Life and work – A possible ›house community‹ at the Early Bronze Age settlement of Schiepzig in Central Germany

Sandra Penske, Torsten Schunke, Jörg Orschiedt, Adam B. Rohrlach, Harald Meller, Wolfgang Haak, and Roberto Risch

Zusammenfassung

Leben und arbeiten – Eine mögliche »Hausgemeinschaft« in der frühbronzezeitlichen Siedlung von Schiepzig in Mitteldeutschland

Die gemeinsame archäologische und archäogenetische Analyse von zehn Individuen, die in der frühbronzezeitlichen Siedlung von Schiepzig begraben wurden, liefert neue Einblicke in die Beziehung zwischen den typischen Langhäusern der Aunjetitzer Kultur und den Menschen, die sie errichteten und bewohnten. Genetische Verwandtschaftsanalysen ergaben einen Stammbaum, der mindestens 15 Individuen umfasst, sich über vier Generationen erstreckt, und zudem in Verbindung mit einem der Langhäuser steht. Die Integration archäologischer und anthropologischer Ergebnisse ermöglicht es uns, intensiv diskutierte Themen in der prähistorischen Archäologie anzusprechen, wie z.B. die Größe einer Gemeinschaft, die Belegungsdauer der Häuser und die Praxis der Körperbestattung im Vergleich zu anderen, weniger sichtbaren Bestattungsformen.

Summary

Combined archaeological and archaeogenetic analyses of ten individuals buried in the Early Bronze Age settlement of Schiepzig provide new insights into the relation between the typical Únětice longhouses and the communities that constructed and occupied them. Genetic relatedness analyses associated with one of the longhouses have revealed a pedigree of more than 15 individuals spanning over four generations. The integration of archaeological and anthropological evidence allowed us to address long-debated issues in prehistoric archaeology, such as community size, house duration, and the practice of inhumation burials versus other, albeit undetected, funerary practices.

Introduction

Rescue excavations in the municipality of Schiepzig, close to today's city of Halle in Central Germany, between October 2005 and March 2006 and between October and December 2007, led to the discovery of an Early Bronze Age settlement of the Únětice Culture (Schunke 2018; Damrau et al. 2019; Duchniewski et al. 2019). It was placed in an excellent topographic location, on a ~20 m high fluvial terrace south of the fertile Saale River Valley, close to salt-bearing springs. The location of the settlement is unusual because it was built on the edge of an artificially excavated ~40 m long and 30 m wide depression, which occasionally held water and became a pond-like feature during the time the settlement existed. The depression held a well-preserved archaeological level with a large amount of faunal remains and stone tools. The archaeozoological and functional analyses of these finds suggest that a substantial number of cattle were butchered and processed in this area (Morgenstern in press; Sferrazza in press; Eguíluz et al. in press). The local production of salt is indicated by *briquetage* debris and could have been related to the conservation of freshly butchered meat.

The preservation of specific activity areas is unique in the context of Únětice settlement archaeology. The study of such areas is usually hampered by the disturbance of its floor levels after millennia of ploughing. Outside the discovered working area, the post holes of different constructions, pits, and a series of burials could be recovered. On its southern side, three typical Únětice longhouses could be identified based on the setting of the post holes (Tab. 1; Fig. 1). The overlapping ground plans indicate that not all three houses could have existed at the same time but suggest at least two successive building phases. Cylindrical and truncated cone-shaped pits have been found in the vicinity of the buildings, which probably were used for storage. Two parallel lines of post holes seem to correspond to a footbridge leading from the longhouses to the working area (Fig. 1).

Seven burials were excavated in the immediate surroundings of these houses, at the southern side of the settlement (Fig. 1). The majority of graves contained no apparent grave goods, with the unusual exception of feature 16047, which contained two bronze needles (one of them transformed into an awl), one bronze awl with a bone handle, a pottery vessel, and a cattle meat offering (Moser 2017). Human remains were only preserved in four of the graves, two of which could be used for ancient DNA analysis (16047/SCI008 and 16051/SCI009; Tab. 1; Fig. 2a).

A fourth longhouse was located north of the working area, and its ground plan could be partly recovered (Tab. 1; Fig. 1). Nine burials were excavated in its surroundings, two

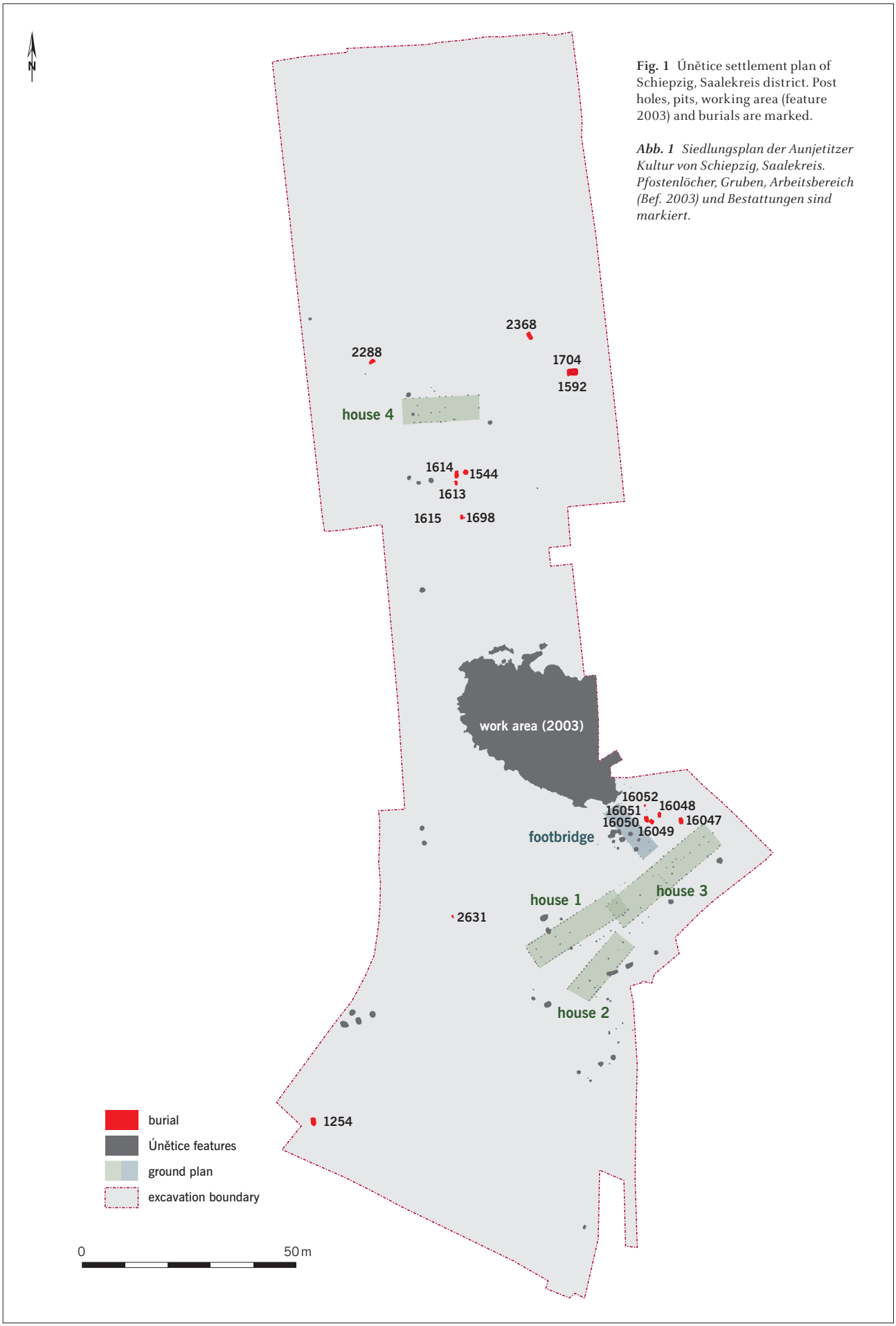

Fig. 1 Únětice settlement plan of Schiepzig, Saalekreis district. Post holes, pits, working area (feature 2003) and burials are marked.

Abb. 1 *Siedlungsplan der Aunjetitzer Kultur von Schiepzig, Saalekreis. Pfostenlöcher, Gruben, Arbeitsbereich (Bef. 2003) und Bestattungen sind markiert.*

House Nr.	Building Type (according to Schunke/Stäuble 2019; Risch et al. 2022)	Length (m)	Width (m)	Surface (m^2)	Orientation (1–360°)
SZ-01	Salzmünde (two trusses)	25.40	6.00	152	57
SZ-02	probably Salzmünde	> 17.70	5.80	> 102.70	50
SZ-03	Salzmünde (two trusses)	30.70	6.80	208.70	40
SZ-04	Salzmünde (two trusses)	> 17.60	5.90	> 103.80	87

Tab. 1 Architectural variant, size and orientation of the Únětice houses at Schiepzig, Saalekreis district.

Tab. 1 *Architektonische Varianten, Größe und Ausrichtung der Häuser der Aunjetitzer Kultur in Schiepzig, Saalekreis.*

of which contained a pot and/or a pin made out of bone or copper. Eight burials yielded remains of eleven individuals, eight of which could be used for ancient DNA analyses (SCI001–007 and 1704/SCI010) (Tab. 2; Fig. 2b).

Overall, the house plans, house sizes, and the rather poorly equipped burials correspond to what is usually known from Early Bronze Age settlements in Central Germany (Risch et al. 2022). Based on archaeological criteria and an extensive series of radiocarbon dates from the working area (Moser 2017), we suggest that the house structures, the burials, and therefore the settlement of Schiepzig existed between ~ 2150–1850 cal. BC. However, due to uncertainty margins, these dates do not allow us to confirm if the site was occupied for 300 years or a slightly shorter period.

The aim of the present study is to better understand the social organisation of early Únětice settlements with a particular focus on the community that built and lived in their characteristic longhouses. The combination and integration of genetic, archaeological, anthropological, and spatial information allows possible insights into kinship structures to be gained, to estimate the size of such communities, and to constrain the duration of the Únětice settlement at Schiepzig.

The anthropological record of the Schiepzig settlement

During the excavations in Schiepzig, in total 17 grave features of the Únětice Culture were discovered; nine were around house 4, seven around and near houses 1–3, and one additional grave was found in isolation. Four graves yielded no human remains (features 1592, 16048, 16049, 16052) and the skeletal remains from one grave (feature 2631) could not be found at the time of the investigations. Thus, 14 graves were available for anthropological evaluation (Orschiedt in press). The majority of these graves were spatially related to the houses, with seven of the graves located south (features 1544, 1613, 1614, 1615, 1698), east (features 1592, 1704), north-east (2368), and north-west (2288) of house 4, while another seven are related to houses 1–3 (features 2631, 16047, 16048, 16049, 16050, 16051, 16052; Fig. 1–2). One feature (1254) was laid out as an isolated single grave, which is over 50 m south-west of house 1, but it contained no human remains (Fig. 1). While one grave around house 4 is a double burial (feature 1613), feature 1615 is a triple burial consisting of a primary deposit of a body (1615-1) and two secondary deposits (1615-2–3; Fig. 3).

The burials are poorly, or only partially, preserved and are fragmented, which affects the certainty of identification of age, sex, and pathological changes of the individuals. The bone substance, on the other hand, is mostly well-preserved but in some cases, the investigations were complicated by erosion or calcareous sinter deposits.

In total, we found five subadult and nine adult individuals. While the child burials were not morphologically sexed for methodological reasons, the sex of all nine adult individuals could be determined (Tab. 2). However, the sex of four individuals could only be determined by a single varying criterion. Therefore, with one exception, these determinations are to be regarded as uncertain. The biological sex of one male and four female individuals could be reliably determined on a morphological basis. Genetic sex determination is therefore of great importance in the final evaluation of the burials. One burial was identified as probably male (1615, Ind. 3) and two others as likely male (1614, 16050) due to their incomplete preservation and age. Together with the genetically sexed children, we find an equal representation of genetically male and female individuals. In contrast, among the adult individuals, whose sex could be determined reliably, a surplus of females over males (5:2) can be observed.

Due to the small sample size, and the partially poor preservation, the age distribution does not give a clear picture. The under-representation of children of the infans I age group indicates that only a part of a larger population was buried here. It is striking that apart from three individuals that could only be generally determined as adults (adult-mature), only one early adult individual is present. The majority of the individuals of the adult and mature age groups (n = 8) are at least late-adult to early-mature (30–50 years) and late-mature (50–60 years).

Further investigations with the aim of assessing the disease burden of the individuals revealed no pathological features with the exception of the burial from feature 2631. In this isolated burial of a 7–8-year-old child, a congenital *coxa antetorta* was found, which had led to an internal rotation of the knees and thus to a walking disability (Jani et al. 1979; Pichler/Schunke 2019). In addition, the child had a marked enlargement of the skull and a divergence of the sagittal suture, which could indicate a hydrocephalus. This

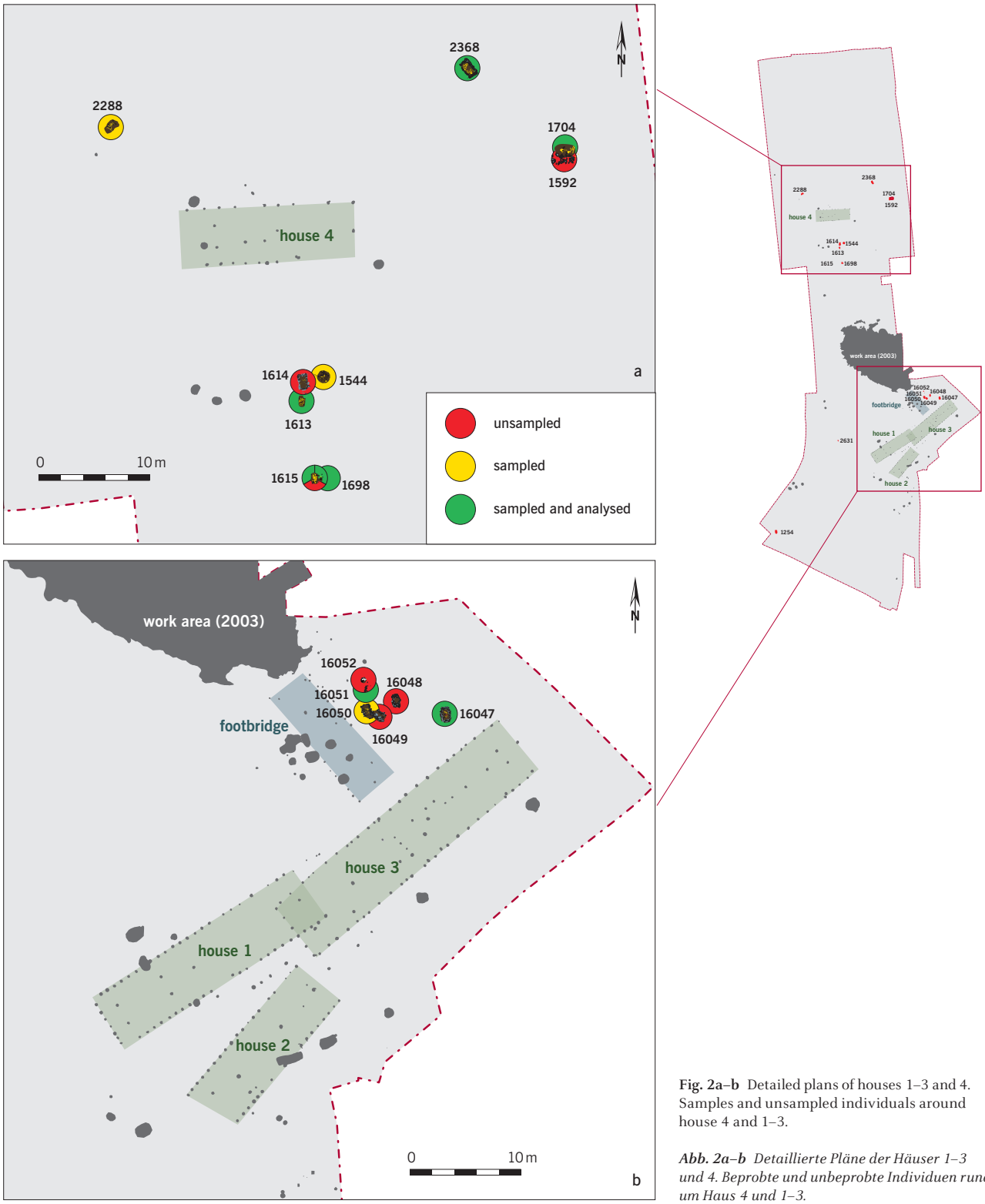

Fig. 2a–b Detailed plans of houses 1–3 and 4. Samples and unsampled individuals around house 4 and 1–3.

Abb. 2a–b *Detaillierte Pläne der Häuser 1–3 und 4. Beprobte und unbeprobte Individuen rund um Haus 4 und 1–3.*

disease can be congenital or acquired, e.g., through inflammation (Aufderheide/Rodríguez-Martín 1998, 57–58).

Pathological changes in the skeletal remains of adult individuals are commonly observed especially in the area of the masticatory apparatus and the joints, independent of the archaeological horizon. Among the adults from Schieppzig, dental pathologies were observed in six individuals (1613, Ind. 1; 1615, Ind. 1–2; 1704; 2288; 2368), of which three are cases of periodontopathy, three individuals with apical processes, and two cases of caries. Overall, the disease burden can be considered rather low. This also applies to the diseases of the spine, which are only recognisable in three older individuals of the age groups early and late maturity (40–60 years; 1615, Ind. 1; 2288; 2368) and which also show slight degenerative changes in other joint areas. In individual cases, further pathological changes indicate hormonally controlled processes, unspecific injuries and cartilage or joint damage.

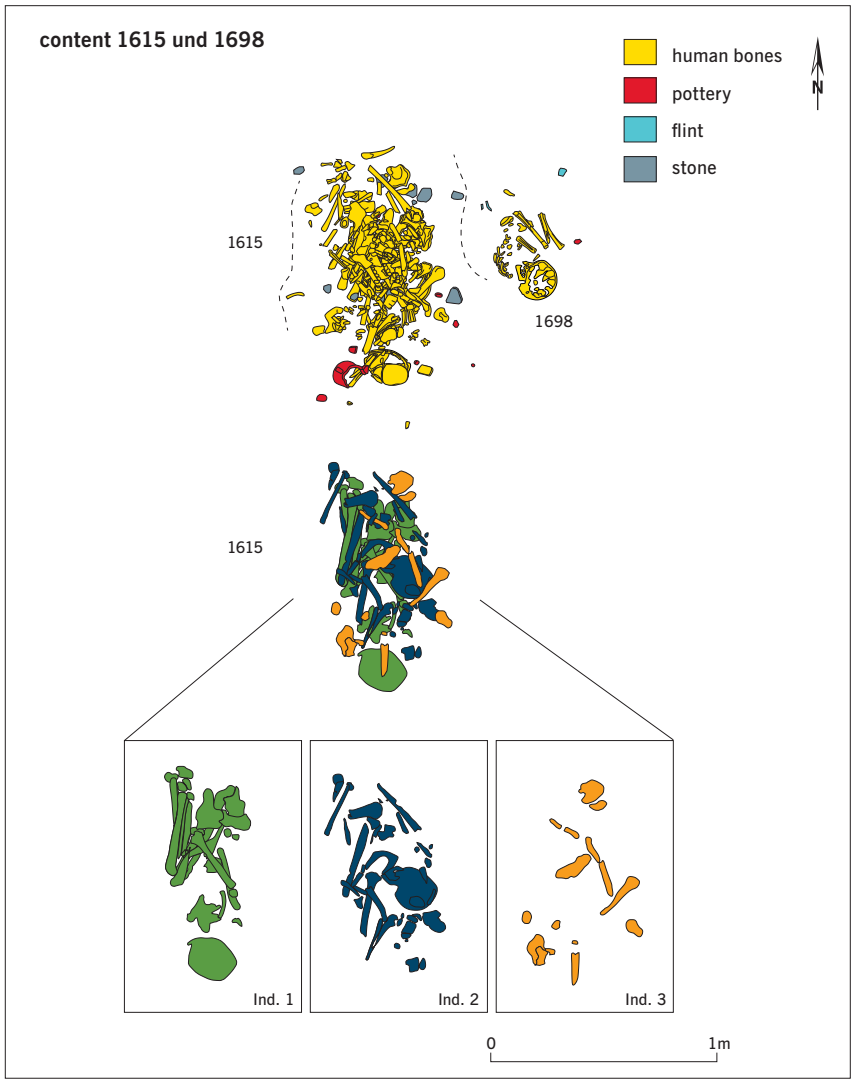

Fig. 3 Burials 1615 and 1698. Detailed plans of the remains belonging to three individuals in 1615. The lower one, Ind. 1 in primary position, and the other two, Ind. 2 and 3 in secondary position.

Abb. 3 *Bestattungen 1615 und 1698. Detaillierte Pläne der sterblichen Überreste von drei Individuen aus der Bestattung 1615. Das untere Individuum, Ind. 1 in primärer Position, und die anderen beiden, Ind. 2 und 3 in sekundärer Position.*

With regard to the stress characteristics, which can be recognised by clear expressions or changes in the attachment points of muscles and ligaments, the assessment is limited by the skeletal posture. In total, indications of greater physical stress were found in eight adult individuals (1544; 1613, Ind. 1; 1615, Ind. 1–3; 1704; 2288; 2368). A difference between the sexes is not observed. As expected, older adults in the mature (40–60 years) and late adult (30–40 years) age groups show stronger stress characteristics. An exception is the clear stress pattern of a young man aged 12–14 (1544), which suggests that subadult individuals were involved in the work process from an early age. However, apart from the fact that certain muscle groups in the area of the upper extremities, such as raising and lowering the arms and the shoulder and neck area, were heavily loaded, no detailed movement sequences can be reconstructed from these load characteristics. This also applies to the load on the lower extremities. All muscles involved here are relevant for locomotion and stabilisation. Overall, it can be seen that both the upper and lower extremities were heavily loaded in individual subjects.

The comparison of the individuals from Schiepzig with a comparative sample of 190 individuals from the Middle Elbe-Saale region (Nicklisch 2017, 80–102) shows a generally poorer preservation of the former. While the age structure is similar in terms of the ratio of adult to subadult individuals, there are differences in the distribution of sexes. While there are more males in the comparative sample, the Schiepzig individuals show a surplus of females among the adults. There are hardly any differences with regard to body height; the women and men from Schiepzig are within the range of variation of the comparative sample, but tend to be located in the lower to middle range of the variation. By contrast, the differences in dental pathology are striking: the Schiepzig series has a significantly lower frequency and intensity of caries. This also applies to the frequency of dental calculus and could be related to a lower consumption of carbohydrates in combination with better oral hygiene. Overall, the individuals from Schiepzig represent a group of people that were carrying out physically demanding work, but at the same time were apparently well nourished and also had an average-to-low disease burden.

Biological relatedness estimation

Eight out of twelve individuals of the Early Bronze Age individuals buried around and associated with house 4, as well

House	ID	Feature	Lab ID	Ind.	Morphological/ Genetic sex	Age	Age group
4	2006:1793	1544	SCI001		–/m	12–14 12.7 ± 2.2	Infans II
	n.a.	1592			No bone preservation		
	2006:1925	1613	SCI002	1	w/w	50–60	Late mature
	2006:1925	1613	SCI003	2	–/m	7 ± 2 7.3 ± 2.2/6.9 ± 2.1	Infans II
	2006:1927	1614			m??/n.a.	20–60	Adult-mature
	2006:1937	1615	SCI004	1	w/w	50–60	Late mature
	2006:1937	1615	SCI005	2	w/w	30–35	Late adult
	2006:1937	1615**		3	m?/n.a.	25–30	Early adult
	2006:2062	1698	SCI006		–/w	5 ± 1.5 5.1 ± 2.1	Infans I
	2006:2068	1704	SCI010		w/w	30–50	Late adult – early mature
	2006:2170	2368	SCI007		m/m	40–50	Early mature
1–3	n.a.	1254			No bone preservation		
	2006:2140	2288**			w/n.a.	40–50	Early mature
	2006:2238	2631*			n.a.	7–8	Infans II
	2007:43547	16047	SCI008		w?/w	35–50	Late adult – early mature
	n.a.	16048			No bone preservation		
	n.a.	16049			No bone preservation		
	2007:43574	16050**			m??/n.a.	20–35	Adult
	2007:43581	16051	SCI009		–/m	9 ± 2	Infans II
	n.a.	16052			No bone preservation		

Tab. 2 Age and sex determination of burials from Schiepzig. Age data of the children: age estimates based on teeth are given first (Ubelaker 1978), followed by age estimates based on long bone measurements (Cardoso et al. 2013). *Currently not traceable, the information given refers to published data (Pichler/Schunke 2019). **Individuals associated with feature numbers 1615-3, 16050 and 2288 were sampled at a later stage and results are unavailable at the time of publishing. n.a. = not available.

Tab. 2 *Alters- und Geschlechtsbestimmung der Bestattungen aus Schiepzig. Altersangaben der Kinder: Zuerst werden Altersschätzungen auf Basis der Zähne angegeben (Ubelaker 1978), gefolgt von Altersschätzungen auf Basis von Röhrenknochenmessungen (Cardoso et al. 2013). *Derzeit nicht nachvollziehbar, die Angaben beziehen sich auf veröffentlichte Daten (Pichler/Schunke 2019). **Individuen, die mit den Befundnummern 1615-3, 16050 und 2288 assoziiert sind, wurden zu einem späteren Zeitpunkt beprobt und die Ergebnisse waren zum Zeitpunkt der Veröffentlichung noch nicht verfügbar. n. a. = nicht verfügbar.*

as two of the six individuals buried near houses 1 to 3, were used for ancient DNA (aDNA) analyses. We were able to successfully generate high-quality genome-wide data (1240k SNP capture data, (Mathieson et al. 2015) for all ten of them (Fig. 2). To estimate possible genetic relatedness between the individuals we used READ (Monroy et al. 2018) and identity-by-descent analysis (IBD; Ringbauer et al. 2023).

House 4

We found close genetic relationships between seven out of the eight individuals associated with house 4, and based on the integration of contextual evidence (age at death, mitochondrial DNA and Y-chromosomal haplogroups) we were able to reconstruct a pedigree spanning over four generations (Fig. 4).

From the triple burial, two out of three individuals yielded aDNA results from which a parent-offspring relationship could be reconstructed. Individual 1615/SCI004 was the mother of 1615/SCI005, an individual that died around the age of 30–35 years (Fig. 3). Individual 1698/SCI006 from a single burial was found to be the granddaughter of 1615/SCI004 and the niece of 1615/SCI005. 1698/SCI006 died when she was around 5 years old. A male individual, 1544/SCI001, buried close to the aforementioned female individuals, was related in the first degree to 2368/SCI007, a second male individual, buried to the north of house 4. Both male individuals carry the same Y-chromosome (I2a2a) and mitochondrial haplogroup (T2a1a), which suggests that 1544/SCI001 and 2368/SCI007 were brothers. Results of the IBD analysis shows that the two brothers were also related in the third degree to both 1615/SCI004 and 1615/SCI005, but the quality of the genetic relationship to these individuals was different: Individual 1615/SCI004 was related to 1544/SCI001 and 2368/SCI007 in direct gen-

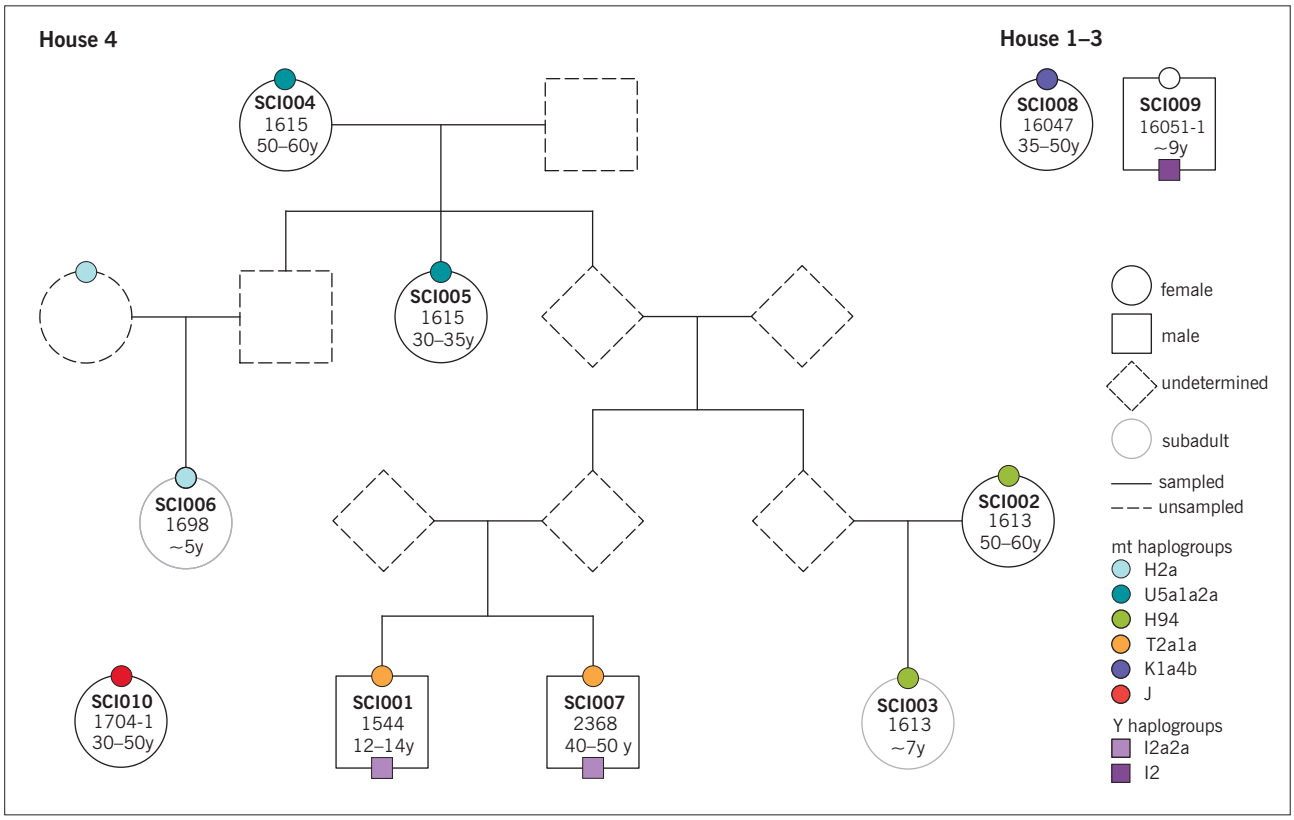

Fig. 4 Genetic relationships between individuals associated with houses 4 and 1–3. Pedigree reconstructed based on READ, IBD, mitochondrial (mt) and Y-chromosome haplogroups for individuals buried around house 4, comprising four generations. Individual 1704/SCI010 and the two individuals from around the houses 1–3 were not genetically related to individuals from the pedigree.

Abb. 4 *Genetische Beziehungen zwischen Individuen, die mit den Häusern 4 und 1–3 verbunden sind. Rekonstruierter Stammbaum basierend auf READ-, IBD-, mitochondrialen (mt) und Y-Chromosomen-Haplogruppen für Individuen, die rund um Haus 4 begraben sind und vier Generationen umfassen. Das Individuum 11704/SCI010 und die beiden Individuen aus der Umgebung der Häuser 1–3 waren genetisch nicht mit Individuen aus dem Stammbaum verwandt.*

erational line and thus the great-grandmother of the brothers, whereas 1615/SCI005 was their great-aunt (Fig. 5).

Two female individuals from a double burial, 1613/SCI002 and 1613/SCI003, shared a first-degree relationship and the same mitochondrial haplotype, while IBD analysis further indicates a parent-offspring relationship with 1613/SCI002 being the mother of 1613/SCI003. IBD analysis also shows that 1613/SCI003 was related in the third degree to other individuals from the pedigree (Fig. 5), and again in direct generational line to 1615/SCI004, whereas 1613/SCI002 was only related to her daughter and thus can be considered an exogenous female. These relationships fit into the existing pedigree with 1615/SCI004 being the great-grandmother, 1615/SCI005 the great-aunt to 1613/SCI003, and the brothers 1544/SCI001 and 2368/SCI007 their first cousins.

1613/SCI002 and the mother of 1698/SCI006 provide evidence for two exogenous females. In addition, the diamond-shaped parental unions in the 2nd and 3rd generation of the pedigree suggest one, if not two, more exogenous females. This observation is further supported by a replacement of mitochondrial haplogroups in every generation. This indicates that the generations are connected by the male line rather than the female line, resulting in possible patrilineality and patrilocality. Individual 1615/SCI005 was the only adult lineage daughter buried at the site (Fig. 4).

In addition to the individuals that can be placed into the pedigree, 1704/SCI010, a 30–50-year-old female individual, was buried at house 4 and was not related to any other individual buried at the site (Fig. 5). Although the available ^{14}C date indicates that 1704/SCI010 was contemporary with the group of biologically related individuals, this female was not buried among this group but in an isolated tomb northeast of house 4. In this case, spatial distancing of the burials seems to mirror biological distance (Fig. 6).

House 1–3

Out of seven burials only three contained skeletal remains. Two individuals were identified as male by osteological criteria, the third was an infant whose sex could not be determined. Only two individuals could be used for ancient DNA analyses and the genetic sex of the infant 16051/SCI009 could be determined as male, whereas the genetic sex of 16047/SCI008 was female and therefore differed from the anthropological determination. Both individuals, a 35–50-year-old female (16047/SCI008) and a ~9-year-old boy (16051/SCI009) were found to be neither related to each other nor genetically connected to the pedigree from house 4 or to 1704/SCI010 (Fig. 5). Like the unlinked individual 1704/SCI010, their mitochondrial and Y-chromosome haplogroups are not found among the individuals of the pedigree

and IBD analysis did not detect any genetically long-distance relationships with other individuals (Fig. 3).

Discussion and Conclusion

The results presented in this study provide critical insights into the livelihood, settlement and social structure of Early Bronze Age communities from Central Germany associated with the Únětice Culture. On the basis of the available data, we were able to reconstruct a pedigree spanning four generations involving seven individuals buried around house 4, which represents a typical Únětice longhouse. Therefore, burials around house 4 likely belonged to a closely related kin group, or a potential ›house community‹. The reconstructed pedigree indicates that at least another eight individuals are missing, and suggests a minimum group size of 15 individuals associated with the long house. This does not include potential siblings or additional children. Indeed, the large majority of burials contained adults, whereas only two children between 5–7 years of age were included in this funerary space. Considering that the mortality rate among children during the Únětice period between the ages of 0–5 years might have been as high as 47 % (Nicklisch 2017, 105), other burial grounds or rites must have existed for sub-adult individuals. The fact that the ten burials found around house 4 kept 13 individuals, seven of which belong to the pedigree, suggests that only a fraction of the group, approximately 42 %[1], was granted a burial around house 4. This situation is even more pronounced around houses 1–3, where the size (Tab. 1) and architectural complexity of these three buildings exceeds by far in capacity the number of burials. In contrast to house 4, it is also possible that these buildings were not used as housing/living complexes, but instead were used for specialised activities, such as barns for storage or stockpiling in relation to the central feature 2003. In view of the frequent location of burials at a certain distance south of the Únětice buildings (Fig. 2a), it is also possible that the burials of house 3 are located outside the limits of the Schiepzig excavation area and, consequently, have not been found yet (Fig. 2b).

One anthropologically determined adult male (1614) buried south of house 4 could not be analysed for DNA, whereas the third individual of feature 1615-3 and a female individual (2288) have not been genetically analysed yet. Moreover, two graves (1254, 1592) spatially related to house 4 did not preserve any human remains, but probably belonged to adult individuals based on the size of the wooden coffin and stone protection. Therefore, it remains unclear whether these individuals were genetically related to the other burials and would occupy missing nodes in the pedigree. It is worth noting that one of the males (1615-3) was buried together with the female individuals 1615/SCI004 and 1615/SCI005. Therefore, considering the order of deposition (Fig. 3) and age at death it is likely that feature 1615-3 is the child of 1615/SCI004, the mature female buried first within the pit, and sibling of 1615/SCI005. It is also possible that 1615-3 is the partner of 1615/SCI004 and putative father of 1615/SCI005, or alternatively he was not related to either.

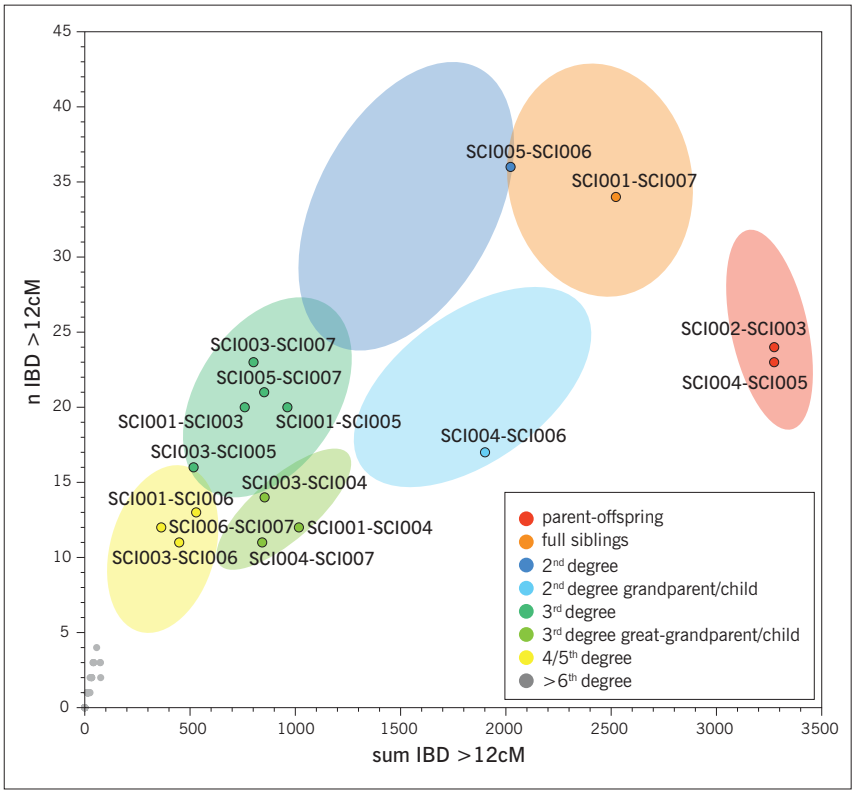

Fig. 5 Identity-by-descent (IBD) within individuals from Schiepzig. Plotting the sum versus the number of shared tracts of IBD in window sizes of > 12 cM resolves degrees of biological relatedness up to the 4–6th degree. Coloured ellipses indicate the observed range of degrees of relatedness from comparative and simulated data.

Abb. 5 *Identity-by-Descent (IBD) bei Individuen aus Schiepzig. Durch Aufzeichnen der Summe gegen die Anzahl gemeinsam genutzter IBD-Teile in Fenstergrößen von > 12 cM werden Grade der biologischen Verwandtschaft bis zum 4.–6. Grad zerlegt. Farbige Ellipsen geben den beobachteten Bereich der Verwandtschaftsgrade aus Vergleichs- und Simulationsdaten an.*

1 15 is the minimal number of individuals necessary to generate the reconstructed pedigree (Fig. 4). Applying a child mortality of 50 % we can tentatively add another nine individuals (estimated from the three attested children predicted to have been born in Schiepzig in each of the three offspring generations). From this extrapolated number of 24 individuals, seven have been identified genetically.

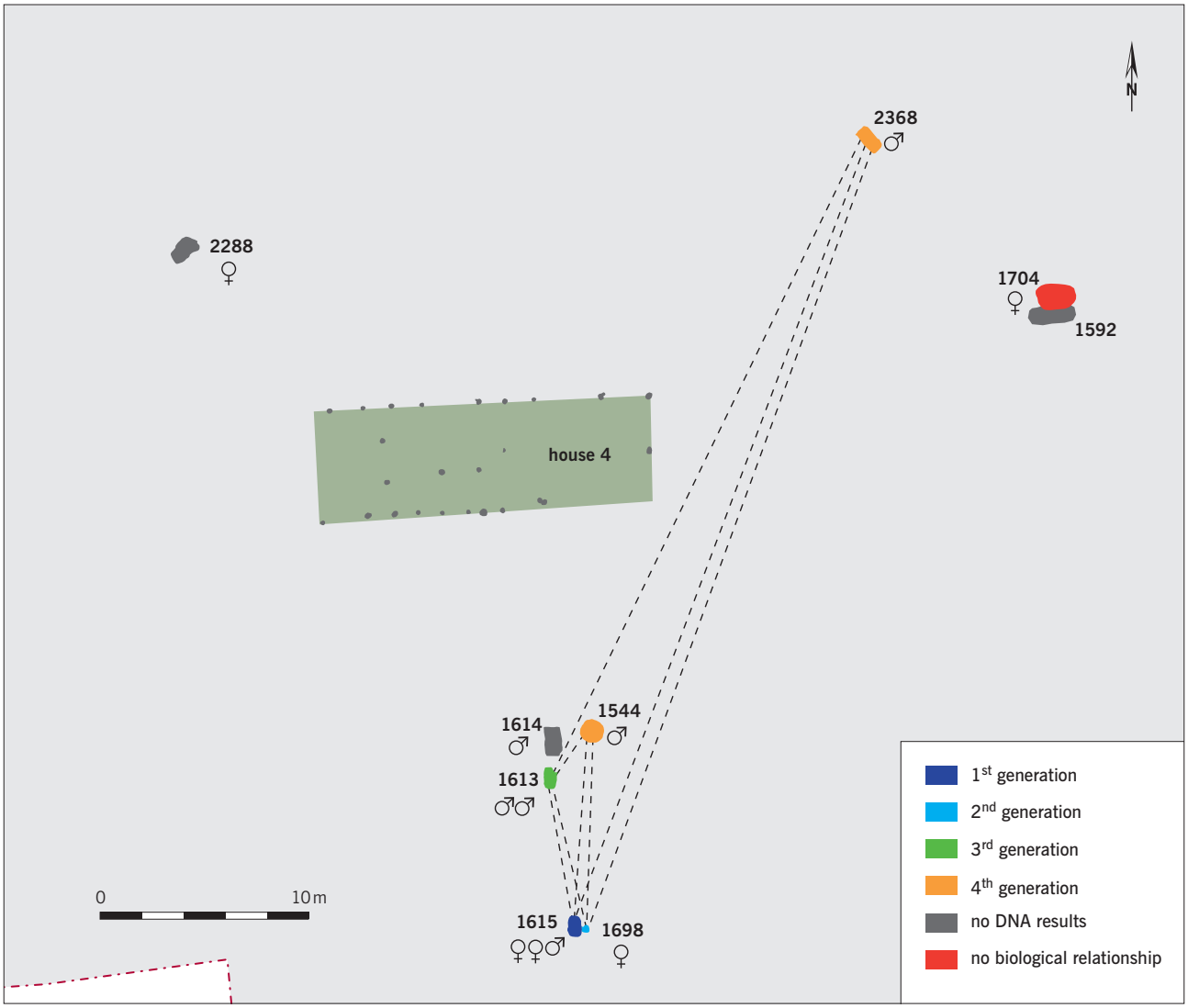

Fig. 6 Detailed plan of the individuals buried around house 4. Colours indicate the maternal mt haplogroup and dashed lines show the connection of the burials via genetic relationships.

Abb. 6 *Detaillierter Plan der um Haus 4 herum begrabenen Individuen. Die Farben zeigen die mütterliche mt-Haplogruppe an und gestrichelte Linien stellen den Zusammenhang der Bestattungen über genetische Beziehungen dar.*

The mothers of at least two generations were not related to anyone in the pedigree except their children, suggesting they came from a different house or community. That suggests the practice of female exogamy that has been observed also in other studies of the European Early Bronze Age (Mittnik et al. 2019; Žegarac Leskovar/Premrov 2021; Villalba-Mouco et al. 2022). Further, albeit subtle, support for this conclusion comes from the stable dietary isotope data. While all individuals of Schiepzig show high $\delta^{15}N$ values, indicating their direct relation with the butchering or animal processing activities at the site, the adult woman 1704/SCI010, who shows no biological relationship with other individual from Schiepzig, has markedly lower $\delta^{15}N$ and $\delta^{13}C$ values. This would imply that she consumed significantly less animal protein and suggests that she could have come from a different region or belonged to a lower social echelon. On the other hand, at least one female lineage daughter, (individual 1615/SCI005) remained in, or returned to, the settlement before she died in her 30s, providing an exception to the rule.

The spatial distribution of the seven genetically linked individuals reveals that not all members were buried in the same funerary area. While members of all four generations were buried south of house 4, the 40–50-year-old male of grave 2368/SCI007 may represent the last individual to die at the site, and was buried over 35 m north from his brother's grave 1544/SCI001, who died at much younger age (Tab. 2; Fig. 6). However, it is also possible that he passed away after the house was abandoned and was therefore not clearly spatially associated.

The interpretation concerning the few genetically analysed individuals around houses 1–3 is different and based on only very few data points, and thus does not allow firm conclusions to be drawn. The finding that individuals 16047/SCI008 and 16051/SCI009 were genetically unrelated does not preclude the existence of a ›house community‹ similar to that of house 4, particularly given that the majority of burials (potential nodes) has not been tested. Hypothetically speaking, it is possible that individuals 16047/SCI008 and

1704/SCI010 were exogenous females who formed unions with lineage males of each respective house, but who had no offspring together that would link them to a pedigree. Overall, however, non-genetic relationships also played a major role in prehistoric societies, but it remains unclear how these are reflected with regards to prevailing burial customs at Schiepzig. Furthermore, it raises questions about the nature and purpose of such social relationships, including possible dependent relationships between people. Answering such questions is, however, outside the scope of this current study.

Importantly, the pedigree not only informs us about the approximate number of people associated with a longhouse, but can also provide a temporal estimate with regards to the duration of such a building. In our case, four generations would provide a maximum upper estimate of 126 years considering a mean generation time of 29 years (Fenner 2005; Nicklisch 2017). More concretely, taking the estimated age at death of individuals and the ages of mothers into account, we estimate a combined lifespan of ~ 80–120 years from the pedigree as a proxy for the duration of house 4 at Schiepzig. This assumes that the house lasted until: 1) the oldest individual of the last generation 2368/SCI007 passed away at the age of 40–50 years; 2) that he, his mother and his grandmother were born in Schiepzig; 3) that his mother, grandmother and great-grandmother 2368/SCI007 gave birth to their children when they were between 20 and 30 years old; and 4) that the great-grandmother belonged to the founding generation of house 4, which she helped to build when she was ~ 20 years old. This »most likely scenario« can be put into context with the more speculative estimates from the archaeological record and experimental archaeology, which range from 75–100 years for longhouses of the Early Neolithic Linear Pottery Culture (Rück 2007) to lower estimates of 20–30 years (Modderman 1972), in line with Late Neolithic palafite houses (Petrequin/Petrequin 2016). Average occupation spans of c. 150 years have also been established for Scandinavian Bronze Age longhouses on the basis of radiocarbon dates (Artursson 2009). Alternatively, if we assume that the first generation contributed to the erection of the building and the last generation decided to build a new one, this would leave an intersection of two main generations that had been living in or using the house effectively. This would reduce the estimated time of occupancy substantially. The spatial separation of burial 2368/SCI007, indicates that house 4 might have been abandoned at the time of his death, which would shorten the sequence by ~ 25 years. Indeed, shorter occupancies of 50–100 years have been suggested for the settlement of Schloßvippach, Sömmerda district (Germany), based on stratigraphic indicators (Walter et al. 2019, 422). Irrespective of the true scenario, the genetic results of the Schiepzig burials provide for the first time an estimate of the life span of the Únětice longhouses based on independent evidence.

It is clear that the social structure inferred from the biological relatedness analyses of the Early Bronze Age Únětice house community found at Schiepzig cannot be applied universally to other Únětice societies, but it provides a first insight into the relations existing within communities in Early Bronze Age Central Germany. Further Únětice burial grounds will have to be analysed genetically in order to determine whether certain genetic relationships within and between houses and communities were sanctioned or allowed, which has the potential to provide a robust scaffold for extended social kin relationships.

Acknowledgements

We thank Juliane Filipp for preparing the settlement plans with burials. The genetic study was funded by the Max Planck Society and the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program under grant agreement no, 771234-PALEoRIDER (to W. H.). The archaeological research has been supported by the State Office for Heritage Preservation and Archaeology of Saxony-Anhalt (T. S., J. Ö., H. M.). and by the Academia program of the Institució Catalana de Recerca i Estudis Avançats (ICREA) of the Catalan Government and the Spanish Ministry for Science and Innovation (PID2020-112909GB-100) (R. R.). We further thank Marie Himmel, Lena Semerau, Raffaela Bianco, and Rita Radzevičiūtė for their help with the sampling processing in the ancient DNA laboratory.

Bibliography

Artursson 2009
M. Artursson, Bebyggelse Och Samhällsstruktur – Södra och mellersta Skandinavien under senneolitikum och bronsålder 2300–500 f. Kr. GOTARC Ser. B. Gothenburg Arch. Ser. Thesis 52 (Göteburg 2009).

Aufderheide/Rodríguez-Martín 1998
A. C. Aufderheide/C. Rodríguez-Martín, The Cambridge Encyclopedia of Human Palaeopathology (Cambridge 1998).

Cardoso et al. 2013
H. F. V. Cardoso/J. Abrantes/L. T. Humphrey, Age estimation of immature human skeletal remains from the diaphyseal length of the long bones in the postnatal period. Internat. Journal Legal Medicine 128,5, 2013, 809–824.

Damrau et al. 2019
C. Damrau/A. Egold/A. Moser/P. Viol, Gräber der Aunjetitzer Kultur. In: H. Meller/S. Friederich (eds.), Salzmünde-Schiepzig – ein Ort, zwei Kulturen: Ausgrabungen an der Westumfahrung Halle (A 143). Teil 2. Arch. Sachsen-Anhalt, Sonderbd. 21,2 (Halle [Saale] 2019) 141–157.

Duchniewski et al. 2019
B. Duchniewski/A. Moser/T. Schunke/P. Viol, Frühbronzezeitliche Hausgrundrisse und Siedlungsnachweise bei Schiepzig und Salzmünde. In: H. Meller/S. Friederich (eds.), Ein Ort – zwei Kulturen. Ausgrabungen an der Westumfahrung Halle (A 143). Teil 2. Arch. Sachsen-Anhalt, Sonderbd. 21,2 (Halle [Saale] 2019) 97–123.

Eguíluz et al. in press
M. Eguíluz/S. Delgado/R. Risch, The economy of the Únětice settlement of Schiepzig according to the macrolithic artefacts. In: R. Risch/T. Schunke (eds.), Schiepzig – Life and death in an Únětice settlement at the river Saale. Forschber. Landesmus. Vorgesch. (Halle [Saale] in press).

Fenner 2005
J. N. Fenner, Cross-cultural estimation of the human generation interval for use in genetics-based population divergence studies. Am. Journal Physical Anthr. 128,2, 2005, 415–423.

Jani et al. 1979
L. Jani/U. Schwarzenbach/K. Afifi/P. Scholder/P. Gisler, Verlauf der idiopathischen Coxa antetorta. Orthopäde 8, 1979, 5–11.

Mathieson et al. 2015
I. Mathieson/I. Lazaridis/N. Rohland/S. Mallick/N. Patterson et al., Genome-wide patterns of selection in 230 ancient Eurasians. Nature 528, 2015, 499–503.

Mittnik et al. 2019
A. Mittnik/K. Massy/C. Knipper/F. Wittenborn, R. Friedrich et al., Kinship-based social inequality in Bronze Age Europe. Science 366,6466, 2019, 731–734.

Monroy et al. 2018
J. M. Monroy Kuhn/M. Jakobsson/T. Günther, Estimating genetic kin relationships in prehistoric populations. PLOS ONE 13, 2018, e0195491, <https://doi.org/10.1371/journal.pone.0195491> (01.06.2023).

Morgenstern in press
P. Morgenstern, Rinderknochen aus einer frühbronzezeitlich genutzten Senke bei Schiepzig, Saalekreis – ein früher Hinweis auf die Herstellung von gepökeltem Fleisch? In: R. Risch/T. Schunke (eds.), Schiepzig – Life and death in an Únětice settlement at the river Saale. Forschber. Landesmus. Vorgesch. (Halle [Saale] in press).

Modderman 1972
P. J. R. Modderman, Die Hausbauten und Siedlungen der Linienbandkeramik in ihrem westlichen Bereich. In: H. Schwabedissen/J. Lüning (eds.), Die Anfänge des Neolithikums vom Orient bis Nordeuropa 5, Westliches Mitteleuropa. Fundamenta. Monogr. Urgesch. R. A 3,5a (Köln, Wien 1972) 77–84.

Moser 2017
A. Moser, Aunjetitzer Grab mit Bronzen – Frühbronzezeitliche Siedlungsreste aus Schiepzig, Saalekreis, unter besonderer Berücksichtigung eines Grabes mit Metallbeigaben. Jahresschr. Mitteldt. Vorgesch. 96 (Halle [Saale] 2017) 77–109.

Nicklisch 2017
N. Nicklisch, Spurensuche am Skelett. Paläodemografische und epidemiologische Untersuchungen an neolithischen und frühbronzezeitlichen Bestattungen aus dem Mittelelbe-Saale-Gebiet im Kontext populationsdynamischer Prozesse. Forschber. Landesmus. Vorgesch. Halle 11 (Halle [Saale] 2017).

Orschiedt in press
J. Orschiedt, Die Aunjetitzer Menschenreste aus der Siedlung Schiepzig. In: R. Risch/H. Meller (eds.), Schiepzig – Leben und Tod in einer Aunjetitzer Siedlung an der Saale. Forschber. Landesmus. Vorgesch. (Halle [Saale] in press).

Petrequin/Petrequin 2016
P. Petrequin/A.-M. Petrequin, Clairvaux et le »Néolithique Moyen Bourguignon«. Coll. Cahiers MSHE Ledoux 22 = S. Dynamiques Territoriales 7 (Besançon 2016).

Pichler/Schunke 2019
S. Pichler/T. Schunke, Ein behindertes Kind aus der frühen Bronzezeit. In: H. Meller/S. Friederich (eds.), Salzmünde-Schiepzig – ein Ort, zwei Kulturen. Ausgrabungen an der Westumfahrung Halle (A 143). Arch. Sachsen-Anhalt, Sonderbd. 21,2 (Halle [Saale]) 124–125.

Ringbauer et al. 2023
H. Ringbauer/Y. Huang/A. Akbari/S. Mallick/N. Patterson et al., ancIBD – Screening for identity by descent segments in human ancient DNA. bioRxiv 2023, <https://doi.org/10.1101/2023.03.08.531671> (01.06.2023).

Risch et al. 2022
R. Risch/S. Friederich/M. Küssner/H. Meller, Architecture and Settlement Dynamics in Central Germany from the Late Neolithic to the Early Bronze Age. Proc. Prehist. Soc. 88, 2022, 123–154.

Rück 2007
O. Rück, Neue Aspekte und Modelle in der Siedlungsforschung zur Bandkeramik: die Siedlung Weisweiler 111 auf der Aldenhovener Platte, Kr. Düren. Internat. Arch. 105 (Rahden 2007).

Schunke 2018
T. Schunke, Siedlungen und Landschaft der Aunjetitzer Kultur in Sachsen-Anhalt – die Siedlungselemente, ihre Strukturierung und Lage. In: H. Meller/S. Friederich/M. Küßner/H. Stäuble/R. Risch (eds.), Siedlungsarchäologie des Endneolithikums und der frühen Bronzezeit. 11. Mitteldeutscher Archäologentag vom 18. bis 20. Oktober 2018 in Halle (Saale). Tagungen Landesmus. Vorgesch. Halle 20,1 (Halle [Saale] 2019) 127–207.

Schunke/Stäuble 2019
T. Schunke/H. Stäuble, Zum Verständnis der Aunjetitzer Langhäuser und der Versuch einer Typologie. In: H. Meller/S. Friederich/M. Küßner/H. Stäuble/R. Risch (eds.), Siedlungsarchäologie des Endneolithikums und der frühen Bronzezeit. 11. Mitteldeutscher Archäologentag vom 18. bis 20. Oktober 2018 in Halle (Saale). Tagungen Landesmus. Vorgesch. Halle 20,1 (Halle [Saale] 2019) 393–417.

Sferrazza in press
P. Sferrazza, A technological and functional analysis of the knapped lithic assemblage from the Early Bronze Age settlement of Schiepzig (Central Germany). In: R. Risch/T. Schunke (eds.), Schiepzig – Life and death in an Únětice settlement at the river Saale. Forschber. Landesmus. Vorgesch. (Halle [Saale] in press).

Ubelaker 1978
D. H. Ubelaker, Human Skeletal Remains: Excavation, Analysis, Interpretation (Chicago 1978).

Villalba-Mouco et al. 2022
V. Villalba-Mouco/C. Oliart/C. Rihuete-Herrade/A. Rohrlach/M. Inés Fregeiro et al., Kinship practices in the early state El Argar society from Bronze Age Iberia. Scien. Rep. 12, 2022, 22415, <https://doi.org/10.1038/s41598-022-25975-9> (01.06.2023).

Walter 2019
D. Walter/A. Endrigkeit/K. Bartel/S. Schneider/O Mecking et al., Häuser der frühen Bronzezeit in Thüringen. In: H. Meller/S. Friederich/M. Küßner/H. Stäuble/R. Risch (eds.), Siedlungsarchäologie des Endneolithikums und der frühen Bronzezeit. 11. Mitteldeutscher Archäologentag vom 18. bis 20. Oktober 2018 in Halle (Saale). Tagungen Landesmus. Vorgesch. Halle 20,1 (Halle [Saale] 2019) 419–432.

Žegarac Leskovar/Premrov 2021
V. Žegarac Leskovar/M. Premrov, A Review of Architectural and Structural Design Typologies of Multi-Storey Timber Buildings in Europe. Forests 12,6, 2021, 757, <https://doi.org/10.3390/f12060757> (01.06.2023).

Source of Figures

1–3 J. Filipp, Bad Bibra
4 S. Penske
5 S. Penske
6 J. Filipp, Bad Bibra

Tab. 1 R. Risch; T. Schunke
Tab. 2 J. Orschiedt; S. Penske

Addresses

Sandra Penske, M. Sc.
Department of Archaeogenetics
Max Planck Institute for Evolutionary Anthropology
Deutscher Platz 6
04103 Leipzig
Germany
sandra_ellen_penske@eva.mpg.de
ORCID: https://orcid.org/0000-0003-2800-0371

Dr. Torsten Schunke
Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt
Richard-Wagner-Str. 9
06114 Halle (Saale)
Germany
tschunke@lda.stk.sachsen-anhalt.de
ORCID: https://orcid.org/0000-0001-7361-5362

PD Dr. Jörg Orschiedt
Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt
Richard-Wagner-Str. 9
06114 Halle (Saale)
Germany
jorschiedt@lda.stk.sachsen-anhalt.de
ORCID: https://orcid.org/0000-0003-3629-8251

Dr. Adam B. Rohrlach
University of Adelaide
School of Computer and Mathematical Sciences
Ingkarni Wardli Building
5005 Adelaide
Australia
and
Max Planck Institute for Evolutionary Anthropology
Deutscher Platz 6
04103 Leipzig
Germany
adam_ben_rohrlach@eva.mpg.de
ORCID: https://orcid.org/0000-0002-4204-5018

Prof. Dr. Harald Meller
Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt
Richard-Wagner-Str. 9
06114 Halle (Saale)
sekretariat@lda.stk.sachsen-anhalt.de
Germany
ORCID: https://orcid.org/0000-0002-7590-0375

Dr. Wolfgang Haak
Department of Archaeogenetics
Max Planck Institute for Evolutionary Anthropology
Deutscher Platz 6
04103 Leipzig
Germany
wolfgang_haak@eva.mpg.de
ORCID: https://orcid.org/0000-0003-2475-2007

Prof. Dr. Roberto Risch
Department of Prehistory
Universitat Autònoma de Barcelona
Edifici B
08193 Bellaterra, Barcelona
Spain
Robert.Risch@uab.cat
ORCID: https://orcid.org/0000-0001-8534-5806