PANARCHY ON THE PLATEAU:

MODELING PREHISTORIC SETTLEMENT PATTERN, LAND USE, AND DEMOGRAPHIC CHANGE ON THE PAJARITO PLATEAU, NEW MEXICO

by

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A Dissertation Submitted to the Faculty of the

DEPARTMENT OF ANTHROPOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

2009

ABSTRACT

LA-UR-09-02500

A wide range of theories – resilience theory and the study of complex adaptive systems, for example – are advancing our understanding of anthropological systems. Recently, anthropologists have applied the panarchy framework to study socionatural systems. This framework allows researchers to assess growth, conservation, release, and reorganization in this nested-cycle model that operates simultaneously at multiple spatio-temporal scales. The long time-depth of the archaeological record is a critical factor in our ability to investigate human behavior within the panarchy's set of nested adaptive cycles.

Archaeological investigation in the US Southwest has focused on processes of aggregation and culture change due to varying environmental and social conditions; the Pajarito Plateau, NM, has been the subject of archaeological research since the late 1800s. The Los Alamos National Laboratory portion of the Plateau has been thoroughly surveyed for cultural resources, but has received less attention by scholars than surrounding areas, including Bandelier National Monument. I use the panarchy framework to build a model of Puebloan settlement, land use, demography, and adaptation to assess the utility of the panarchy model for anthropological systems and fill a void in archaeologists' understanding of the Puebloan Southwest.

I analyze patterns of residential and agricultural land use during the Rio Grande Coalition and Classic periods (A.D. 1150-1600) for the Pajarito Plateau. I conclude that

there is no major change in the use of various landscape ranges between these periods. I reconstruct regional Puebloan momentary population and investigate recent evidence that supports a San Juan Basin source of the dramatic population increase during the Late Coalition. I also investigate aggregation into large plaza pueblos, the development of craft specialization, agricultural intensification, architectural change, and increased participation in the wider Rio Grande marketplace economy as responses of households, clans, villages, and the entire Pajarito population to the highly fluctuating climate of the local landscape. I address these results within the panarchy framework. Further, I argue that the Pajarito Plateau system continued after the population dispersed into the Rio Grande Valley below, to be closer to reliable sources of water and the growing Rio Grande economy.

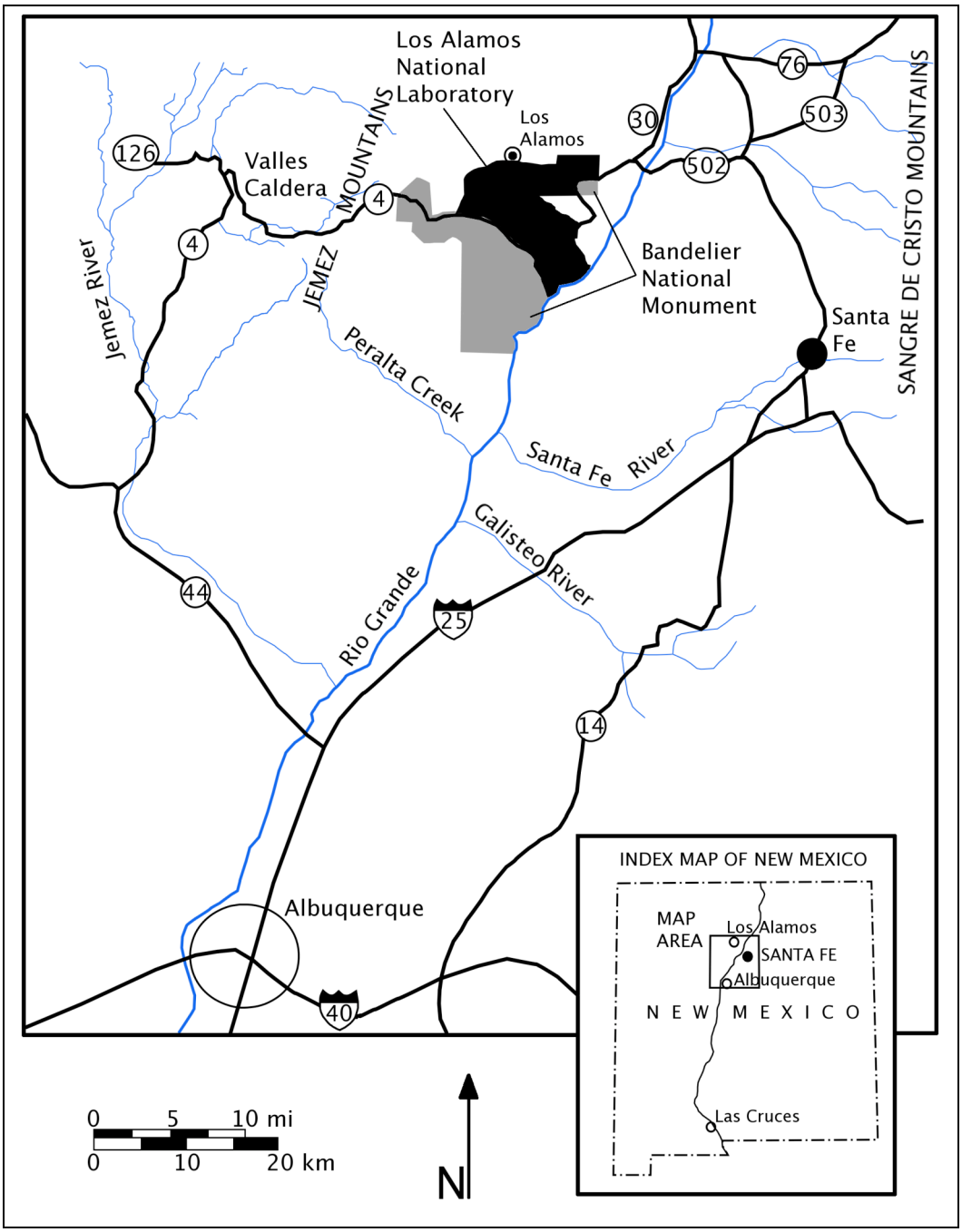

Figure 1.1. Location of Los Alamos National Laboratory and Bandelier National Monument (adapted from Vierra and Schmidt 2008a).

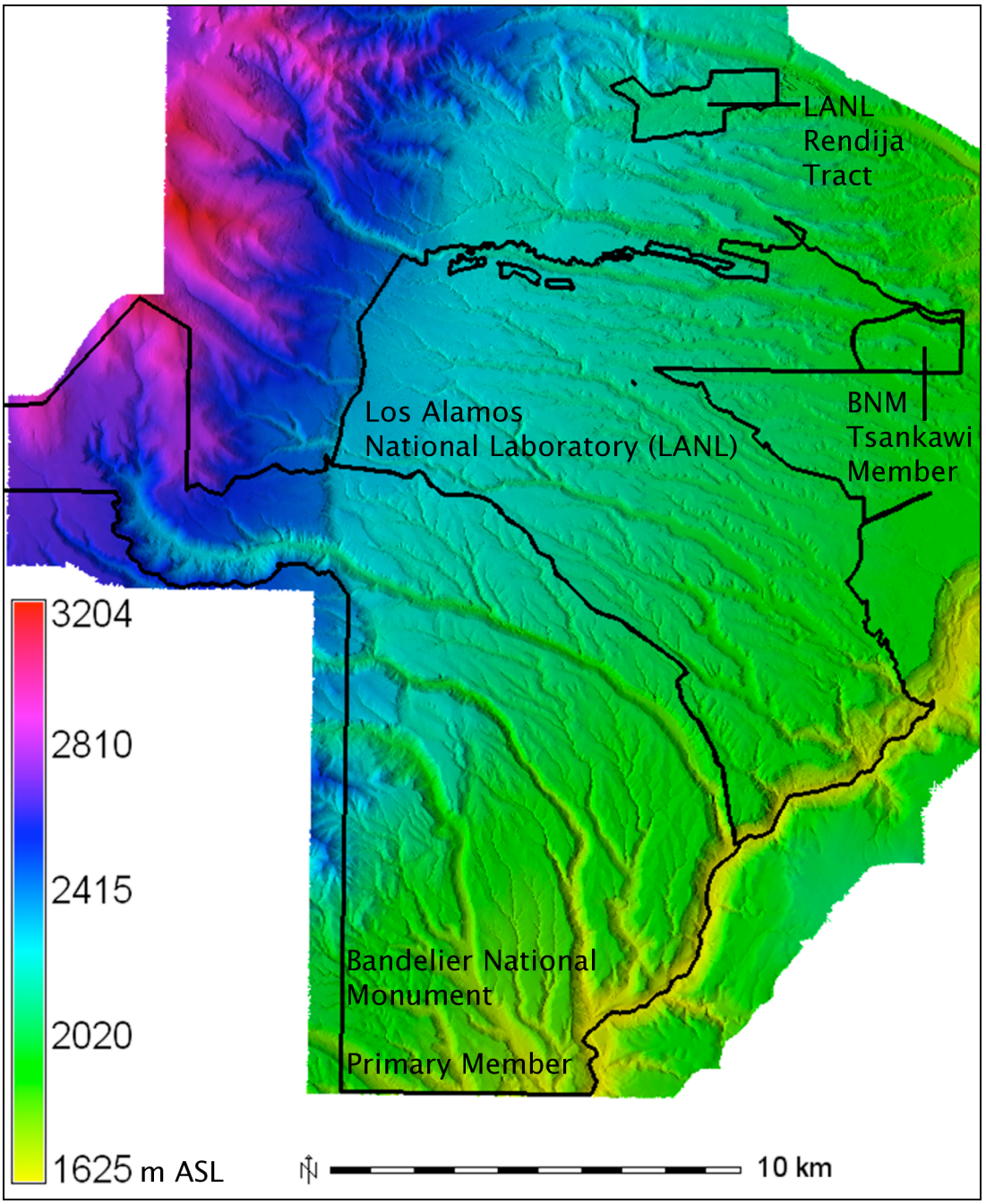

Figure 3.1. Location of Bandelier National Monument primary and Tsankawi members in relation to LANL.

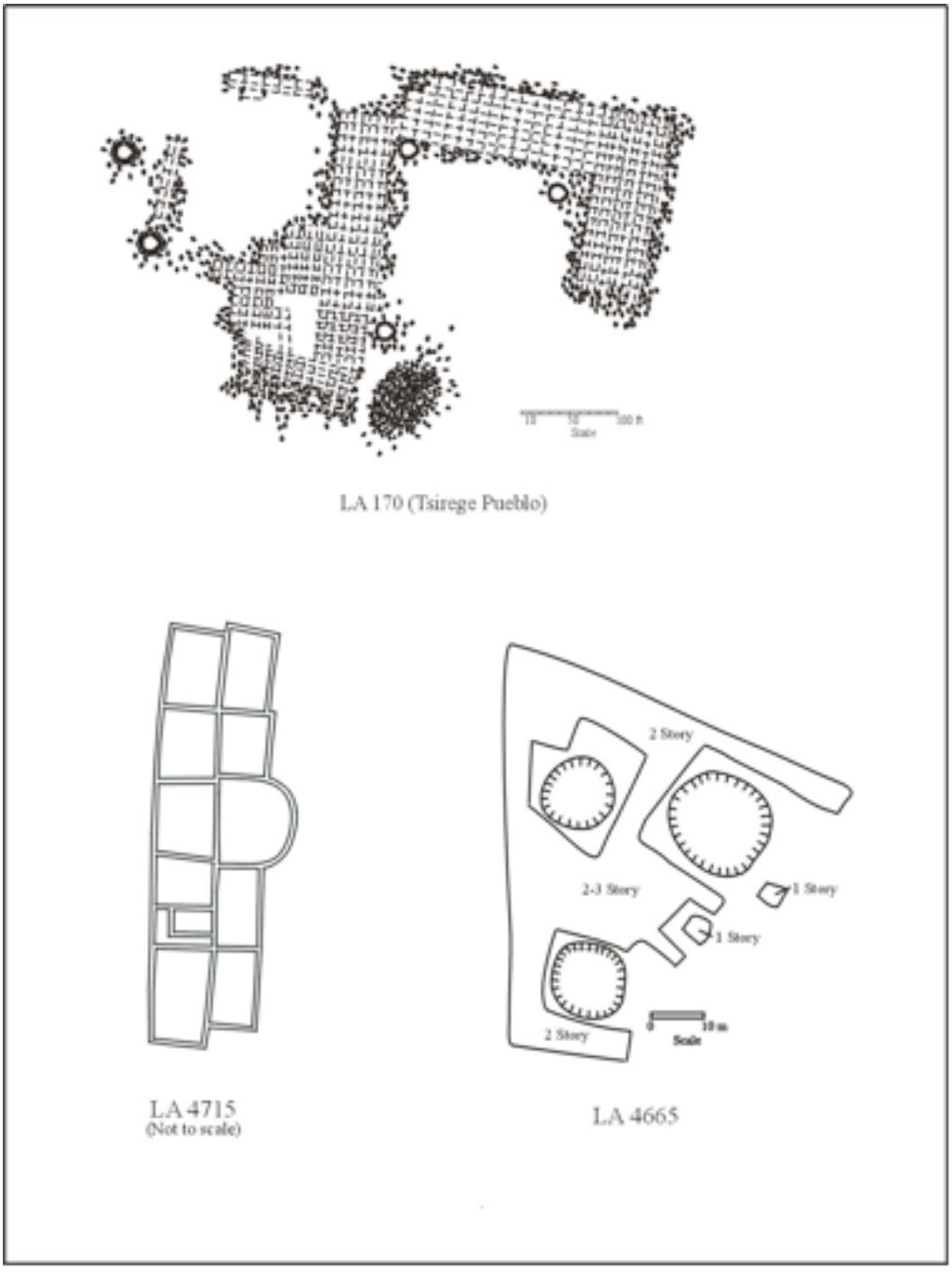

Figure 4.1. Illustrations of a Coalition roomblock (LA 4715), a late Coalition plaza pueblo (LA 4665), and a Classic period plaza pueblo (LA 170). Reproduced with permission from Vierra, Hoagland et al. (2002:3-3, Figure 3.1, LA-UR-02-1284).

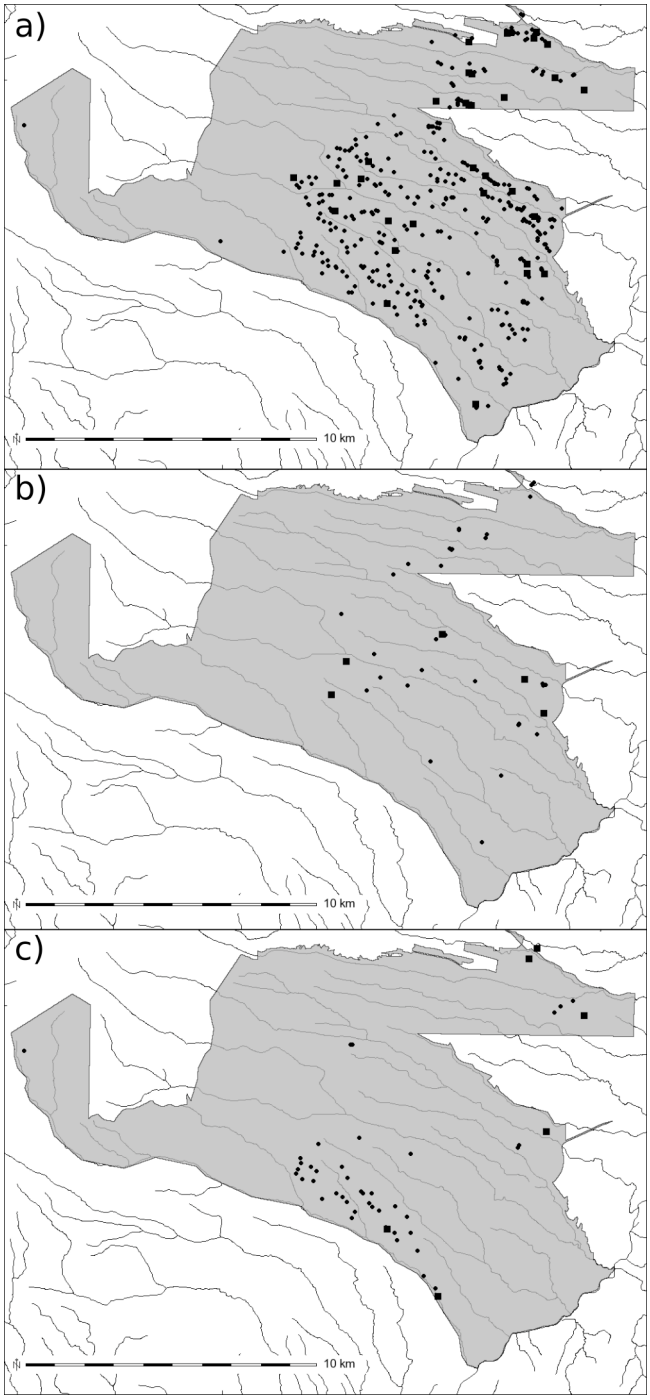

Figure 7.3. Distribution of pueblo roomblocks (circles) and plaza pueblos (squares) for the a) Coalition, b) Late Coalition/Early Classic, and c) Classic periods.

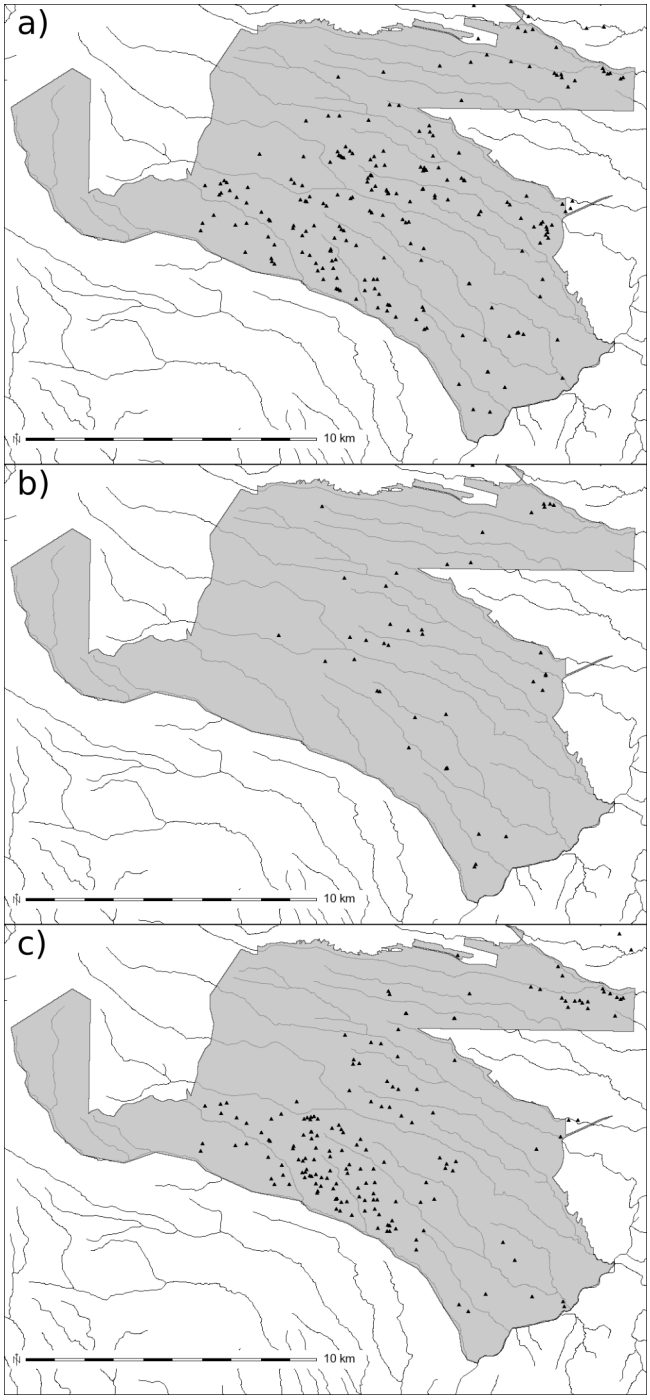

Figure 7.4. Distribution of one- to three/five-room structures for the a) Coalition, b) Late Coalition/Early Classic, and c) Classic periods.

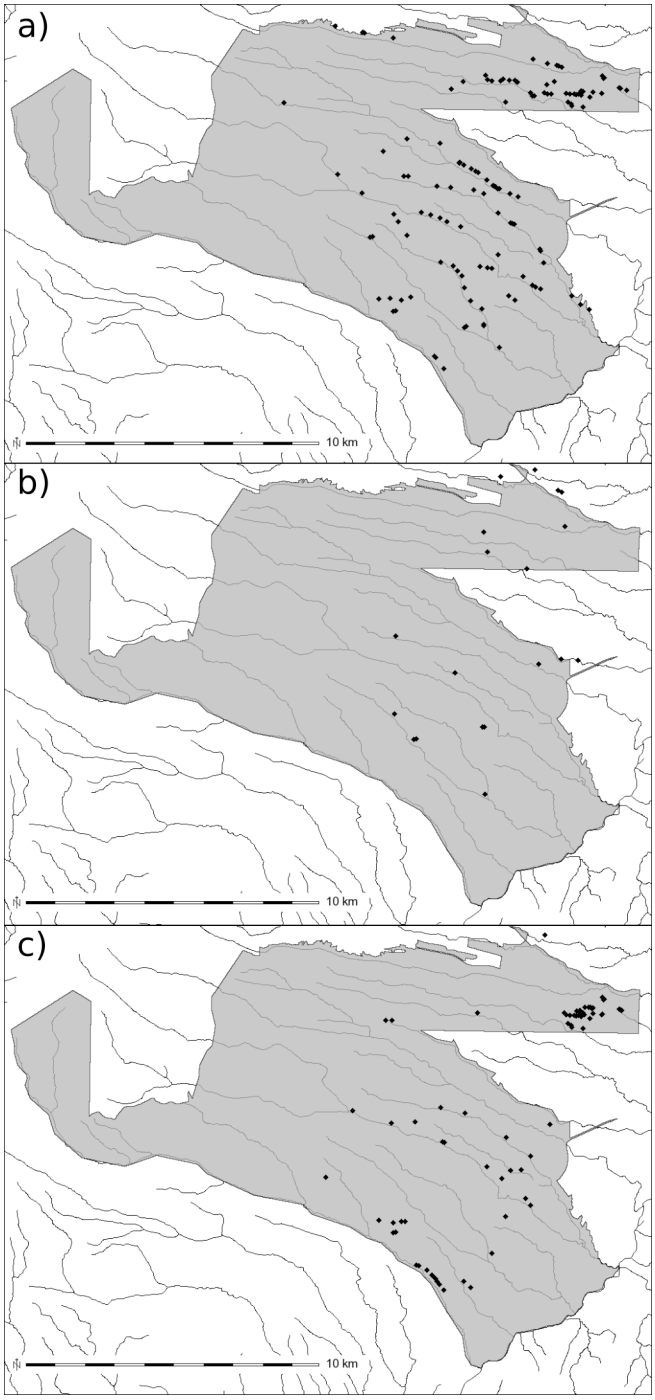

Figure 7.5. Distribution of cavates for the a) Coalition, b) Late Coalition/Early Classic, and c) Classic periods.

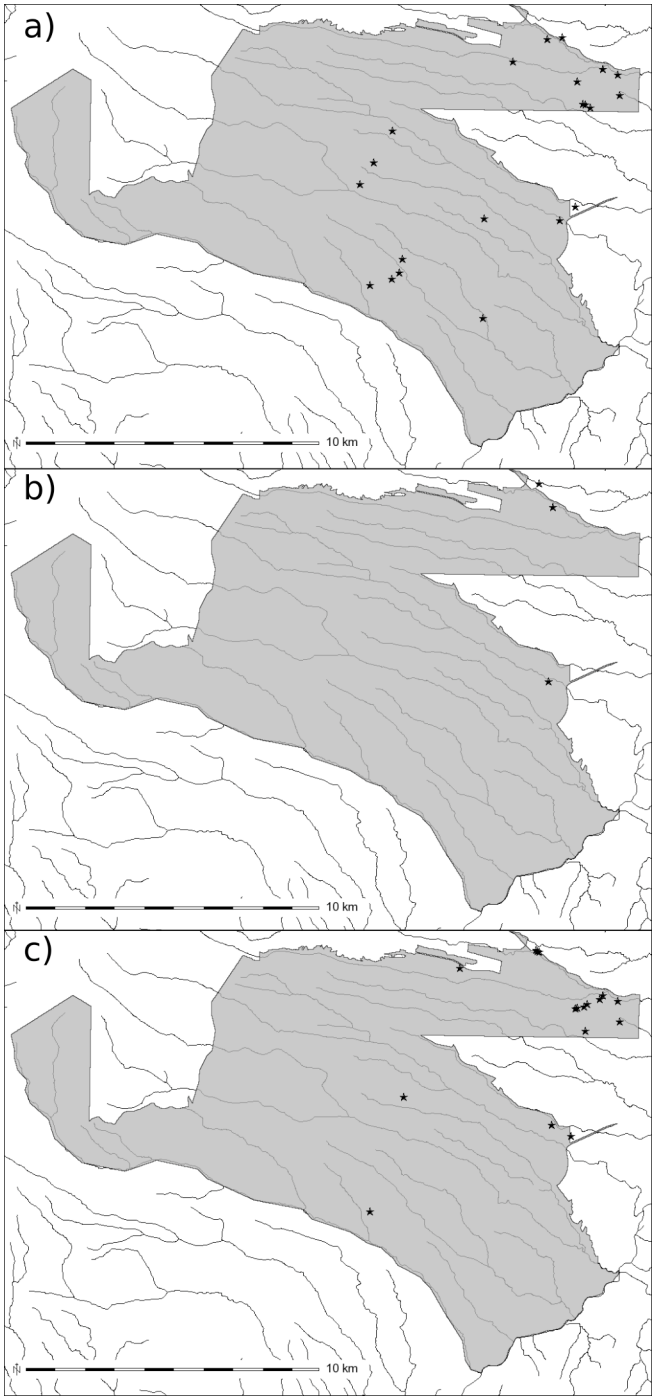

Figure 7.6. Distribution of agricultural sites (grid gardens, water control features, check dams) for the a) Coalition, b) Late Coalition/Early Classic, and c) Classic periods.

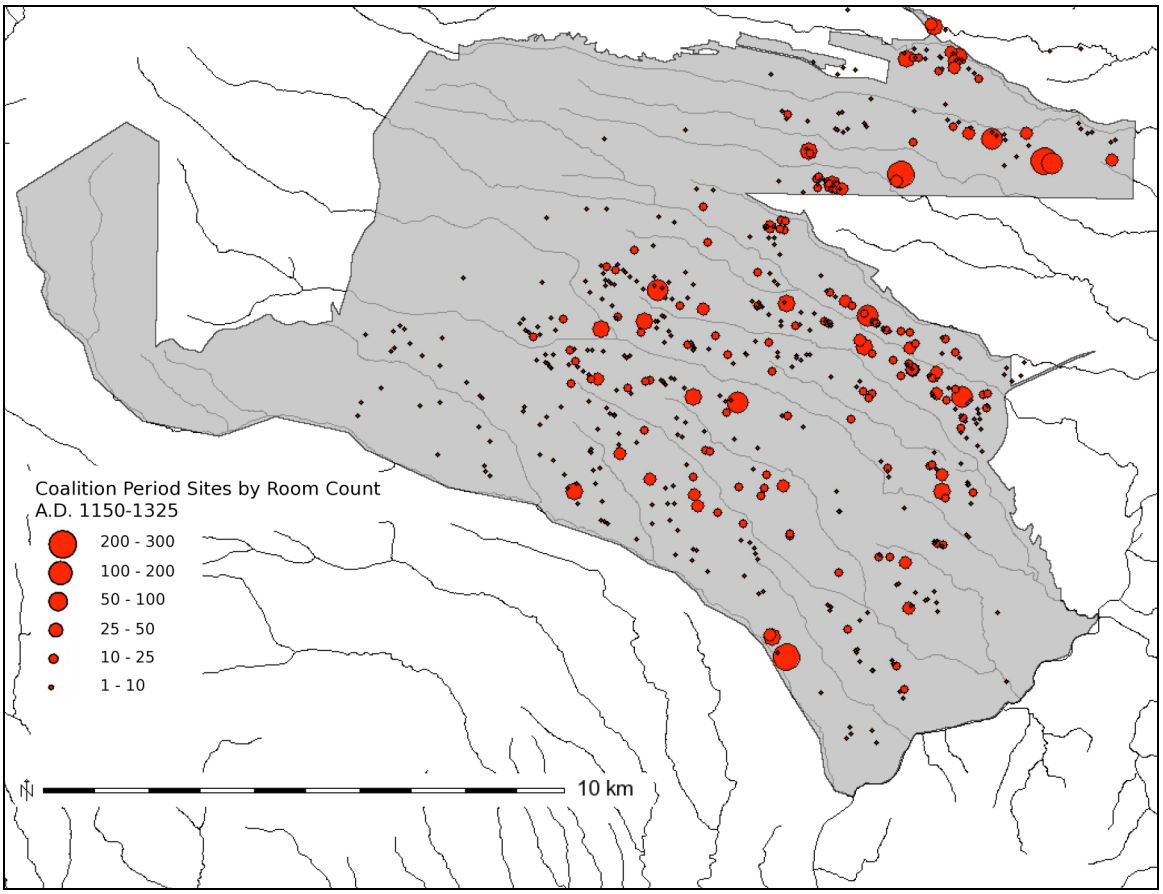

Figure 7.7. Relative site size for Coalition period structural sites.

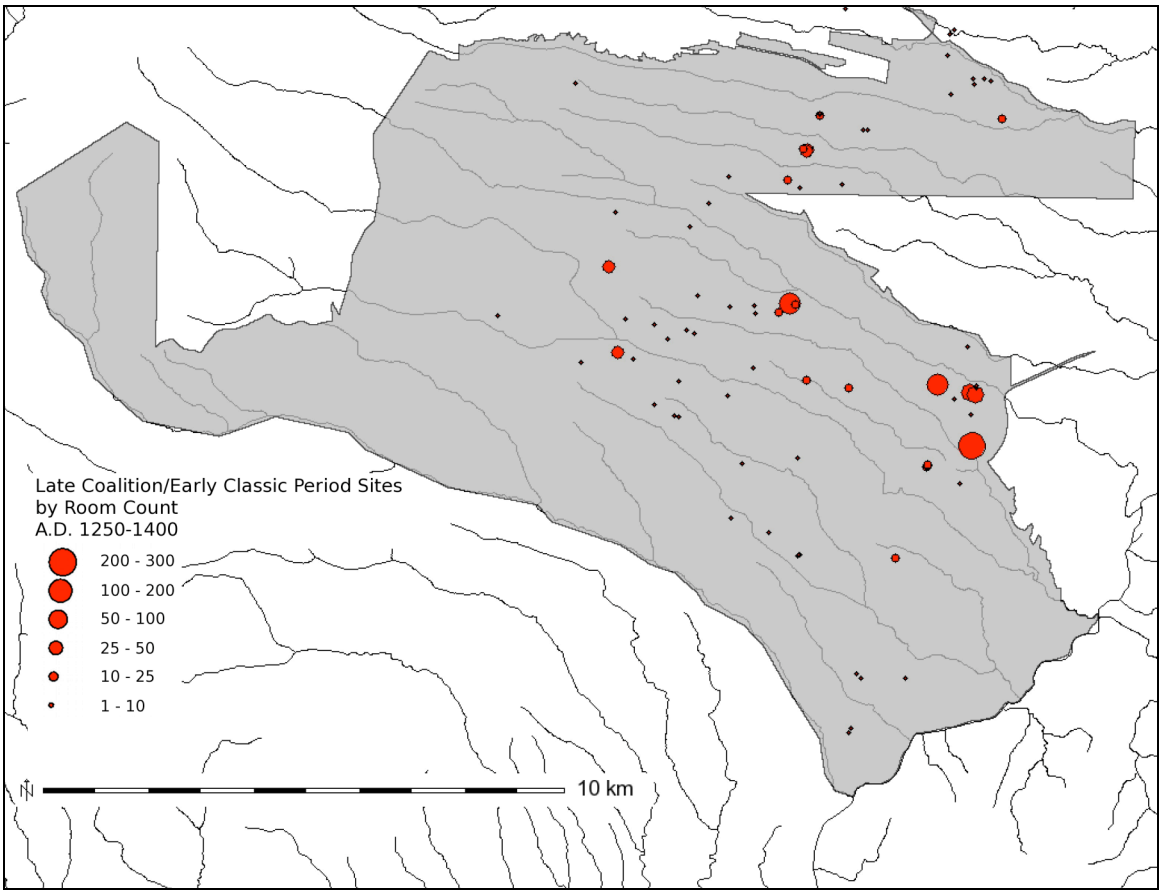

Figure 7.8. Relative site size for Late Coalition/Early Classic period structural sites.

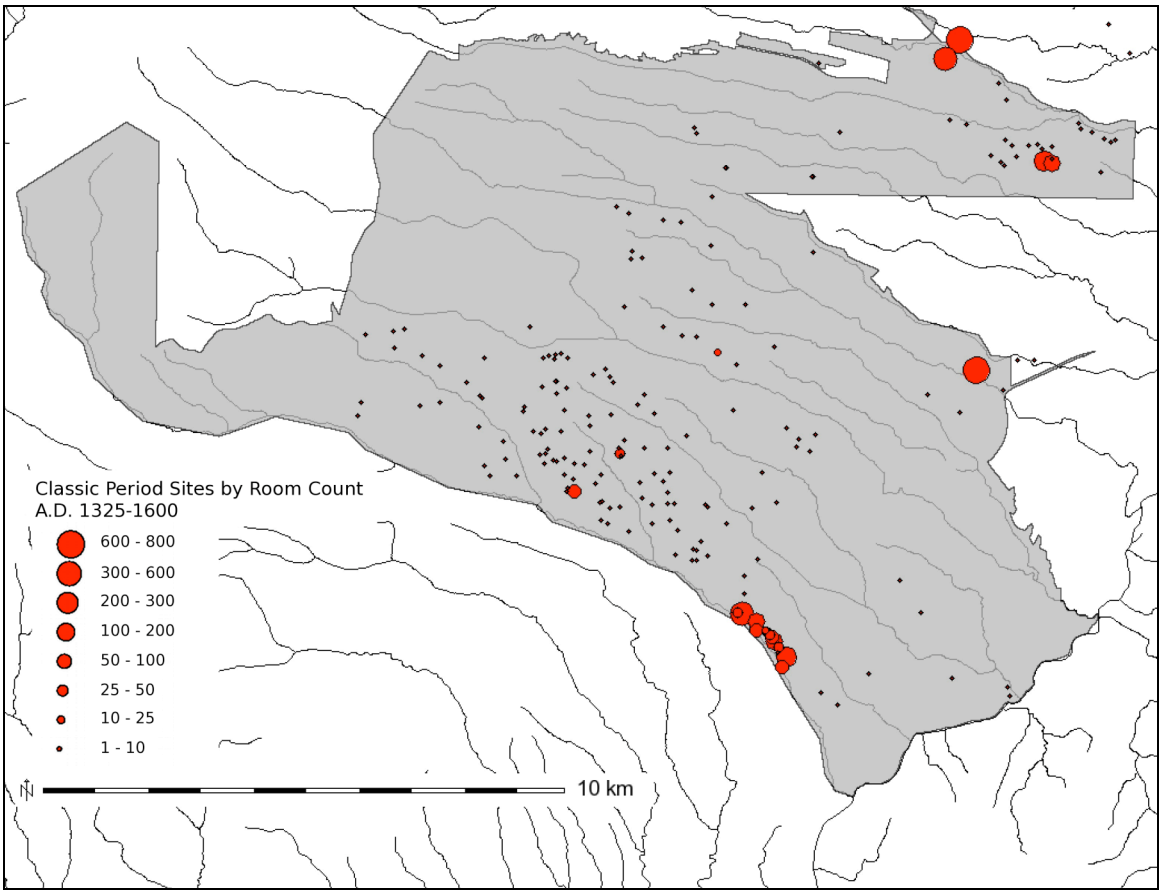

Figure 7.9. Relative site size for Classic period structural sites.

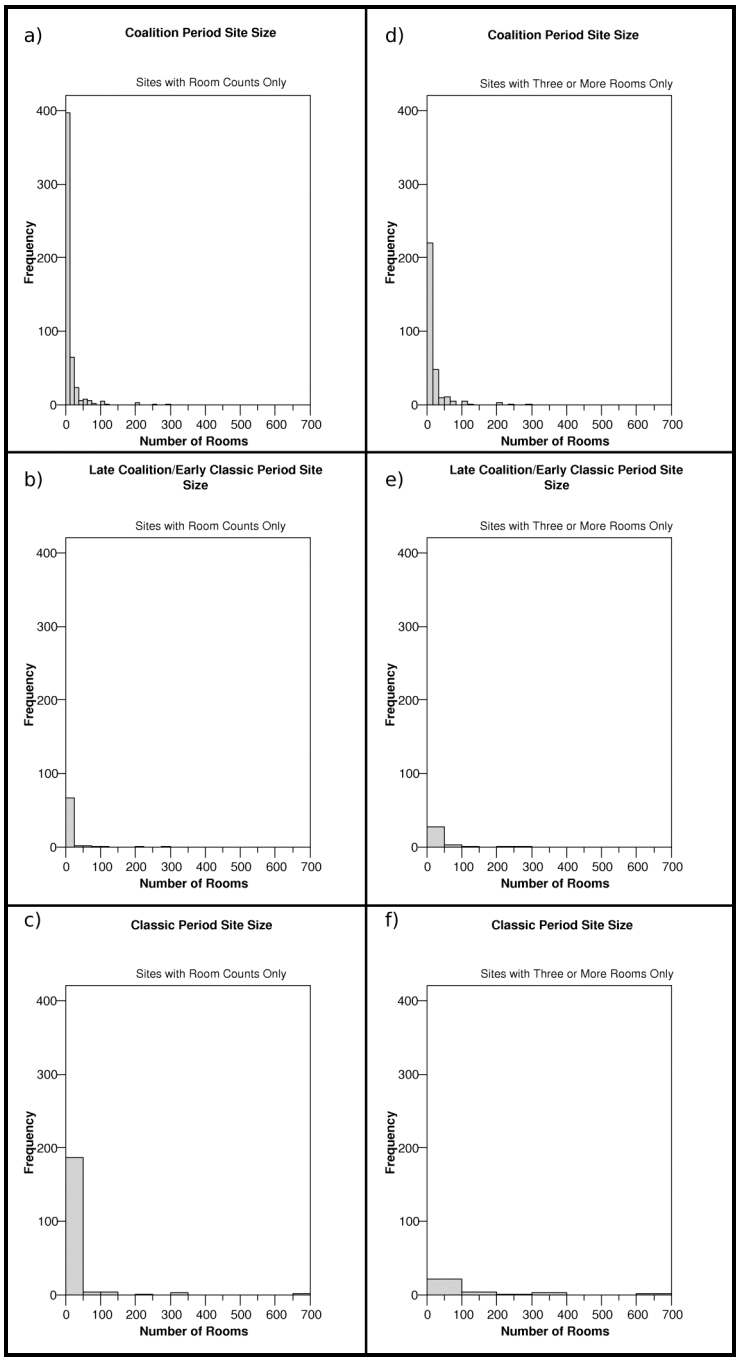

Figure 7.10. Room count distributions through time. Panels a, b, and c show the Coalition through Classic progression of site sizes based on room count for all structural site types (small structures, pueblos, and cavates). Panels d, e, and f show the progression for large sites – those with three or more rooms.

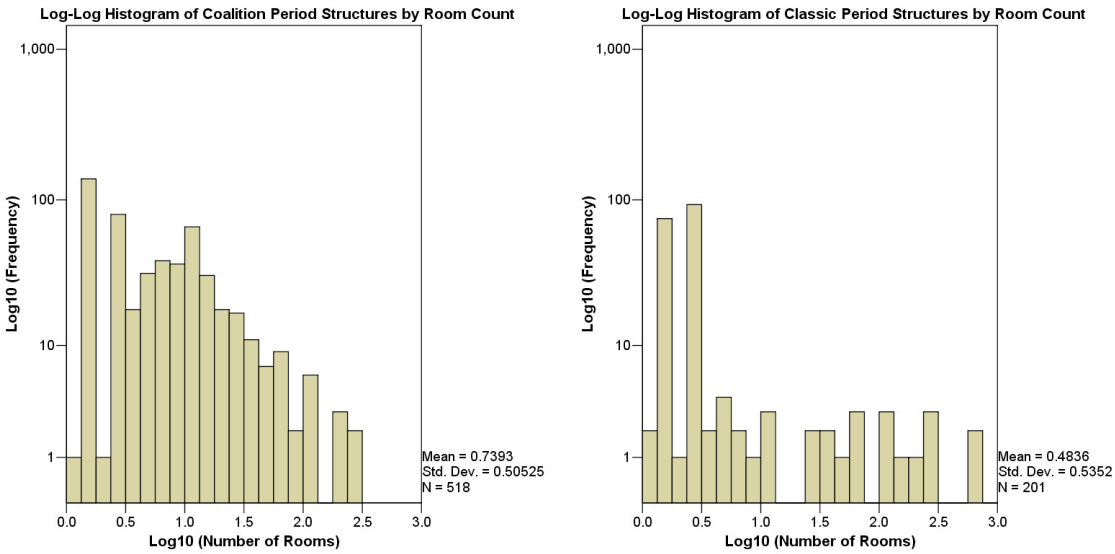

Figure 7.11. Distribution of site size for Coalition (left) and Classic (right) structural sites, logged to highlight changes in size distribution.

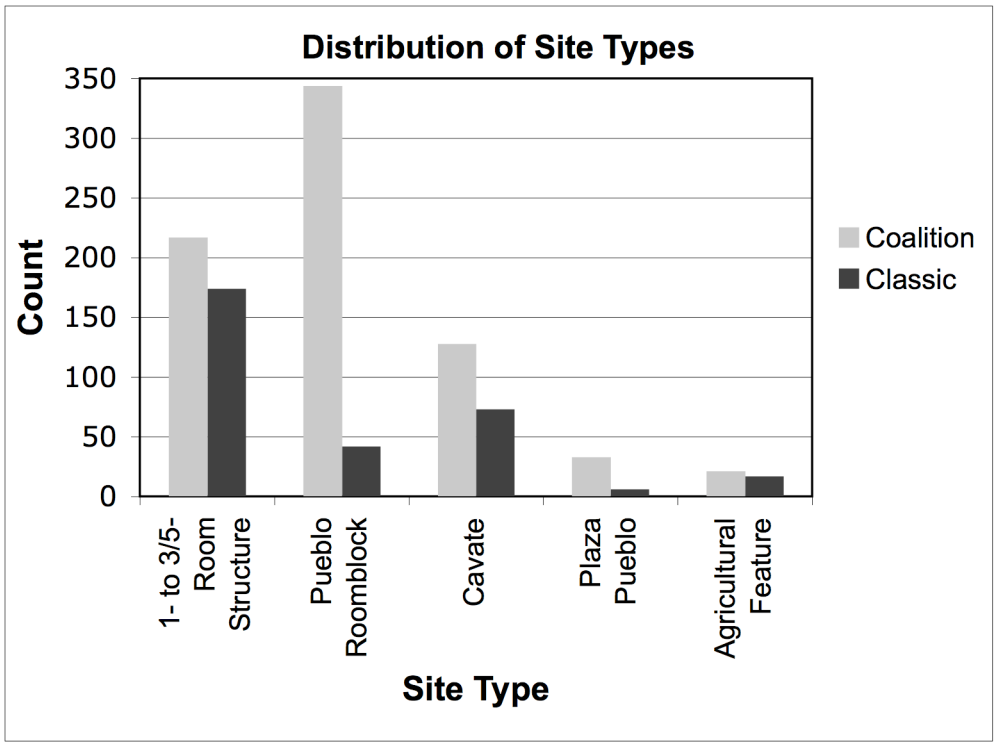

Figure 7.12. Distribution of sites by type during the Coalition and Classic periods. Note the extreme reduction in use of pueblo roomblocks and a select few (very large) plaza pueblos during the Classic period.

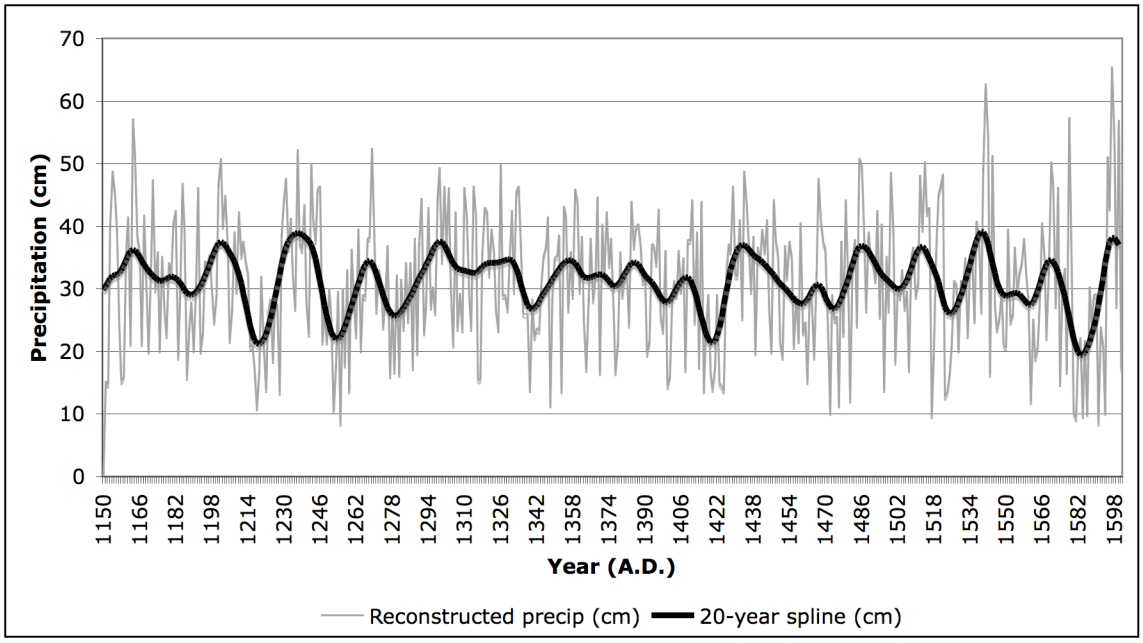

Figure 7.14. Reconstructed precipitation from tree-rings for Coalition and Classic periods (A.D. 1150-1600). Adapted from Towner and Salzer (2008).

Environmental Data. Other important data pertinent to this analysis include elevation (LIDAR data as a digital elevation model at a cell resolution of 5 m), hydrology (modern surface streams and permanent water sources), and soils. Only the soils information must be explored further at this time, as the others are relatively self-explanatory. There are 44 different soil types defined by Nyhan et al. (1978) for LANL and BNM, based on standard characteristics and depth. Of these, only 10 constitute more than 3% of the total area – these mostly comprise rock outcrops, soils formed by the weathering of the Bandelier tuff bedrock, loamy sands and sandy loams formed in canyon alluvium, and moist area soils. Only 4 of the soil types (Andeptic Udothorents, Hackroy Complex, Typic Eutroboralfs, and Totavi Loamy Sand) constitute more than 5% of the total area. The andeptic udothorents soil category represents ~29% (70 km^2) of the 244

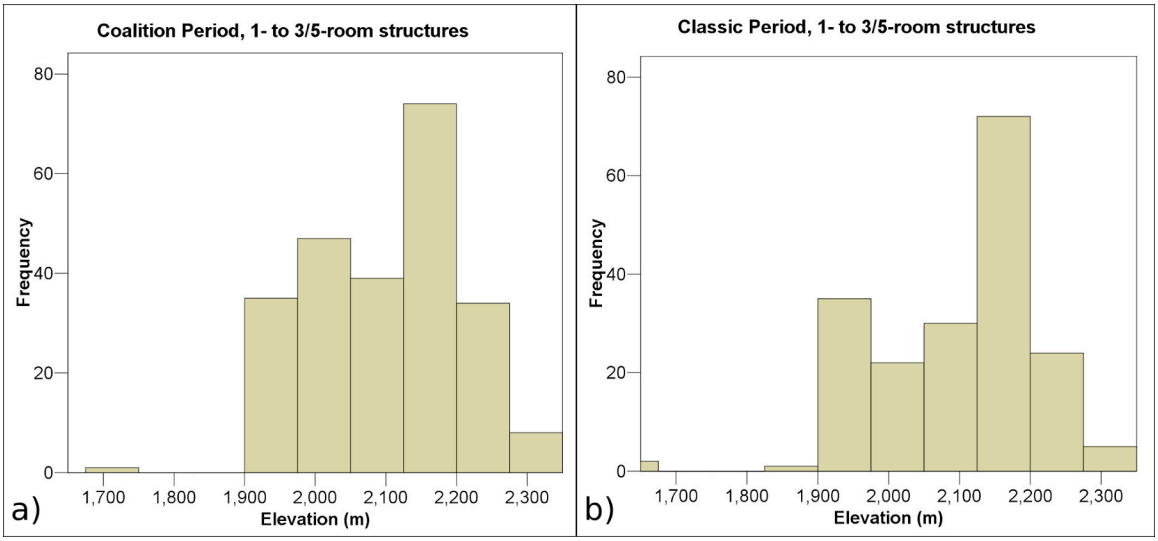

Figure 8.2. Distribution of sites with respect to elevation: (a) Coalition period one- to three/five-room structures; (b) Classic period one- to three/five-room structures.

One may question the ability to reject outright the claims of elevation change in the Classic period, and there certainly may be evidence of an increase in elevation *during* the Coalition or Classic period, but the chronological resolution for the majority of surveyed sites does not allow the assessment of a more refined chronology than that presented in Table 8.1. Perhaps most important is to note that these tests merely refute the claim that central Pajarito farmers relocated to higher elevations through time *on the central Pajarito Plateau*. My research on population modeling (Chapter 9) reiterates Crown et al. (1996:195-197) and Orcutt (1999b) in showing that population declines sharply on the central Pajarito, with approximately 85 percent of its population potentially moving to the southern Pajarito and, therefore, to lower elevations outside of my study area. Therefore, these lower elevation sites were not included in the tests above.

Mesa-top versus Canyon Occupation. Given the lack of a shift in strict elevation for occupation and agricultural sites on the Pajarito Plateau between the Coalition and

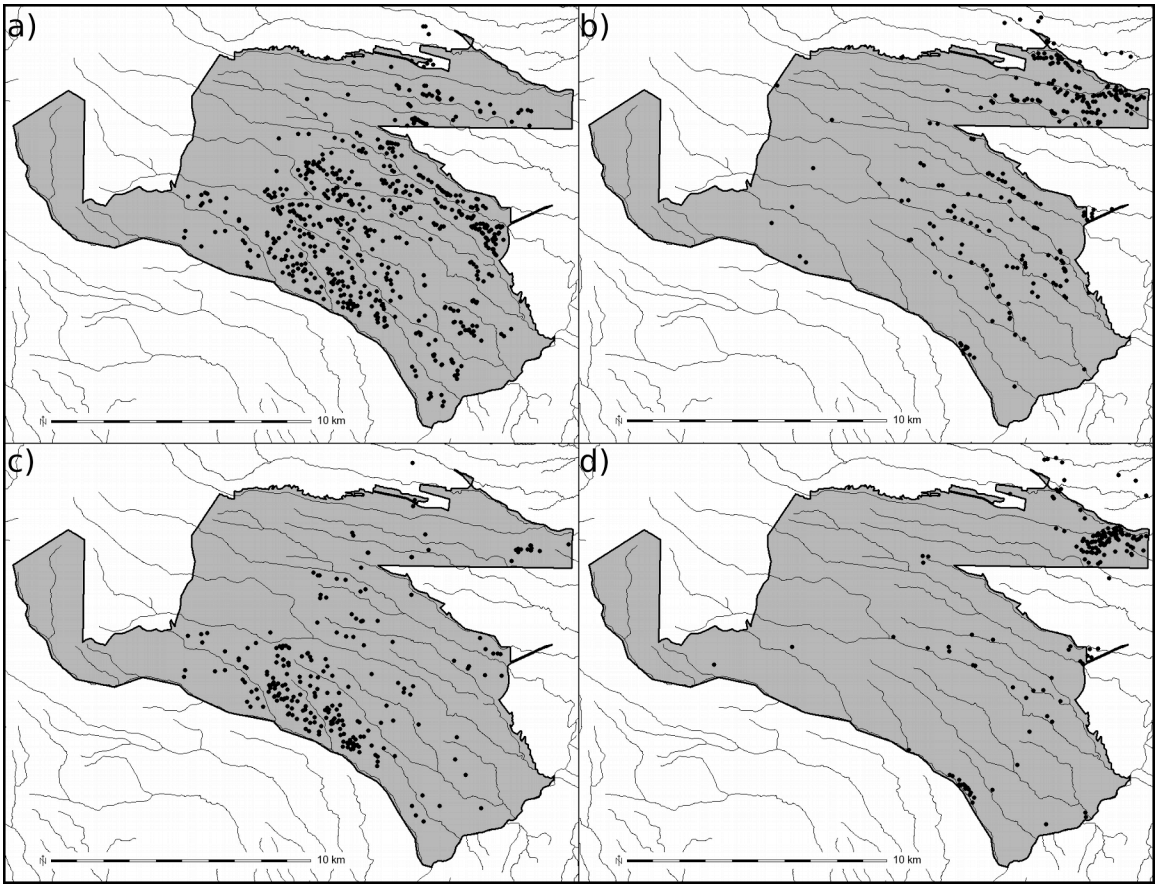

Figure 8.4. Distribution of sites in the Los Alamos region: a) Coalition mesa-top sites; b) Coalition canyon sites; c) Classic mesa-top sites; d) Classic canyon sites.

Computing the chi-square statistic for these data answers the question: how likely is it that we could select samples, with given proportions of mesa to non-mesa sites as different as these, if the Coalition and Classic periods did not differ in regard to differential use of mesas and canyons by prehistoric farmers? The result of the test with respect to all sites (742 Coalition period sites, 311 Classic period sites) suggests that it is unlikely that sampling bias or observational error created the difference in proportion of mesa-top to non-mesa-top sites between the Coalition and Classic periods ($\chi^2 = 4.742$, df = 1, $.02 < p < .05$, $V_c = .067$). Therefore, these data suggest that there is indeed a shift,

Table 8.9. Summary of the Pajarito panarchy (*italics indicate failure to meet expectations from Table 6.1)*.

Period	Ceramics	Architecture	Subsistence	Settlement Pattern	Economy	Central Pajarito Phase
Early Coalition	SF B/w; bowls most common; Produced all over	Hamlets	Maize (and other domesticated crops) supplements wild resources	Use of wide range of areas, low density, higher use of mesas	Local, households produce all that they need	**α** (immigrants) **r** (locals, locals and recent immigrants)
Late Coalition	Specializa-tion begins; biscuitwares and SF B/w both widely distributed, SF B/w decreases in use	Hamlets and villages (some large pueblos, few multi-storied)	Intensify on turkey, maize; use wide range of wild and domesticated species; fish and amphibians	Higher proportion of sites on mesas than canyons	Exchange; cotton, tobacco more prevalent	**r to K**
Early Classic		Some hamlets remain, large pueblos, large multi-storied pueblos, generally with one kiva		Use of canyons increases for habitation, *but no evidence for increase in agriculture in canyons, varying elevations, or lower quality areas (soil or otherwise)*		
Middle Classic	Specialized local production (biscuitwares – central PP – and glazewares – southern PP), but wide regional distribution	Large, multi-storied plaza pueblos, with multiple larger kivas	Everyone not seemingly growing their own food; deer and large mammals for exchange; domesticated crops grown and traded		Market-place exchange within broader Rio Grande economy	**K**
Late Classic		Large pueblos remain, most of population moves off Plateau by mid-1500s			Participation in Rio Grande economy continues after relocation into Tewa Basin	**Ω**

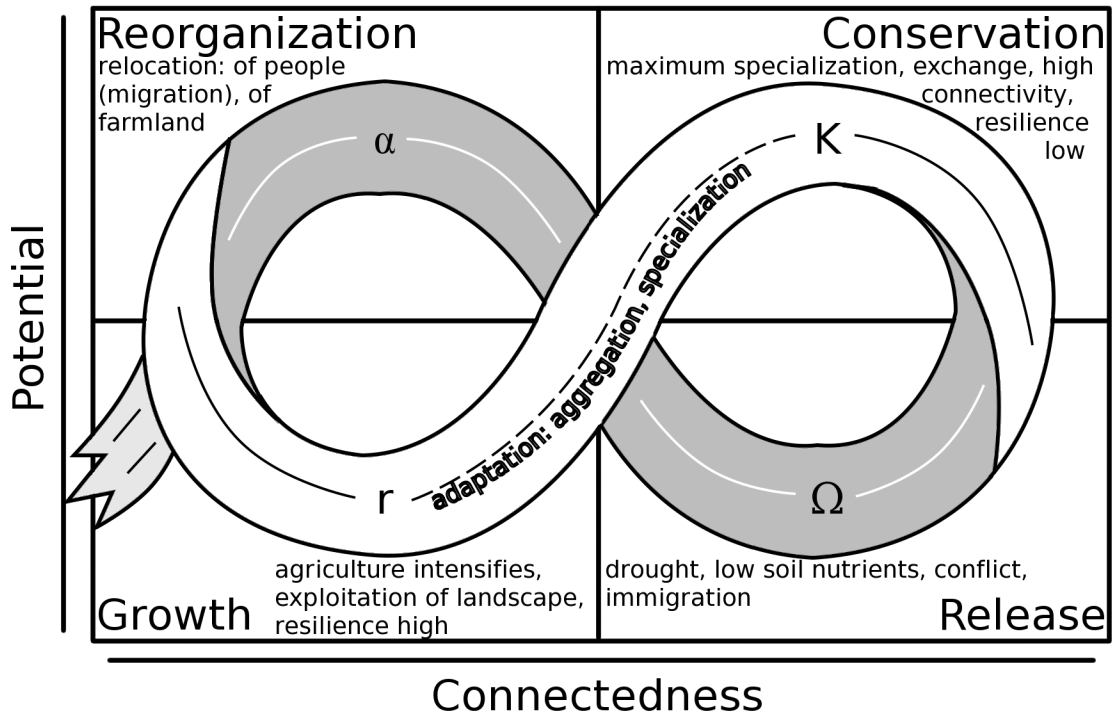

Figure 8.5. Pajarito adaptive cycle, repeated from Chapter 6, Figure 6.2 (adapted from Holling and Gunderson 2002:34, Figure 2-1).

The initial period of the Pajarito cycle is a reorganization (α) phase and immediate and subsequent growth (r) phase, for which little evidence exists on the entire Plateau, is represented by local, seasonal foraging (Vierra and Ford 2007) and the beginning of migration to the region. Santa Fe Black-on-white appears in the mid- to late-A.D. 1100s, and shows a connection with Mesa Verde Black-on-white and Galisteo Black-on-white (Wilson 2008:144-149). Wilson (2008:144-149, 197) argues that there is a stronger connection between the whitewares of the Plateau and the Tewa Basin to the east, suggesting migration to the Plateau was from the Tewa Basin, rather than directly from the San Juan region. Regardless, ceramic evidence supports initial migration as early as the end of the A.D. 1100s, signaling reorganization and the beginning of a

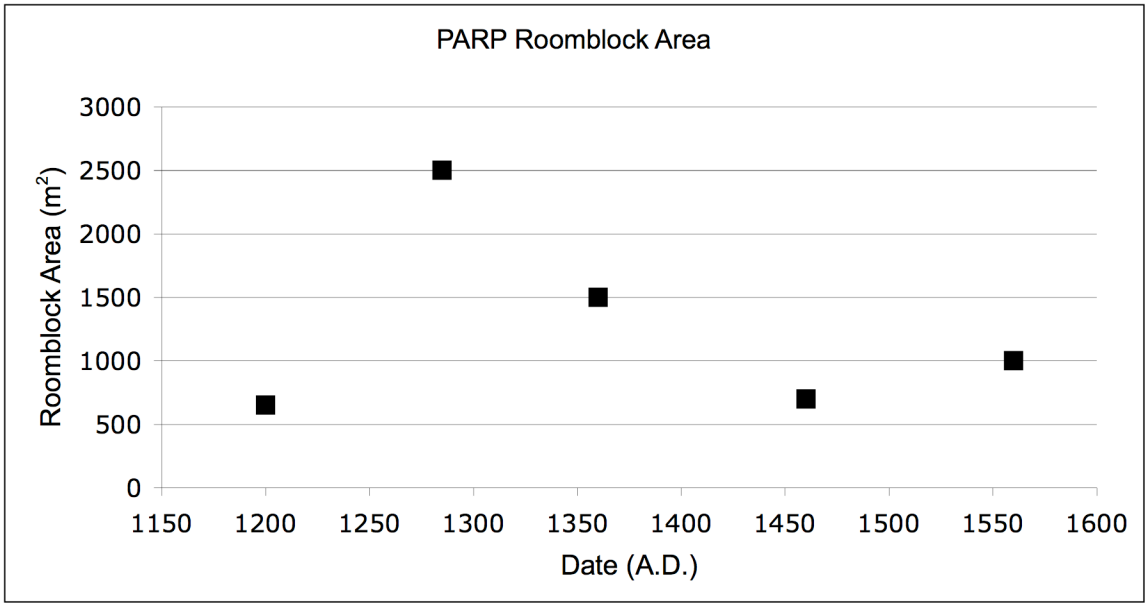

Figure 9.1. Roomblock area for PARP survey (after Orcutt 1999b:Figure 5.1).

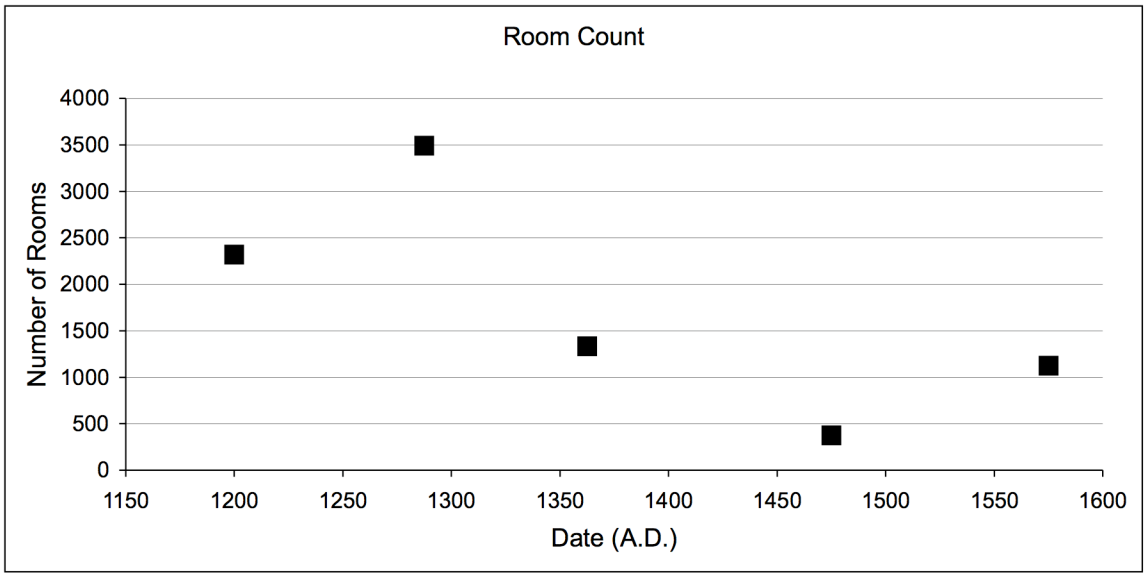

Figure 9.2. Room count on Los Alamos region based on Orcutt (1999b) room distribution methodology.

Various methods exist for estimating momentary population from room counts (Casselberry 1974; Clarke 1974; Hill 1970; LeBlanc 1971; Naroll 1962; Newcomb 1999; Orcutt 1999b; Plog 1974; Preucel 1990). This methodological investigation follows

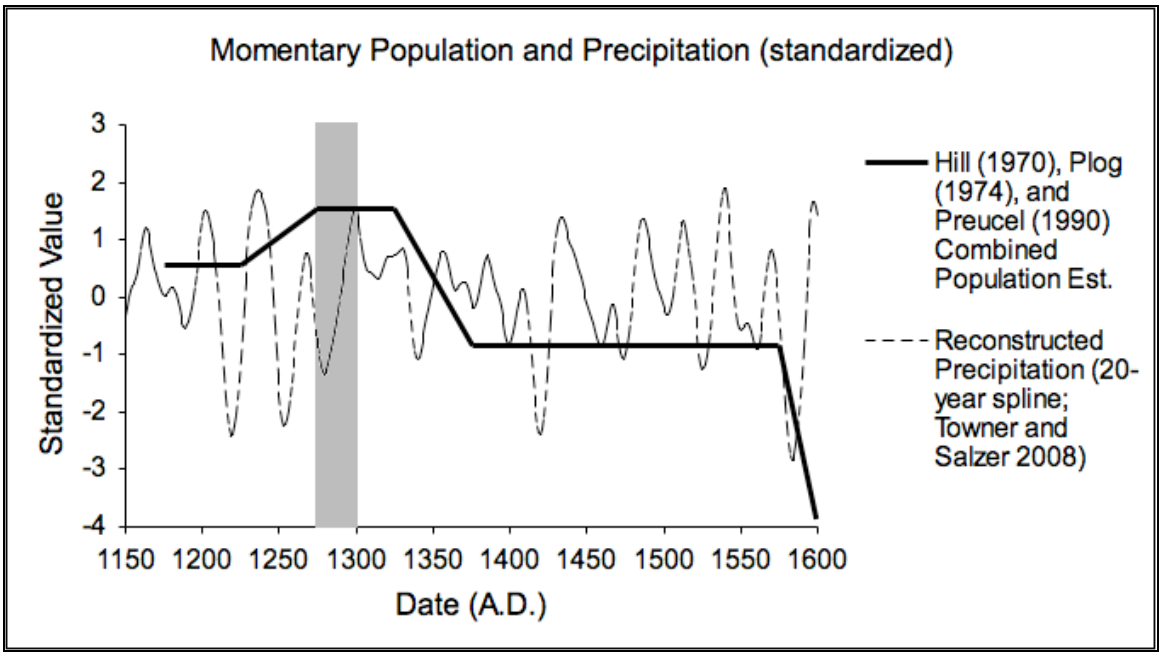

Figure 9.8. Population estimates for Los Alamos study area plotted against precipitation reconstructed from tree-ring indices (Great Drought, A.D. 1276-1299, highlighted; Towner and Salzer 2008).

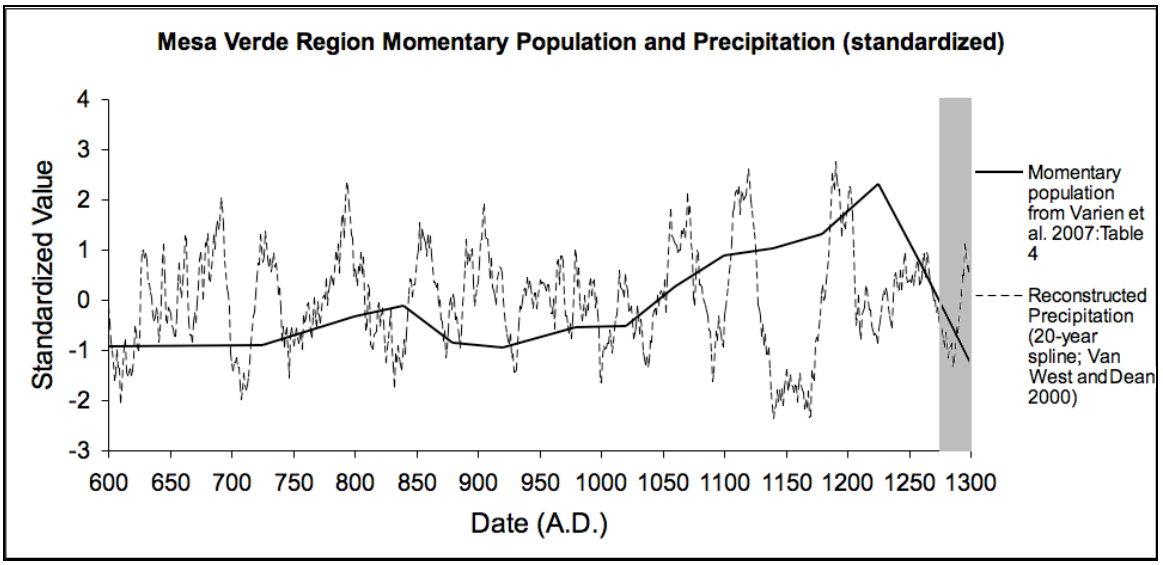

Figure 9.9. Mesa Verde population estimate (Varien et al. 2007:Table 4) plotted against precipitation reconstructed for the Southwest Paleoclimate Project by the Laboratory Tree-Ring Research at the University of Arizona (Great Drought highlighted; see also Van West and Dean 2000).