Article

Tracing the spread of Germanic languages using ancient genomics

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Germanic languages, including German, English, Frisian, Dutch and the Nordic languages, are widely spoken across northwest Europe. However, the timing and location of the prehistoric arrival of this Indo-European linguistic phylum, as well as its Iron Age diversification, remain contentious[1–3]. Here, by sequencing 712 ancient human genomes and analysing them alongside 4,009 previously published genomes, we identify an archaeologically elusive population that entered Sweden, likely from the Baltic region, by around 4000 BP. This population, which became widespread throughout Scandinavia by 3500 BP, offers a potential vector for the introduction of the Germanic language group to Scandinavia[4–6], some 800 years later than traditionally assumed[7–9]. Following the Late Iron Age disintegration of Germanic into its descendant languages, we observe by 1650 BP a southward migration from southern Scandinavia into presumed Celtic-speaking areas, including present-day Germany, Poland and the Netherlands. During the subsequent Migration Period (1575–1375 BP), we see this ancestry among Germanic-speaking Anglo-Saxons in Britain and Langobards in southern Europe. In the same time period, we identify a related large-scale northward back-migration into Denmark and southern Sweden, coinciding with the rise of Danish influence and the linguistically documented emergence of Old Norse. These findings indicate that multiple migrations and geographical locations had a major role in the arrival and formation of Germanic, as well as in its divergence into historical and modern descendant languages.

The arrival of Steppe-related groups in Europe around 5000 BP (calibrated years before present) is commonly considered to be the last major prehistoric migration into the region[10,11]. Archaeologically, two major European groupings of this time are the Corded Ware and the Bell Beaker complexes. Linguistically, these are widely accepted as being connected with the dispersals of multiple Indo-European language groups[12]. In Scandinavia, both complexes have been specifically associated with the introduction of the Germanic language group[7,8,13]. However, these associations are complicated by the significant time gap of between 2 and 3 millennia that exists between these first waves of Steppe-related ancestry (approximately 5000–4500 BP) and the appearance of the first runic inscriptions, the earliest Germanic written evidence (around 1950–1550 BP)[14]. Only by the Late Bronze Age (3200–2800 BP) do linguistic interactions with Celtic-speaking groups in the south[4,5] and Finno-Saamic-speaking groups in the east[6,15] suggest that an early form of Germanic was present in the area between northern Germany and the East Baltic. Despite some preliminary evidence of genetic structure at this time in Scandinavia[16,17], its formation as well as its potential for tracing the spread of Germanic remain unexplored.

By around 2000 BP, Proto-Germanic, the Early Iron Age ancestor of all Germanic languages, was diverging into several subgroups, probably involving an initial East versus Northwest Germanic split[18,19]. This process was associated with various migrations during the Roman Iron Age (1950–1575 BP) and the Migration Period (1575–1375 BP). However, at present, our understanding of the relevant population dynamics is limited. Genetic studies have detected a northern European origin for Late Iron Age and Migration Period individuals often ascribed by post-Classical authors as Goths, Anglo-Saxons and Langobards[20–24], consistent with Late Antique historical sources. However, these studies have not confirmed their specific regions of origin. Consequently, no comprehensive model for the spread and diversification of the Germanic languages currently exists.

To investigate the formation and diversification of Germanic-speaking populations and link the findings to historical linguistic theory, we sequenced the genomes of 712 ancient individuals to above 0.01× coverage (Supplementary Note 4 and Supplementary Table 1.1), with a focus on the Northern European Iron Age and the bordering Celtic-speaking region of western Europe[25] (Fig. 1). Together with published ancient genomes from around the world, we selected samples with suitable average depth of coverage for imputation (approximately 0.1× for whole genomes)[16,17,26]. After overlapping with publicly available ancient SNP capture data suitable for imputation (approximately 1× on targeted SNPs), removing close relatives and applying quality filters, the final imputed dataset contained 578 new and 4,009 published individuals covering 690,211 SNPs (Supplementary Note 4).

Fine-scale Bronze Age population structure

We explored the genomic affinities between all individuals in the dataset using the identity-by-descent (IBD) hierarchical clustering method and mixture modelling (see Methods) to discern the closely related genomic ancestries[16]. As discrete clustering does not display the complexities of admixture (Supplementary Note 5.2), potentially

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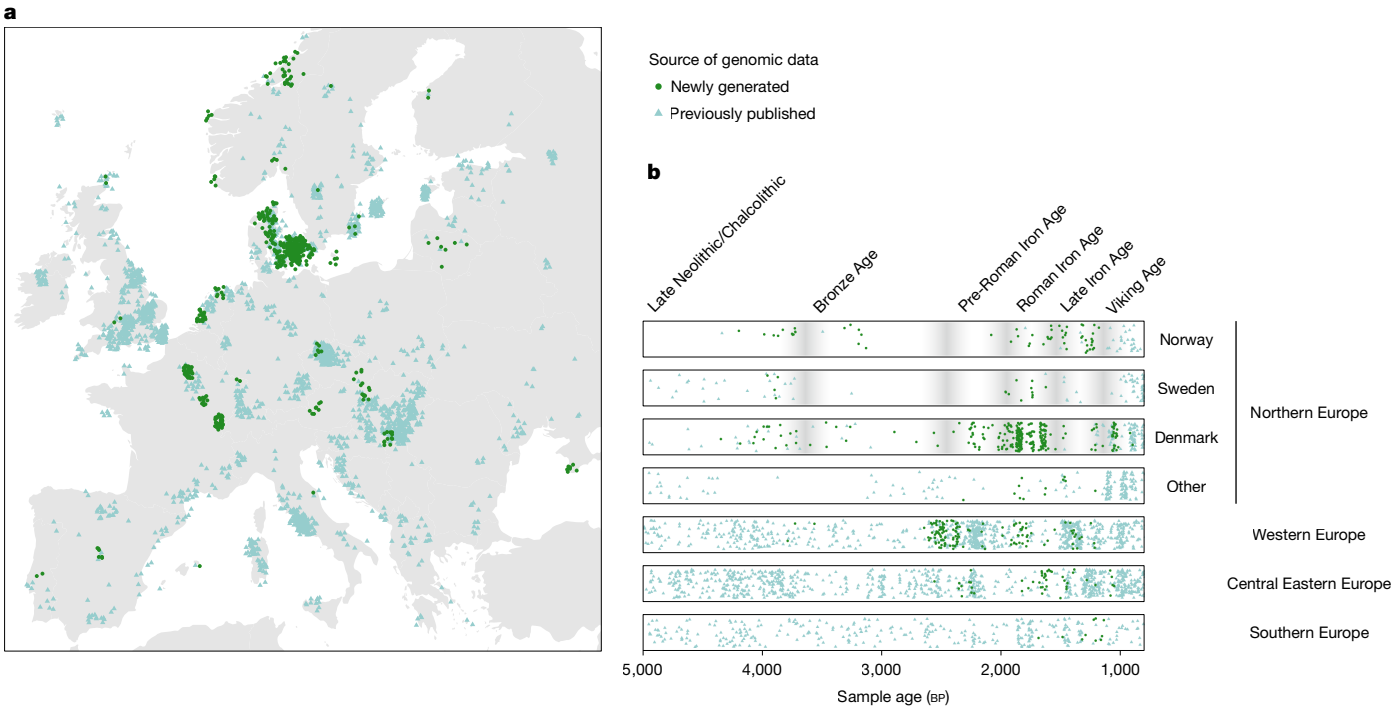

Fig. 1 | Spatio-temporal distributions sampling of the ancient individuals included in the final dataset. The geographical (**a**) and temporal (**b**) distribution of the newly generated and previously published ancient individuals from the Late Neolithic/Early Bronze Age to the Viking Age. Grey bars on the timeline represent the boundary between historical periods denoted above. The map was generated in R (v.4.2.3) using map_data from ggplot2 (v.3.5.0.9000).

giving false impressions of continuity, we applied IBD mixture modelling to assess the genetic structure within the clusters (Supplementary Note 5.3). To understand the general trends through time, we applied ordinary spatio-temporal kriging[27] to the mixture modelling results (Extended Data Figs. 1–4 and Supplementary Note 5.3).

We focused our efforts within the last approximately 5,000 years, commonly considered the hallmark for introduction of Steppe ancestry across Europe and widely acknowledged as a likely earliest possible date for the spread of the Indo-European language family[10,11]. We find that the majority of European individuals over the last 5,000 years fall in four main IBD clusters, with a varying geographical and cultural distinction for each (Supplementary Note 5.2.1). On the basis of this close correspondence with individuals assigned to various archaeological groups, we refer to these clusters as Yamnaya-, Corded Ware (East)-, Corded Ware (North)- and Bell Beaker-related. Notably, individuals from each cluster are placed adjacent to each other in a standard western Eurasian principal components analysis (PCA) (Extended Data Fig. 5 and Supplementary Note 5.1), and each cluster occupies different positions along the well-established cline of Steppe-Farmer ancestry that formed in Europe from the Bronze Age. To understand how the Steppe ancestry of all individuals (Supplementary Note 5.2.3) is related to the structure mentioned above, we applied IBD mixture modelling with sources representative of the Yamnaya, Corded Ware and Bell Beaker clusters (Supplementary Note 5.3).

We find the Steppe ancestry of the majority of the more southern European individuals to be modelled as Bell Beaker-related (Fig. 2, Supplementary Note 5.2.3 and Supplementary Fig. 5.17), together with a series of previously unidentified admixture clines (Extended Data Figs. 6 and 7 and Supplementary Note 5.3.3). We found, with high statistical significance, a correlation between ancestry modelled by the Yamnaya, Corded Ware and Bell Beaker sources in target individuals archaeologically assigned to the corresponding cultures (Supplementary Note 5.3.7). For many individuals, an archaeological assignment was not present; however, we found that individuals with Steppe ancestry modelled primarily as Corded Ware-, Bell Beaker- or Yamnaya-related tend to correspond closely with the regions ascribed to each culture in the archaeological record (Fig. 2).

During the Late Bronze Age (3150–2450 BP), the linguistically inferred presence of Palaeo-Germanic, the Bronze Age predecessor of Proto-Germanic, in southern and eastern Scandinavia falls within the geographic boundaries of the Corded Ware-related ancestries and cultures (Fig. 2). By the Roman Iron Age, Germanic-speaking regions continue to fall within the broader range of individuals of Corded Ware-related ancestry, bordered to the south by Celtic-speaking regions and Bell Beaker-related ancestries (Fig. 2). For Iron Age regions assigned as probably Germanic- or Celtic-speaking, we similarly find in all instances highly significant correlations with Corded Ware and Bell Beaker ancestries (Supplementary Note 5.3.7). This correspondence and continuity suggest that Germanic emerged and primarily continued to be spoken by populations of Corded Ware rather than Bell Beaker-related ancestry.

From the Late Bronze Age onwards, irrespective of clusters, the Steppe ancestry in almost all Europeans is modelled by either Corded Ware (East) or the Bell Beaker sources (Fig. 2 and Extended Data Fig. 2b). Notable exceptions appear in the coastal region of the Netherlands and in Bohemia, where the two archaeological complexes overlap (Supplementary Note 5.7.2).

The spatial range of Palaeo-Germanic

Although Corded Ware-related ancestry persists in northern Europe from the Bronze Age to the Iron Age (Fig. 2), the extent to which migrations occurred within this region is poorly understood. Linguistically, this period encompasses the prehistoric evolution of the Germanic branch following its split from the Indo-European proto-language. This evolution comprises two phases, Palaeo- and Proto-Germanic, separated by the so-called Germanic sound shifts usually dated to around 2450 BP. Lexical exchanges with Celtic in the south[4,5] and Finno-Saamic in the east[6,15] indicate that Palaeo-Germanic was present between northern Germany and the East Baltic by the Late Bronze Age (3200–2450 BP).

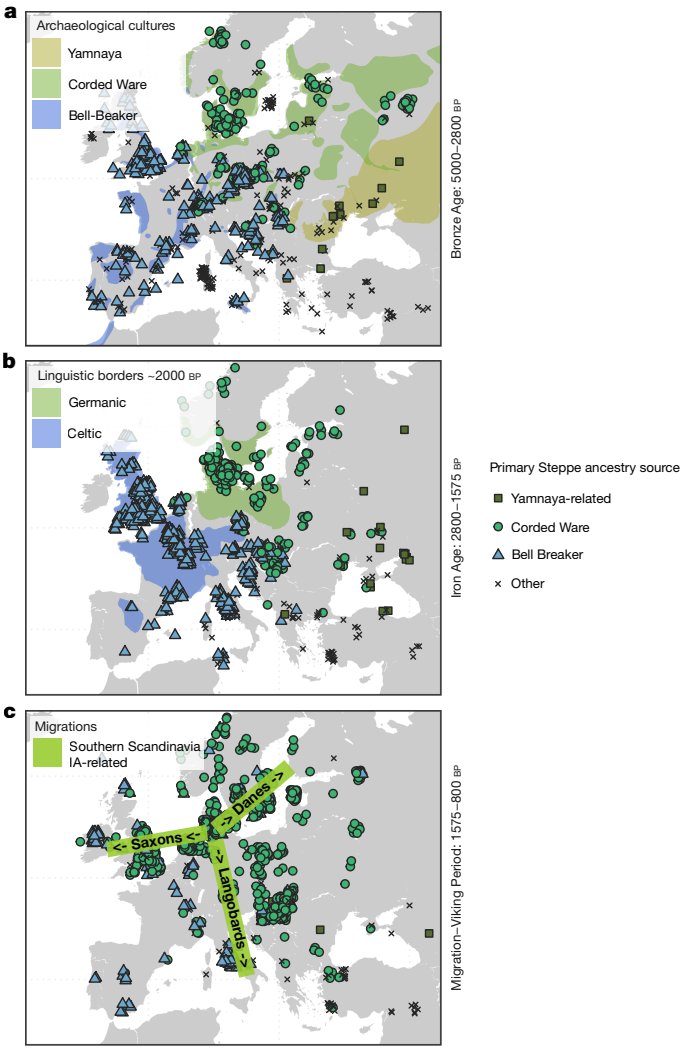

Fig. 2 | Geographical distributions of major archaeological cultures, language families and Steppe ancestry sources. a, Map showing the distribution of major archaeological culture of the Bronze Age and the major early Bronze Age ancestry source for Bronze Age individuals. **b**, Map showing the distributions of Germanic and Celtic speakers from around 1900 BP, and the major early Bronze Age ancestry source for Iron Age individuals. **c**, Map showing three relevant Migration Period expansions, and the major early Bronze Age ancestry source for Migration Period and Viking Period individuals. In **a**–**c**, individuals modelled with less than 10% Steppe ancestry or less than 66% from one of the source groups are indicated with 'x'. Maps were generated in R (v.4.2.3) using map_data from ggplot2 (v.3.5.0.9000). Archaeological boundaries are based on those of Furholt et al.[67]. IA, Iron Age.

The entry of Germanic loans into the Finnic Uralic group cannot be earlier than the putative arrival of their speakers in the Baltic, which according to the latest studies coincides with the arrival of Siberian ancestry after 3500 BP and probably with the cist graves from around 3150–3050 BP[28]. The first identifiably Celtic loans into Palaeo-Germanic must postdate the formation of Proto-Celtic, a process generally dated to about 3200 BP[4,19,29], coinciding with genetic expansions within the historically known Celtic-speaking parts of Europe[25,30] and with cultural influence of the Central European Urnfield Culture in these areas as well as on Scandinavia[31]. To investigate relevant demographic shifts at this time, we first established the population substructure within Bronze Age Scandinavia by re-clustering all ancient individuals older than 2800 BP (Supplementary Note 5.2.2 and Supplementary Table 5.2).

Within Scandinavia, three clusters are apparent (Extended Data Fig. 8a): (1) an Early Scandinavian cluster, including individuals from the Swedish Battle Axe Culture, some of the oldest Danish individuals, and nearly all Norwegians; (2) a later 'Southern Scandinavian' cluster restricted to Denmark and the southern tip of Sweden; and (3) an even later 'Eastern Scandinavian' cluster, spanning Sweden and geographically overlapping with the Southern Scandinavian cluster. In all three clusters, we see a striking correspondence between Y haplogroups and IBD clusters (Extended Data Fig. 8a), largely driven by different frequencies of haplogroups I1a (I1a-DF29), R1a1a1b1a3a (R1a-Z284) and R1b1a1b1a1a1 (R1b-U106), all being strongly associated with Scandinavian ancestry (Supplementary Note 5.2.2). We find a large degree of geographic overlap between the Early, Southern and Eastern Scandinavian clusters of the pre-2800 BP individuals and three subclusters detected in the original northern Corded Ware cluster: Western, Southern and Eastern Scandinavian, respectively (Extended Data Fig. 8b and Supplementary Note 5.2.2). The presence of genetic structure in the Bronze Age has previously been detected[16]; however, its formation and relation to the Bronze Age distribution of Palaeo-Germanic, and to the genetic structure of Iron Age Scandinavia, have not been addressed.

The three pre-2800 BP clusters are found across the region in which Palaeo-Germanic is proposed to have been spoken, and understanding their formation may be informative for the introduction of the Germanic branch of the Indo-European language family to Scandinavia. To investigate this, we applied mixture modelling, using a variety of deep Hunter-Gatherer sources. We find the Yamnaya-related ancestry in the three Scandinavian clusters to be modelled as Eastern Hunter-Gatherer and Caucasus Hunter-Gatherer (Supplementary Figs. 5.23, set 2 and 5.27), in agreement with expectations for Steppe ancestry in Europe[32]. However, when including additional sources (Supplementary Note 5.3.4), we find that Eastern Scandinavians have additional Hunter-Gatherer ancestry modelled entirely by the Latvian/Lithuanian Hunter-Gatherer source, rather than the local Scandinavian Hunter-Gatherers (Supplementary Note 5.3.4 and Supplementary Fig. 5.23, set 3). By contrast, the Southern and Western Scandinavians are modelled with additional Western Hunter-Gatherer ancestry. The subtle differences in the mixture modelling results are consistent with the subtle differences in the distribution of Bronze Age (2800 BP or earlier) individuals in the Scandinavian clusters in the western Eurasian PCA (Supplementary Figs. 5.7, 5.8 and 5.9) and are supported by rotating qpAdm models with 10 different Hunter-Gatherer clusters as sources (Supplementary Note 5.3.4), including representatives of the previously identified genetic structure of Mesolithic Scandinavia[33–35]. The presence of a non-local Hunter-Gatherer ancestry suggests the three clusters did not diversify from a single migration into the region. Although individuals from all three clusters likely spoke Indo-European languages, the Corded Ware-related Battle Axe Culture of the Scandinavian Peninsula and the Single Grave Culture of the Jutlandic Peninsula are traditionally assumed vectors for the Indo-European dialect ancestral to Germanic (Supplementary Note 7.1.3), fitting closely with the early distribution of Western and Southern Scandinavian clusters, respectively. However, the Eastern Scandinavian cluster, too, must be considered as a potential vector for the arrival of Germanic.

Together with archaeological and isotopic evidence (Supplementary Note 5.3.4), these results point to the presence of an unsampled hunter-gatherer population, likely carrying I1 haplogroups, admixing with a Corded Ware-related population, similar to those of Scandinavia, to form the Eastern Scandinavians somewhere between Finland and Northeast Sweden. At present, no genomes from this region and time period exist.

Of note, the arrival of this first Eastern Scandinavian ancestry, 600–800 years after the earliest Corded Ware populations in Scandinavia, coincides with a new burial rite of gallery graves in South Sweden, the Danish Isles[36] and Norway[37], a new house type[38,39] and the first durative bronze networks[40]. These events culminated at the onset of the Nordic Bronze Age (3550 BP) with cultural homogenization and the end of the east-west divide in northern Europe[39].

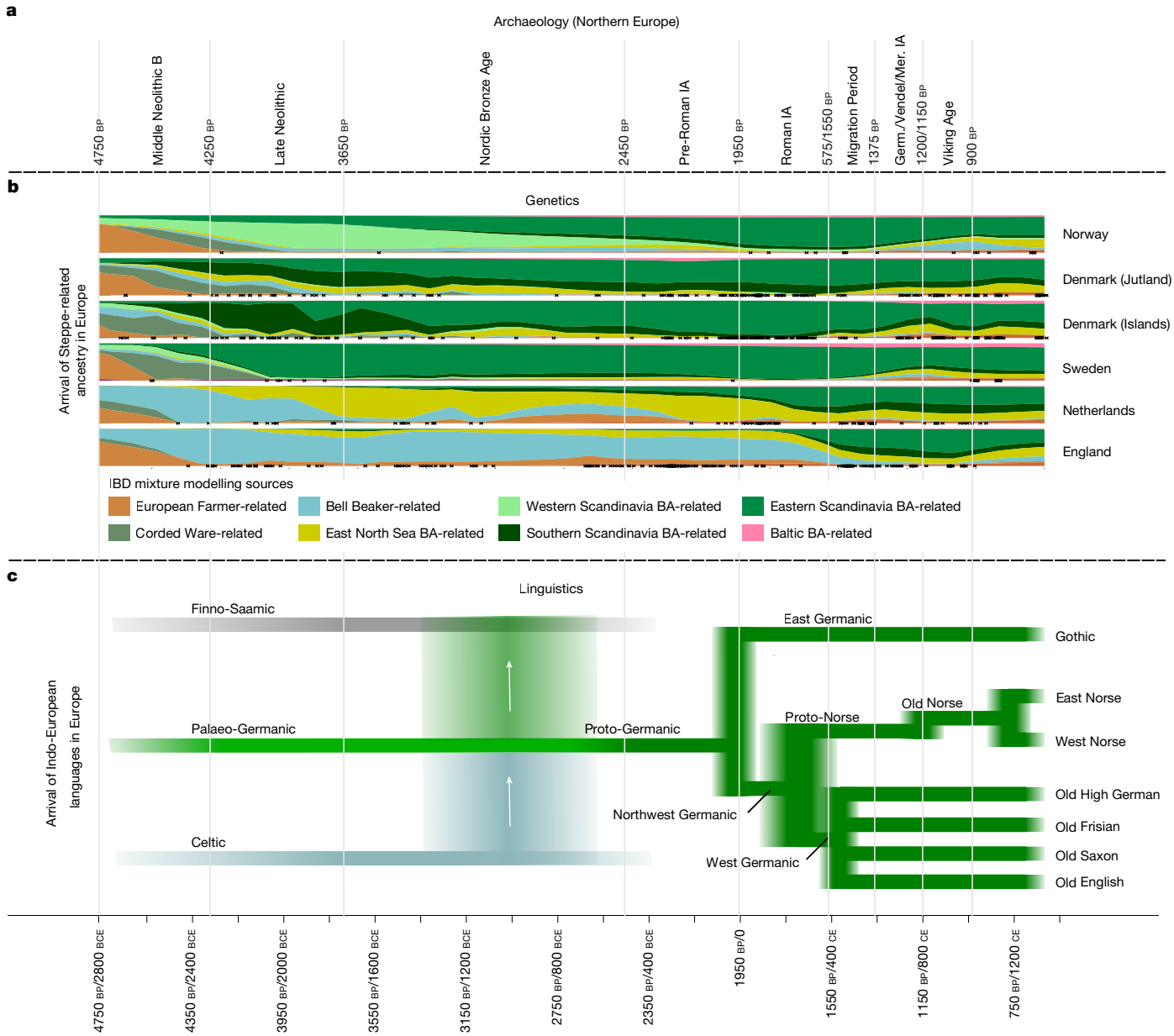

Fig. 3 | Timelines showing archaeological periods, genetic trends and relevant events in the formation of Germanic languages. a, Timeline showing the major archaeological periods for northern Europe. Germ., Germanic; Mer., Merovingian. **b**, Spatio-temporal kriging results using Bronze Age sources (set 5) showing changing trends in ancestry through time. Samples within 250 km of the coordinates assigned to each country are indicated with 'x', providing insight into the confidence with which we can assess the timing of the transition at these coordinates. The coordinates representing each country can be found in Supplementary Fig. 5.134. **c**, Timeline showing the relevant events in the formation of Germanic languages, including arrows representing the passing of loanwords, and the structure of East, West and North Germanic languages.

The Nordic Bronze Age is key in linking the three genetic clusters of the Late Neolithic with the demographic structure of the Iron Age. Archaeologically, the Nordic Bronze Age is a period of strong cultural homogenization in southern Scandinavia, starting around 3600 BP, forming the 'Nordic Cultural Zone', which lasted until the start of the Iron Age (2450 BP)[31,41]. To a large degree, this homogenization is mirrored genetically. At the beginning of the period, we observe a number of admixed Norwegian and Danish Bronze Age outliers, each carrying local and Eastern Scandinavian ancestry (Supplementary Fig. 5.29). By the Iron Age, however, the population structure has become more homogenized by the widespread presence of Eastern Scandinavian ancestry, the trend of which is visible in the spatio-temporal kriging results produced from the mixture modelling output (Fig. 3 and Supplementary Note 5.3.8). The effect of this expansion is most apparent on the Danish Isles, followed by Norway and finally the Jutlandic Peninsula. In Jutland, where the least impact is seen, a large degree of genetic structure distinguishes it from the rest of Scandinavia (Fig. 3).

To assess whether the spread of Eastern Scandinavian ancestry is compatible with being a vector for Palaeo-Germanic, understanding the timing of this migration is crucial. Linguistically, the Late Bronze Age is the period during which Palaeo-Germanic donated vocabulary to Finno-Saamic in the east[6,15] and adopted vocabulary from Celtic in the south[4,5] suggesting that Palaeo-Germanic was spoken in Sweden and Denmark[4,5]. Although genomes are scarce following this period owing to prevalent cremation practices, we used DATES[42] to date the admixture time between the Eastern Scandinavians and the Southern Scandinavians for various Bronze Age and Iron Age clusters in Denmark, to confirm that the formation of the Iron Age populations matched

that of the earliest admixed individuals that we detect directly (Supplementary Note 5.5). The timing of the earliest admixed individuals fits closely with the point estimates from the DATES results, suggesting an admixture time of 3750–3250 BP, consistent with widespread Eastern Scandinavian ancestry within the spatio-temporal range proposed for Palaeo-Germanic. The admixture time for Eastern Scandinavian and local Bronze Age ancestry in Norway (4200–2600 BP) presents a similar range, with point estimates again closely matching the first direct evidence of admixed Western Scandinavian and Eastern Scandinavian individuals. Conversely, at the estimated time of the incorporation of loanwords (3200–2450 BP), Western Scandinavian and Southern Scandinavian Bronze Age ancestry had decreased both in geographical range and proportion. Even at its most expansive distribution, Southern Scandinavian ancestry did not border the region in which Finno-Saamic was spoken, and by 4200–4000 BP, Western Scandinavian bordered neither Finno-Saamic nor Celtic. Combined we find Eastern Scandinavian to be the most parsimonious vector for Palaeo-Germanic.

The Iron Age formation of Proto-Germanic

By the onset of the Northern European Iron Age (2450 BP), Palaeo-Germanic had transitioned into Proto-Germanic, the last common ancestor of the Germanic languages. The Proto-Germanic speech community is assumed to have been present in southern Scandinavia and northern Germany throughout the Pre-Roman Iron Age (2450–1950 BP)[43,44], with the Nordic Iron Age and the Jastorf cultures being plausible archaeological contexts[3,45]. The linguistic transition from Palaeo- to Proto-Germanic is evident from a series of defining sound changes known as the Germanic sound shifts[46,47] and is often ascribed to the assimilation of speakers of an unknown language[48,49], potentially indicative of admixture. So far, it remains untested whether such admixture occurred.

On the basis of IBD mixture modelling (Fig. 3 and Supplementary Fig. 5.32) and the DATES results (Supplementary Note 5.5), we find evidence of genetic continuity in Jutland throughout this period. In the Danish Isles, additional Eastern Scandinavian ancestry is present relative to Jutland; however, the DATES analysis indicates that the formation of the structure of the two regions occurred at a similar time. The absence of major admixture events around the supposed transition from Palaeo- to Proto-Germanic suggests that this linguistic phase shift may have been induced by other factors at the onset of the Iron Age, such as changes in social organization or language-internal developments.

Between 1950 and 1550 BP, the earliest runic carvings attest to relatively undiverged Germanic dialects being spoken across Denmark, Norway and Sweden. At this time, although Eastern Scandinavian Bronze Age ancestry was widespread across the region, the genetic structure that formed during the Bronze Age still persisted between Jutland, the Danish Isles, Sweden and Norway. In Iron Age Jutland, and to a lesser degree the Danish Isles and Norway, individuals continue to be modelled with a minor proportion of the local Scandinavian Bronze Age ancestry (Fig. 3 and Supplementary Fig. 5.29, set 5). The combined genetic and linguistic insights reveal that these genetically distinct Iron Age populations were united by a Germanic dialect continuum.

Germanic Iron Age expansions

For the Roman Iron Age and Migration Period (1950–1375 BP), Late Antique historical sources suggest that multiple migrations of Germanic-speaking groups occurred out of Scandinavia, claiming precise but typically contradictory homelands[50]. Although genetic studies have confirmed a northern European origin for some individuals associated with these populations[20–23], ascertaining precise source regions has proven challenging. To obtain more precise geographical sources of migration, we included a series of the admixed Iron Age clusters in the mixture modelling. These included subclusters from northern Jutland, the Danish Isles, Sweden and Norway (Supplementary Note 5.3.1, set 6). At a broader scale, we find a pattern south of the Nordic region that indicates independent migrations from Jutland and the Scandinavian Peninsula. In western Europe, including present-day Germany, the Netherlands and England, we find the Jutlandic Iron Age source to be the primary Scandinavian ancestry (Extended Data Figs. 9 and 10). By contrast, in the coastal region south and east of the Baltic Sea, we find that populations are primarily mixtures of Swedish Eastern Scandinavian and Baltic Bronze Age ancestries (Extended Data Fig. 9).

Historical and archaeological evidence suggests various regions along the Eastern North Sea coast, from the Netherlands to Jutland, as the sources of the migrations bringing the West Germanic predecessor of Old English to Britain[51]. Although genetic studies have indicated that a large-scale migration indeed occurred at this time, the precise source region has so far remained unclear, with candidates ranging from the Netherlands to southern Sweden[22]. We therefore added an additional Iron Age source from Mecklenburg in northern Germany (Supplementary Note 5.3.1, set 7), to the mixture modelling. This showed ancestry in Anglo-Saxons from England, Frisians from the Netherlands and Iron Age Germans to be modelled as the Northern German source (Fig. 4 and Extended Data Fig. 10b). The small amount of observed heterogeneity in Scandinavian ancestry is consistent with the various homelands of the Angles, Saxons and Jutes along the Eastern North Sea coast migrating to Britain during this period (Extended Data Fig. 11 and Supplementary Note 5.7.5); however, additional sampling from these regions is required for confirmation. Prior to these expansions, individuals from northern Jutland, the Danish Isles and Sweden on the contrary, are modelled primarily as the local Iron Age ancestry. Therefore, we can reject northern Jutland, the Danish Isles and Sweden as the main source areas for the Anglo-Saxon migrations to Britain.

A similar cultural transition to that in Britain occurred in the Netherlands. Following the Roman period, Dutch coastal areas saw a habitation hiatus around 1600 BP and the subsequent appearance of a new material culture that is often referred to as Anglo-Saxon in nature, and which may be related to the emergence of the Frisians[52]. As in Britain, we see a genetic transition occurring from local to northern German/southern Jutlandic ancestry. Here, the incoming ancestry becomes dominant in the area previously dominated by the distinct Eastern North Sea ancestry (Supplementary Note 5.7.2). Although no unadmixed Eastern North Sea individuals are found during the Migration Period, the population replacement was not complete: many later individuals from northern and western Europe from this time onward carry small proportions of Eastern North Sea ancestry.

A third West Germanic-speaking population, the Langobards[53], are historically documented in the regions of today's Czech Republic, Hungary and Italy and have genetically been linked to northern Europe[21]. However, according to post-classical origin legends, their homeland is in southern Scandinavia specifically[54]. We find that the majority of the Langobards are indeed modelled by the Jutlandic Iron Age source (set 6), supporting a homeland around Jutland or northern Germany (Supplementary Note 5.7.4). Notably, there are three outlier Langobards from the Czech Republic and Hungary of Eastern Scandinavian origin, and a number of individuals who genetically appear to be local. This close link between Southern Scandinavian ancestry and linguistically West Germanic groups is also seen in Germany (Extended Data Fig. 9). Here, 56 out of 76 individuals between 1650 and 775 BP fall within the 0_1_3_x clusters, who tend to be modelled by the Northern German source (Supplementary Table 5.1).

Whereas West Germanic groups appear closely linked with the Northern German/Southern Jutland ancestry, consistent with historical evidence, the genetic affiliation of East Germanic groups is currently unknown. A sixth-century origin legend of the East Germanic Goths claims a homeland on the Scandinavian Peninsula[55]. The earliest evidence of plausibly East Germanic-speaking populations

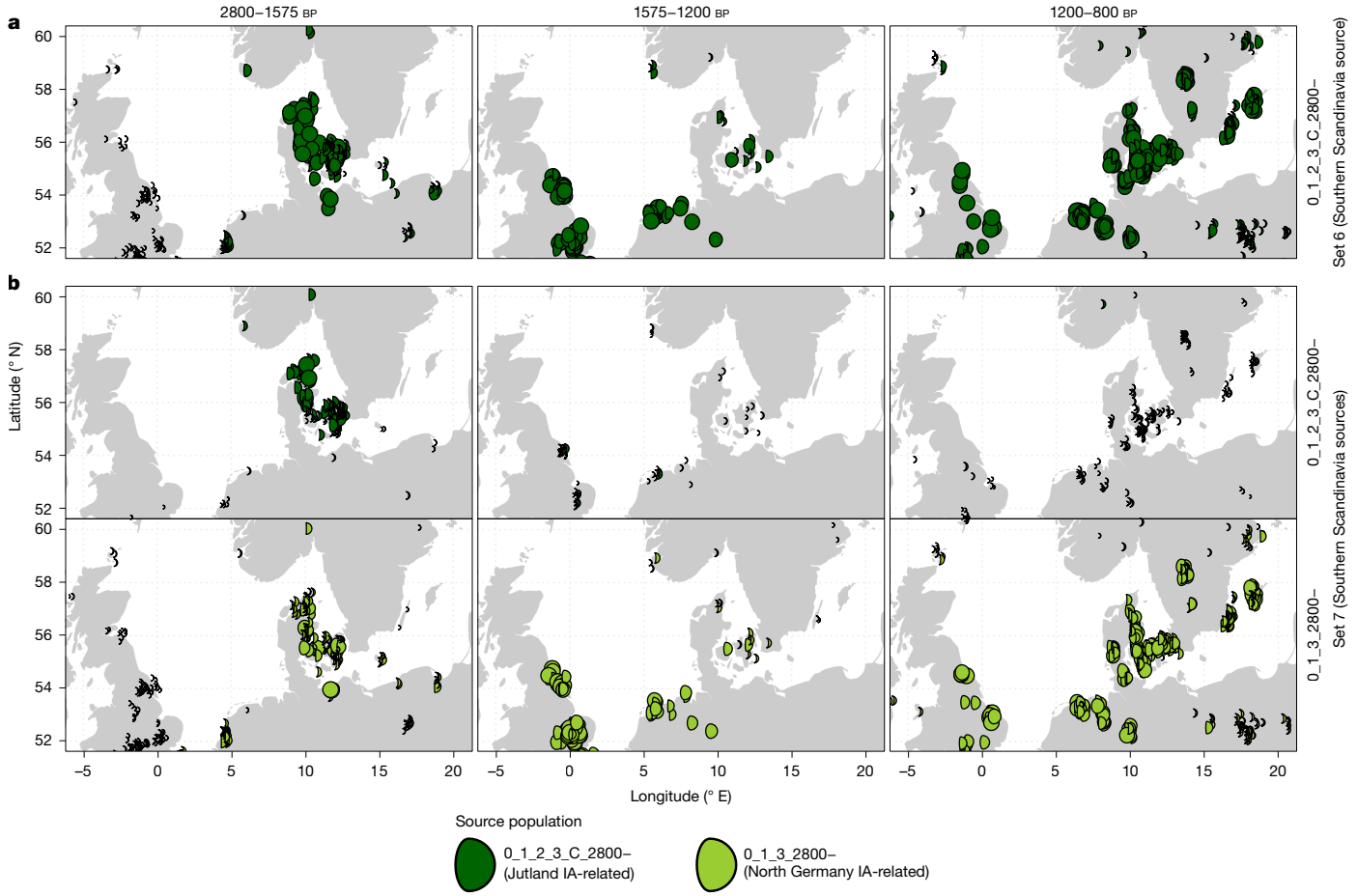

Fig. 4 | A subset of IBD mixture modelling results showing the proportion of Southern Scandinavian Iron Age ancestry for northern Europe with varying source sets. a, A subset of mixture modellings results from set 6, which contains an Iron Age source from northern Jutland (0_1_2_3_C_2800-) but not northern Germany (0_1_3_2800-). **b**, A subset of mixture modelling results from set 7, which includes sources from northern Jutland (0_1_2_3_C_2800-) and northern Germany (0_1_3_2800-). In **a**,**b**, the proportion of ancestry modelled is indicated by the proportion filled and the size of each circle. Full mixture modelling results for northern Europe are shown in Supplementary Figs. 5.25 and 5.26. Maps were generated in R (v.4.2.3) using map_data from ggplot2 (v.3.5.0.9000).

out of Scandinavia are the individuals from the Wielbark culture of present-day Poland, dated to around 1950 BP[23]. We find these individuals to be modelled primarily by Eastern Scandinavian Bronze Age and Swedish Iron Age ancestry (Supplementary Note 5.7.4), supporting a migration from a region and population distinct from those of the West Germanic groups—a scenario that is consistent with Gothic oral history[50]. By contrast, later individuals associated with the East Germanic-speaking groups, the Ukrainian Ostrogoths and the Iberian Visigoths, are modelled with local ancestries (Supplementary Note 5.7.4). Two exceptions are the Iberian Visigoths, who genetically fall on the Baltic cline, suggesting an origin in North East Europe, but not specifically in eastern Scandinavia. The genetic evidence here is consistent with a two-step model on the ethnogenesis of the Goths: an initial migration from Scandinavia, followed by the acculturalization of others, including Baltic and Slavic groups[56].

Migration Period movement into Scandinavia

Unlike West and East Germanic, the distribution of North Germanic languages across Scandinavia is not typically associated with population migrations. Runic inscriptions from across this area testify to Germanic dialects that remained relatively similar to Proto-Germanic between 2000 and 1500 BP. However, from the beginning of the Migration Period to the Viking Period (1575–1200 BP), accelerated linguistic change marked the formation of Old Norse[57], the common language of Viking Age Scandinavians. Following this linguistic transition, the original Germanic runic script, known as the Elder Futhark, was fundamentally remodelled, giving rise to the Younger Futhark, a script exclusively used to record Old Norse[58].

Notably, we observe a striking genetic transition in the Danish Isles and southern Sweden around the time of this linguistic transition. Prior to 1575 BP, individuals in these areas are modelled almost exclusively with various Scandinavian Bronze Age ancestry (Extended Data Fig. 12). However, by 1250 BP—that is, approximately 100 years before the Viking Period—most individuals can be modelled with small proportions of ancestries that prior to 1575 BP were primarily found south of Scandinavia: Eastern North Sea ancestry, Celtic ancestry from Britain, Ireland and France, Slavic-related ancestry from northeastern Europe (Supplementary Note 5.7.6) and European Farming ancestry from western Europe (Extended Data Figs. 9 and 13). Although previous studies have documented an influx of these more southern ancestries[59,60], continuity of the local Scandinavian ancestry has generally been assumed.

To further investigate the transition within Denmark and southern Sweden, we again applied the mixture modelling including Iron Age sources from across Scandinavia and from northern Germany (Fig. 4). We find the Scandinavian ancestry of individuals from Denmark and southern Sweden after 1250 BP to be modelled primarily as the Northern German/Southern Jutlandic Iron Age source ancestry rather than the more local sources. On the Danish Isles, the local ancestry that was widespread from 2200 to 1600 BP essentially disappears by 1250 BP

(Extended Data Fig. 13), whereas in Jutland, we see some degree of local continuity. Owing to the absence of samples between northern Jutland and northern Germany, we cannot rule out a southern Jutland origin as a source.

The above findings of large-scale population movements into Denmark and southern Sweden have potential relevance for understanding the linguistic dynamics of Iron Age Scandinavia, suggesting that the emergence of Old Norse coincides with a period of social and demographic instability[61]. In addition, the expansion of Northern German/Southern Jutlandic Iron Age ancestry through Denmark into the Scandinavian Peninsula may partially explain why the Old Norse language was referred to by its speakers as *dǫnsk tunga*—that is, the Danish tongue[62,63]. However, the close correspondence between Northern German/Southern Jutlandic Iron Age ancestry and Old Norse linguistic identity in southern Scandinavia is not seen in Norway. Here, similar social changes as in southern Scandinavia occurred during the same period, however, the Iron Age to Viking Age transition in Norway is one of genetic continuity (Supplementary Note 5.7.3). As a result, the majority of Viking Age Norwegians display either local ancestry or ancestry reflecting back-migrations from Celtic regions of Britain and Ireland. Of note, the linguistic boundary between the East and West Norse dialect areas[57] roughly corresponds to the border between Northern German/Southern Jutlandic and Norwegian Iron Age ancestry during the Viking Age, even in the areas of Britain settled by these groups (Supplementary Figs. 5.108 and 5.110).

Owing to cremation practices, few genomes exist from the transition period (1575–1200 BP), requiring us to rely on additional lines of evidence for population dynamics during this period to assess when these major transitions in Denmark and southern Sweden may have occurred. On the basis of the present archaeological and historical evidence (Supplementary Note 7.1.4) and evidence of past climatic variation (Supplementary Note 6), we may conclude that the major population shift in southern Scandinavia between the Roman and the Viking periods was not solely driven by the climate events or plague of 1450–1350 BP. Instead it probably took hold between 1550 and 1450 BP, coinciding with the Anglo-Saxon migrations and corresponding to a major cultural change with the introduction of a new elite culture. Historical texts and legends suggest various origins of the Danes[50,64–66], discussed in detail in Supplementary Note 7.1.4. Here we show genetically that the Migration Period population influx in southern Scandinavia had origins around northern Germany, with close similarity to that of the Anglo-Saxons.

Conclusions

Our findings constitute a revision to the formation of West Eurasian ancestry in Europe. By additionally correlating these genetic findings with archaeological and linguistic evidence, we complement previous interpretations of the archaeological record after the Scandinavian Middle Neolithic B (4800 BP), identifying multiple populations movements, and propose a new model for the emergence and spread of the Germanic languages.

Following the first arrival of Steppe ancestry in Scandinavia (4800 BP), we detect the arrival of the closely related Eastern Scandinavian ancestry during the Late Neolithic, revealing links to the North East Baltic region (4000 BP), and offering a previously unknown vector for the introduction of an Indo-European language to Scandinavia. We cannot rule out more complex scenarios—for example, in which Palaeo-Germanic was spread through cultural diffusion, with no genetic impact, in the opposite direction to the spread of Eastern Scandinavian ancestry. However, the fact that Eastern Scandinavian ancestry was widespread by the Nordic Bronze Age, encompassing the broad region where Palaeo-Germanic previously has been hypothesized to have been spoken, makes Eastern Scandinavians a parsimonious population vector for the transmission of this linguistic identity.

The genetic structure that forms at this time persists until the end of the Roman Iron Age (1600 BP), encompassing the Palaeo- to Proto-Germanic periods as well as the subsequent period of linguistic disintegration into East, North and West Germanic. Thus, we reveal that by around 2000 BP, Germanic dialects unified a region divided by distinct genetic borders that had existed for 1,000 years. In the Polish Wielbark culture, we find support for the Late Antique Gothic origin myth of an emigration from eastern Scandinavia. At the same time, however, we observe that the sampled southern European Goths carry little Eastern Scandinavian ancestry, suggesting a largely cultural adoption of Gothic language and identity for these individuals. Consistent with linguistic consensus on a Proto-Germanic homeland in northern Germany and southern Scandinavia during the Early Iron Age, we find the descendant North and West Germanic languages across Europe to be closely linked to Southern Scandinavian Iron Age ancestry, in support of historical documentation of the West Germanic Anglo-Saxons and Langobards. Finally, the linguistic changes leading to the formation of Old Norse appear to coincide with a back-migration of Southern Scandinavians to the Danish Isles and southern Sweden, but not to the more northern parts of Scandinavia, suggesting that a combination of demographic and cultural mechanisms drove the evolution and transmission of this language. We later find the dialectal division between Old West and Old East Norse to correspond to that of the Western Scandinavian Vikings and the Southern Scandinavian Vikings. These findings underline the potential of IBD approaches to unravel genetic, archaeological and linguistic prehistories, at the same time revealing marked differences in the mechanisms behind the proliferation of cultural and biological features.

Online content

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Methods

Data generation

Sampling of ancient human remains was undertaken in collaboration with co-authors responsible for the curation and contextual analyses of these, and with the approval of the relevant institutions responsible for the archaeological remains (detailed in the Reporting Summary). Site descriptions can be found in Supplementary Note 7.

All steps of generating the ancient genomes were undertaken using well-established protocols within ancient DNA, as described in Supplementary Note 1. In brief, samples were inspected visually to identify suitable candidates. Teeth and petrous bone have previously been identified as the optimal skeletal material for recovery of ancient DNA and were hence selected where possible. All drilling, extractions and library builds were carried out in dedicated ancient DNA clean lab facilities at the University of Copenhagen, both manually and with automation. Double and single stranded libraries[68–70] were built and sequenced on the Illumina Hiseq 4000 and the Novaseq 6000. For the purpose of authenticating ancient reads as human, non-USER treated libraries were built to allow for the detection of post-mortem damage[71]. Where possible, USER treated libraries were built from the authenticated extracts to minimize the effects of post-mortem damage on downstream analysis[72]. All reads were mapped to the human reference genomes (build hs37d5) using bwa aln (0.7.17)[73], and duplicates were removed using picard MarkDuplicates (2.25.0). Contaminated libraries were identified using contamix[74] and excluded. The final 712 samples included in this study ranged from 0.01× to 32.83× in autosomal coverage. For the new ^{14}C dates generated as part of this study, calibrated dates were calculated using OxCal (v.4.4) using the IntCal20 calibration curve[75].

Imputation

A set of 4,009 published ancient individuals with coverages suitable for imputation[16,26] was curated, including whole genomes and SNP capture data. The published data were merged with the 712 newly generated genomes and imputed with GLIMPSE v.1.1.1[76] (Supplementary Note 4). As off-target capture sites have been shown to impute poorly, only on-target sites were considered. In addition, sites that imputed poorly (imputation info score <0.5) or did not pass the 1000 Genomes strict mappability mask were excluded. Individuals with coverage lower than recommended (0.1–0.5× for whole genome, 1.0× for captured samples[16,26]) and average genotype probability resulting from the imputation (<0.9) were also excluded. First- and second-degree relatives were identified using ngsRelate[77] (Supplementary Note 5.6), and were then excluded from later analyses. This resulted in a final set of 4,517 individuals (including 578 newly sequenced individuals) covering 697,179 SNPs.

IBD-based analyses

Segments of IBD shared between all individuals in the final imputed set of 4,517 individuals were detected using IBDseq[78] (Supplementary Note 4). Potentially spurious IBD segments with low logarithm of the odds (LOD) scores or in hotspot regions were removed as described[16].

To cluster ancient samples, a network-based hierarchical clustering[79] based on total shared IBD lengths was performed, as described[16]. As short segments are less informative on recent ancestry, single segments less than 2 cM in length or total shared segment lengths of less than 5 cM were excluded. Clusters were then curated as described[16]. For the deeper clusters, individuals were plotted on a map of western Eurasia, showing clear correspondences through time and space. To better visualize IBD clusters and finer-scale patterns in the data, we carried out PCA analysis using GCTA (v.1.94.1) showing the out-of-Africa and western Eurasian diversity and highlighted positions of individuals from the IBD clusters within PCA space. A second clustering run was performed containing only samples from the Bronze Age and earlier (≥2800 BP), as later admixed individuals can bias clustering of the Bronze Age structure (Supplementary Note 5.2.2).

To understand the relationship between and diversity within the clustering, we performed IBD mixture modelling as described[16], allowing us to model target individuals as mixtures of source clusters. In brief, for every individual in the dataset, a palette is created, formed by the normalised proportion of total IBD lengths that each individual shares with all 386 clusters in the dataset. As such, the different ways in which the target and source individuals are related to non-source or target individuals are leveraged when modelling the target palette with the source palettes. We then paint the palettes of 'target' individuals as mixtures of the palettes of groups of 'source' individuals using non-negative least squares (R package limSolve v.1.5.6) to infer ancestry proportions. As a result, even though a temporally distant source and target individual may share very few segments, the shared segments with common intermediate populations are informative in the modelling.

We find this method to be effective for the sampling density and temporal distances relevant to this study (Supplementary Note 5.3). For IBD mixture modelling, the single segment length cutoff was 1 cM and no total shared segment length cutoff was applied, as deeper relationships between samples were of more relevance than to clustering. We first replicated previous results for the formation of European populations before systematically including more proximal sources in a series of sets to reveal insight into the genetic structure of the ancient individuals. We then plotted the mixture modelling proportions on the PCA showing western Eurasian diversity to identify a series of novel admixture clines within the well-established PCA structure (Supplementary Note 5.3.3). For some specific questions, auxiliary source sets were used (Supplementary Note 5.3.2.). To understand how the results of the IBD mixture modelling were reflected on a regional level, we applied spatio-temporal ordinary kriging[27], as detailed in Supplementary Note 5.3.8. Spatio-temporal variograms were fit via a metric covariance model using the R package gstat (v.2.1.2). We used two sets of parameters, one similar to the original publication for ancestries relevant to Europe more broadly (IBD mixture modelling sets 1–4), and a second allowing for the closer proximity between populations of relevance during the Iron Age (sets 5–7).

All plots were generated in R (v.4.2.3), using ggplot2 (v.3.5.0.9000).

Admixture dating

To assess the time of formation of admixed populations detected through the mixture modelling, DATES[42] was run using default settings (Supplementary Note 5.5). A mean generation time of 25 years, and the midpoint of the mean radiocarbon ages of all dated individuals in the target population were used.

Y chromosome and mitochondrial genomes analyses

Genetic sex and the presence of karyotypes 47,XXY and 47,XYY were determined from the ratios of reads mapping to the autosomes and X and Y chromosomes (Supplementary Note 5.4.3). For individuals with an XY karyotype, we used bcftools v.1.17 mpileup to call genotypes for positions located in the single-copy short-read callable 10 Mb region of the Y chromosome, excluding indels, triallelic locus and variants with less than 70% frequency in the population of non-clonal reads in a locus. Haplogroup paths were called conservatively by matching ancestral and derived calls to a custom database in a root-to-tip direction (Supplementary Note 5.4.2). For reads that mapped to rCRS mitochondrial reference genome, a consensus was called and the haplogroups classified using Haplogrep 2.0[80] for all samples with more than 5× mitochondrial coverage. Sequences were then aligned with mafft[81] (v.7.490), and a phylogenetic tree was generated using raxML (v.1.1.0) (Supplementary Note 5.4.1).

Dendrochronology

We used dendrochronological data based on tree-ring measurements from 654 wood samples of *Quercus* sp. from 42 sample sites in

Denmark covering the years between AD 300 and AD 800 (Supplementary Note 6.2). From the dendrochronological data we constructed an average growth-curve for Denmark within this time interval using TSAP-Win (v.4.82b2).

Pollen data in southern Sweden

We used all available pollen data from the province of Scania to investigate the anthropogenic vegetation changes before the Viking age (Supplementary Note 6.2). The pollen records were grouped into 4 characteristic biogeographical regions, standardized to include the 87 most common pollen/plant taxa and the period 4000–900 BP. We applied a simplified indicator-species approach using eight pollen taxa from which changes through time are expected to be mainly due to land-use change. Pollen proportions for these pollen indicators were then summarised in 100-year intervals.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

Sequence data are available at the European Nucleotide Archive (ENA) under accession PRJEB87274. Y chromosome data, including VCF and derived and ancestral calls, are available at Zenodo: https://doi.org/10.5281/zenodo.15163112 (ref. 82). Previously published ancient genomic data used in this study are detailed in Supplementary Table 5.1, with the corresponding publications listed in Supplementary Note 4. Newly generated ^{14}C dates are detailed in Supplementary Table 1.1. All maps were generated in R (v.4.2.3), using 'map_data' from ggplot2 (v.3.5.0.9000).

Code availability

Analyses were done using freely available software, which have been fully referenced throughout the manuscript and supplemental materials and methods. Custom code can be found on https://github.com/abigailramsoe/lundbeck-pipeline and https://github.com/tpinotti/ybyra.

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Author contributions E.W. initiated the study. H.M. and E.W. led the study. H.M., G.K., T.W., R.N., L.H., K. Kristiansen, M.S. and E.W. conceptualized the study. L.V., T.W., L.O., L.H., K. Kristiansen, M.S. and E.W. supervised the research. G.S., P.d.B.D., S.S., A.S., C.P.E.Z., T.W., R.N. and E.W. acquired funding for research. H.M., G.S., P.E., F.D., M.L.S.J., S.B., P.d.B.D., M.E.A., K.G.-S., A.F., T.A., I. Akhvlediani, S.L.A., V.A., B.A., P.B., N.C., P.C., E.C., T.T.C., A.C., S.D.D., S.D., J.D., K.M.F., O.G., U.B.G., Z.T.G., J.H., S.H., M. Henriksen, V.H., M. Høj, M.K.H., R.J., M.D.J., J.W.J., T.J., O.T.K., A.K., R.K., K.I.K., L.M.K., K. Kyselicová, A.C.L., T.L., M.L., N.L., Y.M., V.Y.M., K.M., V. Masyakin, A.L.M., I.M., V. Moiseyev, E. Molnár, N.M., E. Murphy, B.H.N., C.Ö., D.P.-K., G.P., M.S.P.d.L., H.R., W.R., A.S., B.S., V. Slavchev, V. Smrčka, L.S., O.C.U., H.V., J.V., D.V., A. Voloshinov, S.W., H. Wendling, A.W., H. Wilhelmson, K.W., J.Z., B.C., J.-P.D., L.O. and R.N. were involved in sample collection. H.M., M.L.S.J., P.d.B.D., A.F., V.A., E.V.B., O.B., P.C., E.C., R.J., T.J., R.K., L.M.K., K. Kyselicová, N.L., V. Masyakin, V. Moiseyev, E. Molnár, E. Murphy, B.H.N., C.Ö., D.P.-K., G.P., M.S.P.d.L., W.R., V. Smrčka, A. Voloshinov, S.W., H. Wilhelmson, K.W. and J.Z. curated bioarchaeological data. H.M., F.V.S., G.S., P.d.B.D., M.E.A., L.V., C.G., J.C., J. Staring, J. Stenderup, F.E.Y., M.L., S.B.M., B.S.P., M.S.P.d.L., S.W., T.S.K. and L.O. were involved in data generation. H.M., G.K., J.V.M.-M., F.V.S., T.P., T.V., S.M.S., P.d.B.D., A. Ramsøe, I. Altinkaya, R.A.H., E.K.I.-P., W.B., A.I., A. Rosengren, A. Vaughn, M.L., C.P.E.Z., T.S.K., B.C., J.-P.D., R.N. and M.S. were involved in data analysis. H.M., G.K., P.E., L.H., K. Kristiansen and E.W. drafted the main text. H.M., J.V.M.-M., F.V.S., T.P., T.V., S.M.S., P.E., R.F., M.J.-G., H.M.E.L., M.F.M., M.L.S.J., S.B., A. Ramsøe, K.G.-S., S.S., A.F., I. Akhvlediani, S.L.A., E.V.B., E.C., M.D.C., U.B.G., J.Z.G., Z.T.G., S.H., M. Henriksen, M. Høj, R.J., M.D.J., J.W.J., T.J., O.T.K., K.I.K., V.K., L.M.K., K. Kyselicová, A.C.L., M.L., V.Y.M., K.M., V. Masyakin, A.L.M., V. Moiseyev, E. Molnár, N.M., E. Murphy, D.P.-K., H.R., W.R., A.S., B.S., V. Smrčka, L.S., G.T., H.V., J.V., A. Voloshinov, S.W., H. Wendling, A.W., H. Wilhelmson, K.W., J.Z., T.S.K. and L.H. drafted supplementary notes and materials. H.M., G.K., J.V.M.-M., F.V.S., G.S., T.P., T.V., S.M.S., P.E., R.F., M.J.-G., H.M.E.L., M.F.M., F.D., M.L.S.J., S.B., M.E.A., L.V., C.G., A. Ramsøe, I. Altinkaya, R.A.H., E.K.I.-P., K.G.-S., S.S., A.F., W.B., A.I., A. Rosengren, J.C., F.E.Y., S.L.A., M.G.B., J.D., J.Z.G., Z.T.G., V.H., M. Høj, M.K.H., R.J., H.J., M.D.J., J.W.J., O.T.K., K.I.K., V.K., L.M.K., M.L., N.L., K.M., A.L.M., N.M., E. Murphy, B.H.N., D.P.-K., H.R., A.S., V. Smrčka, L.S., G.T., H.V., S.W., A.W., K.W., J.Z., C.P.E.Z., T.S.K., T.W., L.O., R.N., L.H., K. Kristiansen, M.S. and E.W. were involved in reviewing and editing drafts.

Competing interests The authors declare no competing interests.

Additional information

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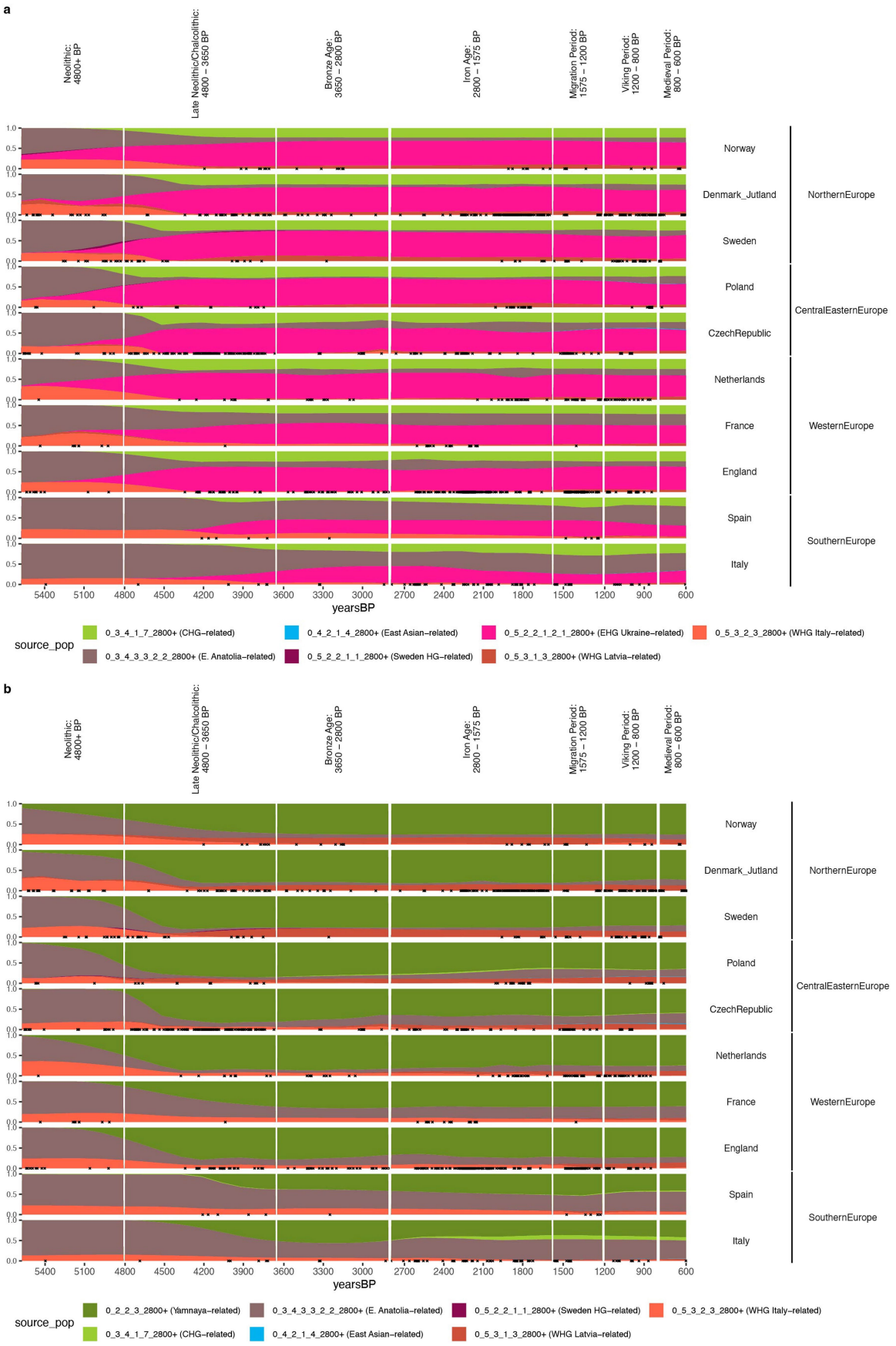
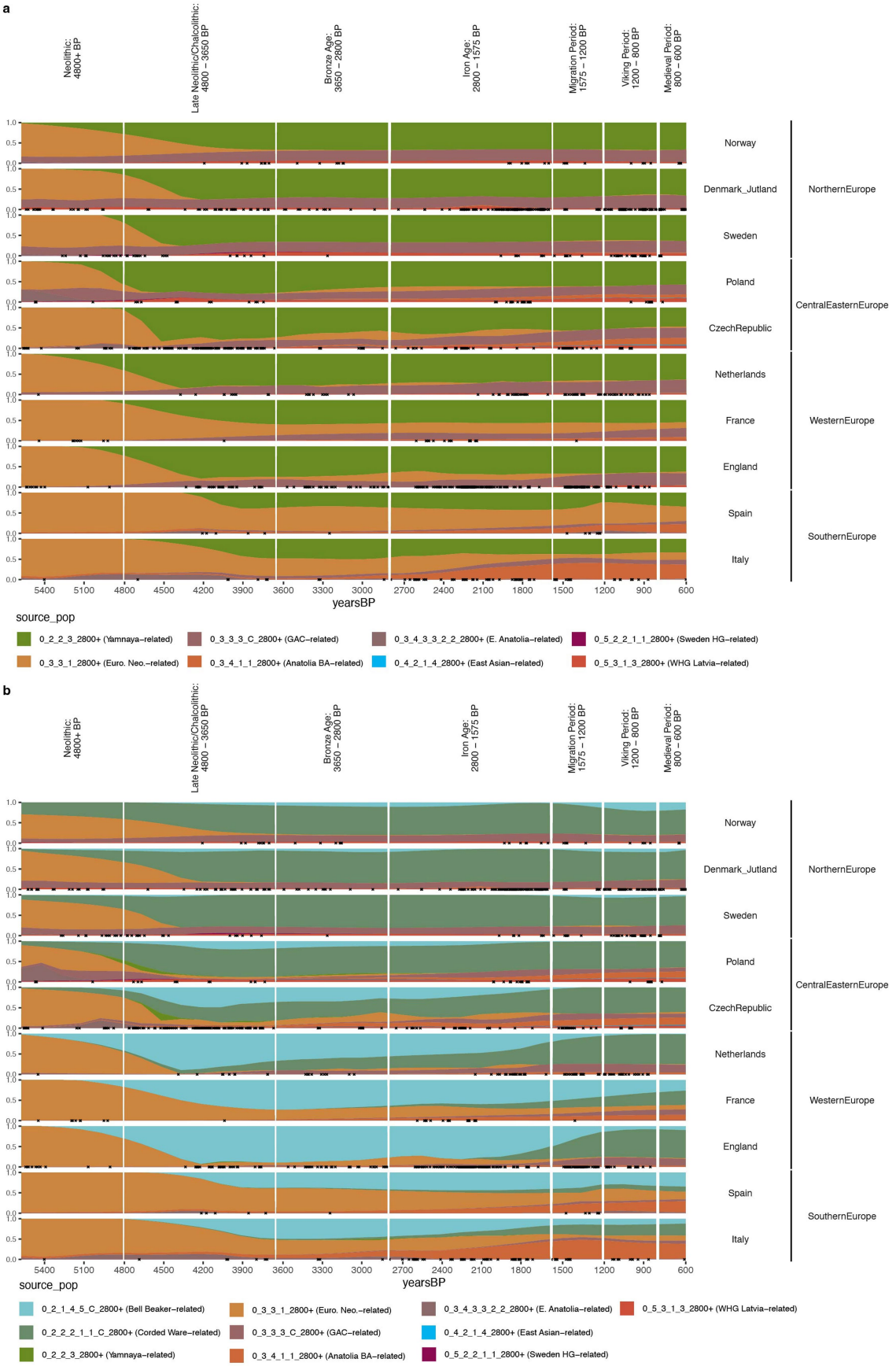


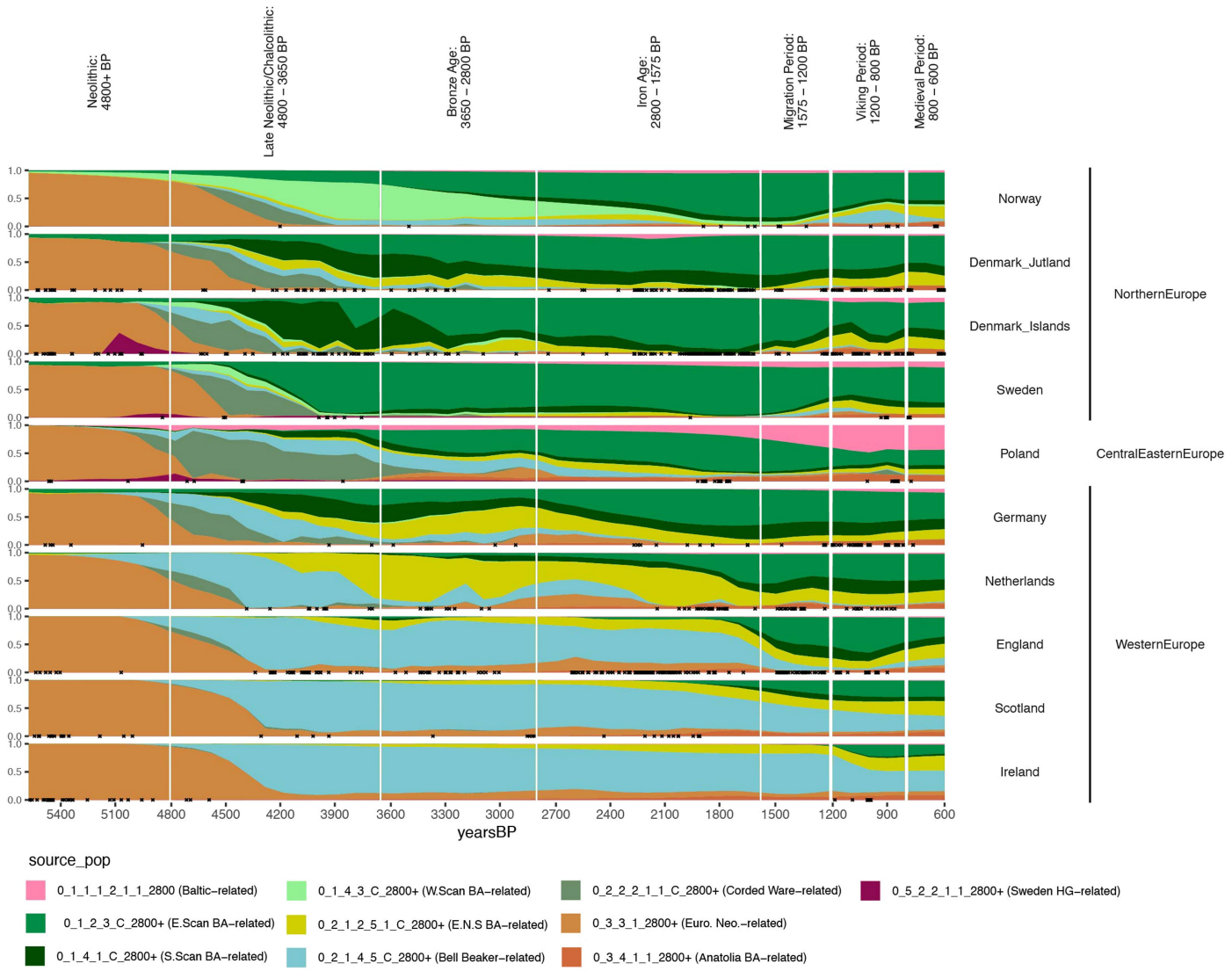
Extended Data Fig. 1 | See next page for caption.

Extended Data Fig. 1 | Spatiotemporal Kriging results showing the general trends of the proportion of ancestries using Hunter-Gatherer and Early Neolithic Farming, and Yamnaya sources (Set 1 and 2). (**a**) Spatio-temporal kriging timelines (Set 1) showing the arrival of Steppe Ancestry, modelled as EHG (pink) and CHG (light green), onto a backdrop of Farming related ancestry, modelled as Early Anatolian Farming (brown) and Western Hunter-Gatherer (orange). (**b**) Spatio-temporal kriging timelines (Set 2) showing the arrival of Steppe Ancestry when including the Yamnaya-related source. The Steppe Ancestry that was previously modelled as EHG (pink) and CHG (light green) in (a), is now modelled directly (darker green). For both panels, the 'Europe-wide' kriging parameters are applied here. Individuals within 250 km of the point used for each country (Supplementary Fig. S5.134) are indicated with an 'x'. While these results represent the general trends, they do not capture the heterogeneity present in many regions, and hence should be interpreted together with the full mixture modelling results (Supplementary Fig. S5.18).

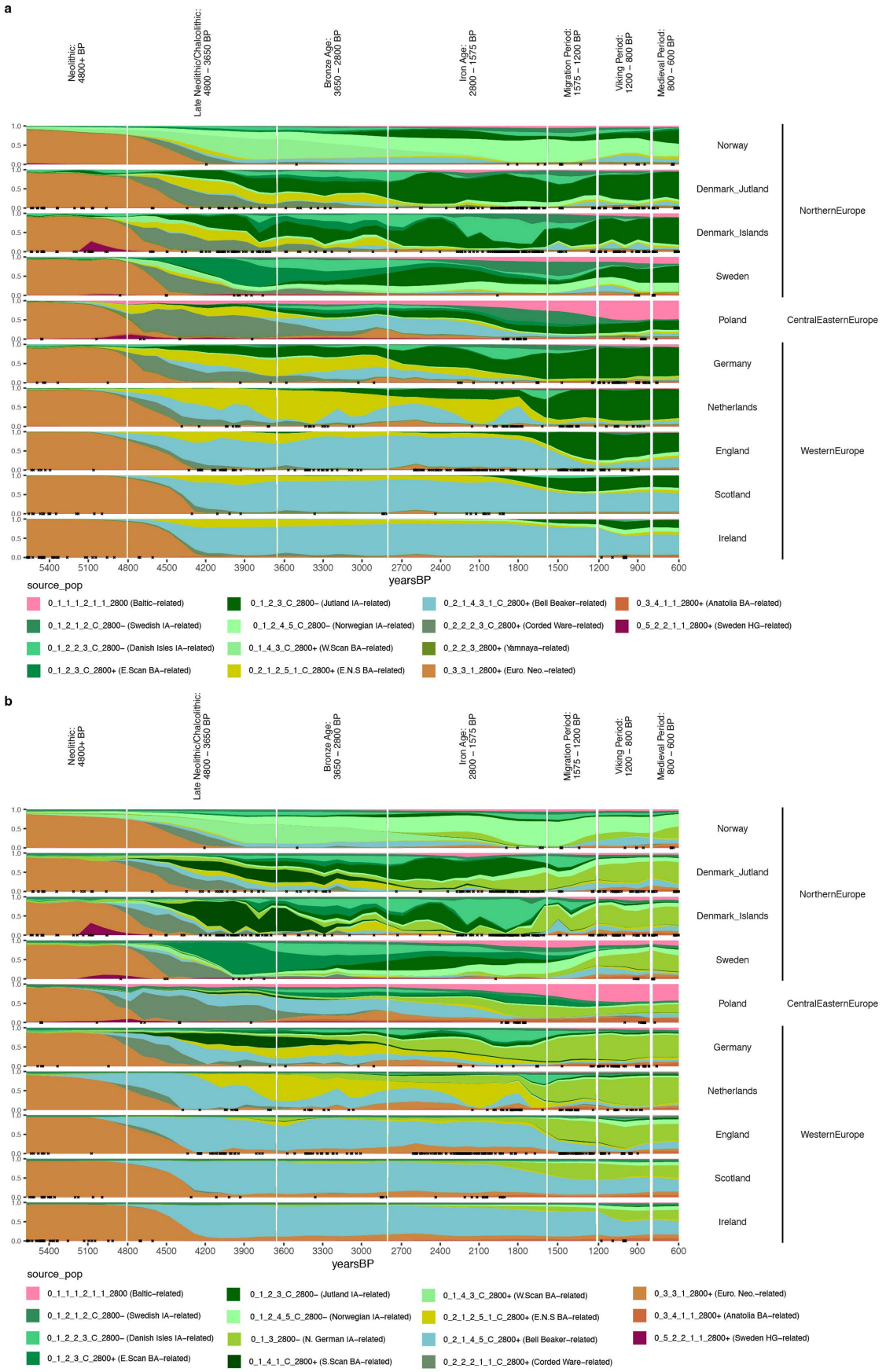


Extended Data Fig. 2 | See next page for caption.

Extended Data Fig. 2 | Spatiotemporal Kriging results showing the general trends of the proportion of ancestries of when including additional Farming-related sources and early Bronze Age source. (**a**) Spatio-temporal kriging timelines (Set 3) showing in northern Europe, Bronze Age populations are modelled only as Yamnaya and Globular Amphora, whereas in the south, some European Farming ancestry persists. (**b**) Spatio-temporal kriging timelines (Set 4) showing the Steppe Ancestry from the Bronze Age populations being modelled only as Corded Ware-related to the north, and Bell Beaker-related in the south. The expansion of Bronze Age Anatolian-related ancestry in Italy during the Iron Age, and to lesser degrees Czech Republic, France and England is apparent. For both panels, the 'Europe-wide' kriging parameters are applied. Individuals within 250 km of the point used for each country (Supplementary Fig. S5.134) are indicated with an 'x'. While these results represent the general trends, they do not capture the heterogeneity present in many regions, and hence should be interpreted together with the full mixture modelling results (Supplementary Fig. S5.18).

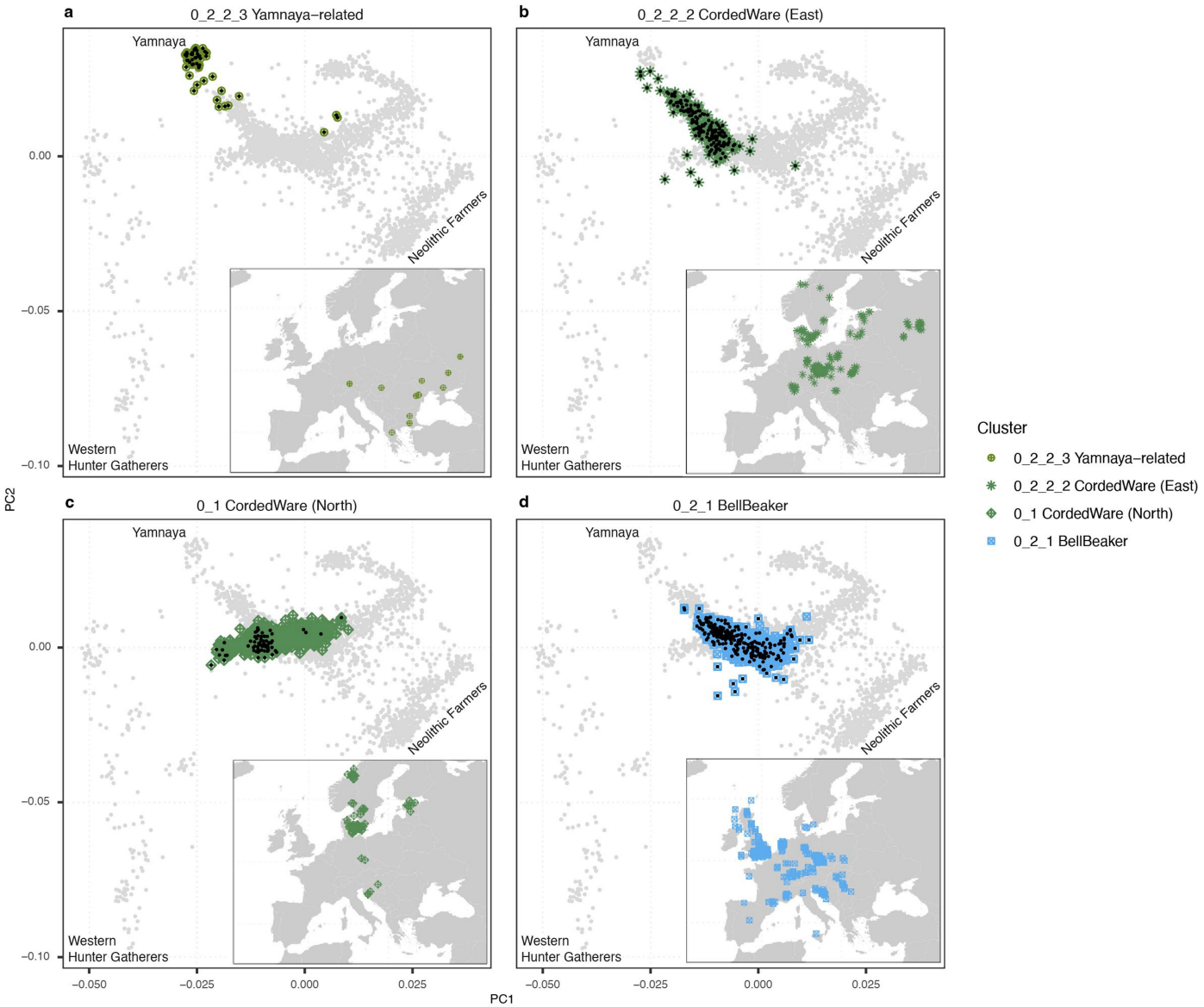


Extended Data Fig. 3 | Spatiotemporal Kriging results showing the general trends of the proportion of ancestries when including additional Bronze Age Scandinavian and Baltic-related sources (Set 5). Spatio-temporal kriging timelines (Set 5) showing in the Late Neolithic / Chalcolithic, the regions of northern Europe are distinct and modelled by various sources. Throughout the Bronze Age and Iron Age, Eastern Scandinavian ancestry becomes widespread, despite the persistence of some local Bronze Age ancestry. During the Migration Period, individuals from England and the Netherlands experience an increase in Scandinavian ancestry reflecting Iron Age Jutland. Individuals from Denmark and Sweden experience and increase in Eastern North Sea ancestry. Norway experiences an increase in Bell Beaker-related ancestry during the Viking Period. The transition in Poland from Iron Age (East Germanic) to Medieval (Slavic) coincides with the arrival of 'Baltic BA'-related ancestry. The 'North / West Europe' kriging parameters are applied here. Individuals within 200 km of the point used for each country (Supplementary Fig. S5.134) are indicated with an 'x'. While these results represent the general trends, they do not capture the heterogeneity present in many regions, and hence should be interpreted together with the full mixture modelling results (Supplementary Fig. S5.18).

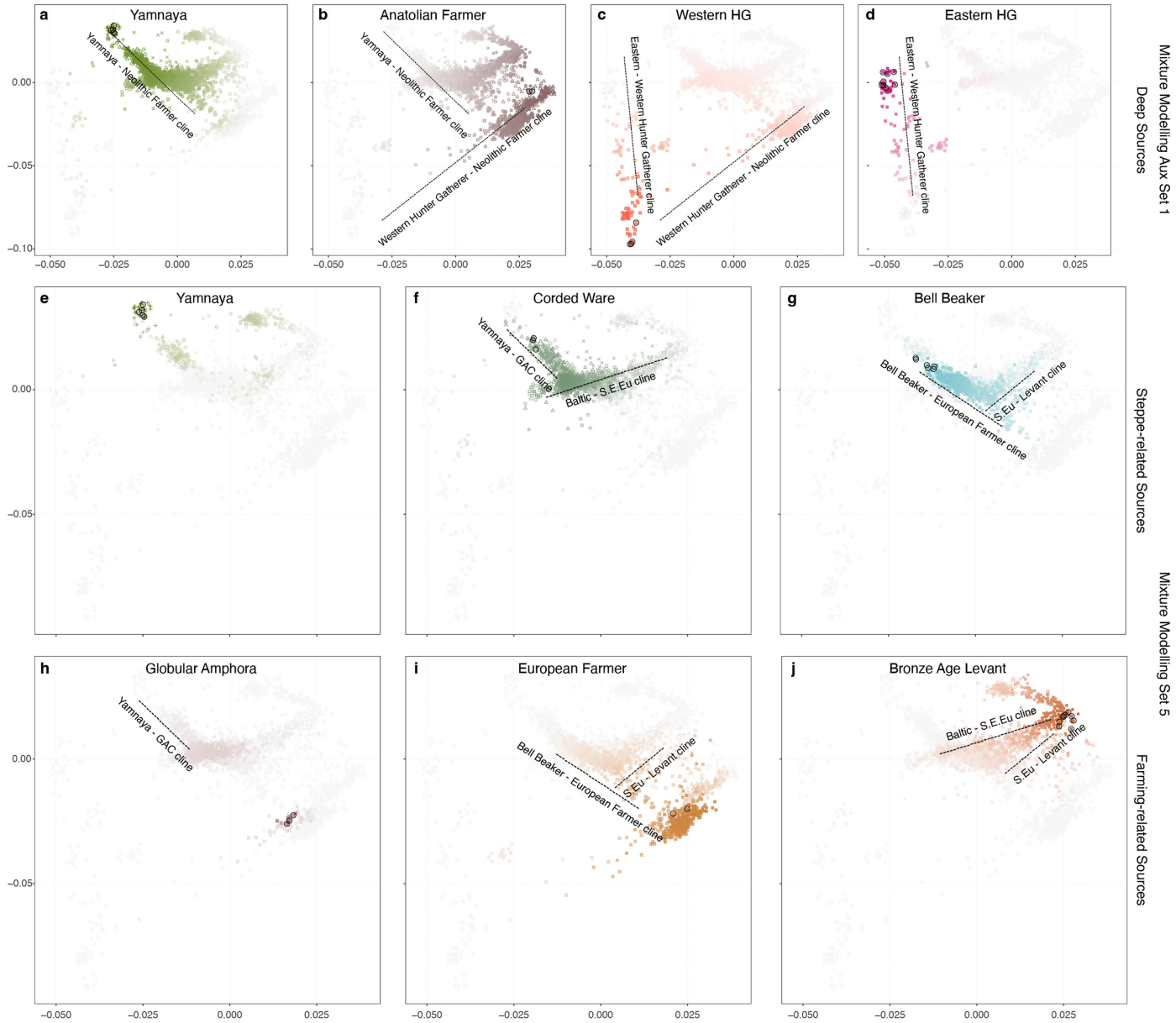


Extended Data Fig. 4 | See next page for caption.

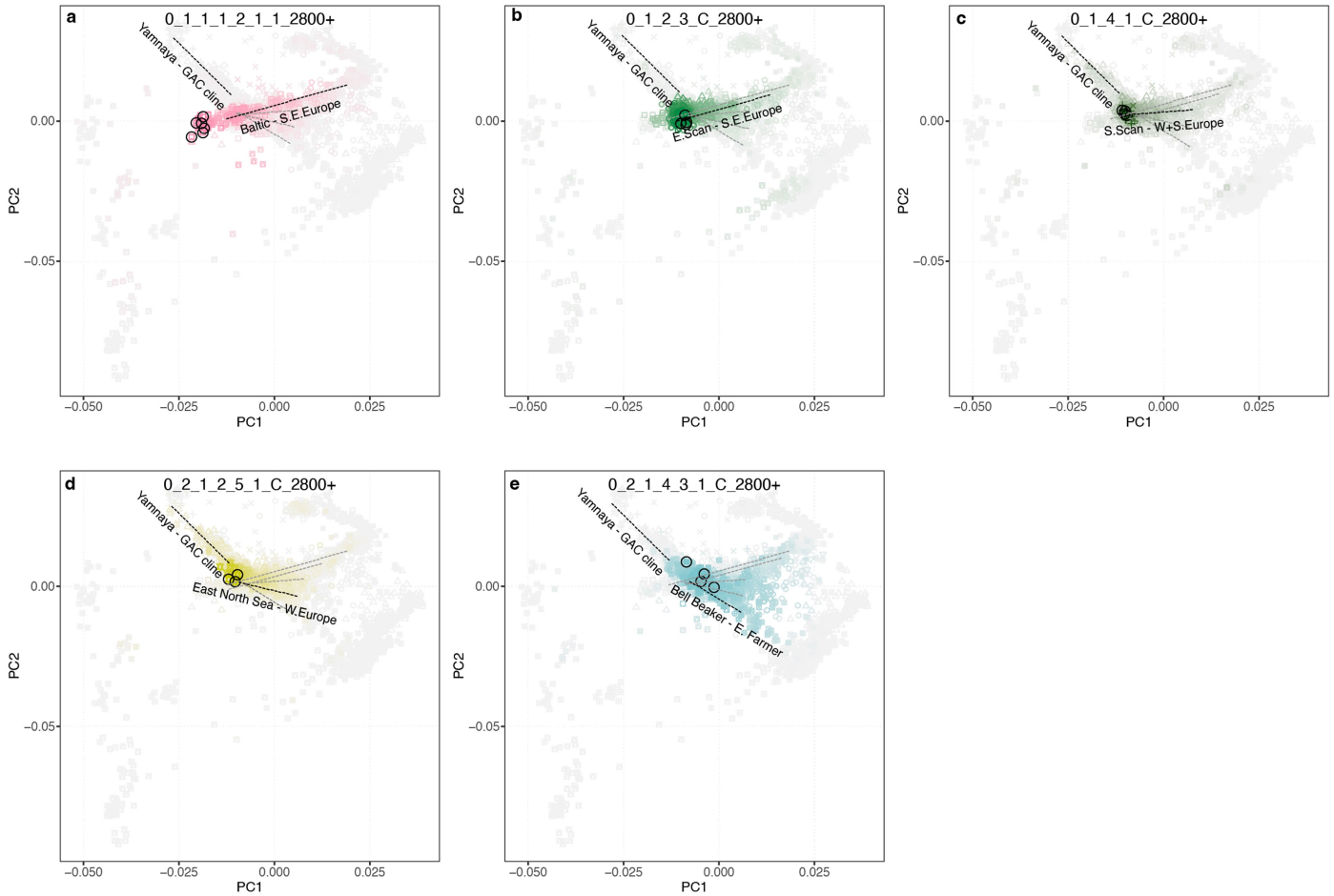
Extended Data Fig. 4 | Spatiotemporal Kriging results showing the general trends of the proportion of ancestries when including Iron Age sources from Norway, Sweden, the Danish Isles and Jutland, and northern Germany. (**a**) Spatio-temporal kriging timelines (Set 6) showing in the migration period, an increase of 'Jutland IA'-related ancestry in England, the Netherlands, the Danish Isles. (**b**) Spatio-temporal kriging timelines (Set 7) showing the migration period transitions seen in (**a**) are better modelled by the Northern Germany/Southern Jutland source. In addition, Jutland sees a transition from local to Northern Germany/Southern Jutland ancestry. The 'North / West Europe' kriging parameters are applied here. Individuals within 200 km of the point used for each country (Supplementary Fig. S5.134) are indicated with an 'x'. While these results represent the general trends, they do not capture the heterogeneity present in many regions, and hence should be interpreted together with the full mixture modelling results (Supplementary Fig. S5.18). For example, in both panels, the presence of Jutlandic IA ancestry in the early Iron Age in Sweden and Norway results from the lack of individuals from these regions, rather than a true signal.



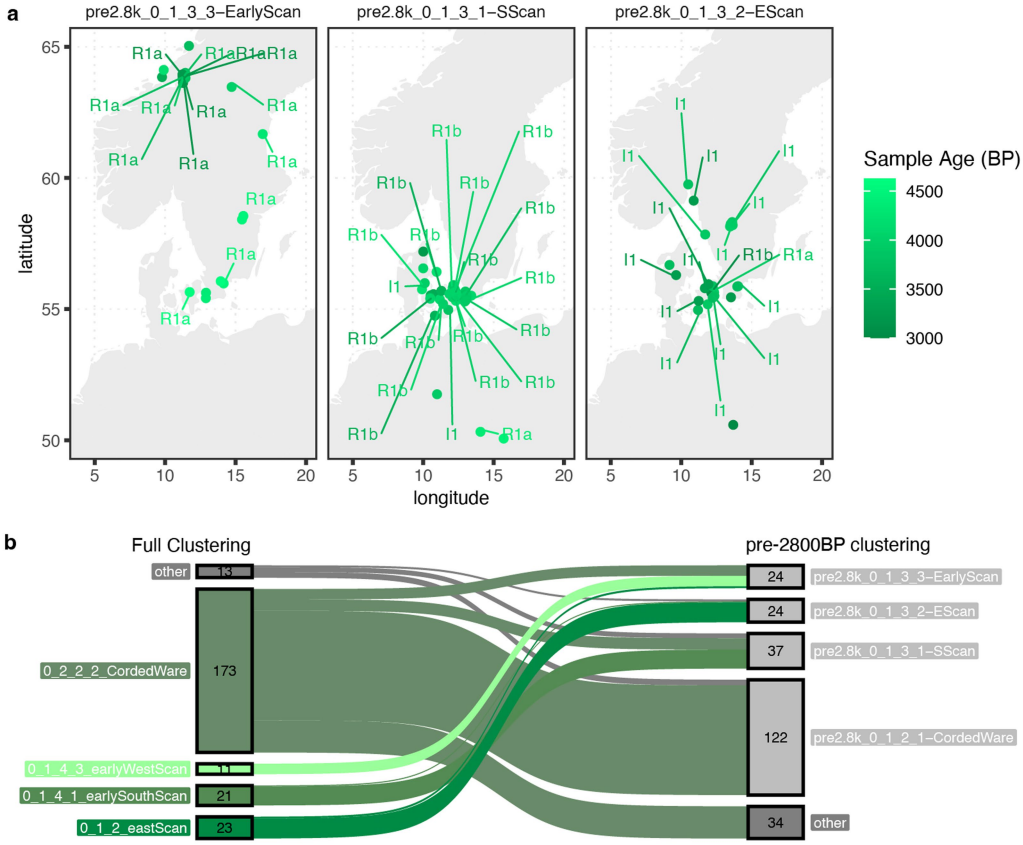
Extended Data Fig. 5 | Distribution of the main four Steppe-related clusters in western Eurasian PCA space and their geographical distribution. (**a,b,c,d**) A PCA of western Eurasian ancient individuals, showing the position of individuals from (**a**) the Yamnaya-related cluster, (**b**) the Corded Ware (East)-related cluster (**c**), the Corded Ware (North)-related cluster, (**d**) the Bell Beaker-related cluster, and their geographical distribution (inset). For all panels, samples older than 2800 BP are indicated with a black point on the PCA, and only samples older than 2800 BP are shown on the map. Maps were generated in R (v4.2.3), using 'map_data' from ggplot2 (v3.5.0.9000).



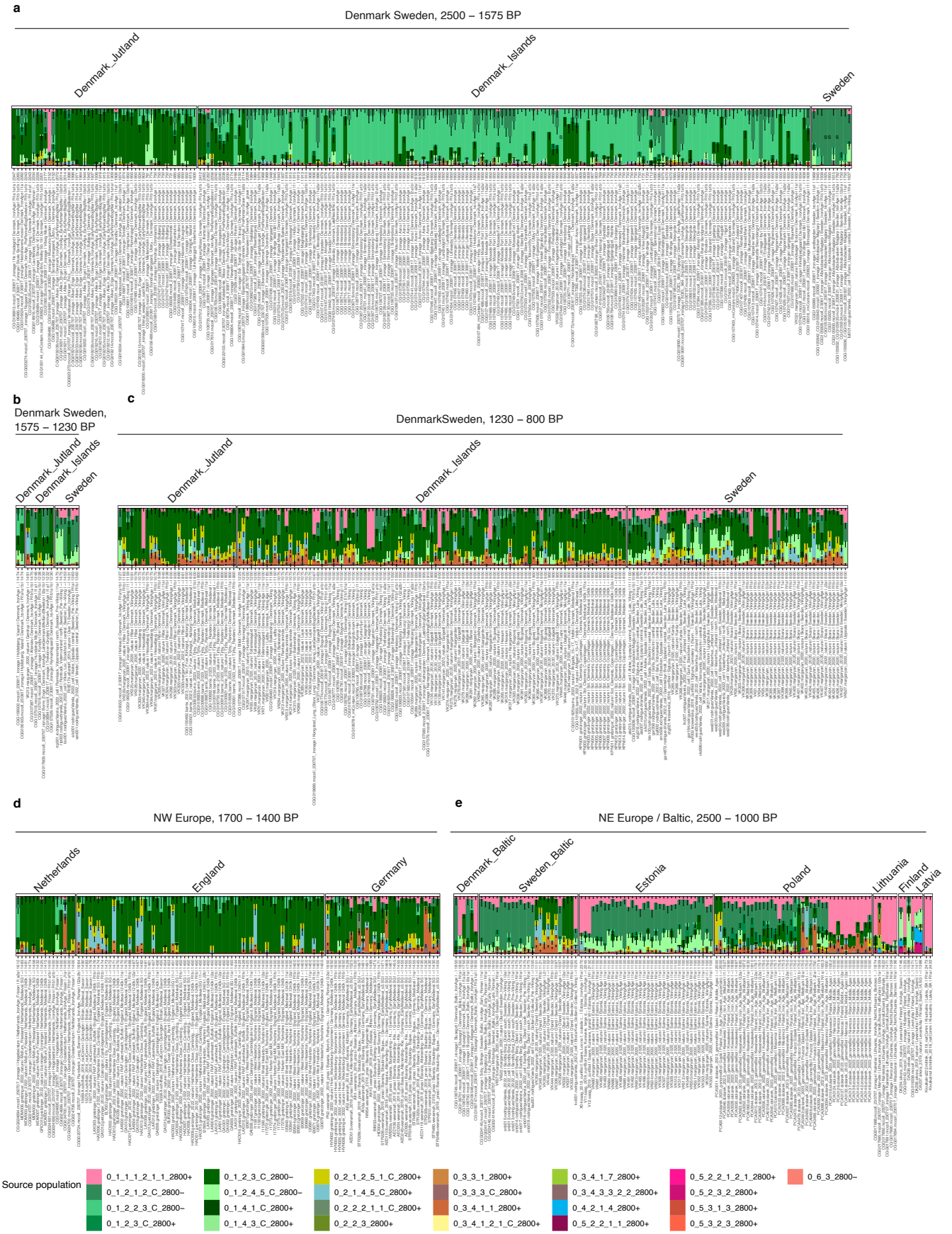
Extended Data Fig. 6 | A subset of IBD mixture modelling results highlighting admixture between various Steppe and Farming-related sources displayed on the western Eurasian PCA (Supplementary Note S5.3.1, Supplementary Fig. S5.20). In each panel, individuals are coloured based on the proportion of ancestry modelled by a specific source, from full colour (100%) to grey (0%). (**a,b,c,d**) Using Auxiliary Set 1, proportions of ancestry modelled by the major ancestries relevant to European population history: (**a**) Yamnaya-related, (**b**) Anatolian Farmer-related, (**c**) Western Hunter-Gatherer related and (**d**) Eastern Hunter-Gatherer related. The well established clines representing (**c,d**) Hunter-Gatherer diversity, (**b,c**) the arrival of Neolithic Farmers to Europe and admixture with Hunter-Gatherers, and (**a,b**) the arrival of Yamnaya-related ancestry and admixture with Neolithic Farmers are annotated. (**e,f,g,h,i,j**) Using Set 5, proportions of ancestry modelled by Steppe-related sources, highlighting the clines between various Steppe-related ancestry sources: (**e**) Yamnaya-related, (**f**) Corded Ware-related and (**g**) Bell Beaker-related, and Farmer ancestry-related sources: (**h**) Globular Amphora Culture-related, (**i**) European Farmer-related and (**j**) Levant/Bronze Age Anatolia-related. For all panels, source individuals are circled and detailed in Supplementary Table S5.3 (Set 5) and S5.4 (Aux Set 1).



Extended Data Fig. 7 | A subset of mixture modelling results from Set 5 displayed on the western Eurasian PCA. Mixture Modelling proportions for sources from Corded Ware (North) subclusters (**a, b, c**) and Bell Beaker subclusters (**d, e**), revealing clines of admixture with groups of varying European Farmer- and Bronze Age western Mediterranean-related ancestry. Source individuals are circled, and admixture proportions follow a cline from full colour (100%) to grey (0%). Full results are in Supplementary Note S5.3.1, Supplementary Fig. S5.20).

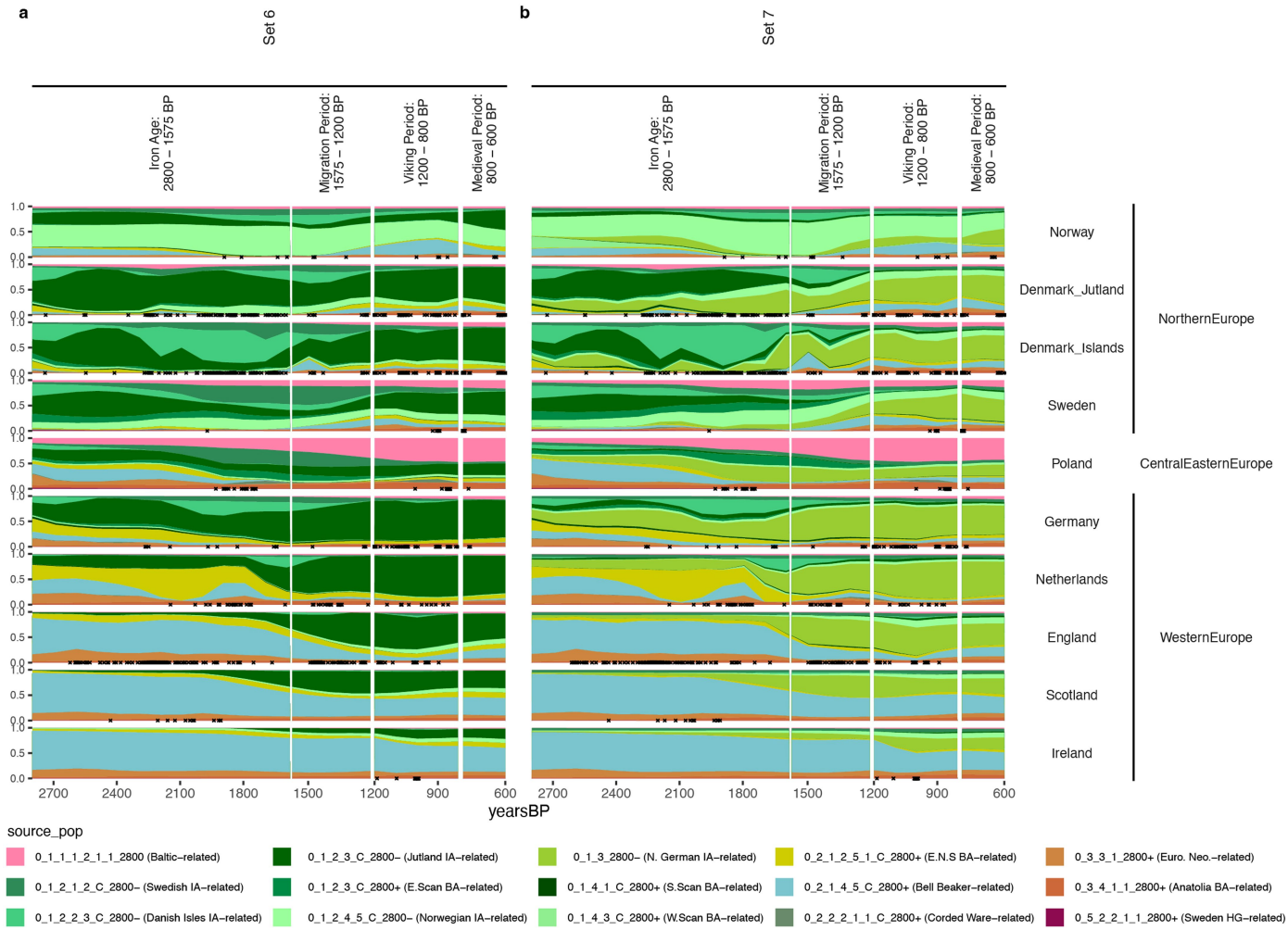


Extended Data Fig. 8 | Scandinavian IBD clusters from pre-2800 BP clustering. (**a**) Geographical distribution of individuals within the Scandinavian sub-clusters from the pre-2800 BP re-clustering. For males with sufficient coverage, major Y-haplogroups are noted. (**b**) Sankey diagram showing the correspondence between the three main Scandinavian clusters and the Eastern Corded Ware clusters in the Full and pre-2800 BP clustering.

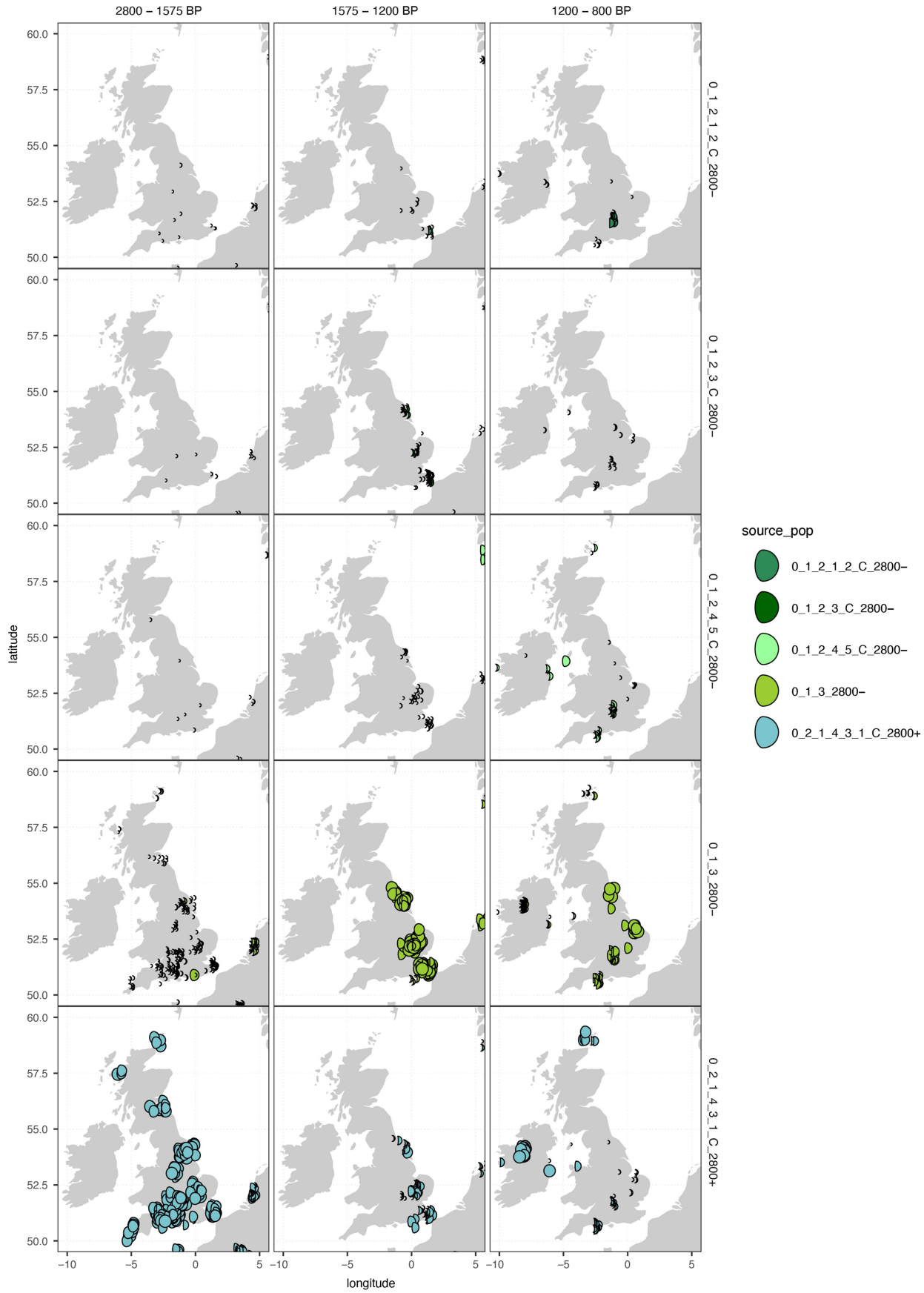


Extended Data Fig. 9 | See next page for caption.

Extended Data Fig. 9 | A northern European subset of IBD mixture modelling results for Iron Age sources (Set 6). (**a**,**b**,**c**) Mixture Modelling results for Jutland, the Danish Isles and southern Sweden from (**a**) 2500–1575 BP, (**b**) 1575–1200 BP, and (**c**) the Viking Age (1200–800 BP, right). (**d**,**e**) Mixture Modelling results for the surrounding regions to the (**d**) west and (**e**) east. Full results can be found in Supplementary Note S5.3, Supplementary Fig. S5.18. Standard errors for each individual's ancestry proportions were calculated using a weighted block jackknife, in turn leaving out each of the 22 chromosomes.

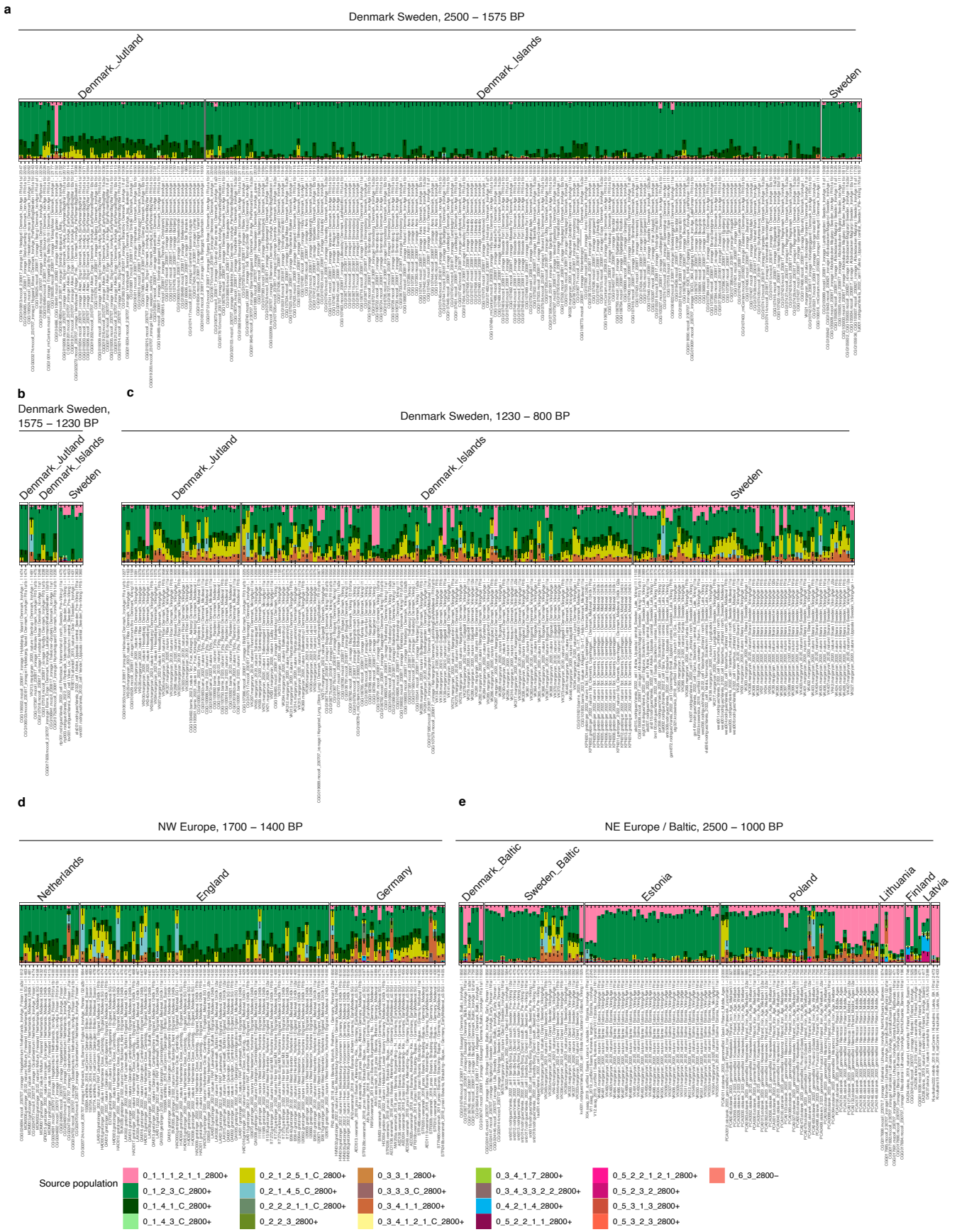


Extended Data Fig. 10 | Spatiotemporal Kriging results showing the general trends of the proportion of ancestries modelled for each Iron Age individual from across Europe for different source sets. (**a**) Spatio-temporal kriging results when using Set 6 including Iron Age European sources from Jutland, the Danish Isles, Sweden and Norway. (**b**) Spatio-temporal kriging results when using set 7, which is identical to set 6 but includes an additional Iron Age source from northern Germany. For both panels, samples with 250 km of these coordinates assigned to each country are indicated with an 'x'. The coordinates representing each country can be found in Supplementary Fig. S5.134. Standard errors for each individual's ancestry proportions were calculated using a weighted block jackknife, in turn leaving out each of the 22 chromosomes.



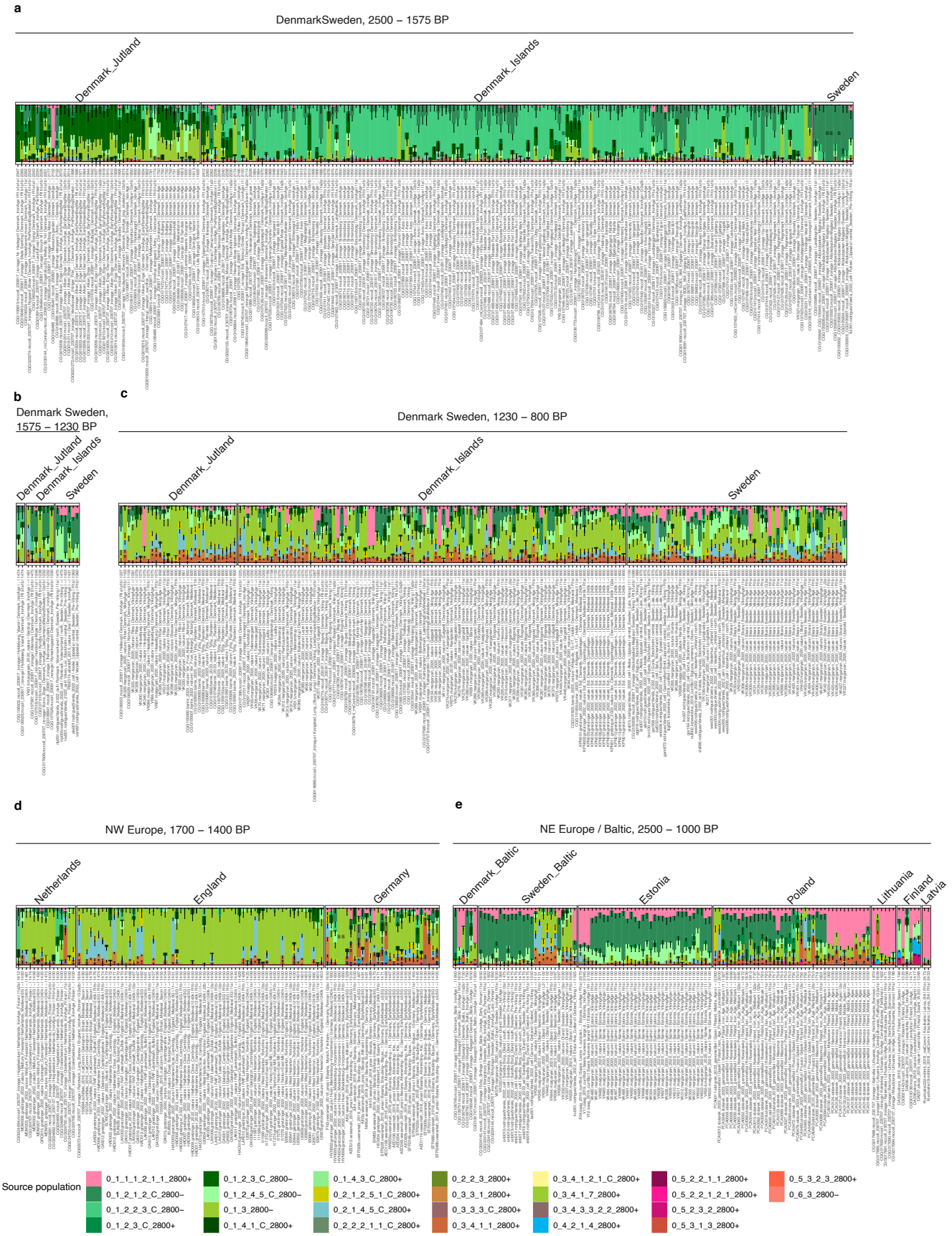
Extended Data Fig. 11 | See next page for caption.

Extended Data Fig. 11 | A subset of IBD mixture modelling results showing the proportion of ancestry in Britain and Ireland (Set 7). In the first column (2800–1575 BP), the dominant ancestry modelled is 0_2_1_1_2 Celtic Bronze Age. In the second column (1575–1200 BP) during the Anglo-Saxon period, a transition causing individuals to be modelled primarily as 0_1_3_2800-Northern Germany/Southern Jutland IA ancestry has occurred, with small proportions of 0_1_2_3_C_2800- Northern Jutland Iron Age ancestry. In the third column (1200–800 BP), the other Scandinavian ancestries are apparent: Swedish Iron Age (0_1_2_1_2_C_2800-) and Norwegian Iron Age (0_1_2_4_5_C_2800-). Full mixture modelling results for northern Europe are shown in Fig. S5.26. Maps were generated in R (v4.2.3), using 'map_data' from ggplot2 (v3.5.0.9000).



Extended Data Fig. 12 | See next page for caption.

Extended Data Fig. 12 | A northern European subset of IBD mixture modelling results for Bronze Age sources (Set 5). (**a**,**b**,**c**) Mixture Modelling results for Jutland, the Danish Isles and southern Sweden from (**a**) 2500-1575 BP, (**b**) 1575–1200 BP, and (**c**) the Viking Age (1200–800 BP, right). (**d**,**e**) Mixture Modelling results for the surrounding regions to the (**d**) west and (**e**) east. Full results can be found in Supplementary Note S5.3, Supplementary Fig. S5.18. Standard errors for each individual's ancestry proportions were calculated using a weighted block jackknife, in turn leaving out each of the 22 chromosomes.



Extended Data Fig. 13 | See next page for caption.

Extended Data Fig. 13 | A northern European subset of IBD mixture modelling results for Iron Age sources, when including two Southern Scandinavian Iron Age sources (Set 7). (**a**,**b**,**c**) Mixture Modelling results for Jutland, the Danish Isles and southern Sweden from (**a**) 2500–1575 BP, (**b**) 1575–1200 BP, and (**c**) the Viking Age (1200–800 BP, right). (**d**,**e**) Mixture Modelling results for the surrounding regions to the (**d**) west and (**e**) east. Full results can be found in Supplementary Note S5.3, Supplementary Fig. S5.18. Standard errors for each individual's ancestry proportions were calculated using a weighted block jackknife, in turn leaving out each of the 22 chromosomes.

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Last updated by author(s): 19/03/2024

Reporting Summary

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Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒	A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒	A description of all covariates tested
☐	☒	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☒	☐	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☐	☒	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Sequencing data and metadata pertaining to the sequencing of ancient genomes is managed on secure servers at the Globe Institute, University of Copenhagen, and via the Illumina Inc. BaseSpace platform.
Data analysis	AdapterRemoval (2.3.2) ancIBD (v0.6) ANGSD (0.938) BCFtools 1.17 BCL Convert (v4.0.3) bwa (0.7.17) ContamMix (v1.0-10) DATES (v753) Decluster (https://github.com/ANGSD/decluster) GCTA (v1.94.1) GenomicRanges (3.15) ggbeeswarm (v0.4.0) ggplot2 (v 3.5.0.9000) ggsankey (v0.0.99999) gstat (v2.1.2) GLIMPSE (v1.1.1) igraph (0.9.9) Haplogrep (v2.0)

IBDseq (version r1206)
leidenAlg (v1.01, https://github.com/kharchenkolab/leidenAlg)
limSolve (1.5.6)
MAFFT (v7.490)
mapDamage2.0 (v2.2.1)
NgsRelate (v2)
OxCal (v4.4)
pathPhynder (1.a)
Picard MarkDuplicates (2.25.0)
plink (v1.9)
ProSize (Agilent) (v4.0.1.4)
pysam (https://github.com/pysam-developers/pysam)
R (v4.2.3)
RAxML-ng (v1.1.0)
Samtools (1.1)
STAdmix (v. c72d845, https://github.com/FerRacimo/STAdmix)
TSAP-WinTM Rinntech (version 4.82b2)

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

Data availability
Sequence data are available at the ENA under accession PRJEB87274. Y-chromosome data, including VCF and derived and ancestral calls, is available in Zenodo at the link: https://doi.org/10.5281/zenodo.15163112. Previously published ancient genomic data used in this study are detailed in Supplementary Table S5.1, with the corresponding publications listed in Supplementary Note S4. All are publicly available. Newly generated C14 dates are detailed in Supplementary Table S1.1. All maps were generated in R (v4.2.3), using 'map_data' from ggplot2 (v3.5.0.9000).

Code availability
Analyses were done using freely available software, which have been fully referenced throughout the manuscript and supplemental materials and methods. Custom code can be found on https://github.com/abigailramsoe/lundbeck-pipeline and https://github.com/tpinotti/ybyra.

Research involving human participants, their data, or biological material

Policy information about studies with human participants or human data. See also policy information about sex, gender (identity/presentation), and sexual orientation and race, ethnicity and racism.

Reporting on sex and gender	No living or recently deceased human research participants were affected by this study.
Reporting on race, ethnicity, or other socially relevant groupings	NA
Population characteristics	NA
Recruitment	NA
Ethics oversight	NA

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	We sequenced ancient genomes from across West Eurasia, primarily from Iron Age Northern Europe. We ran a series of analyses to understand changes in population structure in relation to the distribution of Germanic languages over the last 5,000 years. Genomes for 710 ancient individuals were of sufficient depth for genetic analyses. Of those, 578 were suitable for imputation and were analysed together with 3,939 published samples.
Research sample	Skeletal material from ancient human remains was sampled, extracted and shotgun sequenced to generate low coverage genomes. Sampling focussed on the Iron Age period, as at present, the limited number of published ancient samples from this period have hindered the ability to understand the transition from the Bronze Age to more recent historical period. Linguistically, Northern Europe is suggested to be the homeland of the Germanic languages. Therefore, this region and its surroundings the focus of this study.
Sampling strategy	Sampling was dependent upon the availability of ancient human remains. For specific periods during the Bronze and Iron Age, the prevalence of cremation has resulted in very little skeletal material existing that is suitable for recovery of ancient DNA. Throughout this period however, 'bog' skeletons are still found. We therefor sequenced and generated C14 dates for as many 'bog' skeletons as possible from this region.
Data collection	Sampling and ancient DNA laboratory work was undertaken in dedicated ancient DNA clean lab facilities at the GeoGenetics Centre, resulting in 710 ancient genomes. Additionally, 236 novel accelerator mass spectrometry results were generated at the 14CHRONO laboratory, Queen's University Belfast (52 samples), and at the Keck-CCAMS Group, Irvine, California, USA (184 samples).
Timing and spatial scale	Sample chronology was generated by radiocarbon and context dating. As the last major migration into Europe 5,000 years ago is believed to have brought Indo European languages (including Germanic), the primary ancient individuals of interest fall from the Bronze Age (5000 BP) until the Viking Period (~1000 BP), including the Iron Age and Migration Period. In addition, earlier and surrounding samples were also included for context.
Data exclusions	Libraries with more than 5% mitochondrial contamination and samples with less than 0.01X coverage were excluded from this study. Samples with less than 0.1X shotgun sequenced coverage, or 1X captured coverage were excluded from imputation. Samples that imputed with a genotype probability of less than 0.9 on the capture sites were excluded, as were sites that were not captured, or did not impute well (INFO score <= 0.5).
Reproducibility	Data quality and uncertainty (e.g. contamination) was accounted for in computational analyses to assess robustness of inferences, and all methods and data are made available for future replication.
Randomization	Sample groups were defined to reflect archaeological populations, based on phylogenetic inferences, temporal and geographic provenance, and cultural interpretations evidenced by archaeological contexts.
Blinding	Blinding was not applicable to this study

Did the study involve field work? ☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☐	☒ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Palaeontology and Archaeology

Specimen provenance	The samples analysed in this study come from 58 different institutions. Samples were collected with permission from institutions

Specimen provenance

holding specimens and documented via permissions or agreements letters held by the Lundbeck Foundation GeoGenetics Centre. Full details and documentation for these is maintained in a dedicated database by F.D. and Pernille Olsen of the GeoGenetics Centre. The following list provides the site name, country, sample ID, contact and institution.
Aalstrup, Mellergaard, Denmark. Samples: CGG106530. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Aamosen-Gammelvind, Denmark. Samples: CGG017649. Key contact: Anders Fischer. Institution: Sealand Archaeology, Kalundborg, Denmark
Aastofte, Denmark. Samples: CGG107440. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Albäcksbacken Maglarp, Sweden. Samples: CGG105920; CGG105921; CGG105922; CGG105923; CGG105925; CGG105926; CGG105928; CGG105930; CGG105932; CGG105933; CGG105934; CGG105935; CGG105936; CGG105937; CGG105938; CGG105939; CGG105940; CGG105941; CGG105942; CGG105943. Key contact: Torbjörn Ahlström. Institution: Department of Archaeology and Ancient History, Lund University, Lund, Sweden
Alken Enge, Denmark. Samples: CGG019201; CGG019202; CGG019203; CGG019204; CGG019205; CGG019206; CGG019208; CGG019209; CGG019210; CGG019211; CGG019212; CGG019214; CGG019215; CGG019216. Key contact: Mads Holst. Institution: Moesgaard Museum
Allerslev, Denmark. Samples: CGG107387. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Almager, Denmark. Samples: CGG107467. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Alpegard, Denmark_Baltic. Samples: CGG106548. Key contact: Linda Boye. Institution: Kroppedal Museum, Taastrup, Denmark
Alsted, Denmark. Samples: CGG107384. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Asnæs, Denmark. Samples: CGG107388; CGG107389; CGG107390; CGG107391; CGG107392; CGG107393; CGG107441; CGG107442; CGG107443; CGG107444; CGG107445. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Assistens Kirkegård, Denmark. Samples: CGG105338; CGG105340. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Assleröd, Sweden. Samples: CGG106210. Key contact: KG Sjögren. Institution: Department of Historical Studies, University of Gothenburg, Gothenburg, Sweden
Aunvollen, Norway. Samples: CGG105915. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Aymyrlyg, Russia. Samples: CGG021492; CGG021493; CGG021494; CGG021495; CGG021496; CGG021497; CGG021499; CGG021500; CGG021503. Key contact: Vyacheslav Moiseyev. Institution: Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya Nab. 3, St. Petersburg, Russia
Aymyrlyg, Russia. Samples: CGG021502; CGG021504; CGG021507. Key contact: Vyacheslav Moiseyev, Eileen Murphy. Institution: Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya Nab. 3, St. Petersburg, Russia; Archaeology and Palaeoecology, School of Natural and Built Environment, Queen's University Belfast, Northern Ireland
Bakkendrup, Denmark. Samples: CGG106483. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Bakkendrup, Denmark. Samples: CGG106825; CGG106826; CGG106827. Key contact: Marie-Louise Schjellerup Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Balsnes, Norway. Samples: CGG107012. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Bårse, Denmark. Samples: CGG106796. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark; Museum Southeast Denmark
Barup Sandgrav, Denmark. Samples: CGG107385. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Baunehøj, Denmark. Samples: CGG107468. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Bengtstorp, Sweden_Baltic. Samples: CGG024147. Key contact: Helene Wilhelmson. Institution: Lund University, Sweden
Berciunai, Lithuania. Samples: CGG017690. Key contact: Inga Mekyte, Rimantas Jankauskas. Institution: Saxo-Instituttet, Copenhagen; Vilnius University, Lithuania
Bergvin, Norway. Samples: CGG105634. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Bergvin, Norway. Samples: CGG105635; CGG107018. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Bilidt, Denmark. Samples: CGG107386. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Bjoernstrupgaard, Denmark. Samples: CGG019645. Key contact: Niels Lynnerup, Anders Fischer, Pia Bennike. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Sealand Archaeology, Kalundborg, Denmark
Blæsenborgvej, Denmark. Samples: CGG107383. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Bødkergårds mark, Denmark. Samples: CGG106783; CGG106784. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Bøgebjerg, Denmark. Samples: CGG107446. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Bøgebjerggård, Røstofte, Denmark. Samples: CGG106793; CGG106794. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark; Museum Southeast Denmark
Bogøvej, Denmark. Samples: CGG106774; CGG106775; CGG106776; CGG106777; CGG106778; CGG106779; CGG106780; CGG106781; CGG106782. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen,

Denmark
Bois de Serry, France. Samples: CGG023721. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Bøle, Flatanger M, T21061:2, A7271, Norway. Samples: CGG107036. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Bøle, Flatanger M, T21061:3 A7272, Norway. Samples: CGG107035. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Bomo, Snåsa M, Norway. Samples: CGG107020. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Borre Enge, Denmark. Samples: CGG017609. Key contact: Anders; Pia Bennike; Jens Ulriksen. Institution: Sealand Archaeology, Kalundborg, Denmark; Museum Southeast Denmark
Borremose, Denmark. Samples: CGG106742. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Borritshoved, Denmark. Samples: CGG107469; CGG107470. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Boyasky, Russia. Samples: CGG021459; CGG021460; CGG021461; CGG021463. Key contact: Vyacheslav Moiseyev. Institution: Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya Nab. 3, St. Petersburg, Russia
Bredebjerggård 8, Denmark. Samples: CGG106822. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Broskov, Denmark. Samples: CGG107394; CGG107395. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Bucy le Long, France. Samples: CGG022417; CGG022418; CGG022419; CGG022420; CGG022421; CGG022424; CGG022425; CGG022426; CGG022427; CGG022428; CGG022429; CGG022430; CGG022431; CGG022432; CGG022433; CGG022434; CGG022435; CGG022436; CGG022437; CGG022438; CGG022440; CGG022441; CGG022442; CGG022443; CGG022444; CGG022445; CGG022447; CGG022451; CGG022452; CGG022453; CGG022454; CGG022455; CGG022456; CGG022457; CGG022458; CGG022459; CGG022460; CGG022461; CGG022463; CGG022464; CGG022465. Key contact: Jean-Paul Demoule. Institution: University of Paris I - Panthéon-Sorbonne, France
Bulbjerg, Denmark. Samples: CGG107471; CGG107472; CGG107474; CGG107476; CGG107478. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Bulbjerg, Denmark. Samples: CGG107477. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Camino de las Yeseras, Spain. Samples: CGG022028; CGG022031. Key contact: Jorge Vega. Institution: Argea Consultores SL, Madrid, Spain
Camp du Château, France. Samples: CGG023655; CGG023656; CGG023657; CGG023658; CGG023659; CGG023715; CGG023722; CGG023725. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Chersonesus City, Crimea. Samples: CGG021472; CGG021473; CGG021474; CGG021475; CGG021476; CGG021478. Key contact: Vyacheslav Moiseyev. Institution: Department of Cultures / Archaeology, University of Helsinki, Helsinki, Finland
Cifer-Pac, Slovakia. Samples: CGG018917; CGG018918; CGG018920; CGG018923; CGG018924; CGG018926; CGG018927. Key contact: Klaudia Kyselicová. Institution: Faculty of Medicine, Institute of Physiology, Comenius University Bratislava, Slovakia
Dagsmose, Denmark. Samples: CGG021419. Key contact: Niels Lynnerup; Anders Fischer; Pia Bennike. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Sealand Archaeology, Kalundborg, Denmark
Digomi, Georgia. Samples: CGG021779. Key contact: Vladimer Aslanishvili. Institution: Ivane Javakhishvili Institute of History and Ethnology, Tbilisi, Georgia
Dubrovsky, Russia. Samples: CGG021462; CGG021464. Key contact: Vyacheslav Moiseyev. Institution: Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya Nab. 3, St. Petersburg, Russia
Egebjerg, Denmark. Samples: CGG107396; CGG107397. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Egedal Mose, Denmark. Samples: CGG107534. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Eid, Norway. Samples: CGG105640; CGG105641. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Ekazhevo, Russia. Samples: CGG021451. Key contact: Oleg Balanovsky. Institution: Research Centre for Medical Genetics, Moscow 115478, Russia
Eksercérpladsen, Denmark. Samples: CGG106795. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark; Museum Southeast Denmark
Elkenoere, Denmark. Samples: CGG022099. Key contact: Niels Lynnerup; Anders Fischer; Pia Bennike. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Sealand Archaeology, Kalundborg, Denmark
Endegaarde, Denmark. Samples: CGG107416. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Engbjerg, Denmark. Samples: CGG106821. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Enge, Sømna M, Norway. Samples: CGG107037. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Engeldrup Bro, Melby Sb 19, Denmark. Samples: CGG100144. Key contact: Sophie Bergerbrant. Institution: Department of Archaeology and Ancient History, Campus Gotland, Uppsala University, Sweden
Engholmen, Norway. Samples: CGG107011. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Engholmen 2, Norway. Samples: CGG107013. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Espe, Denmark. Samples: CGG107515; CGG107516. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological

Anthropology, Globe Institute, University of Copenhagen, Denmark
Estevillas Virgen de la Torre, Spain. Samples: CGG022051; CGG022052; CGG022053. Key contact: Jorge Vega. Institution: Argea Consultores SL, Madrid, Spain
Fårevejlegård, Denmark. Samples: CGG107532; CGG107533. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Fauskland, Norway. Samples: CGG105916; CGG105917; CGG105918. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Følstad, Norway. Samples: CGG105643. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Føre 1, Norway. Samples: CGG107014; CGG107015. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Forlev ""Forlev I"", Denmark. Samples: CGG106828. Key contact: Marie-Louise Schjellerup Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Fraugde, Denmark. Samples: CGG107398; CGG107399. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Gadevang Mose, Denmark. Samples: CGG107531. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Gammel Hasseris Grusgrav, Denmark. Samples: CGG107417. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Gedebjerg, Denmark. Samples: CGG107447. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Gerlev STR. Vej 10 Indiv 1 MFG 114/97, Denmark. Samples: CGG106513. Key contact: Jens Winther Johannsen. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Gerlev STR. Vej 10 Indiv 2 MFG 114/97, Denmark. Samples: CGG106514. Key contact: Jens Winther Johannsen. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Gerulata, Slovakia. Samples: CGG021931; CGG021934; CGG021935. Key contact: Václav Smrčka. Institution: Institute for History of Medicine, First Faculty of Medicine, Charles University, Prague, Czech Republic
Gevninge Overdrev, Denmark. Samples: CGG107535. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Glerup, Denmark. Samples: CGG107479; CGG107480. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Græsbjerg, Denmark. Samples: CGG106800. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark; Museum Southeast Denmark
Grønhøjgård, Vaarst, Denmark. Samples: CGG106504. Key contact: Torben Trier Christiansen. Institution: The Historical Museum of Northern Jutland, Denmark
Gruta do Caldeirão, Portugal. Samples: CGG018558; CGG018559. Key contact: João Zilhão. Institution: University of Lisbon - UNIARQ (Centro de Arqueologia da Universidade de Lisboa), Faculdade de Letras, Alameda da Universidade, 1600-214 Lisboa, Portugal
Hallein, Austria. Samples: CGG101225; CGG101232. Key contact: Doris Pany-Kucera. Institution: Natural History Museum Vienna, Austria
Hallstatt, Austria. Samples: CGG101213; CGG101214; CGG101215; CGG101216; CGG101217; CGG101219; CGG101222; CGG101223. Key contact: Doris Pany-Kucera. Institution: Natural History Museum Vienna, Austria
Hamahus, Denmark. Samples: CGG106811. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Hammer Strandhuse, Denmark. Samples: CGG107418. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Haraldsted, Denmark. Samples: CGG107508. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Hastrup, Denmark. Samples: CGG107419. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Havnegård, Denmark. Samples: CGG107517. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Hejringe, Denmark. Samples: CGG106737. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Hellevad, Denmark. Samples: CGG106553. Key contact: Sidsel Wahlin. Institution: Vesthimmerlands Museum, Denmark
Hemmeshøj, Denmark. Samples: CGG107400; CGG107420. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Hestbek III, Denmark. Samples: CGG106492. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Hestehavens mose, Denmark. Samples: CGG106524. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Hoby, Denmark. Samples: CGG107481. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Hogebeintum, Netherlands. Samples: CGG024691; CGG024692; CGG024694; CGG024695. Key contact: Stijn Heeren (c/o Tony Ruter, Kurt Kjaer). Institution: Vrije Universiteit Amsterdam, the Netherlands; Lundbeck Foundation GeoGenetics Center, Globe Institute, University of Copenhagen, Copenhagen, Denmark
Höja gård, Sweden. Samples: CGG015491. Key contact: Chatarina Ödman. Institution: Malmöhus Museum
Højgård, Denmark. Samples: CGG107401. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Højstrupvej, Denmark. Samples: CGG106835. Key contact: Marie-Louise Schjellerup Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Holm, Bindal M, Norway. Samples: CGG107030. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Holubice, CzechRepublic. Samples: CGG021948; CGG021956; CGG021963; CGG021972. Key contact: Václav Smrčka. Institution: Institute for History of Medicine, First Faculty of Medicine, Charles University, Prague, Czech Republic
Hørby Skov, Denmark. Samples: CGG107484. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology,

Globe Institute, University of Copenhagen, Denmark
Humble, Denmark. Samples: CGG106772. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Hundstrup Mose, Denmark. Samples: CGG107518. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Hvidovre, Denmark. Samples: CGG107482; CGG107483. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Hyldebjerg, Vaarst, Denmark. Samples: CGG106502; CGG106503. Key contact: Torben Trier Christiansen. Institution: The Historical Museum of Northern Jutland, Denmark
Hyllebjerg X, Denmark. Samples: CGG106493. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Illemose, Denmark. Samples: CGG106709; CGG106710. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Illerup weapon sacrifice site, Denmark. Samples: CGG019200; CGG019213. Key contact: Mads Holst. Institution: Moesgaard Museum
Jarlsberg Herregaard, Norway. Samples: CGG107001. Key contact: Zanette Tsigaridas Glørstad. Institution: Museum of Cultural History, University of Oslo, Norway
Joa, Norway. Samples: CGG107026; CGG107027; CGG107028. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Joa, Namsos M, Norway. Samples: CGG107032; CGG107033; CGG107034. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Juellinge, Denmark. Samples: CGG106771. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Kaagården, Denmark. Samples: CGG106787; CGG106788; CGG106789; CGG106790; CGG106791; CGG106792. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Kaarebjerg Agre, Tørslev Hage, Gerlev Sogn, Denmark. Samples: CGG106770; CGG106838. Key contact: Jens Winther Johannsen. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Kaireneliai, Lithuania. Samples: CGG017691. Key contact: Inga Mekyte, Rimantas Jankauskas. Institution: Saxo-Instituttet, Copenhagen; Vilnius University, Lithuania
Käldamäki, Finland. Samples: CGG024143. Key contact: Anna Wessman. Institution: University of Bergen, Department of Cultural History, Norway
Kalmargården, Denmark. Samples: CGG107579. Key contact: Susanne Klingenberg; Niels Wickman. Institution: Museum Vestsjælland, Holbæk, Denmark
Kalmargården, Denmark. Samples: CGG107580. Key contact: Susanne Klingenberg; Niels Wickman. Institution: Museum Vestsjælland, Holbæk, Denmark
Kalneliai, Lithuania. Samples: CGG017688. Key contact: Inga Mekyte, Rimantas Jankauskas. Institution: Saxo-Instituttet, Copenhagen; Vilnius University, Lithuania
Kalniskiai, Lithuania. Samples: CGG017692. Key contact: Inga Mekyte, Rimantas Jankauskas. Institution: Saxo-Instituttet, Copenhagen; Vilnius University, Lithuania
Kalvehavegaard, Denmark. Samples: CGG100212; CGG100215; CGG100220; CGG100222. Key contact: Malene Refshauge Beck. Institution: Museums of East Funen, Kertemind, Denmark
Karlstrup, Denmark. Samples: CGG106702; CGG106704; CGG106705; CGG106706; CGG106707; CGG106708. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark; Museum Southeast Denmark
Kavslunde Eng, Denmark. Samples: CGG106805. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Keldeklinte Mose, Denmark. Samples: CGG022103. Key contact: Niels Lynnerup; Anders Fischer; Pia Bennike. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Sealand Archaeology, Kalundborg, Denmark
Kildehus, Denmark. Samples: CGG107485. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Kirkebakkegård, Denmark. Samples: CGG107422. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Kirkebjerggaard, Denmark. Samples: CGG107423. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Kiskundorozsma, Hungary. Samples: CGG021918; CGG021922; CGG021923; CGG021924. Key contact: Václav Smrčka, Erika Molnár. Institution: Institute for History of Medicine, First Faculty of Medicine, Charles University, Prague, Czech Republic; Department of Biological Anthropology, University of Szeged, Hungary
Kongens Nytorv, Denmark. Samples: CGG107536. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Kongsted Lyng (Store Lyng), Denmark. Samples: CGG019689. Key contact: Niels Lynnerup, Anders Fischer, Pia Bennike. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Sealand Archaeology, Kalundborg, Denmark
Koriyata at Suvorovo, Bulgaria. Samples: CGG018087. Key contact: Vladimir Slavchev; Inga Merkyte. Institution: Museum of Archaeology, Varna, Bulgaria; Saxo-Instituttet, Copenhagen, Denmark
Kornum Bro, Denmark. Samples: CGG106529. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Kråkerøy, Norway. Samples: CGG105645; CGG105646. Key contact: Anne Lene Melheim. Institution: Museum of Cultural History, University of Oslo
Kumle Høje, Denmark. Samples: CGG106785; CGG106786. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Kyndby, Denmark. Samples: CGG107519. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Læbrogård, Denmark. Samples: CGG107403. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark

Laignes tumulus de Toucheboeuf, France. Samples: CGG023653. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Landbogården, Sweden. Samples: CGG105989. Key contact: Torbjörn Ahlström. Institution: Department of Archaeology and Ancient History, Lund University, Lund, Sweden
Landledgård, Denmark. Samples: CGG107449; CGG107450; CGG107451. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Landlystvej, Denmark. Samples: CGG107452. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Langdyssegård, Denmark. Samples: CGG107528. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Lauritshoej, Denmark. Samples: CGG018916. Key contact: Mads Holst. Institution: Moesgaard Museum
Le Mesnay les Ecomboles, France. Samples: CGG023720. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Lejre, Denmark. Samples: CGG106830. Key contact: Marie-Louise Schjellerup Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Lejrhøje, Denmark. Samples: CGG107424; CGG107425. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Lekkende, Denmark. Samples: CGG107402. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Les Moidons, France. Samples: CGG023660; CGG023662; CGG023663; CGG023664; CGG023667; CGG023668; CGG023669; CGG023671; CGG023681; CGG023687; CGG023688; CGG023690; CGG023691; CGG023692; CGG023693; CGG023695; CGG023703; CGG023708; CGG023709; CGG023710; CGG023714; CGG023716; CGG023717; CGG023718; CGG023724. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Levänluhta, Finland. Samples: CGG019338. Key contact: Kristiina E. Mannermaa. Institution: Department of Cultures / Archaeology, University of Helsinki, Finland
Lilla Smedby, Sweden_Baltic. Samples: CGG024146. Key contact: Helene Wilhelmson. Institution: Lund University, Sweden
Lille Bjerggård, Sønderholm, Denmark. Samples: CGG106510. Key contact: Torben Trier Christiansen. Institution: The Historical Museum of Northern Jutland, Denmark
Lillestrand, Bogense sb 21, Denmark. Samples: CGG100145. Key contact: Sophie Bergerbrant. Institution: Department of Archaeology and Ancient History, Campus Gotland, Uppsala University, Sweden
Lillevasby, Denmark. Samples: CGG107453; CGG107454; CGG107455; CGG107456; CGG107457; CGG107458; CGG107459; CGG107460; CGG107461; CGG107462; CGG107463; CGG107464; CGG107465; CGG107466. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Los Berrocales, Spain. Samples: CGG022026. Key contact: Jorge Vega. Institution: Argea Consultores SL, Madrid, Spain
Lovosice, CzechRepublic. Samples: CGG021890. Key contact: Vaclav Smrcka. Institution: Institute for History of Medicine, First Faculty of Medicine, Charles University, Prague, Czech Republic
Lund, Norway. Samples: CGG107010. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Lund, Namsos M, Norway. Samples: CGG107024. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Lundbjerggård, Denmark. Samples: CGG105322; CGG105323; CGG105325; CGG105326; CGG105327. Key contact: Ole Thirup Kastholm; Katrine Ipsen Kjær. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Luzice, CzechRepublic. Samples: CGG021981; CGG021991; CGG021993. Key contact: Václav Smrčka. Institution: Institute for History of Medicine, First Faculty of Medicine, Charles University, Prague, Czech Republic
Lygtebæk, Denmark. Samples: CGG106526. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Madaras, Hungary. Samples: CGG021896; CGG021897; CGG021898; CGG021899; CGG021902; CGG021908; CGG021909; CGG021912; CGG021913; CGG021916; CGG021917. Key contact: Vaclav Smrcka, Erika Molnár. Institution: Institute for History of Medicine, First Faculty of Medicine, Charles University, Prague, Czech Republic; Department of Biological Anthropology, University of Szeged, Hungary
Maderne, Denmark. Samples: CGG021421. Key contact: Niels Lynnerup; Anders Fischer; Pia Bennike. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Sealand Archaeology, Kalundborg, Denmark
Mærkebækgård Syd, Denmark. Samples: CGG105329. Key contact: Ole Thirup Kastholm. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Maglebjerghøj, Denmark. Samples: CGG107522. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Maisey-le-Duc tumulus de la Tête de Maise, France. Samples: CGG023647. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Maisey-le-Duc tumulus de la Tête de Maisey, France. Samples: CGG023648. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Maisey-le-Duc tumulus du Puits de Nod, France. Samples: CGG023651. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Mandemarke Bakker, Denmark. Samples: CGG107523. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Marvele, Lithuania. Samples: CGG017685. Key contact: Inga Mekyte, Rimantas Jankauskas. Institution: Saxo-Instituttet, Copenhagen; Vilnius University, Lithuania
Maudziorai, Lithuania. Samples: CGG017694. Key contact: Inga Mekyte, Rimantas Jankauskas. Institution: Saxo-Instituttet, Copenhagen; Vilnius University, Lithuania
Mellemholm, Denmark. Samples: CGG106810. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Mellemholm, Denmark. Samples: CGG106499; CGG106500. Key contact: Torben Trier Christiansen. Institution: The Historical Museum of Northern Jutland, Aalborg, Denmark
Mine Howe, Scotland. Samples: CGG018914; CGG018915. Key contact: Nick Card. Institution: Archaeology Institute, University of Highlands and Islands, UK
Monterrey-Estiviel, Spain. Samples: CGG022041. Key contact: Jorge Vega. Institution: Argea Consultores SL, Madrid, Spain
Mörbylånga, Sweden_Baltic. Samples: CGG024144. Key contact: Helene Wilhelmson. Institution: Lund University, Sweden

Mors, Denmark. Samples: CGG106711. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Mosede Fort, Denmark. Samples: CGG107487; CGG107488; CGG107489; CGG107490; CGG107492; CGG107494; CGG107495; CGG107496; CGG107497; CGG107498; CGG107499. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Mosede Fort, Denmark. Samples: CGG107486. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Museums garden, Denmark. Samples: CGG106486; CGG106491. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Næstved Mark, Denmark. Samples: CGG107407; CGG107408. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Neder Vindinge, Denmark. Samples: CGG107406. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Neverkær Mose Høgholm, Denmark. Samples: CGG106804. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Nordenbrogård ""Hesselbjerg"", Denmark. Samples: CGG106773. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Nordrollnes, Norway. Samples: CGG107019. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Nørre Vedby, Denmark. Samples: CGG106743. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Nørrebjerg, Denmark. Samples: CGG105541. Key contact: Jesper Hansen. Institution: Svendborg Museum, Denmark
Nr. Hedegård, Denmark. Samples: CGG106813. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Nygaard Mose, Denmark. Samples: CGG023274. Key contact: Anders Fischer; Niels Lynnerup. Institution: Sealand Archaeology, Kalundborg, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Nymarksgaard, Denmark. Samples: CGG107529. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Øbjergaard, Denmark. Samples: CGG107433; CGG107434; CGG107435; CGG107436. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Ølby, Denmark. Samples: CGG107415. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Oosterbeintum, Netherlands. Samples: CGG024699; CGG024700; CGG024702; CGG024707; CGG024708. Key contact: Stijn Heeren (c/o Tony Ruter, Kurt Kjaer). Institution: Vrije Universiteit Amsterdam, the Netherlands; Lundbeck Foundation GeoGenetics Center, Globe Institute, University of Copenhagen, Copenhagen, Denmark
Øsjergaard, Denmark. Samples: CGG107437; CGG107438; CGG107439. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Oustrup (Tåderup mose), Denmark. Samples: CGG106735. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Over Vindinge, Denmark. Samples: CGG105332; CGG105333; CGG105334; CGG105337. Key contact: Helle Vandkilde; Marie Louise Schjellerup Jørkov. Institution: Department of Archaeology and Heritage Studies, School of Culture and Society, Aarhus University; Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark Denmark
Parançot, France. Samples: CGG023672; CGG023673; CGG023674; CGG023676; CGG023677; CGG023678; CGG023679; CGG023682; CGG023685; CGG023686; CGG023698; CGG023699; CGG023700; CGG023702; CGG023704; CGG023706; CGG023707; CGG023712; CGG023713; CGG023719; CGG023723. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Radovesice II, CzechRepublic. Samples: CGG021735; CGG021736; CGG021737; CGG021738; CGG021740; CGG021839; CGG021846. Key contact: Vaclav Smrcka. Institution: Institute for History of Medicine, First Faculty of Medicine, Charles University, Prague, Czech Republic
Randwick Long Barrow, England. Samples: CGG020723; CGG020724. Key contact: Alan Outram. Institution: Department of Archaeology and History, University of Exeter
Regnemark, Denmark. Samples: CGG107426; CGG107427; CGG107428; CGG107429. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Regstrup, Denmark. Samples: CGG106836. Key contact: Marie-Louise Schjellerup Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Ripa Bianca, Italy. Samples: CGG019380. Key contact: Alfredo Coppa, Saoienza. Institution: Department of Environmental Biology, Sapienza University of Rome
Rislev, Denmark. Samples: CGG107509; CGG107510. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Rjoa, Sola, Norway. Samples: CGG107044. Key contact: Sean Dexter Denham; Håkon Reiersen. Institution: Museum of Archaeology, University of Stavanger, Norway
Rollsnes, Norway. Samples: CGG107017. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Rolund, Denmark. Samples: CGG106837. Key contact: Marie-Louise Schjellerup Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Romdrup, Christianshøj, Denmark. Samples: CGG106815. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark

Romdrupgård, Denmark. Samples: CGG106816. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Rørsløkke Mose (Tryggelev), Denmark. Samples: CGG106744. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Rosenaeen, Denmark. Samples: CGG011889. Key contact: Niels Lynnerup; Susan Pallesen. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Kroppedal Museum, Denmark
Royne, Orlandet M, Norway. Samples: CGG107029. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Rubenheim, Germany. Samples: CGG023734; CGG023735. Key contact: Volker Heyd. Institution: Department of Cultures / Archaeology, University of Helsinki, Helsinki, Finland
Ruds Vedby, Denmark. Samples: CGG107526. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Sæsing, Denmark. Samples: CGG106525. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Sainte Colombe-sur-Seine Tumulus 3, France. Samples: CGG023637. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Sanddal, Denmark. Samples: CGG019437; CGG019438; CGG019439; CGG019442. Key contact: Ole Thirup Kastholm; Katrine Ipsen Kjær. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Sandlyngmose, Denmark. Samples: CGG107524. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Scheelsminde, Denmark. Samples: CGG106508. Key contact: Torben Trier Christiansen. Institution: The Historical Museum of Northern Jutland, Aalborg, Denmark
Sdr. Tostrup (Sønder Tåstrup), Denmark. Samples: CGG106739; CGG106740. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Sdr. Trander, Aalborg, Denmark. Samples: CGG106040; CGG106041. Key contact: Lars Egholm Nielsen. Institution: North Jutland Museums
Sdr.Tranders, Denmark. Samples: CGG106506; CGG106507; CGG106509. Key contact: Torben Trier Christiansen. Institution: The Historical Museum of Northern Jutland, Aalborg, Denmark
Sejlsbjerg, Denmark. Samples: CGG106820. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Simonsborg, Denmark. Samples: CGG106713; CGG106714; CGG106715; CGG106716; CGG106717; CGG106718; CGG106719; CGG106720; CGG106721; CGG106722; CGG106723; CGG106724; CGG106725; CGG106726; CGG106727; CGG106728; CGG106729; CGG106730; CGG106731; CGG106732; CGG106733. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Skafterup Mark, Denmark. Samples: CGG107501. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Skeie, Klepp, Norway. Samples: CGG107042. Key contact: Sean Dexter Denham; Håkon Reiersen. Institution: Museum of Archaeology, University of Stavanger, Norway
Skeie, Klepp, Norway. Samples: CGG107043. Key contact: Sean Dexter Denham; Håkon Reiersen. Institution: Museum of Archaeology, University of Stavanger, Norway
Skivum VI, Denmark. Samples: CGG106484. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Skjeggesnes, Norway. Samples: CGG105636; CGG105637; CGG105638; CGG105639. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Skole Samling, Denmark. Samples: CGG106485. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Skongeneshelleren, Norway. Samples: CGG107004; CGG107005; CGG107006; CGG107007; CGG107008; CGG107009. Key contact: Zanette Tsigaridas Glørstad. Institution: Museum of Cultural History, University of Oslo, Norway
Skovgårde, Denmark. Samples: CGG106797; CGG106798; CGG106801; CGG106802. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark; Museum Southeast Denmark
Skregeskov, Denmark. Samples: CGG106806. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Skyttemarksvej, Denmark. Samples: CGG107409. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Sludegaard Sømose, Denmark. Samples: CGG105358. Key contact: Jesper Hansen. Institution: Svendborg Museum, Denmark
Slusegård, Denmark_Baltic. Samples: CGG106747; CGG106748; CGG106749; CGG106750; CGG106751; CGG106752. Key contact: Laurine Albris; Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: National Museum of Denmark, Prehistory, Middle Ages and Renaissance; Laboratory of Biological; Department of Forensic Medicine, University of Copenhagen, Denmark Anthropology, Globe Institute, University of Copenhagen, Denmark;
Smidie, Denmark. Samples: CGG106817. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
SOEL 964 Engbjerg, Denmark. Samples: CGG019088; CGG019090; CGG019091. Key contact: Niels Lynnerup; Linda Boye. Institution: Department of Forensic Medicine, University of Copenhagen, Denmark; Kroppedal Museum, Taastrup, Denmark
Solsem, Norway. Samples: CGG105642. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Sønderup XI, Denmark. Samples: CGG106496. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Sondrup Østergaard, Ulstrup sogn, Denmark. Samples: CGG106488; CGG106489. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Sörby Störlinge, Sweden_Baltic. Samples: CGG024145. Key contact: Helene Wilhelmson. Institution: Lund University, Sweden
Sørup Sø (Sørup Mose), Denmark. Samples: CGG106741. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution:

Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Sperrestrup, Denmark. Samples: CGG107410. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Stålmosegård, Denmark. Samples: CGG106516; CGG106517; CGG106518; CGG106519. Key contact: Ole Thirup Kastholm; Mette Høj. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Stenlille, Denmark. Samples: CGG107502. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Stenum, Denmark. Samples: CGG106522. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Stistrup kær VII, Denmark. Samples: CGG106494. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Store Grandløse, Denmark. Samples: CGG107503. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Storfosen, Ørland M, Norway. Samples: CGG107038. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Strandby, Denmark. Samples: CGG106531. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Strandlunden II Gerlev MFG 191/02, Denmark. Samples: CGG106515. Key contact: Jens Winther Johannsen. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Stubberup, Oue sogn, Denmark. Samples: CGG106490. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Sund, Norway. Samples: CGG105604; CGG105605; CGG105606; CGG105608; CGG105609; CGG105610; CGG105612; CGG105614; CGG105615; CGG105617; CGG105622; CGG105623; CGG105626; CGG105628; CGG105629; CGG105631; CGG105632. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Suvlu-Khaye, Crimea. Samples: CGG017681; CGG017682; CGG017683. Key contact: Vyacheslav Moiseyev. Institution: Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya Nab. 3, St. Petersburg, Russia
Tanderup, Denmark. Samples: CGG107525. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Toksværd By, Denmark. Samples: CGG107504. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Toldnes, Norway. Samples: CGG105600; CGG105601; CGG105602; CGG105603. Key contact: Birgitte Skar. Institution: Institute of archaeology and cultural history, NTNU University Museum, Norway.
Tollestrup Mose, Denmark. Samples: CGG023270. Key contact: Anders Fischer; Niels Lynnerup. Institution: Sealand Archaeology, Kalundborg, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Tollestrup Mose, Denmark. Samples: CGG106527. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Tollestrup Mose; Kvinden, Denmark. Samples: CGG106528. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Tomeide, Nesna M, Norway. Samples: CGG107021; CGG107022; CGG107023. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Trekroner-Grydehøj, Denmark. Samples: CGG106841. Key contact: Ole Thirup Kastholm. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Trelleborg, Denmark. Samples: CGG107581; CGG107582; CGG107583. Key contact: Anne Christine Larsen. Institution: National Museum of Denmark, Trelleborg, Denmark
Trelleborg, Denmark. Samples: CGG106823; CGG106824; CGG106832; CGG106833. Key contact: Marie-Louise Schjellerup Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Trundholm Mose, Denmark. Samples: CGG106734. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Tumulus de La Forêt de Châtillon, France. Samples: CGG023644. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Tværvejen etape III, Asperup sogn sb nr 56, Båg Herred, Odense Amt, Denmark. Samples: CGG100143. Key contact: Sophie Bergerbrant. Institution: Department of Archaeology and Ancient History, Campus Gotland, Uppsala University, Sweden
Tveje Merløse, Denmark. Samples: CGG107431. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Tybjerg Mose, Denmark. Samples: CGG107512. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Tyrifjorden, Box 1, Norway. Samples: CGG107002. Key contact: Zanette Tsigaridas Glørstad. Institution: Museum of Cultural History, University of Oslo, Norway
Tyrifjorden, Box 4, Norway. Samples: CGG107003. Key contact: Zanette Tsigaridas Glørstad. Institution: Museum of Cultural History, University of Oslo, Norway
Ubby, Denmark. Samples: CGG107505. Key contact: Marie Louise S. Jørkov. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark
Uglemose, Denmark. Samples: CGG106712. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Værebro Å, Snydebro, Denmark. Samples: CGG105362; CGG105364. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Værløse (Alugod), Denmark. Samples: CGG105397. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Vaineikiai, Lithuania. Samples: CGG017687. Key contact: Inga Mekyte, Rimantas Jankauskas. Institution: Saxo-Instituttet, Copenhagen; Vilnius University, Lithuania
Valkenburg Marktveld, Netherlands. Samples: CGG107735; CGG107736; CGG107738; CGG107739; CGG107741; CGG107742; CGG107744; CGG107745; CGG107746; CGG107747; CGG107748; CGG107749; CGG107750; CGG107751; CGG107752; CGG107753; CGG107754; CGG107755; CGG107756; CGG107757; CGG107758; CGG107759; CGG107760; CGG107761; CGG107762; CGG107763;

CGG107764; CGG107765; CGG107766; CGG107767; CGG107768. Key contact: Lisette Kootker; Maura De Coster. Institution: Geology & Geochemistry cluster, Department of Earth Sciences, Vrije Universiteit Amsterdam, The Netherlands
Valstad, Verdal M, Norway. Samples: CGG107031. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Varpelev, Denmark. Samples: CGG107411; CGG107412. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Varpelev Vest, Denmark. Samples: CGG107413. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Vemmetofte Skovridergård, Denmark. Samples: CGG107414. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Vendsyssel, Denmark. Samples: CGG106523. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Vendsyssel (Holger Friis kaelder), Denmark. Samples: CGG023272. Key contact: Anders Fischer; Niels Lynnerup. Institution: Sealand Archaeology, Kalundborg, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Vendsyssel Svennum, Denmark. Samples: CGG016034. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Verket, Norway. Samples: CGG105650. Key contact: Anne Lene Melheim. Institution: Museum of Cultural History, University of Oslo
Vester Egesborg, Denmark. Samples: CGG107506; CGG107507. Key contact: Marie Louise S. Jørkov; Jens Ulriksen. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Museum Southeast Denmark
Vester Klodske, Denmark. Samples: CGG106803. Key contact: Marie Louise Schjellerup Jørkov; Niels Lynnerup. Institution: Laboratory of Biological Anthropology, Globe Institute, University of Copenhagen, Denmark; Department of Forensic Medicine, University of Copenhagen, Denmark
Vibsig Mose, Denmark. Samples: CGG106535. Key contact: Sidsel Wåhlin. Institution: Vesthimmerlands Museum, Denmark
Vigsnaes, Denmark. Samples: CGG017610. Key contact: Anders; Pia Bennike. Institution: Sealand Archaeology, Kalundborg, Denmark
Vik, Klepp, Norway. Samples: CGG107039; CGG107040; CGG107041. Key contact: Sean Dexter Denham; Håkon Reiersen. Institution: Museum of Archaeology, University of Stavanger, Norway
Vik, Orlandet M, T28126: 11, Norway. Samples: CGG107025. Key contact: Torkel Johansen. Institution: Department of Archaeology and Cultural History, NTNU University Museum, Norway
Vilsted Sogn IX, Denmark. Samples: CGG106495. Key contact: Bjarne Henning Nielsen. Institution: Vesthimmerlands Museum, Denmark
Vindinge Vest I&II, Denmark. Samples: CGG105313; CGG105316; CGG105317; CGG105318; CGG105319. Key contact: Ole Thirup Kastholm; Nadja Mortensen. Institution: The Museum Organisation ROMU, Roskilde Museum, Denmark
Vix les Locheres, France. Samples: CGG023634. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Vix Les Mousselots, France. Samples: CGG023310. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Vix Les Tillies, France. Samples: CGG023626; CGG023627; CGG023628. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Vix mont Saint Marcel, France. Samples: CGG023630. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Vix tumulus 3, France. Samples: CGG023635. Key contact: Bruno Chaume. Institution: UMR6298, ARTEHIS, CNRS (Centre National de la Recherche Scientifique), Dijon, France
Ytre Kvaroy, Lurøy, Norway. Samples: CGG107016. Key contact: Roger Jørgensen. Institution: Arctic University of Norway, University of Tromsø, Norway
Zaboryinsky, Russia. Samples: CGG021458. Key contact: Vyacheslav Moiseyev. Institution: Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya Nab. 3, St. Petersburg, Russia
Zaragizh, Russia. Samples: CGG021996; CGG022000; CGG022002; CGG022003; CGG022004; CGG022005. Key contact: Ruslan Khaskhanov. Institution: Complex Research Institute of the Russian Academy of Sciences, Grozny, Russia

Specimen deposition

All specimens studied are available upon direct contact/request to the archaeologists, curators or officials responsible for their curation at the organisation where they are held.

Dating methods

236 novel radiocarbon dates were generated at the 14CHRONO laboratory, Queen's University Belfast 52 samples), and at the Keck-CCAMS Group, Irvine, California, USA (184 samples).

☒ Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.

Ethics oversight

No ethical oversight was required - all specimens were sampled following protocols designed to minimise invasive impact of sampling, with the full agreement of curators or archaeologists responsible for collections where specimens are held. Our use of shotgun whole genome data also reduces the need to resequence samples in the future (in contrast to targeting specific loci).

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Plants

Seed stocks	*Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.*
Novel plant genotypes	*Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.*
Authentication	*Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosiacism, off-target gene editing) were examined.*