Antiquity 2026 page 1 of 19
https://doi.org/10.15184/aqy.2026.10353

Research Article

Reconnecting the dead in Iron Age Britain: funerary processing and long-distance connectivity at Loch Borralie, Scotland

Laura Castells Navarro[1], Sebastian Metz[1], Madeleine Bleasdale[1], Jane Evans[2], Michael Legge[1], Lindsey Büster[1], David Reich[3,4,5,6] & Ian Armit[1]

[1] Department of Archaeology, University of York, UK
[2] National Environmental Isotope Facility, British Geological Survey, Keyworth, UK
[3] Department of Genetics, Harvard Medical School, Boston, USA
[4] Department of Human Evolutionary Biology, Harvard University, Cambridge, USA
[5] The Howard Hughes Medical Institute, Harvard Medical School, Boston, USA
[6] Broad Institute of MIT and Harvard, Cambridge, USA
Author for correspondence: Laura Castells Navarro ✉ laura.castellsnavarro@york.ac.uk

Though mortuary practices seem largely archaeologically invisible in Iron Age Britain, the visible dead were subject to diverse treatment. Here, the authors report the results of a multi-strand analysis of two Iron Age skeletons buried in a stone cairn at Loch Borralie, north-west Scotland. Manipulation of one skeleton, including the possible removal of the brain, fashioning of long bones into 'tools' and reassembly for burial, suggests complex mortuary processing, while the east-coast origin of both individuals and their biological ties to Orkney reveal long-distance connections, expanding our understanding of funerary practice, mobility and connectivity in Iron Age Britain.

Keywords: stable isotope analysis, ancient DNA, osteoarchaeology, identity-by-descent, funerary processing, mobility

Received: 30 July 2025; Revised: 25 November 2025; Accepted: 18 January 2026

Introduction

Funerary practice in Iron Age Britain (*c.* 800 BC–AD 43) is difficult to discern archaeologically. With a few notable exceptions, such as the Arras Culture inhumation cemeteries in East Yorkshire (e.g. Halkon 2013; Lamb 2020), cemeteries displaying apparently 'formal' funerary rites appear only towards the end of the period and even then, are geographically restricted (Harding 2016). There are, in contrast, abundant examples of human remains found in contexts that would not traditionally be regarded as funerary, such as house floors, grain pits, middens, settlement boundaries and entranceways. This has led to suggestions that the remains of the dead were particularly potent within Iron Age communities, and highly visible within the world of the living (Armit 2017).

Evidence for the circulation and deposition of human remains is particularly prominent in north-west Scotland, including the Northern and Western Isles, where environmental conditions are often highly conducive to the survival of bone (Armit & Ginn 2007). Here, we see some of the strongest evidence for the postmortem curation and manipulation of human remains, including mummification (Parker Pearson *et al.* 2021) and the modification of bones into tools or decorative objects (Shapland & Armit 2012).

It is within this context that we must consider two individuals buried within a low stone cairn at Loch Borralie, Sutherland, close to the north-west extremity of the Scottish mainland (MacGregor 2003; Figure 1). As part of the European Research Council-funded COMMIOS project, which examines the demography and funerary archaeology of Iron Age Britain (Armit 2022), we conducted osteoarchaeological reanalysis, multi-isotope analysis, ancient DNA (aDNA) analysis and radiocarbon dating of the human remains. This article reports the results of these analyses and considers their significance for wider understandings of funerary practice, mobility and social networks in Iron Age Britain.

The Loch Borralie burial cairn

The Loch Borralie cairn survives as a low, disturbed spread of stones set on a shallow slope on the Durness Peninsula (NGR NC 3790 6761; Canmore ID 184571 at https://canmore.org.uk/), on the exposed north coast of Scotland. Although remote and sparsely populated in modern times, the area has a dense distribution of later prehistoric settlement, including the remains of numerous Bronze and Iron Age (dating to the second and first millennia BC) roundhouses (Reid *et al.* 1968: 28–32). Although the cairn was robbed-out to provide stone for nearby field walls, it might have never been substantial; its surviving maximum measurements of approximately 7m north–south by 3.5m east–west and around 1.2m high may approximate its original extent (MacGregor 2003).

Excavation of part of the cairn was conducted in 2000 in response to the discovery of a human cranium that had eroded out from the feature (MacGregor 2003, Figure 2). The work revealed two inhumations: an adult (Individual 1) and a juvenile (Individual 2, to whom the displaced cranium belonged). Both had been laid in an extended supine

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

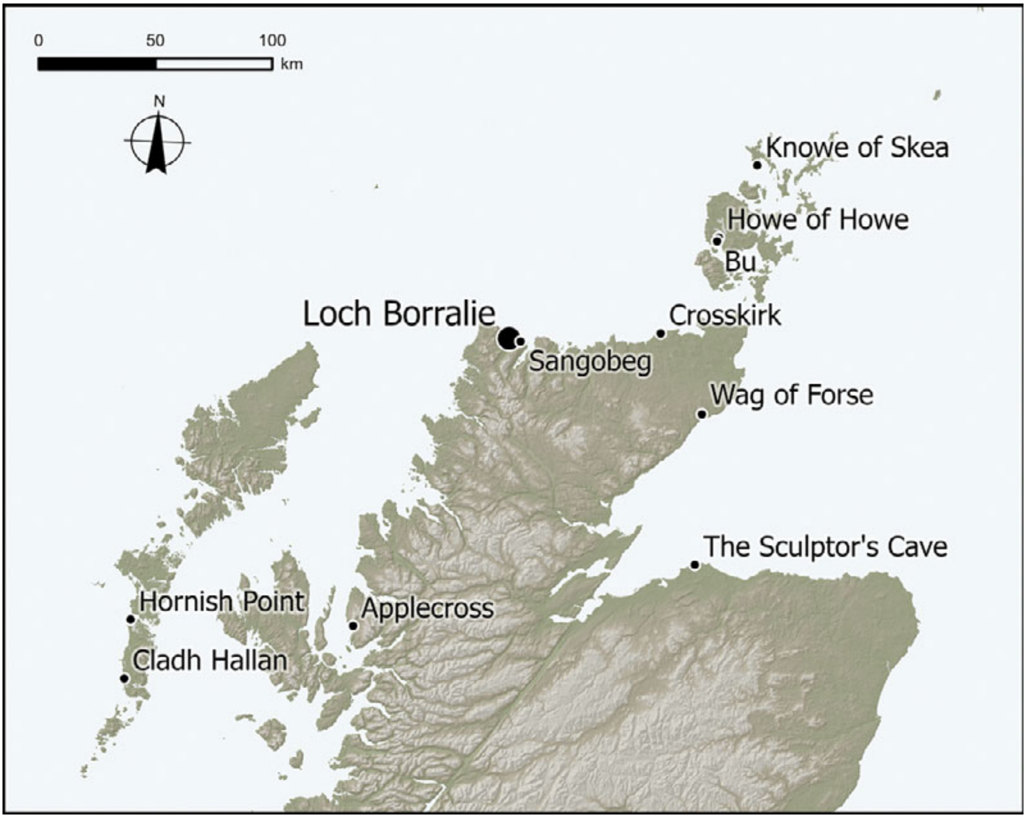

Figure 1. Map showing the location of the Loch Borralie cairn and other Iron Age sites mentioned in the text (map by Helen Goodchild. Produced using Copernicus data and information funded by the European Union - EU-DEM layers).

position with their heads to the east (Figure 3). Individual 1 was associated with a ring-headed pin, broadly dateable to the Iron Age, that may have been used to fasten clothing or a shroud (although it was recovered a short distance from the body), and two pieces of crudely struck quartz. Individual 1 appeared to have been placed on a small, primary mound of stones, while Individual 2 had been buried in a more readily identifiable grave cut that appeared to be stratigraphically slightly later than the interment of Individual 1; both burials pre-date the main body of the cairn (MacGregor 2003: 12).

Chronology

Four radiocarbon determinations have been obtained from the human skeletal remains from the Loch Borralie cairn. An initial determination from the left humerus of Individual 1 (OxA-10253; MacGregor 2003: 11) was withdrawn following the identification of technical issues with the pretreatment of bone samples analysed between 2000 and 2002 at the Oxford Radiocarbon Accelerator Unit (Sheridan & Higham 2006) and replaced with a determination obtained from the left radius of the same individual

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

Figure 2. Excavation photograph of Individual 1 (SC 1061426 © Crown Copyright: HES. Excavation photograph by GUARD).

(OxA-16490; Table 1). More recently, radiocarbon dates for both individuals were obtained from molar teeth (SUERC-111350/1; Table 1). The results form a consistent series, placing the deaths of both individuals within the first centuries BC/AD, most likely between *c.* 50 BC and AD 70, and almost certainly prior to the initial Roman incursions into southern and eastern Scotland that began in AD 79.

Reanalysis

The following presents a summary of the results from the osteoarchaeological, ancient DNA and stable isotope analysis of Individuals 1 and 2. Full analysis and methods are available in the online supplementary material (OSM).

Osteological analysis of Individual 1

Individual 1 is a probable female aged over 30 years at death. Much of the lower part of the skeleton is missing, as is part of the left upper limb (Figure 4). No complete long bones are available for stature estimation. Observable non-metric traits include bilateral supraorbital foramina, bilateral mastoid foramina and complete bridging of the sella turcica of the sphenoid bone. Palaeopathological assessment revealed osteoarthritis of the

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

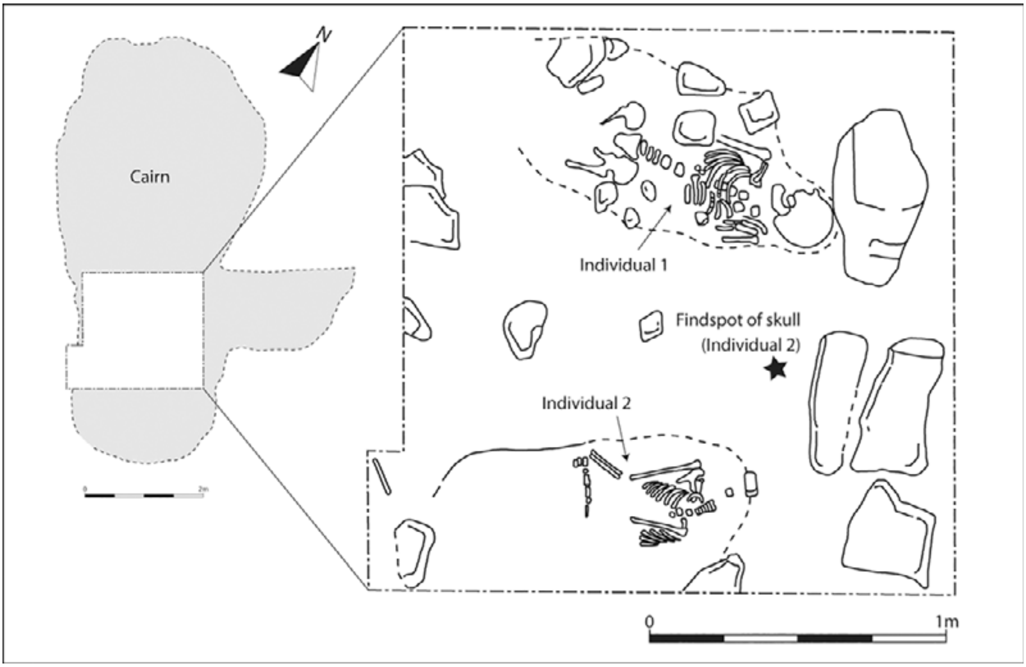

Figure 3. Plan of the original excavations at Loch Borralie (drawn by Lindsey Büster after MacGregor 2003; illustration 4).

cervical vertebrae and a range of traumatic lesions and bone modifications in three main anatomical regions: cranium, scapulae and long bones.

Traumatic lesions

The base of the cranium displays an unusual break where both the condylar and basilar parts of the occipital bone, and a portion of the sphenoid, have become detached (Figure 5a). The characteristics, texture and colour of the break surfaces and the presence of three radiating fractures on the right side of the occipital bone (Figure S2) suggest that the break probably occurred at or around the time of death, when the bone was still wet. Cranial base fractures generally result from high-velocity impacts, which today are associated with motor vehicle collisions, sport accidents, falls or assaults (Bobinski *et al.* 2016). They can also result from long-drop hanging (Waldron 1996) and falls from a significant height, where impact forces are transmitted from the feet or buttocks through the spine to the cranium (Lovell 1997). In all cases, the resultant fractures display relatively consistent patterns (Figure S3), which differ from the pattern observed in Individual 1 suggesting that the fracture resulted from an intentional targeted impact.

Bilateral fractures were identified on both scapulae, at the base of the scapular spine (Figure 5b). The fracture surfaces are smooth and show areas of splintering but as there are no signs of healing, these fractures are classified as perimortem.

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

Table 1. AMS determinations and associated isotope measurements from Loch Borralie. The original, withdrawn date (OxA-10253) is omitted. The radiocarbon ages have been calibrated using the IntCal20 calibration curve (Reimer *et al.* 2020) and OxCal v.4.4 (Bronk Ramsey 2009).

Lab ID	Ind.	Element	$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	$\delta^{34}S$ (‰)	C:N	C:S	N:S	Radiocarbon age (BP)	Calibrated date (68.2% confidence)	Calibrated date (95.4% confidence)
OxA-16490	1	Left radius	−20.0	11.6	/	3.2	/	/	1952±36	cal AD 25–120	40 cal BC–cal AD 203
SUERC-111350	1	Tooth (LRM3)	−20.6	10.7	18.2	3.3	437	131	1997±22	38 cal BC–cal AD 60	45 cal BC–cal AD 106
OxA-16490 and SUERC-111350 combined	1	/	/	/	/	/	/	/	*1985±19*	*28 cal BC–cal AD 65*	*41 cal BC–cal AD 111*
SUERC-111351	2	Tooth (LLM2)	−20.8	11.3	17.9	3.2	466	147	2013±26	44 cal BC–cal AD 25	89 cal BC–cal AD 77

LRM3: lower right third molar; LLM2: lower left second molar.

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

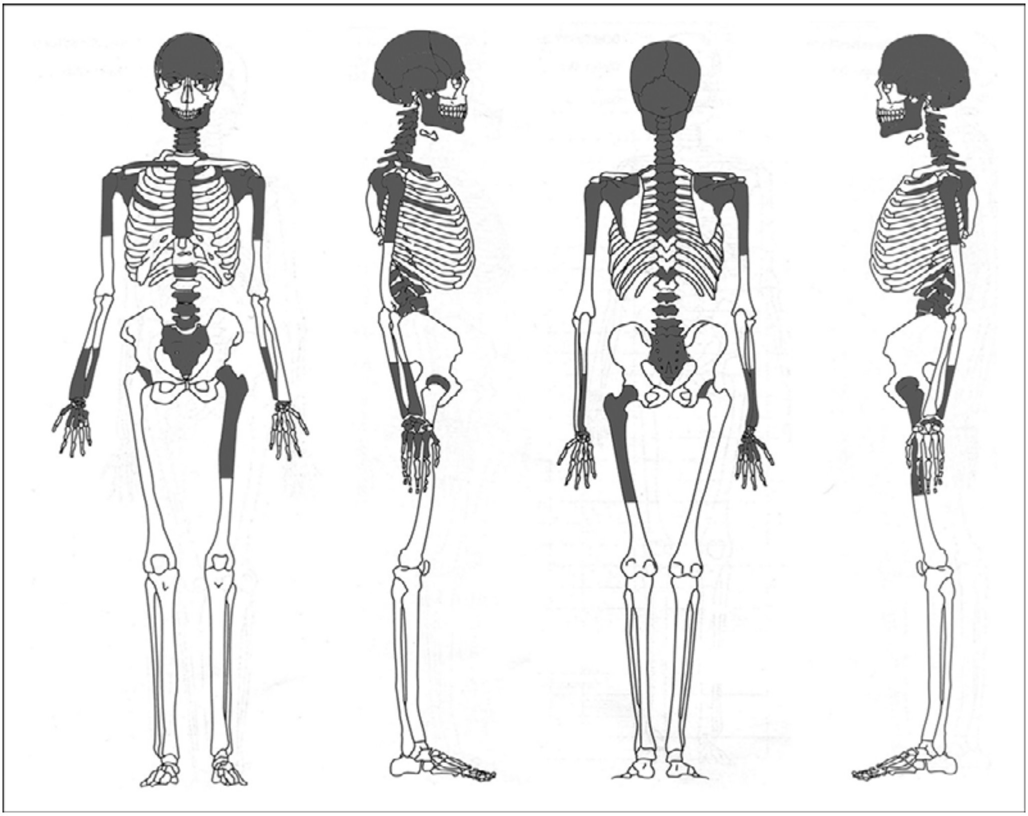

Figure 4. Schematic representation of the surviving skeletal elements of Individual 1 (figure by authors).

Postmortem modifications

Examination of the endocranial surface revealed a series of straight and parallel striations on the frontal bone (Figure 6a). These could have resulted from taphonomic processes, such as trampling, fungal activity and root etching, or could represent intentional cut marks. Trampling marks are typically superficial, with a symmetrical U-shaped cross-section and irregular groove trajectory, they also vary in size and direction (Madgwick 2014; Courtenay *et al.* 2020). Microbial bioerosion is only visible under electron microscopy (Jans *et al.* 2004) and root marks are rarely straight and most often imbricated (Fernández–Jalvo & Andrews 2016). As none of these characteristics fit the observations, it is more likely that the incisions resulted from deliberate scratching or cutting into the endocranial surface of the cranium with a sharp implement. Taken together, breakage of the cranial base and internal cutmarks are suggestive of deliberate removal of the brain soon after the death of this individual.

At least four of the long bones belonging to Individual 1 had been modified prior to deposition. Both humeri and the left ulna and femur were present in the grave as fragments (comprising around 50% of the original bone elements). Although the original report suggests that these bones may have been gnawed by rodents (Roberts 2003), they

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

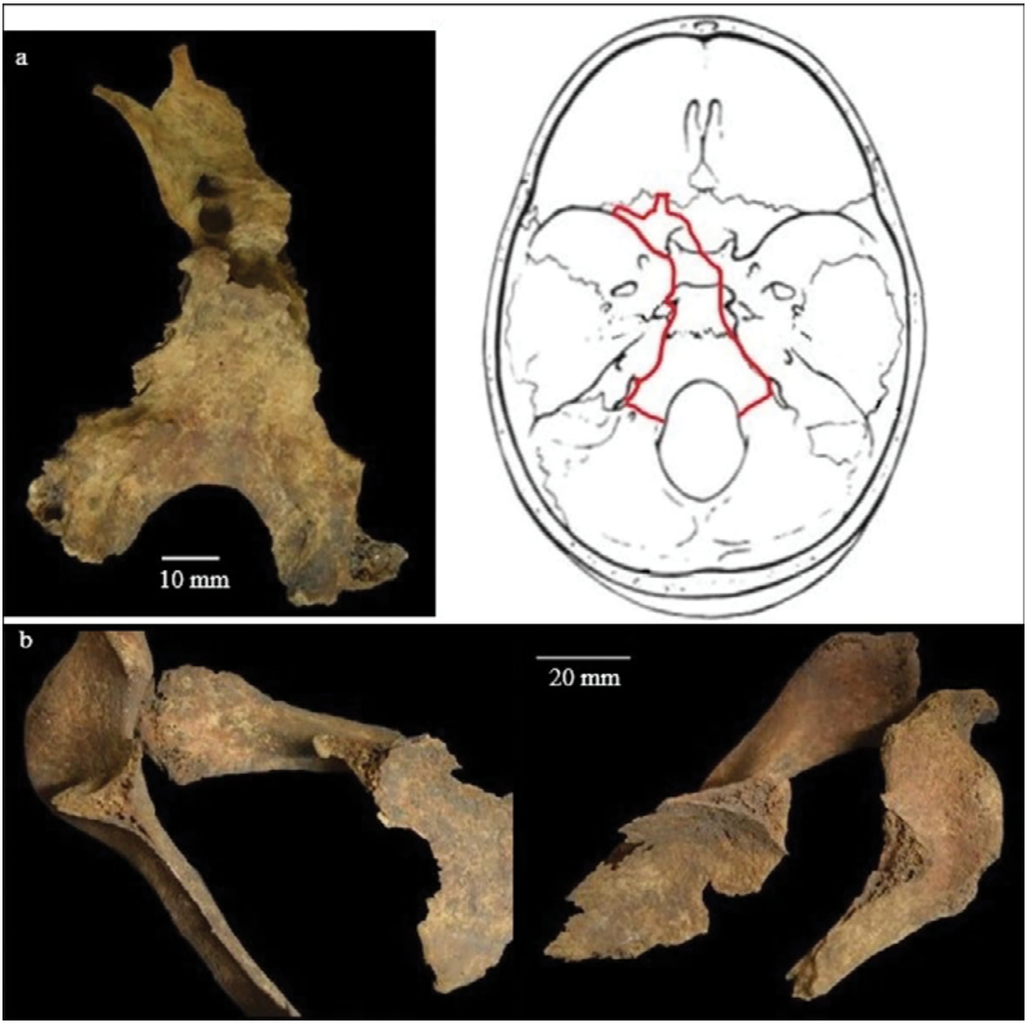

Figure 5. Perimortem lesions observed in Individual 1: a) endocranial (i.e. interior) view of the cranial base fragment formed by the fracturing of the lateral and basilar portions of the occipital and the body and left lesser wing of the sphenoid from the rest of the cranium (schematic shows location of the fragment within the cranium); b) bilateral and almost symmetrical perimortem fractures at the base of the left (left image) and right (right image) scapular spines (photographs by Rebecca Ellis-Haken; figure by authors).

lack the characteristic striations that would be expected from this process. Instead, the humeri and ulna taper towards the end of the fragment; the outer layers of cortical bone have been removed and the internal layers have been whittled/worked to a sharp edge and a singular pointed end (Figure 6b). The left humerus also displays a U-shaped scar on the whittled surface, which suggests that a sharp implement, such as a knife, was used to work the bone to its final shape (Figure 6c). The femur, in contrast, does not have a sharp edge but the fragment terminates in a flat and smooth margin, as if the sharp edge was worked down against another, possibly softer, surface (Figure 6d) after having been whittled.

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

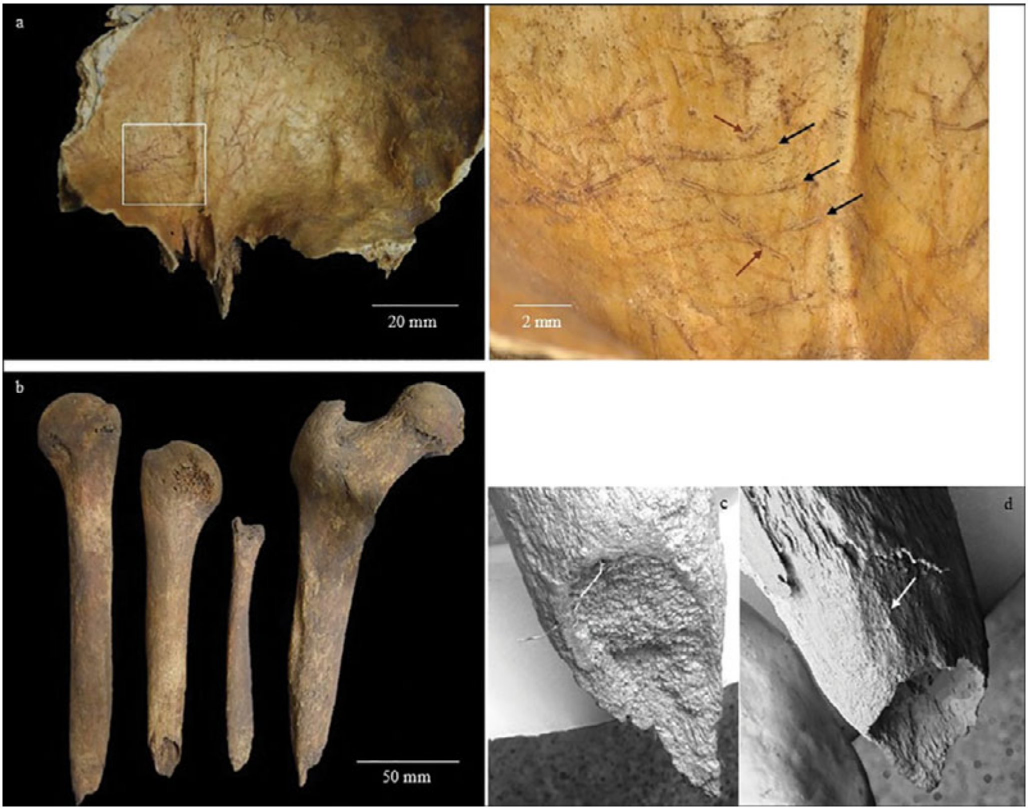

Figure 6. Evidence of intentional postmortem manipulation observed in Individual 1: a) endocranial (i.e. interior) surface of the frontal bone (inset: 20× magnification), black arrows indicate incisions, brown arrows show possible root etching; b) the preserved long bones (right and left humeri, left ulna and left femur); c) Reflectance Transformation Imaging (RTI) representation of modification to the left femoral diaphysis (note the flattening of the distal edge); d) RTI representation of modification to the diaphysis of the right humerus (note the whittling marks arrow) (photograph by Rebecca Ellis-Haken; figure by authors).

Despite clear evidence for the working of these long bones and (in the case of the left femur) the accrual of use-wear, all four had been placed in the grave in their correct anatomical position.

Osteological analysis of Individual 2

Individual 2 is a juvenile, aged between 14.5 and 15.5 years at death. Estimation of osteological sex was not attempted due to the young age of the individual. Only around 25% of the skeleton survives, and the displaced cranium was found on the modern ground surface between the two burials (Figure 2). The presence of linear enamel hypoplasia on the teeth suggests that this individual may have suffered periods of growth disruption and malnutrition, and there are also indications that they may have suffered from vitamin C deficiency. The fourth and fifth cervical vertebrae are fused, most likely

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

due to a congenital failure of segmentation (see OSM). None of the complex patterns of trauma observed in Individual 1 are displayed in the skeleton of Individual 2.

Ancient DNA analysis

We successfully analysed aDNA from inner ear ossicles belonging to both individuals (Table 2; see OSM). Individual 1 is determined to be genetically female while Individual 2 is male. Principal component analysis of the genomic data for both individuals suggests that they are genetically typical of Scottish Iron Age populations (see Figure S6).

The Y chromosome haplogroup for Individual 2 (R1b1a1b1a1a2c1) is common in Iron Age Britain and largely uninformative regarding ancestry. Both individuals, however, share mitochondrial haplogroup T2b30, which is otherwise unique among published ancient individuals from Britain, suggesting that they are maternally related. Although we were not able to detect a close biological relationship between the two using READv2 (Monroy Kuhn *et al.* 2018; Alaçamlı *et al.* 2024), identity by descent (IBD) analysis identified that they share four DNA fragments longer than 8 centimorgans (cM) (43.345cM in total), with the longest segment of 12.144cM suggesting a biological relationship of the fifth degree or more distant. Given the similar dating of the two individuals and the sharing of a highly unusual mitochondrial haplogroup, they are most probably maternally related possibly at the level of second cousins sharing a pair of great-grandparents (corresponding to fifth-degree relationships).

IBD analysis further revealed that both individuals have distant biological relationships (likely eighth degree or more) with individuals found in Orkney (see OSM). Individual 1 is related to an adult male from the Atlantic roundhouse site of Bu, dated to 399–207 cal BC (2271±33 BP; SUERC-69075). This time gap of at least 150 years (perhaps five–six generations) suggests that the latter could have been a direct ancestor of Individual 1, or a collateral relative of a direct ancestor. Individual 2 is biologically related to an individual from Knowe of Skea with a slightly later date of cal AD 25–215 (1915±35 BP; SUERC-8410). Both Orcadian individuals also have distant biological relationships with an adult male (Individual 3) buried in an informal stone cairn at Applecross, on the west mainland of Scotland, around 140km south-west of Loch

Table 2. Summary genetic data from Loch Borralie.

Individual	Genetic ID	Element	SNPs hit on autosomal targets (1240k snpset)	Molecular sex	mtDNA haplogroup	Y chromosome haplogroup
1	I37347	Right malleus	1045530	F	T2b30	n/a
2	I37348	Right malleus	1093398	M	T2b30	R1b1a1b1a1a2c1

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

Borralie (Sheridan *et al.* 2019). The Applecross individual, dating to 42 cal BC–cal AD 119 (1980±28 BP; SUERC-73992), is broadly contemporaneous with the Loch Borralie burials.

Isotope analysis

Multi-isotope analysis was conducted to assess diet and mobility. Tooth enamel from both individuals was sampled for strontium ($^{87}Sr/^{86}Sr$), oxygen ($\delta^{18}O_{carb}$) and carbon ($\delta^{13}C_{carb}$) stable isotope analysis, while radiocarbon dating of dentine from the same teeth yielded carbon ($\delta^{13}C_{coll}$), nitrogen ($\delta^{15}N$) and sulphur ($\delta^{34}S$) isotope measurements. Tooth enamel isotope signatures relate to the period of enamel formation. For this study, a permanent second and third molar were sampled, reflecting enamel formation between approximately 2.5 and 8.5 years (Individual 2) and between 7.5 and 15.5 years (Individual 1), respectively (AlQahtani *et al.* 2010; Hillson 2024).

Both individuals have $\delta^{13}C_{coll}$ values of around −21‰ (Table 1), indicative of a C_3-based diet, which is supported by the enamel $\delta^{13}C_{carb}$ values (Table 3). The $\delta^{15}N$ value is slightly higher for Individual 2, which could suggest that they consumed more animal protein than Individual 1 (although the data reflect the diet of the two individuals at different ages). The combined $\delta^{13}C$ and $\delta^{15}N$ results from the dentine do not suggest that either individual consumed a significant amount of marine protein during childhood.

The strontium concentrations (Sr ppm) for both Individual 1 (190ppm) and Individual 2 (264ppm) (Table 3) are higher than for most individuals from mainland Britain, which normally lie within the range 20–180ppm (Evans *et al.* 2012). These high concentrations are, however, closely comparable to Iron Age communities in coastal island environments such as Orkney and the Western Isles of Scotland (Figure 6) (Evans *et al.* 2012; Montgomery *et al.* 2014). The $^{87}Sr/^{86}Sr$ ratios also resemble those from coastal sites, which tend to have isotope ratios closer to seawater (0.7092) due to factors including sea spray, seaweed fertiliser and high rainfall, which can overwrite the biosphere signature (Figure 7). The $\delta^{34}S$ values of around 18‰ (Table 1) are also more typical of those associated with coastal communities (>15‰; Richards *et al.* 2001). Overall, the isotope data suggest that both individuals spent the early part of their lives in a coastal environment.

The British Geological Survey (BGS) Biosphere Isotope Domains map website (Evans *et al.* 2022) was used to restrict the possible childhood residential origins of the two

Table 3. Summary isotope results from Loch Borralie. *Approximate estimated age of individual captured by enamel sampling.

Ind.	Tooth	Age* (years)	Sr ppm	$^{87}Sr/^{86}Sr$	$\delta^{13}C_{carb}$ (‰) PDB	$\delta^{18}O_{carb}$ (‰) VSMOW	Pb (mg kg^{-1})
1	LRM3	7.5–17.5	190	0.70986	−14.58	25.73	0.08
2	LLM2	2.5–8.5	264	0.70973	−15.86	26.18	0.12

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

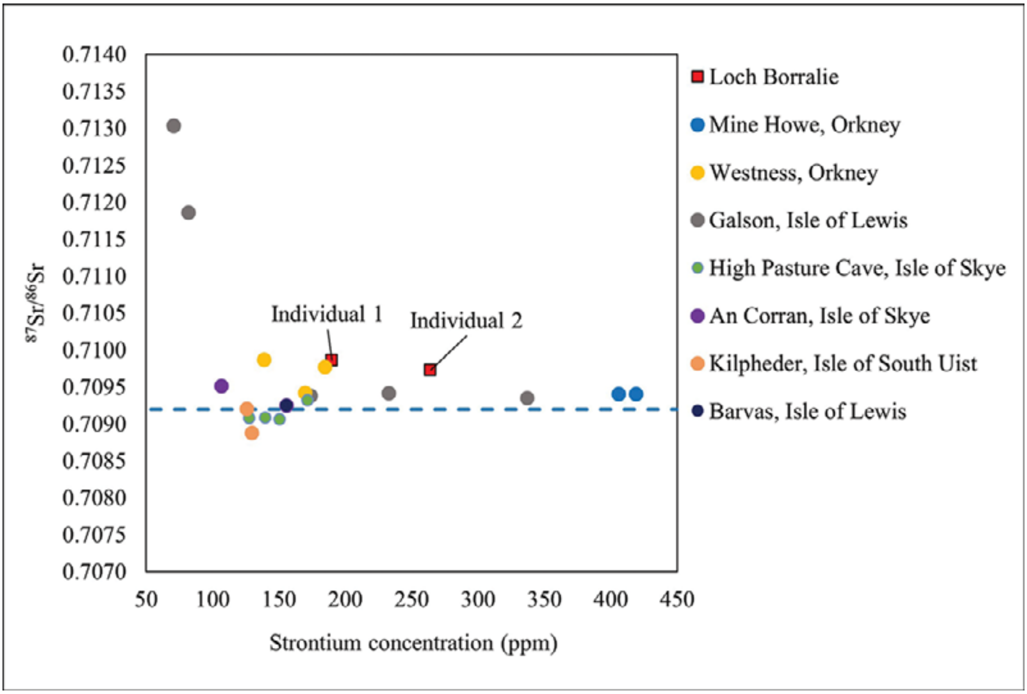

Figure 7. $^{87}Sr/^{86}Sr$ and Sr ppm of human remains from Loch Borralie and other Iron Age sites (data from Evans et al. *2012); the Westness data include only 'Pictish' (Late Iron Age) individuals (Montgomery* et al. *2014). The $^{87}Sr/^{86}Sr$ value for seawater (0.7092) is shown by the dashed blue line (figure by authors).*

individuals based on their combined $^{87}Sr/^{86}Sr$ and $\delta^{18}O_{carb}$ composition (Figure 8a). The geology of the site and surroundings is well characterised, and full details can be found in the OSM. The $^{87}Sr/^{86}Sr$ ratios for both individuals (Individual 1: 0.70986; Individual 2: 0.70973) fall outside the 50% central range anticipated for the immediate area around Loch Borralie (0.7094–0.7096) but are common across several areas of Britain and are therefore unhelpful in constraining possible childhood residence. The $\delta^{18}O_{carb}$ values of Individuals 1 and 2 (25.7‰ and 26.2‰, respectively), however, are not consistent with western Britain and exclude areas of northern Scotland. In terms of regions in reasonable geographical proximity to Loch Borralie, a stretch of the east coast of Sutherland, extending broadly between the modern towns of Helmsdale and Golspie, could accommodate these results and is an area of dense Iron Age settlement (Figure 8b). Other potential locations all lie further to the south and appear considerably less likely, particularly in view of the genetic evidence for biological relationships with individuals in Orkney.

Discussion

Multi-method analysis has successfully reconstructed aspects of the life histories and mortuary treatments of the two individuals buried at Loch Borralie. The pair are shown, through aDNA analysis, to be close biological relatives, possibly as close as maternal second cousins. Isotope analysis demonstrates that they moved to the area around Loch

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

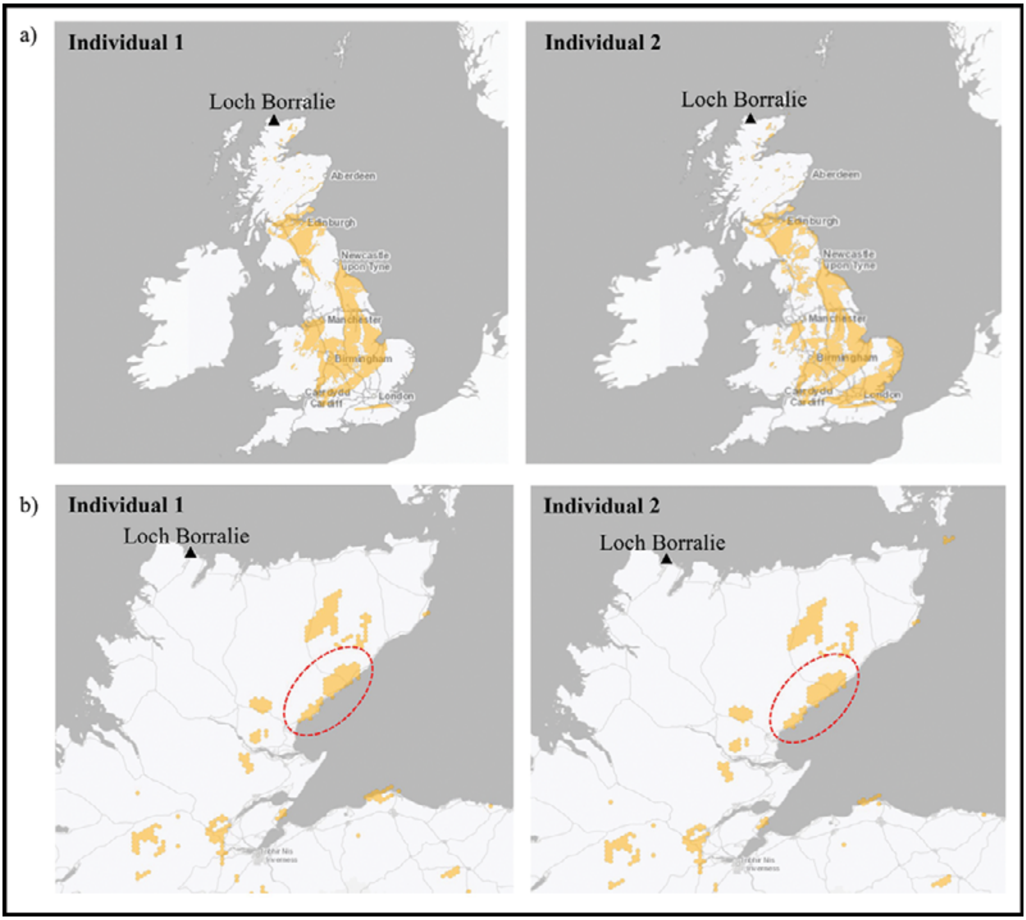

Figure 8. Maps of combined $^{87}Sr/^{86}Sr$ and $\delta^{18}O_{carb}$ (‰) (VSMOW) for Individuals 1 and 2. a) Areas in orange have a data range compatible with these results. b) Detail showing the stretch of east Sutherland coastline that represents the most likely area where the Loch Borralie individuals spent their childhoods (figure by authors).

Borralie sometime after childhood and, for Individual 1 at least, probably after adolescence. The most likely area where they would have spent their childhoods is the east coast of Sutherland, around 80km to the south-east. The journey could have been made on foot over a few days, or else by sea around the challenging waters of the Pentland Firth. Given the closeness of the radiocarbon dates, their similar isotopic profiles and their biological relatedness, it is possible that these individuals travelled together, perhaps as part of a larger group. Nevertheless, the stratigraphy of the cairn suggests that they may not have been buried at the same time, while osteological analysis reveals very different postmortem treatments of their bodies.

The biological relationships identified through IBD analysis add a further layer to our understanding of social networks in Iron Age Britain, beyond Loch Borralie itself. While genome-wide aDNA analysis has been successful in identifying the biological relationships of individuals up to the second or third degree, IBD offers the possibility of

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

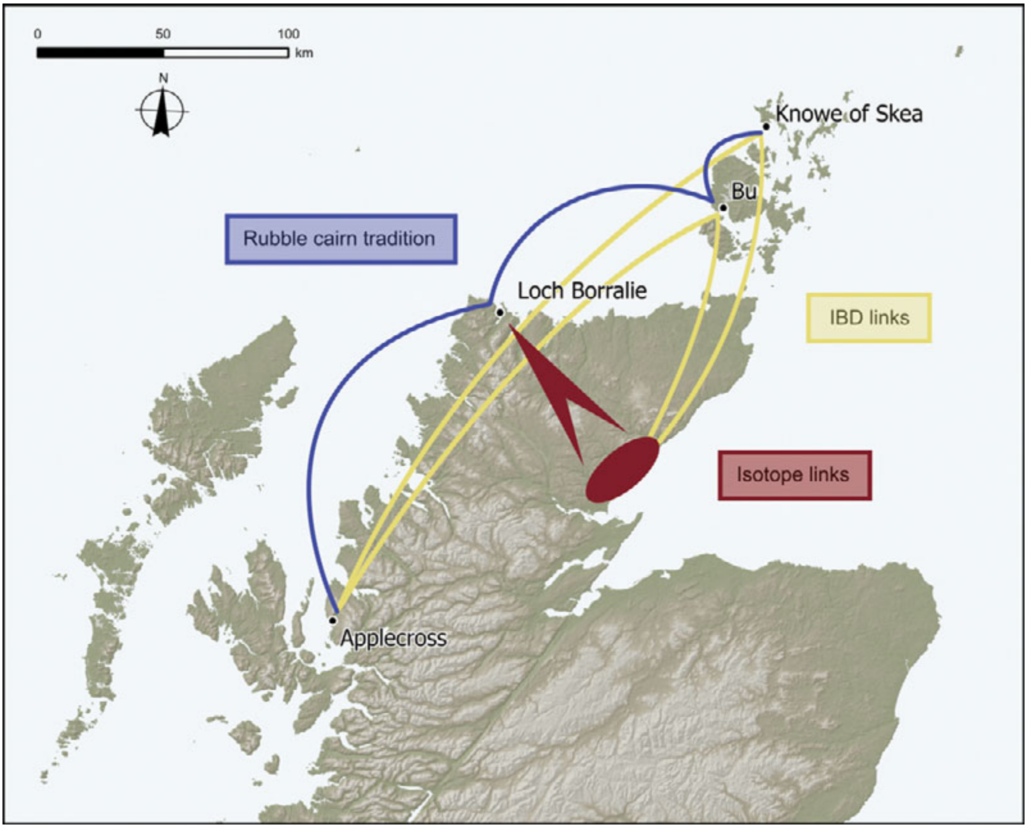

Figure 9. Schematic representation of the network of Iron Age connections identified in northern Scotland (map by Helen Goodchild. Produced using Copernicus data and information funded by the European Union - EU-DEM layers).

reconstructing more distant relationships, potentially far beyond the genealogical knowledge of the individuals concerned. These more distant biological relationships, rather than necessarily offering insights into prehistoric kinship practices, act as a proxy for understanding mobility and connectivity between groups on a broader chronological and geographical scale. In this case, IBD analysis reveals a network of biologically related individuals extending over around 265km from Applecross in the south to Knowe of Skea in the north, while isotope analysis extends this to the east coast of Sutherland (Figure 9). While there is perhaps little likelihood that even the broadly contemporaneous individuals were known to each other, these connections attest to the mobility and interconnectedness of communities over several centuries. The movement of people between coastal communities provides a human dimension to the marked similarities in material culture across Iron Age Atlantic Scotland, most evident in the construction of the monumental broch towers that characterise the region (Armit 2003), and reminds us that seaways were the highways of prehistoric Britain.

Relatively few Iron Age inhumations have been identified in north-west Scotland, yet parallels for the Loch Borralie burials can be discerned. The closest geographical parallel

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

is Sangobeg, around 5km to the east, where the flexed skeleton of a child (around 8–10 years at death) was found on a platform of quartzite pebbles under a low cairn of sand, capped by larger quartzite stones (Brady *et al.* 2007). This inhumation yielded a radiocarbon determination of 166 cal BC–cal AD 59 (2050±35 BP; SUERC-4527), placing it chronologically close to the Loch Borralie burials. Although the Sangobeg bones are poorly preserved, the ends of the surviving long bones are suggested to display indications of 'rodent gnawing' (Roberts 2007: 67). This observation might now warrant reanalysis.

Structural parallels can also be drawn between the Loch Borralie burials and a series of Iron Age inhumations in Orkney, which were placed into rubble deposits within earlier buildings. The best understood examples come from the ruins of Atlantic roundhouses such as Howe of Howe (Ballin Smith 1994) and Bu (Hedges 1987), the latter of which includes an individual identified as a distant biological relative of Loch Borralie Individual 1. The largest burial population yet found in Atlantic Scotland was recovered from the rubble infill of collapsed buildings at Knowe of Skea, Orkney. This comprised bones (many disarticulated) relating to at least 214 individuals, including a substantial proportion of infants (Gooney 2015: 122). Again, one of these individuals has now been shown to be biologically related to Individual 2 at Loch Borralie.

Perhaps the closest structural parallel is a low cairn of rounded cobbles found on a storm beach at Applecross on the west mainland of Scotland (Dagg 2015; Canmore ID 378165 at https://canmore.org.uk/), around 140km south-west of Loch Borralie, within which were the remains of at least six adult males. The burials ranged from the second century BC to the third century AD, encompassing the date range of the Loch Borralie individuals. This pattern of periodic burial within an informal stone mound echoes the sequence at Loch Borralie and, as previously noted, Individual 3 from Applecross is biologically related to the same two Orcadian individuals who have biological links to the individuals from Loch Borralie.

The genetic links now evident between individuals buried in rubble cairns at Loch Borralie and Applecross, and inhumations placed into accumulating rubble at Bu, Howe of Howe and Knowe of Skea, suggest that, rather than expedient and informal deposition of the dead, we may be seeing the archaeological manifestation of a previously unrecognised funerary tradition (Figure 9).

Despite the close similarities in burial form, none of these sites provides close parallels for the complex sequence of postmortem manipulation incurred by Individual 1 at Loch Borralie. Elucidation of the sequence of traumatic lesions—cranial base blunt-force trauma, possible brain removal, probable perimortem scapular fracture—is not possible, but taken in combination with the bone modifications—working of the long bones to form points, use of at least one worked femur as an implement of some kind—it is possible to suggest that the heavily-processed remains of this female were curated for a period of time before being reassembled for deposition within the cairn.

While these modifications might represent deliberate and precise interactions with the remains, it is, however, difficult to reconstruct the motivations behind these complex mortuary treatments. Removal of the brain could, for example, relate to cannibalism, although there is no corroborating evidence such as the processing of long bones for marrow extraction, or it could have been part of an attempt to clean and preserve the

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

skull, for curation and/or display. The long bone modifications are equally hard to explain; potentially the bones may have been used as implements of some kind, as suggested by use-wear on the modified femur, although no signs of use are evident on the other three modified bones. The closest parallel for this modification comes from the site of Wag of Forse, Caithness, where a human femur, worked to a point and showing extensive wear, polish and red staining on one end, had been placed beneath the entrance of an Iron Age roundhouse (Shapland & Armit 2012). This latter bone has been directly dated to cal AD 247–404 (SUERC-24238; 1735±30 BP), placing it rather later than the Loch Borralie example. Further afield, the only other broadly comparable Iron Age example is the broken shaft of a femur found in a ditch at Fairfield Park, Bedfordshire, that had become polished through use as a tool of some form (Webley *et al.* 2007).

From the analysis of trauma patterns alone, it is not possible to distinguish whether these modifications represent curation of a respected member of the in-group, or purposefully abusive treatment of the body of an outsider or low status individual. The final, careful reassembly and deposition of the bones within the cairn, however, implies not only a high degree of anatomical knowledge but also a level of care that suggests reverence rather than denigration.

Although the specific treatment of Individual 1 at Loch Borralie cannot be paralleled in detail, there is substantial evidence for the curation, modification and circulation of human remains in Late Bronze and Iron Age Britain (e.g. Armit 2017). Within Atlantic Scotland itself, the long-term curation of human bodies has been identified elsewhere, for example at Cladh Hallan, South Uist (Parker Pearson *et al.* 2021), the Sculptor's Cave, Moray (Armit & Büster 2020), and Crosskirk, Caithness (Fairhurst 1984; Armit 2017). Although lacking specific evidence for curation, the body of a juvenile male from Hornish Point, South Uist, had also evidently spent some time above ground before being divided between four pits under the floor of an Iron Age wheelhouse (Barber *et al.* 1989; Armit 2012). Modified body parts, including perforated cranial fragments, are also found widely across the region (Shapland & Armit 2012). The evidence from Loch Borralie further emphasises the active role of the dead within Iron Age communities across Britain.

Conclusion

The work at Loch Borralie demonstrates the potential of a multi-method approach, incorporating osteoarchaeology, multi-isotope and aDNA analysis, to deepen our understanding of mortuary behaviour, mobility and connectivity within prehistoric societies. The genetic and isotopic evidence highlights long-term interconnectedness between maritime communities around the north coast and Northern Isles of Scotland, where individuals and small groups periodically moved across wide areas, facilitating the maintenance and spread of cultural ideas and practices. Meanwhile, the complex and protracted mortuary treatment afforded to the female identified as Individual 1 at Loch Borralie demonstrates that, although sparse in terms of their archaeological survival, the Iron Age dead held a strong and compelling presence in the world of the living.

https://doi.org/10.15184/aqy.2026.10353 Published online by Cambridge University Press

Acknowledgements

The authors would like to thank Professor Keith Manchester, Dr Laura Evis, Malin Holst, Dr Mik Lisowski and Dr Barbara Veselka for advice on the palaeopathological and taphonomic aspects of the research, and Professor Melanie Giles, Aristotelis Palyvos, Dr Alison Sheridan and Jen Valentine for their help in organising and facilitating the work. We also thank the wet laboratory and bioinformatics teams at Harvard Medical School. The authors also thank the three anonymous reviewers and *Antiquity*'s editorial team for improving the manuscript.

Funding statement

This research received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme under grant agreement no. 834087 (COMMIOS Project). The ancient DNA work was supported by National Institutes of Health grant GM100233, John Templeton Foundation grant 61220, the Howard Hughes Medical Institute, and the Allen Discovery Center program, a Paul G. Allen Frontiers Group advised program of the Paul G. Allen Family Foundation.

Online supplementary material (OSM)

To view supplementary material for this article, please visit https://doi.org/10.15184/aqy.2026.10353 and select the supplementary materials tab.

Author contributions: CRediT categories

Laura Castells Navarro: Conceptualization-Equal, Formal analysis-Equal, Investigation-Lead, Methodology-Equal, Visualization-Equal, Writing - original draft-Equal, Writing - review & editing-Lead. **Sebastian Metz:** Formal analysis-Equal, Investigation-Equal, Visualization-Equal, Writing - original draft-Equal, Writing - review & editing-Equal. **Madeleine Bleasdale:** Formal analysis-Equal, Investigation-Equal, Visualization-Equal, Writing - original draft-Equal, Writing - review & editing-Equal. **Jane Evans:** Methodology-Equal, Supervision-Supporting. **Michael Legge:** Investigation-Equal, Writing - review & editing-Equal. **Lindsey Büster:** Investigation-Equal, Visualization-Equal, Writing - review & editing-Equal. **David Reich:** Methodology-Equal, Supervision-Supporting, Writing - review & editing-Supporting. **Ian Armit:** Conceptualization-Equal, Funding acquisition-Lead, Methodology-Lead, Project administration-Lead, Supervision-Lead, Visualization-Equal, Writing - original draft-Lead, Writing - review & editing-Equal.

References

ALAÇAMLI, E. *et al.* 2024. READv2: advanced and user-friendly detection of biological relatedness in archaeogenomics. *Genome Biology* 25. https://doi.org/10.1186/s13059-024-03350-3

ALQAHTANI, S.J. *et al.* 2010. Brief communication: the London atlas of human tooth development and eruption. *American Journal of Physical Anthropology* 142: 481–90. https://doi.org/10.1002/ajpa.21258

Armit, I. 2003. *Towers in the north: the brochs of Scotland*. Stroud: Tempus.
– 2012. *Headhunting and the body in Iron Age Europe*. Cambridge: Cambridge University Press.
– 2017. The visible dead: ethnographic perspectives on the curation, display and circulation of human remains in Iron Age Britain, in J. Bradbury & C. Scarre (ed.) *Engaging with the dead: exploring changing human beliefs about death, mortality and the human body*: 163–73. Oxford: Oxbow.
– 2022. Mobility and migration in Bronze and Iron Age Britain: the COMMIOS Project, in M. Fernández-Götz *et al.* (ed.) *Rethinking migrations in late prehistoric Eurasia* (Proceedings of the British Academy 254): 280–91. Oxford: Oxford University Press. https://doi.org/10.5871/bacad/9780197267356.003.0013
Armit, I. & L. Büster. 2020. *Darkness visible: the Sculptor's Cave, Covesea, from the Bronze Age to the Picts*. Edinburgh: Society of Antiquaries of Scotland.
Armit, I. & V. Ginn. 2007. Beyond the grave: human remains from domestic contexts in Iron Age Atlantic Scotland. *Proceedings of the Prehistoric Society* 73: 113–34. https://doi.org/10.1017/S0079497X00000074
Ballin Smith, B. 1994. *Howe: four millennia of Orkney prehistory. Excavations 1978–1982*. Edinburgh: Society of Antiquaries Scotland.
Barber, J. *et al.* 1989. An unusual burial at Hornish Point South Uist. *Antiquity* 63: 773–78. https://doi.org/10.1017/S0003598X00076912
Bobinski, M. *et al.* 2016. Basic imaging of skull base trauma. *Journal of Neurological Surgery Part B: Skull Base* 77: 381–87. https://doi.org/10.1055/s-0036-1583540
Brady, K. *et al.* 2007. A Pictish burial and late Norse/medieval settlement at Sangobeg, Durness, Sutherland. *Scottish Archaeological Journal* 29: 51–82. https://doi.org/10.3366/E147157670800020X
Bronk Ramsey, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51: 337–60. https://doi.org/10.1017/S0033822200033865
Courtenay, L.A. *et al.* 2020. Scratches and grazes: a detailed microscopic analysis of trampling phenomena. *Journal of Microscopy* 277: 107–17. https://doi.org/10.1111/jmi.12873
Dagg, C. 2015. Applecross Old Estate Office: archaeological investigation. Unpublished data structure report for the Applecross Trust.
Evans, J.A. *et al.* 2012. A summary of strontium and oxygen isotope variation in archaeological human tooth enamel excavated from Britain. *Journal of Analytical Atomic Spectrometry* 27: 754–64. https://doi.org/10.1039/C2JA10362A
– 2022. Biosphere isotope domains GB (V2): interactive website. British Geological Survey [dataset]. https://doi.org/10.5285/2ce7fc22-1b6e-4979-968f-42058c0120fb
Fairhurst, H. 1984. *Excavations at Crosskirk Broch, Caithness*. Edinburgh: Society of Antiquaries of Scotland.
Fernández-Jalvo, Y. & P. Andrews. 2016. *Atlas of taphonomic modifications*. Dordrecht: Springer. https://doi.org/10.1007/978-94-017-7432-1
Gooney, D. 2015. Life and death in Iron Age Orkney: an osteoarchaeological examination of the human skeletal remains from the burial ground at Knowe of Skea, Westray. Unpublished PhD dissertation, University of Edinburgh.
Halkon, P. 2013. *The Parisi: Britons and Romans in eastern Yorkshire*. Stroud: History.
Harding, D.W. 2016. *Death and burial in Iron Age Britain*. Oxford: Oxford University Press.
Hedges, J.W. 1987. *Bu, Gurness and the brochs of Orkney. Part 1: Bu* (British Archaeological Reports British Series 163). Oxford: British Archaeological Reports.
Hillson, S. 2024. *Dental anthropology*. Cambridge: Cambridge University Press.
Jans, M.M.E. *et al.* 2004. Characterisation of microbial attack on archaeological bone. *Journal of Archaeological Science* 31: 87–95. https://doi.org/10.1016/j.jas.2003.07.007
Lamb, A.W. 2020. The Deal-type inhumations of Kent: defining an Iron Age mortuary group in light of new discoveries. *Archaeologia Cantiana* 141: 98–124.
Lovell, N.C. 1997. Trauma analysis in paleopathology. *American Journal of Physical Anthropology* 104: 139–70. https://doi.org/10.1002/(SICI)1096-8644(1997)25+%3C139::AID-AJPA6%3E3.0.CO;2-%23

MacGregor, G. 2003. *Excavation of an Iron Age burial mound, Loch Borralie, Durness, Sutherland* (Scottish Archaeological Internet Reports 9). Edinburgh: Society of Antiquaries of Scotland. https://doi.org/10.5284/1017938

Madgwick, R. 2014. What makes bones shiny? Investigating trampling as a cause of bone abrasion. *Archaeological and Anthropological Sciences* 6: 163–73. https://doi.org/10.1007/s12520-013-0165-0

Monroy Kuhn, J. *et al.* 2018. Estimating genetic kin relationships in prehistoric populations. *PLoS ONE* 13. https://doi.org/10.1371/journal.pone.0195491

Montgomery, J. *et al.* 2014. Finding Vikings with isotope analysis: the view from wet and windy islands. *Journal of the North Atlantic* 7: 54–70. https://doi.org/10.3721/037.002.sp705

Parker Pearson, M. *et al.* 2021. *Cladh Hallan: roundhouses and the dead in the Hebridean Bronze Age and Iron Age, part 1: stratigraphy, spatial organisation and chronology*. Oxford: Oxbow.

Reid, R.W.K. *et al.* 1968. Prehistoric settlement in Durness. *Proceedings of the Society of Antiquaries of Scotland* 99: 21–35. https://doi.org/10.9750/PSAS.099.21.53

Reimer, P.J. *et al.* 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon* 62: 725–57. https://doi.org/10.1017/RDC.2020.41

Richards, M.P. *et al.* 2001. Sulphur isotopic variation in ancient bone collagen from Europe: implications for human palaeodiet, residence mobility, and modern pollutant studies. *Earth and Planetary Science Letters* 191(3): 185–90. https://doi.org/10.1016/S0012-821X(01)00427-7

Roberts, J. 2003. The skeletons from Loch Borralie, in G. MacGregor (ed.) *Excavation of an Iron Age burial mound, Loch Borralie, Durness, Sutherland* (Scottish Archaeological Internet Reports 9): 7–8. Edinburgh: Society of Antiquaries of Scotland. https://doi.org/10.5284/1017938

– 2007. The skeletal remains, in K. Brady *et al.* A Pictish burial and late Norse/medieval settlement at Sangobeg, Durness, Sutherland. *Scottish Archaeological Journal* 29: 51–82. https://doi.org/10.3366/E147157670800020X

Shapland, F. & I. Armit. 2012. The useful dead: bodies as objects in Iron Age and Norse Atlantic Scotland. *European Journal of Archaeology* 15: 98–116. https://doi.org/10.1179/1461957112Y.0000000004

Sheridan, A. & T.F.G. Higham. 2006. The re-dating of some Scottish specimens by the Oxford Radiocarbon Accelerator Unit (ORAU). *Discovery and Excavation in Scotland* (New Series) 7: 225.

Sheridan, A. *et al.* 2019. A summary round-up list of Scottish archaeological human remains that have been sampled/analysed for DNA as of January 2019. *Discovery and Excavation in Scotland* 19: 227–250.

Waldron, T. 1996. Legalized trauma. *International Journal of Osteoarchaeology* 6: 114–18. https://doi.org/10.1002/(SICI)1099-1212(199601)6:1%3C114::AID-OA235%3E3.0.CO;2-J

Webley, L.J. *et al.* 2007. *Fairfield Park, Stotfold, Bedfordshire: later prehistoric settlement in the eastern Chilterns*. Oxford: Oxford Archaeology.