European settlement demography: 
a boom and bust pattern in prehistory?

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ABSTRACT - In this paper we compare multiple types of domestic settlements from different chronological periods in prehistoric continental Europe to inform occupancy patterns and demographic trends. We focus in particular on the evidence of a boom and bust pattern that appears to be constant across all the sites studied. We find evidence of a growth plateau after 200 to 300 years of existence. But because the number of sites used is small, due to the quality restrictions of the data, the results still need to be confirmed by further investigations.

KEY WORDS - demography; prehistory; booms and busts; patterns

Evropska poselitvena demografija: 
vzorec rasti in upada v prazgodovini?

IZVLEČEK - V prispevku primerjamo več vrst naselbin iz različnih časovnih obdobij v prazgodovini v celinski Evropi, da bi pridobili informacije o vzorceh poseljenosti in demografskih trendih. Osredotočamo se na podatke sistema o rasti in upadu, ki se zdaj konstanten v vseh naselbinah. Nasli smo namreč dokaze o doseženem platoju rasti po 200 do 300 letih obstoja. A ker je zaradi slabe kakovosti podatkov število naselbin majhno in so zato podatki omejeni, je treba rezultate z nadaljnjimi preiskavami še potrditi.

KLJUČNE BESEDE - demografija; prazgodovina; rast in upad; vzorci

Introduction

Questions concerning population size, density and development are not novel in archaeology, but are deeply linked to interpretations of settlement function, regional organization, and socio-cultural dynamics. One may be the explanation of the other, and vice versa. But despite the importance of demography to archaeological research, it can be challenging to find reliable data to recreate population numbers. In recent years archaeological demography is usually approached using different proxies, such as radiocarbon datasets and summed probability density models to build population size models through time (Crema, Bevan 2021). Agent-based modelling can also be developed to add palynological and climatic information to these models (Baum et al. 2020; Bernigaud et al. 2023). As useful as these statistical methods are for reconstructing ancient population trends, many researchers are critical of summed probability density models for their disconnection from actual archaeological materials (Contreras, Meadows 2014; Torfing 2016). Because these methods focus on defining population numbers over large areas and a
long chronological time frame, they tend to forget the actual settlements behind the dots.

A variety of European prehistoric domestic sites have been excavated, from single farmsteads to giant settlements and the first townships. How many people lived in a domestic site and for how long? Is there a smooth population increase and decrease or are we dealing with population booms and busts? Due to the limited quality of our data, these questions are mainly reflected in supra-regional or regional demographic studies, but very seldom on the site level for comparative purposes of single site ‘biographies’ (cf. Müller 2015; Müller, Diachenko 2019; Großmann et al. 2023; Schmidt, Hilpert et al. 2021). This is unfortunate, as the methodology for such intra- and inter-site estimations is inherent to settlement archaeology.

In this study we collected data for as many sites as possible from well-phased settlements with traces of houses, allowing the reconstruction of the number of houses for each phase. Though the number of excavated prehistoric sites has exploded in recent decades, only a few of them possess absolute chronological phasing and an estimation of the population size. We think that models can be developed on the basis of these data, and in this paper we aim at investigating settlement demography, using the number of houses, to highlight possible patterns in population development and more precisely in site developments.

The data

The data used to study and compare the demographic patterns of individual domestic sites was collected from 22 settlements across Europe (Fig. 1). These sites were selected for the quality of their documentation and their variety. They provide a minimum level of information content necessary for data analysis: a division of settlement activity into phases through absolute dating and an indication of the number of houses or population size for each phase. The sites represent different settlement types and are distributed over a wide geographical area. It is nonetheless difficult to find sites matching this data quality requirements in continental Europe.

Although most of the sites in our sample date from the Neolithic (n=9) and the Chalcolithic (n=7), the three sites selected for the European Bronze Age (n=3) and Iron Age (n=3) are good representatives for these periods. The data imbalance within these chronological time periods mostly relates to different research strategies conducted in these settlements, which generally do not record the data quality required for this study. However, with this wide geographical and chronological range we aimed to compare different types and sizes of settlement, from different areas and time periods, to determine if their demographic development exhibits any regularity.

Of course, 22 settlements are not enough to cover the entire spectrum of possible settlement types in European prehistory. For example, we lack fortified villages and proto-urban settlements from the Chalcolithic Aegean and Iberian Early Bronze Age and foraging camps of the Mesolithic. It has not been possible to integrate such sites, as there is no information about phase categorization and house size for these. It has so far also been difficult to assess the tell-type settlements in south-eastern Europe in the associated lowland areas. And unfortunately, despite numerous excavations, it has not been possible to obtain more precise information on the evolution and number of houses of the oppida of the Late Bronze period. We also excluded single-phase settlements that were occupied for a short time, as no development can be analysed for them. They certainly represent a separate category of very short-term ephemeral domestic activities that should be considered in future studies.

As such, 22 settlements with different characterization could still be integrated to the dataset (Bánffy et al. 2016; Billamboz 2009; Brink 2009; Brozio 2016; Friederich 2011; Hofmann et al. 2007; Isoardi 2008; Kerig et al. 2022; Kurz 2010; Boelicke et al. 1994; Matuschik et al. 2023; Müller et al. 2022; Müller et al. 2011; Müller, Rassmann et al. 2016; Wyss 2002; also Suppl. 1). Langweiler 8 is an Early Neolithic Linear Pottery settlement of longhouses, which, as a central settlement in the Merzbach valley in the Lower Rhine region, shows a differentiated development (c. 5300–4900 BCE). The Linear Pottery site of Vráble (c. 5300–4950 BCE) is a large Early Neolithic settlement with several neighbourhoods. Okolište is a Late Neolithic Butmir tell settlement (c. 5225–4675 BCE), for which gable-parallel houses are documented in various phases of the site. Ovčarovo (c. 4900–4200 BCE) and Poljanica (c. 5000–4600 BCE) are intensively excavated Early Chalcolithic Gumelnita/KGK VI tells, which illustrate the classic development of south-eastern European settlement mounds with several occupancy horizons. We include cluster villages from southern Central Europe with the Middle Neolithic sites Al-
sónyék (c. 4800–4250 BCE), Heilbronn-Neckargartach (c. 5050–4550 BCE) and Friedrichshall-Kochen-dorf (c. 4700–4375 BCE). Data on large Chalcolithic settlements or mega-sites with planned, partly proto-urban structures are drawn from the Eastern European sites of Nebelivka (c. 4000–3690 BCE), Maidanestke (c. 3950–3630 BCE), Taljanky (c. 3950–3500 BCE), Stolniceni (c. 3950–3680 BCE) and Trinc a (c. 3900–3600 BCE). We know the house layout for the southern Swedish Early Neolithic settlement of Almhov (c. 3800–3400 BCE), as well as for the southern German pile-dwelling site of Hornstaad-Hörnle IB (c. 3580–3505 BCE) or the northern German Middle Neolithic site of Oldenburg-Dannau (c. 3265–2930 BCE). Bronze Age settlement developments can be traced in the Alpine settlement of Cresta (c. 2150–1600 BCE) and in the south-central European settlements of Vráble (c. 2100–1800 BCE) and Bad Buchau (c. 1767–1495 BCE). The two latter are a large Early Bronze Age settlement and a fortified pile-dwelling settlement, respectively. For the Pre-Christian Iron Age, settlement sequences are known for the large fortified settlement of Heuneburg (c. 700–550 BCE) and for the oppida of Saint-Blaise (c. 700–100 BCE) and Saint-Pierre (c. 550–100 BCE) in the south of France.

For each site, we collected information about the number of coeval houses for each given phase. This number is given by one or more of the following:

- A complete excavation of the site including the dating of single features (e.g., Cresta bei Cazis (Wyss 2002), Langweiler 8 (Boelicke et al. 1994), Hornstaad-Hörnle (Matuschik et al. 2023, 318), Ovčarovo and Poljanica (Kerig et al. 2022)).
- The chronological phasing of geophysical plans of the whole site by transferring chronological information from the excavated site areas. As an example, in Late Neolithic Okolište the geophysical features could be phased chronologically by target excavations on specific structures (Hofmann et al. 2016; Müller et al. 2013; Müller et al. 2011). For Trypillia mega-sites, a similar method was used (Müller et al. 2016; Ohrnrau 2020), while in the LBK and Vinča sites dating based on the houses’ orientations enabled a chronological interpretation of the geophysical plans of different settlements (Hofmann, Müller-Scheeßel 2020).
- A modelling of the site surface and of the number of houses highlighted for the excavated phases. For Saint-Blaise and Saint-Pierre the house number es-

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**Fig. 1. Location and dating of the sites used in the analysis (Supplements 1 and 2).**
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Analysis and results

We plotted below the number of houses for each phase of the selected sites over time. In order to compare them, the chronological information used in these plots is the lifespan of each site starting from 0, in other words, the foundation of the site (Fig. 2). A pattern emerges immediately. All the settlements seem to start with a first phase of quick demographic growth or ‘boom’ for about 200 to 300 years, followed by a more or less quick decrease¹ or ‘bust’ pattern. For those with a lifespan shorter than 200 years (e.g., Hornstaad-Hörnle), we can also detect a similar pattern, but with faster changes.

This visual interpretation seems to be verified by the loess regression calculation applied on all sites and all information (Fig. 3). There is a less pronounced increase in the first phases of the sites, but a global decrease of the population after 200 years of existence. In order to make sure that this observation is not due to the difference in the number of houses between sites, we did the same calculation based on a percentage of houses for each site and each period. This calculation does not change the global trend, but rather accentuates it.

From these first observations and results, it appears that the site sample can be divided into three categories: sites with a lifespan lower than 200 years, sites with a lifespan between 200 and 400 years, and sites in use for more than 400 years. Here again, the loess regression shows the same pattern – a quick increase of the population prior to reaching its peak, followed by a more or less abrupt decrease, depending on the life expectancy of the sites (Fig. 4).

Except for the first group of sites (the ones lasting less than 200 years), this maximum number of houses mostly seems to be reached within 200 to 300 years of the lifespan of the settlements. However, we can see that for some of the sites this maximum is reached later, which is the case for Taljanky in Ukraine or Saint-Blaise in France. If the loess regression calculation done on this type of site shows that indeed they reach their maximum number of houses later (around 350 years of existence), the created pattern is not radically different (Fig. 5). It still follows the global trend defined by a quick increase until the maximum is attained, directly followed by a continuous decrease until the settlement’s abandonment.

The outlined global trend is also observed in each time period (Fig. 6). Nonetheless, the Iron Age and Bronze Age sites seem to grow much faster than the Neolithic and Chalcolithic ones, though this may be an effect of sample size. As noted earlier, nine and seven settlements date from the Neolithic and the Chalcolithic, respectively, but only three date to each of the Bronze and Iron Ages. However, the global pattern is similar to that found with the previous analysis: a quick increase of the population until 200 years of settlement lifespan, and then a more or less rapid and continuous decrease.

Finally, we also explored the possibility of differences observable due to settlement types. Seven types were defined based on the settlements’ size, location and organization, and this last analysis shows the most differences in the pattern of evolution (Fig. 7). Tells and other centralized domestic sites seem to have a smoother development with a long-time occupation

¹ In order to be able to compare the development of each site, the curves have been plotted on a logarithmic scale of 10 in Figure 2.
and a stabilization phase when they reach their maximum number of houses, before slowly decreasing. On the other hand, hillforts, mega-sites and Linearbandkeramik/Rubané sites reach their peak of occupation rather quickly before, once again, slowly decreasing. Lake dwellings and Alpine sites exhibit a different pattern because they are generally short-lived and have quick phases of abandonment.\(^2\) However, except for these last types, all the studied settlements show a pattern with a maximum number of houses reached after around 200 years of existence (sometimes slightly before, like hillforts, and sometimes slightly after, like tells), and then a slow desertion through time before site abandonment.

**Discussion**

Even if not identical, the multiple analyses provided above all display a recurring pattern. Whatever the chronological period, the population size, lifespan and settlement type, all of the 22 selected sites seem to follow the same ‘evolutionary’ trajectory. They all show a rapid increase in the population until the maximum number of houses is reached after around 200 years, except for the one site being abandoned before 200 years. This maximum is then followed by a slower but continuous decrease until the settlement is completely deserted.

For some sites this pattern is not as clear as for others, in particular for wetland dwellings and Alpine sites. This can be explained by their small number of inhabitants but also because they display a different kind of occupancy. Indeed, they tend to be quickly abandoned and relocated in a new area not far away (Heitz et al. 2021; Köninger 2015). This behaviour raises the question as to what a settlement is and how it should be delimited (Bintliff 2000; Ebert 1992).

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\(^2\) As this type of settlement is mostly dendro-dated and each site phase is defined as a site, categorizing such sites as one would make their duration comparable to that of the other sites. We chose not to do this, as explained below.
Should we or not consider every trace in a close radius as part of the same village? For simplicity, we decided to focus only on structures found in the same location.

The increase in population is most often explained by the natural growth rate of populations under sustainable ecological conditions and/or by the arrival of new settlers because of the attraction of aggregated living (e.g., Vráble). However, different explanations have been offered for the population decline, linking it either to internal or external factors. These include (1) reaching a point of unsustainability by surpassing the ecological threshold; (2) reaching the original planned enclosure infrastructure; and (3) political and social tensions within agglomerated sites (e.g., Maidanestke, Okolište) and destruction caused by conquering groups.

In demography studies, it is currently established that sites grow until they reach a point of unsustainability, meaning that it is not possible for inhabitants to find resources anymore. Were this the case, our results would show that, in every circumstance, the resources necessary for a settlement to survive, whatever its size, are not able to grow more after 200 years of occupancy. This is relevant for food supplies (Bennigaud et al. 2023; Isoardi 2008:45–47), but also related to the limitation of construction supplies and more particularly with regard to the wood needed to build and maintain houses in prehistoric temperate Europe. Indeed, after 200 years of use, the surrounding forest could be significantly reduced, preventing further settlement growth and explaining the slow decline in population numbers (Péfau 2022; Baum et al. 2020; Dal Corso et al. 2019).

Furthermore, the lack of space in an elaborately built enclosed settlement could also be an explanation for the sudden stop in population growth and the consequent decline (e.g., Bad Buchau). In other words,

Fig. 3. Loess regression calculation of the evolution of the number of houses for all sites (Supplements 1 and 3). The figure on the left shows the actual number of houses for each phase of the sites, whereas the figure on the right shows the percentage of houses for each phase compared to the whole number of houses for the same site.
Fig. 4. Regression calculation of the evolution of the number of houses by settlements’ lifespan and kernel density estimate of site duration (Supplements 1 and 3).
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For some sites researchers originally postulated a destruction by invaders, but at present other reasons for their sudden decline seem more probable, especially for tell sites and Trypillia mega-sites. The slow decline of the La Tène sites of Saint Blaise and Saint-Pierre can be explained by a political shift and the growing dominance in the region of the nearby Greek city of Marseille (Isoardi 2013:16). However, evidence of episodic war and destruction by the Roman infiltration at these La Tène sites ultimately caused their demise (Isoardi 2013:19).

The above observations can be described as endogenous or exogenous factors which influenced settlement longevity, or a combination of both. The limits imposed by environmental and ecological conditions (in some cases also caused by abrupt climate change) represent an exogenous factor which, in some cases, only materializes through internal developments, including population growth. Endogenous factors, such as the social conflicts mentioned above, will in turn only materialize when the exogenous pressure, such as ecological limits, becomes effective.
However, a more precise analysis of these interrelationships is only possible through studies on a less local and more regional or even continental scale. Even if these are available for several of the small regions concerned (e.g., the Slovak Žitava valley with the Early Neolithic Vráble or the Sinyukha basin with the Ukrainian Chalcolithic mega-sites (Furholt et al. 2020; Müller et al. 2016)), where settlement changes go from dispersed to agglomerated and back to dispersed, a more detailed comparative analysis on a broader basis is required.

Indeed, it is tempting to consider the relationship between the pattern of boom and bust observed in this paper and those discussed for larger geographic and temporal scales (Großmann et al. 2023; Kondor et al. 2023; Shennan 2018; O’Brien, Shennan 2009). The scope of the data used here, on a site-by-site basis, does not yet allow us to take this step, and requires a regional and, above all, long-term re-contextualization. In time, it will perhaps be possible to contextualize and understand the interaction and interdependencies of population changes at these different scales.

Enlarging the scope of the study could also help us answer other questions that arose over the course of our analysis. The slow but continuous decrease in population raises the question of what is happening to the inhabitants of these settlements. Are they leaving to move into another area? If this is the case, we should observe the creation of new settlements in the regional neighbourhood. We know that this is the case after the Roman conquest of Gaul, for instance, where some oppida were left after the creation of new Roman cities (e.g., Bibracte was abandoned to the benefit of Autun). Is this process more widespread?

Or are the inhabitants dying because of deprivation and/or diseases? The birth rate may also be slowing, explaining the decrease in building new houses. These last questions could be solved by integrating graves and anthropological data into the analysis.
Conclusion

In conclusion, the present study shows a demographic tendency in which a population increase in prehistoric sites never lasted longer than about five to 10 generations (c. 200 years), regardless of the period and region where settlements were inhabited. There can be multiple explanations for the collapse of these sites, from societal and political to subsistence and productivity. Even though the data at our disposal in this study did not allow us to settle for one or the other as more important, it is most probable that a combination of factors influenced the pattern observed in settlement growth and decline. The slow decrease in population numbers following a quickly reached peak highlighted by our analysis probably impacted and changed the social practices within the settlements and their organization. It may also have changed their relationship with other settlements in the area, likely affecting the networks of power, communication and trade in a region. Therefore, the discovery of this pattern of 200 to 300 years is important in order to understand not only the life cycles of settlements, but also of regional trajectories.

This study was a first step in the detection of the demographic evolution of settlement sites throughout prehistory. There is still room for expanding this analysis by adding more settlements into our dataset and especially more sites from the metal ages to balance the data. Indeed, the dataset is still too small and also not diverse enough to generalize the results of this analysis to all European settlements. Structuring the sample by more explicit economic parameters would also be beneficial, by using factors such as the intensity of animal husbandry and importance of resource interdependence between producing villages. For example, including the specialized agro-pastoral subsistence economy from Alpine Neolithic settlements or late Iron Age oppida may explain some patterning in settlement population trajectories. Consequently, research strategies should aim to analyse many more such sites with corresponding data quality. In follow up studies, these results have to be considered on a larger scale in order to assess their involvement in the spatial organization of political, economic, and cultural networks.

Fig. 7. Loess regression calculation of the number of houses per site types (Supplements 1 and 3).
But, as it appears, the observed pattern seems to be constant in the collected data, even when observing/examining different types of domestic settlements. Correlating with other available data, more specifically palynological and anthropological data, is required in further work to be able to more precisely identify the causes and consequences of this pattern.

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References


