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Research Article

Building tombs and entombing the dead as technologies of descent and affinity in Neolithic northern Scotland

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When grounded within relevant archaeological contexts, ancient DNA analysis can provide critical insights into prehistoric human populations. This is demonstrated in this article, where the authors examine the genetic relatedness of individuals whose remains were placed in five Neolithic tombs in Caithness and Orkney, northern Scotland. The results reveal a web of biological ties that, the authors argue, suggests sustained contact between these communities beyond the onset of the Neolithic and shared understandings of kinship, including descent and a sense of affinity, but emerging local differences in how kinship was materialised through monumental architecture.

Keywords: Caithness, Orkney, Neolithic, ancient DNA, kinship, chambered tombs

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Introduction

Early Neolithic (*c.* 3800–3200 cal BC) tombs are widespread across northern Scotland, including Caithness and the Orkney Islands, but our understanding of these monuments, and the people buried within them, is limited by sparse radiocarbon sequences and the fragmented and commingled nature of the osteological assemblages. Identifying the number of individuals of each sex can be difficult, constraining our ability to draw inferences about key aspects of society such as gender and kinship. Now, the application of ancient DNA (aDNA) analysis in combination with osteological and archaeological contextual and architectural analyses affords the opportunity to radically improve our understanding of Neolithic social relationships (e.g. Fowler 2022; Fowler *et al.* 2022; Cummings & Fowler 2023; Carlin *et al.* 2025). This study presents the analysis of 40 new aDNA samples from 22 individuals whose remains were placed in five chambered tombs in Caithness and Orkney (seven of whom match individuals identified in a previous study; Olalde *et al.* 2018), allowing the examination of genetic relatedness in multiple contemporary Neolithic sites spread across nearby islands. Some Neolithic tombs in Europe contained the remains of close genetic relatives (e.g. Fowler *et al.* 2022; Seersholm *et al.* 2024), while others perhaps did not (Carlin *et al.* 2025), raising the question of how much the construction and use of tombs supported varied kinship practices. Here, we address this question for five tombs with similar architectural features, including three with chambers subdivided by slabs ('stalled cairns'). Three tombs are in close proximity around Loch Calder in the north-eastern tip of the Scottish mainland (Tulloch of Assery A and B, and Tulach an t-Sionnaich), a fourth (Rattar East) is on the coast looking out over the Pentland Firth (Figure 1) towards Orkney, where the fifth tomb (Holm of Papa Westray North) was built (Figure 2).

Although it was only possible to obtain aDNA sequences suitable for analysis from a subset of the osteological minimum number of individuals (MNI) in each tomb, this was sufficient for the determination of multiple genetic relatives. Rattar East contained the remains of two brothers, while a father-son pair and a maternal uncle or half-brother to the father were found in the tomb at Holm of Papa Westray North. The remains of three males in a father-son-grandson genetic relationship were placed next to one another at Tulloch of Assery A, while a fourth male who was either an uncle, half-brother or grandfather to the first of these males was entombed at Tulach an t-Sionnaich. One female fourth-degree relative of this latter male was entombed at the Holm of Papa Westray North, while another fourth-degree relative of this same male was entombed at Tulloch of Assery B. Two of the females entombed at Holm of Papa Westray North were fourth-degree or fourth-to-fifth degree genetic relatives of the male at Tulach an t-Sionnaich, suggesting their genetic ancestry connected both of those males. Thus, these two females were genetically related within five degrees to males from groups who used the tombs at Loch Calder, while not being related (closer than the sixth-to-seventh degree) to any of the three closely related males at Holm of Papa Westray North.

Both the similarities in architecture observed across the tombs and the biological relationships identified through aDNA demonstrate a web of connections among the

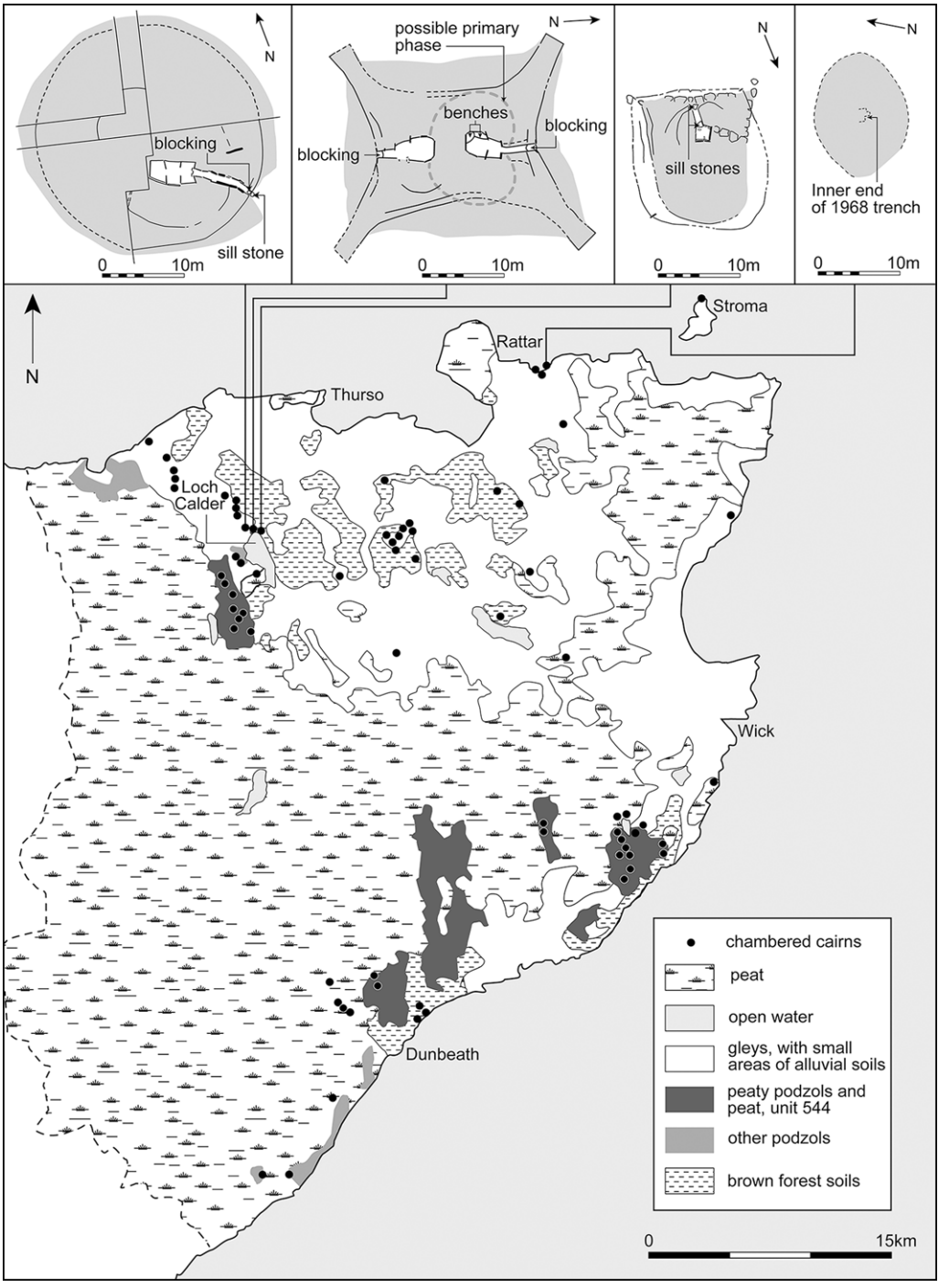

Figure 1. The distribution of chambered tombs in Caithness, with plans of the sites included in this study inset. From left to right: Tulloch of Assery B, Tulloch of Assery A, Tulach an t-Sionnaich and Rattar East (figure by Kirsty Harding, after Davidson & Henshall 1991; various illustrations).

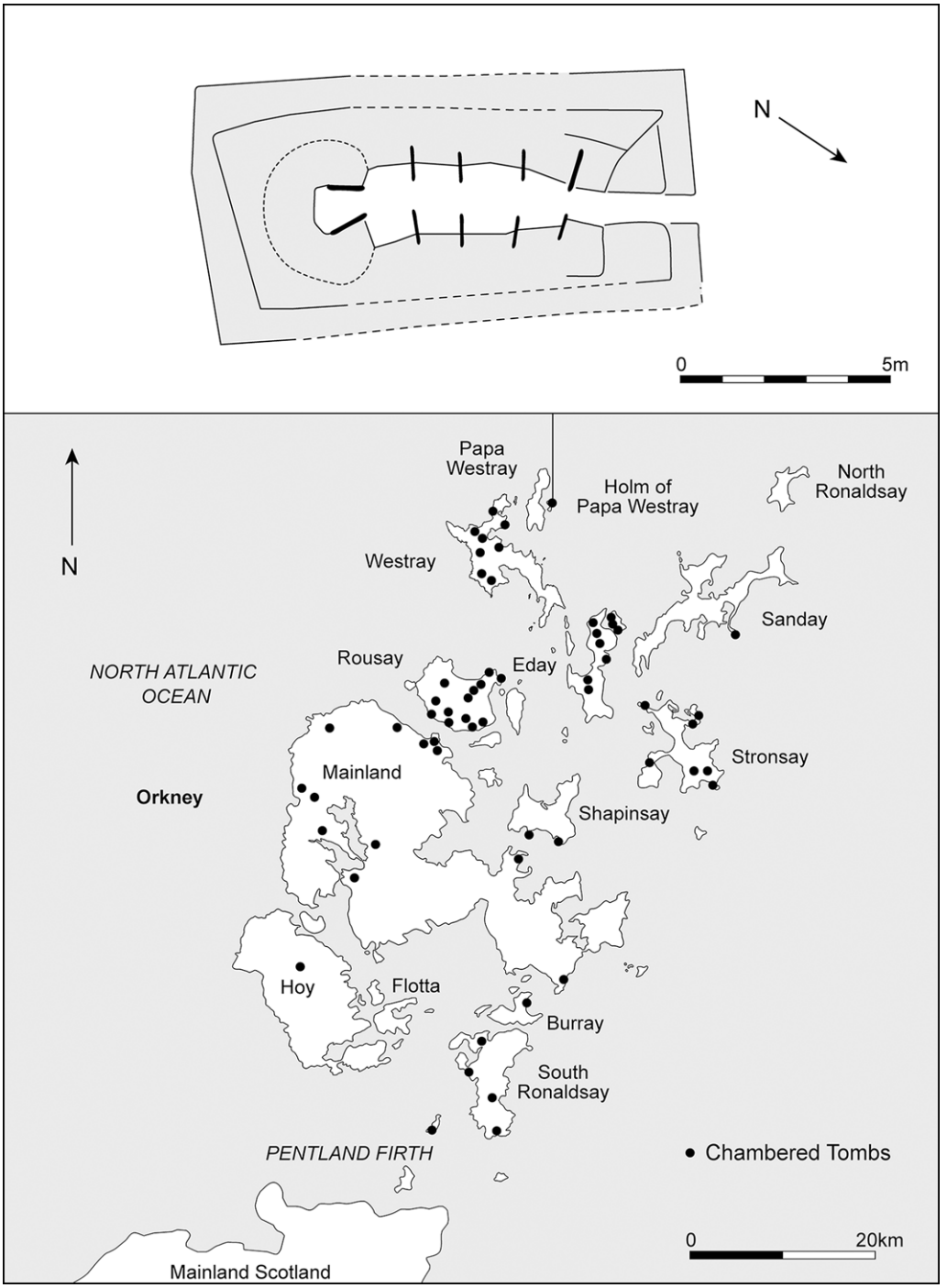

Figure 2. The distribution of chambered tombs in Orkney, with the plan of Holm of Papa Westray North (figure by Kirsty Harding, after Davidson & Henshall 1989; various illustrations).

entombed individuals, suggesting they were members of a small interwoven community sharing both architectural and mortuary practices. In this article we consider what inferences we can draw about kinship based on these results and suggest that affinity with previous tomb-builders in the region was signalled each time a new tomb was constructed—or modified—in the style of the existing tombs. We infer that attitudes towards tracing descent and affinity through these practices continued well into the latter part of the fourth millennium BC, but that local differences in the positioning of tombs and the selection of the dead for interment emerged in Orkney ahead of a major divergence in settlement and monumentality in the Late Neolithic (*c.* 3200–2400 cal BC).

Building tombs: interpreting form

In northern Scotland, chambered tombs were first constructed in the Early Neolithic and can be considered part of the stalled cairn tradition (Davidson & Henshall 1989, 1991). These monuments comprise a chamber, which was constructed using drystone walling, set within an encircling cairn. A series of upright stones, set at 90 degrees to the principal orientation of the chamber, protrude into the chamber area to create 'stalls' (see Figures 1 & 2). The number of stalls within each cairn varies from those with just two, such as the northern chamber at Tulloch of Assery A, to those such as Midhowe on Rousay, which has 13 stalls. At both of these sites, human remains had been placed on a series of horizontal stone slabs (benches) positioned between the stalls (Callander & Grant 1934; Corcoran 1967).

Some stalled cairns were constructed in multiple phases. At Holm of Papa Westray North, for example, the site began life as a small, single box-like chamber set within a small round cairn. At a later date this monument was extended into a four-stalled cairn (Ritchie 2009). A multiphase sequence of construction and alteration was also identified at Point of Cott and suggested for Tresness, both on Orkney, where the size and shape of the cairn were repeatedly modified (Barber 1997; Anderson-Whymark & Cummings 2021), as well as other stalled cairns (Lawlor 2024), although this was clearly not the case at all sites. There is also evidence that some sites saw extended periods of use. From the differences in chamber form it is possible to argue that the northern chamber at Tulloch of Assery A was constructed earlier than the southern chamber, while excavations at Tulach an t-Sionnaich reveal a composite, multiphase site (Corcoran 1967).

Earlier typological approaches proposed that stalled cairns were broadly Early Neolithic in date, with the smaller examples generally considered earlier than the larger examples. Broad similarities in form were argued to be indicative of wider shared practices among the earliest farmers (Davidson & Henshall 1989, 1991), who arrived in northern Scotland as the Neolithic spread to the northern extremes of Britain (Corcoran 1967; Piggott 1954). However, more recent modelling of radiocarbon dates indicates that the stalled cairn tradition was long lived. While the chronology of contemporaneous houses found in Orkney is both detailed and precise (Richards & Jones 2015), the chronology of the chambered tomb sequence of northern Scotland has remained poorly defined and reliant on single dates from most sites (Griffiths 2015; Bayliss *et al.* 2017).

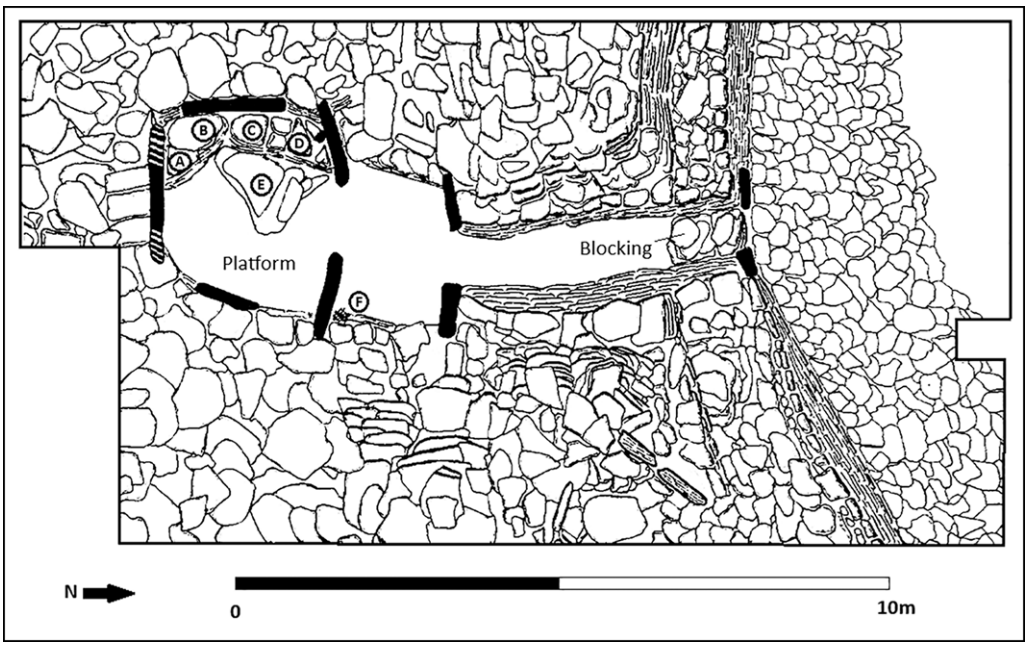

Figure 3. Plan of the north chamber of Tulloch of Assery A showing the location of bone groups A–F (figure by authors, after Corcoran 1967: fig. 9).

The deposits of human remains

Excavations at each of the five sites recovered low numbers of individuals, providing a total MNI of 37. The distribution and fragmentary nature of the bone deposits suggest that many of the skeletal remains had been manipulated prior to the final formation of the deposits, and in some cases bones may have been selected for deposition following bodily decay elsewhere. The remains were re-assessed by Sarah Cuthbert (see online supplementary material (OSM) Appendix 1).

No human remains were found in the south chamber of Tulloch of Assery A, which seems to have been repurposed for occupation in the nineteenth century AD. The osteological MNI from the north chamber is six, three of which are subadults (aged 5–7, 10–11 & 14–16 years). Remains were spread across six bone groups (A–F, Figure 3). Corcoran (1967: 31–33) interpreted bone groups A and B as disarticulated remains placed after the flesh had decayed (he suggests cut-marks on bones from group F, which Cuthbert identifies as root etching). Corcoran described deposits A, C, D and E as each likely a single individual, and groups B and F as consisting of at least two individuals. However, bones from both the 5–7-year-old and the 14–16-year-old have been coded with a 'D', indicating they were recovered from bone group D, and some bones from the 14–16-year-old are coded E, suggesting further commingling of the deposits. Samples for aDNA analysis on the three adults (all males) were taken from bone groups D (I36006) and B (I36007), from the stone stack bench in the western alcove, and

from group E (I2635), which was positioned semi-articulated on sloping flagstones in front of the bench (Figure 3). Bone group B was coated in clay (Corcoran 1967: 32), suggesting the handling and preparation of disarticulated remains prior to placement on the stone benches. The surfaces of many of the bones, including cranial elements, are heavily eroded (see OSM Appendix 1), possibly supporting Corcoran's view that the bones had been moved following decay elsewhere. No artefacts were recovered from the chamber.

Secondary deposition was also suggested for the disarticulated remains from Tulloch of Assery B (Corcoran 1967: 42). It is also possible, however, that the remains derive from bodies that decayed in the chamber and the bones were later largely removed; Cuthbert identifies very little erosion to the bone surfaces. At least four individuals are represented—two adults (the larger of which had a leaf-shaped arrowhead embedded in a lower thoracic vertebra; Corcoran 1967: 63), one neonate and one 14–16 year old—though genetic analysis detected five (three males, including the 14–16 year old, and two females). Although the bones are described as 'heaped together' the later date of one of the individuals suggests that this final configuration was not produced in the Early Neolithic. Some bones were burnt but seem to have been dry at the time of their burning.

At Tulach an t-Sionnaich, Corcoran (1967: 7) again inferred that the fragmented human remains in the single chamber had been collected from elsewhere, though it is possible that later disturbance was at least partly responsible for the fragmentation and commingling. The human remains were intermixed with limpet shells and animal bone and were sandwiched between a layer of stones and a layer of faunal remains, including cattle, deer, bird, fish and mollusc. The remains of two dogs (almost certainly later additions), as well as flint, pitchstone and a sherd of pottery, were also recovered from the chamber. Cuthbert (Appendix 1) reports extensive post-mortem fracturing of the human bones (98%) but was able to identify at least seven individuals: three adults (at least one female), a child, an infant and a neonate (the latter with high bone porosity consistent with scurvy). A single adult male is included in the aDNA analysis (I2634).

Records of the 1960s excavations into the cairn at Rattar East are limited and osteological analysis is similarly constrained as only six crania have been retained, with all other remains reburied at the site "without examination" (Davidson & Henshall 1991: 166). Five of the crania are from adults, one is from a child. DNA was successfully sequenced from the five adults, three of which are male and two female.

The human remains from the Holm of Papa Westray North are also disarticulated and partial, and many may have been moved from their original point of deposition within the tomb. As Ritchie (2009: 30) argues, since "all parts of the body were represented ... there is no need to invoke excarnation to explain what is missing". Cuthbert identifies at least 14 individuals, consisting of eight adults, two juveniles (17–20 and approximately 17 years), and four children (aged approximately 10, six–seven, four and below three years). Only compartments 3–5 yielded "any quantity of undisturbed bone" in 1981–1982 (Harman 2009: 43–44), possibly due to earlier excavations in the nineteenth century (Petrie 1856). The aDNA results derive from the eight adults.

Genetic relatedness

The genetic analysis covers a smaller number of individuals than the osteological MNI (22 compared with 37: see OSM Appendix 3), and in most cases more than one of the bones or teeth sampled derived from the same individual. We identified nine pairs of close genetic relatives (third-degree or closer), all between males. Two of these pairings featured individuals from different tombs: male I2634 from Tulach an t-Sionnaich and I36007 (second degree) and I36006 (third degree) from Tulloch of Assery A (with the latter two also first-degree relatives). Shared identity by descent (IBD) calling allowed us to further detect approximately 100 more distant relative pairs, including 11 pairs sharing more than 200cM (centimorgans) of DNA in IBD segments longer than 12cM, which very likely represent fourth- or fifth-degree relatives (Figure 4, Table S3).

We identified two main Y-chromosome haplogroup lineages: I2a-CTS10057 (I2a1b1a2) and I2a-L161 (I2a1a2). Both were present at Holm of Papa Westray North and Rattar East, while Tulach an t-Sionnach and Tulloch of Assery A only feature males with the I2a-L161 haplogroup. The only male from another haplogroup was I36224 from Tulloch of Assery B, who belonged to R1b-M269, suggesting the presence of steppe-related ancestry in this second-millennium BC individual (cf. Olalde *et al.* 2018). Mitochondrial variability was high, with 19 different lineages in 22 individuals. Three groups of individuals share the same mitochondrial haplotypes, implying a relatively recent common matrilineal ancestor: I35761-I36003, a pair of second-degree relatives from Holm of Papa Westray North; I36004-I36006-I36019-I36022 from three different tombs (I36019 and I36022 are first-degree relatives and I36004-I36019 are distant relatives); and I2633-I36028, a pair of approximate sixth-degree relatives from Tulloch of Assery B.

Genetic ancestry analysis

Most of the 22 individuals plot within the genetic diversity of previously published Neolithic populations from Great Britain (Figure 5), with 20–25% of ancestry deriving from pre-Neolithic European hunter-gatherers (WHG) and 75–80% of ancestry deriving from early European farmers (Table S2). None display the high hunter-gatherer admixture levels observed in a subset of Neolithic individuals from western Scotland (Patterson *et al.* 2021). Four individuals plot outside the main cluster of Neolithic individuals from Scotland in principal components analysis. The position of I36022 is likely due to low quality data since I36019 (his brother) plots within the cluster. Individuals I36224, I36225 and I36227 from Tulloch of Assery B are shifted towards higher values in principal component 2 (PC2) and plot close to post-Neolithic populations from Britain. Modelling the ancestry of these three individuals as a mixture of western hunter-gatherers and early European farmers results in a poor fit. The model is significantly improved by adding 55–72% of Corded Ware-related ancestry as a source of steppe-related influence. These observations, together with the presence of the R1b-M269 Y-chromosome lineage and Bronze Age date for I36224 (Figure 4), indicates a post-Neolithic chronology for these individuals.

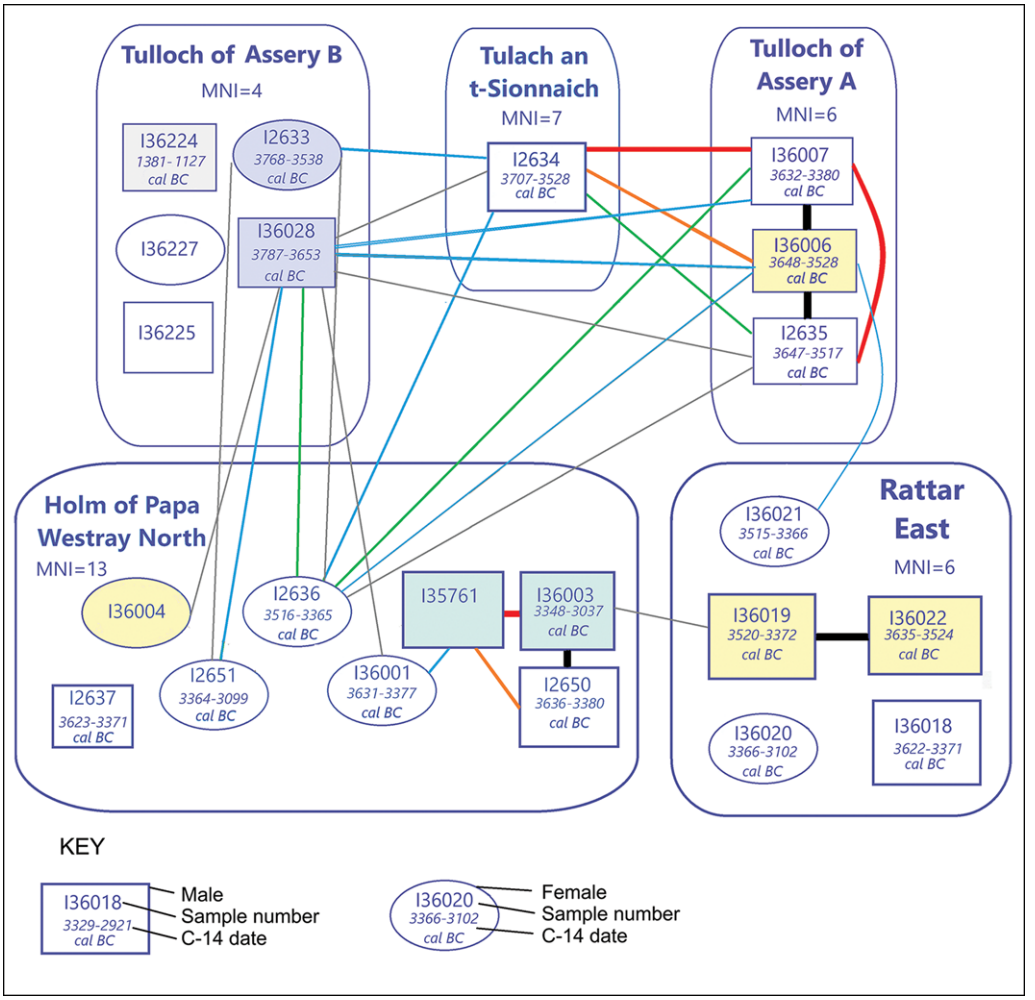

Figure 4. Visualisation of genetic relatedness and chronological relationships between the individuals included in this study. Lines between individuals relate to degree of relatedness: black = first-degree; red = second-degree; orange = third-degree; green = fourth-degree; blue = approximate fourth–fifth degree; grey = approximate fifth-degree. Relatedness beyond the fifth degree is not shown here. MNI is from the osteological analysis (figure by authors).

A chronology for tomb use

If we accept that a phase of tomb construction took place during the lifetime of the earliest individuals deposited in each of these chambers, then Tulach an t-Sionnaich was likely constructed between 3703 and 3534 cal BC, the northern chamber of Tulloch of Assery A between 3648 and 3528 cal BC, Rattar East in the decades surrounding 3520 cal BC (based on the gap in date ranges of the two brothers), and Tulloch of Assery B is likely to have been constructed between 3787 and 3653 cal BC (Table S1). However, each tomb could pre-date these individuals. If I2651 (Holm of Papa Westray North)

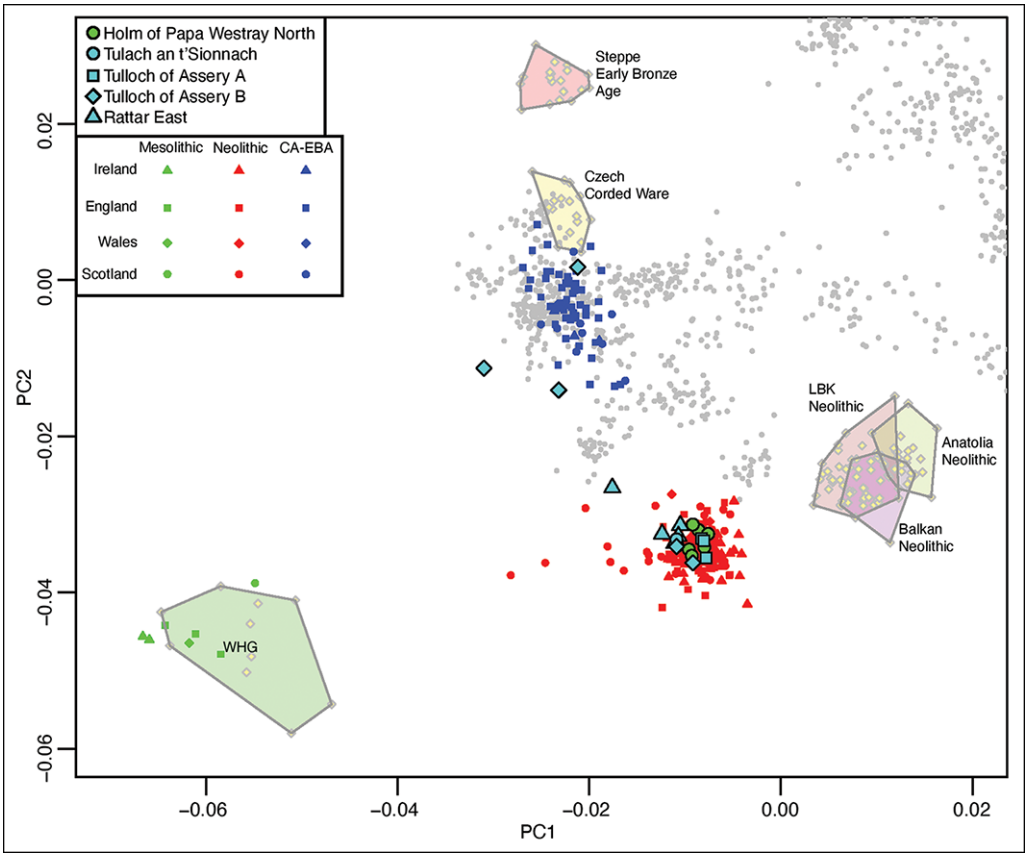

Figure 5. Plot of the genetic diversity of previously published Neolithic populations from Great Britain in comparison to other Neolithic sequences and in relation to the samples reported here (figure by authors).

was the great-great-great granddaughter of I36028 (Tulloch of Assery B), this would pull I36028 towards the end of his date range (3653 BC) and push I2651 towards the start of hers (3360 BC), leaving 293 years between their deaths (Figure 4). This temporal distance seems improbable for such a relationship, however, potentially raising a question about the date of I2651 (particularly given that I36028 is also a fourth-degree relative to I2636 at Holm of Papa Westray and the dates of both individuals are consistent with that). There is a small probability that the date range for I2651 is as early as 3480 cal BC (unlikely), or that these individuals were connected by two different sixth-degree relations, each sharing approximately 150cM of DNA (highly unlikely). The main phase of Holm of Papa Westray North is probably later, with the earliest dates running from 3631–3377 and 3629–3370 cal BC, and the combination of dates for father-son pair I36003-I2650 suggesting they were entombed in the mid-3300s (perhaps *c.* 3380s for the son and *c.* 3340s for the father). The primary small, single-chamber phase at Holm of Papa Westray North is likely to pre-date the deposition of some or all of the dated individuals, although by how much we cannot ascertain due to later disturbance (Ritchie

2009). Fragments of Beaker pottery at Tulach an t-Sionnaich and a Middle Bronze Age date from I36224 at Tulloch of Assery B indicate later phases of deposition.

Inferences about kinship

Kinship is a complex and multidimensional social phenomenon that cannot be reduced to the study of descent (Brück 2021; Ensor 2021; Fowler 2022). Mortuary practices have many purposes and effects but form one of the arenas through which kinship is articulated (Fowler 2022). The evidence outlined above resulted from Neolithic mortuary practices in built architecture, including decisions over whose remains to place where and with whom. We have noted the inclusion of close male genetic relatives at Tulloch of Assery A and Tulach an t-Sionnaich; these individuals, and others in the community may have been connected by patrilineal descent. This need not mean that patrilineal descent was the only important aspect of kinship, nor that it structured all dimensions of life: for instance, lineages need not be linked to specific territories (cf. Kuper 1982), and identification of lineal descent does not reveal which members of the community played what roles in parenting (cf. Fowler 2025). Relationships drawn to the fore during these mortuary practices may have selectively focused on single lines of descent within a more complex system of lateral relationships that shaped everyday life. Thus, where patrilineal descent connected those within a Neolithic tomb, it likely formed one strand in a broader fabric of kinship—at Hazleton North, for example, this fabric could have initially involved a bilateral or cognatic descent system (cf. Whittle 2024)—although ultimately there was clearly a 'patrilineal bias' within that system in which males were preferentially buried in the tomb of close male relatives (Fowler 2022: 72). This makes it difficult to identify distinct kinds of kinship system, and many anthropologists have argued that kinship is always more fluid and contingent than models of such systems allow. We therefore resist drawing conclusions about kinship *systems*, instead reporting on specific *practices* that are visible through trends in the evidence. At Hazleton North this approach enabled the identification of: patrilineal descent with sub-lineages stemming from four female ancestors in the first/second generation; the presence of elective kin; and the decline in frequency of half-siblings from multiple reproductive partnerships during the third to fourth generations (Fowler *et al.* 2022; Cummings & Fowler 2023). Kinship-related mortuary practices there were contingent and dynamic, but patterns were nonetheless evident.

Close genetic relatives can be identified across four of the tombs in this study and application of a similar approach to kinship here permits inference of some recurring kinship practices: fathers and sons were placed together in two tombs, and brothers at Rattar East, while half-brothers or a paternal uncle and nephew were placed in two neighbouring tombs around Loch Calder. While the second-degree relationship between I35761 and I36003 was maternal, and I2633 and I36028 likely shared a maternal ancestor a few generations back, mothers and daughters do not seem to have been entombed together, nor were sisters. Yet two women at Holm of Papa Westray North—I2636 and I2651—had a closer male relative at one of the Loch Calder tombs than any of the males at Holm of Papa Westray North. The bone groups at Tulloch of Assery A,

the only deposit that seems undisturbed since the Early Neolithic, provides the only evidence for a father-son-grandson connection, consistent with tracing patrilineal descent. These remains had been gathered together on stone benches, despite having presumably entered the tomb at different times, suggesting their relatedness was remembered through that process of physical transformation. Given the heavily fragmented nature of the remains, the disturbed or only partially excavated state of some tombs, the presence of post-Neolithic insertions and the smaller size of the genetic sample compared with the osteological MNI, it seems likely that these genetic relationships are surviving fragments from among a denser web of Neolithic people connected by lineal descent. While the fragmentary nature of the evidence means we cannot exclude the possibility that bilateral or cognatic descent was traced during some mortuary deposition, there is no direct evidence for matrilineal connections: no mother-daughter relationships were detected and the closest genetic relationship between any two women was fifth-degree.

The sequence of radiocarbon dates and the genetic evidence suggest that the male I2634 at Tulach an t-Sionnaich was either the paternal uncle, half-brother or grandfather of male I36007 at Tulloch of Assery A. Perhaps depositional practice at these two tombs acknowledged shared membership of a single patriline (a social group, not all members of which need be close paternal genetic relatives), or two closely related patrilines. It is open to speculation as to whether a different kin group was identified with Tulloch of Assery B, but I2636 was a fourth- or fourth-to-fifth-degree relative to one male from each of the other Loch Calder tombs (I36007, I36028 and I36028). While a father-son pair were entombed at Holm of Papa Westray North, it is not possible to discern whether patrilineal descent was significant here: the only other close relationship at this site is between that father and a maternal second-degree male relative, who may have been his half-brother or uncle. It is possible that depositional tendencies changed over time and/or differed between the Loch Calder area and the Holm of Papa Westray, as no adult females were deposited at Tulloch of Assery A while aDNA is available for an equal number of males and females at Holm of Papa Westray North. Further work is needed on Orcadian tombs from this period to assess whether kinship connections were traced differently here.

Tomb construction and form as technologies of descent and statements of affinity

The evidence for the deposition of close genetic relatives within and across these tombs needs to be set in context alongside the construction and form of the monuments to understand how kinship was materialised in Early Neolithic northern Scotland. Our study shows that a small number of simple chambered tombs were constructed in northern Scotland from as far back as 3650 cal BC, but initial Neolithic occupation of these areas is likely to date to before this period (Whittle *et al.* 2011: 824; but see Bunting *et al.* 2022). This means that the sites in this study were most likely not constructed by the first Neolithic people in the area. Rather, those who built the tombs adapted a historic practice already well-established in other parts of Britain. The three Loch Calder

tombs were seemingly built and used in rapid succession in the 3600s to early 3500s; assuming those buried in them were involved in their construction, this effort included closely related individuals at Tulloch of Assery A and Tulach an t-Sionnaich. The process and media of construction were shared, yet the form of each site is quite different: Tulach an t-Sionnaich is a single, box-like chamber, Tulloch of Assery A has two opposing chambers and Tulloch of Assery B a tripartite chamber. Moreover, these tombs were built in close proximity: the Tullochs of Assery are 30m apart, and Tulach an t-Sionnaich is only 200m away. All are intervisible. This clustering of tombs is replicated across Caithness, including at Rattar (Figure 1). If we understand kinship as a process, the construction and architectural form of each tomb could have been key in materialising that kinship (Crellin 2021; Fowler 2022). Thus, by positioning each tomb close to pre-existing sites *and* interring the remains of close genetic relatives, people in Caithness materialised a web of descent. However, rather than doing so by identically replicating tomb architecture, each community drew affinity with other groups through proximity and mode of architectural construction while also establishing difference through architectural form. This may have signalled the renegotiation of social relations, as argued for sequences elsewhere (see Cummings & Fowler 2023).

In Orkney, descent was perhaps traced differently from in Caithness. Early tombs like the primary single-chambered phase at Holm of Papa Westray North were constructed in places but—unlike in Caithness (as far as we currently know)—these were soon accompanied in the Orcadian landscape by dry-stone walled houses (Richards & Jones 2015). These houses, occurring as isolated constructions, drew on chambered tomb architecture in their materials, construction techniques and form. In Orkney, however, sites were not built near to one another, instead being set away from existing sites; even the dense concentration of stalled cairns on Rousay are not typically intervisible. During the subsequent phase at Holm of Papa Westray North several closely related male individuals—a father and son, and the father's maternal uncle or half-brother—were buried, perhaps indicating the persistent nature of patrilineal descent in the Early Neolithic. Thus, we can suggest that the shared architecture of stalled cairns seemingly constructed for small kin groups in both Caithness and Orkney indicates a shared focus on materialising descent and a shared sense of affinity at the broad scale. However, this was manifested differently, with early tomb aggregation and modification on Caithness compared with dispersed stalled cairn and house location on Orkney. In both areas, dry-stone walled constructions materialised some kin relations, and 'housed' others, but in Caithness this was focused on the places of the dead, while in Orkney spaces for both the living and the dead were built in this way.

Conclusions

Consideration of archaeological and genetic evidence indicates that the builders of at least four different stalled cairns in northern Scotland drew on a shared tradition of tomb construction, and that some of them very likely knew one another. It is possible that people entombed at the Holm of Papa Westray North in the 3300s cal BC traced descent from people entombed at the Loch Calder tombs from the 3600s–3500s cal BC

through oral histories as well as tomb architecture. While stressing that descent is only one dimension of kinship, we interpret the construction and use of these tombs as technologies through which lines of descent were projected into the future and traced from the past, and infer reference to a broad sense of affinity in the shared features of tomb architecture and mortuary practice. The longest lines of direct genetic descent within the tombs connect males, including three to five generations of males across Tulloch of Assery A and Tulach an t-Sionnaich. This suggests that patrilineal descent was traced within funerary practices in Early Neolithic northern Scotland. Female relatives also appear in tombs other than those of their closest male relatives, as is the case for two females buried in Holm of Papa Westray North who are genetically related to individuals from mainland tombs, perhaps playing key roles in forming or maintaining connections across the water. Lines of descent may have been traced through both male and female individuals, potentially in a wider system of cognatic descent, perhaps more so at Holm of Papa Westray North than at the Caithness tombs, though the resolution of our data is not sufficient to tell.

We have argued for a shared sense of community and kinship across northern Scotland in the Early Neolithic where kin group identities were expressed through tomb construction, tomb location and deposition. At the same time, we have noted differences in how local kin groups were situated in relation to one another: in thirty-seventh- to thirty-sixth-century Caithness, additional tombs were built close to existing sites, whereas in thirty-fourth-century Orkney new tombs (and stone-built houses) were constructed away from existing sites, indicating a different approach to connections between kin groups. Thus, from a similar start, and while probably maintaining ongoing connections, within a few centuries Neolithic communities either side of the Pentland Firth had sought out new ways of shaping and expressing kinship through tomb construction, modification and the selective deposition of the dead.

Ethics statement

Open science principles require making all data used to support the conclusions of a study maximally available, and we support these principles here by making fully publicly available not only the digital copies of molecules (the uploaded sequences) but also the molecular copies (the ancient DNA libraries themselves, which constitute molecular data storage). Those researchers who wish to carry out deeper sequencing of libraries published in this study should make a request to corresponding author David Reich and request permission from National Museums Scotland.

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Online supplementary material (OSM)

To view supplementary material for this article, please visit https://doi.org/10.15184/aqy.2026.10291 and select the supplementary materials tab.

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