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How far from Chaco to Orayvi? Quantifying inequality among Pueblo households

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ABSTRACT

Recent studies of household inequality based on the distribution of floor area indicate that the distribution of wealth varied significantly across time and space in the prehispanic upland US Southwest. In this study, we first examine inequality among households from Orayvi ca. 1901 to contextualize the patterns of inequality we then report among ancestral Pueblo households in the Basketmaker II-Pueblo III periods from the central Mesa Verde region, middle San Juan region, Chaco Canyon, and the Chuska Valley. At Orayvi just prior to the 1906 split, inequality was relatively low, in line with values typical for horticultural societies. Most inequality at Orayvi was among households rather than among clans and phratries, though clans were more wealth-differentiated than were phratries, factions, or other groups we examined. Degree of ancestral Pueblo wealth inequality varied considerably through time, with levels exceeding those calculated for Orayvi primarily during the Pueblo II period. Wealth disparities exceeding those at Orayvi arose in the Chuska Valley and Middle San Juan regions prior to the marked increase we document at Chaco, suggesting that populations from these areas may have been involved in the development of early great house construction at Chaco Canyon.

1. Introduction

Archaeology benefits from an interplay between atomistic perspectives on social facts that invite a comparative perspective across societies, and holistic perspectives on how social facts fit together over time in the creation of meanings and experiences by members of a particular society. Each approach reinforces the other in constraining the “reconstructive and explanatory claims we project on the cultural past” (Chapman and Wylie, 2016:6). The reason for this is that what constitutes an “empirical anchor” in either of these approaches is examined from another angle by the different “scaffolding of warrants and assumptions” (Chapman and Wylie, 2016:158) required for its use in the companion approach.

Here we adopt a (mostly) atomistic, comparative perspective on house size as a candidate measure of household-level wealth inequality in Pueblo sites across the US Southwest. Wealth inequality is one aspect of sociopolitical inequality, and our work contributes to disentangling it from other related concepts such as status, authority, and power. This not only promotes a more nuanced perspective on societies than just whether they are “egalitarian” or “stratified.” As wealth inequality becomes more widely studied, it is clear that it is deeply implicated in dynamic relationships with violence (Kohler and Ellyson, 2018), ritual practice (Kohler and Higgins, 2016), basis of production (Bogaard et al., 2018), and political organization (Blanton, 2016). In contemporary societies it is well established that high income inequality also negatively affects population health and well-being (Pickett and Wilkinson, 2015). None of these relationships can be examined in a causal framework without vetted measures and demonstrations that these relationships have some degree of cross-cultural consistency. One of the first studies of wealth inequality in contemporary peasant societies found “the paucity of quantitative evidence … [to be] little short of embarrassing” (McGuire and Netting, 1982:270). We seek to help deliver archaeology from similar embarrassment while contributing to the still-contentious issue of the nature of social differentiation as one aspect of leadership in the prehispanic Southwest (Mills, 2000).

These comparative aspects of our research will be complemented by a more contextualized examination of house-size distributions in the well-studied Hopi society inhabiting the pueblo of Orayvi near the dawn of the twentieth century. The Orayvi study is interesting from several perspectives. In and of itself, it documents the degree of

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inequality in a society on the brink of a factional split (Cameron, 1992). In addition, the Orayvi study helps to warrant our examination of households elsewhere by showing that such wealth inequality as existed was structured more prominently at the household level than at the level of clan, phratry or faction. Finally, because all the societies we study here are Pueblo, sharing broadly similar environments and many aspects of their histories and social and economic practices, knowledge of the level of household-wealth differentiation at Orayvi indicated by our proxy measure is obviously relevant to understanding what the values we compute for this measure suggest about earlier, related societies in the Southwest.

House sizes integrate material, relational and embodied aspects of wealth as defined by Borgerhoff Mulder et al. (2009). Some archaeologists therefore have long used house-size distributions as a proxy for wealth distributions (e.g., Coupland, 1985, 1988a, 1988b; McGuire, 1983). After a general hiatus in the 1990s and early 2000s (but see Smith, 1992), a growing number of researchers now base estimates of wealth inequality in societies with no written records on Gini coefficients calculated over house-size distributions (chapters in Kohler and Smith, 2018; Kohler et al., 2017; Porčić, 2018; Smith et al., 2014) or occasionally over other units such as grave goods (Windler et al., 2013). Given this relatively novel usage of the Gini coefficient as an archaeologically promising proxy for concentration of household wealth, it is prudent to examine Gini coefficients in well-known ethnographic settings to help assess how these indices perform, or at least what values can be expected in what kinds of contexts. Here we use Orayvi to calibrate our assessment of a sample of prehispanic households from elsewhere in the northern Pueblo world, adding two new areas—the middle San Juan (MSJ) and the Chuska Valley—to samples from the central Mesa Verde (CMV) region and Chaco Canyon previously analyzed by Kohler and Higgins (2016) and Kohler and Ellyson (2018). We also add new cases to our previous examination of the CMV and Chaco Canyon areas.

Even in the case of early 20th-century Orayvi, researchers have arrived at somewhat conflicting interpretations of the distributions of status, power, and wealth, so there is additionally a sense in which calculation of Gini coefficients for Orayvi helps clarify its social organization. Some ethnographers have described the Hopi as an egalitarian society lacking political organization (Eggan, 1950, 1966; Titiev, 1944). Others, such as Levy (1992) and Whitely (1987), recognized a political hierarchy based on two classes: *pavansinom* ("most important people") and *sukavungsinom* ("grass-roots people", or commoners). *Pavansinom* are primarily members of core segments of matrilineages (those of the prime lineage tied to the senior female clan member or "clan mother") who hold ritual offices. Levy (1992) argued that the inequitable distribution of land was the basis of inequality in Hopi society, with high-ranked clans owning better land and low-ranked clans owning poor lands or none. Within clans, members are ranked in an "internal hierarchy" (Bernardini, 2008) based on lineages with the clan mother controlling the ownership of a clan's land, ceremony, and oral tradition. Thus, at any given time, a single household within a clan holds these offices and privileges. Examination of the distribution of household wealth as proxied by house size across increasingly more inclusive social groupings at Orayvi, such as clans and phratries, helps adjudicate these partially conflicting views of Hopi society.

2. Theoretical and methodological framework

We view wealth as one of the fundamental underlying dimensions along which individuals, households, and larger social groupings in a society may vary. In some societies—and some *types* of societies—this dimension is typically muted; in others it is extremely prominent. Borgerhoff Mulder et al. (2009; Shenk et al., 2010; Smith et al., 2010a) differentiate three types of wealth: embodied, relational, and material. Embodied wealth can be expressed by factors such as body weight, grip strength, and reproductive success. Relational wealth is based on social positioning within food-sharing, trade, defense, or ceremonial-obligation networks. Material wealth consists primarily of those things that are defined as wealth in contemporary societies, including land, livestock, house, and household goods, including items of prestige.

Embodied and relational wealth tend to be prominent distinctions in hunter-gatherer and horticultural societies (Gurven et al., 2010; Smith et al., 2010b), though intergenerational transmission of such resources tends to be only low to moderate, generally resulting in low to moderate levels of wealth inequality in such societies. Possibly because material wealth is more controllable than embodied or relational wealth (Smith et al., 2010a), it appears to be more efficiently transmitted across generations than are embodied or relational wealth. Since material wealth distinctions are especially prominent in agricultural societies (Shenk et al., 2010), it is no surprise that such societies generally exhibit greater wealth inequalities than do hunter-gatherer and horticulturalist societies.

Many traditional anthropological and economic characterizations of society recognize the structural importance and fundamental nature of wealth differences. Differing modes of production (e.g., capitalist, tributary, kin-ordered) constitute specific sets of "social relations through which labor is deployed to wrest energy from nature by means of tools, skills, organization, and knowledge" (Wolf, 1982:75) and have differing implications for how wealth is accumulated and mobilized. Our interest here in modes of production is not intended to promote a return to the sort of classification-focused research that frequently plagued processualist evolutionary studies, but to call attention to the centrality of the classic questions asked by historical materialism: how is social labor organized; how are surpluses deployed; how can these maintain or change a political system (McGuire, 1986; Rosenswig and Cunningham, 2017)?

Kin-ordered systems such as the Hopi, as characterized by Eric Wolf, place upper limits on degree of internal wealth differentiation, though under conditions of "ecological closure" (i.e., limited resources) they "are still more likely to produce inequalities than an egalitarian distribution of life chances" (Wolf, 1982:94). Nevertheless, the absence of any mechanism "that can aggregate or mobilize social labor apart from the particular relations set up by kinship" (Wolf, 1982:95) tends to perpetuate the kin-ordered mode and its relatively modest inequalities.

The other mode of production of interest here is what Wolf termed tributary. Societies organized by this logic include segments of surplus producers and surplus takers, allowing households counted among the latter to aggregate wealth possibly far beyond their ability to produce it themselves. Wolf himself emphasizes the economic dimensions of these systems (e.g., 1982:99) but also notes that the "mechanisms of domination" that enable extraction of tribute from producers are "other than economic pressure" (1982:99). Quite a few scholars (recently, e.g., Froese and Manzanilla, 2018; Stanish, 2017) have recognized mobilizing ritual as critical to inducing social coordination without having to resort to costly coercive practices. Katherine Spielmann went so far as to define a "ritual mode of production" as allowing "economic intensification in small-scale societies" in a way that does not "emphasize the political aspirations of a few over the participatory necessity of the many" (Spielmann, 2002:202). Interestingly, she specifically identifies the societies organized around Chaco Canyon, the Ohio Hopewell, and Neolithic Britain as prominent examples of such organizations.

In this study, we begin by examining inequality among historic households from Orayvi (ca. 1901). In our study, we define "households" as the set of structures and features that were likely associated with or controlled by a family unit (either nuclear or extended). As we will see, these may include spaces that are not solely residential or domestic. Prior to our analysis of inequality, we briefly describe Hopi social organization and the 1906[1] split at Orayvi, to help put the Gini coefficients we will present from Orayvi in context. We also provide a

[1] All dates herein are AD/CE unless otherwise noted.

brief summary of previous investigations of ancestral Pueblo inequality, highlighting two studies utilizing the same methods and samples upon which we expand.

3. Hopi social organization and the Orayvi split

Hopi social organization consists of a set of hierarchical organizational levels crosscut by integrative ties generated via exogamy and membership in religious societies (Eggan, 1950:116–120; Titiev, 1944). The household is the smallest distinct social grouping and has been defined in different ways such as a matrilocal residence unit including in-married affines and unmarried male kin (Eggan, 1950:29-31) and a group of consanguineal individuals occupying a set of adjoining rooms (Titiev, 1944). In the following analysis, we rely on Mischa Titiev's definition of households at Orayvi. Although households are unnamed units in Hopi society, they have been recognized as its basic economic and social units (Connelly, 1979; Eggan, 1950; Levy, 1992; Rushforth and Upham, 1992; Whiteley 2008).

Households are arranged into unnamed matrilineages which are the next-more-inclusive level of Hopi social structure. Levy (1992) noted that lineages were ranked within Hopi society such that prime lineages consisted of the "clan mother", her brothers, and the family of one of her daughters who would become the next clan mother. Alternate lineages consisted of any of the clan mother's sisters who might inherit the position of clan mother should the clan mother's daughter die before her own daughters are old enough to inherit the position. The clan mother's nieces become heads of marginal lineages who would become the least likely to inherit the position of clan mother along with anyone else who has no clear relationship to the prime lineage. A clan consisted of all lineages descending from a fictive or stipulated female ancestor. Clans are totemically named, exogamous, corporate groups (Rushforth and Upham, 1992) which owned or controlled agricultural land, religious ceremonies, and clan houses.

The most-inclusive level of Hopi social structure below the pueblo itself was the phratry, comprised of associated clans. Phratries were also exogamous groups, preventing the formation of marriage alliances within these groups (Levy, 1992). The vertically organized system of household, lineage, clan, and phratry was crosscut by exogamy and by individuals' memberships in religious sodalities and kiva groups. Although clans controlled religious ceremonies and provided chief officers or priests, "common" members of each sodality came from other clans in a village. Kiva groups are another integrative social unit linking individuals from different descent groups. These groups were responsible for the construction and maintenance of specific kivas for religious ceremonies. An individual became a member of the kiva group responsible for the kiva in which they were initiated during tribal initiation ceremonies (Eggan, 1950:96). It seems likely that this system of kiva membership contrasts with that in the Pueblo societies we discuss below, where non-great kivas appear to develop from domestic pithouses and likely retained a strong association with a particular household or clan segment.

The Third Mesa Hopi village of Orayvi is possibly the oldest continuously occupied village in the United States, having been founded as early as the twelfth century (Hargrave, 1932). It became the largest of the Hopi pueblos (Titiev, 1944:72) after growing to almost 900 residents in the last three decades of the 19th century. Ethnographers have described Orayvi as the most conservative Hopi town because it rejected all attempts at directed culture change from the Spanish beginning around 1630 (Whiteley, 1988:5, 28–29) until the fissioning event in September 1906. In part because of this split, Orayvi has been the subject of intensive study.

In 1890 several Hopi chiefs were taken to Washington, D.C. to discuss the U.S. government's policy on the education and Americanization of Hopi children. Among those sent to D.C., Loololma, the chief of the Bear clan and village chief at Orayvi, agreed to accommodate Americanization requests. This met with great opposition at Orayvi, leading to the formation of two factions: one that sided with Loololma and supported assimilation of Euroamerican culture ("Friendlies") and one that opposed assimilation ("Hostiles"). Conflicts between these factions increased during the 1890s until the dispute climaxed on September 7, 1906.

Both social and economic factors have been described as causes for the split. Aside from the tensions generated by acculturative pressure on the Hopi (Clemmer, 1978; Hargrave, 1932), Titiev (1944) suggests that the Hopi social system was better adapted for smaller communities than the large population at Orayvi. Bernardini (1996) casts this same argument in terms of "scalar stress" (e.g., Johnson, 1982) stemming from problems of information flow in the decision-making processes at the large pueblo. Levy (1992) on the other hand identifies an inequity in the distribution and quality of agricultural land as an underlying cause for the split. Whiteley (2008:825) notes that a combination of internal and external factors contributed to the 1906 split. A division within and between maximal sets (i.e., phratries) formed prior to the split. The Bear clan (phratry set I) formed a disproportionate number of marriages with the Maasaw clan (phratry set II) and a similar pattern formed between the Spider and Kookop clans (also involving the same phratry sets); this resulted in a split of politico-ritual leadership with Friendly Bear/Maasaw control over their clan-affiliated ritual and village positions (Soyal and One-Horn societies and "peace chief office") in opposition to the Hostile Spider/Kookop control over their affiliated warriors society and village "war chief" office.

According to oral history, clans at Orayvi were ranked according to their order of arrival, with the Bear clan having greater access to high-quality land and ownership over more important ceremonies because it was the first to arrive. Some clans that did not formally own land were allotted portions of Bear clan land in exchange for their service in the Bear clan's Soyal ceremony (Levy, 1992:36). The Bear clan also owned a large tract of "free land" on which any individual could farm with the permission of the village chief (also a member of the Bear clan). Within clans, access to individual farming plots was determined by the clan mother, with marginal clans more often receiving poor quality land, or none. Levy (1992) found that members of marginal lineages, especially those with no land, were more often associated with the Hostiles.

For generations, archaeologists have relied upon contemporary pueblos such as Orayvi for interpretation of prehispanic archaeological remains in the Southwest, necessarily acknowledging the severe disruptions accompanying the Spanish conquest and subsequent Euro-American influences (Cordell and Plog, 1979). Thus, knowing the value of inequality indices such as the Gini coefficient for Orayvi can help in interpreting prehistoric inequality measures for ancestral Pueblo households elsewhere.

4. Previous analyses of ancestral Pueblo wealth inequality

Although numerous studies have examined social and political inequality in the Pueblo area, particularly in archaeology's processual years (see reviews in Kohler et al., 2018; Lekson, 2015), just three—McGuire (1983) (granting Paquimé a Puebloan identity), Kohler and Ellyson (2018), and Kohler and Higgins (2016)—have applied Gini coefficients to the study of ancestral Pueblo wealth inequality. Using a combination of residential and non-residential areas and measures of heterogeneity, McGuire (1983) found Ginis ranged between 0.2 and 0.8 for the Casas Grandes sequence in northwestern Chihuahua.[2]

[2] A number of investigators have used Ginis to to characterize inequality in other southwestern societies. McGuire (1983) calculated Ginis for the Hohokam sequence in the Gila Basin as ranging from 0.2 to 0.9. It is not clear though whether these, and those he calculated for the Casas Grandes sequence, are based strictly on household area. Pailes (2018) has recently offered an analysis reaching quite different conclusions—that Hohokam inequality at the household level varied little through time and rarely exceeded levels of around 0.30.

Table 1
Normalized Theil indices for households and more-inclusive groupings, Orayvi, 1900.

Group	Within group	Between group	Total Theil
Clan	0.138	0.017	0.155
Phratry	0.150	0.005	0.155
Faction	0.157	0.004	0.161
Post-split location*	0.154	0.010	0.164
Household type	0.137	0.005	0.142
Household size	0.133	0.008	0.142
Clanhouse	0.161	0.011	0.172
Female officers	0.162	0.003	0.162
Male officers	0.160	0.006	0.166
Herd Sheep	0.165	0.001	0.166

"Clanhouse" refers to households identified as clan houses by Whiteley (2008: Table 5.5) and coded as "Y" in Supplementary Table 1) which are here taken as a single group and compared to all other households. Houses identified by Whiteley (2008) as possible or alternative clan houses (coded as "P" in Supplementary Table 1) were excluded.
"Female officers" and "Male officers" refer to the grouping of households by whether or not their female or male household head held a sodality office.
* "Post-split location" refers to location of household following the 1906 split.

Investigations of household Ginis in the Dolores Archaeological Program (DAP) area (Kohler and Higgins 2016: Table 1) found that overall, the Basketmaker III/Pueblo I households in the DAP area exhibited relatively stable Gini values averaging about 0.28, a level typical of horticultural societies (Gurven et al., 2010).

This examination yielded some unanticipated results however. Ginis calculated on storage areas (arguably a measure of expected "income") are higher than those calculated on either residential areas alone, or residential areas plus the storage areas associated with each household. (These are interpreted as a measure of wealth.) Moreover, this contrast between Ginis calculated on storage and Ginis calculated on total household area is greater in villages, where the interhousehold ritual structures are located, than in hamlets. Their inference was that the rituals in these structures—whatever else they accomplished—tended to level income differences among households.

Kohler and Ellyson (2018) expanded the sample beyond the DAP to include additional CMV sites providing a longer temporal range (500–1285), and added Chaco Canyon households between 500 and 1145. The CMV and Chaco areas shared fairly similar Ginis from the mid-500s to the early 800s. When great houses such as Pueblo Bonito began to grow in the mid-800s, inequality increased markedly in Chaco, exceeding the mid-0.40 range expected in agricultural societies (Shenk et al., 2010). Ginis in the CMV remained relatively low until the mid-to-late 1000s, when the apparent expansion of Chacoan organizational forms and practices to the Mesa Verde region caused Gini coefficients in the two areas to equilibrate. After a late-1100s decline, Gini coefficients again increased in the CMV in the early-to-mid 1200s, perhaps as a result of a consolidation of power that Glowacki (2015) called the "McElmo Intensification." In general, except for the Pueblo II (PII) period, Gini scores for both areas hovered around 0.30. The median value for PII was strikingly higher, almost 0.5.

Second, they showed that Gini coefficients during periods of "exploration" were generally lower, but also much more variable, than those during periods of "exploitation." (Exploitation periods are marked by high frequencies of tree-ring dates, high proportions of cutting dates, the emergence of strong settlement clusters and the stylistic "canons" for each of the Pueblo periods; exploration periods were marked by disaggregation, fewer tree-ring dates and higher proportions of non-cutting dates, and experimentation with stylistic canons (Bocinsky et al., 2016).) Third, they showed that periods of exploitation, with their generally higher Ginis, often came to an end amid violence, ushering in periods of exploration with their generally lower Ginis—a finding that we will return to. Since periods of exploitation also terminate with climatic downturns, it is not clear if it was these downturns, or a revolt against high levels of inequality, that initiated the violence. Both may have played some role.

The proximate reason for the higher Ginis in Chaco-related contexts is simply the larger houses (great houses) of elites, but this study does little to clarify the reasons for their appearance. Differences in labor- vs. land limitations may have played some role; Chaco Canyon inhabitants were apparently more land-limited and CMV inhabitants were generally more labor-limited. If so, people caught up in the Chaco system may have had less ability to opt-out by relocating to other areas for farming than did inhabitants of the CMV. However, it is unlikely that such local considerations completely explain the sudden emergence of a few large houses in the mid-A.D. 800s in Chaco Canyon. A complete explanation will certainly need to include the development of an attractive ritual system featuring a novel symbolic repertoire including exotic connections to and materials from Postlassic Mesoamerica (George et al., 2018; Mathiowetz, 2018) apparently centered on a long-lived matrilineal dynasty (Kennett et al., 2017).

Kohler and Ellyson's (2018) study was hampered by small samples of households in several periods. Here we add households to both the CMV and Chaco samples, and more importantly bring two additional areas, the MSJ and the Chuskas, into the analysis.

5. Samples and methods

5.1. Orayvi

Catherine Cameron combined household census data from Titiev (1944) and the U.S. Census for 1900 (United States Census of Population 1900) into her own study of household architecture at Orayvi covering the period from the late 1800s to the early 1900s (Cameron 1999a, 1999b). We have floor areas for 156 households from Orayvi in 1900 from this study (Supplementary Table 1). For 144 of these we have clan, phratry, and faction affiliation for the female household head. A subset of 91 households has been coded for household type (e.g., 'nuclear', 'couple', 'extended', and 'other'), and household size (in number of persons), as reported in (Cameron, 1999a, 1999b). We also include information on clanhouse designations reported by Whiteley (2008: Table 5.5).[3]

5.2. Prehispanic Southwest

Our sample for the prehispanic Southwest (Fig. 1, Table 2,

(footnote continued)
More recently still, Vésteinsson et al. (2019) computed Ginis based on household areas for selected Mimbres and Hohokam sites, calculating indices up to 0.46 for Ballcourt-era Grewe (Hohokam) but quite low values of around 0.20 for the Classic-period Mimbres sites Cameron Creek and Swarts Ruin.

[3] Whiteley (2008) draws upon notes from Titiev (1944) to identify the most likely clanhouse locations (coded "Y" in our Supplementary Table 1) and other alternative clanhouse locations (coded in Supplementary Table 1 as "P") depending upon Whitely's uncertainty due to several factors such as whether and where certain clan members were living at the time of the split. Another confounding factor leading to uncertainty in clanhouse designations is Whitely's uncertainty whether some of Titiev's clan assignments were accurate, or designated related branches of the same clan. For example, the Najavo Badger clan might be a related segment of the Gray (or "Real") Badger clan. Also, Whitely (2008:22–28, 46–61, 218) questions the validity of some of Titiev's clan designations due to such possible interrelatedness between clans and Titiev's rejection of some clan designations (e.g., Tobacco). In our data, we rely upon Titiev's clan designations for female household heads. Households that were not identified as possible clanhouse locations were coded as "N" in Supplementary Table 1.

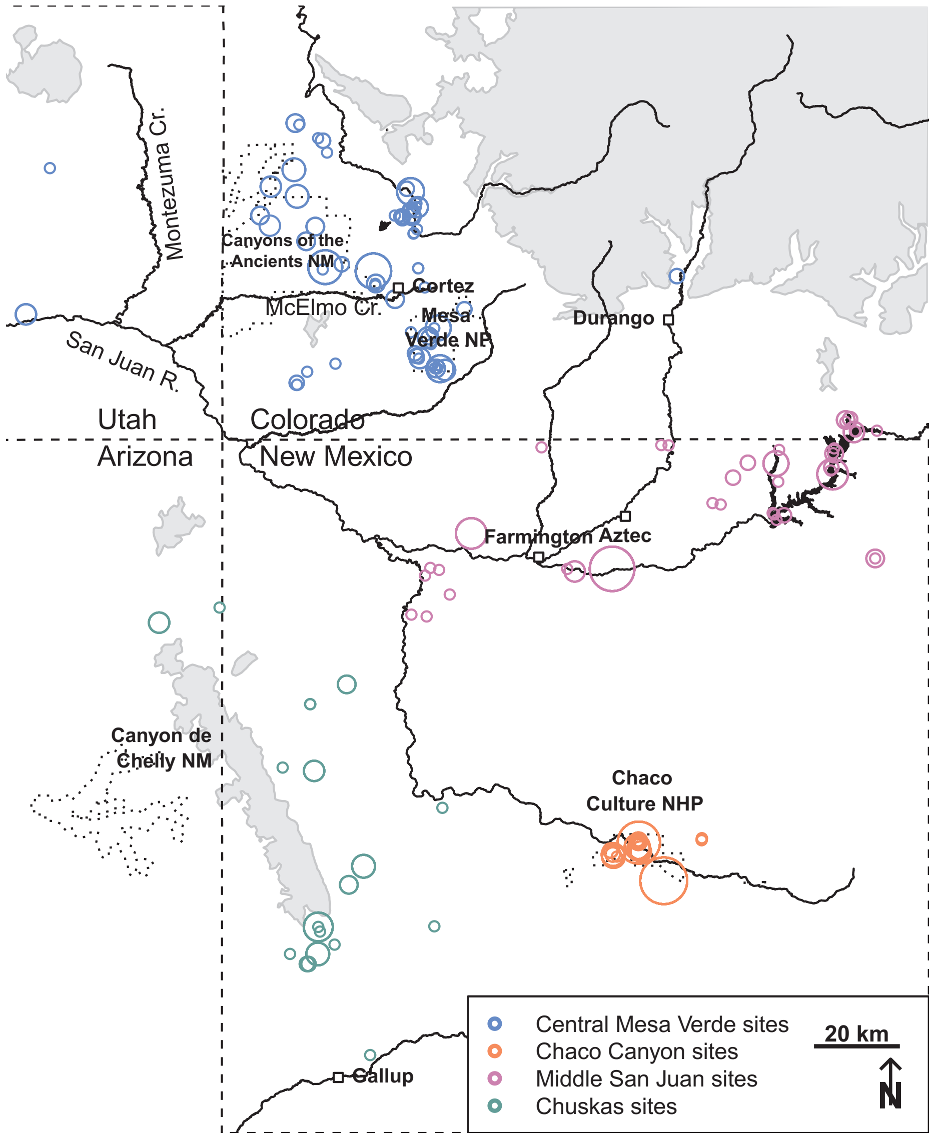

Fig. 1. Site locations in the four ancestral Pueblo regions analyzed. Symbol size is proportional to number of houses in the sample at each site.

Table 2
Sample sizes and Gini coefficients by subperiod and region. Explore- and Exploit-period dates after Bocinsky et al. (2016).

Subperiod	Dates	Chaco N	Chaco Gini	CMV[a] N	CMV Gini	Chuskas[b] N	Chuskas Gini	MSJ[c] N	MSJ Gini	Total Gini
BMII	345 BCE– CE 500	—	—	5	0.27	5	0.43	17	0.42	0.47
BMIII Explore	500–600	9	0.29	6	0.27	—	—	5	0.32	0.28
BMIII Exploit	601–700	14	0.26	22	0.34	12	0.34	4	0.42	0.39
PI Explore	701–790	4	0.22	11	0.30	11	0.26	7	0.29	0.26
PI Exploit	791–890	5	0.69	33	0.29	4	0.21	12	0.31	0.38
PII Explore	891–1035	9	0.49	18	0.24	3	0.26	14	0.32	0.61
PII Exploit	1036–1145	43	0.45	34	0.35	7	0.29	23	0.27	0.38
PIII Explore	1146–1200	2	0.23	12	0.23	—	—	12	0.41	0.32
PIII Exploit	1201–1285	—	—	22	0.30	4	0.20	1	—	0.29
Total households		86		163		46		94		

[a] CMV = Central Mesa Verde.
[b] Chuskas = Chuska Mountains and Chuska Valley.
[c] MSJ = Middle San Juan.

Supplementary Table 2) includes 163 households from the central Mesa Verde region (CMV) and 86 households from Chaco Canyon. These samples include the 38 households from the DAP area first reported by Kohler and Higgins (2016) and the 66 additional households examined by Kohler and Ellyson (2018) from the CMV and the 73 households from Chaco Canyon. This study thus contributes an additional 59 households for the CMV and 13 households for Chaco Canyon. The addition of households from great houses such as Lowry Pueblo, Edge of the Cedars, and Bluff[4] improves the CMV PII sample which contained few households from Chacoan great houses. We also include additional post-1200 households from the Bis Sa'ani Community of Chaco Canyon, extending the temporal coverage of the Chaco sample to the 1200s. Our prehispanic dataset also includes 94 households from the MSJ and 47 households from the Chuska Valley and Chuska Mountains. Many of the MSJ and Chuska samples are derived from CRM survey projects. Unfortunately we do not have any households from the early Basketmaker III period (500–600) or the early Pueblo III period (1146–1200) in the Chuska area. Our MSJ sample includes only one household from the late Pueblo III period (1201–1285) making calculation of house-size distributions impossible. Several great houses, such as Aztec Pueblo in the MSJ and Skunk Springs in the Chuska Valley, are well known but have not been reported in such a way that we could incorporate them in this study, as we rely primarily upon investigators' definitions of household units.

Supplementary Table 2 contains the complete list of sites in this study and citations of their reports. Our criteria for inclusion were relatively precise dating and excavation that was complete enough to identify the area associated with each household. Generally, we include only cases where the complete architectural suite[5] belonging to a household was identified by the original investigators. The Supplementary Materials contain more details on our measurement protocol. We were unable to include very long-occupied multi-story great houses in most cases because of the impossibility of identifying households, though Supplementary Table 2 lists a few exceptions such as the earliest portions of Pueblo Bonito[6] and most of the site of Pueblo Alto. As a result our Gini coefficients for the Pueblo II period are likely conservative.

We acknowledge great disparities in interpretation over the years as to how great houses were used and how many people they housed over what portions of the year (Bernardini, 1999; Lekson, 1984; Stein and Fowler, 1996; Ware, 2018; Windes, 1984). Although we tend to agree with those who say that relatively few people lived year-around in Chaco great houses and these were periodically joined by many others, all that matters for our approach here is that their residents were elite. That much at least seems clear and that is what the Gini Coefficients are intended to show.

5.3. Gini and Theil coefficients

The Gini coefficient has been used widely to measure income or wealth inequality within societies (Cowell 2011; Lindert and Williamson 2016; Milanovic 2011a, 2011b, 2016). Named after its inventor, demographer and statistician Corrado Gini (Salvemini 1978), the Gini coefficient measures the degree of concentration of a quantity among the units of a population. Gini coefficients range from 0 to near 1, with higher values representing increasing inequality (a few households controlling more of the wealth). In our case, high Gini values are generated by samples in which one or a few houses are much larger than the others.

Although the common use of the Gini makes it attractive for comparative purposes, it has some drawbacks (Peterson and Drennan, 2018). For the particular case of Orayvi we have data on clan and phratry membership along with estimates of total household areas embedded in these larger units. The Gini cannot be used to compare within and between group differences in wealth and can only be applied to the entire household distribution without differentiation into subgroups. The normailized Theil Index (Cowell, 2000; Raj, 1992), named after economist Henri Theil, is by contrast decomposable in this way, providing measures for between and within subgroup wealth differentiation. This measurement relies on having a statistical population rather than sample data, preventing its use in our archaeological case, but permitting it for Orayvi.

The Theil index generally provides lower values than the Gini coefficient. Given that the Hopi ~ 1900 were a mixed horticultural and pastoral society (that is, they did not typically use plows, derived animal protein almost exclusively from herding sheep, produced primarily for the household rather than cash-cropping, with labor likely limiting production more than land), we expect Gini values for Orayvi somewhere between 0.27 and 0.47, based on the average Ginis found by Gurven et al. (2010; Borgerhoff Mulder et al., 2009) for 15 horticulturalist and 5 pastoralist wealth measures.[7] If inequality was primarily among households, we expect Theil indices evaluated at the clan level to be higher within-group than between-group. Alternatively, if the major sources of inequality at Orayvi were between clans, then we would expect higher between-group Theil indices than within-group values when evaluated at the clan level.[8] This same logic holds for the other comparisons, for example at the level of phratries or factions.

6. Results

6.1. Orayvi

When households are considered without any subgrouping, the overall Gini coefficient is 0.32 with an 80% confidence interval between 0.30 and 0.35. When we examine the Theil index by clan, phratry, and faction, we find that inequality tends be more pronounced among households than among clans, phratries or factions (Table 1). In particular, about 89% (0.138/0.155) of the total wealth differentiation is associated with households, and only 11% is associated with their clan membership. This supports Levy's (1992), Connelly's (1979), and Eggan's (1950) view that the household was the most important economic unit. The low inequality measures among various groupings of households seem to support Levy's (1992) interpretation that there was a degree of social integration maintained by endogamous marriage restrictions, opening up membership in clan-controlled sodalities to all individuals. Our findings fit less comfortably with Eggan's view that clans and phratries tended to "assert their position at the expense of the village." Instead, it seems inequality may have been predominately household or lineage-based as Levy (1992) and others suggest. This is

[4] Our household measurements from Bluff Great House rely upon several inferred rooms and are thus tentative.

[5] In most of our prehistoric cases, an "architectural suite" consisted of a pitstructure or kiva and any associated external storage pits and/or surface rooms, as determined by site investigators. Exceptions to this include Salmon Pueblo where earlier household suites did not include kivas and Bluff Great House where suites are tentatively inferred here. Public or communal architecture such as Great Kivas, D-shaped tri- or bi-wall structures, and towers were excluded from our analyses. Unless otherwise specified by the original investigators, areas for multi-story rooms were assumed to be the same size as the ground floor. All multi-story rooms are indicated with "(N stories)", where N is the number of stories indicated or assumed by investigators, next to each room number in the "Comment" column of Supplementary Table 2.

[6] Our Pueblo Bonito households are based upon Wilshusen and Van Dyke's (2006; from Lekson 1984) assessment; however, we recognize that Wesley Bernardini (1999) proposed up to 11–12 household suites for early Pueblo Bonito compared to our 6. In a general comparison to Bernardini's household assignments, our early Bonito households based on Wilshusen and Van Dyke (2006), comprise of 2 of Bernardini's "suites" each. Room sizes were estimated using dimensions reported by Roberts (1964). Kiva estimates were derived from total suite estimates made by Windes (1987:340).

[7] Although Gurven et al. (2010) Ginis are not based on house sizes, Kohler et al. (2017, 2018; Kohler and Ellyson 2018) found that Ginis based on house sizes yield Gini values close to those yielded by other measures, such as Ginis calculated on field size or fertility.

[8] All analyses were conducted in R. Gini coefficients were calculated using the package "DescTools" (Signorell et al., 2018) specifying the "Gini" function with 1500 bootstrapping replications and 80% bias-corrected confidence intervals. The normalized Theil index (TT) was calculated using the "decompGEI" function with alpha = 1 and ELMO = 0 from the package "IC2" (Plat, 2012).

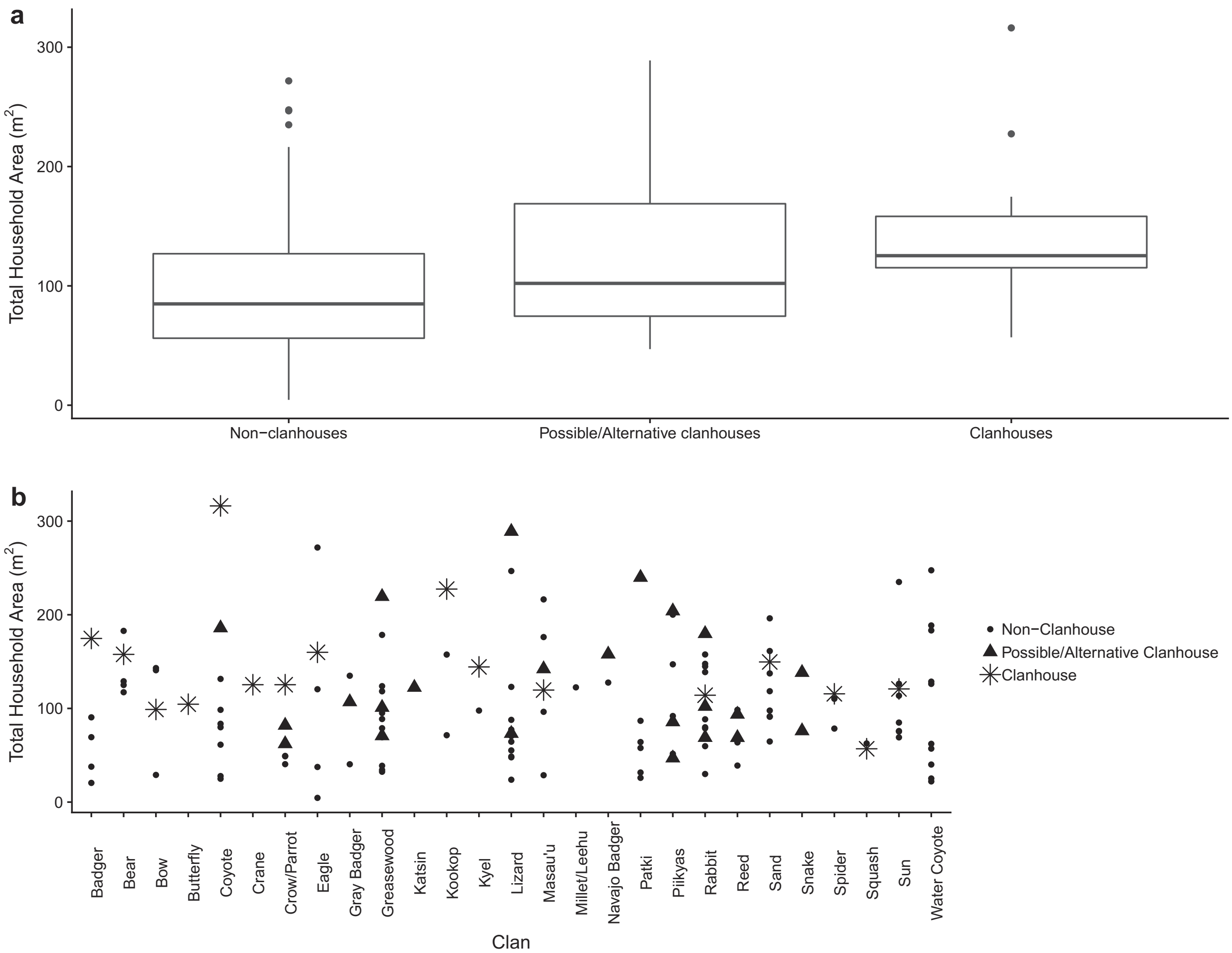

Fig. 2. A: Boxplot of total household areas for Orayvi clanhouses reported by Whiteley (2008: Table 5.5). B: Scatterplot of total area distributions by clan affiliation of female household heads. “Clanhouse” refers to clanhouses confidently reported by Whitely. “Possible/Alternative Clanhouses” refers to alternative locations proposed by Whitely in cases where multiple options for clanhouse locations existed (see endnotes for Whiteley, 2008: Table 5.5). “Non-clanhouses” refers to all other households.

further supported by greater within-group inequality at the clanhouse level. Based on total area, clanhouses (both confidently identified ones and alternative/less confidently identified ones) were typically the largest houses overall at Orayvi (Fig. 2a) and in each clan (Fig. 2b).

The finding that most of the variability in our wealth proxy at Orayvi is among households (rather than, say, among clans or phratries) tends to vindicate our focus in the remainder of this article on measuring wealth inequality at the level of the household.

6.2. Ancestral Pueblo

Table 2 reports Gini coefficients for ancestral Pueblo households, arranged by region and subperiod. Fig. 3a plots these same Ginis through time for each region along with the Gini and confidence interval calculated for Orayvi at 1901. The “All” series reports Ginis calculated for all prehispanic households in each period aggregated into a single sample (ignoring regional locations). Each series is plotted on the eight midpoints of the exploration/exploitation subdivisions of each of the four Pecos periods, producing a temporal resolution of approximately one century on average. Additionally, for the CMV, Chuska and MSJ samples, we include a Gini value for households dating from the late Basketmaker II to the early Basketmaker III period (345 BCE–AD 500), which we plot at AD 300. Although the Durango Basketmaker II households (e.g., Talus Village) are usually considered part of an Eastern Mesa Verde region (Bellorado, 2013; Charles and Cole, 2006; Charles et al., 2006; Matson, 2006; Mowrer, 2006), we include them with CMV due to the broad distribution of Basketmaker II sites in the northern San Juan region. Fig. 4 displays the size distributions (area in m^2) of houses underlying the Gini calculations in Fig. 2 with the mean of all households plotted as a straight line. This allows us to monitor how median house size changes through time and across regions. Comparison of these two figures shows that high Gini values result from distributions of house size with one or more positive outliers and/or a left-skewed distribution of house sizes in which the median approaches the upper hinge.

Prior to ~600, the MSJ and Chuskas are marked by unexpectedly high Ginis. By the mid-600s, however, Chuska society became more equal (similar to ~1900 Hopi society in that respect) as its Gini value decreased, though the 80% confidence intervals for the MSJ and Chuskas do overlap throughout these centuries. The mid-600s increase in the MSJ Gini might be related to differences between upland (dryland farming) and lowland (alluvial fan farming) settlements (Bellorado 2013; Bellorado and Anderson 2013; Charles and Cole 2006; Mowrer 2006). In contrast, Ginis in the CMV, where dry farming is the dominant production regime, remain low into the mid-500s. When households from Chaco enter our sample in the mid-500s, they exhibit Gini values similar to those in the CMV, and below those calculated for historic Orayvi. The value for Chaco soars during the mid-800s however and remains high for the next 250 years. In contrast, CMV, Chuskas, and MSJ Ginis remained low during the ninth and tenth centuries. Wealth

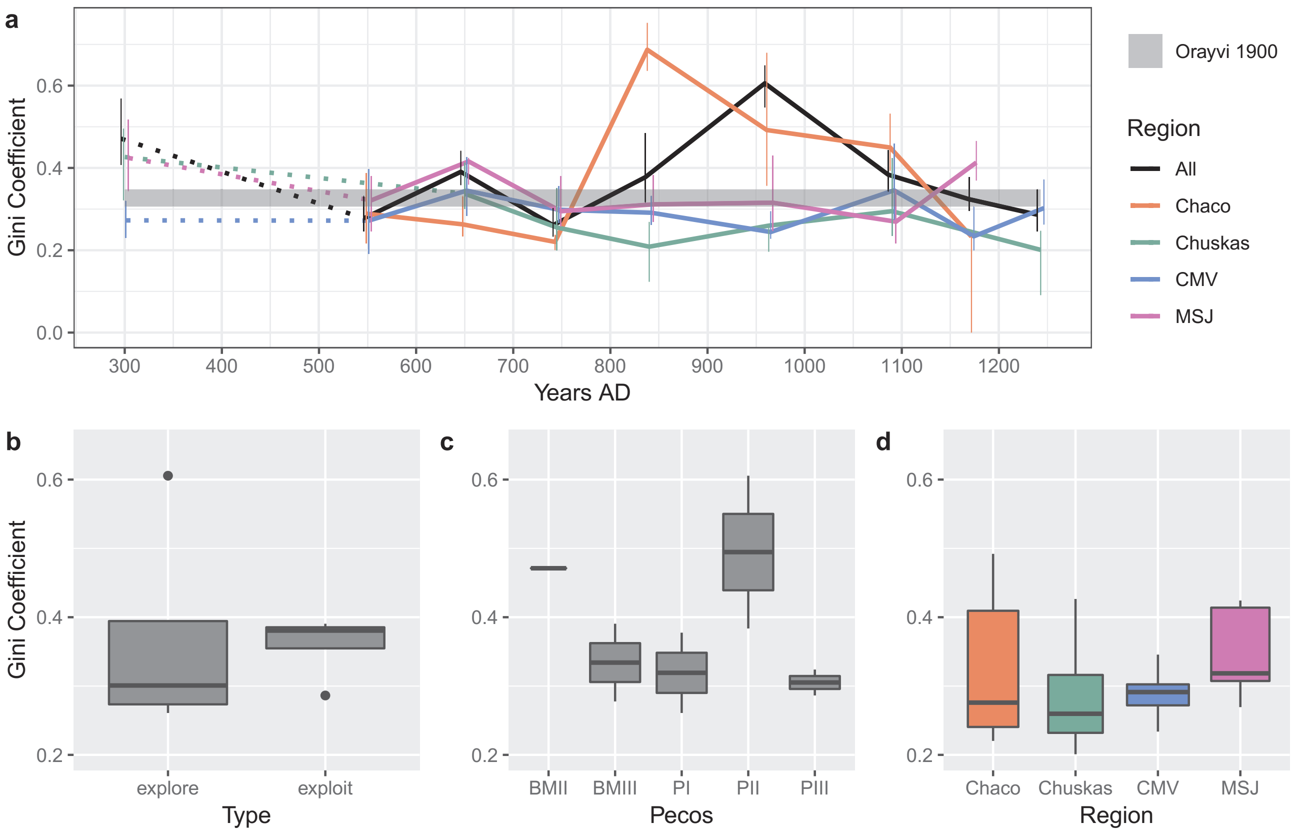

Fig. 3. A: Gini coefficients derived from house-size distributions in the CMV, Chaco, MSJ, and Chuska regions, and all regions pooled. B: Ginis by the exploration and exploitation subperiod types (all houses, all regions pooled). C: Ginis by Pecos periods (all houses, all regions pooled). D: Ginis by region (all periods pooled).

disparities in the Chuskas increased during the late 1000s (though still remaining comparatively low) possibly responding to the fact that the Chuskas by that time were a source of timber, fauna, and maize resources for Chaco (Benson et al., 2003; Cameron, 1984, 2001; Cordell et al., 2008; English et al., 2001; Grimstead, 2010; Grimstead et al., 2016). The increasing Ginis in the Chuska area in the 900s and 1000s are also influenced by households derived from Chacoan Outlier settlement clusters[9] including Sitting Coyote Mesa (NM-Q-15-46) which was contemporaneously occupied and located near Figueredo Great House (Murrell et al., 2014:682). Wealth disparities also increased in the CMV from the mid-900s to the late-1000s as the Chaco regional system expands into southwestern Colorado and southeastern Utah. Wealth disparities increased dramatically in the MSJ in the mid-1100s even as they decreased in the CMV. Finally, Ginis increased markedly in the CMV in the mid-1200s prior to the depopulation of all the areas included in our prehispanic sample.

Brown, Reed, and Glowacki (2014) suggest Salmon Pueblo (founded around 1090) was one of the first MSJ sites built under Chacoan influence, possibly by Chaco Canyon migrants. Wheelbarger (2008) however suggests that other smaller Chacoan great houses in this region date as early as 1050. Brown, Reed, and Glowacki suggest that the MSJ experienced a period of reorganization evidenced by a decline in large-scale construction and long-distance trade following the demise of Chaco in Chaco Canyon in the mid-CE 1100s. The relatively low value we calculate for MSJ Ginis at this time seems in line with this reconstruction. Further evidence suggests that the MSJ briefly became the regional center of an ancestral Pueblo regional system prior to the depopulation of the Central Mesa Verde in the mid-to-late 1200s (Glowacki, 2015; Lekson 1999, 2015). Unfortunately, our current sample does not contain enough households to calculate a Gini for the 1200s in the MSJ, although our sample does suggest that this area harbors the highest wealth inequalities in the northern Southwest in the late 1100s.

Examination of our subregions together (the “All” series), shows that the level of wealth differentiation was already high early in the first millennium AD (but see discussion below) and tended to decline until the mid-800s rise of Chaco. Fig. 3b displays the Gini coefficients by their membership in either the exploration or the exploitation subperiods, using the calculations derived from all houses in all areas. Confirming on a larger sample the results of Kohler and Ellyson (2018), we find that there is a larger range of variation in Ginis in the exploration than in the exploitation periods. Exploitation periods still exhibit the higher median Gini values previously noted by Kohler and Ellyson (2018). The BMII period was not considered in the original definition of these subperiods (Bocinsky et al., 2016) and so is not included in this comparison.

Another way of examining the distribution of Ginis is to organize them by Pecos period (Fig. 3c). When divided this way, inequality seems to “start” high, decline, and resurge in the Pueblo II period before declining once more. The apparently high wealth inequalities in BMII were surprising to us, and we return to this below.

Fig. 3d divides the sequence by region. Compared with the other regions, Chaco has the greatest variation in Ginis; however, the median Gini is highest in the MSJ. The CMV has the narrowest distribution of Ginis. These differences might be connected to differences in dominant maize-farming strategies. Alluvial fan and irrigation farming (Newberry, 1876; Reed, 2008; Vivian, 1974) were practiced in the MSJ in addition to dry-land farming, perhaps leading to overall higher maize yields and more (manipulable) surplus than the dry-farming regimes more common in the other regions. Alternatively, or additionally, the

[9] Sitting Coyote Village and other community clusters near Figueredo Great House include Chaco black-on-white pottery, supporting Chacoan ties to these clusters (Murrell et al., 2014: 681, 699, 764).

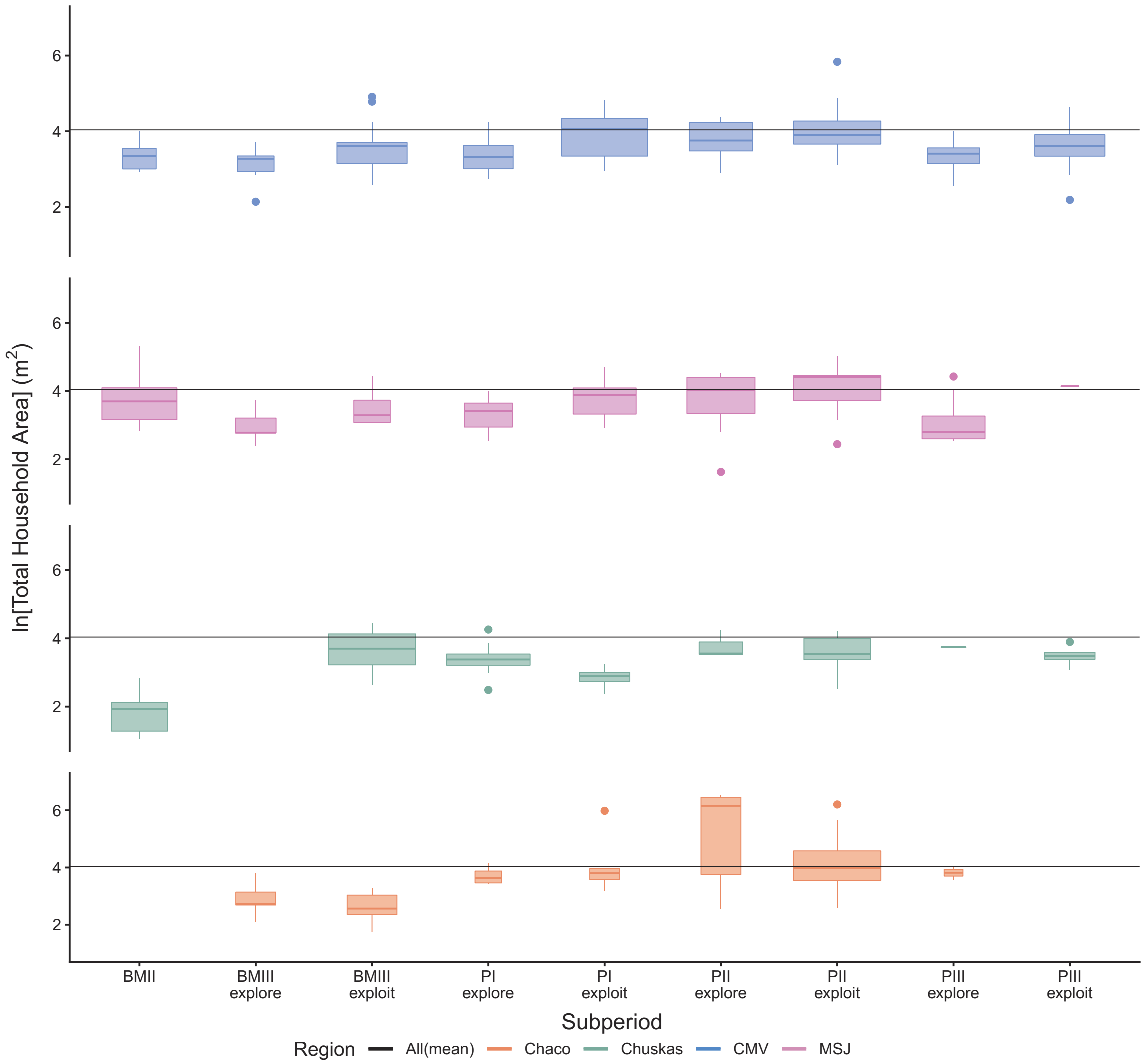

Fig. 4. Boxplots of household areas by region and period. Note that house sizes have been re-expressed by their natural logarithms and that box widths are proportional to sample size in each period. The mean of all households (disregarding temporal or regional partitions) is plotted for reference.

high Ginis in the MSJ may represent real wealth differences between households well placed to profit from irrigation, and those less advantaged.

7. Discussion

When Orayvi households are considered without any subgrouping, the overall Gini coefficient is 0.32 with an 80% confidence interval between 0.30 and 0.35, suggesting a level of wealth inequality typical of horticultural societies, though slightly on the high side—perhaps influenced slightly by sources of income from pastoralism. In short, there is nothing surprising about a value of 0.32 for Orayvi, and it provides a useful comparison for the prehispanic values. Our finding that wealth inequality in early-20th-century Orayvi was structured more at the household than at the clan level (i.e., exhibited most variance among households) is though somewhat surprising. Levy's (1992) inference—that inequality derived mostly from inequities in quality and amount of agricultural land owned by lineages, is strengthened by this finding. That these inequities are not much reflected beyond the level of lineages may be attributable to the integrative mechanisms of marriage exogamy and open sodality and kiva group memberships that prevented the formation of alliances between clans within the same phratry.

Although a strength of Fig. 3 is its direct comparison of our regions through time, a weakness is that it overlooks the relationship of measures of inequality with many potentially important contextual variables. For two of our regions we have momentary population estimates. For the CMV these come from the Village Ecodynamics Project northern research area (VEPIIN; Schwindt et al., 2016), the core portion of the CMV; for the MSJ, from Brown et al. (2014). Fig. 5 plots the trajectories through time of these two regions in the phase space of standardized population estimates and Gini coefficients; the plot for the CMV is more informative because we can distinguish so many more periods there. This style of plot emphasizes the dynamic processes that societies undergo through time, whereas the more traditional scatterplot emphasizes the variables by simply placing societies in the space they define, regardless of their temporality.

In contrast to Figs. 3 and 4, Fig. 5 uses the VEP periods, allowing a temporal precision of about 50 years on average—twice that of Figs. 3 and 4. For the CMV Fig. 5 picks out two fairly distinct regions in phase space. Prior to the mid-1000s, societies exhibited relatively low populations and variable, though usually low, wealth inequality. In this first cycle, surprisingly, wealth inequality peaks ~660 and ~820 rather than at the height of the PI village development, ~860.

CMV societies explored a distinct, higher-population portion of the phase space in the last two centuries they occupied this region. The hinge between these two regions is the 1060–1100 period, graphed at 1080, which marks the first direct influence of the Chacoan regime. From 1080 to 1270, wealth inequality was highly variable, peaking in

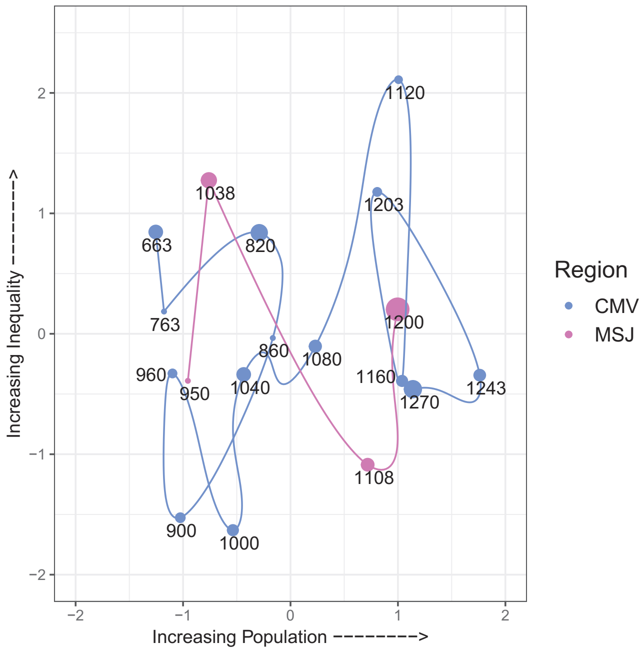

Fig. 5. Plot of Z-scores through time for population estimates (x-axis) and Gini coefficients (y-axis) for the CMV and MSJ series. Population estimates for the CMV are from Schwindt et al. (2016); for the MSJ the estimates are from Brown et al. (2014). The CMV sample is periodized to the VEP schema (~50 years on average); the MSJ sample is periodized to the Brown et al. (2014) schema (~65-year increments on average, note EPII/1145-1175 and LPIII/1225-1291 periods are absent as we could not locate measurable households dating to these periods). Symbol size reflects number of houses in the sample in each time slice.

the early 1100s, crashing 40 years later, and climbing once more in the early 1200s before beginning a final decline. The low value in 1160 may be explained in part by the small sample of houses during the 1140–1180 period; however, out of the 7 households from this period, one household each are from the great houses at Albert Porter and Escalante and the alcove site of Two Raven House.

It is interesting how little village life, at least in the PI villages, increases inequality. In fact, inequality values are higher both before (in the BMII period) and after the termination of the PI villages, in the PII period. As Fig. 3c shows, the BMIII, PI, and PIII periods all have median Gini values around 0.3, similar to those calculated for Orayvi and within the range expected for horticultural societies (Gurven et al., 2010:61), whereas BMII and PII values typically exceed 0.4. We suggest that as BMIII and early PI populations began to settle into large villages, they began to participate in leveling ritual or reorganized socially with the incorporation of endogamous marriage restrictions or other integrative mechanisms such as those discussed above for Hopi society. Wilshusen et al. (2012b:208) suggest that PI village formation brought about the unification of private and public ritual. They and others (Potter, 2012; Wilshusen et al., 2012a; Wilshusen and Potter, 2010) argue that the heart of political organization and power in these early villages lay in community socio-religious institutions, feasting, control of ritual knowledge, and security rather than in conspicuous individual, household, or corporate wealth differences. Kohler and Higgins (2016) too argued that PI ritual likely had "leveling effects" within villages even though some corporate groups were differentiated by their architectural facilities. Similar arguments have been proposed for early villages in the Near East (Kuijt, 2000).

The high Gini values in the BMII period from the Chuskas and MSJ (Fig. 3a) are intriguing but possibly suspect. These samples consist of just 5 houses from the Chuskas and 17 from the MSJ. The Chuska samples range in date to the early BMII period (~390–345BCE) and come from the southern Chuska Valley. Monica Murrell and colleagues (Ciolek-Torello et al., 2014; Murrell et al., 2014) define these structures as houses, but also report that they may well be seasonal reoccupations of the same area; therefore, the variation in the sizes of these structures might reflect differences in sizes between summer and winter habitations (see also Geib's (2011) distinction between 'primary' and 'secondary' BMII habitations). Given their proximity to the boundary between Western and Eastern Mesa Verde, these households might reflect a mixture of these two identities in our sample (Bellorado, 2013; Charles and Cole, 2006; Charles et al., 2006; Matson, 2006; Mowrer, 2006). For somewhat later Chuska contexts, however, there is corroborating evidence for some wealth inequality. For example, Kearns (1998) reported that 8 of 12 individuals buried at a late Basketmaker III site in the Tohatchi Flats area, southern Chuska Valley, were associated with grave goods such as shell jewelry; these goods were found among both children and adults. The presence of other exotic material goods in some burials and possible status distinctions in rock art also supports the existence of relatively prominent wealth distinctions during this time (Charles and Cole, 2006; Mowrer, 2006).

For the pre-BMIII MSJ case, the houses in our sample are from the Navajo Reservoir Project area and Fruitland area, which date between AD 400 and 500 based on corrected dates for the Los Pinos Phase (Charles et al., 2006; Hovezak and Sesler, 2006). One of these, a pithouse from the Cemetery Site (LA 4384), may represent a "proto-kiva" (Eddy, 1966). With an area of approximately 60 m^2, this is not even the largest pitstructure in our pre-BMIII MSJ sample—that is Structure 1 from the Power Pole Site (LA 4257) which had a total floor area of approximately 200.1 m^2. In general, we are more inclined to believe that the house-size proxy is reflecting real wealth differences for the terminal BMII/early BMIII MSJ than for the Chuska case.

The prevalence at Chaco of material goods from the Chuska area and the similarities in pithouse architecture in these two areas indicate longstanding ties in place by 770 or earlier (Miller, 2018; Toll, 1991:100, 2006:133). In addition to providing material resources, people originating in the Chuskas may have participated in initial construction and development of great houses in Chaco Canyon. It is possibly relevant that inequality declined in the mid-AD 800s in the Chuskas as it rapidly increased in Chaco. Finally, although 9th-century migration from the CMV has often been proposed as a stimulus to Chaco's earliest great houses, analysis of ceramic similarities seems to show that Chaco's most important linkages are to the west (including our Chuska area) and southwest, and not to the north, in the three 50-year periods from AD 850 to 1000 (Mills et al., 2018: Figs. 3 and 4).

The suggestion that maintaining household equality was a focus of PI ritual (though perhaps not of PII ritual, unless that focus had become more ostensible than real) implies that inequality was not just an abstract variable but was a deeply felt part of the social experience. If so, did the periodically high levels of inequality noted in Fig. 3 have any visible social effects?

We can begin to address this question for the CMV subarea. Fig. 6 plots the time series of violence (measured by the proportion of traumatized human remains compiled by Cole (2012)) at the midpoints of each VEP period, against the time series of Gini coefficients.[10] With the partial exception of the local peak in violence in the late-1000s, peaks in violence terminate periods of relatively high inequality (see also Kohler and Ellyson, 2018:144–147). When Gini values in the CMV surpassed about 0.30 (the value for Orayvi at 1900 when it was marked by high social tensions between Hostiles/those without land and Friendlies/those with land), a peak in violence soon followed.

Causation here may not be so straightforward, though. The declines

[10] This is similar to Fig. 5.3 in Kohler and Ellyson (2018) except that here the Ginis are computed on larger samples, and periodized to the same VEP schema as the violence series. Ginis are plotted across the start and end dates of each VEP period with violence plotted on the midpoints of each period.

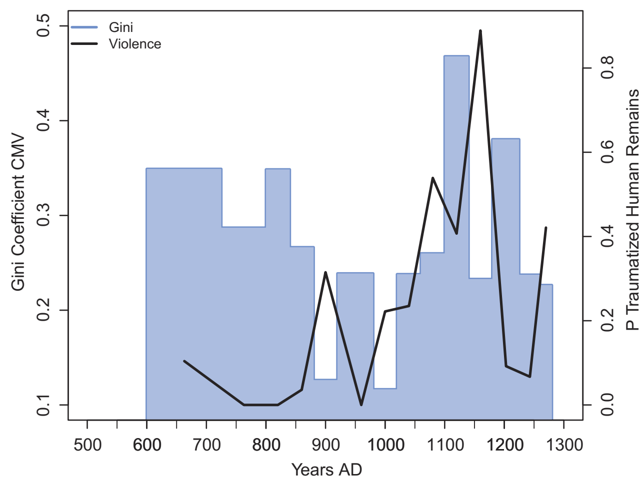

Fig. 6. Wealth inequality (in blocky histogram, proxied by Gini coefficients on house size) versus violence (in black line, proxied by proportions of sets of human remains with violent trauma) through time, central Mesa Verde region. Ginis are plotted across the start and end dates for each period whereas violence is plotted on period midpoints.

in inequality at the end of PI, PII, and PIII periods were also accompanied by climatic downturns constricting the size of the maize dry-farming niche (Bocinsky et al., 2016). The concomitant increases in violence at the ends of those periods may have been a direct result of those climatic events, or may have been connected to settling old social scores as stable regimes came to an end. Teasing out the causation here should be a high priority for future research. The larger point is that inequality is more than a condition; it has the possibility of becoming a motivation for action. Clastres (1977), Trigger (2003), and many others have demonstrated that social and political equality and the suppression of hierarchy were actively sought goals in a number of small-scale and middle-range societies.

In a recent study comparing the dimensions of inequality through time in the North Atlantic and the southern US Southwest, Vésteinsson et al. (2019) conclude that across their samples, unequal access to ritual space is the most consistent indicator of inequality. In Iceland after the introduction of Christianity ca. 1000, and in Greenland, ritual spaces were churches (frequently with cemeteries) associated with farms. In the Hohokam area in the eighth through twelfth centuries, these were cemeteries, community rooms perhaps serving as council chambers, and ballcourts; in the thirteenth and fourteenth centuries, these were platform mounds. In the Mimbres sites they discuss, ritual spaces included, first, great kivas and informal plazas, then small kivas, and eventually, in the Classic period, enclosed plazas incorporated into roomblocks sometimes containing large ceremonial rooms, and sometimes associated with small kivas. They argue that the unequal access of households to ritual resources in both the North Atlantic and southwestern societies would have been more acutely experienced than was the differential access to exotic goods and special objects, and productive resources, that they also document.

In this light it would be worth examining the differential degree of access of households to Great Kivas as another dimension of inequality in Pueblo societies. Obviously, we make no claims that our analysis exhausts the pertinent information about Pueblo inequality. Other relevant considerations might include quality and cost of household construction, centrality of houses within communities, access to superior productive land, water, game, and exotic or difficult-to-produce goods and materials having ritual power, health and stature, order of arrival, and so on. Our goal has been to systematically explore just one of these aspects. We predict that these other dimensions will prove to be partially and positively correlated with our single measure, with the differences shedding light on other social and political dimensions of inequality.

8. Conclusion

Throughout the 1980s and even into the 1990s, southwestern archaeologists were frequently at odds over whether the ethnographically known Pueblo peoples—and especially the Hopi—provided useful models for sociopolitical organization in the prehispanic Pueblo Southwest (Bernardini, 1996; McGuire and Saitta, 1996; Mills, 2000; Rautman, 1998; Saitta and McGuire, 1998). At this point we can see some merit in the positions of both sides in that dispute. Our analysis suggests that household wealth inequality, at least, hovered near the values we compute for early twentieth-century Orayvi during much of the BMIII, PI, and PIII periods. Although full descriptions of sociopolitical organization must consider many dimensions while here we consider only one, nevertheless degree of household wealth inequality is likely intimately connected with such traditional anthropological concerns as differential status, authority, and power, and traditional archaeological markers of decision-making hierarchies such as settlement hierarchies. Overall, we have shown that the applicability of Hopi-like models to prehispanic wealth inequalities depends entirely on the regions and periods under consideration.

We identify one especially prominent excursion from Hopi-like levels of household wealth inequality in our prehispanic sample of Pueblo households. Not unexpectedly, this occurs in the Chaco-influenced PII societies we analyzed. As argued elsewhere (e.g., Crabtree et al., 2017) Chaco's flash of brilliance was built on the labor of multiple households and smaller polities ordered in what Wolf (1982) would call a tribute mode of production. This seems to be the main departure in the prehispanic Pueblo Southwest from a dominant kin-ordered mode of production.

Our finding that Orayvi's level of household wealth inequality ~1900 closely approximates those expected in small-scale horticultural societies should build confidence that house-size distributions can stand as a viable proxy for wealth differences. The Gini values we compute for Orayvi "make sense" given the great deal we know about it.

Levels of social inequality varied within and across the four regions we analyzed. That relatively high levels of inequality arose first in the MSJ (and possibly in the Chuska) areas before rising in Chaco may implicate populations from these areas in the early construction of great houses in Chaco Canyon, continuing to bring materials in from these areas even much later in time. In his comparison of BMIII and PI pitstructures, Miller (2018) identifies a specific architectural practice that seems to be unique to the Chuska Valley and the Chaco Plateau during the sixth through ninth centuries. During this period, oversized pitstructures and smaller residential structures in both areas exhibit the same, unusual floor divisions (Miller, 2018: Fig. 10). Similarities also existed between the architecture of Chuska pitstructures and those in the Mesa Verde/Northern San Juan areas, particularly during the sixth and seventh centuries, though these similarities weaken in the eighth and ninth centuries. Ceramic network analysis (Mills et al., 2018: Fig. 3) reveals strong ties between Chaco Canyon and areas to the west, including the Chuska Valley, by 850.

Finally, even with the larger samples examined here, we continue to find support for the suggestion by Kohler and Ellyson (2018:142, 148–149) that ancestral Puebloan society "functioned best" (at least in the sense of supporting construction, the development of "strong patterns," and regional systems) when levels of household inequality took on intermediate values—roughly between about 0.34 and 0.38—when our portions of the Pueblo Southwest are considered as a whole (Fig. 2b). These are the levels supported during "periods of exploitation" (Bocinsky et al., 2016). We infer that these mark periods when enough wealth is being created that standards of living are stable or improving for most people, providing their motivation for staying in the system. At the same time though, at least in the CMV, we find suggestions that household inequality can get too high in such periods.

When societies with high inequality encounter serious economic difficulties, violence ensues.

Declaration of Competing Interest

The authors claim no conflict of interest.

Acknowledgements

First, to the hundreds if not thousands of archaeologists (see references in Supplementary Material) whose labors over the years have accumulated the samples of households we analyze here: thank you! Our sample incorporates household-area measurements made by Rebecca Higgins and reported in Kohler and Higgins (2016) and additional measurements made by two of the authors (TAK and LJE) reported in Kohler and Ellyson (2018). Aimee Oliver aided in measuring and initial recording of floor areas for many of the new additions to our prehispanic sample reported here. Bill Lipe and RG Matson graciously provided comments on an earlier draft and pointed us to Basketmaker II resources we had not considered. We also thank Andrew Duff and Mark Varien for comments on earlier drafts, and audiences at Aarhus University, the IUPPS meetings in Paris, and at Christian-Albrechts-Universität zu Kiel, where some of the ideas herein were tried out. Finally, we thank Randy McGuire and another, anonymous, reviewer for this journal, for very useful comments. This work was supported by the National Science Foundation grant number IBSS-1620462. Cameron's original Orayvi study was supported by the National Science Foundation (BNS-86-46597 and BNS-88-13797), the Phillips Fund of the American Philosophical Society, the University of Arizona, and the University of Colorado.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jaa.2019.101073.

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