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Research Article

Trypillia mega-sites: a social levelling concept?

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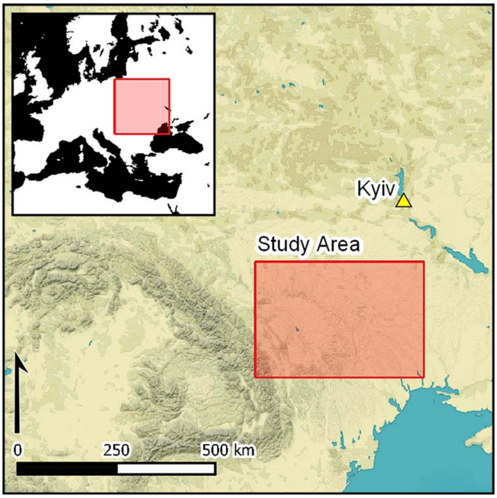

Explanations for the emergence and abandonment of the Chalcolithic Trypillia mega-sites have long been debated. Here, the authors use Gini coefficients based on the sizes of approximately 7000 houses at 38 Trypillia sites to assess inequality between households as a factor in the rise and/or demise of these settlements. The results indicate temporarily reduced social inequality at mega-sites. It was only after several generations that increased social differentiation re-emerged and this may explain the subsequent abandonment of the mega-sites. The results indicate that increases in social complexity need not be associated with greater social stratification and that large aggregations of population can, for a time at least, find mechanisms to reduce inequality.

Keywords: Eastern Europe, Chalcolithic, Gini coefficient, wealth inequality, households, population agglomeration

Introduction

Between *c.* 4200 and 3600 BC, the so-called Trypillia mega-sites were established on the northern limits of the Pontic Steppe (Zbenovich 1996; Videiko 1998; Menotti & Korvin-Piotrovskiy 2012; Müller *et al.* 2016a; Gaydarska 2020). With sizes of up to 320ha and around 10 000 inhabitants, they are among the largest prehistoric communities in Europe. These settlements were built in a partially open forest-steppe landscape with very fertile loess-based soils (Kirleis & Dreibrodt 2016; Dreibrodt *et al.* 2022). They were agricultural settlements inhabited all year round, with an economy based on the cultivation of cereals and pulses and on intensive and extensive animal husbandry centred on cattle (Kruts *et al.* 2001; Kirleis & Dal Corso 2016; Dal Corso *et al.* 2018; Orton *et al.* 2020; Makarewicz *et al.* 2022; Schlütz *et al.* 2023).

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While some researchers assume that these settlements had the character of 'giant' villages (Kruts 2012), others emphasise the urban characteristics of large Trypillia settlements (Videiko 1998; Wengrow 2015). Among the manifold approaches to urban agglomerations, the Trypillia mega-sites represent a form of agrarian agglomeration, which is seen as an alternative concept of urbanism (e.g. Gaydarska 2019; see also Ohlrau 2022), including egalitarian forms of socio-political organisation without central leadership (Müller 2016; Graeber & Wengrow 2022: 316–25).

In our view, the social fabric plays a crucial role in explaining the rise and fall of these mega-sites, as it regulates processes of political decision-making and the distribution of surpluses. Are there differences in wealth between households in the mega-sites and in the sequence of Trypillia settlements in general? Based on the results of extensive excavations and geophysical surveys, this article calculates Gini coefficients—a statistical measure of inequality in the distribution of household income—of house floor sizes, which have been shown to be a suitable proxy for evaluating household variability in diverse cultural contexts and in global comparative studies (e.g. Kohler *et al.* 2017; Thompson *et al.* 2021; Basri & Lawrence 2020).

Data sources

The present study includes approximately 7000 houses from 38 Cucuteni-Trypillia settlements dating to between 4800 and 3000 BC (Table 1, see also the online supplementary material (OSM)). Most of the data have been extracted from geophysical surveys undertaken over the last decade as part of a long-term co-operation between Kiel University, the Eurasia Department and the Roman-Germanic Commission of the German Archaeological Institute and regional partners in Moldova, Romania and Ukraine (Rassmann *et al.* 2014, 2016; Ohlrau 2015; Hofmann *et al.* 2016a & b, in press a; Rud *et al.* 2018, 2019, in press; Ohlrau & Rud 2019; Ţerna *et al.* 2019, in press; Hofmann & Shatilo in press). In addition, we have also made use of house sizes detected during geophysical surveys and excavation plans drawn up by other research groups (Dumitrescu 1954; Petrescu-Dîmboviţa *et al.* 1999; Chapman *et al.* 2018; Asandulesei *et al.* 2020).

The division into three test regions in present-day Romania, Moldova and Ukraine—A, B and C— is designed to compare regions with different scales of population aggregation. It is based on large rivers within the study area extending between the Carpathians in the west and the Dnieper in the east (Hofmann *et al.* 2018) (Table 1 & Figure 1). Region A encompasses settlements in the catchment area of the river Sinyukha, a tributary of the southern Bug, where a concentration of large, aggregated settlements extending up to 320ha has been

Table 1. Regional distribution of settlements.

Region	A	B	C
Number of settlements	16	11	11
Median settlement size (ha)	40.5	9.9	4.1
Median sample size	62	42	41
Median floor area (m^2)	68.8	72.6	58.2

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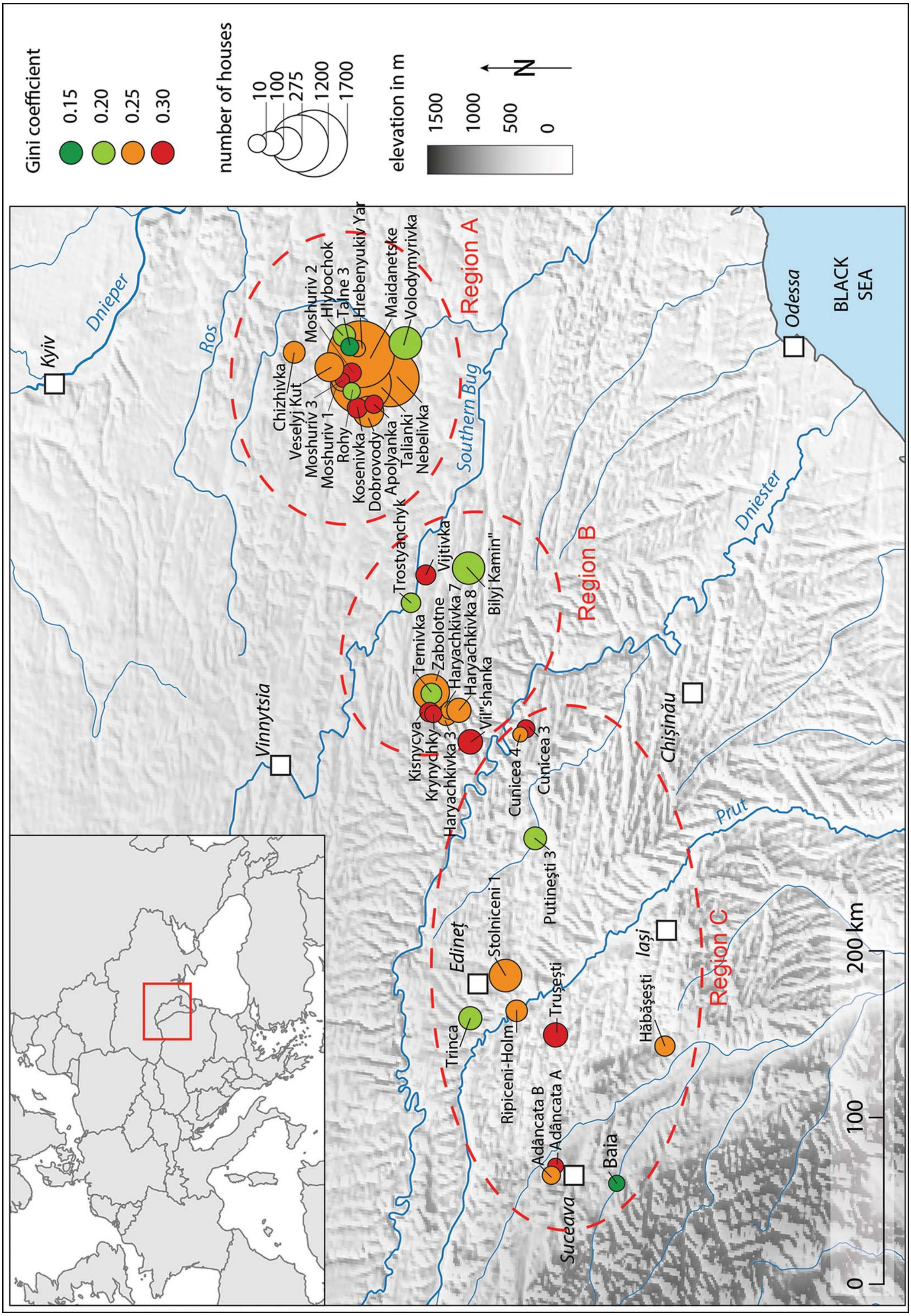

Figure 1. Distribution of surveyed sites by region with sample sizes and Gini coefficients (figure by authors).

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identified (Shatilo 2021). Region B refers to the Dniester-southern Bug interfluve, where settlements larger than 50ha are much rarer and do not exceed 100ha in size (Rud *et al.* 2019). Region C comprises the region between the foothills of the Carpathians and the Dniester, where most sites are relatively small, with the largest not exceeding 30ha.

The chronology of the sites is based on radiocarbon dating, systematically obtained in test trenches for each of the sites investigated (Diachenko & Harper 2016; Müller *et al.* 2016b, in press; Rud *et al.* 2019; Ţerna *et al.* 2019; Millard 2020; Ohlrau 2020; Harper *et al.* 2021; Shatilo 2021). The start and end dates of occupations were determined using the boundary function of OxCal v4.4 (Bronk Ramsey 2009) and the calibration curve IntCal20 (Reimer *et al.* 2020. For sites without radiocarbon dates, mean dating of the periods according to Harper (2013) was used. The often-inconsistent data of the radiocarbon laboratory in Kiev were not relied on.

Trypillia houses show enormous spatio-temporal variation in terms of construction, size and floor plans. The remains of burnt Trypillia houses, so-called *Ploshchadki,* are frequently characterised by massive platforms. Often, but not always, the main living floor was located on the upper surface of this platform, with partly standardised arrangements of ovens, fireplaces (so-called altars), podiums, storage bins and workspaces (Chernovol 2019). Since there are also cases where these elements are arranged partly or completely beneath the platform, some authors assume that these houses had two full storeys (Kruts 2003; Burdo *et al.* 2013). Although there are instances where installations and partition walls were present on two levels, they are mostly concentrated on only one level. We consider this level to be the main living floor, while the other level might represent a space for storage, craft activities or the stabling of animals. Moreover, the reconstruction of buildings with two full storeys is questionable, given the lack of vertical posts necessary to support such a structure. It seems more plausible that the platform was only slightly raised above ground level, but high enough to create a space for certain activities to be carried out beneath the main living space (Müller & Videiko 2016; Müller *et al.* 2017) (Figure 2). We therefore assume that the different levels do not have a significant effect on the usable living space and that the floor size of the houses can be determined with sufficient precision. The shapes of individual houses are visible in geophysical surveys because their daub structures were burnt. We have reconstructed the size of houses based on the outer edge of each discrete, rectangular area of burnt daub. Magnetic anomalies indicated houses of uncertain extent are excluded from the analysis. Also excluded were the remains of communal buildings, which can be identified from their highly visible positioning within the settlements' public spaces and their exceptional size and architecture (Hofmann *et al.* 2019).

Where geophysical surveys have only partially covered the full extent of a settlement, the degree to which the surveyed area is representative of the wider settlement may be questionable. This is especially evident at the sites of Hlybochok and Vijtivka, where magnetometry survey focused on the settlements' central open spaces (see Ohlrau & Rud 2019). Comparisons with other settlements, such as Maidanetske and Bilyj Kamin, show that these central spaces are marked by particularly large houses. This may result in the biasing of house size variability for only partly surveyed settlements like Hlybochok and Vijtivka but, due to its hypothetical nature, this was not factored in our analysis. When these settlements have been fully surveyed, we will check how this affects our results.

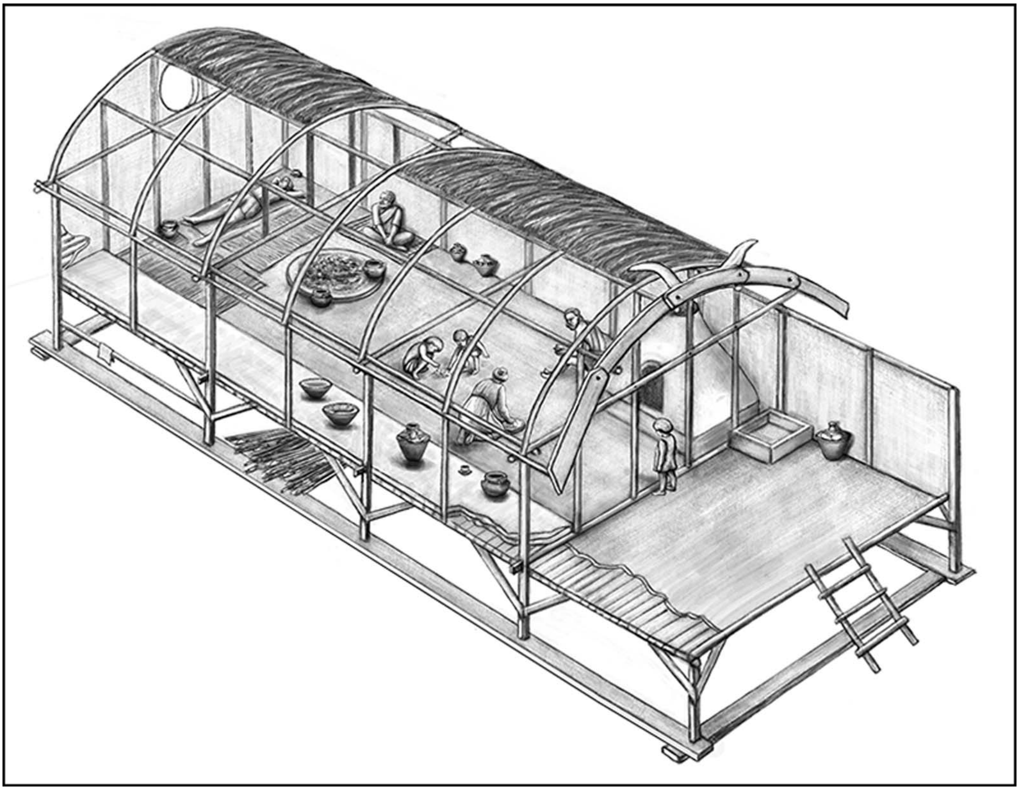

Figure 2. Artist's reconstruction of a Trypillia house with a raised platform at the mega-site of Maidanetske in region A (image by Susanne Beyer).

Methods

The use of house size as a proxy for the economic status and social power of households in a society is based on broad cross-cultural evidence from ethno-archaeological studies and archival sources as it has been found that household wealth and house size are correlated in many societies (e.g. Netting 1982; Kohler *et al.* 2017: suppl. 1). Others see the variability in household sizes mainly as reflection of the number of people belonging to a household (e.g. Wilk 1983; Smith *et al.* 2018). However, household size also appears to be positively related to material household wealth, particularly in agricultural and pastoralist societies, insofar as household wealth can be inherited over several generations and thus tends to accumulate (Mulder *et al.* 2009). In addition, poorer households are prone to lose members to richer households, have lower life expectancy and higher infant mortality rates (Netting 1982). As larger households had greater prosperity and could draw on a sufficient pool of labour, they could be both the cause and the result of a higher household income (Bogaard *et al.* 2018; Porčić 2018). Floor sizes and the general (construction) quality of housing thus potentially reflect the ability of a household to mobilise materials and labour for its construction. Altogether, house floor sizes combined with other indicators seem to be a reliable proxy for

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both the economic status (wealth) and social power of a household within a society (e.g. Smith *et al.* 2018; Basri & Lawrence 2020).

The Gini coefficient is a well-established method of measuring unevenness in the distribution of material within a given population or sample. In economics, it is used to measure the relative concentration or inequality of incomes (see Gini 1921). It is expressed as values between zero and one: in the case of completely equal distribution, the Gini coefficient is zero, and where total income is concentrated with only one individual or in a single household, it has a value of one. In archaeological applications, Gini coefficients have been used to evaluate the inequality of burial assemblages (e.g. Windler *et al.* 2013; Großmann 2021) and house sizes (Kohler *et al.* 2017; Porčić 2018; Bogaard *et al.* 2019; Basri & Lawrence 2020).

To calculate Gini coefficients based on Trypillia house sizes, we have used the DescTools (v0.99.44) package in the open-source programming language for statistical computing, R (v4.0.3, R Core Team 2021). This package allows bootstrapping of the confidence intervals of the coefficient. Bootstrapping is a standard sampling method to get to reliable estimates of the "true" parameters of the underlying distribution. It involves random draws from the sample up to the size of the sample. This process is repeated many times (in our case 10 000 times). We used the unbiased version of the formula for the Gini coefficient which is especially relevant for small sample sizes. This entails multiplying the Gini value by n/(n-1) (Weiner & Solbrig 1984). We calculated bias corrected and accelerated (bca) confidence intervals (Dixon *et al.* 1987) to cater for the fact that conventional confidence intervals are known to be biased and too narrow with a range of 80 per cent (following Kohler *et al.* 2017: 5) with 10 000 bootstrapped replicates (= repetitions, see above). For the graphical output of the locally weighted scatterplot smoothing regression (LOESS) lines, we relied on the smoothing function 'loess' in the ggplot2 package (v3.3.5) with a span of 0.75 and a confidence level of 0.95. LOESS involves continuous polynomial fitting of a subset of the data at hand along the x-axis with weighted least squares regression. This method is very effective in visualising the non-linear relationship between two variables without presupposing any global function (Cleveland 1979).

Results

Differences in house size by region and compared to settlement size

The overall Gini coefficient for all houses is 0.2385 (80% CI: 0.2355–0.2416). The Gini coefficients for each individual settlement are shown in Tables 2–4. These range between 0.1336 and 0.3189 with the mean at 0.2295. Overall, the values follow a normal distribution (Figure 3).

The Gini coefficients do not appear to be related either to overall settlement size or the number of houses within each settlement (Figure 4). Fitting the log-values of settlement size to the respective Gini coefficients yields non-significant p-values for each of the three regions (p-values: 0.4129, 0.5161, 0.768). Note, however, that the largest sites tend to exhibit Gini coefficients that are close to the mean of the overall distribution.

In terms of regional differences, region A has slightly lower median Gini coefficients than region B, which in turn has lower values than region C (Figure 5). However, large overlaps in

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Table 2. Data for sites from study region A. CI: confidence interval for Gini coefficient. Dating of the sites is given with the highest dating probability.

Site	Latitude	Longitude	Date max. (BC)	Date min. (BC)	Date mean (BC)	Settlement size (ha)	Sample size	Median floor area (m^2)	Gini coefficient	Lower CI	Upper CI
Apolyanka	48.73	30.42	3710	3565	3638	21.00	22	137.90	0.2632	0.2190	0.3386
Chizhivka	49.16	30.70	4050	3990	4020	20.00	61	60.50	0.2032	0.1846	0.2330
Dobrovody	48.76	30.38	3800	3700	3750	210.00	228	69.05	0.2306	0.2175	0.2469
Hrebenyukiv Yar	48.82	30.72	4530	4450	4490	3.30	10	76.50	0.2500	0.2015	0.3404
Hlybochok	48.89	30.79	4000	3800	3900	130.00	71	101.30	0.1619	0.1459	0.1850
Kosenivka	48.82	30.40	3690	3650	3670	80.00	38	79.15	0.2960	0.2595	0.3630
Maidanetske	48.80	30.69	3950	3650	3800	200.00	1705	65.60	0.2251	0.2202	0.2303
Moshuriv 1	48.90	30.55	3850	3700	3775	7.00	63	81.00	0.2027	0.1853	0.2272
Moshuriv 2	48.85	30.59	3695	3620	3658	3.60	31	73.10	0.3038	0.2724	0.3492
Moshuriv 3	48.90	30.55	3650	3550	3600	0.30	4	61.25	0.3128	0.2338	0.3574
Nebelivka	48.64	30.56	3970	3770	3870	230.00	1192	58.85	0.2053	0.1993	0.2120
Rohy	48.85	30.49	3670	3615	3642	6.35	16	80.90	0.1597	0.1259	0.2273
Talianki	48.80	30.53	3945	3530	3738	320.00	1367	57.90	0.2076	0.2025	0.2136
Talne 3	48.86	30.73	3790	3700	3745	1.20	21	68.60	0.1336	0.1222	0.1547
Veselyj Kut	48.97	30.62	4070	4000	4035	60.00	185	56.80	0.2352	0.2229	0.2510
Volodymyrivka	48.56	30.75	3920	3800	3860	95.00	275	67.10	0.1585	0.1494	0.1697

Table 3. Data for sites from study region B. CI: confidence interval for Gini coefficient. Dating of the sites is given with the highest dating probability.

Site	Latitude	Longitude	Date max. (BC)	Date min. (BC)	Date mean (BC)	Settlement size (ha)	Sample size	Median floor area (m^2)	Gini coefficient	Lower CI	Upper CI
Bilyj Kamin"	48.27	29.40	3910	3790	3850	100.00	266	80.40	0.1965	0.1848	0.2117
Haryachkivka 3	48.34	28.77	4100	3970	4035	8.50	42	72.55	0.2462	0.2107	0.3056
Haryachkivka 7	48.32	28.77	4230	4050	4140	9.90	20	51.50	0.2189	0.1855	0.2817
Haryachkivka 8	48.31	28.77	4330	4050	4190	7.70	96	76.00	0.2364	0.2142	0.2735
Kisnycya	48.43	28.76	3570	3440	3505	6.75	33	63.20	0.2570	0.2237	0.3151
Krynychky	48.41	28.75	3580	3530	3555	14.00	14	98.20	0.3189	0.2858	0.3830
Ternivka	48.42	28.86	4220	3990	4105	8.00	48	74.10	0.1648	0.1432	0.1986
Trostyanchyk	48.53	29.35	3970	3965	3968	3.25	34	52.80	0.1962	0.1770	0.2254
Vil"shanka	48.21	28.60	4220	4050	4135	25.50	100	46.55	0.2968	0.2752	0.3351
Vijtivka	48.45	29.50	3750	3660	3705	50.00	38	63.30	0.3067	0.2716	0.3615
Zabolotne	48.42	28.87	4250	4040	4145	37.50	372	81.15	0.2188	0.2082	0.2319

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Table 4. Data for sites from study region C. CI: confidence interval for Gini coefficient. Dating of the sites is given with the highest dating probability.

Site	Latitude	Longitude	Date max. (BC)	Date min. (BC)	Date mean (BC)	Settlement size (ha)	Sample size	Median floor area (m^2)	Gini coefficient	Lower CI	Upper CI
Adâncata -A	47.76	26.29	4100	3900	4000	1.85	7	28.57	0.2715	0.2517	0.3164
Adâncata -B	47.76	26.29	4000	3900	3950	1.00	22	48.40	0.2394	0.2054	0.2955
Baia	47.42	26.22	100	4900	5000	2.00	9	30.59	0.1439	0.1124	0.1948
Cunicea 3	47.91	28.67	3700	3500	3600	6.00	20	114.35	0.2539	0.2223	0.3092
Cunicea 4	47.94	28.64	3340	3100	3220	4.50	5	226.60	0.2151	0.1096	0.3332
Hăbăşeşti	47.16	26.96	4313	4051	4182	1.30	41	59.20	0.2435	0.2090	0.3016
Putineşti 3	47.86	28.08	4400	4250	4325	4.10	73	90.5	0.1787	0.1671	0.1976
Ripiceni-Holm	47.96	27.15	4200	3900	4050	6.00	57	48.70	0.2217	0.1974	0.2576
Stolniceni 1	48.02	27.34	3955	3660	3808	33.00	272	80.05	0.2446	0.2323	0.2598
Trinca	48.21	27.11	3894	3659	3776	15.00	79	58.20	0.1980	0.1785	0.2296
Trușești	47.75	27.02	4550	4200	4375	2.40	96	34.05	0.3044	0.2796	0.3370

Figure 3. Distribution of Gini coefficients in the combined sample of sites (bin width = 0.02) (figure by authors).

the boxplots of Gini coefficients for each region suggest that the differences are not statistically significant. This is reflected in the results of Mann–Whitney U-tests of the mutual pairs A-B, A-C and B-C, none of which are significant (p-values: 0.3676, 0.6448, 0.6994).

Differences in house size over time

The Gini coefficients for the settlements range between 0.17 and 0.32. The greatest variability is observed in the early Trypillia phase and the start of the middle Trypillia phases until *c*. 4200 BC. After that, variability decreases significantly (Figure 6A & B). Before *c*. 4400 BC and after 3500 BC, very few data are available. In view of these uncertainties during the earliest and latest phases of the settlement sequence, our conclusions below refer exclusively to the period that is most strongly supported by the data.

Looking at all the regions together (Figure 6A & B), a steady decline in the Gini coefficient from approximately 0.25 to 0.2 is noticeable in the early phase of Trypillian population aggregation, between *c*. 4200 and *c*. 3800 BC. In the subsequent late phase of aggregated settlements, Gini coefficients increase substantially to values of up to 0.25. In the following phase, between *c*. 3650 and *c*. 3500 BC, when populations dispersed away from aggregated settlements into smaller settlements this trend of increasing Gini coefficient continues, rising to more than 0.3 in some cases.

In region A, early settlements such as Veselyj Kut and Chizhivka demonstrate Gini coefficients between 0.2 and 0.25 (Figure 6C & D; Table 2). In contrast, in the following phase (*c*.

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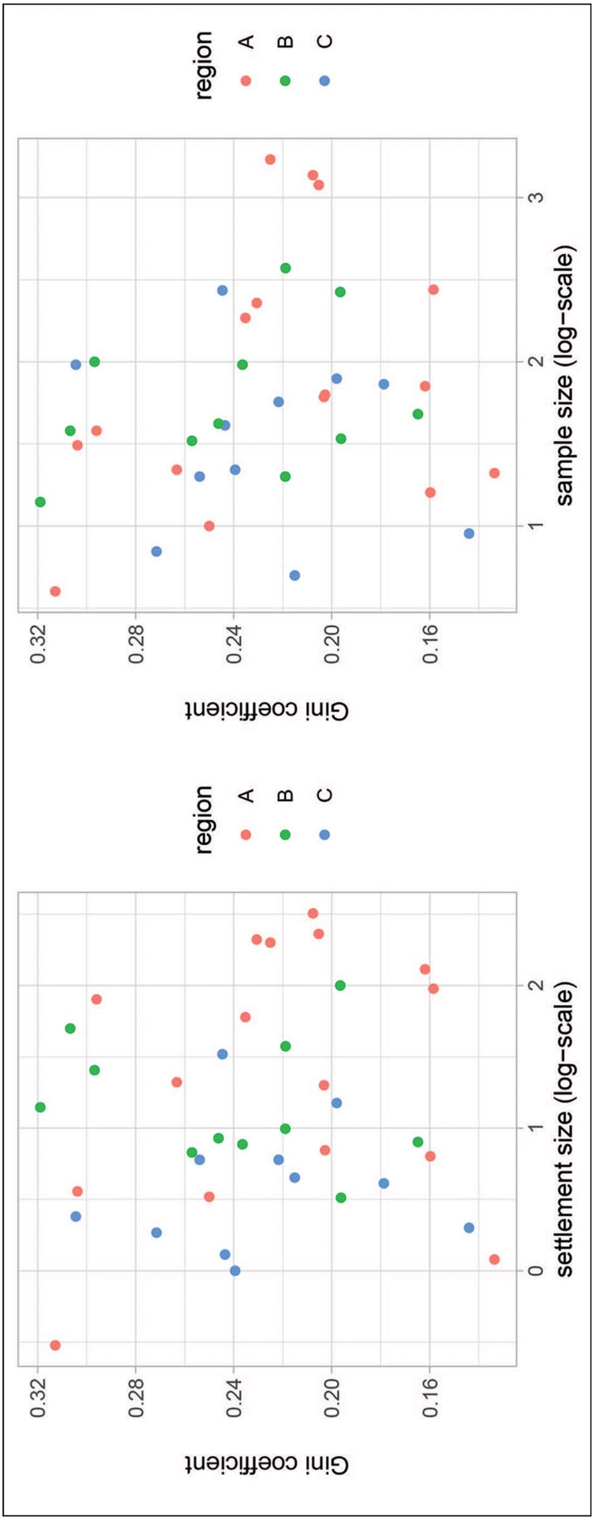

Figure 4. Gini coefficients in relation to settlement size and sample size (figure by authors).

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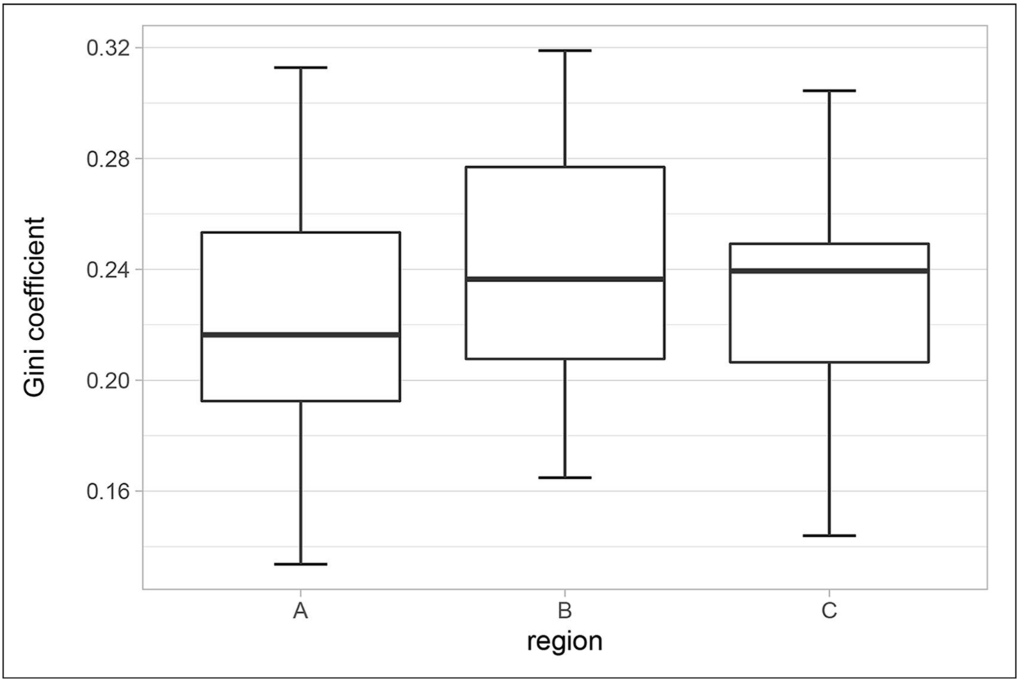

Figure 5. Boxplots of Gini coefficients in regions A–C. The whiskers extend to 1.5 of the interquartile range; there are no outliers (figure by authors).

4000–3800 BC), settlements such as Volodymyrivka, Hlybochok and Nebelivka have much lower Gini coefficients. A reversal of this trend towards somewhat higher, though still comparatively low, Gini coefficients emerges after *c*. 3800 BC. This includes the mega-sites of Maidanetske and Dobrovody, and the smaller settlement of Moshuriv 1. Simultaneously, some of the emerging small settlements, such as Talne 3, show extremely low Gini coefficients. During the phase between 3650 and 3550 BC, when populations began to move away from the large aggregated Trypillia settlements, the trend towards higher Gini coefficients clearly intensifies. This is the case, for example, at Moshuriv 2 and 3, Apolyanka and Kosenivka.

The pattern in region B is similar to that of region A (Figure 6C & E): in the northern sub-region, early settlements, such as Haryachkivka 7 and 8, Vil"shanka and Zabolotne, show average Gini coefficients between 0.2 and 0.3 (Table 3). The variability of house floor sizes also declines here at settlements such as Ternivka, Trostyanchyk and Bilyj Kamin". In contrast to region A, however, no large settlements are known (so far) from the phase between *c*. 3800 and 3700 BC. Following this hiatus, settlements with significantly higher mean Gini coefficients between 0.25 and 0.3 reappear in the northern subregion from 3750 BC onwards represented, for example, by Krynychky and Kisnycya. The pattern of house size variability in region C contrasts somewhat with the pattern in regions A and B (Figure 6C & F). Here, the Gini coefficients (Table 4) tend to increase between *c*. 4200 and 3900 BC; they then decrease (until at least 3800 BC) to increase again later, but the latter trend is documented only at Cunicea 3.

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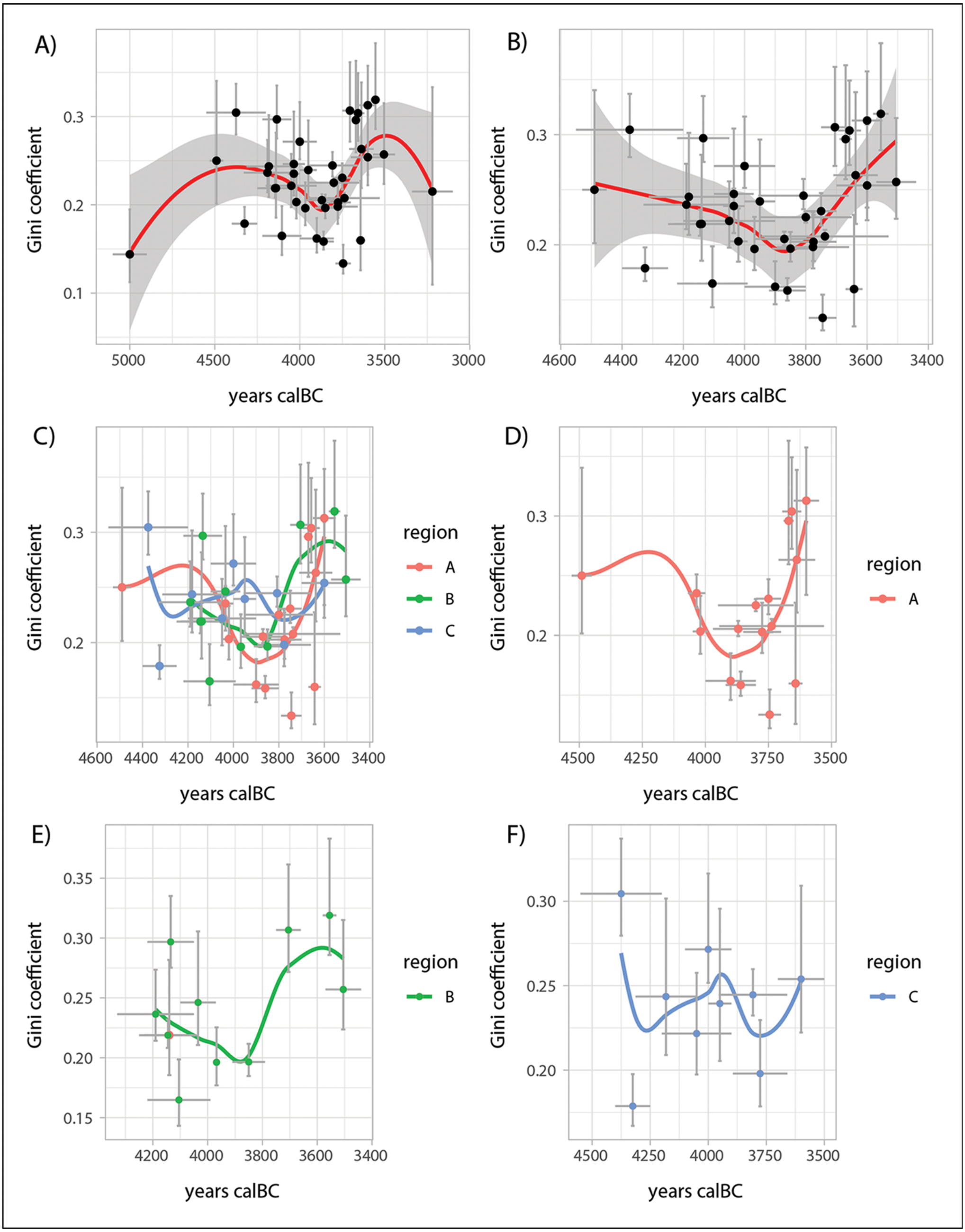

Figure 6. Gini values and confidence intervals for Trypillia sites across time. A–C show results from all regions; D–F show individual regions. Red, green and blue lines: locally weighted smoothing regression (LOESS), for A–B with 0.95 confidence band. Vertical bars: 0.8 confidence intervals for Gini values after bootstrapping. Horizontal bars: dating ranges of individual sites (highest probability) (figure by authors).

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Discussion

Assuming that the variability in the floor size of houses reflects differences in household wealth, we can discern a decline in social inequality in Trypillia communities until at least 3800 BC. Only after 3800 BC, in the final phase of the aggregated settlements, did inequality increase slightly, before reaching a peak after 3750 BC in the phase following the demise of the large settlements. The development outlined here suggests that both an egalitarian ideology and effective mechanisms for avoiding social inequality must have existed within Trypillia communities. It implies intra-settlement mechanisms for reconciling interests and redistributing surpluses that might have been established collectively. These ideological views and mechanisms may have changed over time, enabling a revival of vertical social differentiation. In our opinion, this was a decisive factor in the subsequent gradual demise of aggregated settlements.

Several other arguments can be advanced to support our interpretation of the Gini coefficient data:

1) The architecture of the houses (i.e. floor plan and construction) shows a high degree of standardisation, as do the furnishing of the houses and the economic activities detectable within (Chernovol 2012).
2) The round and oval settlement layouts ensured equal access to structural elements and infrastructure (e.g. central open spaces) and find analogies in the floor plans of communities organised along egalitarian lines in other ethnographic contexts (e.g. Wagner 2019) (Figure 7).
3) At Maidanetske and other sites, large dwellings requiring much construction material are concentrated along the corridors between the concentric rings of houses and other highly visible public places within the settlements (Pickartz *et al.* 2022). This matches the observation made by Castro *et al.* (1981) that richer households occupy economically strategic and more visible positions in settlements.
4) Recent studies that have examined Trypillia sites from a social archaeological perspective, based on systematic comparisons of assemblages from houses, suggest that larger houses contain higher quantities of objects associated with food preparation (Ohlrau 2020: 58) or more evidence of activities associated with higher social prestige (Ţerna 2021).
5) Large aggregated Trypillia settlements frequently demonstrate evidence of a system that included multifunctional assembly houses, the so-called mega-structures (Müller *et al.* 2016c; Hofmann *et al.* 2019). These buildings were positioned prominently in public spaces, indicating wide participation in political processes and the consumption of surplus. They probably functioned as institutions in political decision-making processes and were particularly developed in our region A. The development of house size variability

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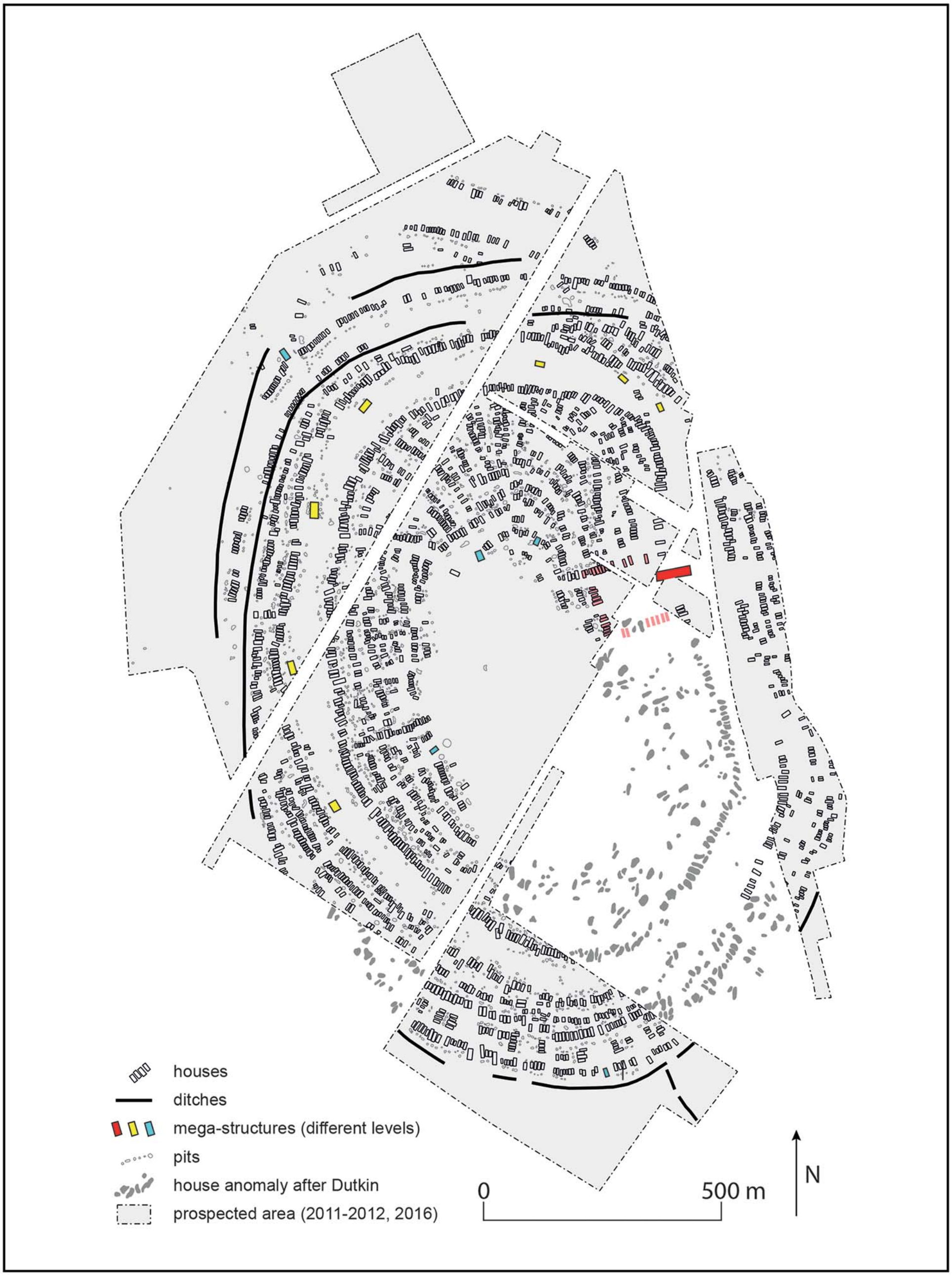

Figure 7. Plan of the Trypillia mega-site of Maidanetske (after Hofmann et al. *2019).*

seems to coincide with changes in decision-making processes. The reduction in size and eventual disappearance of the more modestly sized assembly houses was accompanied by the increasing enlargement and architectural elaboration of central mega-structures,

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starting *c*. 3800 BC at the latest (Hofmann *et al*. 2019). Some of these high-level mega-structures take on monumental forms (Rud *et al*. 2019). In our view, it is reasonable to suggest a link between growing social inequality—manifested in increased variability in house sizes—and transformation of social organisation towards centralised decision-making.

6) Our argument is further supported by the settlement dynamics in study regions A and B. The demise of large Trypillia settlements and the formation of smaller communities in the surrounding regions starts just when social inequality begins to increase again (Hofmann & Shatilo 2022). These smaller communities were likely to have been formed by groups of people who decided to no longer live at a mega-site (Hofmann & Shatilo 2022; Hofmann *et al*. in press b). Thus, the end of the aggregated Trypillia communities and mega-sites coincided with when the mechanisms of social levelling and political participation began to fail and social inequality re-emerged.

Conclusion

We have used variability in the sizes of houses at 38 Trypillia settlements to explore changing levels of inequality across three geographical regions and two millennia using standard Gini coefficients. We interpret the results to indicate that Trypillia mega-sites successfully avoided wealth inequalities between individual households. Their communities may have achieved this through an egalitarian ideology and effective mechanisms of reconciliation of interests and intra-community redistribution of (potentially) collectively generated surplus. Our results shed new light on the nature and possible reasons for the formation and decline of these unique prehistoric communities. We contend that, by enabling members to participate actively in political decision-making processes, the social make-up of aggregated mega-sites might have had a 'reforming' character, which may have been decisive for attracting, for a time, large numbers of people to these communities.

We therefore believe we can partially answer the frequently discussed question of why Trypillia mega-sites emerged. The mega-site concept included a levelling mechanism to prevent social inequality, with co-operative economic management and living arrangements used to minimise inequality. The Gini coefficients generated here show that this was successful for a long time. Only during the later development phase of the mega-sites, from *c*. 3800 BC onwards, did the tendency towards social inequality increase again. Thus, the mega-site phenomenon represents one of a series of historical examples that show that an increase in the complexity of societies is not necessarily associated with an increase in vertical social differentiation. Rather, both the emergence and the break-up of aggregated Trypillia mega-sites were primarily due to the political decisions made by the individuals and communities who lived at—and who eventually decided to leave—these vast settlements.

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Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.15184/aqy.2024.18.

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