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ABSTRACT

The Western Puerco region of east-central Arizona figured prominently in foundational studies of the Early Pueblo period (AD 650-950) yet remains on the periphery of recent research. This article presents new survey and chronometric data from three communities located in a densely occupied portion of the Western Puerco, the Petrified Forest. These data suggest that the Petrified Forest hosted the earliest known aggregated settlement in the region, circa AD 700-800, before residents transitioned to a dispersed settlement pattern that remained in place through the Chaco era. Neighboring portions of the Western Puerco, however, only hosted settlements of a similar size from AD 840 forward. Chaco great houses were founded in these communities during the tenth and eleventh centuries. Unlike better known examples of aggregation in the northern San Juan region that unfolded within only a few generations, similar developments in the Petrified Forest were likely the culmination of hundreds of years of local population growth, increasing sedentism, and use of prominent natural features on the landscape. The lack of fit between the causal factors proposed for village formation in the northern San Juan and eighth century aggregation in the Petrified Forest suggests alternative models are needed to explain the formation of early population aggregates in the Western Puerco and across much of the western portion of the northern Southwest more broadly.

Our understanding of the dramatic and often abrupt changes that accompanied the formation and demise of the earliest Ancestral Pueblo villages in the northern Southwest has been shaped in large part by work in the northern San Juan region (Brew 1946; Kohler and Varien 2012; Martin 1939; Morris 1939; Roberts 1930; Wilshusen and Ortman 1999; Wilshusen and Potter 2010). Yet it remains unclear whether the northern San Juan is a useful analogue for other regions with dense contemporary occupations due in part to differences in long-term regional demographic trends prior to, during, and following the Early Pueblo period (AD 650-950) (Peeples et al. 2012; Schachner et al. 2012; Young and Gilpin 2012). Here, we present the results of recent fieldwork and collections research in the Western Puerco region of east-central Arizona, an area that was the focus of foundational research on the Early Pueblo period (Roberts 1931, 1939, 1940; Gladwin 1945; Wendorf 1953), but has remained on the periphery of recent work. Our research has focused on a densely occupied portion of the Western Puerco that remains poorly understood, the Petrified Forest. The Petrified Forest hosted the earliest known aggregated settlement in the region, circa AD 700-800, prior to residents transitioning to a dispersed settlement pattern shortly thereafter. In contrast, neighboring areas to the east and south did not witness the rise of large aggregated settlements until the ninth century. These communities eventually became the locations of Chaco era great houses, unlike the earlier Petrified Forest aggregates. The development of early aggregated communities based on long-term, in-situ population growth and strong attachment to prominent landscape features in the Petrified Forest, and the Western Puerco more broadly, provides an alternative to models of early village development proposed for the northern San Juan region.

Models for Early Village Development

Nearly four generations of southwestern archaeologists have offered detailed descriptions of the household and community-scale social, economic, and ritual changes that occurred during the Early Pueblo period, yet few have offered explicit models to explain the initial formation of early villages. Here, we use the term village to describe settlements occupied year-round by a group "…large enough that the households would not consider themselves closely related to all the other households" (Kohler and Varien 2010:37-38, see also Wilshusen 1991:204). Recent well-developed models focused on the northern San Juan suggest a number of interconnected push and pull factors that ultimately led to early villages including, migration, population pressure, competition over resources, and the perceived threat of violence (Kohler and Varien 2012; Wilshusen and Potter 2010). Kohler (2012:256) posits population pressure on resources and the resulting competition between households as the ultimate causal mechanism.

Facilities capable of integrating people into large non-kin groups have also been a central focus of research on the Early Pueblo period. A strong relationship between great kivas and early villages is apparent in the northern San Juan (Wilshusen et al. 2012a:23-25), while others have noted a link between great kivas and decreasing residential/seasonal mobility regardless of early village development (Gilpin and Benallie 2000; Young and Gilpin 2012). The formation of an eighth century village in the Petrified Forest with no associated great kiva, and the long-term stability of ninth century community centers in the Western Puerco, offer important points of contrast to similar developments in the northern San Juan, and suggest multiple trajectories for early village development in the northern Southwest.

Environment and Previous Research

As defined here, the Western Puerco is bounded on the west, northwest and south by Leroux Wash, the Puerco River, the Zuni River and the Little Colorado River, bounded on the east by Hardscrabble Wash, and bordered on the north by Chinde Mesa, Padres Mesa, and the Defiance Plateau. Cultural variation has remained a dominant research theme in the region for over 80 years (Gladwin 1945; Mera 1934; Mills 2007; Peeples et al. 2012; Schachner et al. 2012; Throgmorton 2018; Wendorf 1953), and we find it useful to further subdivide this roughly 5000 km^2 area into distinct subregions based on environmental differences and subtle yet persistent cultural distinctions (Figure 1, Table 1). Dividing the Western Puerco into Petrified Forest, Hardscrabble, and Middle Puerco subregions allows much of this variability to be understood as clinal variation within an area with shared cultural traditions.

Intensive research focused on the Early Pueblo period in the Western Puerco commenced with excavations at Kiatuthlanna, Whitewater Village, White Mound Village, and Twin Butte, and with survey and ceramic seriation at Petrified Forest and in the Hardscrabble area (Beeson 1966; Gladwin 1945; Mera 1934; Reed 1947; Roberts 1931, 1939, 1940; Wendorf 1953). Numerous Early Pueblo sites were excavated along the I-40 corridor during the early contract era, but technical reports remain unpublished (Gumerman and Olsen 1968; Gumerman et al. 1982; Ripey 1969; Sciscenti 1962; Wasley 1960). While excavation reports were completed from the next wave of contract work, they often lack feature maps and ceramic counts (Stebbins et al. 1986; Swarthout and Dulaney 1982). The pace of survey and excavation in the region increased dramatically during the late 1980s-1990s during the development of the Chambers-Sanders Trust Lands (Hays-Gilpin and van Hartesveldt 1998:37-39). Table 2 contains a list of survey and excavation projects with sizable Early Pueblo components that are included in the current synthesis.

Several environmental and historical factors have influenced our understanding of the Early Pueblo period. Unlike the northern San Juan, no single large project in an area rich with Early Pueblo archaeology has occurred and data must be gleaned from numerous small projects. While development in the Middle Puerco and Petrified Forest subregions has facilitated survey and excavation, the Hardscrabble area has received little attention beyond Beeson's reconnaissance survey (1966) and Roberts' work (1931). Environmental differences between these areas also influence the efficacy of chronometric methods. Unlike the Middle Puerco and the Hardscrabble areas, the Petrified Forest has not produced datable dendrochronological specimens. In the past it was difficult to compare conventional ^{14}C dates on wood charcoal in a meaningful way to tree-ring dates, but advances in AMS technology, improved sample selection, and Bayesian modeling may help bridge this gap. Nevertheless, we have pieced together a better understanding of Early Pueblo chronology through a combination of survey, reanalysis of curated collections, accessing rare reports and excavation notes, and consulting knowledgeable researchers[1].

THE EARLY PUEBLO PERIOD IN THE PETRIFIED FOREST, EPHEMERAL OR INTENSIVE?

Since Mera and Cosgrove's 1933 survey at then Petrified Forest National Monument, researchers have debated whether the area hosted a dense concentration or a lack of sites dating between AD 700-950 (Burton 1993; Hammack 1979; Jones 1983, 1987; Mera 1934; Reed 1947; Stewart 1980; Theuer and Reed 2011; Wendorf 1953). These disparate interpretations can be attributed to chronological issues related to the rarity of, and poor chronometric data for, early diagnostic ceramic types (Hays-Gilpin and van Hartesveldt 1998:45, 193), and the poor surface

visibility of Early Pueblo period architecture. Our current study clarifies the scale, scope, and timing of the Early Pueblo period occupation of the Petrified Forest and considers it within a regional context.

First, we provide an overview of three Early Pueblo period site clusters in the Petrified Forest area, here called communities based on spatial and temporal proximity (Gilpin 2003; Varien 1999). Our overview presents new data, including radiocarbon dates, from Twin Butte, the largest known Early Pueblo period community in the subregion, and then additional documentation for two other communities, Dead Wash South and Weathertop, previously recorded via NPS surveys. We then present a new ceramic seriation for the Early Pueblo period sites in the region, placing these communities in a more secure temporal and regional context. Finally, we discuss the implications of our research for the study of demography, population movement, and settlement histories in the Western Puerco, and then proceed to a broader consideration of early village development in the northern Southwest.

Twin Butte

Twin Butte was first recorded by Hough (1903:318) as Metate Ruin, and then mapped and excavated as part of Wendorf's (1953) dissertation research. Further documentation by Schachner and Bernardini (2014) and the current project shows that the site contains at least 70 discrete concentrations of artifacts and rubble spread over a 780,000 m^2 area (Supplement 1). Fifty of the artifact scatters have architectural rubble or in-situ stone alignments indicative of arcs or linear arrangements of surface structures, and each of these is likely associated with one or more pithouses. The densest concentration of features at Twin Butte is located on the south facing slope of a large conical butte (Figure 2). This area contains a minimum of ten heavily

eroded arcs of contiguous and non-contiguous slab-lined surface structures and 20 linear sandstone alignments arranged parallel to the slope of the butte interpreted by Wendorf (1953:32-34) as windbreaks for crops. Given the size of the site, the density of rubble, and evidence for superimposed features revealed by Wendorf's excavations, a total of 50 pithouses across the entire site area is likely a conservative estimate and the total number of residential structures could easily be twice as high.

An Intensive and Temporally Restricted Occupation

Wendorf's excavations repeatedly encountered evidence of an intensive yet temporally restricted occupation. A long trench excavated into two-meter deep cultural deposits revealed a complex sequence of construction events (Wendorf 1953:80-84, 116-121), yet two screened stratigraphic test units suggested little change in ceramic assemblages through time (Supplement 2). Excavations in twelve structures associated with six discrete architectural units also documented a complex occupational sequence of superimposed, remodeled, and trash-filled features, yet all contexts produced similar material culture (Wendorf 1953). Our surface recording of ceramics at four unexcavated loci outside of the site core documented assemblages similar to those recovered from Wendorf's excavated features (Supplement 2).

Archaeological survey and limited test excavations within the broader Twin Butte community also support an intensive yet temporally restricted occupation. Survey by NPS (Burton 1993; Burton et al. 2007; Corey 2008; Hammack 1979; Jones 1987) has documented an additional 40 Early Pueblo habitation sites with similar ceramic assemblages within a 2-kilometer radius of Twin Butte (Supplement 1). Excavations at AZ Q:1:42 (ASM), located two

kilometers northwest of Twin Butte, provide further evidence for contemporary occupation across the broader community (Jones 1983).

Twin Butte Radiocarbon Dates

Wendorf's excavations did not recover samples suitable for tree-ring dating and occurred prior to the development of radiocarbon dating, thus he had to rely on ceramic cross-dating for chronological control. We submitted twelve carbonized maize cob fragments and other short-lived plant parts from his excavations for AMS radiocarbon dating.[2] During the summers of 2013 and 2015, carbonized *Zea mays* and *Phaseolus vulgaris* (common bean) specimens were collected from features E2 and U1 in the Twin Butte core and also submitted for dating, bringing our total sample to fourteen.

The results indicate that Twin Butte was occupied between AD 650-900, but the most intensive occupation likely occurred between AD 700-800. An unconstrained uniform phase Bayesian model on ten tightly clustered dates (Bronk Ramsey 2009: 342-345) suggests a median start date of AD 710 and a median end date of 795 (AD 680-830, 68.2%, AD 655-885, 95.4%). All ten dates have modelled 68.2% ranges falling between AD 710-800 and median dates falling between AD 745-780 (Figure 3, Table 3). Five samples associated with four distinct architectural units produced dates with modeled 68.2% probability distributions between AD 710-780 (685-820, 95.4%), and this likely accurately represents the age of the most intensive period of occupation. Dates derived from a textile collected from the site's surface (Wendorf 1953:150-153) and a reed suggest continued use of the site during the tenth century (Table 4). This later use of the site appears to have been ephemeral, as no painted ceramic types post-dating AD 850

were reported from Wendorf's extensive excavations, our ceramic recording units, or excavations at AZ Q:1:42 (ASM).

Two specimens, a maize cob fragment from Feature D1 (795-540 BC, 95.4%) and a reed fragment from Feature C (1210-1000 BC, 95.4%), produced dates that were far earlier than expected (Table 4). Feature D1 is a 2.5m deep granary that likely disturbed preceramic cultural deposits when initially built. It is difficult to interpret the significance of the early date on the reed from Feature C, a boulder and sandstone lined surface structure. We find it likely that the specimen is of cultural origin, but another reed collected from the same feature produced the most recent date from the site, contemporary only with the textile fragment collected from the surface. Due to these context concerns and a gap between the two early dates and the two more recent dates compared to the ten others that form a tight cluster, these four dates were not included in our Bayesian model.[3]

Dead Wash South

Dead Wash South is a cluster of dispersed hamlets located on a low ridge overlooking the confluence of the Puerco River and Dead Wash. This community was initially documented by Reed (1947) and Wendorf (1953:19-20) via Mera's 1934 survey collections and later by NPS (Jones 1987:16; Hammack 1979:44; Wells 1994:76), and has long been considered a key loci of Early Pueblo period occupation in the Petrified Forest. Most of these prior efforts considered individual sites as separate occupations, rather than portions of a single community, obscuring its total size. We re-mapped the community and recorded ceramics during 2016-2017.

Most sites in the Dead Wash South community are small, have low artifact densities, and usually lack surface architecture. In-situ architecture is only visible on the two largest sites

within the community. AZ Q:1:81 (ASM) contains a heavily eroded likely jacal roomblock, and AZ Q:1:60 (ASM) has an alignment of slab-lined cists fronted by a possible pithouse and midden (Figure 4). AZ Q:1:81 (ASM) also contains a 22 x 19 meter shallow depression surrounded by a low berm in a prominent location. A dense midden is located just below this depression, and it is possible that this feature is a shallow great kiva or dance court, although we are not confident in this identification without subsurface testing. Ceramics within the community suggest an Early Pueblo period occupation that post-dates Twin Butte. Contemporary sites lacking surface architecture are rare in the Middle Puerco, but have been noted north of the Mogollon Rim, and in the Hardscrabble, and Zuni areas (Martin and Rinaldo 1960; Peeples et al. 2012: Roberts 1931).

Weathertop

The final site targeted for additional recording, Weathertop (PEFO2013A-72), is located on an isolated mesa overlooking the Puerco River. The site contains more than 10 alignments of slab-lined jacal features, each likely associated with one or more pithouses, that are spread over the 32,000 m^2 extent of the mesa (Figure 5). Architecture on the site has been extensively damaged by looting, but consists primarily of contiguous arcing and linear jacal roomblocks that are one or two rooms wide. Linear jacal roomblocks are more typically associated with sites dating to the ninth century in the Western Puerco including Whitewater (Roberts 1939:22, 67), NA 8968/8969 (Gumerman et al. 1982; Throgmorton 2012:112-113), LA 4487 (Sciscenti 1962; Throgmorton 2012:100-104), and NA 14654 (Stebbins et al. 1986:389). The site that Weathertop bears the closest resemblance to, White Mound, is the only well-dated late eighth or early ninth

century site with linear contiguous rooms in the Western Puerco, and it is also located on a mesa overlooking the Puerco River, albeit 30 miles to the east (Ahlstrom 1985:212; Gladwin 1945).

While the far western portion of Weathertop contains a typical Early Pueblo ceramic assemblage, ceramics in the eastern portion of the site and on a smaller mesa located nearby consist exclusively of fine-sand tempered brown ware sherds (Obelisk Utility/Woodruff Brown) with a smaller relative proportion of an early micaceous brown ware, Adamana Brown. Ceramics and architecture on Weathertop indicate a punctuated occupation dating between roughly AD 200-550 and AD 750-900. Unlike Twin Butte and Dead Wash South, Weathertop does not appear to be associated with a larger community. Full coverage survey nearby is minimal, but informal survey by Sinensky of a 1 km radius around Weathertop in 2018 failed to identify any Early Pueblo sites.

Refining Early Pueblo Period Ceramic Dating in the Petrified Forest

A reassessment of Early Pueblo demographic trends in the Western Puerco relies primarily on ceramic dating. As noted above, dating Early Pueblo sites using ceramics has long proven difficult in the Petrified Forest. This has led to numerous sites being assigned to a broad AD 550-950 interval (Mera 1934:7-9; Reed 1947; Stewart 1980:97; Theuer and Reed 2011:115) that is dominated by gray ceramics with coarse sand temper and a smoothed exterior (Lino Gray), and polished, brown ceramics with fine sand temper and that are often smudged (Woodruff Brown) (Hays-Gilpin and van Hartesveldt 1998:122, 139).[4] Here, we first consider the temporal placement of the Early Pueblo communities only within the Petrified Forest, and then more broadly among contemporary sites across the Western Puerco. Only sites with at least 15 identified sherds were included in our assessment, and only sherds from the best available

contexts, for example a discrete temporal component, or the lowest level excavated in a structure were included.

We used two techniques to build our chronology, correspondence analysis (CA) and frequency seriation aided by Ford diagrams. Past applications of correspondence analysis for ceramic seriation in the Southwest have typically used painted types (e.g., Peeples and Schachner 2012). Since much of our period of interest predates the widespread use of painted ceramics, we included non-painted types. Our dataset also incorporates information from projects spanning 80 years, thus we only used broadly recognizable types in order to minimize inter-analyst biases.

Our Petrified Forest focused CA includes counts of 14 ceramic types from 82 sites that date between AD 200-1125 (Figure 6). We include several sites that clearly predate and postdate the Early Pueblo period in order to anchor the axes of the biplot with ceramic data that exhibit little overlap. In Figure 6, the separation of assemblages along the y-axis tracks the relative proportions of plain brown and gray ceramics, while the x-axis tracks the proportion of plain gray and associated early painted and slipped types compared to corrugated and later painted types. The correspondence analysis illustrates that Twin Butte and Weathertop predate the Dead Wash South community, which in turn predates the Early Pueblo period great kiva at Navajo Springs. The later was previously assigned a Pueblo I (AD 700-900) date based on surface ceramics (Hays-Gilpin and van Hartesveldt 1998). While including long lived utility types such as plain brown and gray provided an opportunity to visualize the temporal placement of a broader range of sites, many of which are nearly entirely lacking painted types, it also obscured subtler, yet temporally significant associations between less common types, and therefore did not allow us to divide sets of sites into temporally discrete groups.

Early Pueblo Period Chronology Across the Western Puerco

Next, we examined assemblages from 67 sites located across the Western Puerco, including a subset of the Petrified Forest sites, that were most likely occupied during the Early Pueblo period. This analysis incorporated seven ceramic types, including La Plata Black-on-white and Lino Black-on-white grouped as a single category, Woodruff Red (includes Forestdale Red, see Fowler 1991:134; Hays-Gilpin and van Hartesveldt 1998:152), White Mound Black-on-white, Kiatuthlanna Black-on-white, Red Mesa Black-on-white, and Neck-Banded (also known Kana'a Gray and fillet-neck) (see Hays-Gilpin and van Hartesveldt 1998 for a description of these types). Our refined correspondence analysis divided the sites into three chronological groups (Figure 7, Table 5). These groups follow widely accepted dates for regional ceramics with two caveats. First, our seriation shows a strong relationship between Woodruff Red (plain and smudged) and well-dated types typically found on sites between AD 650-850. Hays-Gilpin and van Hartesveldt (1998:152) do not posit a date range for Woodruff Red, and our seriation suggests that it is a likely indicator of occupation during the initial portion of the Early Pueblo period.[5] Second, our analysis suggests that neck-banded ceramics, despite often being thought of as a shorthand marker for a Pueblo I period (AD 700-900) occupation on the Colorado Plateau, are far more common on sites that post-date AD 950 in the Western Puerco (Fowler 1994:344, 352; Goetze 1994:92; Waterworth 1996:383, 659). The late appearance parallels patterns on Black Mesa, where Nichols (1987:11-12) found that neck-banded ceramics were rare at sites predating AD 900, increased in abundance after AD 940, and then peaked in usage between AD 1000-1020. Proportions of neck-banded then decreased rapidly between AD 1020-1070 as corrugated surface treatments were adopted (see also Ahlstrom 1998:197). Current information

from the Western Puerco and much of northeastern Arizona suggests that unembellished gray ceramics continued to dominate assemblages until after AD 950.

Available chronometric information enables assignment of date ranges to our ceramic groups (Table 5). We find it particularly reassuring that ceramic assemblages from AD 700-850 tree-ring dated contexts in the Middle Puerco, including White Mound (AD 773-803), AZ K:12:8 (AD 730-768), AZ K:12:10 (AD 802-804), and NA 8948 (AD 758), fall into Group A, alongside our AD 700-800 radiocarbon dated contexts from Twin Butte. The discussion below considers the implications of this refined chronology for the Early Pueblo period occupation of Petrified Forest and regional demography across the Western Puerco.

Demography, Aggregation, and Settlement Histories of the Western Puerco

AD 650-850

Our reassessment of the Early Pueblo period in the Petrified Forest allows this poorly understood, yet intensively occupied, area to be integrated into a broader understanding of regional settlement patterns. Researchers have long agreed that the Petrified Forest hosted a higher population density compared to neighboring areas prior to the seventh century (Burton 1991; Greenwald et al. 1993; Reed 1947:208-210; Schachner et al. 2012:109; Wells 1994; Wendorf 1953:19-21; Young and Gilpin 2012:157), and our radiocarbon assay illustrates that the subregion continued to host the largest known community in the Western Puerco during the eighth century as well. This is particularly significant because the height of the Twin Butte occupation coincided with a hiatus in construction activity across the Middle Puerco (Throgmorton 2012:321, 2017:165). This pattern, however, shifted between AD 780-810 with evidence for intensifying construction at White Mound and several nearby hamlets, and took a

dramatic turn from AD 840 forward with a flurry of construction activity at Whitewater and LA 4487 (Figure 8). We find it notable that the peak period of population growth in the Middle Puerco occurred at roughly the same time as, or shortly after, populations departed Twin Butte, a point we return to below.

Additional lines of evidence indicate that Twin Butte likely represents, at least in part, an in-situ social and economic transformation with local groups becoming increasingly sedentary rather than an influx of migrants. Looking only at ceramics data from excavated AD 600-700 sites in the Petrified Forest (Hays 1993; Latady 1991; Leach-Palm 1994), we see a preference for locally made plain brown and brown smudged ceramics that persists through the AD 700-800 occupation at Twin Butte (Supplement 2). In contrast, excavated AD 600-700 contexts in the Middle Puerco (Wasley 1960, Ripey 1969) contained few brown utility or smudged brown ceramics, and all excavated AD 700-800 sites (Ferg 1978:139; Gladwin 1945; Gumerman et al. 1982; Wasley 1960) contained far lower relative proportions of such ceramics compared to contemporary sites in the Petrified Forest. Some degree of cultural continuity between earlier sites in the Petrified Forest area and Twin Butte is also supported by similarities in architectural traditions (see Throgmorton 2012:315) and mortuary practices, particularly at AZ-P-60-31 and Twin Butte (Table 6). While similar mortuary practices appear to have been shared across much of the Petrified Forest and potentially the northern Mogollon Rim area between AD 600-800, such practices are not evident at sites dating between AD 700-900 across the Middle Puerco (see Spurr 2016 for a review of regional Early Pueblo period mortuary practices).

We also suggest that rather than being an anomalous instance of population aggregation that occurred during the AD 700s in response to external events, that Twin Butte fits a long-term trend in the Petrified Forest of persistent places located at prominent points on the landscape.

These places have evidence for consistent and recurrent use by far larger groups of people compared to contemporary sites in the subregion, including dense concentrations of domestic structures and storage features (Hough 1903: 318-319; Gilpin et al. 2000; Schachner and Bernardini 2014). Three prominent examples from the Petrified Forest, Flattop (~AD 200-550, 40+ pithouses), Woodruff Butte (~AD 500-600, 40+ pithouses), and Cottonwood Seep (~AD 600-700, 300+ pithouses), exhibit little evidence of temporal overlap with one another, with Cottonwood Seep largely falling into disuse by the time that Twin Butte was intensively occupied. Woodruff Butte and Twin Butte contain large, butte-top cleared areas potentially used for communal activities, suggesting use of a form of public space that contrasted with that used in contemporary great kiva communities in other regions. The early Petrified Forest community centers also exhibit evidence of decreasing seasonal and residential mobility through time, as the numerous small and shallow residential structures without hearths at Flattop were seasonally occupied during the summer months, the numerous small and shallow residential structures at Cottonwood Seep have hearths but still may have been seasonally occupied (Ahlstrom et al. 1993), and Twin Butte was likely occupied year-round for at least two generations.

Since community centers predating Twin Butte were primarily occupied during the summer, and community members were heavily invested in maize agriculture (Wendorf 1953:60, 72, 74; Ahlstrom et al. 1993), we find it likely that these sites were associated with labor pooling for farming activities at key points in the agricultural cycle. Such strategies are well-documented in ethnographic studies of indigenous mobile farmers in the broader Southwest (Graham 1994), and the importance of labor mobilization for small-scale farmers worldwide has long been noted (Stone et al. 1990). The central role of farming at community centers, however, appears to have continued even after seasonal and short-term mobility decreased, as attested by

the numerous agricultural features in the heart of the site core at Twin Butte. Thus, while Twin Butte bears an undeniable resemblance to early Pueblo I era sites across the northern Southwest, it also appears to be the manifestation of a local tradition with deep roots in the Petrified Forest that incorporated the use of prominent natural points on the landscape, food storage, and farming activities.

AD 850-950

After several hundred years of intensive, recurrent use of prominent high points in the Petrified Forest, the Dead Wash South community represents a sharp transition to a dispersed settlement pattern that remained dominant in the subregion for the next 400 years. The markers of residential stability apparent at Twin Butte, including large above ground storage facilities, deep trash middens, and front-oriented architecture contrast with the rarity of surface storage features, shallow sheet middens and dispersed haphazard site layouts at Dead Wash South. This transition to a more dispersed settlement pattern, however, is not apparent further east in the Western Puerco region, as exemplified by Kiatuthlanna (AD 850-950) an aggregated settlement that lacks a great kiva (Beeson 1966; Roberts 1931; Schachner et al. 2012:104-105, however see Peeples et al. 2012:177), and the Early Pueblo period component at Whitewater Village (AD 840-950), which contains an aggregated settlement and unroofed great kiva/dance plaza (Roberts 1939).

Even though it has been nearly 70 years since Wendorf completed his work in the Petrified Forest, our analysis suggests that he correctly identified a demographic shift to the southeast following the height of Twin Butte occupation (Wendorf 1953:20). Using the ceramic groups identified above, and placing sites into only a single temporal interval, only two sites in

the Hardscrabble area date between AD 650-850, but 27 sites including Kiatuthlanna date between AD 850-950.[6] This compares favorably to previous research that identified an increase in the number of sites in the Hardscrabble area during the shift from the eighth century to the ninth century, while the Petrified Forest appears to be the only portion of the Western Puerco that experiences a dramatic decline (Schachner et al. 2012:119). The Middle Puerco also witnessed a construction boom between AD 840-900, much of this taking place at the first villages in the subregion (Figure 9). We find it likely that the population dispersal from the Petrified Forest subregion contributed in part to the noted demographic increase in the Middle Puerco and the Hardscrabble areas.

While the frequency of residential moves increased in the Petrified Forest during the ninth century, contemporary community centers in the Middle Puerco and Hardscrabble areas display remarkable residential stability and eventually became the locations of great houses during the tenth and eleventh centuries (Peeples et al. 2012:177-178; Throgmorton 2012:326). These settlement patterns contrast rather dramatically with one another, but in each subregion the ninth century represents the point at which local groups established the settlement patterns that remained dominant until the late thirteenth century. To a certain degree, these later contrasting settlement patterns might have enabled one another, as marginalized residents of more populous areas were able to move in and out of the Petrified Forest in response to social and environmental perturbations, and local groups in the Petrified Forest could attract individuals living on the fringes of larger, more stable community centers to the east (Herr 2001; Schachner 2012).

Diverse Paths to Aggregation

Our reassessment of Early Pueblo period demography and settlement patterns across the Western Puerco suggest distinct trajectories for early village development in the Petrified Forest compared to the Middle Puerco and Hardscrabble areas. Moving now to a broader discussion of comparable developments across the northern Southwest, we explore how subregions of the Western Puerco compare to well-documented examples of early village formation in the northern San Juan (Table 7). We briefly juxtapose key elements of this process in each region, including the mechanisms that fostered collective identity and allowed for the integration of non-kin groups, evidence for competition over resources, and violence. In our discussion we distinguish between *first-wave* (AD 700-810) and *second-wave* (AD 810-950) early villages since they exhibit similarities across regional boundaries.

Population Growth

We note similarities between the primary mechanisms driving population growth in the regions that hosted first wave and second wave villages. In the Petrified Forest and the western Mesa Verde region, first-wave villages developed in areas with the greatest population densities during the preceding centuries, and were therefore likely in part local developments (Allison et al. 2012), while in the eastern Mesa Verde, first-wave villages were founded exclusively by recent immigrants (Potter et al. 2012). However, all of these subregions witnessed population dispersals in the early ninth century as former residents helped fuel population growth at second-wave villages in neighboring regions (Wilshusen et al. 2012a). We find it likely that similar developments in the Middle Puerco and Hardscrabble areas in the early to mid ninth century were fueled in part by immigrants from the Petrified Forest. In short, first-wave villages more often arise from in-situ growth, while second wave villages are more strongly linked to

immigration. These contrasting long-term settlement histories are further apparent in the mechanisms that allowed for the integration of non-kin groups in first and second wave villages.

Communal Architecture and Placemaking

In the eastern and western Mesa Verde regions, researchers have identified a close relationship between first-wave villages (circa AD 710-790) and great kivas (Allison et al. 2012; Potter et al. 2012), but the opposite is true at second-wave villages (AD 840-880) in the central Mesa Verde region (Wilshusen et al. 2012a). This pattern has been linked to early transcendent leaders harnessing the power of ritual performance that had a long local history during the founding of the earliest villages, and a transition to villages being the center of such performance and power irrespective of great kivas within only a few generations (Throgmorton 2017; Wilshusen et al. 2012b). In the Petrified Forest, however, a different pattern is apparent. No great kivas are present at Twin Butte or any of the earlier community centers that preceded it, but such structures are associated with the dispersed hamlets that typified settlement in the subregion during the later Chaco era. Smaller integrative structures present at community centers across the northern San Juan that lack great kivas (Allison et al. 2012; Potter and Chupika 2007; Wilshusen 1989) also have not been identified in the Western Puerco, although few structures from this era have been excavated.

Researchers have long seen communal ritual associated with great kivas as a key facet of the development of denser, larger residential communities in the northern Southwest. The long-lived tradition of community centers at butte-top locations in the Petrified Forest provided an alternative foundation for analogous developments. Such placemaking would arguably have depended on an even stronger connection to local landscape as no place-less, constructed

communal features with obvious parallels to those used elsewhere in the northern Southwest were built. Instead, the collective social memory embodied by community centers associated with prominent landscape features provided the necessary foundation to maintain the shared identity of groups with deep roots in the region. Reference to culturally significant landscape features to promote social cohesion in-lieu of communal architecture has been noted in other edge regions of the Southwest (Miller 2018), and we find it likely that this was more typical than currently thought in locations and/or periods where communal architecture was not widespread. Although natural places have often been proposed as nodes of regional interaction and identity linked to ritual activities in the northern Southwest (e.g., Bernardini and Peeples 2015; Schachner 2011), less frequently have they been examined as places of local significance linked directly to habitation or seasonal aggregation for communal farming activities. Cooperative, seasonal farming activities could have served a similar function to communal rituals performed in a constructed space, gathering people together and forging collective identities. Agricultural themes permeate Pueblo ritual practice and cosmology, yet most archaeological examinations of communal ritual focus almost exclusively on social functions, perhaps missing key aspects of the development of ancient practices.

In contrast to both the first-wave Petrified Forest villages and second-wave northern San Juan villages, second-wave villages in the Middle Puerco are closely associated with great kivas during the period of peak population growth (AD 840-900), and this pattern continues between AD 900-1050 with the founding of early great houses on these sites. Here aggregation and communal ritual appears more strongly linked to the long-term development of the Chacoan regional system, and may also have involved migrating groups from the northern San Juan (Throgmorton 2018:183).

Competition, Property Rights, and Violence

Archaeologists studying early village development in the northern San Juan have also argued that population pressure on resources and the resulting competition between households was the underlying mechanism that triggered aggregation (Kohler 2012:256). Moreover, Wilshusen and Potter (2010) suggest that early northern San Juan villages may have been an attempt to formalize property rights and lay claim to resources or productive land (also see Kohler 1992; Schachner 2010). It is important to note that first-wave villages in the northern San Juan did not develop in the more productive central Mesa Verde region, but rather to the east and west. In the Petrified Forest, there was likely no shortage of arable land given the low regional population densities, and it remains unclear why any particular location would have been more productive than others nearby. Instead, second-wave villages in the Western Puerco and northern San Juan are more closely associated with the most productive areas in their respective regions, and this suggests that alternative factors played a more prominent role in first wave village formation.

Wilshusen and Potter (2010) also suggest that the threat of violence may have played a central role in first-wave and second-wave village formation in the northern San Juan, but there are no known instances of violence or defensive features at Early Pueblo sites in the Petrified Forest area. The location of the Twin Butte site core also attests to a lack of concern over violence. Instead of occupying the area atop the western edge of Puerco Ridge located only 100 meters to the east, the core of the site is located just below the ridgetop and would have been an easy target from above. Defensively located Weathertop, which immediately post-dates the height of the Twin Butte occupation and is likely contemporary with similarly located White

Mound, suggests Petrified Forest groups became more concerned with the threat of violence as aggregation increased in the Middle Puerco. The earliest evidence for violence in the Western Puerco occurred 30 years after the founding of second wave villages (Gumerman et al. 1982; Throgmorton 2012:298), and it therefore seems unlikely that violence played a role in the formation of first-wave or second-wave villages in the Western Puerco.

Alternative Models for Initial Village Formation

The lack of fit between these causal factors and the Petrified Forest archaeological record, and a clear distinction between the long-term, gradually developing settlement histories of the Petrified Forest and the boom-and-bust trajectory of northern San Juan between AD 200-800, suggests alternative models of initial village development are needed to explain the formation of early population aggregates in the Petrified Forest region, and much of the western portion of the northern Southwest more broadly. Twin Butte was the endpoint along a trajectory of community centers placed in culturally significant prominent locations in the Petrified Forest. Residents of these centers became increasingly sedentary and less residentially mobile through time. Similar steady, rather than boom-and-bust, trajectories are also evident in the Middle Puerco and Hardscrabble areas and are also comparable to developments noted across much of the Zuni area during this interval (Peeples et al. 2012), albeit with village development shifted later in time and more closely linked to the initial formation of the Chacoan regional system.

Conclusion

Our examination of aggregation, dispersal, and population dynamics during the Early Pueblo period occupation of the Western Puerco region offers an important point of contrast to

patterns among better studied contemporary groups in the northern San Juan. This study suggests that the earliest villages in the Petrified Forest were the result of in-situ population growth and decreasing frequency of residential mobility that slowly unfolded between AD 200-700. During this era, community centers did not have great kivas and future research should consider whether communal rituals were distinct in the region, providing an alternative model for early village life that potentially had parallels in similarly "edge-situated" regions (cf. Miller 2018). The function served by great kivas in the Western Puerco during the ninth and tenth centuries varied considerably as these features are associated with fostering collective identity in socially diverse second-wave villages in the Middle Puerco, and later attracting families to land-rich-labor-poor areas in the Petrified Forest following a transition to an increasingly mobile dispersed settlement pattern (cf. Herr 2001).

The largest and longest-lived population centers in the Western Puerco were later founded during the ninth century in the Hardscrabble and Middle Puerco subregions, and their longevity contrasts with the often short-lived villages in more well-known regions to the north. The long-term, relatively stable settlement history of the Western Puerco may in part explain why the region continued to be occupied through the AD 900s and into the 1200s, while many early villages came to a rapid and abrupt end in the northern San Juan circa AD 900 as part of a longer, boom-and-bust demographic trend in the region. Wilshusen et al. (2012a:28) suggest that "…villages must establish deep rooted social stability and a clearly defined cultural identity if they are to avoid going bust." In the Western Puerco, and particularly the Petrified Forest, deep local settlement histories based on farming and attachment to natural places likely contributed to the process of village formation unfolding in a steadier fashion. As noted previously by one of the current authors and others (Schachner et al. 2012; Young and Gilpin 2012), our improving

understanding of the Early Pueblo period in the western and southern reaches of the Ancestral Pueblo region reveals marked contrasts with models of early village development proposed for the northern San Juan region. These contrasts suggest this era was far more dynamic than often portrayed, with much of the variability in social organization and material culture that characterizes later regional differentiation emerging early in Ancestral Pueblo history.

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Notes

[1] We thank Dennis Gilpin for sharing his personal field notes and helping us track down even the most difficult to find resources.

[2] Wendorf (1953:159) sent the majority of maize specimens from Twin Butte and Flattop to Paul Manglesdorf at Harvard for analysis, but no report was completed. We contacted Dr. Wendorf (in 2012) and numerous museums, but have not been able to locate these specimens. Please contact the authors if you have any information on their location.

[3] Agreement indices (*sensu* Bronk Ramsey 2009) suggest good fit for the ten dates used in the current model (see Supplement 3), but poor fit for Beta-330993 and Beta-331001 when they are included.

[4] Schachner and Bernardini (2014:42-48) submitted 60 sherds from the Twin Butte collections for instrumental neutron activation analysis at the University of Missouri Research Reactor. Woodruff Brown and Red were assigned to a single compositional group, while Lino Gray and White Mound Black-on-white samples were assigned to two additional compositional groups, both distinct from those used for Puerco Valley Brown Wares. Without further sampling of ceramics from this time period, identifying the production locales for these groups is difficult, but we think it is likely that the former and at least one of the latter were manufactured locally.

[5] Wendorf (1953:101) uncovered two Woodruff Red vessels on the floor of Structure F2, a surface room associated with Pithouse F4, which produced two radiocarbon dates of AD 710-780

(68.2%) or AD 685-820 (95.4%). Woodruff Red vessels were also present in two burials at Twin Butte, and a burial at AZ Q:8:47 (ASM), an AD 700-900 pithouse hamlet located 15 miles east of St. Johns, Arizona, that produced a single tree-ring cutting date of AD 721 (Deats 2004:411-422). Woodruff Red is present but relatively uncommon on AD 600-700 sites in the Petrified Forest (Hays 1993; Hays-Gilpin and van Hartesveldt 1998; Latady 1991), yet common at AD 700-900 sites. A production date of AD 550-950 for Woodruff Red is suggested and a peak production date of AD 700-900 seems likely. To our knowledge, Woodruff Red Smudged is not present in the Western Puerco until AD 700 and may be useful in differentiating between AD 550-700 and AD 700-900 sites.

[6] Our low population estimate for the Hardscrabble area between AD 650-850 contrasts with Schachner et al. (2012:118-119) because the previous assessment assigned individual sites to multiple temporal intervals while the current study constrained each site to a single temporal interval, unless multiple temporal components were identified and ceramics from each were recorded separately.

REFERENCES CITED

Ahlstrom, Richard V. N.
1985 An Interpretation of Archaeological Tree-Ring Dates. Ph.D. Dissertation, Department of Anthropology, University of Arizona, Tucson.

1998 Evaluating Ceramic Dating on Black Mesa. In *Archaeological Chronometry: Radiocarbon and Tree-Ring Models and Applications from Northern Black Mesa*, edited by Francis E. Smiley and Richard V. N. Ahlstrom, pp. 175-201. Center for Archaeological Investigations Occasional Paper No. 16. Southern Illinois University, Carbondale.

Ahlstrom, Richard V. N., Marianne Marek and David H. Greenwald (editors)
1993 *The Coronado Project: Settlement Overlooking the Puerco Valley, Arizona*. Anthropological Research Paper No. 3, Vol. 2, SWCA Inc., Environmental Consultants, Flagstaff.

Allison, James R. Winston B. Hurst, Jonathan D. Till, and Donald C. Irwin
2012 Meanwhile in the West: Early Pueblo Communities in Southeastern Utah. In *Crucible of Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by Richard H. Wilshusen, Gregson Schachner, and James R. Allison, pp. 35-52, Cotsen Institute of Archaeology Press, Los Angeles.

Anduze, Richard A., and David H. Greenwald
1994 *Phase II Data Recovery for US West Communications, Inc., at Three Sites in the Interstate 40 Right-of-Way Between Sanders and Chambers, Apache County, Arizona*. Archaeological Report No. 92-78. SWCA Inc., Environmental Consultants, Tucson.

Bannister, Bryant, John W. Hannah, and William J. Robinson
1966 *Tree-Ring Dates from Arizona K: Puerco-Wide Ruin-Ganado Area*. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

Bayliss, Alex
2015 Quality in Bayseian Chronological Models in Archaeology. *World Archaeology* 47:677-700.

Beeson, William J.
1966 Archaeological Survey Near St. Johns, Arizona: A Methodological Study. Ph.D. Dissertation, Department of Anthropology, University of Arizona, Tucson.

Bernardini, Wesley, and Matthew A. Peeples
2015 Sight Communities: The Social Significance of Shared Visual Landmarks. *American Antiquity* 80(2):215-235.

Billman, Brian, and Patricia Ruppe (editors)
1996 *Phase I and Phase II Data Recovery at Four Sites Near the Sanders Rural Community High School, Sanders Arizona*. Report No. 442. Zuni Cultural Resource Enterprise, Zuni, NM.

Breternitz, David A.
1957 Highway Salvage Archaeology by the Museum of Northern Arizona, 1956-57. *Kiva* 23(2):8–17.

Brew, J. O.
1946 *The Archaeology of Alkalai Ridge, Southeastern Utah*. Papers of the Peabody Museum of American Archaeology and Ethnology, Vol. XXI. Harvard University, Cambridge.

Bronk Ramsey, Christopher
2009 Bayesian Analysis of Radiocarbon Dates. *Radiocarbon* 51(1): 337–360.

Burton, Jeffery F.
1991 *The Archeology of Sivu'ovi: The Archaic to Basketmaker Transition at Petrified Forest National Park*. Publications in Anthropology No. 55. Western Archeological and Conservation Center, Tucson.

1993 *Days in the Painted Desert and the Petrified Forest of Northern Arizona: Contributions to the Archeology of Petrified Forest National Park 1988-1992*. Publications in Anthropology No. 62. Western Archeological and Conservation Center, Tucson.

Burton, Jeffery F., Robert M. Cooper, Lynne M. D'Ascenzo and Elaine A. Guthrie
2007 *It's Not Rocket Science: Contributions to the Archeology of Petrified Forest National Park in Honor of Bob Cooper*. Publications in Anthropology No. 100. Western Archaeological and Conservation Center, Tucson.

Corey, Christopher
2008 *Spirit of the Wilderness Survey: Archeological Inventory at Petrified Forest National Park*. Publications in Anthropology No. 105. Western Archeological and Conservation Center, Tucson.

Dosh, Deborah S.
1993 *Archaeological Testing at Twenty Nine Sites within the Proposed Sanders Rural Community Expansion, Apache County, Navajo New Lands, Arizona*. Technical Report No. 19, Kinlani Archaeology, Flagstaff.

Deats, Stewart
2004 Site AZ Q:2:47(ASM). In *Archaeological Excavations in the Carrizo Wash Valley, East-Central Arizona: Data Recovery on the Fence Lake Mine Transportation Corridor*, edited by Dennis Gilpin, David A. Phillips Jr., Jean H. Ballagh, F. Michael O'Hara III., Linda Martin and Lisa Dickerson. Cultural Resources Report No. 03-265. SWCA, Inc., Environmental Consultants, Flagstaff.

Ferg, Alan
1978 *The Painted Cliffs Rest Area: Excavations Along the Rio Puerco, Northeastern Arizona*. Contributions to Highway Salvage Archaeology in Arizona No. 50. Arizona State Museum, Tucson.

Fowler, Andrew P.
1989 *An Archaeological Survey of a Proposed Water Line at Sanders, Apache County, Arizona*. Report No. 292. Zuni Archaeological Program, Zuni, NM.

1991 Brown Ware and Red Ware Pottery: An Anasazi Ceramic Tradition. *Kiva* 56(2):123-144.

1994 Ceramics. In *Excavations at Early Puebloan Sites in the Puerco River Valley: The N-2007 Project*, edited by Mark B. Sant and Marianne Marek, pp. 323–383, Report No. 271. Zuni Archaeology Research Program, Zuni, NM.

Gladwin, Harold S
1945 *The Chaco Branch: Excavations at White Mound and in the Red Mesa Valley*. Medallion Papers No. 33. Gila Pueblo, Globe, Arizona.

Gilpin, Dennis
2003 Chaco-Era Site Clustering and the Concept of Communities. *Kiva* 69(2):171-205.

Gilpin, Dennis and Larry Benallie
2000 Juniper Cove and Early Anasazi Community Structure West of the Chuska Mountains. In *Foundations of Anasazi Culture: The Basketmaker to Pueblo Transition*, edited by Paul F. Reed, pp. 161-174. University of Utah Press, Salt Lake City.

Gilpin, Dennis, James M. Potter and Joshua S. Edwards
2000 *A Cultural Resources Assessment of Woodruff Butte, Navajo County, AZ*. Cultural Resources Report No. 00-30. SWCA, Inc., Environmental Consultants, Flagstaff.

Goetze, Christine E.
1994 Ceramics. In *River, Rain or Ruin: Intermittent Prehistoric Land Use Along the Middle Little Colorado River*, edited by Carla R. Van West, pp. 103–129. Technical Series No. 53. Statistical Research Inc., Tucson.

Graham, Martha
1994 *Mobile Farmers: An Ethnoarchaeological Approach to Settlement Organization Among the Raramuri of Northwestern Mexico*. Ethnoarchaeological Series No. 3. University of Michigan International Monographs in Prehistory, Ann Arbor.

Greenwald, David H., Marianne Marek and Richard V. N. Ahlstrom (editors)
1993 *Anasazi Settlements Overlooking the Puerco Valley*. Anthropological Paper No. 3, Vol. 3. SWCA Inc., Environmental Consultants, Flagstaff.

Gumerman, George J., and Alan P. Olson
1968 Prehistory in the Puerco Valley, Eastern Arizona. *Plateau* 40:113–127.

Gumerman, George J., Sara Stebbins, and Dana Hartman
1982 Archaeological Investigations Along Interstate 40 (Section 4 - Black Creek to Three Hogans) Near Houck, Arizona. Unpublished manuscript on file, Museum of Northern Arizona, Flagstaff.

Hamilton, Derek W., and Anthony M. Krus
2018 The Myths and Realities of Bayesian Chronological Modeling Revealed. *American Antiquity* 83(2):187-203.

Hammack, Nancy S.
1979 *Archeological Road Corridor Survey, Petrified Forest National Park, 1978 and 1979*. National Park Service, Santa Fe.

Harden, Fred
1992 *Archaeological Site Recording of the Navajo Springs Site Complex (AZ P:60:14) and Site AZ P:61:159, Apache County, Arizona*. Report No. 91104. La Plata Archaeological Consultants, Delores, CO.

Haury, Emil W.
1941 *Excavations in the Forestdale Valley, East-Central Arizona*. Bulletin Vol. XI, No. 4. Social Science Bulletin No. 12. University of Arizona, Tucson.

Hays, Kelley A.
1993 Ceramics from the Coronado Project. In *The Coronado Project: Anasazi Settlements Overlooking the Puerco Valley, Arizona*, edited by Richard V. N. Ahlstrom, Marianne Marek, and David H. Greenwald, pp. 11–37. Anthropological Paper No. 3 Vol. 2. SWCA Inc., Environmental Consultants, Flagstaff.

Hays-Gilpin, Kelley A., and Eric van Hartesveldt
1998 *Prehistoric Ceramics of the Puerco Valley*. Ceramic Series No. 7. Museum of Northern Arizona, Flagstaff.

Herr, Sarah A.
2001 *Beyond Chaco: Great Kiva Communities on the Mogollon Rim Frontier* Anthropological Papers No. 66. University of Arizona, Tucson.

Hough, Walter
1903 *Archaeological Field Work in Northeastern Arizona: The Museum-Gates Expedition of 1901*. Smithsonian Institution, Washington, D.C.

Jones, Anne Trinkle
1983 *Patterns of Lithic Use at AZ Q:1:42 Petrified Forest National Park, Arizona: Data Recovery along the Mainline Road*. Publications in Anthropology No. 25. Western Archeological and Conservation Center, Tucson.

1987 *Contributions to the Archeology of Petrified Forest National Park, 1985-1986*. Publications in Anthropology No. 45. Western Archeological and Conservation Center, Tucson.

Kohler, Timothy A.
1992 Fieldhouses, Villages and the Tragedy of the Commons in the Early Northern Anasazi Southwest. *American Antiquity* 57(4):617-635.

2012 The Rise and Collapse of Villages in the Central Mesa Verde Region. In *Emergence and Collapse of Early Villages*, edited by Timothy A. Kohler and Mark D. Varien, pp. 247-262. University of California Press, Berkeley.

Kohler, Timothy A., and Mark D. Varien (editors)
2012 *Emergence and Collapse of Early Villages*. University of California Press, Berkeley.

Kohler, Timothy A. and Mark. D. Varien
2010 A Scale Model of Seven Hundred Years of Farming Settlements in Southwestern Colorado. In *Becoming Villagers: Comparing Early Village Societies*, edited by Matthew S. Bandy and Jake R. Fox, pp. 37-61. University of Arizona Press, Tucson.

Latady, William R.
1991 *Duration, Tempo, and the Archaeological Record: Excavations at Site AZ-P-60-31*. Report No. 316. Zuni Archaeology Program, Zuni, NM.

Lawson, Michael
1991 *An Archaeological Survey of 5.4km of Proposed Boundary Fencing for the Navajo Nation Chambers-Sanders Trust Lands, Apache County, Arizona*. Report No. 313. Zuni Archaeological Program, Zuni, NM.

Leach-Palm, Laura
1994 *Data Recovery of a Basketmaker III Component at Site AZ-P-60-31 Along N- 2015, Apache County, Arizona*. Report No. 422. Zuni Cultural Resource Enterprise, Zuni, NM.

Marek, Marianne, David H. Greenwald, and Richard V.N. Ahlstrom (editors)
1993 *The Coronado Project: Anasazi Settlement Overlooking the Puerco Valley*. Anthropological Research Paper No. 3, Vol.1. SWCA Inc., Environmental Consultants, Flagstaff.

Martin, Paul S.
1939 *Modified Basketmaker Sites in the Ackman-Lowry Area, Southwestern Colorado, 1938*. Anthropological Series Vol. 23, No. 3. Field Museum of Natural History, Chicago.

Martin, Paul S. and John B. Rinaldo
1960 *Excavations in the Upper Little Colorado Drainage, Eastern Arizona*. Fieldiana: Anthropology Vol. 51, No. 1. Field Museum of Natural History, Chicago.

Mera, H. P.
1934 *Observations on the Archaeology of Petrified Forest National Monument*. The Laboratory of Anthropology, Technical Series Bulletin No. 7, Santa Fe.

Miller, Myles R.
2018 A Millennium of Identity Formation and Maintenance in the Jornada Mogollon Region. In *Life Beyond the Boundaries Constructing Identity in Edge Regions of the American Southwest,* edited by Karen G. Harry and Sarah A. Herr, pp. 239-272. University of Colorado Press, Boulder.

Mills, Barbara J.
2007 A Regional Perspective on Ceramics and Zuni Identity, AD 200-1630. In *Zuni Origins: Towards a New Synthesis of Southwestern Archaeology*, edited by David A. Gregory and David R. Wilcox, pp. 210–238. University of Arizona Press, Tucson.

Morris, Earl H.
1939 *Archaeological Studies in the La Plata District, Southwestern Colorado and Northwestern New Mexico*. Publication No. 519. Carnegie Institute, Washington, D.C.

Nichols, Deborah
1987 Dating Methods. In *Prehistoric Settlement Patterns on Northern Black Mesa*, edited by Deborah Nichols, William J. Parry, and Shirley Powell, pp. 4.1-4.37. Unpublished Manuscript on file, Center for Archaeological Investigations, Southern Illinois University, Carbondale.

Peeples, Matthew A., and Gregson Schachner
2012 Refining Correspondence Analysis-Based Ceramic Seriation of Regional Data Sets. *Journal of Archaeological Science* 39(8): 2818–2827.

Peeples, Matthew A., Gregson Schachner, and Edgar K. Huber
2012 Rethinking Pithouse Communities across the Greater Zuni Area. In *Southwestern Pithouse Communities AD 200-900*, edited by Lisa C. Young and Sarah A. Herr, pp. 168–182. University of Arizona Press, Tucson.

Potter, James M. and Jason P. Chupika
2007 Early Pueblo Communities and Cultural Diversity in the Durango Area: Preliminary Results from the Animas-La Plata Project. *Kiva* 72(4):407-430.

Potter, James M., Jason Chupika, and Jerry Fetterman
2012 The Eastern Mesa Verde Region: Migrants, Cultural Diversity, and Violence in the East. In *Crucible of the Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by Richard H. Wilshusen, Gregson Schachner, and James R. Allison, pp. 53-71. Cotsen Institute of Archaeology Press, Los Angeles.

Reed, Erik K.
1947 *Special Report on Review of Archaeological Survey Potsherd Collections, Petrified Forest National Monument*, Arizona. National Park Service, Santa Fe.

Ripey, Charles D.
1969 Further Investigations at NA 10,088: A Basketmaker III Pithouse Village East of Lupton, Arizona: Preliminary Report. Unpublished manuscript on file, Museum of Northern Arizona, Flagstaff.

Roberts, Frank H. H.
1930 *Early Pueblo Ruins in the Piedra District, Southwestern Colorado*. Bureau of American Ethnology Bulletin No. 96, Smithsonian Institution, Washington, D.C.

1931 *The Ruins at Kiatuthlanna, Eastern Arizona*, Bureau of American Ethnology Bulletin No. 100, Smithsonian Institution, Washington, D.C.

1939 *Archaeological Remains in the Whitewater District, Eastern Arizona Part I, House Types*. Bureau of American Ethnology Bulletin, No. 121. Smithsonian Institution, Washington, D.C.

1940 *Archaeological Remains in the Whitewater District, Eastern Arizona Part II, Artifacts and Burials*. Bureau of American Ethnology Bulletin No. 126. Smithsonian Institution, Washington, D.C.

Sant, Mark B., and Marianne Marek
1994 *Excavations at Early Pueblo Sites in the Puerco River Valley, Arizona: The N-2007 Project*. Zuni Archaeology Program Report No. 271, Zuni, NM.

Schachner, Gregson
2010 Corporate Group Formation and Differentiation in Early Pueblo Villages of the American Southwest. *American Antiquity* 75(3):473-496.

Schachner, Gregson
2011 Ritual Places and Landscapes: Connecting Southwest Peoples across Time and Space. In *Movement, Connectivity, and Landscape Change in the Ancient Southwest*, edited by M.C. Nelson and C. Strawhacker, pp. 423-441. University Press of Colorado, Boulder.

Schachner, Gregson
2012 *Population Circulation and the Transformation of Ancient Zuni Communities*. University of Arizona Press, Tucson.

Schachner, Gregson, and Wesley R. Bernardini
2014 Archaeological Mapping and Sciences at Twin Butte (AZ Q:1:3 (ASM), NA5065) and Black Axe (AZ Q:1:320 (ASM), NA1021, 1022), Petrified Forest National Park, Arizona. Unpublished Manuscript on file, Petrified Forest National Park.

Schachner, Gregson, Dennis Gilpin, and Matthew A. Peeples
2012 Alternative Trajectories During the Early Pueblo Period in the Little Colorado Drainage and Beyond. In *Crucible of the Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by Richard H. Wilshusen, Gregson Schachner, and James R. Allison, pp. 101–126. Cotsen Institute of Archaeology Press, Los Angeles.

Sciscenti, James V.
1962 *The Manuelito Project: Archaeological Salvage Excavations on Interstate 40*. Note 14. Laboratory of Anthropology, Santa Fe.

Spurr, Kimberly
2016 Osteological Documentation of Human Remains from the Beethoven Site, AZ P:8:65 (ASM). In *Settlement Dynamics on a Transitional Landscape: Investigations of Cultural Resources for State Route 77-Snowflake Passing Lanes Project, Navajo County, Arizona*, edited by Sarah A. Herr, pp. 187-199. Technical Report 2010-01, Desert Archaeology, Inc., Tucson.

Stebbins, Sara T., Dana Hartman, and Steven G. Dosh (editors)
1986 *The Coronado Project Archaeological Investigations, Studies along the Coal Haul Railroad Corridor*. Coronado Series 8, MNA Research Paper No. 32.

Stewart, Yvonne G.
1980 *An Archaeological Overview of Petrified Forest National Park*. Western Archeological and Conservation Center, Publications in Anthropology No. 10, Tucson.

Stone, Glenn Davis, Robert McC. Netting and Priscilla Stone
1990 Seasonality, Labor Scheduling and Agricultural Intensification in the Nigerian Savanna. *American Anthropologist* 92(1):7-23.

Swarthout, Jeanne, and Alan Dulaney
1982 *The Coronado Project Archaeological Investigations: A Description of Ceramic Collections from the Railroad and Transmission Line Corridors*. Coronado Series No. 5, MNA Research Paper No. 26.

Theuer, Jason G., and Paul F. Reed
2011 Overview and Assessment of Archaeological Resources for Petrified Forest National Park, Arizona. Unpublished Manuscript on file, Petrified Forest National Park.

Throgmorton, Kellam J.
2012 Pit House Architecture in the Puerco Valley AD 600-900: Form, Function, and Cultural Identity. M.A. Thesis, Department of Anthropology, University of Colorado, Boulder.

2017 Vernacular Architecture in the Chaco World. In *Vernacular Architecture in the Pre-Columbian Americas*, edited by Christina P. Halperin and Lauren E. Schwartz, pp. 186-212. Routledge, New York.

2018 Architectural Traditions in the Early Pueblo Period Puerco Valley. In *Life Beyond the Boundaries: Constructing Identity in Edge Regions of the North American Southwest*, edited by Karen G. Harry and Sarah A. Herr, pp. 157-194. University Press of Colorado, Boulder.

Van West, Carla R. (editor)
1994 *River Rain or Ruin: Intermittent Prehistoric Land Use Along the Middle Little Colorado River*. Technical Series No. 53. Statistical Research Inc., Tucson.

Varien, Mark D.
1999 *Sedentism and Mobility in a Social Landscape: Mesa Verde and Beyond*. University of Arizona Press, Tucson.

Wasley, William W.
1960 Salvage Archaeology on Highway 66 in Eastern Arizona. *American Antiquity* 26(1):30–42.

Waterworth, Robert
1996 Ceramic Artifact Analysis. In *Phase I and II Data Recovery at Four Sites Near the Sanders Rural Community High School, Sanders, Arizona*, edited by Brian Billman and Patricia A. Ruppe, pp. 375–411. Report No. 442. Zuni Cultural Resources Enterprise, Zuni, NM.

Wells, Susan J.
1988 *Archeological Survey and Testing at Petrified Forest National Park, 1987*. Publications in Anthropology No. 48. Western Archeological and Conservation Center, Tucson.

1994 Settlement and Environment at Petrified Forest National Park, Homolovi Ruins State Park and the Southwest Hopi Buttes: A Comparison. In *Middle Little Colorado Archaeology: From Parks to the People*, edited by Trinkle A. Jones and Martyn D. Tagg. Arizona Archaeologist No. 27. Arizona Archaeological Society, Phoenix.

Wendorf, Fred
1953 *Archaeological Studies in the Petrified Forest National Monument*. Museum of Northern Arizona Bulletin 27. Northern Arizona Society of Science and Art, Flagstaff.

Wilshusen, Richard H.
1989 Unstuffing the Estufa: Ritual Floor Features in Anasazi Pit Structures and Pueblo Kivas. In *The Architecture of Social Integration in Prehistoric Pueblos*, edited by William D. Lipe and Michelle Hegmon, pp. 89-111. Crow Canyon Archaeological Center, Cortez, CO.

1991 Early Villages in the American Southwest: Cross-Cultural and Archaeological Perspectives. Ph.D. Dissertation, Department of Anthropology, University of Colorado, Boulder.

Wilshusen, Richard H., and Scott G. Ortman
1999 Rethinking the Pueblo I Period in the San Juan Drainage: Aggregation, Migration and Cultural Diversity. *Kiva* 64(3):369–399.

Wilshusen, Richard. H., and James M. Potter
2010 The Emergence of Early Villages in the American Southwest: Cultural Issues and Historical Perspectives. In *Becoming Villagers: Comparing Early Village Societies*, edited by, Matthew S. Bandy and Jake R. Fox, pp. 165–183. University of Arizona Press, Tucson.

Wilshusen, Richard H., Scott G. Ortman, Shanna Diedrichs, Donna M. Glowacki, and Grant Coffey
2012a Heartland of the Early Pueblos: The Central Mesa Verde Region. In *Crucible of the Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by Richard H. Wilshusen, Gregson Schachner, and James R. Allison, pp. 14–34. Cotsen Institute of Archaeology Press, Los Angeles.

Wilshusen, Richard H., Scott G. Ortman, and Elizabeth M. Perry
2012b Processions, Leaders, and Gathering Places: Changes in Early Pueblo Community Organization as Seen in Architecture, Rock Art, and Language. In *Crucible of the Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by Richard H. Wilshusen, Gregson Schachner, and James R. Allison, pp. 198–218. Cotsen Institute of Archaeology Press, Los Angeles.

Young, Lisa C. and Dennis Gilpin
2012 Before Chaco: Pithouse Communities on the Southern Colorado Plateau (AD 200-850). In *Southwestern Pithouse Communities, AD 200-900*, edited by Lisa C. Young, and Sarah A. Herr, pp. 155-167. University of Arizona Press, Tucson.

Figure Captions

Figure 1. Early Pueblo period sites of the Western Puerco. Descriptions of the numbered sites are provided in Table 1.

Figure 2. Map of the Twin Butte site core and adjacent loci. Features, loci, and excavation units with high-quality radiocarbon dates or ceramic recording units are labeled. Additional maps including a site overview, a community overview, and detail maps of Twin Butte loci are available in Supplement 1.

Figure 3. An unconstrained uniform phase Bayesian model of the Early Pueblo occupation at Twin Butte. Light gray outlines show unmodeled calibrated dates (prior), and the darker gray shows the modeled posterior. One-sigma (68.2%) and two-sigma (95.4%) ranges and median dates are displayed below each date. Additional details (*sensu* Bayliss 2015; Hamilton and Krus 2018) and the code used to create this figure are available in Supplement 3.

Figure 4. Map of the Dead Wash South community with insets of the two largest sites. Full site numbers are AZ Q:1:___ (ASM).

Figure 5. Map of PEFO2013A-72, Weathertop. Ceramic counts are available in Supplement 2.

Figure 6. Correspondence analysis of 14 ceramic types from 82 Petrified Forest sites dating between AD 200-1125.

Figure 7. Ceramic seriation of Early Pueblo period sites in the Western Puerco; (a) correspondence analysis of seven ceramic types from 67 sites; (b) Ford diagram showing the mean percentages of the types assigned to each ceramic group. Gray bars display mean counts of types and black bars represent 95% confidence intervals.

Figure 8. Cutting and near cutting tree-ring dates from Early Pueblo period sites in the Middle Puerco and radiocarbon dates from Twin Butte. Radiocarbon dates are displayed by plotting the earliest and most recent date of the 68.2% range of each modeled date. Tree-ring data are from Ahlstrom (1985), Bannister et al. (1966), and Gumerman et al. (1982).

Figure 9. Cutting and near cutting tree-ring dates from Early Pueblo sites in the Middle Puerco. In order to minimize the bias of individual features with numerous dates from a particular year, only a single date per calendar year per feature is included. All data are from Ahlstrom (1985) and Bannister et al. (1966).

Table 1. Significant Early Pueblo Period Sites in the Western Puerco.

#	Site Name/ Number	Primary/ Maximum Occupation Span (AD)	Chrono-metric Data	Size (m^2)	Surface Room Count	Room-block Count	Pithouse Count
1	Twin Butte[a, b]	700-800, 650-950	^{14}C maize, ceramics	780k	200-400	40-60	50-120
1	Twin Butte Community[a-i]	700-800, 650-950	ceramics, architecture	4.17 (km^2)	65-100	20-35	45-90
2	Dead Wash[a, g-i] South Comm.	850-950, 850-1125	ceramics, architecture	120k	6	1	10-25
3	Weathertop Late[a]	750-900, 700-950	ceramics, architecture	32k	50-110	5-12	5-25
4	Cottonwood Seep/South[j-l]	575-700, 400-700	^{14}C wood, ceramics	600k	N/A	N/A	300+
5	AZ-P-60-31/ NA 20801[m]	650-700, 600-700	^{14}C wood, ceramics	900k	N/A	N/A	100+
6	Navajo Springs Great Kiva[n]	900-1050, 850-1200	ceramics	190k	-	5-14	5-20
7	NA 14654[o-p]	850-950, 850-1050	ceramics, architecture	15k	20	2	10
8	Kiatuthlanna[q-s]	850-950, 750-1100	ceramics, architecture	650k	-	-	100+
9	White Mound[t-u]	775-825, 745-1050	tree-ring, ceramics	30k	80	8	24
10	White-water[t, v]	840-1050, 810-1050	tree-ring	70k	35+	5+	24+

Note: Pithouse counts from Twin Butte and the surrounding community are derived from pithouses and likely pithouses visible on the modern ground surface and the expectation that each roomblock or non-contiguous arc of storage structures is associated with at least a single pithouse. The upper end of the estimate projects an average of *two* pithouses per roomblock/non-contiguous arc. Our pithouse counts do *not* consider superimposed structures, which Wendorf encountered during excavations. Excavations at other sizable Early Pueblo era sites in the Western Puerco such as White Mound (three pithouses per roomblock) and NA 14654 (3-4 pithouses per roomblock) suggest that two pithouses per roomblock might be a conservative estimate.

[a]Current project; [b]Schachner and Bernardini 2014; [c]Unpublished NPS survey PEFO1998B; [d]Burton 1993; [e]Burton et al. 2007; [f]Corey 2008; [g]Hammack 1979; [h]Jones 1987; [i]Mera 1934; [j]Hays 1993; [k]Marek et al. 1993; [l]Site size estimate assuming area between NA 14674, 14675, 14767 and 14771 contains contemporary features; [m]Latady 1991; Leach-Palm 1994; [n]Harden 1992; [o]MNA Site Files; [p]Stebins et al. 1986; [q]Beeson 1966; [r]Roberts 1931; [s]Estimate based on Beeson's descriptions and considering AZ Q:3:1(ASM) and AZ Q:3:73(ASM) as a single site; [t]Bannister et al. 1966; [u]Gladwin 1945; Throgmorton (personal communication, 2018) noted 5 additional PI units at the site distinct from the three excavated by Gladwin; the listed number of surface rooms and pithouses assumes each additional unit contains similar counts of pithouses and surface rooms to those excavated by Gladwin; [v]Roberts 1939; site size estimate assuming area between Group 1 and Group 2 contains contemporary features.

Table 2. Western Puerco Projects with Sizable Early Pueblo Components.

Project	Location	References
Kiatuthlanna	Hardscrabble	Roberts 1931
Whitewater	Middle Puerco	Roberts 1939, 1940
White Mound	Middle Puerco	Gladwin 1945
NPS Survey and Test Excavations[a]	Petrified Forest	Burton 1993; Burton et al. 2007; Corey 2008; Hammack 1979; Jones 1983, 1987; Mera 1934; Reed 1947; Wells 1988; Crystal Forest Inventory Survey (PEFO1998-B, unpublished)
Twin Butte	Petrified Forest	Schachner and Bernardini 2014; Wendorf 1953[b]
I-40 Salvage	Middle Puerco	Ferg 1978; Gumerman and Olson 1968[b], Gumerman et al. 1982[b]; Sciscenti 1962; Wasley 1960[c]
Dissertation/ Thesis	Hardscrabble, Middle Puerco, Petrified Forest	Beeson 1966; Throgmorton 2012
Coronado Project	Petrified Forest, Hardscrabble	Ahlstrom et al. 1993; Greenwald et al. 1993; Marek et al. 1993; Stebbins et al. 1986[b]
Chambers-Sanders Trust Lands	Middle Puerco, Petrified Forest	Billman and Ruppe 1996; Dosh 1993; Fowler 1989; Harden 1992; Latady 1991; Lawson 1991; Leach-Palm 1994; Sant and Marek 1994
Other Contract Projects	Middle Puerco, Petrified Forest, Hardscrabble	Anduze and Greenwald 1994; Breternitz 1957; Ripey 1969[b]; Van West 1994

[a]Includes data from survey on file with Petrified Forest National Park.
[b]Includes data from excavation and analysis notes on file with the Museum of Northern Arizona.
[c]Includes data from excavation and analysis notes on file with the Arizona State Museum.

Table 3. Modeled Early Pueblo AMS ^{14}C Dates from Twin Butte.

Sample Number/Context	Context Description	Material Type	68.2% (AD)	95.4% (AD)	Median (AD)
Start of Primary Occupation	-	-	*680-740*	*655-770*	*710*
Beta-330991, Feature D1	slab/masonry granary	*Zea mays*	710-770	685-775	745
UCI-196520, Feature E2[a]	jacal pit-room	*Zea mays*	710-770	685-770	745
Beta-330995, Strat Test 2	Wendorf's screened test unit	*Zea mays*	720-770	685-780	740
Beta-330996, Strat Test 2	Wendorf's screened test unit	*Zea mays*	715-775	685-815	740
Beta-330999, Feature F4	pithouse	Grass stem[b]	710-780	685-820	740
Beta-331000, Feature F4	pithouse	Grass stem[b]	710-780	685-820	740
UCI-196519, Feature U1[a]	masonry- walled structure	*Phaseolous vulgaris*	720-780	690-820	735
Beta-330998, ST1/ST2	Wendorf's screened test unit	*Zea mays*	710-785	690-830	745
Beta-330994, Strat Test 2	Wendorf's screened test unit	*Zea mays*	720-800	700-855	775
Beta 330997, Strat Test 2	Wendorf's screened test unit	*Zea mays*	720-800	710-850	780
End of Primary Occupation	-	-	*730-830*	*720-885*	*795*

Note: Files with uncalibrated, calibrated, and modeled dates, and code used in Oxcal v4.3.2 are available in Supplement 3.

[a]Feature numbers designated by the current project, all others designated by Wendorf.

[b]Wendorf called these specimens "cane fragments".

Table 4. Calibrated AMS ^{14}C Dates from Twin Butte not Included in the Bayesian Model.

Sample Number	Feature Number/ Type	Material Type	68.2%	95.4%	Median
Beta-33100	surface find	looped bag[a]	AD 895-980	AD 875-1015	AD 935
Beta-330993	Feature C jacal pit room	reed[b]	AD 895-980	AD 875-1015	AD 935
Beta-330992	Feature D1 deep granary	*Zea mays*	775-555 BC	795-540 BC	640 BC
Beta-331992	Feature C jacal pit room	reed[b]	1125-1020 BC	1210-1000 BC	1085 BC

Note: All dates calibrated using the IntCal13 atmospheric curve on the OxCal v.4.3.2 software. Additional information available in Supplement 3.
[a]See Wendorf (1953:150-153).
[b]Wendorf identified these specimens as reeds.

Table 5. Early Pueblo Period Ceramic Groups Derived from Correspondence Analysis.

Ceramic Group	Ceramic Types	Date	Number of Sites	Significant Sites
A	White Mound, Lino/La Plata, Woodruff Red	AD 650-850	18	Weathertop[a], Twin Butte[c], White Mound[d], Green Bear, AZ K:12:8[e], AZ K:12:10[f], NA 8948[g]
B	Kiatuthlanna, White Mound, Red Mesa	AD 850-950	32	Dead Wash South, Kiatuthlanna, NA 14654
C	Red Mesa, Neck-banded, Kiatuthlanna	AD 950-1050	17	Navajo Springs Great Kiva[b], Archer Site[b, h], AZ K:14:24[b] AZ-P-54-9[b], AZ-P-54-11[b]

[a]Late component; [b]Early Component; [c]AMS radiocarbon AD 700-800 (current study); [d]Cutting and near cutting dates AD 765-803 (Bannister et al. 1966); [e]Cutting and near cutting dates AD 730-765 (Bannister et al. 1966); [f]Cutting and near cutting dates AD 802-804 (Bannister et al. 1966); [g]Cutting date AD 758 (Gumerman et al. 1982; Throgmorton 2012:95); [h]Conventional & AMS radiocarbon dates on wood charcoal and *Zea mays*, AD 950-1040 (Van West 1994:249).

Table 6. Mortuary Artifacts from Early Pueblo Sites in the Western Puerco and Northern Mogollon Rim.

Site	Region	Date (AD)	# of Burials	Mean Vessel Count	Pct. w/ Vessels	Max Vessel Count	Pct. w/ Smgd. Bowl	Pct. w/ Shell Ornament
Twin Butte[a]	Petrified Forest	700-800	8	3.63	87.5%	10	87.5%	87.5%
AZ-P-60-31[b]	Petrified Forest	650-700	9	2.75	77.8%	5	77.8%	44%
Bear Ruin[c]	Mogollon Rim	650-750	40	-	87.5%	17	most	5%
AZ Q:8:47[d]	Mogollon Rim	700-900	7	1.14	85.7%	2	42.9%	28.6%
CW Seep[e]	Petrified Forest	600-700	14	0.07	7.1%	2	0%	0%
All sites[f]	Middle Puerco	700-950	24	0.21	16.7%	2	0%	4.2%
White Mound[g]	Middle Puerco	750-850	33	-	few	-	few	few
NA 14654[h]	Hardscrabble	850-950	5	3.6	80.0%	14	20%	20%
Kiatut-hlanna[i]	Hardscrabble	850-950	-	-	most	-	most	occasional

Note: Only data from primary internments are included. Nearly all burials are flexed, supine, with variable head orientation.

[a]Wendorf 1953; [b]Latady 1991; Leach-Palm 1994; [c]Haury 1941; [d]Deats 2004; [e]Ahlstrom et al. 1993; [f]Data are from the following sites and sources: AZ K:15:14 (Anduze and Greenwald 1994), AZ-P-54-9 (Billman and Ruppe 1996), Green Bear (Ferg 1978), NA 8939, NA 8942, NA 8944, NA 8968, NA 8969, NA 8973 (Gumerman et al. 1982); [g]Gladwin 1945; [h]Stebbins et al. 1986; [i]Roberts 1931.

Table 7. Key Attributes of Early Village Development in the Northern San Juan and the Western Puerco.

Region	Village Type	Interval as Regional Population Center	Population Growth	Integrative Mechanism	Population Pressure	Violence
WMV	first-wave	AD 600-810	in-situ/ migration	local/non-local	moderate	unknown
EMV	first-wave	AD 700-810	migration	non-local	moderate	high
PEFO	first-wave	AD 200-810	in-situ	local	low	none
CMV	second-wave	AD 810-880	migration	local/non-local	high	moderate
MP	second-wave	AD 840-1275	in-situ/ migration	non-local	moderate	low
HS	second-wave	AD 840- 1050	in-situ/ migration	unknown	moderate	unknown

Note: WMV = Western Mesa Verde, EMV = Eastern Mesa Verde, PEFO = Petrified Forest, CMV = Central Mesa Verde, MP = Middle Puerco, HS = Hardscrabble.

Figure 1.

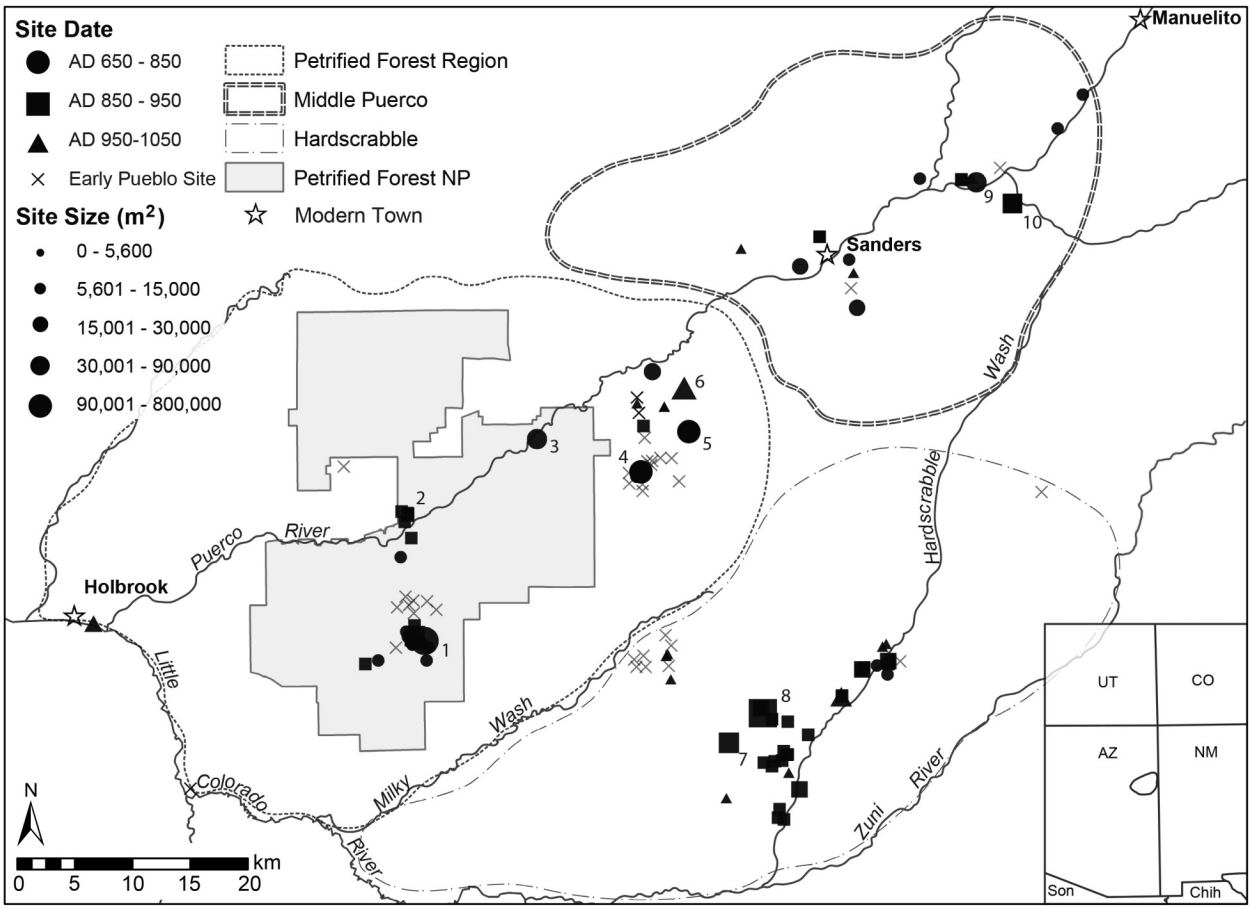

Site Date
AD 650 - 850
AD 850 - 950
AD 950-1050
Early Pueblo Site
Site Size (m²)
0 - 5,600
5,601 - 15,000
15,001 - 30,000
30,001 - 90,000
90,001 - 800,000
Petrified Forest Region
Middle Puerco
Hardscrabble
Petrified Forest NP
Modern Town
Manuelito
Sanders
Holbrook
Puerco River
Little Colorado River
Milky Wash
Wash
Hardscrabble Wash
Zuni River
1
2
3
4
5
6
7
8
9
10
N
0 5 10 15 20 km
UT
CO
AZ
NM
Son
Chih

Figure 2.

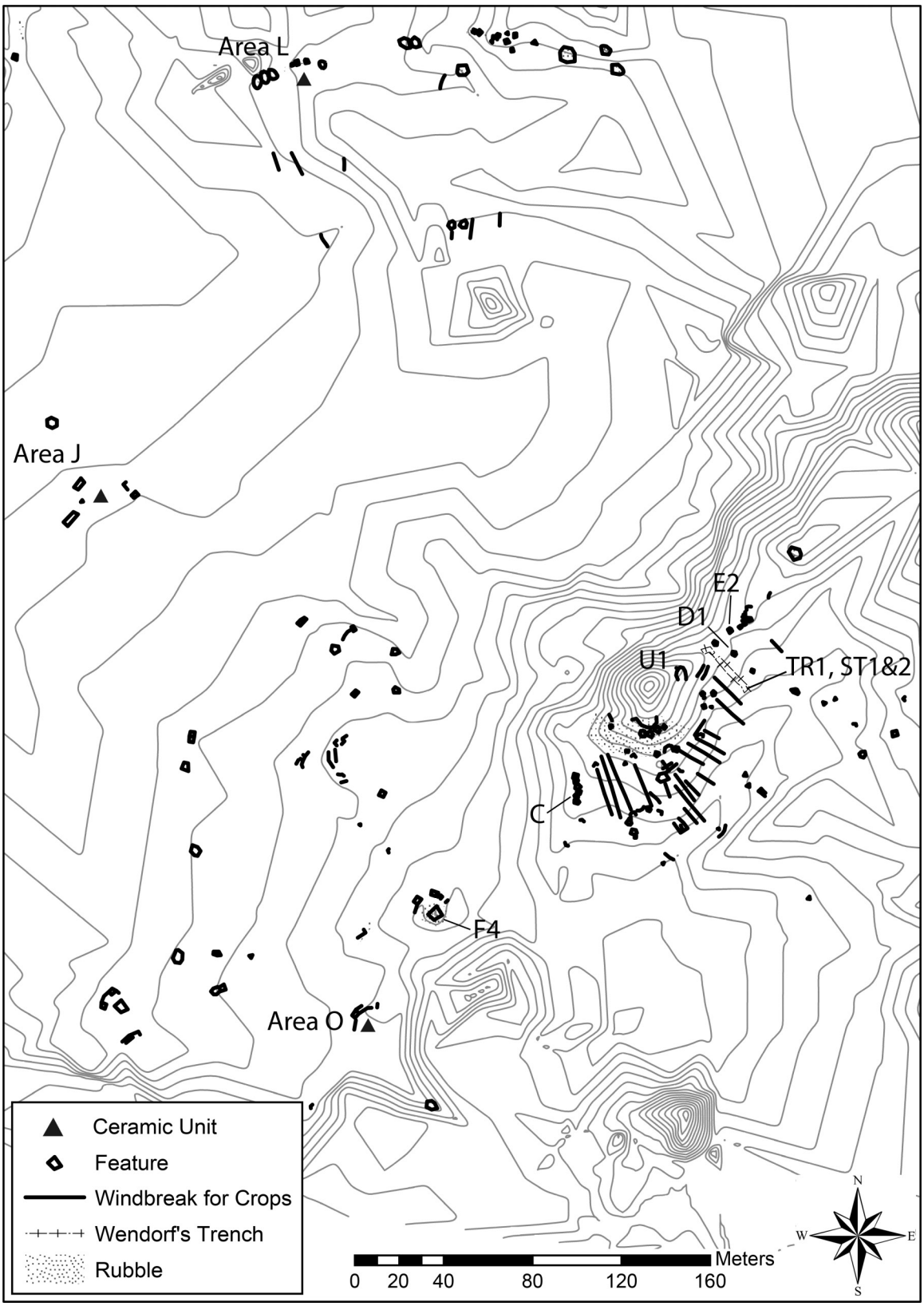

Area L
Area J
Area O
E2
D1
U1
TR1, ST1&2
C
F4
Ceramic Unit
Feature
Windbreak for Crops
Wendorf's Trench
Rubble
0 20 40 80 120 160
Meters
N
W
E
S

Figure 3.

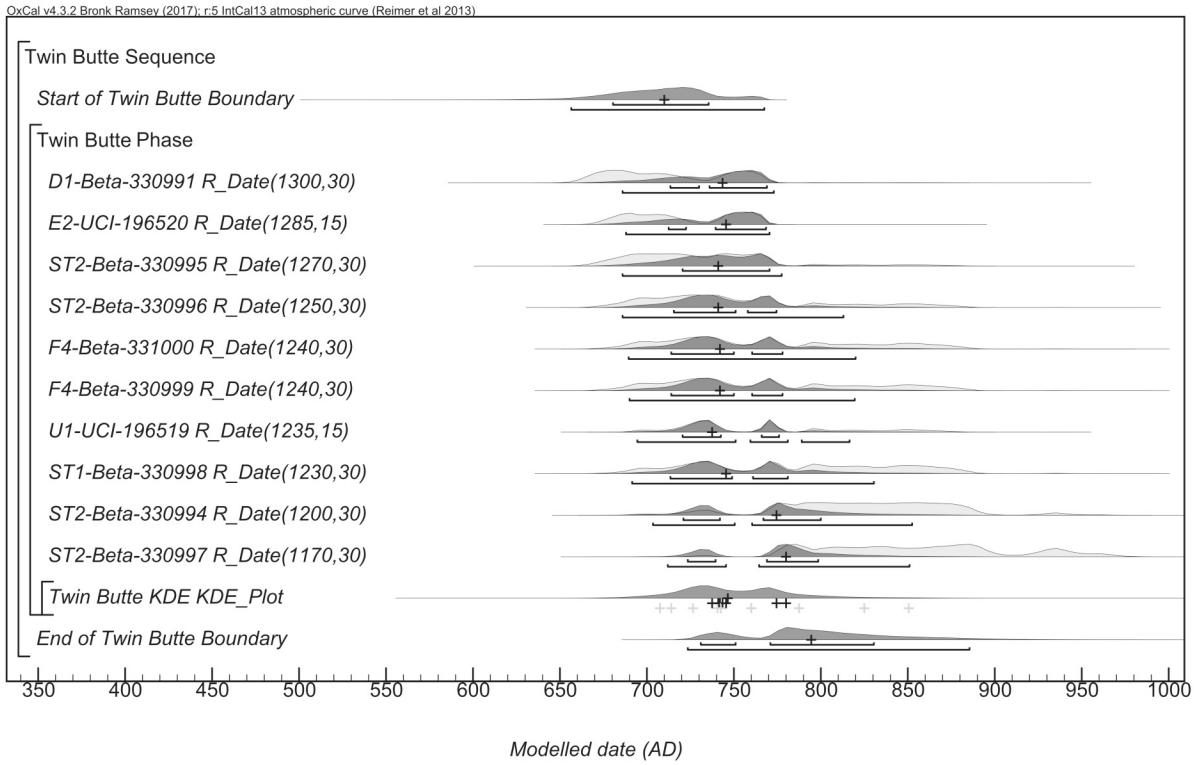

OxCal v4.3.2 Bronk Ramsey (2017); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
Twin Butte Sequence
Start of Twin Butte Boundary
Twin Butte Phase
D1-Beta-330991 R_Date(1300,30)
E2-UCI-196520 R_Date(1285,15)
ST2-Beta-330995 R_Date(1270,30)
ST2-Beta-330996 R_Date(1250,30)
F4-Beta-331000 R_Date(1240,30)
F4-Beta-330999 R_Date(1240,30)
U1-UCI-196519 R_Date(1235,15)
ST1-Beta-330998 R_Date(1230,30)
ST2-Beta-330994 R_Date(1200,30)
ST2-Beta-330997 R_Date(1170,30)
Twin Butte KDE KDE_Plot
End of Twin Butte Boundary
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
Modelled date (AD)

Figure 4.

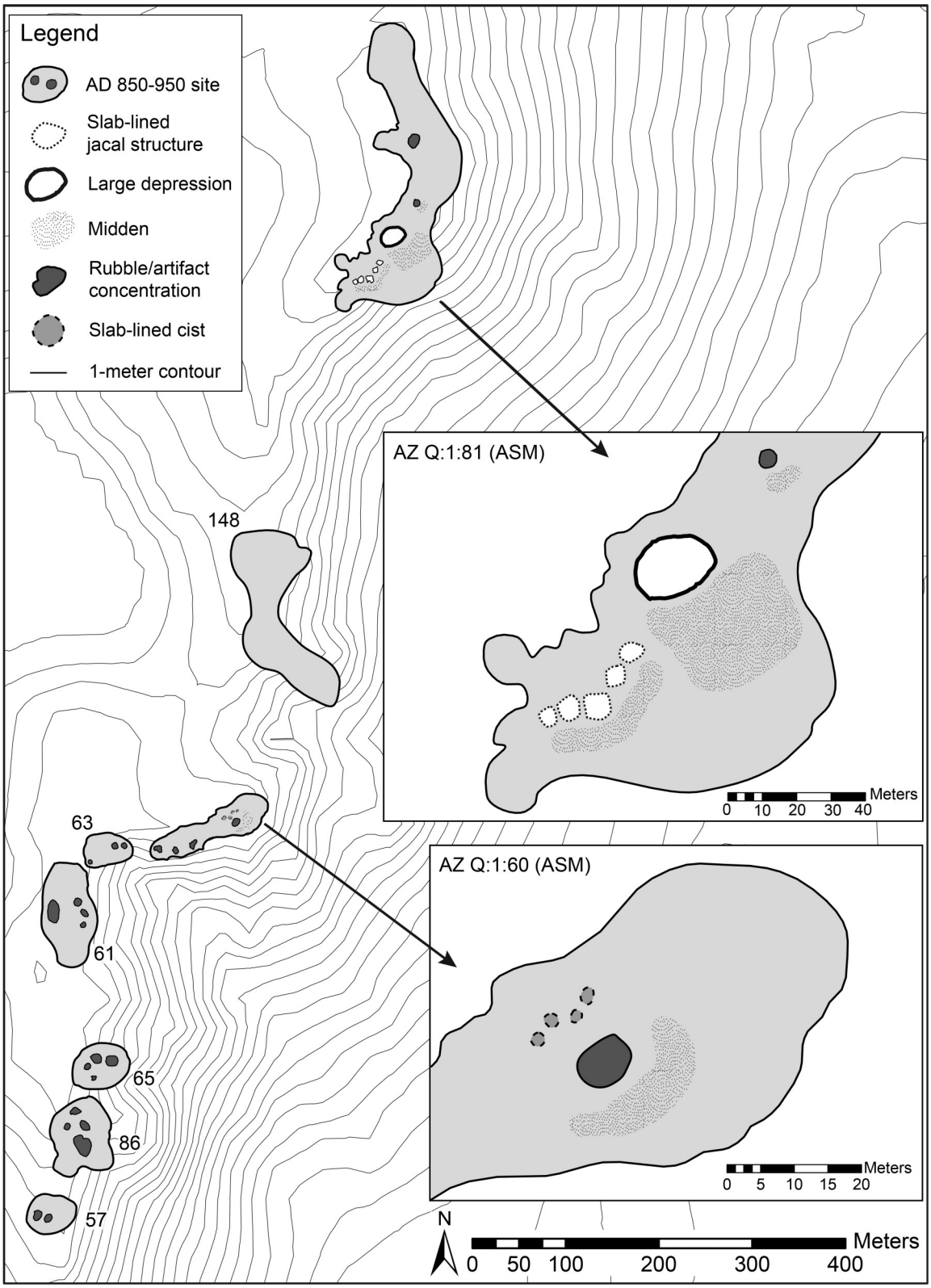

Legend
AD 850-950 site
Slab-lined jacal structure
Large depression
Midden
Rubble/artifact concentration
Slab-lined cist
1-meter contour
AZ Q:1:81 (ASM)
Meters
0 10 20 30 40
AZ Q:1:60 (ASM)
Meters
0 5 10 15 20
148
63
61
65
86
57
N
Meters
0 50 100 200 300 400

Figure 5.

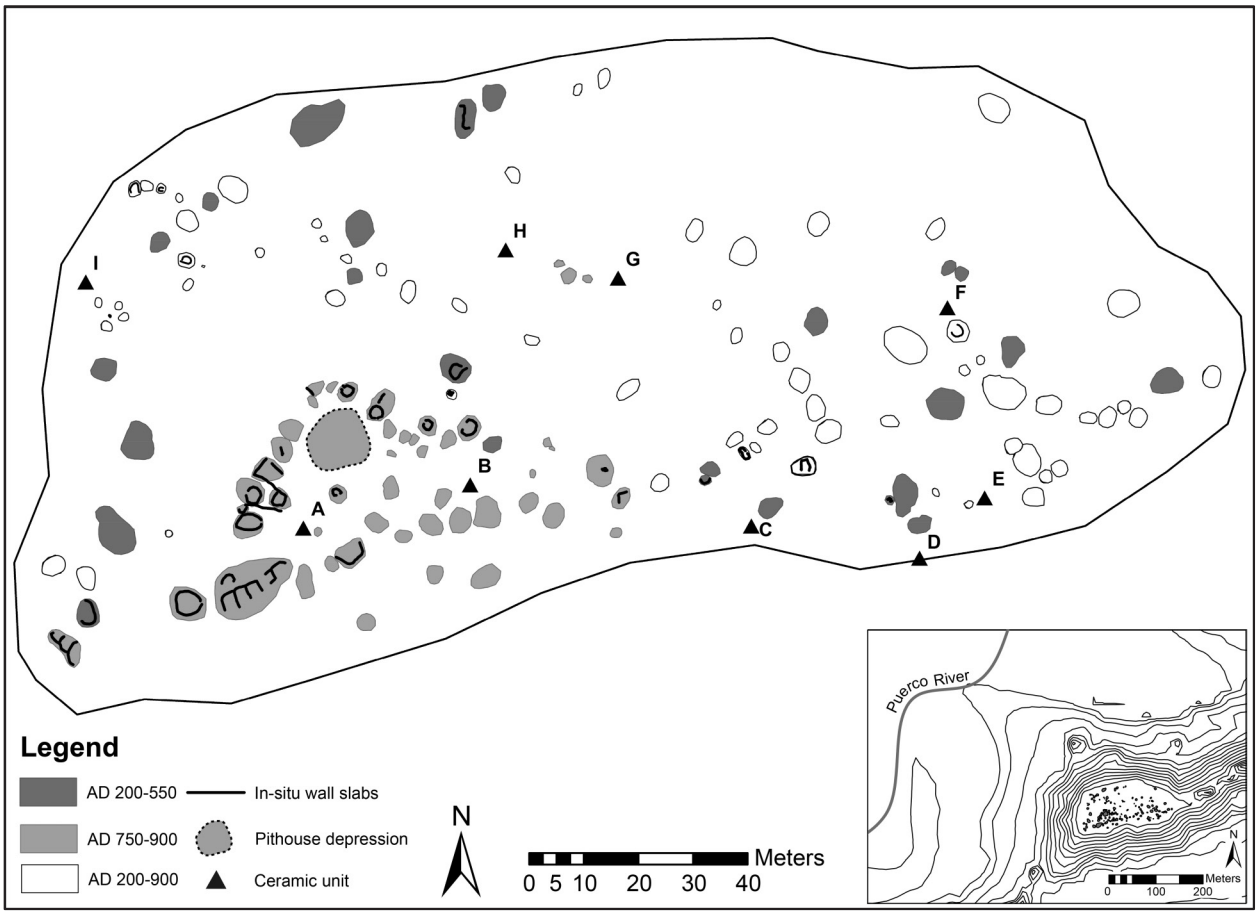

I
H
G
F
B
A
C
E
D
Puerco River
Legend
AD 200-550
In-situ wall slabs
AD 750-900
Pithouse depression
AD 200-900
Ceramic unit
N
0 5 10 20 30 40
Meters
N
0 100 200
Meters

Figure 6.

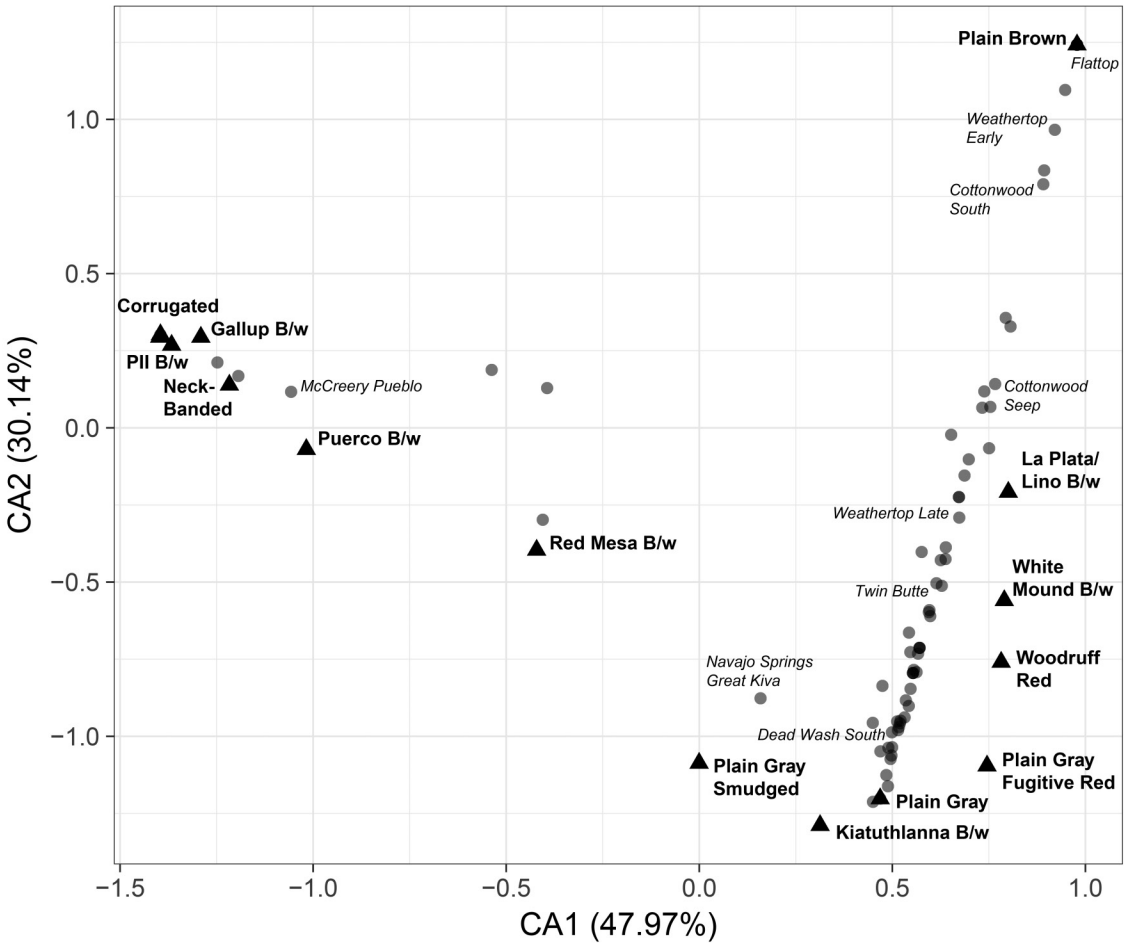

Plain Brown
Flattop
Weathertop Early
Cottonwood South
Corrugated
Gallup B/w
PII B/w
Neck-Banded
McCreery Pueblo
Puerco B/w
Red Mesa B/w
Cottonwood Seep
La Plata/ Lino B/w
Weathertop Late
White Mound B/w
Twin Butte
Navajo Springs Great Kiva
Woodruff Red
Dead Wash South
Plain Gray Smudged
Plain Gray Fugitive Red
Plain Gray
Kiatuthlanna B/w
CA2 (30.14%)
CA1 (47.97%)
1.0
0.5
0.0
−0.5
−1.0
−1.5
−1.0
−0.5
0.0
0.5
1.0

Figure 7.

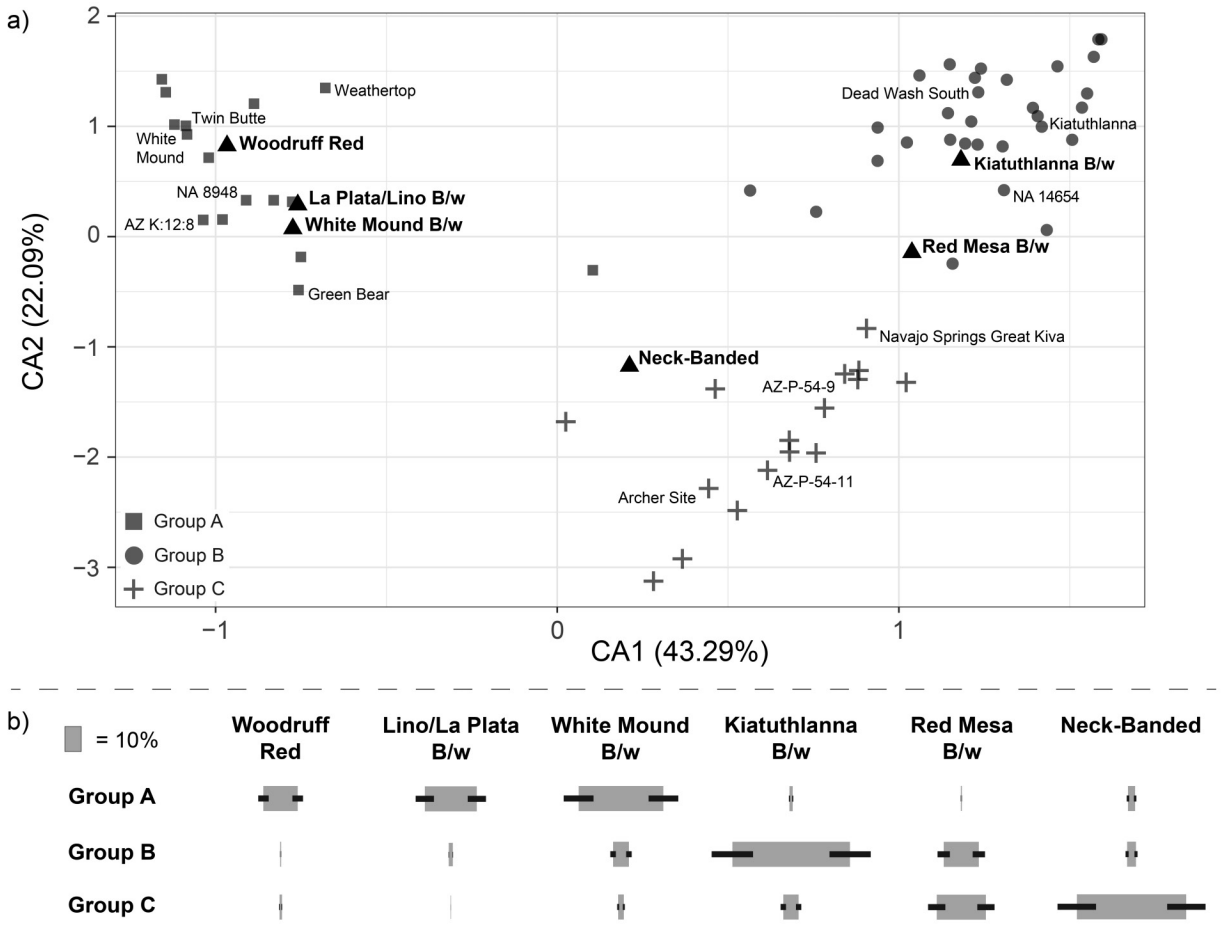

a)
CA2 (22.09%)
CA1 (43.29%)
Weathertop
Twin Butte
White Mound
Woodruff Red
NA 8948
La Plata/Lino B/w
AZ K:12:8
White Mound B/w
Green Bear
Dead Wash South
Kiatuthlanna
Kiatuthlanna B/w
NA 14654
Red Mesa B/w
Navajo Springs Great Kiva
Neck-Banded
AZ-P-54-9
AZ-P-54-11
Archer Site
Group A
Group B
Group C
b)
= 10%
Woodruff Red
Lino/La Plata B/w
White Mound B/w
Kiatuthlanna B/w
Red Mesa B/w
Neck-Banded
Group A
Group B
Group C

Figure 8.

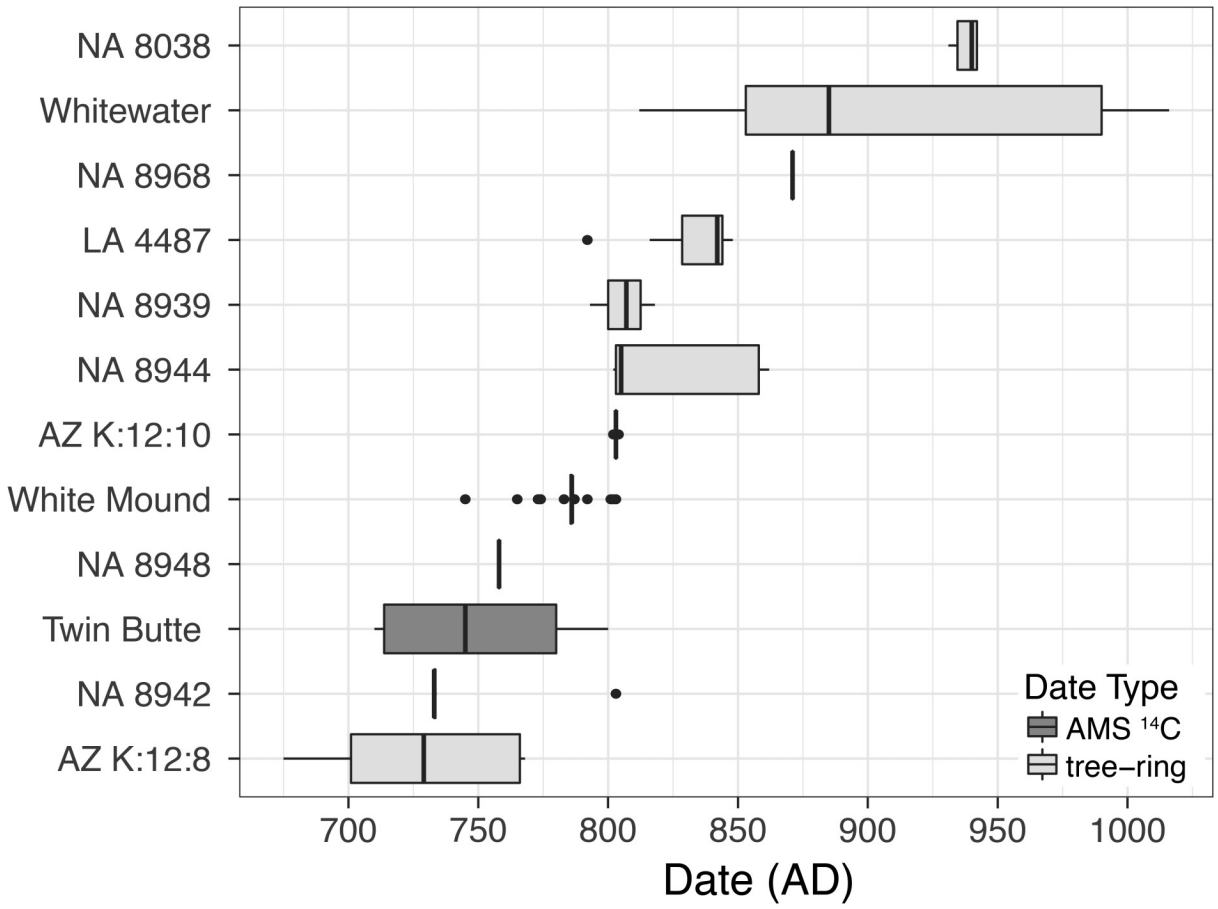
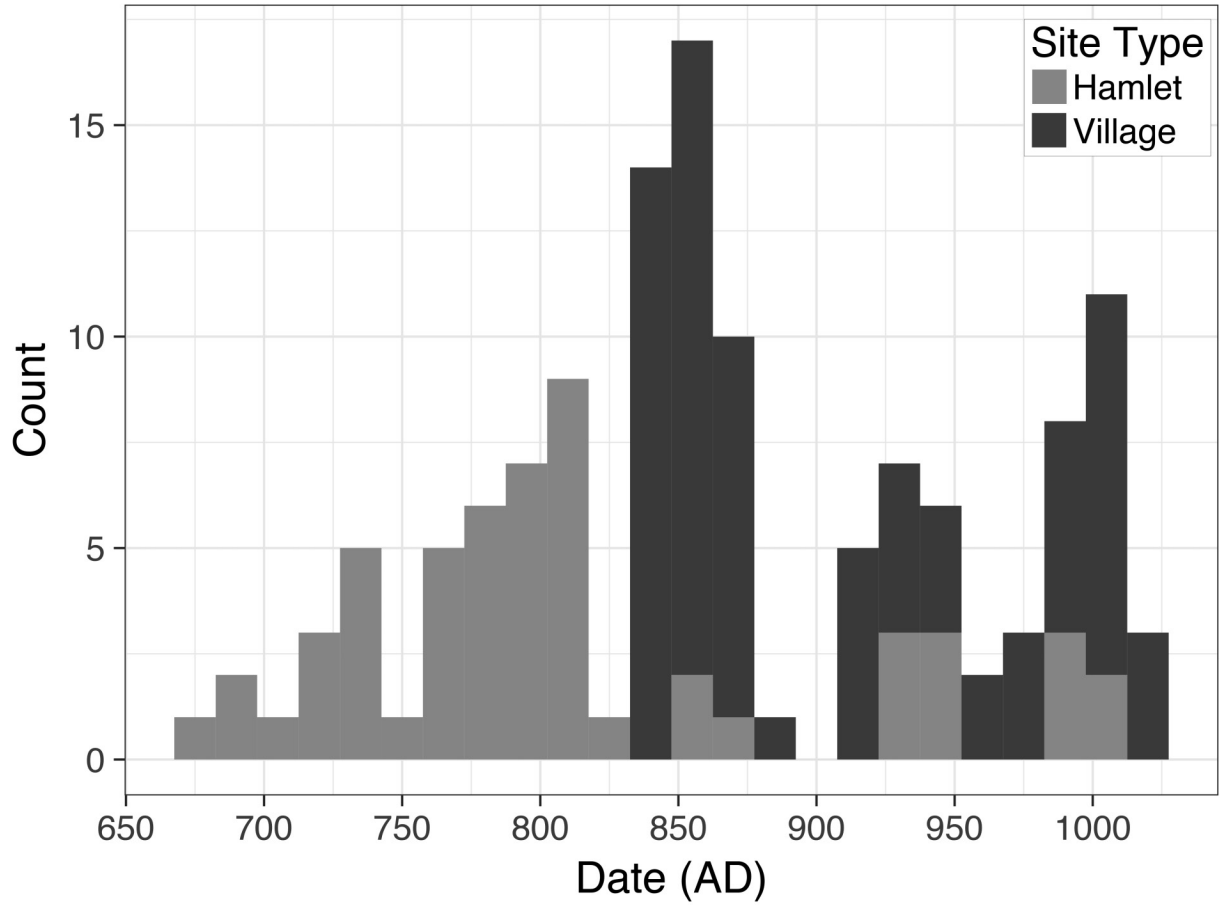

NA 8038
Whitewater
NA 8968
LA 4487
NA 8939
NA 8944
AZ K:12:10
White Mound
NA 8948
Twin Butte
NA 8942
AZ K:12:8
700
750
800
850
900
950
1000
Date (AD)
Date Type
AMS 14C
tree−ring

Figure 9.


Site Type
Hamlet
Village
Count
15
10
5
0
650
700
750
800
850
900
950
1000
Date (AD)