American Antiquity (2023), **88**, 476–496
doi:10.1017/aaq.2023.39

ARTICLE

Mobility, Lineage, and Land Tenure: Interpreting House Groups at Early Agricultural Settlements in the Tucson Basin, Southern Arizona

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(Received 19 December 2022; revised 14 May 2023; accepted 14 May 2023)

Abstract

During the Early Agricultural period (2100 BC–AD 50), preceramic farmers in the Sonoran Desert invested considerable labor in canal-irrigated field systems while remaining very residentially mobile. The degree to which they exercised formal systems of land tenure, or organized their communities above the household level, remains contested. This article discusses the spatial and social organization of Early Cienega–phase settlements in the Los Pozos site group, an Early Agricultural site complex located along the Santa Cruz River in southern Arizona. At Los Pozos, the formal spatial organization of seasonal farmsteads suggests that despite continued residential mobility, multihousehold lineages maintained distinct territories. Enduring "house groups"—likely lineal groups—are associated with disproportionately large cemeteries, suggesting the revisitation of ancestral territory through occupational hiatuses. However, variability in the formality and permanence of Early Cienega–phase settlements throughout the region indicates a flexible continuum of occupational mobility. These higher-order affiliations were only expressed in persistent settlements near highly productive farmland, where the relative priority of households over improved land might be contested.

Resumen

Durante el período Agricultura Temprana (2100 aC–50 dC), los horticultores precerámicos en el desierto de Sonora invirtieron mucho trabajo en sistemas de campo irrigados por canales, aunque al mismo tiempo seguían con una gran movilidad residencial. El grado en que ejercieron los sistemas formales de tenencia de la tierra, u organizaron sus comunidades más allá del nivel del hogar, sigue disputado. Este artículo analiza la organización espacial y social de los asentamientos de la fase Ciénega Temprana en Los Pozos, un complejo de sitios Agricultura Temprana ubicado a lo largo del Río Santa Cruz en el sur de Arizona. En Los Pozos, a pesar de la continua movilidad residencial, la organización espacial de las granjas estacionales sugiere que los linajes multifamiliares mantuvieron territorios distintos. Los "grupos de casas" duraderos, probablemente grupos lineales, están asociados con cementerios desproporcionadamente grandes, lo que sugiere retornos al territorio ancestral a través de pausas ocupacionales. Sin embargo, la variabilidad en la formalidad y permanencia de los asentamientos de la fase Ciénega Temprana en toda la región indica un continuo flexible de movilidad ocupacional. Estas afiliaciones de orden superior solo se expresaron en asentamientos persistentes cerca de tierras agrícolas altamente productivas, donde la prioridad relativa de los hogares sobre las tierras mejoradas podría ser cuestionada.

Keywords: Early Agricultural period; Early Cienega phase; house groups; mobility; land tenure

Palabras clave: período Agricultura Temprana; fase Ciénega Temprana; grupos de casas; movilidad residencial; tenencia de la tierra

The Early Agricultural period (2100 BC–AD 50) was a time of transformation in the Sonoran Desert of Arizona and Sonora. The settlement patterns of preceramic Early Agricultural cultivators—who remained highly mobile but maintained extensive canal systems—lack parallel among later farmers or foragers. The presence or absence of formal systems of land tenure among these "semisedentary" farmers remains unresolved. However, the labor invested in canal systems created a strong impetus to hold territory near optimal canal take-offs and to transfer this land across generations.

I discuss this question using new data derived from compliance-driven archaeology, from an Early Cienega–phase locus of the Los Pozos site group in the Tucson Basin of southern Arizona. Site structure at repeatedly occupied seasonal settlements suggests the organization of households into lineal groups, which likely held ranked precedence over agricultural land. This is indicated by two lines of evidence: (1) the organization of settlement into multihousehold rings with shared activity areas and (2) formal cemeteries associated with these groups. The secondary reburial of individuals who died at other locations also indicates strong associations between ancestry and territory. This analysis joins the growing body of work detailing the complex relationship between agricultural intensification and sedentism, indicating that the institutional prerequisites for sedentary village life emerged during earlier intermittent occupations.

Early Agricultural Sedentism

The Tucson Basin, located in the southern basin and range province of Arizona in North America, is characterized by intermittently flowing water courses, including the Santa Cruz River and Rillito Creek (Figure 1), and by a biannual rainfall pattern with summer monsoons and winter frontal Pacific storms. Between 2100 BC and AD 50, the area was settled by communities of dedicated maize cultivators. Although current interpretations of the Archaic in the US Southwest / Mexican Northwest note the early adoption of maize in diverse areas, this initially amounted to casual horticulture within an established foraging round (see Roth 2016; Vierra 2005, 2018). The Tucson Basin is one of several regions in southern Arizona, Sonora, and Chihuahua, where the scale and sophistication of Middle and Late Archaic maize farming warrants designating an "Early Agricultural" period concurrent with Archaic hunter-forager adaptations (Carpenter et al. 2015; Hard and Roney 2020; Mabry and Vint 2017).

The necessity of such terminology reflects the growing recognition of the long pause between the adoption of cultivars and the emergence of sedentary settlement in many areas of the world (Pringle 1998). Although the Early Agricultural lifeway was radically transformed by the adoption of canal-irrigated agriculture, this did not result in an abrupt transition to sedentism. Early Agricultural settlement was structured by the fundamental tensions between a nascent commitment to canal irrigation and the constraints of preceramic technologies, which limited caching and cooking of dried maize. Early farmers were pragmatically flexible about the dietary prominence of cultivars versus wild staples (Diehl 2015; Diehl and Waters 2006; Sinensky and Farahani 2018). Diet breadth remained high throughout the Early Agricultural period, and early farmers did not invest in durable architecture at their frequently flooded, intermittently occupied settlements (Diehl and Waters 2006; Gregory and Diehl 2002; Gregory and Nials 2005).

The resulting rancheria-type settlement pattern—characterized by shifting communities of small, short-lived farmsteads—is unsuited to the site concept as traditionally applied. Darling et alia (2004) described this pattern as "tethered drift": residential communities became tethered to irrigation districts constrained by topographic features of the river reach, but they also relocated seasonally and generationally in response to alluvial cycles (Gregory and Nials 2005; Haynes and Huckell 1986), local resource depletion (Diehl and Waters 2006), and increasing local population density (Mabry 2008). Flexible settlement strategies produced significant variation in the duration and intensity of occupation, with frequent shifts in the core areas of individual settlements (Mabry 2008). Nonetheless, specific points on the landscape emerged as persistent places over centuries of occupation. The term "recurrent sedentism" (Whittlesey et al. 2010) is applied to such sites, describing the repetition of a basic settlement plan over the course of numerous successive short occupations.

The "Los Pozos Site Group" refers to one such territory, which is composed of five archaeological sites—Rillito Fan (AZ AA:12:788[ASM]), El Taller (AZ AA:12:92[ASM]), Los Pozos (AZ AA:12:91 [ASM]), Wetlands (AZ AA:12:90[ASM]), and AZ AA:12:16(ASM)—located along the eastern bank

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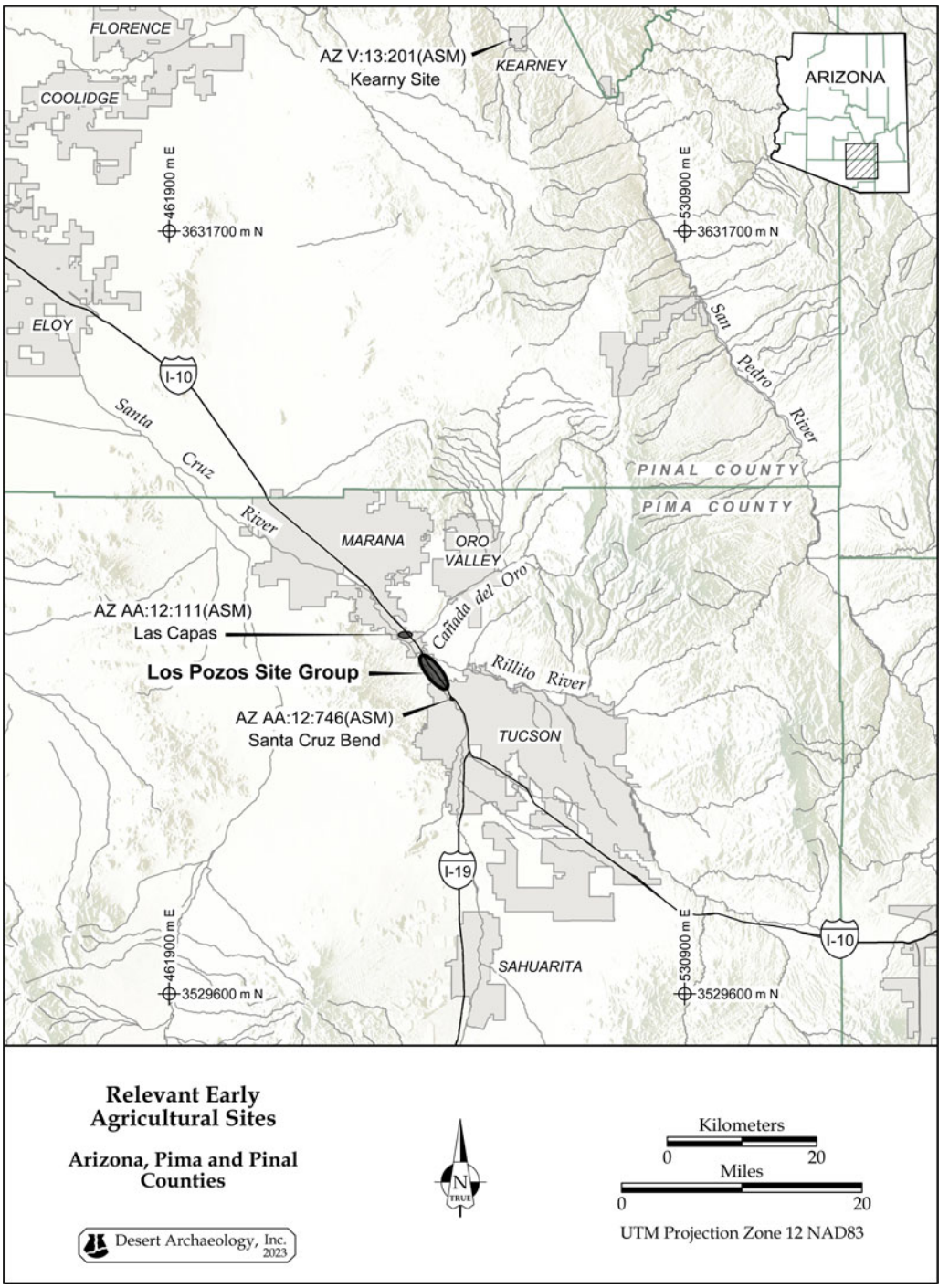

Figure 1. Early Agricultural sites referenced in this article. Figure by Catherine Gilman.

of the Santa Cruz River in Tucson, Arizona. This complex represents a 4 km long palimpsest of recurrent occupation, created over two millennia of highly mobile settlement. The location of these sites along the present-day Interstate 10 corridor has resulted in extensive excavation over several decades of compliance archaeology (Figure 2). Excavation in 2019 by Desert Archaeology for the Arizona Department of Transportation (ADOT) expanded the dataset with work at Los Pozos and El Taller.

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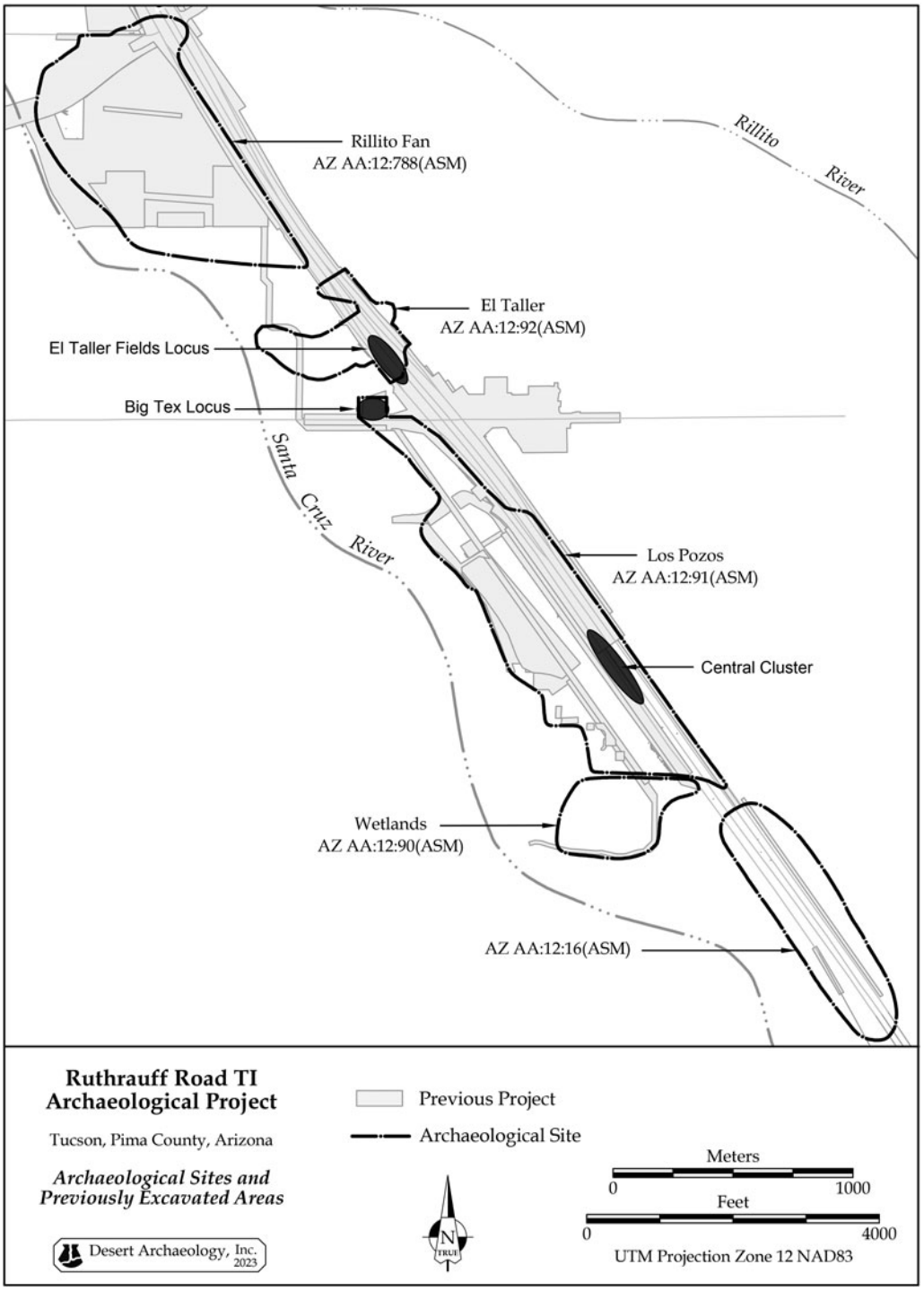

Figure 2. The Los Pozos site group, showing archaeological projects. Figure by Catherine Gilman.

Temporal Trends

The Los Pozos site group is located upstream of an alluvial reach boundary at the Rillito Fan, a large tributary fan at the confluence of Rillito Creek and the Santa Cruz River. Here, sediment deposition and underflow created an optimal environment for canal irrigation (Nials et al. 2011). Irrigation

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agriculture in the Los Pozos site group dates to the Silverbell Interval (2100–1200 BC; Huckleberry 2018a). Silverbell Interval canals were shallow diversion ditches (Whitney 2022), and their maintenance would not have required the scale of community organization and cooperation seen during later Early Agricultural occupations (e.g., Mabry 2000, 2002, 2008). Nonetheless numerous Silverbell-dated loci in this area attest to decreasing mobility.

The succeeding San Pedro phase was characterized by high-volume flooding of the Santa Cruz in the Los Pozos vicinity. This caused channel downcutting, rendering canal irrigation difficult and resulting in local depopulation. Temporary encampments indicate continued use of the area as a resource catchment zone (Nials and Wocherl 2007). The floodplain stabilized in the late San Pedro phase during a period of gentle overbank flooding and pedogenesis (Huckleberry 2023a), and the transition to the Early Cienega phase (800–400 BC) marked transformative shifts in the local settlement pattern.

Reconstructions of canal flow capacity at Las Capas, north of Los Pozos, indicate that canals reached approximately 1.5 km in length and irrigated approximately 15 ha of gridded fields by 800–730 BC, feeding an estimated 50 to 100 persons (Mabry 2002; Mabry and Vint 2017; Vint 2018). Most posit heterarchical management of irrigation communities, with small groups of households forming cooperatives under weak local leadership (Mabry and Vint 2017; Wallace and Lindeman 2012). The evolution of canal systems near Los Pozos was likely similar. Features preserved in fine-grained overbank deposits show that at Rillito Fan and El Taller, complex canal systems fed by the Rillito River replaced smaller Santa Cruz River canals by approximately 820 BC (Huckleberry 2018b). To the south at Los Pozos and Wetlands, larger and more intensively occupied settlements indicate aggregating populations.

Site types by this period included enduring riverine agricultural settlements, smaller hunting/foraging camps on floodplains and on the bajada, and opportunistic seasonal farmsteads along ephemeral creeks and drainages (Vint 2018). In this sense, Early Agricultural settlement patterns already incorporated the same range of locales and biomes utilized by later sedentary farmers. However, Early Agricultural occupations were significantly more discontinuous: construction sequences and seasonal indicators demonstrate that most of the population left for portions of the year, and long occupational hiatuses frequently occurred (Gregory and Diehl 2002). "Central-based wandering" models (e.g., Beardsley et al. 1955)—in which groups spend part of each year mobile and part aggregated in a large base, to which they may not consistently return—are likely relevant.

During this interval, local population growth and in-migration (Roth and Ahlstrom 2000; Sliva 2015) increased pressure to defend irrigable lands. Seasonal agricultural settlements were occupied for longer portions of the year, by larger groups, over longer spans of time. Simultaneously, residential mobility shifted toward a gendered pattern of logistical mobility. Cienega-phase burial populations show decreasing femoral robusticity among women, indicating a hunter/cultivator task distribution in which men remained mobile in pursuit of game but women were increasingly stationary in riverine farmsteads (McClelland 2005; Oglivie 2005; Watson and Stoll 2013). Burial populations at riverine sites, including Los Pozos, show a slight overabundance of women and children (McClelland 2005; Young et al. 2023).

By the Early Cienega phase, formal spatial arrangement is evident at some agricultural settlements. Early Cienega loci at Santa Cruz Bend, Los Pozos, Wetlands, and the Kearny Site (AZ V:13:201) have "house groups," or ring-like arrangements of structures around a central activity area (Clark 2000; Freeman 1998; Mabry 1998, 2008:273; Vint et al. 2023). Formal cemeteries also appeared at this time (Thiel 2021, 2023; Thiel and Mabry 1998; Watson and Phelps 2016). Occasionally, Early Cienega houses cluster around a "Big House" community structure (Halbirt and Henderson 1993; Mabry 1998). Wallace and Lindeman (2012:37) suggest that Big Houses indicate periodic gatherings of larger groups who occupied settlements during ceremonies, canal maintenance, and portions of the agricultural cycle. They indicate organizations above the household level that may correspond to the irrigation community—attributes not evident at comparably sized earlier settlements.

However, this site structure was not universal, or even common—most Early Cienega sites do not have house groups, Big Houses, or formal cemeteries. Moreover, as noted by Mabry (1998:339) with regard to Santa Cruz Bend, house groups were not the normative pattern, even at sites where they

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occur. As demonstrated by Kent (1991, 1992), formal site structure among mobile groups is predicated on the anticipated length of stay. The variability of Early Cienega spatial patterning therefore attests to continued variance in the duration and continuity of occupation within and between sites—that is, Early Cienega forager-farmers had suprahousehold institutions that sometimes structured the organization of residential space, but they did not aggregate at most sites for long enough to warrant it.

By the Late Cienega phase (400 BC–AD 50), populations contracted toward a paleochannel complex in the center of Los Pozos, where a series of buried relic Santa Cruz River channels retained greater effective moisture. The "Central Cluster," with over 254 structures, represented the primary locus of habitation (Gregory 2001; Gregory et al. 2007). This occupation differed significantly from those that preceded it in the number and density of structures, the scarcity of extramural features, and the disappearance of clearly delineated house rings. Large intramural storage pits indicate shifts in household economy (Gregory 2001; Mabry 2008).

Fluoride content analysis of lagomorph bones from house fill demonstrates that frequent replacement of houses at the Central Cluster over approximately 450 years created the erroneous impression of a very large village. However, these hundreds of structures only represent the dwellings of approximately 2–20 contemporaneous households (Gregory and Diehl 2002:213). Consequently, the scale and organization of Early and Late Cienega occupations may not have differed as substantially as feature density suggests. Rather, reduced mobility—the shift from sequentially occupying multiple dispersed habitation loci to repeatedly reoccupying one—obscures site structure. Wocherl (2005:45) has argued that at least nine potential house rings are apparent within the central cluster of Los Pozos, and she notes that the ring pattern is more clearly defined in contemporaneous but lower-density peripheral loci (Wocherl 2010).

Increased population density and decreased mobility were likely a consequence of necessity. Although the environmental carrying capacity was not exceeded by the relatively small Early Agricultural population, there was substantial pressure to hold and defend optimal locations with established canal systems. This pressure was exacerbated by lowering water tables by approximately 100 BC, as indicated by arroyo headcutting and the formation of piping vents (Gregory and Nials 2005; Gregory et al. 2007:52–55; Nials et al. 2011). Consequently, Early Agricultural settlement near Los Pozos trended broadly toward occupations of increasing duration, continuity, and intensity, but with periodic shifts back to more dispersed settlement. Precipitation regimes, and cycles of channel entrenchment along this stream reach, factored heavily in this fluctuation (Gregory and Nials 2005).

The Big Tex Locus

The "Big Tex" locus of Los Pozos and adjacent areas of Los Pozos and El Taller were excavated by Desert Archaeology in 2019 (Vint et al. 2023). Collectively, these areas represent a unique cross section of the site group, which include Silverbell Interval camps, a late San Pedro / Early Cienega settlement dating between 1045 and 380 cal BC (2800 ± 30 BP [Beta-567287] to 2350 ± 30 BP [Beta-567298]),[1] irrigated fields dating to the late San Pedro and Cienega phases, and a Late Cienega pit structure.

Early Cienega features within the Big Tex locus of Los Pozos included two discrete rings of structures, termed the "eastern and western house groups" (Figure 3). Each house group bounded an open communal space and was surrounded by activity areas, indicated by arcs of storage and processing pits. Each was also associated with a well-defined cemetery to the northwest. Calibrated radiocarbon ages from El Taller agricultural fields, approximately 200 m northeast of the houses, range between approximately 800 and 400 cal BC (2330 ± 30 BP [Beta-567299] to 2610 ± 30 BP [Beta-567302]). A minimum of five discrete field systems, delineated by distribution canals, occur within the excavated area, and additional fields were likely present under modern Interstate 10 (Huckleberry 2023b).

Functional Variation and Structure Life Histories

Interpreting the composition of recurrent occupations requires careful consideration of feature function, spatial organization, and sequences of abandonment. Despite the even spacing of structures within the Big Tex house rings, intruding pits indicate that not all structures were simultaneously occupied. Rather, the rings formed over an unknown number of successive occupations. Likewise, variation

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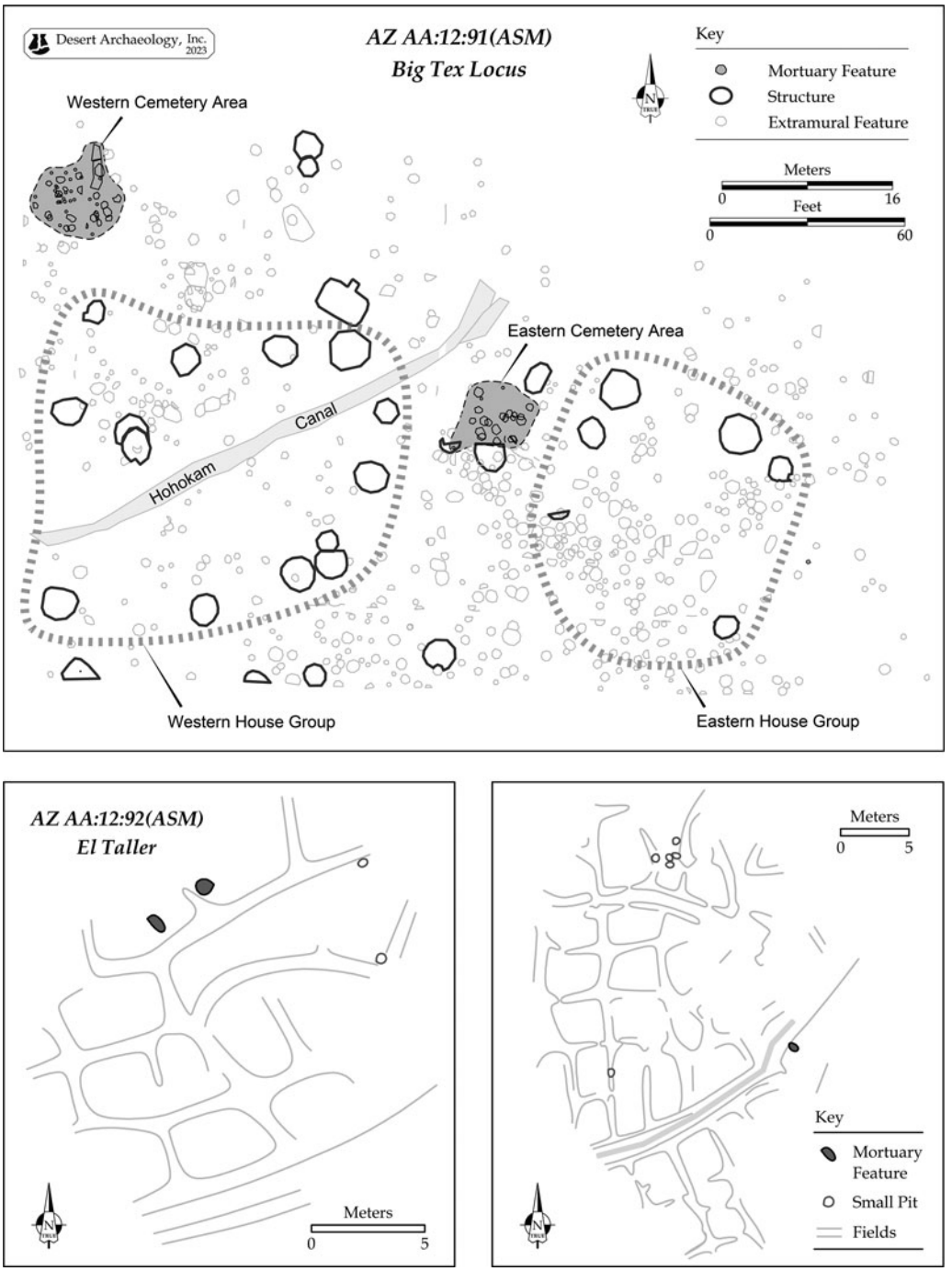

Figure 3. Big Tex house groups and cemeteries (*above*), and fields (*below*) at Los Pozos and El Taller. Figure by Catherine Gilman.

in the size and form of structures suggests that they represent a mix of residential and storage structures, also impacting estimations of population. In identifying storage versus residential structures, I adopt relational typologies advocated by Gregory (2001) and Wocherl (2018), which compare effective floor area (i.e., floor area not occupied by floor pits) of residential versus storage structures, focusing on internal variation within a specific component (Table 1).

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Table 1. Characteristics of Residential, Indeterminate, and Storage Structures.

Feature Number	Structure Type	Structure Diameter (m)	Degree Excavated	Effective Floor Area[a] (m^2)	Total Intramural Pit Volume (m^3)	Wall Height (m)	Prepared Floor/Walls	Remodeling	Burned
Eastern House Group									
4622	Residential	2.93	complete	4.48	0.10	0.34	Y	floor pits	N
4644	Residential	3.80	complete	8.57	0.29	0.15	Y	second floor, expanded	Y
4718	Residential	3.57	complete	9.19	0.13	0.17	?		Y
4268	Storage	1.86	partial	2.45 (-)	unknown	0.27	N		N
4000	Indeterminate	2.82	complete	5.50	0.02	0.35	N		N
4776	Indeterminate	2.33	partial	2.77 (-)	unknown	0.06	N		N
Western House Group									
4122	Residential	2.98	complete	7.77	0.02	0.15	Y		N
4764	Residential	3.27	complete	8.79	n/a	0.25	N		Y
4804	Residential	2.57	complete	4.21 (inferred upper floor) / 2.77 (lower floor)	0.08	0.43	N	second floor, expanded?	N
4849	Residential	3.01	complete	6.22	0.05	0.05	Y	floor pits	Y
4890	Residential	3.02	complete	6.74	0.09	0.10	Y	second floor	N
4009	Storage	2.75	partial	3.23 (-)	0.90	0.13	N	floor pits	N
4033	Storage	2.75	complete	3.40	0.33	0.20	N		N
4680	Storage	2.06	partial	3.45 (-)	unknown	0.14	N		N
4803	Storage	2.39	complete	3.46	0.22	0.24	N		N
4055	Indeterminate	2.97	partial	5.99 (-)	unknown	0.22	Y		N
4124	Indeterminate	2.52	partial	6.46 (-)	unknown	0.16	N		N
4858	Indeterminate	2.90	complete	6.01	0.05	0.15	N		N

(*Continued*)

Table 1. Characteristics of Residential, Indeterminate, and Storage Structures. (*Continued*)

Feature Number	Structure Type	Structure Diameter (m)	Degree Excavated	Effective Floor Area[a] (m^2)	Total Intramural Pit Volume (m^3)	Wall Height (m)	Prepared Floor/Walls	Remodeling	Burned
Other Early Agricultural Structures (no house group)									
4097	Residential	3.15	complete	5.66	0.26	0.10	Y	floor pits	N
4806	Residential	3.17	complete	7.20	n/a	0.07	Y	hearth, floor plaster	Y
4071	Storage	2.60	partial	1.55(~)	unknown	0.42	N		N
4836	Storage	2.40	complete	3.73	0.23	0.32	N		N
4930	Storage	1.98	complete	2.99	0.01	0.30	N		N
5070	Storage	1.61	partial	1.47 (-)	unknown	0.35	N		N
4039	Indeterminate	2.12	partial	3.26 (-)	unknown	0.20	N		N
4155	Indeterminate	1.25	partial	unknown	unknown	0.05	Y		N
4616	Indeterminate	2.50	partial	4.78 (-)	unknown	0.24	N		N
4659	Indeterminate	2.60	complete	4.51	0.02	0.18	N		N

Notes: (-) denotes a maximum effective floor area for partially excavated structures, presuming no pits were located in the unexcavated portion. (~) denotes half-exposed structures, where floor area was calculated by doubling the effective floor area of the exposed portion.

[a] Effective floor areas were calculated based on the total floor area minus total intramural pit area.

Consideration of the size, internal features, construction histories, and artifact assemblages of Big Tex structures suggest three classes of pit structure. The inferred residential structures with larger effective floor areas ($n = 11$, averaging 3 m in diameter) also had more labor invested in construction (prepared floors, identifiable postholes, wall plaster, etc.) and more frequently had floor assemblages or diverse floor features. Residential structures were often burned during abandonment. Layers of clean soil or plaster on the floors of residential structures suggest that they were periodically refurbished. However, limited remodeling indicates that most residences at Big Tex had short occupational durations: structures were replaced by a new house after a limited period of refurbishment. Grass phytoliths from roof thatching indicate construction during the spring and summer months, with limited activity extending into late summer or fall (Diehl 2023a).

Smaller storage structures ($n = 9$, averaging 2.2 m in diameter) were expediently constructed with steep and/or poorly defined pit walls, no postholes, and large intramural pit volumes (Figure 4). They typically filled with trash and alluvium during abandonment. A third category of indeterminate structure ($n = 9$, averaging 2.4 m in diameter) had intermediate effective floor areas and few internal features (Figure 4). Poor preservation was often a factor in classifying a structure as "indeterminate."

When the distributions of residential versus storage features are considered, it is possible to distinguish potential household units, where residential structures pair with storage structures. Not all residences have obvious storage structures, suggesting either shared storage or reliance on multiple storage strategies. Many structures were also noncontemporaneous, complicating relationships between individual features: 60% of structures were intruded by other features, indicating cycles of abandonment and replacement that may have differed between structure types. For example, heavy disturbance within many storage features indicates that intramural pits or the whole structure were repeatedly reexcavated and rebuilt in place.

Some residential structures were also repeatedly rebuilt or refurbished in situ. Patterns of rebuilding preserve even spacing of residences within the ring, suggesting that households occupied customary

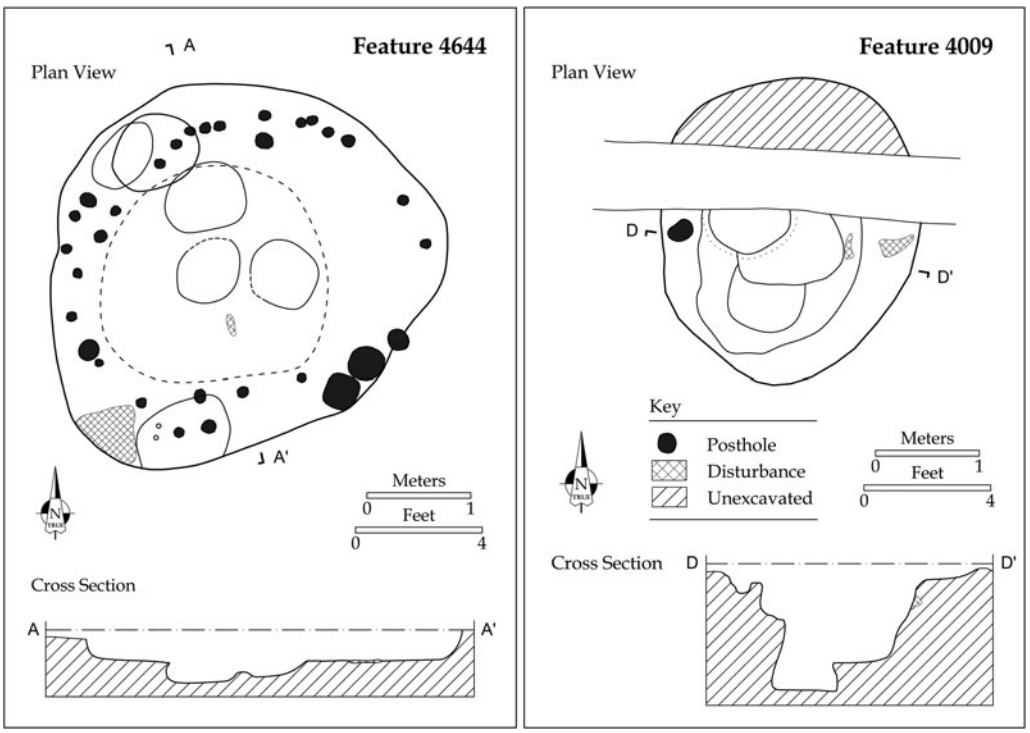

Figure 4. Examples of residential versus storage structures: (*left*) feature 4644 (residential); (*right*) feature 4009 (storage). Figure by Catherine Gilman.

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locations over successive seasonal occupations. For example, in the western residential group, structures 4849 and 4122 were built over older houses that had been abandoned for an unknown duration. In slightly more complex sequences of refurbishment, features 4804 and 4644—originally small storage structures adjacent to houses 4806 and 4622, respectively—were remodeled into residential structures. Both heavily remodeled features were next to houses destroyed in catastrophic conflagrations, suggesting that after the destruction of a residence, a family expanded an adjacent storage structure.

Consequently, although each ring of houses emerged over multiple occupations, it was nonetheless composed of distinct nuclear households at persistent locations, which did not infringe on others' domestic space. The western residential group consisted of a minimum of three persistent households (houses 4890/4849; 4122/4680 and perhaps 4124; and house 4804), whereas the eastern group had only one repeatedly occupied locale (house 4644; Figure 5). Other residential and indeterminate structures within each ring may represent fluctuations in household size that warranted additional housing. Flannery (2002) notes that ethnographically, structures in this size range did not house the entire nuclear family: larger huts housed couples and infants and were the focus of household activity, whereas smaller adjacent huts housed children and unmarried dependents.

Presuming persistent house locations correlate with the focal points of individual households, one can posit rough estimations of momentary site population. Average household sizes among ethnographic hunter-gatherers, shifting cultivators, and smallholder farmers all converge around four to

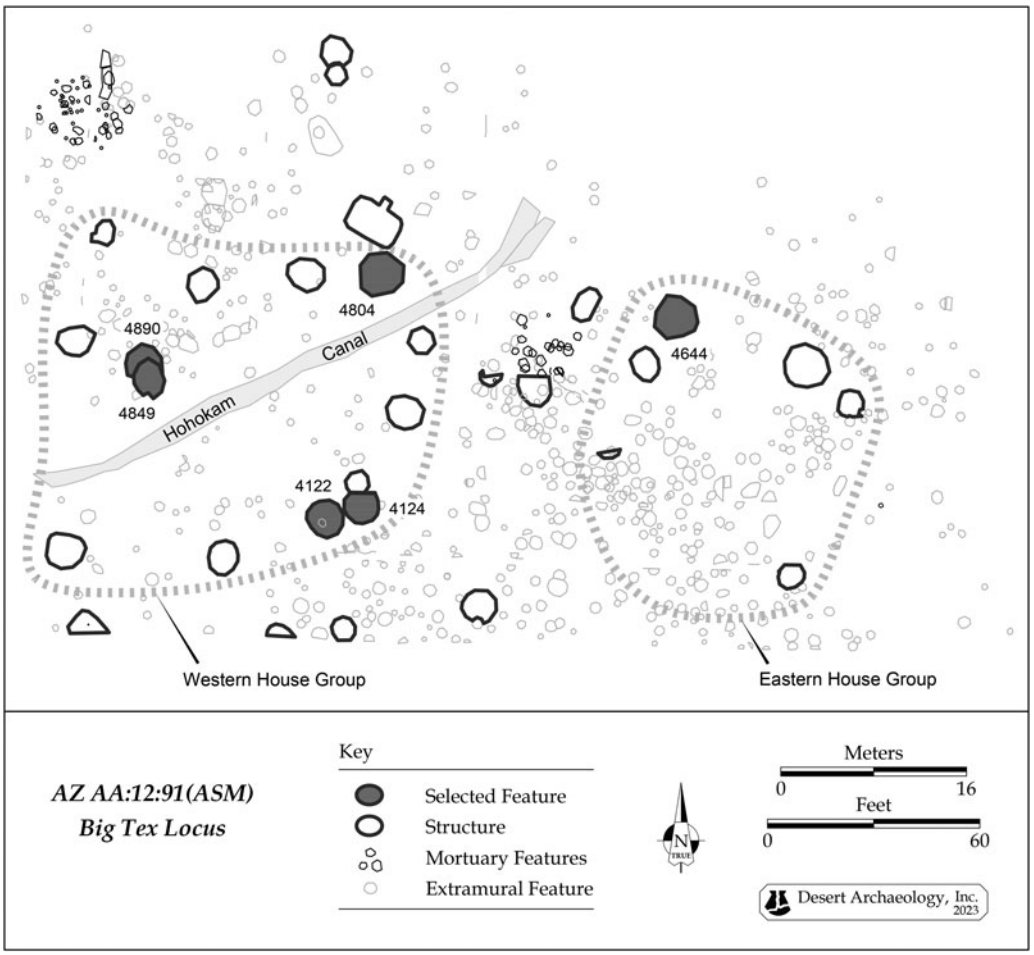

Figure 5. Persistent house locations at Big Tex. Figure by Catherine Gilman.

https://doi.org/10.1017/aaq.2023.39 Published online by Cambridge University Press

six individuals per family (Hamilton et al. 2018; Haviland 1972; Netting 1993). If Early Agricultural forager-farmers fell within this range, the four persistent households at Big Tex composed a relatively small population of 20 to 30 individuals.

Occupational Sequence, Duration, and Intensity

Incipient soil formation indicates that the eastern house ring was built on a stable surface, unlike the western house ring, which frequently flooded. The eastern half of the locus was therefore the obvious choice for early settlement. Radiocarbon ages and diagnostics indicate late San Pedro activity areas underlying the eastern Early Cienega house ring, and two pit structures under the eastern cemetery appear associated with this occupation. The occupational gap between the San Pedro and Early Cienega components is unclear—however, the reuse of San Pedro activity areas by Early Cienega occupants suggests awareness of the earlier component, either from memory or visible remains.

Bayesian modeling indicates that the occupation of both Early Cienega house groups likely overlapped, although occupation of the eastern house ring may have begun earlier (585–415 cal BC versus 540–400 cal BC) and was of a longer median occupa-tional duration (35 years versus 25 years) (Table 2; see also Supplemental Data 1–4). Probability matrices indicate only 0.7281 probability that the eastern group is older (Figure 6). However, a plateau in the calibration curve results in low precision during this interval. Greater extramural feature density and richer trash fill around the eastern group supports that the Early Cienega occupation of the eastern ring was more intensive, of longer duration, or both. By contrast, the larger number of houses and inhumations in the western group suggests a numerically larger group, which used the locus for a shorter interval.

The prevalence of bell-shaped pits versus storage structures in the earlier eastern group suggests a shift in storage strategy. Concentrations of bell pits near the eastern house group could mean that discontinuous occupation during early settlement warranted heavier reliance on easily concealed extramural storage pits. As the settlement grew and achieved greater occupational permanence, lessened mobility may have reduced risk of food theft. Alternately, the shift from extramural storage areas to discrete storage structures signaled the increasing importance of households as independent economic units (Mabry 2008).

Interpreting bell pits as food storage is not universally accepted. Diehl (2023b; Diehl and Davis 2015) questions the utility of Early Agricultural bell pits for food storage due to indications of their frequent flooding. We differ on this point: the correlation of bell pits with the advent of maize farming in multiple regions presents strong evidence of their use as maize storage features (Roth 2016; Wocherl 2005). Moreover, Los Pozos bell pits contain a higher density of redeposited trash than other pit types (Diehl 2023b), and the notable quantities of fire-cracked rock and ground stone present evidence of their association with a suite of activities surrounding intensive, episodic food processing.

However, if the damp environment of Early Agricultural pits did not preclude maize storage, it placed significant constraints on the way maize was cached and the length of time it was stored. The form and wear of ground stone tools indicates that before the AD 500 introduction of flour corn varieties, Early Agricultural populations consumed porridges of rehydrated, fresh, or fermented maize (Adams 1999). Pit storage of fresh to fermented staples among diverse historic groups buffered the harvest season by weeks to months and therefore had real implications for residential mobility (Steinkraus 1996; Whittaker et al. 2014). Nonetheless, it did not typically constitute a long-term surplus, due to diminishing caloric returns and low viability of pit-cached seed stock. Mobility in pursuit of a diversified subsistence base therefore remained a necessity.

In sum, the archaeological evidence of short-lived features, rebuilding, and so forth provides support for relatively brief and intermittent occupations of the Big Tex locus, occurring within the temporal interval provided by chronometric dates. Mobility may have been reduced during later periods of occupation but remained high. Total reconstruction of an Early Agricultural pit structure was necessary every two to five years, as indicated by experimental reconstructions (Gregory et al. 2007:101; Gregory and Diehl 2002:209). Consequently, the 13 residential and indeterminate pit structures that comprise the eastern and western house groups could be constructed by a mere two households over a 25–35-year span or approximately a single generation—although house placement suggests that three or more households were present simultaneously.

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Table 2. Radiocarbon Ages from the Big Tex Locus of Los Pozos.

Area	Feature	Dated Material	Feature Type	Beta Sample Number	Conventional Radiocarbon Age and Error	IRMS $\delta^{13}C$ ‰	Phase
East	4520	*Zea mays* cupules	deep pit	Beta-551686	2460 ± 30 rcybp	−22.8	Early Cienega
East	4551	*Zea mays* cupules	deep pit	Beta-551688	2450 ± 30 rcybp	−10.3	Early Cienega
East	4541	*Zea mays* cupules	deep pit	Beta-551689	2470 ± 30 rcybp	−10.9	Early Cienega
East	4561	*Zea mays* cupules	deep pit	Beta-551691	2440 ± 30 rcybp	−10.6	Early Cienega
Stratum 500	4537	*Zea mays* cupules	bell pit	Beta-551692	3070 ± 30 rcybp	−9.9	Silverbell
Stratum 500	0	Bulk soil humic sample	soil sample	Beta-563244	3200 ± 30 rcybp	−18.5	Silverbell
East	4622.01	*Zea mays* cupules	pit structure	Beta-563248	2430 ± 30 rcybp	−10.1	Early Cienega
East	4644.02	*Zea mays* cupules	pit structure	Beta-563249	2390 ± 30 rcybp	−10.7	Early Cienega
Stratum 500	0	Bulk soil humic sample	soil sample	Beta-563253	3170 ± 30 rcybp	−25.4	Silverbell
South	4097.01	*Zea mays* cupules	pit structure	Beta-567283	2100 ± 30 rcybp	−25.01	Late Cienega
West	4114	*Zea mays* cupules	bell pit	Beta-567285	2400 ± 30 rcybp	−10.5	Early Cienega
West?	4124	*Zea mays* cupules	pit structure	Beta-567286	2490 ± 30 rcybp	−10.5	Early Cienega
Southeast	4161	*Zea mays* cupules	bell pit	Beta-567287	2800 ± 30 rcybp	−10.6	San Pedro
Southeast	4162	*Zea mays* cupules	small pit	Beta-567288	2750 ± 30 rcybp	−10.4	San Pedro
East	4192	*Zea mays* cupules	bell pit	Beta-567289	2420 ± 30 rcybp	−11.0	Early Cienega
East	4263	*Zea mays* cupules	bell pit	Beta-567290	2500 ± 30 rcybp	−10.6	Early Cienega
Southeast	4616.01	*Zea mays* cupules	pit structure	Beta-567291	2760 ± 30 rcybp	−10.2	San Pedro
East	4718.01	*Zea mays* cupules	pit structure	Beta-567292	2440 ± 30 rcybp	−11.0	Early Cienega
West	4764	*Zea mays* cupules	pit structure	Beta-567293	2380 ± 30 rcybp	−10.2	Early Cienega
West	4803.01	*Zea mays* cupules	pit structure	Beta-567294	2390 ± 30 rcybp	−10.8	Early Cienega
East	4809	*Zea mays* cupules	deep pit	Beta-567295	2460 ± 30 rcybp	−10.2	Early Cienega
West	4849.02	*Zea mays* cupules	pit structure	Beta-567296	2420 ± 30 rcybp	−9.5	Early Cienega
West	4890	*Zea mays* cupules	pit structure	Beta-567297	2380 ± 30 rcybp	−10.2	Early Cienega
West	4930.01	*Zea mays* cupules	pit structure	Beta-567298	2350 ± 30 rcybp	−10.3	Early Cienega

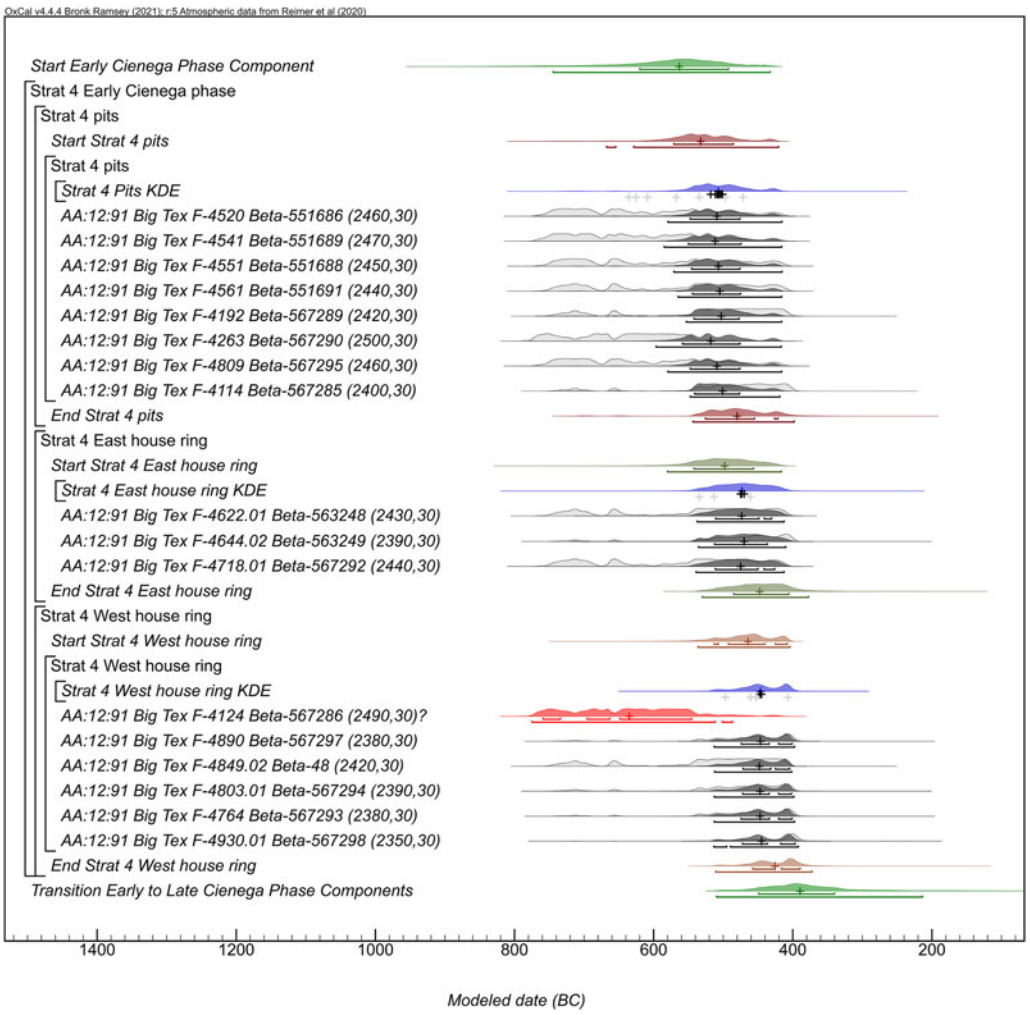

Figure 6. Modeled versus unmodeled radiocarbon ages for the Early Cienega component of Big Tex. Figure by James M. Vint.

However, burial demographics from both cemeteries are strikingly inconstant with occupations of this small size and limited duration, suggesting that although settlement was punctuated by significant occupational hiatuses, the dead continued to be buried there during these hiatuses. This discrepancy is discussed below.

Cemetery Groups

Both the eastern and western cemeteries are located northwest of their associated residential spaces. This relationship may have cosmographic significance: many of the seated burials in these cemeteries also face northwest, or toward the setting sun (Thiel 2023). Both cemeteries contain tightly clustered burials, often layered atop one another. The position of skeletal elements indicates that the deceased was typically wrapped in perishable materials, then buried in a seated position. Disturbance and stratigraphic relationships indicate many years of repeated interment within each cemetery. Burial offerings—particularly Pacific Coast marine shell ornaments—were common. The more populous western group had more offerings on average, but the eastern cemetery contained the single richest funerary object, a necklace with over a thousand shell beads (Thiel 2023; Virden-Lange 2023).

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Superficially, the western and eastern cemeteries seem proportionate to their respective residential groups. The western cemetery, like the western house ring, suggests a larger population (around 74–87 individuals, including approximately 36 adults), whereas the eastern cemetery, like the eastern house group, suggests a smaller unit (around 33–40 individuals, including approximately 19 adults).[2] Young and colleagues (2023) note that the number of subadults in the Big Tex cemeteries indicates a fertility and mortality schedule more characteristic of sedentary farmers than previously documented Early Agricultural populations. Dental wear and pathologies also suggest that maize may have composed an unusually large proportion of the diet for an Early Agricultural site.[3]

Radiocarbon samples were not collected from mortuary contexts, and burials cannot be directly dated. However, it is clear that there are more individuals in each cemetery than can be reasonably accounted for by eight residential structures, each occupied for two to five years by a household averaging five individuals. Even if indeterminate structures at Big Tex were in fact residential, or if residences lasted longer than generally posited, the numbers are disproportionate. The implication is that a significant portion of the Big Tex burial population died while residing elsewhere. Indeed, nearly 29% of the burial population consists of secondary inhumations (disinterred and reburied remains), and an additional 24% consists of disturbed interments that could also be secondary inhumations.

Some disarticulation reflects spatial constraints of the cemetery plots: reburial of persons accidentally disturbed while digging a new grave is suggested by occasional reburial of partial remains with an intact primary inhumation. However, most disarticulated interments appear to represent individuals who were buried elsewhere, exhumed, and then reburied at Big Tex. In some cases, mortuary features containing multiple partial individuals and offerings suggest that entire family groups were moved from one burial plot to another. Indeed, similarities in the chronology, spatial organization, mortuary treatment, and material culture of Big Tex and Wetlands, 2 km to the south, suggest that the same population could have repeatedly occupied both areas through the late San Pedro and Early Cienega phases, relocating burials as they moved between settlements (Vint et al. 2023).

Los Pozos–area burial data confirms that Cienega-phase cemeteries were no longer proportionate to the number of directly associated houses (Young et al. 2023; see also Thiel 2021; Watson and Phelps 2016). Nowhere is this clearer than the Los Pozos Central Cluster, where hundreds of structures produced only 19 associated burials (McClelland 2005). In contrast, the cemeteries of small house groups at Wetlands and Big Tex produced 24 and 127 burials, respectively (Thiel and Mabry 1998; Vint et al. 2023). One possibility—difficult to evaluate with the data available—is that burials are scarce at the Central Cluster and overabundant at earlier loci because Early Cienega cemeteries continued to be used into the Late Cienega phase. Radiocarbon ages confirm that Big Tex was still sporadically occupied as populations aggregated toward the Central Cluster. Continued use of Early Cienega burial plots during occupational hiatuses—or even after the locus largely ceased to be occupied—may have been a way that family groups maintained claims to ancestral territory.

A similar pattern is suggested by the placement of burials within nearby agricultural loci. Field margins contained an unanticipated number of Early Agricultural mortuary features (10 primary inhumations and a disturbed or secondary inhumation). These occurred both between fields and within field berms and cells. Such burials may have asserted claim over agriculturally productive land as mobile groups moved across the landscape according to shifting alluvial regimes or multiyear fallowing cycles. As noted by Netting (1993; see also Mabry 2002, 2008:272), management of canals is typically a communal enterprise, but management of field plots is a household affair. Burials within field systems may have asserted the precedence of specific households to particular fields by right of ancestry.

Lineage and Household Group

Rings of pit structures such as those at the Big Tex locus—sometimes with associated cemeteries or multiple secondary inhumations—have been documented at several Early Cienega sites (Clark 2000; Freeman 1998; Mabry 1998, 2008:273; Thiel and Mabry 1998; Watson and Phelps 2016). Although this arrangement was not the normative pattern, it is widely documented and therefore expresses fundamental aspects of Early Cienega social organization. Mabry (2008) proposed that Early Agricultural house rings are the earliest iteration of the lineage-based courtyard group, the fundamental corporate

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unit of later Ceramic period villages. Although Early Agricultural house groups were antecedent to courtyard groups, the term suggests a level of sedentism and complexity that is not implicated during Early Agricultural occupations. As noted by Wallace and Lindeman (2012:36), the path to village life proceeded through a very long stage of limited, periodic aggregation; only developing large, enduring aggregations of courtyard groups around AD 500. Although these developments were rooted in integrative mechanisms of the Cienega phase, differences in scale and continuity amount to a qualitatively different phenomenon.

In contrast, consideration of the site structure of early historic O'odham *rancherias* along the Santa Cruz—which are more comparable to the Early Agricultural period in terms of population mobility and density—reveals the durability of spatial distinctions between lineal and domestic units during more intermittent occupations by irrigation agriculturalists. Seymour (2011) describes protohistoric O'odham "*plazuela*" groupings at larger summer and winter settlements as paired arcs or rows of houses, each composed of numerous smaller residence/storage structure pairs, surrounding an open activity area.

These arrangements, described by an early Spanish writer (Juan Mateo Manje, quoted in Seymour 2011:246) as "*dividias a trenchos y patcialidades de familias emparentas*"—or "divided at intervals and by sections among families, related by marriage"—are posited to correspond to nested units of household, lineal, and intermarrying lineage groups. Notably, the house rows—lineal groups of related nuclear households—expanded laterally over multiple reoccupations, giving an erroneous impression of occupational density. O'odham villages were patrilocal, and they typically passed rights to agricultural fields down the male line (Castetter and Bell 1942:125–130). By contrast, technological and biological studies of Early Agricultural communities suggest matrilocality (Byrd 2014; Sliva 2015). However, the general concern with spatially manifesting household, lineal, and potentially supralineal divisions relates to the importance of kinship in organizing labor and apportioning resources among irrigation cooperatives (Mabry 2008).

Demonstrating the antiquity of a family's claim to key resource zones is critically important—hence the focus on burial of ancestral remains within agricultural loci, including exhuming and reburying individuals who died elsewhere. Cross-culturally, such corporate affiliations were often expressed by households with valued landholdings and customary patterns of marriage alliance. Conversely, nonlandholding households on community margins showed both shifting affiliations between individual nuclear families and relatively informal settlement structure (Carsten and Hugh-Jones 1995; Joyce and Gillespie 2000). Such systems could account for the variable organization within Early Cienega sites where house groups occur, but not all households belong to these groups.

Geomorphic and paleoenvironmental evidence suggest that there was no scarcity of irrigable land on the Santa Cruz River. However, the labor invested in establishing successful canal systems ensures that conflict would proliferate, were there not systems to establish the relative primacy of households over fallow fields. The mobility of Early Agricultural populations exacerbates such tension. As noted by Netting (1993:162), conflict proliferates among shifting cultivators, who engage in perpetual border disputes to maintain relatively contiguous plots of fields and fallow.

Farmers therefore exist on a flexible continuum from highly mobile cultivators with a high level of conflict; to semisedentary shifting cultivators, where estates are maintained by corporate descent groups; to intensive farmers, where individual households maintain durable rights to heritable smallholdings. This trajectory has bearing on the cultural sequence of southern Arizona, where burial populations show evidence of endemic conflict during the San Pedro phase, decreasing violence and lineal house/cemetery groups in the Cienega phase (Mabry 2008; Watson and Phelps 2016), and finally, relative stability and agricultural intensification during the Ceramic period.

Concomitant with these organizational shifts, we see shifts in how Early Agricultural people expressed the permanence of the household. For example, Gregory (2001:39–40) noted that floor features in the Los Pozos Central Cluster contained structured deposits of shell and bone beads, projectile points, and worked artiodactyl femur heads. Such dedications "may be interpreted as representing a consecration of space and a . . . claim of ownership when the structures were built" (Gregory 2001:40). Such deposits were documented in eight residential structures at Big Tex and are particularly associated with structures with a long use life.

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Feature 4644 had the most complex deposits (shell, minerals, femur heads, projectiles, and ornaments) and also had the most complex life history. This included expansion into an atypically large structure, replacement of floors and postholes, and eventual abandonment via catastrophic conflagration. Following abandonment, the location persisted as a focus of unusual activity. Rare materials recovered from the post-abandonment fill included pigments and 991 obsidian artifacts from widely dispersed sources: debitage, projectiles, and small flaked "erratics," the purpose of which is unclear (Sliva 2023). Four other houses also had subfloor offerings and remodeling sequences of varying complexity. Houses therefore appear to accrue enriched deposits as they accrue occupational depth and significance.

Although none of these structures were sufficiently large or elaborate to constitute "Big Houses," it is nonetheless clear that not all residential structures were created equal. As famously argued by Levi-Strauss (1983), personification of the history of the residential group through periodic consecration of the household structure is strongly associated with the intergenerational transference of an estate, either material or immaterial. Parallel patterns typically occur in cemeteries within or adjacent to residences, which provide a tangible connection between land, house, and domestic group. Although these patterns are most marked in sedentary groups with ranked hierarchies, various degrees of differentiation between ordinary residences and houses that have "hardened" into significant locales are made by mobile farmer/foragers in short-lived settlements with flexible hierarchies (Carsten and Hugh-Jones 1995; Joyce and Gillespie 2000).

Often the significance of such structures is achieved only after the deaths of the family's founding couple, at which point the grave site and residence transform into loci of ceremonial activity. Such intergenerational processes of marking may contextualize several events associated with the smaller but potentially older eastern group at Big Tex. For example, stratigraphy suggests that the richest burial—a woman with an elaborate shell necklace—occurred early in the history of the site. Such a treatment might be afforded to a founding matriarch. The extraordinary quantity of obsidian deposited in House 4644 after abandonment likewise lacks parallel at other Early Agricultural period sites. If these places and persons were important to founding the community, their deaths may have warranted removing valuable materials from circulation.

It is unclear to what degree these patterns apply at Early Agricultural sites in adjacent regions, although some processes are likely applicable. A high degree of sedentism has been inferred at large Early Agricultural sites in Sonora and Chihuahua, but currently, depositional contexts preclude detailed reconstructions of normative site structure (Carpenter et al. 2015; Hard and Roney 2020). Nonetheless, burning and enriched deposits have been proposed as a ritual closure process for Cienega-phase houses at La Playa, Sonora (Goguitchaichvili et al. 2023). Likewise, multiple burials and secondary inhumations at this site suggest related trends in mortuary ritual (Carpenter et al. 2015).

The cultural relationship between La Playa and Los Pozos is close. However, such patterns reflect more fundamental concerns with negotiating the early stages of sedentism. Flannery (2002) posited that the transition from dispersed to aggregated settlement entailed a stage of extended family settlements: sites grew because married descendants remained increasingly attached to the natal residence, pooling labor for intensive subsistence pursuits, and sharing storage to varying degrees. Settlements composed of expanding rings of households marked this transition in Archaic Mesoamerica and the Near Eastern Late Natufian, among others (Flannery 2002). Late Natufian is also notable for mixed secondary/primary burial patterns, indicating both territoriality and high mobility (Bar-Yosef 1998). Ultimately, such settlements reach a size where households refuse to pool risk, resulting in privatization of storage and increasing aggregation, or dissolution of the settlement (Flannery 2002). Both processes seem implicated at Los Pozos, where storage strategies and settlement location shifted by the end of the Early Cienega phase.

Summary

During the Early Cienega phase, populations in the Los Pozos site group coalesced into structured communities residing at repeatedly occupied locales. Initially, these settlements were located in close proximity to arable lands in the Big Tex locus at the northern end of the settlement, and to the Wetlands locus to the south. The division of these settlements into rings of allied households with

https://doi.org/10.1017/aaq.2023.39 Published online by Cambridge University Press

shared central space mirrors the division of agricultural fields into household plots along shared canals—reflecting the formalization of domestic space based on the needs of irrigation cooperatives.

The rise of land tenure by lineal or quasilineal groups may have entailed formal patterns of marriage alliance between the holders of desirable farmland—patterns that were seen among historic smallholder farmers with similar segmented spatial organization (Joyce and Gillespie 2000; Seymour 2011). The importance of established land tenure was marked by patterned placement of ancestral burials within residential areas and agricultural plots—including the disinterment of burials during relocation between habitation loci—and the intentional deposition of valuable ornaments and materials in graves and subfloor pits within residences.

These Early Cienega communities were short-lived, and they consisted of small groups of seasonally occupied residences that coalesced temporarily at agriculturally productive locales. Settlements cycled over intervals that spanned one to two generations before being reconfigured either in situ or relocated a short distance away within their territorial range. Although not fully sedentary, the degree of organization expressed in Early Cienega patterns of site structure, house construction, and house replacement was unprecedented at earlier sites, blossomed during the subsequent Late Cienega phase, and was a prelude to the enduring courtyard groups of the Ceramic period that followed. Such relationships between aggregation, intensification, and sedentism are neither simple nor unidirectional. However, there are common responses to scalar stress and decreasing mobility. The patterns seen during the Early Cienega phase echo transformations in diverse societies on the cusp of village life.

Acknowledgments. I would like to thank my friends and colleagues: Jim Vint for OxCal modeling and the supplemental material included with this article, Catherine Gilman for drafting figures, Hunter Claypatch for Spanish translation, Mason Niquette for chronometry review, Gary Huckleberry and two anonymous reviewers for helpful comments, and everyone else who contributed their thoughts, research, and insights.

Funding Statement.. This research was financed by the Arizona Department of Transportation (ADOT) under contracts awarded to Desert Archaeology Inc.

Data Availability Statement. Data used in this article may be requested from Desert Archaeology Inc. Desert Archaeology reports can be requested online at https://desert.com/publications.

Competing Interests. The author declares no competing interests.

Supplemental Material. For supplemental material accompanying this article, visit https://doi.org/10.1017/aaq.2023.39.
Supplemental Data 1. OxCal model code.
Supplemental Data 2. OxCal model output for the Big Tex locus.
Supplemental Data 3. Modeled dates for the Early Cienega component of the Big Tex locus, Los Pozos.
Supplemental Data 4. Probabilities for the relative age of house groups.

Notes

1. Radiocarbon ages are 95.4% calibrated ranges. 95.4% Highest Probability Distribution modeled date ranges are used for the transitions, beginning, and end of occupation phases within the Big Tex locus.
2. Due to poor preservation, disturbance, and commingling, burial counts are approximate.
3. That is, increased consumption of heavily processed carbohydrates.

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https://doi.org/10.1017/aaq.2023.39 Published online by Cambridge University Press

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Cite this article: Gruner, Erina P. 2023. Mobility, Lineage, and Land Tenure: Interpreting House Groups at Early Agricultural Settlements in the Tucson Basin, Southern Arizona. *American Antiquity* **88**(4):476–496. https://doi.org/10.1017/aaq.2023.39.