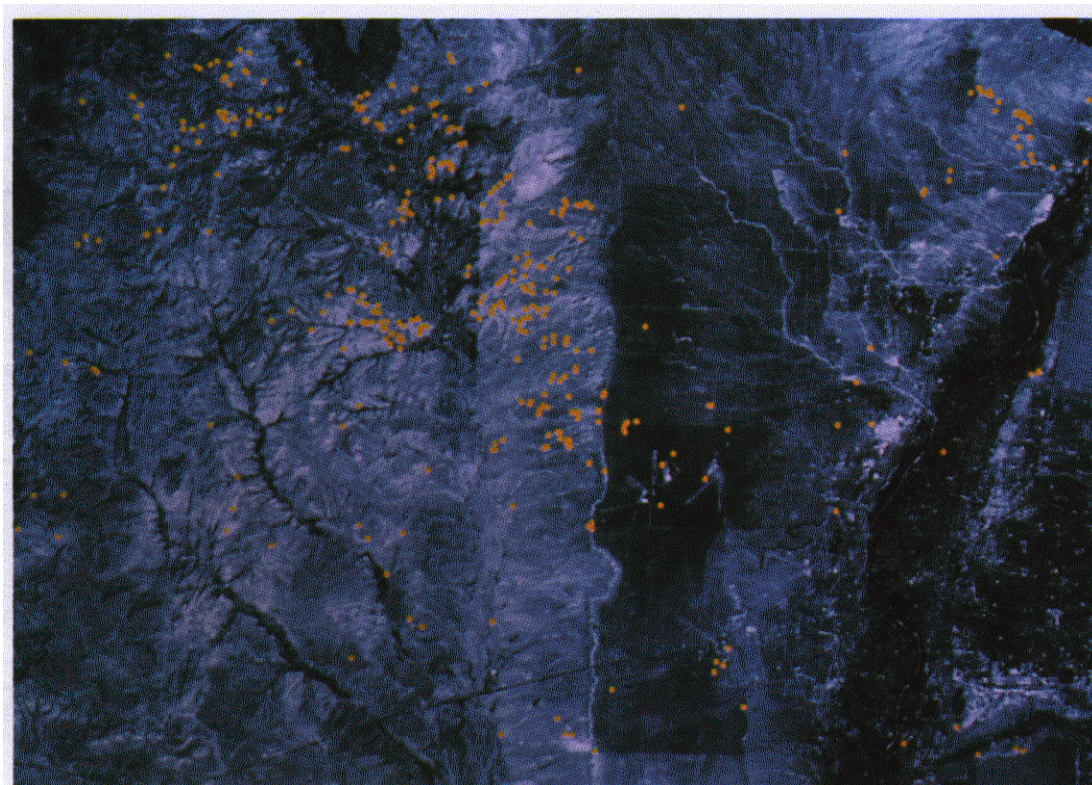


Figure 2. Archaic site distribution, ca. 5500 B.C.-0 A.D.

the river valleys. At the end of the Pleistocene, vegetation zones were lower in elevation than they are today. The West Mesa would have supported a ponderosa pine forest, with spruce and fir on the highest ridges (Judge 1973: 40). With the drying and warming of succeeding millennia, vegetation zones migrated higher in elevation and northward, and the Pleistocene megafauna became extinct. The economy established locally in response to these changes is generally considered to have been a mixture of hunting prey species such as deer, antelope, and rabbits, and gathering plant foods such as grass seeds, forbs, succulent seeds and fruits, early season greens, and pinyon nuts. Such resources are widely but discontinuously distributed throughout the Upper Sonoran life zone, which today encompasses all of the study area.

For a hunting and gathering population in an arid region, survival depends on mobility. As edible plants ripen at different locations throughout the year, a population of human consumers must continuously reposition themselves on the

landscape. Transportation of food by people typically has a high energetic cost (Lightfoot 1979). Food transported as little as 100 km. may cost as much as $\frac{1}{3}$ of its energy value in consumption by human bearers (Culbert 1988: 93). It is generally necessary, therefore, for hunter-gatherers to move consumers to resources rather than resources to consumers. The entire population must be mobile. A yearly seasonal round for Southwestern foragers might have started with a move to lower elevations for early spring greens, movement throughout mid elevational ranges from late spring through early fall to take advantage of seed-bearing plants and succulent fruits, then to higher elevations in the fall to gather pinyon nuts and engage in late-season hunting of ungulates. If the pinyon crop was particularly good, winter occupation would have had to be near where the nuts were gathered and stored.

Topographic diversity can ameliorate the need for high mobility. In a landscape with significant altitudinal variation, a variety of edible plant foods becomes available throughout the year. These are

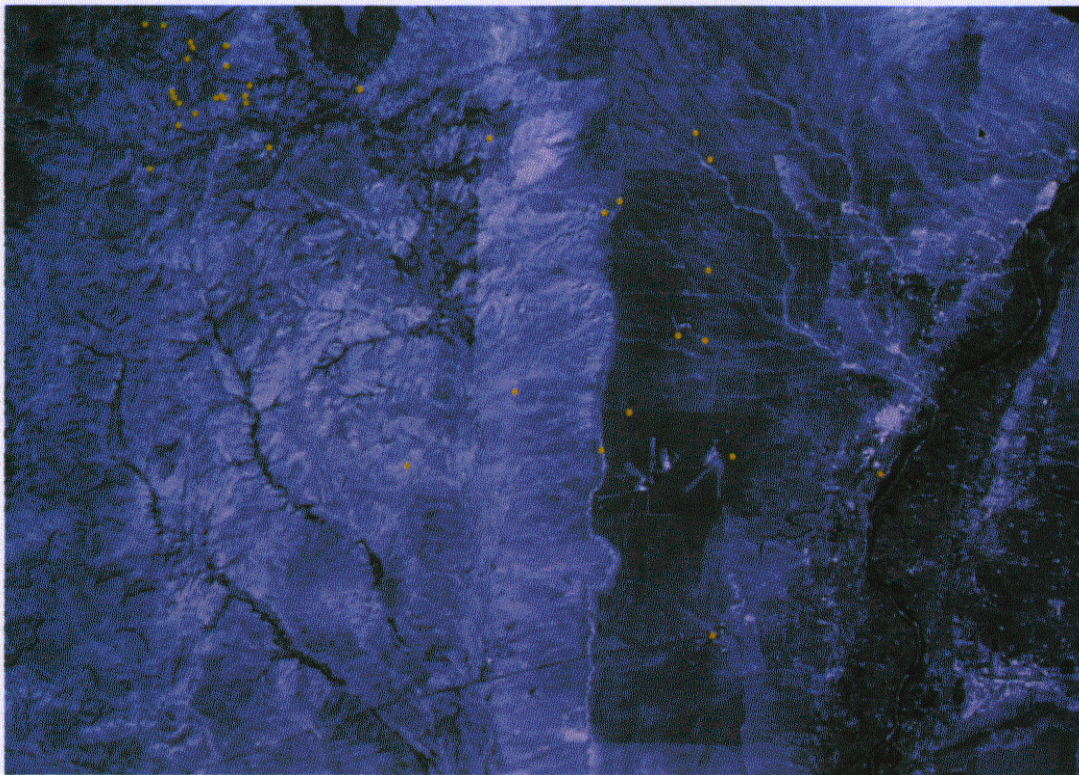


Figure 3. Basketmaker II site distribution, ca. 0-500 A.D.

separated by large vertical distances but small horizontal distances. A topographically diverse landscape allows hunters and gatherers to obtain a yearly round of resources with less mobility than would otherwise be necessary (Tainter and Gillio 1980: 17). In a landscape that is highly diverse, a foraging population might even be able to become sedentary, and exploit a full range of resources from a single location. The topographic diversity of the Arroyo Cuervo region does much to explain why the Archaic-period American Indian populations preferred to settle in an area that Euro-Americans consider useful for little more than cattle raising.

The main investigator of the archaeological sites in the Arroyo Cuervo region, the late Cynthia Irwin-Williams, found evidence of population growth in the prehistory of the area, particularly after about 3,000 B.C. (Irwin-Williams 1973). Although the population of hunter-gatherers probably never exceeded an average of one person per one or two square kilometers, in time this

growing population led to predictable consequences. From about 3,000 to 2,000 B.C. onward there was increasingly intensive use of the West Mesa (Reinhart 1967; Campbell and Ellis 1952; Tainter and Gillio 1980: 46-48), where people built structures, probably of stone, brush, and hides, for short-term occupation (Deni Seymour, personal communication, 1995). In the Arroyo Cuervo region stones for breaking and grinding seeds and nuts were added to the technology, suggesting that these foods played an increasingly important part in the diet.

After about 2,000 B.C. the pace of change quickened. Larger social groups formed at the Arroyo Cuervo canyon heads (Irwin-Williams 1973: 11), and there may have been greater social integration through ritual. By the end of the last millennium B.C. the residents of the West Mesa were occupying sand dune-covered ridges overlooking drainages, and building more substantial subterranean structures (Reinhart 1967).

In the first few centuries A.D. continued growth of population made the hunting and gathering

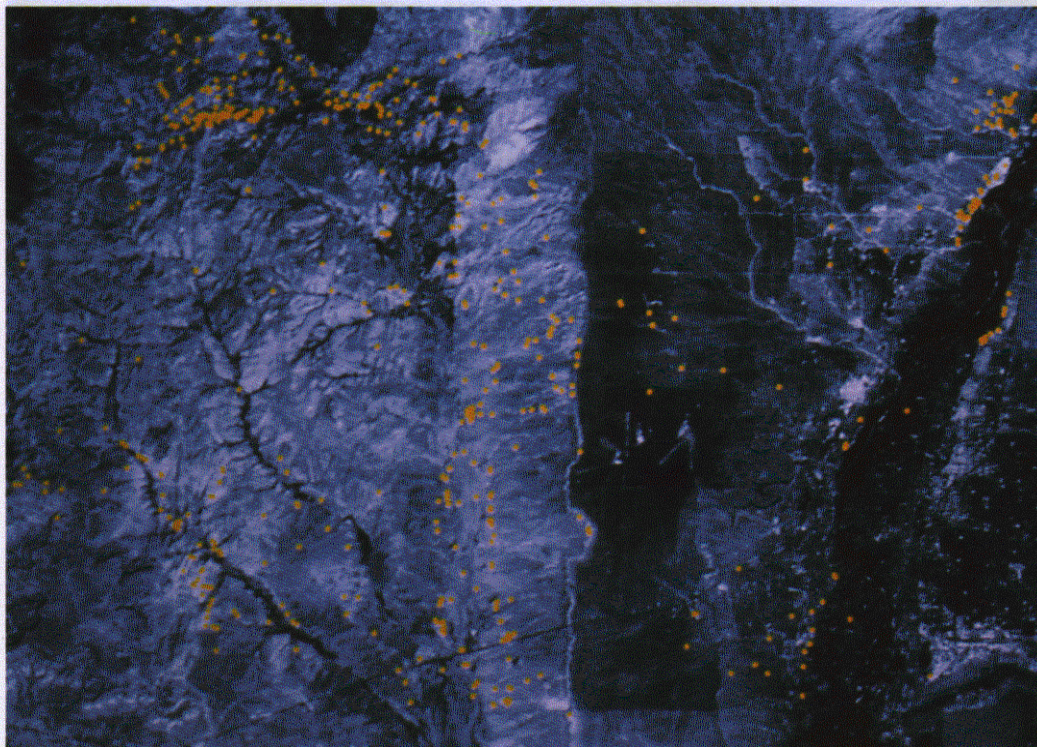


Figure 4. Basketmaker III-Pueblo II site distribution, ca. 500-1100 A.D.

economy untenable, and brought a dramatic transformation in patterns of land use (fig. 3) (Irwin-Williams 1973; Reinhart 1967; Tainter and Gillio 1980: 45-48). Agriculture became the main basis of subsistence, possibly quite rapidly. By about 500 to 700 A.D. maize appears to have had a role in the economy as great as it had at European contact (Hegmon 1995). The use of pottery became widespread, as it was useful for reconstituting and cooking dried maize. The bow and arrow were adopted, suggesting a change in hunting strategies (Glassow 1972, 1980).

In the Arroyo Cuervo region the canyon heads, which had been occupied for perhaps 6,000 years, were abandoned some time after 600 A.D. in favor of the cultivable valley bottoms (fig. 4). The higher-elevation parts of the West Mesa were never again used as intensively. In the last few centuries A.D. there was a substantial occupation on the eastern rim of the West Mesa, along washes with gentle gradients suitable for floodplain agriculture (Frisbie 1967; Allan 1975; Tainter and Gillio 1980: 47). The

labor requirements for cultivating, tending, and harvesting agricultural fields, and the difficulty in transporting large harvests, meant that hereafter populations had to be largely sedentary (Wills and Huckell 1994: 50-51). As mobility was reduced, land use became increasingly intensive in the vicinity of sedentary communities.

The period from about 1000 to 1400 A.D. witnessed even more dramatic transformations. The Rio Puerco Valley supported a dense agricultural population (fig. 5) (Fritz 1973; Washburn 1972, 1974; Burns 1978; Pippin 1987), which farmed the floodplain and its side drainages. In some years they had temporary fields in the Arroyo Cuervo but this area was, for the most part, abandoned. Populations that clustered around a site called Guadalupe Ruin were part of a regional political and economic system centered in Chaco Canyon to the west (Pippin 1987; Tainter 1984, 1988: 178-187, 1994; Tainter and Plog 1994). By 1350 A.D. the upper Rio Puerco Valley was abandoned by farming populations. The reasons for this are still

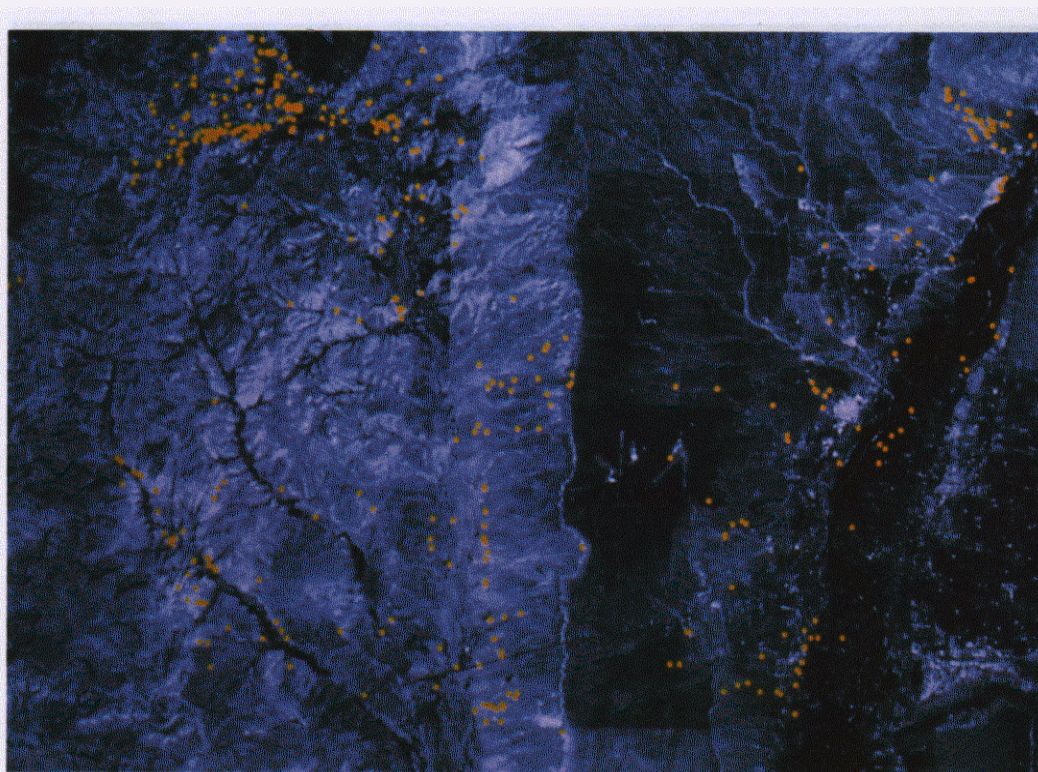


Figure 5. Pueblo III site distribution, ca. 1100-1300 A.D.

unclear, but then as now the area is highly susceptible to erosion (Burns 1978).

The abandonment of the upper Rio Puerco was part of a broader process. During the course of the 14th century A.D. much of the upland areas of what are now western New Mexico, and eastern and northern Arizona, were abruptly abandoned. The populations that survived this crisis (Cordell 1995) concentrated thereafter in a few areas, including the Rio Grande Valley (fig. 6) (Wendorf 1954; Wendorf and Reed 1955; Collins 1975; Dickson 1979; Tainter n.d.). This area came to be used intensively for the first time, and large communities were established on a scale never seen before. The entire region experienced a profound discontinuity in its pattern of cultural evolution. Settlement patterns changed from dispersed to aggregated. Social complexity increased in response to the problems posed by large aggregations of people. Ritual systems of social integration, such as the Katchina Cult, were adopted (Schaafsma and Schaafsma 1974). Parts of the

valley bottom were farmed at a level of intensity not seen again until the 19th century. In 12,000 years of native occupation, it was the most significant and far-reaching transformation in land and resource use.

PREHISTORIC SETTLEMENT AND DISTURBANCE PROCESSES

Although we need a much deeper understanding of these changes in land use, our present knowledge has implications for understanding ecosystem disturbance processes in prehistory. While there are various definitions in ecology of what constitutes a "disturbance" (e.g., the definitions cited in Lundquist, Geils, and Negrón [1995: 781; and Wright, Chapman, and Jimerson [1995: 259]), for this study a definition given to me recently by Russell Graham seems most useful: a disturbance is anything that alters a trajectory or a trend (personal communication, 1995). The mas-

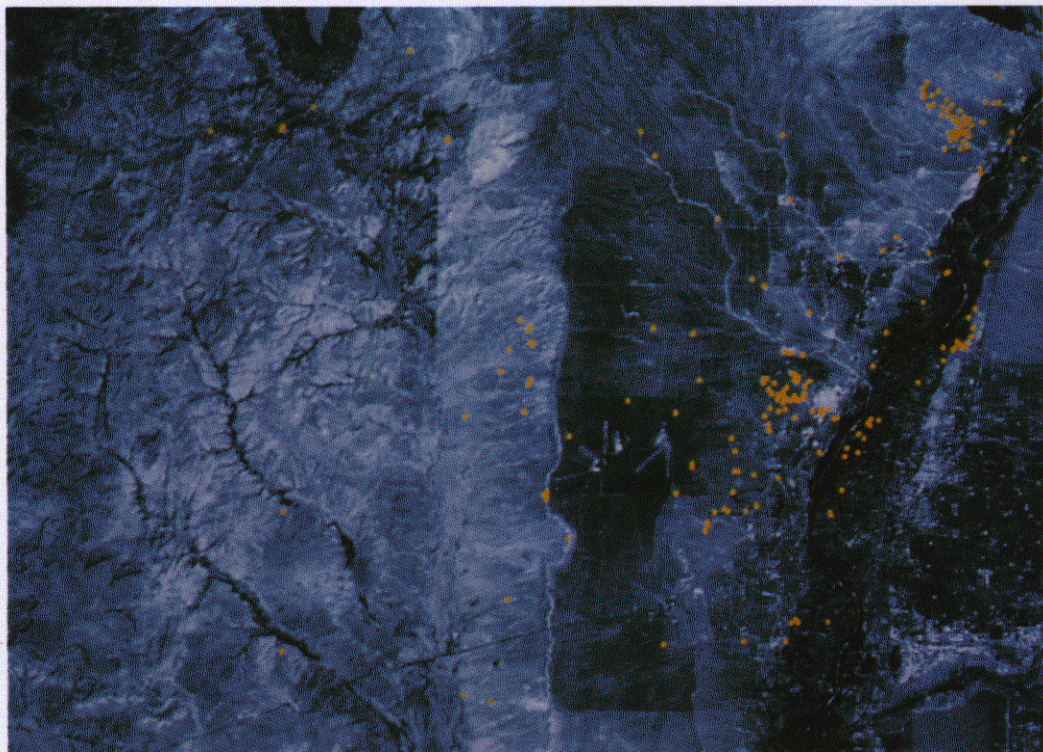


Figure 6. Pueblo IV site distribution, ca. 1300-1600 A.D.

sive convergence of human populations on the northern and middle Rio Grande Valley in the 14th century A.D. would certainly appear to qualify. Within a few generations this area went from supporting a small, dispersed agricultural population, to supporting much of the remaining population from large parts of the Southwest. Communities of up to 2,000 to 3,000 rooms were built. Lands were cleared for agriculture, and every piece of wood useful for construction, cooking, or heating would quickly have been consumed within easy walking distance. The distribution and abundance of native plant and animal species would have been altered in a short time, as would nutrient cycling and the composition of soils. It is important to ask how Rio Grande Basin ecosystems would have evolved subsequently, and up to today, if this massive disturbance had not occurred.

This pattern of disturbance was continued and intensified with the Hispanic and Anglo-American intrusions in the 16th through 19th centuries. The Hispanic *entrada* in the 17th century would, at least initially, have amounted to little more than the replacement of the portion of the American Indian population that in the previous century had been lost to European diseases (cf. Ramenofsky 1987). Yet the Hispanic introduction of cattle and sheep had far-reaching environmental consequences, which became particularly acute with the incorporation of New Mexico into the North American and international economies in the 19th century (Scurlock 1995; Wozniak 1995). The Puebloan intrusion in the 14th century and the Euro-American settlement were the most severe disturbances to Rio Grande Basin ecosystems since the end of the Pleistocene.

The earlier role of hunter-gatherer populations in ecosystem processes of the Arroyo Cuervo and West Mesa presents a subtler problem. We know that in other parts of North America, hunting and gathering populations actively manipulated vegetation to increase the production of useable resources (e.g., Lewis 1973). Whether this was done prehistorically in the Arroyo Cuervo/West Mesa region is not yet known, but research elsewhere in the Southwest is showing how to investigate this possibility (Sullivan 1995). Certainly as population in the area grew, there would have been increasing pressures to manipulate vegetation. Even without such manipulation, the fact that there were 6,000 years of intense human use of this

area suggests that the forager population was a major ecosystem component. Certainly the hunter-gatherers would have had a controlling influence on such factors as the distribution and abundance of seed-bearing plants, ungulates that they hunted, rodents that were attracted to their food stores, carnivore populations, tree growth in the pinyon-juniper zone, accessibility of water for wildlife, nutrient cycling, soil formation, and erosion. Over 6,000 years, humans were as integral to these ecosystems as nearly any other component. If disturbance is considered to be the disruption of a trend, then the human occupation of the Arroyo Cuervo and West Mesa suggests what some may consider a counterintuitive notion: the greatest disturbance to these ecosystems may have been the *withdrawal* of the human population in the 7th to 8th centuries A.D. Certainly a great variety of ecosystem structures and processes, which had been regulated for 6,000 years by gradually intensifying human use, would suddenly have had to establish new ranges of tolerance and adjust to new conditions.

CONCLUDING REMARKS

Ecosystem management is a developing field that has yet to delineate the full range of pertinent structures and processes. The human populations of North America have been an essential part of these structures and processes, even a controlling part in some cases. They can no more be left out of ecosystem analyses than can, for example, paleoclimate. In the Arroyo Cuervo and West Mesa areas, the processes of ecosystem adjustment after the human withdrawal should be understood before we can be confident that we know these systems well enough to manage them. Ecosystem research and management of the future has to combine the findings not only of contemporary environmental and social sciences, but of the historical sciences as well. It is from that combination, and only from that combination, that the delineation of historical reference conditions, ranges of variation, and disturbance processes will emerge.

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