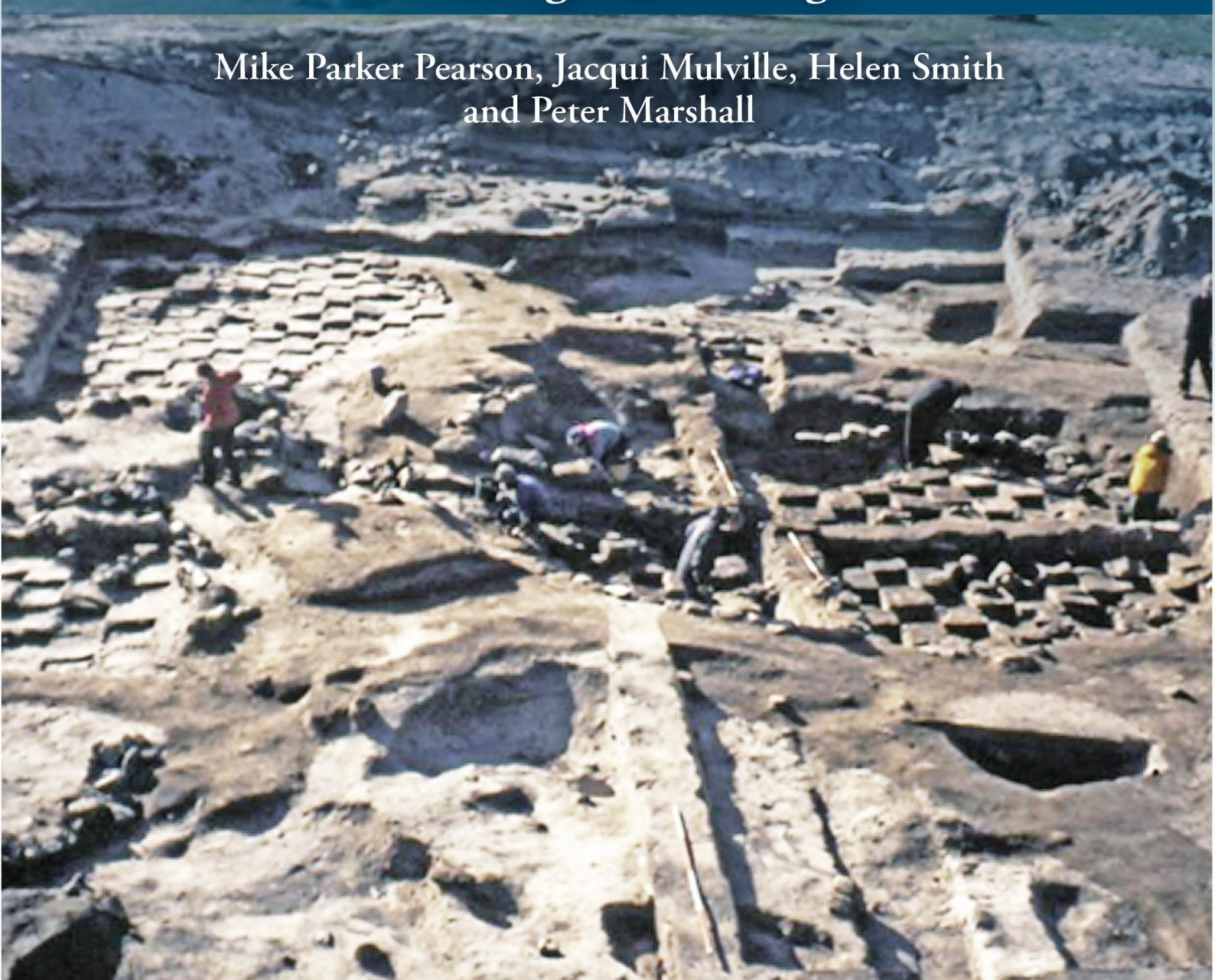
PART 2: MATERIAL CULTURE, SUBSISTENCE, SKELETONS AND SYNTHESIS

CLADH HALLAN

Roundhouses and the Dead in the Hebridean Bronze Age and Iron Age

Mike Parker Pearson, Jacqui Mulville, Helen Smith and Peter Marshall



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Roundhouses and the Dead in the Hebridean Bronze Age and Iron Age

Part 2: Material culture, subsistence, skeletons and synthesis

by

Mike Parker Pearson, Jacqui Mulville, Helen Smith and Peter Marshall

with contributions by

Victoria Alexander, Julia Best, Tom Booth, Judy Cartledge†, Mike Charlton, Sue Colledge, John Compton, Trevor Cowie, Oliver Craig, Lucy Cramp, Glyn Davies, Jessica Davies, David Dungworth, Mark Edmonds, Sally Evans, Richard Evershed, Helen Goddard, Jacob Griffith, Alexandra Hale, Fraser Hunter, Linda Hurcombe, Clare Ingrem, Jennifer Jones, Matt Juddery, Matthew Law, Richard Madgwick, Katherine Martin, Victoria Mullin, Brendan O'Connor, Adrienne Powell, Christophe Snoeck, Gillian Taylor, Nigel Thew, Lore Troalen, Thibert Verolet and Christie Willis

with principal illustrations by

Alan Braby, Adrian Chadwick, Irene De Luis and Laura Hogg

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Front cover: Cladh Hallan Area A under excavation in 2000 and showing the row of three roundhouses, viewed from the north

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Victoria Alexander
Red River Archaeology
Cardiff

Julia Best
School of History, Archaeology and Religion
Cardiff University
Cardiff

Tom Booth
Francis Crick Institute
1 Midland Road
London

Alan Braby
Independent researcher
East Lothian

Adrian Chadwick
Independent researcher
Chepstow

Mike Charlton
Institute of Archaeology
University College London
London

Sue Colledge
Institute of Archaeology
University College London
London

John Compton
c/o Linda Hurcombe
Department of Archaeology and History
University of Exeter
Exeter

Trevor Cowie
Formerly National Museums Scotland
Chambers Street
Edinburgh

Oliver Craig
Department of Archaeology
University of York
King's Manor
York

Lucy Cramp
Department of Anthropology and Archaeology
University of Bristol
43 Woodland Road
Bristol

Glyn Davies
West Yorkshire Archaeology Advisory Service
Morley
Leeds

Jessica Davies
c/o Jacqui Mulville
School of History, Archaeology and Religion
Cardiff University
Cardiff

Irene De Luis
c/o Mike Parker Pearson
Institute of Archaeology
University College London
London

David Dungworth
Heritage Science Solutions
Portsmouth

Mark Edmonds
Department of Archaeology
University of York
King's Manor
York

Sally Evans
MSDS Marine
Moorside Lane
Holbrook
Belper

Richard Evershed
Cabot Institute for the Environment
University of Bristol
Bristol

Helen Goddard
Conwy Culture Centre
Town Ditch Road
Conwy

Jacob I. Griffith
Brussels Bioarchaeology Lab
Vrije Universiteit Brussel
Brussels

Laura Hogg
School of History, Archaeology and Religion
Cardiff University
Cardiff

Fraser Hunter
Department of Scottish History and Archaeology
National Museum of Scotland
Chambers Street
Edinburgh

Linda Hurcombe
Department of Archaeology and History
University of Exeter
Exeter

Claire Ingrem
Independent researcher
Uplyme

Jennifer Jones
UCLan Centre for Field Archaeology and Forensic Taphonomy
University of Central Lancashire
Fylde Road
Preston

Matt Juddery
Testbourne Community School
Micheldever Road
Whitchurch

Matthew Law
School of Sciences
Bath Spa University
Bath

Richard Madgwick
School of History, Archaeology and Religion
Cardiff University
Cardiff

Peter Marshall
Historic England
Cannon Bridge House
25 Dowgate Hill
London

Katherine Martin
Independent researcher

Victoria Mullin
Smurfit Institute of Genetics
Trinity College
Dublin

Jacqui Mulville
School of History, Archaeology and Religion
Cardiff University
Cardiff

Brendan O'Connor
Independent researcher

Mike Parker Pearson
Institute of Archaeology
University College London
London

Adrienne Powell
Oxford Archaeology
Janus House
Osney Mead
Oxford

Helen Smith
Independent researcher
Sheffield

Christophe Snoeck
Brussels Bioarchaeology Lab
Vrije Universiteit Brussel
Brussels

Gillian Taylor
Centre for Biodiscovery
Teesside University
Middlesbrough

Nigel Thew
Independent researcher
Geneva

Lore Troalen
Collections Services
National Museums Scotland
Chambers Street
Edinburgh

Thibert Verolet
c/o Lore Troalen
Collections Services
National Museums Scotland
Chambers Street
Edinburgh

Christie Willis
Willis Osteoarchaeology Services
Torworth
Retford

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This final monograph on our research in South Uist needs to emphasise that it was the University of Sheffield's Department of Archaeology who instigated our work here as part of an inspired department-wide project, brought together by Keith Branigan and involving a phenomenal team, including Andrew Fleming, John Moreland and Marek Zvelebil. For all the staff and students, of many universities, who worked in South Uist, and particularly for Niall Sharples, we think this quotation from the first book Mike ever read on archaeology sums it up: 'If you work with a group of archaeologists who know what they are doing, they will be happy to teach you all they can, so that you not only get the greatest pleasure from archaeology, but can also make a real contribution to it' (Burland 1963: 64).

Preface

M. Parker Pearson, J. Mulville, H. Smith and P. Marshall

This second and final volume on excavations at Cladh Hallan includes specialist reports on artefactual and ecofactual assemblages from this Bronze Age and Early Iron Age site. Volume 1 provides a full description of the excavations, the site sequence and specialist reports on the soil micromorphological and radiometric analyses as well as on the unusually large pottery assemblage (Parker Pearson *et al*. 2021). Useful and insightful reviews of that volume have been published by Brophy (2023), Carruthers (2022) and McDonald and Hamilton (2023).

By way of introduction to Volume 2, it may be helpful to provide a brief review of Cladh Hallan's phasing, dating and structural sequence so that the reader can glean a basic understanding of the site and its long sequence without having to repeatedly turn to Volume 1. That said, a quick guide to the page numbers where a summary of findings from each phase can be found in that volume is given here in Table 1. This shows the date ranges of phases of occupation at 68% probability. Throughout this volume authors occasionally use dates at 95% probability. The reader should refer to Chapter 14 of Volume 1 for full details of the radiocarbon dates and the calculation of the phases' date ranges. To help users of the specialist reports published here, Chapter 23 of this volume includes plans of the site's phases

The largest and deepest stratigraphic sequence was investigated in Area A, where a row of three eleventh-century roundhouses (constructed in Phase 8 and in initial use in Phase 9; see Table 1) was associated with an unusual

Table 1. The dating of Cladh Hallan's 16 phases and their distribution by excavation area. Dates are taken from highest posterior density intervals (cal BC) at 68% probability in Table 14.3 in Volume 1 except for the start date for Phase 1 and the dates for Phase 5 which are estimates. The final column indicates the page numbers of Volume 1 where a summary of findings from each phase can be found

Phase	Date range cal BC (68% probability)	Approximate date cal BC	Excavation area	Summary in Volume 1 (pp nos)
1	2000–1775 BC	20th–early 18th centuries	Area A	51
2	1930–1695 BC	Late 20th–18th centuries	Areas A, C	51
3	1800–1310 BC	18th–14th centuries	Area A	51
4	1370–1250 BC	14th–mid 13th centuries	Area A	78–80
5	1300–1060 BC	13th–early 11th centuries	Area A	78–80
6	1250–1060 BC	Late 13th–early 11th centuries	Area A	78–80
7	1125–1050 BC	Late 12th–early 11th centuries	Area A	78–80
8	1095–1020 BC	11th century	Area A	120–121
9	1075–1005 BC	11th century	Areas A, C, D	198–204
10	1035–970 BC	Late 11th–early 10th century	Areas A, C	243–246
11	1010–775 BC	10th–early 8th centuries	Area A	276–280
12	800–745 BC	Early 8th century	Area A	309–312
13	775–655 BC	Mid 8th–mid 7th centuries	Areas A, C	329–330, 351–353
14	740–605 BC	Late 8th–7th centuries	Area A	376–378
15	685–570 BC	Mid 7th–early 6th centuries	Area A	377–378
16	635–535 BC	Late 7th–mid 6th centuries	Areas A, C	353–354, 377–378, 391

set of foundation deposits that included four human burials, two of which were composite collections of parts of several mummified bodies.

The earliest traces of human activity in Area A were criss-cross ardmarks within a Beaker-period cultivation soil (Phase 1; Figure 23.1). These were covered by a small cemetery of cremation burials with two pyres (Phase 3). One of the cremation burials served as the base for a hearth for a post-built oval house (House 2835; Phase 4). This was then ploughed over (Phase 5) and dug into by pits, one of which was evidently intended to remove cremated bones from the burial (Phase 6). In Phase 7 a sunken-floored structure with a cigar-shaped plan (Structure 2477) was built in the centre of Area A and a tiny roundhouse (House 3260) was built further south, half of it encountered within the southern edge of the site.

The row of three east-facing roundhouses within Area A was aligned north-northeast–south-southwest and consisted of a large central house (House 401) flanked to the south by House 801 and to its north by House 1360 (Figure 23.2). All had sunken floors and shared party walls with sand wall cores. House 401 was the main area of deposition of clay refractories (heat-resistant materials) for casting bronze weapons and tools (see Chapter 1). Many of these mould fragments were deposited within the entrance area of the house, built over in the later part of Phase 9 by a small, circular forecourt structure. House 801 was inhabited less intensively, due partly to its short occupation span within Phase 9, although, like House 401, it possessed a sleeping area as well as a central hearth. House 1370 similarly had evidence of inhabitation associated with its two successive floor layers (both within Phase 9) though diverse activities in its interior included animal stalling as well as potting and metallurgy.

Around 1000 cal BC in Phase 10, House 801 was demolished, leaving Houses 401 and 1370 to be rebuilt as a paired modular unit. In the later part of Phase 10, a new roundhouse (House 2190) was built on the southern edge of the former House 801. It was gone by Phase 11, leaving only the two roundhouses; although House 401 was again rebuilt, House 1370 was replaced by a more ephemeral structure. From Phase 12 onwards, House 401 was the only roundhouse in Area A except for a poorly surviving structure, House 1500, in the south of the excavation trench in Phase 14 (Figure 23.3). With successive rebuilds in each phase, House 401 progressively changed from a habitation to a workshop and storage space. Its sequence ended in Phase 16 (Figure 23.4). Later in the same phase, a small double roundhouse (House 640) was built in the northeast corner of Area A and may have served as a smokery and/or a steam room.

Area A covered the northern half of a large settlement mound (Site 55; Parker Pearson 2012a: 26, 48 footnote). With a north–south width of 80m, this mound may preserve remains of another three or four roundhouses in its southern half, one of which (House 2049 in Phase 9) was recorded in a small trench (Area D) dug within the southernmost extent of the mound.

Just 100m to the northwest, in Area C, a second double roundhouse (House 150) was in use during Phase 13, its floors containing copper-alloy metallurgical debris deposited in advance of the building's abandonment in Phase 16 (Figure 23.5). This double roundhouse had been dug into a midden of Phases 9 and 10, itself placed on top of layers at the base of which were deposits containing Cordoned Urn pottery (Phase 2). West of this was Area B, a heavily disturbed area where archaeological deposits had largely been destroyed by sand quarrying and wind erosion.

1 Metallurgy: ceramic material associated with metalworking

T. Cowie and M. Parker Pearson

Ceramic material identified as being associated with Late Bronze Age metalworking amounted to 422 pieces, with a total weight of just over 2.3kg.[1] This total does not include a relatively small number of items whose interpretation as metallurgical debris is uncertain. While some of these have an 'industrial' look to them, a domestic function seems more likely. Other pieces initially identified as possible crucible or mould fragments during excavation have been discounted on subsequent identification as being pottery. The extremely fragmentary and soft, friable nature of many of the mould fragments has made for problems of identification. Their recovery is testament to the relatively benign burial environment and quality of finds retrieval.

The assemblage of Late Bronze Age ceramic material associated with metalworking comprises the following categories:

- Crucibles.
- Pouring gates.
- Cores.
- Inner valves representing parts of a minimum of at least 16 different moulds/mould units, including at least two swords, three spearheads, a socketed chape, a possible socketed knife, two socketed axeheads, a further socket possibly for a spearhead, a tanged bifid razor, a corrugated band, a minimum of three pin moulds and a ring or penannular bracelet.
- Abraded inner valve fragments retaining some features.
- Miscellaneous valve fragments mostly too abraded to be informative.
- Outer wrap fragments.

1.1 Crucibles

Only a relatively limited number of 37 definite crucible sherds are present. A few sherds initially identified in the field as possible crucible fragments have been subsequently identified as rims of pouring gates, wrap fragments or as burnt or re-fired pottery and as a result have been discounted. Conversely, some pieces originally recorded as fragments of mould have been re-classified as crucible.

Crucibles are under-represented in the assemblage of ceramic material associated with metalworking, leaving many aspects of their original form, profiles and capacities uncertain. All are round-topped, with some variations in the degree to which the walls draw in or taper towards the mouth (Figure 1.1). One possible crucible sherd (SF 5002.1, context 923) may have had a more flattened rim but is too fragmentary for any certainty and, in the absence of any slagging, may simply be a burnt potsherd (not illustrated).[2]

On the other hand, it is evident that a range of sizes is represented. The rim sherds available for examination can be distinguished, albeit rather qualitatively, as follows:

- *moderately thick-walled*: sherds with wall thicknesses less than 10mm – SF 4113 (context 412); SF 4130 (context 1791); SF 4946 (context 1507); SF 4687 (context 1311).
- *thick-walled*: four sherds have wall thicknesses of 10mm–15mm and probably all derive from the same vessel – SF 4117 (context 1226); SF 4149 (context 1739); SF 4150 (context 1591); SF 4159 (context 1439).
- *very thick-walled*: sherds with wall thicknesses more than 15mm – SF 4123 (context 655); SF 5400 (context 1933).

Given their very fragmentary state and the unrepresentative amount of rim present, accurate estimation of vessel diameters and capacities of the individual crucibles is not possible except for the very thick-walled vessel represented by SF 4123 which has an estimated rim diameter of approximately 200mm (Figure 1.2).

In most cases, the surviving portions of the crucible rims are featureless but, at the break-edge of one of the two joining fragments of the rim of the large thick-walled crucible SF 5400, the presence of a slight dip and a slight out-turn suggests that the rim has fractured just at the point where it may have been dipping down into a pouring lip. Similarly, SF 3724 is a rim sherd with part of its pouring lip surviving (Figure 1.3). Good examples of crucibles with intact pouring lips are Crucible A from Dainton, Devon (Needham 1980: 186–8, figs 4 and 5b) and Crucible 1 from Springfield Lyons, Essex (Needham and Bridgeford 2013: 62, fig. 3.6).

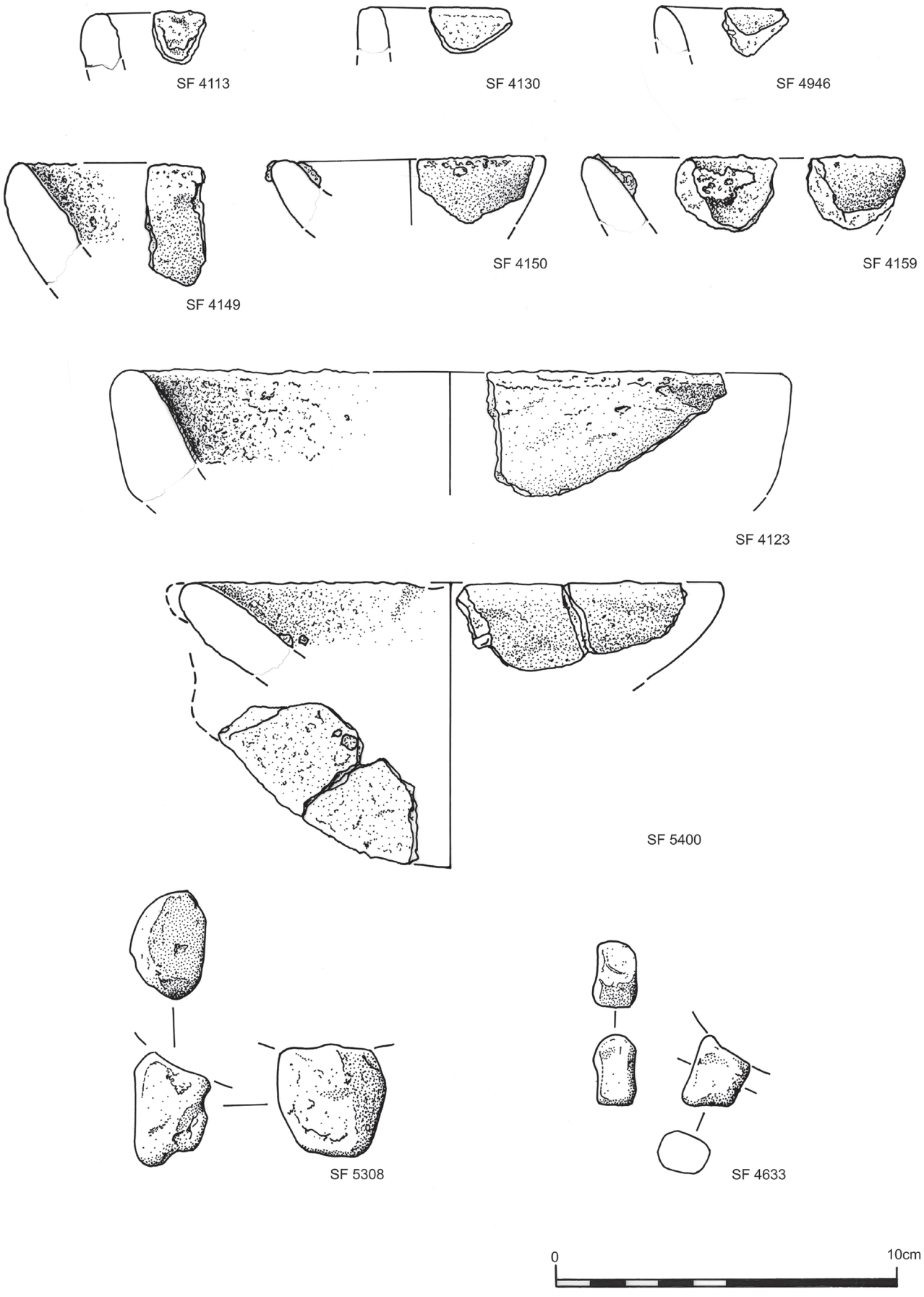

Figure 1.1. Crucibles from Cladh Hallan

Figure 1.2. A crucible rim in section (SF 4123 from floor layer 655)

Figure 1.3. A crucible sherd with bronze droplets adhering to its surface (SF 3724 from layer 1612)

In most cases the present condition of the sherds reflects the exposure of the ceramic vessels to high temperatures, quite possibly over a prolonged working life. Most of the sherds show evidence of vitrification/slagging, especially SF 3724, SF 4123, SF 4159, SF 4150 and SF 5400. A feature of specific interest is the evidence for relining and heightening of the rim of crucible SF 4149 which has been built up by the addition of an extra slab of clay resulting in a narrower, more tapered rim approximately 10mm higher than the original rim (Figure 1.4). The relining and heightening of crucible rims is also documented from Dainton (Needham 1980: 189).

Figure 1.4. A crucible rim in section with relining and heightening (SF 4149 from context 1739)

Analysis of the bronze traces in the crucibles was undertaken by Dr Andy Heald as part of his doctoral research (Heald 2005) and subsequently by Matthew Juddery as an MSc dissertation (Juddery 2010).

Among the miscellaneous ceramic material likely to be associated with metalworking are two items whose interpretation remains uncertain but which may be the detached legs or feet of footed crucibles (Figure 1.1). One of these (SF 4633 from context 874) is a stubby fragment of baked clay with a slightly waisted appearance (Figure 1.5). Clearly deliberately shaped rather than an accident of firing, one end has a slightly concave surface suggesting that this may have originally been affixed to a corresponding *convex* surface; the other end may be worn but appears close to original in its form. This may be the detached leg or foot of a footed crucible (Stuart Needham pers. comm.); a further possibility is that it is some kind of test piece. Crucible A from Dainton is a good example of a footed crucible (Needham 1980: figs 4–5).

Although larger and in very worn condition, another oddity (SF 5308 in context 1311) may be a crucible foot. This fragment of fired clay has two slightly curved sides meeting at an angle which may be original, while on one surface there is what appears to be a rough, projecting tenon. The fragment has a coarse 'industrial' feel to it, raising the possibility that it is the detached foot of a large crucible or heating tray. However, as in the case of some of the other miscellaneous ceramic material from the site which defies easy interpretation, this piece could be domestic rather than metallurgical in origin.

Figure 1.5. The foot of a footed crucible (SF 4633 from context 874)

In general, the fabric of the crucible sherds can be distinguished by the marked presence of inclusions of coarse sand/grit. The fabric of the crucibles was analysed by Daniel Sahlén in his study of ceramics associated with metallurgy in later prehistoric Scotland (Sahlén 2011; 2013). In hand specimens, Sahlén characterised the general appearance of the crucible fabrics as sandy to very sandy clay with some larger sand grains and grains of grit; the inclusions are predominantly quartz but other mineral groups are present. The analysed fragments are partly oxidised, yellow-brown to reddish-brown in colour, and are severely heat-damaged or vitrified. The material was divided into two preliminary fabric groups, and selected sherds were sampled for petrological study of the material in thin-section.

Table 1.1. Crucible fabrics from Cladh Hallan (after Sahlén 2011)

Fabric	Description	SF number
Fabric 1	Sandy to very sandy clay with some larger grains of sand. The material is porous and light brown (7.5YR 6/4) to very pale brown (10YR 7/3).	SF 4117; SF 4123; SF 4130; SF 4149; SF 4150; SF 4159; SF 4165; SF 4793; SF 4950; SF 4991; SF 5002
Fabric 2	Sandy clay with a large amount of larger grains of sand and grains of grit. The material is reddish-yellow (5YR 6/8) to yellowish-red (5YR 5/8).	SF 4113; SF 4155; SF 4946; SF 5400; SF 5484

As in the other categories of metallurgical material under discussion, the question of what is under-represented or wholly absent is pertinent to the interpretation of the nature and location of the metalworking. In the case of the crucibles, very few body sherds are present and those that are present are very small (there are only three definite wall sherds which are not otherwise associated with rim sherds: SF 4155 [context 1414] and SF 4584.1, SF 4584.2 [context 1933] and SF 5828 [context 2011]). Why this should be so marked may be due to a combination of factors. Firstly, workshop practice among traditional metalworkers

Table 1.2. Contextual associations for crucible sherds

Phase	SF no.	Context	Area
8	SF 4165	770	Forecourt
8	SF 4130	1791	Forecourt
9	SF 4633	874	Forecourt
9	SF 4793.1	874	Forecourt
9	SF 5582	1132	Forecourt
9	SF 4354	1933	Forecourt
9	SF 4584	1933	Forecourt
9	SF 4584	1933	Forecourt
9	SF 5578	1933 sq 3825	Forecourt
9	SF 5578	1933 sq 3825	Forecourt
9	SF 5400	1933 sq 3826	Forecourt
9	SF 5400	1933 sq 3826	Forecourt
9	SF 5585	2210	House 1370
9	SF 5579	1369 sq 3549	House 1370
9	SF 4687	1311	House 401
9	SF 5577	1311 sq 2964	House 401
9	SF 5583	1311 sq 2999	House 401
9	SF 5580	1311 sq 3093	House 401
9	SF 5581	1311 sq 3094	House 401
9	SF 5413	1311 sq 3231	House 401
9	SF 5308	1311 sq 3242	House 401
10	SF 5002	923	Area C midden
10	SF 5002	923	Area C midden
10	SF 4149	1739	House 1370
10	SF 4946	1507	House 401
10	SF 4945	1507	House 401
11	SF 3371	752	Forecourt
11	SF 3724	1612	House 1370
11	SF 4991	800	House 401
11	SF 4155	1414	House 401
11	SF 4123	655 sq 2267	House 401
11	SF 4113	412	S Area
11	SF 4113	412	S Area
12	SF 4150	1591	Forecourt
12	SF 5828	2011	House 1500
12	SF 4117	1226	House 401
12	SF 4159	1439	S Area

suggests that crucibles may be prized and/or maintained and this is reinforced by the evidence for relining or heightening of rims (SF 4149, noted above) which suggests that care was taken to prolong the working life of successful crucibles. Unless dealing with a sealed workshop context – which is not the case at Cladh Hallan – crucibles will therefore tend to be under-represented. Also, failure of the crucible at the end of its working life will have a bearing on what does survive – the body of the vessel will be more susceptible to damage and fragmentation.

Conversely, the rim and upper body, especially if heavily vitrified or slagged, may be more resistant to fragmentation, thus promoting greater chance of survival. However, the pattern of loss or discard will also depend heavily on particular workshop practice – whether discarded crucibles or crucible fragments ended up with other mould debris or were in some way treated differently. For example, even if unusable for casting, broken crucibles might still have been curated in some way, either as convenient receptacles around the workshop or broken up for use as grog.

Most crucible sherds were recovered from Phase 9 contexts, the majority from House 401's forecourt floor layer (1933) or its interior floor layer (1311). Only one other sherd was recovered from a floor layer – floor 655 of House 401 in Phase 11. The remaining 15 sherds from Phase 10–12 contexts are not from floor layers and are likely to have been secondary depositions in fills, disturbed from floor 1933 by pit-digging or removed from their original contexts of deposition. Two of these were deposited in the midden sequence within Area C, 100m to the northwest of the roundhouses in Area A.

The distributions of crucible sherds within floors layers 1311 (Phase 9) and 655 (Phase 11) in House 401 and 1369 (Phase 9) within House 1370 are largely peripheral to the distributions of mould fragments and copper-alloy droplets as well as to the houses' central hearths which appear to be the foci for bronze-casting (see Figures 1.12 and 1.26). The same is true for their distribution within floor layer 1933 (Phase 9) within House 401's forecourt where they cluster to the northwest of the main cluster of mould fragments on the north side of the house's entrance (see Figure 1.13). Thus it is very likely that crucibles and their fragments were treated differently, moved and deposited in ways that were different to the treatment of mould fragments.

1.2 Pouring gates

Eight finds can be identified as fragments of pouring gates from mould assemblies, with a compact sandy fabric similar to that of some of the surviving fragments of outer wrap. A minimum of five different pouring gate rims can be distinguished on the basis of variations in form and wall thickness (Figure 1.6). However, these are all are too fragmentary to allow any estimation of their original dimensions, making correlation with a specific mould assembly impossible.

Although none of the pouring gates can be assigned with any confidence to any of the moulds identified below, the variations in their size would be broadly in keeping with the range of moulds required to produce the variety of types represented in the assemblage, ranging from swords to

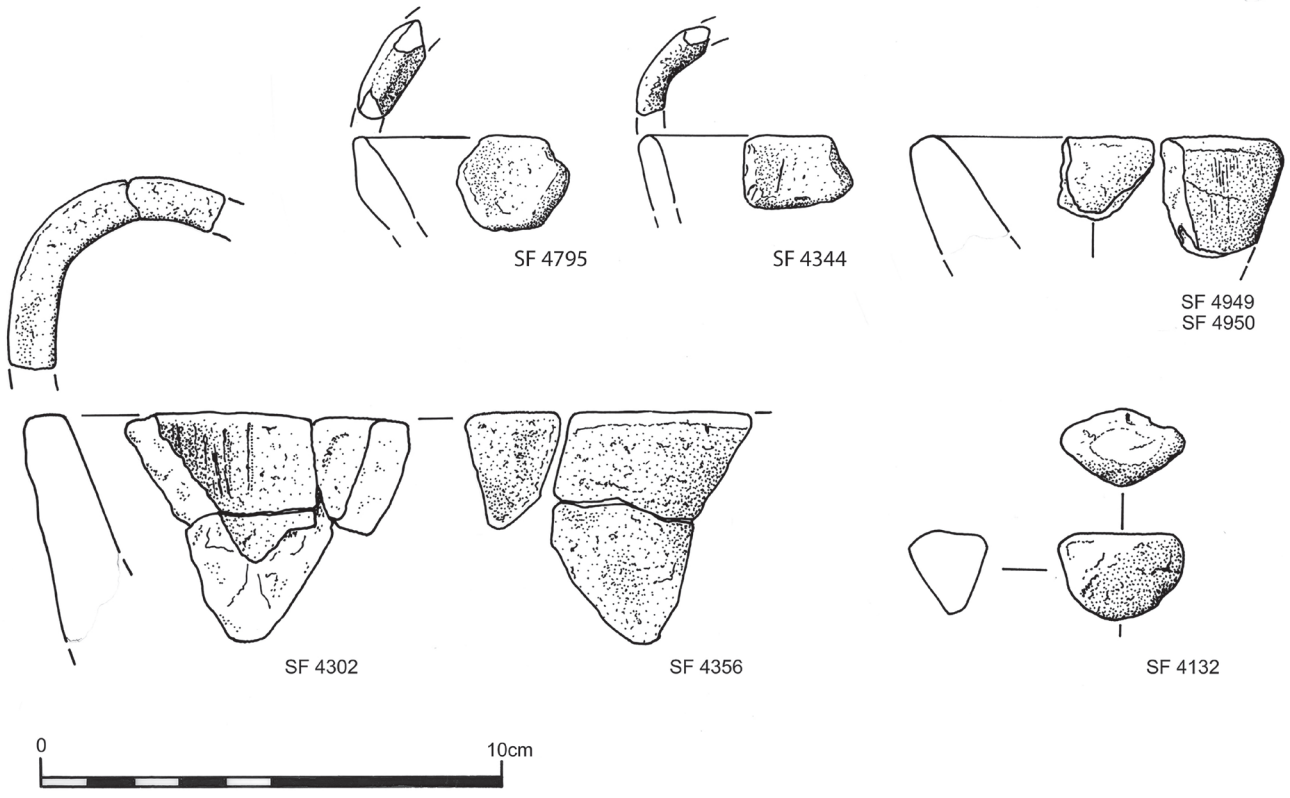

Figure 1.6. Pouring gates and a mould core from Cladh Hallan

Table 1.3. Pouring gates identified from Cladh Hallan

Mould	SF no.	Brief description	Context	Phase
Pouring gate 1	SF 4302 SF 4356.1-2	Two pouring gate rim sherds and a wall sherd. Cross-context join.	2185 1933	10 9
Pouring gate 2	SF 4949 SF 4950	Two pouring gate rim sherds probably from same assembly. Probable cross-context link.	1575 518	10 11
Pouring gate 3	SF 4795.1– SF 4795.2	Pouring gate rim sherd and non-joining wall fragment but probably from same assembly	2210	9
Pouring gate 4	SF 4344	Pouring gate rim sherd	1933	9
Pouring gate 5	SF 5584	Pouring gate rim sherd	1680	9

Figure 1.7. A pouring gate for a sword (SF 4302 and SF 4356 from contexts 2185 and 1933)

small tools. For example, the mouth of Pouring gate 1 must have been at least 60mm across, while Pouring gate 4 has a projected diameter of only 40mm (with the caveat that an oval opening could of course have been somewhat larger).

In summary, although the group of pouring gate fragments sheds only limited light on their original forms, it is potentially representative of the arrangements in place for casting a variety of objects or products. Although none of the gates can be linked to specific mould assemblies, the size of Pouring gate 1 (SF 4302 and SF 4356) would be in keeping with a large casting such as a sword mould (Figure 1.7), while Pouring gate 2 (SF 4949 and SF 4950) would be consistent with a mould unit for at least the size of a socketed axehead.

Parallels for the general form of the pouring gates are known from Jarlshof, Shetland (Curle 1933: 120, 122, figs 39, 41; 1934: 278–9, 282, figs 46.1, 49), and Galmisdale, Isle of Eigg (Cowie 2002: 8). Unlike at Jarlshof, where an intact sword mould was discovered with its pouring gate (Curle 1934: fig. 46.1), at Cladh Hallan there is no such correlation or tie-in with a specific mould assembly. Apart from the serendipity factor, the survival of the few pouring gate fragments may also simply reflect the greater degree of compaction of the clay involved in the process of modelling and shaping the rim (and therefore providing a slightly greater resistance to disintegration).

Pouring gates 1, 2 and 4 derive from deposits associated with House 401 and its forecourt. The conjoin in Pouring gate 1 shows a relationship between context 2185 (a floor layer in the forecourt of House 401 in Phase 10) and, directly beneath it, context 1933 (early Phase 9 floor layer in the forecourt of House 401). Context 1933 also produced the fragment SF 4344 representing Pouring gate 4. The two sherds making up Pouring gate 2 show a possible relationship between context 1575 (fill beneath floor layer 1310 of Phase 10 in the northwest quadrant of House 401) and context 518 (fill in House 401's forecourt in Phase 11, most likely residual from layer 1933 in Phase 9). Pouring gate 5 is from outdoor surface 1680 (Phase 9) within the front yard beyond House 401's forecourt, thus deposited a little further from House 401 than the cluster of mould fragments within layer 1933. Finally, Pouring gate 3 is from context 2210 (fill of pit 2378 below floor 1369 in House 1370 in Phase 9).

1.3 Cores

Among the miscellaneous ceramic material likely to be associated with metalworking, three items merit a mention although their interpretation remains uncertain. SF 4132 (context 1705 within floor layer 1311; 6.2g) is an irregularly wedge-shaped fragment of fired clay (see Figure 1.6); while its convex 'outer' surface seems to be a real reflection of its original shape, the other faces simply result from breakage and wear. This fragment appears to be the remains of the clay core from a mould unit for a socketed object – most likely a socketed axehead. If correctly identified as a core, the surviving size of the fragment provides an approximate indication of the minimum socket dimensions, implying an axehead with the proportions of, for example, Type Gillespie or Type Portree (Schmidt and Burgess 1981: 184–7, 191–7, plates 73–4, 77–9). A less likely possibility is that this could be part of the worn foot from a large crucible or tray.

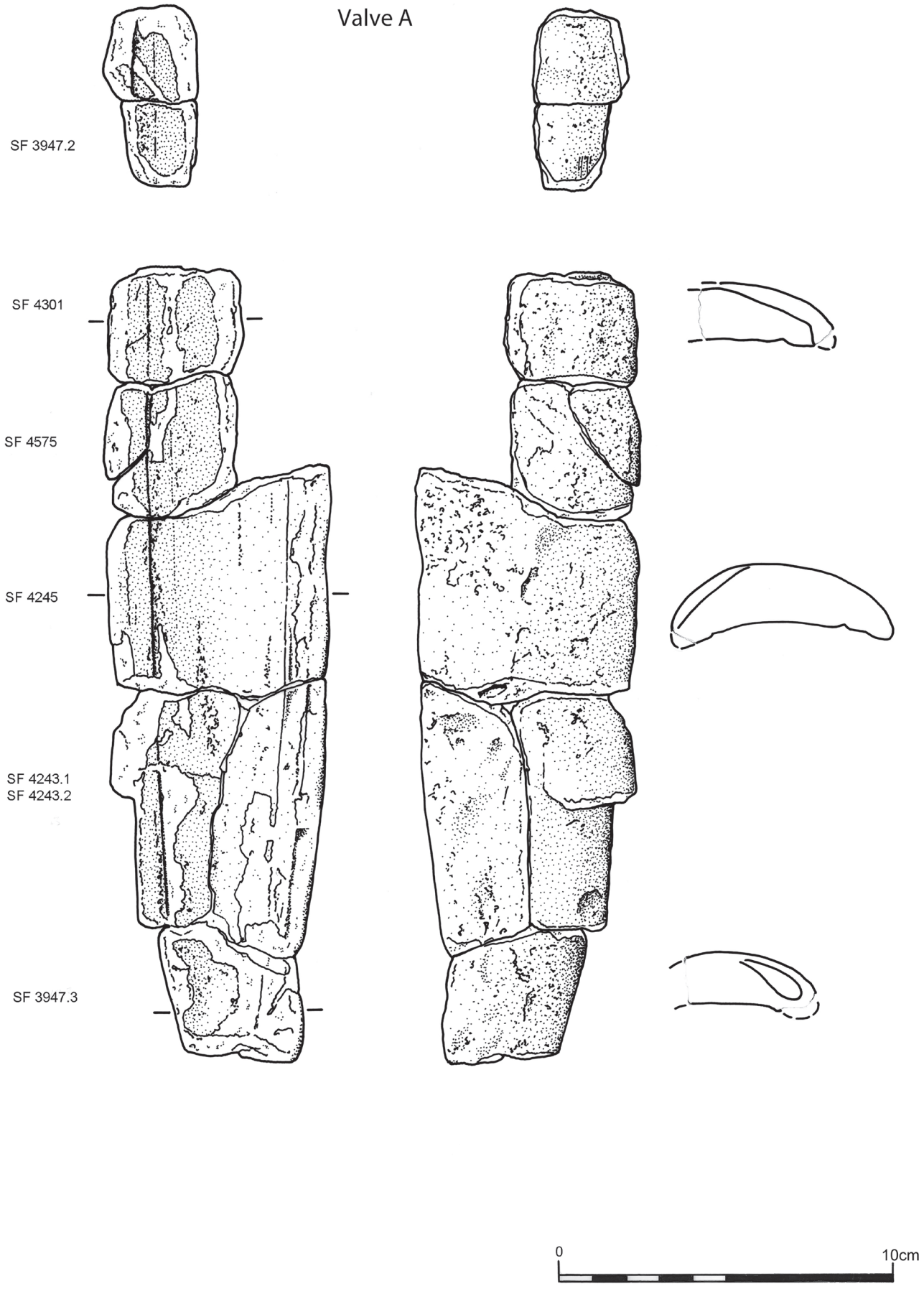

Figure 1.8. Valve A of the mould for Sword 1

A further two pieces (SF 4105.2 in context 583; SF 4996.1 in context 2764 [3g], not illustrated) may also be possible fragments of cores. Both contexts are assigned to Phase 8 (construction of House 401) but can be considered as equivalent to the Phase 8–9 transition. Layer 583, in the north part of House 401's forecourt, is associated spatially with the mould fragment cluster there in layer 1933 while context 2764 is the fill of a small, posthole-sized pit (2765) 2m southwest of House 401's central hearth.

The under-representation of such material is not unexpected: much of this type of material would be cleaned out during the primary cleaning of the casting. By its very nature, the more resistant parts of the core would tend to be prised out of the socket in small, relatively shapeless pieces.

1.4 Inner valves

Inevitably the most informative element of the assemblage comprises a range of fragments of inner valves. Varying from single but in some cases still diagnostic pieces to more substantial portions, they represent at least 16 different moulds or mould assemblies (as defined by Needham 1980: 181–4). Owing to the fragmentary and presumably redeposited nature of the assemblage these must be taken as minimum figures in terms of actual numbers of objects cast. That said, the surviving fragments may be assumed to be a reasonably fair reflection of the range of weapons, tools and ornaments manufactured at the site.

In general, the mould fragments have a grey to dark grey matrix and valve contact surfaces; the external surfaces of the valves tend to be reddish-brown through to a stronger red in the case of heavily fired or refired fragments. In the case of catalogued items, details of colour have been included to provide a more rounded description and to complement the illustrations.

Mould assembly 1: Sword 1

Both numerically and by weight, the assemblage from Cladh Hallan is dominated by fragments deriving from a single mould unit for a leaf-shaped sword. While some of the moulds from Cladh Hallan are represented by no more than single fragments of valve, in this case substantial portions of both valves are present, amounting to a minimum of 24 fragments, some of them quite sizeable as implied by the total weight of 619.1g. Further pieces may be present among the miscellaneous inner valve fragments, too small and worn to allow identification, but their small size would not significantly alter this picture.

The principal fragments assigned to this sword mould assembly comprise a series of single and conjoining fragments retaining matrix surface and contact faces. A number of these display the full width of the matrix and a complete or near-complete section through inner valve and outer wrap, recorded as A and B (Figures 1.8–1.10).

In addition to the main body of fragments retaining significant features, a further nine inner valve fragments (45.2g) represent portions of the mid-blade region of the sword. Although they lack contact faces and edges (and consequently indications of their location on the blade) they can be identified with some confidence as further fragments of this mould unit on the basis of their fabric, colour and condition. These include one piece (SF 4580) with a clear junction between inner valve and wrap, which was sampled for fabric analysis (Sahlén 2011).

On the basis of surviving features such as colour, fabric and condition, some of the more abraded fragments can also tentatively be attributed to this mould assembly. Although impressive in their bulk, the extant portions of the valves represent only some 50% of the original sword mould. Moreover, the surviving elements have their limitations in terms of typological analysis as the matrix is well represented only from the broadest portion of the blade down to a point close to the tip. By contrast, very little of the upper blade survives (and then from valve A only) with nothing at all recognisable from the hilt portion, thereby depriving us of the key features which would shed light on the typology of the weapon, whether Wilburton types with rivet slots in their hilt tangs or Ewart Park types with rivet holes (Colquhoun and Burgess 1988: 40, 66).

Figure 1.9. Conjoining fragments of Valves A and B of Sword 1

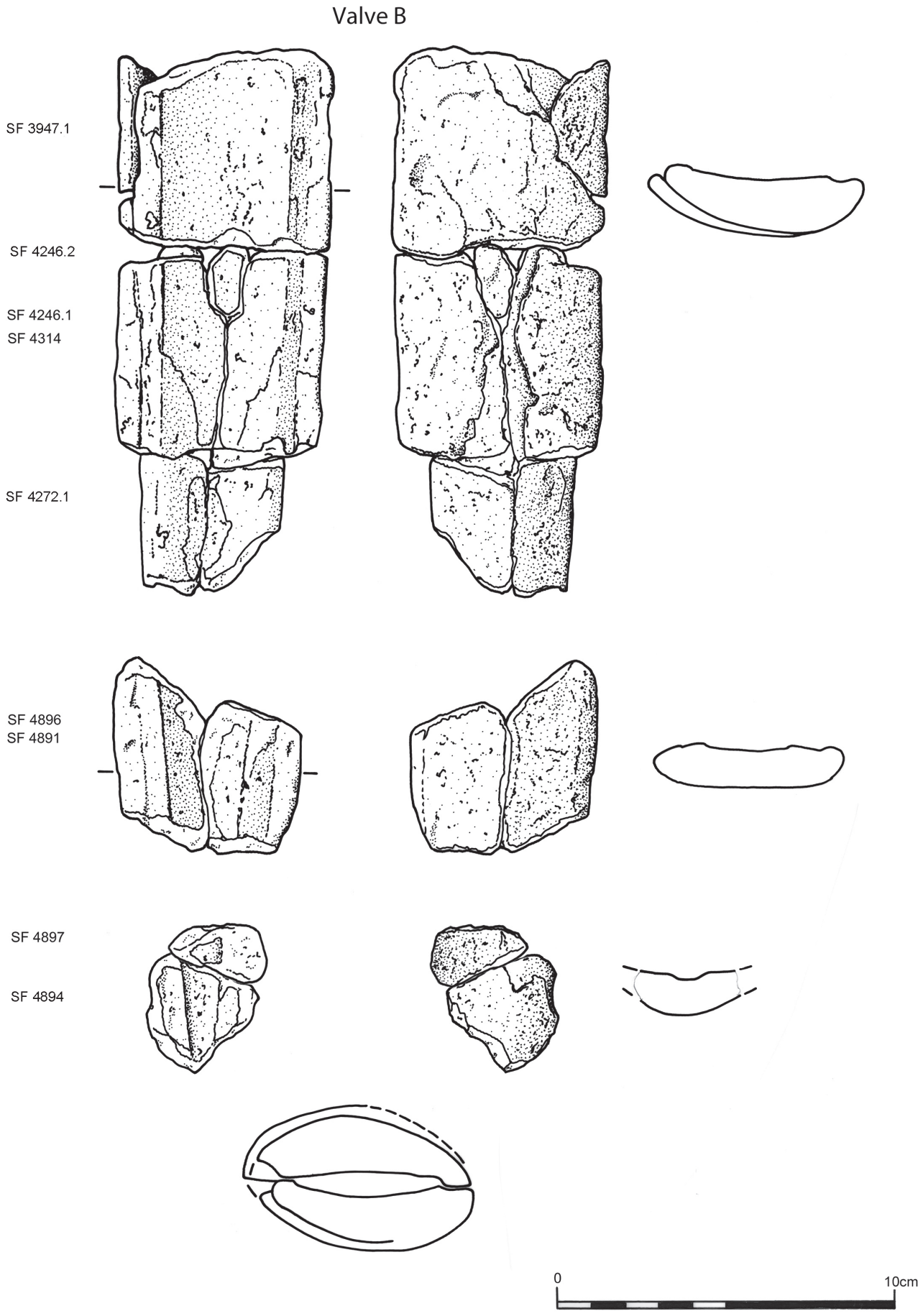

Figure 1.10. Valve B of the mould for Sword 1

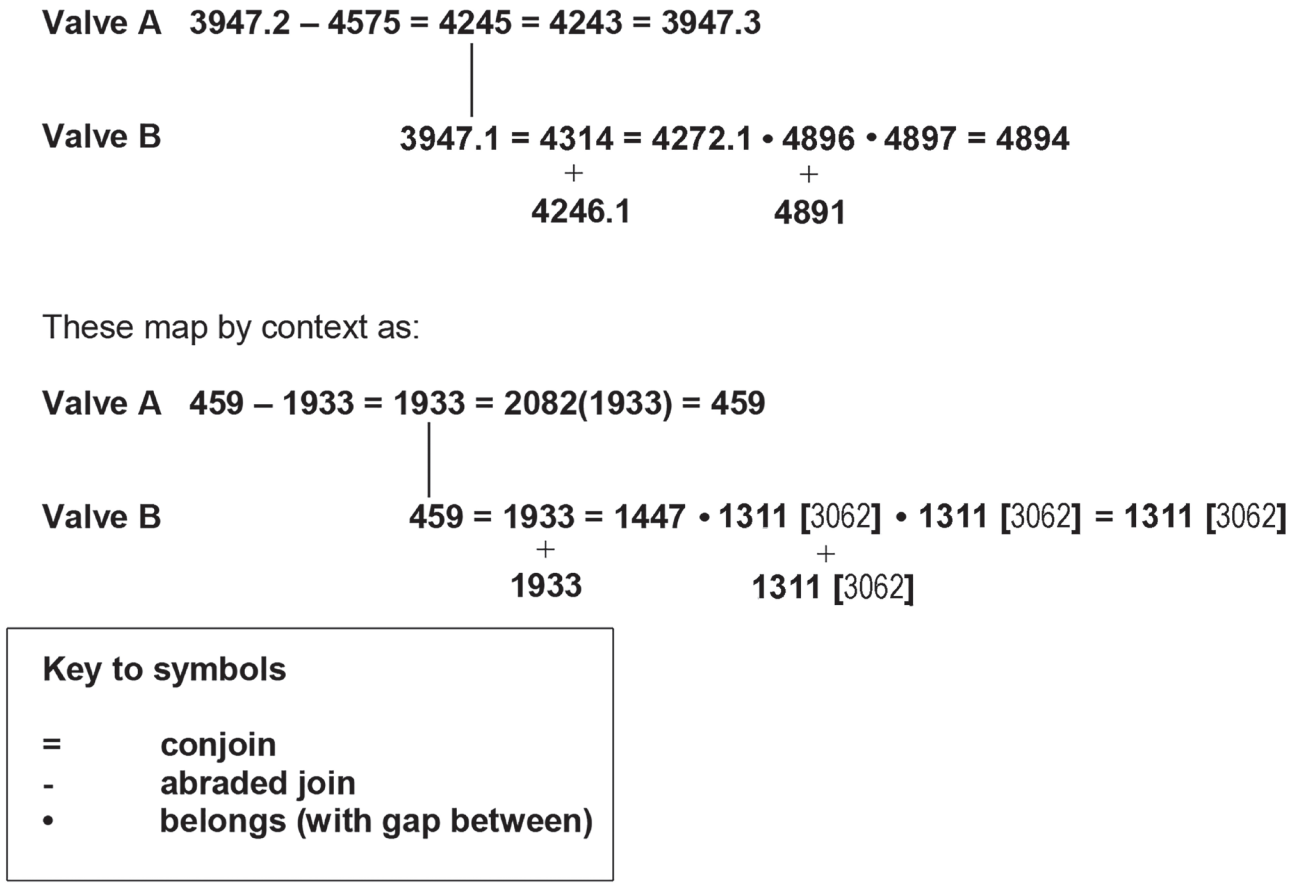

Figure 1.11. Joins for the mould assembly of Sword 1

Despite this drawback, useful information can be gleaned from the extant portions of the mould (see Figures 1.8–1.10). The survival of the complementary valves around the central portion of the blade allows accurate measurement of its dimensions, indicating a blade *c*. 6mm thick at the midpoint and 41mm in maximum width (at the upper end of the complete blade sections). Despite the partial survival of the portions of the matrix for the lower blade, it is apparent that the blade tapers quite gently to the tip.

Some more subtle features are also detectable in the matrix cross-sections. It was noted that the profile of the blade already displays slight blade-wing hollowing. On the other hand, the junction of the matrix and valve contact surfaces is quite pronounced, implying that the casting would have had a slightly thickened edge, and consequently indicating that creation of the typical sharp edge of the sword blade was intended wholly as part of the post-casting working phase. Although much of the matrix surface is pitted and eroded, portions are in relatively good condition; none of these show any sign of the graining which would indicate the use of a wooden model, possibly but not certainly allowing us to infer that an existing sword was used.

Turning to the mould's construction, its valve edges tend to be tapered to a rounded edge (in contrast to the mould assembly for Sword 2). Furthermore, the two full cross-section complementary sherds (SF 4245 and SF 3947.2) show clearly the oblique contact junctions, indicating that the inner valves were prepared in a similar fashion to the sword mould units at Dainton, Devon (Needham 1980: 206–7, fig. 13).

Characteristically, the inner valve and outer wrap can be distinguished by marked differences in the fabric (Sahlén 2011). Also the wrap tends to be slightly darker red-brown than the inner valve.

A particular feature of Sword 1's mould unit is a marked white deposit at the boundary between the wrap and the inner valve on those fragments preserving the full profile (visible in Figure 1.9); where this 'separation layer' is present, the outer wrap appears to slough off very readily. This may be either a fortuitous chemical effect or the result of a deliberate coating of the outer surface of the inner valve (possibly powdered wood ash; Neil Burridge pers. comm.) to promote easier separation of the outer wrap after casting.

Despite their weathered condition, 17 abraded fragments of inner valve (86.4g) can be classed as fragments of sword mould (Tables 1.5–1.7). Similarities in form and fabric suggest that many or most of these derive from the mould assembly for Sword 1. For example, several fragments have traces of the distinctive light-coloured separation layer between the inner valve and wrap which marks the better-preserved portions of Sword 1.

Apart from fragments of wrap still adhering to the valves or bagged together, eight detached fragments of outer wrap (52.7g) are certainly or probably derived from this sword

Table 1.4. Contextual associations for Mould assembly 1 (Sword 1)

Valve A				
SF no.	*Context*	*Phase*	*Area*	*Weight (g)*
SF 3947.2	459	11	Forecourt	27.1
SF 3947.3	459	11	Forecourt	31.4
SF 4243.1–2	2082 (1933)	9	Forecourt	103.8
SF 4245	1933	9	House 401	101.2
SF 4301	2200	10	Forecourt	29.8
SF 4575.1–3	1933	9	House 401	35.7
Valve B				
SF no.	*Context*	*Phase*	*Area*	*Weight (g)*
SF 3947.1	459	11	Forecourt	84.6
SF 4147	1542	10	Forecourt	10.7
SF 4157	1414	11	House 401	12.2
SF 4246.1	1933	9	House 401	36.2
SF 4246.2	1933	9	House 401	5.2
SF 4252	1933	9	House 401	14.3
SF 4272.1	1447	11	Forecourt	14.1
SF 4314.1-2	1933	9	House 401	46.6
SF 4314.2	1933	9	House 401	-
SF 4891	1311 sq 3062	9	House 401	20.8
SF 4894	1311 sq 3062	9	House 401	12
SF 4896	1311 sq 3062	9	House 401	21.8
SF 4897	1311 sq 3062	9	House 401	4.4

Table 1.5. Inner valve fragments from Mould assembly 1 (Sword 1) but unassigned to specific valve

SF no.	Context	Phase	Area	Weight (g)
SF 4278	659	12	House 401	2.1
SF 4847	1680 sq 2868	9	SE Area	5.1

Table 1.6. Inner valve fragments, mostly sword mid-blade and probably Mould assembly 1 (Sword 1) but unassigned to specific valve

SF no.	Context	Phase	Area	Weight (g)
SF 4128.2	412	11	S Area	2.5
SF 4161	1423	11	House 401	5.6
SF 4331	1857	12	N Area	3.8
SF 4580	1933	9	House 401	9.9
SF 4688	2405	9	W Area	1.8
SF 4848	2733	8	House 401	3.1
SF 4899	1311 sq 3062	9	House 401	7.4
SF 4901	1311 sq 3062	9	House 401	8.3
SF 5333	1311 sq 3050	9	House 401	2.8

Table 1.7. Abraded inner valve fragments, probably parts of Mould assembly 1 (Sword 1)

SF no.	Context	Phase	Area	Weight (g)
SF 4111	1119	10	Forecourt	2.4
SF 4900	1311 sq 3062	9	House 401	8.6
SF 5684	1311	9	House 401	7.8
SF 5685	2342	9	House 401	5.6
SF 5682	1308	10	House 401	7.4
SF 5715	2003	10	House 1370	2.2

Table 1.8. Fragments of wrap certainly or probably part of Mould assembly 1 (Sword 1)

SF no.	Context	Phase	Area	Weight (g)
SF 4247	1933	9	House 401	4.3
SF 4272.2	1447	11	Forecourt	5.3
SF 4272.3	1447	11	Forecourt	2
SF 4272.4	1447	11	Forecourt	1.2
SF 4272.5	1447	11	Forecourt	7.6
SF 4316	1933	9	House 401	5.7
SF 4343.1–2	1933	9	House 401	17.8
SF 4558	1933	9	House 401	8.8

mould assembly. Admittedly the number of pieces is small but all were recovered from either context 1933 or context 1447. In particular, wrap fragment SF 4558 from context 1933 (Phase 9 of House 401's forecourt) joins SF 4272 (comprising inner valve and wrap fragments) from Phase 11 context 1447, also within the forecourt. Since the pieces within these Phase 11 contexts are most probably disturbed from original contexts within layer 1933 by pit-digging, this reinforces the association of Mould assembly 1 (Sword 1) with this forecourt layer at the beginning of Phase 9.

The lower part of Valve B, towards the tip of the sword blade (SF 4891, SF 4894, SF 4896 and SF 4897), from floor layer 1311 near the hearth of House 401, belongs with SF 4314 from forecourt layer 1933 (Figures 1.11–1.13). Given that House 401's hearth is associated with copper-alloy droplets suggestive of bronze-casting on this central hearth (see Figure 1.26; see Volume 1: fig. 5.45), this link raises the likelihood that initial opening of the mould assembly took place within the house before the remaining mould fragments were taken away, some of them to be deposited within the forecourt of House 401. Thus the tip of the sword was revealed beside the hearth whereas Valve B's mould fragments from higher up the blade were deposited outside House 401's entrance on the north side.

As noted elsewhere in this report, fragments of outer wrap are under-represented in the Cladh Hallan assemblage as a whole and, even allowing for the presence of wrap still adhering to the sword valves and other detached portions, it is clear that much of the outer wrap was removed from the house's interior and deposited elsewhere than within the

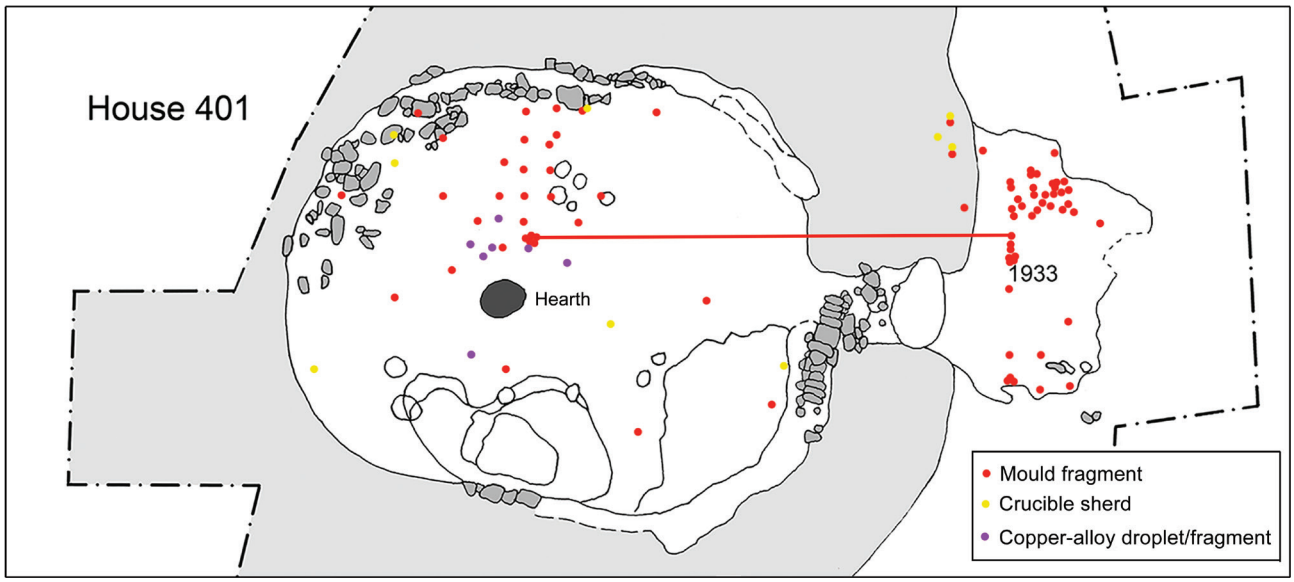

Figure 1.12. Distribution of mould fragments and other metalworking materials in the forecourt and interior of House 401. The red line indicates a conjoin between two fragments

entrance. Thus the large deposit within layer 1933 within the forecourt, as well as the fragments from within floor layer 1311, constitute only a fraction of all of the debris from casting.

Mould assembly 2: Sword 2

Fifteen sword mould fragments (93.7g; Table 1.9; Figure 1.14) are clearly derived from a different mould unit (or units) from that of Mould assembly 1. Several features distinguish these fragments from Mould assembly 1. In terms of the mould structure, the edges of these valves tend to be more squared off (in contrast to the valve edges of Sword 1 which tend to be tapered to a rounded edge as noted above). In addition, the valve itself tends to be thinner at the centre. Where portions of the outer wrap adhere to the inner valve, the wrap is seen to be of a perceptibly different character to that of Sword 1, being grittier and containing a higher organic component. However, in some cases fragments attributed to this sword appear to lack any traces of adhering wrap and are now represented only by the inner valve, mostly in noticeably worn condition. This could indicate that, at least in some portions of the mould, the outer wrap came away cleanly after casting.

The very partial survival of this mould unit leaves the precise form of the blade in doubt. While its identification as a sword mould is certain, this is partly due to the thickness of the valve towards the centre line being insufficient to accommodate a midrib (thereby ruling out the possibility of a large spearhead). By comparison with Sword 1, however, this sword is sparsely represented in the assemblage, with its recognisable fragments amounting to no more than about 5% (even allowing for a few additional unattributed sherds that might not have been recognised). The maximum surviving matrix width is 20mm (SF 4217) while one fragment is likely to derive from a location close to the tip (SF 4572) although the matrix is too eroded for certainty. Parts of both valves appear to be represented.

In contrast to Sword 1, only one of Sword 2's mould fragments (SF 5031) came from within floor 1311 of House 401. The remaining five fragments from Phase 9 contexts are all from within the house's forecourt. SF 5029 from layer 1930 (Phase 8) can also be considered to be part of this stratigraphic group within the Phase 8–9 transition involving the house's construction. Interestingly, of the four mould fragments that can be pinpointed spatially within these layers, three (SF 4191, SF 4217, SF 4846) are from among the more sparsely spread mould fragments on the south side of the forecourt. Only SF 4572 was found in the dense cluster on the north side among the fragments from Sword 1 (Figure 1.13). It can be assumed that Sword 2's process of manufacture involved the same steps as for Sword 1, being cast on the hearth and then the clay mould broken off there before other fragments were deposited in the forecourt. Once again, the vast majority of mould fragments from this sword appear to have been disposed of elsewhere.

Fragments of Sword 2's mould from Phase 10 and 11 contexts are likely to have been removed from their original Phase 9 contexts by pit-digging within the forecourt. They were re-deposited either within the forecourt and its immediate surrounds or transferred further afield into the northern roundhouse, House 1370. This latter displacement may indicate that at least some of the spoil from the Phase 10 and 11 storage pits in House 401's forecourt was spread within House 1370.

Inner valve fragments, probably parts of a third sword mould assembly

Twenty-five additional inner valve fragments of sword mould were recovered from Phase 11 and 12 contexts

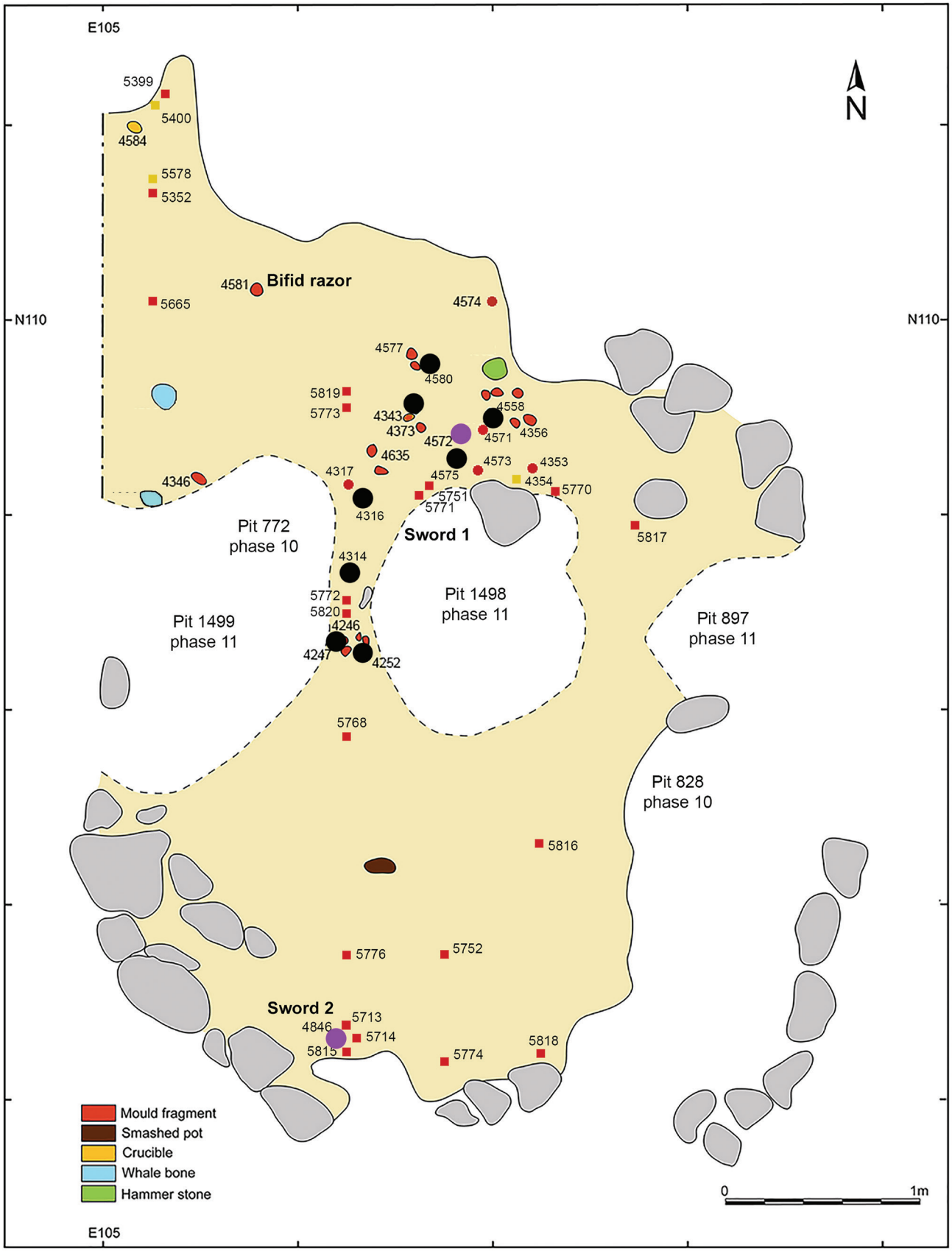

Figure 1.13. Distribution of mould fragments for Sword 1 (black circles) and Sword 2 (purple circles) within the floor layer 1933 of House 401's forecourt (see Volume 1: fig. 5.39 for base plan)

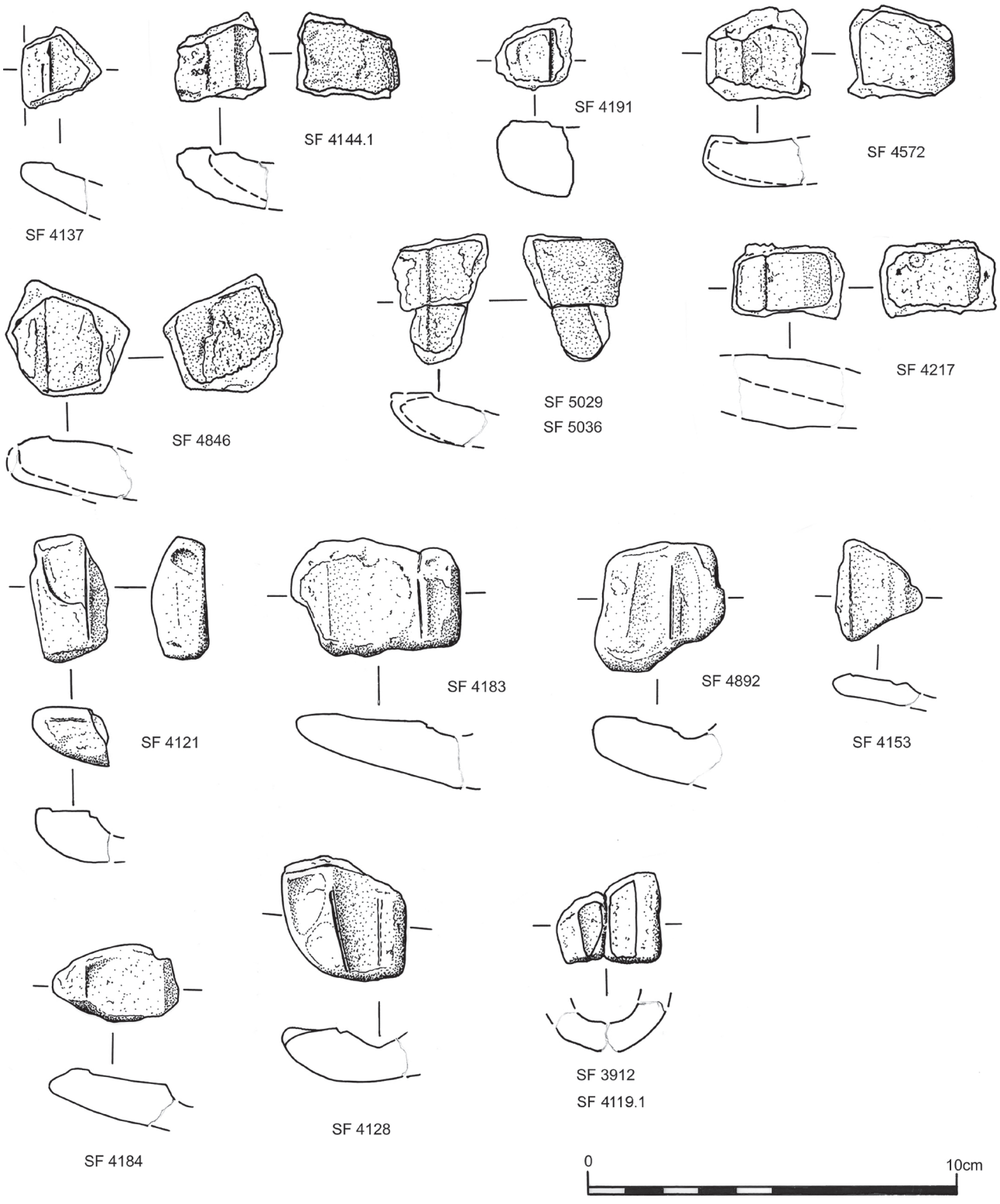

Figure 1.14. Mould assemblies for Sword 2 (top rows), Spearheads 1 and 2 (third row), and Spearhead 3, a chape and a socketed knife (bottom row)

within House 401 and from fill layers associated with House 1370 and its environs. These were initially considered to be possibly components of Sword 1's mould assembly on the basis of fabric and colour. However, the large quantity from floor layer 655 (Phase 11) of House 401 suggests that these 13 fragments (total weight 167.2g) were deposited on this floor during a later episode of bronze-casting. This observation is further supported by their spatial distribution (see Figure 1.26) and by the large size of some of the fragments (Table 1.11).

Mould assembly 3: Spearhead 1 (fillet-defined)

A minimum of 28 fragments can be classed as parts of mould units for casting socketed spearheads. Of these, five have sufficient diagnostic features to permit the

Table 1.9. Miscellaneous abraded inner valve fragments, possibly from the mould assembly for Sword 2

SF no.	Context	Phase	Area	Weight (g)
SF 4127.1	1204	11	House 1370	3.3
SF 4127.2	1204	11	House 1370	1.6
SF 4127.3	1204	11	House 1370	1.6
SF 4137	1611	10	House 401	3.6
SF 4144.1	773	10	Forecourt	9.3
SF 4158	1310	10	House 401	12.8
SF 4191	1932	9	Forecourt	8.9
SF 4217	2082	9	Forecourt	14.3
SF 4572	1933	9	Forecourt	11.2
SF 4846	1933 sq 3319	9	Forecourt	15.5
SF 4992	1644	10	House 1370	2.7
SF 5025	2082	9	Forecourt	4.5
SF 5029	1930	8	Forecourt	3
SF 5031	1311	9	House 401	7.4
SF 5036	1447	11	Forecourt	6.8

Table 1.10. Featureless valve fragments tentatively assigned to Sword 2 on the grounds of colour and fabric

SF no.	Context	Phase	Area	Weight (g)
SF 4106.2	589	12	NE Area	1.2
SF 4276	474	12	NE Area	3.0
SF 5034	874	9	Forecourt	0.9

Table 1.11. Abraded inner valve fragments, possibly parts of a third sword mould assembly based on their contextual association with floor layer 655 and associated deposits

SF no.	Context	Phase	Area	Weight (g)
SF 4109.1–2	1254	11	House 401	27.5
SF 4112	572	12	NE Area	7.2
SF 4134	474	12	NE Area	2.7
SF 4135	1548	11	House 1370	2.7
SF 4156	1414	11	House 401	8
SF 4174.1–3	1414	11	House 401	11.0 + 2.9 + 1.4
SF 4332	1857	12	N area	2.2
SF 4629	2337	11	W area	7.7
SF 4944.1–2	1547	11	House 1370	??
SF 5649	655	11	House 401	13.5
SF 5650	655	11	House 401	33.4
SF 5651	655	11	House 401	5.5
SF 5652	655	11	House 401	10.7
SF 5653	655	11	House 401	8.6
SF 5654	655	11	House 401	2.8
SF 5655	655	11	House 401	1.9
SF 5656	655	11	House 401	1.6
SF 5657	655	11	House 401	1.4
SF 5658	655	11	House 401	1.7
SF 5659	655	11	House 401	1.7
SF 5660	655	11	House 401	35.5
SF 5730	655	11	House 401	48.9

identification of a minimum of three separate spearheads. The remainder comprise miscellaneous and mostly heavily worn inner valve fragments identified as probably from spearhead moulds but lacking distinctive features.

Three separate fragments (SF 4121, SF 4183 and SF 4892) probably derive from the inner valve of a leaf-shaped spearhead with a fillet-defined blade (Figures 1.14–1.15). In the case of SF 4121, the surviving matrix surface represents part of the base of the blade, which emerges almost perpendicular to the socket. Part of the midrib – probably less than half its width – is present. Although the centre of the fragment has broken off short of the midrib, the matrix expands to preserve the width of the blade wing up to the fillet (allowing a half-width of *c*. 14mm to be inferred). Two further features may be noted; firstly, at the lower break, there is evidence of a narrow perforation, possibly fulfilling a dual function as a core support during casting which would probably be worked up subsequently into a peghole. Secondly, in the side of the valve just where blade and edge almost meet, there is a small but seemingly deliberate notch; its function is uncertain but it may possibly represent a form of keying for registration of the opposing valves.

SF 4183 derives from further up the body of what is most probably the same spearhead. The best preserved of the three fragments, it appears to have broken along the crest of the midrib, giving a blade half-width of 33mm and a midrib half-width of *c*. 6mm. The matrix surface is slightly hollowed across the blade wing, and tapers to a rounded edge, possibly just as a result of abrasion since the contact face is only very faintly defined.

The third fragment attributable to this spearhead is SF 4892, on which the surviving matrix preserves evidence of a narrow midrib – *c*. 7mm in width – and thus located high on the blade. The width of one half of the blade is preserved, giving a half-width of *c*. 15.5mm, tapering to 14.0mm over some 20mm, while the midrib/blade junction is emphasised by a very fine fillet. As in SF 4183, the matrix surface tapers to the valve edge, resulting in faint contact face definition, but this may again just be due to the worn and weathered condition of the fragment.

The three fragments attributed to this spearhead all come from Phase 9 contexts. Whilst the largest of them (SF 4892) is from the same location as mould fragments of Sword 1 close to the hearth within House 401, another is from the forecourt, on its south side where fragments from Sword 2 cluster. The third fragment is from within the southern roundhouse, House 801; it is one of only two mould fragments definitely from this building's floor (1150) and the abandonment layer above it (1149).

Comparable mould features for Spearhead 1 of notched keys can be seen on clay moulds from Galmisdale,

Figure 1.15. Mould fragment for a fillet-defined spearhead (SF 4121 from context 1149)

Table 1.12. Fragments of Mould assembly 3 (Spearhead 1)

SF no.	Context	Phase	Area	Weight (g)
SF 4121	1149	9	House 801	10.6
SF 4183	1931	9	Forecourt	2.2
SF 4892	1311	9	House 401	18.3

Eigg (Cowie 2002) and North Kessock, Inverness (Clark *et al*. 2017) and on a steatite mould from Stittenham, Highland (Coles 1962: 37, 89).

Mould 4: Spearhead 2 (fillet-defined)

The remains of a second fillet-defined spearhead are represented by a single mould fragment, SF 4153 (3.8g; see Figure 1.14). This can be distinguished from Spearhead 1 on account of the more rounded and broader form of the fillet. Moreover, the obtuse angle of the midrib side relative to the blade wing suggests that the midrib itself may have been lozenge-shaped rather than round. Assuming that the break occurred around the crest of the midrib, the surviving matrix appears to preserve a segment approximating to half the width of the blade; in this case *c*. 20mm. The valve edge itself is in a damaged condition. This fragment was recovered from context 852 (an inter-floor fill in Phase 10) in the forecourt area.

Table 1.13. Fragment of Mould 4 (Spearhead 2)

SF no.	Context	Phase	Area	Weight (g)
SF 4153	852	10	Forecourt	3.8

This mould fragment was recovered from the south side of House 401's forecourt, in the same area as fragments from Spearhead 1 and most of those from Sword 2. However its stratification in between a sequence of thin floor layers raises the likelihood that it derives from a casting event within House 401 during the transition from Phase 9 to 10.

Spearheads 1 and 2 belong to Davis' Group 13 of spearheads with fillets (2015: 162–75, fig. 6, table 6, plates 105–16). The fillets are raised ridges that run alongside the midrib for its full length; in addition, these spearheads often possess a pair of pegholes in the socket (*ibid*.: 162). As a group, they are the longest Late Bronze Age spearheads in Britain, with an average length of 270mm, and Davis describes them as special weapons for the warrior elite (*ibid*.: 163). They are distributed across Britain with a good number from mainland Scotland (for example, one of the spearheads from a hoard found at Auchtertyre, Moray) (*ibid*.: 167, no. 1182).

Mould 5: Spearhead 3

A single mould fragment (SF 4184; 8.9g) indicates the presence of at least one further spearhead in the assemblage (see Figure 1.14). This can be distinguished from the previous two spearhead moulds by the absence of a fillet. The surviving matrix indicates a plain and relatively broad blade wing. However, on the basis of the marked and rapid contraction in its width from 20mm to 17.5mm over only 10mm, it may be inferred that this must be located towards the base of an 'ivy-leaf blade', now classed as Type 11B spearheads, with a wide blade base (Davis 2015: 17, 95–6, table 6). The fragment has broken short of the midline, resulting in the survival of less than half of the midrib; as such, it is uncertain whether it was originally of rounded or lozenge section. No intact valve edge survives, nor any obvious traces of the outer wrap.

Although unstratified, the location (E105.60/N109.00) of this fragment is in keeping with the distribution of fragments from Spearheads 1 and 2: it was found within the south side of the forecourt, most likely within layer 1933 and assigned to Phase 9.

Plain spearheads of Davis' Type 11B with a wide blade base are distributed throughout Britain. Examples from Ballimore and Torran in Argyll (2015: 99, nos 553, 554, plates 60, 155) are relevant here, while other Scottish findspots include St Andrews (Fife), Talladale

Table 1.14. Fragment of Mould 5 (Spearhead 3)

SF no.	Context	Phase	Area	Weight (g)
SF 4184	Unstratified (E105.60/N109.00)	9 ?	House 401	8.9

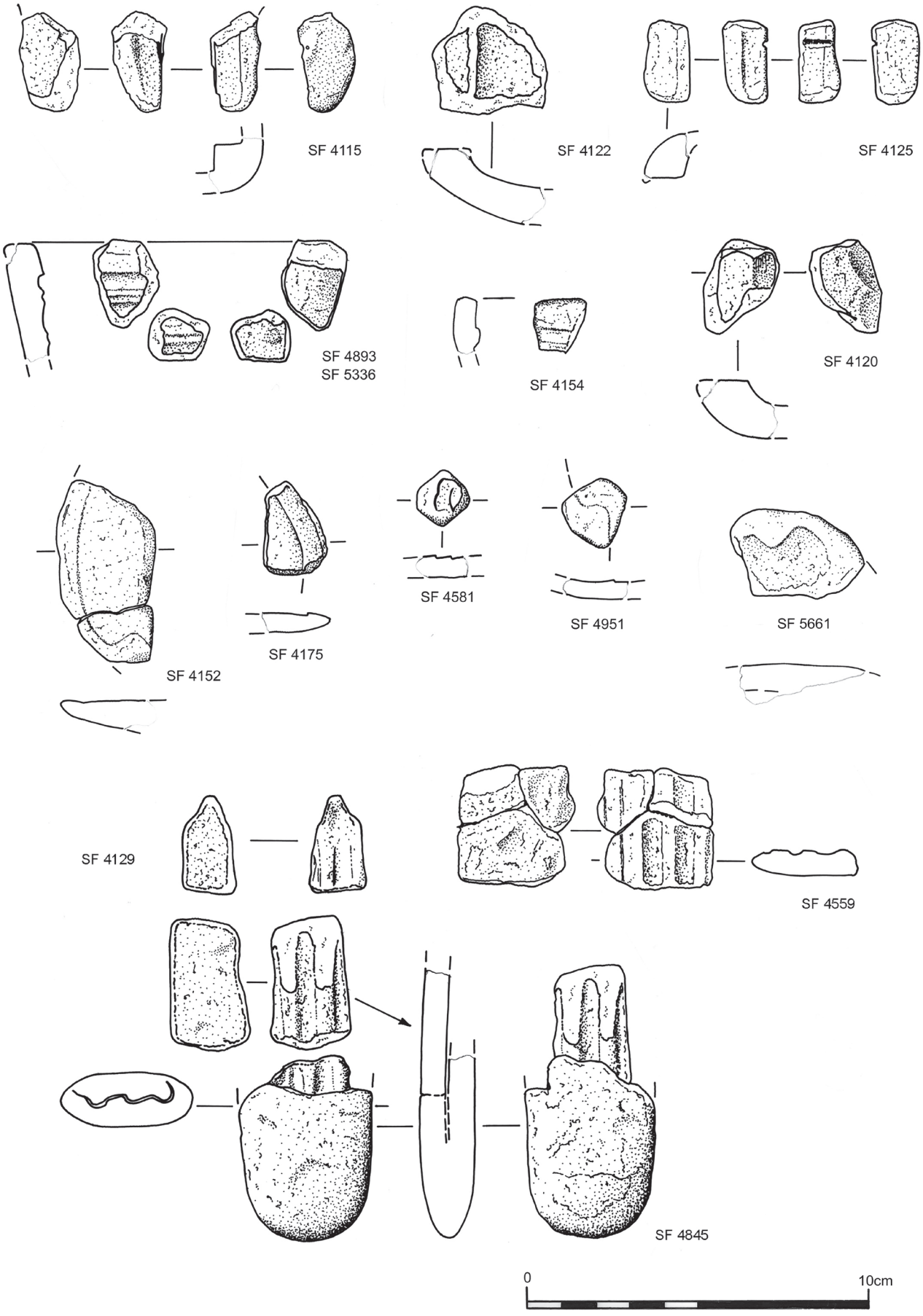

Figure 1.16. Mould fragments of socketed axeheads (top and second row), a socket of a spearhead or knife (right end of second row), a tanged bifid razor (third row) and a corrugated sheet ornament (bottom)

(Highland), Kettleshiel (Borders), Hawick (Borders) and unprovenanced locations in Aberdeenshire and, broadly, Scotland (*ibid*.: 98–104 [nos 576, 593, 600, 584, 550, 555, 616]).

Abraded inner valve fragments probably from moulds for spearheads

Twenty-three worn inner valve fragments (118.9g; not illustrated) were identified as probably derived from moulds for socketed spearheads but all lack sufficiently diagnostic features to merit more detailed discussion.

The diagnostic spearhead fragments that derive from Phase 9 (and Phase 8) contexts are mostly from floor layer 1311 within House 401 and from layer 1933 within its forecourt. Single fragments come from the front yard (1680), the later floor layer (1369) of House 1370 and another layer (1790) associated with that house.

Miscellaneous spearhead mould fragments were found in Phase 10 and 12 contexts around House 1370. One uncontexted piece came probably from above the ruined House 801. These may derive from different phases of metalworking in a variety of locations rather than dispersal of weathered fragments from within House 401 and its forecourt in Phase 9. These other locations could include floor 1369 of House 1370 (Phase 9) and floor 1308 of House 401 (Phase 10; Figure 1.26).

Table 1.15. Miscellaneous and mostly heavily worn inner valve fragments identified as probably from moulds for spearheads (not illustrated)

SF no.	Context	Phase	Area	Weight (g)
SF 4110	474	12	NE Area	1.8
SF 4136	1790	9	NE Area	2.6
SF 4151	731	12	N Area	3.1
SF 4208	1741	10	NE Area	2
SF 4616.1	1738	10	NE Area	3.1
SF 5089	n/a	-	House 801	2.1
SF 5723	2791	8	Forecourt	6.1
SF 5721	2974	8	House 401	3.5
SF 5686	1311	9	House 401	2.7
SF 5687	1311	9	House 401	1.2
SF 5732	1311	9	House 401	6.3
SF 5699	1311	9	House 401	2.1
SF 5733	1311	9	House 401	7.8
SF 5701	1311	9	House 401	11.5
SF 5734	1311	9	House 401	13.3
SF 5676	1369	9	House 1370	2.4
SF 5805	1680	9	SE Area	1.5
SF 5710	1705	9	House 401	8.7
SF 5735	1933	9	House 401	21
SF 5712	1933	9	House 401	3.1
SF 5711	1933	9	House 401	4
SF 5665	1933	9	House 401	5.1
SF 5680	1933	9	House 401	3.9

Mould 6: chape

This mould is represented by a single worn but informative fragment (SF 4128), whose distinctive lozenge-section and tapering form permit the object cast to be identified as a chape (Figures 1.14 and 1.17). For a relatively delicate casting, the valve is proportionately quite thick, with a broad and slightly undulating contact face. The surviving area of the matrix has a half-width of 9.5mm, which contracts to 7mm over a distance of 20mm. These measurements map well against the lower bodies of chapes such as one from Gogarburn House, Corstorphine, Midlothian (Colquhoun and Burgess 1988: plate 173B). As in these examples, the Cladh Hallan chape would have had a plain (as opposed to beaded) central arris. The beading along the edge is slight and is interrupted at the top where a break in the contact face probably represents the location of a narrow core support. The extant area of matrix surface is slightly bowed rather than flat, a feature that can be detected on surviving examples of chapes.

Fragment SF 4128 is from a deep and finds-poor cultivation soil (412) on top of the ruined House 801. It is most likely to be residual within this Phase 11 context. Beyond Cladh Hallan, evidence for casting chapes comes from Aubervilliers, Paris, where fragments from a minimum number of 16 moulds were found amongst a

Figure 1.17. Mould fragment for a chape (SF 4128 from context 412)

Table 1.16. Fragment of Mould 6: chape

SF no.	Context	Phase	Area	Weight (g)
SF 4128.1	412	11	S Area	14.8

large assemblage deriving mainly from the production of pins (Mélin *et al*. 2020).

Mould assembly 7: socketed knife?

Although the break edges are abraded, two fragments of mould (SF 3912 and SF 4119.1) can be united with some confidence to give a full cross-section of a valve with a profile in keeping with a casting for the socket of an object with an oval section (see Figure 1.14). If so, a width of *c*. 17mm can be inferred, with a gentle lengthwise taper. On the basis of the surviving half-breadth of the matrix, the original breadth of the socket must have been in the region of 10mm–11mm, suggesting a fairly delicate socket. Among the known range of Late Bronze Age metalwork types, the artefacts that best correspond with these features – an oval section and relatively delicate proportions – are socketed knives. Although some socketed knives can be relatively sturdy, smaller examples are known, for example in the hoard from St Andrews (Cowie *et al*. 1991; 1998; NMS online records 000-180-000-809-C, 000-180-000-824-C).

These two joining fragments provide a cross-context relationship between the Phase 10 filling (1507) of the cellar within the southern half of House 401 (SF 3912), and the Phase 11 cultivation soil 412 (SF 4119.1). It is possible that SF 3912 derives from a bronze-casting event within House 401 during the transition from Phase 10 to Phase 11, along with other mould fragments from layer 1308 and the fill (1423) of pit 1424 (Figure 1.26; Volume 1: 250–3, 264, 276, fig. 7.25).

Mould assembly 8: socketed axe(s)

Although lacking any conjoins, a group of six small mould fragments appear to represent discrete fragments of one or possibly more socketed axe moulds (Figure 1.16). It is possible that all six sherds could go together, but some caution is required owing to minor differences in colour of the outer wrap – which varies from grey to reddish – and seemingly in the fabric of the valve fragments which appear to have an uneven distribution of coarse sand or small grits. For the purposes of discussion, they will be treated as a unit.

Taking the fragments in turn, two show evidence of horizontal rim mouldings (SF 4893 and SF 5336); although the two fragments do not join, the available overlap in their profiles and similarities in fabric are consistent with their derivation from a single mould. Together they can be interpreted as part of the upper portion of an axehead with deep, complex rim mouldings (*cf* Type Gillespie variant Luncarty, Type Portree and Type Dowris variant Dungiven; Schmidt and Burgess 1981: 184–7, 195–6, 201–2, plates 73–4, 78, 81, corpus nos 1038–1067, 1138–1143, 1192–1199).

Table 1.17. Fragments of Mould assembly 7 (socketed knife?)

SF no.	Context	Phase	Area	Weight (g)
SF 3912	1507	10	House 401	4.6
SF 4119.1	412	11	South area	5.0

A further group of four fragments can tentatively be associated with the foregoing (comprising four body sherds SF 4106 [not illustrated], SF 4115, SF 4122 and SF 4125). None conjoin but, despite their small size, some details of the castings can be teased out. SF 4115 and SF 4125 indicate a side wall of 6mm maximum thickness, while SF 4122 represents a portion of the blade face. SF 4115 is identifiable as part of the right-hand side of the valve, with the half-width of the side tapering from 6mm to 3mm over a distance of 15mm. SF 4122 appears to represent a fragment from the blade end of the mould which tapers out from a half-width of 2.5mm over a distance of 20mm. However, the portion of the matrix representing the *actual* cutting edge has been lost through either fracture or attrition.

It has proved difficult to convey the subtlety of these features in the illustrations but, when correctly orientated, the mould fragment indicates that the face of the axehead has been gently bowed, with a maximum surviving width of 24mm (*i.e*. a figure consistent with *about* half of the original width of the blade face). Finally, SF 4125 retains a feature relating to the casting process in the form of traces of neat transverse, narrow core supports.

Although derived from contexts assigned to different phases and with seemingly different fabrics, it is of interest that four of the six socketed axehead mould fragments were found in or close to House 401. In particular, the recovery of the fragments SF 4893 and SF 5336 from the Phase 9 floor of House 401 reinforces their interpretation as being portions of a single mould unit for a socketed axehead with complex rim mouldings. However, the six fragments could derive from as many as three different axehead moulds deposited in at least two different phases.

Mould 9: socketed axe 2

One other valve fragment in the assemblage is most readily identifiable as part of a socketed axe mould unit. The matrix

Table 1.18. Fragments of Mould assembly 8: socketed axehead(s)

SF no.	Context	Phase	Area	Weight (g)
SF 4106.1	589	12	NE area	6.5
SF 4115.1	882	12	House 401	3.2
SF 4122	457	12	Forecourt	12.6
SF 4125	641	12	NE area	4.7
SF 4893	1311 sq 3062	9	House 401	4.7
SF 5336	1311 sq 3062	9	House 401	2.4

surface of SF 4154 (Figure 1.16) has two slight ribs about 5mm apart and separated by a furrow; in the absence of original edges, orientation of such a small fragment is problematic but a slight convexity of the valve back support allows interpretation of these features as being horizontal. As such, the fragment probably represents the horizontal mouth moulding of a socketed axe (*cf* Type Gillespie, Type Portree and Type Dowris variant Dungiven: Schmidt and Burgess 1981: 184–7, 191–7, 201–2, plates 73–4, 76–9, 81, corpus nos 1038–1067, 1138–1151, 1192–1199).

SF 4154 is from context 1423 in House 401, the fill of a pit dug when the house walls were being rebuilt during the transition from Phase 10 to Phase 11 (see Volume 1: 250–3). Since the roof must have been dismantled at this point, the casting could have taken place within the centre of this temporarily open- or part-roofed building (*ibid*.: 264, 276, fig. 7.25).

A further two pieces (not illustrated) have tentatively been included with the range of socketed axe mould fragments. SF 5690 is a fragment of valve, retaining traces of two original surfaces; it is probably from the rim of a valve for a socketed object (possibly also an axehead or spearhead) with an internal diameter of *c*. 30mm.

A fragment of inner valve (SF 5683) has a curved channel but no clear contact or matrix surface surviving. It is just possibly from the area of a loop from the mould for a socketed axehead but it is too abraded to be certain. Whereas SF 5690 would seem to derive from the casting event within House 401 in Phase 9, SF 5683 from floor layer 1308 may be the product of a later casting within the same house but during the Phase 10–11 transition (*ibid*.).

Mould 10: possible spearhead or knife socket

One valve fragment (SF 4120) has a curved profile suggestive of a circular socket; as projected, this would give an approximate diameter of 24mm, which would be in keeping with a spearhead or knife socket (see Figure 1.16).

Table 1.19. Fragment of Mould 9: socketed axehead 2

SF no.	Context	Phase	Area	Weight (g)
SF 4154	1423	11	House 401	2.1

Table 1.20. Fragments of mould for an uncertain, possible socketed axehead

SF no.	Context	Phase	Area	Weight (g)
SF 5690	1311	9	House 401	2.1
SF 5683	1308 sq 2560	10	House 401	3.1

Table 1.21. Fragment of Mould 10: possible spearhead or knife socket

SF no.	Context	Phase	Area	Weight (g)
SF 4120	1413	11	House 401	7.1

However, orientation of the contact surface is problematic as the surviving condition of the fragment suggests a contact face which would be distinctly, and possibly unfeasibly, oblique. SF 4120 is from context 1413 in House 401 (a sand layer below 655 in its northeast quadrant) assigned to the beginning of Phase 11 and thus may derive from bronze-casting within that house during the Phase 10–11 transition.

Mould assembly 11: tanged bifid razor

A small group of mould fragments (five pieces, totalling 18.7g) recovered from several contexts of Phases 8–11 combine to represent portions of both valves of a mould for casting a tanged razor (Figures 1.16, 1.18–1.19).

They include two fragments from one valve (SF 4152.1–2: note that this is possibly a modern break) and three which are probably from the complementary valve (SF 4175, SF 4581 and SF 4951). In the hand, SF 4152 and SF 4175 interlock reasonably well.

The surviving areas of the matrix on what may be termed valve A represent the lower part of one side of the blade and its junction with the tang, while the presumed opposing valve B includes the notched distal portion of the blade. In each case, the junction of the matrix and the

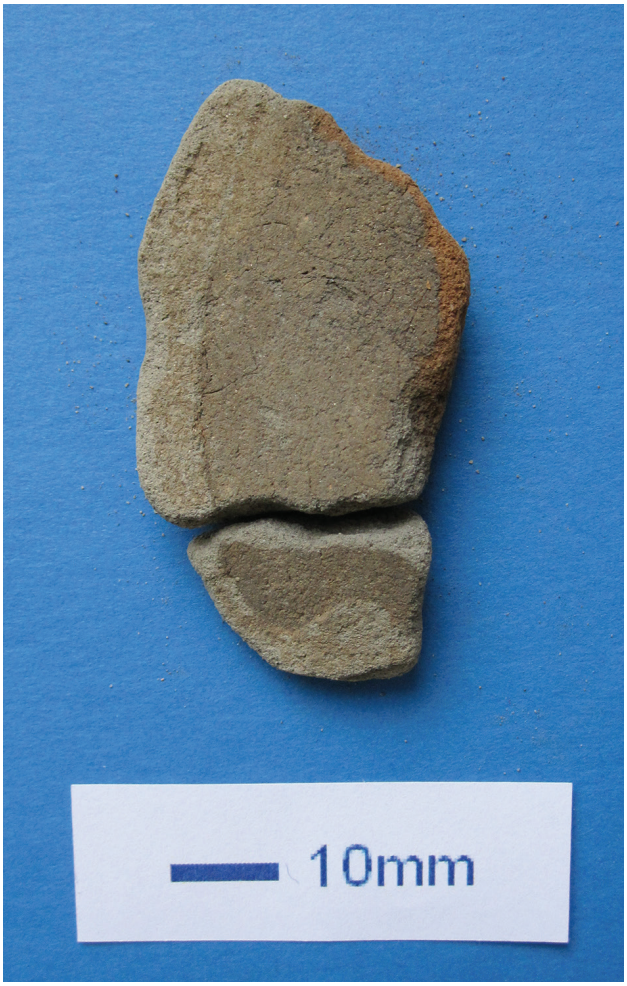

Figure 1.18. Mould fragment for a tanged bifid razor (SF 4152 from context 1388)

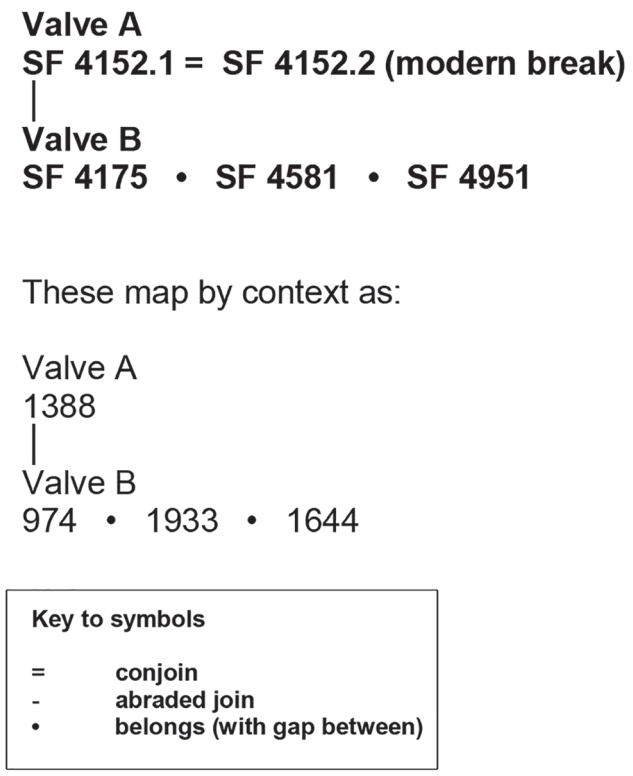

Figure 1.19. Joins for the mould assembly of the tanged bifid razor

contact surface is barely perceptible (only 0.1mm–0.2mm high), resulting in a very thin blade as cast. The midrib is plain (lacking the reeding characteristic of some bifid razors).

A further piece (SF 5661; Table 1.22) represents the distal notch of a bifid razor. This burnt and abraded inner valve fragment is dark red-orange-grey with its contact face and area of grey matrix surface intact. The distance between the razor's tips is 15mm.

As such, this mould invites comparison with Jockenhovel's Type Feltwell (1980: 64–72, tafel 10.164–76, tafel 11.177–189), Type Dowris (*ibid*.: 72–5, tafel 11.190–6, tafel 12.198–203) or other double-edged razors with tang handle and pointed V- or U-formed blade cut (*ibid*.: 72–7, tafel 12.204–16). The latter and Type Feltwell are distributed across Britain and Ireland whereas Type Dowris has an Irish distribution. The geographically closest findspot is a Type Feltwell razor in the Adabrock hoard from the Isle of Lewis (*ibid*.: 66, tafel 10.183).

The assignment of two of the mould fragments to Phases 8 and 9 within the forecourt and entrance of House 401 places this bifid razor's production within the first and main casting event. One of these fragments (SF 4581) was located within the north side of the forecourt on the northern edge of that cluster of mould fragments that included those of Sword 1 (see Figure 1.13). Other fragments from the same bifid razor mould from a fill (1644) and a posthole fill (1388) in House 1370 in Phase 10 are clearly residual, presumably re-deposited within the spoil of storage pits dug out from House 401's forecourt in Phase 10 (Figure 1.20). Finally, SF 5661's location in the floor layer 655 of House 401 in Phase 11 might also be residual but the identification of a likely casting event on this floor from the distribution of mould fragments north of its hearth (see Volume 1: fig. 7.25) raises the possibility that this is from a second bifid razor cast together with a sword in Phase 11 (see above).

Mould assembly 12: corrugated 'sheet' ornament (band/strip)

A group of mould fragments represents portions of both valves for a rather unusual and enigmatic casting, seemingly a corrugated band or strip (Figures 1.16 and 1.21).

Six fragments (SF 4845.1–2; SF 4559.1–3, SF 4129) all share a very similar pale orange-brown, compact fabric and all appear to belong to this mould assembly. A seventh fragment (SF 5022) has traces of what may be ribs on the surviving matrix surface, but its paler grey colour, thickness and more abraded condition set it apart and its association with this assembly is doubtful. On the grounds of similarity in their fabric, a further two inner valve fragments may also possibly be from this mould assembly but are not considered further (SF 4139, SF 4577.1; Table 1.23).

The main surviving portion (SF 4845.1–2) consists of the rounded end of the mould assembly, with part of both valves still intact and in position; the intact portion is 54mm in length with an overall width of 39.5mm and maximum thickness of 16.5mm. As a result, the structure of the mould assembly is clear in the section where the valve has fractured. The overall mould unit has an oval cross-section. On the face of the valve, an uneven groove towards the edge represents the line demarcating the junction of the two valves. What may be termed valve A, the right valve as drawn, is slightly thicker at 8.5mm–9.2mm in thickness; the complementary valve B is slightly thinner, varying from 6.5mm–7mm, and is held in place by a sealing of clay along the overlap.

Despite its relative completeness, the nature of the object which was cast (or which was intended to be cast) from this mould is uncertain but seems likely to have been some form of ribbed or corrugated band, presumably for an ornamental purpose. The matrix indicates a corrugated strip which would have been 27.5mm in width, with four ribs 9.3mm apart from crest to crest. At the break, where the cross-section is preserved, the inferred thickness of the cast metal appears to be as little as 0.1mm–0.2mm in the mid sections, increasing to 0.5mm at the edges. Nor is there any absolute certainty that this mould was intended for casting a bronze object, with gold being an alternative possibility given the apparent thinness of the casting.

The original length of the casting is unknown. However, the overall length of valve A can be extended with certainty to 79mm by the addition of a detached but originally joining piece (SF 4845.2); it can be further extended by adding SF 4559.1–3 and SF 4129 which do not join but whose approximate locations can be inferred with reasonable

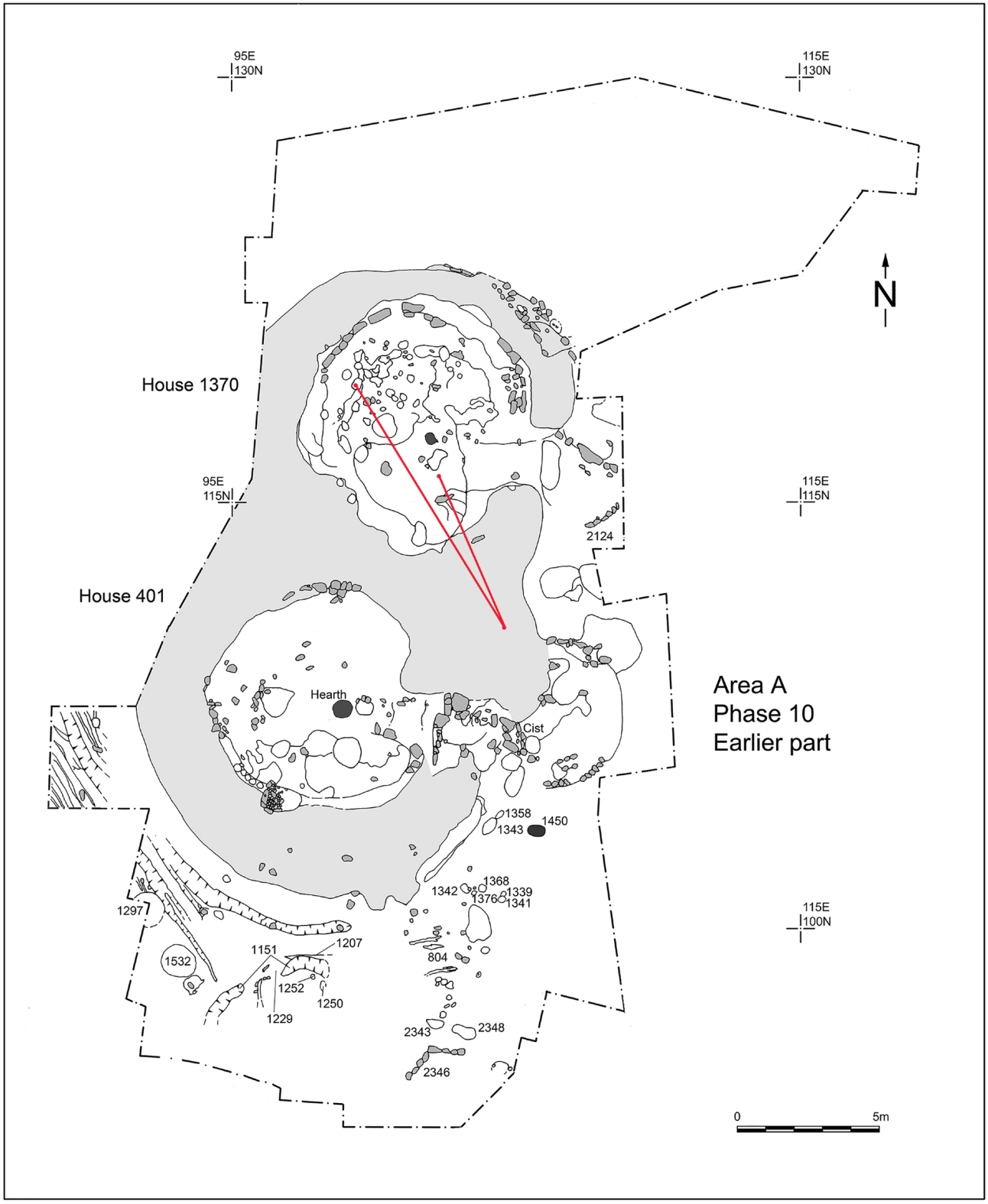

Figure 1.20. Distribution of mould fragments for the tanged bifid razor

confidence. As re-assembled, the minimum length of the mould assembly is 108mm. As noted above, SF 5022 is only doubtfully associated with this mould unit; if so it may be part of the complementary valve (valve B).

Three of the fragments attributed to this mould assembly derive from the same part of House 401's floor layer 1311, close to the central hearth where casting presumably took place in Phase 9. Another piece (SF 4577.1), tentatively part of this assembly, was deposited within House 401's forecourt. Two of the remaining pieces are presumably residual, recovered from Phase 11 contexts within Houses 401 and 1370. The same is likely to be the case for the tentatively identified piece from an outdoor layer of windblown sand (1299) in Phase 10.

Table 1.22. Fragments from valves A and B of Mould assembly 11: tanged bifid razor

Valve A				
SF no.	*Context*	*Phase*	*Area*	*Weight (g)*
SF 4152	1388	10	House 1370	11.8
Valve B				
SF no.	*Context*	*Phase*	*Area*	*Weight (g)*
SF 4175	974 (U/S)	-	-	3.0
SF 4581	1933	9	Forecourt	1.5
SF 4951	1644	10	House 1370	2.1
Not allocated to specific valve				
SF no.	*Context*	*Phase*	*Area*	*Weight (g)*
SF 5027	1930	8	House 401	2.2
SF 5661	655 sq 4779	11	House 401	8.0

Figure 1.21. Two views (vertical and horizontal) of the corrugated sheet ornament mould assembly (SF 4559)

Table 1.23. Fragments of Mould assembly 12: corrugated 'sheet' ornament; SF 4139 and SF 4577 are attributed to this mould assembly only tentatively

SF no.	Context	Phase	Area	Weight (g)
SF 4129	1547	11	House 1370	4.1
SF 4559.1–3	1311 sq 3067	9	House 401	9.4
SF 4845.1	1311 sq 3067	9	House 401	30.8
SF 4845.2	1311 sq 3067	9	House 401	39.5
SF 5022	800	11	House 401	4.2
SF 4139	1299	10	SE area	1.6
SF 4577.1	1933	9	House 401	2.0

Mould assembly 13: pin

Two types of pin mould are represented in the Cladh Hallan assemblage (Figures 1.22–1.23). Mould assembly 13 is made up of fragments with a sub-rectangular or squarish section whereas the other type of pin mould (Mould assembly units 14–15) consists of tubular fragments. Unfortunately, in neither case do any portions of the moulds shed light on the form of the pin heads so the original form of the pins is unknown.

Four fragments with a sub-rectangular or squarish section (SF 4308, SF 4589, SF 5352, SF 5414) form Mould assembly 13 and are identifiable as elements of a type of mould assembly not previously recognised in northern Britain, in which multiple moulds for individual pins would have been butted up against each other to be cast together as a unit (Stuart Needham pers. comm.; Needham 2007b: 258).

The complementary nature of the elements of the mould unit can be seen most clearly in the case of SF 4308 and SF 5352, which respectively possess gently convex and concave faces, with slight 'lipping' of the edges, where the contiguous moulds would have butted against each other (Figure 1.24). Indeed, these two pieces may be from joining elements of an original composite unit; if so, they provide a cross-context association between contexts 874 and 1933. SF 4589 and SF 5414 are broken fragments from a mould of similar form to the foregoing, betrayed by the slight flattening of the original face where it survives and by the similarity in their fabric.

Late Bronze Age pin moulds are known from a number of sites in Britain, Ireland and the near Continent. Highstead in Kent has produced mould fragments for square-sectioned pins cast in multiples in moulds that were both round and sub-rectangular in section (Needham 2007b: fig. 149). Evidence of similar multiple casting of pins with round sections – like those at Cladh Hallan – was found associated with hearths at Fort-Harrouard, Eure, in northern France (Mohen and Bailloud 1987). Large-scale casting of pins – some 80 in total – has been recorded from pits at Aubervilliers, a Parisian suburb (Mélin *et al*. 2020). Needham (2007b: 260–2) also refers to pin moulds from the Late Bronze Age ringfort of Rathgall, Co. Wicklow

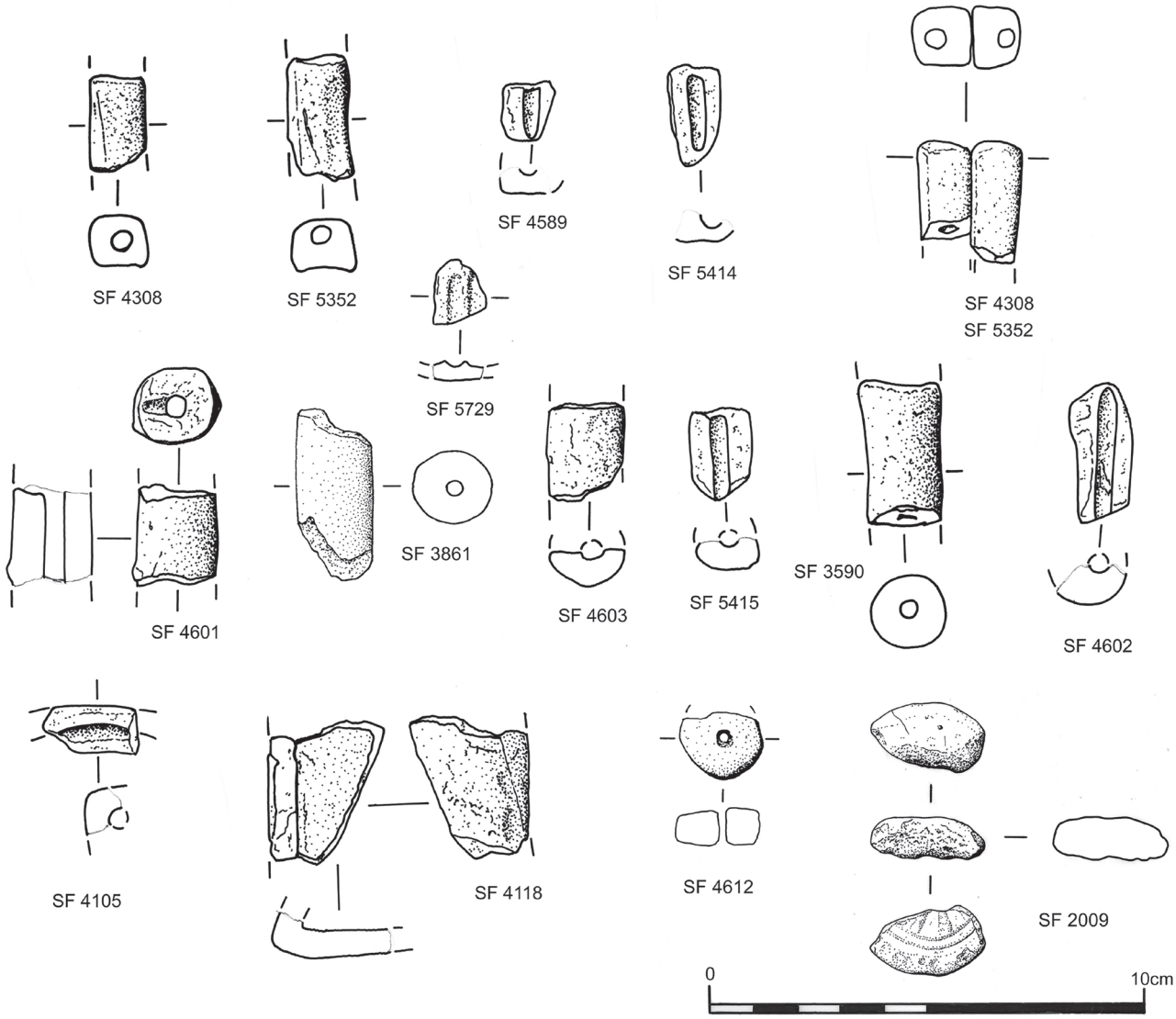

Figure 1.22. Mould fragments for pins, a pin disc and a bracelet

(Raftery and Becker 2024) and insecurely dated examples from Aylesford, Kent. Finally, mention should be made of a mould for the disc-shaped head of a pin from Jarlshof, Shetland (Curle 1933: 116–17). All of these are disc- or nail-headed pins; none of the Cladh Hallan moulds from Area A derive from the head of the pins though a single mould fragment from a Phase 10 midden layer in Area C is from part of a disc (see below).

While the type of mould technology is clear, the pieces themselves are too fragmentary and unrepresentative for the type of pin to be identifiable (the longest surviving fragment is only 22m in length). The perforations in the fragments indicate a pin shank of <3.7mm diameter. No bronze pins are known from the Western Isles though the hoard from Point of Sleat, Skye, includes a fine disc-headed example (Coles 1962: 46, 111–12; NMS online records 000-100-034-430-C).

All four fragments of this pin (Mould assembly 13) are from layers within the forecourt of House 401. Whilst one of these is assigned to Phase 8, they can all be considered as part of the cluster of mould fragments deposited here in the Phase 8–9 transition.

Mould assembly 14: pin

The second type of pin mould represented in the assemblage is a simple tubular form, represented by seven fragments. As in the case of the moulds with squared sections, the pieces of tubular mould consist only of undiagnostic mid-portions so that the types of pin which would have been cast remain unknown. On the basis of minor variations in fabric, two or possibly three tubular pin moulds appear to be represented. One further fragment (SF 5399) may possibly represent a heavily worn piece of tubular mould but, as the definition of the matrix is poor and the fabric is dissimilar to the other fragments, its status is uncertain and it is not discussed further.

Mould assembly 14 comprises four fragments with comparable features, two with intact sections (SF 3861, SF 4601), and two which are broken longitudinally (SF

Figure 1.23. Mould fragments for pin mould assemblies 13, 14 and 15

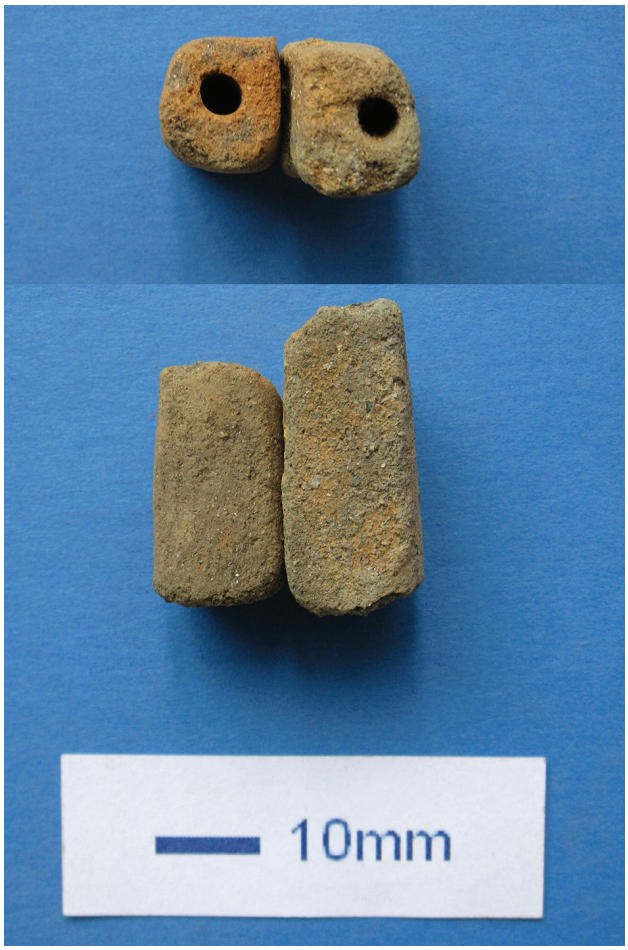

Figure 1.24. Two views (vertical and horizontal) of the conjoining pin moulds in mould assembly 13 (SF 4308 and SF 5352)

Table 1.24. Fragments of Mould 13: pin

SF no.	Context	Phase	Area	Weight (g)
SF 4308	874	9	Forecourt	4.2
SF 4589	874	9	Forecourt	1.1
SF 5352	1933	9	Forecourt	5.8
SF 5414	2791 sq 4245	8	Forecourt	2.5

4603 and SF 5415; Figures 1.22–1.23). However, in view of their fragmentary condition, the relatively generic form of such tubular moulds, and their retrieval from disparate contexts, their attribution to a single unit must be seen as tentative. The larger of the two intact pieces (SF 4601) has a minimal taper, reducing from 18.5mm to 17.5mm in diameter over a distance of 20mm externally, while the perforation reduces from 4.6mm to 4.4mm. At the narrower end there is a possible transverse groove (or broken perforation): its origin is unclear but one possibility might be traces of seating for a separate clay cap to the mould (*cf* Highstead; Needham 2007b: 258, figs 148–149). In the case of SF 3861 (Figure 1.22), the surviving portion of the mould tapers from *c*. 22mm to 20.75mm over a length of 40mm, with a corresponding taper in the perforation from 4mm to 3.6mm. A possible runnel of bronze adheres to its interior. The two broken fragments are less informative: SF 4603 has the remains of a perforation from 3.3mm–3.4mm in diameter and shows little or no taper. In the case of SF 5415, the perforation is only 2.5mm (but this may be an underestimate given the incompleteness of the cross-section).

In view of their incompleteness, it is unclear how the casting process was undertaken in the case of the tubular pin moulds. However, it may be noted that in the case of SF 4601, part of the circumference of the valve is slightly flattened. While this may simply reflect compression of the damp clay surface of the valve prior to firing, it also raises the possibility that several tubular moulds could have been formed together to create a composite assembly in a manner akin to Mould assembly 13.

The fragments attributed to Mould assembly 14 derive from a variety of contexts and phases. SF 5415's attribution to Phase 5, dating to the thirteenth–early eleventh centuries, must be called into question since it is a clear stratigraphic outlier to the overall assemblage. Its position beneath the east wall of House 401, close to the cluster of mould fragments here, makes it likely to be part of the casting episode during the Phase 8–9 transition when House 401

Table 1.25. Fragments of Mould assembly 14: pin

SF no.	Context	Phase	Area	Weight (g)
SF 3861	1549	10	House 801	21.6
SF 4601	1831	12	House 1370	7.4
SF 4603	1644	10	House 1370	3.4
SF 5415	3265	5	House 401	1.9

was constructed. The remaining three fragments were widely distributed from the south to the north in Phase 10 and 12 contexts and thus are all residual.

Mould assembly 15: pin

On the basis of differences in their proportions, colour and fabric, three fragments – two intact (SF 3590 and SF 4612) and one broken (SF 4602) – have been assigned to a separate pin mould. All three appear to have a slightly finer, more compact fabric than the pieces assigned to Mould assembly 14. In the case of SF 3590, the external diameter of the fragment reduces from 17mm to 18mm over a surviving length of 32mm, while the perforation tapers markedly from 4mm to 3.4mm.

SF 4612's perforation tapers from 4mm to 2mm and its flat base is the foot end of the mould where the pin narrows to its tip. This flat base is not sealed but is perforated right through, a feature noted elsewhere (Mohen and Bailloud 1987; Needham 2007b: 258). As Needham explains, the melt was introduced from the tip of the pin, with the opening sharing the same diameter as the shank and the actual point of the pin being formed only in post-cast working (*ibid*.).

In the case of the broken sliver (SF 4602), the perforation has a diameter of *c*. 3.3mm–3.2mm. The strongly oxidised fabric of this piece suggests that the fragment has been re-fired at some stage, and again hints at complex taphonomic processes following the casting and opening of some moulds.

One of the fragments (SF 4612) derives from the fill of pit 2234 (Phase 9) in the southwest quadrant of House 1370, associated with floor layer 1369. The other two fragments derive from Phase 12 contexts above the ruined House 1370. It is thus possible that this pin was cast during Phase 9 occupation associated with floor layer 1369.

As regards the manufacture of the moulds themselves, cracks visible in SF 4601 might possibly suggest that an original model (*e.g*. an existing pin) has been pressed into a half sausage of clay and then the other half added. This could explain the longitudinal breakage seen on the smaller pieces where the line of the perforation runs slightly asymmetrically since where the pin was pressed into the clay had no material effect on the outcome of the casting.

In summary, the group of tubular pin mould fragments indicates the production of pins with tapered shanks, up to 4.6mm in diameter in the case of Mould 14. While the specific type cast in the mould is uncertain, comparable shank diameters can be found among pins from Scotland and Ireland (Coles 1962; Eogan 1974). However, one or more of them could have been disc-headed pins on the basis of SF 2009 from Area C (below). Mould fragments for disc-headed pins are among an assemblage of similar size and composition from Dún Aonghasa on the Aran Islands (Cotter 2013: 36–9).

Table 1.26. Fragments of Mould assembly 15: pin

SF no.	Context	Phase	Area	Weight (g)
SF 4612	2235	9	House 1370	4.0
SF 3590	1131	12	House 1370	12.0
SF 4602	1831	12	House 1370	4.0

Mould for the disc of a disc-headed pin from Area C

A fragment of valve for a disc of a disc-headed pin (SF 2009; Figures 1.22, 1.25) is one of only two mould fragments from Area C, 100m northwest of the main site (Area A). It was recovered from midden layer 906 in Phase 10. This Late Bronze Age midden was cut into by House 150, a double-roundhouse constructed in Phase 13 in *775–650 cal BC (95% probability)* and used for bronze-casting, as indicated by mould fragment SF 5702 and numerous copper-alloy droplets (see Volume 1: 337–42, figs 10.12–10.13, 10.15–10.16). However, the most likely explanation for SF 2009's context is that it was indeed securely stratified within the earlier midden and was deposited during Phase 10, *c*. 1035–970 BC. It could tentatively be associated with any of the pins cast in Phases 8–9 and 9–10 in House 401 or late Phase 9 in House 1370.

The disc would have been *c*. 25mm in diameter with probably six wedge-shaped spokes within two concentric rings, the outermost of which forms the contact face of the valve. The valve deepens slightly (*c*. 1mm) towards the centre of the disc so may have formed a slight boss for subsequent soldering to the top of the pin shank. The spoked pattern of this wheel-shaped disc is similar to that

Figure 1.25. Mould fragment for the wheel-shaped disc of a disc-headed pin (SF 2009 from context 906)

Table 1.27. Mould for disc of a disc-headed pin from Area C

SF no.	Context	Phase	Area	Weight (g)
SF 2009	906	10	Area C Midden	2.8

incised on the disc of a pin from Knockabawn, Co. Sligo (Eogan 1974: fig. 3.13) though that disc is much wider and with a larger dome; numerous pins with discs of similar diameter to the Cladh Hallan example are known from Ireland (*ibid*.: fig. 3). Whilst the spearhead associated with the Knockabawn pin is likely to date to the Middle Bronze Age, pins with comparable smaller discs from Rathgall and Haughey's Fort can be dated to *c*. 1200–1000 cal BC (Katharina Becker pers. comm.; Raftery and Becker 2024: 289–93). However, no close parallels to this wheel-shaped disc are known from Britain or Ireland.

Mould 16: penannular bracelet or annular ring

Although the traces of the matrix on some of the pin moulds seem almost curved, this is likely to be a result of severe wear, as the overall shape of the valve tends to favour their identification as eroded fragments of tubular pin moulds. However, in the case of one small mould fragment (SF 4105.1), the surviving matrix is clearly *deliberately curved*. That and the fact that it backs onto a strongly convex valve edge strongly suggest that this represents part of one valve of a mould unit for casting a bracelet or ring (Figure 1.22). The profile of the groove indicates a round- or oval-section rod, *c*. 4mm in thickness, while projection of the curve indicates an external diameter of *c*. 55mm. It is rather thicker than the two copper-alloy bracelets found at Cladh Hallan so neither of these is the product of this mould (see Chapter 2).

The fragment was recovered from context 583 (Phase 8), a fill layer immediately north of House 401's forecourt. Although assigned to Phase 8, this layer may have incorporated material spilled over from the forecourt layer 1933 in Phase 9. Thus Mould 16 can be considered as part of this Phase 8–9 assemblage.

Abraded inner valve fragments retaining some features

Apart from the inventory of material assigned to specific moulds, there is almost inevitably a range of mostly abraded valve fragments which retain some surface features but which defy ready identification (those fragments with enough distinctive features to permit probable attribution to mould units for swords have already been noted above in the sections dealing with Swords 1 and 2).

Table 1.28. Fragment of Mould 16: penannular bracelet or annular ring

SF no.	Context	Phase	Area	Weight (g)
SF 4105.1	583	8	Forecourt	2.0

Twenty-nine mostly small and abraded inner valve fragments (totalling 125.9g) lack diagnostic features but retain at least some traces of contact faces or matrix surfaces, even if these are generally rather pitted or worn and weathered. In some cases, valve fragments must derive from locations towards the edges of the mould unit involved, owing to the curvature of the outer face of the fragment and often the presence of the adhering remains of the coarser outer wrap (*e.g*. SF 4166; Table 1.29). Most of these miscellaneous fragments have the fabric typical of the moulds in general but one small group of inner valve fragments with unusually highly reduced almost 'sintered' fabric appears to have been re-fired and to have had a similar depositional progression following casting and breaking-open of the mould. The group is composed of SF 4109.1–2, SF 4156 and SF 4174.1 (Table 1.11), suggesting a relationship between context 1254 and context 1414, both of which are fill layers within the northwest quadrant of House 401 during Phase 11.

Their overall distribution reveals a broad change over time from house and forecourt floors (1311, 1369, 1933) associated with primary or near-primary discard from bronze-casting in the Phase 8–9 transition to secondary-discard fill layers in Phases 10–12. Early contexts in Phases 5 and 6 are most likely intrusive from Phase 8–9 (see Volume 1: chapter 3).

Fifteen inner valve fragments (total of 28.7g) have traces of what present as shallow channels or grooves. Although grouped together for cataloguing purposes (and to facilitate any fresh research), it cannot be assumed that they are related. Generally, the marginally greater depth of the grooves has resulted in the survival of a narrow band of grey matrix surface where erosion has removed the surrounding surfaces but, in the absence of clear contact faces or profiles, they are all too worn and incomplete for the type of object cast to be identifiable with certainty. Their distribution (Table 1.30) is similar to inner valve fragments without diagnostic features (Table 1.29) in that, after Phase 9, they are from secondary contexts in fill layers.

1.5 Outer wrap fragments

Only 18 pieces of wrap (74.9g), a relatively small number, have been identified as *detached* fragments of the outer wrap which would usually have enveloped the inner valves. A few retain some construction features such as remnants of the envelope edge, where they have become detached along the edge of the mould, while the profile of others shows they derive from the rounded or slightly angular coped midline of the face of the mould.

In addition to these detached pieces, traces of outer wrap still adhere to many inner valve fragments, notably those making up the best-preserved portions of the mould assemblies for the two swords (as discussed previously).

Table 1.29. Abraded inner valve fragments without diagnostic features

SF no.	Context	Phase	Area	Context type	Weight (g)
SF 5722	3265	5	S area	Ard furrows	4.7
SF 5718	2408	6	Forecourt	Pit fill	1.8
SF 5717	2408	6	Forecourt	Pit fill	1.1
SF 4143	803	8	House 801	House wall	1.3
SF 5720	2887	8	House 401	Pit fill	3.5
SF 5663	1150	9	House 801	House floor	38
SF 5030	1311	9	House 401	House floor	3
SF 5693	1311	9	House 401	House floor	10.3
SF 5695	1311	9	House 401	House floor	6.2
SF 5698	1311	9	House 401	House floor	1.8
SF 5704	1369	9	House 1370	House floor	2.2
SF 5706	1369	9	House 1370	House floor	1
SF 5705	1369	9	House 1370	House floor	3
SF 5697	1680	9	Front yard	Yard surface	0.9
SF 5035	1916	9	House 1370	Doorway	2
SF 5736	1933	9	Forecourt	Forecourt floor	3.8
SF 4144.3	773	10	Forecourt	Pit fill	3.3
SF 5041	1308	10	House 401	House floor	1.8
SF 4166	1310	10	House 401	Fill layer	9.3
SF 5039	1310	10	House 401	Fill layer	1.9
SF 5728	1776	10	House 1370	Fill layer	2.4
SF 5731	655	11	House 401	House floor	3.3
SF 5023	800	11	House 1370	Fill layer	4.9
SF 4109.3	1254	11	House 401	Fill layer	1.9
SF 4109.4	1254	11	House 401	Fill layer	2.8
SF 4109.5	1254	11	House 401	Fill layer	1
SF 4148	659	12	House 401	Fill layer	5.8
SF 4115.3	882	12	House 401	Wall fill	1.8
SF 4248	1990	12	N Area	Pit fill	1.1

Table 1.30. Abraded inner valve fragments with distinct grooves

SF no.	Context	Phase	Area	Context type	Weight (g)
SF 4895	1311	9	House 401	House floor	1.6
SF 5737	1311	9	House 401	House floor	1
SF 4635	1933	9	Forecourt	Forecourt floor	3.8
SF 5399	1933	9	Forecourt	Forecourt floor	3.3
SF 5703	2211	9	House 1370	House floor	2
SF 4144.4	773	10	Forecourt	Pit fill	1.4
SF 5729	852	10	House 1370	Forecourt fill	0.6
SF 4138	1628	10	House 1370	Posthole fill	1
SF 4119.2	412	11	S Area	Cultivation soil	1.9
SF 4140	412	11	S Area	Cultivation soil	2.8
SF 4160	1458	11	House 1370	Gully fill	2
SF 3946	413	12	NE Area	Fill layer	1.2
SF 4115.2	882	12	House 401	Wall fill	1.4
SF 4195	1985	12	N Area	Pit fill	2.1
SF 5032	1989	12	N area	Pit fill	2.6

Characteristically the mould envelope is relatively coarser (see Sahlén 2011). In the case of several pieces of wrap, the fabric is quite compact and relatively well-fired (or perhaps accidentally re-fired); this may have contributed to their differential survival among a category of mould components that was already depleted due to being less well fired.

Even accounting for where material adheres to valves and allowing for occasional misidentifications, wrap is clearly significantly under-represented among the ceramic material associated with the metalworking activity at Cladh Hallan. What possible factors might have led to the marked under-representation of wrap? Unless recovered and preserved (either by accident or design), moulds are especially vulnerable in the aftermath of casting. Results from experimental castings suggest that the outer envelope is particularly vulnerable to destruction due to its coarse, relatively poorly fired fabric. If quenching of the mould takes place immediately after casting, the whole mould – and the wrap especially – is prone to spalling and disintegration, reduced to the consistency of a digestive biscuit.

Since casting occurred on the hearths of Houses 401 and 1370 in certain phases, the under-representation of fragments of the coarser outer wrap, in relation to the inner valve, may be due to either selective removal of wrap debris from the house floor, or its loss during subsequent trampling, or a mixture of the two. Additionally, the more distinctive inner valves might have been retained and either left on the floor or, in the case of casting within House 401 in Phase 9, collected up and deposited within the forecourt.

1.6 Miscellaneous fragments mostly too abraded to be informative

A range of 156 miscellaneous small fragments (weight 214.6g) and another 314 tiny crumbs (from 10mm–2mm flotation residues) are too weathered or worn and usually too featureless to be informative. Some do retain slight traces of original matrix surface but, in the absence of surviving contact faces, it is not possible to identify to type; in other cases, the plano-convex profile of the fragments suggests that they derive from the edges of the valves concerned, but the small size of the pieces again precludes attribution to specific moulds. The mould fragments are generally heavily oxidised; most are <20mm in their maximum dimension, with weights ranging from 0.2g to 10.8g, indicative of their small size.

Some of the miscellaneous fragments appear to derive from the same or closely similar mould units (*e.g.* with close similarities of fabric) but in no case can these then be compared with any confidence to the series of identified moulds. Where there are large numbers from house floors, such as those from floor layers 2211 and 1369 in House 1370 (Phase 9) and floor layer 655 in House 401 (Phase 11), we may assume that these derive from casting events on those floors, especially when – as in the case of floors 1369 and 655 – their distribution close to the hearth and in the presence of copper-alloy droplets is additional evidence of metallurgical activity there. The fact that the fragments are so small is most likely the result of trampling on those floors, a pattern common to all the floor distributions except for forecourt layer 1933 where the main cluster of mould fragments

Table 1.31. Outer wrap fragments

SF no.	Context	Phase	Area	Context type	Weight (g)
SF 4947	1664	8	House 801	Posthole fill	9.7
SF 5021	2741	8	Front yard	Pit fill	2.3
SF 4902	1311	9	House 401	House floor	3.5
SF 5306	1311	9	House 401	House floor	1.5
SF 5335	1311	9	House 401	House floor	1.4
SF 5707	1369	9	House 1370	House floor	1
SF 4141	1698	9	House 401	House floor	1.2
SF 4189	1932	9	Forecourt	Fill layer	2.1
SF 4244	1933	9	Forecourt	Forecourt floor	1.8
SF 4346	1933	9	Forecourt	Forecourt floor	5.5
SF 4353	1933	9	Forecourt	Forecourt floor	3.8
SF 4573	1933	9	Forecourt	Forecourt floor	11.3
SF 5678	1933	9	Forecourt	Forecourt floor	2.3
SF 4816.1	2210	9	House 1370	Fill layer	2.7
SF 4729.1	2211	9	House 1370	House floor	6.1
SF 5024	2211	9	House 1370	House floor	8.4
SF 4948	1541	10	Forecourt	Fill layer	8.3
SF 5037	1447	11	Forecourt	Pit fill	2

Table 1.32. Miscellaneous fragments of mould

SF no.	Context	Phase	Area	Context type	Weight (g)
SF 4874	2402	6	Forecourt	Pit fill	2.2
SF 5719	2408	6	Forecourt	Pit fill	1
SF 5028	1930	8	House 401	Wall fill	1.2
SF 5800	2593	8	House 1370	Posthole fill	0.2
SF 5798	2671	8	House 401	Pit fill	0.5
SF 4996.2	2764	8	House 401	Pit fill	2.4
SF 5724	2791	8	House 401	Wall fill	2.9
SF 5726	2791	8	Forecourt	Wall fill	1.3
SF 5727	2791	8	Forecourt	Wall fill	2
SF 5725	2791	8	Forecourt	Wall fill	1.3
SF 5795	2791	8	Forecourt	Wall fill	5.8
SF 5139	2935	8	House 401	Posthole fill	1.9
SF 5331	415	9	Front yard	Midden layer	1.2
SF 4637	874	9	Forecourt	Fill layer	1.1
SF 4793.2	874	9	Forecourt	Fill layer	0.9
SF 5664	1150	9	House 801	House floor	1.2
SF 4898	1311	9	House 401	House floor	0.2
SF 4903	1311	9	House 401	House floor	0.3
SF 5334	1311	9	House 401	House floor	1.5
SF 5337	1311	9	House 401	House floor	2.1
SF 5338	1311	9	House 401	House floor	2.9
SF 5339	1311	9	House 401	House floor	4.5
SF 5688	1311	9	House 401	House floor	1.1
SF 5689	1311	9	House 401	House floor	2.4
SF 5691	1311	9	House 401	House floor	0.5
SF 5694	1311	9	House 401	House floor	1
SF 5696	1311	9	House 401	House floor	2.2
SF 5700	1311	9	House 401	House floor	0.5
SF 5786	1311	9	House 401	House floor	0.6
SF 5750	1311	9	House 401	House floor	4.9
SF 5748	1311	9	House 401	House floor	0.6
SF 5747	1311	9	House 401	House floor	1.8
SF 5738	1311	9	House 401	House floor	3.1
SF 5745	1311	9	House 401	House floor	10.8
SF 5787	1311	9	House 401	House floor	0.5
SF 5788	1311	9	House 401	House floor	0.3
SF 5746	1311	9	House 401	House floor	1.4
SF 5809	1311	9	House 401	House floor	0.3
SF 5808	1311	9	House 401	House floor	0.6
SF 5785	1311	9	House 401	House floor	0.6
SF 5667	1369	9	House 1370	House floor	0.5
SF 5677	1369	9	House 1370	House floor	1
SF 5780	1369	9	House 1370	House floor	0.6
SF 5749	1369	9	House 1370	House floor	0.2
SF 5767	1369	9	House 1370	House floor	0.4
SF 5765	1369	9	House 1370	House floor	0.6
SF 5781	1369	9	House 1370	House floor	3.2

SF no.	Context	Phase	Area	Context type	Weight (g)
SF 5753	1369	9	House 1370	House floor	0.5
SF 5766	1369	9	House 1370	House floor	0.5
SF 5769	1369	9	House 1370	House floor	0.7
SF 5782	1369	9	House 1370	House floor	0.4
SF 5668	1680	9	Front yard	Yard surface	0.6
SF 5669	1680	9	Front yard	Yard surface	6.7
SF 5670	1680	9	Front yard	Yard surface	0.2
SF 5671	1680	9	Front yard	Yard surface	7.2
SF 5811	1680	9	Front yard	Yard surface	0.1
SF 5756	1680	9	Front yard	Yard surface	1
SF 5810	1680	9	Front yard	Yard surface	0.2
SF 5755	1698	9	House 401	House floor	0.9
SF 5709	1705	9	House 401	House floor	2.2
SF 5708	1705	9	House 401	House floor	6.8
SF 4317.1	1933	9	Forecourt	Forecourt floor	1.2
SF 4317.2	1933	9	Forecourt	Forecourt floor	0.9
SF 4570	1933	9	Forecourt	Forecourt floor	2
SF 4571	1933	9	Forecourt	Forecourt floor	2.3
SF 5714	1933	9	Forecourt	Forecourt floor	2.6
SF 5713	1933	9	Forecourt	Forecourt floor	3.7
SF 5679	1933	9	Forecourt	Forecourt floor	2.3
SF 5759	1933	9	Forecourt	Forecourt floor	1
SF 5816	1933	9	Forecourt	Forecourt floor	2.9
SF 5818	1933	9	Forecourt	Forecourt floor	0.3
SF 5752	1933	9	Forecourt	Forecourt floor	3.1
SF 5774	1933	9	Forecourt	Forecourt floor	1
SF 5772	1933	9	Forecourt	Forecourt floor	0.2
SF 5820	1933	9	Forecourt	Forecourt floor	0.6
SF 5768	1933	9	Forecourt	Forecourt floor	3.9
SF 5776	1933	9	Forecourt	Forecourt floor	0.9
SF 5815	1933	9	Forecourt	Forecourt floor	0.6
SF 5773	1933	9	Forecourt	Forecourt floor	2.1
SF 5819	1933	9	Forecourt	Forecourt floor	0.1
SF 5751	1933	9	Forecourt	Forecourt floor	3.5
SF 5771	1933	9	Forecourt	Forecourt floor	0.4
SF 5770	1933	9	Forecourt	Forecourt floor	0.4
SF 5817	1933	9	Forecourt	Forecourt floor	0.6
SF 4995	2082	9	Forecourt	Fill layer	1.1
SF 5716	2082	9	Forecourt	Fill layer	3.6
SF 4796	2210	9	House 1370	Fill layer	0.6
SF 4729.2	2211	9	House 1370	House floor	0.6
SF 5666	2211	9	House 1370	House floor	0.5
SF 5784	2211	9	House 1370	House floor	0.2
SF 5813	2211	9	House 1370	House floor	1.3
SF 5783	2211	9	House 1370	House floor	0.6
SF 5760	2309	9	House 1370	Forecourt floor	0.1
SF 4144.2	773	10	Forecourt	Pit fill	1.9
SF 4144.5	773	10	Forecourt	Pit fill	0.2

(Continued)

Table 1.32. Miscellaneous fragments of mould (Continued)

SF no.	Context	Phase	Area	Context type	Weight (g)
SF 4144.6	773	10	Forecourt	Pit fill	0.1
SF 4794	797	10	S Area	Gully fill	1.7
SF 5799	857	10	Forecourt	Forecourt floor	0.3
SF 5758	1280	10	Forecourt	Posthole fill	0.3
SF 5802	1304	10	Forecourt	Fill layer	0.3
SF 5764	1308	10	House 401	House floor	0.3
SF 5040	1310	10	House 401	Fill layer	0.9
SF 5397	1611	10	House 401	Fill layer	2.6
SF 4324	1693	10	House 1370	Fill layer	2.2
SF 4616.2	1738	10	NE Area	Windblown sand	1.7
SF 4131.1	1776	10	House 1370	Fill layer	0.9
SF 4131.2	1776	10	House 1370	Fill layer	0.3
SF 5778	2003	10	House 1370	House floor	0.6
SF 5777	2003	10	House 1370	House floor	0.6
SF 5812	2003	10	House 1370	House floor	0.4
SF 4114	412	11	S Area	Cultivation soil	2.3
SF 4119.3	412	11	S Area	Cultivation soil	1.4
SF 5762	655	11	House 401	House floor	0.6
SF 5739	655	11	House 401	House floor	0.4
SF 5742	655	11	House 401	House floor	0.5
SF 5743	655	11	House 401	House floor	0.2
SF 5779	655	11	House 401	House floor	5.6
SF 5744	655	11	House 401	House floor	0.3
SF 5761	655	11	House 401	House floor	0.2
SF 5775	655	11	House 401	House floor	2.1
SF 5792	655	11	House 401	House floor	0.6
SF 5741	655	11	House 401	House floor	0.6
SF 5740	655	11	House 401	House floor	2.3
SF 5763	655	11	House 401	House floor	0.1
SF 5790	655	11	House 401	House floor	0.6
SF 5797	879	11	Forecourt	Fill layer	0.3
SF 4116	1203	11	House 1370	Fill layer	1.6
SF 4145	1203	11	House 1370	Fill layer	2.7
SF 5038	1447	11	Forecourt	Pit fill	0.3
SF 4133.1	1612	11	House 1370	Gully fill	1.2
SF 4133.2	1612	11	House 1370	Gully fill	1.2
SF 5793	473	12	NE Area	Ash layer	0.4
SF 4284.1	474	12	NE Area	Fill layer	1.8
SF 4284.2	474	12	NE Area	Fill layer	1.1
SF 4142	572	12	NE area	Fill layer	2.6
SF 5801	595	12	House 401	House floor	0.6
SF 5807	595	12	House 401	House floor	0.5
SF 4115.4	882	12	House 401	Wall fill	0.5
SF 5672	1145	12	House 401	Posthole fill	0.6
SF 5673	1181	12	House 401	Fill layer	0.6
SF 5674	1191	12	House 401	House floor	0.6
SF 5754	1191	12	House 401	House floor	0.4
SF 5675	1199	12	House 401	Pit fill	0.6

SF no.	Context	Phase	Area	Context type	Weight (g)
SF 4994	2002	12	N Area	Pit fill	2.1
SF 5829	2011	12	House 1500	Fill layer	2.2
SF 5829	2011	12	House 1500	Fill layer	2.2
SF 5757	2183	12	N Area	Pit fill	0.5
SF 5791	465	13	House 401	House floor	0.4
SF 5806	465	13	House 401	House floor	0.1
SF 5794	517	13	House 401	Fill layer	0.2
SF 5804	585	13	House 401	House floor	0.6
SF 5803	585	13	House 401	House floor	0.4
SF 5796	585	13	House 401	House floor	0.6
SF 5662	891	13	House 401	Posthole fill	1
SF 5398.1-2	U/S	n/a	n/a		2.7
SF 5398.2	U/S	n/a	n/a		0.9

was protected beneath the north wall of the forecourt, built in the later part of Phase 9.

Given the general similarities in fabric, it is likely that fragments from non-floor contexts – especially those from Phase 9 – are largely the increasingly comminuted fragments and crumbs from the range of moulds recognised and represented in the assemblage proper. This is likely to be the case for the large numbers from floor layer 1933 from House 401's forecourt (Phase 9). Some of the pieces are no more than slivers and barely distinguishable as mould; however, they are still a testimony to the benign burial environment and the quality of the preservation and recovery of the evidence, despite the amount of trampling on floor surfaces.

1.7 Discussion

The casting of bronze weapons, tools and ornaments requires a series of stages: extraction of suitable clay for preparation of the moulds and crucibles, manufacture of the prototypes or models, storage and preparation of the scrap metal and/or ingots for casting, gathering of the fuel, preparation of the metalworking hearth, preparation of the equipment including tools and bellows, and the process of casting itself. Within the central areas of Houses 401 and 1370 where casting took place at the central hearths, on the basis of casting materials concentrated around them, there was no casting pit as at Jarlshof. However, the sequence of water tanks beside the hearth of House 401 in Phases 9–10 (see Volume 1: 138, 216–17, figs 5.20, 5.29) could have been used to quench the fresh castings. From the clusters of mould fragments and other casting debris around hearths, these were the locations where initial parting and breaking open of the moulds was carried out. There is no evidence, however, for where the castings were cleaned or for the tools that were used to do this.

The assemblage sheds considerable light on the loci of the casting activity despite the difficulties of identifying such evidence. One of the reasons for this is that bronze-casting is a relatively 'clean' process; it is possible to achieve accomplished castings for even large items such as swords without a formal workshop setting – unlike ironworking which makes many more technological demands (Neil Burridge pers. comm.). The traces can be difficult to detect since the debris of bronze-working is so easily removed: any significant droplets of bronze would be recovered, much of the equipment could be portable or re-usable (*e.g.* crucibles, associated tools) and furnace material and mould debris removed from the house's interior. All in all, the residues of bronze-working are potentially quite limited.

Fortunately there are different lines of evidence for detecting the loci of casting. The spatial distributions of mould and crucible fragments have been plotted on the Cladh Hallan house floors alongside the distributions of copper-alloy droplets and other copper-alloy waste and in several cases it is clear that these materials are distributed around the central hearth (Figure 1.26). In the Phase 9 floors of 1311 in House 401 and 1369 in House 1370 and the Phase 11 floor 655 in House 401, their deposition is focused on the immediate north side of the hearth. There are lesser concentrations of mould fragments within floor 2211 of House 1370 (Phase 9), floor 1308 of House 401 and floor 2003 of House 1370 (both Phase 10). However, their low numbers, their distribution away from the hearth and the absence of associated copper-alloy droplets collectively rule these out as casting loci.

A second line of evidence is provided by the soil micromorphological analysis of the house floors. Burnt shell fragments and phytolith slag from the floors of both House 401 and House 1370 derive from high-temperature burning accompanying metallurgical activities (Hamlet and Simpson in Volume 1: 411–12). The resulting calcium carbonate and glassy slag features in the basal layer (Unit A) of floor 1311 in House 401 provide evidence that this casting event took place around the start of the house's occupation (*ibid*.: 402, fig. 13.10). Similar phytolith slag from the top of floor layer 1311 (Unit I; *ibid*.: 405, fig. 13.11) reveals a second casting event at the end of Phase 9. In House 1370, burnt shell indicative

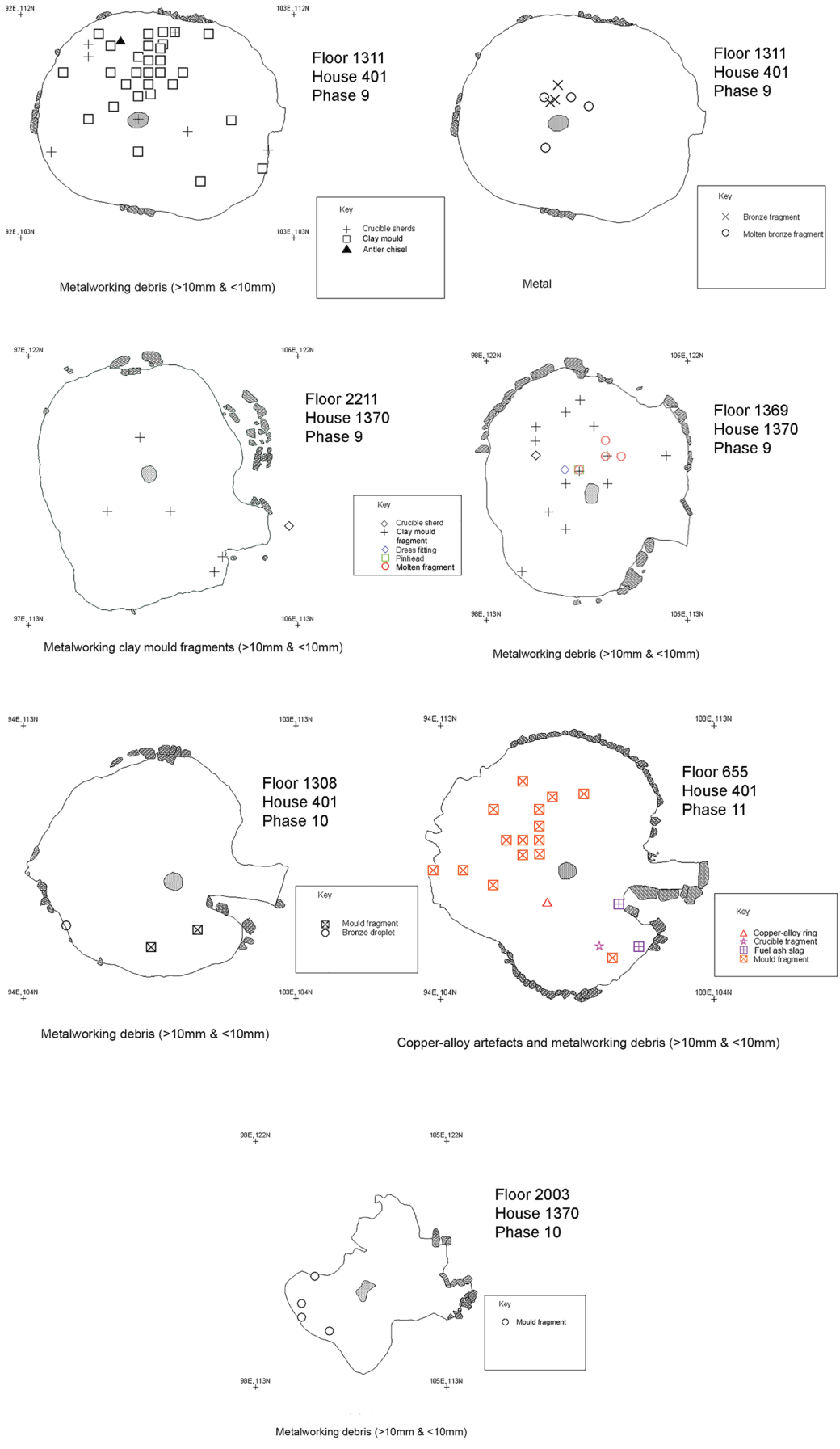

Figure 1.26. Distributions of metalworking materials (mould and crucible fragments and bronze droplets and waste) within floor layers 1311 of House 401 (top), 2211 and 1369 of House 1370 (second row), 1308 and 655 of House 401 (third row) and 2003 of House 1370 (bottom)

of high-temperature firing is found in floor layer 1369, the uppermost layer within Phase 9 (sample 3849; *ibid*.: figs 13.3 and 13.8).

A third line of evidence comes from use-wear analysis of bone and antler points (see Chapter 4). This reveals that two antler-tine chisels have embedded fragments of possible chalcopyrite, likely derived from bronze-casting. One of these (SF 4723) is an 80mm-long blunt point, 6.4mm wide at its tip which is faceted into a shallow convex end; it was found in the northwest quadrant of floor 1311 in Phase 9 of House 401. The other (SF 4977) is a smoothed antler tine, 77mm long and 21mm in diameter, shaped down to produce a narrower, bevelled tip with some axial scratches. It was deposited in the fill layer (659; start of Phase 12) laid on top of floor 655 within House 401 so was probably incorporated within sand brought from outside the roundhouse (from Phase 11 or earlier). These antler chisels could have been used to break open the moulds or to remove excess metal from the castings. Without the use-wear analysis, their unremarkable form, as slightly modified antler tine tips, would have made them difficult to identify as tools associated with metalworking.

In summary, the distributions of mould and crucible fragments, their spatial association with copper-alloy droplets and an antler chisel, and the soil micromorphological evidence combine to reveal four loci of bronze casting. The earliest of these dates to the beginning of Phase 9 in House 401. Two others are at the end of Phase 9 in House 401 and in House 1370. A fourth locus is evident from the distributions of mould and crucible fragments, and copper-alloy droplets in floor layer 655 of House 401 (Phase 11: Volume 1: fig. 7.25). Unfortunately, no soil micromorphological samples were available from this floor layer to corroborate the spatial patterning seen in Phase 11.

An important feature of the soil micromorphological analysis is the stratigraphic positioning of these casting events within the floor layers. At the beginning and end of phase occupations, they raise the likelihood that casting took place around the transition from one phase to another, namely the Phase 8/9 and Phase 9/10 transitions.

Whilst we have no such stratigraphic evidence for the casting event in floor 655 of House 401 (Phase 11), the presence of mould fragments from the fill (1423) of pit 1424 between the builds of House 401's Phases 10 and 11 would also support interpretation of casting as occurring during a transition. Additionally, the quantities of baked clay – possibly oven or furnace debris – in this pit (see Volume 1: 251, fig. 7.4) and the mould fragments and bronze droplet from the pit's vicinity in the Phase 10 floor layer 1308 (see Volume 1: fig. 6.25) could have been related to this casting event. The sherds from ten near-complete pots in pit 1424 are potentially the remains of a large cooking event or feast held in the liminal period between the house's dismantling at the end of Phase 10 and its rebuilding at the beginning of Phase 11.

The digging of pit 1424 between dismantling and rebuilding of House 401's wall would have required the roof to be taken down. This may reveal the circumstances of each bronze-casting event in Houses 401 and 1370, with the metalworking hearth operated within the roundhouses' temporarily roofless or semi-roofed interior. High-temperature industrial processes inside a roofed structure could potentially set the roof on fire although Crew and Rehren's (2002) experimental studies have highlighted the practical necessity for some form of cover. House 401 would not have had a roof on it during construction in Phase 8 and at the very beginning of Phase 9, and again in the transition from Phase 10 to 11 when the walls were substantially repositioned. Similarly, House 1370's walls were repositioned – the roof being removed – when it was remodelled between the use of floors 2211 and 1369, the latter being associated with bronze-casting activity.

Despite the large quantities of mould and crucible fragments in floor layer 1933 within House 401's forecourt (Phase 9), this was an area where these materials were deposited but not where casting took place. Not only were copper-alloy droplets absent from 1933 but also there is no source of heat where the casting could have taken place. Thus there must have been special reasons why such materials were deposited here. The preference for the north side of the forecourt, where the cluster of fragments was densest, mirrors the use of the north side of the hearth in House 401 for casting. Yet there is a further consideration of the symbolic significance of deposition in the forecourt, selecting a transitional space between the home and the outside world that can be described as liminal.

This concern with placing metallurgical debris conspicuously on boundaries and in entrances – normally enclosure entrances – has been noted elsewhere (Mörtz 2019), and Mörtz describes the depositions of sword moulds as connected to ritual activities (*ibid*.: 224–5). At Springfield Lyons in Essex, fragments from at least ten moulds for swords and a sickle were deposited in ditch terminals on the north sides of the east and west entrances of a ringfort in the eleventh–tenth centuries BC (Needham and Bridgeford 2013). Sword mould fragments were deposited in an entrance to Norton Fitzwarren hillfort, Somerset (Ellis 1989). At Rathgall in Co. Wicklow, mould fragments were associated with a bronze-casting workshop immediately outside the ringfort's central enclosing ditch on its east side (Raftery 1976: 344–6; Raftery and Becker 2024). A pit containing pin mould fragments was located immediately outside the southeast-facing entrance of a rectangular enclosure at Highstead, Kent (Bennett *et al*. 2007: 24, fig. 18). At South Hornchurch, Essex, fragments of a single sword mould were deposited on the western perimeter of an apparently east-facing roundhouse (Guttmann and Last 2000: 335–7, figs 14 and 19).

These sites form only a very small proportion of the total known from Late Bronze Age Britain and Ireland, as is superbly documented in a recent overview (Webley *et al*. 2020: 87–115). It is very clear from this exhaustive study that metallurgical debris was deposited in a range of different contexts that could relate to a wide spectrum from the ritual and liminal to the purely pragmatic.

Cladh Hallan's evidence places it towards the more deliberately symbolic end of that spectrum.

Metalworking debris might have been deposited in many cases away from its places of production. Casting was carried out within Houses 401 and 1370, and roundhouses might have been regular locations for such activities in addition to specialised workshops such as that at Rathgall. A good example of this is a Middle Bronze Age roundhouse at Tremough, Cornwall, where stone mould fragments were found scattered on its floor, concentrated around the hearth of this hollow-set building (Jones *et al*. 2015).

The metallurgical debris from Cladh Hallan is representative of all parts of the post-procurement metalworking process although the representation of individual mould units is only partial. Fragmentation and dispersal probably followed quenching and parting of the moulds. These were particularly friable, especially if quenched after casting, and would have broken down into fragments. Where left on exposed surfaces or exposed to foot traffic and trampling or exposed to the elements, they would be unlikely to survive. The contexts in which mould fragments do survive demonstrate these destructive processes. Mould fragments left on house floors were recoverable mostly as tiny fragments, a notable and fortuitous exception being the group of diagnostic fragments from the mould of Sword 1 from square 3062 within floor 1311 of House 401. The relatively good preservation of mould fragments on the north side of the forecourt can be explained by the fact that this part of House 401's entrance was protected beneath the north wall later in Phase 9.

The mould fragments reveal that a wide variety of weapons, tools and ornaments was cast at Cladh Hallan (Figure 1.27). Their stratigraphic locations and matching within mould assemblies allow the different bronze artefacts cast to be allocated, with varying degrees of certainty, to each of the four casting events:

- Transition from Phase 8 to Phase 9 on floor 1311 within House 401, with re-deposition in floor layer 1933 of House 401's forecourt. *1095–1015 BC*.
- Transition from Phase 9 to Phase 10 between floors 1311 and 1310 within House 401. *1045–985 BC*.
- Within Phase 9 (but towards its end) in floor 1369 within House 1370. *1045–985 BC*.
- Transition from Phase 10 to Phase 11 in floor 655 and associated layers within House 401. *1015–930 BC*.

From the first casting event within House 401, with material re-deposited on its forecourt, the cast objects included at least eight items: the two swords (Swords 1 and 2), a spearhead (Spearhead 1), one or more socketed axes (Socketed axe(s), Uncertain socketed axe), a corrugated sheet, two or more dress pins (Mould assembly 13) and a penannular bracelet or annular ring. One of the socketed axes may be represented by a possible core fragment, and possibly the second and third possible socket core fragments derive from this casting episode. A second pin mould (Mould assembly 14) may, tentatively, derive from this casting event.

No bronze castings can be assigned with certainty to the subsequent three casting events. It is possible that Spearheads 2 and 3 were cast in House 401 during the Phase 9–10 transition, based on stratigraphy, but their mould fragments' locations within the forecourt could well indicate that these were residual from deposition there in the Phase 8–9 transition.

The third pin mould (Mould assembly 15), from Phase 9 and 12 contexts within and above House 1370, could derive from the casting episode in the later part of Phase 9 associated with floor layer 1369. The chape, from a Phase 11 context above ruined House 801, could derive from any of the first three casting episodes.

Other unidentified items were cast in one or more of the three episodes after the first one during the Phase 8–9 transition. The 13 abraded inner valve fragments of sword mould from the floor layer 655 of House 401 in Phase 11 are very likely to have resulted from casting on the central hearth of that roundhouse during the Phase 10–11 transition. Not only are they from within a floor layer, thus likely the result of primary or near-primary deposition, but also they fall within a distribution – focused on the hearth and flaring northwards from it – which mirrors that recorded on floors associated with previous casting episodes. Thus it can be inferred that at least one otherwise unidentified sword and a possible second razor were cast during the Phase 10–11 transition in *1015–930 BC (at 95% probability)*. The socketed knife (?) and Socketed axe 2 could also have been cast in House 401 during this Phase 10–11 transition.

Bayesian statistical modelling of Cladh Hallan's stratigraphic sequence of phases provides a relatively precise chronological framework for the four metallurgical casting episodes (Marshall *et al*. 2021). On average, a casting episode was undertaken every 40–50 years or once every 1–2 generations, from the roundhouses' initial construction to their second and third rebuilds. It is entirely possible that these three lifetimes of the roundhouses corresponded to the adult lifetimes of successive heads of House 401's household. The casting episodes could each have provided for a lifetime of supply of weapons, tools and equipment. Of course, it is possible that these four episodes are the only ones to be archaeologically visible and that many more castings were carried out; however, the coincidence of casting episodes with phase transitions more likely implies that these were indeed tied in with cycles of household production and reproduction. Since the subsequent transition between Phases 11 and 12 (*815–765 BC*) may well have been a period when iron replaced bronze, this would explain the evident cessation in bronze-casting.

Bronze-casting at eleventh–tenth-century BC Cladh Hallan took place episodically within the domestic sphere. There was no apparent need for a dedicated 'workshop' where production could be a continuous process. It was probably just one specific form of specialised production within a much wider range of metalworking practices more widely within Britain and Ireland (Webley *et al*. 2020: 122–5). Working within a household mode of production, Cladh Hallan's inhabitants might be thought of as having no need of Gordon Childe's itinerant smiths (Childe 1940: 163) or Mike Rowlands' regional centres of production proposed for the British Middle Bronze Age (Rowlands

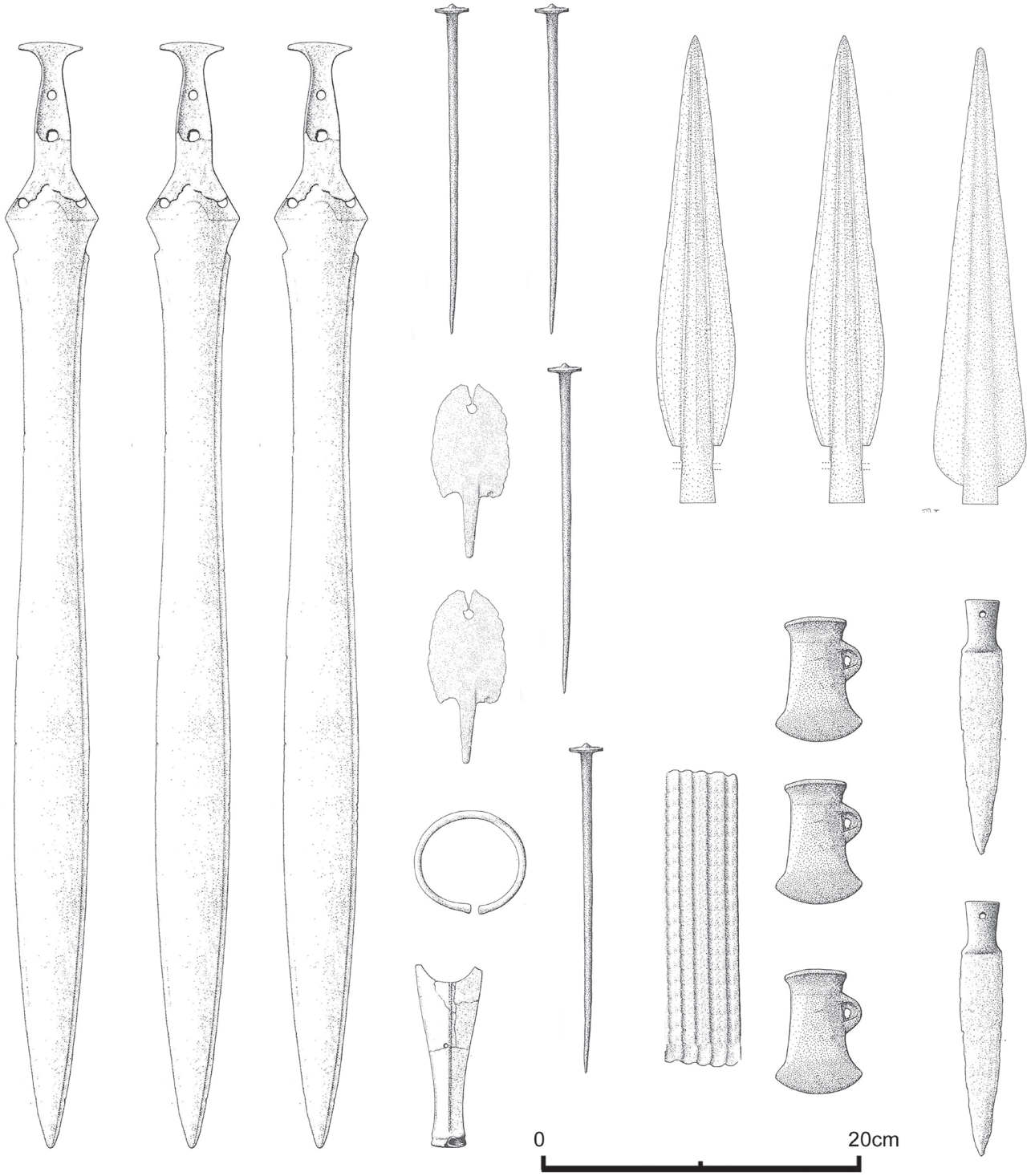

Figure 1.27. Schematic representation to convey the range of bronze artefacts cast at Cladh Hallan (from Colquhoun and Burgess 1988: plate 85.579; Davis 2015: plates 59.550, 110.1183; Eogan 1974: fig. 3; Jockenhovel 1980: table 10.164; Schmidt and Burgess 1981: plates 77.1112, 147.A9, 152.B42)

1976: 163–8). The identification of sword mould and crucible fragments from Late Bronze Age Cill Donnain (Parker Pearson and Zvelebil 2014: 133–5), just four miles north of Cladh Hallan, would suggest that bronze-casting was carried out within each local community rather than at a central place from which the products were distributed and exchanged.

That said, restricting casting events to once in a generation or less would surely have had deleterious consequences for the passing-on of metallurgical skills and practical know-how to successive generations. It might be that certain families or residential groups retained the specialist skills of metalsmithing, serving the many small communities within the island of South Uist, or within the

Western Isles as a whole, or even within the wider maritory that included the west coast of the Scottish mainland and the north coast of Ireland. They could indeed have been semi-itinerant, their services required at each household's foundation and rebuilding.

The notion of peripatetic bronze-smiths serving an extended community spread across the islands is rather different from Childe's out-dated notion of metalworkers as a distinct society liberated from the bonds of custom and free to travel where demand led them (Childe 1940: 163). It also differs from Rowlands' argument that dispersed smiths of the Middle Bronze Age worked from a central workshop to supply surrounding populations (Rowlands 1976: 163–4). The Late Bronze Age pattern, with evidence for large-scale pooling and concentration of scrap-metal and ingots, further suggested to Rowlands that bronze-casting was carried out in some regions at widely-separated centres with further specialisation provided by weapon smiths (*ibid*.: 167–8). Perhaps the true situation for the Late Bronze Age lay somewhere in between the two, at least for the Western Isles and the wider region of western Scotland.

For those of us lucky enough to have spent field seasons in the Western Isles, one further analogy comes to mind, that of the township bull. Every year, each township receives the prize bull that will inseminate the herd to produce their offspring. His task completed, the bull is then transported to the next township and the next, within and between islands, on a lengthy tour of duty over many months. Might Late Bronze Age metalworkers have made similar tours, hosted by communities up and down the islands and possibly even further afield, attending the rites of passage and other ceremonial events at household and community level? As members of a distinct community different from their hosts, it may explain why their byproducts – the fragmented moulds – were deposited in liminal locations and at liminal times, perhaps to protect households from perceived supernatural dangers.

1.8 Conclusion

Cladh Hallan's excellent circumstances of preservation, complex stratigraphy and refined chronology, together with corroborative methods of investigation such as soil micromorphology, spatial analysis and typological analysis have provided a rare opportunity to explore the context and practice of bronze metallurgy during the Late Bronze Age in the eleventh–tenth centuries BC. Four episodes of bronze-casting can be identified in Phases 9–11, three of them within House 401 from its construction in *1095–1015 BC* (at 95% probability) to its second rebuilding in *1015–930 BC*. A fourth episode is identified in the northern roundhouse, House 1370, towards the end of Phase 9. These are all moments when the houses are likely to have been roofless, a practical expediency against setting the roof on fire and, symbolically, a liminal state of transition in which to effect the transformation of scrap metal into new objects.

The first casting event which took place on the north side of the central hearth within the centre of newly built House 401 in *1095–1015 BC* has left most traces among its mould fragments of the objects cast. These included two swords, at least one spearhead, at least one socketed axe, a bifid razor, two or more dress pins, a penannular bracelet or annular ring, and a corrugated sheet. Many of their fragments were re-deposited within House 401's forecourt, most of them in a heap on the north side of this entrance. Their subsequent protection below the walls of a circular forecourt building constructed later in Phase 9 has ensured their good preservation. Re-deposition of mould fragments within entrances is known from other Late Bronze Age settlements in Britain and may have served as a form of ritual protection for the inhabitants.

A second casting took place towards the end of Phase 9 within the northern, ancillary roundhouse (House 1370) but preservation of mould fragments was too poor to infer any products other than a dress pin from Mould assembly 15.

The third casting event is identified in House 401 during the transition between Phases 9 and 10 (*1045–985 BC*). Debris within a pit dug while the roof was off included what might have been baked clay from a furnace as well as a mould fragment and smashed pots from a feasting event. Again, no cast artefacts could be associated with this episode with any certainty.

The fourth casting event, on the north side of the central hearth in House 401, took place probably during the transition from Phase 10 to Phase 11 (*1015–930 BC*). Although the finds within the associated floor layer are heavily worn and abraded, some are sword mould fragments. Finally, a chape and another dress pin cannot be assigned, even tentatively, to any particular casting episode.

Bronze-casting at Cladh Hallan was performed episodically within a domestic setting. Its timing was associated with house construction and rebuilding – approximately every 40–50 years – and may have coincided with the life cycle of the inhabitants, perhaps the succession of a new head of household on the death of the previous. This picture of an essentially domestic mode of production does not, however, entirely do away with the concept of the itinerant smith. Such specialist technologies would have had to have been practised regularly to ensure their effectiveness and generational transmission so we can envisage a situation where semi-itinerant specialists served local communities, called upon in those liminal periods when houses were built and renewed.

Notes

1 This chapter and the catalogue provide basic information on stratigraphy and artefact location and the reader can consult Volume 1 for further information (including distribution plots). The entries 'clay moulds' and 'metalworking' in that volume's index are the quickest route to relevant information. Page numbers and figure numbers in Volume 1 are therefore, in general, not given here.

2 In the case of groups of fragments with a single SF number, individual mould fragments were subdivided for cataloguing purposes by adding a decimal point to provide a unique identifier (*e.g.* SF 5002.1, SF 5002.2 and so on).

2 Metalwork

M. Juddery, M. Parker Pearson, L. Troalen, T. Verolet, B. O'Connor and D. Dungworth

The metalwork from Cladh Hallan consists of 16 copper-alloy objects, 17 droplets and molten lumps of copper alloy, seven copper-alloy fragments, two fragments of iron, and a gold penannular ring from Late Bronze Age–Early Iron Age contexts in and around the roundhouses in Area A, as well as 12 copper-alloy fragments and more than 70 copper-alloy droplets from Early Iron Age contexts in House 150 in Area C. In addition, six mammal bones with copper staining (but no associated metalwork) attest to the former presence of copper-alloy items in Area A.[1]

2.1 Copper-alloy artefacts from Late Bronze Age contexts in Area A

Matt Juddery and Mike Parker Pearson

Among the many copper-alloy objects found at Cladh Hallan are three rings, two penannular bracelets, two pins and a small triangular punch or chisel. Two unusual tanged, rectangular copper-alloy objects are thought to be either unfinished razors or spokeshaves (Figure 2.1). The metalwork assemblage from Cladh Hallan is typical of finds from Late Bronze Age settlement sites in Britain, which tend to be dominated by personal ornaments and small tools, although this is less the case in Scotland where recent excavations of settlement sites have produced moulds rather than their products (Brendan O'Connor pers. comm.).

Copper-alloy artefacts

Any number in square brackets (e.g. [5049], floor) is an environmental sample number.

Phase 8

SF 5417 context 1930 (wall core of House 401; E102.45 N103.4). A copper-alloy pin head.

Phase 9

SF 3801 context 1311 (floor of House 401; E99.51 N109.62, 3.49m OD). A copper-alloy blade, 91mm long by 28mm wide, up to 2.5mm thick and weighing 18.4g (Figures 2.1–2.2). It appears to have had a tang since there is a slight thickening in the middle of its top end where the tang could have broken off. The blade widens along its length from 24mm at its top end to 28mm at its cutting edge. The cutting edge is concave in shape and flat in cross-section. It could be a spokeshave with its concave blade being used to make bows and arrowshafts, handles and paddles (though probably too early for wheel spokes; Roger Thomas pers. comm.). There is no known parallel for this object. It is in poor condition and could be either unfinished or an artefact that has subsequently been altered.

SF 3802 context 1311 (floor of House 401; E99.72 N109.72, 3.48m OD). A complete copper-alloy tanged artefact, 88mm long by 32mm wide (blade width), up to 3mm thick and weighing 11.2g (Figures 2.1, 2.3). Its tang (discovered broken in two but conjoining) is 39mm long and 4mm wide, widening to 8mm where it meets the concave top of the blade. Its cutting edge, like that of SF 3801, is also slightly concave in plan and slightly curved in cross-section. This too could be a spokeshave (Roger Thomas pers. comm.). The blade is slightly trapezoidal, expanding in width from 29mm at its top to 32mm at its cutting edge. The shoulders are slightly flared, reminiscent of a bifid razor. The object is in fairly poor condition. As with SF 3801, no exact parallels for this object are known; however, it is most likely either a spokeshave or an unfinished or miscast bifid razor.

SF 4621 context 2211 (floor of House 1370; E101.08 N118.77, 3.94m OD). A complete copper-alloy penannular bracelet, bent into a '6' or '9' shape and weighing 3.3g (Figures 2.1, 2.4). It was originally oval in shape, about 60mm across. It has a lozenge cross-section, 2mm wide and 1mm thick, and its terminals narrow to curved tips about 1mm wide. This item thus differs from Late Bronze Age penannular bracelet forms with expanded terminals.

SF 5138 context 1369 (floor of House 1370; E100.75 N118.25). A fragment of copper-alloy plate, 12mm by 11mm, up to 5mm thick (though mostly 2mm thick) and weighing 0.9g, with a small, broken ring cast onto one end.

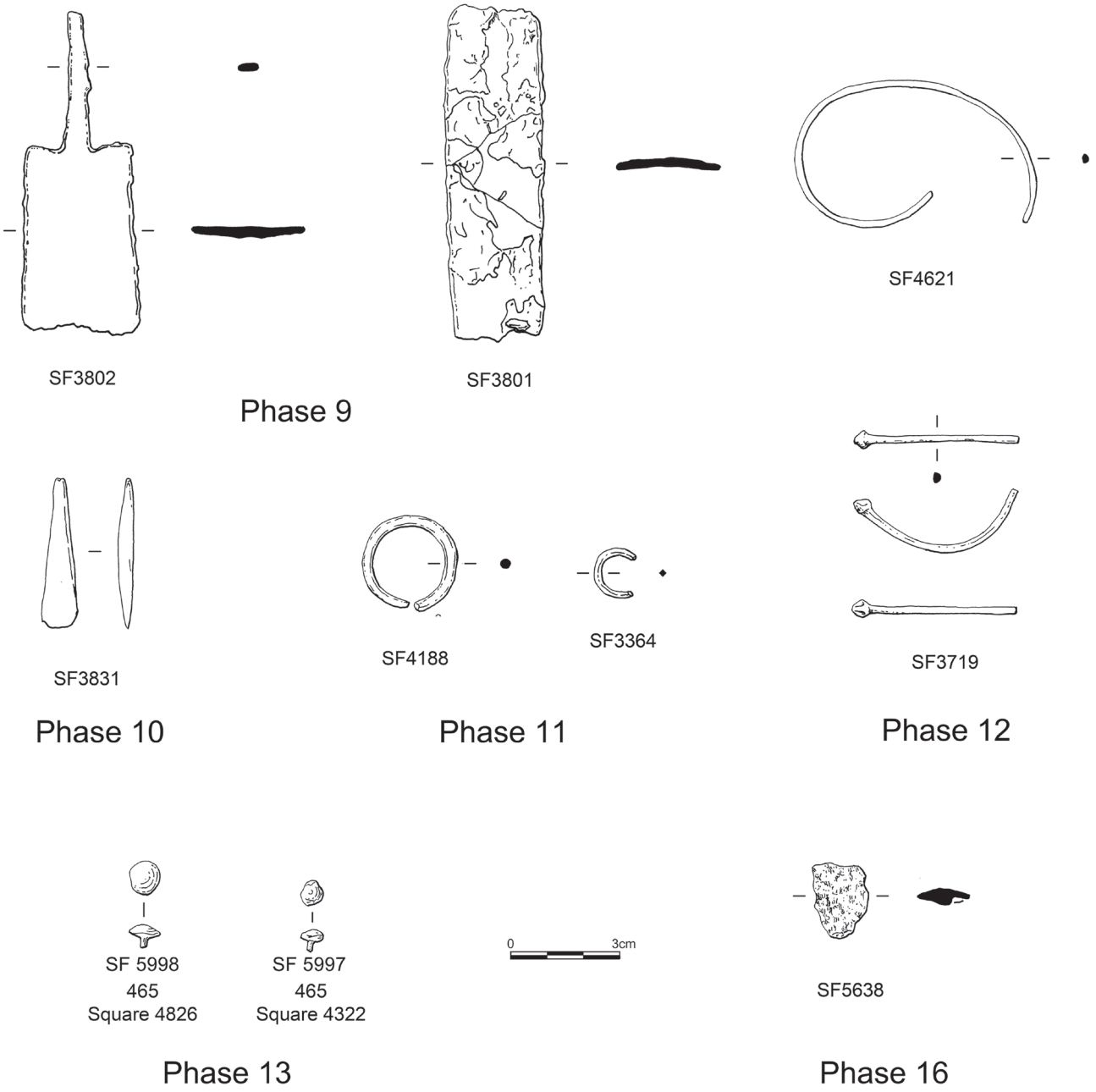

Figure 2.1. Copper alloy artefacts and an iron artefact (bottom right) from Cladh Hallan

The ring was originally 10mm in diameter with a hole 2mm in diameter. It is probably a broken dress fitting.

Phase 10

SF 3831 context 1310 (inter-floor fill of House 401). A copper-alloy, triangular-shaped tanged chisel, 41mm by 9.5mm (blade width), 3mm thick and weighing 4.6g (Figures 2.1, 2.5). The tang narrows to 2mm wide. Its curved blade is damaged at one corner and the thickness of the chisel decreases to less than 1mm at both ends. Tiny mineralised fibres, less than 0.5mm in size, are preserved in the corrosion product. It is a tanged chisel, common from the Late Bronze Age and Early Iron Age throughout the British Isles. Comparisons include a parallel-sided small chisel or awl from the Breiddin hillfort, Powys (Coombs 1991: 137, fig. 56, no. 155), a longer and wider-bladed chisel from a Late Bronze Age timber platform at Shinewater, Sussex (Greatorex 2003: fig. 7.5c), and a shorter but wider-bladed chisel from a Late Bronze Age–Earliest Iron Age midden site at Whitchurch, Warwickshire (Waddington and Sharples 2011: 38, fig. 27, no. 789). The Cladh Hallan chisel's small size suggests that it would have been used for woodworking or possibly to create decoration or patterns on bronze metalwork.

Phase 11

SF 3364 context 655 (floor of House 401; E97.55 N107.2). A small copper-alloy ring with an external diameter of 14mm (internal diameter 11mm) and weighing 0.1g (Figures 2.1, 2.6). It is about two-thirds complete and it has a lozenge

Figure 2.2. A copper-alloy blade (SF 3801) from floor 1311 of House 401

Figure 2.3. A copper-alloy tanged artefact (SF 3802) from floor 1311 of House 401

cross-section. Its fineness suggests that it was probably worn as an ornament. Like SF 4188, this is a common example of a Late Bronze Age ring. A tiny fragment from the fill (746) of posthole 747 immediately below its location probably comes from this ring. A similarly incomplete ring of this size has been found at Whitchurch (Waddington and Sharples 2011: fig. 31, no. 070).

SF 4188 context 800 (inter-floor fill of House 401; E96.9 N107.9, 3.77m OD). A complete copper-alloy penannular ring, 25mm in external diameter (internal diameter 21mm) weighing 2.4g (Figures 2.1, 2.7). It has a circular cross-section, 2mm in diameter. Its terminals are plain and are 1.5mm apart. Like SF 3364, this is a common example of a Late Bronze Age ring. A similar penannular example of 21.5mm diameter from an unstratified context within Sculptor's Cave, Covesea, Moray, is described as a finger ring and considered to be post-Bronze Age (Hunter 2020: 143, illus. 5.45, SF761). Annular rings of this size have been found at Late Bronze Age–Earliest Iron Age Whitchurch (Waddington and Sharples 2011: fig. 31, nos 450, 683, 928).

Phase 12

SF 3719 context 1591 (fill northeast of forecourt of House 401; E106.59 N112.9). A copper-alloy penannular bracelet, with an external diameter of about 50mm and weighing 1.6g (Figures 2.1, 2.8). It is about one-third complete and was oval in shape with a lozenge cross-section (1.5mm wide and 2.5mm thick). Its expanded terminal is club-shaped (5mm long, 3.5mm thick and up to 5.5mm wide). This ornament represents a variation on penannular bracelets with outward-expanded terminals (so-called Covesea bracelets) that are common throughout Scotland during the Late Bronze Age.

The most notable parallels are from Sculptor's Cave, Covesea, Braes of Gight and Glentanar, Aberdeenshire and Balmashanner, Angus (Anderson 1892; Armit and Büster 2020; Muirhead 1891; Pearce 1970). These Covesea armlets have previously been compared to Urnfield and Nordic bracelet types, prompting suggestions of a migration from the Continent into northeast Scotland near the end of the Late Bronze Age (Coles 1962: 54). However, O'Connor has pointed out that penannular bracelets were very common throughout Europe during the Late Bronze Age and that the idea of a migration based upon Covesea armlets cannot be sustained (O'Connor 1980: 212–13). O'Connor also suggests that these bracelets could be local imitations of Irish gold and bronze bracelets with

Figure 2.4. A copper-alloy penannular bracelet (SF 4621) from floor 2211 of House 1370

Figure 2.5. A copper-alloy tanged chisel (SF 3831) from inter-floor layer 1310 of House 401

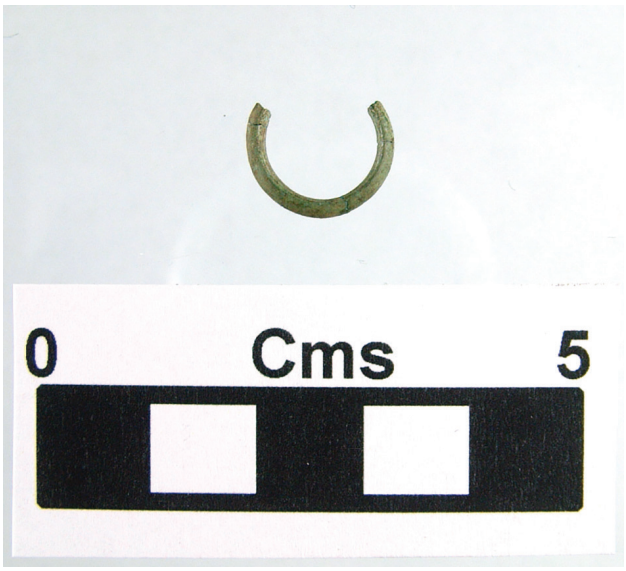

Figure 2.6. A small copper-alloy ring (SF 3364) from floor 655 of House 401

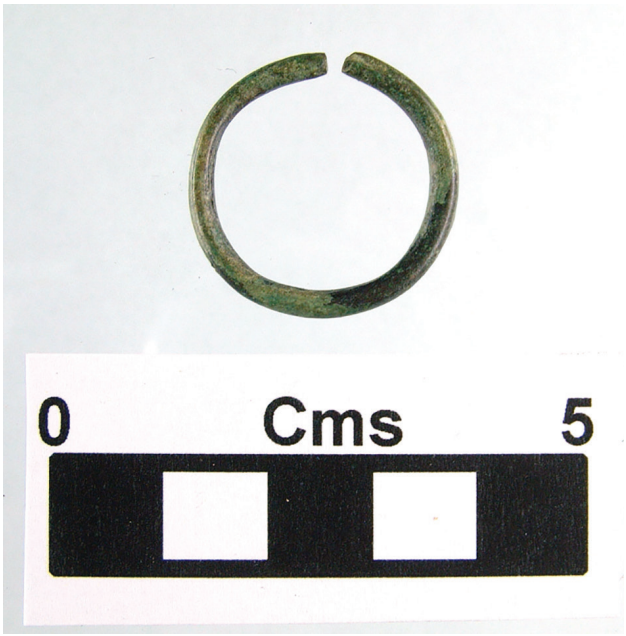

Figure 2.7. A copper-alloy penannular ring (SF 4188) from inter-floor layer 800 in House 401

evenly expanded terminals (*ibid.*). This Irish connection would not be surprising in the Western Isles during the Late Bronze Age, since relations with Ireland are attested by the distribution of Irish socketed axes forms, such as bag-shaped axes (Schmidt and Burgess 1981).

SF 4202 context 2000 (fill east of House 1370). A broken copper-alloy pin shaft.

Phase 13

SF 3017 context 514 (fill within House 401; E95.7 N108.6). A copper-alloy disc, 10mm in diameter and 2mm thick.
SF 5997 context 465 ([4322] floor layer within House 401). A copper-alloy dome-headed rivet, 6mm in diameter and 7mm long (Figure 2.1).
SF 5998 context 465 ([4826] floor layer within House 401). A copper-alloy dome-headed rivet, 9mm in diameter and 7mm long (Figure 2.1).
Context 521 (fill within House 401). Two tiny copper-alloy fragments, possibly rivets, 3mm and 2mm long by 1.5mm diameter.

Unstratified (Area A)

SF 3359 unstratified (from the front yard area east of House 401). A broken half of a perforated copper-alloy disc,

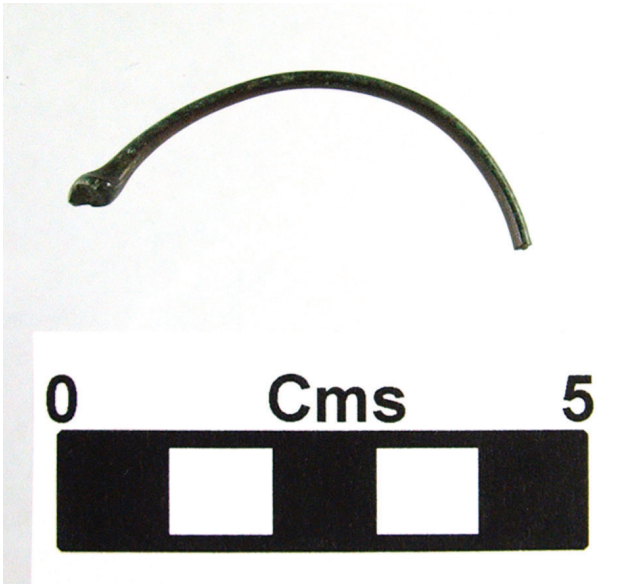

Figure 2.8. A copper-alloy penannular bracelet (SF 3719) from layer 1591 in the yard in front of the roundhouses

17mm by 8mm, 2mm thick and weighing 0.4g. Excluding corrosion products, this slightly plano-convex sectioned disc was originally 19mm in diameter and 1.5mm thick with a central hole 3.5mm in diameter.

Copper-alloy droplets and molten lumps

Phase 9

SF 4691 context 1311 (floor of House 401; E97.95 N108.38, 3.56m OD). A melted lump, 19mm by 9mm and 3mm thick. 0.8g.

SF 4767 context 1311 (floor of House 401; E97.25 N108.75). A melted lump, 9mm by 6mm and 2mm thick, with a curved cross-section. 0.05g.

Context 1311 (floor of House 401). Two tiny droplets and a fragment.

SF 5461 context 1369 (floor of House 1370; E101.25 N118.25). Three small amorphous lumps which have been melted. Qualitative surface EDXRF (energy dispersive X-ray analysis) shows them to be leaded tin bronzes with a wide range of impurities (notably silver, arsenic and antimony). 0.4g.

SF 5410 context 1369 (floor of House 1370; E101.25 N118.25). A droplet, 10mm by 10mm by 7mm, possibly a corroded pinhead. 0.4g.

Context 1369 (floor of House 1370). Four tiny droplets.

Phase 10

SF 5047 context 1308 (floor of House 401; E95.25 N106.25). A droplet, 1mm in diameter. 0.02g.

Phase 11

SF 3460 context 1204 (floor of House 1370). A curved, melted lump, 18mm by 7mm by 6mm. 1g (Figure 2.9).

Figure 2.9. A curved, melted lump of copper alloy (SF 3460) from floor 1204 of House 1370

Figure 2.10. A melted lump of copper alloy (SF 3523) from inter-floor layer 1203 of House 1370

SF 3523 context 1203 (inter-floor fill of House 1370; E99.5 N121.0, 4.20m OD). A melted lump, 17mm by 8mm by 10mm. 3.9g (Figure 2.10).

Unstratified

SF 4305 unstratified. A droplet, 2.5mm in diameter. 0.05g.

SF 4347 unstratified (E95.0 N126.3, 4.57m OD; beyond the northwest edge of Area A). A comma-shaped melted lump, 10mm by 5.5mm and 2mm thick. 0.6g.

Copper-alloy fragments

Phase 8

SF 4585 context 1312 (construction layer of House 401; E93.13 N106.99, 3.51m OD). A fragment, now broken into many tiny pieces less than 2mm across. 0.05g.

Phase 9
SF 4231 context 1311 (floor of House 401; E96.4 N108.54, 3.61m OD). A triangular fragment of plate, 6mm by 5mm and less than 0.5mm thick. Less than 0.05g.

Phase 10
SF 3832 context 1760 (inter-floor fill of House 401). A fragment(s) from the northeast quadrant of House 401.
SF 4240 context 2139 (pit fill in House 1370). A fragment.
SF 4264 context 1709 (floor of House 1370). A fragment from the hearth area of House 1370.
SF 3821 context 1900 (fill of House 1370). A triangular fragment of plate, 8mm by 7mm and 1mm thick. 0.05g.

Copper staining on bones or teeth

Phase 9
SF 4690 context 1311 (floor of House 401; E96.6 N108.65). A copper-stained fragment probably of bone, 4mm by 3mm by 0.5mm.

Phase 10
SF 3832 context 1760 (inter-floor fill of House 401). A copper-stained animal bone, 40mm by 11mm. The staining is 26mm long and 9mm wide.
SF 3857 context 1310 (inter-floor fill of House 401). A copper-stained animal bone.
SF 4237 context 1205 (windblown sand on floor in House 1370; E101.2 N119.6, 3.96m OD). A copper-stained animal pelvis fragment, 49.3mm long with a maximum width of 37.5mm. Copper staining covers an area of 25mm by 1mm.
SF 4239 context 1205 (windblown sand on floor in House 1370). A copper-stained animal tooth found next to SF 4237.

Phase 12
SF 4237 context 1190 (fill of posthole 1189 in northwest quadrant of House 401). A copper-stained bone.

2.2 Gold penannular ring

SF 4296 context 1790 (fill layer east of House 1370; Phase 9). A gold-plated penannular ring (SF 4296) with a copper-alloy core (Figure 2.11). It is penannular, 18mm in diameter, and has a 2mm-wide gap between terminals. It was deposited after *1135–1035 cal BC* and before *1050–950 cal BC* according to the site's chronological model (Marshall *et al*. 2021).

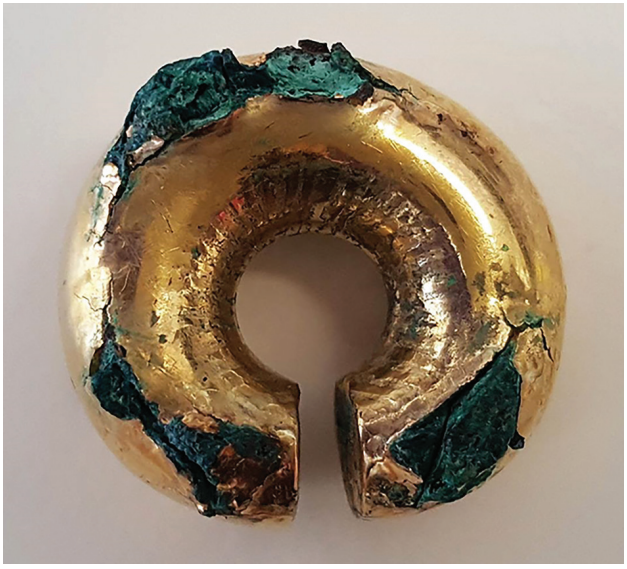

Figure 2.11. A gold-plated penannular hair ring (SF 4296) from layer 1790 in the yard in front of House 1370

Analysis

Lore Troalen and Thibert Verolet

The Late Bronze Age gold penannular ring found at Cladh Hallan was investigated by optical microscopy, surface X-ray fluorescence analysis and scanning electron microscopy. In contrast to the rings from the Sculptor's Cave at Covesea (Becker *et al*. 2020), the Cladh Hallan ring exhibits the yellow and gold wasp-like stripes that have been observed in some gold rings from this period (Northover 2000; Meeks *et al*. 2008). The copper-alloy core is highly corroded and visible where the gold foil cover is now damaged (Figure 2.12).

The composition of the gold foil cover and copper-alloy core were investigated by X-ray fluorescence (XRF)[2] without any surface cleaning or surface preparation. While analysis of the gold foil was quantitative, the copper-alloy core could only be analysed qualitatively due to the high level of corrosion. Additionally, measurements of the composition of the gold foil and electrum stripes were undertaken with a scanning electron microscope (SEM).[3] The main concern with regard to surface analysis of archaeological gold objects is the extent of depletion or corrosion of the gold alloys that may affect their surface composition (Scott 1983; Rapson 1996; Tissot *et al*. 2015).[4] It is expected that the XRF analysis provides a composition close to the bulk composition of the gold plate, although there might be some depletion of copper from the outermost 3 microns as a result of the burial conditions (Hook and Needham 1989); SEM analysis provides information on surface composition (< 1 micron) and is more likely to have been affected by compositional changes of the surface or the irregular geometry of the artefact.

Results of the technological study

The process of making penannular rings in the Late Bronze Age is not yet fully understood: it is possible that the metalworker started with a bar of bronze, and the gold foil was added before it was bent into the ring shape (Meeks *et al*. 2008). In this process, the overlapping seam is bonded by hammering and burnishing, and the gilded cylinder is then worked into a loop. Alternatively, it is possible that the gold was applied *after* the copper-alloy core was shaped as

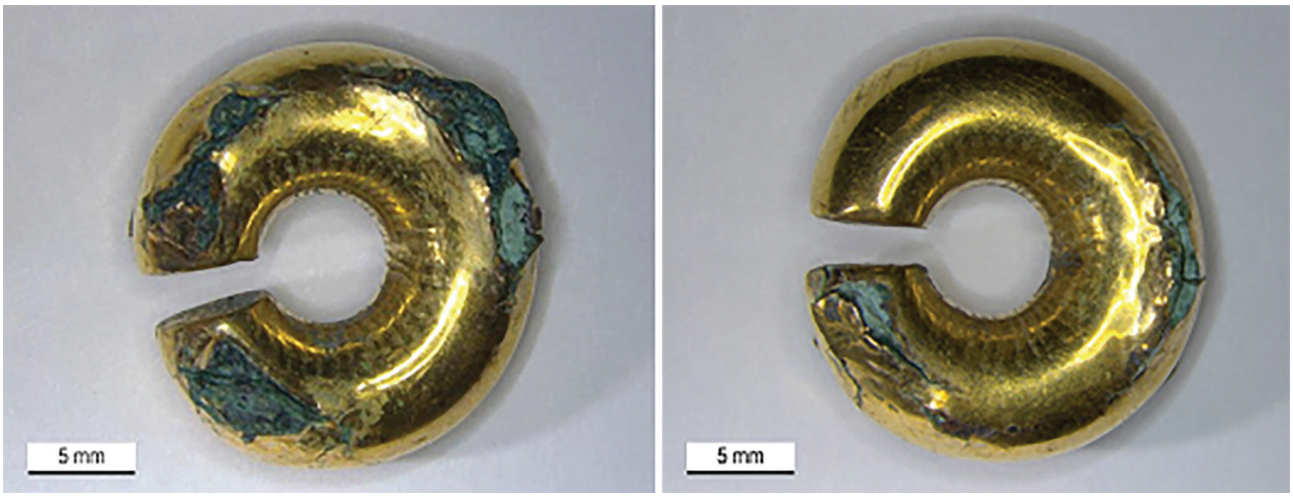

Figure 2.12. Stereoscopic imaging of the Cladh Hallan hair ring, front (left) and reverse (right)

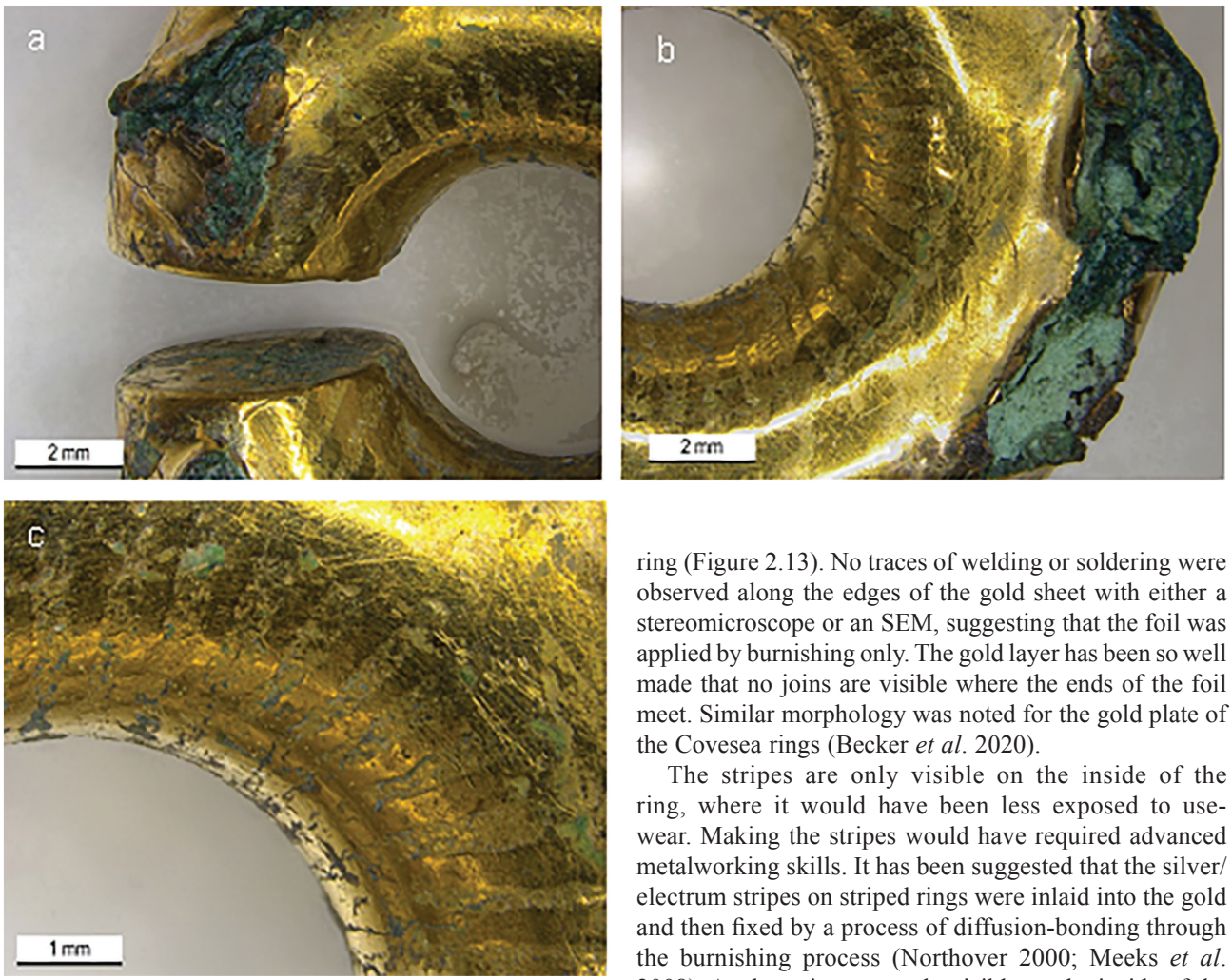

Figure 2.13. Stereomicroscopic observation of the hair ring and its stripes (a, b and c)

a ring, as suggested by Eluère in her study of penannular rings from France (Eluère 1982: 52). The morphology of the gold foil on the Cladh Hallan ring does not allow us to confirm whether the core was plated and then bent, as no creases of the gold foil are visible on the inside of the ring (Figure 2.13). No traces of welding or soldering were observed along the edges of the gold sheet with either a stereomicroscope or an SEM, suggesting that the foil was applied by burnishing only. The gold layer has been so well made that no joins are visible where the ends of the foil meet. Similar morphology was noted for the gold plate of the Covesea rings (Becker *et al*. 2020).

The stripes are only visible on the inside of the ring, where it would have been less exposed to use-wear. Making the stripes would have required advanced metalworking skills. It has been suggested that the silver/electrum stripes on striped rings were inlaid into the gold and then fixed by a process of diffusion-bonding through the burnishing process (Northover 2000; Meeks *et al*. 2008). As the stripes are only visible on the inside of the ring, it is not possible to observe their morphology on the outside. Examples of penannular rings with electrum stripes from the British Museum's collection show that the stripes are wider outside the ring, due to stretching, and narrower on the inside due to compression (Meeks *et al*. 2008). This difference in width of the stripes has been interpreted as the result of the bending of the ring after it was inlaid (*ibid*.). It is therefore possible that a similar

process was applied to the Cladh Hallan ring, even though the stripes would not have formed a continuous spiral, as seen on some other striped rings.

Analysis of the gold foil and the stripes

Three measurements were undertaken on different parts of the object with XRF and four measurements were performed with SEM on the stripes, whilst two were taken on the edges of the stripes (Table 2.1). With regard to the gold alloy, the Cladh Hallan ring has an Ag/Au ratio similar to other Scottish rings from Covesea (Becker *et al*. 2020) within the range of compositions known for such rings in Britain (Northover 2000; Meeks *et al*. 2008). The silver levels observed in the Cladh Hallan ring correspond well with what would be expected for British and Irish alluvial gold sources (Chapman *et al*. 2006; Standish 2012) but the copper content, up to 6–7 wt%, suggests some addition to the alluvial gold source (Figure 2.14). Similar addition of copper to alluvial gold sources was also observed in rings from the British Museum collection (Meeks *et al*. 2008) and in Irish gold items from the Late Bronze Age (Standish 2012) and is also observed in Irish rings from that period (Hartmann 1970; Northover 2000). The quantification of residual levels of tin cannot be achieved accurately by XRF analysis due to the high silver content in the gold alloy and the overlapping of X-ray lines. However, traces of tin in the range of 0.4 wt% were detected by XRF analysis. Traces of tin in the range of 0.01–0.3 wt% have been found in the majority of the Early Bronze Age goldwork from Ireland (Hartmann 1970; Chapman *et al*. 2006; Standish 2012) and thus might be expected in this case.

SEM observation reveals the inlay morphology of the stripes, with a depletion where it has been burnished into the gold plate (Figure 2.15). Elemental mapping using the energy dispersive detector in the SEM reveals that the stripes are made of an electrum alloy with about 27 wt% silver in the centre, and up to 38 wt% on the edges. This gradient in silver content is visible in the elemental mapping displayed in Figure 2.16 (b and c). Similar gradients in composition have also been observed in the rings analysed in the British Museum collection (Meeks *et al*. 2008) and are consistent with a diffusion-bonding process (Gänsicke and Newman 2000; Northover 2000).

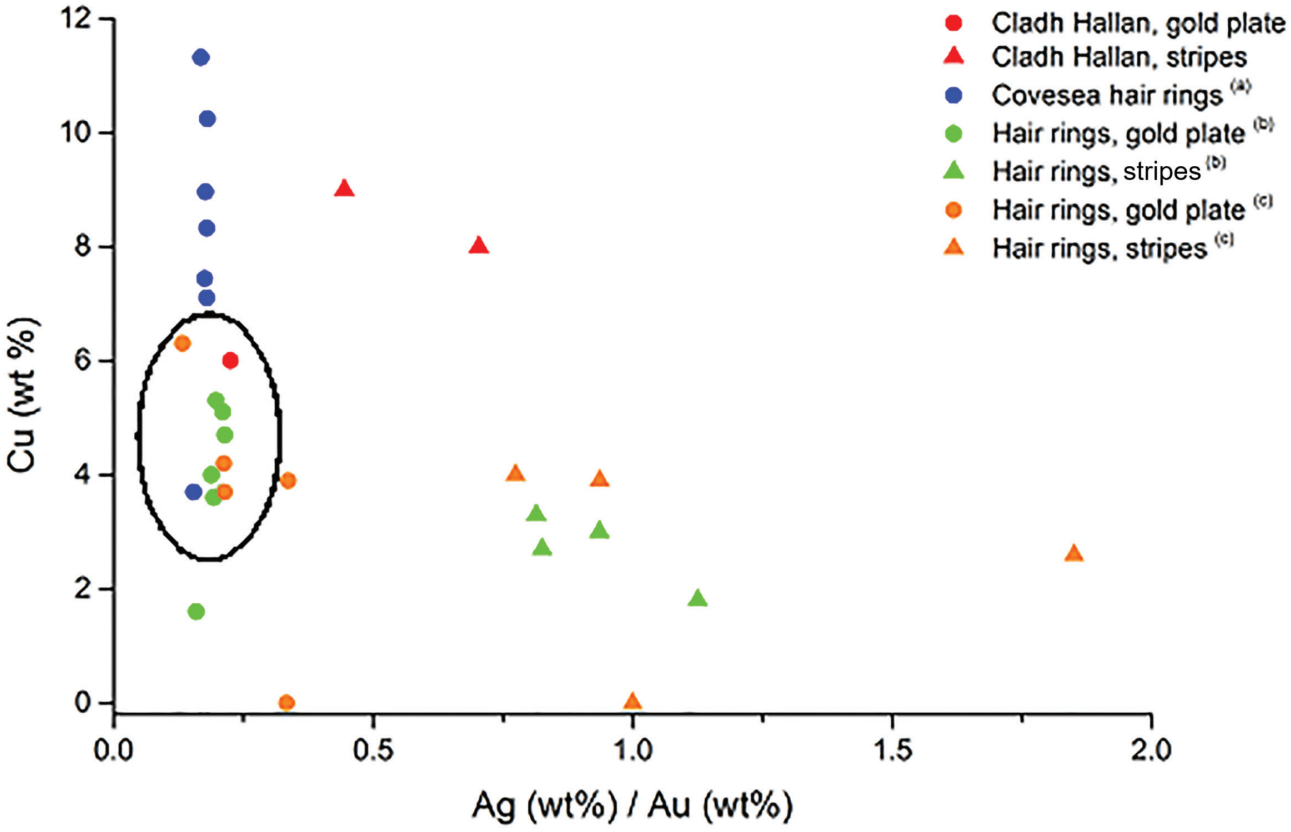

Figure 2.14. Cu (wt%) as a function of Ag (wt%)/ Au (wt%) obtained by XRF and SEM analysis for the Cladh Hallan hair ring, compared with compositional data of published gold hair rings: Covesea plated hair rings (XRF analysis; (a) Becker et al. *2020), plated hair rings (EDS analysis on abraded surface; (b) Meeks* et al. *2008), plated hair rings with stripes (EDS analysis; (c) Northover 2000)*

Table 2.1. The elemental composition of the gold ring from Cladh Hallan. Average values obtained by surface X-ray fluorescence and energy dispersive X-ray analysis obtained on three distinct measurements and normalised to 100 wt%. Values marked as a dash stand for not determined

Analysis	Au (wt%)	Ag (wt%)	Cu (wt%)	Sn (wt%)
XRF gold layer	76.3 ± 0.5	17.2 ± 0.2	6.0 ± 0.2	0.4 ± 0.2
SEM gold layer	74 ± 1	19 ± 2	7 ± 1	-
SEM tiger stripes, centre	65 ± 3	27 ± 2	9 ± 4	-
SEM stripes, edges	56 ± 4	35 ± 3	9 ± 4	-

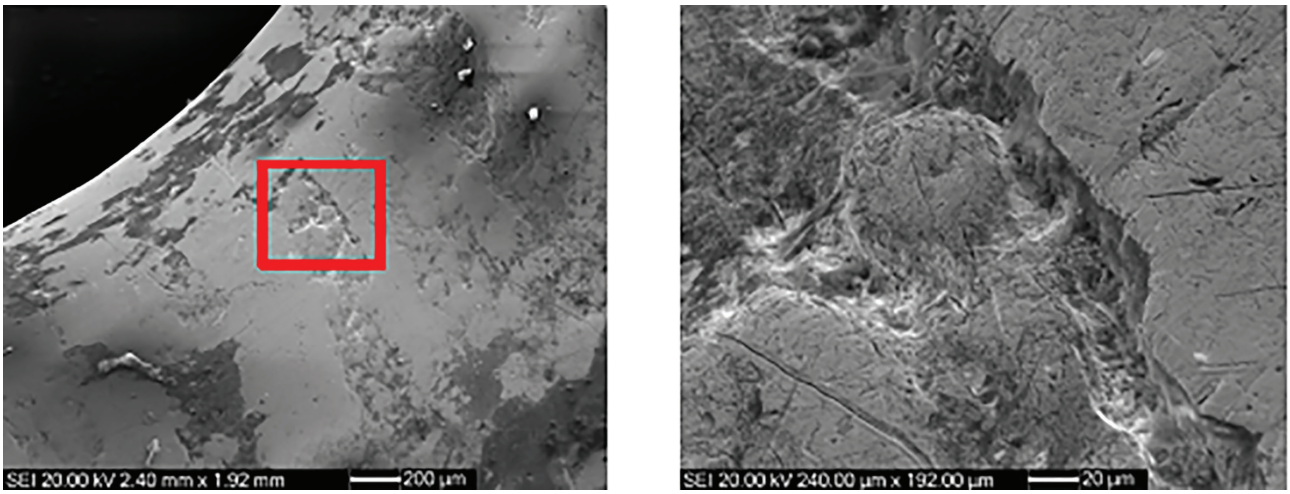

Figure 2.15. SEI micrographs of the inlayed stripes, showing depletion where the electrum stripe has been burnished into the gold plate

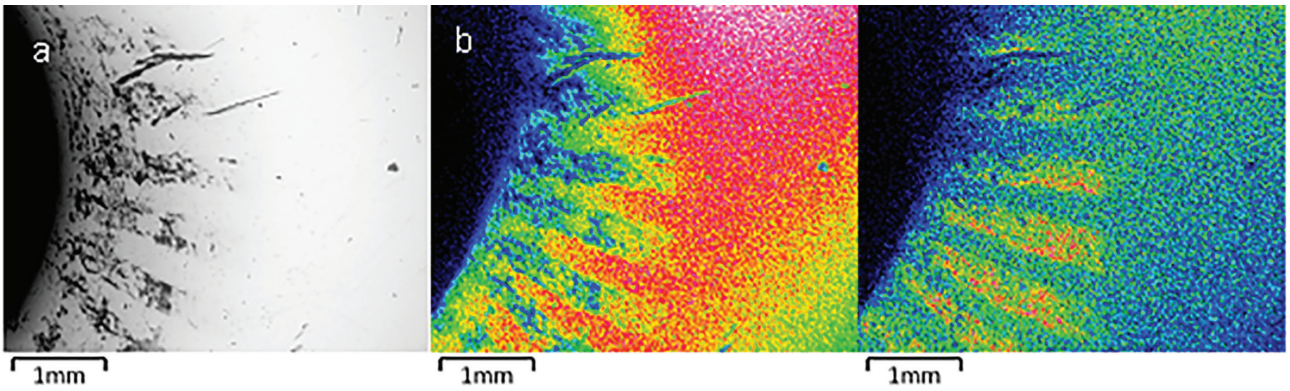

Figure 2.16. (a) BSC micrograph of the electrum stripes; (b) elemental mapping of gold (Au, M line); (c) elemental mapping of silver (Ag, L. line)

Discussion of the gold pennanular ring

Brendan O'Connor

This gold ring belongs to a distinct but somewhat heterogeneous group of objects known variously as 'ring-money' (Wilson 1863: 451–6; Taylor 1980: 64–5, 133–4, map 5, plate 33, e–i; Northover 2000), 'hair-rings' (Eogan 1994: 89, 137–42; 1997) or most recently 'les petites parures annulaires en or ou plaquées de tôle d'or' (Armbruster 2021: 190–200). They have not been subject to a comprehensive survey, though some of the examples in the British Museum have been examined in detail (Meeks *et al*. 2008), and the corpus is constantly increasing because these rings are susceptible to recovery by metal detector. Their purpose remains uncertain. The hair-ring interpretation was supported by an identification of organic material between the terminals of rings from Covesea, Moray, as human hair but analysis has shown this to be vegetable matter instead (Armit and Büster 2020: 125). Armbruster (2021: fig. 200) prefers to regard these ornaments as used in body piercings, albeit this is not a new idea (Wilson 1863: 452–3).

Like most examples from Scotland, the Cladh Hallan ring has a base-metal core covered with gold sheet, though it is unusual in that the sheet is striped and not plain. Some rings have lost much of the covering gold sheet (*e.g*. Shepherd 2007: fig. 17.4c) so examples now consisting only of copper alloy may be included in the

corpus (St Andrews hoard, Fife, and Torastan on the Isle of Coll). Only two Scottish finds are of solid gold, one from Ballaggan, Durisdeer, in Nithsdale (O'Connor *et al*. 2008), and the other from Dairsie, Fife (Queen's and Lord Treasurer's Remembrancer 2014: 26. St Andrews Museum). The Ballaggan ring has a striped surface like the Cladh Hallan example.

The best-known Scottish rings come from the Sculptor's Cave at Covesea where ten examples were excavated in a context clearly associated with death, the underworld and the afterlife (Armit and Büster 2020: 119–30). Two of these rings were stratified in contexts dated to between 1000 and 820 cal BC (*ibid*.: 30–3) but they were all probably deposited during a short episode of funerary activity in the tenth century BC (*ibid*.: 250). Other Scottish finds are listed in the Covesea report (*ibid*.: table 5.12; illus. 5.28). Since that list was compiled, an additional ring has been found at Covesea (Lindsey Büster, pers. comm.) and three more elsewhere in Scotland: Nairn (copper-alloy core, banded gold sheet: TT 03/19; DES 20, 2019: 125), Freswick, Caithness (plain gold sheet, clay core: TT 67/18; DES 20, 2019: 101) and Dunino, Fife (TT 66/17; DES 18, 2017: 95). The find from Nairn reinforces the distribution around the Cromarty Firth, with two others in Moray at Clarkly Hill, Duffus (Queen's and Lord Treasurer's Remembrancer 2010: 9. Elgin Museum) and Coire Na Fuaraig, Kirkmichael (formerly Banffshire) (Taylor 1980: 90; Eogan 1994: 141; Murgia *et al*. 2014. British Museum WG.23) plus an example from Cromarty (Armit and Büster 2020: table 5.12).

In addition to the finds from South Uist and Coll, a third Hebridean example comes from Skye (Wilson 1863: 455–6; Taylor 1980: 92; Eogan 1994: 141. NMS FE 9). Two Scottish hoards contain rings – St Andrews (Cowie *et al*. 1991) and Balmashanner, Angus (Andersen 1891–92; Taylor 1980: 89; Eogan 1994: 141, plate 14; Schmidt and Burgess 1981: 251–2, no. 1686, plate 152B, 37–9. NMS X.DQ 155–7) – both belong to the St Andrews/Ewart Park metalwork assemblage. Recent radiocarbon dates for related Scottish hoards give a range covering the dates of the rings from Covesea and Cladh Hallan (Mörtz *et al*. 2021: table 2). The Balmashanner hoard includes other unusual or exotic objects: beads of amber and cannel coal or shale, gold lock-rings and one of the earliest datable iron objects from Scotland (Eogan 1994: pl. 14). There are also amber beads and jet or shale armlets from St Andrews (Cowie *et al*. 1991: 53, pl. 8) and amber beads also occur at Covesea (Armit and Büster 2020: 159–60).

These rings are numerous in Ireland, though most finds lack provenance or context (Taylor 1980: 120–2; Eogan 1994: 137–40, fig. 42; Armit and Büster 2020: 120–2). The only hoard find appears to be Tooradoo, Co. Limerick, which contains four examples with tin cores, which have sometimes been classified as a separate type developed from ring-money, as 'bullae' (Taylor 1980: 65, 108, CoLm 14–17, pl. 35f; Eogan 1983: 104–5, no. 103, 4.1–4, fig. 58A; 1994: 89, fig. 37, 1–4; 2008; Cahill 2009: 7–8) or as Lough Gara-type rings (Cahill 2013: 51, n. 19). Like Balmashanner, this hoard also includes a necklace of amber beads. A similar ring with a tin core was found in a burnt mound at Rathmore, Co. Wicklow (Cahill and Mullarkey 2010: 90; Hawkes 2018: appendix 2, WW07), and a decayed tin core covered with gold foil was found beneath the trough of a mound at Killeens, site I, Co. Cork (O'Kelly 1954: 131, 155, fig. 10; Taylor 1980: 102, CoCk 40; Hawkes 2018: 16, 127–8, 183, 290, appendix 2, CO04), perhaps dated to *c*. 1200 BC (Brindley *et al*. 1989–90: 26, 30; Hawkes 2018: 280). Other examples are from Rathgall hillfort, Co. Wicklow, both with base-metal cores; one ring was excavated from a pit burial dated to 1290–1040 cal BC and another from a workshop area (Raftery 1976: 342, 346, pl. II, 3–4; Warner 2014). Perhaps the context most relevant to Cladh Hallan is a find from a roundhouse at Ballyprior Beg on the Island Magee peninsula in Co. Antrim, probably made of tin/lead alloy and without gold sheet (Suddaby 2003: 58–9, 78–9, 86, 88, fig. 17) and dated to 1373–1019 cal BC (*ibid*.: 83, table 9).

Finds from England and Wales also tend to lack archaeological context although two rings with tin cores come from a cremation which may have preceded the North Ring enclosure at Mucking in Essex (Bond 1988: 14, 16, 21, 52, fig. 13, 1–2). A rare example with a clay core was excavated at Cadbury Castle, Somerset, but not from a useful context (Knight *et al*. 2015: 68, no. 425b). A map was published in 2009 (Carozza *et al*. 2009: fig. 14) but the distribution has been amplified by subsequent metal detector finds regularly recorded by the Portable Antiquities Scheme (Boughton 2021: 90–1). The presence of small penannular rings of solid gold in some Penard hoards of *c*. 1275–1100 BC – Fitzleroi Farm, Fittleworth, Sussex (Needham and Anelay 2021: 611, fig. 20.28; BM 1996, 0902.37) and Poulton, near Cirencester in Gloucestershire (DCMS 2004: 26–33, no. 17, nos 22–5 and 43–5, figs 17.3–4; Corinium Museum) – suggests that rings like the Cladh Hallan example appeared at this time and the composite ring from Montaigu-la-Brisette supports this chronology (see below).

In Wales, a solid gold ring from Cwm Cadnant, Anglesey, may have been associated with copper ingot fragments (Boughton 2021: 90, fig. 148), while a fragment of gold foil perhaps from a ring has been excavated at Llanmaes, Glamorgan, in a context broadly contemporary with the Cladh Hallan ring (Gwilt *et al*. 2016: 302; PAS NMGW-093625).

Across the Channel, rings have been found in France, Belgium and the Netherlands, mainly between the Seine and the Meuse. Many of these come from burials, which are often dated to before 1000 BC (Billand and Talon 2007; Warmenbol 2017; 2021; Peake *et al*. 2017: 778–9; Armbruster 2021: 197, fig. 197; Armbruster *et al*. 2022: fig. 2) though examples from Emblem, Antwerp, and Herstal, Liège, are somewhat later, between 1054–847 cal BC (Dalle and De Mulder 2015: 90–1) and 992–833 cal BC (Warmenbol 2021: 125) respectively. Cave finds from the Trou de Han, Han-sur-Lesse, and the Trou del Leuve, Sinsin, both in the Belgian province of Namur, reinforce the association with the underworld found at Covesea. These continental finds have base metal cores, but two

northwestern outliers, from Lanrivoaré and the Île de Batz in Brittany, are solid gold and may thus be of Irish origin (Eluère 1982: 52, 259–60, figs. 64, 1 and 171; Mélin *et al*. 2016). A recent find of a composite double ring with an unusual bronze core, from Montaigu-la-Brisette, Manche (Armbruster *et al*. 2022), supports the origin of the single rings in the Penard metal assemblage when composite rings of solid gold occur with single rings in finds like Fitzleroi Farm (see above).

2.3 Iron

David Dungworth and Mike Parker Pearson

Iron artefacts

Context 1311 ([3133] floor in House 401; Phase 9). A fragment of iron, 18mm by 4mm by 3mm (Figure 2.17). It is a fragment of shaft or wire, slightly curved with a lenticular cross-section and narrowing at one end as if forming a tip. It is possibly a fragment of a penannular bracelet. It was recovered during sorting of heavy residues (<10mm) so was not seen *in situ* within floor layer 1311. Since this layer is dated to the eleventh century BC (*1070–950 cal BC at 95% probability*), the certainty of this artefact's context has to be questionable though an imported iron artefact of this date is not impossible.

SF 5638 context 409 (midden fill within House 401; Phase 16). A fragment of iron, 19mm by 15mm and 4mm thick (Figures 2.1, 2.18). It is sub-triangular with one curved and two straight edges. The latter appear to be breaks and it may be part of a circular disc originally *c*. 30mm in diameter. It is a small fragment found in association with a broken pot (SF 2048) in layer 409, one of the last layers to be deposited within House 401 during Phase 16. It was discovered within the sand matrix around the pot during post-excavation. The fact that the iron was not discovered *in situ*, together with the proximity of layer 409 to the quarry surface, undermines the reliability of this contextual association. Nonetheless, it would not be unusual to find iron in use around the seventh–sixth centuries BC.

Figure 2.17. The iron fragment from floor 1311 of House 401, viewed from above and side (top) and by X-ray (bottom). Floor 1311 in Phase 9 went out of use in 1045–985 cal BC

Evidence for ironworking?

There is no evidence from the site of ironworking during the Late Bronze Age. Small quantities of what initially appeared to be hammerscale were recovered from Early Iron Age layers in Phase 13 (eighth–seventh centuries BC) and Phase 15 (late eighth–early sixth centuries BC). Hammerscale-like flakes and spheroids were recovered during sorting of heavy residues (<10mm) from contexts 521 (<1g; fill of House 401; Phase 13), 522 (<1g; fill of House 401; Phase 13), 465=585 (8g; floor of House 401; Phase 13), 490 (3g; hearth in House 401; Phase 13), 452 (<1g; floor of House 401; Phase 15), 469 (<1g; fill of House 401; Phase 15), 497 (5g; hearth in House 401; Phase 15). However, on further analysis, they were found not to be hammerscale (Mike Charlton pers. comm.).

A single lump of haematite (SF 4199) was found unstratified within Phase 12 layers (*815–720 cal BC*) on

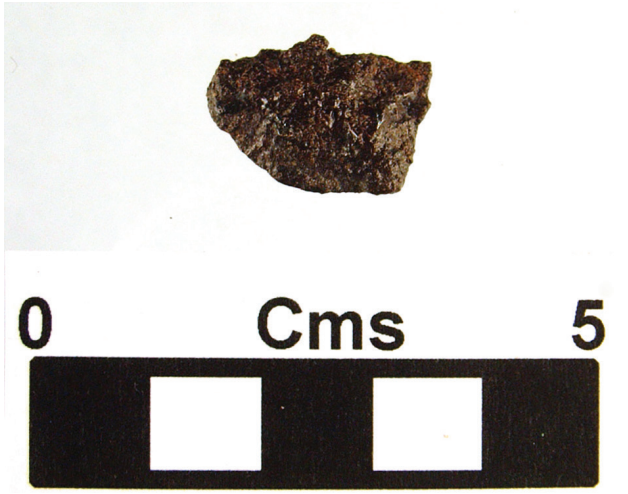

Figure 2.18. A fragment of iron (SF 5638) from midden fill 409 in Phase 16 within House 401. Phase 16 ended in 680–545 cal BC

the surface of the excavation (at E 106.7 N 121.56) outside the northeast wall of House 1370. However, there is no indication that it was collected as an ore-bearing rock.

Five small flakes of an iron-rich material, superficially similar to hammerscale, were found within Late Bronze Age floors 1308 (Phase 10) and 655 (Phase 11) and posthole fill 2307 (Phase 10). Qualitative surface EDXRF analysis (by David Dungworth) showed them to be rich in iron but otherwise rather variable (other elements detected include zinc, aluminium, calcium, silicon, phosphorous and titanium). Unlike the fuel ash slag from the site, they show no sign of having been exposed to a high enough temperature to cause vitrification. Nor are they associated with hearths, as fuel ash slags and copper-alloy droplets sometimes are; the two in floor 1308 (from squares 2317 and 2332) are from the southwest quadrant, and the two in floor 655 (from squares 2200 and 2211) lay over a metre northwest of the hearth. The other fragment is from posthole 2308 (square 3666) in front of House 1370. It is difficult to be certain what these flakes are but, if they are not geological, they may possibly be pieces of rusted iron from the wheelbarrows used during excavation. Similar material was recovered from floors 1150 and 2211 (Phase 9) and contexts 586 (Phase 13), 722 (Phase 16), 891 (Phase 13), 2210 (Phase 9), 2309 (Phase 9), 2753 (Phase 8) and 3257 (a cremation deposit from Phase 3).

An iron point was found in Area C in 1989 and assigned to context 014/1 (equivalent to Early Bronze Age levels in Area C's midden) but it is most likely of recent origin.

2.4 Early Iron Age copper-alloy metallurgy in Area C

Mike Parker Pearson

House 150 in Area C, about 100m northwest of the row of roundhouses in Area A, was used in Phase 13 during the Early Iron Age for copper-alloy working. This double roundhouse was composed of two circular rooms, of which the eastern was used as a metalworking area. The drifts of windblown sand that accumulated against its inside walls during deposition of its sequence of four floors suggest that it was occasionally and/or partially open to the elements, perhaps with a wide doorway to the east.

At the centre of this east room was a sequence of floors within which droplets and fragments (Table 2.2) and a few artefacts of copper alloy were found. It is likely that the artefacts (Table 2.3) were casual losses of copper-alloy scrap that evaded the melting process.

The earliest floor (252) had no evidence for metalworking but the floor layer (251) above it produced seven copper-alloy specks and droplets of which three were retained (Table 2.2; see Volume 1: 337–8, fig. 10.12). These were concentrated in and around its central hearth (212). Above floor layer 251, floor 241 contained a cluster of 35 droplets and four fragments of copper alloy also around its central hearth (see Volume 1: 338–9, fig. 10.13). Above floor 241, a clearly defined sequence of two floor layers (235 covered by 233) contained 28 droplets and two fragments in the lower layer and six droplets in 233 (see Volume 1: 340–3, figs 10.15–10.16). These were clustered around a central hearth and anvil stone (see Volume 1: fig. 10.14). Floor 235 contained two copper-alloy points, a sphere and a strip whilst a copper-alloy ring and a rivet were found in floor 233 (Table 2.3).

Only one mould fragment (SF 5702) was recovered from House 150, from floor layer 241 (see Volume 1: fig. 10.13). The only other from Area C – a mould fragment of a disc for a disc-headed pin – was from a Late Bronze Age context within the midden into which the double-roundhouse was sunk (SF 2009 in layer 906; Phase 10; see Chapter 1).

2.5 Discussion

Spatial and chronological analysis of copper-alloy objects from Area A

Matt Juddery

Most of the copper-alloy objects described in section 2.1 were associated with Houses 401 and 1370 across Phases 9–12. Many were found in contexts in Phase 9, which was the main phase of metalworking activities (see Chapter 1). Whilst a single pinhead (SF 5417) was found in the construction levels of the roundhouses (Phase 8), the

Table 2.2. Droplets and fragments of copper alloy from Phase 13 contexts in the east room of House 150 in Area C

Context	Type	SF no.	Type	n	Weight (g)
233	Floor	1057–1058, 1062	Droplets	6	1.93
235	Floor	1065, 1076	Fragments	2	0.05
235	Floor	1063–1064, 1066, 1069–1072, 1075, 1077–1079, 1084	Droplets	28	5.41
241	Floor	1081, 1097, 1104	Fragments	4	0.1
241	Floor	1080, 1082–1083, 1085–1096, 1098–1100, 1102–1103, 1105–1107	Droplets	35	10.94
243	Posthole	1109	Droplets	1	0.01
245	Posthole	1111	Droplets	1	0.1
251	Floor	1112–1114	Droplets	3	3.7
258	Stakehole	1074, 1116	Droplets	4	0.31

Table 2.3. Copper-alloy artefacts from Phase 13 floors in the east room of House 150 in Area C

Context	SF no.	Easting	Northing	Type	Weight (g)
233	1060	111.69	16.25	Rivet	-
233	1061	111.55	16.38	Ring	1.1
235	1067	112.02	16.41	Point	0.3
235	1077	111.46	16.35	Point	-
235	1068	112.09	17.23	Sphere	0.5
235	1073	112.23	16.88	Strip	0.1
U/S	3029	-	-	Strip	-

metalwork otherwise derives from the multiple occupation deposits of the houses' lengthy period of occupation.

Phase 9

The two unusual objects (possible spokeshaves SF 3801 and SF 3802) were deposited together on the north side of the entrance in the northeast quadrant of House 401 close to the iron artefact (from square 3133; see above) and a piece of coral (see Volume 1: figs 5.37, 5.45). A penannular bracelet (SF 4621) was the only copper-alloy object found on floor 2211 in House 1370 (see Volume 1: fig. 5.76). Its positioning north of the central hearth mirrors that of objects SF 3801 and SF 3802.

Molten copper-alloy fragments and droplets were deposited in this phase. Four were found in House 401 around the north side of the central hearth. Those from House 1370 were similarly found in close association with the central hearth.

Phase 10

Only the small chisel (SF 3831) can be securely placed in Phase 10. Its precise find spot, from within the fill between two floor layers in House 401, is unknown. Copper-alloy fragments and copper-stained bones were found in Phase 10 contexts in both House 401 and House 1370.

Phase 11

Rings SF 3364 and SF 4188 were both deposited in House 401 during Phase 11 (see Volume 1: fig. 7.25). Both were found near the hearth on the west side of the house. Ring SF 3364 was found with two antler picks, an unmodified antler, a smashed pot and a modified cetacean bone (see Volume 1: figs 7.6, 7.7, 7.15). An unfinished bangle fragment of shale (SF 3273) was also found on the floor in this area. Ring SF 4188 was found with no other associations in a fill layer (800) beneath floor layer 655. It is difficult to determine whether ring SF 3364 was deliberately deposited at the floor's abandonment since it is small enough to have been a casual loss. Ring SF 4188 was deposited during rebuilding of the house at the beginning of Phase 11. Two melted copper-alloy lumps were found in the remains of House 1370.

Phases 12 and 13

A penannular bracelet (SF 3719) was found in the Phase 12 yard area east of House 401's entrance. From Phase 13, fragments of rivets (SF 5997 in square 4322 and SF 5998 in square 4826) were found in flotation residues from floor layer 465 within House 401. A copper-alloy disc and two possible rivets were also found in House 401.

The Late Bronze Age metalwork in wider context

Matt Juddery

The metalwork and clay mould assemblage from Cladh Hallan belie the lack of hoards and single finds from elsewhere in the Western Isles. The majority of metalwork items and mould fragments are from Phase 9 at Cladh Hallan (starting in *1095–1015* and ending in *1045–985 cal BC at 95% probability*), which places them in the Poldar phase of the Scottish early Late Bronze Age (Wilburton in southern England and Hallstatt A2 on the Continent). There are three known Late Bronze Age hoards recorded from the Western Isles: the Adabrock hoard, Isle of Lewis, two Ewart Park swords from Iochdar, South Uist (Colquhoun and Burgess 1988: 99, plate 85.579 for the surviving sword) and a hoard of four spearheads found at Bay Craavat, Cairinis, North Uist (Close-Brooks 1976). These are all contemporary with the occupation of Cladh Hallan, although they appear to be slightly later than the first phase of metalworking during the Phase 8–9 transition.

The Adabrock hoard, based upon the two Feltwell-type razors and a bowl fragment, is dated to the Duddlingston phase (Hallstatt B3). Likewise, the two swords found at Iochdar are classed as Caledonian step 1 swords (distinctively large), early in the Ewart Park series (Colquhoun and Burgess 1988: 102). This would suggest a date for them around 900 BC, which would be closer in date to the likely third sword represented by mould fragments in floor layer 655 of House 401 from the Phase 10–11 transition in *1015–930 BC* (see Chapter 1 for the third mould assembly). Three of the Cairinis (Carinish) finds are long spearheads with flame-shaped blades of Davis' Type IIA (2015: 28, 64, plate 18, nos 190–192) and the fourth is also long with a channelled blade of Davis' Group 17 (*ibid*.: 205, plate 143, no. 1463). The latter are distributed across Scotland and Ireland and date to the Ewart Park phase (*ibid*.: 208). Thus the Cairinis hoard is broadly contemporary with the material from Cladh Hallan.

By the Middle and Late Bronze Age, roundhouses and other domestic structures had become substantial, permanent features in the British landscape. Settlements took on more significance as settings for rituals and the negotiation of social relations. These included rituals of abandonment of a type that is attested widely in non-industrial societies (LaMotta and Schiffer 1999). In Late Bronze Age Britain, roundhouses might be partially or completely dismantled, destroyed or altered periodically over their lifespan and then often re-built. This is amply demonstrated by the

row of roundhouses at Cladh Hallan, especially House 401, the central roundhouse (see Volume 1). Elsewhere, at Green Knowe, Peeblesshire, there appears to have been no continuous occupation of the site but rather a deliberate abandonment and re-occupation of the site, suggested by the superimposition of three roundhouses on platform 2 (Jobey 1981). At Cùl a'Bhaile, Jura, a hut circle shows evidence for multi-phase construction and alteration including re-roofing on three occasions (Stevenson 1985).

Joanna Brück (1999a; 1999b; 2006) has suggested that these practices are linked with the demographic and social events of the people who lived in them. Rites of passage, such as the death of a family member or marriage, could be marked by the abandonment or destruction of the roundhouse. These may have been accompanied by event-marking deposits, upon abandonment or re-building of houses, involving a range of things from animal burials to refuse deposits or bronze objects. These deposits appear to have marked out critical social space within the settlements. Often the deposits were placed at entranceways or boundaries. For example, at South Lodge in Dorset, bronze artefacts were deposited in three of the four corners of the enclosure ditch (Barrett *et al*. 1991). At Springfield Lyons in Essex, two deposits of mould fragments for swords and other items were deposited in the northern terminals of ditches forming the east and west entrances of the ringwork (Buckley and Hedges 1987; Brown and Medlycott 2013). At Black Patch, Sussex, a bronze razor was placed on the north side of the entrance of hut 3 (Drewett 1982) and at Bestwall Quarry, Dorset, a copper-alloy bracelet was placed within a Middle Bronze Age roundhouse on its abandonment (Ladle and Woodward 2003; 2009). Cladh Hallan's metalwork depositions on floors are further instances of such closing deposits. This marking-out of social space also coincided with increased numbers of enclosed settlements during the Late Bronze Age and into the Early Iron Age. Roger Thomas (1989; 1997) has argued that this was part of a process of re-drawing of social boundaries, creating clearer distinctions between 'insiders' and 'outsiders' in response to increased pressure on land and agriculture.

The symbolic aspects of copper-alloy metallurgy are now starting to be recognised within Bronze Age studies (Brück 2006). The symbolic cycle of birth, death and regeneration is thought to have been central to how Late Bronze Age/Early Iron Age people viewed and understood the world. Not only was the agricultural cycle 'good to think with' and used as a metaphor for the physical and social lives of people (Brück 2006; Williams 2003) but the process of metallurgy also lends itself well to this metaphorical cyclical approach. Bronze was transformed from one state to another through a process of fragmentation and fire. Furthermore, this often involved breaking and recycling existing bronze objects (Rohl and Needham 1998). Indeed, fragmentation or destruction appears to have been a crucial element in facilitating change and transformation. Late Bronze Age hoards and single finds often contain deliberately damaged, broken or unfinished objects (Bradley 1990; York 2002). This 'ritual killing' of objects, even including the roundhouses themselves, enabled regeneration and transformation.

There is also a close relationship between metallurgical production and biological processes. Cremation was the dominant funerary rite during the Late Bronze Age. It too transformed the human body, through the medium of fragmentation and fire. This suggests that people understood or viewed social and biological change as a series of cycles and transformations. This close link between metalworking and social and demographic change suggests that metalworking and technology were potent metaphors for understanding the world and for production of the self (Brück 2006).

The deposition of metalworking debris and bronze objects not only marked out social space and events but also showed a concern with changing or transforming the nature or status of a place or settlement. The destruction of settlements and the deposition of fragmented metalworking debris and objects, such as the broken mould fragments and possible spokeshaves at Cladh Hallan, enabled the regeneration of the settlement and for it to continue its cycle of life, death and regeneration.

The Iron Age metalwork and metalworking

Mike Parker Pearson

Evidence for non-ferrous metalworking is common in Iron Age roundhouses across the Western Isles and western Scotland, although most of this is from the Middle and Late Iron Age (Heald 2005; Heald and Hunter 2006). House 150 at Cladh Hallan is important because it not only dates to an earlier period of the Iron Age (after *775–650 cal BC* and before *680–470 cal BC*) in Phase 13 but it also provides a context for metalworking actually within a building whose successive floor layers have been well preserved. Thus it is possible to gain some idea of the location and temporality of non-ferrous metalworking in a form that is rare for the British Iron Age. The isolated position of House 150 within the settlement complex at Cladh Hallan is notable, as is its exposed location on top of a settlement mound and dune (see Volume 1: fig. 1.3). The architecture of the building is also unusual; not only is the double-roundhouse plan rare but this specific shape is so far unique. Whether the house was constructed as a non-ferrous smithy, rather than being adapted for such use, is uncertain but the small quantities of domestic refuse and the recovery of copper-alloy droplets from all of the east room's four successive floors suggest the former. There is no reason to consider that this was not a purpose-built smithy for non-ferrous metalworking.

The fragment of iron from within the final phase (Phase 16) of roundhouse 401 within Area A raises the possibility that iron was in use at Cladh Hallan in the same period as House 150's non-ferrous metalworking. However, there are uncertainties about the context of this iron artefact and there is no evidence for any ironworking within the areas excavated at Cladh Hallan.

The rise in quantities of struck flint in the Cladh Hallan assemblage during the period of bronze–iron transition (Phase 12 at Cladh Hallan; see Chapter 5) is interesting with respect to the adoption of iron at Cladh Hallan, and suggests that the end of the Bronze Age in this region was accompanied by a shortage of metal, requiring other materials to be used for producing sharp edges. Thus there may have been a period during the eighth century BC when iron tools were hard to manufacture or obtain. A similar rise in the use of struck flint can be noted in the same period at Toft's Ness in Orkney (Finlayson 2007: tables 7.6.1, 7.6.2).

Notes

1 This chapter and the catalogue provide basic information on stratigraphy and artefact location and the reader can consult Volume 1 for further information (including distribution plots). The entries 'copper alloy' and 'metalworking' in that volume's index are the quickest route to relevant information. Page numbers and figure numbers in Volume 1 are therefore, in general, not given here.

2 XRF analysis was undertaken with an Oxford ED 2000 air path instrument, with Rhodium target X-ray tube collimated to a point of about 2 mm × 1.5 mm, coupled to an Si (Li) detector. Conditions were for gold analysis: 35 kV, 1000 μA with 0.125-mm Rhodium filter for 150 s and then 50 kV, 1000 μA, 0.5-mm Copper filter for 300 s. Spectral deconvolution and quantification were performed using ED 2000SW software and the calibration was evaluated for gold alloys using a set of certified standards (Troalen *et al.* 2014).

3 SEM analysis was undertaken in a CamScan MX 2500 working in High Vacuum mode using the Secondary (SEI) and Backscattered detectors (BSC). Energy dispersive X-ray analysis was performed with an 80 mm^2 $XMax^N$ Oxford detector. Several areas of the ring (gold plate and stripes) were analysed, without surface preparation, at the working distance of 30 mm, 20 kV with AZtec software and normalised to 100 wt%.

4 The information used for processing the quantification comes from a layer whose thickness depends principally on the amount of gold (highest Z) in the alloy, the energy of the X-ray lines used for elemental quantification, and the type of incident radiation (Troalen *et al*. 2014). The effective depth analysed by XRF at these experimental conditions is 13–14 μm for Au(L_α), 28–32 μm for Ag(K_α) and 8–9 μm for Cu(K_α) for Au/Ag/Cu alloys that are close to the composition of the Cladh Hallan ring (Troalen *et al*. 2014).

3 Bone and antler tools

G. Davies

The assemblage of worked bone consists of 879 artefacts of which 849 are analysed in this report.[1] Similarly large assemblages have been excavated at other Iron Age Hebridean sites of Foshigarry and Bac Mhic Connain (Beveridge and Callander 1931; Hallén 1994) and Dun Vulan (Parker Pearson and Sharples 1999). In general, the material from Cladh Hallan is well preserved, with the bone surface being in good condition and the bone implements retaining good strength. As a result, the assemblage has preserved the forms and evidence of working and wear that provide the potential for detailed analysis.[2]

Bone tools and fragments of bone-working debris were recovered from 14 of the phases identified on the site, but for Phases 3 to 7 there are only a handful of pieces of worked bone and these phases were therefore largely excluded from any comparative analysis between the phases, be it for species exploited, bone condition or tool types made.

3.1 Species and bone element

When a prehistoric inhabitant wanted to manufacture a bone tool at a site such as Cladh Hallan there would have been little problem of where to source the raw materials. Such materials were very common on most prehistoric settlements because they literally lay around the site. The relatively small number of bone tools on most archaeological sites when compared to the number of animal bones (for Cladh Hallan, less than a thousand tools compared to more than 150,000 animal bone fragments) demonstrates the availability of potential raw material. Some of the bone pieces may not have been as desirable as others if heavily butchered or cooked but generally raw material shortage would not have been a problem. The choice of species and bone element used in tool manufacture must therefore have been determined by factors other than the availability of raw material. The general availability of bone as a raw material should not hide the fact that fresh bones from specific species, particularly wild ones such as deer and cetaceans, may have been available only intermittently following successful hunts or strandings.

The identification of worked bone to specific species and bone element is often complicated by the extensive modifications undertaken in the manufacture of these artefacts. In many cases it has only been possible to identify bone down to the size of animal it came from; in these cases the bones were identified to one of two size groups: cattle-sized (covering cattle, horse and large deer), and sheep/goat-sized (sheep, goat and small deer). For birds, fish and cetaceans, bones were identified to species or to general groups. Many of the bone tools can be identified only as long bone shaft fragments (lbsf) since modifications to the bones associated with tool manufacture and use have removed diagnostic features on the bones. Consequently, long bone fragments dominate the assemblage, although significant numbers of metapodial bones were identified. The latter were mainly utilised in the manufacture of bone points, presumably due to their suitability, in shape and physical properties, as raw material for this purpose.

In the case of deer antler and cetacean bones, these elements have been included in the analysis even when not obviously worked. The reason for this is that both are often seen as desirable raw materials from wild animals and the material must have been brought to the site from elsewhere. Deer antler could have come with carcases of hunted animals but also through the collection of shed antler, and a number of shed antlers were identified in the assemblage. In the case of cetacean bone, the animals – particularly the larger species – would usually have been butchered where landed, or scavenged from strandings, and any large pieces of cetacean bone on the site are unlikely to have been brought in with meat. Cetacean bone on site is therefore likely to have been brought to the site for reasons unrelated to food supply (see Chapter 11). Cetacean bone has other uses, such as fuel but, as with the antler, all the cetacean bone from the site has been considered in this report.

Table 3.1 provides the results of the identification of species exploitation for all phases and Figure 3.1 shows

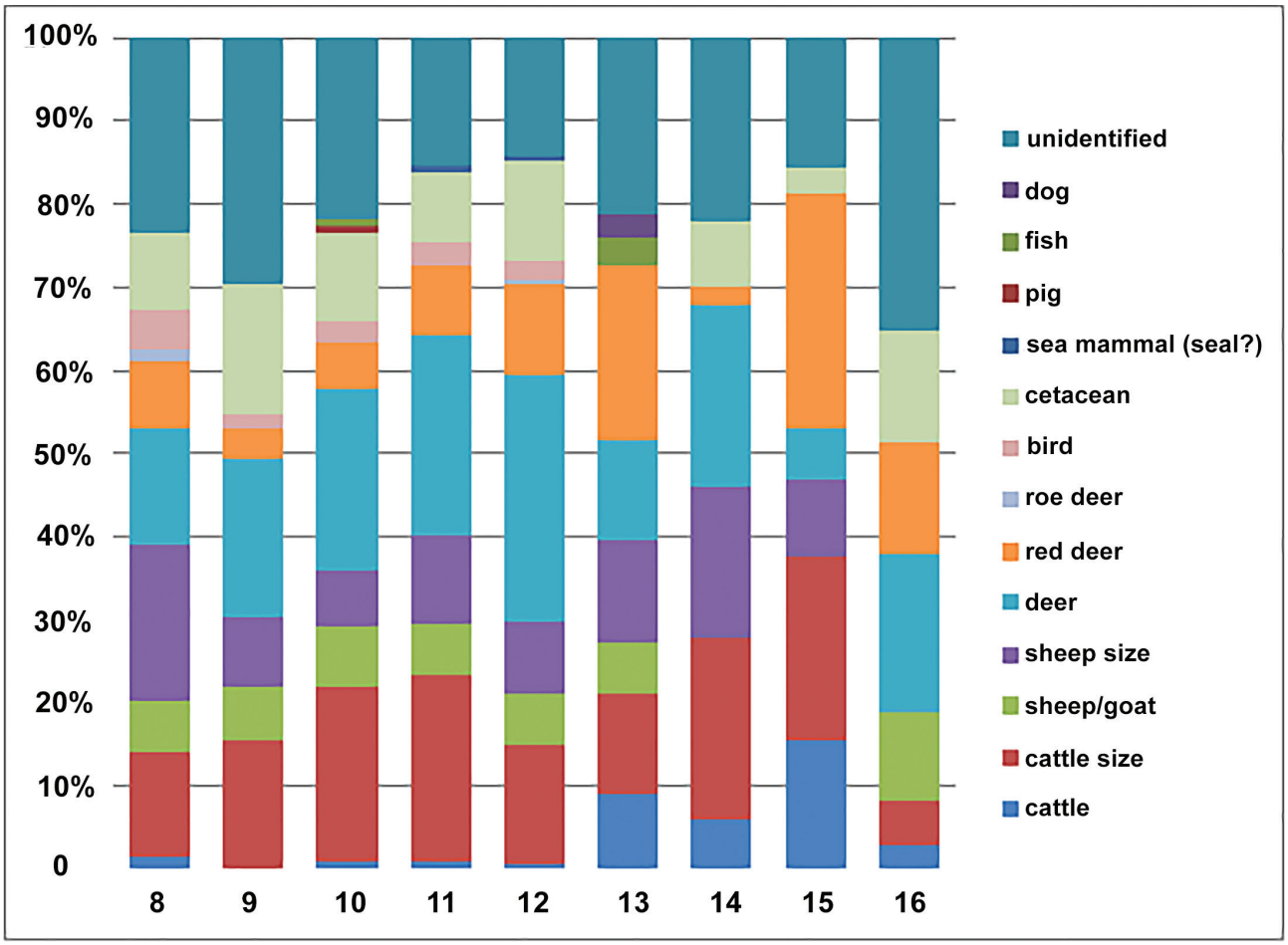

Figure 3.1. Bar chart showing percentages of species exploitation in Phases 8–16 for all species

Table 3.1. Species exploited by phase

Species	Phase																Total
	0	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*u/s*	
Cattle							1		1	1	1	3	3	5	1		16
Cattle size					2	1	8	26	26	32	21	4	11	7	2	8	148
Sheep/goat		1					2	11	11	9	9	2			4		49
Sheep size						1	11	14	9	15	13	4	9	3		1	80
Deer	1		1			4	6	32	30	34	44	4	11	2	7	9	185
Red deer						1	4	7	8	12	16	7	1	9	5	1	71
Roe deer							1				1						2
Bird							2	3	4	4	3						16
Cetacean				1	1	1	5	26	14	12	18		4	1	5	5	93
Sea mammal, seal?	1									1	1						3
Pig									1								1
Fish									1			1					2
Dog												1					1
Unidentified	2		1		1	3	14	50	28	22	21	7	11	5	13	4	182
Total	**4**	**1**	**2**	**1**	**4**	**11**	**54**	**169**	**133**	**142**	**148**	**33**	**50**	**32**	**37**	**28**	**849**

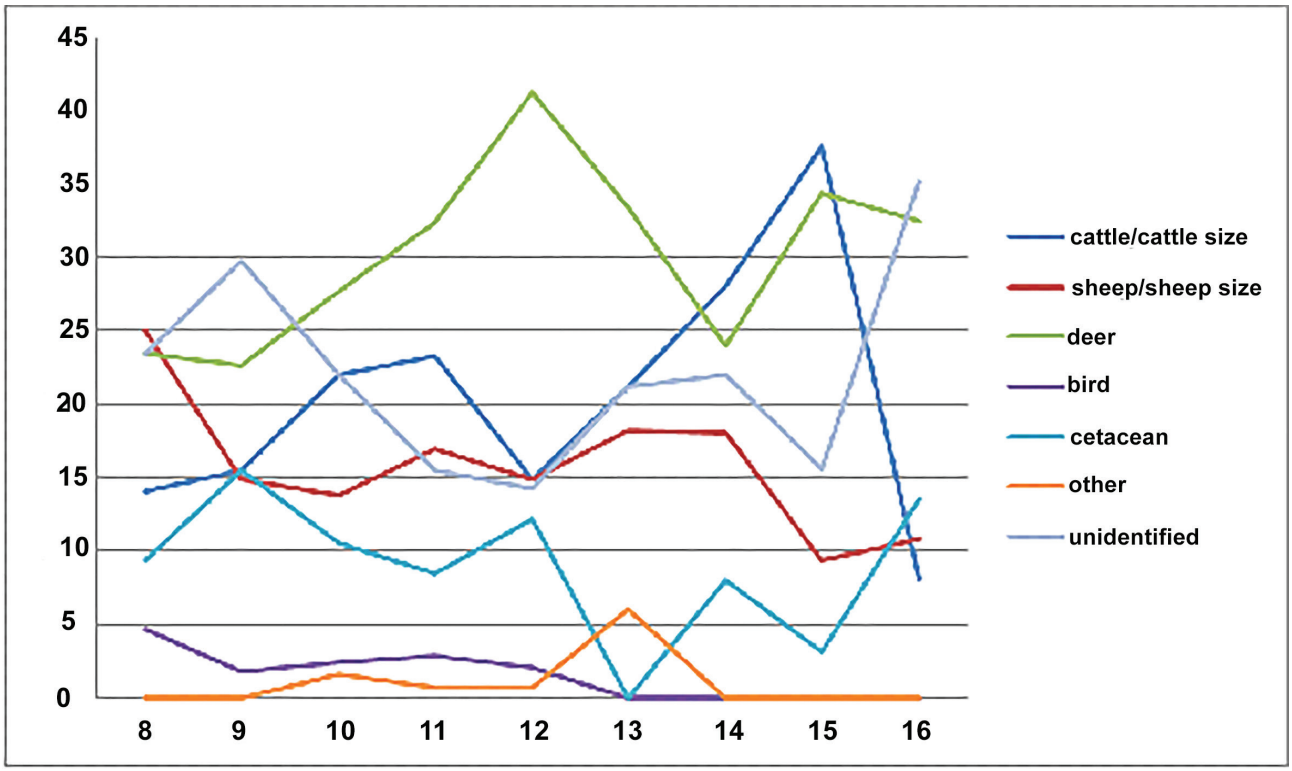

Figure 3.2. Percentages of species exploitation in Phases 8–16 for the main species

Table 3.2. Percentages of species exploitation in Phases 8–16 for the main species

Species	Phase								
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Cattle/cattle size	14.1	15.5	22.0	23.2	14.9	21.2	28.0	37.5	8.1
Sheep/sheep size	25.0	14.9	13.8	16.9	14.9	18.2	18.0	9.4	10.8
Deer	23.4	22.6	27.6	32.4	41.2	33.3	24.0	34.4	32.4
Bird	4.7	1.8	2.4	2.8	2.0	0.0	0.0	0.0	0.0
Cetacean	9.4	15.5	10.6	8.5	12.2	0.0	8.0	3.1	13.5
Other	0.0	0.0	1.6	0.7	0.7	6.1	0.0	0.0	0.0
Unidentified	23.4	29.8	22.0	15.5	14.2	21.2	22.0	15.6	35.1

the percentage species exploitation for the main species for Phases 8 to 16. From Table 3.1 it is clear that both domestic and wild species were used in the production of bone tools. Among the domestic animals, sheep/goat and cattle make up almost all of the assemblage of worked bone with the one piece of pig being a tusk fragment. In the case of wild species, deer and cetacean predominate, but their high numbers are possibly deceptive as cetacean bone and deer antler are both easy to identify. Of all the identified records for deer, 247 out of 258 are for antler; without this easily identifiable material, deer would appear only as a minor component of the assemblage.

The main species exploited all show fluctuating patterns of use but there does appear to be a general trend away from using the bone of sheep-sized animals towards the larger animals. This is shown in Table 3.2 and Figure 3.2 where the percentages of sheep and sheep-sized bones have been combined as have the cattle and cattle-sized bones. Phase 16 does not follow this trend but the general trend appears valid over the rest of the phases, with bones from sheep-sized animals starting at 25% and ending at 11% while cattle-sized bone provides 14% of the assemblage in Phase 8 and 37% in Phase 15. The avoidance of pig bones may relate to their different skeletal structures compared to other ungulates, the absence of large metapodial bones and the shorter long bones possibly making them less desirable for bone tool manufacture.

The exploitation of wild species fluctuates. For deer and cetacean there are small fluctuations in the percentage of bones used over Phases 8 to 12 (Table 3.2 and Figure 3.2). In later phases the variations are more pronounced, possibly reflecting changes in availability or in the desirability of specific material types. Bird long bones were occasionally used for tool manufacture (see Table 12.13 and Figure 12.3),

Table 3.3. Bone element exploited for tool production in all phases by species

Element	cattle	cattle size	sheep/goat	sheep size	pig	deer	red deer	roe deer	cetacean	sea mammal	bird	dog	fish	unidentified
Antler						182	64	2						
Tooth					1		1		2	3		1		
Vertebra									13				2	
Rib		21		4					4					
Scapula	10	32		2										
Humerus														
Radius			1	2										
Ulna	1	1	2	4										
Femur	2	2												
Tibia		3	2	3										
Metacarpal		2					1							
Metatarsal		5	9			1	2							
Metapodial	3	21	35	23		3	2							
lbsf		60		42							16			
Phalanx		1												
Unidentified									74					182
Total	**16**	**148**	**49**	**80**	**1**	**186**	**70**	**2**	**93**	**3**	**16**	**1**	**2**	**182**

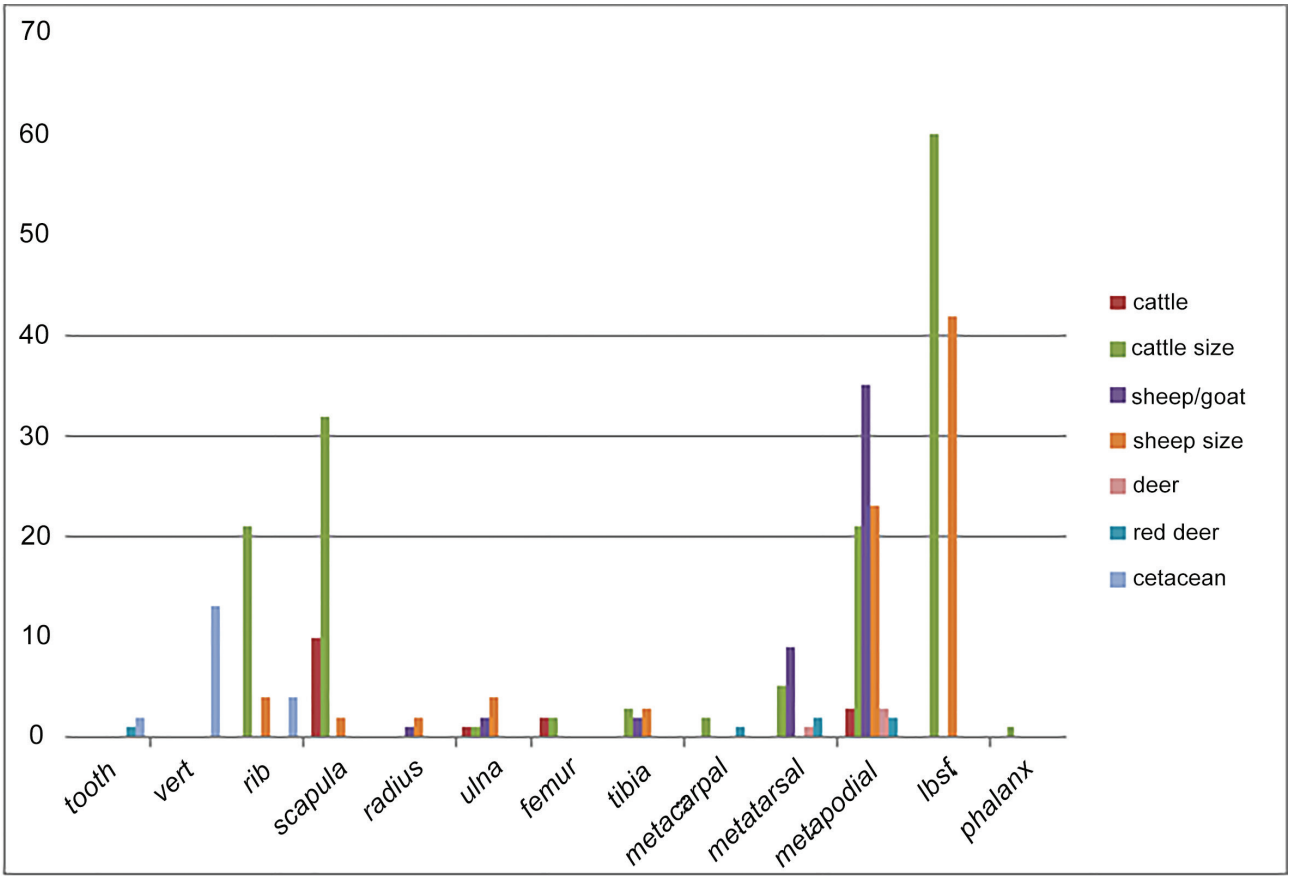

Figure 3.3. Bone element utilisation by species (excluding antler and unidentified cetacean bone)

while the exploitation of other species such as pig, dog and sea mammal appears to have been restricted to occasional use of specific bone elements such as teeth.

The choice of bone element in bone tool manufacture will have been based on the perceived properties of the bone, availability of material, and cultural traditions. The last of these factors, cultural traditions, could be defined as those choices made that are based on common practice and beliefs and is possibly the most difficult to identify. It appears obvious that the decision to use a large carnivore's tooth to make a bead or pendant is largely based on cultural tradition, but other less obvious decisions may be based on common practice (for example, which end of a metapodial to shape the point on).

Table 3.3 and Figure 3.3 show the bone elements used for different species. Figure 3.3 excludes antler and cetacean bone as these elements have such high counts that they obscure the details relating to other bone elements. From Table 3.3 and Figure 3.3 it is clear that the people of Cladh Hallan were very selective in the bones they chose to use in tool manufacture. A handful of identifiable bone elements – deer antler, cattle-sized scapulae, sheep-sized and, to a lesser extent, cattle-sized metapodial bones, and cetacean bone – were used for most of the assemblage. Many pieces could only be identified as lbsf from cattle- and sheep-sized animals but, based on the rest of the assemblage, it may well be that many of these will have derived from metapodial bones. Metapodial bones were often used in prehistory for bone tools as their size, shape and strength makes them a good raw material for bone tool manufacture.

It has been suggested for later periods (MacGregor 1985: 30) that the utilisation of metapodial bones may also be a result of butchery and skinning practices, in which metapodial bones with low nutritional value were separated from the carcass with the skin and removed from the food supply, thus avoiding the damage from butchery and cooking that many other bones suffered. This may have made them attractive for use in tool manufacture. Application of this argument to the prehistoric Outer Hebrides should be undertaken with caution as it implies

Table 3.4. Surface condition counts for Phases 8–16

Condition	**Phase**								
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Good	29	104	88	81	69	20	35	11	23
Average	22	55	34	53	69	12	13	20	13
Poor	3	10	11	8	10	1	2	1	1
Total	**54**	**169**	**133**	**142**	**148**	**33**	**50**	**32**	**37**

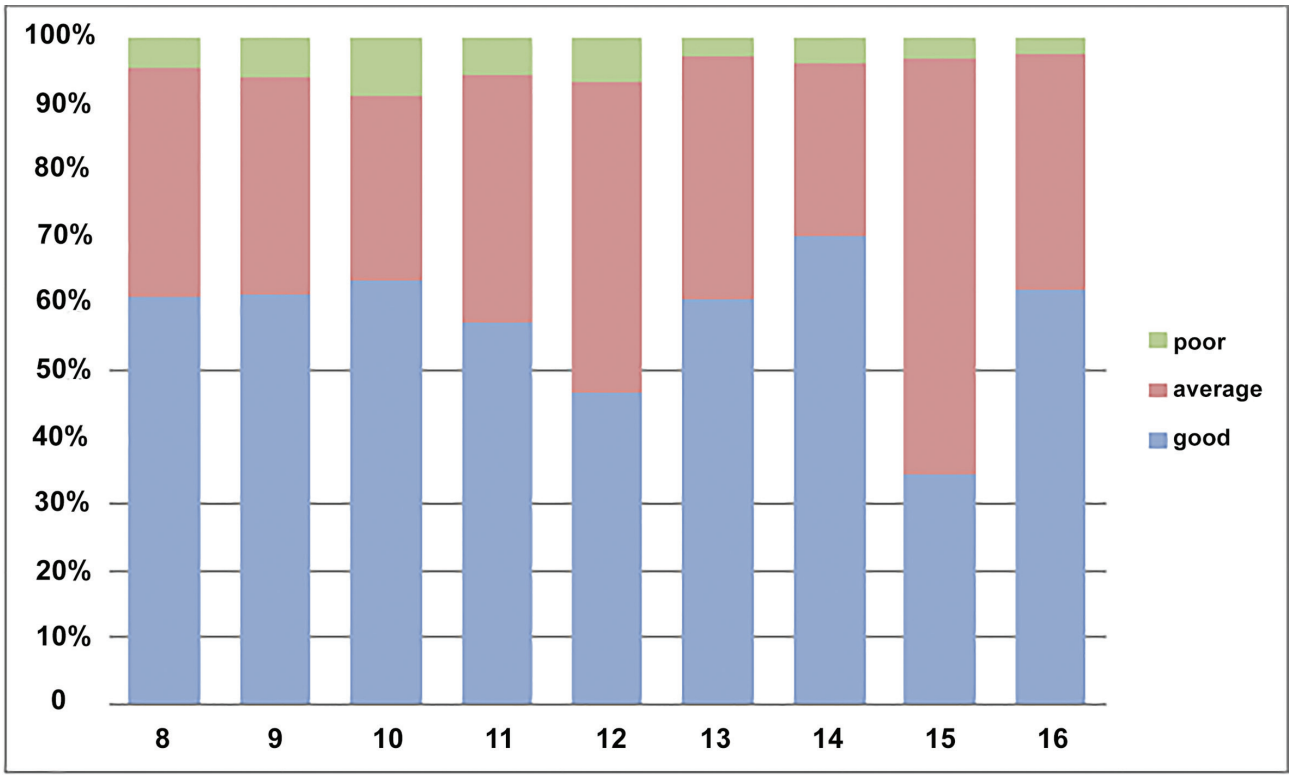

Figure 3.4. Surface condition percentages by phase

that the processing of the carcass was standardised to separate meat and other products before passing them to further specialists. In addition, although there is little meat on a metapodial, it does contain bone marrow. This was a valuable food source that is unlikely to have been ignored.

3.2 Bone condition and fragmentation

The surface condition of the worked bones was assessed by assigning all of them to one of four categories:

- good (the surface is well preserved and has the potential to preserve working and wear marks);
- average (the surface preserves working and wear marks but preservation is not uniform across the surface);
- poor (the surface does not survive while working and wear marks are absent or rare); and
- uncertain (used where the surface condition is difficult to discern).

The fragmentation of the worked bone was assessed by assigning the pieces to one of four categories based on their level of completeness thus enabling an assessment of the variation concerning degrees of fragmentation between phases. The four categories were as follows:

- complete;
- near-complete (a tool with a small fragment broken off);
- broken (a large piece from a broken tool, relative to the size of the tool); and
- fragment (a small fragment of a bone tool, relative to the size of the tool).

In general, the surface condition of the worked bone is good, with 58% assessed as being in good condition and 36% as average. Only 6% are considered to have a poor surface condition. The uncertain category was used in only a handful of cases where the bone tool consisted primarily of cancellous bone where it was difficult to determine if the original worked surface was preserved. These figures

Table 3.5. Bone tool fragmentation by phase

Fragmentation	Phase								
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Complete	7	34	21	23	12	5	21	4	3
Near-complete	11	21	17	22	17	5	4	3	4
Broken	21	78	78	72	99	20	18	20	19
Fragment	14	31	10	22	17	2	4	5	11
?	1	4	7	3	3	1	3		
Total	**54**	**168**	**133**	**142**	**148**	**33**	**50**	**32**	**37**

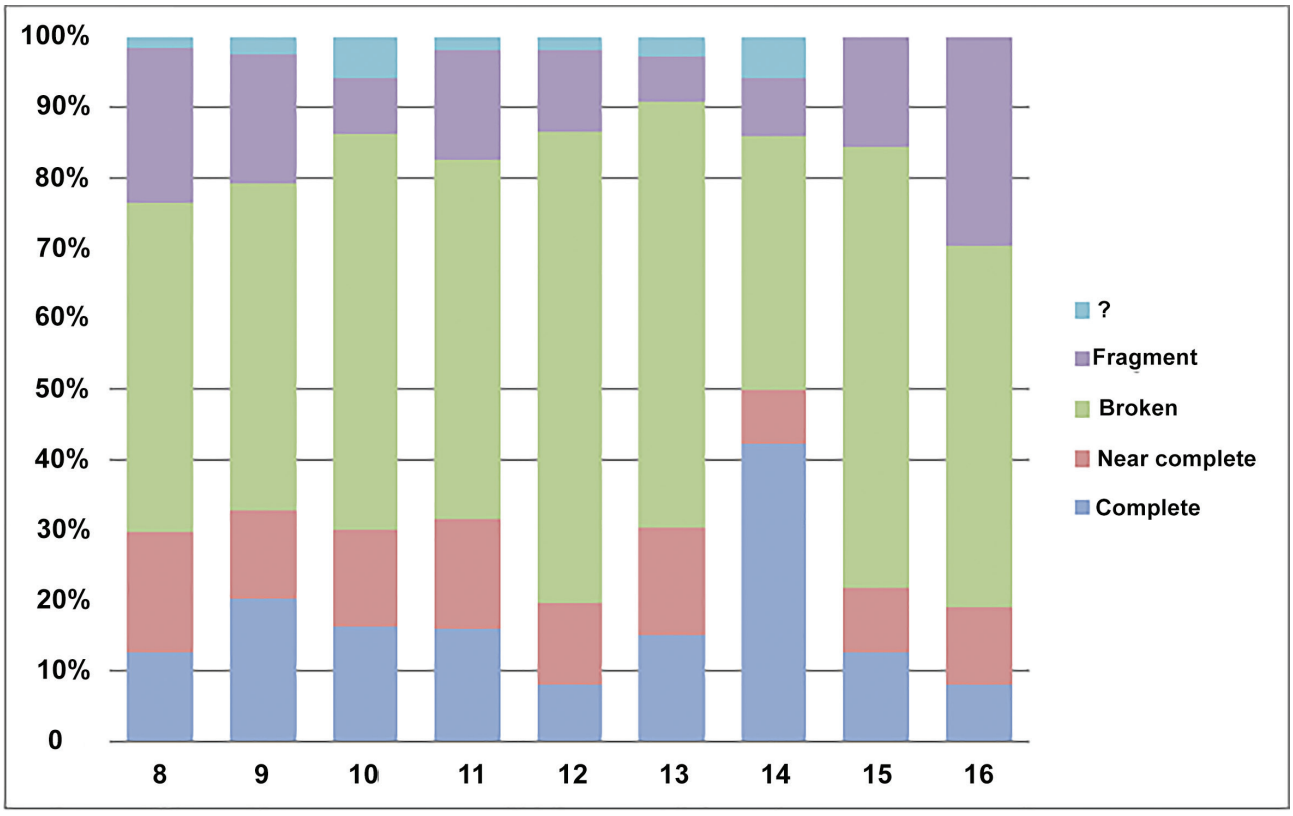

Figure 3.5. Percentages of bone tool fragmentation by phase

show the well-preserved state of the assemblage, conducive for detailed analysis.

There were no obvious differences in the surface condition of bone tools between the different phases (Table 3.4 and Figure 3.4), with the exception of Phase 15 which had fewer bone tools with a good surface condition.

A comparison of the completeness of the worked bone by phase (Table 3.5 and Figure 3.5) shows a remarkably consistent picture, with broken pieces making up the majority of the assemblage for all phases except Phase 14. In Phase 14 complete pieces are the most common, in terms of fragmentation. This does not appear to relate to general conditions of preservation, however, as the surface condition of the Phase 14 bone tools shows a range similar to those in other phases.

Table 3.6 provides counts for bone fragmentation by tool group (detailed below), and Figure 3.6 shows tool group fragmentation percentages. For the majority of tool groups

Table 3.6. Bone tool fragmentation by bone tool group

Tool group	Fragmentation				
	complete	near complete	broken	fragment	?
Antler tools		4	162	25	3
Bone discs	8	9	8		
Hafted	2	1	13	4	
Manufacturing	7	2	10	1	
Misc.	19	11	47	18	2
Ornaments	7	7	5	1	1
Pins	22	8	14	8	
Points	55	51	104	43	15
Scapula tools	3	5	22	10	
Spatulas	3	3	18	4	
Spindle whorls	4	1			
Whale bone tools	4	10	52	11	2

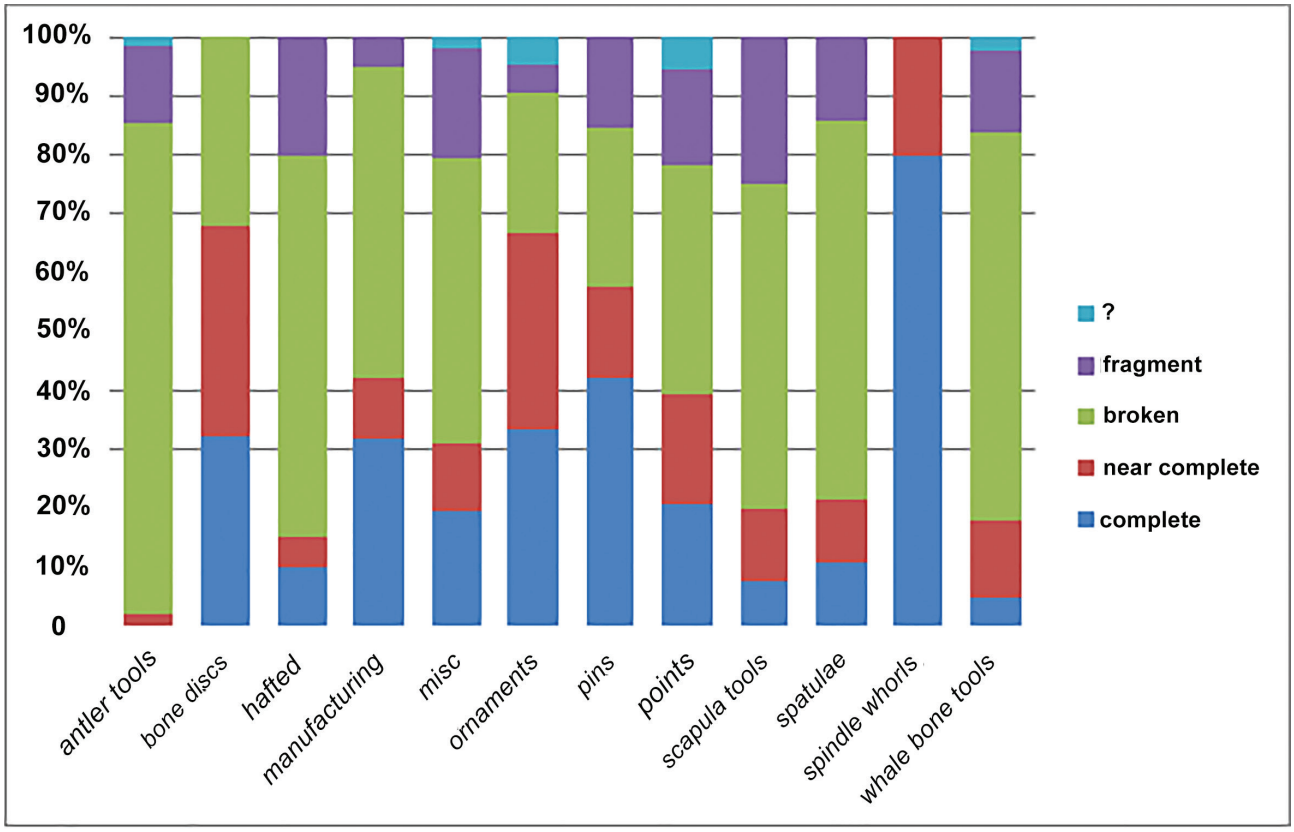

Figure 3.6. Percentages of bone tool fragmentation by bone tool group

there are examples of all types of fragmentation present with no one type dominant, although broken pieces are often the most common. For compact pieces such as spindle whorls, ornaments (beads) and bone discs, complete or near-complete pieces are most common. Pins are often complete or near complete but this may be due partly to the difficulty of identifying pin fragments, the broken tips of which may have been classified among the group of general points.

The antler and whale bone tools show high degrees of fragmentation due, in part, to the presence of significant numbers of broken pieces that, although not obviously worked, are likely to have been raw material. The only unbroken whale bone objects are teeth. Other tool groups that appear most susceptible to breakage include scapula tools, spatula tools, and points. All of these are generally long or thin or both.

Analysis of the variation in fragmentation for different bone tool types suggests that breakage was most likely related to the compactness and robustness of the bone tool. Taphonomic processes such as animal gnawing are only rarely evident and do not impair tool interpretation. The lack of gnawing evidence may, in part, be due to the lack of appeal of worked bone as a food source. Bone tools made from long bones would usually have been split, the bone marrow removed and the bone cleaned, all of which would have made them less desirable than bones from food waste that would also have been available on the site. In addition, bone tools would have been curated while still useful or desired and may not have been available for animal gnawing (see Chapter 10).

The general consistency in bone condition and fragmentation suggests that there is little difference in the preservation of the bone tools between the phases but the degree of fragmentation of bone tools does appear to relate to tool type. The slightly poorer surface condition of Phase 15 tools and lower fragmentation of Phase 14 tools may be explained by reference to variations in the bone tools present in the different phases, as is discussed in the section on typology.

3.3 Manufacturing

The manufacturing sequence of the majority of bone tools such as points can be divided into two main stages: firstly, the production of a blank or roughout and, secondly, the shaping of these blanks into tools. The techniques involved in rough-out manufacture usually incorporate the extraction of a blank from a long bone shaft. This can be achieved in a number of ways; two commonly used means are groove-and-splinter, and smashing and chipping the bone to shape. Positive identification of these rough-out techniques is often problematic due to later shaping, as well as wear from use. This is made especially difficult with implements such as pins or needles manufactured for prolonged use with heavy polishing, thus obscuring any evidence of rough-out manufacture.

Groove-and-splinter involves the use of a stone tool, usually a flint, to cut a V-shaped groove running along the edge of the piece to be split (Davies 1994); the piece is then wedged apart or split. Although this technique is known from a number of prehistoric sites, no definite evidence for this was identified at Cladh Hallan. It is possible that groove-and-splinter was used on some of the pieces at Cladh Hallan, with the evidence of grooving obscured by later working and wear.

When using techniques of bone-smashing or chipping to produce a rough-out, a stone or stone tool is used as a hammer to break and splinter the bone. Chipping can be used to tidy up a smashed bone, removing excess material left following bone-smashing. There was extensive evidence for this technique at Cladh Hallan, with several of the points showing smashed or chipped edges where the bone was split to produce a rough-out for shaping.

Following the production of a blank, further techniques can be used to process the blank to leave the finished tool. These generally fall into two groups – grinding and scraping – evidence for both of which was found in the assemblage. Experimental bone production, as conducted by Newcomer (1974), revealed that one of the simplest ways to shape the rough-out to its final tool form is to grind the tool against stone. It is possible that pumice was also used, because large amounts were found on the site, although any appropriately grained stone such as sandstone will serve for grinding (Davies 1994).

Grinding can be undertaken by rubbing the rough-out on the stone or the stone on the bone. The direction of grinding is observable from scratches on the bone and can be axial, cross or oblique. In the cases where grinding scratches were observed in the Cladh Hallan assemblage, they are often multidirectional, indicating that more than one direction of grinding was used to shape the tool.

Shaping of a rough-out can also be undertaken by scraping or shaving with a flint or metal knife or scraper. This usually leaves axial scratches on long bone-based tools because the natural action is to scrape along rather than across the bone. Axial scrape-marks were also observed in the Cladh Hallan assemblage. In numerous cases, evidence of both grinding and scraping was observed on the same tool.

Once shaped, some tools were taken a stage further and polished. Identifying polish from manufacturing can be difficult as polish can also result from wear and, in some cases such as pins, very high polish resulting from long-term wear would obscure any initial polish from the manufacturing process. Where polish has been deliberately imparted, for example on pins and needles, this was probably produced by rubbing the piece with either pumice or leather (Hallén 1994: 194).

Drilling was also observed in the Cladh Hallan assemblage, being used to perforate bone discs, pendants and teeth. These perforations usually have a distinctive hourglass-shaped hole in section. This results from using a V-shaped drill point and drilling from both sides. There are also examples where the two different ends of the drilled hole do not line up correctly, thereby leaving a perforation with a kink midway along it (*e.g.* SF 3406

from context 663; Figure 3.19). In addition to the shape of the hole, circular scratch-marks in and around the hole can be used to identify which end, or ends, were used for drilling. Not all of the perforations were made from both ends; some were drilled from one end only (*e.g.* SF 3168 from context 462).

3.4 Typology

All the bone tools from Cladh Hallan were classified as one of 53 different tool types that were grouped into 12 tool groups. The 12 tool groups are primarily based on tool form and function, such as points or ornaments, although in two cases the tool groups are defined on the basis of raw material: antler and whale bone. The use of tool groups allows for easier comparison between phases (Tables 3.7–3.9 and Figure 3.7) and also allows for difficulty in identifying some of the more fragmentary pieces that can be assigned to the tool group if not the tool type; for example, the fragmentary tips of pins and needles might not be distinguishable.

The 12 tool groups are:

- Points – characterised by bone pieces which have been shaped to form a pointed tip.
- Pins and needles – pointed tools used in the manufacture and wearing of clothes.
- Scapula tools – characterised by modified or shaped scapulae, utilised as shovels or similar tools.
- Spatula tools – characterised by bone pieces that have been shaped to form a flat tip with some width rather than convergence to a point.
- Hafted tools – long bone tools with pointed or chisel ends with a hollowed-out core adapted for hafting.
- Ornaments – consisting of those pieces that fulfil a more decorative rather than practical role.
- Spindle whorls – bones used as (parts of) spindle whorls in spinning yarn.
- Bone discs – characterised by bone pieces manufactured into circular discs, many of which have a central perforation.
- Miscellaneous – all those pieces which either do not fit into any of the above categories or are too fragmented to be definitively classified.
- Manufacturing – debris from tool production.
- Antler tools – antler picks and pieces of antler that are or may be raw material.
- Whale bone tools – objects made of whale bone or possible whale bone raw material.

Table 3.7 lists all the bone tool types and provides counts for their occurrence in all phases of the site, and Table 3.8 provides tool type percentages for Phases 8 to 16. Due to the relatively small counts for many of the tool types in individual phases, calculation and comparison of percentages is problematic; comparison between the phases is therefore primarily undertaken on the tool groups, with the percentage figures for tool groups for Phases 8 to 16 provided in Table 3.9 and Figure 3.7.

Table 3.9 and Figure 3.7 show the variation in percentages of the different tool groups by phase. A modified version of these data, excluding working debris and potential raw material (unworked antler and whale bone), is provided in Table 3.10 and Figure 3.8. The modified data have been provided to show variation in actual bone tools, not in bone tools together with their related manufacturing debris and potential raw material.

From Table 3.10 and Figure 3.8, a number of observations can be made regarding chronological variations in the bone tool assemblage. During Phases 8–14, points form the most common group of tools in all these phases, comprising approximately 35% to 48% of the bone artefacts.

All other groups of artefacts are much less common during these phases, most forming generally less than 10% of the assemblage although some tool groups such as antler tools occasionally reach around 20%. In the later phases, starting in Phase 13 but most notably in Phases 15 and 16, the relative proportions of different bone tool groups change. Some of the groups, such as bone discs, ornaments, spatula tools and spindle whorls, ceased to be deposited, while others such as points, antler pins and scapula tools became more variable in their relative proportions; this is most clearly seen in Figure 3.8.

This trend from a wide range of tool groups with fairly stable relative proportions to a reduced range with more variability could be due not only to real changes in the bone tool assemblage but also to variations in the range of contexts sampled from the different phases. In order to determine whether chronological variation or contextual variation is the cause of this changing pattern in the bone tool assemblage, the proportions of bone tools coming from house contexts was calculated for each phase (Table 3.11 and Figure 3.9). This reveals a remarkably similar pattern to that seen in Table 3.10 and Figure 3.8. This suggests that the changing proportion of bone tool groups in the tool assemblage is not related to contextual variation between the different phases. The small number of bone tools from the later phases (Table 3.7) means that this conclusion is tentative.

The identification of different tool types was based, where possible, on perceived functional attributes such as pointed ends or spatulate ends. However, as noted previously, this is not always possible and some of the tool type definitions are less functionally based and more descriptive. All the bone tools are described in the bone tool catalogue. Temporal variation in specific bone tool groups and bone tools will be discussed in the individual descriptions of bone tool types.

Points

A total of 268 bone points are present, sub-divided into five tool types (see Figure 3.13). They are the largest group in the assemblage, forming almost a third of the total of bone tools. For all phases but one, bone points are the largest group of bone tools, consistently between 25% and 45%

Table 3.7. Bone tool counts by phase

Tool groups	Tool types	Phase																Total
		0	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*u/s*	
Antler	imported	1		1			3	4	16	18	19	24	3	3	1	4	4	**101**
	pick						1	1	2	4	4	3	2	0	5	1		**23**
	sleeve								1	0	0	0		0		0		**1**
	worked						1	3	7	8	9	20	4	2	4	7	4	**69**
Bone discs	perforated							1	2	1	2	6		1		0	2	**15**
	not perforated							1	5	0	1	1		0		0	1	**9**
	?									0	1	0		0		0		**1**
Hafted	point									0	0	1	1	1		0		**3**
	spatula									0	1	0		0		0		**1**
	?								1	0	1	0		0		0		**2**
	misc.						1		5	5	3	0		0		0		**14**
Manufacturing	debris							2	5	4	2	4	1	0		0	1	**19**
Miscellaneous	antler side plate									0	1	1		2	1	0		**5**
	bone toggle									0	0	0	1	0		0		**1**
	double-pronged								1	0	1	0		0		0		**2**
	handle							1	1	1	0	3		0		0		**6**
	misc.	1		1			1	4	9	8	5	6	2	0	4	0		**41**
	peg								9	4	0	0		4		0		**17**
	shaft frag.						2	1	6	5	6	4		0	1	0		**25**
Ornaments	bead									2	3	1	1	0		0		**7**
	ornament								1	1	1	0		1		0		**4**
	tooth pendant	1								0	0	2	1	0		0		**4**
	pendant							1	1	3	0	1		0		0		**6**
Pins *etc.*	double-ended needle									0	1	1		0		0		**2**
	double-ended pin									0	0	2		1		1	1	**5**
	needle									0	1	2	1	1		1	1	**7**
	pin						1	4	4	4	6	3	1	3	1	3	1	**31**
	pin/needle								3	0	0	1	1	0		2		**7**
Points	awl		1			1		4	19	18	16	11	2	0	2	4	1	**79**
	blunt point							3	9	3	3	7		1		1	1	**28**
	expedient point	1						2	3	6	2	3	2	6		2	1	**28**
	point/pin								2	1	1	0	1	2		0		**7**
	point					1		11	26	15	26	18	6	12	2	5	3	**126**
Scapula tools	blade-like									0	2	1		2	1	0		**6**
	broad-ended								2	0	0	0		0	2	0		**4**
	round-ended									0	0	0		0	1	0		**1**
	shovel							1		2	2	0	1	0	2	0		**8**
	?							1	2	0	5	5	1	1	2	1	1	**19**
	square-ended							1		0	0	0		0	1	0		**2**
Spatula tools	pointed							1	1	1	4	3		0		0	2	**12**
	rounded							1	2	4	1	1		0	1	0		**10**
	square-ended							1	2	1	0	1		0		0		**5**
	?					1				0	0	0		0		0		**1**
Spindle whorls										0	0	1	1	3		0		**5**

(Continued)

Table 3.7. Bone tool counts by phase (Continued)

Tool groups	Tool types	Phase																Total
		0	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*u/s*	
Whale bone	imported				1	1		1	11	7	5	7		2		4		**39**
	lamp								1	1	0	0		0		0		**2**
	mortar									1	0	0		0		0		**1**
	plate							1	1	0	1	0		0		1		**4**
	rod									0	0	0		2		0		**2**
	vertebrae vessel									0	1	0		0		0		**1**
	blade							1	3	1	2	0		0	1	0	2	**10**
	whale bone structural									0	0	0		0		0	2	**2**
	whale bone worked						1	2	5	3	3	4		0		0		**18**
Total		**4**	**1**	**2**	**1**	**4**	**11**	**54**	**168**	**133**	**142**	**148**	**33**	**50**	**32**	**37**	**28**	**848**

Table 3.8. Bone tool type percentages for Phases 8–16

Tool group	Tool type	Phase								Total
		8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Antler	imported	9.4	9.5	13.0	13.4	16.2	9.1	6.0	3.1	10.8	**11.9**
	pick	3.1	1.2	2.4	2.8	2.0	6.1	0.0	15.6	2.7	**2.7**
	sleeve	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**
	worked	6.3	4.2	5.7	6.3	13.5	12.1	4.0	12.5	18.9	**8.1**
Bone discs	perforated	1.6	1.2	0.8	1.4	4.1	0.0	2.0	0.0	0.0	**1.8**
	not perforated	1.6	3.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	**1.1**
	?	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	**0.1**
Hafted	point	0.0	0.0	0.0	0.0	0.7	3.0	2.0	0.0	0.0	**0.4**
	spatula	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	**0.1**
	?	0.0	0.6	0.0	0.7	0.0	0.0	0.0	0.0	0.0	**0.2**
	misc.	0.0	3.0	4.1	2.1	0.0	0.0	0.0	0.0	0.0	**1.7**
Manufacturing	debris	3.1	3.0	3.3	1.4	2.7	3.0	0.0	0.0	0.0	**2.2**
Miscellaneous	antler side plate	0.0	0.0	0.0	0.7	0.7	0.0	4.0	3.1	0.0	**0.6**
	bone toggle	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	**0.1**
	double-pronged	0.0	0.6	0.0	0.7	0.0	0.0	0.0	0.0	0.0	**0.2**
	handle	1.6	0.6	0.8	0.0	2.0	0.0	0.0	0.0	0.0	**0.7**
	misc.	6.3	5.4	6.5	3.5	4.1	6.1	0.0	12.5	0.0	**4.8**
	peg	0.0	5.4	3.3	0.0	0.0	0.0	8.0	0.0	0.0	**2.0**
	shaft frag.	1.6	3.6	4.1	4.2	2.7	0.0	0.0	3.1	0.0	**2.9**
Ornaments	bead	0.0	0.0	1.6	2.1	0.7	3.0	0.0	0.0	0.0	**0.8**
	ornament	0.0	0.6	0.8	0.7	0.0	0.0	2.0	0.0	0.0	**0.5**
	tooth pendant	0.0	0.0	0.0	0.0	1.4	3.0	0.0	0.0	0.0	**0.5**
	pendant	3.1	0.6	1.6	0.0	0.7	0.0	0.0	0.0	0.0	**0.7**
Pins etc.	double-ended needle	0.0	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	**0.2**
	double-ended pin	0.0	0.0	0.0	0.0	1.4	0.0	2.0	0.0	2.7	**0.6**
	needle	0.0	0.0	0.0	0.7	1.4	3.0	2.0	0.0	2.7	**0.8**
	pin	6.3	2.4	3.3	4.2	2.0	3.0	6.0	3.1	8.1	**3.7**
	pin/needle	0.0	1.8	0.0	0.0	0.7	3.0	0.0	0.0	5.4	**0.8**

Tool group	Tool type	Phase									Total
		8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Points	awls	7.8	11.3	13.8	11.3	7.4	6.1	0.0	6.3	10.8	**9.3**
	blunt point	4.7	5.4	2.4	2.1	4.7	0.0	2.0	0.0	2.7	**3.3**
	expedient point	3.1	1.8	4.9	1.4	2.0	6.1	12.0	0.0	5.4	**3.3**
	point/pin	0.0	1.2	0.8	0.7	0.0	3.0	4.0	0.0	0.0	**0.8**
	point	21.9	15.5	10.6	18.3	12.2	18.2	24.0	6.3	13.5	**14.9**
Scapula tools	blade-like	0.0	0.0	0.0	1.4	0.7	0.0	4.0	3.1	0.0	**0.7**
	broad-ended	0.0	1.2	0.0	0.0	0.0	0.0	0.0	6.3	0.0	**0.5**
	round-ended	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	**0.1**
	shovel	1.6	0.0	1.6	1.4	0.0	3.0	0.0	6.3	0.0	**0.9**
	?	1.6	1.2	0.0	3.5	3.4	3.0	2.0	6.3	2.7	**2.2**
	square-ended	1.6	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	**0.2**
Spatulate tools	pointed	1.6	0.6	0.8	2.8	2.0	0.0	0.0	0.0	0.0	**1.4**
	rounded	1.6	1.2	3.3	0.7	0.7	0.0	0.0	3.1	0.0	**1.2**
	square-ended	1.6	1.2	0.8	0.0	0.7	0.0	0.0	0.0	0.0	**0.6**
	?	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**
Spindle whorl	spindle whorl	0.0	0.0	0.0	0.0	0.7	3.0	6.0	0.0	0.0	**0.6**
Whale bone	imported	1.6	6.5	5.7	3.5	4.7	0.0	4.0	0.0	10.8	**4.6**
	lamp	0.0	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**
	mortar	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**
	plate	1.6	0.6	0.0	0.7	0.0	0.0	0.0	0.0	2.7	**0.5**
	rod	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	**0.2**
	vertebra vessel	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	**0.1**
	blade	1.6	1.8	0.8	1.4	0.0	0.0	0.0	3.1	0.0	**1.2**
	whale bone worked	4.7	3.0	1.6	2.1	2.7	0.0	0.0	0.0	0.0	**2.1**
Total		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 3.9. Bone tool group percentages for Phases 8–16

Tool group	Phase								
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Antler tools	18.8	15.5	21.1	22.5	31.8	27.3	10.0	31.3	32.4
Bone discs	3.1	4.2	0.8	2.8	4.7	0.0	2.0	0.0	0.0
Hafted	0.0	3.6	4.1	3.5	0.7	3.0	2.0	0.0	0.0
Manufacturing	3.1	3.0	3.3	1.4	2.7	3.0	0.0	0.0	0.0
Misc.	9.4	15.5	14.6	9.2	9.5	9.1	12.0	18.8	0.0
Ornaments	3.1	1.2	4.1	2.8	2.7	6.1	2.0	0.0	0.0
Pins	6.3	4.2	3.3	5.6	6.1	9.1	10.0	3.1	18.9
Points	37.5	35.1	32.5	33.8	26.4	33.3	42.0	12.5	32.4
Scapula tools	4.7	2.4	1.6	6.3	4.1	6.1	6.0	28.1	2.7
Spatulas	4.7	3.0	4.9	3.5	3.4	0.0	0.0	3.1	0.0
Spindle whorls	0.0	0.0	0.0	0.0	0.7	3.0	6.0	0.0	0.0
Whale bone tools	9.4	12.5	9.8	8.5	7.4	0.0	8.0	3.1	13.5
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

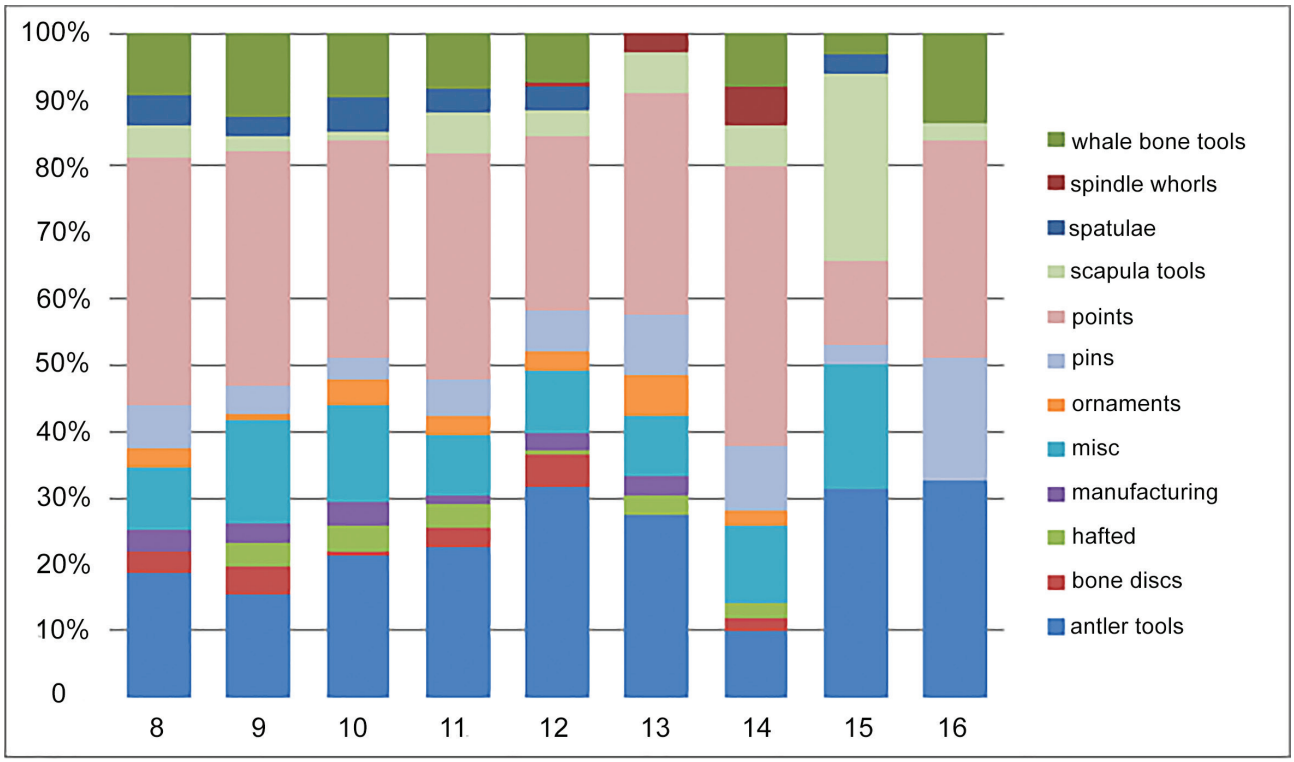

Figure 3.7. Bone tool group percentages for Phases 8–16

of the assemblage (Figure 3.10). The exception is Phase 15 where they form only 12% of the assemblage.

Awls

Awls are one of the most common bone tools from Cladh Hallan, with 79 identified, but this should be considered a minimum figure as many of the tool fragments that could only be identified as points may have been bone awls (see Figure 3.14). These implements, which have long, straight shafts, show high levels of wear polish around the tip, the polish often extending for a significant distance up the shaft. They generally range in length between 50mm and 150mm. The tip is formed from the gradual tapering of the shaft to form a fine point. The majority of these are round in cross-section with multiple manufacturing marks, often continuing along the shaft. Their function is generally interpreted as having been for use as piercing tools, being used on materials such as leather (although further functions may have included incising decoration on pottery, textile-weaving and basketry). Replication experiments of the wear patterns of awls utilised for basketry have been conducted by Olsen (1984), producing tip polish similar to that seen on the majority of the awls at Cladh Hallan. However, similar wear evidence does arise on the tips of awls, as well as pins and needles, in the piercing of leather (Olsen 1984: 208). It is worth noting the possible multi-functionality of tools such as these, rather than their exclusive utilisation for a single task.

Table 3.10. Bone tool group percentages for Phases 8–16, excluding manufacturing debris and raw material

Tool group	Phase								
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Antler tools (minus raw material)	10.9	7.4	10.4	11.2	20.4	20.7	4.4	29.0	27.6
Bone discs	3.6	5.1	1.0	3.4	6.2	0.0	2.2	0.0	0.0
Hafted	0.0	4.4	5.2	4.3	0.9	3.4	2.2	0.0	0.0
Misc.	10.9	19.1	18.8	11.2	12.4	10.3	13.3	19.4	0.0
Ornaments	3.6	1.5	5.2	3.4	3.5	6.9	2.2	0.0	0.0
Pins	7.3	5.1	4.2	6.9	8.0	10.3	11.1	3.2	24.1
Points	43.6	43.4	41.7	41.4	34.5	37.9	46.7	12.9	41.4
Scapula tools	5.5	2.9	2.1	7.8	5.3	6.9	6.7	29.0	3.4
Spatulas	5.5	3.7	6.3	4.3	4.4	0.0	0.0	3.2	0.0
Spindle whorls	0.0	0.0	0.0	0.0	0.9	3.4	6.7	0.0	0.0
Whale bone tools (minus raw material)	9.1	7.4	5.2	6.0	3.5	0.0	4.4	3.2	3.4

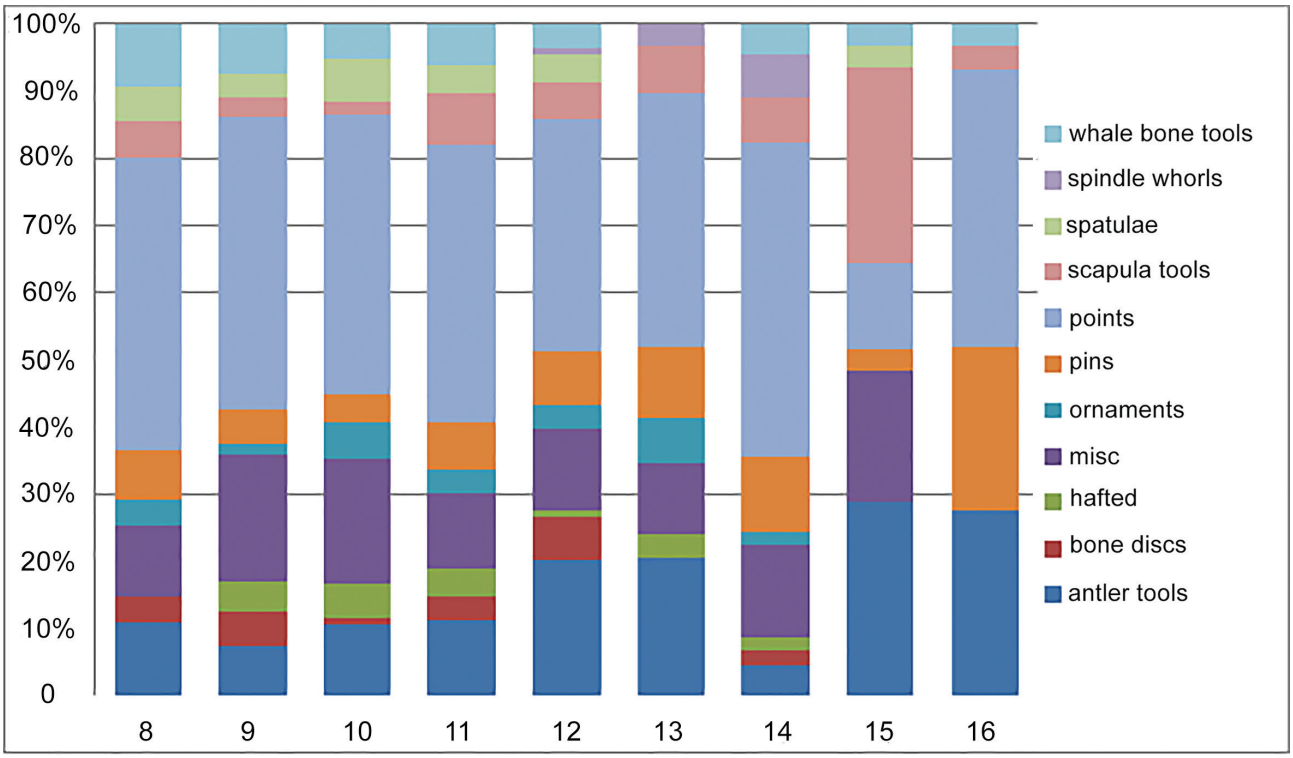

Figure 3.8. Bone tool group percentages for Phases 8–16, excluding manufacturing debris and raw material

A large proportion of the bone awls were manufactured from metapodial bones of both sheep- and cattle-sized animals, with the former the most common; other awls were made from what could only be identified as long bone shaft fragments, either due to the evidence allowing for definite bone element identification having been removed during the manufacturing process or because the awl is now broken in such a way that its diagnostic features are missing. Mammal metapodials were probably selected for awl manufacture because their shape and robustness made them appropriate raw material for awls (see examples in Figure 3.14). In the majority of these cases, the handle end is formed from the complete distal articulation. Similar examples are seen at Orcadian sites such as the Broch of Gurness (Hedges 1987) and Burrian (MacGregor 1974). In contrast, however, at sites such as Skara Brae (Childe 1931) and Foshigarry (Hallén 1994) the majority of articulations retained were those of the proximal end. This difference is believed to relate to slaughtering patterns at the various sites (*ibid*.: 205). In a small number of cases, the awls were made from the metapodial bones of immature individuals with unfused or partially fused distal epiphyses. Some of these epiphyses survive, as is the case with SF 3777 and SF 3781; in others they are

Table 3.11. Bone tool group percentages by phase for house deposits, excluding manufacturing debris and raw materials

Tool group	Phase								
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Antler tools	10.6	5.8	6.8	10.2	22.4	20.7	4.4	29.0	27.6
Bone discs	4.3	5.8	1.4	3.4	12.2	0.0	2.2	0.0	0.0
Hafted	0.0	4.1	6.8	3.4	0.0	3.4	2.2	0.0	0.0
Misc.	12.8	19.8	18.9	10.2	12.2	10.3	13.3	19.4	0.0
Ornaments	4.3	1.7	6.8	4.5	2.0	6.9	2.2	0.0	0.0
Pins	6.4	5.0	5.4	8.0	4.1	10.3	11.1	3.2	24.1
Points	38.3	47.1	44.6	40.9	36.7	37.9	46.7	12.9	41.4
Scapula tools	6.4	2.5	1.4	9.1	6.1	6.9	6.7	29.0	3.4
Spatulas	6.4	3.3	2.7	3.4	2.0	0.0	0.0	3.2	0.0
Spindle whorls	0.0	0.0	0.0	0.0	2.0	3.4	6.7	0.0	0.0
Whale bone tools	10.6	5.0	5.4	6.8	0.0	0.0	4.4	3.2	3.4
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

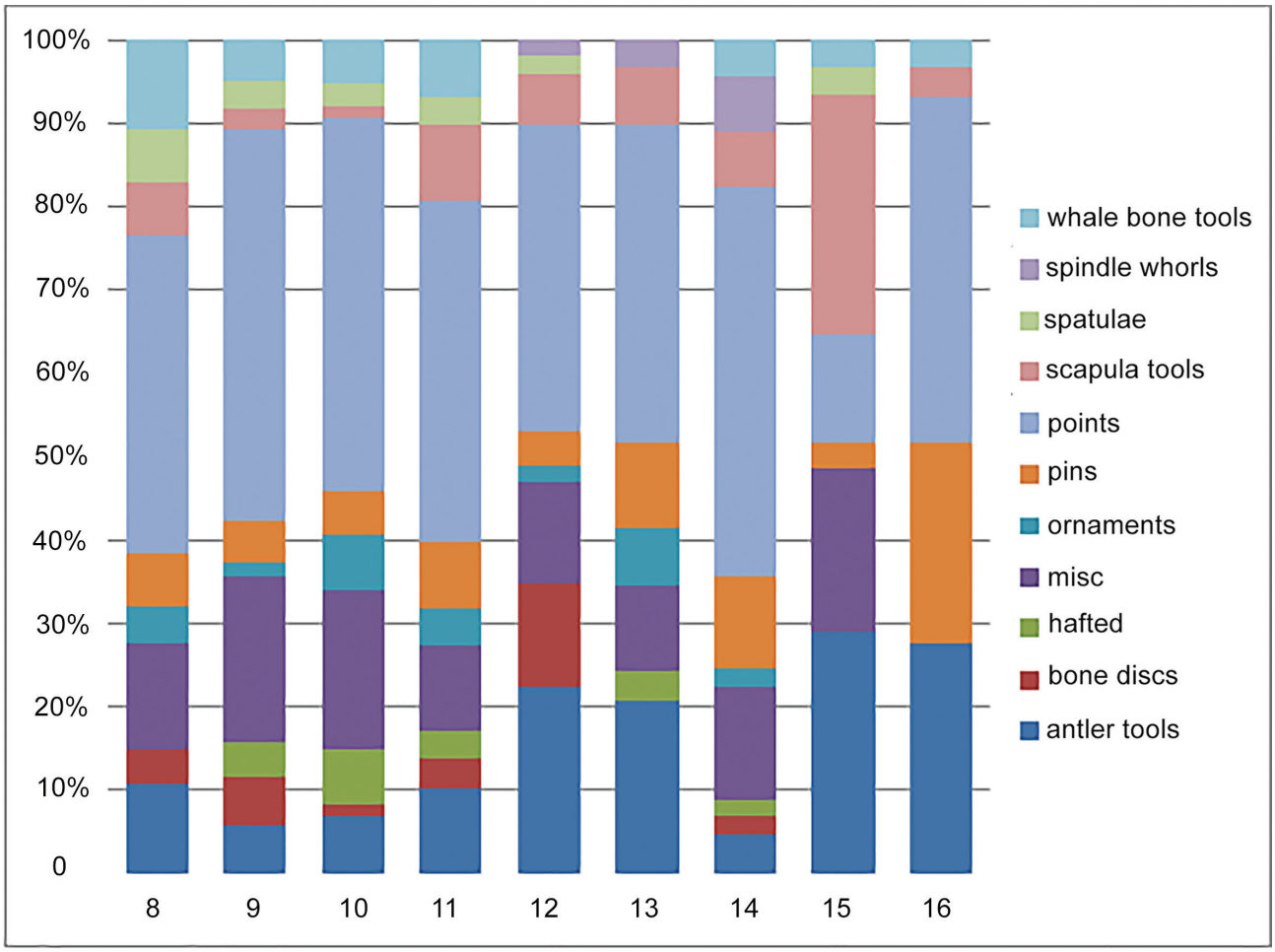

Figure 3.9. Bone tool group percentages by phase for house deposits, excluding manufacturing debris and raw materials

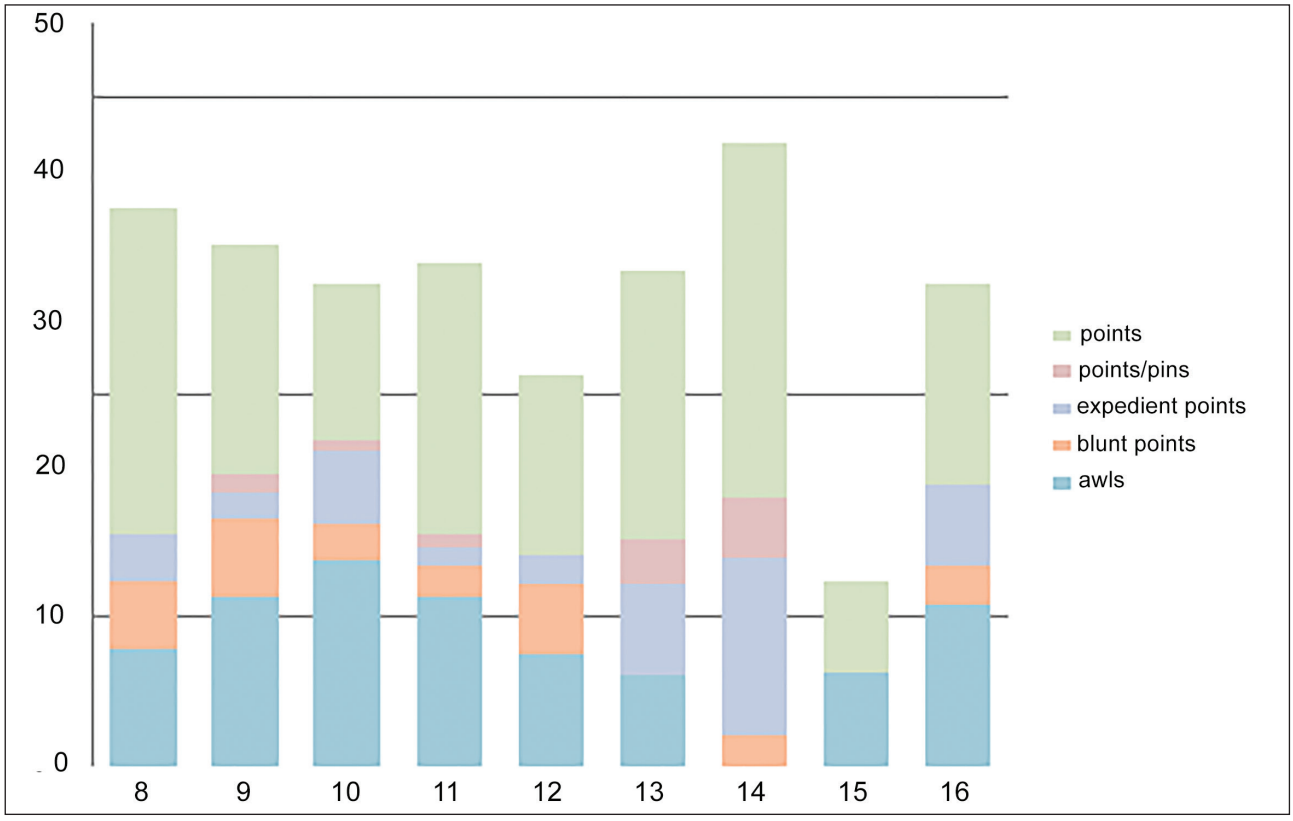

Figure 3.10. Bone point percentages for Phases 8–16

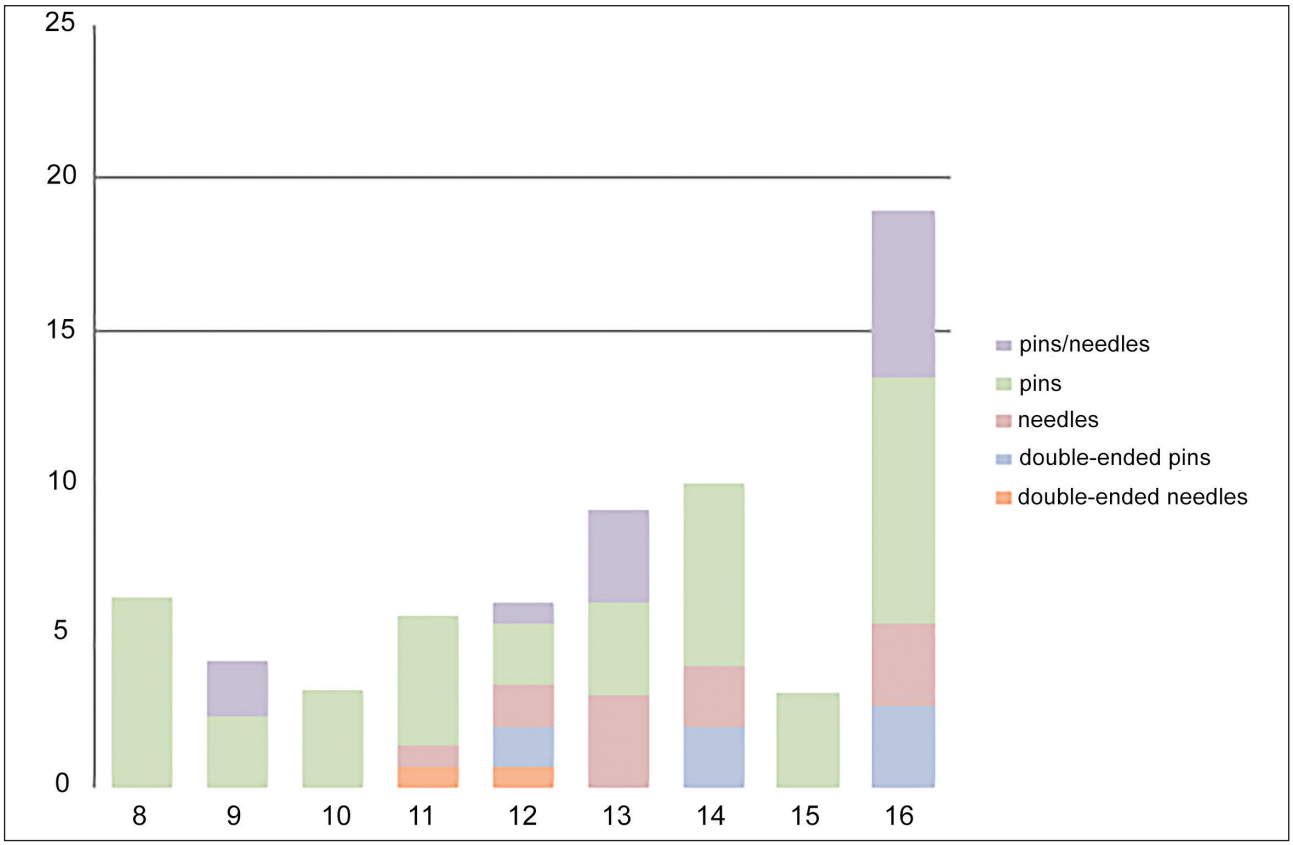

Figure 3.11. Percentages of bone pins and needles for Phases 8–16

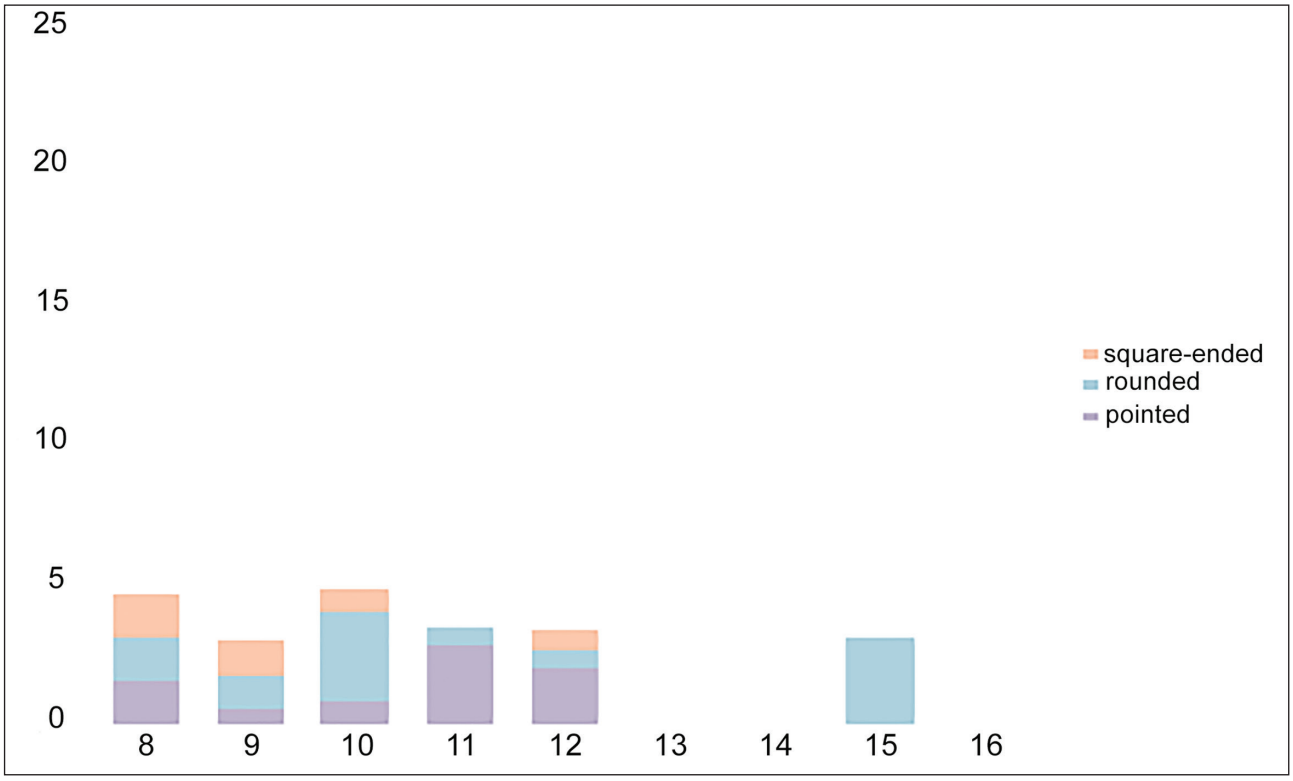

Figure 3.12. Percentages of spatula tools for Phases 8–16

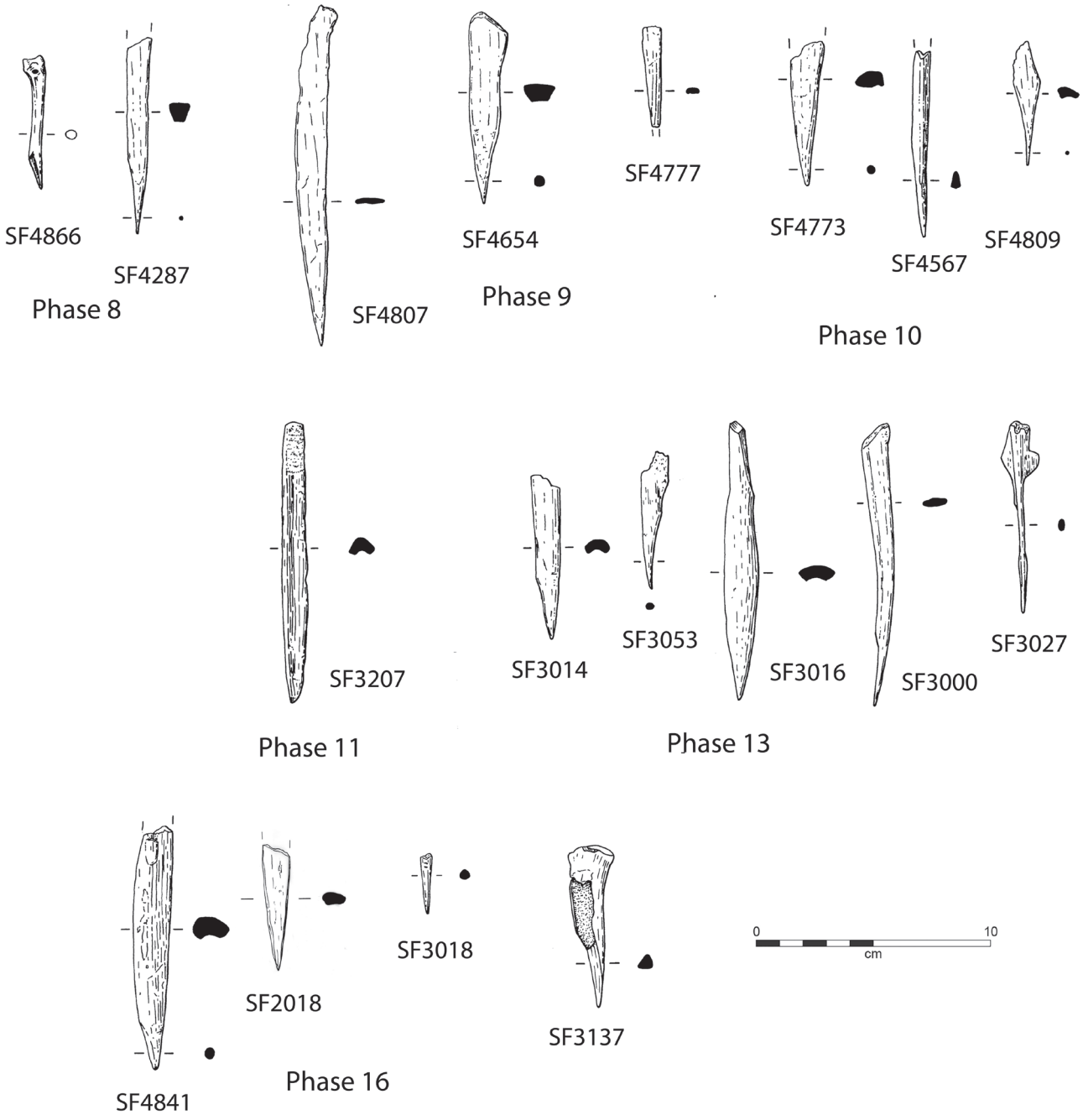

Figure 3.13. Bone points from Cladh Hallan

missing, lost during manufacture or use, or subsequently after discard. Examples are SF 4325 (Figure 3.14) and SF 3674.

Some awls such as SF 3072 (Figure 3.14) have utilised the natural shape of the distal end of the ulna as a handle, a technique seen also at sites such as Howe (Ballin Smith 1994: illus. 96) and the Broch of Gurness (Hedges 1987: fig. 2.27).

Blunt points

The 28 blunt points vary greatly in size. They have pointed tips, although their blunt and rounded shapes suggest that they were not used for the same tasks as awls. In the majority of cases, the tip is highly polished, again continuing along the shaft. On occasion (SF 4651 from context 2377), the tip is slightly damaged on the end, probably through use, although the reason for this is difficult to establish. Some evidence of manufacture is often seen around the tip, again continuing down the shaft. Similar to the awls, a number of these points are fashioned from metapodial bones, with the tip formed from the oblique splitting of the bone at the proximal end with the distal articulation left intact (for examples SF 3471 and SF 3486). A function for these implements is difficult to ascertain, although one interpretation proposed by Crowfoot (1945) was that they were used either

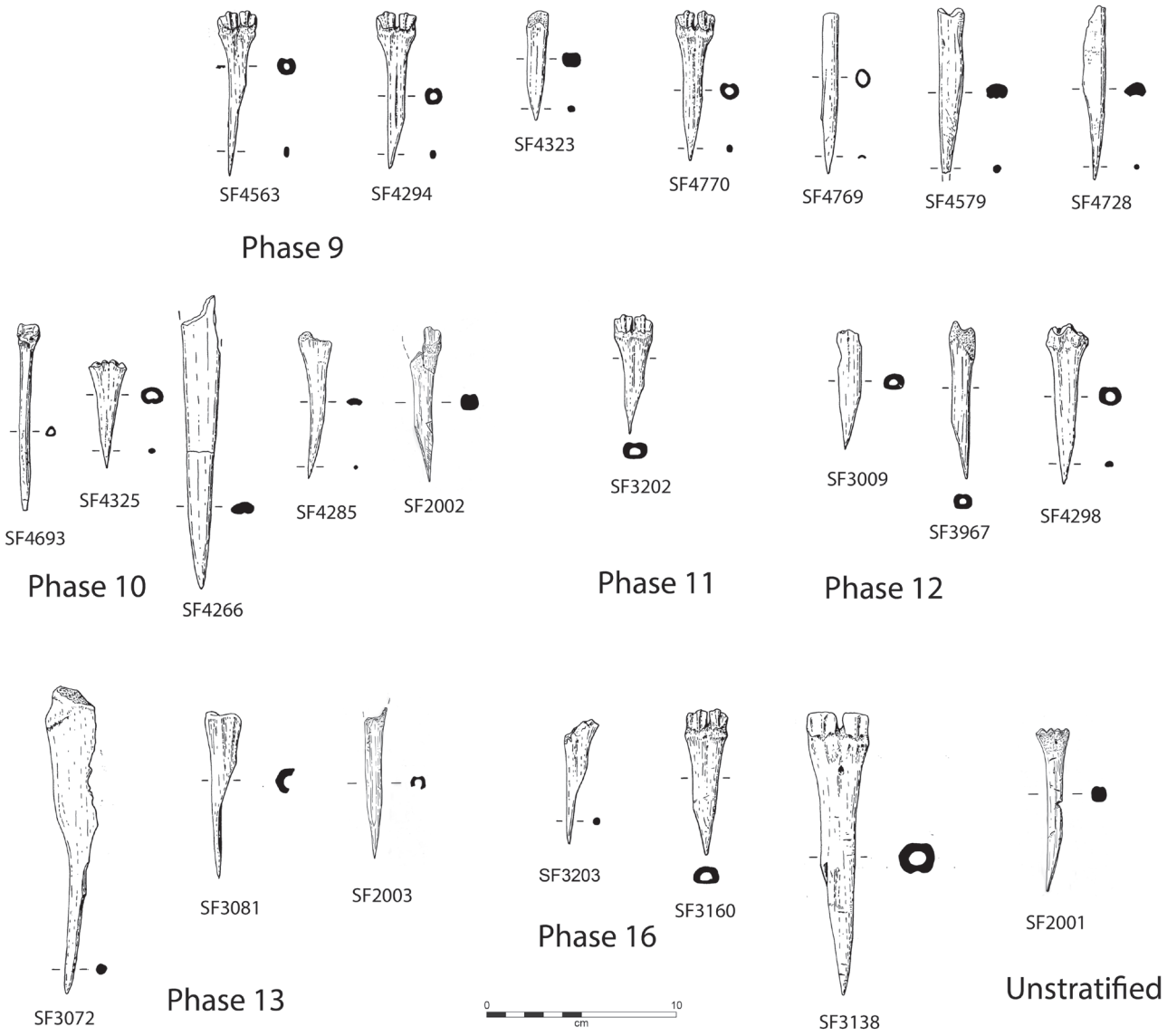

Figure 3.14. Bone awls from Cladh Hallan

horizontally or vertically as 'dagger beaters' to beat up the loose weft of a loom. It is noted that a certain level of polish and smoothness does occur on the blunt tools, believed by MacGregor (1974) to be compatible with their use in the weaving process.

Expedient points

The 28 expedient points are splinters of bone conveniently broken so that they can be utilised either without modification, or with minimal modification. They generally vary in length between 45mm and 85mm. The pointed tips range from fine to moderately blunt. With little evidence of manufacturing, and usually with polish only seen on the very end of the tip, these points are typically interpreted as being possible awl substitutes fulfilling a similar function of perforating hides, burnishing or textile-weaving and basketry, based on ethnographic studies (Olsen 1984: 387; Davies 1994). Hallén (1994: 197), however, disputes this, believing the implements to be debris from bone-splitting rather than piercing tools. Due to their lack of modification, as well as their lack of robustness, it appears likely that the tools were not curated but discarded after only limited use.

General points

There are 126 bone points that have been assigned to a tool type of general points. These are a general group that includes a number of fragmentary pieces or pieces that could not be easily assigned to one of the other categories within the points group. Included within this category are parts of points where, in many cases, just the point's tip remains. In these cases, if complete, many would probably have been awls. Due to the fragmentary nature of this category, the point sizes vary greatly with lengths from 14.3mm to 117.4mm, although the majority fall within the range of 50mm–70mm. The sharpness of the tips also varies from quite fine to fairly blunt. Many of these points were manufactured from longitudinally split long bones from mammals such as cattle and sheep/goat although

bird bones were also used. Comparable evidence can be found at other sites such as Howe, Orkney (Ballin Smith 1994: 172–3, illus. 95), and A' Cheardach Mhor, South Uist (Young and Richardson 1960: 155, fig. 13). Nearly all of the points have polish, presumably from use, extending along the shaft from the tip, as well as manufacturing and use wear marks.

There are also a few shouldered points. Typically, these are shouldered on both sides and were probably used in a similar way to awls. A possible reason for manufacture is that the shoulder of the point acts as a restrictive device to limit piercing depth.

Points/pins

There are a few bone point fragments (seven pieces) that have fine tips. It is difficult to determine if they are from small points or large pins.

Pins and needles

The bone pins and needles form a significant group within the Cladh Hallan assemblage with a total of 52 pieces (Figure 3.15). These are represented in all of the main phases on site but generally form less than 10% in any phase with the exception of Phase 16 when they make up 18.9% of the bone tools (Figure 3.11).

Pins

There are 31 pins from Cladh Hallan. All were heavily modified during manufacturing, making identification of the original bone element difficult, although they were presumably manufactured from mammal long bones, probably of cattle or sheep/goat. The size and nature of the pins vary greatly, although the majority are round-sectioned and highly polished, with lengths ranging from 38.9mm to 90.4mm, and with tips fashioned to a fine

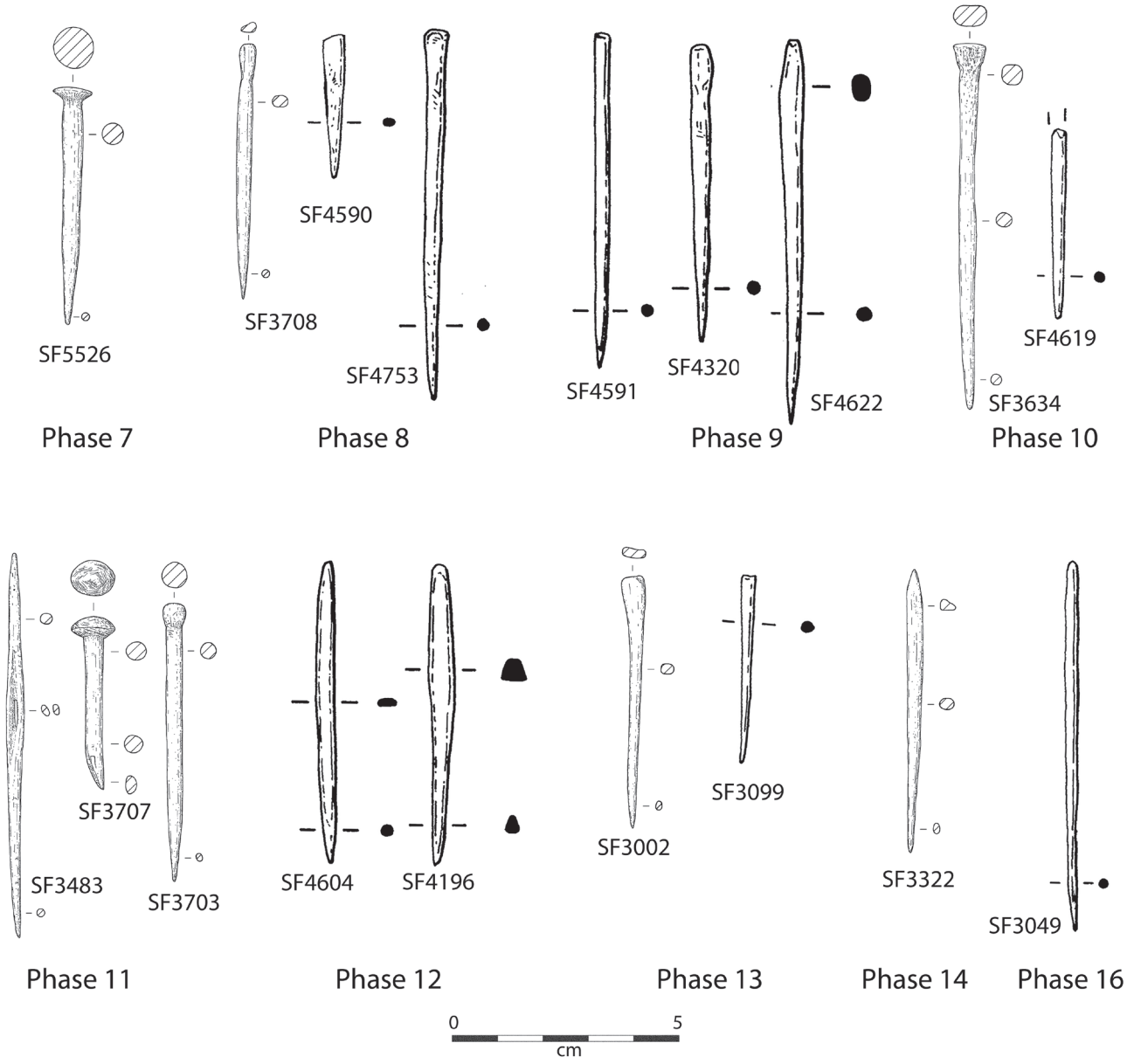

Figure 3.15. Bone pins and needles from Cladh Hallan

point. Despite claims by Lethbridge (1952: 187) that pins could have been used for the removal of shellfish, such as whelks, from their shells, it is widely believed that pins formed one of the principal forms of fastening clothing (MacGregor 1985: 113). It has also been suggested that longer pins could have been used as hair pins (MacGregor 1974: 71). Within this assemblage, various group types are identifiable such as headless pins, examples being SF 3002 (see Figure 3.15 for all pins described) and SF 3851, with the top of the pin being indistinguishable from the shaft, which is fashioned with either a flat or a rounded head, and which tapers from the widest point to form a fine tip, also seen at Sollas (Campbell 1991: 161, illus. 21, 617).

Nail-headed pins, of which SF 3703 and SF 3634 are examples (Figure 3.15), have been found at Foshigarry (Hallén 1994: 210, illus. 9, nos 4, 5 and 7) as well as at Dun Cuier, Barra (Young 1956: 321), where Young interpreted them as probably being used in making moulds for casting bronze pins (*ibid*.: 321). This is possible at Cladh Hallan, as there is evidence for pin casting (see Chapter 1) but unlikely given the different thicknesses. At Cladh Hallan, the heads tend to be round-sectioned, flat or very slightly rounded with a width and thickness between 5mm and 10mm.

Also identified in the assemblage is a spherical-headed pin (SF 3707) not unlike those found at Burrian (MacGregor 1974: 72, fig. 5, 1–7) and at A' Cheardach Mhor, South Uist (Young and Richardson 1960: fig. 13, 28–9). The head is wide, with a relatively short shaft, indicative of an Iron Age style (Hallén 1994: 210). Similar in size and shape to this is a rectangular-headed pin (SF 3708), slightly rounded on top with a length of 73mm, again similar to one found at Burrian (MacGregor 1974: 72, fig. 5.15). There is also a flat-headed pin (SF 5526).

Unusual pins include SF 3372 with a visible indentation running around the shaft just below the head, and SF 3949 which exhibits two grooves running in a wedge shape across the head.

Double-ended pins

Five complete double-ended pins are present in the assemblage. They are ubiquitously polished and, apart from SF 3647, have one tip finer than the other. All are of a similar size, with a length of around 50mm. The pins vary in section with round-, flat- and square-sectioned shafts. Two of the pins (SF 3322 and SF 2021) exhibit distinctive swelling of the shaft near one end; it has been suggested for single-tipped pins that this would have had the effect of holding the pin more securely in position when thrust through the weave of the material (MacGregor 1985: 116).

Needles

Probably the finest bone artefacts found at Cladh Hallan, in relation to their explicit manufacture and delicacy, are the seven needles. Varying little in size, between 37.8mm and 64.5mm in length, all have highly polished, fine tips with gradually tapering sides. In cross-section, four are round-sectioned, while the others are slightly rectangular. All the needles, apart from SF 3363 – a possible double-ended needle – have circular eyes made by drilling: the generally hourglass shape of the hole suggests that drilling was from both sides. Examples of this have been found on sites such as the Broch of Burrian (MacGregor 1974: 73, fig. 6) and Skara Brae (Childe 1931).

One implement (SF 3950) rapidly tapers to form a wide head at the base, accommodating a circular eye larger than those of the other needles. As suggested by Olsen (1984), such needles were possibly designed for thicker twine or yarn and may have been used on coarsely woven material such as netting (*ibid*.: 401). An alternative interpretation is that of MacGregor (1985) who believes that, in most instances, the perforation was probably for attaching a cord and that such items were pins used to secure an article of dress.

The relative scarcity of bone needles on the site may be the result of the comparative absence of a large-scale textile industry. Childe (1931) suggested that bone awls or expedient points at Skara Brae were used for piercing and presumably pushing twine through material. However, it may be the case that the number of needles, like that of pins, is underestimated due to their misclassification as bone points due to their fragmentary state.

Double-ended needles

There are two double-ended needles (SF 3363 and SF 3483; Figure 3.15). They have fine tips at both ends, and a central perforation presumably fashioned by the purposeful gouging of a longitudinal trough on both surfaces until the centres of the gouges meet to form an elliptical eye. Numerous examples of this type have been found at Howe, Orkney (Ballin Smith 1994: 171, illus. 95), Foshigarry and Dun Thomaidh, North Uist (Beveridge and Callander 1931). Olsen (1984) states that the fashioning of an elliptical eye allows the thread to lie in the trough, reducing the possibility of thread breakage, and that the double end allows the needle to be easily reversed and pulled back out of the material (*ibid*.: 358). Although a specific function for such a piece is undetermined, one possibility is that it was used in fishing net manufacture. An alternative function suggested by Ballin Smith, using evidence of larger notched netting needles found at the Howe, is use as fish gorges (Ballin Smith 1994: 171).

Pins/needles

There are four cases where a fine tip and shaft was identified but, due to the broken condition of the piece, it is not possible to determine if the object had a head or a hole; they could thus have been either pins or needles.

Spatula tools

There are 28 spatula tools from Cladh Hallan (Figure 3.16). These are only a small component of the assemblage, accounting for less than 5% in Phases 8 to 12 and absent in Phases 13, 14 and 16 (Figure 3.16).

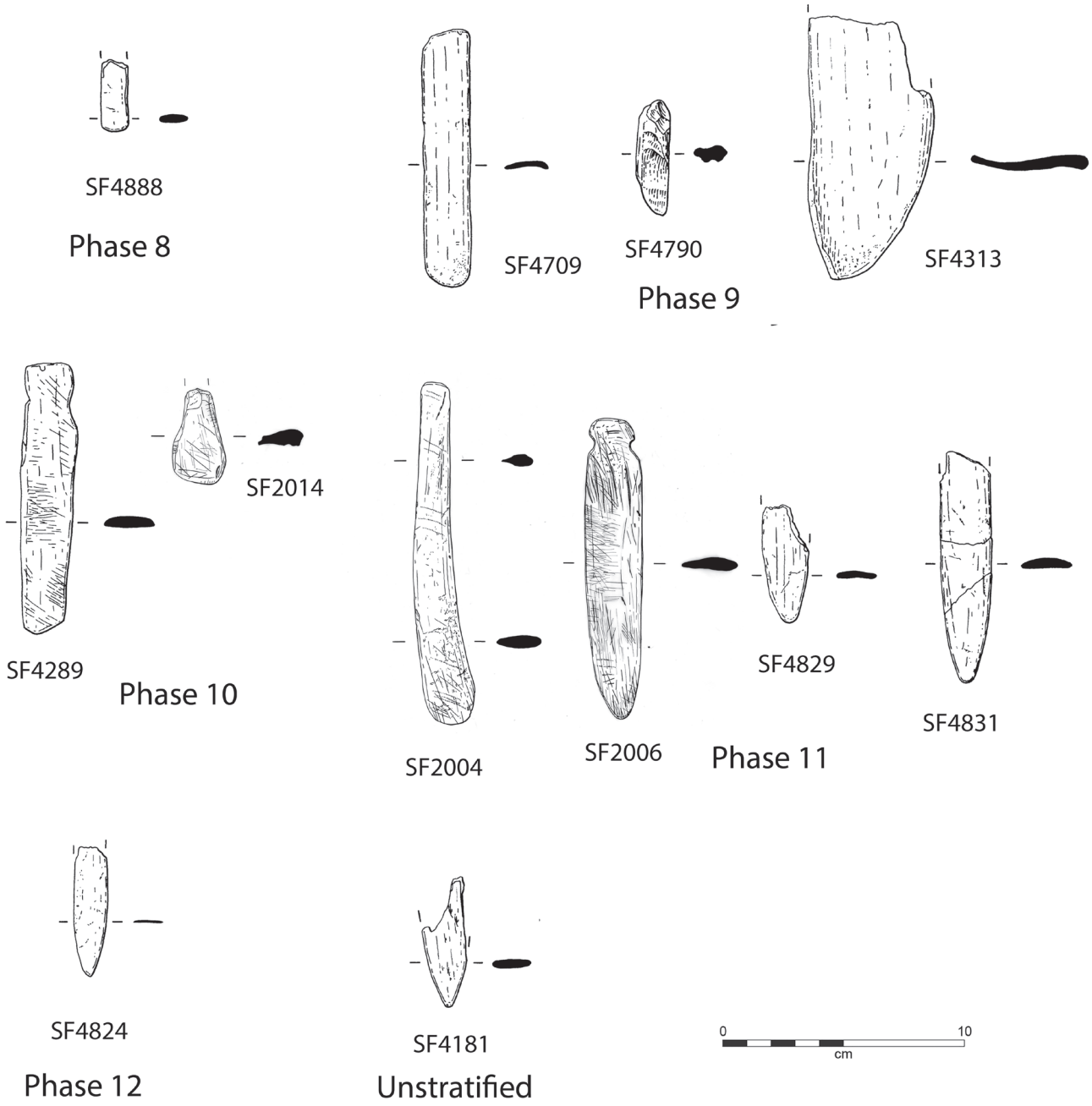

Figure 3.16. Bone spatula tools from Cladh Hallan

Pointed spatulae

There are 12 pointed spatulae and these appear to be smaller than the other spatulae, with an average length of approximately 60mm. These spatulae have edges which converge to form a pointed end. A number of these are scoop-shaped in cross-section (for example, SF 3862 and SF 4181; Figure 3.16), giving the appearance of a split tube.

Round-ended spatulae

The ten round-ended spatulas were manufactured from a range of bones including long bones, ribs and fragments of scapulae. The end is fashioned into a round end, with some exhibiting a semi-circular shape. Polish and marks of manufacture and use-wear are evident, and most artefacts are of a comparable size. Whether these spatulae differ in function from the square-ended tools is unclear.

Square-ended spatulae

The five square-ended spatulae have flattened ends, giving a chisel-like appearance. The majority are manufactured from long bones, and range in length between 30mm and 110mm with a width of approximately 10mm–20mm. The tips show evidence of working and occasionally polish, presumably from use. The shafts are also often polished, again presumably through handling.

The function of spatulae as a group is difficult to interpret, bearing in mind the potential for multi-functionality. Possibilities include scraping, chiselling and burnishing

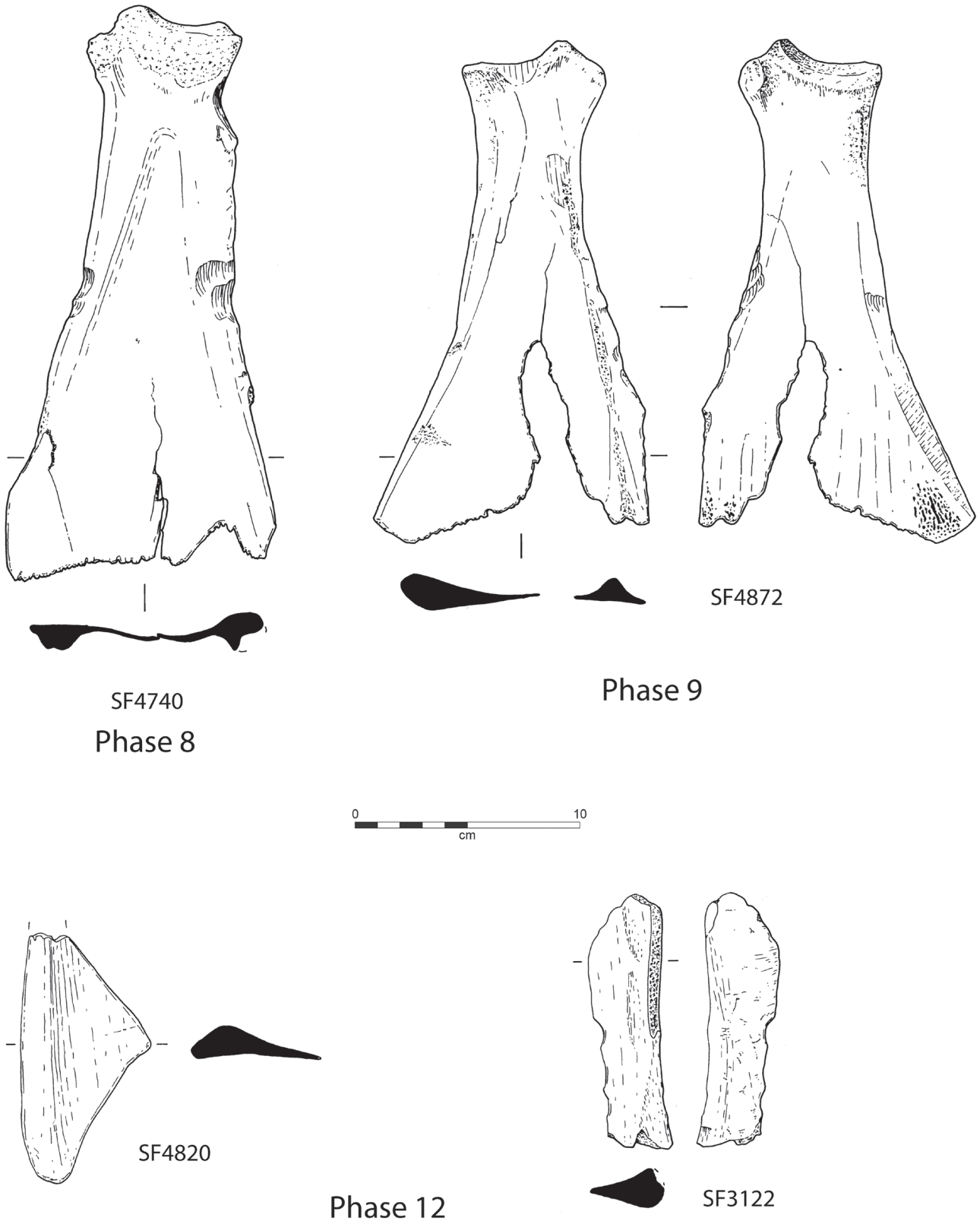

Figure 3.17. Bone scapula tools from Cladh Hallan

(Davies 1994: 207) as well as the interpretation of Wainwright (1979, cited in Hallén 1994: 207) that they were modelling tools for fashioning wax patterns in 'lost wax' bronze-casting. This interpretation seems unlikely due to the relatively unwieldy nature of these spatulae. Further suggestions include their use for smoothing pottery; similar antler and bone spatulae found at Sollas, North Uist (Campbell 1991: 159–61, figs 19–21) have been interpreted as being used in this way. Alternatively they were used in some manner for cooking, as suggested by Olsen (1984).

In addition, a number of the spatulae show signs of deliberate notches cut into the side edges and, in the case

of SF 4289 (Figure 3.16), deliberately stepped shoulders. Similar features have been found on spatulate forms from Foshigarry (Hallén 1994: 200, illus. 4). These were made of cetacean bone, and the notched features have been interpreted as being used for attaching wooden handles (Beveridge and Callander 1931: 351).

Scapula tools

A total of 40 scapula tools were identified in the assemblage (Figure 3.17). These fall into two broad groups: tools with a working end, and tools with a working side like a blade. These tools are generally only a small part of the assemblage, approximately 5%, but they make up 28.2% of the assemblage in Phase 15 (see Figure 3.8).

Blade-like scapula tools

Six scapulas have been shaped with the spine and one edge removed to leave a long blade-like edge on one side. These are all broken and it is difficult to identify the key characteristics of these pieces beyond their blade-like edge. The function of these pieces is uncertain, but possibilities included scraping or use as a batten or beater in weaving.

End tools

Scapula end tools are tools manufactured from scapulae that have had the lateral spine removed. They are generally interpreted as shovels for anything from grain to sand. The majority were manufactured from ungulates, mainly cattle. In many cases the 'neck' of the shaft near the distal end shows signs of polish, probably indicating its use as a handle; in some cases the neck and articular end has been cut down to make it thinner, possibly as an aid to handling. In addition, highly polished 'finger rests', halfway up the shaft on the edges, are visible on SF 4740 (Figure 3.17) and SF 3122 (Figure 3.17). In the majority of cases, the edge of the broad end shows signs of wear down to the cancellous bone, with multiple scratch-marks running perpendicularly down from the end, indicating extensive use. Examples of this type of tool have been found at Skara Brae (Childe 1931) and Howe (Ballin Smith 1994).

There is variation in the shape of the end-tool scapulae: some are rounded at the end while others are square-ended. This could be deliberate or a result of wear. Also of interest are SF 4872 (Figure 3.17) and SF 4740, both scapula end tools with denticulated broad ends that have small and rounded teeth. Possible uses include their being a specialised shovel or scraper. Wear polish was seen predominately on the medial face towards the denticulated end. A further possible interpretation is that they could have been used to separate plant strands such as flax, although the teeth appear to be too small for this purpose.

There are 19 worked scapula tools that are broken and fragmentary and cannot be confidently assigned to a tool type although they were probably end tools. Spade-marks (1229) dug into layer 429 at the south end of the site in Phase 11 (see Volume 1: 210, figs 6.8–9) have the same dimensions as the widths of the cattle scapula tools and probably result from the use of tools such as these.

Hafted tools

Hafted tools are a group of tools identified by the presence of a socket made by creating a hole or removing one of the articular ends to leave a socket formed by the medullary cavity. The other end was then shaped into a point or spatula form. These occur only occasionally in the assemblage and are often incomplete, being identified only from the remains of the socket but with the tip end missing. Where identifiable, the tip end is usually pointed.

Tools of this type have been identified on several prehistoric sites in Scotland, and potential uses are discussed by Hallén (1994). A wide range of uses has been proposed, including spear tips, weft-beaters, knives, gouges and weaving shuttles but the most intriguing interpretation relates to the association of similar forms with iron spearheads in East Yorkshire (Stead 1991) and in Danish and British Iron Age weapon deposits (Kaul 1988; Field and Parker Pearson 2003). These associations suggest that these tools could well have been spearheads.

Bone discs

A total of 25 bone discs were identified (Figure 3.18). These have been sub-divided into two groups: those that are perforated, and those that are not. As with many of the less common tool types, these are present in the earlier Phases 8 to 12 but absent in the later Phases 13, 15 and 16.

Perforated bone discs

Fifteen perforated bone discs (*e.g.* SF 4213; Figure 3.18) have been identified. These were generally manufactured either from pieces of scapula blade or epiphyseal discs from cetacean vertebrae. All the discs have a central perforation, interpreted by MacGregor (1985) as being unable to take much strain and thus used purely decoratively. Multiple-perforated discs, not represented here, have been interpreted as being used as dress or girdle fasteners (MacGregor 1985: 80, fig. 10, 147–8). MacGregor also cites further examples of single perforated discs at Dun Trodden and Baleshare, North Uist (*ibid.*: 141). Similar pieces were also found at Foshigarry (Hallén 1994: 217, illus. 11, 5–7), made of cetacean bone; these discs were interpreted as vessel lids but, whilst plausible, this seems unlikely for the majority of the Cladh Hallan perforated discs given their small diameters.

Bone discs (not perforated)

There are nine bone discs that are not perforated. These could have been objects in their own right or are unfinished perforated discs. As with the perforated discs, they are made from scapula blade fragments or cetacean vertebral discs. The larger discs could have been vessel

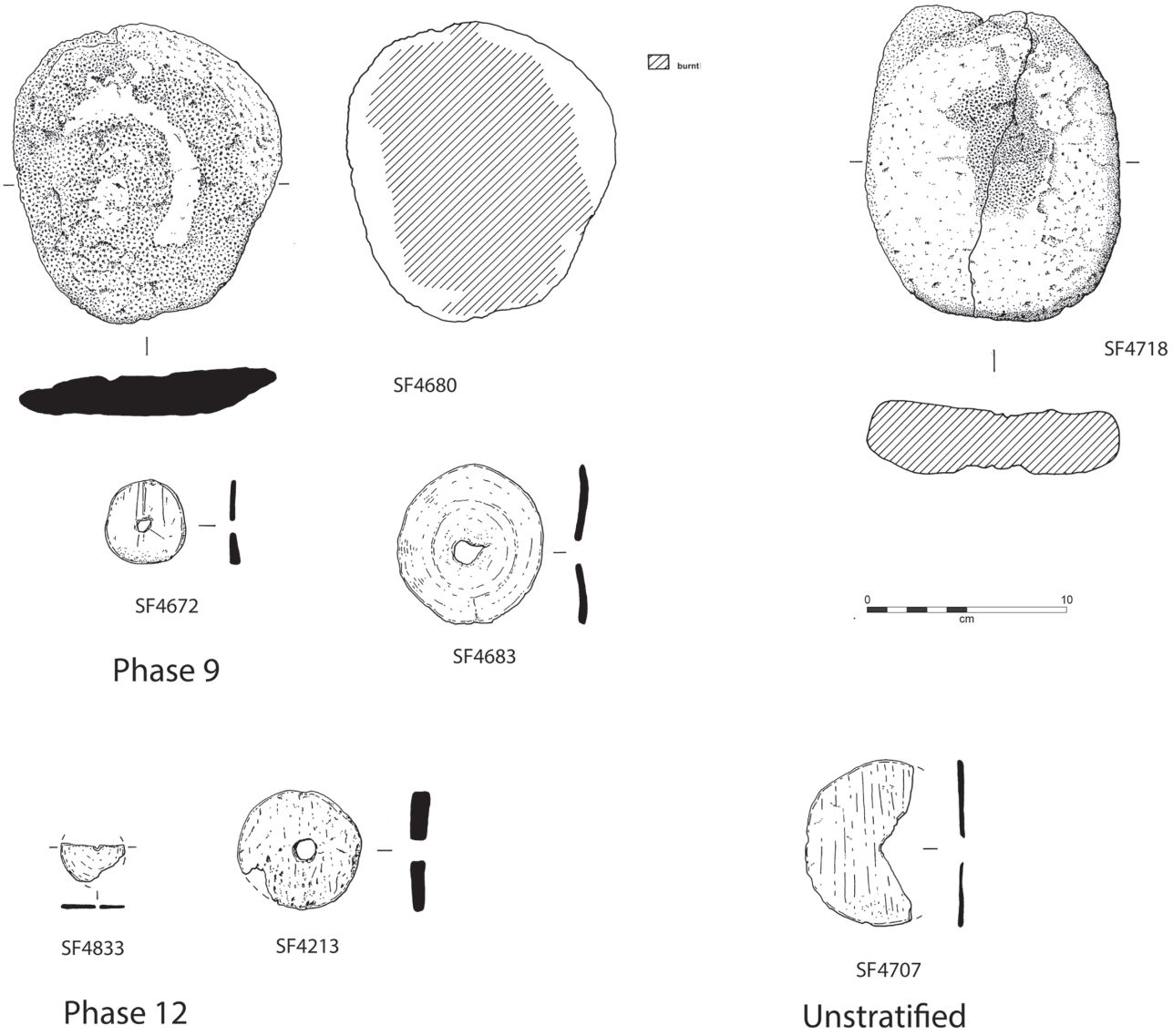

Figure 3.18. Bone discs from Cladh Hallan

lids (Hallén 1994), although this seems unlikely for the smaller discs, which could have been gaming pieces or counters.

Ornaments

The 21 bone ornaments from the site were recovered from Phases 8 to 14 (Figure 3.19). It should be noted that all bar one of these pieces are, in themselves, undecorated but have been interpreted as decorative in use.

Beads

A number of bone beads were found. The majority are cylindrical with a circular perforation through the middle, giving the pieces a hollow appearance (for example, SF 3966 and SF 4330; both in Figure 3.19). Typically, the bone beads were made by cutting out a section of long bone. The size of the bead was determined by the bone used in its manufacture. Other types of beads are also present, such as SF 4825 (Figure 3.19) where a hole has been made through a sub-triangular piece of bone.

Bone pendants

Six pendants were found, all of which are highly polished and are roughly triangular in plan. The end of SF 3873 (Figure 3.19) almost tapers to a blunt point with a circular perforation, fashioned probably with a borer or knife. SF 4614 (Figure 3.19) is broken halfway up the perforation. Sporadic wear marks, as well as polish, are visible around the perforation. These are similar to pendants found at Foshigarry (Hallén 1994: 225, illus. 16.2) and most likely used by being suspended from a thong or cord.

Tooth pendants

There are also four teeth that have been modified, probably as pendants. Two (SF 3406 [Figure 3.19] and SF 3326)

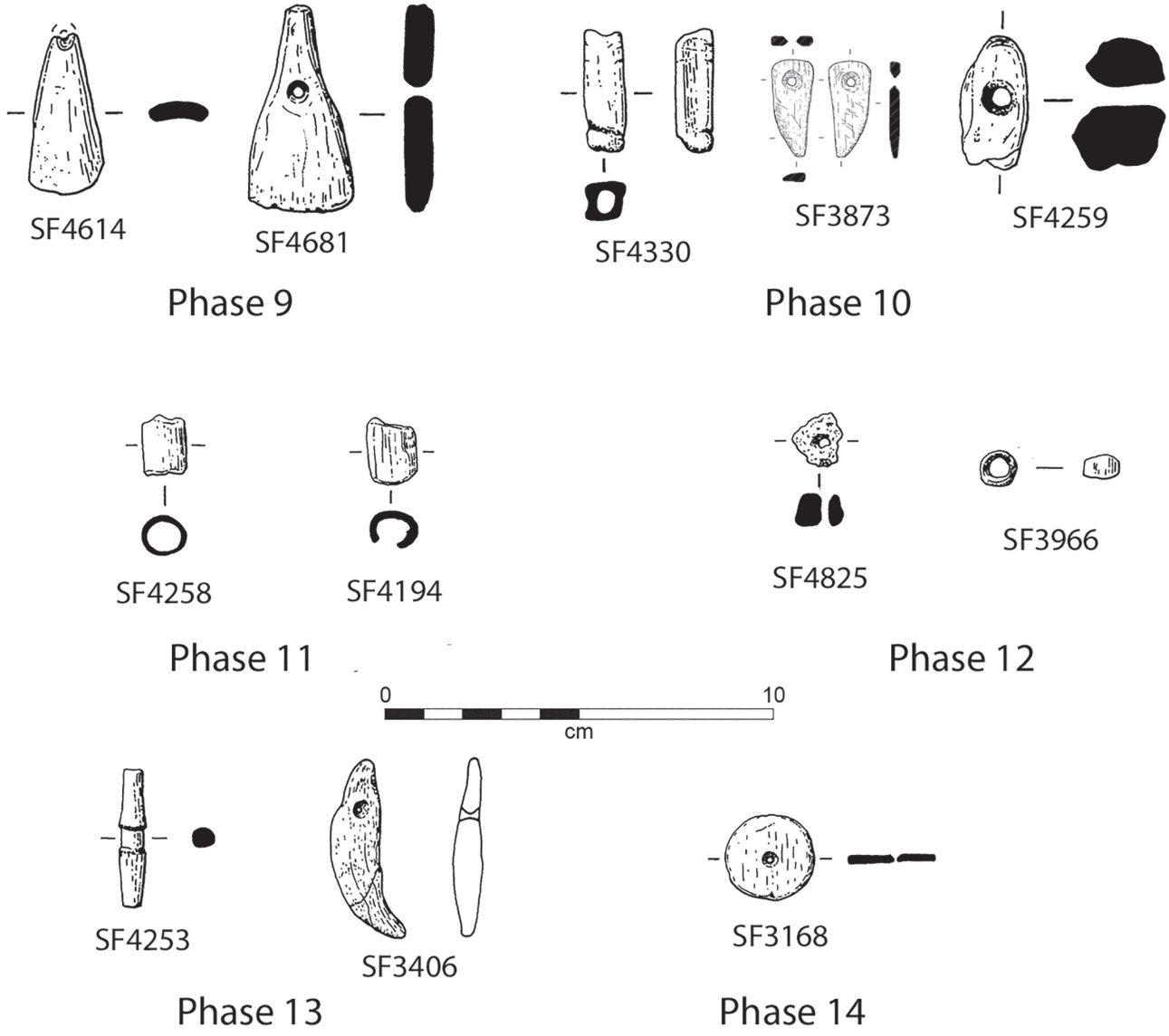

Figure 3.19. Bone ornaments and a toggle from Cladh Hallan

have holes perforated through the roots. The former was made from a dog's canine while the other was made from a tooth probably of a sea mammal, as was one of the other two tooth pendants. These are not perforated but there is evidence of working; in one of these (SF 3355 from a female pig) this resulted in two notches being made in the root, enabling a string or thong to be attached.

Other ornaments

There are four further artefacts that have been classified as ornaments. SF 3539 is a plate from the side of a boar's tusk; this has limited wear and is probably unfinished. The other pieces are a small circular disc of bone (SF 3168; Figure 3.19), a phalanx with a small circular perforation (SF 5855) and a fragment of bone which has five parallel grooves cut in its surface (SF 4600). This last piece is the only bone ornament that appears to have been decorated but its fragmentary state precludes further identification.

Spindle whorls

Five trimmed and centrally perforated cattle-sized femur heads were made into spindle whorls. All were recovered from Phases 12 to 14. These pieces are paralleled on sites such as Dun Cuier (Young 1956: 321), Howe (Ballin Smith 1994: 171, illus. 93) and the Broch of Gurness (Hedges 1987: fig. 2.35, 183, 186). The perforation, bored upwards from the trimmed base, is usually wider at the base end and measures between 7mm and 10mm in diameter. In some cases (*e.g.* SF 3764; Figure 3.20), the top has also been smoothed while others have been left domed (*e.g.* SF 2079; Figure 3.20). Due to the nature of the cancellous bone, evidence of manufacture was difficult to recover.

Miscellaneous

There are 97 artefacts assigned to the miscellaneous bone tool group (Figure 3.20). As the name suggests, this covers those

artefacts and fragments that could not be assigned to one of the other main tool groups. These pieces include unusual artefacts as well as fragmentary remains of worked bone that could not be fully identified. Remains classified as miscellaneous were recovered from all phases other than Phase 16 and generally form around 10% to 15% of each phase's assemblage.

Antler side-plates

There are five pieces of antler that have been classified as antler side-plates, all recovered from contexts between Phases 11 and 15. These pieces are made from flat plates of antler, with the complete pieces 64mm–75mm long, 15mm–20mm wide and 4mm–7mm thick. All of the plates have holes drilled through them near their ends. Two of the plates were held together with a small bone peg (SF 2077; Figure 13.20). Similar artefacts have been found at the Iron Age settlement of Sollas (Campbell 1991: illus. 19, 630–1) and at Gurness (Hedges 1987: fig. 2.18) and the Broch of Burrian (MacGregor 1974: 78, fig. 9, 103), often with the pegs still surviving in these 'plates'. As

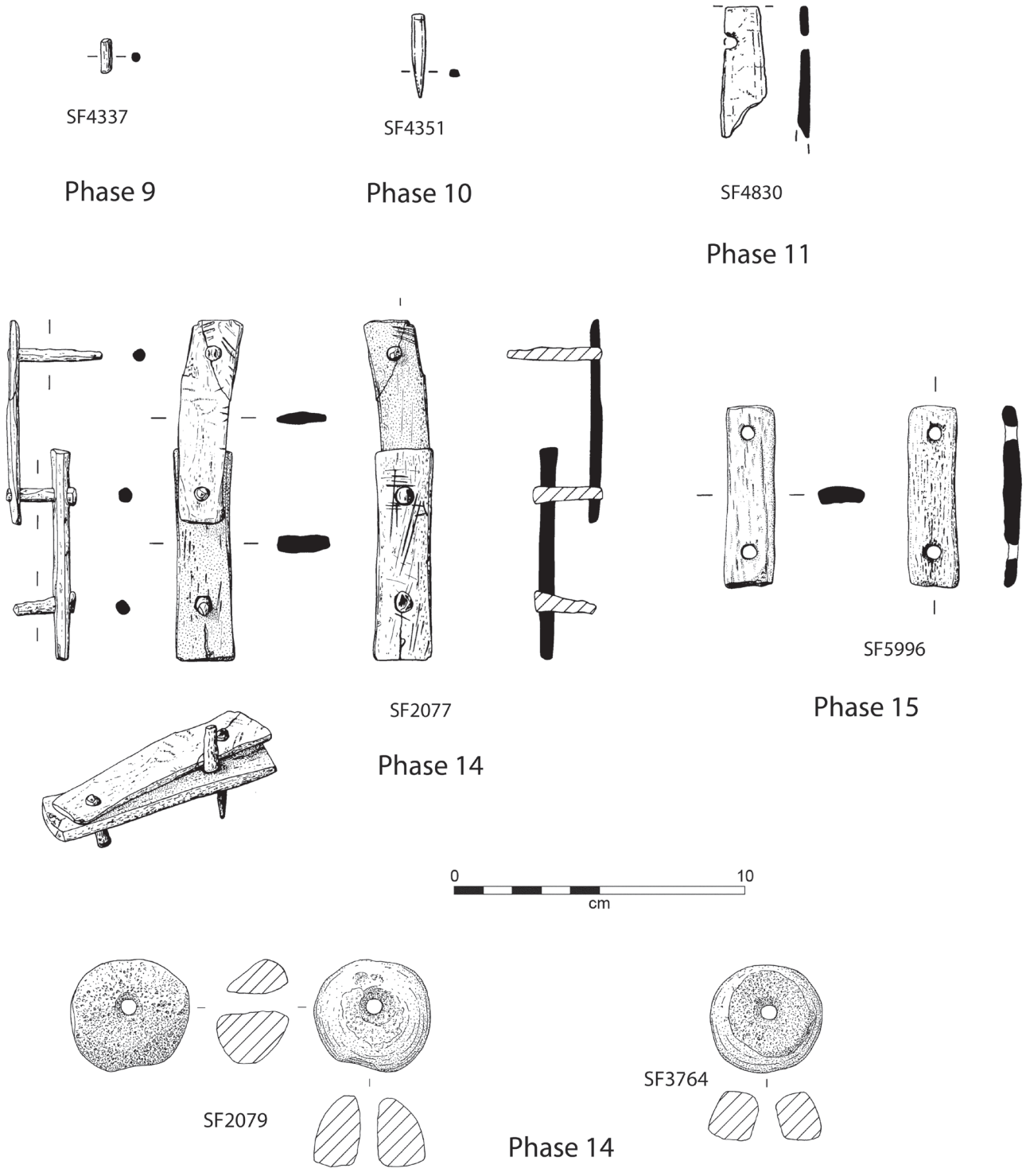

Figure 3.20. Bone spindle whorls and miscellaneous bone and antler artefacts from Cladh Hallan

suggested by Campbell (1991), it is unlikely that these were used as side-plates for bone combs or knife handles: the bone pegs would not have provided the pressure to hold the combs together in the same way as metal rivets. In addition, there are no signs of sawing marks on the edges of the plates that would result from cutting the teeth, a feature commonly found on bone comb plates. MacGregor (1974) has suggested that such plates may have been decorative applications on wooden objects though Campbell (1991) believes that their use was probably practical rather than decorative.

Pegs

Sixteen small pegs were recovered, three in association with antler side-plates. To manufacture these pegs, it appears that a long thin shaft was shaped to a round section. This often has a series of facets which may be due to scraping with a flint; the shaft was then cut through with a series of chops or grooves until almost through the peg which was then snapped off, often leaving a burr on the end to be cleaned up later. The pegs themselves are between 10mm and 30mm long, and are either rounded or multifaceted in section. The majority have blunt ends with flat or slightly rounded heads.

Bone toggle

One bone toggle was identified (SF 4253; Figure 3.19), with an indented groove running centrally around the diameter of the piece, separating two cone-shaped ends that taper down to flat heads. A possible function for this item is as a clothes fastener; alternatively, it could have been a decorative piece or a fish gouge.

Double-pronged artefacts

There are two unusual pieces made from antler (SF 3893 and SF 3769; Figure 3.21). These have both been cut across one end by groove-and-snap while the other end has a slot cut into the end, leaving two prongs. One of the pieces also has a notch cut in the side of its shaft. The function of these two objects is unknown, and this is not helped by what may be their incomplete state and the poor surface condition of one of them. It is unclear whether each should be viewed as an object with two prongs at one end or as an object with a slot at the end. These pieces may have been parts of larger composite objects.

Handles

Six handles were recovered. These were manufactured with the aim of attaching a tool, usually by inserting the tool into the handle. Five of the handles were made from antler and one from a rib. One handle still contains a broken fragment of the tool inserted in it (SF 4234; Figure 3.21). None of the other handles retain any of their tools. The tool inserted in SF 4234 is made from bone, and has broken off to leave a small stub sticking out of the handle. It is not known what the tools inserted into the other handles were made of.

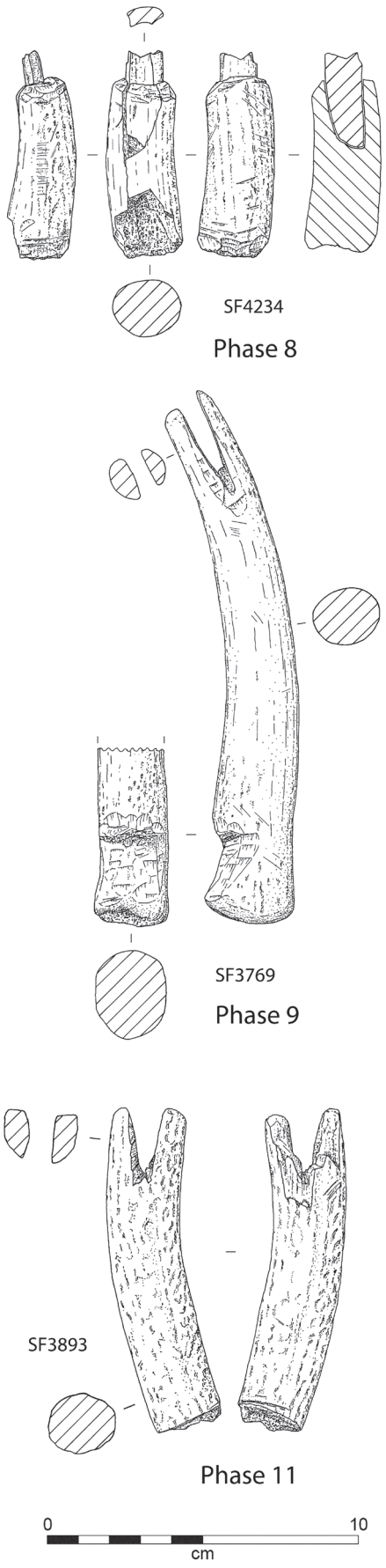

Figure 3.21. An antler handle and double-pronged artefacts from Cladh Hallan

Shaft fragments

There are four shaft fragments, for example SF 3657 and SF 3644, which are probably bone points, although their identification was impossible due to the absence of the tools' tips.

Miscellaneous

Miscellaneous items include small fragments of bone tools that could not be identified and other pieces of worked bone that do not fall into the categories identified above. These are all described in the bone tool catalogue.

Worked antler

A total of 195 items have been assigned to the antler tool group (Figure 3.22). This is one of the less well-defined groups and includes antler picks, fragments of worked antler and possible antler raw material. The possible raw material was excluded from much of the statistical analysis but is considered here. Antler picks and worked fragments total 93 pieces, recovered from all phases from 8 to 16. The number of antler tools (excluding raw material) in the earlier Phases 8 to 11 is around 10%, increasing in the later phases to over 20% of the assemblage from each phase.

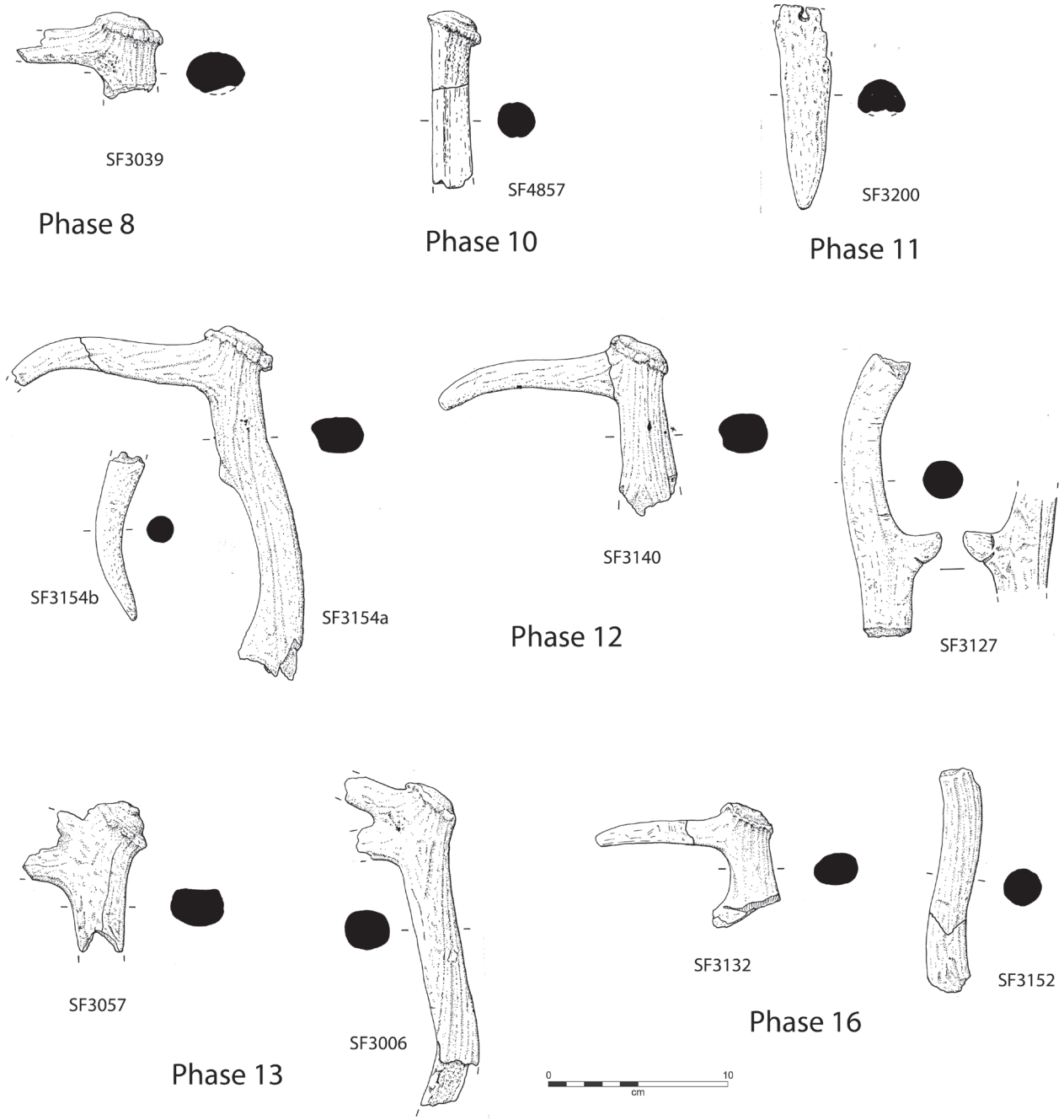

Figure 3.22. Antler artefacts from Cladh Hallan. SF 3057 and SF 3006 are unworked

Figure 3.23. An unusual antler tool (SF 5065) from the fill (2854) of a posthole in House 401 in Phase 8. It has a mallet-shaped end and a slot-like hafting hole

Phase 14 is, as usual, an exception to this, with only 4.4% antler artefacts.

Antler picks

The remains of a total of 23 antler picks were recovered from Cladh Hallan. Antler picks are found in most phases but generally in small numbers, usually less than 5% of the assemblage. The exception is in Phase 15 where they make up 15% of the assemblage. This is notable because scapula tools are very common in this phase, with scapula-end tools or shovels making up 25% of the entire assemblage. The number of digging tools from Phase 15 appears significant but the small size of the worked bone assemblage for this phase (32 pieces in total) means that any theories related to behaviour and activities must be tentative.

Both shed and unshed antler are identified among the antler picks, that were usually made by removing the bez and trez tines and crown. The beam then formed the handle and the brow tine the pick head (Figure 3.22). The brow tine was often shortened although it is not possible to determine if this was done deliberately or was a result of use. The picks' tips are often heavily worn, with the interior cancellous bone of the tine exposed. The tip ends are rounded and often have scratches running across the tine tip near the end, demonstrating the action of use, the pick being used to prise (rather than chip) at its chosen target.

Measurements have been taken on the antler picks following Clutton-Brock (1984). Unfortunately the antler picks are mostly in a fragmentary state and measurements could only be taken on 14 out of 23 picks. Examination of these shows that the antlers from Cladh Hallan are rather smaller than those examined from Grimes Graves and Durrington Walls by Clutton-Brock (1984). The average burr circumference at Cladh Hallan is 149.3mm while at Grimes Graves and Durrington Walls it was 213mm and 198.5mm, respectively. Examination of the range of burr circumferences shows that the Cladh Hallan deer mostly had antlers of a similar size and that none were as large as the average at Durrington or Grimes Graves. The size of antlers probably reflects the small size of deer, suggesting that the deer exploited by the people of Cladh Hallan were small (see Chapter 10). This may have been an island effect as suggested to explain the small size of the red deer at Iron Age Cnip (McCormick 2007).

Worked antler

A total of 69 pieces of worked antler were recovered from all phases from 8 to 16. These pieces show evidence of working, groove-and-snap, chopping, scraping and grinding but are either too fragmentary to identify or are rough-outs or debris from cutting up sets of antler for raw material. It is often difficult to tell the difference between a fragment of tool and an off-cut piece of debris. For polished antler tine tips, if the polish is in the realm of natural deer damage (Olsen 1989) the tine tip has not been considered as worked and is not described as such unless there is other evidence of working, for example of chopping, grinding or scraping *etc*.

'Imported' antler

One hundred and one pieces of antler do not show evidence of working. As with the whale bone discussed below, being wild animals the deer were not killed and butchered on site but were presumably killed elsewhere and then brought to the settlement (see Chapter 10). Transportation of deer carcases could have been undertaken whole or as joints, with the antler also brought back to site. In addition, shed antlers could have been collected and brought home; five of the antler picks were made from shed antler, supporting this hypothesis. In addition, antler has long been a desirable material for tool production. Unworked antler from the excavations has therefore been included in the catalogue as a possible raw material for tool production but is excluded from much of the statistical analysis of the assemblage.

Whale bone

There are 79 pieces in the whale bone tool group from Cladh Hallan (Figure 3.24). Whale bone artefacts are present in all phases bar one (Phase 13) but rarely in large quantities. Several different types of artefact have been assigned to the whale bone group but most are only represented by a handful of specimens.

Whale bone blade

There are ten whale bone blades in the assemblage. These tools are often referred to as blubber mattocks and are known from many sites in coastal Scotland. Clark (1947) first noted the similarity between these tools and tools used by the Inuit. At Cladh Hallan these blades were made from flat pieces of whale bone and, where hafting remains are present, they consist of notches on the sides of the blade. At other sites, both notches and perforations through the blade were used for hafting (Davies 2007).

Although the term 'blubber mattock' suggests a specific function, there has been some debate over their use. MacGregor (1974) has suggested their use as oar blades

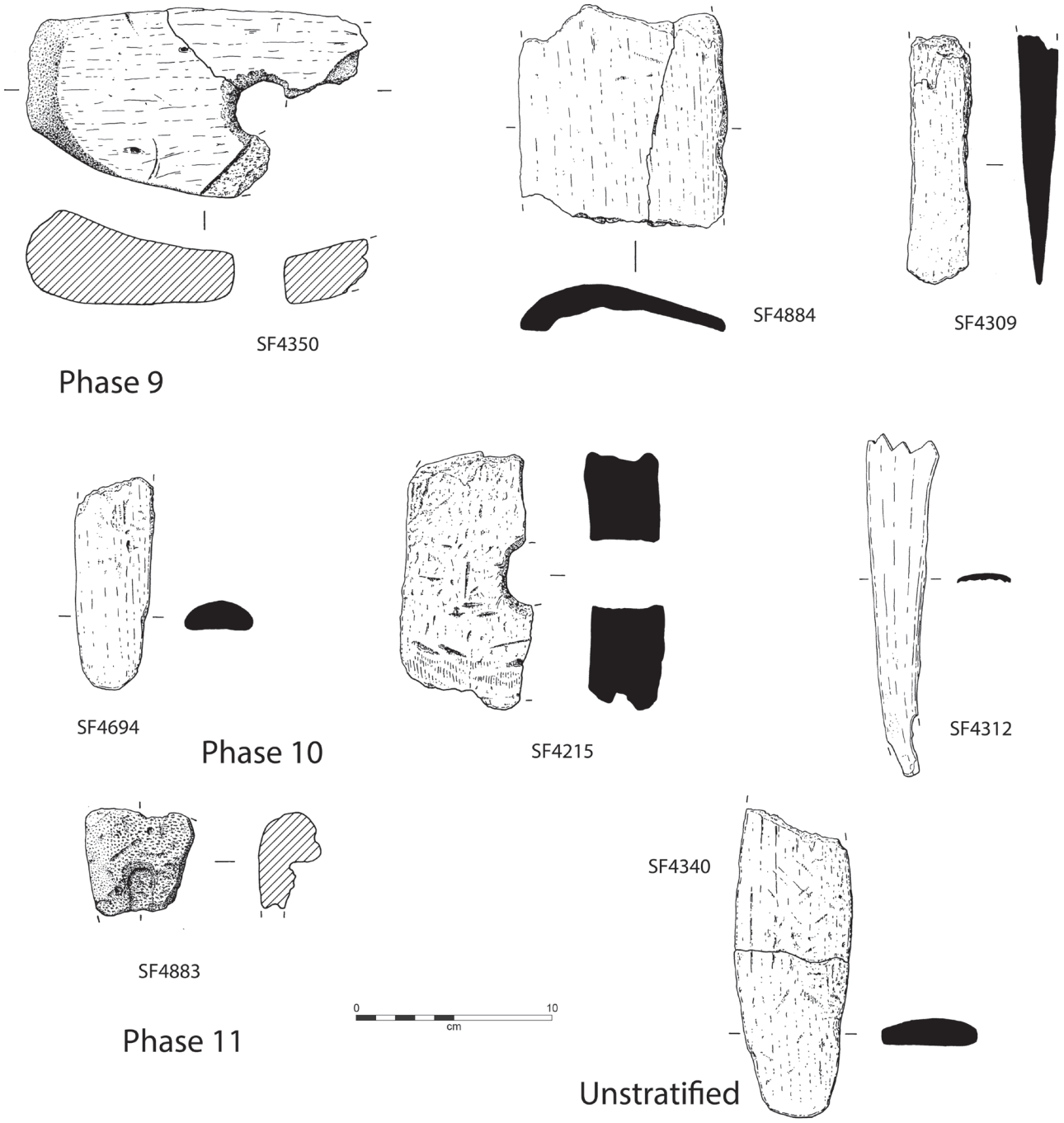

Figure 3.24. Whale bone artefacts from Cladh Hallan

and peat spades, and it is not impossible that they could have been used as spade blades on a light sandy soil. Many of the blades at Cladh Hallan have signs of polish and chipping on their edges, confirming that they were used as mattocks or spade blades rather than as oars, but without identifying the material they were used on.

Whale bone lamp

Two whale bone objects were recovered that could have been whale bone lamps (SF 3811 and SF 3711). One is a plate of whale bone with a depression in the middle (SF 3811; see Volume 1: fig. 5.72) while the other is a lump of sperm whale bone (SF 3711) with a depression on one side. Both of the depressions contain darker, blackened bone that appears to have been burned. The natural grease within the bone may have been exploited in these objects but this would have made it difficult to restrict any flames to within the depression. It may be that the bones were degreased before being used to hold a flame and were simply vessels to hold a fire.

Whale bone mortar

One large piece of humpback whale phalange (SF 3382) was formed into a possible mortar or pounding/grinding

vessel. This piece is cut flat across one end and then a conical depression has been made in the other end. This depression is almost pointed at its base which would suggest that a thin pestle would have been used if it was a mortar. There is a second shallower depression on the side of the piece that shows crushing damage. It would appear that this piece was used for pounding or grinding and that it had more than one kind of use.

Whale bone plate

Four pieces of whale bone have been shaped into large flat plates. None of these are complete as they all have broken edges. In their incomplete state, it is difficult to ascertain their function.

Whale bone rod

Two whale bone rods were recovered. SF 3631a is the more complete piece, although it is broken in two pieces that conjoin. The piece is 270mm long and 34mm in section; the denser outer bone has been used to make this piece, while the more porous inner bone has been removed. The rod is straight and one end is rounded with chipping damage while the other is discoloured from heating. The second piece (SF 3631b) looks to be a fragment from a similar rod.

Whale bone vertebral vessel

One unfused whale vertebra (SF 3501) has been partially hollowed out from one of the epiphyseal surfaces to produce a hollow vessel, 33mm deep, with all processes and spines removed. There is no evidence of pounding as is seen in the whale bone mortar but, equally, the vessel could not have held liquid because of being far too porous.

Structural whale bone

Two pieces of whale bone were used structurally. SF 4560 is a large slab of whale bone used to cap a cist in the doorway of House 401 (see Volume 1: 108, figs 4.37–4.38). This bone is in poor condition and fragmentary, which makes it difficult to determine if it was deliberately shaped as a cap. SF 5018 is a large piece of sperm whale skull found in the wall beside the entrance to House 1370 (see Volume 1: fig. 5.55). Again, the piece is fragmentary and its function could not be determined.

Worked whale bone

A total of 18 pieces of worked whale bone were recovered from Phases 7 to 12 but none were recovered from Phases 13 to 16. The worked whale bone pieces are generally lumps of bone that show evidence of working such as chop- and cut-marks or smoothing or grinding of surfaces. Due to its cellular structure, whale bone often suffers from damage over time and many of the pieces are in a fragmentary state.

'Imported' whale bone

There are 39 of pieces of whale bone that do not show evidence of working. As large sea mammals, whales are butchered on the shore where landed or stranded and are too bulky to be carried to a settlement for butchery. Therefore any material from a whale at Cladh Hallan has been brought there after butchery. This material has therefore been brought to the site for a reason. The three most likely uses for whale bone are as a raw material for tool manufacturing, as a building material (taking account of the size of some bones) or as a fuel. Being very rich in fat, whale bone can be used as a fuel (Mulville 2002). The whale bone on site has therefore been considered in the bone tool catalogue as an 'imported' raw material even when not worked.

Manufacturing

Manufacturing debris includes off-cuts or fragments of bone debris from tool manufacturing (Figure 3.25). This debris is not common and makes up less than 4% of the worked bone in any phase. Manufacturing debris was recovered from Phases 8 to 13 but not from Phases 14 to 16. This absence from the later phases is probably not because of an absence of bone working but due to the small assemblage sizes for these later phases.

3.5 Comparisons with other sites

The worked bone assemblage from Cladh Hallan is similar to those from a number of sites such as Howe (Ballin Smith 1994), A' Cheardach Mhor (Young and Richardson 1980), Foshigarry (Beveridge and Callander 1931; Hallén 1994), Sollas (Campbell 1991) and the Broch of Burrian (MacGregor 1974). As a result, it is possible to make comparisons between Cladh Hallan and these slightly later assemblages from the end of the first millennium BC and the early first millennium AD.

Despite the large size of the Cladh Hallan assemblage, the range of tools is relatively limited and is most similar to that of Dun Vulan (Parker Pearson and Sharples 1999). A very small number of exceptional artefacts were found at Cladh Hallan. Certain artefact types are absent from the assemblage, such as the bone harpoons found at Foshigarry (Beveridge and Callander 1931: 334, fig. 17), pins with decorated heads at Foshigarry (*ibid.*: 336, fig. 19, no. 1) and the Broch of Burrian (MacGregor 1974: 72–3, fig. 5, no. 24) and projectile points (Davies 1994; Hallén 1994). In addition, the general standard of the bone-working is simple and basic: initial shaping of the bone was usually by smashing and chipping rather than the more controlled but time-consuming process of groove-and-splinter manufacture. This suggests the importance of functionality, practicality and expedience for the makers and users of the artefacts, rather than any great concern with elaborate manufacture and ornamentation.

Through this analysis, it is possible to establish the variability of bone artefacts at Cladh Hallan, based on morphological criteria, and to assign possible function(s) to each of the resulting tool groups. As a result, they can be linked to specific domestic activities such as cooking, food production and potting activities for spatulate tools, and scraping and digging for scapula

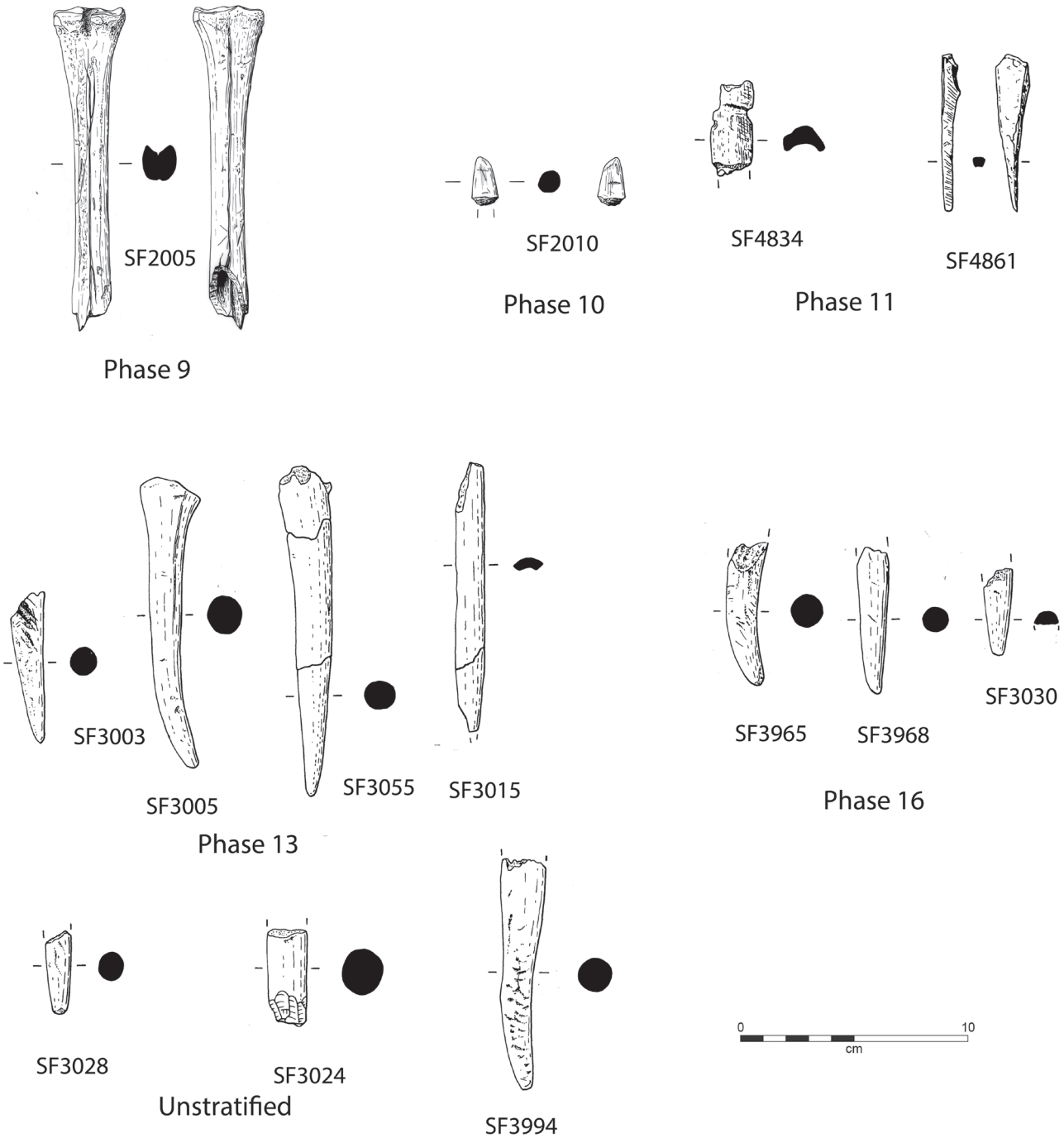

Figure 3.25. Bone and antler manufacturing debris from Cladh Hallan

tools. Leather-working is indicated by awls and needles. The small assemblage of spindle whorls, pins and needles is indicative of weaving, as suggested by Ballin Smith (1994). The small number of artefacts related to clothing production might suggest that this was undertaken on a restricted scale but it is possible that the required tools were made from other materials.

The lack of any significant decoration on any of the worked bone implements is suggestive of a functional dominance in the assemblage of the household cluster, with little regard for any prestigious connotations, similar to the bone assemblage at Howe, Orkney (Ballin Smith 1994).

Catalogue

Key to measurements

L length; W width; T thickness; D diameter; WT tip width; TT tip thickness; c-size = cattle-size; s-size = sheep-size; s/g = sheep/goat; lbsf = long bone shaft fragment. In each entry the SF number is followed by the context number.

Phase 3 – South area

5193; 3286 An awl with the distal end of fused bone forming the handle. The shaft is broken obliquely. The fine tip is

Table 3.12. Counts by phase of bone tool groups not included in the analysis

Tool group	Phase															Total
	3	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*U/S*	
Antler						1	1									**2**
Bone discs							2									**2**
Hafted																
Manufacturing																
Miscellaneous						1	1									**2**
Ornaments							2									**2**
Pins etc.					1	2	2								1	**6**
Points	1				1		3	1								**6**
Scapula tools					1	1										**2**
Spatula tools						2	1									**3**
Spindle whorls																
Whale bone		1				4										**5**
Total	**1**	**1**			**3**	**11**	**12**	**1**							**1**	**30**

shaped axially and is smoothed and polished. L84.0mm, W10.0mm, T8.8mm, tip L9.1mm, tip W3.3mm.

Phase 3 – Beneath House 1370

5120; 3233 An expedient point made from a flat piece of c-size metapodial. A long tapering point at one end, point roughly shaped and slightly polished. L142mm.

5259; 3246 An unworked Odontoceti tooth.

5195; 3300 A splinter of c-size mandible with a rough point at one end with smoothing at tip. L132mm.

5191, 3342 A fragment of s-size metapodial. The shaft has been partially worked through and the piece has broken at this point; this could be bone-working waste. L43mm.

5926; 3355 A fragment from the shaft of a point just back from the tip; s-size lbsf. The tip is axially shaped possibly by scraping. The bone is dark stained, possibly from heating. L31.7mm.

Phase 4 – House 2835

5188; 3194 A piece of unworked deer antler.

5889; 2835 A small flat piece of bone, possibly scapula. The edge is abraded and smoothed. L42.5mm.

5249; 3457 A flat disc-like piece of cetacean bone; articular surface one side, possible fusion surface the other. Possibly part of a vertebral disc but if so large. A number of fine scratches on the articular surface but some, at least, appear modern. L198mm, T42mm.

Phase 5 – South area

5088; 2909 A lump of dense unworked whale bone. Part of the bone looks like an articular surface, smooth and dense bone. No evidence of working but could be raw material.

Phase 6 – Northeast area

4867; 2402 A broken awl, L77mm, max. W9mm, T5mm. A lbsf, worked into a fine, round-sectioned tip. The tip is quite highly polished with faint axial scratches, possibly from scraping.

5548; 2408 The tip fragment from a possible spatula tool, c-size rib. The incomplete nature of the piece makes identification uncertain.

5982; 2417 The shaft and most of the tip of a long slender point made from a thin-looking lbsf, c-size, possibly deer. The handle end is missing, broken off. The bone has been split axially but there is no sign of grooving. The edges of the shaft have been obliquely ground and there are axial working marks towards the tip, the very end of which is missing. L117.8mm.

Phase 7 – House 2476

4720; 2475 An antler tine with a polished tip. A series of fine cross-scratches on the shaft may be from grinding. The shaft has been broken across square and possibly smoothed but this end has modern damage. L82.5mm, D18.3mm.

4765; 2476 An unusual red deer antler pick. The antler is shed and the brow tine forms the point, the tine is smoothed and the tip is worn down and heavily scratched, The bez tine has been removed. A slot has been cut through the antler from anterior to posterior (same axis as brow tine), by chopping the antler from both sides and digging out the cancellous tissue. The work is so extensive it is not possible to determine if a tine could have been located here. At the start of the next tine the beam has been grooved through on both sides and snapped off. Broken into 5 main pieces that refit. The slot is *c.* L60mm, W7mm.

4804; 2476 The shaft of a tool with the ends missing. One edge of this lbsf shows extensive polish from working.

After being broken a slight polish developed at one end; this may indicate use post-breakage.

5019; 2476 An axially split fragment of a s-size metapodial with working evidence along one edge. The edge has been smoothed after the bone was split and there are faint axial scratches from the smoothing process. The split in the bone passes through the fused proximal end of the bone. L45.7mm.

5024; 2476 A modified vertebral process of a dolphin.

5526; 2476 A flat-headed pin with a round shaft; lbsf. Axial working marks from scraping, with a light polish. L13.0mm.

5266; 2476 A piece of unworked deer antler.

5885; 2476 A piece of unworked deer antler.

5314; 2476 A probable scapula shovel, c-size, broken into 8 fragments with the spine removed, the glenoid missing and the spine cut down at the distal end with the end eroded.

Phase 7 – House 3260

5175; 3305 A lump of whale bone with 2 cut-marks but no obvious form. It could be the remains of butchery rather than working but is more likely to be raw material.

5908; 2883 A fragment of lbsf from near the tip of a point or spatula tool. The piece shows polish and extensive axial and oblique working. L47.9mm.

5909; 2883 The proximal end of a c-size metapodial. The end has been perforated and a sub-rounded hole the diameter of the medullary cavity made in it. The hole has damage around it, suggesting that the end was subject to hammering or chipping. L47.8mm, D of hole 19.5mm.

Phase 7 – South area

5097; 2975 A piece of unworked deer antler.

5098; 3052 The fine tip of an awl made on a lbsf. The shaft widens out back from the tip. The tip has been worked axially to shape it. L53mm.

5053; 2433 A probable headless pin, with its tip missing; lbsf. High polish all over. L55mm.

Phase 8 – Forecourt

3708; 1416 A pin, L56mm, D mid-shaft 4mm. Very slightly curved, polished, sub-rounded in section with a fine point. The head has a slightly flattened oval section with notches in the ends of the oval delineating the head, W3.5mm, L7mm, T2.5mm, and very slightly rounded on top.

Phase 8 – House 1370

4287; 1397 A complete trapezoidal-sectioned point, L82mm, shaft W9mm, T7mm. Near-complete and in good condition. This is a lbsf, fashioned into a highly polished, round-sectioned fine tip of *c.* L34mm. Axial scraping is evident, running down from tip to shaft.

4651; 2377 A broken blunt point made from a s-size tibia, L75mm, max. W16mm, T22mm. The shaft is triangular in section. The tip is split obliquely, to form a blunt tip with high polish. The rest of the piece is smoothed and lightly polished. Oblique grinding is seen along the tip's split edge.

4697a; 2377 A red deer antler pick. The burr is near-complete on a shed base; the brow point is worn down and has a slightly flattened end. The bez tine is removed as is the trez. There are cross-scratching wear-marks on the brow tine.

4697b; 2377 Three large and six small fragments of unworked antler beam.

4698; 2377 A fragment of unworked dolphin bone.

4721; 2509 A piece of Balaenidae (probably right whale) bone, rectangular in plan with rounded ends and a long shallow notch on one side. One surface is convex and one concave; the convex surface has denser bone and the curve is probably natural on the original outer bone surface. A hole has been made part-way through the bone near one end, with the hole worked from both faces of the bone. The incomplete perforation suggests that this is an unfinished piece. L213mm, W71.8mm, T20.0mm.

4733; 2379 A shouldered point made from an obliquely split s-size metapodial; cross-ground on shaft, tip tapers to point but tip end missing. The tip has moderate to high polish which obscures the working. The handle end is broken off. L54.4mm.

5018; 1370 A sperm whale skull fragment at the entrance to House 1370. One large piece (L420mm, W370mm, T125mm), 3 medium and 4 small fragments. The large piece has patches of black discoloured bone, possibly from burning.

5115; 3190 A piece of unworked deer antler.

5173; 3295 A short awl with the tip end missing. The distal epiphysis of this s-size metapodial is fused and forms the handle; the shaft is broken obliquely. The point is shaped on the break and some axial scratches remain. L57.1mm.

5864a; 3589 The tip fragment from a point. No working evidence is visible; lbsf. L19.4mm.

5864b; 3589 Four fragments of c-size scapula blade. Spine has been removed and the stump cleaned up with cross-grinding. In its fragmented state it is impossible to be certain of the original tool type.

5872; 1397 A fragment from the shaft of a point, just back from the tip; s-size lbsf. The shaft has been split obliquely across and the tip shaped but no working evidence survives due to the poor surface condition. L31.9mm.

5952; 3376 A shaft of c-size lbsf with one end removed by groove-and-snap; the other end is missing with the shaft broken through. The groove appears to have been cut around the bone. Just below the groove is a second partial groove that only appears to be on one side of the bone. This part of the bone is damaged and it is not possible to determine the full extent of the second groove.

5205; 3378 An unworked cetacean vertebral disc.

5216; 2643 A bird lbsf cut across one end. The other is broken, leaving a tube of bone. L80mm.

Phase 8 – House 401

3693; 1312 A flat, rectangular piece of whale bone, squared-off on one end and the sides, broken on the other end. L50.2mm, W70.4mm, T8.8mm.

3696; 1312 A complete disc of scapula, D34mm, T2mm. Perfectly circular, lightly curved disc, with a circular central perforation D4mm. This hole has been made from both sides. Multidirectional scratches are seen on both sides.

3705; 1312 A blunt point, L55mm, max. W8mm, T6mm; c-size lbsf. The tip is quite flat, rounded and rectangular with rounded edges in section. Polish and multidirectional scratches near the tip. Extensive cross-scratching on shaft obscures possible splitting evidence

3830; 1912 A broken and fragmented cattle scapula tool, probably a shovel, L262mm, min. shaft W60mm, max. T26mm. Spine removed and the distal articulation reduced in thickness, leaving a rectangular end in section. The blade is worn along its end which now runs diagonally back from the end of the spine.

4234; 2129 A broken composite tool, with a bone tool in an antler handle. Handle cut to size by groove-and-snap, the groove made by chopping. Handle has extensive scratching, probably from use. A bone tool has been inserted but this is broken and only a stub survives. What remains of the tool shows cross-grinding used to shape the shaft. The piece is burnt and cracked. Handle L58.5mm, D22.0mm.

4560; 2105 A sperm whale skull fragment used as a cap for a cist, now broken into one large (L440mm, W290mm, T145mm), 2 medium and 56 small fragments. The large piece, one of the medium and 8 small fragments show a discolouration in patches, possibly due to burning.

4587; 1312 A pointed bone spatula, made from a split c-size rib, L82mm, T2mm, max. W18mm. The rib is shaped to form a pointed end, with polish near the point on one face. Slight polish, probably from wear/handling, is visible on the shaft. The non-pointed end is broken.

4590; 1312 A complete pin, L30mm, mid-shaft T2mm, max. W4mm. This small lbsf has a fine trapezoidal-sectioned tip, and is polished all over with its slightly curved surface.

4740; 2557 A complete square-ended scapula tool, L253mm, max. W115mm, T27mm. Robust c-size scapula, with the glenoid on the medial face worn down to the cancellous bone. Halfway up the shaft are curved notches in each side, possibly handling aids ('finger rests'). The proximal broad end is denticulated. The blade has suffered damage, with a deep chip lost on the denticulated edge, but the denticulations are either starting to form in this gap or smaller denticulations have been made along the broken edge. Quite highly polished all over, with multiple scratch-marks, straight but multidirectional, running down from the denticulated edge. It would appear that this tool is some form of scraper although the denticulated nature of the working edge suggests that the material being scraped might have had a fibrous quality, *e.g.* scraping the hair from a skin to make leather.

4753; 2748 A very straight, highly polished, round-sectioned pin, L82mm, mid-shaft D3mm, max. D5mm; lbsf. Tip is exceedingly fine; the flat head is circular in section, W5.7mm, T5.3mm. The head slightly tapers out from the shaft, but only on one side. Multidirectional scratch-marks on the head, with some oblique grinding on the shaft just below the head.

4757; 2774 An incomplete pin, L56mm, max. W3mm; lbsf. Round-sectioned, very slightly curved into an s-shape, with a blunt tip, and broken horizontally at the other end. The preservation condition is less than average, although one can observe a few patches of polish.

4763; 2795 A lbsf broken at both ends, L33mm, shaft W7mm, T5mm. The piece has 3 faces, one curved with slight polishing, one flat with sporadic cross- to oblique grinding marks and one where the piece was broken from the rest of the bone.

4866; 2416 A point, L55mm, shaft D4mm; lbsf. This is made from the tibiotarsus of a large duck (*cf.* Mallard). Polish obscures earlier working evidence. The hollow shaft is obliquely split from the side to form a fine tip *c.* L14mm.

4888; 2129 A square-ended spatula, broken with most of the shaft missing, L29mm, W10mm, T5mm; lbsf. This piece is mostly covered in a black discolouration, indicating burning. Edges are parallel, with one thicker than the other. The end is fashioned into a horizontally flat tip. The piece is polished all over, with a few multidirectional scratch-marks just visible on one face. The non-tip end looks broken, possibly as a result of burning.

4889; 2129 A scapula bone disc, broken in half, with a few scratch-marks on both sides, D70mm, W30mm, T3mm. Possible evidence along the broken edge of what might have been a central perforation, but little of this remains.

4925; 1930 The proximal end of a s/g metatarsal shaft is split obliquely, oblique and cross-grinding has been used to shape the piece but it is unfinished. L123mm.

4927; 1930 A piece of unworked deer antler.

4928; 1930 A small splinter of bird lbsf with a polished surface. L36.8mm.

5356; 2907 A killer whale vertebral body with the processes removed close to the body to leave a clean surface. Both epiphyses are fused. One epiphyseal disc has 2 probably modern cut-marks. D120mm, T74mm.

5887; 2570 A broken-off antler tine, possibly roe deer, with a number of fine axial scratches and a small patch of possible scraping. L71.4mm.

5938; 3486 A s-size lbsf with a possible point at one end but the poor surface condition precludes formal identification.

5957; 3017 A small splinter of antler with the remains of a groove, probably for snapping across one end. L33.7mm.

5137; 3492 A near-complete pin; polished with a sharp point and a flat-topped round head. L115mm, D3.5mm; lbsf.

5075; 2844 The tip of a spatula-like tool; c-size lbsf. The handle end has been narrowed down to almost a spike, presumably to be hafted into something. L77mm, WT20mm.

5065; 2854 An unusual antler tool. The burr has been removed and the proximal end shaped to a hammer or mallet-like end. The shaft has been similarly shaped and there is a hole through the shaft that could be for hafting to a handle (but the hole is long and thin, 48mm × 18mm). Overall the object is similar to a mace head but the slot-like hafting hole is unusual and may have a different use. L100mm.

Phase 8 – House 801

3520; 803 An expedient point, L65mm, W4mm, T3mm. A slightly curved s-size lbsf, whose fine tip is polished. The rest of the shaft is not worked.

3902; 1773 An unworked antler tip fragment with scratches that could be natural.

4983; 2555 A split c-size rib forming a slightly curved flat spatula, round-ended at one end, with cross-grinding to shape. The other 'handle' end is squared-off and thick. Neither end is sharp. L83.2mm, W16.3mm, WT7.4mm, T4.3mm.

5207; 803 A fused s-size distal metapodial handle with the shaft broken obliquely. A fine point shaped by oblique grinding/scraping with the end of the tip missing. L67.7mm.

5208; 803 A point based on an axially split s-size lbsf. The condition of the bone surface has not preserved working or wear evidence. L46.9mm, W7.9mm, tip L1.42mm, W7.7mm.

5442; 803 The tip of a point, L26mm, a mid-shaft W11mm, T2mm. Extreme tip W2mm, rounded end. Axial scratches are visible on both sides.

5866a; 2738 A fragment from the shaft of a point or spatula, with oblique grinding along the edge; c-size metatarsal. L26.1mm.

5866b; 2738 A small broken piece of c-size metatarsal. This is a flat piece from the back of the bone with the proximal articular end removed. Extensive oblique grinding on the surface of the bone and the natural hole in the bone has been enlarged by circular boring probably with a flint; the piece has broken through this hole. This could be part of a pendant or the hole could be for stringing up the piece which could be part of a handle for some other object. L18.4mm, D of hole 4.1mm.

5942; 803 A small chip of whale bone with one chop-mark on it. L27.6mm.

5985; 803 A small, thin, narrow, sub-rectangular plate of bone. This has been extensively shaped and the original bone cannot be identified. There are some axial working marks but most of the surface is smooth. It is unclear if this is a complete object or part of a larger object. L52.0mm, W4.5mm, T1.6mm.

5986; 803 A splinter of lbsf, with oblique working marks on one edge and a point at the end. L53.2mm.

5389a; 803 A fragment of whale bone blade. L71mm.

5389b; 803 A fragment of whale bone blade. L63mm.

5079; 803 A headless pin with a fine tip and polish all over, round section; lbsf. L72mm.

5080; 803 A flat piece of sub-rectangular whale bone plate. L120mm.

5212; 803 A s-size rib split axially into a thin plate. The inner cancellous tissue has been mainly removed. Both ends are rounded. L82mm.

Phase 8 – Northeast area

3039; 583 A piece of unworked red deer antler.

5539; 2552 The fine tip of a polished point; lbsf. L15.6mm.

5879; 2748 The broken shaft and tip of a point, possibly an awl, from which the handle is missing; s-size metapodial. The shaft has been broken across obliquely and a fine tip shaped on the end by axial scraping. L70.6mm.

5063; 2748 A small s-size scapula shovel, head broken off, spine removed. Blade end is polished from use. L150mm.

Phase 8 – South area

3770; 1791 A s-size lbsf fashioned into a point, L74mm, shaft W8mm, T4mm. This is a slender piece, which tapers into a long fine point, quite highly polished, as is the shaft. Axial scraping marks are seen running down from the tip along the shaft, mainly on the anterior face.

3813; 1791 A broken-off antler tine tip with a blunt end and a smooth surface on the tip and shaft. Back from the tip are a number of axial and oblique scratch-marks, probably from scraping, that may be from shaping the tip. L89.5mm.

3816; 1791 An awl, fashioned from a s/g metapodial, L67mm, shaft W15mm. It is roughly, obliquely broken on its edge/anterior face. Multiple axial scraping marks from working are seen all around the tip, running from the tip to the shaft split. The end of the tip is broken, making it difficult to identify the tip's fineness. The distal articulation is completely intact.

3890; 1880 A red deer antler base and beam. The burr is partially removed and worn down, and the first tine is missing; the break appears old and worn. The beam is damaged and broken into 12 fragments that mostly refit. The wear on the base may suggest use as a hammer or similar object. It does not appear to have been a pick. The largest piece is L320mm; the beam has a max. D51.2mm above the first tine.

Phase 9 – Area C

2005; 926 A red deer metacarpal with remains of a groove started in the natural groove on the rear of the bone. The groove is unfinished and the bone is broken mid-shaft.

5841; 926 A small fragment of whale bone. One edge has a scalloped appearance that is probably from chopping the bone. L30.5mm.

Phase 9 – Area D

4592; 2028 A red deer antler pick made from the beam and 1st tine; the second tine has been removed. The first tine has high polish and cross-scratches at the tip. The beam handle is broken through. The whole thing is in 3 refitting pieces. L295mm, L tine 120.0mm.

4784; 2041 A piece of unworked antler.

Phase 9 – Forecourt

4326; 2082 A fragment of worked lbsf, L65mm, max. W15mm, T9mm. The fragment shows polish and faint cross-grinding along one edge.

4591; 2082 A slightly curved pin, L74mm, mid-shaft D3mm, max. D4mm; lbsf. Axially worked and highly polished all over, with a fine tip. The pin is round-sectioned with a round-sectioned head, D3.6mm.

4884; 2082 A roughly square-shaped piece of whale rib, split axially to leave a thin plate; the inner cancellous tissue is largely removed leaving the denser outer bone. One end is broken with sharp edges while the other has more rounded edges; this may be evidence that one break was the result of manufacturing and the more rounded edges are the result of wear. The incomplete state makes identification of tool difficult but this may have been part of a blade from a mattock/shovel. L111.4mm, W105.3mm, T13.9mm.

4885; 2082 A piece of unworked cetacean bone.

5932; 2082 A small fragment of c-size scapula blade with rounding along its end. L30.8mm.

Phase 9 – House 1370

4294; 2193 A s/g metapodial awl, L82mm, shaft W9mm, T8mm. It is split obliquely from the anterior face/side edge interface. The awl has a fine point, with small multidirectional scratch-marks around the tip, *c.* L28mm. Prominent cross-grinding is visible just below the shaft/tip interface. Half of the anterior face of the distal articulation is missing; otherwise it is intact.

4315; 2235 A possible point, L49mm but incomplete. The piece is made from a slit lbsf. The point is slightly scoop-sectioned, with a fine half-rounded tip. Moderate polish is visible over the bone surface, with multidirectional scratches down the posterior face, and a few long axial grinding marks running along the side of the posterior face. Faint oblique grinding along one edge.

4321; 2238 A piece of unworked antler.

4563; 2210 A complete awl, manufactured from a s/g metapodial, L86mm, W10mm. Diagonally split from one edge, this piece is slightly polished all over, with a fine tip L49mm, and axial grinding marks running along the posterior face of the tip and cross-grinding around the tip/shaft anterior interface.

4564; 2210 An unworked tooth from a sperm whale, L160mm, D66.4mm.

4579; 2210 A broken awl, L86mm, shaft W13mm, shaft T8mm. The handle end is broken. A very slight curved indentation is seen on one side of shaft, with cross-grinding in it, *c.* 15mm from the broken end. The shaft is rectangular in section and fashioned into a round-sectioned tip, the very end of which is broken off. It is moderately polished all over with oblique grinding and cross-grinding along one shaft edge.

4600; 2210 A fragment from a larger piece, L19mm, T2mm. It is smooth on one face, with 6 ridges running straight and parallel across the other face, these having been produced by the incision of 5 parallel U-shaped grooves cut in the bone surface. Its use is unknown although it might have been ornamental.

4614; 1369 A triangular pendant, L39mm, max. W18mm. The piece is flat on one face with slight polish on the face and the edges; one edge is slightly curved and polished with faint multidirectional scratch-marks. One other edge is broken, the break located at a circular perforation which appears not to be finished.

4622; 2347 A slightly curved pin, L85mm, max. D6mm; lbsf. The pin is fairly uniformly round-sectioned, with a fine tip. The piece is quite polished, with a shaft that widens to a thicker dia. towards the head, which is more polished than the shaft. The head is W5.7mm, T2.5mm.

4644; 2210 A c-size scapula disc, D83mm, T3mm. This is an unperforated disc, broken in half. Very slight polish is seen on one face.

4649; 2210 An antler tine, L165mm, removed from the beam. Possible chopping marks may have partially cut a groove before snapping. The tip has been damaged, showing the cancellous tissue but additional use has smoothed off the surface. The wear to the tip could be natural or human.

4671; 2393 A whale rib broken at both ends. Midway along the rib is partially cut through and one side split off. Due to the cancellous nature of whale bone no working marks are visible. L355mm, W70.5mm, T39.1mm.

4674; 2393 A s/g metapodial, manufactured into a short awl, L60mm, shaft W10mm, T6mm. Split axially working down the middle, half of the distal articulation remains. It tapers quite rapidly to a fine tip, with polish seen along edges near the tip, as well as axial working along one edge. In addition multidirectional marks are visible, mainly cross-grinding marks near the tip on its posterior face.

4711a; 2445 A piece of antler beam with groove-and-snap at one end. L130.5mm.

4711b; 2445 A piece of unworked antler.

4718; 2211 A disc manufactured from a long bone epiphysis of humpback whale. This piece is thicker than other similar discs. The bone is primarily cancellous, with a thin layer of denser bone on one side. No working marks. D165.0mm, T34.2mm.

4769; 2210 A complete bird-bone awl, L84mm, shaft D10mm; lbsf. This is round-sectioned with a hollow shaft, broken and smoothed horizontally to leave a flat end. It has been split obliquely on the other end to give a curved, fine tipped point L53mm. Slight oblique grinding is seen from the tip, with axial scraping around the tip/shaft split.

4771; 2210 A broken, round-ended spatula, L85mm, max. W28mm, max. T7mm; lbsf. The piece is slightly scooped in section with a wedge-shaped end. Cross-grinding can be seen towards the tip on the posterior face, with increased cross-grinding further down the shaft. The non-tip end is polished, presumably from handling.

4777; 2443 A point fragment, L42mm, mid-shaft T3mm, max. W7mm. The point is made from a s/g metapodial. This is a slender piece, with the tip of the point broken off and the handle missing. The non-tip end has been broken diagonally from one face, and is polished, probably from use. The rest of the point is also polished. Two long scratch-marks can be seen running from the tip to about three-quarters of the way along the shaft on the posterior face. The piece has been shaped by axial and cross-working, probably a mix of grinding and scraping.

4790; 2210 A round-ended spatula, L48mm, mid-shaft W13mm, T7mm; lbsf. The tip end is broken but polish on the broken surface suggests continued use. The piece is polished all over with sporadic multidirectional scratches.

4806; 2210 A bird-bone pin, L45mm, max. D3mm; lbsf. The general condition of the bone precludes accurate identification but the shape suggests a pin. This is a round-sectioned pin, with a fine, straight tip. The head has been fashioned into an almost rectangular-sectioned, flat head, W3.8mm, T1.2mm.

4807; 2210 A near-complete point made from a c-size rib split axially. The point is L142mm, mid-shaft W13mm, T3mm. The point has a fine tip, with a slight curve on its shaft. Polish can be seen from the tip down, petering out towards the non-tip end. Sporadic scratch-marks can be seen all over, predominantly from cross-grinding.

4812; 2210 An unperforated c-size scapula bone disc, L53mm, max. W41mm, T3mm. This is a fragment from what probably would have been a bone disc, with one curved edge, and 2 broken edges. A number of scratch-marks, mainly running in one direction, can be seen on both sides.

5127; 2211 A piece of unworked antler.

5132; 1369 An awl formed from a s-size metapodial broken obliquely, leaving the distal end as the handle. A fine tip was shaped at the end. Poor surface condition precludes identification of working technique. L70.5mm, W21.7mm, T13.3mm, tip L25.0mm.

5142; 1369 A shaft fragment from a point with the tip end missing. The piece is made from a lbsf splinter. The tip was shaped by grinding and some faint cross-scratches survive from manufacturing. The tip is polished. L49.5mm.

5145; 1369 A piece of unworked antler.

5146; 1369 A lump of bone with one end shaped down to a thin round section by scraping. The shaft left by shaping was then cut through and snapped to remove a possible peg. L37.8mm, W10.0mm, T7.5mm, D of shaft stub 4.5mm.

5214; 1369 An awl made from a s/g metatarsal; the distal end forms the handle. The obliquely split shaft is shaped to a fine tip. The surface has suffered from erosion but some axial scratches from working survive. L109.8mm, W20.3mm, T13.3mm, tip L45.1mm.

5351; 1369 A peg tapering slightly along its length; faceted appearance from working, scraping. Longer than most other pegs, L30mm, D4.0mm.

5486; 1369 A point tip, with some fine axial scratches partially removed by polish. L13.4mm; lbsf.

5487; 1369 A faceted point tip. No working evidence survives. The bone has a smooth surface. L19.6mm, tip L10.3mm, D4.3mm; lbsf.

5530; 2210 A small peg with a faceted shaft. It is polished across one end and the shaft tapers towards the other end. L13.4mm, D5.5mm; lbsf.

5534; 1369 A small peg which tapers to one end. There are facets along the shaft, and a burr on one end where it has been cut across. L15.2mm, D4mm; lbsf.

5535; 1369 The tip of a pin or needle, rounded in section, smooth with a slight polish. No working evidence visible. L24.1mm, D2.3mm; lbsf.

5536; 1369 A fine point tip fragment showing cross-working, possibly from grinding. L22.7mm.

5537; 1369 The tip of a point. Some oblique working is visible but the piece is burnt which has removed or obscured much of the evidence. L10.7mm.

5538; 1369 A cylindrical peg showing faceting on the shaft and burrs on both ends. L6.6mm, D4.2mm.

5540; 2235 The tip of a point; the fineness of the piece suggests it is a possible pin. It is highly polished so no working marks are visible. The point is round in section. L18.9mm, D3.2mm; lbsf.

5543; 1369 The tip of an antler tine with faint axial scratching, possibly from paring down tip to a finer point. End of tip slightly blunt. L29.5mm.

5567; 1369 A shaft fragment of a pin or needle with the tip missing. Polished surface, no working visible. L19.3mm, D2.5mm.

5569; 1369 A small peg intended for use in a larger object. Slight faceting around the shaft. No polish on the peg. L8.3mm, D4.1mm; lbsf.

5571; 2211 A small round bone peg, meant to form part of a larger object. The peg shows faceting around shaft with both ends polished. The polish may show the peg

was once part of an object now broken. L13.3mm, D3.8mm.

5842; 2211 A collection of 32 small chips of whale bone, derived from chopping up whale bone. The chips are similar to wood chips and often have a curve or curl to them. A couple of the chips are from the bone's surface; the others are from inside. One of the surface chips also has a chop-mark that did not cut as deep.

5845; 1369 A small lbsf perforated through the end to expose the medullary cavity. The cancellous bone has been smoothed off to leave a possible hafting hole. L25.9mm.

5846; 2350 The end of a c-size lbsf that suggests that it has been perforated at its end but the fragmentary nature of the piece makes this identification uncertain. Possibly hafted? L49.5mm.

5911; 1916 Two fragments of c-size metapodial. Although these do not refit, they appear to be part of the same piece. It has an axial hole in the fused proximal end. The hole is the same size as the medullary cavity and is sub-angular in shape. This could possibly have been used for hafting. The tip end of the piece is missing. L91.7mm.

5912; 2211 A collection of 14 small chips of whale bone from chopping whale bone. The chips are similar to wood chips and often have a curve or curl to them.

5913; 2211 An awl manufactured from a s-size metacarpal. The awl is broken into 3 pieces that refit. The distal epiphysis is fused and forms the handle, with the bone broken obliquely midshaft and a point shaped on the end; the tip of the point is missing. No working or wear marks survive on the eroded surface of the bone. L87.1mm.

5921; 1369 A s-size lbsf with a few faint cross-scratches that could relate to working. L42.4mm.

5928; 1369 A very eroded lbsf splinter, the end of which appears to be pointed but the highly eroded state precludes confirmation that this piece is worked.

5961; 2211 A flat elongated triangular piece of bone removed from a c-size scapula blade. The corners are rounded and the edges have been smoothed and rounded. L85.4mm, W28.6mm.

5155; 1369 A lbsf cut around and snapped off; the other end is broken through. In general appearance this is a bead but this is uncertain. L18mm, D9mm.

5291; 1369 A small disc with a perforation in the centre. The perforation is made from both sides. D27mm.

5310; 1369 A fragment of shed antler, the head of which has been shaped to a rounded dome-like structure. The other end may have been cut through but it is heavily abraded and the overall form is uncertain. L66mm.

5136; 2197 A splinter of a lbsf shaped into a fine round-sectioned pin. At one end longitudinal scratches from shaping; probably scraped axially. L67mm.

5147; 2211 Two fragments of a c-size rib, split axially. A rough point at one end but the poor condition of the bone surface means it is impossible to determine if the point was manufactured or the result of breakage. L148mm.

Phase 9 – House 401

3715a; 1598 Several pieces of unworked antler including 3 tines from a crown that refit and 32 small beam pieces. Note these may not all be from the same antler.

3715b; 1598 A red deer antler pick with the brow tine forming the pick point. The brow tine is worn down and smooth at the tip. The antler is shed and the burr mostly present.

3733; 1624 A flat piece of whale bone, L16.4mm, W80.9mm, T15mm. Most of the cancellous tissue has been removed leaving the denser surface tissue. This appears to be part of a blubber mattock but any notches or hole for hafting are missing.

3768; 1311 A blunt point fashioned from an antler tine. The tip shows several axial and oblique scraping, and possibly grinding, marks. The tip is round in section. L92.8mm.

3769; 1690 A section of antler tine, L175mm, D26.3mm. One end has been squared-off, possibly by groove-and-snap, but later wear has smoothed the bone and obscured the grooving. The other end has had a slot 28.5m deep and W6.5mm cut into the end to leave 2 square-ended prongs *c.* T6.5mm. It is unclear how the slot was made but on one side the antler surface has been smoothed by cutting/chopping around the surface next to the slot. At the end away from the slot a deep notch has been cut into the antler tine just above the end of the object. The notch which was made by chopping is asymmetrical, being steeper on one side than the other; the notch is 4.5mm deep. The object is generally smooth but the surface condition is variable.

3772; 1705 A blunt point, L65mm, shaft W9mm, T6mm. This is a curved point, made from a splinter of rib. A few faint oblique scratches near the tip.

3775; 1705 A broken-off antler tine tip. The surface is very smooth and the tip is blunt with the cancellous bone exposed. On the tine there are several fine axial scratch-marks that may be from scraping, and a few cross cut-marks. L57.2mm.

3777; 1690 An awl formed from a s/g metapodial, L82mm, shaft W13mm. The shaft is obliquely split from the anterior face and a lightly polished fine tip is shaped at the end. Oblique grinding can be observed on the anterior face of the shaft. The distal articulation is unfused but complete and the epiphysis is now loose, suggesting that it was only recently fused prior to death.

3779; 1705 An antler tine tip, smoothed and with some scratches but this could be natural.

3780; 1690 A blunt point, L85mm, max. W11mm, T7mm. This is a quite highly polished point, becoming increasingly polished towards the tip, which is flattened and slightly wedge-ended. The handle end is broken. Multidirectional scratches are visible on the point;

they are mostly cross-scratches on the shaft and axial towards the tip.

3781; 1690 An awl made from a s/g metapodial, L76mm, tip L43mm. The awl is split axially with a fine point shaped on the end. There are multiple axial scraping marks and cross-marks, with a lightly polished tip. The distal articulation is unfused, but complete and intact.

3782; 1690 A polished antler tine but no other working or wear is visible and the polish could be natural. A patch of black staining on the tine shaft of unknown origin.

3817; 1690 A split antler tine but no working or wear marks evident.

3820; 1624 A point, L111mm, shaft T7mm, max. W21mm. This c-size lbsf is fashioned into a point with axial and cross working. A lightly polished tip, with a tip length of *c.* 36mm.

3822; 1690 A complete point, L55mm, shaft W7mm, shaft T4mm, max. W9mm. The point is made from a split s-size lbsf which has been shaped to a round-sectioned tip. There are extensive axial and oblique working marks.

3826; 1311 A blunt point shaped on the tip of an antler tine, L7.91mm. The tip has been shaped to a blunt point with the cancellous tissue exposed on the tip and part-way down one side of the shaft. There are also a number of multidirectional scratches on the shaft.

3854; 1705 A point made on the end of a small splinter of s-size lbsf, L55mm, W6mm, with tip W2.5mm, tip T2.1mm. The point is fashioned into a long (*c.* 30.3mm) slightly curved, highly polished, fine tip. Cross-ground scratch-marks are mainly evident at the shaft/tip interface.

3859; 1690 A piece of worked c-size metapodial, L22mm, max. W24, T13mm. This is a small fragment from a larger piece. The proximal articular end of the bone has been removed and the end smoothed flat; most of the rest of the bone is missing. The natural hole on the posterior surface of the bone appears to have possibly been enlarged.

3860; 1690/1624 A point L78mm with a triangular-sectioned shaft W13mm, T8mm. The piece is slightly curved along its length and has a fine tip which is rounded in section. The tip is polished with oblique working marks partially obscured by the polish.

4241; 1311 A piece of unworked antler.

4250; 1690 A point, L65mm, shaft W6mm, max. T4mm. This is a slender lbsf, with the edge of the distal articulation surviving. One edge of the shaft is uneven. The tip is quite blunt with some polish on it, although the condition of the bone is poor.

4320; 1311 A complete, highly polished pin, L65mm, max. D4mm. The pin is straight-shafted and round-sectioned for 47mm from the tip end, which is fine. The other end is more rectangular-sectioned. The head has a flat end, W3.5mm, T3.1mm. The piece is highly polished all over.

4323; 1698 A broken awl, L57mm, mid-shaft W9mm, T8mm. It is made from the shaft of a metapodial, split obliquely from the anterior face which abruptly tapers into a short, fine-tipped point. The whole piece is polished with faint evidence for primarily axial scraping scratches towards the tip. The other end is broken. The bone's surface has been worn away at the handle to show the porous inner bone.

4350; 1933 A piece of whale bone broken into 2 refitting pieces. The object is roughly rectangular in plan with a moderate curve and a thick, sub-rectangular section. One end is broken with an oblique fracture. The fracture passes through a hole made through the bone, drilled from both sides. The bone appears too thick for a blubber mattock and may have been part of a composite object. L185mm, W94.5mm, T42.9mm.

4566; 1933 Two large pieces of whale bone, which refit. The refitted piece is roughly triangular, L200mm, T50mm.

4583; 1311 A roughly circular delphinoid's bone disc, max. D65mm, min. D45mm, T7mm. The disc has an unevenly worn edge, making the original size and shape difficult to discern.

4618; 1311 A piece of unworked antler.

4623; 1311 A piece of unworked antler.

4654; 1311 A point, L79mm, mid-shaft T7mm, max. W17mm. The point has poor to average surface condition and is broken. This is a lbsf tapering to a very slightly curved fine tip *c.* L31mm. It is difficult to see any wear marks due to the eroding bone surface.

4661; 1311 A probable blunt point, L79mm, mid-shaft W13mm, T7mm. This is a robust but broken piece, whose very tip is missing but probably blunt. Oblique grinding on the posterior face near the tip is visible, with increased cross-grinding further down the shaft.

4662; 1311 A s-size metacarpal fashioned into an awl, L65mm, mid-shaft T8mm, max. W14mm. The awl is split axially from the proximal articulation (of which over half is still visible). The other end has been fashioned into a point, one side of which is straight. The other side curves down to form a fine tip. Polish along the edges of the tip and on the posterior face.

4663; 1311 A point, L64mm, max. W9mm, T6mm. This is a lbsf of almost rectangular section, which has been fashioned into a fine, round-sectioned tip. The tip is quite highly polished. Slight polish is also evident along the edges with a few scratch-marks seen around the tip/shaft interface, mostly oblique grinding scratches.

4665; 1311 A lbsf used as an expedient point, L127mm, max. W21mm, T8mm. This splinter has very straight edges that converge to form a sharp tip. Moderate polish is present on the edges and tip. A few axial scratches towards the tip end.

4672; 1311 A sub-circular perforated bone disc, D42.6mm, between T2.0mm and T5.1mm. The perforation is irregular, semicircular on one side and triangular on the other; the max. diameter of the hole is 8.5mm. There are several scratches on the bone surface but their origins are not clear.

4680; 1311 An unperforated sperm whale epiphyseal disc from a vertebra. The disk is not fused. The denser outer surface is in poor condition with the surface lost and the cancellous tissue exposed. In addition it is blackened, probably from burning. No evidence of working. D151.5mm, T20.8mm.

4681; 1311 A sub-triangular piece of c-size lbsf with a hole near the thinner end. The hole is bored from both sides with an hourglass section. Circular scratches in and around the hole suggest it was drilled with a pointed borer, possibly a flint. The wide end of the object is almost square-ended, with a spatula-like appearance but much thicker. One surface of the wide end has a high polish with faint axial scratches; the edge is chipped and battered. The piece tapers to a blunt end with slight shoulders that start near the hole. This appears to have been some form of scraping tool that may have been hafted through the hole. L51.7mm, WT26.2mm, T6.7mm, Dhole 3.20mm.

4683; 1311 An epiphysial plate from the vertebra of a small cetacean (Delphinidae). A hole has been made through the centre of the disc, D79.1mm, T4.5mm, Dhole 12.4mm.

4709; 1311 A round-ended spatula, L105mm, mid-shaft T3mm, W19mm. Made from a split c-size rib, the piece has straight parallel edges. Wear polish is present on both surfaces of the tip, and on the shaft edges and surfaces, presumably from handling.

4723; 1311 An antler tine tip which has been shaped to a blunt point with a shallow convex end. Shaping is by axial working and has left a facet around half the tine to shorten and shape the tip. L80.0mm, WT6.4mm, TT5.1mm.

4728; 1311 An awl manufactured from a lbsf, L91mm, shaft W11, T7mm. This is a heavily worked tool, with a long round-sectioned tip and a fine point. The tip is highly polished, probably through use. The piece is polished all over with numerous manufacturing marks. Towards the tip are many axial scratches from scraping, overlaid with multidirectional scratch-marks. On the medial face there are numerous cross and oblique grinding marks, whilst heavy cross-grinding is evident on the edge towards the handle end.

4770; 1698 A complete awl, manufactured from an obliquely split s/g metapodial, L79mm, shaft W10mm, T8mm. Polished all over, The tip is fine *c.* L25mm. A few multidirectional marks on the shaft. The distal articulation is complete and intact.

4776; 1311 A complete point, L84mm, shaft T4mm, max. W15mm. This is a lbsf worked into a fine, almost triangular-sectioned tip, quite highly polished with a very few axial scratch-marks, partly obscured by polish.

4801; 1311 A broken expedient point, L54mm, mid-shaft W6mm, T6mm. This is a lbsf splinter, with an almost square-sectioned shaft. The shaft tapers from the edges to form a very fine, narrow tip *c.* L27mm. Extensive polish is seen on the tip and on the edges around the tip. No working away from the tip.

4872; 1311 A broad-ended c-size scapula tool, L225mm, max. W119mm, T15mm. This has smoothed edges with small rounded serrations on its end; the spine has been removed and there is some polish over the break. Wear polish and scratches are visible along the caudal side and polish is present on the side edges of the tool.

5151; 1311 A piece of unworked antler.

5217; 1311 An antler handle that has broken axially exposing the internal structure. One end of the handle contains a V-shaped internal cavity in the cancellous tissue which would have contained the inserted tool. The outer surface at the tool end has been pared down by chopping and cut across square. The butt end is mostly missing but may have been rounded. The axial breakage may have been related to the insertion of a tool into the handle applying excessive force. L114.7mm, Dshaft 23.2mm, Dhole 11.0mm, depth hole 24.0mm.

5243; 1690 A fragment of a probable pointed spatula made from a s-size lbsf. Only the tip survives. No working evidence but there is slight polish at the tip. L48.0mm, W9.0mm.

5293; 1698 An awl formed from a s-size metapodial, with the fused distal articulation forming the handle. The shaft is obliquely split and the tip is missing. The surface is eroded and condition precludes detailed analysis. L83.9mm, W18.3mm, T10.8mm.

5294; 1698 An unfused s/g metapodial used to make a short awl. The distal end of the bone forms the handle and the bone has been split by smashing. The method used to shape the tip is uncertain but a hint of faceting may indicate grinding. L55.0mm, tip L11.0mm, WT5.0mm, TT2.7mm.

5297; 1311 A s-size distal metapodial shaft split obliquely to form an awl; the point shaped by axial scraping. The tip and shaft show polish. The distal epiphysis is unfused. L77.2mm, W18.8mm, T12.3mm, tip L32.1mm.

5309; 1311 A lbsf with moderate polish on one end. Incomplete condition precludes identification.

5403; 1311 The tip of a point. The tip is fine and shaft is flat in section. No working evidence survives but the tip is polished. L28.7mm.

5484; 1311 A tip fragment from a pin or needle, sub-rounded in section. L28.9mm, D2.8mm.

5527; 1311 A small peg that tapers slightly; it is polished across one end while the other is rounded. The shaft is faceted. L14.3mm, D4.0mm.

5528; 1311 A small flat plate of bone, about a quarter of a full circle. A line of three holes runs along one of the broken edges. The holes are all made from one side, which is the same for all. The holes were probably made with a pointed borer. L13.5mm, T0.9mm, Dholes 1.2–1.4mm.

5529; 1311 A cylindrical peg, slightly more crudely made than most other pegs. Some faceting and one end is slightly convex. L10.3mm, D5.3mm.

5547; 1311 The spine of a c-size scapula. The broken edge has been smoothed and a shallow notch made in it.

The notch has cross-scratches possibly from grinding. There are also a number of oblique cut-marks on the surface that may relate to butchery. Notch L7.4mm and depth 1.7mm.

5550; 1311 A piece of antler beam near the crown where 2 tines branch off. One tine removed by groove-and-snap, the groove made by chopping. The other tine has been removed but then smoothed and polished over the tine stub. Why one is polished and the other is not is unknown: it may be that the smoothed and polished area was a working surface or that the grooved tine was removed to utilise an old tool as raw material.

5565; 1311 A fine point tip, highly polished with axial working marks. L13mm.

5854; 1705 A piece of c-size tibia shaft forming a long flat plate of bone, broken at both ends. Probably from the shaft of a point or spatula. The edges of the piece have been extensively worked by cross-grinding to shape and smooth them. It is unclear how the bone was split but the slightly uneven breaks along the edges suggest it was by smashing. L96.6mm.

5891; 1311 A small almost pin-like point made on a lbsf but only the tip is shaped and smoothed. A few isolated fine cross-cuts on the shaft and the tip is smooth and lightly polished. L49.7mm.

5894; 1690 A piece of antler, broken off a larger object. The piece appears to be an L-sectioned splinter from a cylindrical or oval object. The surface has been smoothed and the inner cancellous tissue has been largely removed. This may have been a sleeve. Halfway along the piece is an area of damage on one side of the L-section. It is not clear if this is damage or working but it could relate to a possible perforation that does not survive. At one end the piece has been cut straight across and the end smoothed. Just back from this end, and running parallel to it, are a number of chop-marks that would appear to relate to manufacturing except they are very fresh and not smoothed off at all. This would suggest either the piece was not cleaned off during manufacturing or smoothed from wear or the chop-marks relate to use or repair. L70.2mm.

5910; 1705 Two axial fragments of a small c-size metapodial that refit. The proximal end is fused and has been perforated axially; the incomplete remains of the hole suggest an angular, possibly sub-square hole. Some cross-grinding on the shaft but no evidence regarding the tip end. L106.6mm, H17.5mm.

5930; 2489 A chip of antler probably removed by chopping the antler. It is thin and not dissimilar to a wood chip. L23.0mm.

5946; 1933 A fragment from the proximal end of a c-size metapodial. The proximal surface has been perforated, possibly for hafting, and the surface of the bone shows cross-grinding. L45.9mm.

5962; 1311 A fragment from the tip of an antler tine. The tip has been shaped down to a blunt point with the cancellous tissue exposed and the surface smoothed. L35.3mm.

5964; 1793 A piece of unworked antler.

5970; 1311 A piece of c-size lbsf with a small area of articular surface at the end. The shaft has been extensively shaped. First the bone was split (uncertain how) then the shaft was smoothed and rounded to an oval section by axial and oblique working. The end was then grooved around, in a clean and smooth groove and the smoothing of the groove has blended it into the smoothed shaft. The bone has snapped through at the groove but it is uncertain if this was deliberate as the broken edge has not been cleaned and smoothed like the rest of the bone, which suggests it was not worked or used after this break. The groove may have been a part of the piece rather than a deliberate snapping point. L42.8mm.

5975; 1690 The fine tip of a point manufactured from a s-size metapodial. The tip has a light polish and faint axial working scratches possibly from scraping. L48.0mm.

5209; 1311 A small peg with a notch at the fatter end. This may be part of a larger object. L21mm.

5302; 1311 A split c-size rib; the interior cancellous bone has been removed and the end rounded. There are fine scratch or cut-marks running across the bone mainly on the curved outer side. L90mm.

5288; 1311 A polished and shiny plate of possible pig tusk. The piece is broken and at one end a hole has been drilled through the piece where it is broken; a quarter of the circumference of the hole remains. At the other end the piece has a groove cut halfway through the piece, and the piece has broken at this point. L35mm.

5240; 1311 A fine pin broken into 2 pieces. The shaft is sub-rounded in section and has been worked to a point axially. L49mm.

5204;1311 The tip of a point with the shaft widening rapidly. The tip has been worked axially. L25mm.

Phase 9 – House 801

3379; 832 A broken broad-ended c-size scapula tool, L250mm, shaft W44mm. The tool is fragmented, but the spine has been removed and the broken edge smoothed over. No sign of working or wear on the blade end but very little of the end survives. The glenoid has been cut back on the lateral and medial sides to leave a sub-rectangular sectioned end.

3393; 822 One large lump and several smaller fragments of sperm whale skull.

3394; 832 A piece of unworked whale bone.

3395; 832 A piece of unworked whale bone.

3396; 832 A piece of unworked whale bone.

3397; 832 A piece of unworked whale bone.

3408; 832 Two large lumps and several smaller fragments of unworked whale bone.

3492; 1382 An awl made from a s/g metapodial, L61mm, W12mm. This is quite a short awl, with a fine tip, obliquely split on the proximal end. The tip is quite

highly polished as is the shaft. The distal articulation is intact and forms the handle of the tool.

3637; 822 A blunt point, L117mm, max. W15mm, tip W4mm. This is made from a c-size lbsf; there are cross-scratch-marks around the tip and down one of the broken edges. The point's end is fashioned into a flattened, rounded tip.

3506; 1150 A tool manufactured from a tine from an antler crown, with a small side tine attached. The side tine has been broken off; this is a modern break and the tine refits. The main tine has been cut from the beam by groove-and-snap; the end has then been cleaned off. The tip of the object has been worn preferentially on one side, suggesting use in a standardised way. Tine L240mm.

3507; 1150 A blunt red deer antler tine point, broken into 9 refitting pieces and 6 small fragments. The tip is smooth and slightly rounded; at the handle end the tine has been cut through, probably by chopping, and then smoothed off. Due to the fragmentary nature no measurements were possible but the overall length is *c.* 200mm.

3508; 1150 A shouldered point, L149mm, max. W29mm. The point is made from a split c-size lbsf and has a shoulder on one side of the point where a fine tip has been shaped. The point is covered by extensive cross and oblique grinding scratches on the shaft and tip.

3509; 1150 An antler tine tip, L59.6mm, removed by groove-and-snap. The surface is smoothed and has a number of fine multidirectional scratches. The tip is blunted and damaged.

3513; 1150 A flat plate of blue whale bone, roughly rectangular with squared-off edges. The plaque is L95.8mm, W69.4mm, T13.1mm. This piece is made from the dense outer surface bone with the cancellous bone removed. This piece is not like a blubber mattock: it is smaller and better made and has no evidence for hafting or mounting on a handle.

3515; 1150 A point, L60mm, max. W14mm. This point has a flat-sectioned shaft and a fine tip. Working evidence, scratches, along its edges and at the tip.

3727; 1150 A fine awl, L59mm, max. W8mm, T4mm; s-size lbsf. This has a fine point tip. The tool is polished on its tip with lighter polish on the shaft.

3730; 1150 An expedient point, made from an obliquely split c-size rib. The point is L124mm, shaft T5mm, max. W32mm. This has a fine, polished tip. There are no obvious working marks but the tip and shaft edge are smoothed and lightly polished. The handle end utilises the natural end of the bone.

3739; 1150 Three fragments of an unworked antler tine; there is damage to the tip but this may be natural. In addition, a tip fragment from another tine.

4337; 1150 A small, circular-sectioned bone peg, L12mm, shaft D4mm. Both ends of the peg are rounded and polished. Three-quarters of the surface is covered in black, charred residue.

5292; 1150 A splinter of s/g metapodial probably split by smashing. The point tip has been shaped by axial and oblique scraping. The tip end is missing with moderate polish at tip end. L70mm.

5296; 1150 A fragment of s-size radius. The surface is polished but there is no evidence of manufacturing. The piece is made from an axially split bone but there is no evidence of how this was done. L45mm.

5570; 1150 A finely polished point tip formed by axial scraping along the edges of a splinter of bird long bone. L25mm.

5960; 822 A splinter from a whale bone blade. The piece is broken off a larger object but at one end has a bevelled edge with a smooth V-shaped section, and scratches, probably from wear, running back from the edge. L68.5mm.

5965; 1150 A shaft from a bone tool; the tool is made on a split lbsf obliquely ground to shape the shaft. Both the tip and the handle are missing so the tool type cannot be identified. L46.5mm.

5967; 1150 A fragment of c-size scapula blade with rounding and polish on the end of the blade and cancellous bone exposed. L3.25mm, W4.11mm.

5295; 1150 A small subrounded unperforated bone disc broken into 2 pieces. D20mm.

5301; 1150 A large c-size rib split axially into a thin strip. The sides have been shaped and smoothed. Both ends are missing. One end looks like a point but this is a natural break. L136mm.

Phase 9 – Northeast area

3811; 1765 A large rectangular slab of sperm whale skull 270mm × 190mm × 70 mm. In the middle of one side is a circular depression D90mm and 10–20 mm deep. This depression appears to be burnt and is coloured black. It would appear that the whale bone has been used to carry a fire, possibly as a lamp. If the bone was rich in oil, however, it is unlikely that the fire would have stayed contained in the depression burnt into the surface. This may suggest that the bone was used after it had largely been degreased, either naturally or deliberately.

4303; 1764 An antler tine with polish at the tip. The tine had been removed by groove-and-snap. L173.0mm, D31.2mm.

4309; 1790 A wedge-shaped piece of whale bone. The wedge has parallel sides 31mm apart and its end is slightly rounded, and smoothed with occasional chips. The wedge is L125.6mm and the butt end is irregular and chipped.

4313; 1790 A broken, rounded, broad-ended spatula tool, L108mm, max. surviving W50mm, max. T5mm. The tool is broken longitudinally down one edge, with the other edge curved and heavily worn down. Multidirectional scratch-marks can be seen, although these are predominately axial, on the shaft and end.

4348; 1790 A piece of unworked whale bone.

4625; 2309 A piece of unworked antler.

5016; 1790 A piece of unworked whale bone.

5880; 1790 A red deer antler tine with a chipped and damaged tip and a number of small cut- or chop-marks across the tine just back from the tip on one side, inner curve. L100.8mm.

5953; 1790 A c-size lbsf with one edge showing a number of scars from where chips have been removed, probably deliberately. L81.6mm.

Phase 9 – Southeast area

4739; 416 An antler tine with a smooth rounded tip. The outer side of the curve of the tine has a series of scratches; these are in 2 groups at different angles and do not appear natural but appear to be the result of use. L130.6mm.

5566; 1680 A possible point, this has an eroded surface that means that the identification is only based on overall shape and not on any working or wear marks. L38.7mm.

5847; 1680 A fragment from the proximal end of a c-size metapodial. The proximal surface has been perforated possibly for hafting. Some cross-grinding on the bone shaft surface. L47.4mm.

5881; 1680 The remains of a shaft from a probable point with both the tip and handle end missing. Made from a s-size metapodial with the shaft broken obliquely and the point shaped on the break. Oblique and axial working scratches are visible. L48.5mm.

Phase 10 – Area C

2004; 906 A c-size rib with a rounded spatula shape at one end. No working or wear visible. L141.5mm, W20.3mm.

2010; 904 The highly polished and blunted tip of an antler tine. The tip has been removed from the tine by groove-and-snap. The groove has been cut in a series of short grooves that together combine to circle the tine. L17.4mm, D10.5mm.

2011; 902 The tip from a round-ended spatula, the piece is made on a flat piece of split s-size lbsf. The tip and edge show cross-working marks, possibly from grinding. L28.9mm, WT10.2mm.

2014; 902 A short square-ended spatula with a chisel-like appearance, this does not have a handle but tapers rapidly to a stub end. This piece appears to have the potential for slotting or hafting into a handle. The piece is polished all over and cross and oblique scratches from working may represent both grinding and scraping. L39.2, WT19.4, WS 11.7mm; c-size lbsf.

Phase 10 – Forecourt

2002; 1002 An awl manufactured by breaking a s/g metatarsal obliquely and shaping the broken end to a pointed tip. There are extensive axial and oblique working marks near the tip, and the tool is smooth and lightly polished all over. The bone is broken into 2 refitting pieces. L81.3mm, tip L30.9mm.

3365; 773 A peg, L16mm, shaft D 2mm. The peg is slightly polished and very slightly curved. The ends of the peg are flat.

3382; 840 A large piece of humpback whale phalange, L180mm, W103mm, T71.4mm, oval in section. The fatter end has been cut off square while the opposite end contains a conical depression, almost pointed at the bottom and 46mm deep. On one side of the bone is a second depression, 68mm × 46.5mm × 12.2mm deep. The second depression shows extensive damage from what appears to be pounding. It would appear that this tool might be a sort of mortar with a range of surfaces/depressions.

3401; 889 A possible antler pick in six pieces. The brow tine is broken short, while the bez tine is long and curved. The end of the bez tine is damaged and smoothed, possibly through use. The antler is shed and the burr complete. No measurements are possible in its current state.

3409; 1119 A piece of unworked antler.

3454; 1303 A cattle scapula shovel, L238mm, W112mm at the end, min. shaft W49mm. The tool's whole surface is polished, with the lateral ridge deliberately removed. The broad end, polished through use wear, is concave and curved, with the cranial side higher than the caudal side. The piece has been worn down to the cancellous bone on the edge of these 2 sides. The glenoid has been cut down on its lateral side.

3609; 773 Three pieces of red deer antler beam, 2 of which refit. The 2 pieces that refit have an area of chop-marks on one side. The single beam fragment has the stub where a tine has been removed and smoothed off; it also has patches of chop/cut-marks. These beam fragments could have been handles for antler picks but this cannot be concluded definitely. L220mmm.

3676; 813 An awl, manufactured from a s/g metapodial, L86mm, tip L58mm. The point is split obliquely down the length of the bone to form a long tip. The tip is exceptionally fine and polished with oblique and axial scraping scratch-marks along the tip shaft. The fused distal articulation is completely intact.

3684; 1539 A pointed bone spatula, shaft and tip; the surviving L67mm, mid-shaft T4mm, max. W17mm. The piece is polished all over and manufactured from a split c-size lbsf. The tip is flat and comes to a near point. Multidirectional scratch-marks can be seen on each face but the primary working appears to be oblique.

3963; 773 A piece of red deer antler tine, possibly the brow tine, that shows extensive smoothing, particularly on the inner curve of the tine, cross-scratching and a blunted and damaged tip. The tine may be from an antler pick but in its fragmentary state it is impossible to be sure.

5340; 1539 A smoothed and polished antler tine tip with a series of fine cross-scratches along the convex edge of the tine at the point of max. curvature. The origin of the scratches is uncertain. L13.24mm.

Phase 10 – House 1370

3511; 1205 An awl, L74mm, W13mm, tip L37mm. The s/g metapodial is split obliquely from the side to form a fine tip at its proximal end. Multiple axial ground scratches are noticeable running along the longitudinal axis from the tip. Additionally a few cross-scratches can be seen all round the shaft/tip interface.

3753; 1646 A large irregular lump of cancellous whale bone, unworked but evidence of burning at one end. Possibly fuel.

3761; 1644 A splinter of antler with cross-grinding on one edge.

3762; 1644 A broken point, L36mm, max. W9mm, T3mm; s-size lbsf. The point has a fine tip and is broken across the shaft. Faint axial and oblique scratches are visible near the tip which has a light polish.

3767; 1709 An amorphous unworked lump of cancellous whale bone.

3788; 1644 An antler tine with the tip removed by groove-and-snap. No other signs of working or wear so is probably manufacturing waste. L18.8mm.

3790; 1644 An awl, L67mm, shaft/tip interface W11mm; s/g metapodial. The tool is split obliquely, leaving a fine point L43mm, round in section and highly polished. Mostly axial ground scratch-marks are visible along the tip, with the distal articulation intact and complete. The end of the tip is broken off.

3796; 1644 A red deer antler pick with some skull still attached. The brow tine is straight and forms the point of the pick. The pick end is smoothed with cross-scratches across its end. The bez tine has been removed and the beam is broken just above the bez tine.

3803; 1644 A s-size metapodial awl, L69mm, shaft W11mm, T8mm. The shaft is split obliquely from one edge and shaped to form a fine tip, *c.* L31mm. The tip is moderately polished, with many scratch-marks visible on the edge of the shaft, including cross-grinding and axial scraping.

3856; 1623 A split c-size rib spatula with a rounded end, L55mm, mid-shaft W15mm, T3mm. The spatula is relatively narrow, fashioned to form a quite thin and rounded tip, with polish surrounding the tip, as well as down the rounded edges. Possible very faint cross-grinding marks.

3863; 1644 The broken-off tip of an antler tine, smoothed but no definite human working or wear.

3866; 1644 A fragment of a humpback whale bone blade. No remains of any potential hafting are present. One side of the bone is the dense outer bone while on the other the cancellous bone is mostly removed. L99.5mm, W61mm, T15.6.

3870; 1693 The tip of a point, L32mm, max. W9mm, T6mm; s-size lbsf. The piece is axially worked.

3871; 1644 A point made from a shag ulna, L61mm, shaft W5mm, T5mm; lbsf. The shaft is broken obliquely and the point shaped on the end. The bone is slightly curved and the tip has been damaged but it has continued in use, with polish forming on the broken surface of the tip.

3872; 1644 A s/g metapodial point, L53mm, max. W12mm. The piece consists of a bone fragment broken at both ends, comprising a small shaft and the beginning of an obliquely split tip, starting 32mm from tip. The point is axially worked and moderately polished all over and could possibly have been an awl.

3873; 1644 A complete bone bead/pendant, L25mm, max. W11mm. A flat, roughly triangular pendant, with one straight edge, a round-cornered square end, and a curved side. Centrally, *c.* 3mm from the square end, is a circular perforation, made from both sides by drilling with a pointed object. The piece is highly polished with a few scratch-marks on both sides below the perforation.

3903; 1776 An antler tine tip fragment with scratches but these could be natural.

4193; 1644 A broken piece of antler tine with the possible remains of groove-and-snap at one end. L154mm.

4215; 1916 A block of whale bone broken on one edge; the break has occurred where a sub-circular hole has been made through the bone. The hole is made from both ends and passes through the denser outer bone and the more porous cancellous bone. A number of chop and hammer marks on one of the faces of the bone. The bone appears too thick to be part of a blubber mattock but may be part of a larger composite object. L131mm, W 66.4mm, T36.2mm, Dhole 28.6mm.

4259; 1644 A bead/pendant, L18mm, W32mm, T18mm, formed from a skull fragment/mastoid process. This is an oval-shaped piece, with a central circular perforation made from both ends with an hourglass section. Hole D6.3mm. The bone surface is smoothed and polished all over.

4266; 1693 A lbsf fashioned into an awl. Broken, L157mm, shaft W15mm, T6.6mm. This is a slim wedge-shaped piece, smoothed all over surfaces, with rounded edges with a slight polish. The tip is fashioned to a fine point, whilst the non-tip end is broken. On one face, cross-grinding marks are evident running along the length of the shaft.

4289; 1205 A lbsf split to form a flat plate and shaped by cross and oblique grinding. The handle end is squared across and has 2 notches 15mm up the shaft from the handle. The notches are finished by cross-grinding. The tip was originally rounded but is broken leaving a third of the original tip. Polish over the break shows it continued in use. L111.9mm, W21.3mm, T6.2mm, WT15.6mm, notches *c.* 2.0mm deep.

4290; 2138 A red deer antler broken into 8 main and several minor pieces that refit; the breaks are modern. The base is missing, first tine is complete, the second tine is missing via an old break, the third tine is missing and there are a series of chop-marks where it has been removed, one of 2 crown tines survives. The piece does not appear to have been used but the chop-marks to remove the third tine demonstrate manufacturing. *c.* L500mm.

4299; 1900 A point tip fragment, L33mm, max. W10mm, T7mm. The tip fragment is round-sectioned. A few

scratch-marks are evident, including 2 shallow grooves running around the tip on one side near the tip, and one situated on the other side.

4300; 1205 An expedient point, L43mm, mid-shaft T6mm, max. W7mm. This is a point made from a lbsf shaped into a triangular-sectioned tip. The tool is quite polished at the tip and smooth all over.

4304; 1205 A point fragment, L37mm, max. W11mm, T6mm. This is the tip fragment of a point, the shaft being trapezoidal in section, tapering to a quite fine round-sectioned tip, which is broken longitudinally in half up to 7mm from the tip. Slight polish can be seen as well as oblique grinding over the bone's surface. Grinding has created a series of facets around the tip.

4325; 2159 An awl, manufactured from a s/g metapodial, L54mm, W13mm. The shaft is obliquely split from the anterior face and has a fine point. It is lightly polished with a faint groove from multiple scratch-marks seen running down the posterior face of the tip. The distal articulation is unfused and missing.

4330; 2152 A bone bead/pendant, L31mm, W10mm, T9mm. This is a rectangular-sectioned hollow bead, with the perforation being oval. Just below one end is a notch running across one face, *c.* W2.5mm. Just below the other end are 4 small notches running horizontally across the edges, 2 on one edge and one on 2 other edges. Polish is seen all over the bone surface, especially at the ends and along the edges.

4336; 2138 A curved and nearly complete pin, L96mm, mid-shaft W4mm, T2mm. Polish on the shaft becomes increasingly evident towards the tip end. The head is splayed and it may be this piece has exploited the natural shape of a bone such as a fibula.

4341; 1205 A point, L33mm, max. W10mm, T5mm. This is the tip fragment of a point, the tip end being exceptionally fine, with polish on the edges and on one face. The fragment is from a lbsf and is in good condition Multidirectional scratches are seen, mostly through axial scraping and grinding on the polished surfaces. On the non-polished side, 2 exceedingly shallow grooves can be seen running parallel to the edges converging near the tip.

4773; 2003 A broken blunt point, L61mm, mid-shaft T5mm, max. W12mm. The tip is blunt with sporadic multidirectional scratch-marks over the point but these are obscured by wear polish. There are remains of cross-grinding scratches on the shaft.

4789; 1746 A tip of antler tine with polish at the end. Back from tip is a patch of oblique scratching and a few deeper marks that may be from chopping. L69.6 D16.2mm.

4805; 1205 A near-complete, long c-size rib bone, L300mm, shaft W31mm, T5mm, max. W34mm (fragmented into 7 fitting pieces, and 2 fragments). About 50mm from the tip are shoulders on each side, and again on one side *c.* 30mm from the tip. The tip itself is pointed, although the very end is broken. Centrally on the tip between the single shoulder and the tip end there are two circular perforations, about 10mm apart, *c.* D3.5mm. There appear to be the remains of broken bone pegs lodged in the perforations.

4837; 1383 A small bone fragment, L21mm, max. W11mm, T3mm. The piece has a number of straight fine cut-marks running slightly diagonally across the face which is polished.

4852; 1942 A piece of unworked antler.

4852a; 1205 A piece of unworked antler.

4857; 2103 A handle for a composite tool manufactured from a deer antler. The antler is shed and the base and burr have been smoothed off. The handle is broken into 2 refitting pieces but the end where the tool is inserted is incomplete although the remains of the slot where the tool would fit are present. The slot is sub-rectangular in section and narrows to a point. L97.8mm.

4927; 2003 A piece of unworked whale bone.

5532; 2003 The shaft of a fine point or pin, highly polished, round in section. L15.7mm, D3.0mm.

5848; 2138 Two c-size lbsf that refit to form a splinter of long bone. One of the broken edges appears to have been smoothed but the poor surface condition does not retain any working or wear marks. L99.2mm.

5876; 1644 The remains of a lbsf. One end has been cut through, probably by groove-and-snap; at the other end the bone has been broken or cut obliquely across and the break smoothed off. The piece could be the remains of a hafted tool but due to its fragmentary nature this cannot be confirmed. L97.0mm.

5896; 1709 A splinter of c-size lbsf with cross-grinding marks and rounding on one broken edge, by cross-grinding, and rounding to one broken end. L67.2mm.

5923; 1693 The axially perforated end of a c-size metatarsal. The sub-rounded perforation is the same dia. as the medullary cavity and has been cleaned by scrapping around the inner surface. The shaft and tip are missing. L45.7mm, Dhole 20.6mm.

5931; 1205 Two fragments of a probable deer metatarsal which refit. The piece has been split axially. The 2 pieces are from the fused proximal end and a sub-rounded hole has been made in the end, of the same diameter as the medullary cavity. The hole could have been used for hafting the piece onto a handle or shaft. The shaft of the bone has been obliquely broken/cut and shaped to a tip, the end of which is missing. Extensive cross and oblique grinding across the broken/cut edges and bone shaft surface. L80.5mm, Dhole 21.0mm.

5939; 1776 An axially split c-size lbsf, the split passing through the articular surface, There are faint oblique scratches on the surface of the bone but not on the broken edges. Possibly unfinished. L73.5mm.

5958; 2156 A splinter of antler beam or tine with the remains of a V-shaped groove cut around one end. L63.5mm.

5968; 1693 Three pieces of refitting proximal c-size metatarsal. The end is perforated with a hole equal in dia. to the medullary cavity. On one side of the shaft there are the remains of extensive working marks from

cross-grinding to shape the bone to a working tip. The tip is missing and the form of the piece is unknown. L40.8mm, Dhole 19.2mm.

5974; 1205 A splinter of c-size metapodial shaft fragment. The proximal end has a hole through the articular surface into the medullary cavity and the end has been ground down to remove the surface. No remains of the tip end survive but there are some oblique and cross-grinding marks on the surface of the bone shaft. L82.4mm.

Phase 10 – House 2190

4312; 2189 A piece of unworked whale bone.

4351; 2189 A bone peg, L29mm, shaft W4mm, shaft T2mm. This is a highly polished straight peg, axially worked, rectangular in section, leading to a fine round-sectioned point. It is highly polished all over with a flat head, W3.9mm, T2.1mm.

4605; 2189 An incomplete point; the surviving piece L50mm, max. W8mm, T5mm. An elongated 'S' shape in plan, with a rounded trapezoidal section; the bone's tip is quite fine. The non-tip end has split down the middle. Poor surface condition means no working evidence survives and the identification of this tool is based solely on its shape.

4792; 2189 A possible point, L41mm, mid-shaft W11mm, T5mm. Although the bone preservation condition is poor, this short shaft has parallel edges and a fine tip, with an overall length of 205mm.

5109; 3181 A whale vertebral body with both epiphyses fused. The processes have been removed to leave a smooth body. One edge of the body is missing, possibly cut off. Discolouration on one side of the bone.

5110; 3181 A piece of unworked antler.

5211; 2189 A point made from a c-size lbsf splinter. Axial scraping to shape the tip and some fine oblique scratches at the tip which is highly polished. L64.1mm, tip L26.9mm, WB 8.3mm, TB 4.3mm.

5355; 2189 An antler tine removed from the beam. The outer surface of the curve has a very smooth polish with numerous multidirectional scratches. The tip is not obviously polished.

5860; 2189 An antler tine removed from the beam. There are chop-marks on the antler just above the break with the beam and the other end shows the remains of a groove cut around the tine and snapped through. L75.0mm.

5178; 2189 A small bone or antler peg. L31mm.

Phase 10 – House 401

3524; 1308 A c-size scapula shovel tool, L217mm, max. W107mm, T22mm. The broad end is concave and curved. Polish is seen on the tip of the broad end with fine scratch-marks towards the end. The glenoid has been cut down/worn away on its medial side.

3537; 1308 An awl made from a s/g metapodial, L114mm, shaft W10mm, T8mm, tip L *c.*43mm. The point has a very fine tip with prominent polishing, and is made from an oblique break from the side on the proximal end. Some axial scraping along the tip as well as multiple cross-grinding marks on the side around the tip/shaft interface can be seen. The distal articulation is intact and complete with the point's shaft being slightly polished.

3539; 1308 A plate from the side of a boar's tusk, L91.8mm, W19mm, T4.4mm. No evidence of working on the inside surface nor evidence that the plate was deliberately removed. In a small area of the outer surface near the root, where the enamel surface is gone, the exposed tooth is heavily scratched and polished, presumably deliberately.

3568; 1210 An unworked whale (Balaenopterinae) vertebral epiphysis.

3624; 1308 A bird-bone point, L94mm, W11mm, T9mm thick, made from the long bone of a goose or similarly large bird. This is a hollow, round-sectioned bone, split obliquely to form a fine point with a tip L24mm. Multidirectional scratch-marks are visible around the shaft/tip interface.

3634; 1472 A pin, L81mm, mid-shaft D4mm, max. D4mm. The pin is slightly polished, curved and with a moderately uniform round section. The point tip is quite fine. With a length of 5mm, W7mm and T4mm, the head is flat and oval-sectioned. In addition, it tapers out from the shaft on its edges, giving a roughly triangular-shaped head. Slight notches can be observed on the head/shaft interface.

3639; 1470 A c-size lbsf made into an expedient point by axial scraping along one edge; no other working or wear visible. L68.1mm.

3648; 1507 A s/g metatarsal manufactured into an awl, L103mm, W10mm, T8mm, tip L53mm. The point is obliquely split from one edge to form a long, fine-tipped point. The point's surface is polished all over, with multidirectional scratch-marks seen at the shaft to tip transition. Axial scraping is visible on the tip and along the broken bone edges; the distal articulation is complete and fused.

3660; 1507 An expedient point with a fine tip, L58mm, max. W13mm. The piece does not show any signs of working but there is polish at the tip that may be wear from use.

3674; 1310 A s-size metapodial, fashioned into an awl, L64mm. It is obliquely split along one edge, almost all the way up to the distal articulation, with a tip L51mm. Axial scraping marks can be seen down one edge of the shaft to the tip, the very end of which is missing. The distal articulation is unfused and not present.

3689; 1310 A complete blunt point, L103mm, max. W10mm. The point tapers into a round-sectioned tip, lightly polished and blunt. The tip has axial scraping while the shaft also has cross and oblique working.

3710; 1575 A piece of unworked antler.

3711; 1575 A rounded lump of sperm whale bone with a depression on one side. The depression and the area around it are slightly darker, possibly the result of

heating. This could therefore be a whale bone lamp although that is uncertain.

3732; 1595 A complete bone peg, L16mm, mid-shaft D3mm. This is a smoothed peg, roughly circular in section. Slightly coned in shape, it has a round-tipped head, D4mm, and a blunt tip at the other end. Multidirectional scratch-marks, though mainly diagonal, are visible along shaft.

3734; 1595 A complete awl, L73mm, max. W18mm, T7mm. This is a quite highly polished piece, with a wide round-sectioned shaft tapering towards a fine highly polished tip. Axial scraping was used to shape the tip. In addition, cross-grinding evidence can be seen on the posterior face just below the tip. The handle end is polished, possibly though wear, and has been rounded off.

3735; 1600 A blunt point, L147mm, shaft W20mm, T7mm. Multiple scratch-marks, probably from grinding, are evident, multidirectional near the tip but increasingly cross-scratches moving away from the tip.

3736; 1600 A bird-bone awl, L103mm, shaft D6mm, made from the ulna of a small goose. Slightly curved shaft has been split obliquely to form a fine tip, L18mm. A few oblique and axial scratch-marks can be seen from shaping the tip, whilst the distal end is complete and intact.

3741; 1611 A complete awl, manufactured from a s/g metatarsal, L85mm, tip L52mm. It is split longitudinally and tapers to a fine point with multidirectional scratch-marks, mostly cross-ground, towards the shaft end.

3742; 1611 Ten pieces of unworked antler, some refitting.

3743; 1611 A pin, L75mm, shaft D3mm. The pin is straight, quite highly polished, rounded and is oval in section with a flat head, T3.5mm, W4.1mm. The tip is broken off. There are axial and oblique working marks on the shaft.

3744; 1575 A small sub-circular perforated disc made from Mysticeti whale bone, D31.7mm, T6mm. The hole is irregular and up to D4mm. There are no working marks but the edge of the disc has been smoothed.

3747; 1629 A c-size metapodial awl, L144mm, max. W19mm. This is a large shaft fragment, fashioned into a fine, quite highly polished point with multiple scratch-marks especially around the tip, including axial scraping and cross-grinding. The point is manufactured on the distal end, with the proximal end as the handle although the articular surface is missing.

3748; 1629 A s-size metapodial awl, L103mm, W10mm, T9mm. It is obliquely split along the edge, forming a very long, fine tip, L60.6mm. Axial scraping has been used to shape the tip. The tip and shaft are both polished.

3763; 1575 A point made on a c-size lbsf, L149mm, shaft W12mm, T5mm. This bone fragment is fashioned into a point at one end with some faint and fine axial scratches at the point which is polished; the other end shows no signs of working but the tip end does have polish and may be an expedient point.

3853; 1611 An expedient point, L118mm, max. W15mm. The point's tip is rounded. The point is made from a c-size lbsf. There are possible faint axial scrape marks from shaping the tip.

3900; 1310 A fragment of antler shaft with chop and cut-marks on one edge. Does not appear to be part of a tool; more likely manufacturing waste

3905; 1310 A piece of unworked antler.

3907; 1507 A piece of unworked antler.

4567; 1850 A point, L81mm, max. W12mm, T6mm. This is a point manufactured from a s-size ulna split longitudinally, leaving a roughly triangular-sectioned shaft. The tip, triangular in section, is quite fine with very slight polish around the tip.

4619; SW quadrant A highly polished broken pin; the surviving piece is L42mm, shaft D3mm. The pin is straight, fine-tipped and broken across the shaft. Marks from axial working are visible on the shaft.

4694; 1310 A large blade-like or spatulate object made from a piece of fin whale bone. The end is rounded, thick and fairly smooth but unpolished. L109.1mm, WT28.8mm, TT9.1mm.

4695; 1310 A piece of unworked antler.

4778; 1844 A piece of unworked antler.

4779; 1844 A piece of unworked antler.

4791; 1308 A point, L63mm, mid-shaft T6mm, max. W14mm. This is a flat lbsf, fashioned to an uneven tip with poor preservation, the tip being moderately sharp and almost round-sectioned. The poor surface condition limits the potential for observing working and wear marks.

5014; 1308 A bead/pendant made from a perforated fish vertebra; all spines/projections have been removed. There are no marks from manufacturing but fish bone does not preserve these well. The hole is roughly central but has a slight bulge on the hole to one side, away from the main weight of the bone; this could be due to hanging on a string/thong. D20.7mm, Dhole 5.7mm.

5341; 1308 A piece of unworked antler.

5402; 1310 A fine-tipped expedient point made on a lbsf. The tip has a rounded section and a light polish with faint cross-scratches. L55.2mm, W4.2mm, T4.0mm, tip L 6.9mm.

5562; 1494 A splinter of lbsf shaped by cross-grinding and a small patch of axial grinding to a blunt point. L12.91mm.

5564; 1507 A s-size tibia shaft fragment; the distal end has been removed and the broken shaft surface smoothed. The shaft narrows but there is no clear working end to the tool. The marrow cavity forms a tube almost to the end of the tool. L90.2mm, WT9mm, TT4.3mm.

5843; 1310 A c-size rib; it does not appear worked but has been utilised. One edge on the outer curve is worn down to expose the internal cancellous bone and there are extensive cross-scratches in the same area of the bone. The wear suggests the rib has been used as a scraper or similar tool with the edge of the bone cutting

into or abrading some material. The material scraped must have been abrasive enough to scratch the surface of the bone and not just polish it; this may suggest something other than skin or leather. L142.9mm.

5844; 1501 A large splinter of c-size metapodial. The proximal end of the bone has been perforated to form a hole of similar dia. to the medullary cavity. The proximal articular surface appears to have been smoothed across. There are extensive oblique grinding marks on the bone's surface. The tip end is missing. L95.0mm.

5853; 1611 A metapodial shaft fragment, possibly deer. The bone has been broken roughly mid-shaft and one of the broken edges has been shaped and smoothed. Any tip to the piece is absent as is any handle. L82.7mm.

5855; 1310 A fragment from the distal end of a first or second phalanx. A small perforation has been made through the bone shaft into the medullary cavity. The hole is circular but no obvious marks show how it was made. Dhole 3.0mm.

5873; 1310 A small fragment from the proximal end of a c-size phalanx. The piece has been broken through axially and is possibly cut or chopped through just below the articulation, although no working or wear marks survive. It could be the debris from bone-working removed to leave the shaft of the bone.

5925; 1310 A small oval-sectioned peg with flat ends; the peg tapers and has a notch part-way down one side. L14.2mm, SD6.1mm.

5956; 2210 A small chip of whale bone, produced by chopping whale bone.

5966; 1308 A fragment of antler with the remains of a groove from groove-and-snap at one end. The groove would have been V-shaped with a sharp bottom. L40.8mm.

Phase 10 – Northeast area

4608; 1738 A broken point, fashioned from a s/g metapodial, L79mm, mid-shaft W10mm, T9mm. Broken off just below the distal articulation, the point is obliquely split from the side. The tip is broken off, making its identification impossible. Small scratches can be seen mainly around the shaft/tip interface.

Phase 10 – South area

3548; 1209 A piece of unworked antler.

3583; 1320 A point, L79mm, max. W11mm. This point, made on a s-size lbsf, has only been moderately shaped with faint scratch-marks seen along one edge and around the tip. The shaft is straight and rounded on one side, and is split longitudinally to form an almost semi-circular section.

3874; 429 A broken flat piece of worked c-size rib, L49mm, W18mm, T3mm. The tool has straight, parallel sides, with oblique scratch-marks. The end of the bone is squared off with a flat non-working edge. This object is likely to be the handle end of a flat, probably spatulate tool, but this cannot be confirmed.

5858; 1319 A broken splinter of c-size lbsf in 3 refitting pieces. The bone surface is heavily worked, with oblique grinding. The piece may have been a point; the shaft is narrowing but the tip is absent. L100.5mm.

Phase 10 – Southeast area

3485a; 1367 A red deer antler pick with a long curving brow tine. The brow tine is abraded with scratches parallel to the beam, showing it was used in a dragging action. The bez tine is removed. The antler is shed and the burr is relatively undamaged.

3485c; 1367 A red deer antler tine with a damaged tip. The poor condition precludes identification of the cause.

3787; 1299 A fragment of deer skull and antler base still connected, also 25+ fragments of poorly preserved antler and 2 fragments of skull. No working or wear marks but the poor condition of the antler may be a factor in this.

3825; 1299 A s/g metapodial fashioned into an awl, L112mm, shaft W12mm, T8mm. The point is split obliquely on the proximal end and shaped by axial scraping to form a fine tip. The point is slightly polished. The distal articulation is completely intact.

3896; 1287 An antler crown with three tines. Two of the tines are smoothed, polished and extensively scratched: these appear to be the working end of the object. The third tine is broken, axially; this tine has some smoothing at the tip but the wear is not as extensive as on the other tines and this appears to have been the handle. The tool appears to have been a hand rake: this could have been used in the soil or through rough fibres.

4285; 1455 A curved awl point, L76mm, mid-shaft T4mm, max. W17mm. The piece is in good condition and near-complete. The point is split longitudinally and worked into a round-sectioned fine tip, highly polished with cross-grinding around it. The edges are also moderately polished.

4809; 1299 A broken shouldered point, L51mm, W10mm, T5mm. This is a small fragment from the tip of a point; the shaft is missing. Axial scraping has been used to shape the tip. L22mm.

Phase 10 – West area

4693; 2426 A bird-bone awl with it tip missing, L98mm, shaft D5mm, made from the tibiotarsus of a Great Black-Backed Gull. Diagonally split from the edge, with a hollow, round-sectioned shaft, the point has a tip whose extremity is broken. There are scratches, both cross and oblique, showing the working used to shape the tip. The working is probably a mix of scraping and grinding.

4738; 2426 A piece of unworked sperm whale skull.

Phase 11 – Forecourt

3320; 458 A complete awl, L88mm, shaft W10mm, max. W15mm; lbsf. Split longitudinally down the middle from the distal articulation, which is highly polished through use, the awl is fashioned into a round-sectioned fine tip. The piece is polished all over, especially towards the tip. Numerous cross-grinding marks can be seen on the posterior face of the shaft as well as multidirectional scratch-marks on the anterior face and around the tip.

3375; 753 A square-ended, chisel-like tool, L124.9mm. It is made from a red deer metapodial that has broken into 2 refitting pieces. The working end of the bone is split and shaped down to a square end W15.6mm, L60.8mm. The end has been shaped by cross-grinding.

3441; 518 A near-complete (but fragmented in three pieces) expedient point, L128mm, max. W.20mm, max. T9mm; c-size tibia. The point is split longitudinally down the shaft from the distal articulation, much of which remains. The tip is blunt and polished but there is no evidence of working to shape the point or shaft after splitting.

3891; 897 A section of antler beam L36.5mm, D36.8mm, removed from the beam by using groove-and-snap to cut across both ends. This may be a waste product or an unfinished object.

3892; 1431 An antler tine with tip missing. A number of deep cut-marks across the tine shaft that are possibly related to working.

3993b; 458 A piece of unworked antler.

4265; 1447 A caudal vertebra of a dolphin (*Lagenorhynchus* sp.) with all processes removed. Epiphysis fused. D52.6mm, T25.9mm.

4299a; 1447 A piece of unworked antler.

5013; 518 The tip of a point, L46.6mm, W13mm, T5.5mm, made from a split s-size lbsf. The tip surface is smooth and working marks are not visible.

5871; 458 A fragment of a split c-size lbsf, with a probable point at one end. The tip is missing but axial scrapping marks from shaping down the bone towards the point survive. L61.0mm.

5919; 518 The tip and part of the shaft of a point made from a s-size metapodial. The shaft is broken through obliquely and a tip for a point shaped on this. The tip has been shaped by axial working, possibly scraping, with cross-working at the very end. A light polish has developed on the tip. L50.3mm.

5943; 518 A section from the shaft of a bone tool made from a s-size metapodial. The piece may be from a point but the tip is missing and this cannot be confirmed. The bone has been broken/cut across at an oblique angle and has been shaped by extensive cross to oblique grinding to form the missing tip. L58.3mm.

5949; 752 A sub-square round-cornered flat bone plate made from a section out of a c-size scapula blade. The bone has been heavily worked and smoothed but little survives of the working evidence due to the smoothing. L31.0mm, W29.0mm.

5983; 518 A section of c-size scapula blade shaped into a blade-like tool with rounded edges and end. The handle end is missing and large patches of cancellous bone are exposed by the removal of the surface bone. This is probably mostly deliberate but some may be due to wear. L99.2mm, W39.8mm.

5984; 518 An antler tine tip shaped and smoothed down to a blunt point with the cancellous internal tissue exposed. L21.0mm.

Phase 11 – House 1370

3458; 1204 A straight point L42mm, max. W6mm; s-size lbsf. This has a reasonably fine polished tip and a more rectangular-sectioned shaft with rounded edges but lighter polished. Axial and cross-working scratches can be seen along both edges.

3462; 1204 A s-size lbsf L50mm, max. W8mm. Much evidence of cross-grinding across the shaft edge.

3471; 1222 A complete awl, manufactured from a s/g metatarsal, L122mm, W11mm, tip L44mm. The tool is split obliquely from the side/anterior face interface to form a point at the proximal end. The tip is polished, with occasional scratches. The distal articulation is complete and intact.

3474; 1222 A complete awl, L143mm, max. W20.2mm, max. T8mm; c-size metapodial. This is a long awl, split longitudinally from what is probably the proximal articulation, smoothed and polished to form a flat shaft. The shaft tapers to form a long, round-sectioned tip, the very end of which is broken. A multitude of oblique ground scratches are seen all over the length of the tip and shaft.

3478; 1203 A roughly square plate of blue whale bone 143.1mm × 113.7mm; it varies in thickness between 6mm at one end and 36.6mm at the other. A hole roughly in the centre is oval, elongated on the long axis, and is 23.8mm × 34.6mm. This piece appears to have similarities to some blubber mattocks, but it is unclear how well porous whale bone would stand up to being hafted, although the elongated perforation may give a clue to this.

3641; 1224 A complete awl, fragmented into 3 pieces, fashioned from a s/g metapodial, L108mm, shaft W9mm, T9mm. This tip has a fine point with polish, and faint axial and cross-working marks.

3642; 1224 A s/g metapodial awl, L67mm, shaft W12mm, T7mm. The distal articulation is completely intact, but the tip is broken off. The bone is broken obliquely and faint oblique working scratches are visible although these have mostly been smoothed away.

3699; 1547 A complete scapula bone disc, fragmented into 4 refitting pieces, D33mm, T2mm. This slightly irregularly edged circular bone disc has a central circular perforation, D5mm. Sporadic multidirectional scratch-marks are visible on both sides.

3703; 1557 A complete pin, L62mm, max. D4mm, mid-shaft D3mm. This is a polished, straight and round-sectioned pin with a finely pointed tip. The head,

L4.7mm, W5.4mm, T5.1mm, is slightly fatter than the shaft, circular in section, and has a flat top.

3707; 1547 A pin, L39mm, mid-shaft D4mm. This is a highly polished, straight, circular-sectioned pin. The tip appears to have been broken off and a second tip shaped on an oblique break. The second tip is not as well made as the rest of the pin, with extensive evidence of cross-grinding scratch-marks visible along the oblique surface. The pin is nail-headed, L4.4mm, W9.5mm, T7.5mm.

3712; 1204 Two pieces of antler tine that refit; total L153.8mm. A number of chop-marks near the point where the antler tine was removed from the beam; this is likely to be waste from cutting up antler for working.

3713; 1547 A lump of whale bone with part of a circular hole or void within it. This does not appear worked and may be natural to the bone.

3721; 1203 An antler tine with some damage to tip; could be natural.

3852; 1610 A broken point, L74mm, shaft W10mm, T6mm. This point is made from a s-size lbsf. The bone has very poor surface condition so it is not possible to observe any working or wear evidence.

3862; 1204 A pointed spatula, L81mm, max. W21mm, T11mm; c-size lbsf. This is a scoop-sectioned shaft. The shaft has been shaped by cross-grinding. Evidence on the tip is not clear but there are some scratches. The tip is flat with a pointed spatulate end. The non-tip end is broken across a modern break.

3869; 1458 A point, L60mm, max. W16mm, T4mm; c-size rib. This is a flat, slightly curved, wedge-shaped piece, highly polished on the anterior face and along the edges. The tip is fine, with the edges and anterior face near the tip showing axial scratch-marks.

3895; 1203 An unworked antler tine.

3906; 1580 A broken point, L61mm, shaft D9mm, tip L21mm; s-size lbsf. The point tip is made on an oblique break across the bone shaft. A few cross-ground scratches are evident just below the tip. The non-tip end is unevenly broken.

4257; 1224 A partly burnt piece of Mysticeti whale vertebral epiphysis. Context suggests it could have been used as fuel.

4772; 1582 A piece of unworked antler.

4823; 1547 An awl, L54mm, shaft T5mm, max. W9mm. Obliquely chopped at the non-tip end, this piece is round-sectioned, cone-shaped and hollow. A small longitudinal section of the bone is missing, and the shaft tapers to a fine, highly polished tip. The shaft is also polished with axial grinding marks along it.

4834; 1204 A scoop-sectioned piece, L40mm, max. W17mm, max. T10mm. A sizeable notch is visible on one side, 11mm from a slightly polished squared off end. A groove running diagonally across the bone and a second smaller notch at the other end. Multidirectional scratch-marks and polish are present on the shaft.

5922; 1203 A fragment of s-size scapula blade, the end of which is rounded and polished. L21.5mm, W39.1mm.

5929; 1612 A flat piece of antler from the side of the beam or tine. The surface does not show working marks or wear but the distal end has been cut or broken off and appears smoothed or rounded off. L94.5mm.

5944; 1610 A small fragment of antler. One of its edges is flat and smooth and this could possibly be the remains of a groove or cleaned-up edge. The small size precludes full identification. L17.8mm.

5959; 1203 A fragment of a c-size metapodial shaft with extensive coarse cross-grinding marks and chop-marks. L42.7mm.

5971; 1203 Two fragments of a c-size metapodial that refit. The piece has split axially. The 2 pieces are from the fused proximal end and a hole has been made in it: this could have been used for hafting the piece onto a handle or shaft. The working or tip end is missing. L76.0mm, Dhole22.0mm.

5973; 1458 The tip of a point manufactured on a c-size metapodial shaft. The shaft of the point is wide and flat and the point tip oval in section. The tip is polished and shows axial scratches, probably from working. L56.0mm.

5978; 1224 A fragment of proximal red deer metatarsal. A hole has been made through the end into the medullary cavity, possibly for hafting. From the limited evidence the hole appears angular rather than round. The shaft and the tip end are missing. L38.7mm.

5981; 1458 A point made from the humerus of a shag. The articular end of this bird bone forms the handle and the shaft has been broken across obliquely with the fine point tip shaped on the end. The break on the shaft shows signs of axial working to smooth the break and shape the tip. Heavy polish over most of the tip and shaft. L80.0mm.

5989; 1582 A point tip with the shaft and handle missing. A light polish near the tip and faint cross-scratches from working on the tip; less evidence of working on what remains of the shaft. L38.9mm; s-size metapodial.

5990; 1582 A splinter of c-size metapodial shaft fragment. The proximal end is fused and it appears that this was worked but the fragmentary nature of the piece means this is not certain. The tip end is missing. The surface of the shaft shows extensive cross-grinding. L81.5mm.

5993; 1204 A splinter of c-size lbsf, one end of which shows cross to oblique working marks. This is near the articular end, only a small fragment of which survives.

5994; 1204 A flat c-size lbsf articular surface. One part of the bone surface is very highly polished. This could be from wear through use or palaeopathological wear of the surface due to a condition such as arthritis.

5995; 1204 A point shaped on a s-size lbsf. The condition of the piece precludes the preservation of working or wear evidence. L60.5mm.

Phase 11 – House 401

959; 655 A bird-bone awl L50mm, *c.* tip L30mm. The point is highly polished, with scratch-marks by the

tip. Axial working marks can be seen along the tip and shaft.

3200; 655 A red deer antler tine, extensively shaped. The tip has been paired/scraped down to leave a shorter flatter tip; the other end has been cut square across. A hollow been made into the cancellous tissue and a small hole drilled into the antler just back from the square end; the hole gives access to the hollow. It would appear that this antler has been made into the tip of another tool, and has been hollowed to aid hafting, with the small hole enabling the piece to be fixed to the haft. L112.9mm, depth hollow 48.8mm, Dhole3.6mm.

3202; 655 An awl, manufactured from a s/g metapodial, L62mm, shaft W12mm, *c.* tip L25mm. The awl is highly polished, with numerous multidirectional scratches; oblique grinding on the edge of the tip, and axial grinding on the tip face. In addition, faint marks are visible on the anterior shaft face but are otherwise obscured by polish. The distal articulation is intact and complete.

3207; 713 A near-complete point, L116mm, shaft W9mm, T6mm. This c-size lbsf has a damaged tip and eroded surface. The shaft cross-section is near-circular by the tip. The other end has a square-ended flat head, W6.5mm, T2.4mm.

3372; 655 A nail-headed pin, L52mm, W4mm, T4mm. This pin is slightly polished, straight but asymmetrical in thickness and width. It is sub-rounded in section with a fine point. Just below head, the shaft is narrower, W3.3mm, T2.8mm. A number of faint axial marks on the shaft that are probably from working.

3377; 787 A shouldered point L90mm, max. W32mm; c-size lbsf. The tip is highly polished as is the shoulder, but the rest of the piece does not show shaping. The tip end is broken off, but is still quite fine. Scratch-marks are also evident.

3398; 872 A lump of cancellous Mysticeti whale bone with the remains of a hole through it. None of the original bone surface survives and the hole is through porous cancellous bone that does not preserve working evidence, so it is not possible to confirm how the hole was made although it looks drilled in general appearance. L71.3mm, W51.7mm, T28.2mm, Dhole 11.5mm.

3400; 655 A nail-headed pin, L66mm, shaft D3mm. The pin is nearly round-sectioned with a slight curve along its length. It is moderately polished, with a fine point. The pin has a domed nail head.

3402; 655 A complete blunt point manufactured from a c-size metapodial, L105mm, shaft W20mm, shaft T10mm. The point is split longitudinally in half from the proximal articulation. The shaft is trapezoidal in section. The tip is blunt, with polish on the end, while the rest of the piece has very little evidence for wear.

3410; 888 A roughly semi-circular lump of sperm whale bone, L151.6mm. One side is the dense outer bone and one side the porous cancellous bone. Not a finished object but appears to have been roughly shaped.

3412; 655 An antler pick in a fragmentary state, *c.* 25 pieces. Only the base and brow tine refit. The brow tine is the point of the pick and heavily worn down and blunted. The antler is shed.

3414; 655 An antler pick broken into 11 pieces. The brow and bez tines are present: the bez is very short and the brow is abraded and smoothed with a worn-down and slightly faceted tip, suggesting a prising action. The antler is shed. Measurements are not possible in its current state.

3446; 1290 A s/g metapodial awl, L114mm, W25mm, T9m, *c.* tip L52mm. The tip is fine, slightly curved and cut obliquely from the anterior face. Axial scraping can be seen on the tip.

3466; 1290 An unusual antler object made from the base, beam and part of the crown of the antler, leaving a L635mm curved staff, with a rounded handle at the base and 2 tines at the crown. The object is broken and 9 pieces have been refitted although it is not complete. At the base the burr has been removed and the base rounded and smoothed to leave a probable handle. The brow and bez tines have been removed and their sites smoothed off; there is no sign of a trez tine. There are the remains of 2 tines at the crown. One, still attached, has been shortened and flattened into a blade-like shape; the other is broken off and its form is unknown. (One damaged loose tine was recovered with the object but it does not refit so it is impossible to say if it is the missing tine). It is not clear if the object is functional or for display.

3467; 1290 A delphinid tooth L79.5mm. The tooth has a worn patch on one side of the enamel; this worn patch is very smooth and does not have any scratches. A possible ornament.

3469; 1290 A piece of unworked antler.

3483; 1352 A double-ended needle L84mm, shaft W2.5mm. At the eye, W4mm; the shaft T2.2mm. The needle is fine-tipped at both ends, round-sectioned and highly polished. The eye in the middle is elliptical, running 46mm–52mm from the end along its length. The eye was possibly carved by a flint tool, working from either side to form the hole.

3486; 655 A s/g metapodial awl, L112mm, W9mm, T8mm, *c.* tip L40mm. The bone piece is split obliquely and shaped to a blunt tip at the proximal end. The tip is slightly polished with a few scratch-marks, mainly axial, on the edges. The distal articulation is complete and intact.

3487; 655 A point shaped on the end of a red deer antler tine; the piece is broken with the handle end and tip of the point missing. The tine end has been shaped down by cross-grinding to give a finer point, the end of which has broken off. L118.2mm, D16.4mm.

3489; 655 A s/g metapodial awl L86mm, W10mm, T9mm. This is a bone split obliquely which tapers quite rapidly into a fine tip at the proximal end. The tip is quite highly polished with axial scraping and cross-grinding along the side of the tip. The distal articulation is complete and intact.

3493; 655 A piece of unworked antler.
3494; 655 An antler tine with several deep scratches near tip but these could be natural damage.
3496; 655 A c-size scapula tool, L182mm, min. shaft W48mm, shaft T19mm. The glenoid is shaped to a roughly rectangular shape and the spine has been removed and the broken edge smoothed off. The broken condition of the object makes its tool type identification impossible.
3501; 1413 An unfused pilot whale vertebra, L86.5mm, W95.5mm, with all processes and spines removed. The body has been partially hollowed out from one epiphysial surface to produce a hollow vessel, 33mm deep.
3502; 1413 A pin, L40mm, shaft D3mm. The pin is highly polished, straight and with a fine tip, circular in shaft section and has a flattened nail head.
3505; 655 A point, L111mm, shaft D8mm; c-size lbsf. The tip is fairly fine, and the section sub-rounded. Faint axial and cross working marks are present on the tip and shaft.
3512; 1413 A complete scapula bone disc, D26mm, T2mm. The disc is circular, with a slight thickness variation from one side to the other. The piece is centrally and circularly perforated from both sides, and is polished on both sides. The piece has multidirectional scratches, mainly on one side.
3516; 655 A red deer antler pick manufactured from a section of antler beam and a tine; the base has been removed by groove-and-snap. The tine is at a low angle to the beam and the end is heavily abraded and worn almost flat, parallel to the beam, suggesting a dragging motion in use. There are also numerous scratches running across the side of the tine parallel to the flattened tip. No measurements were possible; the piece is broken into 10 fragments
3517; 1392 A point L100mm, max. W17mm. Made on a c-size lbsf splinter; only the very tip is worked.
3518; 1392 A small flat plate of blue whale bone, L66.2mm, W54.6mm, T5.7mm. The plate is made from the denser outer bone with the more porous inner bone removed; no working marks are visible. The piece may be a rough-out for a more developed object.
3519; 1392 An expedient point, L74mm, shaft W9mm; s-size lbsf. This has a fine polished tip. Light polish is also present on the shaft.
3528; 1392 A c-size scapula shovel tool, L178mm, max. W82mm, T21mm. The spine has been removed and the glenoid cut down on the lateral and medial sides to leave a rectangular shape. Both the spine and glenoid breaks have been smoothed off and lightly polished. The blade end shows extensive wear and the blade length has been shortened considerably.
3530; 1392 An unworked red deer antler tine.
3531; 1392 An unworked red deer antler tine.
3533; 1392 A piece of unworked red deer antler.
3547; 1255 An unworked red deer antler tine.
3567; 1332 An unworked red deer antler tine in two fragments.
3576; 655 A piece of unworked red deer antler.
3578a; 1413 An unworked red deer antler tine.
3578b; 1413 An unworked red deer antler tine.
3582; 1255 A scapula blade fragment, L47mm, with some wear on one edge.
3586; 655 A point made from a s-size split long bone, L103mm, max. W14mm, max. T6mm, approx. tip L23mm. This has a moderately polished fine tip, broken at the end. The point is shaped on the tip but the shaft is unshaped. Cross-grinding marks and axial scraping marks are visible near the tip.
3599; 1414 A complete c-size scapula blade tool, L182mm, W50mm. This is a heavily modified scapula tool; the glenoid has been shaped to a rough rectangle, and part of the neck and blade and all of the spine have been removed. The tool is shaped like a slightly curved elongated rectangle. The surface has numerous multidirectional working scratches with cancellous tissue exposed in two patches. The glenoid and neck appear to be a possible handle but it is not clear how the piece was used.
3600; 1414 A fragment of a c-size scapula tool, L110mm, max. W48mm, T18mm. The piece is from the tip end of the caudal side of a scapula. Part of one face appears to have been deliberately flattened, to leave a smooth surface. The tool is highly polished all over, and is probably part of a scapula shovel, but is too fragmentary to be certain.
3604; 1414 A near-complete nail-headed pin, L39mm, mid-shaft D4mm. This is a highly polished, straight, circular-sectioned pin. The tip appears to have been broken off and a second tip shaped on an oblique break. The second tip is not as well made as the rest of the pin with extensive evidence of cross-grinding scratch-marks visible along the oblique surface. The nail head is L4.4mm, W9.5mm, T7.5mm.
3605; 1414 A complete point, L126mm, max. W21mm. This is a c-size split parallel-sided metapodial shaft fragment with an elongated taper to form a fine and flat point. The handle end has been cut across square and shaped by chipping. The shaft shows some cross-grinding and axial scraping is evident on the tip.
3608; 1423 A highly polished, slightly curved bone disc, made from piece of scapula blade, D26mm, T2mm.
3616; 1423 A fragment of the very tip of a point, max. L14mm, D5mm. The piece is cone-shaped and rounded in section. The tip is quite fine, with the whole fragment being highly polished with observed axial scratch-marks from working.
3617; 1423 An awl, L143mm, max. W18mm, T7mm. This axially split metapodial retains a small part of the proximal articulation intact. The shaft itself is split in half, the edges of the broken shaft have been cross-ground to smooth them, and the tip has been axially scraped. The tip is broken at the very end. The surface is all quite highly polished. The bone has a deep natural furrow on its posterior surface probably indicative of a deer.

3620; 1423 A broad-ended cattle scapula shovel, L226mm, min. shaft W44mm increasing to W94mm at the broad end, max. T21mm. This is a highly polished tool, with the top of the glenoid articulation flattened as is the ridge. The broad end is irregularly concave. This concave end is heavily worn as the result of extensive use and wear. Multiple scratch-marks are visible, and two small depressions appear to have been worn into the two sides of the neck presumably as the result of handling.

3621; 1423 A blunt antler tine point, L84mm, with a smooth tip. The point is asymmetrical with a straight and a curved side. The curved side of the tip has many deep scratches; the origin is uncertain but they may have originated through wear.

3643; 1445 A piece of unworked red deer antler.

3644; 1445 A near-complete antler point, L71mm, shaft W15mm, T10mm. The piece is fairly short and robust with a tip shaped at one end by whittling down the shaft to a round-sectioned point, the tip of which is missing. Shaping the tip has left a number of fine facets around the tip. The handle end has been shaped square across the antler with possible chips removed to shape the end.

3662a; 1423 An incomplete, highly fragmented c-size scapula tool, L272mm, min. shaft W47mm, max. T33mm. This is a broad-ended piece, highly fragmented, and smoothed with only a very small worn section of the broad end remaining.

3948; 655 A c-size metapodial point, L77mm, max. W20mm, T9mm. The point is broken with the tip damaged and a break across the shaft with the handle end missing. There is some axial and cross working to shape the tip.

3959; 655 A complete short bird lbsf awl, L50.1mm, made from the ulna of a large Grey Goose. The bone has been broken obliquely and a fine point shaped by axial and oblique working.

3969; 655 Two pieces of antler, a base and a tine end, which do not refit but are possibly from the same object; the tine end is shortened, blunted and damaged. These might be from a pick.

4194; 800 A near-complete hollow, cylindrical bead, D12mm, L15mm. This lbsf piece is highly polished, and slightly trapezoidal in plan. Two notches run partway around the bead towards one end and, where the bead is broken, a longitudinal section (W6mm) is missing.

4258; 800 A hollow, thin-walled, near-complete cylindrical bead, L14mm, D10mm. This lbsf piece is quite highly polished especially on the ends, with few cross-scratch-marks, probably from manufacturing.

4781; 746 A tip of antler tine, smoothed but not polished. Extensive cross, oblique and axial scratches have shaped the tip. L53.0mm.

4829; 1414 A slightly scooped, shaped and sharpened lbsf spatula, L48mm, shaft W18mm, T3mm. The spatula tapers into a rounded point with handling polish over the shaft on its posterior face, as well as along the edges and around the tip on the anterior face. The shaft of the non-tip end is slightly broken along the edge.

4831; 655 A broken, pointed c-size bone spatula, made from a rib with three pieces refitting, L95mm, shaft W20mm, T3mm. The spatula is polished all over and has various multidirectional working scratches on the tip and shaft.

5094; 1374 The tip of a point with a sub-rounded section; the working method is unclear but faint cross-scratches are present. L16.4mm.

5552; 1413 A fragment of bead made from the beam of an antler grooved around twice to leave a ring of antler; the cancellous tissue has been removed. These small grooves have been cut to form continuous grooves and cleaned up following snapping. L17.2mm, D26.0mm, Dhole 11.7mm.

5561; 1414 A lbsf shaft fragment cut across one end and broken on the other. It is covered in extensive rough scratches, both cross and oblique, plus some cut-marks which cut the scratches.

5563; 1290 A small piece of s-size lbsf with polish and oblique scratches, possibly part of a tool but its fragmentary state precludes identification. L44.1mm.

5862; 655 A complete awl made from a c-size metacarpal split axially with the proximal end of the bone forming the handle. The tip is shaped to a fine point by axial working, possibly scraping, and is oval in section. The tip shows smoothing of the bone, probably from use but a polish has yet to develop. L96.5mm.

5867; 655 A section of antler beam with a stump where a tine (possibly the trez) was. The proximal end of the beam and the tine have been grooved around and snapped off, The grooves were made by chopping around with numerous chop-marks on both grooves. There are also chop-marks on the beam away from the grooves but these are not extensive enough to form a groove or other feature on the antler. L125.4mm.

5920; 655 A small fragment of worked whale bone with one side flat and smoothed.

5977; 655 A small fragment of antler with the remains of a groove on one end. The groove is probably for snapping through the antler. L14.2mm.

5979; 655 A short and rather stumpy pin-like point made from a splinter of long bone shaft. The piece has a sharp point at one end and a damaged but apparently rounded tip at the other. The shaft is smoothed and rounded-off but uneven in appearance. The shaft is thicker towards the rounded rather than the sharp end. The piece appears too short and stumpy for a pin but that is the nearest comparison. L48mm, max. W6.5mm, max. T5.3mm.

Phase 11 – Northeast area

5404; 1138 A spatula fragment of split c-size rib, there is no obvious working but the end has a roughly pointed flat end with smooth edges. L47.0mm, T19.8mm.

Phase 11 – South area

3362; 412 A bird-bone awl, L74mm, W10mm, T6mm, tip L28mm, made from the carpometacarpus of a swan. The point is rounded in section and is split obliquely to form a very fine point, with mainly axial working on the tip and shaft. The awl is highly polished all over. The non-tip, proximal articulation end is near-complete.

3388; 412 A flat blade of whale bone, broken at one end. On one side the bone has two shallow notches made by chopping; the other end is rounded and smooth. The piece would fit in the general category of blubber mattock. L154.0mm, W103.1mm, T15.5mm.

3391; 412 A blunt point made from an antler tine tip, L59mm. The tip is smoothed with several small wear scratches that could be natural or human in origin but, on one side, eight deep parallel cuts across the antler appear human in origin.

3465; 1316 A broken, unfused Delphinidae vertebral epiphysis, D58mm; the bone is perforated through the centre with a D9.6mm hole.

3588; 412 An unworked whale bone.

3638; 412 An antler tine tip, at the break from the beam, with a small area of possible grooving from groove-and-snap. In the outer side of the curve is an area where the antler has been cut or chopped smooth. L94.5mm.

3714; 412 A broken point tip and lower shaft, L64mm, max. W10mm. The c-size lbsf shaft is worked into a cone-shaped, round-sectioned point, with multiple axial scraping marks from working. The very end of the tip is missing, but it is still moderately fine.

3893; 412 A near-complete tool made from a section of antler beam, L107mm, D23.5mm. One end has been cut across by groove-and-snap. The other has a slot, L22mm, W12mm, cut into the end to leave two square-ended prongs *c.* T8mm. The slot appears to have been cut by sawing down the edges and then breaking off the remaining central prong. The piece has no wear marks and it is uncertain if this is a double-pronged tool or a single-slot tool.

3894; 412 A section of antler tine split axially, L50mm, W19.2mm, T15.6mm. One end has been cut across square and smoothed off flat; the other has been oblique-ground to form a blunt, rounded end with cancellous tissue exposed.

3897; 412 An unworked antler tine.

3904; 412 An unworked antler tine.

4830; 412 An antler side plate fragment, L46mm, W15mm, T6mm. The piece is perforated with a circular hole D5mm. The piece is slightly scooped in section and square-ended. The poor preservation makes it difficult to see polish or scratches.

4838; 412 A broken awl, L87mm, max. W8mm, T5mm. This point is formed from the longitudinal splitting of a s-size long bone. The piece is slightly curved and polished with the tip having been fashioned into a fine point. The bone preservation of the tip is less than average.

4839; 412 A near-complete awl, manufactured from a sheep/goat metapodial. The tip is missing and the remaining tool is L74mm with a mid-shaft W10mm, T9mm. The distal articulation is intact and complete. The bone is split obliquely from the anterior face and a tip shaped on it. The missing tip was probably fine with approx. L21mm. Polish is seen towards the tip, as well as cross-grinding scratches and axial scraping.

4840; 412 A broken awl fashioned from a sheep/goat metapodial, L56mm, W11mm, T9mm. Obliquely split from the anterior face, this piece has a fine tip of approx. L29mm. The distal end is broken off just below the articulation. Axial scraping marks are visible along the edges of the tip with cross-grinding along one side. Slight wear polish is seen over the bone surface.

5943; 412 Three fragments of a hafted tool made from a c-size metatarsal split axially. The 3 pieces, 2 of which refit, are all from the fused proximal end which has a hole made in it; this could have been used for hafting the piece onto a handle or shaft; the working or tip end is missing. L56.1mm, D of hole 16.5mm.

5963; 412 The tip of a point made from a s-size lbsf. The tip is axially and obliquely worked. L36.5mm.

Phase 11 – Southeast area

2006; 414 A pointed-ended spatula made from a flat plate of c-size long bone. At the handle end are two opposing notches made in the sides of the bone. The bone is polished over its whole surface, including the notches, and has patches of axial oblique and cross-scratches from working, particularly towards the handle end. L123.8mm, W16.4mm, tip L13.5mm, shaft W2.32mm, notch W7.8mm, D2.9mm.

4861; 420 A bone tool fragment from a lbsf has oblique grinding along one edge. L69mm, W13.9mm.

5448; 420 A broken needle, L64mm, mid-shaft W4mm, T2mm; lbsf. The eye, at the distal end, is D3mm. The point is broken off. The distal end is polished over a length of 25mm.

Phase 11 – West area

4883; 2337 A piece of unworked whale bone.

Phase 12 – Forecourt

3865; 738 A complete awl, L97mm, W10mm, T9mm, made from a s/g metapodial. The point is obliquely split from the anterior face to form a fine tip on its proximal end, highly polished with a tip L43mm. Axial and cross-scratch-marks are seen along the edges; these manufacture marks are difficult to see due to wear polish.

3951; 738 A probable point, L65mm, W5mm, made from the radius of a cormorant. The shaft is oval/rounded in section and curved. The tip is missing but the bone

has been cut obliquely and shaped by cross-grinding and axial scraping.

3952; 738 A bone ornament/pendant, L48mm, shaft W7mm, T3mm. The pendant is long and thin, made from a s-size lbsf, with a rounded end; the other end has notches on either side of the bone allowing attachment.

3962; 743 A piece of unworked antler.

5850; 738 A broken sheep scapula tool; the glenoid and neck survive but the blade is missing as is the spine. Extensive scratch/cut-marks along the remaining base of the spine suggest this was deliberately removed. It is not possible to determine what the complete tool would have been. L61.6mm.

5852; 738 A scapula tool, of which the glenoid and neck of the c-size scapula are present. On the glenoid the lip of the articulation is smoothed and worn on one side. The spine has been removed and the are several patches of cross-scratching on the neck, possibly from grinding, and some axial scratches from cutting and scraping. The blade of the scapula is missing.

5892; 457 Two refitting pieces of whale bone from the edge of a larger piece; the bone surface is smoothed and rounded. L11.14mm.

5914; 457 A small red deer antler broken into 9 pieces that refit. The antler is shed with the brow and bez tines missing, There are cross marks on the bez tine that could be from chopping a groove around the tine for groove-and-snap. Also a groove runs around the beam where it has been snapped through.

5916; 457 A square-ended spatulate tool made on a c-size split long bone fragment. The tool is broken with the shaft of the tool largely missing and the tip end only partly present. The tip has been shaped by oblique grinding. L70.2mm, W of tip 8.9mm.

5917; 457 Three pieces of a c-size rib that refit. A point has been shaped at one end but no working or wear marks survive. L192mm.

5915a; 457 A fragment of a circular-sectioned pin or needle shaft. This has faint remnant axial scraping marks and a light polish. L29.5mm, D3.8mm.

5915b; 457 A broken bone needle, oval in section. The needle has a circular hole made from both sides to produce an hourglass shape. The needle is broken through at the hole and mid shaft so the tip is missing; the shaft has a slight hint of faceting possibly from axial scraping. L36.7mm, hole D2.7mm, shaft D5.9mm.

Phase 12 – House 1370

3645; 1461 An antler tine L103.3mm, D18.9mm. The tip is a rounded and blunt point. The tip and shaft have been extensively smoothed and shaped by cross-grinding and axial scraping. In addition, a conical hole, max. D16mm, L8.5mm, has been made in the end of the tine.

3647; 1461 A straight, slightly polished, complete double-ended pin, L49mm, shaft W3mm, T2mm. The pin's mid-shaft is rectangular in section, fashioned at both ends into slender circular-sectioned pin tips, both of which are relatively fine. Possible axial scraping is seen on one tip.

4819; 1512 A small fragment of whale bone with one side smoothed and flat. L37.3mm.

4822; 1221 Two small fragments of whale bone that refit; one surface and edge are flat and smooth, almost polished. L50.1mm.

4825; 1461 A complete bone bead, L13mm, max. W12mm, T9mm. The piece is roughly triangular, although the condition of bone preservation is very poor. A central, circular perforation is visible running through the bead.

4972; 1530 Two fragments of unworked whale bone.

5874; 1530 The handle end and part of the shaft of a bone tool made from a split c-size long bone. The shaft shows extensive coarse oblique scratches, possibly from grinding. The tip end is missing. L64.1mm.

5940; 1461 A splinter of c-size long bone shaft smoothed down one broken edge with patches of oblique scratches on the bone surface. L94.4mm.

Phase 12 – House 401

3036; 574 An unworked antler tine.

3127; 595 An antler beam debris from manufacturing; both ends have been roughly grooved around by a mix of chopping and cutting and then snapped off. The stump of a tine also remains which has been snapped off following grooving. L220mm, shaft D34mm.

3140; 595 An antler pick made on the brow tine, which is shortened and has a rounded end. The sides of the brow tine, which is shed, have extensive wear scratches running across the tine. The pick is fragmentary with 2 large pieces that refit but *c.* 30 small fragments do not.

3154a; 595 An antler pick utilising the brow tine. The antler is shed with the burr complete. The brow tine forms the pick point and has a damaged and rounded end. There is no bez tine, just two small ridge-like stumps.

3154b; 595 An unworked red deer antler tine.

3194; 659 An unworked red deer antler tine.

3196; 595 An unworked red deer antler tine, possibly roe deer.

3369; 759 A worked piece of whale (Balaenidae) bone.

3381; 885 An unworked red deer antler beam broken into 3 pieces that refit.

3381; 885 An unworked red deer antler beam broken into 2 pieces.

3381; 885; An unworked red deer antler tine with the tip missing.

3381; 885 Ten unworked red deer antler fragments.

3381; 885 A red deer antler beam with heavily eroded base still present. Two tines are missing, possibly deliberately removed, but poor surface condition precludes certainty. No manufacturing or wear marks. L200.5mm, base D56.4mm.

3381; 885 A point made from a red deer antler tine tip with abrasion and coarse cross-scratches at its tip. Near the

tip, slight narrowing of the tine caused by removal of antler is possibly deliberate. L95.0mm.

3384; 659 A possible point, L112mm, W11mm, max. T14mm; lbsf. The condition of preservation is very poor, with only the general shape suggesting it is worked.

3399; 595 An awl, L156mm, max. W16mm, max. T12mm, approx. tip L38mm; c-size lbsf. This is a large piece with a polished tip and multidirectional working scratches. The shaft is almost triangular in section and slightly polished.

3420; 595 A complete spindle whorl manufactured from a c-size femur head, D31mm, T20mm. The piece is worn so that only cancellous bone is visible; the base is shaped flat, but is still slightly rounded with a central circular perforation, D7.5mm.

3430b; 1188 An unworked red deer antler tine.

3444; 1269 An antler beam broken at one end; at the other end the beam has a three-tined crown but all the tines are missing. All three tine breaks show evidence of damage from chopping/hammering, probably from roughly removing the tines. L256mm.

3447; 659 A broken point, L106mm, W15mm, T5mm; c-size lbsf. This is lightly polished on the shaft and fine tip. Some wear or possibly manufacture scratches are slightly obscured by polish on the shaft and tip.

3447a; 659 A possibly worked red deer antler, consisting of a burr and longitudinally split beam; the first tine is missing and the second is broken. No evidence of wear or manufacturing marks but the longitudinal split is suggestive. L151.8mm, base D50.1mm.

3450; 659 A broken point, L70mm, W11mm, T5mm; s-size possible radius. The tip is quite fine and curved, circular in section and with little evidence of polish. Scratches from cross-grinding and axial scraping are on the point shaft and tip.

3452; 1315 A broken blunt point, L93mm, W10mm; c-size lbsf. The tip is circular in section, polished but damaged in the middle with a concave indentation on the end of the tip. The point has a few axial and cross working marks.

3453; 1315 A perforated sperm whale bone epiphysis, D71.5mm, T11.8mm. The disc is broken in half through the perforation and refits with SF 4826 below. The perforation appears smooth and possibly worn.

3456; 1315 A near-complete sperm whale bone disc, D60.8mm, T8.6mm. The disc edge is rough, unperforated and has not been finished like most bone discs. No working evidence survives.

3461; 1306 A complete bird-bone awl, L61mm, approx. tip L10mm, made from the humerus of a shag. This is a highly polished lbsf, obliquely split with a rapid taper to a short very fine tip. Multidirectional scratch-marks can be seen all over tip. The section at the tip/shaft interface is rounded.

3545; 659 A handle made from a c-size rib, L81mm, W21mm, T3mm; the end of the handle is squared off with two notches 2.5mm deep cut 16mm from the end. Some oblique ground scratch-marks can be seen on the shaft.

3587; 1175 A blunt point made from an antler tine tip with a smooth blunted tip. Numerous axial and oblique scratches run back from the tip.

3593; 595 An unworked deer antler tine.

3678; 1307 A perforated vertebral epiphysial disc from a Delphinidae; the disc has been perforated through the centre with a round hole but there is no other working or wear visible. The hole may have been made from both side as there are a few faint scratches around the edge of the hole. T4.5mm, D59.6mm, Dhole 9.3mm.

3949; 659 A complete headless pin, L74mm, D3mm. The pin is moderately fine-tipped, round-sectioned, slightly polished and curved. One face of the head has two cuts in it and there is a slight element of faceting on the tip.

3966; 595 A complete small bone bead manufactured by cutting a section out of a long bone. The outer surface is round and the inner hole sub-round. L5.6mm, D9.3mm, Dhole 5.9mm.

3967; 676 A broken s/g metapodial awl, L81mm, W9mm, approx. tip L34mm. The point is broken and the distal end is missing; this was probably unfused as smoothed cancellous bone is showing with a U-shaped indentation in the top. The shaft is split obliquely to provide a fine point. The tip is shaped by cross-grinding and axial working.

4236; 1190 An antler tine removed from the beam by groove-and-snap, the groove made by a series of cuts and possibly chops; some of the cuts are very fine. L118.0mm, D26.8mm.

4342; 659 An antler tine from the crown; the tine has a been worn and flattened on one side of the tip while on the other there are parallel chop/cut-marks across the tine running back from near the tip. L128.5mm.

4820; 1157 A fragment of a scapula tool; this is part of the blade of a c-size scapula highly polished with a smoothed and rounded end edge. Numerous axial scratches run back from the end edge; these could be working or wear or a combination. It is not possible to determine the tool type.

4821; 1155 A c-size lbsf with both ends missing, made from a split long bone, L102mm, W19mm, T5mm. Axial working scratches and a light polish are visible. It is not possible to determine the tool type.

4826; 1315 A sperm whale vertebral epiphyseal plate, unfused, shaped into a bone disc with a small perforation in the centre. The disc is broken and 2 pieces refit to make about half of the original tool (which refits with SF 3453 above). D63.6mm, T12.1, Dhole 6.5mm.

4833; 659 A perforated scapula bone disc, L31mm, W22mm, T2mm. This is an irregular shaped fragment from a bone disc broken in half and the edge of which is damaged. A hole surviving as a semi-circular perforation would have been central within the disc. The hole has been drilled from one side and cleaned up from both. Polish is seen on both sides and along the disc edge where undamaged.

4977; 659 A section of antler tine smoothed all over. The overall shape suggests the end towards the tip has been shaped to produce a narrower end; there are some axial scratches, and the cancellous tissue has snapped but there is no evidence of grooving. The other end has fine cut-marks and the possible remains of grooving where it is snapped. L77.4mm, D20.9mm.

5283; 595 The broken-off tip of a point, with a fine tip, made on a s-size long bone. Faint axial scratches show evidence of working but cannot confirm technique. L43.2mm.

5289; 595 A possible fragment of antler side plate. This piece, L24.5mm, W9.8mm, T5mm, has the remains of a circular drilled hole at one end of the broken piece and three deep cut-marks crossing the bone at the other. These cut-marks may be the remains of working marks from an unfinished piece or decoration; the fragmentary nature of the piece makes it impossible to tell.

5544; 1191 A large c-size long bone splinter shaped to a point at one end by cross and oblique grinding forming a slightly blunt point. Only the tip shows working with light wear polish. The tip is almost square in section with a slight shoulder on one side from working. L134.2mm, tip L15.1mm, tip W5.2mm, tip T5.5mm.

5551; 595 The tip of a lbsf point with a series of facets around the tip; finer working is not evident but the shape of the facets suggests scraping. L29.2mm.

5557; 595 An awl made from a split deer metatarsal with the proximal end as the handle; the bone was probably smashed to split it. The tip is shaped by axial and oblique working, probably scraping. The tip end is missing. L16.95mm.

5558; 659 A lbsf splinter tip shaped to a rough, expedient point by axial scraping. L86.6mm, tip L32.0mm, tip W7.5mm, tip T6.2mm.

5849; 721 A small fragment of c-size scapula blade with a slightly rounded, possibly abraded edge. L44.1mm.

5859; 659 A near-complete point made from a sheep/goat radius; the proximal end forms the handle. The shaft has been broken across obliquely and a fine slightly shouldered tip shaped on the end by cross-grinding. L77.2mm.

5868; 659 The broken-off tip of a c-size lbsf point. The point is quite robust looking and has a light polish over cross working marks. L32.5mm.

5904; 659 A small round-ended spatula tool made on an axially split s-size long bone. The surface is smoothed but some fine oblique scratches survive on the shaft and tip. L28.1mm, tip W4.5mm.

5905; 659 A small fragment of c-size scapula blade with a slightly rounded edge and a lightly polished surface. L37.5mm.

5906; 659 A point made from an obliquely broken s-size long bone. The tip of the point is slightly flattened and blunted. The handle is missing. There is light polish on the tip. L63.2mm.

5907; 659 A long slender splinter of broken long bone shaft with a point at one end. L101.4mm.

5927; 659 A small fragment of antler with the remains of a groove on one end. L23.7mm.

5937; 595 The tip of an antler tine with faint scratch-marks running across the shaft *c.* 15mm back from the tip which shows slight rounding. It is uncertain if this is working or natural damage. L61.5mm.

Phase 12 – North area

3418; 731 An expedient c-size lbsf point, L79mm, W13mm. The tip is fairly blunt, with slight use polish from about halfway down the shaft to the tip. At 9mm from the tip a series of cuts form a small and shallow groove on one side of the shaft, running perpendicular to the long axis of the point.

3625; 731 A near-complete awl with the tip missing, manufactured from a s/g metapodial, L91mm, W10mm, T9mm. The shaft is obliquely split, with heavy working evidence around the shaft/tip interface on both edges; this is mainly cross and oblique grinding. Multidirectional scratches are visible towards the tip. The end of the tip is broken, with the distal articulation complete and intact.

4261; 2001 A finely worked whale bone object. The piece is broken so the full form is unknown; this appears to be the corner of a sub-rectangular object with a rectangular hole in the centre. On one side of the object there is a small hole where the bone is trimmed to half thickness. This could be an area where 2 pieces were originally joined together. This piece is part of a larger object. L47.0mm, W35mm, T14.4mm, Dhole 3.7mm.

4295; 731 A broken, highly polished blunt point, L59mm, W18mm, T6mm; lbsf. This is a rounded, almost pointed blunt point. Black discoloration indicates burning, possibly causing fragmentation into three pieces.

4333; 2183 An antler tine from the crown with part of the beam attached, with one chop-mark on the tine, the tip of which is highly polished particularly on the outer curve. The tip wear is so extensive as to have exposed the cancellous tissue inside. This piece appears to have been utilised. L 205mm.

4609; 2090 A possible broken point, made from a s-size metapodial, L56mm, W10mm, mid-shaft T6mm. The tip is broken off making identification uncertain. A few cross-scratch-marks can be seen on the shaft.

4610; 1831 A lbsf, L65mm, W5mm, T5mm, from a broken bone tool. The tip is missing. The piece has multiple cross-grinding marks along one edge.

4613; 1831 A fragment of a pointed spatula, L43mm, W20mm, T4mm; s-size lbsf. The shaft is broken across, whilst the shaft at the other end tapers into a pointed, rounded tip which is broken. The surface condition is good and there are faint axial scratches along one edge.

4868; 1831 A broken point, L26mm, W12mm, T6mm; lbsf. The tip is blunt although the very end is broken. Axial scraping is seen on the edges and on the posterior face. Slight dark brown discoloration, darkening to nearly black on the anterior face towards the tip, may indicating burning.

4975; 1990 Two small refitting pieces of a probable antler handle. This is made from a piece of antler rounded to form the butt and with a probable socket although the latter is largely missing. L62.5mm, D18.5mm.

4976; 731 An unworked antler tine.

5941; 731 A red deer canine made into a pendant by cutting two notches on opposite sides of the root to enable a cord or thread to be attached. The notches are V-shaped and *c.* 2mm wide and 1.8 deep. The tooth has a patch of scratches on one side possibly from grinding to smooth and shape the tooth. L20.8mm.

5951; 1831 A small section of s-size rib with two shallow square-sectioned grooves on one side; one groove runs for the length and the other for only part of the length. Not apparent if functional or decorative. L44.8mm.

5976; 731 A near-complete awl made from a s/g metapodial with the fused distal end forming the handle. The shaft is cut across obliquely and a point has been shaped on the end; the tip is shorter than most awl tips and slightly asymmetrical in its shape. This could possibly have been reshaped following damage to the tip. The shaping has been done by cross and axial working. The tip end is broken off. L66.5mm.

Phase 12 – Northeast area

2013; 423 A dog metatarsal broken obliquely; the broken end appears to have been worked, possibly to a point, although the tip is missing. The worked end is smooth but no clear working marks are visible. L62.4mm.

3009; 527 A broken awl, L61mm, shaft W11mm, T8mm, probably from a s/g metapodial, broken below the distal articulation and split obliquely from the anterior face on the proximal end to give a short, fine-tipped point. The bone surface is smoothed and slightly polished on the tip's extremity.

3021; 531 An antler tine tip, broken into three pieces. It has a very smooth surface and a small group of cross-scratches and a slight facet at the tip. There is no definite working, and the wear could be from the deer. L51.3mm.

3122; 642 A blade-like tool formed from the blade of a c-size scapula; the caudal edge has been used as the main structure with part of the thin scapula blade retained and shaped to a smooth and irregular edge. Two shallow linear depressions, L30mm, W6mm, T1.5mm, are located near the caudal edge orientated on the long axis of the bone. A number of scratches running back perpendicular to the working edge suggest use in some form of scraping motion. L155mm, W 44mm.

3326; 473 A pendant made from an Odontoceti tooth, L58.6mm. The root end has been perforated with a circular hole (D5.0mm–5.5mm) perforated from both sides though these do not quite line up. At the top of the hole are two small notches, one at either end, caused by wear from a string or thong that the tooth has been strung on. The notches are *c.* 1mm deep. There are no working marks to show what the hole was made with.

3363; 470 A broken, probably double-ended needle, L46mm, W6.5mm, T2mm. This is a fine-tipped, rectangular-sectioned, moderately polished needle, broken towards the top of the eye, which is elliptical.

3374; 474 A near-complete awl, L98mm, shaft W9mm, T8mm, made from a s/g metapodial. The bone is split obliquely to form a fine tip *c.* L9mm. Cross and axial working scratches are visible on the tip and shaft. Half of the distal articulation is broken off. The point is lightly polished all over.

3482; 838 A piece of unworked whale bone.

3602; 470 The broken-off tip of a blunt point formed from an antler tine, L57.5mm. The tip is smooth and has a blunt rounded end. Just before the break a notch has been made on one side of the antler by chopping.

3855; 531 A near-complete awl made from a s/g metapodial, L77mm, obliquely split down one edge all the way to the tip, L42mm. The tip has been heavily worked and its extremity is broken; axial grinding and scraping scratch-marks form a very smooth tip with slight polish over the entire surface. The distal articulation is completely intact.

3868; 641 An unworked antler tine.

3585; 572 A flat piece of whale bone with the cancellous tissue removed. As a fragment from a larger piece, this may derive from possibly a blubber mattock/blade, a plaque or similar flat object.

3901; 473 An unworked fragment of antler.

3901b; 473 An unworked fragment of antler.

3923; 474 An unworked fragment of cetacean bone.

3953; 474 A broken needle, L38mm, W4mm, T3mm. There are extensive cross and oblique grinding marks from shaping. The needle is fairly straight and rectangular in section. The needle is broken at the eye and at the tip.

3955; 470 A broken pin, L25mm, shaft D2mm, highly polished, round-sectioned, slender and straight with a very fine point. There are axial scratches, possibly the result of working. The point is broken mid-shaft and the head end is missing.

3956; 474; A broken blunt antler point, L36mm, max. W6mm. The point tip has multidirectional scratch-marks mainly as a result of wear.

3957; 474 A blunt point, L59mm, max. W19mm, T6mm, shaped from a c-size lbsf to form a blunt tip which is highly polished. The polish obscures most of the working but there are traces of axial and oblique scratches. The tip is slightly wedge-shaped.

3961; 474 A broken whale bone object, L52mm, W25mm. The piece is part of a larger object so it is not possible

to determine its use. The piece is shaped and smoothed on most sides.

4201; 2000 An unworked piece of antler.

4206; 473 A fragmented red deer antler pick; the brow tine is worn down at the tip which shows extensive damage. Its poor condition means working and wear marks are difficult to see. Two pieces refit but 12 do not.

4213; 473 A whale bone disc, D61mm, T7.9mm. The disc is perforated with a roughly circular hole, D12mm. No working marks are evident. The thickness and weight may suggest a different use to other small perforated discs from the site.

4214; 473 An unworked piece of antler.

4298; 470 A near-complete awl, L84mm, shaft W12mm, T9mm, made from a s/g tibia. Obliquely split, a fine point has been manufactured on the proximal end with a polished tip. There are multiple cross-grinding marks on the edges and anterior face below the tip. The distal end is complete and intact.

4604; 470 A complete double-ended pin, L67mm, shaft W4mm, T2mm. This lbsf is straight and highly polished with one fine end and one blunt end. The ends are rounded in section with the shaft flatter and more rectangular in section. The good surface condition preserves evidence of axial working under the high polish.

4780; 474 An unworked piece of antler.

4782; 473 An unworked piece of antler.

4783; 473 An unworked piece of antler.

4808; 474 A shed antler base with part of the beam attached. The beam has been cut or broken squarely across. Its poor condition precludes any idenfication of working marks. L77.1mm.

4811; 474 A fragment of split c-size rib with both ends missing, L101mm, shaft W15mm, T3mm. This is a smoothed piece, with axial grinding marks running along the shaft on its posterior face.

4824; 572 A pointed bone spatula, L53mm, mid-shaft W13mm, T1mm. This is a very flat spatula, fashioned from a rib to form a flat point.

4835; 531 A fragment of a whale bone object with a smooth and polished surface. This was possibly part of a blade or mattock-like tool. L51.0mm, T24.4mm.

5555; 531 A broken point made from a s-size axially split metapodial shaped to a fine point (tip missing) by axial and cross working, possibly by a mix of grinding and scraping. L51.5mm.

5861; 2000 A splinter of antler removed from a beam or tine; the edges of the splinter have been cross ground to shape and smooth the piece. L103.8mm.

5899; 423 A probable small point shaped on the shaft of a s-size ulna. The surface condition means that no working or wear marks survive. L54.0mm.

5924; 474 A broken point made from a s-size metapodial; only the tip and part of the shaft remain. There are faint axial working marks at the tip which is asymmetrical. L54.5mm.

5934; 531 A cattle-sized metapodial, shaped to a short point. The tip end is missing but there is axial working near the tip. The proximal end of the bone is fused and there appears to be the remains of a hole through the articular surface similar in diameter to the medullary cavity. However, it is uncertain if this was a complete hole or just the cleaning of the medullary cavity during manufacturing. L61.9mm.

5945; 572 A splinter of antler beam or tine with the remains of a groove cut at one end. There are also several scratches running parallel with the groove. L82.3mm.

5869a; 473 A piece of antler from the side of a beam or tine. One end has been grooved around to snap and the other has a modern break. The groove has been cut in a series of sections. L92.2mm. There is also a small fragment of similar antler.

5869b; 473 A splinter of antler tine, the surface of which has been smoothed; there are cross-scratches on the smoothed surface. L50.9mm.

5935a; 473 An antler tine; one side of the tine tip has been shaped and smoothed and there are a few possible cross-scratches. Cancellous tissue is just beginning to be exposed. L72.2mm.

5935a; 473 An antler tine with damage around the tip, some of which appears to be from chop-marks. The tip of the tine is squared off and blunt. L52.4mm.

5992a; 473 Two small pieces of s-size rib that refit. These have two shallow square-sectioned grooves on one side. It is not apparent if these are functional or decorative. L79.1mm.

Phase 12 – South area

3134; 411 An unworked antler tine.

3614; 1441 An unworked piece of antler in fragments.

3898; 1441 An unworked piece of antler.

4196; 1441 A reasonably straight, near-complete polished pin, L67mm, shaft W5mm, T4mm; lbsf. One end of the pin is fine-tipped, almost triangular in section, with cross-grinding marks near the tip. The other end is more rectangular in section, blunt, and rounded. The pin has a thickened waist.

4207a; 2011 An unworked piece of antler.

4207b; 2011 An unworked piece of antler.

4209; 2011 A possible handle made from antler. The end for inserting the tool is broken off and damaged. The butt end has been shaped by cutting through and rounding off. L80.8mm, D29.2mm.

4226; 2097 An unworked piece of cetacean bone.

4233; 2093 A complete blunt point made from a cattle metapodial, L128mm, mid-shaft W17mm, T14mm. This is a slightly curved piece, split longitudinally from the proximal articulation. The tip of the point is blunt, with slight damage in the centre of the tip. Extensive cross-grinding evidence is seen especially along the edges from the tip to about halfway down the shaft. Multidirectional marks are visible on the anterior and posterior faces around the tip.

4297; 1441 An unworked piece of antler.

4338; 2011 A pointed spatula, L43mm, shaft W11mm, T3mm. The lbsf is a tip fragment with a narrow and rounded end. Polish can be seen around the tip's edges.

4339; 1441 A tip fragment from a point, L35mm, max. W9mm, T5mm. This is a slightly curved point, with a tip apparently blunted from use. The shaft is lightly polished as well. The tip is sub-rounded in section.

4862; 1441 An unworked piece of antler.

5886; 2011 Three small fragments of antler, two of which refit. There are chop-marks at one end of the refitting pieces that may have formed part of a groove. L26.3mm.

5895; 1441 A chip of antler probably removed by chopping the antler. It is thin and slightly curved and not dissimilar to a wood chip. L23.6mm.

Phase 13 – House 401

2003; 1003 A broken awl made from a s-size metatarsal; the bone is broken with the handle end missing. The shaft is broken obliquely and a fine point is shaped at the end. Axial and oblique scraping have been used and a moderate polish has developed at the tip end. L79.1mm, tip L26.5mm, shaft W9.3mm.

3000; 521 A complete polished expedient point made from a c-size ulna, L115mm, max. W11mm, T4mm. The point is curved with a slight shoulder on one edge with a fine tip. The non-tip end is broken diagonally and polished from wear over the break.

3002; 517 A complete polished pin, L56mm, shaft D2mm, head W5.1mm, head T2.1mm; lbsf. The pin is round-sectioned, highly polished and with a fine point leading to a moderately flattened and flared head.

3003; 512 The end of an antler tine; the surface is very damaged and battered some of which comes from a series of chop or deep cut-marks on one side of the tine. L68.3mm.

3005; 517 An antler tine with a smoothed but uneven surface; the tip has a high polish and there are several axial and oblique scratches probably from wear and five small but deep cut-marks. L130.1mm.

3006; 517 Unworked red deer antler beam base.

3014; 513 A broken point, L66mm, max. W11mm, T6mm. This is the tip from a large c-size lbsf point, with a fine round-sectioned tip, broken through the point shaft on the non-tip end. Oblique working marks on the tip's edge are visible, with axial scraping marks around the tip.

3015; 513 A splinter of long bone with cross-grinding along one edge. The splinter is broken off a larger object but there is insufficient evidence to determine what the complete tool could be. L117mm, shaft W13mm, T6mm.

3016; 513 A point made from a c-size lbsf, L116mm, shaft W13mm, T6mm. The broken tool is fashioned into a round-sectioned fine tip. There are axial working marks along the tip and oblique ground marks along one edge.

3027; 465 A near-complete point, manufactured from a s/g ulna, L82mm, shaft W5mm, T3mm. The very top of the distal end is broken. The ulna shaft has been fashioned into a tip, slightly polished all over, with a few scratch-marks, mainly axial from scraping.

3032; 521 A broken-off red deer antler tine with a smooth surface, rounded and blunt tip, and numerous cross-scratches on the shaft, possibly from wear. This could be a tine from an antler pick. L87.6mm, shaft D19.4mm.

3050; 520 A red deer antler tine with a smooth tip and fine cut-marks across the tine on its inner curve. The tip end is damaged with a chip broken off and the broken surface smoothed. L85.9mm.

3053; 465 An expedient point, L56mm, max. W11mm, T4mm. A long bone splinter fashioned into a narrow fine-pointed tip; faint axial marks near the tip may be from working.

3055; 465 A red deer antler tine broken into four large and five small pieces that refit. The tip is smooth and polished but this could be natural damage. The tine has been removed from the beam, probably by groove-and-snap as there are several deep cut-marks across the tine just where it has been broken, although most of the original break is missing. L144.3mm.

3057; 465 Unworked red deer antler base.

3059; 465 A red deer antler pick made from the beam and first tine. The tip of the tine is missing and both the tine and beam show extensive polish. The piece is broken into three pieces but these refit. L265, tine L130mm.

3072; 565 A complete awl, L159mm, max. W26mm, T18mm, made from a cattle ulna. It is split longitudinally through half of its proximal end and along the shaft; this tool is fashioned into a round-sectioned fine-tipped point with heavy cross and axial working around the tip.

3075; 465; An unworked red deer antler tine in six pieces.

3081; 597 A complete awl, L85mm, W14mm, tip L66mm, made from a s/g metatarsal. The proximal articulation has a circular, central perforation making the piece hollow. The shaft has been obliquely split down the edge to give a quite fine tip. The piece is polished all over its surface.

3099; 465 A broken needle, L42mm, shaft D2mm, max. W2mm. The needle is highly polished, and is slightly curved with a fine tip. The piece is broken at the very beginning of the head but the start of a central, circular perforation can be seen.

3403; 1105 A red deer antler pick. Its blunt, rounded and abraded point is on the bez tine, very close to the brow tine; the burr is quite worn down while the beam is broken between the bez and trez tines. The antler is shed.

3404; 1113 A complete spindle whorl, D34mm, T15mm, made from a c-size femur head. The head is trimmed horizontally to create a dome-shaped piece, which is centrally and perpendicularly perforated.

3406; 663 A tooth pendant, L45.2mm, W13.3mm, T7.5mm, from a dog canine. A hole, D3.1mm, has been drilled

through the root from both sides and the holes do not line up. A notch has also been ground into the root on the front edge just above the hole. It is unclear why a hole and a notch would have both been needed.

3426; 1108 A broken and highly fragmented cattle scapula shovel, L269mm, max. T23mm, min. shaft W53mm. The glenoid has been cut down on the lateral side and the spine removed. Most of the blade end is missing but the surviving bits show rounding and wear scratches. A patch on the edge of the neck next to the glenoid is discoloured black, *c.* L40mm.

3427; 1108 A heavily fragmented cattle scapula tool, L282mm, min. shaft W46mm. The spine is broken and there is some rounding of the broken surface but no other evidence of working or wear.

3589; 585 A near-complete bone bead made from a drilled fish vertebral body, D20mm, T10mm. The central circular perforation, D5mm, has a slight notch on one side that may be from having been strung on a cord.

4253; 861 A near-complete toggle, L35mm. A notch is evident running all around the piece *c.* L5mm. The notch section is flat and separates two perfectly flat-headed cone-shaped shafts, circular in section. The bone surface is smooth, with sporadic scratch-marks in the notch.

5533; 585 A fragment of a burnt point tip in 2 pieces. This has been scraped axially with some cross working. L2.27mm.

5554; 597 The smoothed tip of a pin or needle, round in section, no working evidence surviving; lbsf. L31.7mm, shaft D2.8mm, tip L7.0mm.

5870; 465 A small, fine, near-complete point made on a s-size lbsf. Though pin-like, it is less extensively worked than most pins and it does not have a head. L53.6mm.

5877; 465 A small and fine curved point made from a s-size rib fragment. The tip is fine with faint evidence of axial working, which is also present on the surviving shaft. The handle end is missing. L52.1, shaft W4.6mm.

5897; 663 A piece of antler split axially with both ends extensively worked; one end has been chopped to form three facets which form a tapering end to the piece. The other end has two V-shaped notches, cut by chopping, that extend a third of the way through the piece, The notches are asymmetrical and near-vertical on the inner side while on the other side they are much shallower and form a tapering side which is broken through. The overall effect is of a parallel-sided piece with a blunt end opposing a fishtail-shaped end. None of the chopped surfaces show further working, giving an unfinished appearance to the piece. L46.0mm, W26.5mm.

5898; 465 A broken point made from a s-size ulna shaped to a point at its distal end. The point end has a light polish but no working or wear marks. L72.8mm.

Phase 13 – House 150

1059; 233 A small flat square piece of blue whale bone cut from a piece split so one side is dense compact bone and the other is cancellous tissue. The two edges have been shaped with bevelled edges. One end is cut across square and one is broken. L36.8mm, W27.3mm.

1097; 241 A smoothed and shaped splinter of antler; the piece is broken and the full tool is unidentified.

Phase 14 – House 1500

3613; 1435 An unworked blue whale bone fragment.

3618; 1435 An unworked cetacean bone fragment.

3631a; 1436 Two fragments of blue whale bone that refit to create a whale bone rod, L270.5mm, T34mm. The rod is irregular in section: one side is compact dense surface bone and the other is cancellous bone that is smoothed and mostly removed. One end of the rod is rounded off to a blunt end and shows some chipping damage. The other end is also rounded with black discolouration probably from burning.

3631b; 1436 A fragment of whale bone, probably the end of a rod similar to 3631a but with the shaft and other end missing.

3633; 1436 A complete perforated awl with a slightly blunt end, manufactured from a red deer metatarsal, L114mm, tip L81mm. This is a point whose shaft is longitudinally split for most of its length with the proximal end as the handle and the blunt tip shaped on the split shaft. Polish obscures any working marks. The proximal end is polished, with a centrally broken perforation through the end presumably for attaching to a string or thong. Black discoloration is visible on the tip's extremity.

3635; 1436 A broken point, L91mm, max. W12mm. This c-size lbsf has a highly polished medium-fine tip end. Polish is also visible along the edges almost all the way down the length of the piece.

3654; 1436 A complete blunt point, L111mm, tip L50mm. This is a robust tool, whose cattle metapodial shaft has been broken obliquely and a blunt point shaped on the end of the break. The fused distal end forms the handle. Sporadic multidirectional scratch-marks are evident on the shaft and tip. The broken edges of the bone have been worn smooth from the tip almost back to the break.

3655; 1436 A broken point, L67mm, max. W7mm. The s-size lbsf is split longitudinally and worked into a round-sectioned tip, L30mm, the end of which is broken off. The poor condition of bone preservation makes it difficult to observe polish or scratches.

3656; 1436 A near-complete point, L83mm, max. W15mm. This is a c-size metapodial shaped into a medium-fine, fairly short point, highly polished around its tip. It has highly sporadic cross and oblique working marks; the 'handle end' is broken square across the bone and has scars from chips removed from the end.

3657; 1436 A broken point, L101mm, shaft max. W14mm, T7mm. This is a c-size lbsf, shaped to a point possibly by axial scraping; the tip is damaged with the end broken off.

3658; 1436 A broken point, L108mm, max. W18mm. This is a c-size metapodial shaft fragment shaped to

a medium-fine point, quite highly polished around the tip with cross-grinding marks from shaping the tip. A number of deep cut-marks are visible running across the shaft about halfway down the shaft.

3659; 1436 A complete expedient point, L72mm, shaft W6mm, T3mm; s-size lbsf. This has a fairly blunt tip which is slightly polished with a few cross-grinding scratch-marks.

3662; 1436 An unworked antler tine

3671; 1436 A broken blunt point made from a splinter of antler, L70mm, shaft T8mm, max. W11mm. The tip is rounded in section, with polish evident on the sides.

3720; 1596 A near-complete needle, L69mm, W3mm increasing to 5mm towards the eye, mid-shaft T2.5mm; lbsf. This is a straight, highly polished needle with a very fine tip. The piece is broken across the eye, which appears to have been round. The shaft has been worked by cross-grinding while the tip was axially scraped.

3722; 1596 A complete point, L79mm, shaft T3mm, max. W6mm. This slender s-size lbsf point is split longitudinally and shaped to form a fine polished tip. Oblique grinding is visible along the shaft edges, with axial scraping near the tip.

3723; 1596 A complete pin-like point, L77mm, max. W6mm; lbsf. The tool is slightly curved, slender, lightly polished with a reasonably fine tip. Multidirectional scratch-marks are evident, being especially prominent along one edge towards the head end. Axial scraping marks are also visible on one edge.

3749; 1615 A fragment of the tip of a point, L33mm, max. W6mm, T3mm. This c-size lbsf is quite polished towards the tip with axial working scratches from scraping.

3764; 1621 A complete spindle whorl, manufactured from a cattle femur head, D38mm, T17mm. The piece is trimmed on top and bottom to leave flat surfaces. A circular perforation through the centre of the piece expands into a cone shape towards the bottom.

3798; 1752 An expedient point utilizing a s-size lbsf, L56mm, shaft W5mm, T3mm. The tool is fairly straight and has a few cross-scratch-marks on one edge and a few axial scraping marks on the tip but is largely unchanged from the bone splinter.

3851; 1436 A complete pin, L82mm, max. D3mm. This is a curved and polished pin, circular in section with a fine tip. The head is flattened with a rounded top. There are extensive axial scraping marks all over the pin from working.

3864; 1596 A large flake and three small fragments of antler, L118.5mm, W48mm, T15mm. The flake has a fine edge on three sides, which does not appear worked or worn. On the fourth side the edge is rounded and worn, evidence that the flake broke off a larger, rounded object.

3867; 1596 A complete peg, L17mm, max. D3mm. The peg is roughly oval in section and both ends have been broken off after being partly cut through. Axial working can be seen on the shaft.

3899; 1457 An unworked antler tine.

5936; 1436 A piece of scapula forming a bladed tool. A long section of blade from the side of the c-size scapula has been shaped by cutting parallel to the edge of the blade. There are some axial scratches along the shaped blade's edge. the handle end is broken through.

Phase 14 – House 401

2030; 462 An incomplete scapula tool, L104mm, max. T24mm, min. shaft W33mm. Of its 15 fragments, 1 large fragment consists of a complete distal articulation. The bone surface is smoothed with occasional oblique grinding on the edge towards the articulation.

2057a; 462 A broken expedient point, L73mm, W7mm–8mm. This is a long bone splinter with evidence of scraping mid-shaft along broken edges to shape it. There is no evidence of working on the tip which is quite fine.

2072; 462 A complete, thick, circular disc, D16mm, T7mm. The disc is discoloured black all over from burning. It is highly polished with faint multidirectional scratches all over.

2077; 462 A complete composite artefact of three pegs and two antler side plates, both with two holes. Plate a (L75.3mm, W20.8mm, T5.8mm) has the holes D5.7mm and 5.6mm. Plate b (L72.8mm, W18mm, T4mm) is broken but refits and has holes D4.8mm and 4.9mm. The two plates have been shaped by cutting and chopping and some oblique grinding on the edges. The plates appear quite roughly finished and they may not have been completed. One plate has two pegs through its holes and the other has one. The pegs are sub-rounded and faceted from shaping by axial scraping. One peg tapers and two are straight-sided. The pegs are L26.2mm by D5.8mm, L24mm by D5.7mm, and L35.9mm by D5mm.

2079; 462 A complete spindle whorl made from a cattle femur head, max. D39mm, T25mm. The piece is worn down to the cancellous bone on the base. A central circular perforation can be seen, D10mm, with the top around the perforation flattened. It is unclear if the bone is from a fused or unfused bone but it may be that an unfused epiphyseal head has been used.

2081; 462 A broken blade-like c-size scapula tool, L106mm, max. W54mm, T10mm. This piece has a curved edge made on the blade that runs along one side. The handle end is broken across its width. Long curved, axially ground marks are visible on one face and on the shaped edge.

2082; 462 A complete point, L106mm, shaft W13mm, T5mm. This is a fragment from a c-size lbsf with a point shaped on the tip. The tip is round-sectioned, fine and highly polished. Numerous small cross-grinding marks can be seen around the tip, with axially ground marks along the posterior face and further down the tip.

2083; 462 A complete pin, L57mm, D4mm; lbsf. The pin is highly polished and is round-sectioned with a fine tip.

The head is slightly flattened and wider. Slight damage on the head but this appears old as the break surface is lightly polished probably from wear. Cross-grinding is visible around the tip and shaft.

2084; 462 A complete expedient point, L145mm, W23mm; lbsf. The tip, which does not appear to be shaped, is slightly smoothed and polished.

2085; 462 A broken point manufactured from a s-size ulna, L55mm, W7mm, T3mm. The point is curved and broken below the proximal articulation. The point has been manufactured on a break mid-shaft on the ulna. Fashioned into a fine tip, the point is highly polished all over with small cross-grinding scratch-marks near the tip.

2086; 462 A complete expedient point, L60mm, T3mm, W4mm. This is a slightly curved point, broken expediently to form a tip at one end, with very slight polish on the very end. The shaft is trapezoidal in section, forming another expediently broken end with a fine point whose tip is slightly polished. Slight polish is also seen on shaft faces.

2089; 462 Thirteen fragments of unworked antler.

3168; 462 A small circular disc, possibly made from a scapula blade as an ornament. The bone has a small hole just off centre and this was drilled from one side only. The bone is polished from use and has numerous fine scratches from wear.

3322; 462 A complete double-ended pin, L62mm, D3mm. It is highly polished, with a fine round-sectioned point at one end. The shaft diameter increases towards the other end, which then tapers to an abrupt fine tip with a flatter, more oval section. Axial scraping marks are visible running all along the pin.

3323; 462 A broken point, L62mm, W5mm; s-size lbsf. The point is highly polished with a flattened tip on a round-sectioned shaft. The shaft is slightly curved and retained some faint axial scratches from working that have been mostly obscured by later polish.

3324; 462 A broken point, L92.2mm, T12.5mm, W16mm. Made from a sheep-size tibia shaft fragment, this is broken diagonally across the shaft and shaped to a tip with axial oblique scraping. The handle end is broken. The piece is slightly polished towards the tip.

3325; 462 A near-complete spindle whorl, D31mm, T16mm, manufactured from the unfused proximal epiphyseal head of a c-size tibia? The piece has been shaped into a roughly circular form, with a circular central perforation. The piece is worn down to cancellous bone around the basal edge, and over much of the flat base.

3993a; 462 A complete expedient point, L70mm, W5mm, T3mm. This is a s-size thin bone splinter; the tip is shaped by axial scraping and is slightly polished.

5972; 462 An antler tine probably from the crown of the antler. The tine has been grooved around where it joins the beam and has been snapped off; the groove has been cut in a series of sections. L88.2mm.

5980; 462 The broken-off tip of a point made from a c-size lbsf and shaped by axial scraping. L40.0mm.

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38; 452 A small s-size spatula tool with a rounded end. The bone is split and the tip has been shaped by cross, axial and oblique working probably by scraping; the tip and shaft have a light polish. L52.2mm, W5.3mm.

39; 466 A probable antler pick but the brow and bez tines are missing broken off, therefore this cannot be confirmed. The antler was shed and the burr is damaged and worn down possibly from use. The antler is in ten pieces. No measurements could be taken.

40; 466 A probable cattle scapula shovel; the spine has been removed and the rough edge has been smoothed off probably by wear. Most of the blade is missing but a small section survives and here it can be seen that the blade has a worn and indented edge. In addition there are indentations on the neck of the scapula for holding the shovel.

2007; 433 A small fragment of lbsf which appears to be from a tool, possibly spatulate in form, manufactured from a split long bone. There are no wear marks and the identification is based on shape alone. L30.4mm.

2020; 452 An antler pick, made from a shed antler. The brow tine has been heavily worn down and is now short although the tip appears to have been shaped to give a blunt point. The bez tine has been broken off following grooving part way around.

2021; 452 A complete pin, L54mm, D3mm; lbsf. The pin is highly polished, with a rounded blunt head, round-sectioned, which gradually tapers to a quite fine tip. A few probable axial marks from manufacture can be seen running down from the tip ends.

2022; 452 A near-complete broad-ended c-size scapula tool, L241mm, max. T17mm, min. shaft W47mm. The scapula tool is split diagonally down from the top caudal edge, which is fashioned into a round end, worn through use. The curved edge is also worn, running down to the middle of the shaft. The piece is slightly polished, more so towards the tip end.

2023; 452 A near-complete, cattle scapula tool, L270mm, min. shaft W50mm. This is a blade-like tool, or a broad-ended tool with a deep notch in the end which extends to the centre of the blade. A number of oblique cut-marks are present on the neck of the scapula.

2024; 452 An incomplete, cattle scapula shovel, broken into three pieces, L264mm, max. T27mm, min. shaft W63mm. Much of the blade is missing as is the spine; there is no clear evidence of working but there are the remains of cut-marks from butchery. The blade end appears slightly worn and smoothed suggesting use.

2025; 452 A broken antler pick, the base of which is shed and the burr worn down. The brow tine is heavily worn and is now short and round-ended. The bez tine has been broken off.

2026; 452 A complete awl, L108mm, W23mm, T17mm. This point is made from a c-size metapodial, split obliquely from the side and fashioned into a round-sectioned point. The tip is rounded and blunt but its condition is poor and it may have been sharper once.

The distal epiphysis is fused and complete, and has been worn flat through wear. The piece is smoothed and has various multidirectional scratch-marks around the tip and shaft.

2027; 452 A red deer antler base with short sections of beam and brow tine attached. There is smoothing and polish on the base which is shed. This may be part of an antler pick.

2028; 452 A total of 38 fragments of antler, some of which refit. Two heavily worn tine tips and one piece of beam with grooving from groove-and-snap show working and wear but it is not possible to determine what tool or tools are present.

2038; 452 A complete point, L52mm, W9mm; lbsf. This is a scoop-sectioned fragment, fashioned into a flat, round-tipped point, quite similar to a spatula. Cross-grinding is visible on one side of the posterior face with axial ground marks running down the middle of the posterior face from the tip as well as along the edges. Iron-stained discoloration can be seen all over the surface.

2040; 466 A complete c-size scapula tool, L226mm, max. T21mm, min. shaft W46mm. It is split diagonally from the top caudal edge, which is fashioned into a round-cornered square end, W28mm, worn at the end through use. The lateral ridge is also worn due to use. Just below the split on the cranial side of the medial face, a diagonal patch of bone (L20mm) is worn flat through oblique grinding.

2041; 466 A near-complete, rounded scapula tool, L233mm, max. T24mm, min. shaft W47mm. The tool is split horizontally down from the top caudal edge, which is fashioned into a rough round end, worn down to the cancellous bone through use. A worked edge runs down from the caudal tip to the middle of the shaft and then horizontally across to the cranial side. Deep oblique grinding marks are visible down the caudal edge on the lateral side. Small horizontal facets can be seen on the medial side.

2041; 466 A small, smoothed bone fragment, L38mm, W9mm, T4mm. Broken at one end, the face on the other end is worked to provide a diagonal slope down to a broken end.

2047; 466 An antler pick broken into 10 pieces; the beam is highly fragmented. The tip of the pick point is missing and the bez tine is broken off possibly during manufacturing. The antler was shed.

2055; 466 A highly fragmented and incomplete probable scapula tool, with identification of tool type impossible due to fragmentation. The bone surface of the larger fragments is smoothed, with sporadic scratch-marks above the distal articulation fragment, which is intact and complete.

2056; 450 An incomplete and heavily fragmented cattle scapula tool, possibly broad-ended. A large fragment consists of the complete distal articulation and part of the caudal side. The spine has been removed and the break smoothed off. A series of facets on the edges of the tool are smooth and form four shallow notches on the caudal side and one on the other side. A small hole or notch in the centre of the blade survives in part. The edge of the blade was shaped and smoothed at least in part.

2063; 452 A worked c-size rib, L83mm, W13mm, T3mm. The rib is cut through at one end at an oblique angle and the cut surface shows some polish that may be due to wear. There are prominent horizontal cut-marks from butchery on the shaft.

2065; 466 An unworked antler tine.

2066; 469 A broad-ended cattle scapula tool broken into ten pieces that have been refitted. Most of the blade end is missing but one small section on the edge near the blade end shows a shallow concave curve that may be due to working or wear. The spine is also missing possibly having been deliberately removed. L245mm.

2067; 469 A blue whale bone rib fragment split to provide a flat blade; both ends and one side are missing and no working or wear marks are visible. L108.3mm, W 58.5, T194mm.

3319; 469 A near-complete awl, L128mm, W14.2mm, T10mm. This c-size lbsf is a robust bone tool, scooped and triangular in section, and is fashioned into a round-sectioned, quite fine-tipped point. Polish is seen all over, especially around the tip and down the edges. The non-tip end has been horizontally broken and possibly cleaned up by chipping. Both cross and axial grinding can be seen around the tip.

5955; 466 Two fragments of s-size rib. The surface on the outer curve of the rib is missing, exposing the cancellous internal structure. The missing outer surface appears to have been removed or worn away by some form of abrasive or rubbing action, but no scratch-marks are visible.

5987; 466 The broken tip of a point made from a lbsf. The tip is fine and has faint axial and oblique scratches around it with light to moderate polish over most of its surface. L53.0mm.

5988; 466 A cattle-sized metacarpal shaft fragment, one edge of which has several marks from where chips have been removed. It is uncertain if this is deliberate bone working or accidental damage. L46.8mm.

5918a; 466 A red deer antler tine tip, the end of which has been smoothed and rounded leaving a patch of cancellous tissue exposed. L64.5mm.

5918b; 466 A red deer antler tine tip, the end of which has been smoothed and rounded, leaving a patch of cancellous tissue exposed, A chip has come off the tip of the tine and this exposed break has then been smoothed off by further wear. L116.4mm.

5918c; 466 A red deer antler tine tip; the end is broken but it appears that the end was smoothed and rounded exposing cancellous tissue before the damage to the end occurred. There are also several scratches and scrapes on the antler mostly axially. L118.7mm.

5996; 452 A rectangular antler side plate with two holes drilled through, one at either end The plate is

L64.4mm, W18.5mm, T6.6mm. The outer surface is slightly curved using the natural curve of the antler. The two holes are D4.9mm and D4.4mm. There are no marks of working or wear due to the bone surface's condition.

Phase 16 – House 401

35; 451 A probable pin, L32mm, D2mm–3mm. The pin is round-sectioned with a fine tip, which is slightly flattened. Broken horizontally across the shaft, the pin is fragmented into two pieces. The bone surface is slightly smoothed.

2012; 407 An unworked red deer antler tine.

2016; 403 An unworked piece of red deer antler.

2017; 403 A fragment from the tip of a lbsf point, with high polish and some possible faint axial working marks. L26.2mm.

2018; 403 The broken-off tip of a lbsf point, The point is made on a split long bone and is flat in section, the tip is fine and shows some axial working marks. L53.4mm.

2057b; 409 A near-complete bone needle, L57mm, W2.6mm. This lbsf is slightly curved and polished with a round-sectioned tip end, diagonally broken at the very end but still polished from use. The shaft flattens two-thirds along the shaft towards the head end, which is flat-headed and highly polished from use, with rounded corners. At 2mm from the head (W3.6mm, T1mm) is a central, circular perforation, D2mm.

3049; 587 A complete pin, L82mm, D2.6mm, with a head (D1.5mm). This very slightly curved, round-sectioned lbsf is highly polished with a fine tip. The head is rounded, giving the appearance of a blunt point. Axial working is visible running down from the tip and surrounding the shaft.

3321; 451 A near-complete double-ended pin shaped from a lbsf, L56mm, W4mm, T3mm. The pin is oval in mid-section, its fattest point, and tapers to both ends. At one end is a sharp but damaged point while the other end is slightly rounded and blunt. The piece is slightly curved and highly polished all over with axial scratches from working. An axial groove runs along one side of the mid-shaft.

3992; 451 An unworked antler tine.

5549; 409 A fragment of an expedient point, shaped from a lbsf to a rough point at one end by axial scraping. L99.9mm.

5553; 407 A near-complete point made on a lbsf smoothed to a point at one end. The tip is quite fine but is made on a crude rough-out. There are faint remains of axial working. L62.0mm.

5559; 409 The tip of a broken point; the tip is smooth and tapers from a wide lbsf shaft. The bone is burnt and this obscures working but some axial scratches survive. L45mm.

5856; 409 A small antler with the base and beam; the brow tine is missing and the stump appears smoothed off and is apparently worked although working marks are absent. The antler is shed but the burr is mostly missing.

5857; 688 A small fragment of antler with a small patch of cross-grinding marks on one broken edge. L32.1mm.

5900; 684 A c-size scapula blade fragment with slight damage on the end that could be from abrasion, with a light polish on the bone surface. L77.1mm.

?; 409 An unworked red deer antler fragment.

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3018; 542 A point tip, L24mm, D5mm. Only the tip of the lbsf point remains, hexagonal in section and cone-shaped, with a reasonably fine tip. Two very small notches are cut into one corner edge, whilst a larger notch made from a number of smaller notches can be seen on the opposite side. Polish can be seen all over the surface.

3030; 534 An antler tine tip, very smooth and polished but no other working or wear; the tip is blunted.

3132; 627 A broken red deer antler pick with the brow tine as the point; this is smoothed and worn down with a rounded end. Cross-wear scratches are present on both sides of the brow tine. The bez tine is removed down to a stump. A groove has been cut across the beam next to the bez tine on one side. The antler is shed.

3137; 545 A near-complete expedient point, L68mm, W14mm, T12mm. This is a s/g ulna? split longitudinally across half of the proximal articulation, with polish on the point tip.

3138; 627 A complete awl, L145mm, W19mm, T17mm, with a tip L72mm. This is a cattle metapodial, with the top of the distal articulation horizontally flattened. The shaft is split obliquely from the side and worked to a fine round-sectioned tip. A series of quite deep, short scratch-marks and grooves are seen around the tip, decreasing along the posterior face. Axial scraping marks are visible on the edges of the tip, as are multidirectional marks around the shaft-tip interface.

3152; 639 A section of red deer antler beam broken in two pieces that refit. The beam is broken squarely at both ends where the cancellous tissue has been removed to leave hollows in the antler, 77.6mm and 61.0mm deep. L178mm, D30.2mm.

3160; 639 A complete awl, L76mm, W14mm, T8mm, with a tip L29mm. Split obliquely from the anterior face, this s/g metapodial has a fine tip, smoothed with slight polish. Faint axial working marks can be seen around the tip, with more prominent cross and axial ground scratch-marks overlying them towards the tip-shaft interface on both the posterior and anterior faces. Towards the distal articulation, which is intact and complete, the condition of bone preservation decreases.

3203; 632 A highly polished broken awl, L64mm, W14mm, T10mm, with a tip L39mm. This s/g metapodial is

broken just below the distal articulation, the shaft having been obliquely split from the side/anterior face edge to form a fine tip. Faint oblique grinding marks run down from the tip's edge.

3569; 632 An unworked broken cetacean vertebral epiphysis.

3965; 632 An antler tine tip smoothed and polished with extensive scratching; some appear to be cut-marks but others are probably damage from wear. The tip is damaged and blunted. L61.5mm.

3968; 632 An antler tine tip well smoothed, with some scratches and damage possibly from wear. It also has some fine cross cut-marks near the tip. L65.0mm.

4828; 584 An unworked broken blue whale vertebral epiphysis.

4841; 646 A broken blunt point, L103mm, mid-shaft W15mm, T9mm. This is a very slightly curved c-size lbsf with a few axial working scratch-marks and polish over most of it except towards the non-tip end. The shaft visibly tapers into a blunt tip which is highly polished.

4842; 638 A broken awl, manufactured from a s/g tibia, L72mm, W12mm, T10mm. The distal articulation is unfused and missing, whilst the tip is fashioned on the obliquely split shaft. The tip is broken but axial working marks survive. The bone surface is smooth all over.

5447; 632 The tip of a fine point, L35mm, mid-shaft W8mm, T3mm; lbsf. The very tip of the point, less than D1mm, has been snapped and there are longitudinal scratch-marks along the point. This could be the end of a needle.

5541; 534 A broken pin, sub-rounded in section with moderate polish and a slightly blunt tip. L18.8, D2.5mm.

5556; 627 The fine tip of a pin or needle, sub-square in section. Smoothing of this lbsf has removed any working evidence. L2.07mm.

5901; 645 An unworked cetacean bone fragment.

Phase 16 – House 150

1023; 160 An unworked blue whale bone fragment.

Unstratified

42; u/s A complete perforated disc, D39mm, T3mm, manufactured from the blade of a c-size scapula. It has a central, perfectly circular perforation, D3mm, and very faint scratch-marks, multidirectional, on one face. The disc edges are squared off to the disc surface.

2001; u/s A near-complete awl made from a s-size metapodial. The shaft is cut obliquely to form a point with a tip that shows some axial working and a light polish; the end of the tip is broken off. Midway along the shaft, a notch has been cut into the marrow cavity, Either side of the notch are further small grooves. L85.0mm, W8.5mm.

2019; 1005 A broken whale bone blade. Both ends are squared off and both surfaces are flat and smooth (but this may be exploiting the natural smooth bone surface). At one end, the edge has a wedge-shaped profile. L153.8mm, W 85.0mm, T31.1mm.

3024; u/s A fragment of antler tine or beam grooved around and snapped at one end; the groove was made by chopping. The other end is broken. L41.9mm, D20.9mm.

3028; u/s An unworked antler tine.

3083; 592/465 An unworked antler tine.

3084; 592/465 A broken-off antler tine; the tip end is very smooth and has numerous multidirectional cut-marks around it. L87.8mm.

3327; u/s A near-complete double-ended pin, L44mm, D2mm. This lbsf has a rounded blunt tip at one end, almost rectangular in section, whilst the other end is fashioned into a fine tipped, round-sectioned end. The piece is smoothed, but not really polished and is fragmented into two pieces.

3355; 400 A canine probably from a female pig, L48.3mm, shaped by grinding notches deep into the root. Two notches at the interface between tooth and root, one on the front and one on the back. Further up the root a notch runs three-quarters of the way around, deep enough to cut into the cavity in the centre of the root.

3358; 400 A piece of unworked antler.

3366; u/s Half of a perforated Odontoceti epiphyseal disc, D84mm, perforated at its centre with a circular hole D11mm. There are no other signs of working or wear.

3385; 400 An expedient point, L85mm, shaft W12mm. Tip is blunt with slight polish traversing its circumference; otherwise no other polishing is evident. A small patch of oblique, possibly grinding, scratches near the tip and down one edge.

3413; 400 A splinter of bone shaped by extensive working until it is circular in section, L80mm, max. D6mm. Blunt rounded point at one end with very slight polish at the tip. The shaft is consistent in size and shape. The other end is missing, broken off. This piece does not look like a typical point: it is more extensively worked and the shape is unusual. The working marks show extensive oblique grinding.

3597; u/s A broken awl, L116mm, W16mm. This large c-size lbsf has been fashioned to form a point, almost rounded in section, with a reasonably fine tip. Axial scrape marks are visible running down from the tip.

3649; 1513 A fragment of a highly polished scapula tool, L76mm, W45mm, T13mm. The c-size scapula's spine has been removed while the blade end and one edge show extensive polish and smoothing from wear. Scratches running back from the end are from wear and indicate the direction of use.

3950; u/s A complete bone needle, L43mm, W4mm, with a head, W9mm T4mm. This is a round-sectioned fine-tipped needle, with a flat sub-triangular flat head with rounded corners. The head is flat and polished, giving

the piece a pin-like appearance. Central to the head, a circular perforation, D4mm, has been made from both sides, evident from its narrower central waist. The needle is slightly polished all over its surface.

3994; u/s A broken-off antler tine, the tip of which is very eroded and damaged but some fine cut-marks suggest the damage is from human working or wear. L111.2mm.

3995; u/s The base of an antler broken off across the beam just above the burr. The piece is very smooth and the burr is almost gone. There are possible grinding scratches which may relate to the removal of the burr, D25.8mm. The base is small so this is possibly roe deer.

4181; u/s A broken pointed spatula, L53mm, W17mm, T4mm. This c-size rib piece consists of the tip end fragment. It is highly polished all over with faint scratch-marks, mostly through axial grinding, but some cross scratch-marks are visible on one side towards the tip. All these marks are partly obscured by polish.

4340; u/s A large blade tool manufactured from a split whale rib. Most of the cancellous tissue has been removed, leaving the harder, denser outer bone. The tool is shaped to a shallow rounded tip with a shoulder *c.* 30mm back from the tip on one side. No working or wear survives. L160.0mm, W58.9mm, T36.1mm.

4606; u/s An unworked piece of antler.

4611; u/s A broken pointed spatula, L42mm, W18mm, T5mm, made from a c-size halved rib. With a pointed yet quite rounded tip, this spatula is broken diagonally along its shaft. Below-average bone preservation makes any wear difficult to see.

4707; u/s A near-complete disc fashioned from a c-size scapula, D81mm, T2mm. The disc has light polish on one side with intermittent, multidirectional scratch-marks. On the other side, 11 small circular indentations vary in size, *c.* D2.5mm; these are possibly caused by pressure on localized points. Slight polish and scratch-marks can be seen.

4813; u/s A fragment of antler shaft either from a beam or a tine. One end has been grooved around by chopping and snapped off. The other is broken. L53.4mm, D32.6mm.

5048; u/s A near-complete possible pin with the tip missing. The handle has been worked to a rectangular section with extensive axial and oblique grinding and scraping. This lbsf is unusual and may not be a pin but possibly part of something else. L51.9mm, handle L39.8mm, W6.6mm, T3.0mm.

5049; u/s A near-complete blunt point with a rectangular section cross-ground to a blunt tip; lbsf. The handle end is slightly eroded, obscuring whether the piece is complete or not. L83.4mm.

5156; u/s An unworked antler fragment.

5169; u/s A fragment of a pin made from a bird long bone. One end has been worked around and its tip snapped off and the other end is broken to leave a fine tube.

5851; u/s A broken point made from the metapodial of a red deer. The handle is missing but part of the shaft and tip remain. The tip is shaped by cross and axial working and is only roughly shaped; there is no evidence of working on the surviving shaft. The end of the tip is missing. L67.4mm.

5950; 415? A broken expedient point made from a c-size lbsf shaped to a rounded tip at one end by axial working, possibly scraping. L81.8mm.

Notes

1 Some bone and antler artefacts were recovered during faunal analysis after the bone and antler artefact analysis was completed. They are listed in Table 3.12.

2 This chapter and the catalogue provide basic information on stratigraphy and artefact location and the reader can consult Volume 1 for further information (including distribution plots). The entries ‘antler’, ‘worked bone’ ‘hides/bone/antler’ in that volume’s index are the quickest route to relevant information. Page numbers and figure numbers in Volume 1 are therefore, in general, not given here.

4 Use-wear analysis of bone and antler points

V. Alexander

4.1 Introduction

Only a restricted number of tools could be studied for use-wear because of the huge size of the Cladh Hallan assemblage.[1] These were selected from the floor layers and pits of Phases 8–16 in House 401, which produced 47% of the total worked bone assemblage, and 49% of all 'points' from Cladh Hallan. Eighty artefacts were selected on the quality of their surface preservation as average, good or excellent (see Chapter 3). Of these, 62 are 'points', seven are 'worked' antler tines, and 11 'unworked' or imported tines (as defined in Chapter 3), forming 26% of the total assemblage of 'points' (69% of House 401's assemblage), and 13% of all 'unworked' and 'worked' antler (see Chapter 3 for explanation of these categories).

4.2 Methodology

A multi-method approach was used in this study, encompassing metrical, use-wear, and spatial analysis of the tool group of bone and antler 'points', alongside selected antler tine tips from the 'unworked' and 'worked' antler groups.

Metrical analysis

Eight measurements were taken on each point (Figure 4.1). The chosen metrics are based on those recorded for 'points', 'pins', and 'point-like' tools by Buc *et al*. (2014), Gates St-Pierre (2007), and Anderson (1981). All are applicable to both 'points' and antler tines. Collectively they offer information on overall artefact dimensions, fragmentation and traits specific to tool manufacture and use.

Reflectance transformation imaging (RTI)

RTI was used primarily to evaluate wear resulting from manufacture and taphonomy, and polish. For each artefact, about 60 images were taken in a dome shape with a Nikon D800 camera with 105mm micro lens, using a Nikon Speedlight SB-900 external flash as the only light source (Newman 2015). Surface modifications, potentially caused by manufacture, use and taphonomic processes, were recorded on the object's whole surface. Use-wear striations were examined in terms of placement, shape, frequency, distribution, arrangement, continuity, form, internal features, length, width and depth (Averbouh 2000; Legrand and Sidera 2007; Gates St-Pierre 2007; Buc and Loponte 2007; Buc 2011; Christidou 2008; Wojtczak and Kerdy 2018). These sets of characteristics were also applied to microscopic analysis alongside RTI, allowing comparability between the two methods.

The parameters for the recording of polish derive from Grace's (1989) six-type system. Taphonomic processes were considered as any modification not caused by

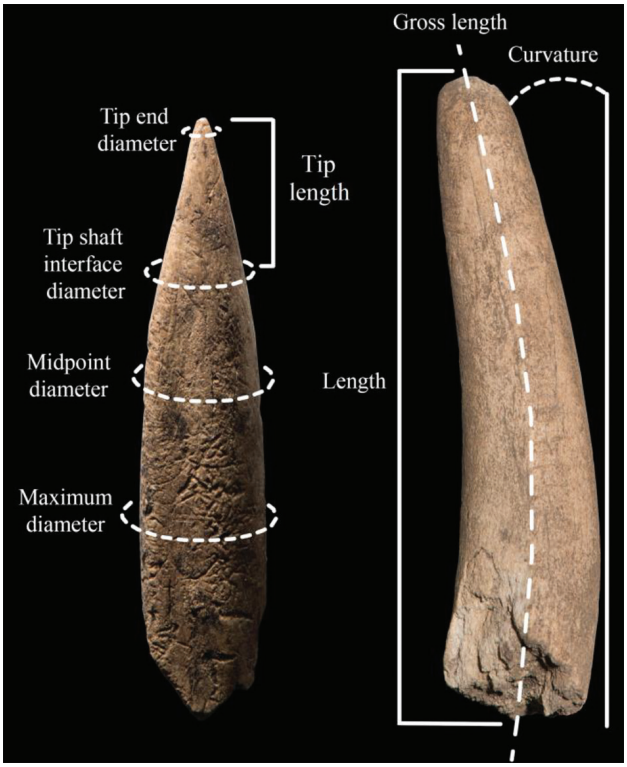


Figure 4.1. Locations of measurements taken on artefacts

manufacture or use, be these pre- or post-depositional, and were recorded by type, placement, distribution, severity and form. Manufacturing marks were defined as any surface modification that could clearly be differentiated from use or taphonomy, using comparative examples from Foxon (1991), Becker (2001), Buc and Loponte (2007) and Wojtczak and Kerdy (2018).

Microscopy

Microscopy was undertaken at both low power (8× to 60× magnification on a Nikon SMZ100 stereomicroscope) and high power (50× to 1,000× on a Nikon ME600 optical microscope) to offer the greatest range of magnification. Surface modifications, manufacturing marks and taphonomy were analysed and recorded using the same system as set out above.

Functional analysis

The resultant use-wear striation data from RTI and microscopy were compared with results from pre-existing use-wear studies of bone 'points' and their interpretations of use-wear striations considered diagnostic of certain materials/functions. Metrical data were used to examine the relationship between the pre-existing typologies assigned by Davies (see Chapter 3) and the proposed functions interpreted from use-wear analysis. Correlations between metric and functional data could then be made (see Schibler 1981; MacGregor 1985; Choyke 1997).

Spatial analysis

All small finds from House 401 with suitable data were used in spatial analysis. Similarly, samples of 'points' were plotted spatially using both their original typologies and proposed functions to reveal any potential relationships. Only material from house floors and associated pits and postholes (33 [41%] out of 80 tools selected) were included in the spatial analysis. Most of these (35% of the 80 tools selected) were from House 401, mostly from Phases 9–14.

Limitations

Methodological limitations include subjectivity, availability of comparative data and accuracy. Use-wear microscopy relies on visual comparison and largely non-metric descriptors though this study has tried to eliminate associated problems of subjectivity through the use of metric and/or predetermined characteristic descriptors. The issue of multiple 'working areas' also posed a problem during RTI analysis as only one side of a tool can be captured. To resolve this issue, those areas of the artefact with the highest level of preservation and most indicators of use/wear were captured, regardless of side. This has resulted in multiple views of several tools. Whilst surface modifications may consequently have been missed, Gates St-Pierre (2007) has argued that only the likely active working areas need to be viewed, as modifications elsewhere on the artefact are usually from manufacture and/or hafting, or are the result of taphonomic processes.

4.3 Results

The results of use-wear, metrical and spatial analysis together illustrate the diversity of 'point' morphology and function, whilst demonstrating their links to roundhouse use and domestic tasks.

Use-wear striations

Striations were found on 45 artefacts (56%; Table 4.1), most frequently on the tip of the 'point'. 'Awls' and 'points' have the most striations, with none on 'unworked' antler. U-shaped striations are the most common (82% of all striations; Table 4.1), with 'blunt' tools having mostly high-frequency/clustered striations and 'awls' with a mixture of high, medium, and low-frequency instances (see Table 4.1). 'Awls' are divided between crossed and parallel striations, whereas 'points' and 'blunts' have mainly parallel striations, and 'expedients' mostly crossed (Table 4.1). Some 49% of use-wear striations are longitudinal and 36% transverse. Striations on 'awls' are divided equally between longitudinal, transverse and crossed distributions. Forms of striation are split almost evenly between ribbon and straight (Table 4.1).

Most 'points' and 'blunts' have straight striations, whilst those on 'expedient' points and 'worked' artefacts are of ribbon type; there is no preference for 'awls'. All have U-shaped or mixed striations (see Table 4.1). Lastly, 70% of all striations are smooth internally, with only 'expedient' points showing a tendency towards rough-bottomed striations.

Use-wear striations vary in length except on 'awls', on which 61% of striations are long (see Table 4.1). In terms of width and depth, striations of shallow to moderate depth are most common. These overlaps in form, placement and metric morphology of striations suggest that tool types were multifunctional, whilst the lack of striations on 'unworked' antler tines confirms that these artefacts were not tools.

Manufacturing marks

Of the 80 artefacts, 22 show evidence of manufacture. This includes grinding marks on tool tips, cuts, and scraping by a metal blade/tool, with metal blade-scraping and general manufacturing marks being most common (Table 4.2). Both of these are most frequent on 'points'. Cuts are present on four samples, half of which are 'worked' antler.

Polish

Over 83% of all artefacts have some form of polish, with the most common being a fully polished tip. No polish, moderate tip polish (4t), and a fully polished tip/shaft interface (5ti) are the next most frequent. All 'awls' are polished, along with 89% of 'points' and 68% of all antler tips (Figure 4.2), though polish on the latter may be the result of natural wear rather than human utilisation.

Table 4.1. Types of use-wear striation by 'point' types

		Awl	Blunt	Expedient	Imported	Point	Shoulder	Worked	Total
		n = 22	*n = 13*	*n = 8*	*n = 11*	*n = 18*	*n = 1*	*n = 7*	*N = 80*
None		4	7	2	11	7	-	4	**35**
Placement	Multiple	-	-	-	-	-	1	-	**1**
	Shaft	1	-	2	-	-	-	-	**3**
	Shaft, tip	6	4	2	-	3	-	1	**16**
	Tip	10	2	2	-	8	-	2	**24**
	Tip	1	-	-	-	-	-	-	**1**
Arrangement	Multiple	-	1	-	-	-	-	-	**1**
	Crossed	8	-	4	-	4	-	2	**18**
	Parallel	10	5	2	-	8	1	1	**27**
Distribution	Multiple	-	-	-	-	-	-	1	**1**
	Longitudinal	7	1	4	-	8	1	2	**23**
	Random	6	-	-	-	-	-	-	**6**
	Transverse	5	5	2	-	4	-	-	**16**
Frequency	30	6	5	1	-	8	1	1	**22**
	31	5	1	4	-	3	-	2	**15**
	32	7	-	1	-	1	-	-	**9**
Continuity	Breaks	4	1	1	-	1	-	1	**8**
	Continuous	14	5	5	-	11	1	2	**38**
Form	Ribbon	9	2	5	-	4	1	3	**24**
	Straight	9	4	1	-	8	-	-	**22**
Shape	Multiple	1	3	1	-	1	-	-	**6**
	U	17	2	4	-	11	1	2	**37**
	V	-	-	-	-	-	-	1	**1**
	V?	-	-	1	-	-	-	-	**1**
Internal features	Rough	4	1	4	-	4	-	1	**14**
	Smooth	14	5	2	-	8	1	2	**32**
Length	Multiple	-	-	-	-	-	-	1	**1**
	Short	4	1	-	-	3	-	1	**9**
	Moderate	3	1	2	-	5	-	1	**12**
	Long	11	4	4	-	4	1	-	**24**
Width	Multiple	1	1	-	-	1	-	1	**4**
	Very narrow	5	1	1	-	5	-	-	**12**
	Narrow	6	-	3	-	1	-	1	**11**
	Moderate	4	3	2	-	3	1	1	**14**
	Wide	2	1	-	-	2	-	-	**5**
	Very wide	-	-	-	-	-	-	-	**-**
Depth	Multiple	-	3	-	-	1	-	2	**6**
	Very shallow	4	-	-	-	4	-	-	**8**
	Shallow	6	1	1	-	4	-	-	**12**
	Moderate	6	1	5	-	3	1	1	**17**
	Deep	2	1	-	-	-	-	-	**3**

Taphonomic degradation

Almost half of all samples show some form of taphonomic degradation, with 47% of these being modifications on antler from natural wear. For the remainder, trampling is the most likely cause. No type of bone artefact has more wear than any another (Table 4.3).

Material

Of the various tool types ('awl', 'point' and other point types: 'blunt', 'expedient' and 'shouldered'), antler was only used to manufacture seven out of 62 artefacts. In contrast, 'blunt' points are split evenly between bone and antler. In terms of skeletal element, the majority of 'awls' are made

Table 4.2. Manufacturing marks by 'point' types

Manufacturing mark	Awl	Blunt	Exped.	Point	Shlder.	Worked
Cut	1	-	1	-	-	2
Grinding	-	-	-	1	-	-
Grinding? Metal manufacture	1	-	-	-	-	-
Metal blade manufacture	1	1	-	4	-	-
Metal blade manufacture?	2	-	-	-	-	-
Metal blade scraping	1	-	-	4	1	-
Metal blade scraping?	-	-	-	1	-	-
Metal blade scraping Cut?	1	-	-	-	-	-
Total	**7**	**1**	**1**	**10**	**1**	**2**

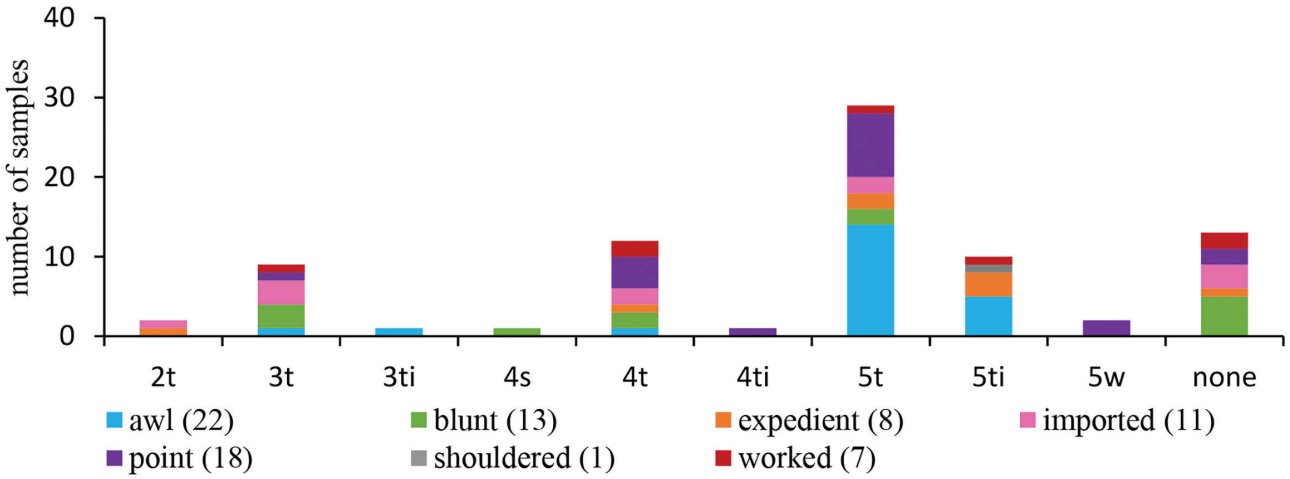


Figure 4.2. Polish on different 'point' types

Table 4.3. Taphonomic alteration by 'point' types

Taphonomy	Awl	Blunt	Exped.	Import	Point	Worked
Surface erosion	-	-	2	-	1	-
Natural antler wear	-	-	-	11	-	6
Natural antler wear?	-	3	-	-	-	-
Trampling	3	-	-	-	2	-
Trampling?	3	2	-	-		-
Weathering?	-	-	-	-	1	-
Root-etching	1	-	-	-	-	-
Total	**7**	**5**	**2**	**11**	**4**	**6**

from metapodia (see Figure 3.3), whilst 'expedients' are long-bone fragments, potentially from ulnae (Figure 4.3). Epiphyseal heads are found almost solely on 'awls', with a few exceptions on 'points' and 'expedients'. 'Points' are the most diverse in terms of element.

4.4 Functional analysis

Artefacts were assigned to one of seven functional groups on the basis of microscopic use-wear analysis (Table 4.4). These groups were identified by comparing use-wear striations with results from use-wear studies of 'points' (Hedges 1987; Hallén 1994; Buc 2011).

Most functional groups include multiple 'point' types, with both 'awls' and 'points' having five proposed functions each, suggesting that function is largely independent of tool type (Figure 4.4). Functions of 'worked' antler are no different to those of bone 'points', and the only types without 'unknown' functions are 'imported', shouldered and 'worked' tools.

Use-wear striations

The placement and form of striations differ between proposed functions. Hide-working and basketry tools are both identifiable by use-wear striations on the tip; these

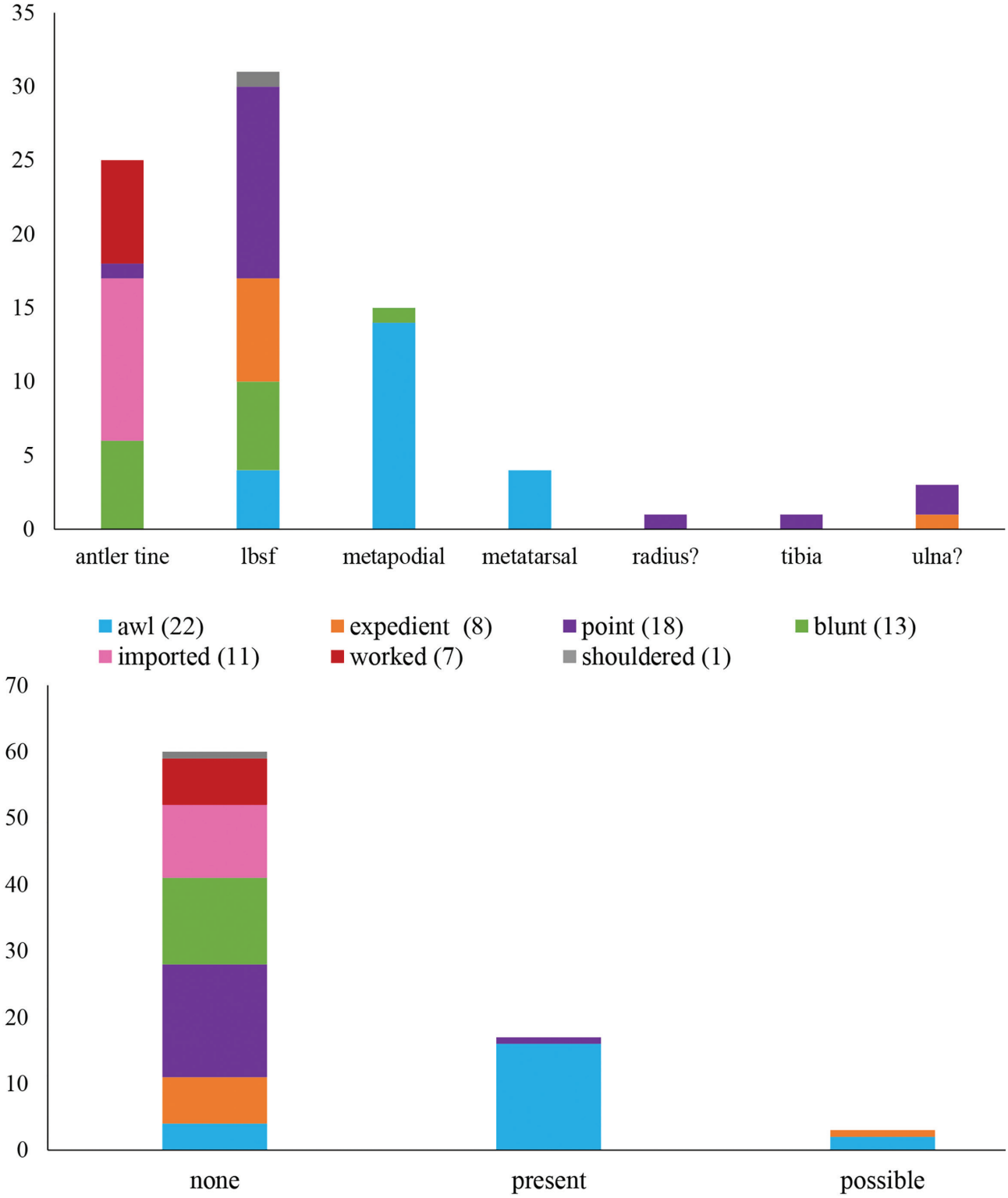


Figure 4.3. Skeletal elements used for different 'point' types

are longitudinal, largely parallel, continuous and U-shaped. However, basketry tools have more diverse use-wear patterns (Table 4.5). As suggested by the name of their category, artefacts with 'unknown' functions are diverse in all aspects of form and morphology of striations, with 63% of these not presenting any striated use-wear. There is a possible correlation between striation morphology and proposed function; for example, likely 'hide-working' tools tend to have long, narrow and shallow striations whilst those on 'pottery' tools are long, moderate in width and of varying depth. However, these correlations are not strong and can be affected by a myriad of factors, discussed below.

Table 4.4. Functional categories assigned on the basis of use-wear analysis

Category	Function	n	% of samples
Basketry	Hold open weave on baskets, guide materials	7	9%
Basketry?		4	5%
Chisel	Percussive tool used like a chisel and/or wedge	4	5%
Chisel?		4	5%
Hide	Work skins and/or hides, most likely in a perforating manner	19	24%
Hide?		3	4%
Plant processing	Process plant matter, most likely in a scraping motion to break down fibres	3	4%
Pottery	Decorate pottery and/or smooth clay	3	4%
Unknown	Function could not be determined	15	19%
Utilised	No evidence of explicit functional use, may have evidence of other forms of human modification	11	14%
Utilised?		3	4%
Weaving	Weft-beater or other tool used in weaving process	4	5%

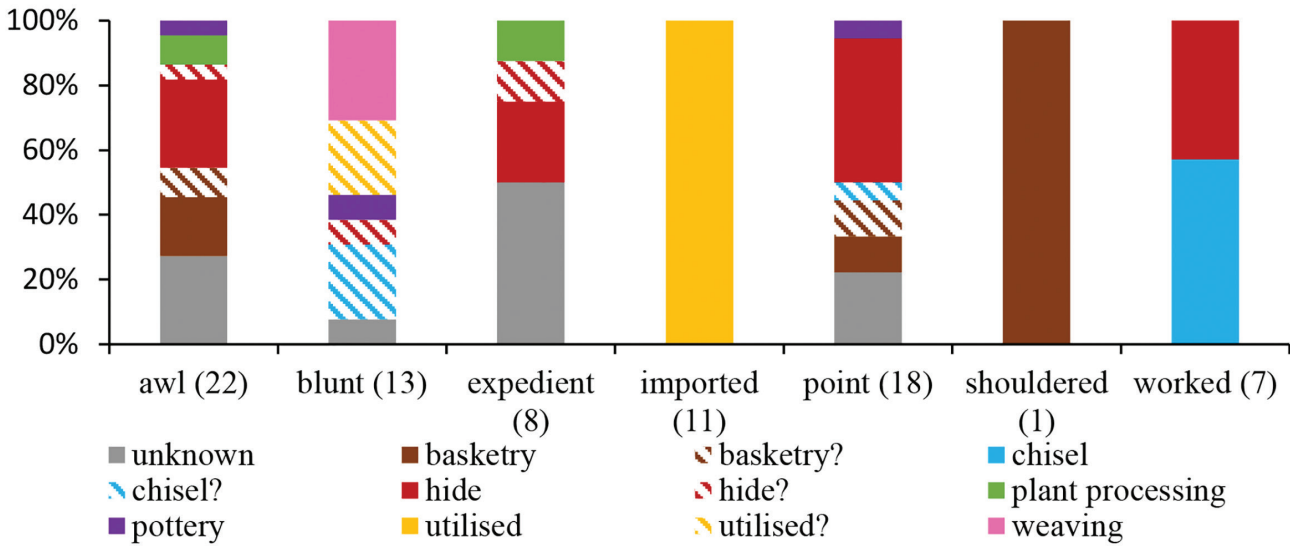


Figure 4.4. 'Point' types compared with proposed use-wear functions

Manufacturing marks

Manufacturing marks are present on tools of various assigned functions (*e.g.* 'basketry' *etc.*). Tools of 'unknown' function reveal most evidence for their manufacture. Grinding, as a method of manufacture, appears in all functional groups save 'weaving', and only one 'weaving' artefact has evidence of manufacture (by metal tool). Overall, there is no clear relationship between type of manufacturing modification and proposed function.

Polish

Whilst 25 artefacts have little or no polish, 55 (69%) have medium to high polish. Additionally, all those with a proposed function of 'basketry', 'hide-working', and 'plant processing' have some form of polish (Figure 4.5). Implements of 'unknown' function and those assigned to 'hide-working' have the greatest range of polish. Furthermore, all 'plant processing' tools, and 91% of 'hide-working' tools have polish.

Taphonomic processes

Taphonomic wear affects 'chisels', 'hide-working' and 'utilised' artefacts, with 'hide-working' tools being most affected by trampling.

Material by function

Tool materials differ somewhat by function, with 'chisels' predominantly being made of antler (Figure 4.6). 'Utilised' artefacts are also entirely of antler as they consist solely of 'unworked' (*i.e.* imported) antler tine tips. The other functional categories are dominated by bone. 'Hide-working' points are made from varying skeletal element types, whilst other functional categories are more constrained (Figure 4.6). Most 'unknown' points are made of long-bone shaft fragments or metapodia.

Table 4.5. Surface modifications by proposed 'point' functional groups

		Basketry	**Basketry?**	**Chisel**	**Chisel?**	**Hide**	**Hide?**	**Plant processing**	**Pottery**	**Unknown**	**Utilised**	**Utilised?**	**Weaving**	**Total**
		n = 7	*n = 4*	*n = 4*	*n = 4*	*n = 19*	*n = 3*	*n = 3*	*n = 3*	*n = 15*	*n = 11*	*n = 13*	*n = 4*	*N = 80*
None		-	1	2	3	4	-	-	-	9	11	2	2	**34**
Placement	Multiple	1	-	-	-	-	-	-	-	-	-	-	-	**1**
	Shaft	-	-	-	-	-	-	-	1	1	-	-	-	**3**
	Shaft, tip	2	-	-	-	4	1	1	2	3	-	1	2	**16**
	Tip	4	3	2	1	10	2	2	-	2	-	-	-	**25**
Arrangement	Multiple	-	-	-	-	-	-	-	1	-	-	-	-	**1**
	Crossed	3	1	2	-	6	2	2	-	2	-	-	-	**18**
	Parallel	4	2	-	1	9	1	1	2	4	-	1	2	**27**
Distribution	Multiple	-	-	-	-	1	-	-	-	-	-	-	-	**1**
	Longitudinal	2	2	2	-	10	1	-	-	6	-	-	-	**23**
	Random	2	-	-	-	2	1	1	-	-	-	-	-	**6**
	Transverse	3	1	-	1	2	1	2	3	-	-	1	2	**16**
Frequency	30	3	1	-	-	6	2	1	3	3	-	1	2	**22**
	31	3	-	2	1	7	1	-	-	1	-	-	-	**15**
	32	1	2	-	-	2	-	2	-	2	-	-	-	**9**
Continuity	Breaks		3	1	1	-	-	3	-	-	-	-	-	**8**
	Continuous	6	4	2	1	1	15	-	3	6	-	1	2	**38**
Form	Ribbon	3	1	2	1	6	2	2	1	5	-	1	-	**24**
	Straight	4	2	-	-	9	1	1	2	1	-	-	2	**22**
Shape	Multiple	-	-	-	-	1	1	-	2	-	-	-	2	**6**
	U	7	3	1	1	14	1	3	1	5	-	1	-	**37**
	V	-	-	1	-	-	-	-	-	-	-	-	-	**1**
	V?	-	-	-	-	-	-	-	-	1	-	-	-	**1**
Internal features	Rough	3	1	1		5	1		-	2	-	1	-	**14**
	Smooth	4	2	1	1	10	2	3	3	4	-	-	2	**32**
Length	Short	2	1	1	-	4	1	-	-	-	-	-	-	**9**
	Moderate	3	1	1	1	3	2	-	-	-	-	-	-	**12**
	Long	2	1	-	-	7	-	2	3	6	-	1	2	**24**
Width	Multiple	-	-	-	1	2	-	-	-	1	-	-	-	**4**
	Very narrow	2	2	-	-	5	1	1	-	1	-	-	-	**12**
	Narrow	2	-	1	-	6	-	1	-	1	-	-	-	**11**
	Moderate	1	1	1	-	2	2	-	3	2	-	-	2	**14**
	Wide	2	-	-	-	-	-	1	-	1	-	1	-	**5**
	Very wide	-	-	-	-	-	-	-	-	-	-	-		
Depth	Multiple	-	1	1	1	1	-	-	1	-	-	-	1	**6**
	Very shallow	1	2	-	-	4	-	1	-	-	-	-	-	**8**
	Shallow	1	-	-	-	5	2	-	1	3	-	-	-	**12**
	Moderate	4	-	1	-	5	1	2	-	3	-	1	-	**17**
	Deep	1	-	-	-	-	-	-	1	-	-	-	1	**3**

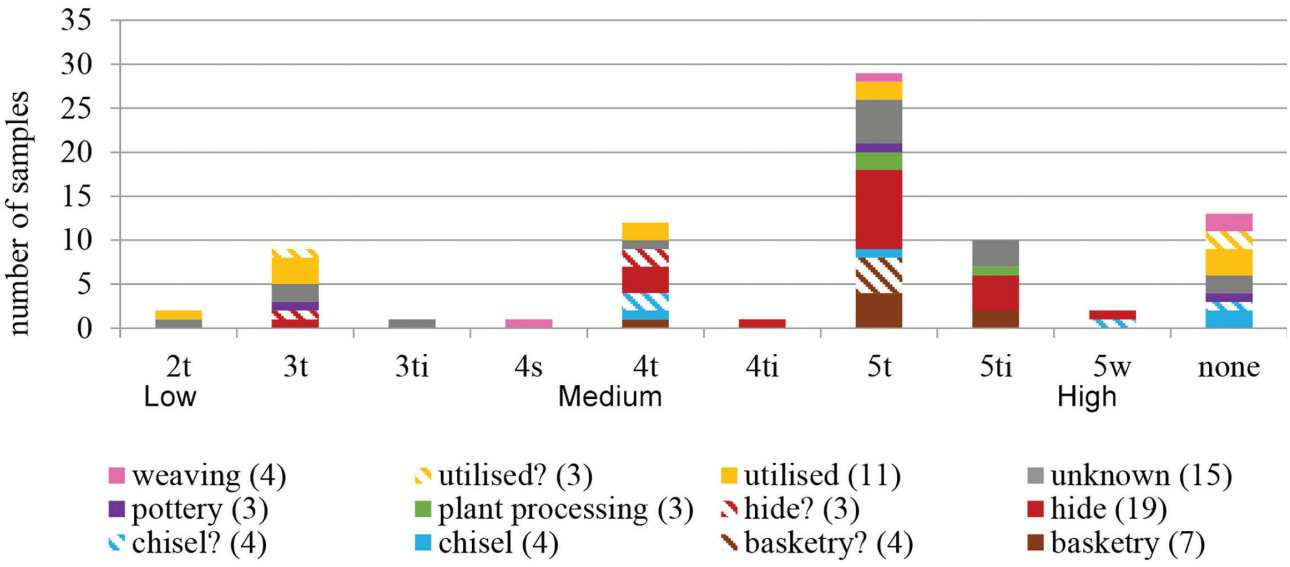


Figure 4.5. Polish compared with different 'point' functions

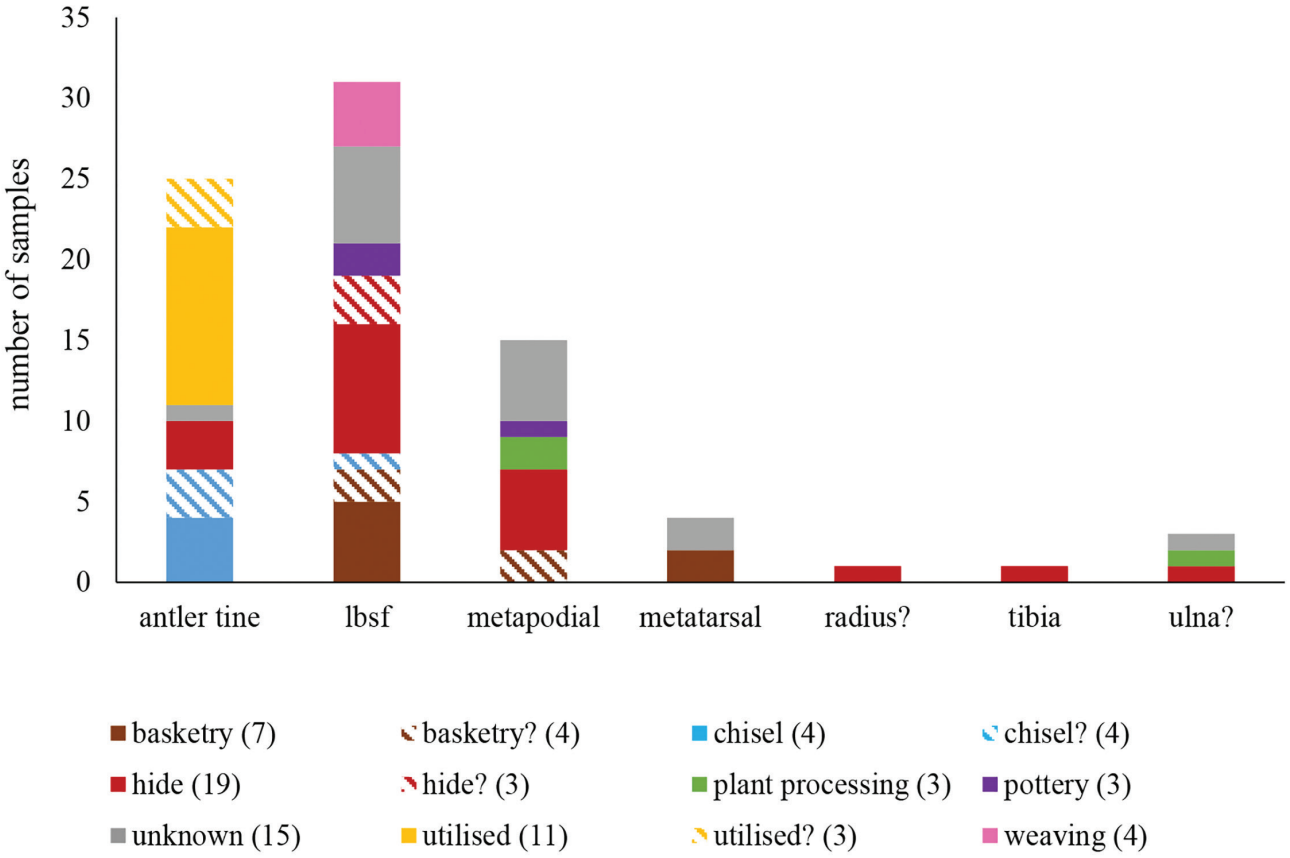


Figure 4.6. Skeletal elements compared with different 'point' functions

The presence of epiphyses also varies between functional groups, with 'hide-working', 'basketry' and 'plant processing' tools most frequently retaining these. Broken tools, where the presence of the epiphysis could not be confirmed, were excluded from this analysis.

Potential residues

Several tools have possible residues which may derive from manufacture and/or function (Figures 4.7–4.9). Two pieces of 'worked' antler have possible fragments of either chalcopyrite or mica. Chalcopyrite could indicate that antler tools were involved in metalworking.

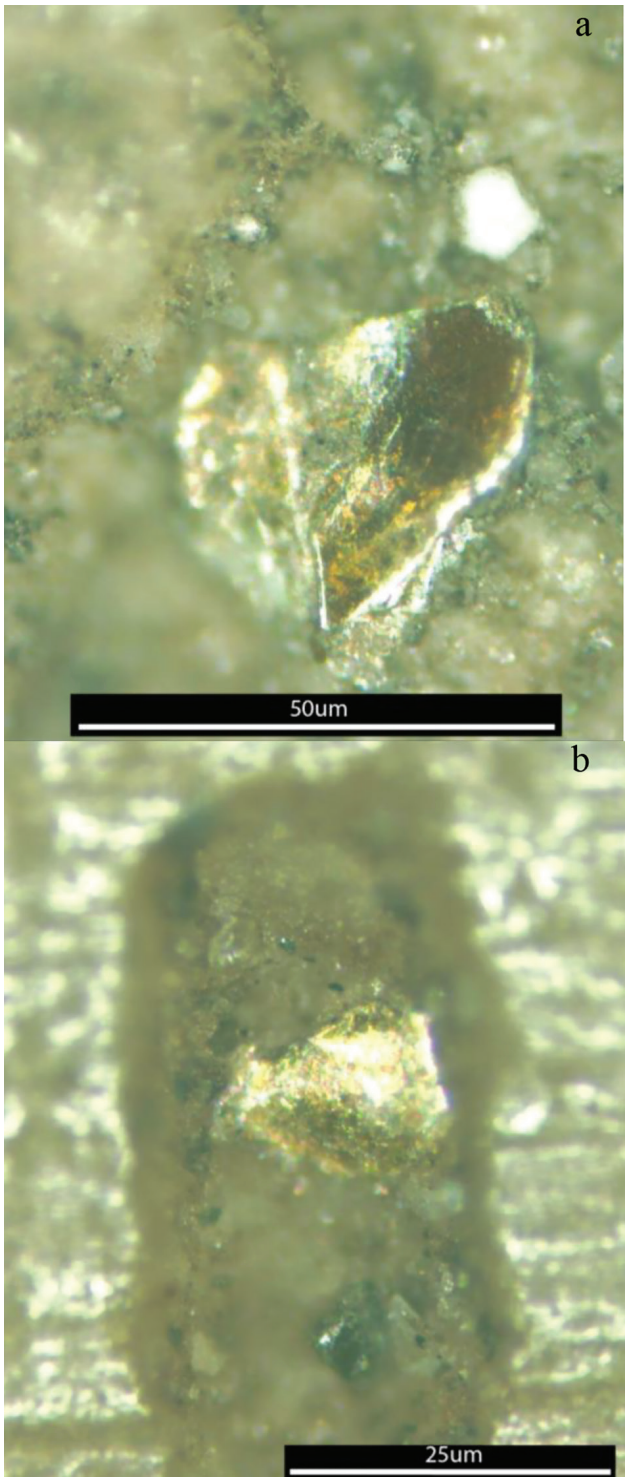


Figure 4.7. Photomicrographs of potential residues: a: SF 4723, chalcopyrite/mica found in a transverse striation on the shaft/tip interface; b: SF 4977, embedded chalcopyrite/mica found on the antler tool's shaft

A possible collagen fibre curl was also identified on the tip of an 'awl'. This could be residue from manufacture, or a scraping from the tool's surface during use. As no function was determined for this tool, further interpretation is limited. Thirdly, one 'awl' exhibits two deep blue striations on its tip, close to its edge (Figure 4.9). These could be pigments transferred from another object's surface.

Figure 4.8. Bevelling on the tip of an antler tine (SF 4977) from use as a chisel

4.5 Metrical analysis

Tool and tip length vary considerably between and within typological and functional groups. The greatest range in tool length is for 'awls' (55mm–110mm), but variations in length amongst all tools are probably due largely to fragmentation rather than original form since only 29% of all tools are complete. When tip length is plotted by tool type, 'awl', 'blunt', 'expedient' and 'unworked' tools have similar averages (Figure 4.10). Yet when plotted by function there is less similarity between each group's average value. Tip length also varies widely, with both tool types and functional groups having large standard deviations. Tool curvature is present in 30 artefacts, of which 24 are made of antler and the rest from long-bone fragments, radii and an ulna. Functionally, 'chisels' and 'utilised' tools are most curved and 'weaving' tools and 'awls' the least.

Functional relationships

End diameters of tips fall into three groups when plotted against function and tool type (Table 4.6). Overall, the types of 'awl', 'point', 'expedient', and 'shouldered' tool have smaller end diameters (0.5mm–4.4mm; average 1.8mm), whilst 'blunt', 'worked', and 'unworked' tools have higher values (2.2mm–7.4mm; average 5.4mm). Functional groups with smaller tip diameters include tools for 'basketry', 'plant processing' and the majority of 'hide-working', whereas larger diameters are more common among 'chisels', 'weaving' and 'utilised (?)' artefacts. 'Pottery' working tools have a wide range of values. This relationship is mirrored when tip and shaft interface diameters are plotted against typology and proposed function, though they are less tightly clustered. When tip length is analysed in relation to function, the relationship is broader, most likely due to the tools' varying levels of preservation or fragmentation.

4.6 Chronological analysis

The quantities of each point type within this sample of 80 tools vary across Phases 8 to 16. 'Points', notably those for 'hide-working', are present in all but Phase 15 whilst 'blunts' only appear from Phase 12 onwards. The range

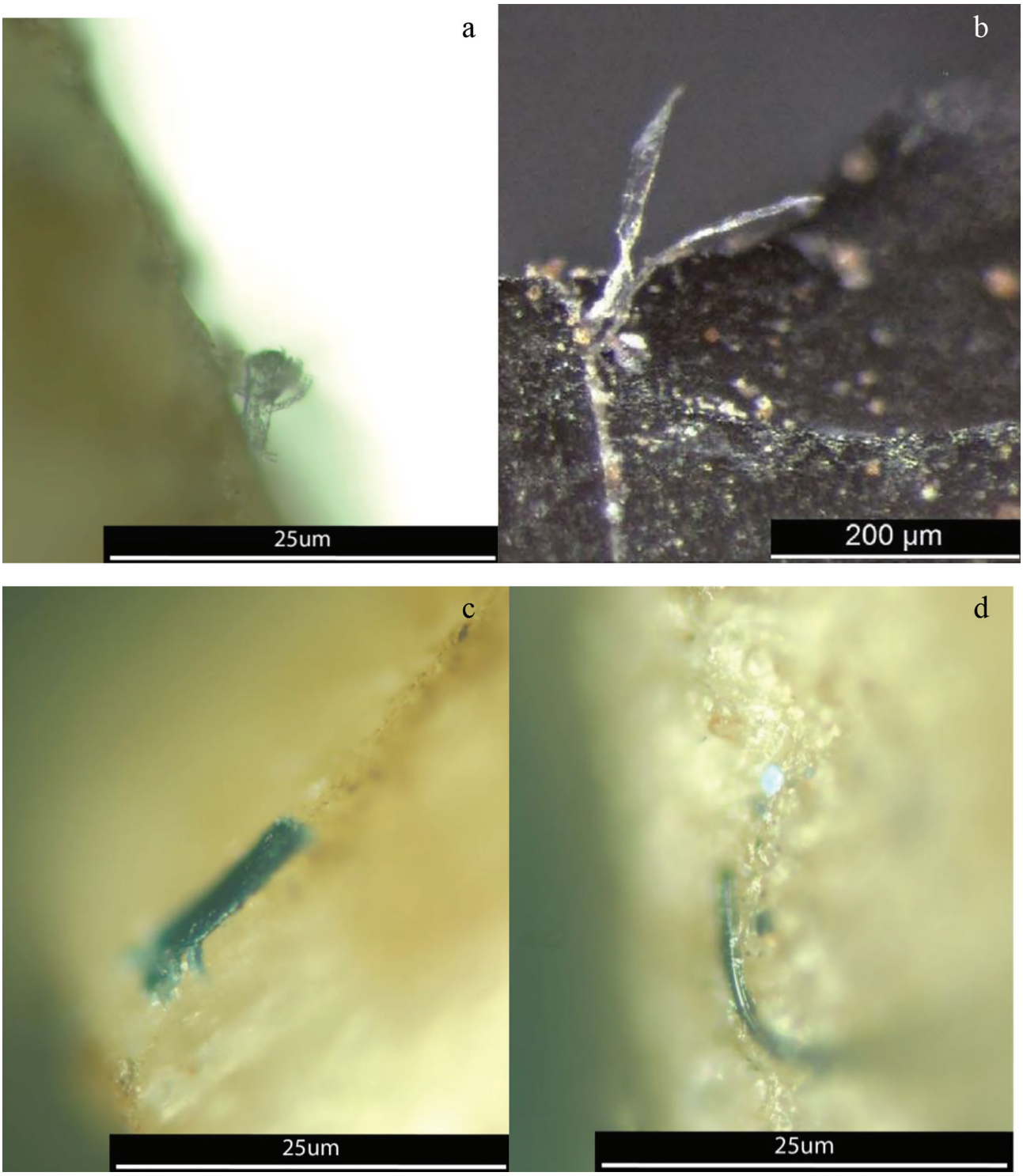


Figure 4.9. Photomicrographs of potential residues: a: SF 3081, collagen fibre on tip; b: collagen fibre on lithic from experimental bone sawing (Zupancich et al. *2016: 4); c and d: SF 3747, unknown residue/pigmentation placed on the edge of the tool tip*

and quantity of proposed functional groups vary between phases: in some phases only one or two groups are represented (Figure 4.11). The earliest and latest phases have no examples of manufacturing marks. Throughout the other phases, evidence of 'point' manufacture using metal blades is most frequently identified, whilst the only clear example of grinding comes from Phase 14. Tools with taphonomic alteration are present in all phases except Phase 15 and are most numerous in Phase 9 although Phase 12 has the highest proportion of taphonomic modifications (55%).

4.7 Spatial analysis

In Phase 9 contexts, three 'hide-working' points (SF 4663, SF 4665 and SF 3820) were found in House 401's two

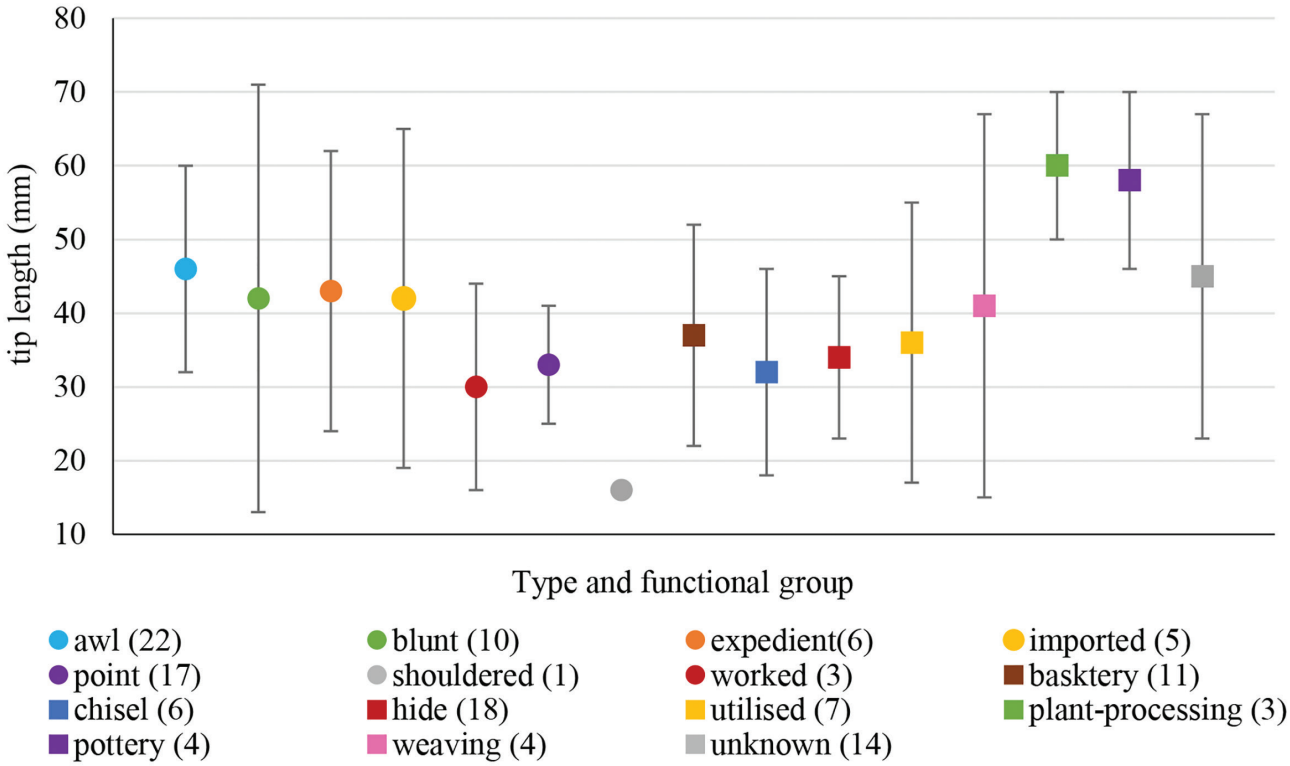


Figure 4.10. Average tip length compared with point types and functional groups. Error bars are 1 standard deviation

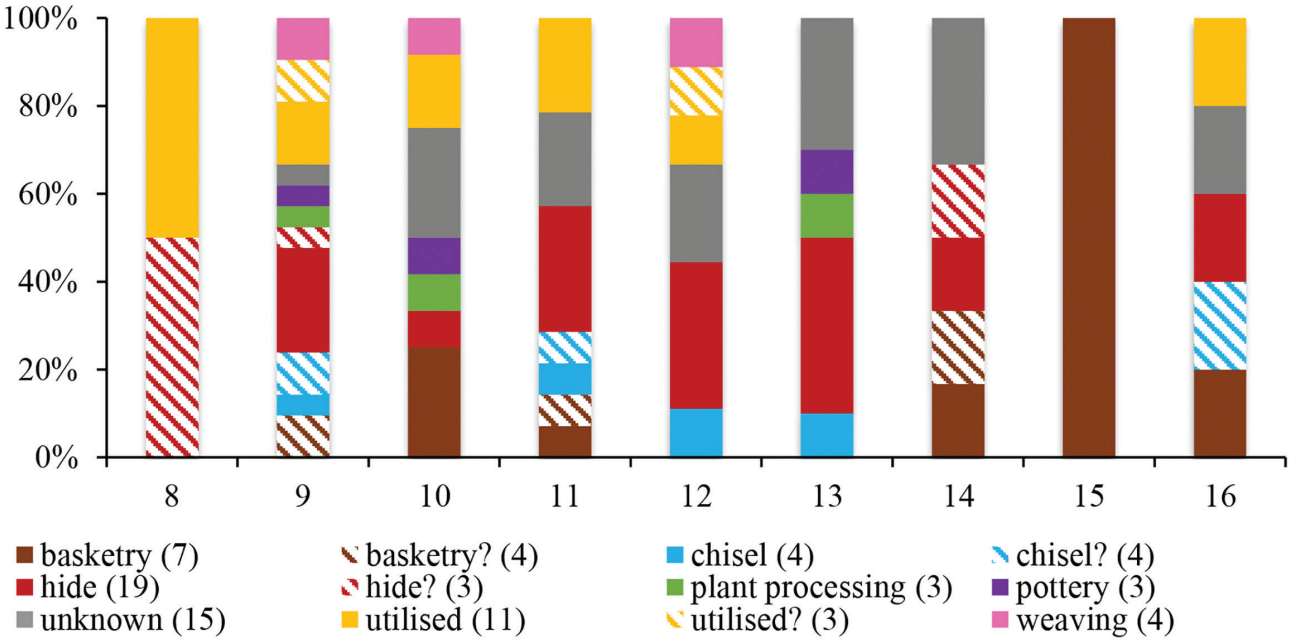


Figure 4.11. Proposed tool function by phase across Phases 8–16

southern quadrants alongside pumice rubbers and stone tools (Figure 4.12; see Volume 1: figs 5.44–5.45). A point of 'unknown' function (SF 4662) lay beside two of these points. Tools for 'pottery' (SF 3777) and 'weaving' (SF 4661) were found in the west of House 401. Three antler 'chisels' (SF 4723, SF 3775, and SF 3826) were found in the northern quadrants, close to clay mould fragments and pumice (see Figure 4.12). Lastly, two pieces which are likely 'utilised' – a 'blunt' point (SF 4623) and a piece of 'unworked' antler (SF 3768) – lay directly south of the 'chisels' near fragments of copper and metalworking waste.

Phase 10 continues the pattern set by Phase 9, with a 'utilised' tine (SF 5341) in the centre of the house

Table 4.6. Tip metrics by proposed 'point' functional groups

Proposed function	Tip end dia. (mm)		Tip and shaft interface dia. (mm)		Tip length (mm)	
	Average	Range	Average	Range	Average	Range
Basketry	1.4	0.5–1.9	9.1	5.4–12.3	39.9	16.4–63.1
Basketry?	1.8	1.2–2.6	8.2	4.5–10.1	33.3	18.2–48.6
Chisel	7.1	5.5–8.1	14.1	12.9, 15.2	25.7	13.2, 38.2
Chisel?	5.9	3.4–7.7	14	13.8, 14.2	39	31.3, 46.8
Hide	2.5	0.7–6.2	12.9	8.3–15.8	35.9	23.7–55.8
Hide?	1.5	0.9–2.2	7.2	7.2	27.3	16.1–46.3
Plant-processing	0.9	0.5–1.2	12.2	11.3, 13.1	59.5	52.3–70.3
Pottery	2.4	1.3–3.2	6.9	4.4–10.3	57.6	29.8–107.3
Unknown	2.1	0.9–4.4	9.9	5.3–15.9	44.8	23.8–98.7
Utilised	4.6	1.6–8.2	11.3	9.3–16.6	41.6	8.5–59.6
Utilised?	4.5	3.2–5.5	11.8	5.5–20.3	25.9	25.8–29.2
Weaving	6	4.3–7.7	12.2	9.8–15.9	40.9	13.9–63.5

(Figure 4.13; see Volume 1: fig. 6.24). A pit in the southwest quadrant contained a 'pottery' tool (SF 5562). Thirdly, a possible 'basketry' tool (SF 3648) was found in a pit with flint flakes and bone discs, located just outside the house in the southwest quadrant. Awl SF 3747 is from this southwest quadrant.

In Phase 11 a 'utilised' tine tip (SF 3531) formed part of a tight cluster with other bone and antler tools in the southeast (Figure 4.14; see Volume 1: fig. 7.26). Another tine (SF 3494) was located west of the central hearth. Three potential 'hide-working' points were distributed in the western quadrants. SF 3617 was close to the house wall in a pit, whilst the others (SF 3202 and SF 3489) were more dispersed, located beside a range of artefacts (Figure 4.13). A possible 'chisel' made from a 'blunt' point (SF 3621) is one of several bone tools from the fill of a pit in the house wall. A possible 'basketry' point (SF 3486) was found near utilised bone and a stone tool in the northwest quadrant. Two points of 'unknown' function (SF 3402 and SF 3446) were located in the western quadrants, amongst other worked bone and pottery.

In Phase 12, two possible 'hide-working' points (SF 3399 and SF 3450) in the southeast quadrant were deposited near a spindle whorl (Figure 4.15; see Volume 1: fig. 8.30). A large area west of the central hearth was devoid of material.

Phase 13's floor layer contained a wide range of artefacts and material culture but only one 'hide-working (?)' point (SF 3027) comes from this floor, lying amongst pottery sherds, flint, pumice, bone points and other worked bone in the southwest quadrant (Figure 4.16; see Volume 1: fig. 9.13). Awl SF 3081 is also from this quadrant.

Lastly, Phase 14's floor layer has limited distribution patterns (see Volume 1: fig. 11.11). In the southwest quadrant two points, SF 2082 ('basketry') and SF 2086 ('hide-working'), were located near a spindle whorl and a piece of pumice (Figure 4.17). In the northwest, two points of 'unknown' function (SF 2084 and SF 2085) lay near another piece of pumice.

Between Phases 9 and 14, certain distribution patterns can be noted within House 401. 'Hide-working' points are entirely absent from the northeast and rarely in the northwest quadrant. Points which are possibly unused are concentrated in House 401's central area and slightly to its west. 'Chisels' are found exclusively in the northern quadrants and 'basketry' points in the southwest (Figure 4.18). Interestingly, when the same tools are plotted with respect to their tool types, these patterns disappear (see Figure 4.19). The tool types are dispersed across the house except in the northeast quadrant; no single group clusters in a particular area though it could be argued that 'awls' are largely located in the west.

4.8 Methods of manufacture

The manufacturing techniques identified are to be expected from a site of this period and region. Grinding was identified on 12 tools, compared with 36 out of the 80 identified as having grinding scratches without microscopic study (see Chapter 3). The discrepancy may be due to the difficulty of differentiating use-wear from manufacturing striations by eye.

One new observation is the evidence for manufacturing of 'points' with metal-bladed tools, which were used to split, cut and scrape these artefacts. Similar observations have been made by Foxon (1991: 13), who identifies the use of 'heavy-bladed' metal tools at Sollas, North Uist, and Midhowe, Orkney, and by Hallén (1994) at Foshigarry and Bac Mhic Connain, North Uist. Becker (2001) has also found ample evidence of points manufactured with metal blades at medieval Berlin-Spandau, including marks very similar to those from Cladh Hallan.

Tools can also be repurposed as new types and for different functions by tip reshaping, but evidence for this

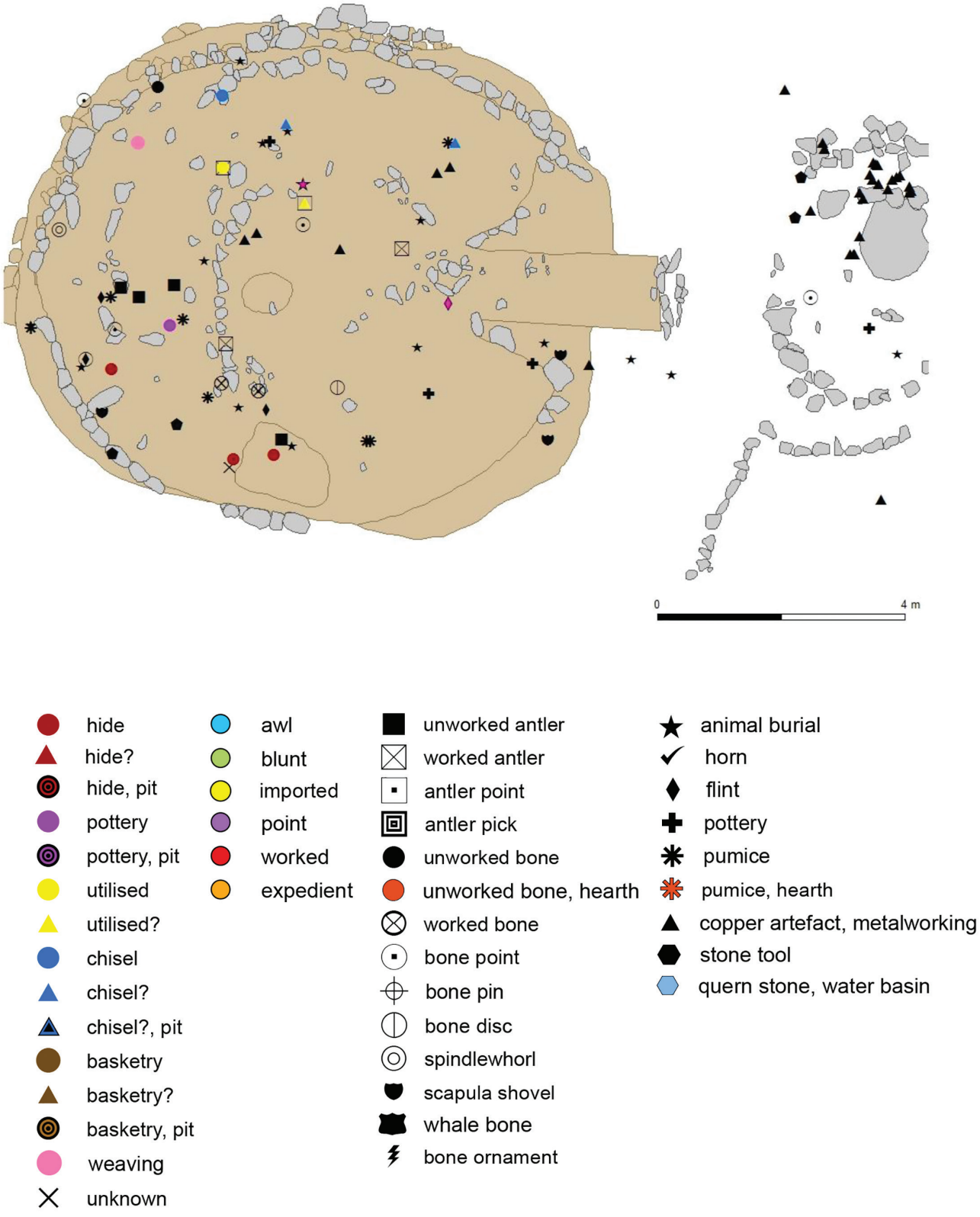


Figure 4.12. Artefact distributions in Phase 9 of House 401 (floor 1311)

is hard to identify (Choyke 1997). Tools of 'unknown' function may represent such repurposing at Cladh Hallan, and their possible multi-functionality is discussed below.

Although the sample reveals no clear correlation between manufacturing technique and function, there is evidence of an attained level of manufacture for certain functional groups. Tip-end diameters cluster by functional group regardless of the skeletal element from which the tool was made. For example, 'hide-working' tools have similar tip-end diameters whether they are made from antler, long bones or metapodia, despite the varying degrees of manufacturing required. The relationship

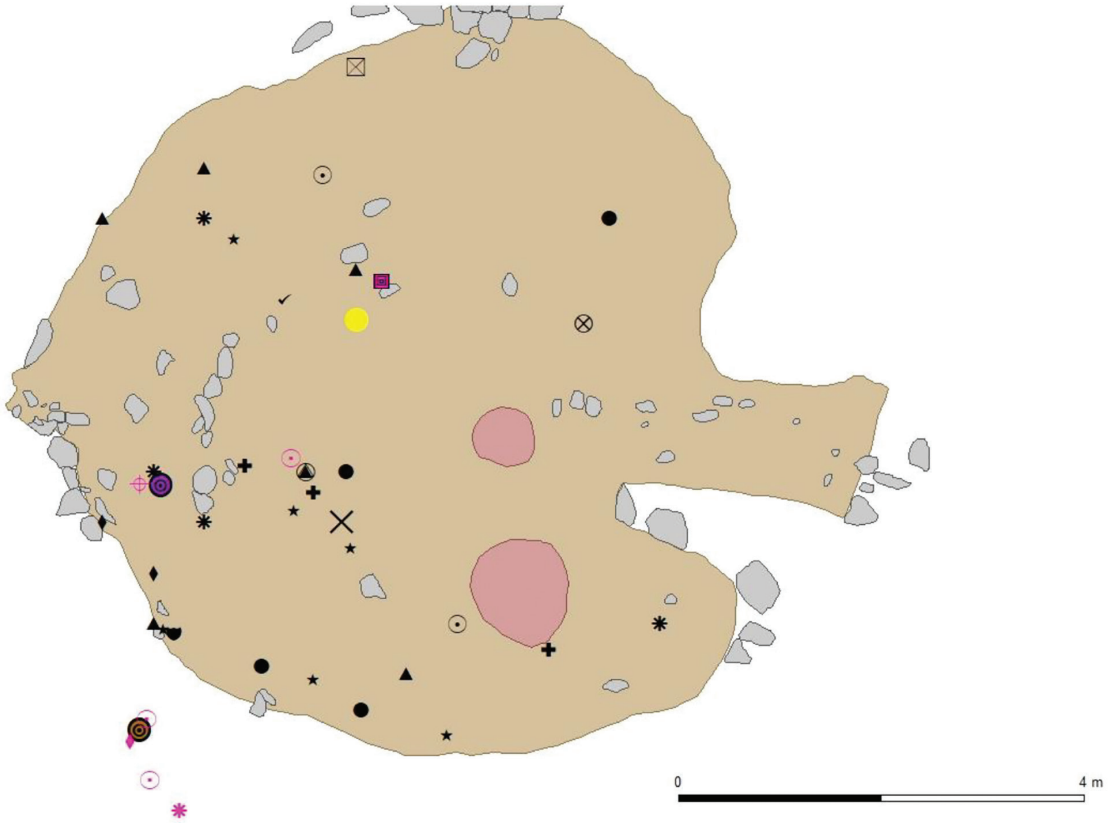


Figure 4.13. Artefact distributions in Phase 10 of House 401 (floor 1308)

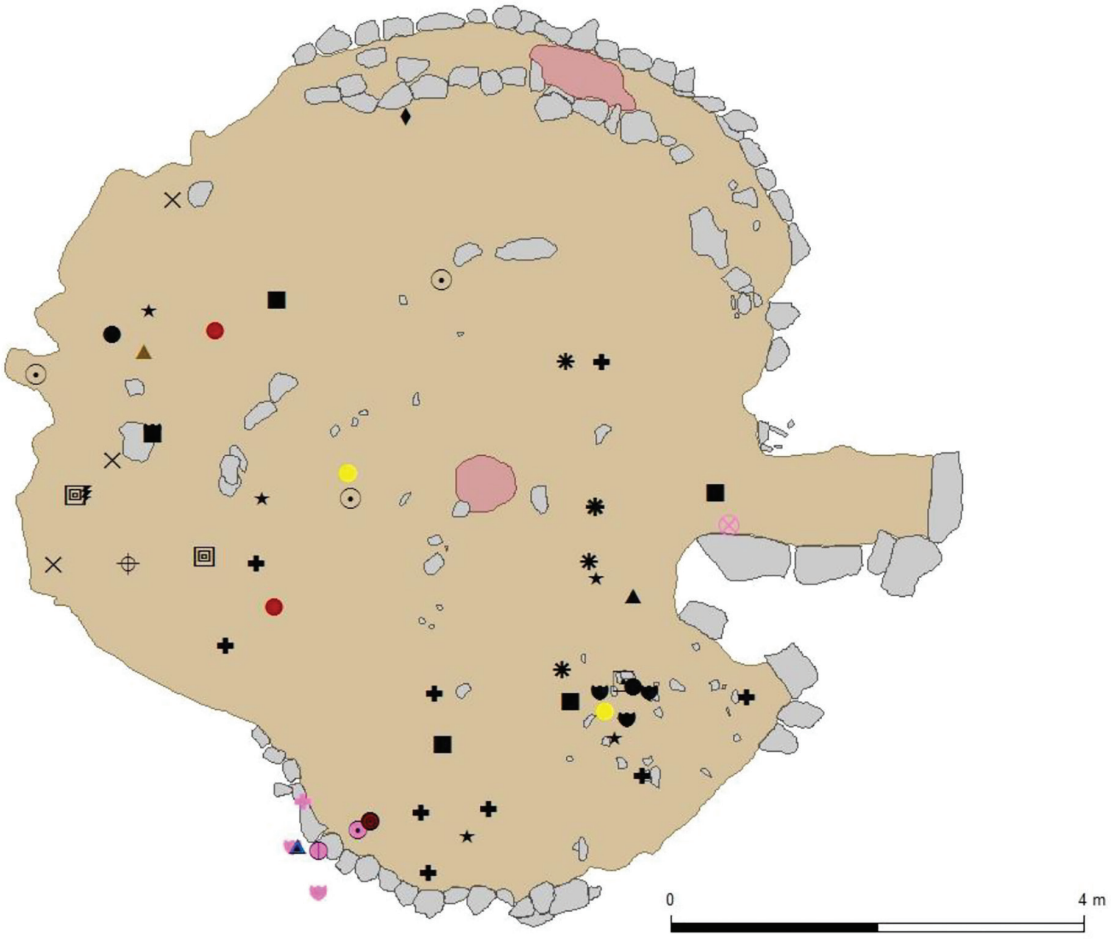


Figure 4.14. Artefact distributions in Phase 11 of House 401 (floor 655)

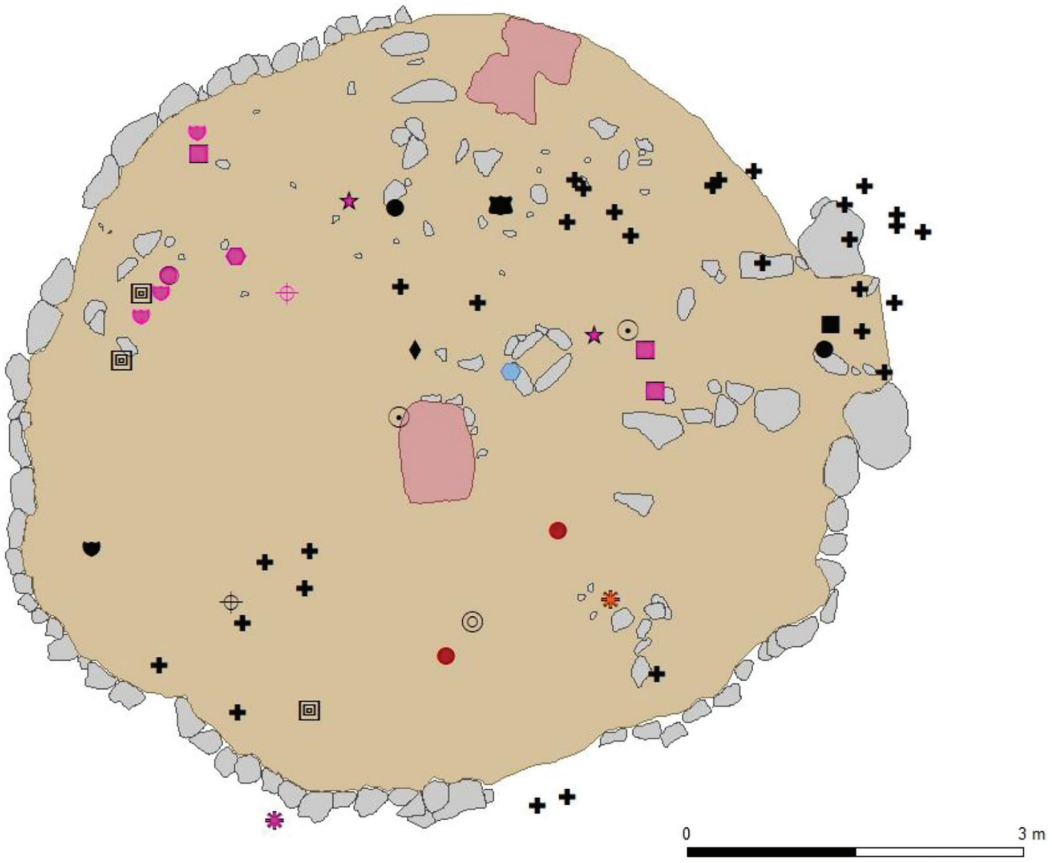


Figure 4.15. Artefact distributions in Phase 12 of House 401 (floor 565)

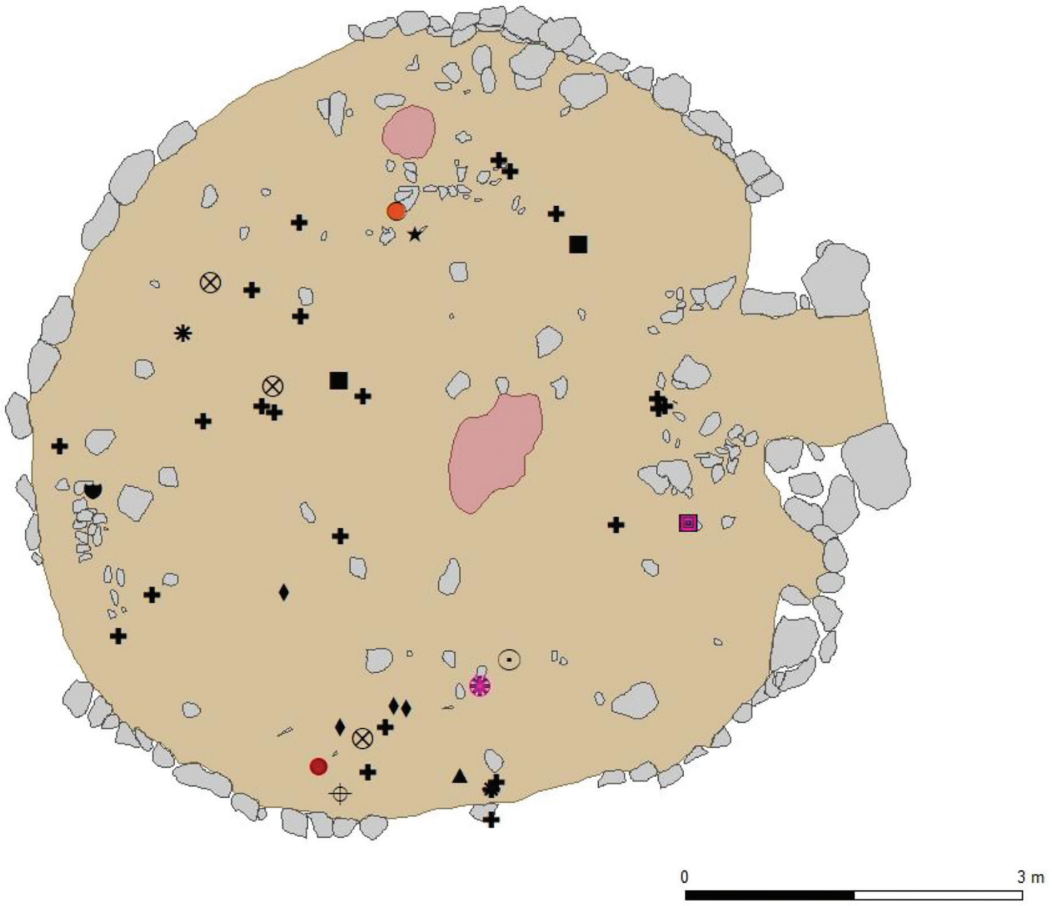


Figure 4.16. Artefact distributions in Phase 13 of House 401 (floor 465)

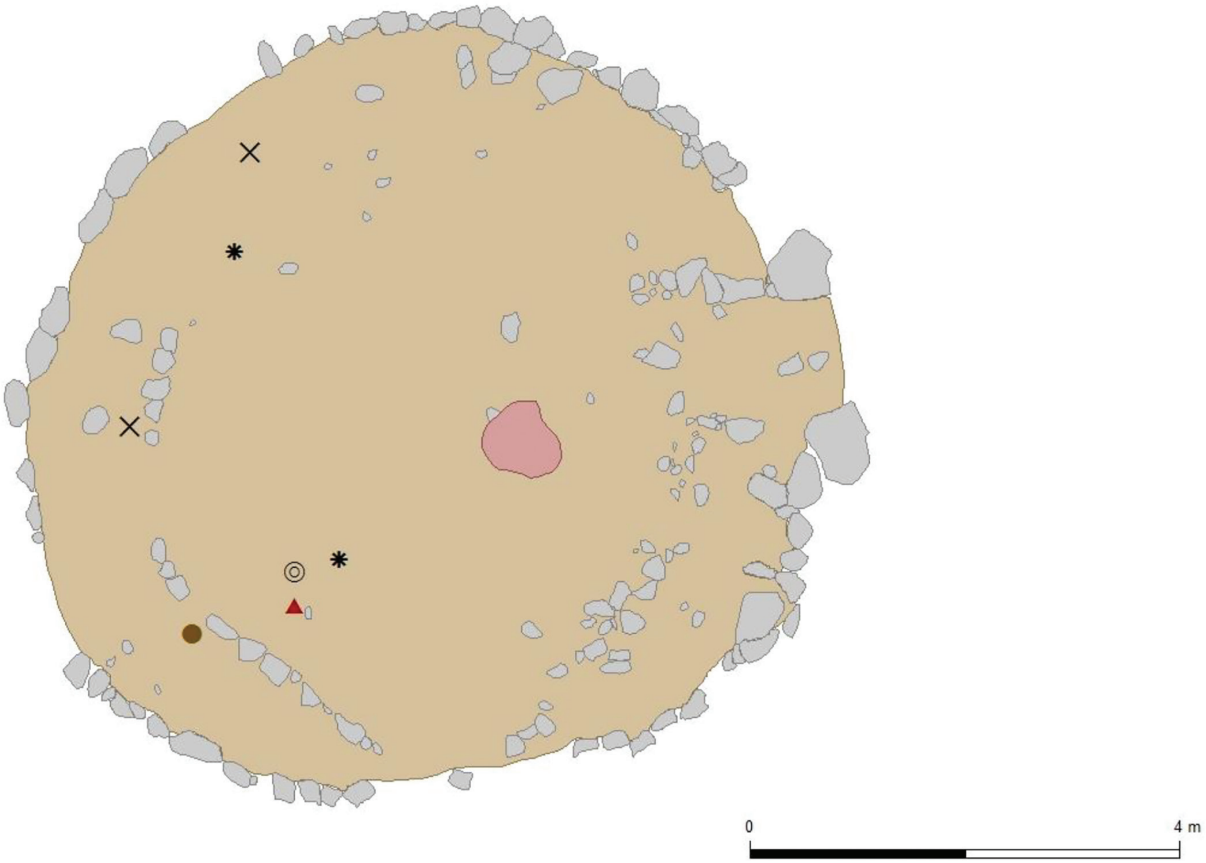


Figure 4.17. Artefact distributions in Phase 14 of House 401 (floor 462)

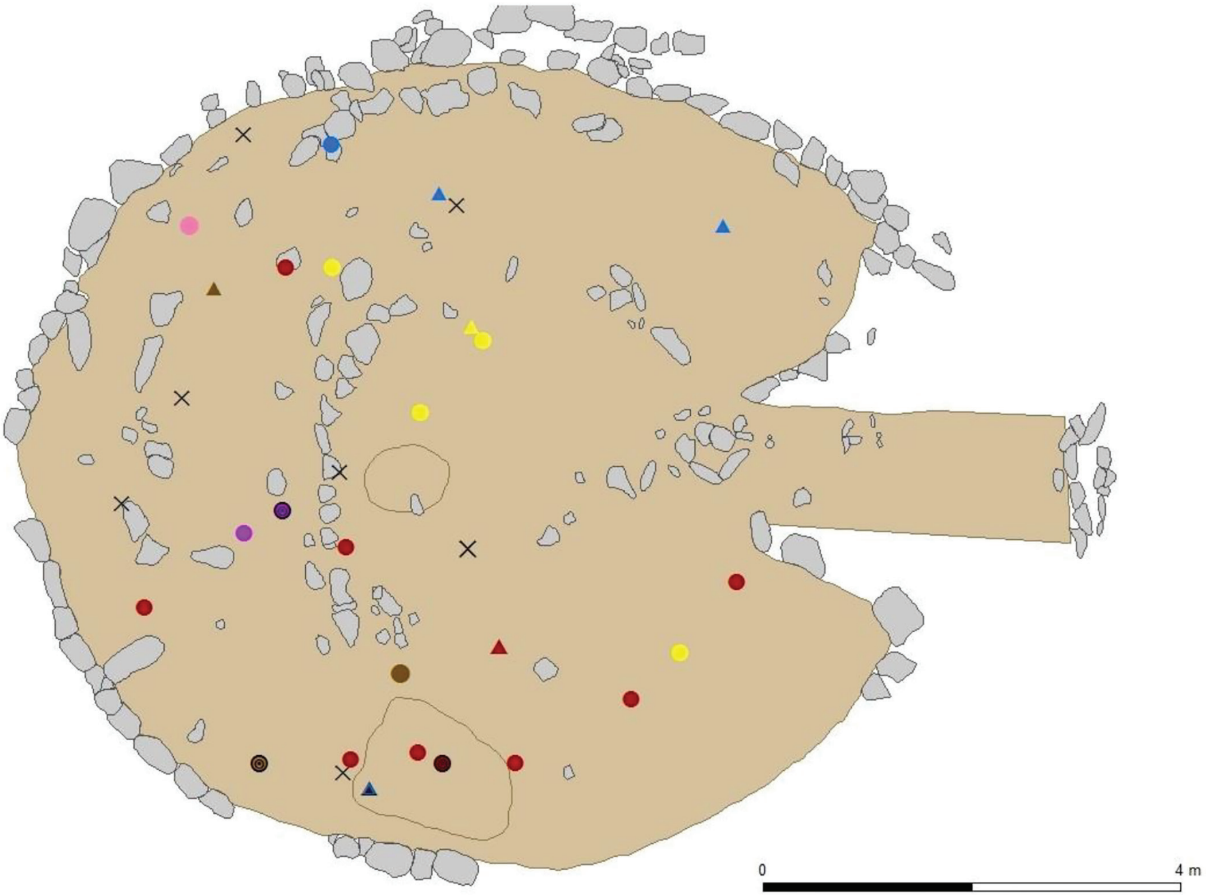


Figure 4.18. Locations of point artefacts within House 401 by proposed function

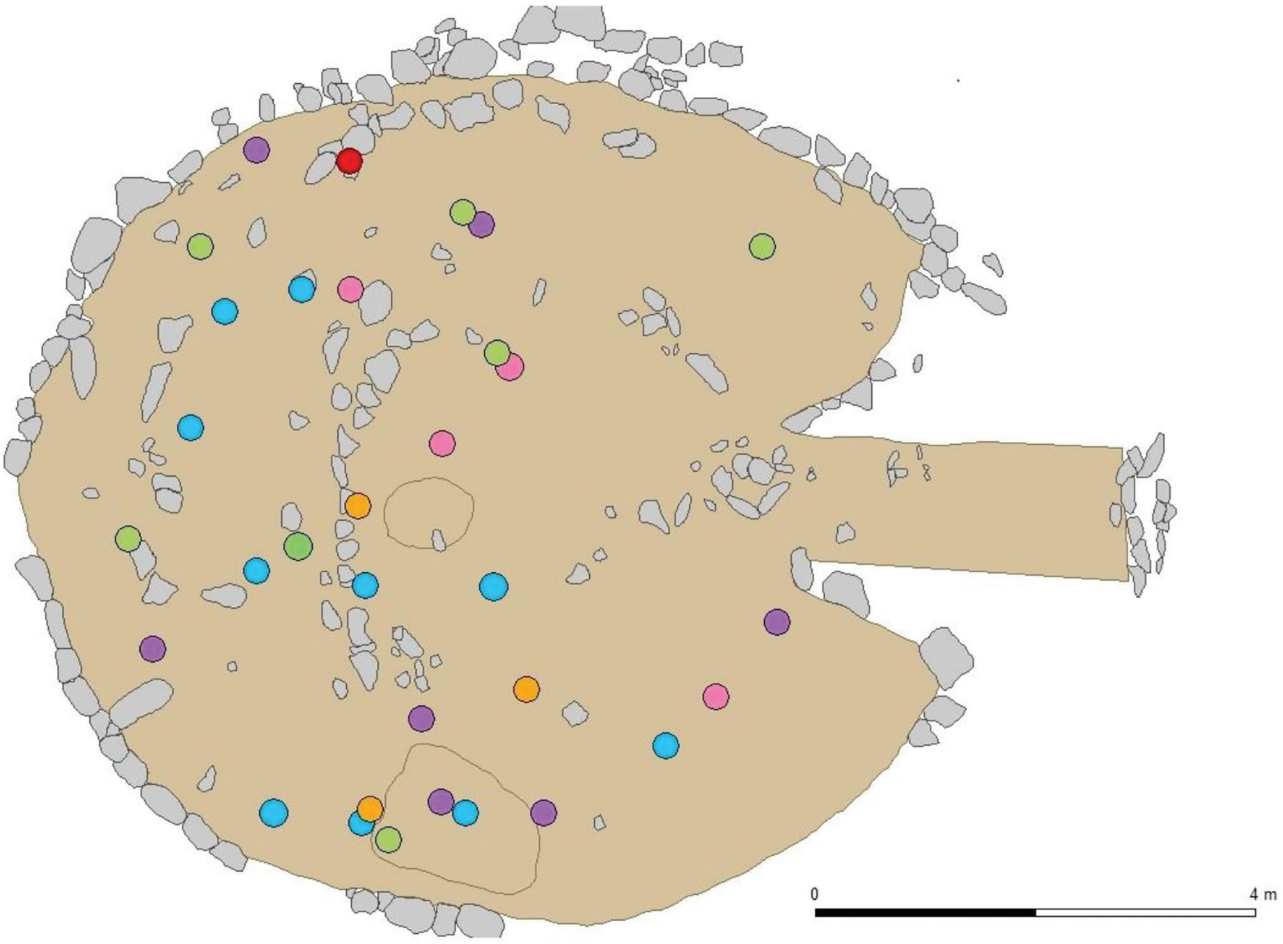


Figure 4.19. Locations of point artefacts within House 401 by tool type

between function and tool material (skeletal element) at Cladh Hallan is flexible, with proposed functions only loosely linked to specific skeletal elements. For example, 'chisels', 'pottery' tools and 'weaving' tools show some slight preference for element, with antler correlated with 'chisels' and long-bone fragments with 'pottery' and 'weaving' tools (see Figure 4.6). This correlation is unsurprising as antler is known for being a durable material which can withstand direct percussion and strong blows (Brain 1981; Whittaker 1994).

The relationship between function and the species from which tools were made is more interesting. Overall, most tools in this study are made from deer, followed by sheep/goat, though the preference for deer is due to the 18 antler tines. This reflects the overall Cladh Hallan assemblage's composition in which 182 artefacts are of antler and only four are of deer bone (see Figure 3.3). This lack of deer bone could be due to the difficulty in assigning species to skeletal elements which have been highly modified (see Chapter 3). However, it more likely stems from the collecting of antler as a resource, supported by the identification of shed antlers in the worked bone assemblage.

Despite the durability and quantity of antler at Cladh Hallan, it accounts for only 8% of 'points' in the sample. This may be because of the increased effort and time required to shape a tine into a smoothed, refined 'point' in comparison with a bone fragment (Clark and Thompson 1954; MacGregor 1985; Foxon 1991). Whilst this supports the characterisation of the Cladh Hallan assemblage as practical and unconcerned with 'elaborate manufacture' (see Chapter 3), the correlation of tip-end diameters with functional groups regardless of material reveals that this may not always have been the case. One explanation for this among the antler material is that tines, which naturally vary in size, were chosen for their task on the basis of size, requiring only minimal modification. For example, a tine with a small diameter would be used for hide-processing whilst one of larger size would be more appropriate for a 'chisel'. Such decision-making would support the conclusion that the overall assemblage was practical and expedient (see Chapter 3).

4.9 Taphonomic alteration

Microscopy has identified taphonomic modifications on 35 tools out of the 80 analysed (Table 4.3). 'Hide-working' tools have the highest rate of taphonomic alteration, excluding natural antler wear. Whilst this may be due to the large sample size compared to other functional categories, deposition could play a part. The majority of 'hide-working' tools come from floor contexts, therefore increasing their chances of undergoing taphonomic processes such as trampling.

4.10 Tools and functions

The proposed functional outcomes derived from this use-wear analysis both support and diverge from those previously proposed (*e.g*. Childe and Paterson 1929; Foxon 1991). As established in Chapter 3, 'points' and 'awls' were multifunctional and were used in a range of domestic craft activities. These two tool types were used for hide-working, basketry, processing of plant fibres, pottery-making, and as chisel-like tools.

The most common functional category for both 'awls' and 'points' is 'hide-working', a grouping which also encompasses 'expedient', 'blunt', and 'worked' artefacts. The working of skin and hide is a common task for a prehistoric settlement site, with pointed implements being used to make holes for clothing and covers, and to spike hides put out to dry (Christidou 2005). This function has long been attributed to 'points', both in the Outer Hebrides and beyond (Anderson 1895; Foxon 1991; Gates St-Pierre 2007). As shown by the results of spatial analysis, many 'hide-working' tools were found near pumice rubbers and flint scrapers, tools which are also involved in hide-processing (see Volume 1: figs 5.44, 6.24, 7.26, 8.30, 9.13, 11.11). The range of tool polish associated with 'hide-working', and indeed many other functional categories, is likely due to duration of use. The inability to capture the 'time dimension', as Legrand and Sidera (2007) call it, plagues tool research and limits the accuracy of any functional conclusions. Similarly, motion of use can affect polish and wear, and 'hide-working' tools would have been used to either pierce and/or scrape hide. Whilst researchers can differentiate between piercing and scraping in experimental studies (see Griffitts 2001; Gates St-Pierre 2007; Buc 2011), these separate processes are almost indistinguishable on material from archaeological contexts. Consequently, of the 22 possible 'hide-working' tools, only four were identified as being used in a piercing/drilling motion, and, even so, these present a range of polishes.

Another function for 'awls' and 'points' is 'basketry', identified for six 'awls', four 'points', and one 'shouldered' artefact. The manufacture of baskets requires pointed tools to punch holes in the weaving material through which more material can be passed (Hurcombe and Lemieux 2005; Hurcombe 2014). Basketry, like hide-working, has long been a suggested function for 'points', drawing on countless ethnographic examples.

Several artefacts not categorised as 'basketry' tools from use-wear analysis could have been used as fids to make rope, a process associated with basketry. Fids are tools which are used to open knots for splicing lengths of rope (MacGregor 1985: 180). They can be perfectly conical or scooped, and several pointed bone tools from Cladh Hallan are conceivable as fids in terms of form/size, use-wear, and polish. 'Awls' and 'points' are also used in rope/cordage-making, in a similar manner to basket-making (to hold open weave and pass through material). Twisted-fibre cordage was identified in the southwest quadrant of floor 1311 of House 401 (see Volume 1: 145). Bone 'needles' from the site could have been used to make fishing nets (see Chapter 3). Furthermore, long grass and heather, which both grow abundantly on South Uist, are known to have been made into relatively thick rope into the 20th century within the isles (Smith 2012: 399).

The manufacture of baskets and rope would have also required the processing (*i.e*. breaking down) of plant fibres, a function which has been attributed to three artefacts from the study (two 'awls' and one 'expedient' tool). Whilst denticulated flint tools are generally used to split plant fibres, Gates St-Pierre (2007) found that pointed bone implements are also effective. Scapula-end tools at Cladh Hallan could also have been used to separate plant fibres (see Chapter 3).

As proposed in Chapter 3, the use of 'blunt' points as weft beaters is supported by their diagnostic polish; of the 13 'blunts', four can confidently be assigned a 'weaving' function, most likely as weft beaters which at this size are commonly called pin-beaters (Nosh *et al*. 2014). These pin-beaters were probably used on warp-weighted looms, given the loom weights from Houses 1500 and 401, and their known use during the period (Campbell 1991; McQuade *et al*. 2009; Harrington 2007; see Volume 1: chapters 9, 11).

Antler 'blunts' could have been used as enlarged fids. At the Late Bronze Age site of Asva in Estonia, antler tines with spiral use-wear striations were considered to have been used to manufacture thick cord for fishing- and/or seal-hunting nets (Maldre and Luik 2009: 43). Several antler 'blunts' in the Cladh Hallan dataset present wear similar to the examples from Asva. However, many of the possible antler fids from Cladh Hallan have natural antler wear which hampers interpretation, rendering this suggestion speculative. The remaining nine 'blunts' belong to a variety of functional groups, including 'chisel', 'hide-working' and 'pottery' tools (see Figure 4.4).

At Cladh Hallan, four 'worked' tines and four 'blunts' belong to the functional group of 'chisel'. Tip deformation, found on all 'chisels' to varying degrees, is associated with a variety of functions, making explicit determination difficult. One possibility is that 'chisels' were used in metalworking as striking tools for indirect percussion. Most archaeological chisels are made of metal and have angled, wedge-like tips though examples in antler were used in Bronze Age Europe (Luik 2011; Fregni 2014). Chisels of different materials were used in Bronze Age metalworking for removal of excess metal and for applying repoussé decoration (Fregni 2014). The interpretation of these objects as chisels is supported by possible fragments of chalcopyrite embedded on the surface of two 'chisels' from Phase 9 (SF 4723; Figure 4.7a) and Phase 12 (SF 4977; Figures 4.7b and 4.8). SF 4723 and a third antler chisel were found in the north of House 401, an area used for bronze-casting in this phase of the house's occupation (see Chapter 1 and Volume 1: fig. 5.44).

These 'chisels' could also have been used as pressure-flakers for flint-working (Foxon 1991: 105), or wedges in groove-and-splinter manufacture, or for working pumice. Examples of antler and bone pressure-flakers are numerous in the literature, supported by results of experimental studies (Stodiek 1990; Averbouh and Bodu 2002; Bello *et al*. 2016).

It is also possible that 'worked' and 'blunt' artefacts are 'bevel-ended tools' of a type common in western Scotland and thought to have been used for prising limpets off rocks (Griffitts and Bonsall 2001) or processing hides (Hardy and Birch 2009). Made of splinters of antler or bone and possessing bevelled and/or rounded ends, the use-wear on 'bevel-ended tools' is described as longitudinal striations of varying size with small areas of polish (Griffitts and Bonsall 2001: 211). This matches the use-wear and polish identified on several Cladh Hallan tools. However, the difference between a 'chisel' and a 'bevel-ended tool' is minor, with both presenting similar morphology and wear (Hardy and Birch 2009). As the two cannot be confidently differentiated, the possible function of shellfish harvesting is encompassed under the category of 'chisel'.

The next functional category is 'pottery' tool, which comprises single examples of a 'point', an 'awl' and a 'blunt'. The 'blunt' tool was likely used to smooth pots, supported by transverse striations and areas of bright contact polish, which have both been identified on experimental bone pottery smoothers (see Buc 2011; Wojtczak and Kerdy 2018). It is possible that the deep blue/black pigment residue on one 'awl' (SF 3747; Figure 4.9) is related to pottery manufacture: Egyptian blue pigment was found at the nearby Middle Iron Age site of Sollas (Campbell 1991) but the composition of the Cladh Hallan pigment has not been studied.

'Expedient' points are bone splinters used as 'awls'/piercing tools with little or no modification (see Chapter 3). Use-wear supports this interpretation, with half of the analysed tools identified as having been used in 'hide-working' and 'plant processing'. The other 50% are of 'unknown' function, the largest percentage of any tool type. Hallén (1994) argues that 'expedient' points are bone-working debris, and the lack of use-wear striations on two of the 'unknown' samples supports this.

Of the 15 'unknown' tools, six present use-wear striations which indicate a variety of functions. Often these tools overlap in diagnostic wear, possibly suggesting their use for a multitude of tasks. Alternatively, manufacturing striations may have compromised visibility of use-wear, a possibility given this functional group has the most manufacturing marks (32%). The remaining nine implements do not have striations, but many have a high level of polish on the tip and/or shaft (see Figure 4.5). These may result from activities which did not create striations and/or these tools were used for a short duration of time.

Lastly, 14 'utilised' items represent material which has been exploited, but not necessarily used as functional tools. Much of this category comprises 'unworked' antler, probably a raw material for tool production (see Chapter 3). Three antler 'blunts' have also been included within this group of 'utilised' material, although their extensive wear is likely caused by the animal wearing the antlers rather than by their use as tools. Indeed, the biggest problem affecting functional identification of antler is natural damage, an issue which has been well discussed (Olsen 1984; 1989; Villa and d'Errico 2001; Jin and Shipman 2010).

Integrating functional groups and tool types

Use-wear analysis clearly demonstrates that 'point' typology on its own is not a reliable indicator of function within the Cladh Hallan assemblage. This conclusion is unsurprising given the number of studies reaching similar typological conclusions (Le Moine 1991; Gates St-Pierre 2007; Buc 2011). Researchers working on Scottish assemblages have also expressed dissatisfaction with current 'point' typologies, with both Foxon (1991: 147) and Hallén (1994: 205) admitting that 'point' typologies are descriptive in nature and do not address function well. Since the accuracy and consistency of typologies affect how well researchers are able to interpret not only the artefact in question, but also its associated material culture and technology, it is essential to establish a typological scheme which bridges the divide between tool type and function.

Correlation of morphometric traits with function can help to resolve this problem. As demonstrated by use-wear analysis, tip-end and shaft and tip interface diameters are associated with certain functions, thereby enabling integration of morphological typology with function. However, Choyke and Schibler (2007) warn that the use of tool metrics to define typology is dangerous, as tools commonly undergo processes (use, breakage, and repair) which can affect these measurements. Instead of reflecting function, they argue that morphology reflects duration and intensity of use.

Still, tip metrics have been used successfully in other 'point' typologies (*e.g.* Ambler 1966) and, as tip-end and tip and shaft interface diameters model a tip's start and terminus, they could provide an overview of the whole tip's wear. Whilst detailed, high-power microscopy is not always suitable for typological distinction, given the need for equipment and processing time, some functional use-wear characteristics can be identified with a 30× magnification hand lens. These include striation placement, arrangement, distribution and form which, when identified together, can be found to correspond with particular functional uses.

Skeletal element has been used successfully in both Schibler's (1981) and Foxon's (1991) typologies, providing a useful pointer for attaining working classifications. Though the link at Cladh Hallan between function and element is variable, as previously discussed, it establishes a preliminary typological division. Long-bone fragments generally provide tools for 'weaving', 'basketry', 'pottery', and 'hide-working', metapodials provide 'plant-processing' and 'hide-working' tools, and antler tines 'chisels' and 'utilised' tools.

By combining these use-wear characteristics and metric measurements, a set of functional types can be proposed (Table 4.7). These types have alphabetical names to avoid confusion with previously established typologies, an idea borrowed from Childe (1931), Kidder (1932) and Ambler (1966). Additionally, alphabetical categories can be easily modified to fit assemblages with a wider range of functions and/or morphometric traits than studied here. A confidence interval has been given for each metric trait and is representative of one standard deviation. Though these intervals are quite large, they reflect the diverse manner of use and morphology of the overall functional group.

Table 4.7. A classification scheme for points based on use-wear striations and tip morphology

	Proposed typological groups					
	A	*B*	*C*	*D*	*E*	*F*
Tip end diameter (mm)	1.43±0.5	7.08±0.4	2.51±1.3	0.97±0.4	2.43±1.0	6.03±0.7
Tip and shaft interface diameter (mm)	8.65±1.9	14.05±1.6	10.05±2.3	12.20±1.0	6.90±1.4	12.20±1.7
Element	Long bone	Antler (tine tip)	Long bone or metapodial	Metapodial	Long bone	Long bone
Placement	Tip	Tip	Tip	Tip	Tip, shaft	Tip, shaft
Arrangement	Parallel	Crossed	Parallel	Crossed	Parallel	Parallel
Distribution	Longitudinal or transverse	Longitudinal	Longitudinal	Longitudinal	Transverse	Transverse
Form	Straight	Ribbon	Straight	Ribbon	Straight	Ribbon or straight
Likely function	Basketry	Chisel	Hide	Plant-processing	Pottery	Weaving

House 401 over time

The wide range of functions for bone and antler points from Phase 9 contexts reveals that this was a period of intense activity within House 401 (Figure 4.12). Use-wear analysis of 'points' and lithics (see Chapter 5) reveal especially hide-working within the southwest quadrant of floor layer 1311. However, the northern area contained a 'chisel' (SF 4723) with possible traces of chalcopyrite or mica, suggestive of metalworking. This correlates with the use of this part of the house during Phase 9, at the beginning and at the end of this phase on the basis of soil micromorphological analysis and finds, for bronze-casting (Chapter 1; see Volume 1: 411–12).

Phase 10 displays a lack of hide-working points, which correlates with a drop in pumice to suggest a decline in hide-working (Figure 4.13; see Chapter 7; see Volume 1: fig. 6.25). The presence of basketry tools in this phase could be associated with the greater emphasis on storage, as revealed by quantities of unsooted pottery sherds in the southwest of the house (see Volume 1: 220, fig. 6.22). The rise in the number of 'unknown' tools could be linked to increased multi-functionality, a pattern found among the pumice artefacts in this phase, half of it also showing multi-functional use (see Chapter 7). This phase saw smaller quantities of debris left in and on the floor of House 401 (see Volume 1: 220–31).

The increase in 'hide-working' points and pumice in Phase 11 marks a return to more intense activity in hide-processing (Figure 4.14). The presence of 'hide-working' points in the western half of floor layer 655 supports its interpretation as a craft area (see Volume 1: 264–72, fig. 7.26). The sparsity of finds in the north supports interpretation of this area's continued use for sleeping (see Volume 1: 259–61, figs 7.25–7.30).

In Phase 12, the site's material culture changed character again, perhaps linked to technological developments during the bronze–iron transition (see Volume 1: 295–6). Functions of points become less varied, with only hide-working, weaving and 'chisels' identified (Figure 4.15). The identification of a pin-beater (SF 5544) for weaving and a spindle whorl (SF 3420) are evidence for textile production in this phase (see Volume 1: 295).

In Phase 13 the range of functions for points is similar to that of Phase 9, though in smaller quantities and without any weaving tools (Figure 4.16). From this stage onwards, House 401 entered a steady decline into disuse, with activities continuing to be carried out in the same areas (Figures 4.17–4.19). This locational consistency of activities suggests that the domestic industries of House 401 changed little over the 600 years that Phases 8 to 16 represent (Figure 4.20). In terms of spatial organisation, points appear to have been used in similar spaces throughout House 401's occupation to suggest a structured 'sunwise' use of space (see Volume 1: 16–17, fig. 1.20).

The identification of similar use-wear on 'worked' antler and on bone 'points' suggests that 'worked' antlers are indeed antler 'points'. Conversely, 'expedient' points may be debris from bone-working rather than tools.

4.11 Conclusion

Use-wear analysis of a sample of 80 bone and antler artefacts from House 401's various phases reveals that bone 'points' and 'worked' antler were involved in a wide range of activities at Cladh Hallan. These activities include fibre-working, textile manufacture, metalworking, pottery-smoothing and hide-working. They conform largely with those identified in Chapter 3, as well as from other research (Hallén 1994; Becker 2001; Christidou 2005; Gates St-Pierre 2007). The proposed multi-functionality of various types of point previously proposed (see Chapter 3; Hallén 1994) has also been confirmed. However, identification of use-wear indicative of several functions on individual artefacts shows that multi-functionality extends beyond tool type. Use-wear also reveals that 'worked' antlers are probably misidentified 'points' (as proposed in Chapter 3). Furthermore, the interpretation of 'unworked' antlers as raw and/or part-manufactured material, put forward in

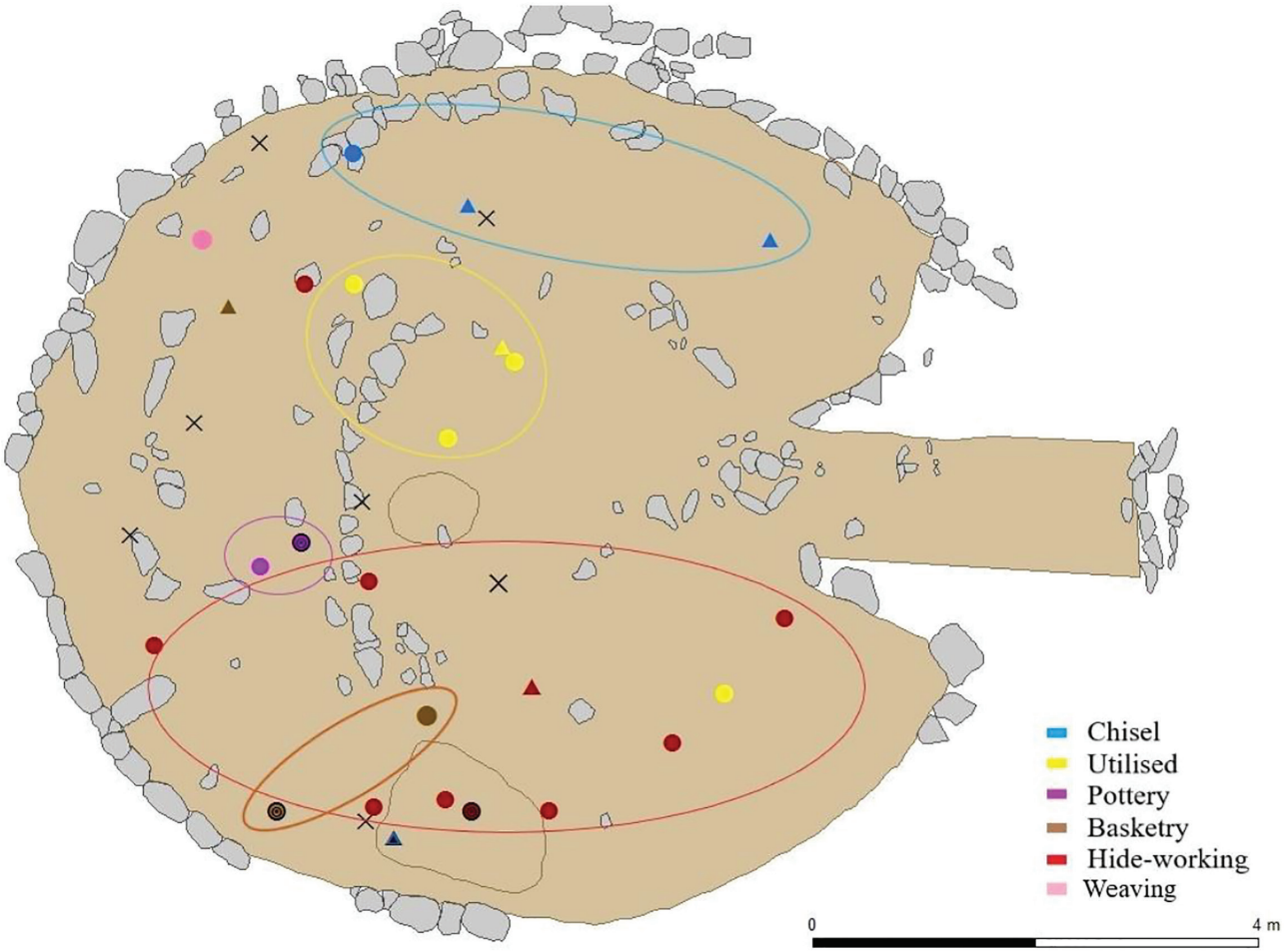


Figure 4.20. The spatial distribution of 'point' artefacts by function in Phase 9 within House 401

Chapter 3, has been proven correct by the absence of use-wear, and corroborated by their locations within non-active working spaces within House 401. Finally, the identification of probable chalcopyrite and/or mica on two proposed 'chisels' may link these antler tools to bronze metallurgy, corroborated by their spatial and contextual association with bronze-casting debris.

In terms of tool manufacture, wear patterns associated with grinding, cutting and modifying with metal-bladed tools have been identified, confirming inferences and observations at Cladh Hallan and elsewhere in Atlantic Scotland (Chapter 3; MacGregor 1985; Foxon 1991; Hallén 1994). Taphonomic modifications were identified on a number of artefacts, with tools from floor contexts showing a higher degree of alteration, probably mostly due to trampling.

The use-wear and metric analyses have revealed that typologies of form do not correlate directly with function, indicating that tool morphology is not an accurate indicator of use. This supports and confirms previous characterisations of these typologies as 'descriptive rather than functional' (Foxon 1991; Hallén 1994). Given the discrepancies identified between form and function, an alternative system of classifying 'points' can be proposed using use-wear, metric traits, and skeletal element composition.

By integrating the results of use-wear analysis with spatial data from within House 401's sequence of floor layers, several inferences can be made about activities through time and space (Figure 4.20). Firstly, 'points' were used in a similar manner throughout House 401's main period of use, except for Phases 10 and 13–16 when hide-working declined. Comparable fluctuations in other forms of material culture, such as worked pumice and stone tools (see Chapters 5–7), support these variations and suggest that they are site-wide phenomena and not merely changes in worked bone technology. Finally, artefact and 'point' distributions within House 401 provide evidence for an ordered use of space over many phases, consistent with the 'sunwise' model (see Volume 1: 16–17, fig. 1.20).

Note

1 This is a shortened version of an MSc dissertation *What's the 'point' of it 'awl'?* presented at Cardiff University in 2018.

5 Worked flint, quartz and stone

M. Edmonds, K. Martin, J. Compton and L. Hurcombe

5.1 The lithic assemblage

Mark Edmonds and Katherine Martin

This report documents the character of the lithic assemblage recovered during excavations at Cladh Hallan (Figure 5.1). A total of 349 pieces of flint and quartz and 25 pieces of worked stone were studied out of a complete assemblage of 586 pieces; the majority of flint was studied but some of the quartz was unavailable for analysis at the time. The composition of both the sample assemblage and the full assemblage reflects the exploitation of local sources of flint, quartz and a small quantity of fine-grained stone. Taken together, the tools and debitage attest to the continued, if limited, use of these raw materials throughout the history of occupation in the area.

Methodology

The Cladh Hallan material joins a growing list of assemblages that have been published from the Western Isles in the last two decades (*e.g.* Wickham-Jones 1995). To aid comparability, a close correspondence with established methodologies is followed here.

Raw materials

With the exception of a very small number of artefacts made from sandstone and slate, the vast majority of the artefacts in the Cladh Hallan dataset reflect the use of locally available flint and quartz. Notes were made on the condition of each piece, primarily to establish whether any information on likely source areas could be identified. This effectively involved the characterisation of any remaining cortex on individual pieces, to determine whether or not the sources involved were beach pebbles.

Categories and attributes

Material was sorted according to a variety of formal attributes (Table 5.1). Further insights were provided by more detailed technological analysis, designed to establish the nature and variability of the reduction sequences followed in different contexts. For flakes and blades, this involved a basic division into primary, secondary and tertiary removals, where *primary* pieces were defined as having more than 50% of their dorsal surfaces unflaked, *secondary* pieces more than 0% but less than 50%, and *tertiary* pieces were all flaked. Information was also recorded on the presence, absence and character of platform preparation, on the nature of flake/blade terminations and on the directions of dorsal scars on struck flakes and blades.

Metrical analyses were also undertaken. For flakes and blades, length was measured from the distal end to the proximal point of impact. With bipolar flakes, the length was defined as the measurement between opposing points of impact. For all flakes and blades the breadth was defined as the measurement at right angles to the length and was taken at the broadest point of the piece. For cores, the length was defined as the measurement from the major platform to the opposite end of the piece, with bipolar cores measured between the opposing points of impact, and the breadth was the measurement at right angles to the length and taken at the broadest point of the platform, or in the case of bipolar cores at the broadest point of the striking edge.

The composition of the assemblage as a whole is described, before being broken down into groups corresponding to individual house/yard units.

Table 5.1. Categories used in analysis of the Cladh Hallan assemblage

chip/spall	blade	small flake	single platform core	formal tools
chunk	retouched flake	crushed flake	bipolar core	crushed chunk
flake	edge-damaged flake	chunk	multiple platform core	shatter

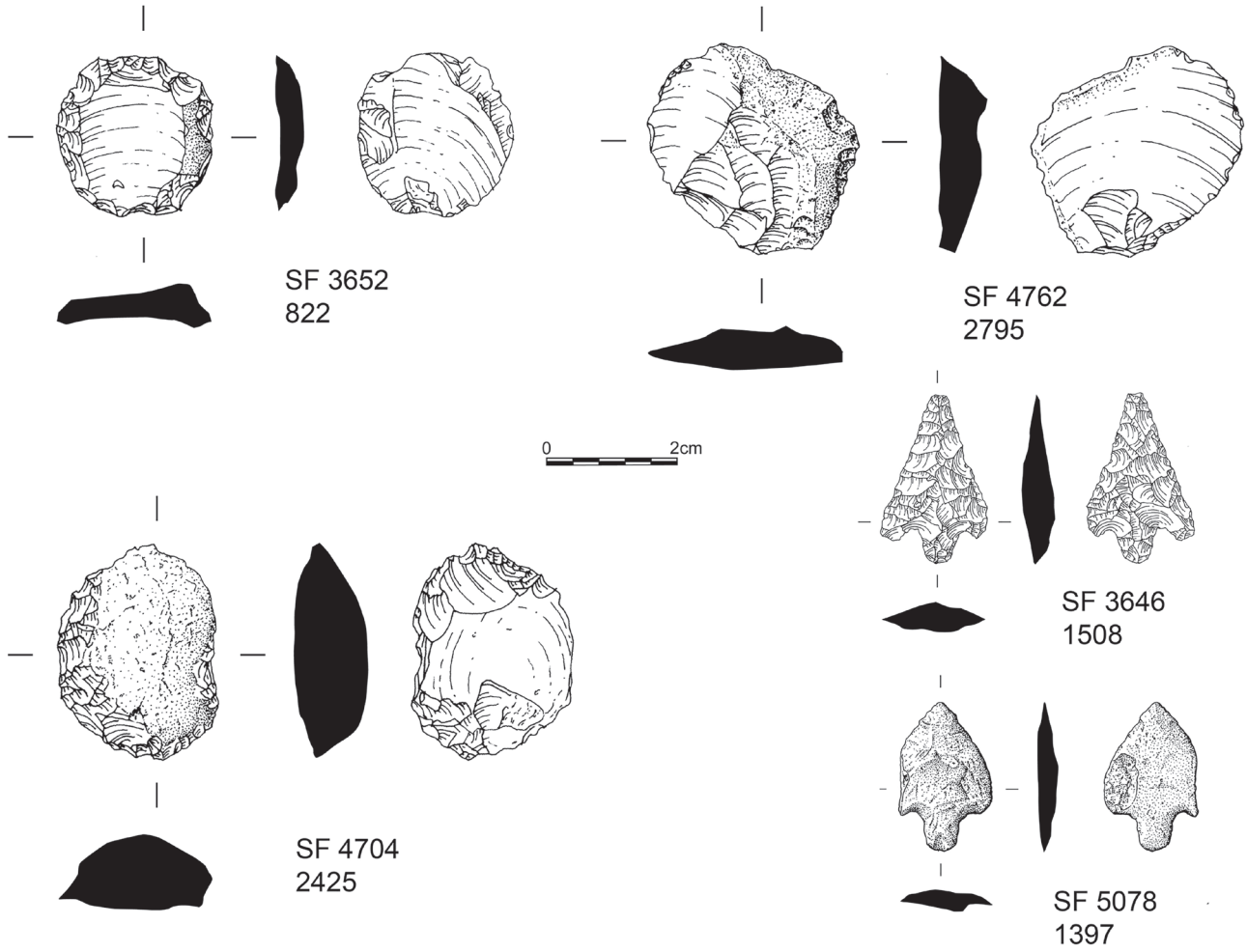


Figure 5.1. Flint artefacts from Cladh Hallan

Assemblage composition

The sample assemblage comprises 349 pieces. The majority of these are flint, which, so far as can be determined, appears to be derived from beach pebbles. That said, there is also abundant evidence for quartz-working, flakes and reduction debris in this material amounting to roughly a third of the assemblage as a whole (Table 5.2). Twenty-five pieces of flaked stone were also examined. Flakes dominate the assemblage, but there are also a significant number of cores and more irregular working debitage (by which is meant chips and chunks). Relatively few formal retouched tool types were identified. Among these, scrapers dominate (*n* = 19 out of 26), with smaller numbers of borers and two barbed and tanged arrowheads (one made from flint [SF 3646] and another on a fine-grained slate [SF 5078]; Figure 5.1).

Table 5.2. Breakdown of the overall assemblage. The category of flint here includes one sandstone and one slate item

Category	Whole assemblage		Flint		Quartz only	
	n	%	*n*	%	*n*	%
Debitage	98	28	52	24	46	35
Flakes	197	56	125	57	72	55
Cores	29	9	19	9	10	8
Retouched tools	25	7	22	10	3	2
Total	**349**	**100.0**	**218**	**100.0**	**131**	**100.0**

Raw material

Two-thirds of the assemblage is flint and a third is quartz, with 25 pieces of flaked stone and one piece of fine-grained slate (the latter in the form of a barbed and tanged arrowhead; Table 5.3).

As can be seen from Table 5.2, flint and quartz were used in similar ways; flakes dominate both assemblages, although the quartz assemblage contains more debitage and fewer cores and retouched tools. There were no significant spatial differences in where flint and quartz were uncovered. Most of the quartz is of a poor, coarse-grained quality.

It is assumed that the majority of the flint assemblage comes from beach pebbles, as this is the only source of flint to be found on South Uist. The surviving cortex is often smooth, consistent with its having been rolled by tidal action. The assemblage is of variable quality: some of the flint is relatively good, being smooth and homogeneous, but some is of considerably poorer quality, with inclusions and incipient fractures. The flint assemblage includes a

Table 5.3. Raw material composition of the assemblage

Material	Whole assemblage	
	n	*%*
Flint	216	61
Quartz	131	38
Sandstone	1	0.5
Slate	1	0.5
Total	**349**	**100.0**

Table 5.4. Pebbles and split pebbles within the assemblage. The category of flint here includes one sandstone and one slate item

Material	Whole assemblage		Flint		Quartz only	
	n	*%*	*n*	*%*	*n*	*%*
Pebbles/split pebbles	37	11	29	13	8	6
Total	**349**		**218**		**131**	

number of split pebbles, many of which show signs of having been worked (Table 5.4).

The split pebbles have maximum dimensions varying between 22mm and 55mm, although all except one have maximum dimensions between 22mm and 40mm. These pebbles give a good idea of the type of nodule that knappers had to work with. As most of the pebbles are small, it can be assumed that both knapping technology and the resultant artefacts were constrained to a certain extent by the available raw material. When compared with the flint, a slightly smaller percentage of the quartz assemblage is made up of split pebbles, suggesting a broadly similar kind of source. The maximum dimensions of the quartz pebbles are slightly larger than the flint, varying between 35mm and 60mm.

Condition

The generally irregular nature of working made it very difficult to ascertain whether a piece was broken or whole. Pieces were only defined as broken when there is clear evidence for breakage, making the overall total very low (Table 5.5). The number of visibly burnt pieces is even smaller, which certainly suggests that these materials were not actively used as potboilers *etc*. (Table 5.6).

Most of the flint assemblage is in a fresh condition and

Table 5.5. Broken pieces within the assemblage

Condition	Whole assemblage	
	n	*%*
Broken	52	15
Unbroken	297	85
Total	**349**	**100.0**

Table 5.6. Burnt pieces within the assemblage

Condition	Whole assemblage	
	n	*%*
Burnt	11	3
Unburnt	338	97
Total	**349**	**100.0**

the original colour and texture is visible on most pieces; the material is usually a smooth brownish-grey flint. Only a few pieces had corticated to a white or cream, and although the causes of cortication on flint are complex, this suggests that the whole flint assemblage was buried with very similar depositional conditions after discard and was never exposed to the elements for very long. There is also no evidence for the recycling of flint, as no pieces retain evidence for reworking through corticated surfaces. This does not necessarily mean that recycling was not carried out at all, just that cortication had not occurred before it did.

There are, however, three pieces that are heavily corticated, which may indicate that they are residual. The first two are long, thin, tertiary flint flakes (SF 3663) found on the floor (1436) of House 1500 (the short-lived structure at the southern end of the site; Phase 14). They are conjoining pieces; one has clear blade-like characteristics, and the flake from which this possible blade was removed shows characteristics of blade-working. True blades are very rare this late in prehistory (late eighth–seventh centuries BC) and these two flakes are so heavily corticated that they are a creamy white all over. Several other pieces also hint at residuality. In addition to the two barbed and tanged arrowheads, these include a well-made tertiary flint scraper (SF 4182) found on the surface of the Phase 8 wall core (1929) in the southeast front of House 401 (the central roundhouse, first construction in Phase 8 and rebuilt and occupied until Phase 16). The standard of knapping on this piece is far higher than for the rest of the assemblage and it is the only flake to have a prepared platform. It is therefore likely that this too is residual. The same is also likely to apply to a microlithic point, with blunt backing and bifacial retouch (SF 5256) which was recovered from beneath the northern house, House 1370 (from Phase 3 windblown sand 3448, which overlay the Beaker ploughsoil; see Volume 1: 38).

Technology

The assemblage is dominated by knapping debris, including cores, worked and split pebbles, debitage flakes, chunks and chips (Table 5.7). There is a very restricted range of formal retouched tool types.

Roughly half of the cores within the assemblage are bipolar, this figure being a lowest estimate in that several chunks are likely to be the remnants of this particular reduction method. This technique, when nodules are held and struck on an anvil, is an effective way to work beach pebbles. However, it is clear that platform-working

Table 5.7. Breakdown of assemblage by type. The category of flint here includes one sandstone and one slate item

Type	Whole assemblage	Quartz *n*	Flint *n*
Chip/spall	42	25	17
Chunk	28	14	14
Flake	206	72	125
Blade	3		3
Retouched flake/blade	9	1	8
Flake with heavy crushing/fracturing on edges	1		1
Chunk with heavy crushing/hammering	7		7
Single platform core/core fragment	6	4	2
Bipolar core/core fragment	14		14
Multiple platform/direction core/core fragment	9	6	3
Borer	5	1	4
Irregular scraper	12	4	8
Utilised/edge-damaged flake	13	4	9
Thumbnail scraper	7		7
Barbed and tanged arrowhead	2		1 (plus 1 slate)
Total	**349**	**131**	**218**

was also carried out, not only from the cores themselves but also because many flakes have platforms on their distal ends. However, as multiple- and single-platform cores are similar in number, there does not seem to be a concern with regular or controlled platform-working. It is assumed that bipolar-working was conducted to split whole pebbles, thus providing a suitable flat surface on which a platform could be created.

Table 5.8. Breakdown of assemblage by reduction

Reduction	Whole assemblage		Flint only		Quartz only	
	n	%	*n*	%	*n*	%
Primary	79	38.0	67	42.9	12	24.0
Secondary	79	38.0	53	33.3	26	52.0
Tertiary	50	24.0	37	23.7	13	24.0
Total	**208**	**100.0**	**126**	**100.0**	**72**	**100.0**

Table 5.9. Maximum dimensions of flakes

Flake dimensions	
Range (mm)	**Frequency**
11–15	4
16–20	28
21–25	65
26–30	56
31–35	36
36–40	10
41–45	2
46–50	4
51–55	2

The maximum dimensions of split pebbles within the assemblage suggest that bipolar-working was commonly employed to remove flakes from small cores. The flint cores were worked to a small size, the maximum length being 61mm, though all but two were abandoned between 15mm and 32mm in length. These sizes correlate well with the size of the split pebbles within the assemblage. The platform cores also tend to be wider in breadth, their widths varying between 22mm and 36mm, suggesting that they were abandoned at an earlier stage of working than the bipolar cores.

The working of small pebbles is likely to lead to relatively large numbers of primary pieces, and the information on reduction sequences within the assemblage is helpful for the argument that beach pebble flint was used. This is demonstrated most directly in Table 5.8, where primary pieces are the most common category amongst flint flakes and blades, and are well represented amongst the quartz.

As can be seen in Table 5.9, the maximum dimensions of flint and quartz flakes are mainly between 15mm and 40mm, which is consistent with the size of the split pebbles within the assemblage. This confirms the emphasis on beach pebbles also suggested by the high frequency of primary flakes.

Also significant are the scores for breadth/length ratios. Like many later prehistoric assemblages, the majority of flakes here are markedly short and squat, with a length/breadth ratio of 1:1, some 90% having length/breadth ratios of between 0.50–2.0, and 80% between 0.75–1.75 (Table 5.10).

The scar directions of the ripple marks on the ventral surface of flint flakes and retouched tools also confirm that bipolar-working was used to split flint pebbles, which were then worked further as platform cores. As can be seen in

Table 5.10. Length/breadth ratios of flakes

Flake length/breadth ratios	
Range (mm)	**Frequency**
0.25–0.5	2
0.51–0.75	11
0.76–1.0	27
1.01–1.25	52
1.26–1.5	57
1.51–1.75	27
1.76–2.0	21
2.01–2.25	1
2.26–2.50	3
2.51–2.75	2
2.76–3.0	2
3.01–3.25	0
3.26–3.5	0
3.51–3.75	1
3.76–4.0	0
4.01–4.25	0
4.26–4.5	1

Table 5.11. Scar direction on ventral surface of flint flakes and retouched tools

Scar direction	**Flint only**	
	n	*%*
Single direction	75	72.8
Bipolar	9	8.7
Indeterminate	19	18.4
Total	**103**	**100.0**

Table 5.11, single-direction ripples, whereby the flake has been removed from a platform, are by far the most common. The smaller number of flakes with bipolar scar ripples appears to relate to the working of small pebbles because the maximum dimensions of these flakes all lie between 20mm and 30mm. When they exist, the scar directions of ripples on the dorsal side of flakes and retouched tools are nearly always multi-directional, not only again showing that platform-working was the principal method by which flakes were removed, but also demonstrating that there was a lack of concern with removing them in a controlled and ordered fashion.

Table 5.12. Distribution of flint by phase and context type (total assemblage; ten items were not analysed)

Phase	**Floor/hearth**	**Inside fill**	**Outside fill**	**Wall cut fill**	**Sand wall**	**Collapsed wall**	**Hearth ash layer**	**Posthole**	**Pit**	**Pyre**	**Gully**	**Abandonment**	**Windblown**	**Ploughing**	**Total**
1								1					4	4	**9**
2															
3	1									2	2				**5**
4	1												2		**3**
5			2										2	1	**5**
6									4						**4**
7	1	1		1											**3**
8		5			8			6	12						**31**
9	33	3	2		1			1	1		1				**42**
10		3	1					2	2		1		3		**12**
11	1	3	2	1					1						**8**
12	2	1	10	2			1		26				1		**43**
13	6	3						2							**11**
14		1						1	3						**5**
15	1	11													**12**
16		5	3	3								2			**13**
U/S															**20**
Total	**46**	**36**	**20**	**7**	**9**	**0**	**1**	**13**	**49**	**2**	**4**	**2**	**12**	**5**	**226**

Chronology and context

The chronological distribution of flint is very different to that of quartz. Whereas flint was dispersed throughout Phases 1–16 (Table 5.12), quartz was largely absent after Phase 11 (Table 5.13), having become less common after Phase 9. Phases 8–9 were the periods when both quartz and flint were used in quantity, both being distributed within house floors in appreciable numbers. Flint declined in Phases 10–11 but rose again in Phase 12 (the period of the bronze–iron transition), the first time that worked flint outnumbered flaked quartz (Figure 5.2). Flint continued to be used until Phase 16.

The contexts in which flaked stone (materials other than flint and quartz) were found are mostly fill layers, very different from those contexts (particularly floors and cut features) in which worked quartz and flint tended to be found (Table 5.14). The narrow chronological period in which flaked stone was deposited, centring on Phase 8–10 fills, makes it most likely that these were not tools but by-products of stone-working during construction, especially the episode of roundhouse building in Phase 8 (from which Phase 9 and 10 fills may have originated). These 25 pieces of flaked stone were not identified geologically though they are probably all from beach cobbles. The only items not of flint or quartz which are definitely tools are either from Phase 8 contexts (a tanged arrowhead [SF 5078; Figure 15.1] from the wall core of House 1370 and a flake [SF 4865] from the wall core of House 801) or from a Phase 10 context (a flake [SF 3549] from the fill beneath the floor of House 401).

Location

House 401 produced roughly half of the whole assemblage, most probably as a function of the longevity of its occupation (Table 5.15). Although the other assemblages are very small, they mostly contain more flint than quartz. However, two locations diverge from this pattern. House 1370 produced a greater percentage of the quartz assemblage than the other small groups. House 1500 produced flint pieces only and over half of these were found on the floor (1436), a pattern which is interesting given the suggestions that this space was associated with skin- and hide-working (Volume 1: 373–6).

House 401 is also the only location to contain every type of artefact and to contain all four groups (flakes, cores, retouched tools and debitage) in any quantity. Flakes are always in the majority within the significant assemblages. House 801's floor is interesting because nearly 20% of its small assemblage of 16 artefacts comprises retouched tools, one of each type (see Volume 1: fig. 5.13). House 1370's floors are also interesting because within their small assemblage of 19 artefacts they contain a quarter of the whole core assemblage, again one of each type (see Volume 1: figs 5.76 and 5.80).

Table 5.13. Distribution of struck quartz by phase and context type (total assemblage; only a sample of 131 was analysed)

Phase	Floor/hearth	Inside fill	Outside fill	Wall cut fill	Sand wall	Collapsed wall	Hearth ash layer	Posthole	Pit	Burial/pyre	Gully	Abandonment	Windblown	Ploughing	Total
1													18	44	**62**
2															
3					1				12	2	10				**25**
4	3							1					10		**14**
5			4										5	1	**10**
6									11						**11**
7		1		4					1						**6**
8		8			20			35	24	11	1				**99**
9	52	3	3						1				1		**60**
10	1	4						6	1	3					**15**
11	2	5	3						1		1		1		**13**
12		1					1								**2**
13															
14															
15															
16		1													**1**
U/S															**19**
Total	**58**	**23**	**10**	**4**	**21**	**0**	**1**	**42**	**51**	**16**	**12**	**0**	**17**	**44**	**337**

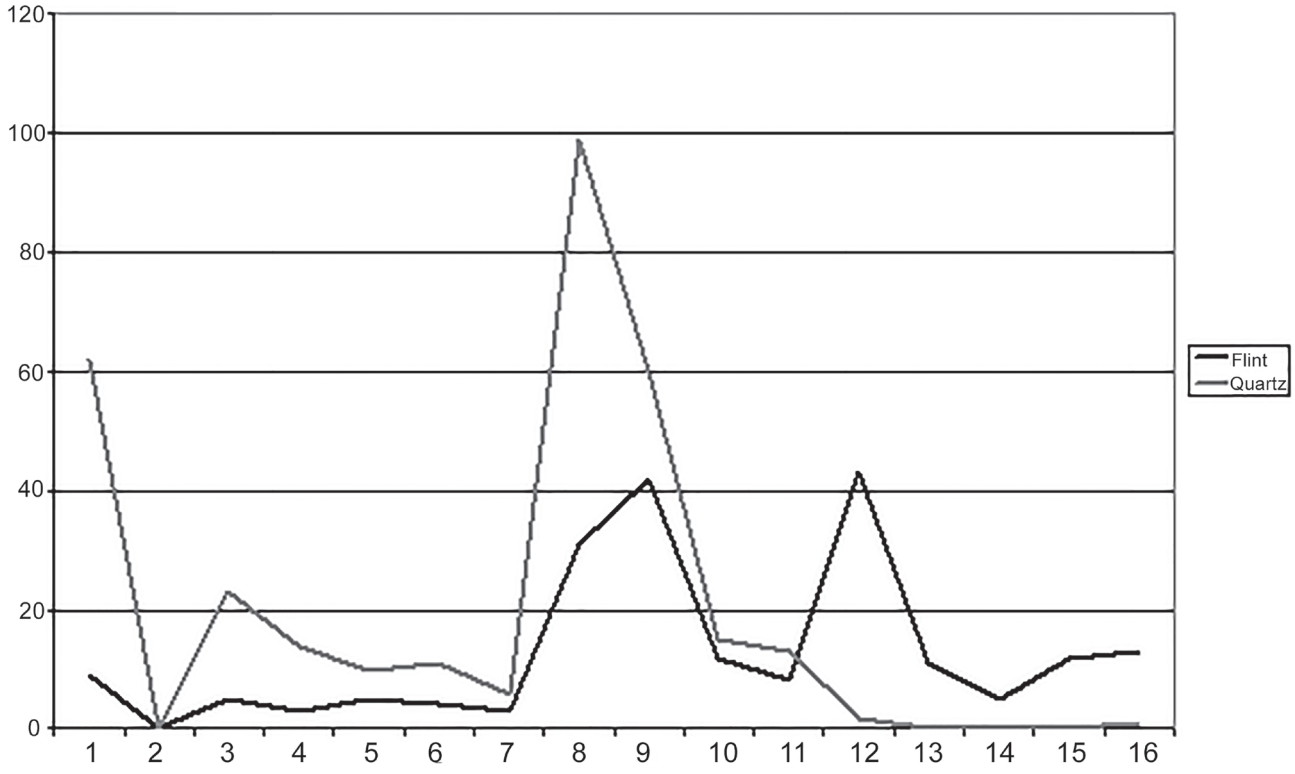


Figure 5.2. Relative frequencies of flint and quartz artefacts through time (Phases 1–16) at Cladh Hallan

Table 5.14. Distribution of flaked stone by phase and context type (total assemblage)

Phase	Floor/hearth	Inside fill	Outside fill	Wall cut fill	Sand wall	Collapsed wall	Hearth ash layer	Posthole	Pit	Burial	Gully	Abandonment	Windblown	Ploughing	Total
1															
2															
3															
4															
5															
6															
7															
8					2										**2**
9		6						3	1						**10**
10	1	7			1										**9**
11		1	1	1											**3**
12			1												**1**
13															
14															
15															
16															
Total	**1**	**14**	**2**	**1**	**3**	**0**	**0**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**25**

Table 5.15. Breakdown of assemblage by location (sample assemblage). The category of flint includes one sandstone and one slate item

Location	Flint *n*	Quartz *n*	Total
401	100	64	164
640	2	0	2
801	30	22	42
1370	28	32	60
1500	20	0	20
2049	0	1	1
2190	2	1	3
Outside	8	3	11
Later deposits	14	5	19
Unstratified	14	4	18
Total	**218**	**131**	**349**

Information on reduction sequences for House 401 also follows that of the assemblage as a whole, with primary and secondary flakes being almost equal and tertiary flakes considerably lower. The other three major houses diverge from this pattern although this could just be a factor of random variations within small assemblages. House 801 has roughly 80% of its assemblage made up of secondary and tertiary flakes. House 1370 has roughly 80% of its assemblage made up of primary and secondary flakes, although 50% of this figure is secondary. House 1500 has nearly 80% of its assemblage made up of primary and tertiary flakes.

Discussion

The Cladh Hallan stone assemblage reflects the working of beach pebble flint and quartz associated with the Late Bronze to Early Iron Age occupation of the immediate area. Both the stratigraphic evidence and the lack of cortication on the flint rule out the possibility that the assemblage has been affected to any great extent by problems of residuality; this is never more than a minor component. Quartz significantly makes up around a third of the assemblage. Both these raw materials could have been collected relatively easily from local sources. The use of both flint and quartz perhaps indicates that flint was not hugely abundant and/or that the quality of the material used was not a great concern.

The domination of the flint assemblage, and especially the flake assemblage, by primary pieces demonstrates that small pebbles were utilised. The presence of split flint pebbles within the assemblage, and the fact that the core and flake sizes are consistent with the size of these split pebbles, confirms that beach pebble flint was the dominant raw material source. There is no definitive evidence for the movement of raw materials over greater distances; what was ready to hand seems to have been sufficient.

The knapping technologies employed appear to have been controlled by the predominantly small size of flint pebbles. The assemblage has both bipolar and platform cores. It is assumed that bipolar-working was used to split open pebbles to create a level surface, which could be modified into a platform core from which to remove flakes. The fact that many flakes have platforms, and that single-direction ripples are the dominant scar direction on the ventral side of flakes, also shows that platform-working was the dominant method used to detach flakes.

The cores were worked down to a small size but were not exhausted. There is the possibility that platform cores were abandoned at an earlier stage in the working process than bipolar cores, presumably due to the bipolar technique being ideal for the working of small cores and pebbles. These patterns of core-working and the utilisation of beach pebble flint can be directly compared to the characteristics of the lithic assemblages analysed by Caroline Wickham-Jones from other locations in the southern Western Isles (Wickham-Jones 1995).

The assemblage is dominated by working debris and, given the restricted number and range of formal secondary retouched tool types, it is assumed that a large number of the unmodified flakes were utilised in domestic activities relating to the occupation of the settlement. A number of the scrapers were made on primary flakes, probably because these provided an ideal preform.

Overall, the small size of the assemblage is telling, particularly when considered in relation to the history of occupation. Stone was certainly being used on site, largely in an *ad hoc* manner. As such, the evidence conforms to broader acknowledgements that stone remained a practical resource in prehistoric Britain well into the first millennium BC, particularly where raw material was locally and readily available (Edmonds 1995; Young and Humphrey 1999). It was not, however, utilised to anything like the extent that it had been in earlier periods, and this low frequency runs in parallel with an evident lack of concern for the maintenance of specific reduction sequences or the production of a range of distinct artefact categories (Wickham-Jones 1995). That said, the tight clustering of length/breadth ratios in the Cladh Hallan assemblage suggests that, although the knappers were not concerned with the finished appearance of their products or with a regular working process, they were more generally interested in creating a regular size and type of flake, no doubt because this was appropriate or sufficient for use in various tasks. In other words, the working at Cladh Hallan was a process geared to achieve immediate satisfaction and not delayed expectation (Herne 1991).

5.2 Microwear analysis

John Compton and Linda Hurcombe

A microscopic use-wear analysis was carried out on flint and quartz tools from house floor layers of Phase 9, dating to the eleventh century BC. This study of lithic tools was intended to provide additional data to aid interpretation of the site, as well as to test several hypotheses with microanalysis. Firstly, the potentially non-domestic use of

Table 5.16. Distribution of all lithics by phase and location (total assemblage)

Phase	Flint			*Quartz*			Flaked stone		
Phase 1	Beaker layers			*Beaker layers*					
	9			*62*					
Phase 3	Pyre area	S area		*Pyre area*	*S area*				
	4	1		*23*	*2*				
Phase 4	House 2835			*House 2835*					
	3			*14*					
Phase 5	Central area	S area		*Central area*	*S area*				
	1	4		*0*	*10*				
Phase 6	NE area	S area		*NE area*	*S area*				
	3	1		*11*	*0*				
Phase 7	House 2476	House 3260		*House 2476*	*House 3260*				
	1	2		*0*	*6*				
Phase 8	House 801	House 401	House 1370	*House 801*	*House 401*	*House 1370*	House 801	House 401	House 1370
	6	19	3	*8*	*37*	*41*	1	0	1
	S area	NE area		*S area*	*NE area*				
	0	3		*5*	*8*				
Phase 9	House 801	House 401	House 1370	*House 801*	*House 401*	*House 1370*	House 801	House 401	House 1370
	11	14	14	*3*	*30*	*21*	0	0	10
	S area	NE area	W area	*S area*	*NE area*	*W area*			
	0	3	0	*2*	*3*	*1*			
Phase 10	House 2190	House 401	House 1370	*House 2190*	*House 401*	*House 1370*	House 2190	House 401	House 1370
	3	5	0	*1*	*8*	*3*	0	2	6
	S area	NE area	W area	*S area*	*NE area*	*W area*	S area	NE area	W area
	3	0	1	*0*	*0*	*3*	0	1	0
Phase 11		House 401	House 1370		*House 401*	*House 1370*		House 401	House 1370
		6	0		*7*	*3*		2	1
		NE area	S area		*NE area*	*S area*			
		0	2		*1*	*2*			
Phase 12		House 401	House 1370		*House 401*	*House 1370*			
		31	0		*1*	*0*			
	N area	NE area	S area	*N area*	*NE area*	*S area*	N area		
	5	3	4	*0*	*1*	*0*	1		
Phase 13		House 401							
		11							
Phase 14	House 1500	House 401							
	4	1							
Phase 15		House 401							
		12							
Phase 16	House 640	House 401	House 150		*House 401*				
	2	9	2		*1*				

House 1370 (the northern roundhouse) could be confirmed by a lack of use-wear – or wear patterns different from the other houses – on the tool surfaces, suggesting that different activities were carried out in this building. Secondly, House 401's association with bronze-working might be supported by evidence of metalworking polishes or residues found on its tools. Thirdly, and most importantly, attributing some of the tools to actual uses would provide evidence to compare with Fitzpatrick's sunwise cycle hypothesis (Volume 1: fig. 1.20; Fitzpatrick 1994; 1997; Parker Pearson and Sharples 1999). It would be possible to establish whether some of these artefacts (many of which are fragments or broken flakes) were employed as tools rather than being discarded and trampled into the houses' floors as unwanted debris or debitage from lithic production.

Applying this microanalysis to the sunwise cycle hypothesis has its limitations. Finding affirmative use-wear would only support the interpretation if the tools were indeed in primary contexts and were discarded where they were used – as opposed to being used outside and then stored or discarded inside.

Assemblage composition

Sixty-eight artefacts from Phase 9 were provided for analysis, of which 26 were flint and 42 were quartz. This lithic sample – already small enough without having to apply sampling techniques to reduce the sample size – was further divided by house provenience and artefact form. Descriptions of artefact forms were kept simple, limited to whether they were primary, secondary or tertiary products, in addition to one of the following forms:

- fragment: any sample lacking a reasonably smooth, flaked surface – often irregular and coarse on all sides – and without distinguishable ventral or dorsal sides;
- pebble: any seemingly unworked, rounded sample;
- flake: any sample produced from intentional flaking of stone, displaying perceptible ventral and dorsal sides;
- flake fragment: any flake with one or more clear breaks to demonstrate that it came from a larger flake; or
- retouched flake: any flake with evidence of additional modification such as pressure-flaking.

Methodology

The study was performed using an Olympus BX60 microscope at magnifications of 50× to 500×. Pre-treatment of tools was kept to a minimum, only involving washing with acetone if the tool was thought to have been handled too much. Although soil remained on portions of each tool, hydrochloric (HCl) solution was not applied. Additional macroscopic analysis of the samples was not pursued, as tool measurements were not critical in studying microwear; neither were independent measurements necessary, thanks to previous recording of such data (see Edmonds and Martin above).

Each tool was scanned at a variety of magnifications in the interest of detecting several different forms of microwear. After a brief macroscopic inspection of a tool to determine its form, it was scanned at 50× magnification to note any discernible edge wear, adhering to the microchipping analysis patterns described by Kooyman (2000). Investigation continued at 200× in a grid pattern – rather than following the tool's edges – to detect micro-polishes and finer striations (Keeley 1980; Kooyman 2000). Magnification was increased to 500× to discern details of various striations, polishes and possible residues, but such a level of detail was not employed for common scanning. Where possible, inferences were drawn about a tool's possible use-action or worked material.

The process was limited by the type of microscope used and thus led to the omission of an important aspect of polish identification. Although polishes are often visually distinctive, use of an atomic force microscope 'demonstrate[s] great potential ... in the study of the differentiation and formation of microwear polishes' (Kimball *et al.* 1995: 10).

Floor layer 1150 in House 801

Of the 12 tools examined from House 801 (the south house), ten are flint flakes. This majority over the two quartz artefacts is different from the other two houses, both of which have more quartz than flint, both in the assemblage as a whole and in this dataset. None of the quartz had identifiable signs of use, but there are four flint tools with considerable use-wear (SF 3737, SF 5328, SF 5316 and SF 5312 in Table 5.17). For the distribution of the flint and quartz in the house floor, see Volume 1: fig. 5.13.

Floor layer 1311 in House 401

House 401, the central house, provides the greatest number of stone tools in this dataset, of which the majority are quartz. All six of the flint artefacts are flakes, and the quartz tools are split almost evenly between fragments and flakes – 14 and 13 respectively. For the distribution of flint and quartz in the house floor, see Volume 1: figs 5.44, 5.51. The analysis of all these artefacts, and their possible use, is presented in Table 5.17. The figures show examples of micro-chipping (Figure 5.3) and polish (Figure 5.4) on artefacts from this floor.

Floor layer 2211 in House 1370

In House 1370, the north house, Phase 9 activity is represented by two floor layers: context 2211, the lower layer, and context 1369, the upper layer. Artefacts from floor 2211 consist of only two pieces of flint and three of quartz, described in Table 5.17. This context is one of the few to have unworked pebbles, of which there were two quartz examples.

Table 5.17. Analysis of microwear (numbers in square brackets refer not to SF numbers but to sample square)

Ctxt	Find #	Material/tool	Ventral side	Dorsal side	Notes
2211	[4068]	Tertiary quartz fragment	Prolific thin, shallow, long striations	-	-
2211	[3750]	Quartz pebble	Scattered polish, no striations	Minimal polish	All polish is on high points of pebble. Probably used for smoothing a harder substance due to irregularity of polish (dry hide? Soft wood?)
2211	[4029]	Primary quartz fragment	-	-	-
2211	[3751]	Tertiary flint flake fragment	Very smooth, pitted edge polish on fragmented edge	Light polish on fragmented edge and sharper edges	Fragmented edge polishes are confusing, but regular polishing suggests some use
2211	5262	Primary flint fragment	Extreme edges show edge wear without striations, moderate edge wear without microfracturing	-	Shape of tool allows for little cutting potential. Might have been used vertically (only edge contacts work surface) to scrape
1311	[3027]	Quartz fragment	-	-	-
1311	[2994]	Quartz fragment	-	-	-
1311	[3063]	Quartz flake	-	-	Minor edge wear and striations, but appear to be natural
1311	[3069]	Quartz flake	Mixed parallel and perpendicular striations, smooth (silica) polish over ~40% of edge corresponding to sharper edge	Same, but lower striation count	-
1311	[2994]	Rounded quartz fragment	-	-	Prolific but short and unaligned striations, minimal coarse polish evidence
1311	[3139]	Primary quartz frag/flake(?)	Minimal striations and polish in very limited sections of the surface	Cortex	Use uncertain, though shape is ideal for polishing or smoothing
1311	[3139]	Tertiary quartz flake	Few erratic striations, silica polish, some instances of 'trenching' near the cutting edge	-	Possible wood working?
1311	[3158]	Primary quartz fragment	-	-	-
1311	[3093]	Tertiary quartz flake frag	-	-	-
1311	[3093]	Primary quartz flake frag	-	-	-
1311	[3077]	Coarse quartz fragment	-	-	-
1311	[3124]	Secondary quartz flake	-	Random striations	Wear is too erratic to attribute to use. May be associated with post-depositional effects
1311	[3128]	Coarse quartz fragment – one smoother side	Possible silica polish	-	-
1311	[3894]	Coarse quartz fragment	-	-	Flatter section has some aligned striations – polishing stone?
1311	[3006]	Tertiary quartz flake	Striations aligned point-to-base (Parallel)	Parallel striations near edge	Probable cutting tool for softer materials (plants, bone?)

(Continued)

Table 5.17. Analysis of microwear (numbers in square brackets refer not to SF numbers but to sample square) (Continued)

Ctxt	Find #	Material/tool	Ventral side	Dorsal side	Notes
1311	[3141]	Coarse quartz fragment	-	-	-
1311	[3084]	Tertiary quartz frag/flake (?)	-	-	-
1311	[3103]	Tertiary quartz flake	45 degree striations, silica polish	-	Plant slicing
1311	[3075]	Tertiary quartz flake	Varying striations (all angles)	-	-
1311	[3035]	Secondary quartz flake	Erratic striations	-	Possible, unidentified use
1311	[3239]	Tertiary quartz fragment	Many very small striations	-	Small particles – soil or metal 'residue?'
1311	[4107]	Primary quartz fragment, one heavily eroded side	(Eroded side) Heavily fractured and faceted, no striations	-	Cortex
1311	[3090]	Tertiary quartz flake	Shallow and thin, angled and perpendicular striations, possible silica polish	-	-
1311	[3079]	Tertiary quartz fragment	Possible highly pitted polish, instance of odd crystalline 'residue'	-	-
1311	[3098]	Primary quartz flake	Perpendicular striation, strongest with some silica polish near edge	-	-
1311	3774	Tertiary quartz flake	-	-	-
1311	3939	Tertiary quartz fragment	Edge possesses very small pitting and polish. Irregular striation present on rest of sample. Also polarized-light-positive particle found	Edge scarring	Scraping for a medium substance, perhaps bark stripping due to the fairly even edge polish
1311	3778	Tertiary flint flake	-	-	-
1311	[3075]	Primary flint flake	-	-	-
1311	5278	Secondary flint flake	Scattered polish on blunt edge, edge has rare polish and a few angled striations	Polish restricted to very edge of tool	Heavy edge damage. Wood slicing possible
1311	3824	Tertiary flint flake	Strong, bright, but not ubiquitous polish on edges. Pitting also present	Similar polish	-
1311	4798	Secondary flint flake	Some edge microchipping. Presence of edge polish unclear	-	Use unknown but improbable
1311	4670	Secondary flint flake	-	-	-
1150	4255	Secondary flint flake	-	Some edge microfracturing	Macroscopically appears to be well-suited for tool use, but basically no evidence for use
1150	[2881]	Secondary quartz fragment	Fracturing and striations abound, mixed with wave lines from initial breaking	Cortex	Low chance of use. More probable that damage incurred in flaking and post-depositional damage
1150	[2881]	Secondary quartz flake	Fractured surface, improbably polished	-	-
1150	4335	Tertiary flint flake	Edge wear much more sizeable on one edge	-	Seems to be just a thinning flake
1150	3737	Secondary retouched flint flake - scraper	Strong polish and edge microfracturing	-	Most certainly used for scraping a softer substance, perhaps wet hide or soft wood

Ctxt	Find #	Material/tool	Ventral side	Dorsal side	Notes
1150	5328	Secondary flint flake	Scattered polish – harder material like bone, perhaps. Restricted to edges. No visible striations	Small amount of same polish	Bone cutting seems like a plausible guess
1150	5320	Secondary flint flake	-	-	-
1150	5313	Secondary flint flake	Thin line of polish near a dull edge	-	-
1150	5281	Secondary flint flake	-	-	-
1150	5312	Tertiary flint flake	-	Some edge polish from medium hardness substance	-
1150	5316	Primary flint flake	Fairly uniform polish with broad, long striations	-	Polishing for a medium substance
1150	5324	Secondary flint flake	-	-	-
1369	5215	Primary flint flake	Edge polish, no striations	-	-
1369	5133	Secondary flint flake	Edge microfracturing	-	-
1369	5218	Secondary flint flake	Scattered edge polish and microfracturing	-	Cutting hard substance? Low polish wear, so softer substance possible.
1369	5213	Secondary flint flake	-	-	-
1369	[3587]	Secondary flint flake	-	-	-
1369	[3514]	Quartz pebble	-	-	-
1369	[3536]	Tertiary quartz flake	Slightly random striation, polish on higher points of tool surface	Much more smoothing, polishing, striations	Smoothing or scraping a harder substance
1369	[3581]	Primary quartz flake	Very random striations	-	Probably not used
1369	[3509]	Tertiary quartz fragment	-	-	-
1369	[3509]	Secondary quartz fragment	(Smoothed portion) Heavy striation and regular, smooth polish	-	Fragment worn down through repeat grinding/ polishing
1369	[3613]	Tertiary quartz flake – drill?	-	-	No sign of use
1369	[3557]	Secondary flint flake	-	-	Expertly chipped, but no signs of wear
1369	[3484]	Secondary flint flake frag	Minimal rough polishing	Edge microscarring	Low-penetration cutting
1369	[3562]	Primary quartz flake	Some smoothed surfaces, but likely only naturally produced during flaking	-	-
1369	[3606]	Primary quartz fragment	Natural, random striations, seemingly polished zones on lower parts of surface – contrary to standard polish patterns	-	Unlikely to have been used
1369	[3486]	Quartz fragment	More natural, random striations	-	-
1369	[3504]	Tertiary quartz flake frag	Roughly perpendicular, short striations, small patches of polish	Perpendicular, short, shallow striations	Might be part of a larger scraping tool. Lack of surviving edges makes exact use uncertain.
1369	4200	Primary flint flake	Minimal edge polish, no striations	-	Doubtful use

Table 5.18. Use-wear analysis by context (numbers in square brackets refer not to SF numbers but to sample square)

House floor	Not used (*42%*)	Uncertain (*22%*)	Probably used (*18%*)	'Identifiable' (*18%*)
2211 (Lower North) – 5	4029	4068, [3751]	5262	[3750]
Percentage	*20%*	*40%*	*20%*	*20%*
1369 (Upper North) – 18	5213, [3587], [3514], [3581], [3509a], [3613], [3557], [3486]	5215, 5133, [3562], [3606], 4200	[3509b], [3504]	5218, [3536], [3484]
Percentage	*44%*	*28%*	*11%*	*17%*
1311 (Middle) – 33	[3027], [2994], [3063], [3158], [3093a], [3093b], [3077], [3141], [3084], 4107, 3774, 3778, [3075b], 4670	[3139a], [3124], [3075a], [3035], [3239], 4798	[3069, [2994], [3128], [3894], [3090] [3079], [3098], 3824	[3139b], [3006], [3103], 3939, 5278
Percentage	*43%*	*18%*	*24%*	*15%*
1150 (South) – 12	4255, [2881b], 4335, 5320, 5281, 5324	[2881a], 5313	5312	3737, 5328, 5316
Percentage	*50%*	*17%*	*8%*	*25%*

Table 5.19. Tool form by context

House floor	Flint – 26 (38%)	Flakes (96%)	Fragments (4%)	Quartz – 42 (62%)	Pebbles (7%)	Fragments (48%)	Flakes (45%)
2211	**2**	1	1	**3**	2	1	-
1369	**8**	8	-	**10**	1	4	5
1311	**6**	6	-	**27**	-	14	13
1150	**10**	10	-	**2**	-	1	1

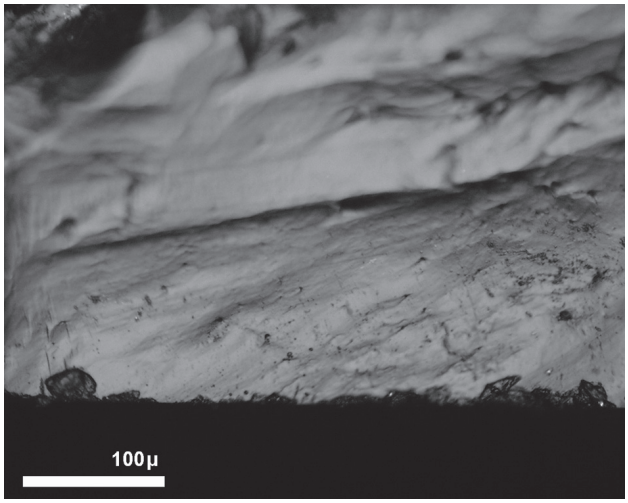


Figure 5.3. Dorsal-edge micro-chipping on quartz tool SF 3939 (from floor 1311 of House 401) at 200× magnification

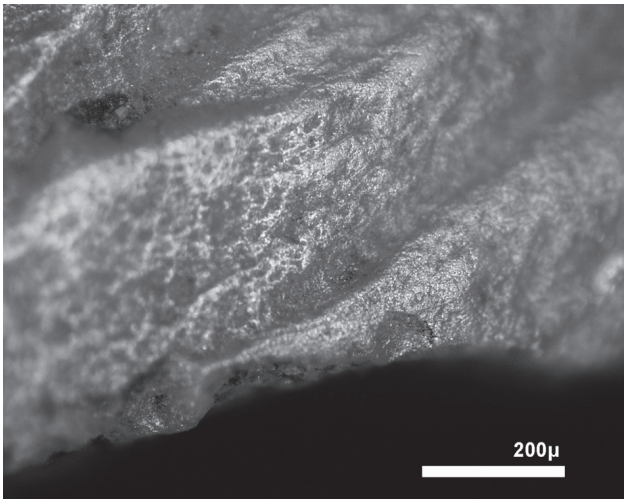


Figure 5.4. Polish on the ventral surface of flint tool SF 3824 (from floor 1311 of House 401) at 100× magnification

Floor layer 1369 in House 1370

Context 1369, the upper floor layer of Phase 9 in House 1370, produced considerably more finds than the lower (2211). This analysis examines a total of eight flint flakes and ten quartz finds, including fragments (n = 5) and flakes (n = 5). For the distribution of flint and quartz in floor 1369, see Volume 1: fig. 5.80. The figures show polish (Figure 5.5) and striations (Figure 5.6) on artefacts from this floor.

Conclusions

Despite the different quantities and proportions of flint and quartz in the dataset, derived from Cladh Hallan's three main roundhouses, the percentage of used tools is roughly equal in the three buildings (Table 5.18). Averaged across all three houses, 42% of the assemblage is discernibly unused, including pebbles, rough fragments and a few flakes. For another 22% of the assemblage, it is uncertain whether these objects were used. The remaining artefacts

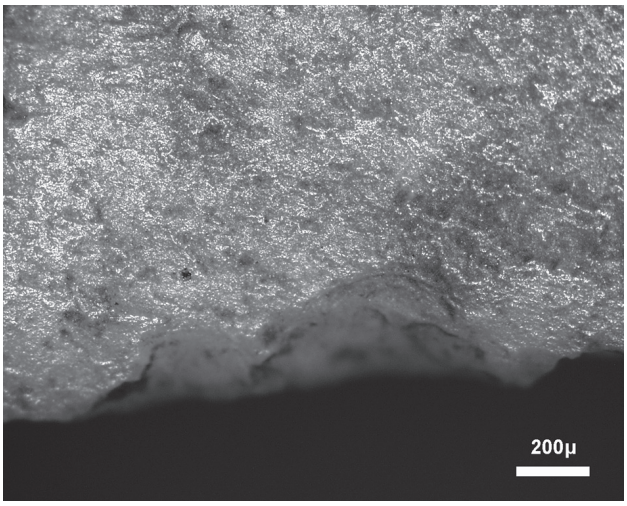


Figure 5.5. Polish on the ventral surface of the flint tool from floor 1369 (sample square 3484) of House 1370, at 50× magnification

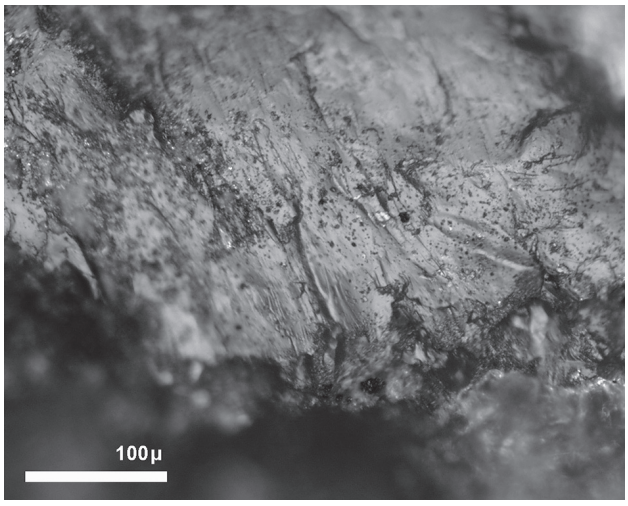


Figure 5.6. Striations on the ventral surface of the quartz tool from floor 1369 (sample square 3504) of House 1370, at 200× magnification

were probably or discernibly used, most commonly for polishing wood or bone, cutting unidentified hard substances, and scraping. No tools were identified as having been used for cutting softer plants or meat.

House 801's floor layer had the smallest number of flint and quartz artefacts, of which 33% were confirmed as used tools. Scraping and cutting use-actions were identified, complementing the bone points and pumice scrapers and rubbers found nearby. Assuming the tools were discarded where they were used, distribution and tool use in House 801 supports Fitzpatrick's diurnal cycle hypothesis.

House 401's floor layer had the largest assemblage, with 39% of the analysed artefacts bearing confirmed use-wear. The most common use-actions were polishing and cutting, and several tools have good evidence of working wood and bone. These data correspond well with the large numbers of worked bone artefacts and antler fragments found in the house floor (1311), many in proximity to the bone-working tools (see Volume 1: fig. 5.44). The smoothing or polishing process is further supported by the presence of large numbers of pumice stones in the house (*ibid.*). The use-wear analysis has produced no evidence for any tool being used in bronze-working: the dull polishes associated with applying lithics to metal are uncommon and sparse, and no metal residues were identified. The use-wear analysis supports the hypothesis of a distinct and enduring spatial distribution of activities within House 401 (based on the Fitzpatrick hypothesis; see above).

Of the 23 lithic artefacts from the floor layers (1369 and 2211) of Phase 9 in House 1370, 31% had diagnostic signs of use. Of those use-actions identified, polishing is most common. Several instances of tools being used for scraping and cutting make this assemblage comparable to those of Houses 801 and 401; the analysis establishes the use of many of the tools – enough to support the Fitzpatrick hypothesis. From the perspective of this microanalysis, only the spatial distribution of many of the tools (not concentrated in the southwest, as in other houses and phases) points to House 1370 being atypical in its domestic use of space. Other evidence indicates that the use of House 1370 had an altogether different character to that of the other houses (see Volume 1: 176–83, 201).

6 Coarse stone artefacts

H. Goddard and M. Parker Pearson

There are 149 coarse stone artefacts from Cladh Hallan, found in contexts from Phase 3 to Phase 16 (Table 6.1).[1] They are mostly from Area A and from Phases 8–12, the construction and use of the roundhouses. The tools are mostly made from pebbles or cobbles of rock types likely to have been found on the local beach, notably of sandstone, quartzite, dolerite and gneiss. There are also saddle querns made from large blocks of gneiss, most of which were probably obtained from rock outcrops. The pebble and cobble tools are mostly polishers and grinders, with smaller numbers of sharpening stones, cleavers, hammerstones and 'potlid' slabs. More unusual items consist of a mattock or ard point, two pecked stones, a drilled stone, a scraper, a doughnut-shaped weight and four possible gaming counters.

Since the machair is a stoneless shell sand, all of the stones at Cladh Hallan are manuports. The querns and many of the wall stones came from rock outcrops (either inland or on the west coast's promontories) but the vast number of pebbles and cobbles must have been brought from the beach. Only a tiny percentage of these display traces of wear or use and are reported on here. However,

Table 6.1. Types of coarse stone tools by phase at Cladh Hallan

Type	Phase													Total
	3	*4*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*16*	*U/S*	
Polisher	2	1			4	19	4		9	3	4	2	2	**50**
Grinder (continuous facet)			1			1	1	1	1					**5**
Grinder (partial facet)						2	2	1	1					**6**
Pestle grinder (single-ended)						3	1	1					1	**6**
Pestle grinder (double-ended)				1		3		1	1					**6**
Sharpening stone			1		1	1	3		1				1	**8**
Mattock/ard point					1									**1**
Cleaver/chopper					1	3								**4**
Hammerstone (single-ended)				1		3	1		1				3	**9**
Hammerstone (double-ended)					1		1	4						**6**
Scraper									1					**1**
Saddle quern					5	9	1		4			2	1	**22**
Top stone of quern							1						3	**4**
Grinding slab					1	1		3	1					**6**
Flat stone					1	1		3	2					**7**
Pecked stone				1	1									**2**
Drilled stone						1								**1**
Loomweight												1		**1**
Gaming counter		1						1			2			**4**
Total	**2**	**2**	**2**	**3**	**16**	**47**	**15**	**15**	**22**	**3**	**6**	**6**	**10**	**149**

many may have been used as tools but on materials that left no macroscopic traces, or too infrequently or too lightly to have left traces. In addition, many manuports may have been brought for aesthetic and other reasons which are no longer discernible. On some machair sites, this can be detected (as in the deliberate selection of black and white pebbles for longhouse floors on the Norse-period site at Cille Pheadair; Parker Pearson *et al*. 2018) but there was no such evidence at Cladh Hallan, except for large cobbles that were heated and presumably used as pot boilers. These were not quantified or systematically recorded.

6.1 Saddle querns and grinding tools

Saddle querns

Of the 22 saddle quern finds from Cladh Hallan, two remain *in situ* and 20 are in the finds archive. Only two are complete (SF 5051; Figure 6.3) or near-complete (SF 3504 from one side of the stone box forming water tank 1384 [Phase 12; Volume 1: figs 8.11, 8.44] and none was recovered from their position of use. Three of the least broken examples were found in foundation layers within the walls and wall cores of two of the three roundhouses (Phase 8; SF 4724 and SF 5418 are still *in situ*). Like the broken saddle quern probably incorporated into the walling of Dun Vulan (Parker Pearson and Sharples 1999: 39, 231, fig. 2.20), these must have been used for grinding in another setting, possibly even at another settlement, before being incorporated into the walls of the roundhouses. The most impressive of these is a saddle quern (SF 4724; Figure 6.1 and see Volume 1: fig. 4.38 [top left]) whose large size and robustness make its breakage most likely deliberate rather than accidental. It was placed within the wall core at the front (east) of House 401, immediately south of the doorway, and was incorporated into an adjacent stone-lined and stone-capped cist (2105; Volume 1: 107–9). An unworked beach cobble was placed within its trough, mimicking the position of a top stone or grinding stone. Two other broken querns were found in the walling of House 1370 (SF 5418, SF 5258, Figure 6.1; Volume 1: 111) but there were none within the walls of House 801. The fourth quern fragment from Phase 8 is a small fragment from within the fill of the burial pit of the composite male-female former mummy on the south side of House 1370's interior (SF 5244, Figure 6.1; see Volume 1: 92).

Other large portions of saddle querns came from consecutive Phase 9 floors in House 1370 (SF 4722 from 2211 and SF 4628 from 1369; Figure 6.2), from pit 2137 in House 1370 (SF 4291; Figure 6.1; see Volume 1: 170, fig. 5.62) and from a sand layer (731) which covered the northern part of the site in Phase 12 (SF 4211; Figure 6.3; see Volume 1: fig. 8.40). In all, eight quernstones and fragments came from house floors. Others were incorporated into stone structures. One of these (SF 4732; Figure 6.2) was used as a slab for a water tank (context 2404/2418) in House 401 in Phase 9 (see Volume 1: 138, fig. 5.20). Another two (SF 3500, SF 3504) were similarly incorporated into a water tank (1384) in the same roundhouse in Phase 12 (see above); their installation marks the termination of quernstone deposition in and around House 401.

The spatial patterning of quern fragments on House 401's floor 1311 (Phase 9; SF 4307, SF 4667 [Figure 6.2], SF 4734; see Volume 1: 145–7, fig. 5.44) and on floors 2211 and 1369 in House 1370 (SF 4722, SF 4628; Figure 6.2; Volume 1: 173–4, 176, figs 5.77, 5.80) shows a distribution predominantly in the southern part of the roundhouse or near the central hearth, although one fragment (SF 4667) on floor 1311 was in the house's northwest quadrant along with a grinding slab (SF 4562; see below). A single quern fragment was also found in the northwest of House 801 (SF 3738; Volume 1: fig. 5.13). Similarly, the two quern fragments (SF 1024, SF 1025) from House 150 (the double roundhouse in Area C from Phase 16) were found in the north and the south of its east room (Volume 1: 344, figs 10.18–10.19). Unfortunately, querns seem never to have been left as *de facto* refuse in the places where they were used. Nonetheless, the smaller fragments of broken querns may be the residues of querns that were used and broken, either accidentally or deliberately, within the house; conceivably some of the smaller pieces evaded collection and disposal outside.

All but one of the querns have the characteristic hollow or concave working surface caused by long-term grinding. The exception is a small, approximately rectangular flat quernstone (SF 3738) from floor 1150 of House 801. This is similar to examples of the early first millennium BC from Dún Aonghasa, Co. Galway, Ireland (Clarke 2005: 141) although it lacks the smooth facets along its sides that are found on some of the Irish examples.

The incorporation of querns into foundation deposits, similar to that of some of the human remains (see Chapter 19), suggests that they had a symbolic significance greater than their practical purpose. Staple foods such as bread often carry a heavy symbolic load so it is perhaps not surprising that the technology for grinding cereals might also have been similarly significant. The case for ritual deposition of saddle querns between the Neolithic and the Bronze Age in Britain has been made elsewhere (Buckley and Ingle 2001: 326–7) and their deliberate deposition within Bronze Age settlements has also been discussed (Barrett and Needham 1988; Brück 1999a). Cladh Hallan's deep stratigraphy provides further contextual evidence for their association with symbolically charged events of foundation and death. We might speculate that querns were the 'teeth' of the community's 'body'; this may explain why there was emphasis on the human teeth associated with the mummified bodies buried beneath House 1370 (the woman holding teeth in her hands and the toothless male provided with a mandible with a full set of teeth; see Chapter 19 and Volume 1: chap. 4). Secondly, the quern was a measure of an individual's work. If women were the grinders of barley, then their lifetime's achievement in nourishing the household was given substance in the size and depth of wear within their quernstone. Brück (1999a; 2006) has suggested that the breaking of querns, together with the smashing of pots, may have been a metaphor for

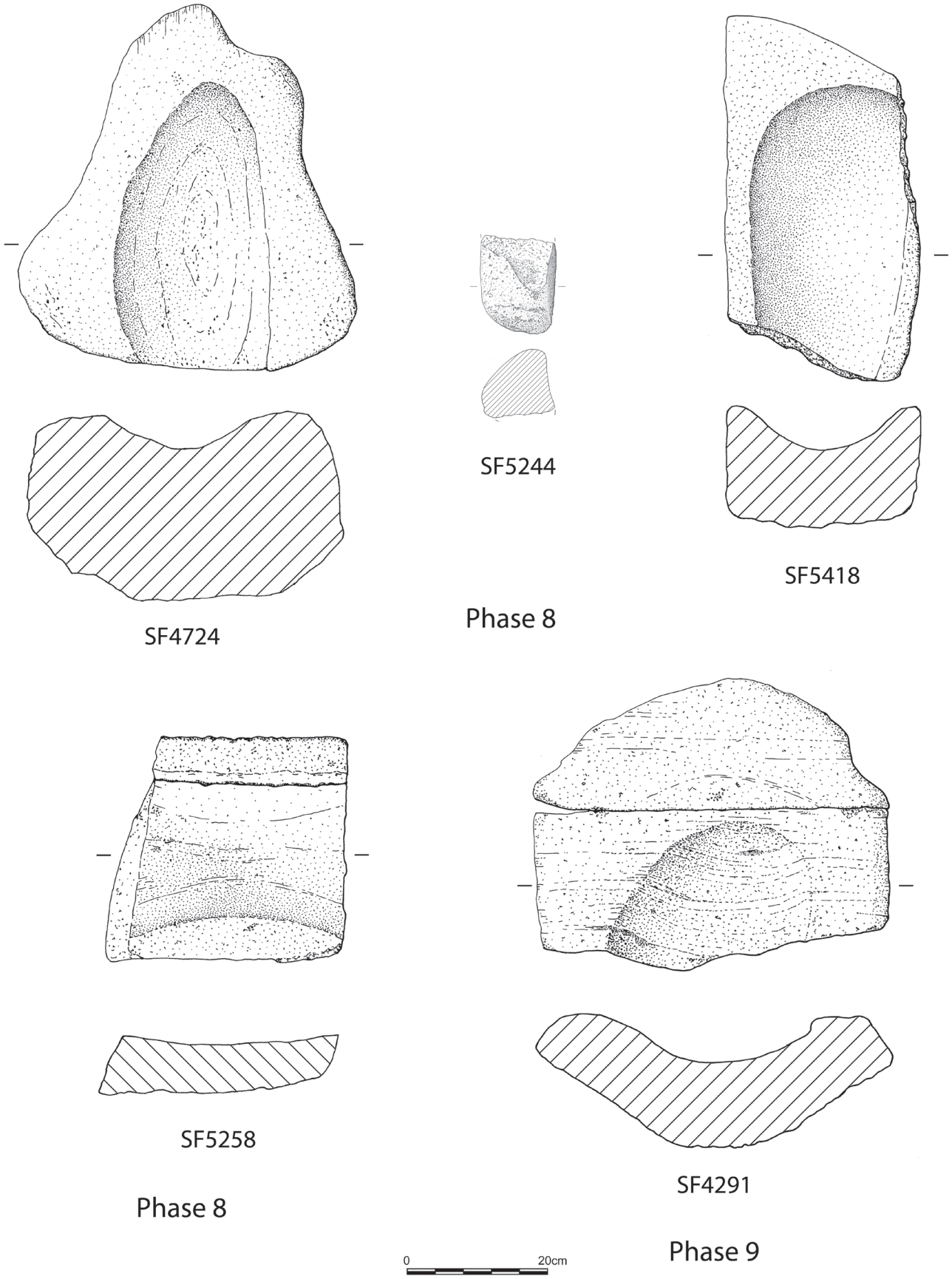


Figure 6.1. Saddle querns from Phases 8–9 at Cladh Hallan

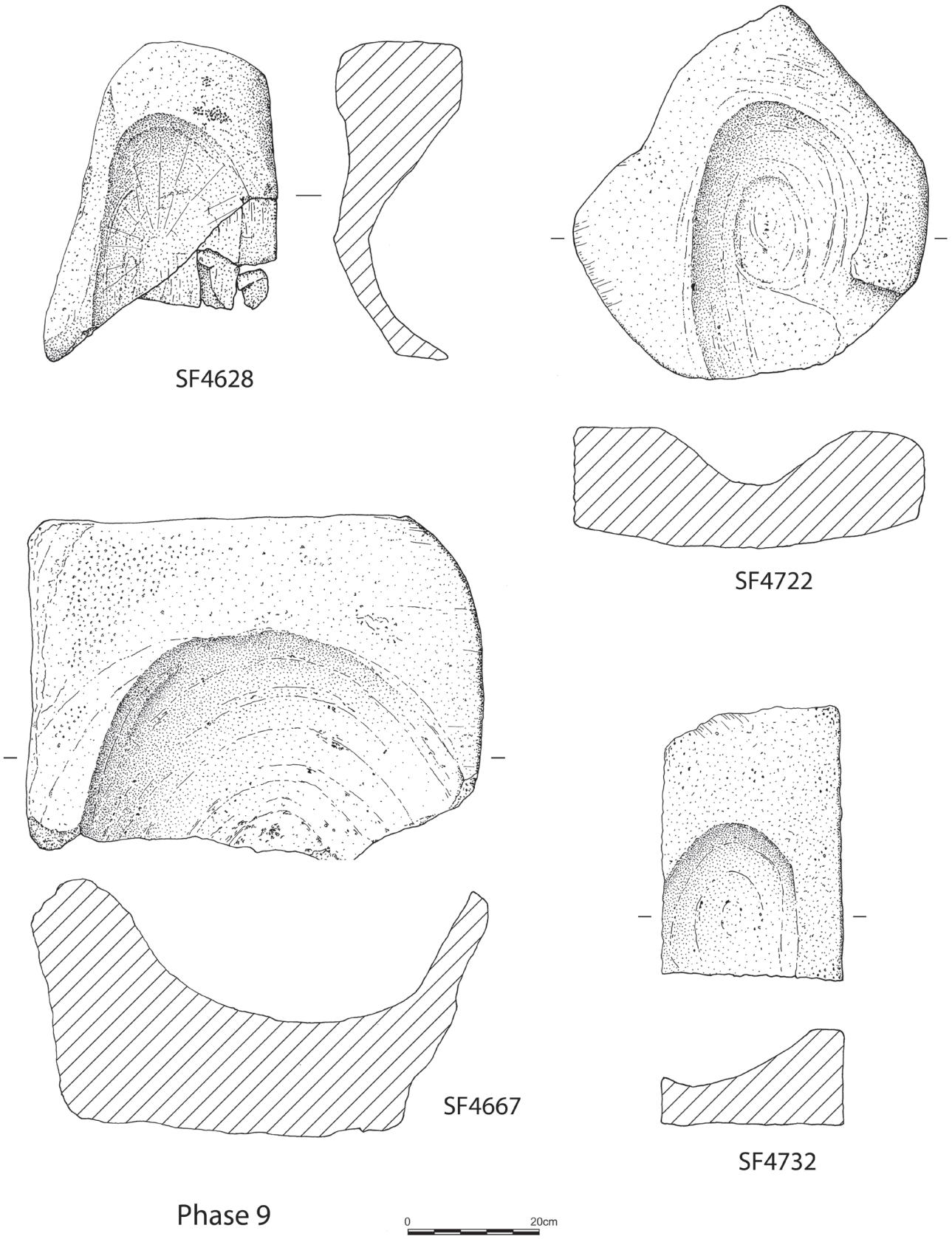


Figure 6.2. Saddle querns from Phase 9 at Cladh Hallan

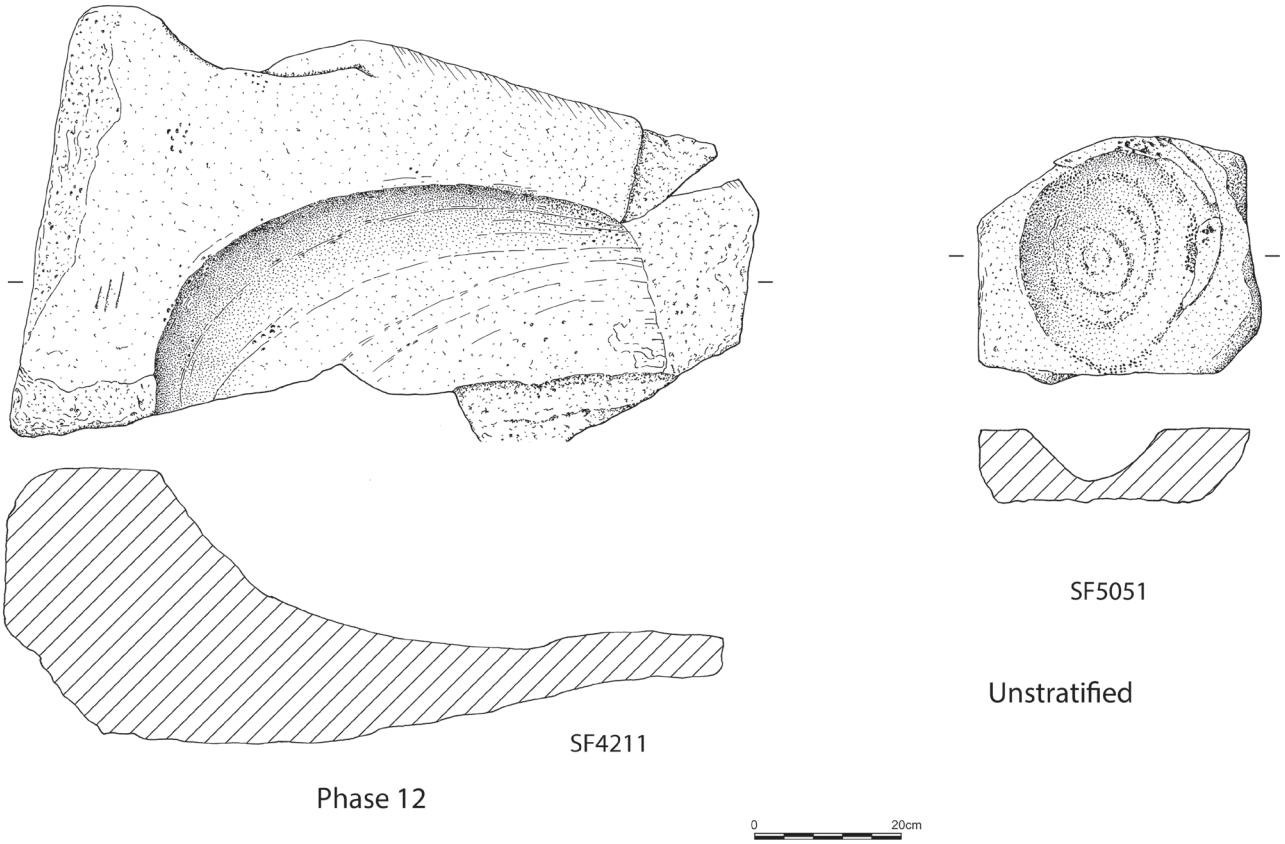


Figure 6.3. Saddle querns from Phase 12 at Cladh Hallan

human death and this association is strengthened by the evidence from Cladh Hallan.

Grinding slabs

There is a small group of stone artefacts which are not saddle querns but smaller flat or slightly concave surfaces on which materials were ground up (see also *Flat stones* below). They are generally between fist-sized and plate-sized and were presumably used to grind up small quantities of foodstuffs, plant matter or powders. They are found in Phase 8 (SF 3498), Phase 9 (SF 4562) and Phase 12 (SF 5432) but the remaining three are from Phase 11 (SF 3577, SF 3543 and SF 5469) where the latter two lay within the southeast quadrant of House 401 (Volume 1: fig. 7.26).

Grinding cobbles

There are 23 grinding tools from Cladh Hallan, divided into rounded cobbles and pestle-shaped cobbles (Figures 6.4–6.6). The rounded cobbles can be sub-divided into those with a continuous facet and those with facets on just part of their surface (Clarke 2006). The pestle-shaped grinders can be divided into single-ended and double-ended forms. These four types occur in even numbers. Like most of the stone tool types, they are found only in Phases 6 to 12, and there is no evident chronological preference among the four particular types. None were deposited within construction and foundation contexts in Phase 8.

Most of these grinding tools were found on or within house floors (12 examples) with nine from other fills and one unstratified. In Phase 9, there were five from the floors of House 401, one from the floor of House 801, and one from floor 1369 of House 1370 (see Volume 1: figs 5.44, 5.13 and 5.77). In Phase 10 there were three from floor 1308 in House 401 (*e.g.* SF 3540; Figure 6.5) and one from floor 2003 in House 1370 (see Volume 1: figs 6.25 and 6.38). In Phase 11, there was one from floor 1204 above House 1370.

In summary, the grinding tool in House 801 was found southeast of the hearth. In the floors of House 401, three were found southeast of the hearth (two in the southeast quadrant and one in the southwest), one west of the hearth and one in the northwest quadrant. In Phase 10, the three in floor 1308 of House 401 were all found south of the hearth. In House 1370, the grinder in floor 1369 was found in the northwest quadrant and that in floor 2003 was in the southwest quadrant. Of the four types of grinder, rounded cobbles with continuous facets were the least frequently left on house floors (four out of five being found in fill layers outside the houses).

The purpose of grinding stones was, not surprisingly, to grind substances although just what substances is unknown. At Cladh Hallan, the absence of rubbers or top stones for the saddle querns (just four were found,

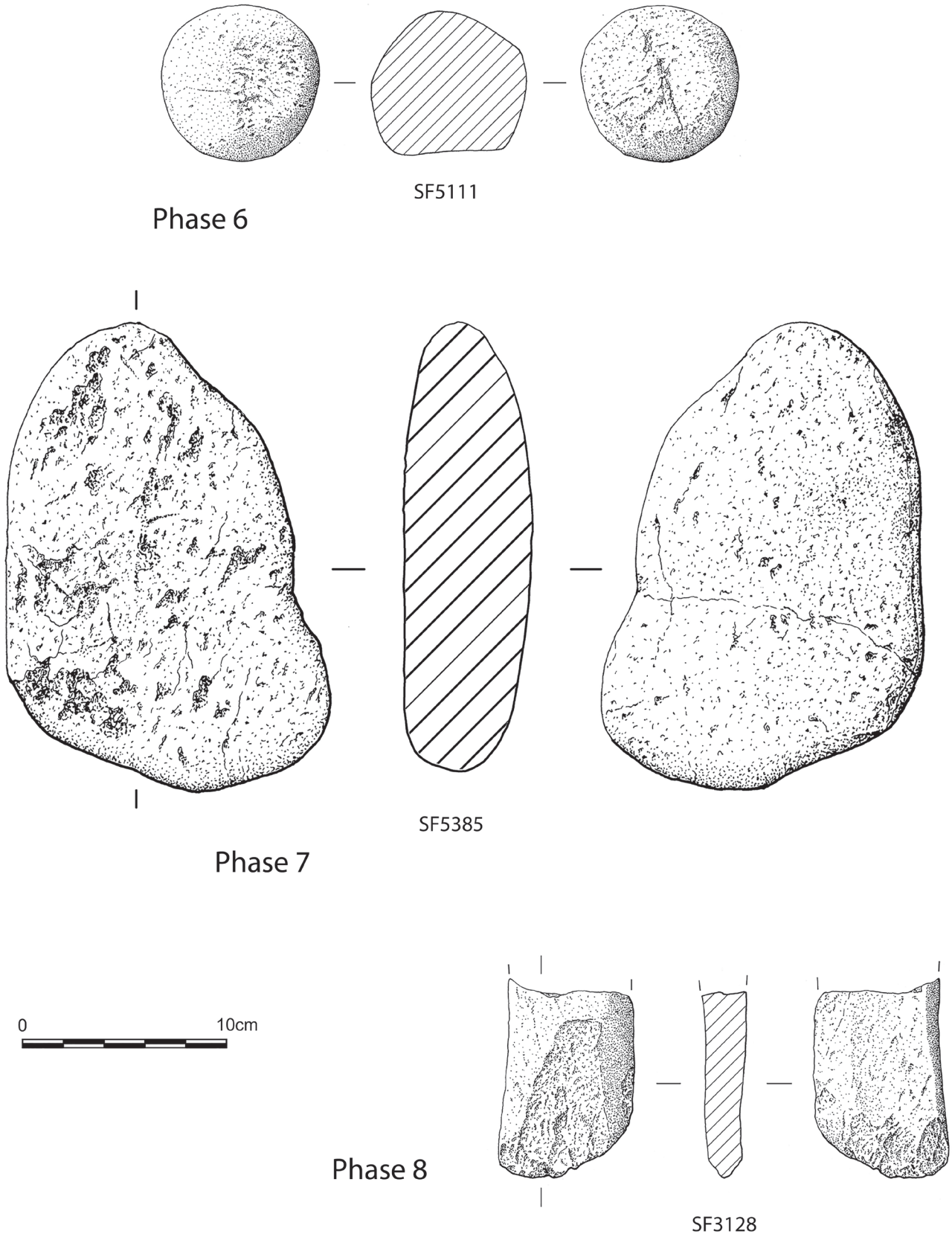


Figure 6.4. Coarse stone tools from Phases 6–8 at Cladh Hallan

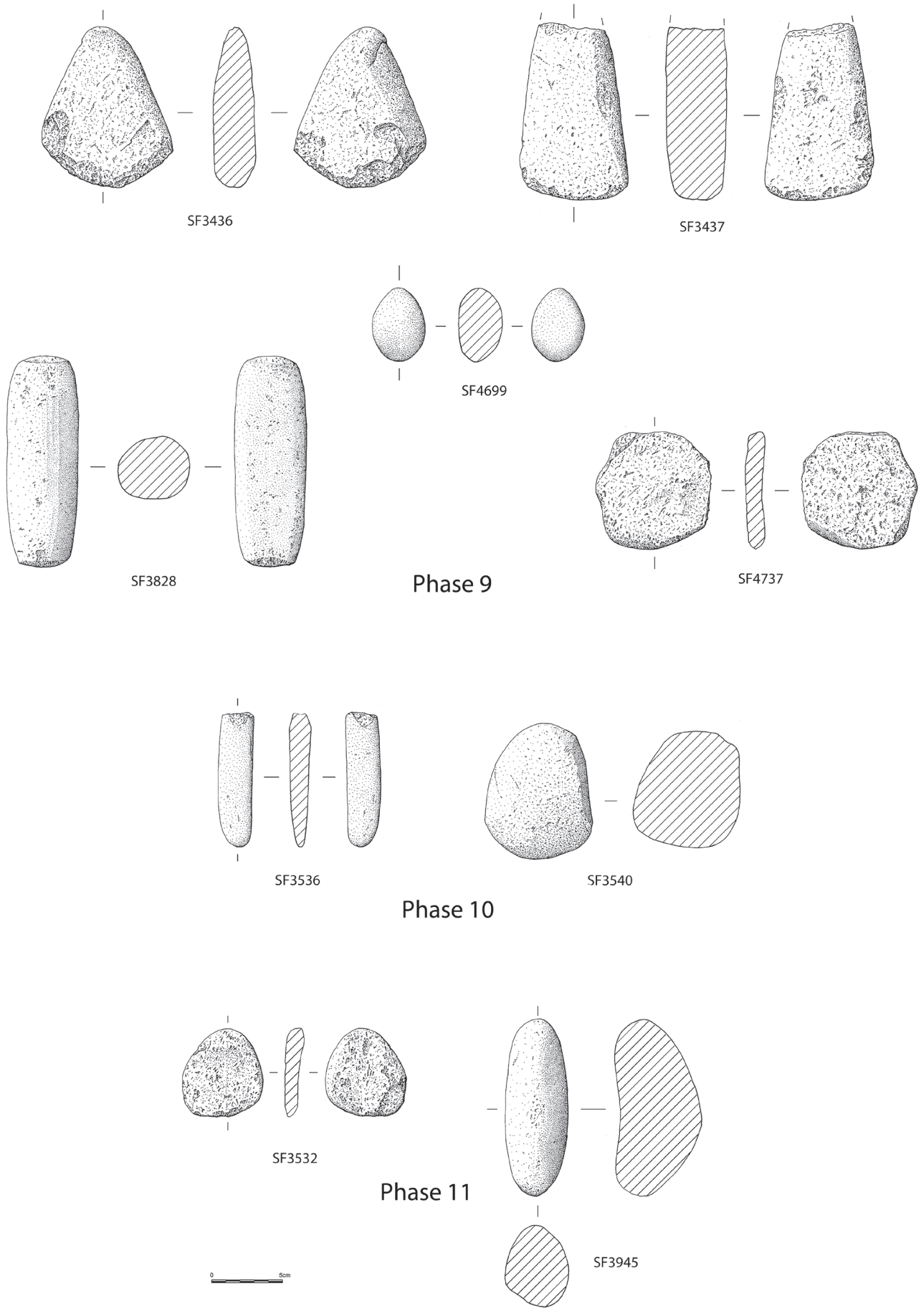


Figure 6.5. Coarse stone tools from Phases 9–11 at Cladh Hallan

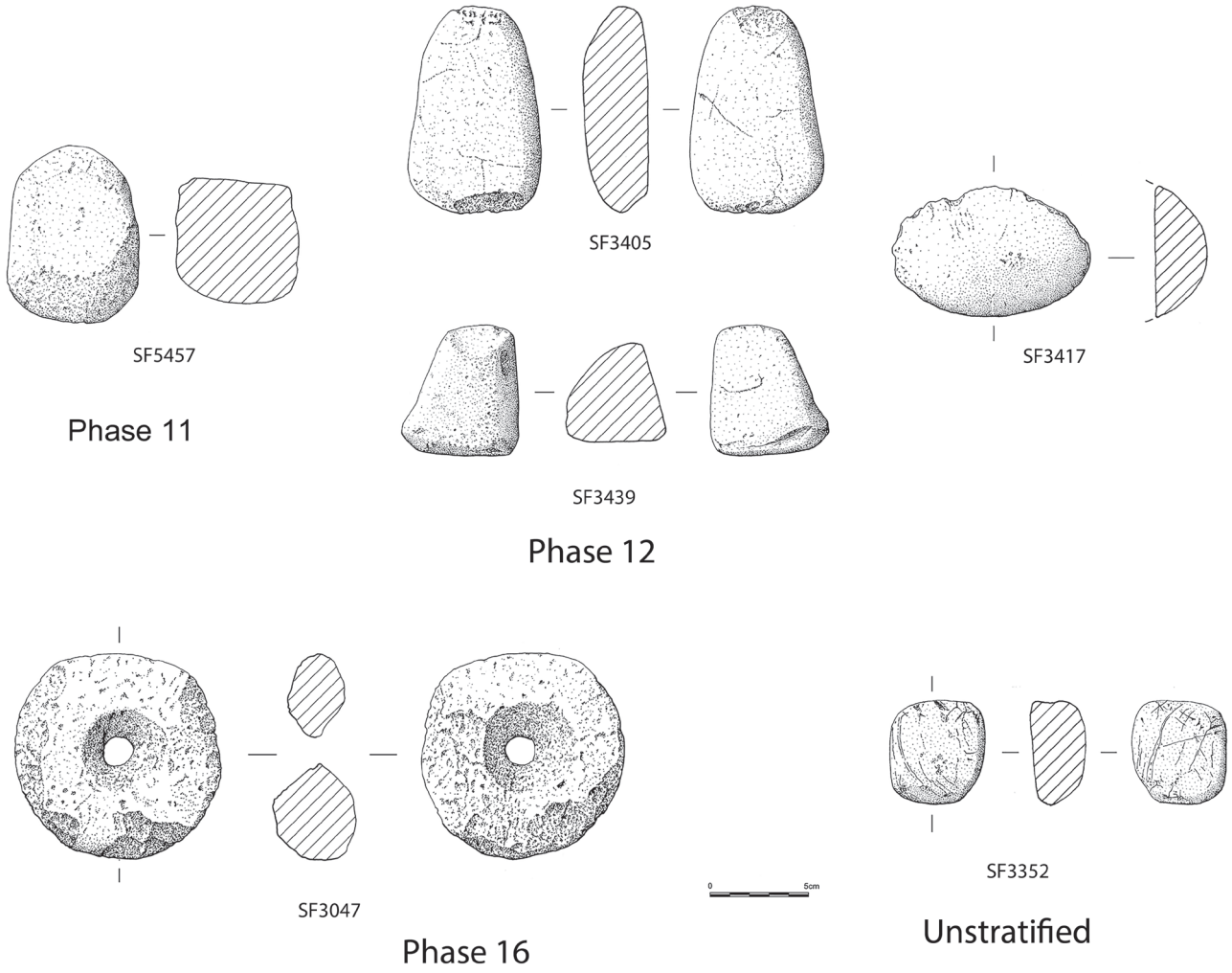


Figure 6.6. Coarse stone tools from Phases 12–16 at Cladh Hallan

mainly unstratified) and the trough-shaped profiles of some of the deeper saddle querns indicate that many or all of these pestle-shaped and cobble grinders were probably used in conjunction with the saddle querns to grind barley into flour. Their frequent discard on the southeast side of the hearth would suggest an association with food preparation activities.

6.2 Hammerstones

There are 15 hammerstones from Cladh Hallan, nine of them with pecking at one end and six with pecking on both ends. They are found in contexts between Phases 6–7 and 12, and three are unstratified. Four are from house floors and the remainder from fill layers (SF 4197 is from House 401's wall core). One of those from a house floor is a hammerstone (SF 3437; Figure 6.5) found on floor 1150 in House 801, placed to the northeast of the hearth along with a stone cleaver (SF 3436; see below). These probably represent closing deposits, the equivalents of which in Houses 401 and 1370 were bronze artefacts (see Chapter 2), and thus do not lie in the location where they were used as tools. The hammerstone within floor 1308 (SF 3541; Phase 10) of House 401 lay south of the hearth, within the southeast quadrant. That within floor 1290 (SF 3459; Phase 11) lay within House 401's northwest quadrant. Thus there is no consistent spatial pattern in their deposition on house floors.

Some stone tools were used for multiple purposes. Six tools were used as polishers and hammerstones (SF 4657, SF 4797, SF 3661, SF 5432, SF 3351, SF 3353) and 11 tools were used as grinders and hammerstones (SF 5111, SF 5104, SF 3828, SF 3526, SF 4223, SF 3606, SF 3945 [Figure 6.5], SF 5433, SF 3405 [Figure 6.6], SF 4228, SF 4180; Figures 6.4–6.6). SF 5457 (Figure 6.6) was used as a hammerstone, a grinder and a polisher.

The number of hammerstones at Cladh Hallan is unusually low when compared with certain other prehistoric Hebridean sites. The Early Bronze Age assemblage at Kilellan Farm on Islay is dominated by hammerstones (50 out of 84 tools; Clarke 2005: 133), as is the Middle Iron Age site of Dun Vulan (21 out of 38 tools; Parker Pearson and Sharples 1999: 230–32) and the Late Iron Age site of Mound 1 at Bornais (Sharples 2012b).

The numbers from the Neolithic site of Allt Chrisal on Barra (7 out of 52; Clarke 1995: 141) are closer to the ratio of hammerstones to other tools at Cladh Hallan. It is difficult to explain these variations. They could indicate a drop in the use of hammerstones during the Late Bronze Age and Early Iron Age, after the demise of large-scale flint and quartz working and before the rise of substantial stone architecture. Alternatively or additionally (and perhaps less likely), hammerstones may have been mostly used away from the house and additionally discarded in midden deposits, of which few have been excavated at Cladh Hallan.

6.3 Sharpening stones

There are eight sharpening stones. These are thin, often rectangular-shaped pebbles with wear in the form of smoothing and striations. They are found in Phases 6–7 to Phase 12 with one unstratified. Sharpening stones may have been used to sharpen copper-alloy blades. Swords, spearheads, axeheads and other bladed items were being cast at Cladh Hallan in Phases 9–11 and it may be no coincidence that sharpening stones are commonest in Phase 10 contexts.

Only two of the sharpening stones are likely to come from contexts close to where they were used; SF 3536 within floor 1308 (Figure 6.5; Phase 10) and SF 4689 within floor 1311 (Phase 9) were both in House 401's southwest quadrant. Of the remainder, three come from pits and a posthole, two from fills (SF 3940; Figure 6.7), and one was unstratified.

6.4 Specific tools

Mattock/ard point

This broken stone tool (SF 3128; Figure 6.4), with its working end bifacially flaked to a sharp edge, could be a broken mattock, an ard tip or some other tool type such as a cleaver. It is made from a cobble and is not comparable to the worked stone ard tips from St Kilda (Fleming 2005). However, it is similar to the ard tip roughout of gneiss from South Vatersay kerbed cairn 4B on Barra which is probably from the same period (Branigan and Foster 2000: 208, fig. 5.23.1). The Cladh Hallan tool was incorporated into the exterior side of the northeast wall core of House 401, analogous to the incorporation of the Vatersay ard tip on top of the southwest kerb of the cairn.

Cleavers/choppers

There are four of these cobble tools which are broadly axe-shaped with curved, bifacially flaked blades. One was found in a posthole beneath House 401 (SF 5076; Phase 8) and the remainder were deposited during Phase 9. SF 3436 (Figure 6.5) was placed on floor 1150 of House 801 as a closing deposit together with a hammerstone. The other two were found in House 1370 in a posthole (2214; SF 4310) and in the fill (2210) deposited over floor 2211 and sealed by floor 1369 (SF 4646). They are not known from any other Hebridean prehistoric site except for South Vatersay kerbed cairn 4B on Barra which is probably from the same period (Branigan and Foster 2000: 209, fig. 5.23.2). Although this artefact is of gneiss and is described as an axe rough-out, it has the same basic shape and curved blade as the cobble-formed Cladh Hallan cleavers.

Scraper

This split cobble (SF 3417; Figure 6.6) has crude retouching which may or may not have been deliberate. It appears to have been a scraper similar to the retouched stone flake illustrated from Kilellan Farm (Clarke 2005: 136, fig. 87.4).

6.5 Polishers

These are the most numerous type of artefact, consisting of 50 examples (Figure 6.7). The vast majority are pebble tools rather than cobbles and are identified by their polished, striated and/or smoothed surfaces. Although Clarke has previously sub-divided this category into two: smoothed stones and those exhibiting polish or gloss (Clarke 1995: 141), they are considered as a single category here (although those with polish or gloss are SF 3611, SF 3632, SF 3666, SF 3668, SF 3694, SF 4638, SF 4699 [Figure 6.5], SF 4750, SF 4980, SF 5279 [Figure 6.7] and SF 5437). In eight cases, the extensive wear on the pebble has created visible facets. Most of these are from Phase 9 contexts (SF 3942, SF 3944, SF 4557, SF 4844 [Figure 6.7], SF 5426 and SF 5466) with the remainder from Phase 12 (SF 3439; Figure 6.6) and Phase 16 (SF 3352; Figure 6.6).

Polished or smoothed stones are found in most phases between Phase 3 and Phase 16 and are especially numerous in Phase 9. They were found almost as often in house floors (21 cases) as in other contexts (24 instances), and 11 of the 19 from Phase 9 were found within floor 1311 of House 401, mostly in its southwest quadrant. This concentration of polishers in the southwest quadrants of roundhouse floors is also evident in House 1500, but not in later phases of House 401 or in House 801 or House 1370, where their numbers were, in any case, small.

As Clarke (1995: 140) has pointed out, there are problems with the identification of smoothed stones since naturally smoothed pebbles may be mistaken for artefacts whilst those that have been used as tools are easy to overlook during excavation. A number of smoothed pebbles recorded as polishers were discarded during analysis because they displayed no clear traces of striations or polish. It is difficult to assess how many *bona fide* polishers were discarded in error during excavation but they are likely to be under-represented in later phases (*i.e.* the first few seasons of excavation) when excavators were not attuned to looking for them. This could explain why none were found in Phase 11 contexts, when other forms of stone tool are numerous, although plenty of polishing

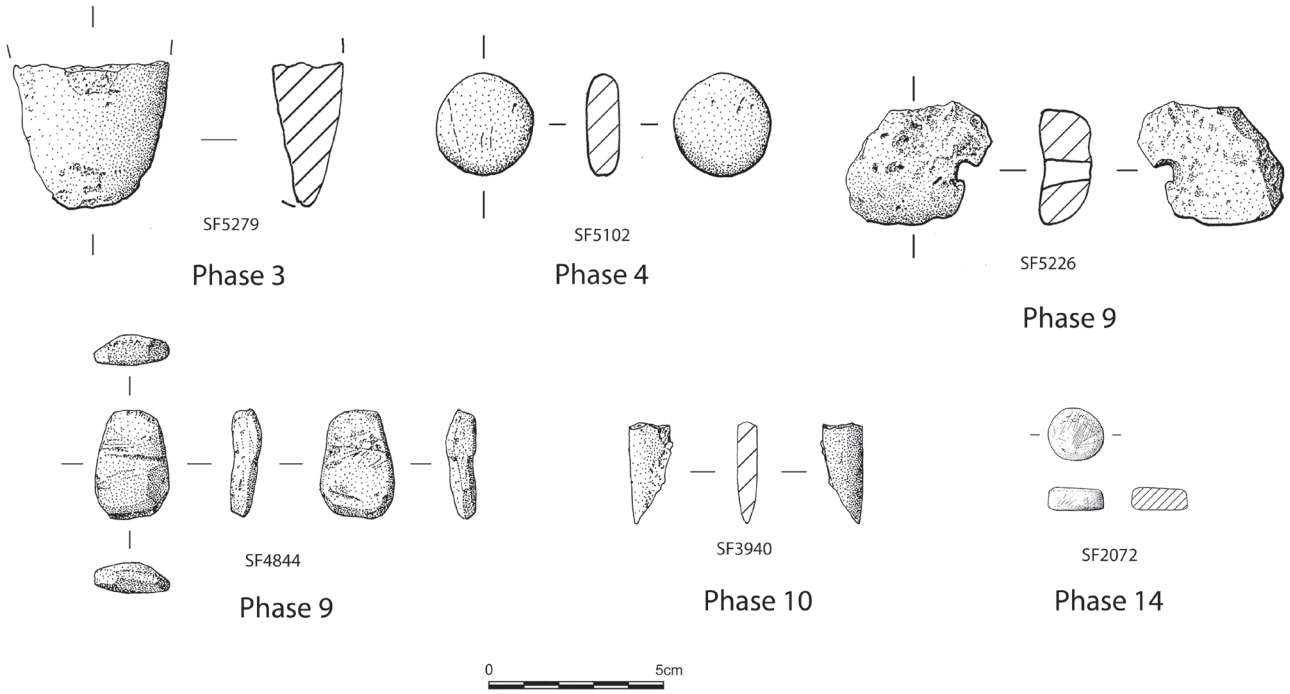


Figure 6.7. Small stone artefacts from Cladh Hallan

stones had already been found in later layers by the time that these deposits were excavated.

The purpose of polishing stones may appear self-evident. Their spatial and contextual association with worked pumice and bone points in the southwest quadrants of House 401 (floor 1311) and House 1500 indicates a likely use in hide-working, in which cured hides were pegged onto wooden frames, scraped with pumice to remove fat and hair, and then rubbed with stone polishers to soften the leather (see also Chapters 3, 4 and 7). A similar interpretation has been independently proposed for these three artefact types found in association at the early Christian monastic site of Portmahomack, Tarbat Ness in eastern Scotland where they are thought to have been used in making vellum out of calf skins (Carver 2004: 18–19, fig. 2). At Cladh Hallan, the cull patterns for calves, lambs and piglets indicate that their hides would have been available for manufacturing soft and fine leather clothing and other leather goods (see Chapter 10).

Polisher reworked as a cutting tool

One polisher (SF 3553) from an inter-floor fill layer in House 401 (Phase 10) was unifacially flaked to provide a cutting edge. It is similar to an Orcadian 'Skaill knife'.

6.6 Modified stones

Flat stones

Flat stones may have been used as pot lids, pot bases, potting slabs on which to form pots, bakestones, grinding or polishing surfaces, and trays/discs. There are seven examples from Cladh Hallan, all flat gneiss pebbles, which display signs of use or modification.[2]

Flat stones with evidence for modification or use are found in Phases 8, 9, 11 and 12. One with a polished surface was found in the construction deposits outside the doorway of House 401 (SF 3498; Phase 8). A disc-shaped stone (SF 4737; Figure 6.5) came from the southeast edge of floor 2211 in House 1370 (Phase 9), close to a collapsed unfired pot, and may have been a potting slab. Three came from House 401 in Phase 11 and have traces of grinding or wear on one surface. One of these (SF 3532; Figure 6.5) appears to have been left where it was used, in the southeast quadrant of the roundhouse as part of an unusual deposit possibly related to potting (floor 1392 [floor 655]; Volume 1: 256, fig. 7.26).

Pecked stones

There are two gneiss stones which have random peck marks across their surfaces. One is a small flat slab (SF 5385; Figure 6.4) from the floor of Structure 2477 (Phase 7), where it was found in association with another flat slab (SF 5083). The other is a large block of hard black altered basalt incorporated into the basal course of the northwest interior wall face of House 1370 (Phase 8; see fig. 4.40 in Volume 1). The small diameter and depth of these peck marks suggest that they were made with a metal point.

Drilled stone

A rough stone, broken across the drill hole (SF 5226; Figure 6.7), is one of two examples of perforated stones from Cladh Hallan. Unlike the probable loomweight (see below),

it is a small perforation into a probably much smaller stone. It may have been a weight and was located on the southwest margin of floor 2211 of House 1370.

6.7 Loomweight

This centrally perforated, doughnut-shaped stone (SF 3047; Figure 6.6) came from the abandonment fill (587) of House 401 in Phase 16. It is likely to have been a weight, possibly a loomweight. There is little evidence for textile-working other than five bone spindle whorls from Phases 12 to 14, although two angled postholes close to the south wall of House 401 in Phase 13 may have supported a vertical loom.

6.8 Gaming counters

Gaming counters are rare in Britain before the first centuries BC–AD when they appear in contexts such as high-status burials in Hertfordshire and Essex in southeast England (*e.g.* Stead 1967). So it was something of a surprise to discover four modified, circular pebbles in much earlier contexts at Cladh Hallan. There are, however, hints elsewhere that such items could have been in use at such early dates. A stone counter or gaming piece was recovered from the Late Bronze Age settlement of Dean Moor on Dartmoor, Devon (Fox 1957), whilst four worked stone discs interpreted as gaming counters are also recorded from the Sculptor's Cave, Covesea (Cruickshanks 2020: 114–15, illus. 5.23, SFs 949, 951–953). Found unstratified within a site with a major Late Bronze Age–Early Iron Age component, the Covesea pieces are, however, assumed to date to the Roman Iron Age (Hall 2020: 115–16). Yet, given their similar dimensions and shapes to the Cladh Hallan counters (from contexts spanning the Middle Bronze Age to Early Iron Age), it is not unfeasible that they could be of similar date. Similar gaming counters have also been found in Middle and Late Iron Age contexts at The Cairns broch in Orkney (Archaeology Institute, UHI, n.d.).

The earliest of the Cladh Hallan counters (SF 5102; Figure 6.7) is from the southeast area of the floor of House 2835 (Phase 4), dating to the fourteenth–mid-thirteenth centuries BC. It may well be just a polisher or a polished pebble but its perfect circularity is suggestive of its use as a counter. The ground, circular pebble (SF 3686) from layer 1224 in the ruins of House 1370 (Phase 11) raises similar questions. Of the two counters (SF 2072 and SF 3168; Figure 6.7) from the surface of the southwest quadrant of floor 462 in House 401 (Phase 14), SF 3168 is less ambiguous. With vertical sides and flat surfaces, it resembles a cough lozenge and is difficult to interpret as anything other than a gaming counter. It has been suggested that such counters were used in simple games such as Nine Men's Morris.

6.9 Discussion

Cladh Hallan's assemblage of coarse stone tools is one of the largest from the Western Isles, even more than the Iron Age and Norse-period assemblages from Bornais (Sharples 2005; 2012a; 2020) and the Neolithic–Bronze Age site at the Udal (Ballin Smith 2018: 174–83). At the time of writing, there are no other Later Bronze Age–Early Iron Age settlements from the region with comparable assemblages. No stone tools are described from the Early Iron Age levels at Baleshare (Baile Sear; Barber 2003) and there is only a single item, a sharpening stone, from the Early Iron Age settlement of Borve 52 on Barra (Branigan and Foster 2000). The Later Bronze Age cairn 4B at South Vatersay produced an ard tip, a cleaver and a grinder (*ibid*.).

Together, the Neolithic site of Allt Chrisal on Barra, the Early Bronze Age site of Kilellan Farm on Islay, Middle Bronze Age to Early Iron Age Cladh Hallan, Middle–Late Iron Age Dun Vulan, and Late Iron Age Bornais Mound 1 provide a long-term chronological perspective on coarse stone tool use in the region. The Allt Chrisal assemblage consists mostly of grinders, faceted cobbles, hammerstones, smoothed stones and bevelled pebbles (Clarke 1995: tab. 4.40). The Kilellan assemblage is dominated by hammerstones, with smaller numbers of bevelled pebbles, facially pecked cobbles and grinders (Clarke 2005: tab. 36). Bevelled pebbles, also described as limpet hammers, are entirely absent at Cladh Hallan, as are faceted and facially pecked cobbles. In contrast, Cladh Hallan and Dun Vulan have sharpening stones (absent from Kilellan Farm and only one example from Allt Chrisal). Both Cladh Hallan and Dun Vulan have broken quernstones – saddle querns at Cladh Hallan and mostly rotary querns at Dun Vulan – which form about 10% of each assemblage, much higher than on earlier sites. In contrast, the proportion of grinders (31% at Allt Chrisal, 7% at Early Bronze Age Kilellan Farm, 16% at Cladh Hallan and 5% at Dun Vulan) shows no particular chronological trend. Cladh Hallan's assemblage is dominated by polishers, which form only a tiny element of the earlier assemblages and are absent from Dun Vulan. As mentioned above, Cladh Hallan and Allt Chrisal are unusual in having small proportions of hammerstones (13% at Allt Chrisal and 9% at Cladh Hallan in contrast to 65% at Kilellan Farm and 55% at Dun Vulan) although, if multi-functional tools are included, Cladh Hallan's total is 21%.

In summary, the proportions of coarse stone tool types at Cladh Hallan document long-term changes in certain activities. Hide-finishing, grain-processing and blade-sharpening are more prominent than at sites in the region dating to the Neolithic and Early Bronze Age. In contrast, bevelled pebbles and other types of cobble tool were little used or no longer in use, possibly linked to changes in shellfish collection and the declining use of struck lithics.

Within the chronological sequence at Cladh Hallan, stone tools were most common in the construction and initial occupation of the Late Bronze Age roundhouse row, falling off after Phase 12 when only Houses 401, 1500 and 150 were in use. Otherwise, there are few prominent changes within the assemblage which are not related to the overall volume of finds. If the doughnut-shaped, perforated weight was indeed used on a loom, it and the other evidence for textile manufacture suggest that spinning and weaving occurred only during the Early Iron Age inhabitation of

Cladh Hallan and were then only a limited activity. The brief use of cleavers in Phases 8 and 9 may have ended with their replacement by metal tools. The absence of sharpening stones after Phase 12 is also notable but is probably due to the decline in the overall size of the assemblage. Although no iron tools have been found at Cladh Hallan, it is interesting that there was no increase in the use of stone tools after the end of the Bronze Age, suggesting that iron was plentiful enough (but presumably carefully recycled) to require no supplementary tools or substitutes in stone.

The depositional contexts of coarse stone tools at Cladh Hallan show some interesting trends. Quantities are small before Phase 8 but show a division in deposition between house floors and pit fills. Thereafter, pits rarely contained stone tools (ten items only). Some 13 stone tools (9%) were incorporated into the foundations of Houses 401 and 1370 and a further four (3%) come from later wall deposits and 17 (11%) from construction layers below floors. Thus a quarter of the assemblage derives from foundational deposits. The other principal depositional contexts are the house floors, with 57 tools (39%) found on top of or within floor layers. Some of these, such as the hammerstone and cleaver in House 801, were closing deposits but others are likely to have been incorporated into the floor matrix close to where they broke or were abandoned. The remaining third of the assemblage (38%) derives from fill layers, pits and postholes.

Over time, there were differences in deposition. From Phase 9 to Phase 12 the relationship of artefacts within floor layers to those within fills changed: stone tools were most common in floor layers in Phase 9, in roughly equal proportions in Phases 10 and 11, and mostly in fill layers in Phase 12. However, from Phase 13 to Phase 16 most were from within floor layers.

Those coarse stone tools from foundational deposits were primarily placed in these during Phases 8 and 9. This is very similar to the pattern of deposition of human remains on the site, most of which were also foundational deposits (see Chapter 19). The one type of stone tool whose deposition most closely mirrors that of human remains is the saddle quern, with larger fragments incorporated into the walls and wall cores or buried in pits, two water tanks and a stone cist under the houses, one fragment in the burial of the composite mummy beneath the south side of House 1370, and smaller pieces within house floors (analogous to the finds of teeth and small bone fragments on house floors).

Catalogue

Any number in square brackets (e.g. [5049], floor) is an environmental sample square number.

Phase 3 – Cremation pyre and pit

5279 context 3356. A fragment of a highly polished cobble, 45mm × 40mm and 18mm thick. Possibly a fragment of a circular-sectioned polished stone tool. Dolerite. Figure 6.7.

5194 context 3286 (pit 3287). A polisher, 97mm × 81mm and 48mm thick. It is a cobble with one polished and striated surface which has a light orange/brown stain. Quartzite. East of House 3260.

Phase 4 –House 2835

5102 context 2835 ([5049]; floor). A possible counter/gaming piece, 28mm dia. and 10mm thick. It is a small perfectly circular flat pebble with one polished and striated surface. Quartzite. Figure 6.7.

5182 context 3194 (layer under floor). A pebble polisher, 73mm × 68mm and 37mm thick. It has one polishing surface with striations which is discoloured dark brown. Fine-grained sandstone.

Phase 6 – The pit alignment.

4875 context 2402 (pit fill). A sharpening stone fragment, 37mm × 21mm and 9mm thick. It is sub-rectangular in shape and section, with three edges showing some wear and a fourth edge highly worn and smoothed. Siltstone. North of forecourt of House 401.

5111 context 3119 (pit fill). A grinder with a continuous facet, also used for pounding, 78mm dia. and 70mm thick. It is a rounded cobble with grinding facets all round its circumference, and only two areas are not ground. One facet exhibits extensive peck marks. Brown quartzite. SE area of wall core, House 401. Figure 6.4.

Phase 7 – Structure 2477

5470 context 2476 (floor). A hammerstone fragment, 71mm × 55mm × 25mm. This is a large flake, broken off the end of a hammerstone, with a pounding facet and a single fracture scar from its use prior to breakage. Quartzite.

5385 context 2476 (floor). A peck-marked stone, 215mm × 155mm and 58mm thick. It is a sub-rectangular slab where the working face shows extensive pitting with large peck marks up to 10mm across. Altered basalt. Figure 6.4.

Phase 7 – House 3260

5104 context 2883 (abandonment fill). A double-ended pestle-shaped grinder and hammerstone, 129mm × 48mm and 42mm thick. It is an oblong cobble with one end wider than the other. Both ends exhibit fracture scars, with the wider end more damaged than the other. Metamorphic sandstone.

Phase 8 – House 801

5455 context 3159 (pit fill). A parallel-sided, triangular-sectioned, burnt stone, 97mm × 78mm and 80mm high. Its geometrical shape makes this stone appear artificial but it has not been worked. It is recorded

as a small find because of its significant contextual association with an unmodified scallop shell (SF 5454) and a sheep scapula within a deliberately split pot (SF 5242) in pit 3158.

Phase 8 – House 401

3128 context 637 (within wall core of NE front). A possible broken mattock/ard point, 92mm × 66mm and 26mm thick. The non-working end has broken off, leaving a rectilinear shape in appearance and section. The working end has been bifacially worked and has a sharp edge. One of the longitudinal edges is worn and abraded, corresponding with a more worn and rounded end of the tool on this side (a result of the angle at which the share was worked through the soil?). Mudstone/siltstone. Figure 6.4.

3694 context 1312 (fill). A highly polished pebble, 51mm × 35mm and 17mm thick. This teardrop-shaped pebble is polished all over except for a small area near its tip which has been battered. Fine-grained gneiss.

4197 context 1930 (mislabelled as 401; E102.65 N106.6 4.45 OD; within wall core of SE front). A heart-shaped beach boulder, 220mm × 180mm × 120mm, used as a hammerstone. It has small pounding facets on each of its three ends. The larger of these facets are both 60mm across whilst the smaller one is 40mm across. Gneiss.

4198 context 1930 (mislabelled as 401; E103.3 N106.36 4.52 OD; within wall core of SE front). A fragment of quern, 270mm × 225mm and 110mm high. This is about a quarter of an original quernstone, with just one original edge extant. The ground-out bowl is flat and wide (40mm deep) and extends to the edge of the grinding surface. Gneiss.

4724 context 2105 (within wall core of E front). An almost complete saddle quern, 520mm × 460mm and 75mm deep, broken at one end. It is irregular in shape with rounded edges and a flat base. The working surface is saddle-shaped, elongated and shallow. The breaking of this large and solid quern would have been no small undertaking. Fine-grained gneiss. The quern remains *in situ* at Cladh Hallan. Figure 6.1.

4877 context 2520. A polisher, 77mm × 34mm and 17mm thick. An elongated and tapered pebble with a flat, smoothed side. Metamorphic sandstone.

4920 context 1930 (within wall core of SE front). Fragment of a cobble with a flat, polished surface, 94mm × 91mm and 35mm thick. It is plano-convex in section with a smoothed surface on the flat face. Fire-cracked mudstone/siltstone.

5076 context 2923 (posthole fill). Fragment of a cleaver/chopper, 119mm × 110mm and 31mm thick. It is triangular in shape and section, with a sharp, curved working edge which exhibits fracture scars. Fine-grained sandstone.

5093 context 3026 (posthole fill). A small sharpening stone, 68mm × 12mm and 11mm thick. It is rectangular, with one squared-off end and one irregular end. Its rectangular section is naturally formed but one long face is marked with longitudinal striations. Siltstone.

Phase 8 – House 1370

4750 context 2588 (posthole fill). Part of a large bakestone/potlid, 155mm × 222mm and 26mm thick. It is sub-oval in shape and has a handle extension produced by chipping. One surface is highly polished, suggesting that this object may also have been used as a working surface. Gneiss.

5244 context 2611 (within pit 2612 containing composite female-male skeleton). A fragment of a quernstone, 132mm × 102mm and 76mm thick. The surviving outer edge slopes inwards to a flat and smooth base. Part of the original upper surface remains and is concave and highly smoothed. The other edges are broken. Gneiss. Figure 6.1.

5258 context 1397 (wall core at E front). A quernstone fragment, 340mm × 315mm and 80mm thick. It is broken into two pieces and formed part of a larger quern. Its slightly concave grinding surface is smooth but is only 12mm deep. It was placed in the north terminal of the doorway of House 1370. Gneiss. Figure 6.1.

5418 context 1397 (exterior wall at N). A quernstone, 520mm × 270mm and 170mm thick. It is broken at one end and on one side. Its grinding surface is worn to a depth of 60mm, exposing a thin white quartz band (a layer 3mm thick) within the grey gneiss. The quern remains *in situ* within the outer wall face of House 1370 at E 103.40 N 123.00. Hard, banded grey and white gneiss (the best stone of any quern from Cladh Hallan).

Context 1370 (interior wall at NW; E100 N121.6). A large block of black altered basalt, 840mm × 400mm and 200mm thick, with 19 randomly distributed peck marks on one face (varying in dia. from 5mm to 23mm and < 5mm deep). The stone was set into the basal course of the interior wall of House 1370 on the house's northwest side, and the pecked side faces towards the interior of the house. They were presumably made with a metal spike. The stone remains *in situ* at Cladh Hallan.

Phase 8 – Forecourt of House 401

3498 context 770. A polishing surface, 80mm × 63mm and 23mm thick. It is square in shape and plano-convex in section with the flat face heavily smoothed and striated. Gneiss.

Phase 9 – House 801

3661 context 822 (robbed-out wall core). A polisher/pounder, 82mm × 26mm and 11mm thick. It is a smooth elongated pebble, plano-convex in section with a flat polished surface on both faces and with some pecking at one end.

3942 context 822 (robbed-out wall core). A polisher, 54mm × 38mm and 18mm thick. It is a smooth pebble and there are polishing facets at one end and along one side. Dolerite.

5427 context 1150 (floor). A pebble polisher, 54mm × 48mm and 18mm thick. Dolerite.

3436 context 1150 (floor). A cleaver/chopper, 110mm × 90mm and 29mm thick. It is axe-shaped, made from a triangular-shaped stone, and the widest end has been bifacially worked to produce a curved cutting edge. Mudstone. Figure 6.5.

3437 context 1150 (floor). A hammerstone, 116mm × 75mm and 42m thick. It is sub-rectilinear in shape and section with one end wider than the other (this is also broken off so wear cannot be discerned at this end). The wider end displays pecking and fracture scars and there is some longitudinal edge pecking on the body. Dolerite. Figure 6.5.

3738 context 1150 (floor). A small flat-topped quernstone, 212mm × 160mm and 67mm thick. It is rectangular in shape and flat with well-worn rounded corners. Both faces have been used as working surfaces; one is very smooth and polished whereas the other exhibits some smoothing but extensive pecking. Gneiss.

3740 context 1150 (floor). A pestle-shaped grinder, 99mm × 72mm and 8mm thick. It is an oblong-shaped cobble with a large grinding facet on one end and a smaller, less developed facet on the other. Dolerite.

3745 context 1150 (floor). A large pestle-shaped grinder, 160mm × 87mm and 68mm thick. It is an oblong cobble which is slightly larger at one end. Both ends exhibit well-developed grinding facets. There is also a small amount of abrasion at the larger end. One long face has been smoothed and has longitudinal striations. Dolerite.

5438 context 1150 (floor). A polisher, 54mm × 44mm and 15mm thick. One side of this pebble is polished. Gneiss. This came from the northern half of the house or from the hearth environs but its precise position cannot be located.

Phase 9 – House 401

4689 context 1311. An elongated sharpening stone, 85mm × 29mm and 18mm thick. It is smoothed throughout and has rounded ends. Two slight facets are visible within this soft sandstone and one long side is concave from wear.

5426 context 1311 (floor). A polisher, 78mm × 58mm and 35mm thick. It is a spherical cobble with one well-worn concave polishing facet on one end. Metamorphic medium-grained sandstone.

4307 context 1311 ([2982]; floor). A quernstone fragment, 72mm × 87mm and 48mm thick. It has a smoothed and pecked concave upper surface. The sides and base are flat and the exterior surface curves inwards slightly. Gneiss. To correct an error in Volume 1: 144–5, where the quern fragment is in twice, in both the southwest and the southeast quadrants: it is actually from the southeast quadrant.

4562 context 1311 (E97.7 N110.1 3.30OD; floor). A burnt, flat beach slab, 165mm × 120mm and 55mm high (now broken into 7 pieces of rotted stone). On one side there is a flat grinding surface which has become very slightly concave. This fragment comes from a small flat grinding slab which would have broken across its middle. The stone was set on edge within floor 1311. Gneiss.

4638 context 1311 ([3004]; floor). A polisher, 87mm dia. and 31mm thick. It is disc-shaped with one flat face and one convex face, both of which are highly polished. Fine-grained sandstone.

4642 context 1311 ([3004]; floor). A broken and burnt cobble with a polished surface, 110mm × 94mm and 60mm thick. One of the two flat sides of this large cobble has been polished. Gneiss.

4667 context 1311 ([3105]; floor). A broken saddle quern, 340mm × 280mm and 220mm deep. It is a square-shaped fragment with a saddle-shaped profile and a flat base, forming the larger half of a quern broken transversely across its middle. Greater abrasion on one side has created a narrower edge in section (whose outer face slopes inwards towards the base). The other two surviving sides are thicker in section with flat outer faces that are at roughly perpendicular angles to the base. The ground-out bowl is 220mm wide and 86mm deep. Grey and black-banded gneiss. Figure 6.2.

4699 context 1311 (floor). A pebble polisher, 40mm × 52mm and 31mm thick. The largest face is completely flat and highly polished with striations. Fine-grained pink quartzite. Figure 6.5.

4714 context 1311 (floor). A grinder, also used for polishing, 72mm × 80mm and 68mm thick. It is a rounded cobble, sub-rounded in section with one large grinding facet at its widest end and a flat, pecked surface at the other end. There is a flattened polished face along part of the body. Dolerite.

4716 context 1311 (floor). A pestle-shaped grinder, also used for polishing, 139mm × 108mm and 78mm thick. It is an elongated cobble, sub-triangular in section. Both ends have well-worn grinding facets. There are two large polished areas on either side, one with many striations. Dolerite.

4640 context 1311 ([3004]; floor). A pebble polisher, 62mm × 64mm and 32mm thick. One flat side is polished with striations. Fine-grained pink quartzite.

4734 context 1311 (floor). A quernstone fragment, 99mm × 73mm and 38mm thick. It has a smoothed and polished concave upper surface with squared-off sides and a flat base. External surface curves inwards slightly. Gneiss.

4921 context 1311 ([3913]; floor). A split pebble with smoothed edges, 92mm × 51mm and 11mm thick. The larger of the two surfaces is flat but shows no evidence of polishing or grinding although its upper edges are smoothed, suggesting that the stone was used as a polisher. Sandstone.

5439 context 1311 (floor). A polisher, 54mm × 37mm and 23mm thick. It has a flat, polished surface on one side. Quartz.

3752 context 1598 (cellar floor). A pestle-shaped grinder, 141mm × 76mm and 45mm thick. It is an elongated pebble, spherical in section, with a grinding facet on one end. Fine-grained sandstone.

5440 context 1690 ([3011]; floor). A small polisher, 26mm × 22mm and 8mm thick. A highly polished black pebble with longitudinal striations on one side. Metamorphic sandstone.

3805 context 1698 (floor). A grinder, 90mm × 84mm and 49mm thick. It is a rounded cobble with a well-defined grinding facet at one end. Fine-grained sandstone.

3807 context 1698 (floor). A pestle-shaped grinder, 112mm × 46mm and 33mm thick. It is an elongated pebble with an expanded end which has three grinding facets surrounded by small flake scars on three sides. Metamorphic mudstone.

4732 context 2418 (lining of water tank). A fragment of a saddle quern, 490mm × 272mm and 95mm deep. It is rectangular in shape with straight sides and a flat base. The working surface is elliptical and is situated off-centre, creating one very thin and one thicker side in profile. Gneiss. Figure 6.2.

Phase 9 – House 401 forecourt

4582 context 1933. A grinder, 80mm × 65mm and 58mm thick, formed from a fist-sized cobble. There are five grinding facets, three of which are damaged by a large flake scar. Two opposite sides of the grinder are unworked, together with a strip linking the two sides. Metamorphic sandstone.

Phase 9 – House 1370

3828 context 1369 (floor). A large pestle-shaped grinder, 147mm × 51mm and 44mm thick. It is cylindrical in shape with well-developed grinding facets on each of its ends. There is also some pecking at both ends. Quartzite. Figure 6.5.

4557 context 1369 (floor). A polisher, 63mm × 24mm and 18mm thick. It is an elongated pebble, plano-convex in section with highly smoothed surfaces throughout and one slightly concave area on the flattest face. There are two polishing facets at its wider, thicker end. Dolerite.

5466 context 1369 (floor). A polisher, 58mm × 32mm and 8mm thick. It is an elongated black pebble, polished on both its flat sides and marked with transverse striations. There are five polishing facets; one is along the centre of one flat side and the other four are on the other flat side, from its centre to its long edge. Dolerite.

3944 context 1776 (fill). A polisher, 85mm × 74mm and 23mm thick. It is an oval pebble. One of its sides is polished flat in the centre, to produce a slight facet 45mm dia. Quartzite.

4628 context 1369 (floor). A quernstone, 540mm × 390mm and 150mm high, whose end has been broken off (after recovery it has subsequently broken into 8 pieces). It is rectangular in shape with a concave base that curves gently upwards at one end. In profile the unbroken end exhibits a flat outer face and an almost straight steep curve to the working surface. This working surface levels out before increasing again into a curved gradient up to the other edge which is 80mm deep due to the rising base. The bowl is 280mm wide, 100mm deep and at least 360mm long. Gneiss. Figure 6.2.

4626 context 2210 (inter-floor fill). A pebble polisher/burnisher 60mm × 38mm and 24mm thick. It is smooth and sub-rectangular in section with one slightly concave polishing surface. Basalt.

4646 context 2210 (inter-floor fill). A cleaver, 145mm × 88m and 36mm thick. The non-cutting end is naturally handle-shaped with a small amount of pecking at the end. The curved cutting edge has been bifacially flaked. The 'handle' exhibits four shallow striations running down its length. Metamorphic sandstone.

4656 context 2210 (inter-floor fill). A pounder, 87mm × 47mm and 22mm thick. It is an elongated pebble, elliptical in section with a small amount of pecking on one end. Gneiss.

4844 context 2210 (inter-floor fill). A very small but heavily worked polisher, 30mm × 21mm and 10mm thick. It is sub-rectilinear in shape and in section. Along its edges are seven separate and well-worn facets. One face is smoothed throughout, and the other surface displays two polishing facets. Also halfway along the length of this surface is a groove running perpendicularly to the long axis. Surrounding this are a number of smaller parallel grooves. These incisions are found on the other face but not around the edges (not continuous). Mudstone. Figure 6.7.

4980 context 2210 (inter-floor fill). A broken beach cobble, 135mm × 90mm and 60mm thick. The central area of its flattest side has signs of polishing and black discolouration. Metamorphic sandstone.

4722 context 2211 (floor). A largely complete saddle quern, 540mm × 490mm and 220mm high. It is an irregular boulder with flat sides and a flat base and is broken at one end. The working area is sub-rounded and broken at one end. The ground-out bowl is at least 380mm long and is 270mm wide and 85mm deep. Gneiss. Figure 6.2.

4737 context 2211 (floor). A large bakestone/pot stand/lid, 165mm × 172mm and 24mm thick. It is a regular disc with some fractured areas around the edges. One surface is slightly worn and smoothed. Gneiss. Figure 6.5.

5226 context 2211 (floor). A fragment of a drilled stone, 38mm × 32mm and 15mm thick. It is irregular in shape and one side has broken across an hourglass-shaped perforation (9mm max. dia. and 4mm min. dia.). Sandstone. Figure 6.7.

4291 context 2138 (pit fill). A broken quernstone, 540mm × 370m and 210mm high. It is an irregular boulder with a U-shaped profile of sloping sides and a small flat

base. It has broken transversely across its centre (and this surviving piece has subsequently split in two). The surviving working surface is oval (270mm wide) and shallow (70mm deep). Banded gneiss (unusually, the strata run perpendicular to the grinding surface). Figure 6.1.

4310 context 2214 (posthole fill). A broken cleaver/chopper, 124mm × 82mm and 22mm thick. It is a large flat piece (perhaps broken during an attempt to re-sharpen the working edge). It has a curved blade and its original outer surface displays flake scars along this cutting edge. Metamorphic mudstone/siltstone.

Phase 9 – House 1370 forecourt

4657 context 2377 (pit fill). A large polisher/pounder, 110mm × 112mm and 43mm thick. It is disc-shaped and rounded in section with a large polished and striated facet on one face. Parts of the circumference exhibit peck marks from pounding. Gneiss.

Phase 9 – Southeast area

3298 context 415. A polisher, 101mm × 52mm and 20mm thick. An elongated pebble whose naturally squared edges have been polished. Dolerite.

5441 context 1680 ([3194]; yard surface). Fragment of a probable quernstone, 40mm × 29mm and 45mm thick. The smooth and angled upper surface of this fragment is probably the grinding surface of a well-used saddle quern. Gneiss.

Phase 10 – House 401

3526 context 1308 ([2321]; floor). A pestle-shaped grinder, 120mm × 90mm and 52mm thick. It is a slightly elongated, triangular-shaped cobble whose broad end has two grinding facets with some pecking at either side. Metamorphic sandstone.

3536 context 1308 (floor). A sharpening stone, 94mm × 25mm and 12mm thick. It is an elongated pebble with rounded edges, striations on both sides and some pecking on one of its ends. Dolerite. Figure 6.5.

3540 context 1308 (floor). A grinder with a continuous facet, 92mm × 82mm and 68mm thick. It is a round cobble with one large grinding facet around most of its circumference. Quartzite. Figure 6.5.

3541 context 1308 (floor). A pestle-shaped hammerstone, 111mm × 52mm and 31mm thick. It is an elongated pebble with pecking on one end. Medium-grained sandstone.

3544 context 1308 (floor). A grinder, 75mm × 88mm and 58m thick. It is a roughly spherical cobble with four grinding facets at one end. Dolerite.

3553 context 1310 (inter-floor fill). A broken pebble with a polished surface, 95mm × 70mm and 17mm thick. One of the two sides of this broken thin cobble is flat and polished. The cobble has subsequently been flaked unifacially to make a Skaill knife. Dolerite.

3940 context 1310 (inter-floor fill). A fragment of a sharpening stone with a polished edge, 29mm × 12mm and 4mm thick. The 29mm-long edge is broken at both ends and on its inner side, and is V-shaped in section. Micaceous schist. Figure 6.7.

4922 context 1310 (inter-floor fill). A pebble polisher, 51mm × 48mm and 10mm thick. Dolerite.

3943 context 1507 (fill of cellar). A probable sharpening stone fragment, 60mm × 18mm and 16mm thick. It is an elongated fragment of a smoothed pebble which has been worn into a sub-triangular shape in section. Fine-grained sandstone.

5428 context 1595 (inter-floor fill). A possible quernstone fragment, 80mm × 59mm and 19mm thick. It is a roughly square-shaped fragment of stone with a flat unworked base and sides but with a well-polished, slightly concave upper surface. Gneiss.

5429 context 1595 (inter-floor fill). A fragment of a rubber for a quern or grinding slab, 79mm × 58mm and 15mm thick. It is a sub-rectangular flat fragment with one highly smoothed surface. Gneiss.

5437 context 1595 (inter-floor fill). A polisher, 53mm × 42mm and 14mm thick. It is a highly polished black pebble. Gneiss.

Phase 10 – House 1370

4223 context 2003 (floor). A grinder, 82mm × 77mm and 68mm thick. It is a rounded cobble with four grinding facets at one end and a small amount of pecking at the other end. Dolerite.

5467 context 2003 (floor). A polishing stone, 88mm × 37mm and 27mm high. This is a naturally beak-shaped black beach pebble, pointed at one end. There is no sign of wear on its tip but the pebble's flat underside has transverse striations. Dolerite.

Phase 10 – Forecourt of House 401

3455 context 1303 (windblown sand). A hammerstone, 120mm × 58mm and 26mm thick. It is an elongated pebble with pecking at both ends. Medium-grained sandstone.

Phase 11 – House 401

3459 context 1290 (floor). A hammerstone, 148mm × 28mm and 27mm thick. It is an oblong cobble with slight pecking at one end and pecking and fracture scars at the other. Metamorphic sandstone.

3577 context 1413 (inter-floor fill). A grinding surface on an oval pebble, 99mm × 84mm and 19mm thick. The polished surface is slightly concave. Metamorphic sandstone.

3532 context 1392 (floor). A potlid/base used as a grinding surface, 131mm × 117mm and 20mm thick. It is roughly disc-shaped with a concave grinding surface on one face. Gneiss. Figure 6.5.

3543 context 1392 (floor). A fragment of a grinding surface, 210mm × 190mm and 75mm high. One of its two flat sides may have been used as a grinding surface. Gneiss.

5469 context 655 (floor). A flat beach pebble used as a grinding surface, 83mm × 55mm and 19mm thick. One of its flat sides is ground down to a flat, slightly concave surface. There are transverse striations on its slightly rounded base. Both ends of this pebble are damaged, probably before or during its period of use. Sandstone.

3606 context 1414 (inter-floor fill). A pounder/grinder, 107mm × 59mm and 38mm thick. It is an irregular-shaped cobble with pecking at one end (the other end is broken) and a small pecked facet on one edge. One flat side is smoothed. Medium-grained sandstone.

3607 context 800 (inter-floor fill). An almost complete flat-topped grinding surface, 315mm × 150mm and 70mm thick. It is an oval-shaped piece of degraded gneiss with a convex base and a highly worn, smoothed and pecked flat top. Some of the original working surface and most of the edges have been lost.

4269 context 800 (inter-floor fill). A fragment of a potlid/bakestone, 71mm × 68mm and 24mm thick. It is hemispherical in shape and shows possible traces of wear on its upper surface. Schist.

Phase 11 – House 1370

3686 context 1224 (floor). A possible counter/gaming piece, 28mm dia. and 8mm in thickness. It is perfectly spherical, smoothed and flat with traces of grinding around the edges. Sandstone.

3691 context 1204 (floor). A large pestle-shaped grinder, 210mm × 119mm and 81mm thick. It is a large, elongated cobble with a single small grinding facet at one end. Dolerite.

3945 context 1203 (inter-floor fill). A pestle-shaped grinder, 121mm × 55mm and 45mm thick. It is an irregular-shaped cobble with a small grinding facet on each end and a small amount of edge-pecking on the body. Fine-grained sandstone. Figure 6.5.

Phase 11 – Forecourt of House 401

5433 context 467 (pit fill). A grinder/pounder/polisher, 64mm × 88mm and 67mm thick. It is a rounded cobble with grinding facets at each end which are also heavily pecked. There are three faceted polishing surfaces on the body, giving it a sub-rectilinear appearance in section. Fine-grained sandstone.

5457 context 467 (pit fill). A double-ended, cube-shaped grinding cobble used as a hammerstone and polisher, 89mm × 68mm and 61mm thick. Its two opposing ends have rounded grinding facets, one of which has been damaged by removal of a thin flake from its surface. One of its other four faces has a pecked indentation from use as a hammerstone. Two other faces are slightly concave and are slightly polished. The sixth face is also concave but only very slightly shiny from polishing. Figure 6.6.

Phase 11 – Front yard

3422 context 518 (midden). A broken hammerstone, 74mm × 78mm and 40mm thick. It is hemispherical in shape with heavy pecking on the surviving end. One of its flat sides is smoothed. Fire-cracked fine-grained sandstone.

Phase 11 – Behind House 401

4797 context 2337 (fill layer). A small hammerstone/polisher, 72mm × 36mm and 22mm thick. It is a smooth elongated pebble, roughly plano-convex in section, with fracture scars and pecking at one end. One face on the body is flat with a polished surface. Schist.

Phase 12 – House 401

3158 context 595 (floor). A fragment of a polishing or sharpening stone, 35mm × 9mm and 18mm thick. It is D-shaped in section and the base is very flat and smooth. Fine-grained pink sandstone.

5468 context 595 (floor). A polisher, 73mm × 39mm and 11mm thick. This light grey beach pebble is worn flat on one side, with slight polish at both ends and longitudinal striations on one of these polished ends. Sandstone.

3405 context 721 (wall fill). A double-ended pestle-shaped grinder and hammerstone, 109mm × 64mm and 33mm thick. There are grinding facets at each end. It is heavily fractured from hammering at both ends and slightly smoothed across the rest of the body. One or more flakes have been detached from each end during hammering. Quartzite. Figure 6.6.

3439 context 1210 (pit fill). A polisher, 59mm × 58mm and 44mm thick. It is irregular in shape and exhibits three flat polishing facets. Fine-grained sandstone. Figure 6.6.

3500 context 1385 (fill of water tank). A broken quernstone, 350mm × 310mm and 190mm high. It is broken transversely at an angle across its centre. The ground-out bowl is 100mm deep and was at least 200mm long and at least 160mm wide. Gneiss.

3504 context 1385 (fill of water tank). An almost complete quernstone, 475mm × 470mm and 180mm high. Only the upper surface of one corner is missing, making this the only fully operational quernstone recovered from a stratified context at Cladh Hallan. Its ground-out bowl is 350mm × 260mm and is 70mm deep. Gneiss.

Phase 12 – House 401 forecourt

2053 context 477 (ring of stones around pit). A burnt stone block with damaged edges, 130mm × 115mm and 65mm high. It was probably part of a larger block and one of its two flat sides may have been used as a grinding surface. Gneiss.

2054 context 477 (ring of stones around pit). A stone block, 210mm × 175mm and 90mm high, freshly damaged around its edges but otherwise complete. One of its two flat sides may have been used as a grinding surface. Gneiss.

3499 context 475. A broken pebble with a flat polishing surface, 70mm × 55mm and 14mm thick. This naturally triangular-shaped stone has one flat surface which is partially polished. Metamorphic sandstone.

Phase 12 – House 2190

5099 context 2189 (abandonment fill). A polishing stone, 106mm × 37mm and 11mm thick. It is a flat and elongated stone with squared-off ends and smoothed body. It is smoothed at one end and along one edge. Metamorphic siltstone.

Phase 12 – South end

5430 context 412 (fill). A fragment of a probable sharpening stone, 47mm × 49mm and 11mm thick. It is square in shape and rectilinear in section with two surviving sides. One side is flat and smoothed with sharp edges and the other has been worked to a curve. Fine-grained sandstone.

5431 context 412 (fill). A fragment of worked stone, 64mm × 31mm and 15mm thick. Its edges and surfaces are smoothed and exhibit some peck marks. Fine-grained sandstone.

5432 context 412 (fill). A fragment of a polishing surface, 90mm × 89mm and 5mm thick. It is roughly square-shaped and the outer two are well-worn and rounded. The upper surface is slightly concave and shows evidence of pecking and smoothing. The underside is flat and fire-cracked. A quernstone or miscellaneous grinding surface. Gneiss.

3389 context 412 (fill). A broken pounder, 108mm × 81mm and 68mm thick. It is a rounded cobble, broken in half, with extensive pecking on the surviving working end. Fine-grained sandstone.

3479 context 412 (fill). A pebble polisher, 62mm × 41mm and 21mm thick. Dolerite.

3623 context 412 (fill). A fragment of a saddle quern, 219mm × 155mm and 102mm thick. It is irregular in shape on its four sides and has a convex base. Part of the original working surface is preserved, which slopes inward to form half of a saddle depression. The surface is well-worn, smoothed and pecked. Degraded gneiss.

5456 context 412 (fill). A cracked and broken cobble, 66mm × 64mm and 45mm thick, slightly polished on its flat face. Sandstone.

4228 context 2093. A fragment of a grinder and hammerstone, 60mm × 54mm and 29mm thick. Part of a grinding facet and a pecked facet are visible on this fragment. Metamorphic sandstone.

Phase 12 – Northeast area

3370 context 474 (fill). A grinder, 102mm × 92mm and 67mm thick. It is a round cobble with one large grinding facet around most of its circumference. Dolerite.

3417 context 1131 (fill). A split cobble whose edges have been crudely retouched, 98mm × 61mm and 26mm thick. Small flakes have been taken off this split cobble, at either end and along one side, to form a crude scraper. It is possible that this damage was accidental and that the stone is not a tool. Sandstone. Figure 6.6.

5827 context 413 (fill). A worn polisher, 18mm × 14mm and 8mm thick, with three flat wear facets. It is grey-brown and could have been abraded to make a pigment. Mudstone.

Phase 12 – Northwest area

4211 context 731 (fill). A fragment of a saddle quern, 495mm × 320mm and 120mm high (Figure 6.3). It is sub-rectangular in shape with a mostly flat base which curves upwards at one side. This half of the quern has broken longitudinally through its centre. In profile, one edge is thick with a rounded outer face and a steeply angled working surface. This working surface becomes more gently curving and shallower towards the other edge where the depth is greatly reduced to 24mm where it meets the base. The ground-out bowl is at least 300mm long and 75mm deep. Gneiss. See Volume 1: fig. 8.40.

Phase 13 – House 401

5434 context 465 (floor). A pebble polisher, 86mm × 42mm and 33mm thick. Dolerite.

3281 context 465 ([4426]; floor). A pebble polisher, 49mm × 42mm and 11mm thick. Dolerite.

3282 context 465 ([4413]; floor). A pebble polisher, 85mm × 42mm and 32mm thick. One of its flat surfaces is smoothed and striated. Dolerite.

Phase 14 – House 401

2072 context 462 (floor). A small stone disc (gaming piece?). Figure 6.7.

3168 context 462 (floor). A pastille-shaped black stone gaming counter with flat surfaces and a vertical edge.

Phase 14 – House 1500

3611 context 1435 (floor). A polisher, made from an elongated pebble 147mm × 46mm and 32mm thick. This pebble widens to a semicircular spatulate end which is polished on one side. Its butt end is thickened, providing a natural handle, whilst its spatulate end is thinned to 12mm near its tip. Dolerite.

3632 context 1436 (floor). A polisher, 148mm × 40mm and 19mm thick. It is a well-smoothed elongated pebble,

plano-convex in section, with polish marks on both tips especially on the narrower tip. Dolerite.

3666 context 1436 (floor). A polisher, 51mm × 29mm and 18mm thick. A highly polished, red oval pebble with longitudinal and angled striations on both sides. One side is flat. Mudstone.

3668 context 1436 (floor). A polisher, 69mm × 40mm and 21mm thick. A highly polished, green oval pebble with longitudinal striations on both sides. Mudstone.

Phase 16 – House 401

3047 context 587 (abandonment fill). A doughnut-shaped loom weight, 106mm × 110mm and 32mm thick. It has been chipped and smoothed into a disc shape and has a smooth central hourglass-shaped perforation (50mm dia. narrowing to 15mm dia.). Metamorphic sandstone. (see Volume 1: 370 [missing from index]). Figure 6.6.

Phase 16 – House 640

3275 context 544. A broken polisher, 80mm × 21mm and 10mm thick. An elongated pebble with longitudinal striations on one side near the break. Dolerite.

3169 context 632. A polisher, 73mm × 51mm and 10mm thick. It is flat and square-shaped. On one face there are two polishing surfaces, one of which is slightly concave, and one of the long sides is polished. Mudstone.

Phase 16 – House 150

1024 context 189 (floor). A fragment of broken saddle quern, since lost.

1025 context 184 (floor). A fragment of broken saddle quern, since lost.

Unstratified artefacts

3351 context 400. A broken polisher/pounder, 77mm × 80mm and 50mm thick. It is irregular in shape, fractured in two places (one of these fractures is along the pounding edge), and pecked at one end. Part of the body has a polishing facet.

3352 context 400. A highly polished stone, 47mm × 52mm and 28mm thick. It is a small pebble which has been polished to a shiny finish, creating four flat surfaces and two well-rounded ones. A burnishing or polishing stone. Gneiss. Figure 6.6.

3353 context 400. A broken polisher/pounder, 78mm × 70mm and 30mm thick. It is square in shape and rectilinear in section. There is a small polishing facet on one edge, and one face of the body is also flattened through polishing. The edges are pecked on two of the corners from pounding. Dolerite.

3356 context 400. A polisher, 50mm × 42mm and 18mm thick. It is roughly square-shaped and has a large polishing surface on part of the body and on two of its edges. Fine-grained mudstone.

3001 unstratified. A large top stone for a quern, 128mm dia. It is a spherical cobble with one flattened grinding facet. Quartzite. It was found in the upper layers, in the environs of House 401.

3299 unstratified. A large sharpening stone, 121mm × 47mm and 18mm thick. It is elongated and rectilinear with smoothed surfaces throughout. Fine-grained sandstone.

3425 unstratified. A broken hammerstone, 108mm × 80mm and 22mm thick. It is oval-shaped and almost flat as a result of fracturing and flaking. The working end is chipped and abraded and has one large fracture scar on one face. Dolerite.

3432 unstratified. A quern top stone, 142mm × 108mm and 81mm thick. It is a large, rounded cobble with one well-defined grinding facet on its flattest face. Metamorphic sandstone.

3476 unstratified. A quern top stone fragment, 102mm × 149mm and 58mm thick. It is sub-rectilinear in shape and the upper surface is flat and smoothed with some pecking. The base is convex and burnt. Gneiss.

4180 Unstratified. A broken pestle-shaped grinder, 68mm × 24mm and 28mm thick. It is cylindrical in shape, with a clean break at one end, and a rounded surviving end with two grinding facets. The body shows signs of edge pecking and grinding along one edge. Basalt or other hard volcanic material.

5051 Unstratified. A small, complete quernstone, 384mm × 320mm by 102mm thick. A sub-rectangular-shaped stone with flat top and bottom surfaces. The grinding surface is oval-shaped (240mm × 300mm) and 74mm deep, exposing a series of four dark bands bedded horizontally within the gneiss (Figure 6.3).

Notes

1 This chapter and the catalogue provide basic information on stratigraphy and artefact location and the reader can consult Volume 1 for further information (including distribution plots). The entry ‘worked stone/stone tools’ in that volume’s index is the quickest route to relevant information. Page numbers and figure numbers in Volume 1 are therefore, in general, not given here. An exception has been made for quernstones and the loomweight: I notice these should have been indexed separately in Volume 1 but they weren’t. For these artefacts, we therefore include references to Volume 1.

2 Seven flat stones which display no such signs of use have been discarded. For the record, they are SF 5100 and SF 5101 from floor 2835 of House 2835 (Phase 4), SF 5083 from floor 2476 of Structure 2477 (Phase 7), SF 4923 from the east wall core of House 401 (2129), SF 5255 from posthole fill 3539 in House 401 (both Phase 8), SF 4880 from fill layer 802 (Phase 10), and SF 3074 from the abandonment fill of House 640 (Phase 12). These unmodified flat stones may, of course, have been used for some purpose by the inhabitants.

7 Pumice

M. Parker Pearson and H. Goddard

The assemblage consists of 453 pieces of unworked pumice weighing 3700.5g (Table 7.1) and 179 worked or shaped pieces; of these 172 are weighed, totalling 2645.2g (Table 7.1). Only 39 of the unworked pieces weigh over 20g and only 11 of these are over 50g. The largest piece weighs 258g. Of the worked pieces, 44 weigh over 20g and eight are over 50g.

7.1 Background

Like the Dun Vulan and Baleshare (Baile Sear) assemblages (Parker Pearson and Sharples 1999: 232; Newton and Dugmore 2003: 135), the Cladh Hallan pumice is brown and black, with the former predominating, and it differs from the entirely brown assemblage from Allt Chrisal on Barra (Branigan *et al*. 1995: 144–8). Newton and Dugmore correlate this brown and black dacitic pumice to tephra layers from the Icelandic Katla volcanic system, originating before 4500 BC. Geochemical analysis of the pumice from Northton, Harris, and the Udal, North Uist, as well as from Barra and elsewhere in Scotland supports this conclusion that the Katla volcanic system is indeed the source of most pumice from the northwest European coast although not definitively so (Binns 2006). It was produced by one or more volcanic eruptions from *c.* 5000 BC onwards (Newton 2018).

This is one of the larger assemblages of worked and unworked pumice from the Western Isles, much greater than the 55 pieces from the Neolithic site of Allt Chrisal, the 133 pieces from Neolithic–Bronze Age Udal (Ballin Smith 2018: 169–74), the 43 pieces from Early and Middle Iron Age Baleshare and the 42 pieces from Middle and Late Iron Age Dun Vulan. All these settlements had very

Table 7.1. Weights of unworked pumice by phase

Phase	Quantity	Weight (g)	Av. weight
3	1	3	3
4	1	1	1
5–7	39	357	9.1
8	41	877	21.4
9	80	604	7.5
10	61	396	6.5
11	94	493	5.2
12	55	323	5.9
13	18	91	5
14	11	61	5.5
15	1	7	7
16	25	105.5	4.2
U/S	26	382	-
Total	**453**	**3700.5**	**8.2**

Table 7.2. Weights of worked pumice by phase, with combined average weight of both worked and unworked pieces

Phase	Quantity	Weight (g)	Av. weight	Combined average weight
3	4	70	17.5	4.1
4	1	18	18	9.5
5–7	3	106	35.3	9.3
8	16	438	27.4	23.1
9	47	692.5	14.7	10.2
10	22	268.7	12.2	8
11	24	340	14.2	7.1
12	17	312	18.3	8.8
13	12	105.5	8.8	6.5
14	4	30	7.5	6.1
15	5	36.5	7.3	7.2
16	12	131	10.9	6.4
U/S	5	97	-	-
Total	**172**	**2645.2**	**15.4**	**10.1**

easy access to the coast, where pumice would have been collected, with the exception of Allt Chrisal, whose hillside location and greater distance from broad, sandy beaches would have made the exploitation of coastal resources a little more difficult. Of course, the size of the assemblage reflects the size of the four excavations, with Cladh Hallan easily the largest. Unfortunately the Dun Vulan pumice was not weighed but comparisons of average pumice weight can be drawn between Cladh Hallan (10.1g) and the Allt Chrisal (22.9g) and Baleshare (6.1g) assemblages, although the use of sieving through a 10mm mesh at Cladh Hallan and Baleshare will have skewed the comparison with Allt Chrisal (see Volume 1: section 1.6 for Cladh Hallan excavation methods).

None the less, there is likely to be a real difference between Allt Chrisal and Cladh Hallan, judging by the higher proportion of larger pieces at Allt Chrisal, where a third (about 18 pieces) are over 20g and five over 50g. This difference could be explained in several ways: decreasing availability of larger pumice through time due to erosion; more intensive use in the second and first millennia BC; or a change of use over the same time period. The most likely explanation for declining nodule size is that of natural erosion prior to the pumice's collection from the beach.

The proportions of worked to unworked pieces are also different on each site: 21:34 at Allt Chrisal, 49:84 at Neolithic–Bronze Age Udal, 180:453 at Cladh Hallan, 3:40 at Baleshare, and 10:32 at Dun Vulan. Baleshare is clearly an anomaly with such a small proportion of worked pieces but the other sites show a progression from the Neolithic to the Bronze and Iron Ages of declining modification. The small quantity of pumice, just 14 pieces all unworked, from the Norse-period site of Cille Pheadair (Parker Pearson *et al.* 2018: 412) indicates that it was scarcely ever collected by the end of the first millennium AD.

7.2 Uses of pumice

Branigan *et al*. (1995: 144–5) suggest that pumice was used at Allt Chrisal for three different activities: flat-worn pumice was used to scrape and clean animal skins (13 items); concave-worn pumice was used to smooth wood or bone artefacts (4 items); and thin-grooved pumice was tied with string or twine to be used as weights or floats (4 items). Ballin Smith (2018: 172–3), describing Neolithic–Bronze Age pumice from the Udal, identifies the various uses of pumice similarly for smoothing wood including driftwood, working hides or leather, and making ornaments. She suggests that smaller pieces were used for smoothing and polishing wooden or bone items: arrow shafts, pins, spatulas and leather. She also increases the number of wear patterns on pumice to eight attributes: worn, smoothed, convex, concave, trimmed, grooved, perforated and facets (*ibid*.: 169).

A similar classification of types of wear pattern can be made for the Cladh Hallan pumice, defined here as grooved, flat, convex, concave and drilled. Four attributes (worn, smoothed, trimmed and facets) are not included here although they might be described in the catalogue. For worn and smoothed surfaces, it is difficult to separate

Table 7.3. Types of wear on worked pumice by phase

Phase	Groove	Flat	Concave	Drilled	Convex	Concave + groove	Convex + flat	Flat + concave	Flat + drilled	Concave + convex	Convex + groove	Flat + groove	Convex + concave + flat	Flat + groove + concave	Total
3	2					1		1							**4**
4			1												**1**
5	1		1				1								**3**
8	7	3	4		1	1			1						**17**
9	7	22	6			4		3			1	3	1	1	**48**
10	3	7	3	1		2	2	2	1			2			**23**
11	4	10	4		1			1	1			2		1	**24**
12		8	4					1		1	1	2			**17**
13		10				2		1	1						**14**
14		2										2			**4**
15		4	1												**5**
16	2	3	3		2	1		2							**13**
U/S	1	4						1							**6**
Total	**27**	**73**	**27**	**1**	**4**	**11**	**3**	**12**	**4**	**1**	**2**	**11**	**1**	**2**	**179**

Figure 7.1. Flat-worn pumice (SF 3294, SF 3888, SF 3989 and SF 4615)

Figure 7.2. Concave-worn pumice (SF 3043, SF 3841, SF 5064 and SF 5187)

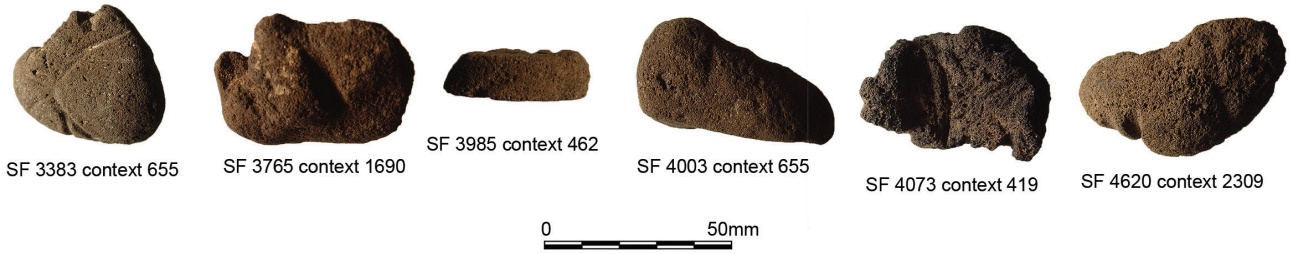


Figure 7.3. Grooved pumice (SF 3383, SF 3765, SF 3985, SF 4003, SF 4073 and SF 4620)

Figure 7.4. Drilled pumice (SF 3343, SF 3456, SF 3592 and SF 3836)

humanly modified surfaces from natural modification. Trimmed items were not identified at Cladh Hallan and, while facets are found on many items, they generally form edges between different faces (flat, concave, convex) so do not inform on likely use. Unlike at Allt Chrisal, the grooves in the Cladh Hallan grooved pumice do not curve around the pumice but are generally flat. Hence the grooves were probably not made by string or twine but with solid items such as bone pins, needles or edged tools. Drilled pumice covers those pieces with a hole or perforation (Table 7.3).

More than a quarter of all the worked pumice at Cladh Hallan came from Phase 9.[1] This is particularly enhanced by the 24 worked pieces from House 401's floor 1311 (and associated floor layers; see catalogue). Except for Phases 3–7 and 16, assemblages are dominated by pieces with flat wear, interpreted as hide rubbers (Figure 7.1). Such pieces were presumably used to remove fat from the underside and hair from the exterior of the calf skin or other animal hide being treated.

Many worked pieces have grooves (53 items; Figure 7.3), again most prolific in Phase 9. Concave wear surfaces are similarly common (on 54 items), far more so than convex surfaces (on 8 items) and only five pieces have evidence of drilled holes.

There seems not to have been any significant change in proportions of different wear patterns between Phases 8 and 15, except that numbers of worked pieces with two or three patterns of use (for example, flat and grooved on the same piece) are highest in Phases 9 and 10. In Phase 10, nearly half of the worked pieces have evidence of multiple uses.

Creating wear marks on pumice is not difficult or time-consuming and thus the worked pieces probably represent fairly short periods of work in which large rubbers may have been worked to a flattened nub within just a few hours or even minutes of scraping a hide. Equally a groove may have formed from just a short while of polishing a bone pin or similar artefact.

The only pieces which may have been fashioned into particular forms are the drilled items and possibly four of the flat pieces (SF 5165, SF 3970, SF 3989 [Figure 7.1] and SF 5237). Of the drilled pieces (Figure 7.4), SF 3546 has an unfinished hole and may have been stuck on the end of the spindle whose bone whorl (SF 3404) was found in close association. SF 3343 looks like a pendant and is too small to be a float. SF 3836 has two perforations and could also have been suspended as an ornament.

7.3 Sizes of worked and unworked pieces

Sieving of deposits at Cladh Hallan through a 10mm mesh[2] allows for systematic comparison of recovery from different phases and different contexts. Although there will have been minor variations in the ability of excavators to recognise pumice during excavation or in the sieves, it is unlikely that the difference between worked and unworked pumice will have been affected in this way since its identification was mostly after rather than during retrieval.

Overall, the unworked pumice is smaller (average 8.2g per piece) than the worked (average 15.4g). This may be due either to smaller pieces being collected from the beach by the settlement's inhabitants but then being deemed too small to be used, or to the fact that small pieces may derive from broken tools and are too small and fragmentary to allow the identification of wear patterns on their restricted surfaces.

Pumice with small vesicles is the most common form of worked and unworked nodules, but some pumice has large vesicles. Pumice with large vesicles occasionally shows signs of wear but this is not always easy to identify because of its coarse surface, and it is likely that pumice with large vesicles is under-represented among the worked items. The only contexts in which unworked pumice was larger than worked pieces are Phase 10 fill layers 1507, 1575 (House 401) and 1900 (House 1370) and floor layer 1436 in House 1500 in Phase 14 (three unworked pieces [SF 4027] larger than the rubber SF 3845).

Changes in size and quantity through time

With just eight small worked pieces in Phases 3–7, it is not until Phase 8 that quantities of worked pumice are significant. The vast majority of these pieces from early phases are from pit fills and most are not worked.

The assemblage of worked pumice from the early phases is too small to draw any sustainable conclusions. For the following phases, the average weight of both the worked and unworked pieces is highest in Phase 8 (Tables 7.1–7.2). Thereafter, average weights decline, probably due to a lessening of size in source material by the mid to late first millennium BC. The average weight of the worked pieces from Phase 12 contexts is, however, anomalous; the high average indicates the presence of a number of very large pieces in a numerically small phase assemblage (see catalogue).

The decline in size of worked pumice during Phase 10 is matched by a decline in quantity, as total numbers of worked and unworked (weighed) pieces fall from 127 in Phase 9 to 83 in Phase 10 then rise to 118 in Phase 11. The correspondence of this decline in size and quantity during Phase 10, together with a greater proportion of worked pieces used for multiple tasks (see below), suggests that there could have been a temporary shortage of pumice. This is difficult to understand since the raw material was surely collected off the beach.

7.4 Contextual associations of pumice

The absence of pumice from the earliest layers (Phases 1 and 2) and the small quantities from Phases 3–7 are not surprising given the limited size of excavated deposits. However, more pieces than the rubber (SF 5187; Figure 7.2) and one unworked fragment might have been expected from House 2835's floor and postholes in Phase 4. Perhaps the seven unworked fragments and a concave rubber (SF 5362) from the plough furrows (3265; beneath House 401) and ploughsoil (2981) immediately above House 2835 originally derived from this house's floor layer.

In Phases 5–7, in contrast to earlier phases, there is a surprising quantity of pumice, given that quantities of other finds (pottery, animal bones, stone and bone tools) were relatively few. Almost all the pieces are unworked. Thirty-one pieces (out of the total of 42 pieces for Phases 5–7) came from five pits, with 13 from pit 2401 alone. The two layers (2475 and 2476) associated with the floor of Structure 2477 (the cigar-shaped building) produced six unworked pieces of pumice but no worked pieces.

In Phase 8, the construction of the roundhouse row, many pieces came from postholes and pits beneath the floor of House 401 which were probably filled during the house's occupation. Most of these lay within the southeast, southwest and west areas of the house. The same is likely to be the case, but on a smaller scale, for sub-floor postholes in House 801 where flat rubbers were found in the southwest and northwest quadrants. There were, however, substantial numbers in construction fills of House 801, especially in the wall core (803), and a couple of pieces in the large pit (1792) beneath its entrance. Outside House 1370, the double pit (2551) associated with the cremation pyre contained eight unworked pieces and four rubbers in its various fills.

In Phase 9 and thereafter, the deposits with the largest quantities of pumice were mostly the floor layers of the three main roundhouses. Furthermore, quantities of worked as well as unworked pumice are high in these floor layers. The exceptions to this pattern are:

- the extensive and deep sand layers of Phases 11 and 12 (412 [17 unworked and two worked pieces], 731 and 755);
- abandonment layers 822 (end of Phase 9, House 801 [unworked only]) and 627 (Phase 16, House 640);
- two of the inter-floor layers in House 401 (1310, Phase 10; 659, Phase 12) and one in House 1370 (2210, Phase 9); and
- in House 401 floors 595 (Phase 12), 462 (Phase 14) and 452 (Phase 15) are unusual in having relatively low quantities of pumice within them, in contrast to the other floor layers in this house.

Distributions of pumice within house floors

Pumice (both >10mm and <10mm) was found in quantity within the compressed matrices of the multiple floors of Houses 401 and 1370, with smaller quantities in the single floor layers of Houses 801, 1500, 640 and 150. The large number of worked pieces within the first floor (1311) of House 401 offers the possibility of investigating whether different tasks were performed in different parts of this house during the long-term accumulation of the floor matrix. Of course, pumice pieces may have been tossed, kicked or otherwise removed from their place of use but most are likely to have been dropped in close vicinity and compressed into the soft, sandy floor.

Discussion of the spatial distributions of pumice within floor layers, with accompanying distribution plots, can be found in the chapters in Volume 1 describing the houses and their floors.

7.5 Conclusion

Pumice was an important material at Cladh Hallan, used for cleaning hides, polishing artefacts and perhaps for hair removal or other bodily treatment. It was collected from beaches and, by comparison to the assemblages from other sites in the Western Isles, the pieces deposited at Cladh Hallan are on average smaller than the nodules collected during the Neolithic and larger than the pieces available in the Middle Iron Age. This decline in nodule size can also be observed within the Cladh Hallan sequence. Although pumice should have been an ever-present resource, there appears to have been a temporary shortage of it at Cladh Hallan in Phase 10.

The chief task for which pumice was required was probably hide-cleaning. The flat pumice rubbers used in this activity dominate the worked assemblage and are also the most common pumice artefacts from house floors. Worked and unworked pumice occurs most frequently in the southwest quadrants of the roundhouses, where it was commonly associated with the bone points used to stretch hides and polishing stones used to soften the leather. Leather-working was an important aspect of daily life except in Phases 10 and 12 (floors 1308 and 595) when the kit of pumice rubbers, bone points and polishing stones was largely absent from House 401. Thereafter, the activity picked up again and continued to be practised well into the first millennium BC.

Pumice was also used for manufacturing tasks which left concave wear faces or grooves in this soft volcanic material. The large quantity of worked pumice from floor 1311 in House 401 during Phase 9 provides a remarkable insight into the spatial dimension of the two activities which led to these distinct patterns of wear – activities which were carried out in different areas, with grooved pumice being deposited in the south and southeast, flat rubbers in the southwest and concave rubbers in the west-southwest. A smaller concentration of flat rubbers in the northwestern sleeping area indicates that either hides were sometimes scraped here or that these tools were used upon people's bodies for skin treatment or hair removal.

Of the nine house floors where pumice could be plotted in sufficient quantities, floors 1311, 655, 465 in House 401, floor 1150 in House 801 and floor 1436 in House 1500 show the likely importance of pumice for hide preparation within the southwest quadrant or western side of the house. Pumice was also used in the food preparation area of the southeast quadrant and in the sleeping area of the northwest quadrant. It rarely ended up within the floor of the northeast quadrant. House 801 was probably only used for a short period, and the discrete and small concentrations of pumice perhaps reflect this. The main concentration within House 801 was in the southwest, where debris lay in front of a low earth 'bench', with a second smaller concentration in the sleeping area in the northwest.

In House 1370, pumice seems not to have been used for hide-processing, and the few tools and unworked pieces were mostly located in the northwest, although the southwest was used for certain, limited tasks. Pumice was

also rare in the front yard outside the roundhouse row and in the floors of House 150 in Area C. It was used in House 640 but largely ended up burnt on the fire and raked out onto the hearth's north side. During Phase 11, a small structure in the ruins of House 1370 contained large quantities of pumice within its small floor (1204).

Catalogue

Any number in square brackets (e.g. [5049], floor) is an environmental sample square number.

Phase 3 – South area

5199 context 3391 (cremation deposit). A banana-shaped fragment, 55mm × 34mm and 18mm thick, with a deep V-shaped groove (6mm across and 9mm deep) cutting one of two other, shallow grooves on its convex surface. 10g.

5366 context 3286 (fill of pit 3287). An irregular smooth piece, 38mm × 28mm and 19mm thick. It has two concave and smooth wear facets at opposite ends, and one narrow grove running along its long axis. 6g.

5381 context 3290 (fill of pit 3631). An irregular-shaped brown nodule, 60mm × 50mm and 45mm thick. It has five separate wear facets on its body, all of which are flat except for the smallest which is concave. There is a short groove on one side. 30g.

5372 context 3300 (fill of pit 3631). A nodule, 47mm × 45mm and 29mm thick, with six faint grooves on its top and bottom. 24g.

Phase 4 – House 2835

5187 context 2835. A complete rubber, 53mm × 33mm and 22mm thick. It is an oblong nodule, plano-convex in section with the flat face exhibiting one slightly concave and smooth wear facet. 18g. Figure 7.2.

Phase 5

5362 context 2981 (ard marks). An irregular nodule, 33mm × 21mm and 16mm thick. It has one highly smoothed and slightly concave wear facet. 4g.

Phase 6

4692 context 2417 (fill of pit 2401). A large spherical nodule, 75mm × 66mm and 53mm thick, with large vesicles. It has one pronounced groove, 10mm wide and 5mm deep, across one half and a slight second groove coming off the main one. 69g.

Phase 7

5376 context 3261 (abandonment fill, House 3260). An oval-shaped nodule, 66mm × 52mm and 28mm thick. It has one convex face and one flat and smoothed wear facet. 33g.

Phase 8 – House 401

4785 context 2705 (fill of pit 2706). A broken nodule, 41mm × 31mm and 20mm thick, used as a rubber. Its flat face has an incomplete drill hole (7mm dia. and 5mm deep) off-centre. 12g.

4759 context 2784 (fill of posthole 2785). A rubber, 72mm × 58mm and 30mm thick. It is an irregular nodule with one large flat, slightly concave wear surface. 48g.

5364 context 2844 (fill of posthole 2845). A shaped piece, 20mm × 18mm and 16mm thick. It has been shaped into a rough cube with flat sides on three out of six faces. 3g.

5458 context 3486 (wall core). A rubber, 59mm × 36mm and 37mm thick, with large vesicles. It is triangular in cross-section and has a large concave wear surface. 16g.

Phase 8 – House 801

3746 context 1663 (fill of stakehole 1664). A shaped piece, 28mm × 21mm and 13mm thick. It is a sub-triangular fragment where two of its four faces have been smoothed flat. 4g.

4679 context 2394 (fill of pit 1792). A large irregular nodule, 109mm × 53mm and 50mm thick. It has one small groove at its tip and possibly a second one next to it. 78g.

4682 context 2394 (ditto). A large, near-complete, irregular nodule, 78mm × 75mm and 53mm thick, with large vesicles. It has a total of 6 well-formed grooves (*c.* 5mm wide) covering its surface, all of which are at varying angles to each other and exhibit no noticeable pattern. 111g.

4719 context 2430 (ditto). An irregular nodule, 71mm × 51mm and 41mm thick, with large vesicles. On its flattest and smoothed face there are two shallow and narrow grooves forming a V-shape. On the other side is a third shallow groove approx 10mm wide running along the long axis of the piece, and possibly another four grooves. 39g.

5165 context 1743 (fill of posthole 1742). A fragment, 15mm × 11mm and 7mm thick, of a piece with two flat faces and a flat edge (like SF 3989 from 459; see Figure 7.1). 1g.

5230 context 803 (wall core). A glassy nodule with large vesicles, 36mm × 33mm and 18mm thick. It is hemispherical in shape and plano-convex in section with the flat face showing traces of wear. 5g.

5375 context 803 (ditto). A broken piece, 27mm × 26mm and 15mm thick, of irregular shape. It has a convex smoothed face with a bevelled edge which is smoothed flat. 4g.

4078 context 1663 (fill of stakehole 1664). A near-complete rubber, 55mm × 41mm and 20mm thick, with a scarred, formerly flat face on its base. 10g.

Phase 8 – Double pit (2551=2508=2553) east of House 1370

5822 context 2746 (pit fill). A complete rubber, 68mm × 32mm and 20mm thick, with very large vesicles. It has a flat face on its base. 14g.

5823 context 2746 (ditto). A near-complete rubber, 58mm × 55mm and 41mm thick, with large vesicles. It has a concave face on its base. 58g.

5064 context 2748 (ditto). A complete rubber, 45mm × 35mm and 22mm thick, with large vesicles. It has a concave face on its base, which is coated in a clay residue. 14g. Figure 7.2.

5821 context 2748 (ditto). An incomplete rubber, 63mm × 42mm and 34mm thick, with large vesicles. It has a concave face on its base, and traces of four grooves in a radial arrangement on its upper surface, with a possible fifth groove cutting across three of them. 21g.

Phase 9 – House 801

4011 context 430 (abandonment fill). A complete rubber, 80mm × 57mm and 38mm thick. It is oval in shape and plano-convex in section. The flat face is slightly concave and is well polished. The rubber has a flat bevelled edge and four large grooves on its top. 62g.

4594 context 1150 ([2726]; floor). A broken nodule, 61mm × 42mm and 31mm thick. It has one shallow 7mm-wide groove running along its long axis and has another running along one of its broken faces. 25g.

5349 context 1150 ([2684]; ditto). A small rubber, 35mm × 21mm and 16mm thick, with a loaf-shaped profile and a flat face on its base. 7g.

5459 context 1150 ([2670]; ditto). A broken piece of a rubber, 27mm × 23mm and 8mm thick. It has two opposing flat facets and all but one of its edges is broken. 2g.

Phase 9 – House 401 floor (1311=1624=1690=1698=1704=1705)

4355 context 1311. A flat rubber.

4930 context 1311 [3149]. A small broken rubber, 28mm × 20mm and 16mm thick, with a flat face. 2g.

4932 context 1311 [3060]. A complete rubber, 50mm × 36mm and 28mm thick. This nodule has a slightly concave face on its base and two facets, one flat and one slightly concave, on its top. 19g.

5130 context 1311 [3919]. A complete but heavily used black rubber, 48mm × 45mm and 18mm thick, with large vesicles and triangular in section. It has five worn faces, the basal one of which is convex as are two bevelled edges, and the top two faces are concave and flat. 15g.

5348 context 1690 [3014]. A broken rubber, 45mm × 28mm and 17mm thick, with large vesicles. The damaged base has a slightly concave face. 11g.

4655 context 1311. A complete rubber, 45m × 33mm and 23mm thick. It is rectangular and has one flat wear facet. 17g.

4660 context 1311 [3006]. A shaped piece, 45mm × 28mm and 22mm thick. It has two concave and two flat faces forming a wedge shape, with one small groove on the end of one triangular face. 9g.

4678 context 1311. An irregular nodule, 58mm × 42mm and 38mm thick. It has three concave wear facets adjacent to each other. 50g.

4632 context 1311. A complete rubber, 52mm × 38m and 35mm thick. It is oval in shape and plano-convex in section. The flat face has a groove in it and the edge of the face is slightly bevelled. The rubber has a second flat face. 31g.

5224 context 1311 [3243/3244]. A small brown nodule, 21mm × 19mm and 22mm thick, with a small protuberance with faceted edges and a concave facet. 4g.

5235 context 1311 [3018]. A black broken rubber, 43mm × 25mm and 17mm thick, with large vesicles. It has two flat faces adjacent to each other at right angles. 7g.

5444 context 1311 [3039]. A triangular-shaped rubber, 45mm × 42mm and 13mm thick, with large vesicles. It has a rough but flat face on its base. 12g.

5639 context 1311 [3139]. A fragment of a worn rubber, 12mm × 12mm and 9mm thick, sub-triangular in section with flat facets on three sides. 0.5g.

5640 context 1311 [3243]. A complete but almost exhausted rubber, 21mm × 17mm and 15mm thick, with a triangular section and a flat base. 2g.

5641 context 1311 [2989]. A battered but complete rubber, 37mm × 29mm and 16mm thick, plano-convex in section with a longitudinal groove (2mm wide) on its underside. 6g.

5642 context 1311 [2989]. A complete rubber, 41mm × 35mm and 23mm thick. It is plano-convex in section and has a flat facet on part of its base. 14g.

3818 context 1624. An irregular nodule, 47mm × 41mm and 24mm thick. It is well smoothed throughout and has two short, deep grooves on its body, one of them within the flat face. 18g.

4595 context 1624 [2989]. A rubber, 64mm × 46mm and 35mm thick. It is irregular in shape with one large and flat wear facet. 42g.

3765 context 1690. A complete and well-used rubber, 65mm × 45mm and 20mm thick. It is irregular in shape and is completely flattened with use on one face, with two bevelled edges. The non-working surface is cut with two deep grooves which terminate in deep notches at the edge of the piece. 27g. Figure 7.3.

3776 context 1690. A rounded nodule, 38mm × 28mm and 25mm thick. It has two deep V-shaped grooves on its surface. 11g.

3839 context 1690. A rubber, 41mm × 32mm and 15mm thick. It is sub-triangular in shape and has been used on two adjacent faces. 9g.

4282 context 1698 [2937]. A shaped piece, 32mm × 33m and 34mm thick. It has been worn into a cuboid shape

and has a groove on one face and is slightly concave on three other surfaces. 15g.

4940 context 1704 [3095]. A small rubber, 42mm × 28mm and 22mm thick. It is sub-rectangular and triangular in section with a wear facet on its flat face. 11g.

4615 context 1705. A near-exhausted rubber, 38mm × 18mm and 8mm thick. It is Brazil nut-shaped with two flat faces and a flat bevelled edge. 2g. Figure 7.1.

Phase 9 – Forecourt of House 401

4935 context 2082 (fill). A small, brown kidney-shaped piece, 25mm × 22mm and 5mm thick. It has one single small notch on one edge. 2g.

Phase 9 – House 1370

5435 context 2210 (inter-floor fill). An irregular nodule, 56mm × 38mm and 26mm thick. It has one wear facet and one flat face which exhibits no sign of wear.

4933 context 2210 (ditto). A brown nodule, 53mm dia. and 28mm thick. It is roughly spherical and flat, with one slightly concave wear surface and one shallow etched incision on its other face. 24g.

5154 context 2211 ([4007]; floor). An irregular and broken black lump, 63mm × 45mm and 35mm thick, with three short lengths of grooves of different diameters (6mm, 5mm and 2mm). 39g.

5129 context 2211 (floor). An irregular nodule, 43mm × 40mm and 25mm thick. It is well-worn throughout and exhibits two separate wear facets, of which the largest is slightly concave and the other is flat. 22g.

5161 context 2211 (ditto). An irregular nodule, 34mm × 22mm and 7mm thick. It has one groove running across its long axis on one face. 5g.

5371 context 2211 (ditto). An irregular nodule, 38mm × 22mm and 21mm thick. It is fractured across one half and exhibits one flat wear facet. 5g.

4319 context 2235 (fill of posthole 2234). A near-complete rubber, 45mm × 31mm and 27mm thick. It has one flat wear facet. 13g.

4631 context 1369 (floor). A broken rectangular-shaped well-smoothed brown piece, 37mm × 36mm and 17mm thick, with a flat face. It has a smooth semi-circular notch 12mm dia. three-quarters along the length of one of its shorter sides. 11g.

5122 context 1369 ([3540]; ditto). A square piece, 31mm × 28mm and 18mm thick. It is triangular in section and is smoothed throughout, in particular with one highly polished facet on one edge. 8g.

5166 context 1369 ([3623]; ditto). A fragment of a rubber, 35mm × 25mm and 21mm thick, with a small part of a concave facet surviving on its base. 6g.

5237 context 1369 ([3519]; ditto). A very small, shaped piece, 33mm × 18mm and 8mm thick. It has been worked on two opposing faces into the shape of a flat isosceles triangle where the longest edge is curved. 1g.

5377 context 1369 ([3524]; ditto). A shaped nodule, 48mm × 24mm and 20mm thick. It is triangular in shape and section, and one face is particularly smooth and completely flat and has been used as a rubber. 10g

5443 context 2377 (fill of pit 2367). An irregular lump of black pumice, 60mm × 41mm and 31mm thick, with large vesicles. One face has a pronounced hollow, probably from concave wear, and on another side there is a groove or gouge. This piece was found with pot SF 4706. 22g.

Phase 9 – Area D

4942 context 2021 (fill). A smoothed hemispherical nodule, 50mm × 35mm and 15mm thick. It is flat and has a wear facet on one face. 20g.

Phase 9 – Front yard

4987 context 415 (midden). An irregular nodule, 40mm × 32mm and 25mm thick. It has a longitudinal groove on one face. Burnt. 11g.

4096 context 416 (midden). A fragment of a broken rubber, 27mm × 15mm and 19mm thick, with two adjacent flat faces at right angles. 4g.

4322 context 1680 ([2787]; yard surface). A broken rubber, 32m × 23mm and 18mm thick. Part of the flat face survives. 5g.

4597 context 1680 (yard). A complete rubber, 63mm × 25mm and 22m thick, formed from an elongated brown nodule. It is plano-convex in section with a well-worn facet on the flat face, a groove running longitudinally along the convex face, and a flat bevelled edge. 12g.

Phase 9 – Northeast area

3844 context 1756 (outside, House 1370). An irregular nodule, 48mm × 35mm and 28m thick. It has one deep groove on its body. 24g.

4620 context 2309 (ditto). A 'boomerang'-shaped brown piece, 73mm × 40mm and 25mm thick. It has a total of seven short and deep grooves at varying angles to each other on the body. 18g. Figure 7.3.

Phase 10 – House 401

3453 context 1507 (fill of cellar). A complete, small rubber, 30mm × 22m and 22m high, with a damaged flat face. 6g.

3679 context 1507. A broken, triangular-sectioned rubber, 28mm × 12mm and 11mm thick. One of its three sides is flat and the other two are convex. 2g.

3889 context 1575. A complete hemispherical rubber, 56mm × 35mm and 28mm thick. It is plano-convex in section where the flat face has been smoothed through use and is sooted. The straight edge has one large longitudinal groove. 19g.

4229 context 1310. A small broken rubber, 31mm × 26mm and 19mm thick, with a flat face and cream-coloured residue around its sides. 6g.
5436 context 1308. A small shaped piece, 20mm × 14mm and 7mm thick. It is a hemispherical piece, plano-convex in section which has wear on two faces.
5824 context 1308 [2349]. A complete rubber, 40mm × 32mm and 19mm thick. This triangular-shaped piece has a concave face on its top and two small flat facets, adjacent to each other at one corner. 13g.

Phase 10 – Forecourt of House 401

3560 context 1119. A complete rubber, 50mm × 45mm and 33mm thick. It is cone shaped with a wide flat base that exhibits use wear. There is a small hole, 3mm deep and 5mm in dia., in the centre of the flat face. 28g.

Phase 10 – House 1370

3592 context 1327. An irregular piece of pumice, 29mm × 23mm and 13mm thick, with a 5mm dia. hole drilled through it. 3.7g. Figure 7.4.
3838 context 1644. A near-complete rubber, 52mm × 43mm and 23mm thick. It is an irregular lump with one well-worn flat wear facet and, on top, a concave facet. 27g.
3835 context 1693. A triangular-sectioned rubber, 56mm × 30mm and 26mm thick, with large vesicles. It has two flat faces and a convex one, and one of its ends has a flat facet. 16g.
3846 context 1709. A small, complete rubber, 43mm × 29mm and 20mm thick. It is a hemispherical piece which has been smoothed and flattened on one face and has three bevelled facets. 10g.
3847 context 1709. A round brown nodule, 41mm × 34mm and 20mm thick. It has one flat wear facet. 15g.
4937 context 1900. A tiny fragment, 19mm × 17mm and 9mm thick. It has a flat face and one deep, short groove etched into one end creating a notch on the edge of the piece. 1g.
4938 context 1900. An angular brown fragment, 22mm × 18mm and 15mm thick. It has two notches on opposite edges but no evidence for a connecting groove on the body. 5g.
4934 context 2138. A fragment, 63mm × 35mm and 27mm thick. It is the curved end of a broken nodule with part of its flat face remaining. 27g.
4286 context 2139. An irregular nodule, 35mm × 25mm and 21mm thick. One face has a concave wear facet and on the other is a shallow groove. 7g.

Phase 10 – West of House 401

4703 context 2426. An irregular nodule, 40mm × 35mm and 22mm thick. It has one concave face on the body and a shallow notch at one end which shows traces of continuing as another groove on the body. 11g.

Phase 10 – House 2190

4568 context 2189. An irregular nodule, 50mm × 35mm and 31mm thick. It has three shallow and barely formed grooves on its body. 19g.

Phase 10 – South area

3556 context 797. A fragment of a rubber, 42mm × 28mm and 23mm thick, with a flat face on its base. 10g.
4022 context 797. A complete rubber, 37mm × 35mm and 24mm thick, with a flat face on its base and two flat facets on its top. 15g.
4043 context 797. A broken rubber, 32mm × 25mm and 19mm thick, with a concave face. 7g.

Phase 10 – Area C midden

5835 context 116. A broken rubber, 18mm × 13mm and 10mm thick, with remains of three flat facets. 1g.
5840 context 904. A rubber, 58mm × 45mm and 20mm thick, with a notched facet 16mm wide and 3mm deep. 20g.

Phase 11 – House 1370

3702 context 1204. A rounded and smoothed brown nodule, 75mm × *c*. 50mm and 38mm thick. It is egg-shaped with seven grooves distributed randomly across its two opposing surfaces. 39g.
4012 context 1204. A heart shaped smooth brown nodule, 32mm × 22mm and 11mm thick. It is slightly grooved in three places. 3g.
4596 context 1204. A complete rubber, 62mm × 32m and 22mm thick. It is an elongated irregular nodule with one large and flat wear facet. 17g.
3834 context 1458. A small almost exhausted rubber, 37mm × 13mm and 12mm thick. It is cone shaped where two smooth flat faces have been created longitudinally on part of the surface. 2g.
4062 context 1458. A broken fragment of a large rubber, 65mm × 43mm and 40mm thick, with large vesicles. It has one flat facet. 31g.

Phase 11 – House 401

3331a context 655 (southwest quadrant). A small complete rubber, 38mm × 30mm and 17mm thick. It has a slightly concave face. 8g.
3331b context 655 (southwest quadrant). An irregular globular nodule, 53mm × 33mm and 22mm thick. It has six grooves on its body. 20g.
3333 context 655 (southwest quadrant). A rubber, 52mm dia. and 25mm thick. It has been worked into a disc and one surface is worn flat. This surface is incised with four faint narrow grooves in a ‘cross’ pattern. The main working face has been highly polished and worn into a slightly concave surface, and there are three other flat surfaces. 29g.

3383 context 655. A rounded brown nodule, 52mm × 46mm and 28mm thick. It is well worn and exhibits eight intersecting small incisions/grooves on one face. 25g. Figure 7.3.

3566 context 655. A worked piece, 50mm × 25mm and 20mm thick. It is sub-rectangular in shape with one end wider than the other. One long edge has been worked to create a flat and smooth wear facet. Burnt with peat ash adhering. 13g.

4003 context 655. A complete rubber, 74mm × 29mm and 23mm thick. It is wedge shaped and plano-convex in section. The flat face and one side face exhibit wear facets. The flat face also exhibits one longitudinal groove which appears to have been reduced by later polishing. 22g. Figure 7.3.

5460 context 655 [2205]. A small fragment of a rubber, 18mm × 13mm and 10mm thick. It has broken off a larger piece and is triangular in cross-section with a concave face. 1g.

5643 context 655 [2212]. A complete rubber, 48mm × 38mm and 16mm thick. It is oval in section and has a concave face on one side. 14g.

5825 context 655 [2231]. A complete rubber, 74mm × 47mm and 33mm thick, with large vesicles. It has a concave face on its base and a concave face on its top. 45g.

3563 context 1290. A complete rubber, 38mm × 24mm and 16mm thick, plano-convex in section with a flat, slightly convex face scored with a longitudinal cut. 6g.

3836 context 800. A broken plano-convex-shaped piece, 35mm × 33mm and 20mm thick. It has broken across one of two perforations (both 5mm in dia.) drilled 15mm apart. One of its sides is polished flat. Whilst this was probably a modified rubber, the drilling of symmetrical holes suggests that it could have been used for suspension. 5g. Figure 7.4.

4187 context 800. A small irregular nodule, 40mm × 31mm and 28mm thick. It has five flat wear facets. 12g.

Phase 11 – Front yard

3561 context 518. A shaped piece, 47mm × 36mm and 17mm thick. It is a sub-triangular fragment where three of its four faces have been flattened and smoothed. 9g.

Phase 11 – South area

3564 context 412. An irregular nodule, 48mm × 22mm and 18mm thick. It has a highly smoothed and flat wear facet and two smaller flat facets. 10g.

4075 context 412. An irregular fragment of a probable rubber, 22mm × 21mm and 33mm thick, with a small patch of a flat facet remaining. 11g.

Phase 11 – Forecourt of House 401

3989 context 459. A triangular-shaped piece, 30mm × 30mm and 8mm thick. It has been ground and smoothed into an isosceles triangle with two flat faces and three flat edges. 2g. Figure 7.1.

3565 context 755. A worked piece, 33mm × 29mm and 16mm thick. It is rectangular in shape and section, broken at both ends. One face is flattened and has a regular longitudinal smoothed hemispherical groove. 9g.

3728 context 755. A fragment of a rubber, 33mm × 22mm and 18mm thick. It is a sub-triangular fragment from a rubber with one flat face. 3g.

3997 context 756. A broken fragment of a rubber, 29mm × 25mm and 18mm thick. It has one or possibly two flat faces. 3g.

Phase 11 – Northeast area

5445 context 1138. An almost exhausted rubber, 26mm × 13mm and 9mm thick, with a flat face on its base and a deep concave face on its top. 1g.

Phase 12 – House 401

4203 context 659 (inter-floor fill). An oval-shaped brown nodule, 53mm × 28mm and 28mm thick. It is plano-convex in section and has a possible concave wear facet on the flattest face which is itself cut by a longitudinal groove. Another deeper groove cuts longitudinally into the convex face. 13g.

4219 context 659. A nodule, 88mm × 76mm and 37mm thick with large vesicles. It is teardrop shaped and plano-convex in section with a concave wear facet on its flattest edge, a flat bevelled edge and a possible groove (13mm wide) on its top. 68g.

3448 context 659. A complete rubber, 42mm × 35mm and 16mm thick. It is plano-convex in section and has a flat face. 16g.

3555 context 659. A small broken rubber, 28mm × 26mm and 17mm thick, plano-convex in section with a flat face. 4g.

4036 context 1191 (floor). A complete rubber, 45mm × 38m and 15mm thick. It is irregular in shape and has a flat wear facet on one face, which has been re-worked into a concave face. 11g.

3457 context 1281 (fill of water tank). A nodule, 55mm × 48mm and 45mm thick. It is irregular in shape and has one flat and well abraded wear facet. 30g.

Phase 12 – Northeast area

4941 context 470 (peat ash layer)). A complete polisher, 63mm × 48mm and 30mm thick. It is oval in shape and plano-convex in section and has a large wear facet and a groove-like cut on its flat face. 32g.

4088 context 473 (fill). A small nodule, 41mm × 27mm and 21mm thick, with a small flat facet on one side. 9g.

5838 context 413 (fill). A fragment of a rubber, 36mm × 15mm and 9mm thick, with a flat facet. 1g.

5839 context 424 (fill). A fragment of a rubber, 29mm × 15mm and 10mm thick, with a concave facet. 2g.

Phase 12 – North and northwest area

4086 context 718 ([4653]; midden). A broken rubber, 50mm × 32mm and 18mm thick. It is a broken oblong nodule, plano-convex in section, with an uneven concave wear facet. 10g.

3841 context 731 (grey sand fill). A near-complete rubber, 57mm × 49mm and 35mm thick. It is sub-rectangular in shape and plano-convex in section. The worked face is slightly concave and well worn. 41g. Figure 7.2.

4052 context 731. A fragment of a probable rubber, 32mm × 20mm and 15mm thick, with a flat face. 3g.

5446 context 1530 (pit fill). A small fragment of a probable rubber, 21mm × 13mm and 15mm thick, with part of a flat facet. 1g.

3888 context 1831 (fill). A complete rubber, 62mm × 57mm and 40mm thick. It is a smooth and rounded grey coloured nodule with one well developed and flat wear facet. 56g. Figure 7.1.

4929 context 1857 (fill). A small irregular piece with large vesicles, 32mm × 23mm and 18mm thick. It has one single groove. 4g.

Phase 12 – Northeast area

3026 context 558 (pit fill). A shaped piece, dark brown in colour, 45mm × 33mm and 22mm thick. It is trapezoidal in shape and triangular in section, and all four faces have been smoothed. Three of the worked facets are concave and one is convex. 11g.

Phase 13 – House 401

3277 context 465 (floor, NW quadrant). A small nodule, 43mm × 27mm and 18mm thick. It is oval in shape with flat faces and has a wear facet covering one of these. 12g.

3285a context 465 (southwest quadrant). A complete rubber, 48mm × 46mm and 35mm thick, with large vesicles. It has a concave face with a flat face on top. 23g.

3285b context 465 (southwest quadrant). A complete rubber, 55mm × 38mm and 23mm thick. It is a sub-rectangular piece with a flat wear facet on its larger face and two flat bevelled sides. 19g.

3293a context 465 [4318]. A fragment of a worn rubber, 25mm × 25mm and 9mm thick, with a flat base.

3293b context 465 [4318]. A fragment of a worn rubber, 22mm × 16mm and 8mm thick, with a flat base.

5573 context 465 [4318]. A fragment of a worn rubber, 17mm × 11mm and 8mm thick, with a flat base. 0.5g.

5574 context 465 [4318]. A complete but almost exhausted rubber, 28mm × 21mm and 7mm thick, with a slightly concave base cut by a single groove (2mm wide). 1g.

5575 context 465 [4301]. A fragment of a rubber, 23mm × 6mm and 16mm thick, with a flat base. 1g.

3335 context 517 (hearth). An almost complete rubber, 43mm × 36mm and 19mm thick. It is plano-convex in section and has a concave face which is scarred by four faint grooves running laterally and a longitudinal gouge. 12g.

3343 context 517 [4231]. An oval piece, 20mm × 17mm and 8mm thick, worn flat on both sides with flat vertical sides. There is an hourglass-sectioned perforation (5mm–2mm dia.) towards one end. This piece could be a pendant (it is surely too small to be a float) but there is no evidence of wear from being attached on a string. 1g. Figure 7.4

3291a context 517 [4221]. A small, complete rubber, 35mm × 20mm and 10mm thick. It is elliptical in shape with two smoothed faces. 3g.

3291b context 517 [4221]. A near-complete rubber, 31mm × 27mm and 16mm thick. It is spherical with a flat face. 7g.

3071 context 565 ([4352]; floor). A small rubber, 38mm × 30mm and 13mm thick. It is sub-triangular with two flat faces and two flat edges. 8g.

3558 context 792 (pit fill). A complete rubber, 41mm × 22mm and 28mm thick, with a flat face. 10g.

3546 context 1113 (posthole fill). A partly drilled disc, 38mm dia. and 13mm thick. It is a circular disc with flattened vertical sides. The beginning of a hole (5mm deep and 5mm in dia.) can be seen in the centre of one face. It is possibly an unfinished spindle whorl or fishing float. It was found at E99.25 N105.67 with SF 3404 (a bone spindle whorl). 8g. Figure 7.4.

Phase 14 – House 401

3985 context 462 (floor). A complete rubber, 49mm × 30mm and 15mm thick. It has been smoothed into an elliptical shape with flat faces, one of which is smoothed through use. The other face has two grooves on its surface. 8g. Figure 7.3.

4063 context 462. An uneven, roughly circular rubber, 33mm in dia. and 16mm thick, with a flat face on its base. 5g.

Phase 14 – House 1500

3845 context 1436 (floor). A small, complete rubber, 32mm × 25mm and 12mm thick. It has a flat face on its base and there is a 4mm-wide notch or groove up its side. 8g.

3726 context 1596 (posthole fill). A complete rubber, 42mm × 20mm and 19mm thick, with a flat face on its base and another perpendicular to it. 9g.

Phase 15 – House 401

5576 context 433 ([4065]; fill). A broken rubber, 25mm × 18mm and 13mm thick. It has a plano-convex section with a flat wear facet on its base. 2.5g.

3990 context 452 (floor). An oblong nodule, 51m × 34mm and 21mm thick. It has two slightly concave wear facets. 11g.

4095 context 452. A rubber, 50mm × 22mm and 20m thick. It is rhomboid in shape and triangular in section. It has four smoothed and flat wear facets. 11g.

3970 context 466 (inter-floor fill). A triangular-shaped piece, 40mm × 32mm and 22mm thick. It has been worked to produce flat surfaces on two of its four faces. 9g.

4065 context 466. A glassy irregular fragment with large vesicles, 38mm × 2mm and 15mm thick. It has one wear facet. 3g.

Phase 16 – House 401

4084 context 407 (abandonment fill). A smooth irregular brown nodule, 35mm × 30m and 24mm thick. It has two small grooves on its body, one which circles the entire circumference. 9g.

4073 context 419 (floor). An irregular globular nodule, 63mm × 41mm and 13mm thick. It is notched around its edges in seven places as a result of continuous grooves on the body, of which there are nine all together. On the narrowest part of the nodule, three of these grooves run closely parallel to each other. 14g. Figure 7.3.

3043 context 587 (abandonment fill). A brown nodule, 59mm × 42mm and 27mm thick. It is rectangular in shape with irregular edges caused by notches and grooving in four places along their length. Both faces exhibit concave areas of wear. 42g. Figure 7.2.

3329 context 677 (packing deposit for wall). An irregular nodule. 40mm × 28mm and 40mm thick. It has one wear facet. 6g.

Phase 16 – House 640

3278 context 588 (fill). A complete rubber, 65mm × 28mm and 26mm thick. It is an elongated irregular nodule with an entirely flat face and a slightly concave face. 22g.

3294 context 588. A shaped piece, 42mm × 30mm and 22mm thick. It is sub-triangular in shape and is smoothed flat on three faces. 15g. Figure 7.1.

3305 context 656 (floor). A battered but largely complete rubber, 48mm × 32mm and 13mm thick with concave wear across its underside.

3332 context 632 ([4562]; floor). A small brown nodule, 30mm × 22mm and 20mm thick with a small flat wear facet. 5g.

5644 context 632 [4556]. A complete rubber, 36mm × 23mm and 20mm thick, with a concave facet on its base. It also has a flat facet on its top side. 7g.

5645 context 632 [4571]. A fragment of a worn rubber, 18mm × 15mm and 10mm thick, with a concave base. 0.5g.

5834 context 627 (windblown sand). A fragment of a worn rubber, 19mm × 16mm and 4mm thick, worked flat on both sides. 0.5g.

Phase 16 – House 150 (Area C)

5836 context 210 (floor). A fragment of a small rubber, 17mm × 13mm and 8mm thick, with two convex wear facets. 1g.

5837 context 233 (E111 N15; floor). A fragment of a burnt rubber, 40mm × 25mm and 14mm thick, with a convex wear facet. 9g.

Unstratified artefacts

4005 context 400 (windblown sand). A complete oval-shaped rubber, 42mm × 29mm and 20mm thick. It has one flat wear facet. 11g.

4035 context 400. An irregular nodule, 50mm × 35mm and 32mm thick. It has two well-worn and flat wear facets. 21g.

4630 unstratified. A near-complete rubber. 53mm × 40mm and 28mm thick. It is worn flat on one face. Burnt. 26g.

4684 unstratified. A rubber, 58mm × 50mm and 30mm thick. It is sub-rectangular in shape with one irregular face and one flat face exhibiting a concave wear facet. 30g.

4931 unstratified. A rubber, 45mm × 32mm and 19mm thick. It is oval in shape and flat on one surface. Adhering to both sides is a layer of raw clay. 9g.

5382 unstratified. A small irregular light brown nodule, 33mm × 27mm and 19mm thick. It has four wide and shallow grooved incisions on its body.

Notes

1 This chapter and the catalogue provide basic information on stratigraphy and artefact location and the reader can consult Volume 1 for further details. The entry ‘pumice’ in that volume’s index will take the reader to the spatial distribution plots. Page numbers and figure numbers in Volume 1 are therefore, in general, not given here.

2 Except for windblown sand or the deep accumulation of layer 412, a Phase 11 sand deposit; see Volume 1: 248–50.

8 Bangles and beads

F. Hunter, M. Parker Pearson and M. Charlton

8.1 Lignite, shale and related materials

Fraser Hunter

There are eight fragments of jewellery in a range of black shiny stones. Although well-attested in Late Bronze Age and Early Iron Age Britain, such objects are very rare in the Western Isles, as the raw materials are not locally available. The Cladh Hallan finds provide evidence of the import of both objects and raw materials, with manufacturing taking place on site.

The fragments come from Phases 11–14 (tenth–seventh centuries BC) and 16 (late seventh–mid sixth centuries) and comprise two annular beads and six bangle fragments. Jewellery of shale, lignite and similar materials was in widespread use in the Late Bronze Age and Early Iron Age, with both bangles and beads finding ready parallels (*e.g.* St Andrew's, Fife; Staple Howe, East Yorkshire; Heathery Burn, Co. Durham; Eldon's Seat, Dorset; Llangwyllog, Anglesey; Cowie *et al*. 1991: 53, pl. 8; Brewster 1963: figs 66–8; Britton 1968: nos 7–11; Cunliffe and Phillipson 1968: 225–6; Sheridan and Davis 1998: 157, fig. 12.7). It is noteworthy that beads of this period are markedly less regular than those of the Early Bronze Age and are rarely found in quantity, suggesting that they were worn singly or in composite necklaces with mostly organic companions. Bangles have so far evaded any meaningful typological classification.

The Cladh Hallan finds present a number of unusual features in terms of source material and manufacture. Previous work has shown that a range of black organic-rich rock types was used throughout European prehistory for the manufacture of shiny black jewellery (Pollard *et al*. 1981; Sheridan and Davies 2002). Analysis (by X-ray fluorescence) and visual examination indicate that several different rock types were used to manufacture the Cladh Hallan jewellery: lignite, cannel coal or canneloid shale, and a range of oil shales (for methodology see Davis 1993; Hunter *et al*. 1993). These are not available from the local geology and either the raw material or the finished object must have been imported to South Uist, although the non-destructive techniques of analysis used cannot distinguish the precise provenance. Lignites are known from Skye and Mull, while the nearest sources of oil shale and cannel coal would have been either Sutherland (the Golspie source) or the central Scottish coalfields (Gibson 1922). Bangle SF 3092 has an unusual banded appearance, caused by the lamination of organic-rich and inorganic-rich layers; it was probably selected for this appearance, but must have been difficult to work. Similar materials have been noted from central Scotland.

Two bangles, possibly three, were broken in the course of manufacture. This suggests the import of part-finished objects rather than blocks of raw material. There is increasing evidence for the staged production of bangles, with rough-outs being made at source and then moved in this form for final finishing (Hunter 2007). The absence of characteristic working debris from Cladh Hallan despite the methodical excavation suggests the arrival of rough-outs rather than blocks on site: the shaping of blocks into rough-outs generates considerable working debris (see Hunter 2007), whereas the final stages of abrasion generate no archaeologically-recoverable material.

Because of the exotic nature of the raw material, such jewellery is rare in the Western Isles: later prehistoric examples are listed in Table 8.1. The bulk of dated finds are rather later, and (with the possible exception of Clettraval, North Uist) Cladh Hallan is the only site which has so far produced evidence of manufacture.

Catalogue

Phase 11

SF 3273 (context 655, floor of House 401). Unfinished bangle fragment, broken in the course of manufacture. It seems a D-shaped section was planned. Externally one facet of the D is well-finished with a low polish, but the other still has fine knife-cut facets; abrasion scars indicate it was in the course of being polished. The internal section is angled from bifacial perforation; one facet is well-finished, the other bearing angular

Table 8.1. Finds of later prehistoric jewellery of black organic stone from the Inner and Outer Hebrides

Site	Island	Site type	Object	Date	Reference
An Dunan	Lewis	Ritual island site	Penannular armlet	400–100 BC	Gilmour 2002: 59 Hunter 2013
Loch na Berie	Lewis	Broch	Bead made from reused bangle fragment	M–LIA	Unpub. (Museum nan Eilean)
Garry Iochdrach	N Uist	Wheelhouse	Bead	MIA	Beveridge and Callander 1932: 41
?	N Uist	Stray find (Mackenzie collection)	Bangle		Close-Brooks and Maxwell 1974: 290
Clettraval	N Uist	Wheelhouse	?Lump of raw material	MIA	Scott 1948: 67
Newton	N Uist	Stray	Bangle		Unpub. (NMS GT 1272)
Udal South	N Uist	Settlement	Bangle	?	Unpub. (Museum nan Eilean)
Bruthach Mor	Benbecula	Wheelhouse?	Bangle	MIA?	Unpub. (Cambridge Uni. Museum Z20850, ex Lethbridge collection)
Cladh Hallan	S Uist	Settlement	Bangles, beads, working debris	1000–550 BC	This report
Tobha Beag	S Uist	Island dun	Bangle	MIA?	D. Garrow pers. comm.
Allt Chrisal	Barra	Aisled roundhouse	Bangle	c. AD 1–300	Gowans 2000: 188
High Pasture Cave	Skye	Cave	Bangle	MIA (*c.* 400–100 BC)	Cruickshanks and Hunter 2025: 320–5
Dun Ardtreck	Skye	Broch	Ring pendant, bead	MIA	MacKie 2000: 391–2, ill. 25 nos 56–7
Unlocated	Skye	Peat moss	2 intact bangles	?	NMS X.FN 5 & lost
Dun Mor Vaul	Tiree	Broch	Bangle, bead, ring, counter	MIA	MacKie 1974: 135, 141, fig. 15 nos 222–3; fig. 17 nos 325, 458
Dun Cul Bhuirg	Iona	Fort	2 discs	MIA (*c.* 100 BC–AD 300)	Ritchie and Lane 1980: 223, fig. 3 nos 91, 94
King's Cave	Jura	Cave	Bangle	IA	Mercer 1978: 54, fig. 4
Ardnahoe	Islay	Open	Bangle	?	C. Ellis pers. comm.
Coultorsay	Islay	Open	2 bangles	Early medieval	R. Toolis pers. comm.

abrasion scars. L 36mm, W 9.5mm, H 8.5mm; 1.7g; internal D 80mm–85mm (12% surviving). Material: cannel coal or canneloid shale (good conchoidal fracture, laminar trend to structure).

Phase 12

SF 3092 (context 470, thick layer of peat ash; E104.15 N119.04; 4.85m OD). Fragment from the inside surface of a small bangle, perhaps unfinished, in a decorative stone with fine black and red-brown bands, the latter shown by XRF to be very iron-rich. Rounded biconical perforation with circumferential (and some transverse) abrasion scars. It was probably unfinished, although this is not certain as the inside surface of such items was often left with toolmarks since they were hidden in use. The diameter is small but, if it was unfinished, this could have expanded further. Even at the surviving diameter, it could be for a child; compare a steatite example from Sumburgh, Shetland, suggested to be a child's bangle (Sharman 2000: 68, no. B226). L 22mm, W 8*mm, H 11.5*mm, 1.2g; internal D 40mm–45mm (14% surviving).[1] Material: oil shale (from evidence of banding; irregular conchoidal fracture).

SF 3161 (context 595, floor of House 401; E97.05 N106.19, 4.09m OD). Fragment flaked off the top surface of an unfinished bangle, which has been perforated but with little subsequent working, as the top surface is flat and the edges are still faceted from initial knife-shaping. Shaping (by abrasion) was in progress when fracture occurred, with transverse abrasion scars on the face, circumferential and angled ones on the external edge and circumferential ones on the internal edge (slightly angled from bifacial perforation). L 36mm, W 13.8mm–15.3mm, H 4.2*mm, 1.9g; internal D 55mm–60mm (min.) (13% surviving). Material: lignite (very organic; laminar, with visible compressed wood structure; cracking badly).

Context 595a (floor). Fragment of a D-sectioned bangle, split horizontally around the centre of the section. Interior slightly convex, exterior near-hemispherical, the two meeting at a fairly sharp edge. Interior shows traces of circumferential scars overlain by angled ones, and notable use-polish; toolmarks have been polished away on the exterior, which shows use-polish and some use-damage. No indications of repair after breakage. L 22.5mm, W 5.6mm, H 7.5mm (originally c. 12mm);

internal D 55mm–60mm (11% surviving). Material: laminar, notably grey; oil shale.

Context 595b (floor). Reworked D-sectioned bangle, the exterior well-rounded with a broad convex face before turning sharply into the slightly convex interior. This has circumferential abrasion; the exterior is polished to a medium lustre, with extensive use-scratching. It is unclear how much of the profile is preserved; it split horizontally, but the fracture edges were gently abraded to round it off while the broken ends were more extensively abraded to smooth them. Each end shows attempts at biconical perforation, well-developed at one end with two conical hollows, incipient at the other with peckmarks at the requisite points. It may have been intended for reuse as an element within a composite bracelet or necklace, or as a pendant with the perforation abandoned at one end. In any event, the modification was unfinished. L 26.5mm, W 6mm, H 3.6*mm; internal D 55mm–60mm (13% surviving). Material: dark, laminar; oil shale.

Figure 8.1. Fragment of bangle SF 5832

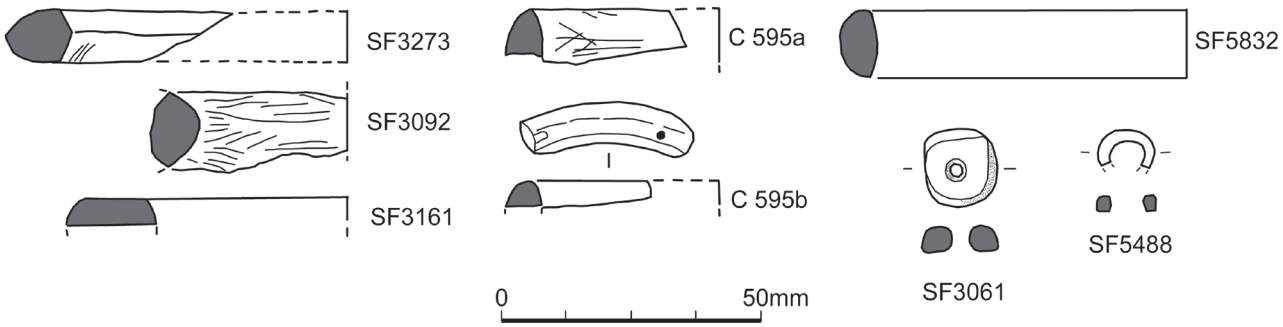


Figure 8.2. Bangles and beads of shale and related materials. Bangles are drawn as section and internal view, with the radius reconstructed

Probably Phase 12

SF 3061 (unstratified; E96.43 N103.52). Irregular annular bead with biconical perforation (D max. 5mm, min. 3.2mm). One surface is naturally flat, the other split across a lamination plane; the edges are roughly rounded, with faint facets and abrasion scars still visible, and some use polish on the edge and around the perforation. D 12.6mm–13.3mm, H 5mm, 0.2g. Material: oil shale? (laminar; inorganic glittery mineral inclusions).

Phase 14

SF 5488 (context 1752, posthole fill within House 1500; E101.7 N95.0). Well-finished fine disc bead with a large perforation and a D-section (flat externally, angled internally from biconical perforation). Near-circular but slightly faceted from manufacture, with faint abrasion scars surviving. External D 9.3mm, internal D 4.7mm, W 2.1mm–2.3mm, H 2mm, <0.1g (60% surviving). Material: lignite (very organic; slight laminar cracking; more compact than SF 3061).

Phase 16

SF 5832 (context 403, uppermost sand fill of House 401). Fragment of a bangle with D-shaped section (rounded externally, biconical internally), with abrasion scars, low polish and, on the interior face, use polish. There is a 5mm-long transverse cut-mark on one edge close to the break. L 37mm, W 6mm, H 10.4mm; 2g; internal D 95mm–100mm (10% surviving). Material: cannel coal or canneloid shale (good conchoidal fracture, laminar trend to structure with crack developing on one edge).

8.2 Blue glass bead

Mike Parker Pearson and Mike Charlton

During sorting of flotation residues, a tiny blue glass bead was found in the sample for floor layer 655 (square 3291) within the east-facing doorway of House 401 from Phase 11 (*c.* 1010–775 BC). Broken across its middle, just under half of the bead survives. External D 2mm, internal D 1mm, W 0.5mm, H 1mm, (40% surviving).

The bead was analysed by ICP-MS. Whilst most of its element composition is consistent with ancient glass, it has an unusually high level of manganese oxide (13 wt%), double the concentration expected for prehistoric material. Ian Freestone writes: 'While the possibility that the bead is pre/protohistoric cannot be dismissed, its high manganese content is very unusual and we were unable to find a parallel. If ancient, its composition is consistent with a natron glass manufactured in the southeastern Mediterranean in the first millennium BCE, although relative to the other trace elements, the Zr and Sr contents are at the low end of the range for these types of glass.'

We conclude that it is most probably a modern bead broken off from clothing worn by one of the residue sorters.

Note

1 An asterisk * indicates the section is incomplete in this dimension.

9 Fuel ash slag

M. Parker Pearson

A small amount of fuel ash slag (0.638kg) was recovered from stratified contexts, together with a further 43g unstratified (Table 9.1). Fuel ash slag is produced in fires with temperatures in excess of 900ºC (Henderson *et al*. 1987a; 1987b), normally hotter than domestic hearths (*c*. 300ºC–650ºC) but possible in outdoor bonfires. It can often be mistaken for metalworking slag, although most of it has a glassy texture deriving from the melted silica in the surrounding sand.

The distribution of fuel ash slag in space and time (Table 9.1) sheds some light on activities at Cladh Hallan. Only one piece of fuel ash slag came from Area C, from an Early Bronze Age midden layer associated with sherds of Cordoned Urn ceramics (Phase 2; late twentieth–eighteenth centuries BC; see Volume 1: 33–4). The remainder was from Area A and probably derived from three or more separate events or processes in different parts of the settlement. The first of these was the Early–Middle Bronze Age cremation pyre 3558 in Phase 3 (eighteenth–fourteenth centuries BC) in the northern part of Area A (see Volume 1: 46–7, figs 2.25–2.27). Not only was there slag in layers derived from the pyre but it also entered contemporary and later contexts in the pyre's vicinity (mostly in, around and under House 1370). A second episode took place in Phase 10 (late eleventh–early tenth centuries BC) behind or west of House 401 (see Volume 1: 210–11, fig. 6.6). A third episode took place somewhere in the vicinity of House 401 in Phase 12 (early eighth century BC), although there is no indication of exactly where; the largest piece (72g) of fuel ash slag from the entire site is from a Phase 12 context within House 401 but it and the other piece of slag from this phase were incorporated in the sand fills brought into the house to form the base of the renewed floor.

Figure 9.1. Fuel ash slag from the pyre debris layer (2793) on the cremation platform 3558 in Phase 3

Table 9.1. Fuel ash slag (weight in g) by location and phase from Cladh Hallan

Location	Phase												Total
	2	*3*	*5*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*U/S*	
House 401			16.8	15.6	9.5	95.3	6.3	97.4	3		16.3		**260.2**
House 1370		98.6	104.1	101.3	44.5	5							**353.5**
Other	1.2		7.4	6.8	5.4	2	1.8					43	**67.6**
												Total	**681.3**

10 Faunal remains of mammals (excluding cetaceans)

J. Mulville and A. Powell with J. Davies, A. Hale and R. Madgwick

Cladh Hallan boasts a substantial collection of well-preserved animal remains dating to the Bronze and Iron Age, meticulously recovered and documented. This chapter examines the mammalian species, excluding cetaceans,[1] which were predominantly introduced to the site, whether alive or deceased, through human intervention. Analysing the attributes of this faunal collection provides insights into the role of these species as sources of nutrition, their economic value, and their symbolic significance for humans. Additionally, we explore the dynamic interactions between animals and humans within social frameworks.

Three primary factors contributed to the comprehensive recovery of a nearly pristine set of faunal remains from Cladh Hallan. Firstly, excavation techniques incorporated a thorough approach involving both manual retrieval and sieving of most contexts across various scales (see Volume 1: section 1.6 for excavation methods). Secondly, many deposits, including floor layers, were of a cumulative nature. Finally, the calcareous shell sand, ubiquitous along the west coast's machair and forming the settlement's substrate, offers optimal chemical and physical preservation conditions. Consequently, bone preservation surpasses that of most other prehistoric sites in Britain and Europe, with minimal evidence of erosion or weathering, ensuring the retention of surface features, modifications (such as cut-marks) and delicate elements.

When Cladh Hallan was initially inhabited, the terrestrial habitat hosted a limited variety of species, while the skies and seas teemed with a greater diversity. The first documented land species to arrive after the last glacial maximum, a period when the Outer Hebrides lacked large mammals, include pygmy shrews, voles/mice and mountain hares (Serjeantson 1990; Fairnell and Barrett 2007). These smaller species may have reached the islands via rafting, although the 27km-wide channel between the mainland and the Western Isles hindered colonisation by most terrestrial mammals. Once on the islands, many species managed to disperse across the archipelago as a result of lower sea levels and/or low tides during this period.

These islands were inhabited by early gatherer-hunters (Bishop *et al*. 2015: 67–8) and later by Neolithic farmers who augmented the terrestrial species by introducing a limited selection of domestic and wild species. Starting from the third millennium BC, domesticated food animals such as cattle and sheep become prevalent in regional assemblages, with occasional findings of red deer at Neolithic sites such as the Udal, North Uist (Finlay 1984; Finlay Aird 2018) and Northton, Harris (Finlay 1984; 2006), along with limited remains of domestic pig and dog at Northton as well as dog at the Udal (Finlay 2006: 147–8; Finlay Aird 2018: 98). The origin of the red deer found in Orkney, Shetland, and the Western Isles remains uncertain (Stanton *et al.* 2016).

10.1 Methodology

The following sections provide a detailed account of the methods of recovery and analysis. Identification and recording strategies were employed to gather data on age, sex, size, health, and peri- and post-mortem alterations (*e.g.* butchery) whilst articulated bones (from whole skeletons to limbs), associated material (such as repeated or unusual elements) and worked bone were also analysed.

Identification

Identifications were checked against reference skeletons held by the School of History, Archaeology and Religion, Cardiff University. Sheep bones have been speciated where possible using the criteria of Boessneck (1969) and Payne (1985). No goat bones were distinguished amongst the caprine remains and the small number of ovicaprines subject to genetic analysis were all identified as sheep. For the purposes of this report remains categorised as sheep or sheep/goat are referred to as sheep in the text. The criteria described by Lister (1996) have been used to confirm that all large cervid bones belong to red deer (*Cervus elaphus*) rather than fallow deer (*Dama dama*). The major identification challenges of this assemblage were

the identification of cattle versus red deer for both adult and neonatal elements. Whilst complete fused bones offer a series of identification criteria, fragmented and immature elements are more challenging. Where appropriate metrical evidence was employed to separate species during analysis; for example, some cattle specimens were reallocated as red deer based on our pre-existing datasets (see *Comparative datasets*, below). Rabbit remains were present as an intrusive species and there were no positive identifications of hare. Material identified as lagomorph has therefore been excluded from analysis. Fragments of mammal bone that could not be identified more precisely were classified as 'cattle/horse-sized' (horse, cattle or red deer size), 'sheep/pig-sized' (sheep, pig, large dog or roe deer size) or 'hare/fox-sized' (hare, otter or cat size). This material contributed to overall NISP where the elements met the zone or proportion recording criteria and are utilised in general description of the assemblage, for example in assessing taphonomic damage, but are excluded from species-specific analysis

Recording

The recording method used is a modified version of the diagnostic zone system described by Serjeantson (1996) in which, for each recordable fragment, a zone is recorded only when over 50% is present. Lateral metapodials, fibulae, and carpals or tarsals other than magnum, astragalus, calcaneum and naviculo-cuboid were not recorded; of these only the calcaneum was zoned, the remainder being treated as one zone and thus only recorded when more than half complete, as were phalanges other than lateral phalanges. Ribs were only recorded when the head was present and vertebrae (except axis, atlas and the first sacral segment, each for practical purposes treated as a single zone) when over 50% of the centrum was present. Only certain cranial fragments were counted: occipital, horn core (base or tip), antler (burr/pedicle or tine tip), zygomatic, premaxilla, mandible, isolated mandibular teeth and hyoid. Other fragments may have been recorded, such as rarer taxa or antler beam fragments, but were not used for quantification purposes. Additionally, pig and deer maxillary canines were recorded for sexing purposes and all elements in articulating groups were recorded.

This produced a basic fragment count, or number of identifiable specimens (NISP), for all taxa and taxa groups present. To facilitate comparison between the most frequent taxa the minimum number of elements (MNE) has also been calculated for key species. This is based on the sum of the most frequent zone for each element, taking symmetry (*i.e.* lefts and rights) into account. Minimum numbers of individuals (MNI) were then derived from the most common element in the MNE counts for these species. The recommended minima for analysis of NISP is 300 (Hambleton 1999) but there are no recommended minima for MNI totals.

Ageing and sexing

Where possible, sexes were separated using morphological characteristics of the pelvis in sheep, cattle (Grigson 1982) and equids (Getty 1975), of the horn core in sheep, and of the canines in pigs (Schmid 1972), red deer (d'Errico and Vanhaeren 2002) and equids. Genetic identification of sex was also employed (for methods see McGrory *et al*. 2012 and Mullen, this volume).

Tooth eruption and wear data were recorded. To maximise the information, dental wear stages were recorded for mandibles with more than two ageable teeth, for single deciduous fourth premolars (dP4s) and for single third

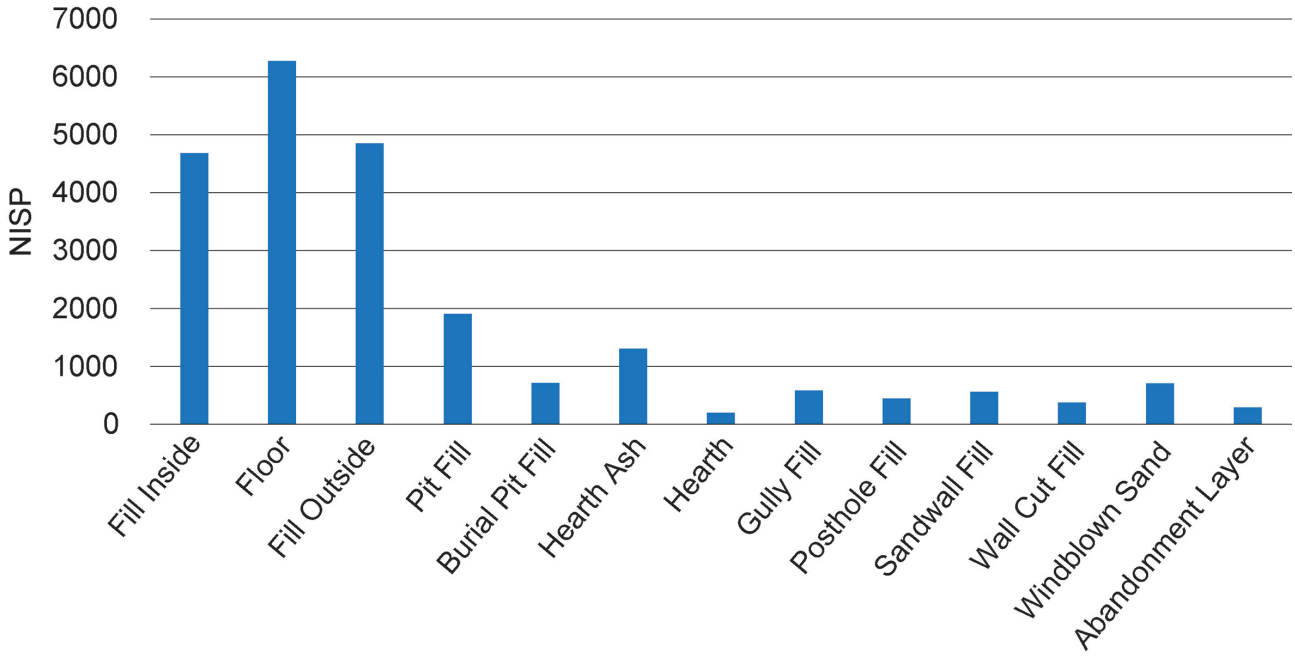


Figure 10.1. NISP per context description where NISP >100

molars (M3) using the method of Grant (1982); in addition, the Grant diagrams for cattle were adapted and combined with the method of Brown and Chapman (1991) to record this information for red deer (similar to Bowen *et al.* 2016 for fallow deer and van den Berg *et al*. 2021 for reindeer). These data were then grouped into age classes following Payne (1973) for sheep/goat, Halstead (1985) for cattle, and O'Connor (1988) for pig and red deer.

There can be an overlap in the recording of tooth wear stage values for loose dP4s with M3s, for example in sheep, which can lead to overestimation of the number of sheep of this age (Payne 1973: mandible wear stage D). To avoid this problem, additional data from mandibles with full dental arcades were used to assign loose teeth to the correct mandibular wear stage. Dog tooth wear was related to observations of wolf tooth wear by Gipson *et al*. (2000: figs 10.4–10.5). For dental wear data, detailed analysis is restricted to sample sizes that contain over 15 ageable records.

The fusion state of post-cranial bones (scapula, humerus, radius, ulna, metapodials, pelvis, femur, tibia) was recorded as 'neonate', 'unfused' or 'fused', 'shaft' and/or 'epiphyses'. Neonatal material was identified by developmental indicators (*e.g*. size, shape, fusion, bone texture, proportions of compact and cancellous bone) and comparisons to neonatal reference material. For the domestic mammals age groups were derived from timings of epiphyseal closure given by Sisson and Grossman (Getty 1975). For red deer, elements have been grouped into early-, mid- and late-fusing, assuming a similar sequence of fusion as in the other artiodactyl species present (Bosold 1968; Cegielka 1995). In calculating the percentage of unfused bone, the unfused total for each element was derived from the unfused or neonate epiphysis or shaft, whichever figure was greater. Detailed analysis of fusion data is restricted to sample sizes with information on fusion states for 50 elements or more. Finally, antler development stages were recorded after Schmid (1972: fig. 23).

Measurements

Bones of all species were measured, where possible, following von den Driesch (1976), Davis (1992), Levine (1982) and Ericson and Storå (1999). Withers heights were calculated using Matolcsi (1970) for cattle, Teichert (1975) for sheep and pigs and Harcourt (1974) cross-checked with Clark (1995) for dogs.

To utilise the maximum amount of information for each available dataset and allow for cross-comparisons the logarithmic scale index (LSI) was employed. This method is widely used in zooarchaeology to study geographical and chronological diversity of animal morphologies (Wolfhagen 2020). The log ratio of the difference between the individual measurements and the standard measurements in a particular dimension (*e.g*. length, breadth, width) are compared to an appropriate calculated standard for each species; these are selected to lie within ~30% of the archaeological values to ensure that LSI values approximate to proportional differences. The selected standards are the mean of measurements of mainland prehistoric domestic cattle (Phase 2, Elms Farm; Johnstone and Albarella 2015), modern Shetland sheep (Davis 1996) and mainland Mesolithic red deer (Howard 2009). These were chosen to facilitate broader comparisons and, for deer, to facilitate discussions on insular and mainland deer size and shape. Calculation of the LSI is calculated using the following: LSI = [log x − log m] = log (x/m), where x denotes the measurement to be judged and m denotes the measurement from the standard reference.

For the LSI length and width, measurement values are analysed separately, since dimensions lying on different axes can react to different extents to changes, producing size and/or shape differences (Davis 1996; Meadow 1999; Albarella 2002; Wolfhagen 2021).). The log base used is log10, and length, breadth and depth measurements are separated to aid in the interpretability of LSI parameters. These data are visualised using box and whisker plots, which show the minimum value, first quartile, median (middle line of the box), the mean (x), the third quartile and the maximum value of a dataset and outliers. A data point is considered an outlier if it exceeds 1.5 times the interquartile range below the first quartile or above the third quartile.

For the LSI analysis, only one measurement value per specimen was included for each dimension. It is possible, however, that for associated bone groups (*e.g*. sheep burials) different elements from one animal are represented in the analysis. The data employed for each species for the LSI calculations are listed in Table 10.1.

Measurements from unfused, fusing or porous/light elements, as belonging to skeletally immature individuals, were excluded but it is possible that immature astragali were included because these elements are hard to classify as fully mature. Some measurements were excluded, such as collum scapulae (SLC), as their sizes tend to increase after skeletal maturity and through the life of an animal, *i.e*. they are heavily affected by age. It was not possible to exclude values from skeletal elements more affected by sex (*e.g*. distal metapodials), as this would have reduced the amount of available data.

Table 10.1. Measurements used for LSI analysis; codes after von den Driesch (1976)

Element	Length	Width
Humerus	GL	BT
Radius	GL	
Metacarpal	GL	BFd
Pelvis		LA
Femur	GL	Bd
Tibia	GL	Bd
Astragalus	GLl	Bd
Calcaneum	GL	
Metatarsal	GL	Bfd
M3	L	WA

Gnawing, butchery and burning

The incidence of burning was recorded for all fragments, identifiable or otherwise. For all identified bones (including those in the general size categories) gnawing and butchery marks were noted where present. Both carnivore and rodent gnaw-marks were observed; butchery marks were described by type (*e.g*. cut, chop, sawn) and location. Tool-marked material may represent either butchery activities, worked bone or worked-bone waste, *e.g*. sawn antler. Where distinction between worked and butchered bone is possible, the tool-marks associated with worked bone are not regarded as butchery.

Worked bone

Bone and antler were identified as artefacts both on site and during subsequent analysis. Mammalian materials (except Cetacea) were incorporated in this analysis and subject to the standard recording methodologies (*e.g*. species, element, side, zones, measurements *etc*.). A full discussion of tools, including typology and manufacture, can be found in Chapter 3. Discussions of worked bone in this present chapter are limited to their impact on the assemblage characteristics.

Articulated and associated material

Three approaches to the identification of articulated and associated material have been taken: identification on site, in the laboratory and finally data-led. The first method is employed when associated material is noted during excavation. This can be easy, for example in the form of an *in situ* articulated complete skeleton or limb, and these are given a special find number (SF number) and recorded in detail. There are more complex situations if associated material has been disposed of after disarticulation, or if contexts or areas are disturbed but often large quantities of complete bones of a single species are recognised in the field and recorded as special finds. Articulating or associated material can also be identified in the laboratory, sometimes across contexts or areas, by considering species, side, age, size and occasionally pathologies. This is easier for complete elements. Finally, associated material can sometimes be identified during the data analysis and associations checked (*e.g*. left and right elements with identical measurements). Each association is identified by either the site allocated SF number (these numbers sometimes cover more than one group of articulated elements) or a Laboratory Articulation Number (LAN). Details about articulated and associated material is recorded in the 'completeness of skeleton' field of Table 10.11.

Recovery

Bone was recovered initially by hand-picking followed by dry sieving of all deposits through a 10mm mesh. Selected contexts were further processed by flotation with the residues sieved through 10mm and 1mm mesh so they could be re-incorporated into each sample. Bone from the <10mm fraction is not included in this report.

Comparative datasets

The Bronze Age to Early Iron Age assemblage from Cladh Hallan represents one of the largest faunal datasets from the Western Isles. Only Late Iron Age/Norse Bornais (Sharples 2005; 2012a; 2020) has produced an assemblage of a comparable size. There are small Bronze Age–Early Iron Age assemblages from Northton, Harris (Finlay 1984; 2006), the Udal (Serjeantson n.d.; Finlay 1984; Finlay Aird 2018) and Rosinish, Benbecula (Serjeantson 1984) but only assemblages analysed using identical zone-based or similar methodologies have been utilised to allow broader chronological changes in species presence, abundance, age and size to be tracked.

The series of sites analysed with similar methodologies, all from South Uist, are collectively described as the SEARCH/Cardiff projects and have been combined into the following groups for detailed analysis:

- Bronze Age–Early Iron Age (Cladh Hallan and Sligeanach [Mulville and Madgwick 2012]);
- Middle–Late Iron Age (Dun Vulan [Mulville 1999]; Cille Donnain [Mulville in Parker Pearson and Zvelebil 2014]; Bornais Mound 1 [Mulville and Powell 2012)];
- Norse (Bornais [Mulville and Powell 2012; Mulville 2020] and Cille Pheadair [Mulville *et al.* 2018]).

Where appropriate, comparisons have been drawn with Iron Age and Norse Bostadh and Loch na Berie (Thoms 2003) on Lewis. For discussions of size and shape, information from Neolithic sites further afield has been included.

10.2 Assemblage summary

The extensive assemblage recovered from Cladh Hallan has around 150,000 fragments of mammal bone[2] derived from a securely dated sequence of 16 phases; it is one of the largest faunal assemblages from insular Scotland. This material, most of it associated with the series of Late Bronze Age–Early Iron Age roundhouses, provides detailed evidence for the role of animals over *c*. 1400 years, from the Beaker period (*c*. 2000 BC, Phase 1) to the Early Iron Age (Phase 16, ending in *640–580 BC at 95% probability*). The site provides a story of the island lifeways in general and a unique perspective on daily life in prehistory at a human – and animal – scale. Individual houses preserved features that included the central fireplaces, sleeping platforms and activity areas within their semi-subterranean floors (composed of thin layers of sand mixed with ash from the hearth). The excavations recovered small, trodden-in materials from these soft floors as well as debris left on their surfaces.

The row of roundhouses remained in use over a long period, with the central roundhouse, House 401, going through nine phases of construction and renewal between Phase 8 and Phase 16 (for dating of the phases, see the preface table [this volume] and Volume 1: chapter 14).

There are indications that the occupants and activities within the three roundhouses varied between the houses and over time (see Volume 1). For example, the central house (401) has the largest and most elaborate finds assemblage, with copious evidence for varied activities and especially cooking, the southern house (801) has a more limited tool assemblage that focused on hide-working and the northern house (1370) has an impoverished assemblage with evidence for craft activities and the soil micromorphology analysis shows it was sometimes used as a byre.

Number of identified specimens

Over 24,000 specimens (16% of the total assemblage) were identified to species, species group or size group (*e.g.* sheep, sheep/goat or sheep/pig size; Table 10.2) and an element, deriving from over 1,000 contexts. Within the worked bone assemblage, a number of items cannot be identified to species and/or element.

Table 10.2. NISP for all specimens

Species	NISP
Sheep/goat	13235
Cattle	4498
Pig	260
Dog	375
Cat	2
Red deer	2151
Roe deer	29
Cervid	46
Otter	14
Reptile	1
Rodent	8
Carnivore	1
Insectivore	1
Atlantic seal	43
Common seal	14
Seal	40
Sheep/pig size	2617
Cattle/horse size	796
Hare/fox size	4
Unidentified small mammal	8
Total	**24143**

10.3 Distribution of bone by area and phase

Analysis by area and phase is focused on material identified to the level of a species or species group therefore all 'size' categories have been excluded. This increases the quality of the data but decreases the overall NISP to just under 21,000 (Table 10.3).

Faunal remains were recovered from pre-house activity phases, but larger amounts were recovered from the construction, occupation, abandonment and infilling of houses and other structures. Animal bone was found in the majority of features, including pits, postholes, floor layers, hearths and middens. The bulk of the assemblage derives from activity associated with the row of Late Bronze Age–Early Iron Age roundhouses and forecourt sequences in Area A, in particular House 401 (39% of the NISP) and House 1370 (16%). Externally, the northeastern area (14%), which contained midden deposits, produced the most bone.

Whilst the assemblage can be subdivided into the phases that constitute the site activity, the early phases (Phases 1 to 7), representing the Beaker and Early–Middle Bronze Age activity (cultivation, burials and small houses) produced little material, and numbers from each individual phase fall under the recommended minimum of 300 NISP for zooarchaeological analysis (Hambleton 1999).

From the Late Bronze Age roundhouses' foundation in Phase 8, the quantity of material increases to around 1,300 specimens and then continues to rise: from 3,200 fragments in Phase 9 (the primary occupation of the roundhouse row) to nearly 5,100 in Phase 12 when only House 401 remained in use as a dwelling. From the start of the Early Iron Age (Phase 13 onwards) the assemblage decreases in size under 1000, but above 300, NISP. By Phase 16, however, the appearance of new double roundhouses (Houses 640 and 150) increases the recorded assemblage to around 1,300 fragments.

The larger assemblages from each of Phases 8–13 form coherent analytical units whilst the smaller phase assemblages have been grouped to create adequate sample sizes:

- Phases 1–3, Early Bronze Age (this remains a small sample and is excluded from many analyses);
- Phases 4–7, Middle–Late Bronze Age; and
- Phases 14–16, Early Iron Age.

10.4 Distribution by context type

Figure 10.1 presents data for context types with a NISP of greater than 100 (98% of material). More than half of all recorded specimens are derived from interior contexts: floor layers (26%; defined as occupation surfaces), fills (21%; layers above and between floors), cut features (9%; mostly pit fills), hearths (7%) and animal burial pits (3%). The deposition of material within the floors provides information on interior domestic activities whilst the inter-floor fill layers derive most likely from outdoor deposits brought into the house with the sand used to

Table 10.3. NISP by area and phase (this excludes material only identified to size group)

Area	Phase																Total
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Forecourt	0	0	0	0	0	0	0	9	125	264	521	317	0	0	0	0	**1236**
House 1370	0	0	57	115	0	0	0	238	809	868	1055	239	0	0	0	0	**3381**
House 2835	0	0	0	79	0	0	0	0	0	0	0	0	0	0	0	0	**79**
House 401	0	0	0	0	0	0	3	425	1265	913	1665	1411	933	284	652	554	**8105**
House 801	0	0	0	0	14	0	10	331	213	0	0	2	0	0	0	0	**570**
House 2476	0	0	0	0	0	0	79	0	0	0	0	0	0	0	0	0	**79**
House 3260	0	0	0	0	0	0	78	0	0	0	0	0	0	0	0	0	**78**
House 2190	0	0	0	0	0	0	0	0	0	129	0	0	0	0	0	0	**129**
House 150	0	0	0	0	0	0	0	0	0	24	0	0	35	0	0	209	**268**
House 640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	523	**523**
House 1500	0	0	0	0	0	0	0	0	0	0	0	14	0	101	0	0	**115**
Area C	0	5	0	0	0	0	0	0	163	445	41	1	0	0	0	0	**655**
Area D	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**2**
N Area	0	0	1	0	0	0	0	0	0	2	0	578	0	0	0	0	**581**
NE Area	0	0	59	0	0	141	0	171	347	84	37	2091	0	0	0	0	**2930**
NW Area	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	**2**
S Area	5	0	24	0	6	16	1	124	0	188	698	345	0	0	0	0	**1407**
SE Area	0	0	0	0	0	0	0	0	322	146	8	0	0	0	0	0	**476**
W Area	0	0	0	0	0	0	0	0	9	35	17	49	0	0	0	0	**110**
Total	**5**	**5**	**141**	**194**	**20**	**157**	**171**	**1298**	**3255**	**3098**	**4042**	**5049**	**968**	**385**	**652**	**1286**	**20726**

re-lay the floors. Outdoor layers, adjacent to the houses, are the other large group (22%). All other groups comprise less than 3%, deriving from both internal and external features such as gully fills, wall-core fills and abandonment layers. Windblown sand layers were found both internally and externally.

The abundance of material from internal contexts, within the houses, indicates the predominance of practices that generated bone waste within the domestic sphere. The soft sandy floors would have facilitated the incorporation of some material into their surfaces, but other material was purposefully buried or removed outside.

10.5 Taphonomy

The taphonomic characteristics of the animal bone provide information regarding the depositional history of the material, the effects of preservation and fragmentation on the assemblage and the nature and location of activities taking place. To enable comparison with other sites this includes both identified and unidentified material from all records, therefore the overall number of fragments is larger than that used in other analyses. The incidence of modifications resulting from gnawing, butchery and burning is shown in Table 10.4. Overall, the preservation of the animal bone assemblage is outstanding, with few modifications and material recovered in near-pristine condition – even small unfused epiphyses of very young animals are present.

Burning

Overall, just under 3% of all bone is burnt. This is comparable with levels of burning observed at other sites in South Uist, where figures of *c.* 2–3% have been recorded (Iron Age Dun Vulan and Bornais [Mulville 1999; 2005; Mulville and Powell 2012]); Norse Cille Pheadair and Bornais [Mulville *et al.* 2018; Mulville 2020]).

Across the site, proportions of burnt bone vary by phase (Figure 10.2). The presence of cremations and pyres in Phase 3 is possibly reflected in the higher levels of burnt material in Phases 1–3, but there are only seven pieces from these phases. Burning events increased from Phase 9 onwards, when the roundhouses were occupied. Material from Phase 13, derived from the fifth occupation phase of House 401 and the first phase of House 150, has the highest proportion of burnt bone. For House 150 this burnt material is possibly associated with high-temperature processes taking place in the house, such as copper-alloy metallurgy.

Butchery

The proportion of butchered bone can affect the information retrievable from an assemblage, since heavily processed species and elements will be more fragmented and less likely to be identifiable and recordable. Between *c.* 5% and 8% of bone in the Cladh Hallan assemblage is butchered, with higher proportions in Phases 9, 10 and 13 (Figure 10.3). Chopping marks, created by heavy-bladed tools, only become common from Phase 9 onwards and may be linked to the casting of bladed copper-alloy tools (see Chapter 1) and their consequent impact on butchery practices. The only elements identified as sawn are red deer antler, which could point to the use of a specialist tool for antler-working. There are seven occurrences noted, from Phase 8 to 13; of these, four are recordable antler bases.

Animal-damaged material

Gnawed bone can provide information on the management of waste. Overall, 11% of the remains exhibit signs of gnawing (Table 10.4). Most is canid-derived, with much smaller quantities of rodent gnawing (a maximum of 2%) and a handful of canine-digested bone. This level of damage is seen at other prehistoric sites on Uist where dogs were present, such as Dun Vulan (14%), Late Iron Age Bornais Mound 1 (10%) and Norse-period Mound 3 (16%) (Mulville 1999; 2005; 2020; Mulville and Powell 2012). There is a higher proportion from Norse-period Mound 2 (30%–38%), Mound 2a (21%) and at Cille Pheadair (21%) (Mulville *et al.* 2018) where the high percentages may be linked to the greater numbers of dogs on those sites. On sites with few dog remains, such as are known from Neolithic Orkney, gnawing is less than 1% (Fraser 2015: 172).

At Cladh Hallan the proportion of gnawed bone varies through time (Figure 10.4). Phases 4–7 have the highest proportion and Phase 13 has the lowest. The former may be a product of the small sample size, whilst the latter could be related to higher proportions of burnt bone (see above) since burnt material will have been less attractive to canids. The persistent proportion of rodent-gnawed bone,

Table 10.4. Taphonomic alterations to bone by phase, NISP and % NISP

		Phases 1-3	Phases 4-7	Phase 8	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phases 14-16	Total
Burnt	NISP	7	9	21	100	108	124	175	91	101	**736**
	% NISP	*4%*	*1%*	*1%*	*2%*	*3%*	*2%*	*3%*	*7%*	*3%*	***3%***
Butchered	NISP	11	32	118	377	316	365	385	98	171	**1873**
	% NISP	*7%*	*5%*	*7%*	*8%*	*8%*	*7%*	*6%*	*8%*	*6%*	***7%***
Gnawed	NISP	25	120	224	612	445	560	833	69	313	**3065**
	% NISP	*15%*	*19%*	*14%*	*14%*	*11%*	*11%*	*13%*	*6%*	*11%*	***11%***

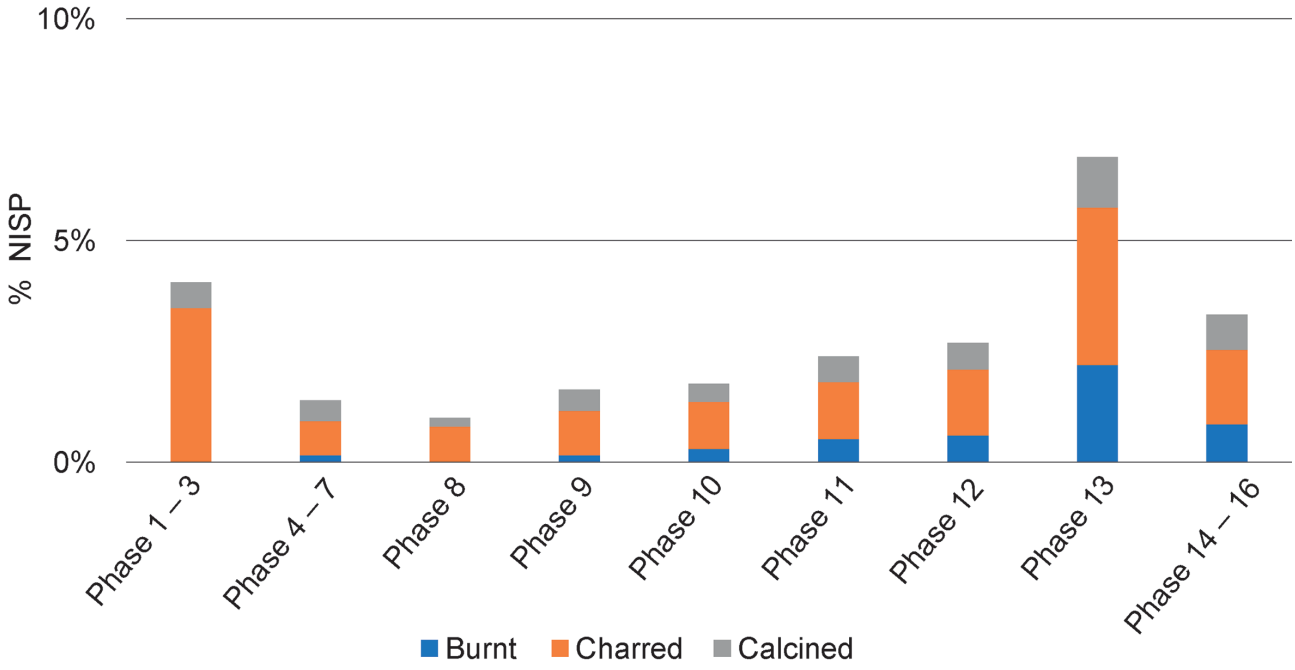


Figure 10.2. Percentage NISP of heat-damaged bone by phase

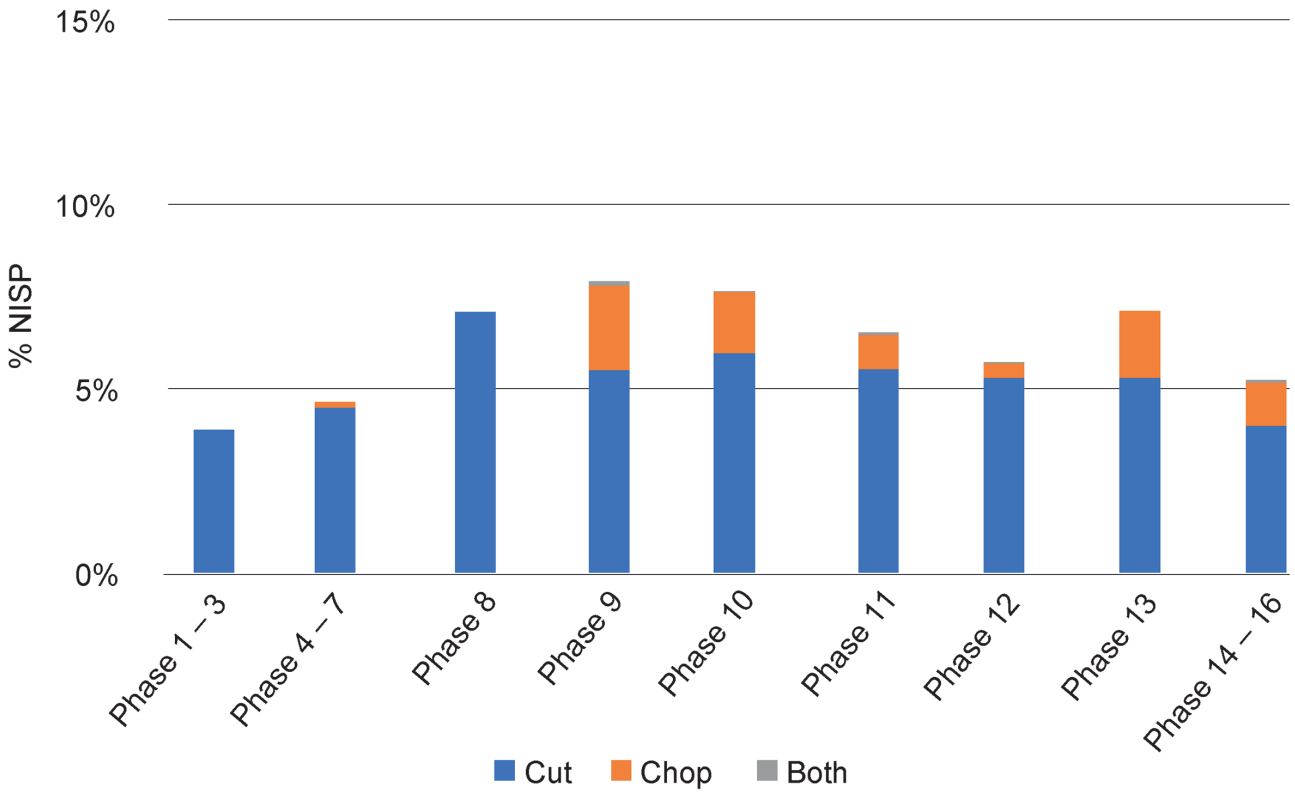


Figure 10.3. Percentage NISP of butchered bone by phase

from Phase 7 onwards, suggests that small mammals were living close to people and their homes.

Worked bone summary

As noted in Chapter 3, there are over 700 items of worked bone and antler.[3] Where items are identifiable to species and quantifiable employing the zone method, they are included in our analyses. The relevant information for the zooarchaeological interpretation of the site is the effect of preferential selection (including the retention of key elements for tool production) on body part distribution or the relative abundance of species. Where appropriate any potential impact is noted.

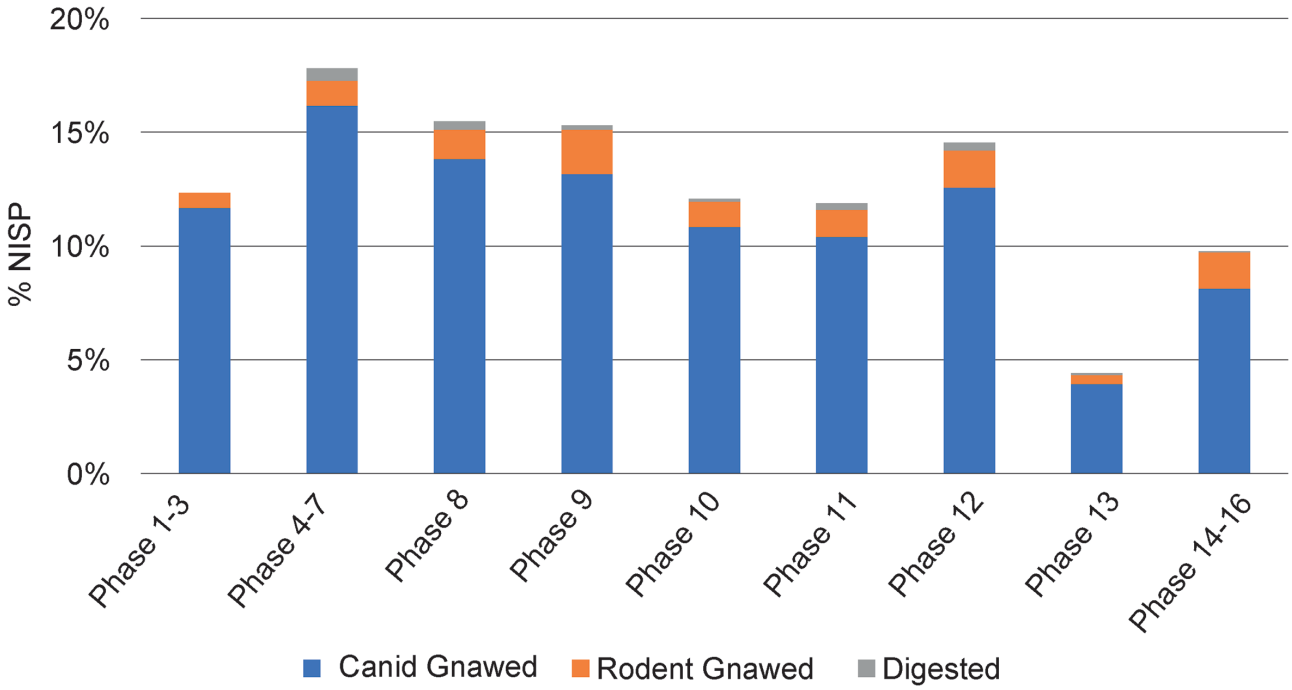


Figure 10.4. Percentage NISP of animal-damaged bone by phase

Of those items in the worked bone assemblage subject to full recording within this analysis (about 200), worked metapodials of sheep and scapulae of cattle are the most common. Bone points (NISP 70) are the predominant tool type, and these are concentrated in Phases 9–12. Over half are made from sheep (90% are metapodials) and about a fifth from red deer (metapodials predominate). There are 19 cattle scapula tools, with wear consistent with their use as shovels, and seven of these are from House 401 in Phase 15 (floors 450 and 452, interior fills 466 and 469). Fifteen of the 28 antler picks were recovered from within House 401, from Phase 11 onwards. Phase 15 again produced the most antler picks, and these derived from similar contexts to the scapula shovels (contexts 452, 466) as well as hearth deposits (context 499).

10.6 Species abundance

The identifiable components of the assemblage are dominated by domestic animals, with sheep, cattle, pig and dog accounting for nearly 90% (Table 10.5). Sheep (all material identified as sheep/goat and sheep) formed the mainstay of the food economy – with over 13,000 specimens they are over three times as abundant as cattle (*c.* 4,500) which, in turn, are hundreds of times more common than pigs (*c.* 250). Dog remains (375) outnumber those of pigs, but as these include two burials that comprise at least one-third of the dog remains, dogs are less abundant than pigs in terms of numbers. The only other potentially domesticated species – cat – was only identified from two quantifiable elements.

There were over 100 associated bone groups, accounting for around 1,300 specimens (see *Articulations*, below). The majority of these derive from 10 sheep bone groups (702 NISP, including three mostly complete skeletons), accounting for 5% of the sheep remains, and as noted above, two dog burials make up one-third (136 NISP) of dog remains.

A limited diversity of wild mammals is evident in the area. Among terrestrial species, red deer, with the number of identified specimens (NISP) exceeding 2,150, rank as the third most significant food source, approximately half as prevalent as cattle. No definitive wild boar identification was made, as detailed in the section on pig metrics below; although a sizable upper canine, potentially wild in origin, was discovered, it was deemed unsuitable for comparative measurement (SF 3539; see Chapter 3).

Tentative identifications of roe deer have been made, a species absent from the current fauna of the outer islands (Western and Northern Isles), suggesting potential shifts in distribution over time. Other wild terrestrial mammals are notably scarce, with fewer than 15 NISP, including otters, and smaller mammals. Otters were seldom exploited, with only 14 quantified elements.

Small mammals were found both as bone remains and evidenced by rodent gnawing. Among the identifiable specimens, three mandibles indicate the presence of two long-tailed field mice or wood mice (*Apodemus sylvaticus*) in Phases 10 and 12, and one house mouse (*Mus musculus*) in Phase 16. The presence of the latter aligns with recent research suggesting that house mice first appeared in mainland Britain during the Late Bronze Age (García-Rodríguez *et al*. 2021), becoming more prevalent in the subsequent Iron Age. Earlier studies suggest the islands harboured an established population by the Norse period at Bornais and Cille Pheadair (Williams 2018).

Table 10.5. NISP of major species/groups. This includes sheep and dog associated bone groups

Species	Phase																Total
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Sheep/goat	4	3	108	164	15	102	94	873	2058	1928	2718	2950	755	247	432	784	**13235**
Cattle	0	1	25	22	4	42	41	306	761	752	809	1110	115	79	124	307	**4498**
Pig	0	0	2	1	1	3	4	30	46	50	43	60	4	2	5	9	**260**
Dog	0	0	0	0	0	3	0	1	6	24	44	271	16	5	1	4	**375**
Cat	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**2**
Red deer	1	1	6	7	0	5	26	79	351	311	386	617	66	50	86	159	**2151**
Roe deer	0	0	0	0	0	2	1	5	3	3	5	7	1	0	0	2	**29**
Cervid	0	0	0	0	0	0	0	0	12	10	8	8	3	1	2	2	**46**
Otter	0	0	0	0	0	0	0	0	2	0	5	6	1	0	0	0	**14**
Reptile	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Rodent	0	0	0	0	0	0	0	1	0	1	4	1	0	0	0	1	**8**
Carnivore	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
Insectivore	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Atlantic seal	0	0	0	0	0	0	3	1	4	12	6	11	0	1	0	5	**43**
Common seal	0	0	0	0	0	0	0	0	3	1	7	2	1	0	0	0	**14**
Seal	0	0	0	0	0	0	2	2	5	5	7	4	0	0	2	13	**40**
Sheep/pig size	0	0	10	1	2	12	10	109	626	455	451	488	189	51	87	126	**2617**
Cattle/horse size	0	0	0	4	0	7	10	42	172	135	160	174	23	18	15	36	**796**
Hare/fox size	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	**4**
Unidentified small mammal	0	0	0	0	0	0	0	0	1	0	0	1	6	0	0	0	**8**
Total	**5**	**5**	**151**	**199**	**22**	**176**	**191**	**1449**	**4054**	**3688**	**4653**	**5714**	**1180**	**454**	**754**	**1448**	**24143**

Marine mammals are chiefly represented by pinnipeds (seals), with approximately 100 identified specimens, alongside a significant assemblage of cetaceans (see Chapter 11). A jawbone, probably from a slowworm, is present. The species is the only reptilian species currently recorded on the island.

Species abundance by area

The distribution of major food animals (cattle, sheep, pig and red deer; totalling *c.* 20,000 combined NISP) has been compared across the areas of the site where the NISP exceeds 300 (see Table 10.3; Figure 10.5). Many of these areas encompass multiple phases. A marginal increase in the proportion of red deer is observed in House 640 (Phase 16; interpreted as being a smokery; see Volume 1: chap. 12) and in the northeastern and southeastern zones of Area A. Apart from these instances, there is only slight variation in the species composition deposited in the various houses and outdoor areas. Houses with <300 NISP include Houses 2835 (Phase 4), 2476 and 3260 (both Phase 7) with <100 NISP each, House 1500 (Phases 12 and 14) with <200, and House 150 (Phases 10, 13 and 16) with 300 NISP.

Changes over time

To better understand changes over time, the main food species were compared using two methods of quantification – NISP and MNI (based on MNE; Table 10.6). The NISP and MNI are both subject to biases that should be considered when assessing what the relative proportions of species designate.

NISP data will be impacted by the occurrence of associated bone groups, in particular the substantive groups of articulating sheep bone in Phase 4, Phase 8 (two incidences), Phase 11 (three), Phase 12 (two) and Phase 13 (two) each of which contributes between 14 and 120 NISP. Additionally, the curation, collection and possible importation of elements for use as tools – notably cattle scapulae and sheep metapodials – could affect the MNE and, in turn, the MNI in smaller samples. The effect on MNI appears to be minimal, however: cattle scapulae, for example, were recovered in similar proportions to mandibles, the other most abundant element.

As the size of the main species assemblage at Cladh Hallan is at least one order of magnitude (and at times, two) larger than comparable insular sites, any analysis of the site data should be robust.

Nearly 500 stock animals are represented in the MNI estimate, based on calculations for each phase or phase group (Table 10.6). With a MNI of 366 sheep, 114 cattle, 60 deer and 16 pigs, this site has a high representation of individual animals for all species except for pigs. MNIs for each phase or phase group range from 9 to 80 for sheep, from 2 to 27 for cattle, 2 to 14 for red deer and 1 to 3 for pigs. The limited presence of pigs could be attributed to the bones present representing just the occasional importation of meat joints to the settlement, although the data on body parts and the presence of neonatal bones suggest the existence of a local pig population (see section 10.10 *Herd demographics*, below).

The MNI calculation may underestimate the total number of animals, as it assumes that each phase is fully represented by the data, counting only the most common elements or zones. Since some deposits and phases span considerable periods – potentially tens or hundreds of years – and considering the lack of adequate resources for preserving fresh meat (at least until the establishment of the smokery in Phase 16), it is reasonable to assume that animals were regularly slaughtered and consumed within an annual cycle. Therefore, although MNI estimates, which compress generations, may be

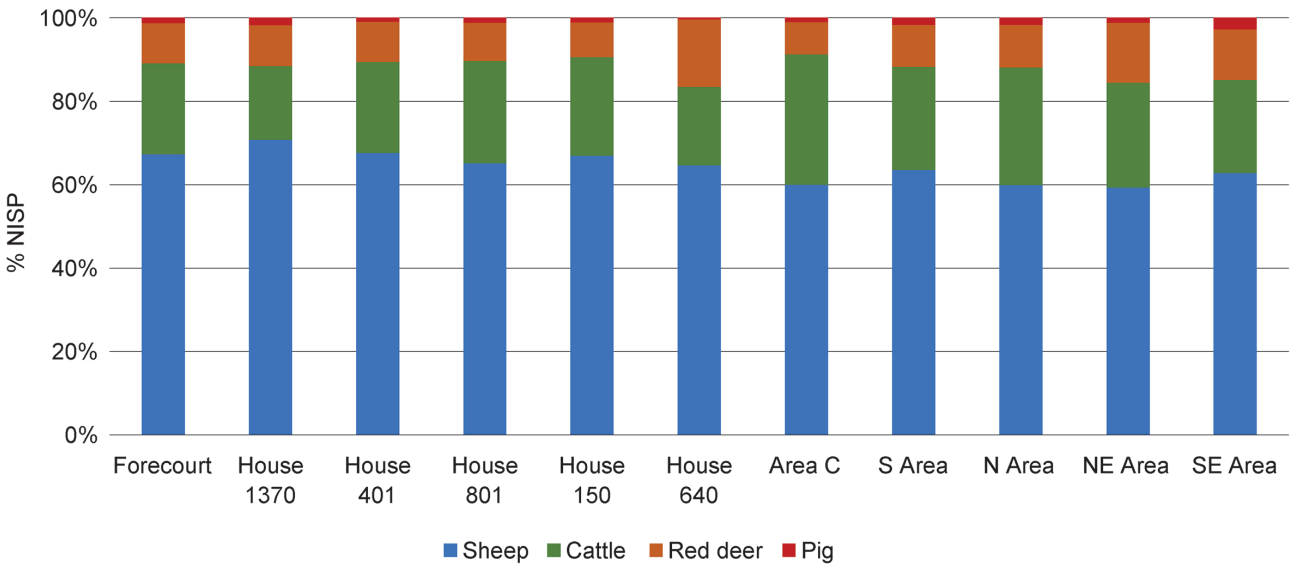


Figure 10.5. Relative proportion of main species (percentage NISP) by area (includes sheep [702 NISP] and dog [136 NISP] associated bone groups)

Table 10.6. Relative abundance by NISP and MNI for main species

Phase	NISP				MNI			
	Sheep	*Cattle*	*Red deer*	*Pig*	*Sheep*	*Cattle*	*Red deer*	*Pig*
1–3	115	26	8	2	9	2	2	1
4–7	375	109	38	9	12	5	2	1
8	873	306	79	30	27	9	4	2
9	2058	761	351	46	62	17	11	2
10	1928	752	311	50	57	17	8	2
11	2718	809	386	43	74	17	8	2
12	2985	1110	617	60	81	27	14	3
13	720	115	66	4	13	8	2	1
14–16	1463	510	295	16	32	12	9	2
All phases	**13235**	**4498**	**2151**	**260**	**367**	**114**	**60**	**16**

inaccurate, they do still offer an indication of the relative importance of species. Furthermore, using MNE and MNI estimates to understand animal usage, such as the amount of meat produced, is also influenced by the age distribution of the animals, particularly the high proportion of very young animals (see *Body part analysis* and *Meat weights*, below).

10.7 Comparison of quantification methods

The NISP, MNE, and MNI methods of quantification exhibit their own biases, as evidenced by the slight variation observed between them in terms of taxa representation. Overall, however, the relative proportion of species remains very similar, which can be attributed to the combination of good preservation and systematic recovery methods employed to minimize the loss of small and/or fragmented material.

A comparison of NISP and MNI results for each of the phases/phase groups highlights the predominance of sheep (Figure 10.6). Phases 1–3, with their small sample sizes, are included for informational purposes only. There is minimal variation in species proportions, with a slight decline in sheep numbers and an increase in cattle and red deer in the later phases, with the latter being most numerous in Phases 12 and 14–16. The presence of pig remains is limited, with a minimum of one and a maximum of three individuals in any phase. The only exception is Phase 13, which represents the fifth occupation of House 401 and occupation of House 150 in Area C, where fewer sheep and more cattle are represented by MNI in comparison with NISP. This phase is also noteworthy for its proportion of burnt bone (see *Burning*, above).

10.8 Fragmentation indices

Dividing the NISP by the MNI offers insight into the number of fragments per individual, with species exhibiting higher numbers probably subjected to processes resulting in loss, destruction, fragmentation, or disposal of material elsewhere. Younger and more fragile bones tend to fragment more readily. At Cladh Hallan, all species show nearly identical numbers of fragments per individual, averaging between 40 to 50 NISP per MNI (Figure 10.7). Cattle demonstrate the highest levels of fragmentation, while red deer exhibit the lowest, suggesting that red deer bones are often deposited intact, with very similar patterns observed for sheep and pigs.

Fragmentation levels vary across different time periods. In Phases 1–3, fragmentation levels are low, with deer displaying the lowest values. Subsequently, fragmentation increases until Phase 9, indicating a rise in breakage, possibly resulting from increased processing or more frequent deposition on floors and thus significant trampling. Cattle consistently exhibit the highest values, averaging in the mid-40s, while sheep and pigs show mid-30s values, and deer experience an increase in fragmentation over time to levels comparable to cattle.

Phase 13 once again shows an unusual pattern: there is a deviation in fragmentation, with higher levels observed in sheep and pigs. It is conceivable that the abundance of burnt material has influenced the fragmentation levels of both sheep and pig bones. In Phases 14–16, high values for all species are noted, with red deer displaying comparatively lower fragmentation. Overall, most species undergo similar taphonomic processes, including the rare and generally less mature pig specimens.

10.9 Herd demographics

Estimating the sex and age profile of slaughtered domestic animals at Cladh Hallan involves utilising various sources of evidence, including shape, genetic information, dental wear and bone fusion. This information provides insights into the animal management strategies practised by the inhabitants. For example, in cattle herds, a high proportion of adult females could indicate a dairy economy, while adult males may be more valued for traction.

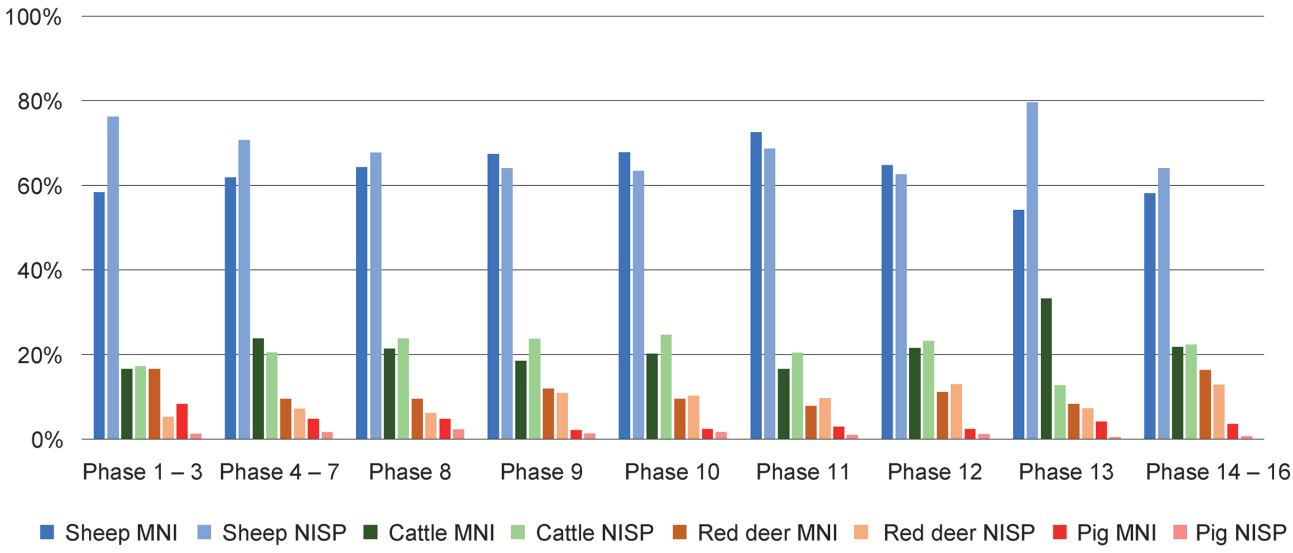


Figure 10.6. Percentage relative abundance (MNI and NISP)

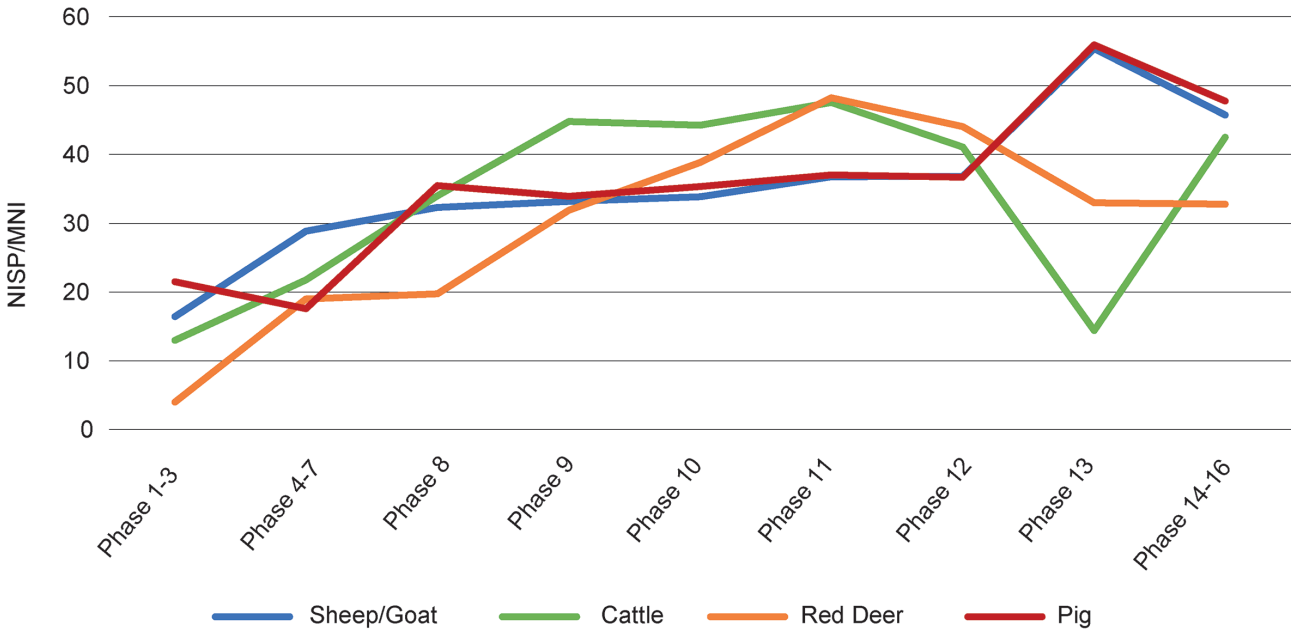


Figure 10.7. Fragmentation index for the main food species

Table 10.7. Morphological and genetic sexing information

Species	Method	Age	Female	Female?	%	Male	Male?	%	Total
Sheep	Morphological	>5 month	68	5	*72%*	26	3	*28%*	102
	Genetic	Adult	3		*80%*	2		*20%*	5
	Total		**71**	**5**	***71%***	**28**	**3**	***29%***	**107**
Cattle	Morphological	>10 month	20		*80%*	5		*20%*	25
	Genetic	<6 months	2		*29%*	5		*71%*	7
	Genetic	7–18 months	2		*100%*			*0%*	2
	Genetic	3–7 years	1		*100%*			*0%*	1
	Genetic	Adult	8		*89%*	1		*11%*	9
	Total		**33**		***75%***	**11**		***25%***	**44**
Pig	Morphological		3		*27%*	8		*73%*	**11**
Red deer	Genetic	Adult				1			1

Sex data

Sex data were available for over 100 sheep, 44 cattle, 11 pigs, and one deer element (Table 10.7), representing a significant portion of the MNI for each species. Both morphological and genetic data were utilised for sex determination. Morphological separation focuses on the pelvis for sheep and cattle, and on teeth for pigs. There is an inherent age bias in morphological preservation, however, favouring older individuals with fused bones and formed teeth. For instance, the pelvis fuses around 5 months in sheep and 10 months in cattle, while pig canines can be distinguished sexually from their eruption at a relatively young age.

Information regarding younger animals at Cladh Hallan is primarily available from genetic sexing, derived from mandibles, thereby providing detailed age information. Although there are a few occurrences of both left and right elements, such as pelves, recovered from a single individual, to avoid duplication, the repeat records for the three mostly complete sheep burials were excluded (SF 3392, SF 5177 and SF 4748; see section 10.13 *Articulated bone groups*, below).

Morphological identification

For sheep, morphological identification from fused pelves (indicating animals over 5 months old) suggests a prevalence of adult females, accounting for 70% of the sample. Cattle exhibit a higher proportion (80%) of fused pelves (indicating animals over 10 months old) identified as female. Regarding pigs, the presence of predominantly male canines suggests a male predominance, consistent with findings from other sites such as Northton, Harris (Finlay 1984; 2006). It is important to note, however, that the predominance of males in the pig dataset may be influenced by the collection of their impressively large teeth by the settlement's inhabitants. Furthermore, additional evidence of worked pig teeth supports this observation (*e.g.* SF 3539; see Chapter 3).

Genetic identification

There have been two campaigns of genetic sexing of samples from the Cladh Hallan assemblage. One sampled petrous bones from a range of species (see Chapter 21) whilst the other sampled cattle mandibles and provided a combination of age and sex data (McGrory *et al*. 2012).

Genetic analysis of petrous bones provided sex determination for a sample of sheep (n = 5), cattle (n = 8) and red deer (n = 1; Figure 10.8) and the samples were chosen from contexts across the site's phases.

These results indicate a predominance of female animals at Cladh Hallan. Specifically, sheep exhibit a female-to-male ratio of 1.5:1, while cattle show a ratio of 4:1. The single red deer petrous bone is from a male animal. Additionally, the genetic data from cattle mandibles (Figure 10.9) provide evidence of male animals dying young, with a female-to-male ratio of 1:1.5 in animals under 6 months old, and only females represented in the over 7-month age groups. These findings align closely with the results obtained from morphological sexing data.

Overall, the cattle and sheep populations at Cladh Hallan are predominantly female. The aged genetic sex data for cattle suggest a bias toward the slaughter of male animals at a young age. Utilising multiple lines of inquiry is crucial in this analysis, as younger animals cannot be sexed morphologically and they are not represented among the petrous bone samples (which are assumed to derive from adult animals). Therefore, it is only through the use of genetic data and the targeting of an age range of mandibles that a complete representation of all ages and sexes can be achieved. This underscores the importance of employing diverse methodologies to gain a comprehensive understanding of the animal populations and management practices at the site.

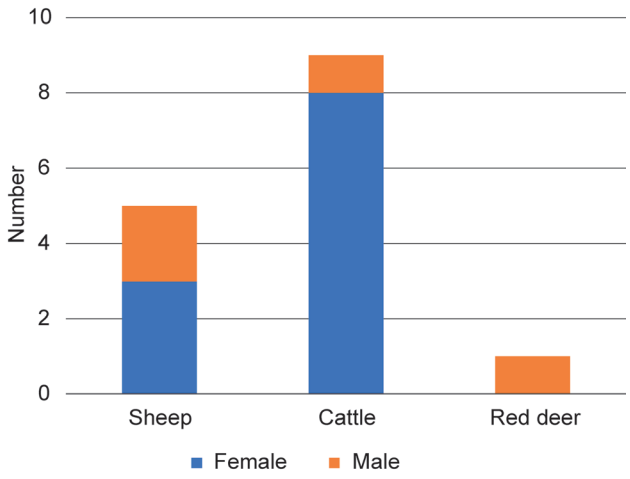


Figure 10.8. Genetic sex determination based on petrous bone (see Chapter 21)

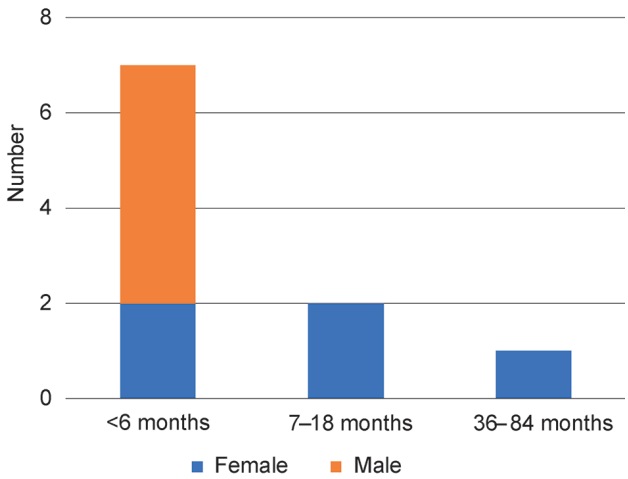


Figure 10.9. Mandibular genetic determination and age data for cattle (after McGrory et al. *2012)*

Age data

The animal bone assemblage from Cladh Hallan yielded a substantial quantity of ageing data across all phases for most food species. Specifically, there are over 400 individual records for sheep dental age, *c.* 250 for cattle, 90 for deer but fewer than 10 for pigs. These dental records are complemented by a significant amount of epiphyseal fusion information, with *c.* 4,000 records for sheep, 1,700 for cattle, 600 for red deer and 100 for pigs. It is important to note that while there are a few repeat records for sheep mandibles (*e.g.* both left and right mandibles recorded), the large sample size minimises any potential effect. Each mandible in the dataset contained a dp4 or LM3, and loose versions of these teeth were also included in the analysis.

The dental ageing data for sheep and cattle from all phases were combined and compared to standard production models. Interpretation of ageing data relies on assumptions, notably on a single season of birth, although recent evidence suggests that prehistoric farmers were capable of manipulating the birthing season of domestic stock to ensure a continuous supply of meat and/or milk (*e.g*. Gron *et al.* 2015).

Fusion datasets may be biased as a result of the poor preservation of young bone, although this was less of an issue in this well-preserved assemblage compared to the majority of archaeological sites. The percentage of unfused bone for each element was calculated by comparing the number of fused/newly fused elements with the number of unfused shafts/epiphyses and/or neonatal shafts/neonatal epiphyses, divided into species-specific age groups for presentation.

Details of the fusion or development stage of long bones for the four main species are summarised in Table 10.8. Neonatal MNI for sheep and cattle were calculated as a percentage of the total MNI for each species. Given the very small sample size for pigs, their neonatal MNI was not calculated. The fusion age classes relate to slightly different ages for each species and are outlined in the table caption.

Table 10.8. Relative proportion of age classes in each of the main food species using MNI and NISP data. Neonates = <2 months. Fusion age class (FAC) data uses NISP: Sheep FAC1 <1 year, FAC2 <2 years, FAC3 <3.5 years; Cattle FAC1 <1 year, FAC2 <2 years, FAC3 <3 years, FAC4 <4 years; Deer FAC1 <1 year, FAC2 <2 years, FAC3 <3.5 years; Pig FAC1 <1 year, FAC2 <2 years, FAC3 <3.5 years, FAC4 <4 years

Age class	Sheep	Cattle	Deer	Pig
Neonates (MNI)	8%	40%	31%	N/A
Neonates (Fusion)	19%	40%	22%	26%
Fusion age class (FAC) 1	28%	71%	37%	33%
Fusion age class (FAC) 2	59%	39%	54%	75%
Fusion age class (FAC) 3	67%	49%	49%	77%
Fusion age class (FAC) 4		75%		90%

For this part of the study, groups with information on fusion states with fewer than 50 elements were excluded from detailed analysis, while the small dataset for pigs precludes their phase-by-phase analysis.

Sheep flocks

The Cladh Hallan assemblage has excellent potential for the accurate reconstruction of the ages of individual sheep through time. The dental ageing data of over 400 left- and right-sided mandibles/ageable teeth represent a minimum of 200 individuals, from a population calculated from the overall MNI to be some 360 sheep. As noted above, the fusion dataset is also substantial and allows comparison of all phases/phase groupings as well as inferences about herd reproduction. There is likely to have been an early, focused lambing period at Cladh Hallan, similar to inferences from Neolithic sites in Orkney where lambing periods occurred in mid to late spring/early summer, with lambing mostly restricted to a period of three months (Balasse *et al*. 2019; Blanz *et al*. 2022).

Sheep dental evidence: overview

Given the large size of the dataset, only material assigned to a single age category was used in the analysis. Mortality from all phases combined is shown in Figure 10.10 alongside Payne's (1973) three idealised production models. For sheep, a low rate of early death is evident, with an average of 7% dying under 2 months and 19% dead by 6 months. After this time there is a steep increase in death rates, with half of the flock dead by 6 to 12 months, associated with a cull of animals in the autumn/winter. This is followed by a steady attrition of about one-tenth of the herd in each subsequent year until their third to fourth year, with all animals slaughtered by 8–10 years. This pattern fits most closely with Payne's meat production model.

Sheep dental evidence: by phase

Phases 8–12 and 14–16 have a sufficiently large sample (15 mandibles or more) to consider in detail (Figure 10.11). The number of animals surviving their first year declines from Phase 8, with Phases 9 and 10 having the highest rate of yearling death. The intensity of the cull then reduces and, during the later roundhouse occupations (Phases 11 and 12), the emphasis shifts, with more than half surviving their first year and one-third surviving beyond 3 years. In Phases 14–16 (Early Iron Age) there is a return to an emphasis on younger animals, with a higher mortality rate between 1 and 3 years. For all phases, the pattern closely matches the model for the production of meat.

Sheep fusion evidence: across time

Although there are only a small number of specimens in Phases 1–4, 5–7 and 13, the large body of sheep data allows comparison across most of the site's occupation (Figure 10.12). Most phases are similar and demonstrate

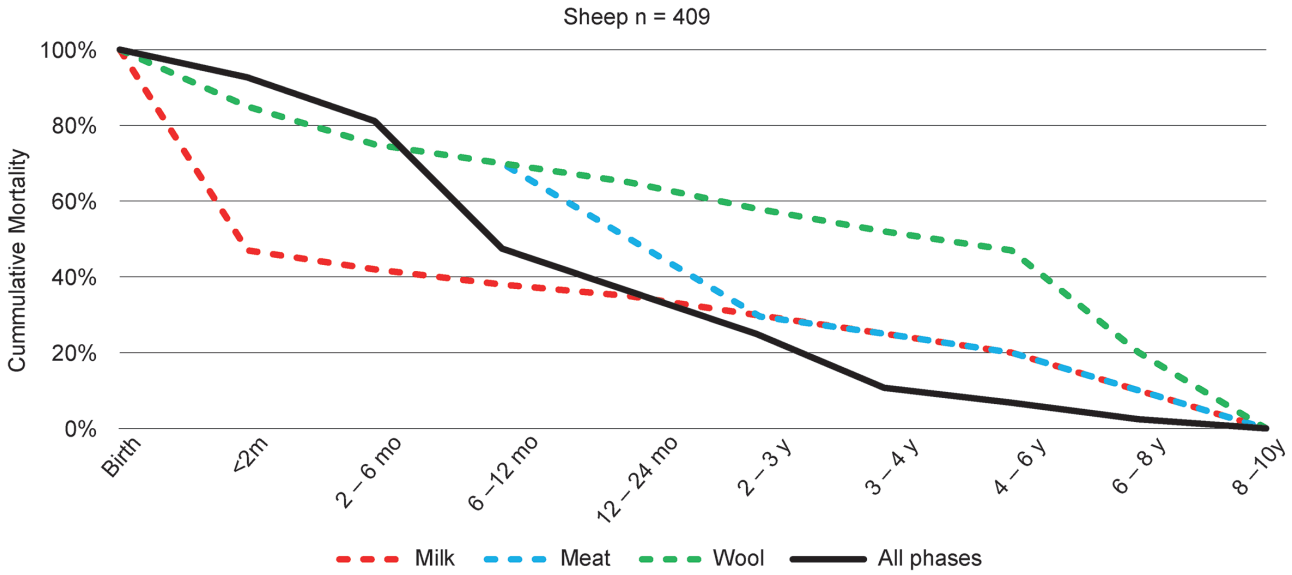


Figure 10.10. Sheep dental data: cumulative mortality by age group compared to production models (after Payne 1973).

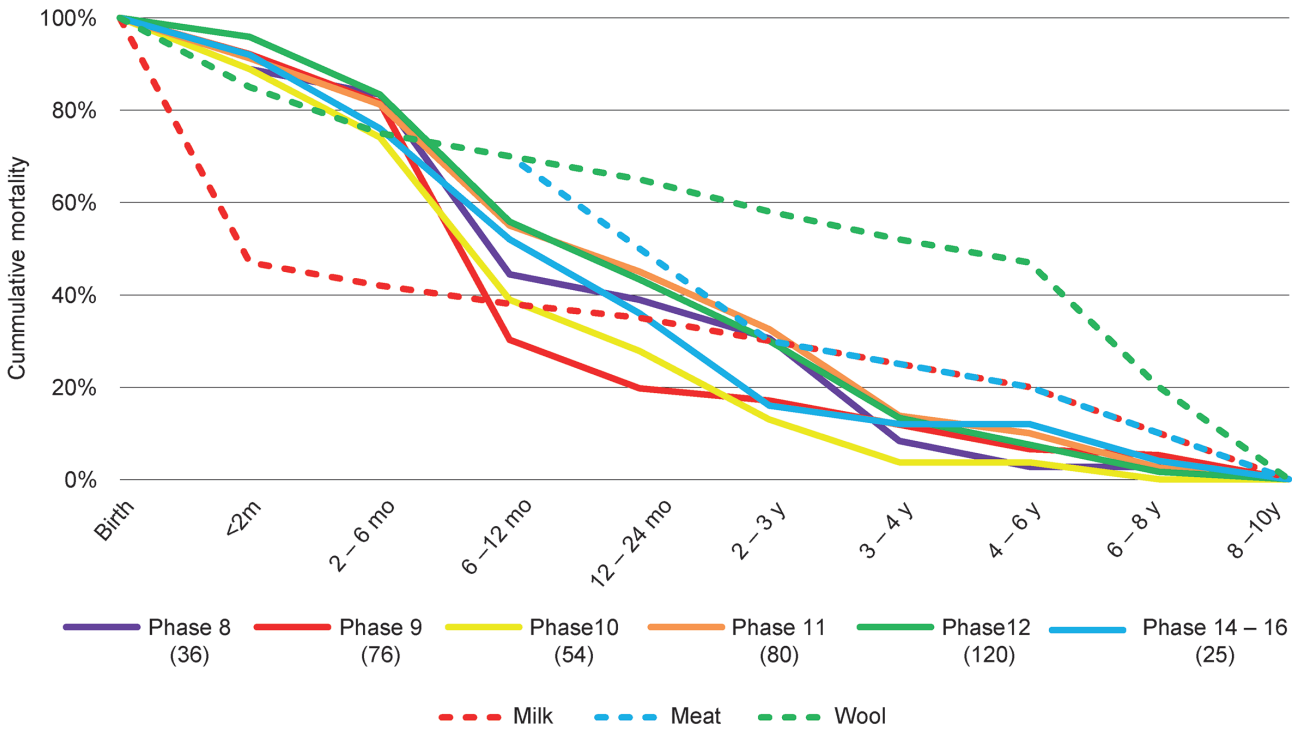


Figure 10.11. Sheep dental data: cumulative mortality by age group and phase compared to production models (after Payne 1973). The number of aged individuals per phase is noted in brackets

the highest rates of slaughter as occurring up to 1 year, a lower rate between 1 and 2 years, and then an increase between 2 and 3.5 years. The smallest sample from Phase 13 (excluded from analysis of mandibles and not shown in Figure 10.11) stands out as rather different, with more animals dying in the first year, followed by a low rate of mortality.

On average, around one-fifth of all fused information is derived from neonatal material; this is a higher figure than either the mandibular data (7%) or the MNI for neonates at 8% (Table 10.8). This reflects the different properties of this grouped dataset since the presence of neonatal skeletons (*e.g.* SF 3690 and LAN 83 in Phase 11) can bias the fusion data.

Sheep sex

Over twice as many female as male sheep have been morphologically and genetically identified, with a ratio of 2.5:1 for adult females to adult males (Table 10.7). It is interesting to note that the sheep found within House 401 as disarticulated bone groups are all female and about 2 years of age, a prime age for meat

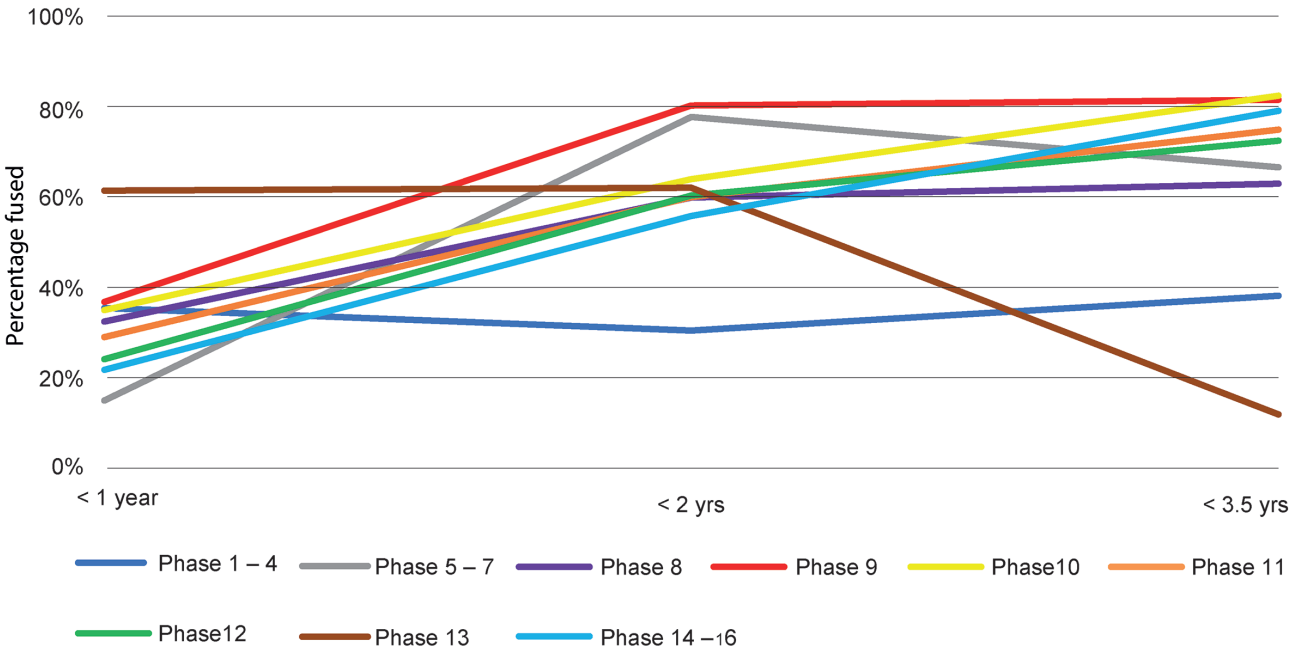


Figure 10.12. Sheep percentage of unfused bone by age group and phase

production. If we assume that the sample of sexed and aged material is representative of the flock overall, there is a bias toward the slaughter of young males. In most animal management systems, male animals are surplus to requirements and, unless castrated, will be harder to manage and may limit attempts to improve the herd.

Cattle herds

There are 250 individual age stage records for cattle, calculated from left and right mandibles. Dividing this assemblage into lefts and rights produces a number similar to the MNI of 114 (Table 10.6) therefore most cattle deposited on the site are represented in this dataset. The body of data for fusion includes over 1,700 records across all phases. The small number of specimens from Phases 1–4, 8 and 13 precludes their analysis.

Cattle dental ageing: overview

Given the large size of the dataset, only material assigned to a single age category was used in the analysis. The mortality pattern from all phases combined (Figure 10.13) is compared with two models: a hunted aurochs population (Helmer and Monchot 2006) and a milk-focused population from Grimes Graves (Legge 1992). Cladh Hallan has an initial higher death rate than both models, with a high

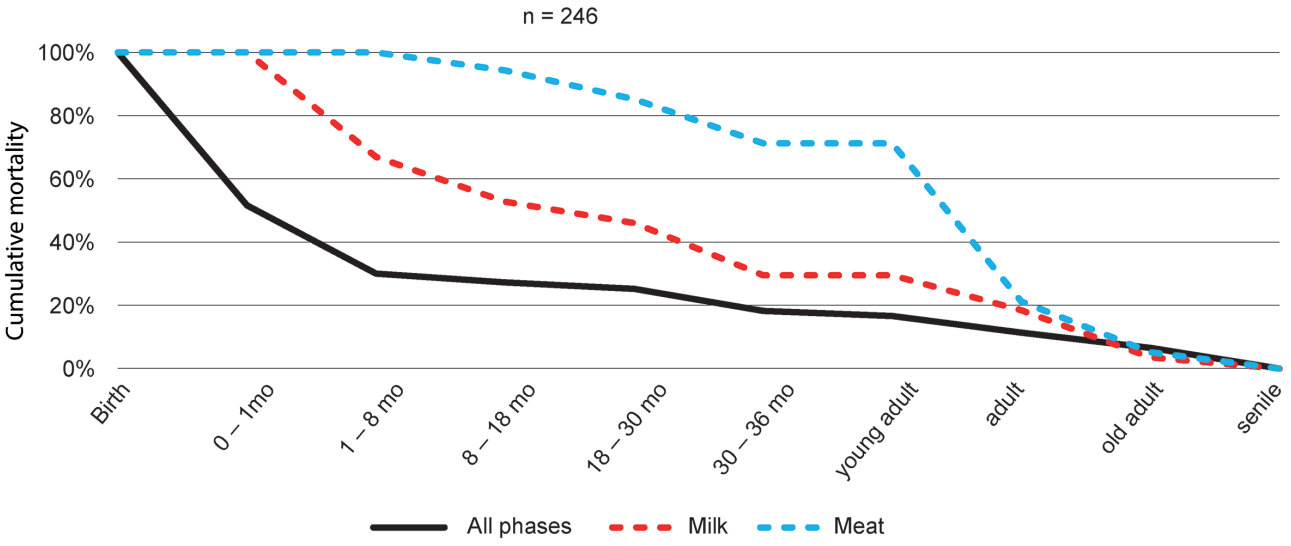


Figure 10.13. Cattle dental data: cumulative mortality by age group compared to production models (after Legge 1992; Helmer et al. *2005)*

rate of neonatal mortality. These neonates are represented by numerous deciduous premolars, both loose and in mandibles, in very early stages of wear (Grant 1982: stage A or B).

Cattle dental ageing: over time

A detailed comparison of data can be undertaken for Phases 8–12 and 14–16 as these meet the minima of 15 ageable items. The high level of neonatal deaths in all these phases is in sharp contrast to the sheep population but is mirrored in the deer assemblage (see below).

Phases 8–12 have a similar pattern, suggesting that during the main house occupation phases a consistent system of cattle husbandry was in place (Figure 10.14). Most individuals died young, with between 40% and 60% of animals dead within the first month, and up to 75% before their first winter, the remaining individuals dying as older adults.

The smaller dataset (n = 20) available for Phases 14–16 (the final occupation of House 401 and the use of House 150 and latterly House 640) has a different age profile. Fewer animals died in the first month of life and the mortality profile closely resembles the milking model from Grimes Graves (Legge 1992). This different pattern is, however, not reflected in the fusion datasets (see below) and may be related to the phase group's small sample size.

Cattle fusion evidence: across time

The assemblages from Phases 1–7 and 13 are too small for detailed analysis. The phases vary, with increasing numbers surviving their first year, with around 70% of bone unfused in Phase 9 and 10, falling to around 40% in Phases 12 to 16 (Figure 10.15).

Fusion evidence for neonatal bone slightly exceeds the proportion in the associated dental dataset, with an average 40% of all material with fusion information being neonatal (Table 10.8). This is a similar figure to the mandibular data (48% average for all phases) and the proportion of neonates calculated from MNI (40%).

Cattle sex

For cattle, the combined sex data indicate a ratio of 3:1 female: male (Table 10.7). The morphological sexing suggests a higher ratio in the adult population, and this is confirmed by the age analysis which points to a higher death rate in young males. This selection of younger males for slaughter in is line with the production model focused on milk, although other interpretations have been suggested for this sex bias (McGrory *et al*. 2012).

Deer herds

The dataset for red deer ageing is substantial, with 87 red deer individual mandibular estimated age stage records. Dividing this figure in half to allow for lefts and rights produces a figure somewhat lower than the MNI of 60. This indicates that despite the inclusion of loose dp4s and M3s, fewer individuals can be identified than by the zone data. Only three phases (Phases 9, 11 and 12) have more than the minimum of 15 items. The body of data for fusion includes nearly 600 records across all phases, but only Phases 11 and 12 have more than the minimum sample size of 50.

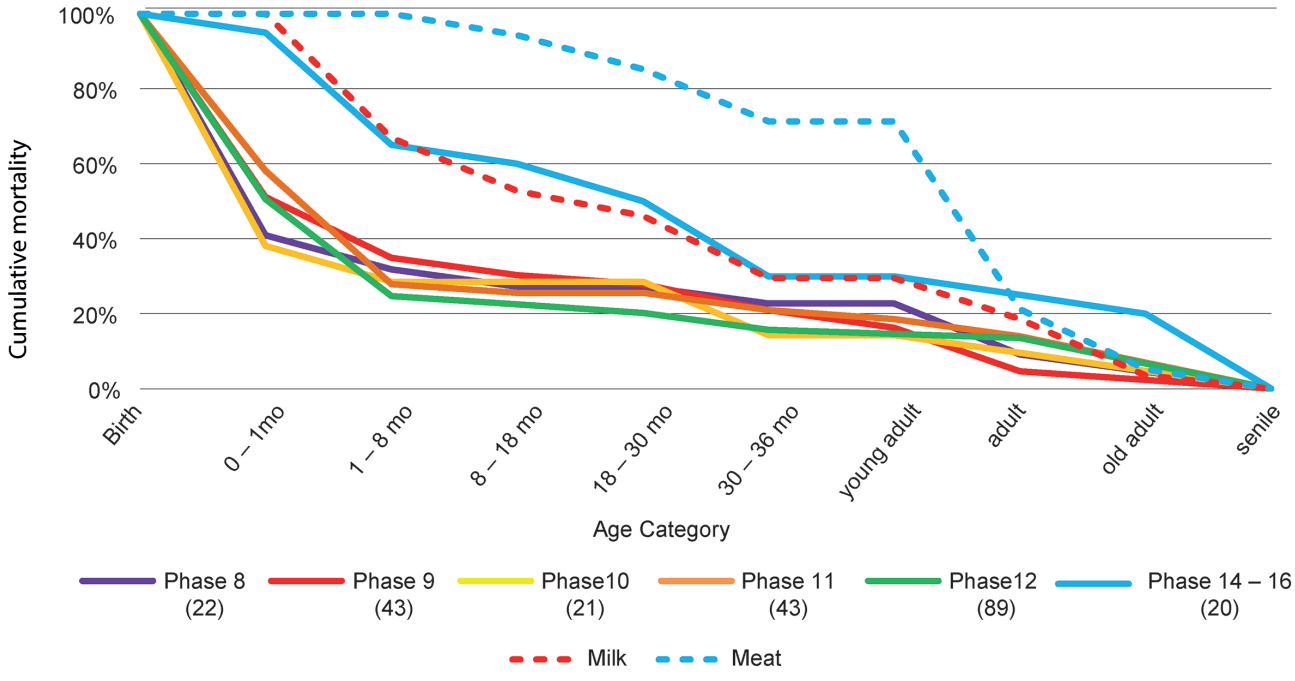


Figure 10.14. Cattle cumulative mortality by age group and phase compared to production models (after Legge 1992; Helmer et al. *2005). The number of aged individuals per phase is noted in brackets*

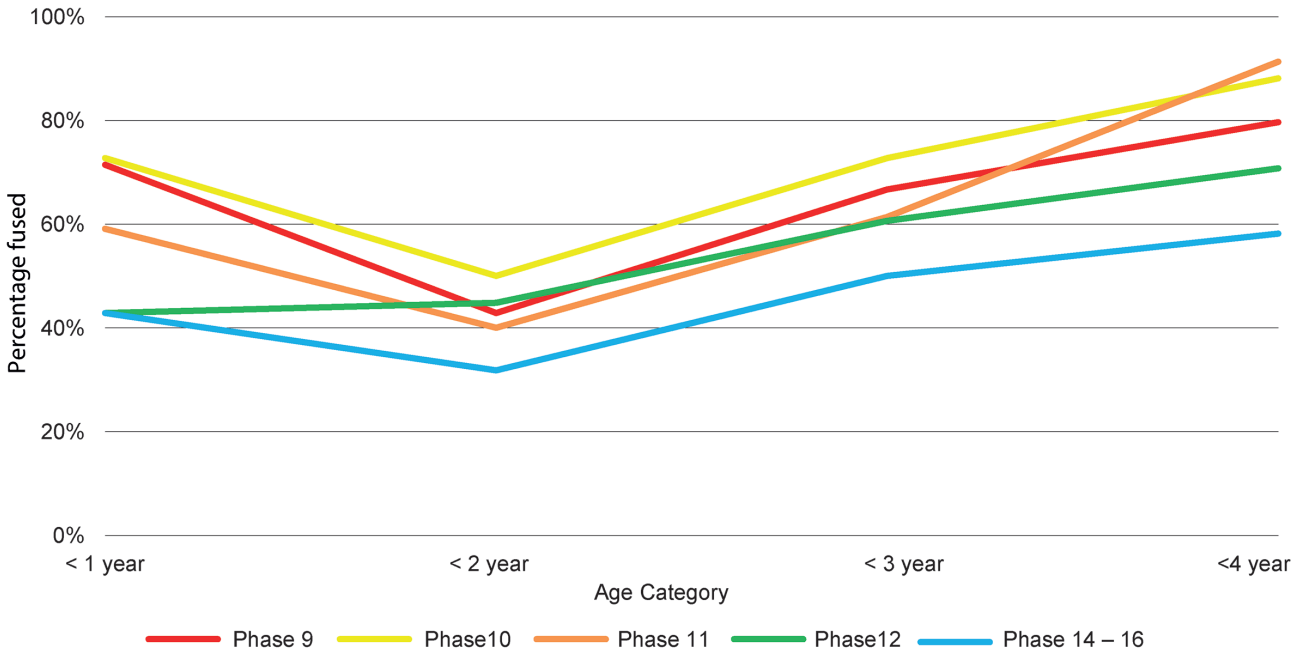


Figure 10.15. Cattle percentage unfused bone by age group and by phase

Red deer dental data

The deer culling strategy exhibits significant consistency over time, as depicted in Figure 10.16. Analysis of combined data from all phases reveals that between a half and a third of deer perish as neonates (under 5 months) in each phase, averaging at 37%. This pattern of slaughter resembles that observed in cattle (averaging at 50%) rather than in sheep (averaging at 10%), which is notably uncommon. The arguments attributing neonatal deaths to natural causes, as seen in domestic species, have also been employed for red deer herds, for example the deer on Rum (Clutton-Brock *et al*. 1982). The causes of this observed mortality in red deer would have been diverse (stillbirth, feeding difficulties, abandonment, accidents, eagle attacks) and it is unlikely that these dead calves were selected for transportation to the site. The evidence suggests that these very young animals were explicitly targeted and utilised. Procurement of red deer continued with a focus on immature/juvenile individuals, with more deaths occurring among sub-adult/adult prime

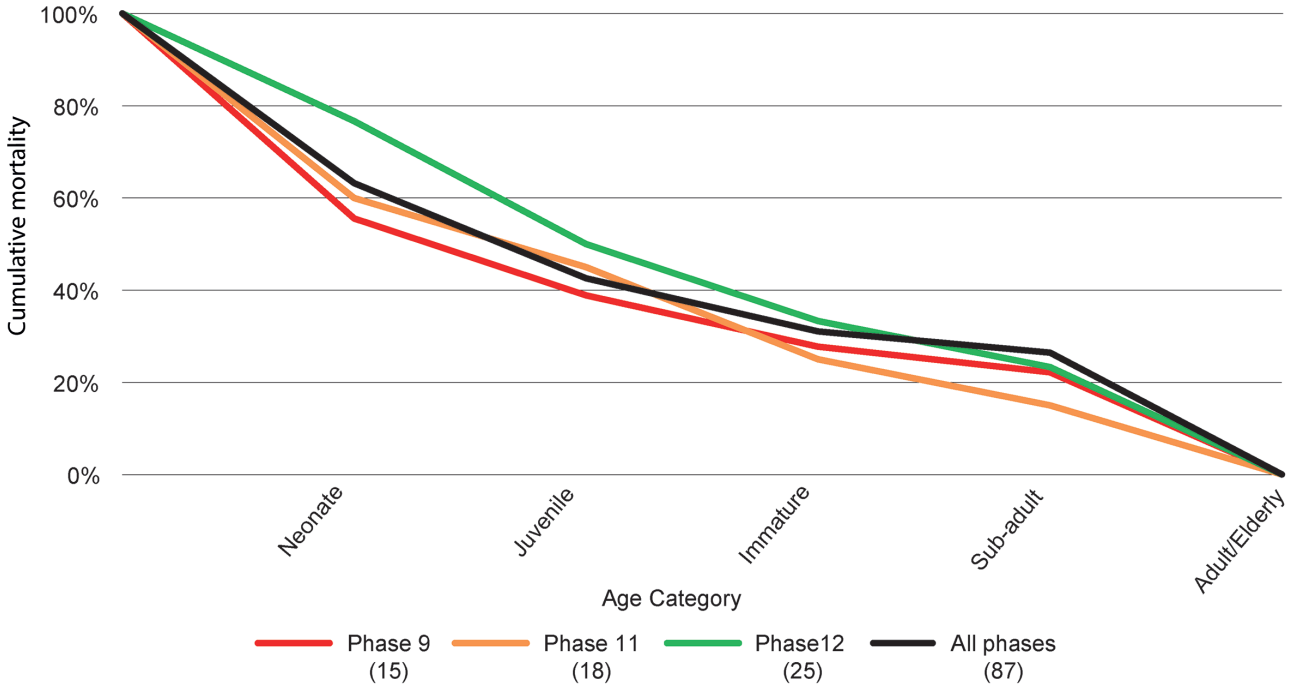


Figure 10.16. Red deer dental data: cumulative mortality by age category (adult is >3 years)

specimens. No elderly deer were detected among the mandibles examined. The preference for prime, and to a lesser extent sub-prime, animals in later phases hints at strategies aimed at maximising venison acquisition. Comparing the three larger phase assemblages (Phases 9, 11 and 12) indicates a slight decrease in emphasis on neonates over time, but overall, the strategy remains highly consistent.

Red deer fusion

Fusion data indicate a similar culling strategy to that for sheep, with an average of 35% of the earliest fusing bone unfused (Figure 10.17). There is an increase in death rate between 1 and 2 years (immature to juvenile) and the low proportion of unfused bone in the later ages reflects the focus on the slaughter of adult animals. The four phases with assemblages large enough to be compared in detail have similar patterns.

Fusion evidence for neonatal bone slightly exceeds the proportion given in the associated dental dataset, with an average 22% of all material with fusion information being neonatal (Table 10.8). This figure is lower than both the percentage of neonates indicated by the mandibular data (37%) and the proportion of neonates in the MNI population (31%). This discrepancy suggests that there are biases in these data, with less neonatal bone than teeth recorded.

Red deer sex

Sexing information on red deer relies on antler, annually produced and shed by males from around 2 years of age. This material is preferentially collected for use and its presence is hard to relate to herd population structure. There is a bias towards the preservation and identification of male skulls with antler-bearing robust pedicles and no non-antler bearing skulls for males or females were reported. Seven incidences of unshed antler still attached to pedicles suggest the hunting of males. A single red deer petrous examined for aDNA indicates the presence of an adult male in Phase 4 (Table 10.7). There is also a single worked red deer canine; these teeth are present in both sexes but those in male deer are larger and easier to work (Choyke 2001) so this probably also indicates the presence of a male.

Red deer antler ageing

Antler can provide age estimates by examination of both their size and shape, for increasing complexity of branches. Many of the more complete antlers have been adapted or utilised as picks or other tools and are therefore missing parts. It is apparent that, in the majority of antlers found at Cladh Hallan, the bez tine had developed. This appears at stages E or F in Schmid's (1972) classification, and indicates the deliberate selection of larger, stronger well-developed antlers. This mirrors the pattern seen at numerous British Neolithic monuments, for example Stonehenge and Avebury (Worley *et al*. 2014).

Pig herds

Dental and fusion data

The small number of pigs at the site produced only eight cases of dental ageing. The majority are sub-adult animals,

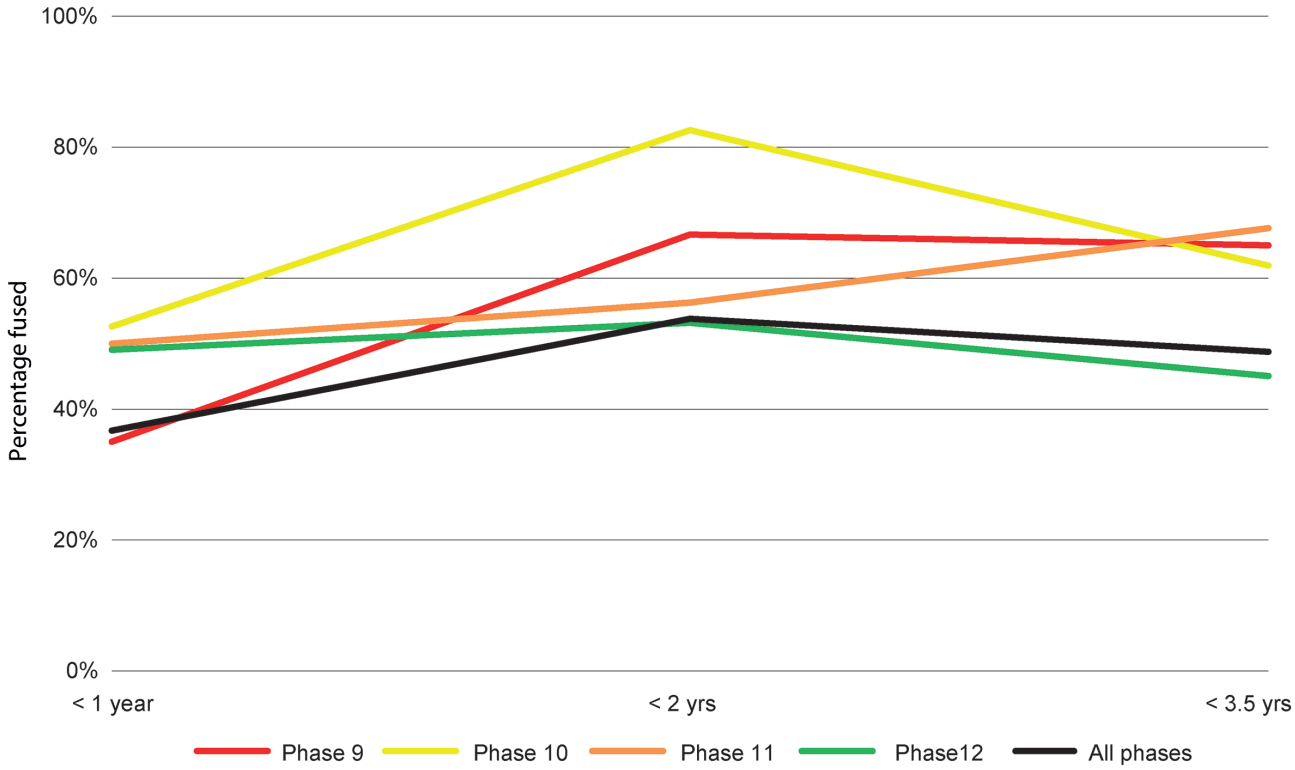


Figure 10.17. Red deer percentage of unfused bone by age group and by phase

Figure 10.18. Pig percentage of unfused bone by age group for all phases

with a single adult and an immature specimen. Fusion information was recorded for only 88 incidents, which precludes any detailed analysis. A summary of data from all phases (Figure 10.18) demonstrates that most bone is unfused (76%) with a few animals surviving until adulthood (3 years). Less than 30% of remains are neonatal but the presence of new-born animals suggests breeding on site. Pigs can breed early, becoming sexually mature at 4–5 months, thus a skeletally immature population can persist.

Pig sex

Analysis of the proportion of male to female teeth indicates a predominance of males. This may be a result of an interest in larger adult male teeth for ornamentation although lower canines from both a male and a female are represented in the worked bone assemblage. The former (SF 3539) is a section of enamel exterior, and the latter (SF 3355) is notched for attachment to a cord.

10.10 Butchery by species

As noted above, butchery marks are found on all the food species. Sheep, cattle and red deer were all butchered to the same degree, with an average of between 6% and 7% of bone bearing marks. The small sample of pig bone has slightly less butchery, with just 4% of bone bearing marks.

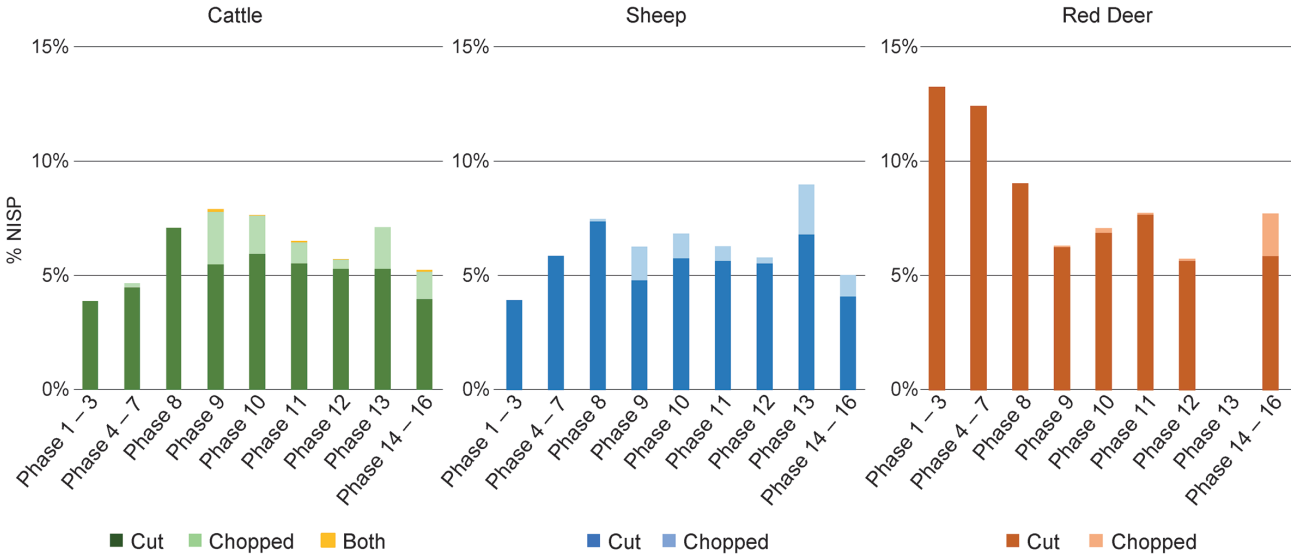


Figure 10.19. Percentage of butchered bone by phase/phase group

The proportion of butchery varies slightly across the phases (Figure 10.19) but is biased by smaller sample sizes (for example, for red deer in the early phases).

Cut-marks are more common than chop-marks, the latter present on only 1% of material in all species. The type and placement of the marks demonstrate a range of processes including skinning, disarticulation and filleting. The low prevalence of marks on such well-preserved bone suggests skilful butchers. Of note is the low proportion of chop-marks on deer bone, which may relate to the processing of carcasses away from the settlement and to access to heavy-bladed tools.

The proportion of butchered bone in the neonatal assemblage, calculated from all material identified as neonatal on fusion and/or texture and/or size, is slightly less than that in adults, with 4% of sheep, 3% of cattle and 3% of deer showing marks. There was one butchered axis in the 10 neonatal pig elements. As for adults, the proportion of chop-marks is lower, with only 1% showing the use of heavier blades compared to 2% to 3% showing finer cut-marks. The similarity in proportions indicates that these young animals, despite having smaller bodies unlikely to require major division for food preparation and consumption, were processed to a similar degree.

10.11 Body part analysis

For each of the major food species, the relative abundance of each element (MNE) was calculated for the entire assemblage. As the number of neonatal specimens recovered is high, the same calculation was repeated for foetal/neonatal data alone (in *italics* in Table 10.9). This assists with understanding the relative quantities of food – or other products – contributed by each species. This data is summarised in Table 10.9 which shows the MNI and the most common element for each phase/phase group. Those with a MNI of one do not have element information included.

The abundance of body parts is affected by the age at which individual elements are fully fused and are therefore more robust. At Cladh Hallan the higher proportion of immature bones of cattle and pigs, and to a lesser extent of deer, would affect body part representation if there were poor preservation. Thus, a lower abundance of later fusing elements – the proximal humerus, ulna, tibia, distal radius and femur – would be expected. Instead, however, the presence of these body parts even within neonatal specimens reveals good levels of preservation whilst the zone-recording method ensures that the data are not biased. Butchery practices also affect fragmentation; as noted above, the larger cattle elements are more commonly butchered and more highly fragmented than sheep, so their remains are less abundant.

The following sections present the relative abundance of body parts for sheep, cattle and deer with the proportion of each element/element part (adding up lefts and rights) expressed as a percentage of that expected from the MNI (*i.e*. two times the MNI for paired elements) for each of the phases/phase groups. The larger datasets for cattle and sheep are presented by phase, but a phase with less than 15 MNI should be treated with caution. Red deer and pig have too few specimens for a detailed analysis and are only represented as summary data. Note, analysing all phase data as a single group results in a smaller MNI than adding the totals for each phase.

By plotting lefts and rights separately for each phase, it was possible to show that there was no bias on side selection for any phase or species.

Sheep

The MNI for all phases is 366 individuals. Phases 1–3, 4–7 and 13 each have a MNI of under 15 (Table 10.9) so, the body part data for these may be affected by small sample size. The most common element overall is the mandible, and the least are the head, the neck and the phalanges (Figure 10.20).[4] For the head and neck, whilst skulls often fragment, the recording of dense elements (*e.g*. the occipital) should overcome this bias but bones of the neck may have suffered fragmentation during butchery. The relative abundance of the mandible suggests that it, along with the skull and accompanying neck vertebrae, were treated differently to other elements. In addition to the mandible, some of the rich meat-bearing bones such as the radius and scapula are also common. Over time there is a change, with greater representation of the lower limbs, in particular the hindlimb (*i.e*. distal tibia, astragalus, calcaneum and metatarsal). This suggests recovery of more bones from excavated contexts in later phases that relate to waste/midden deposits.

Cattle

The total MNI for all phases is 114. For body part analysis, only Phases 9–12 have a MNI over 15 (Table 10.9) and the other phases' distribution is likely to be affected by sample size. As for sheep, the mandible is most abundant (Figure 10.21). Elements are evenly distributed but are less well represented, which may be due to greater fragmentation of the larger cattle bone. Bones of the head and neck are more common than for sheep but remain rare, except in Phase 11. Scapulae are also abundant. As noted previously, these elements are employed as tools, with cattle scapula shovels recorded from many phases (see catalogue in Chapter 3). Overall, the small number of reported tools is unlikely to have a major impact on assemblage proportions. Elements of the lower limb and feet are common, with the larger cattle phalanges recovered in greater numbers than those of sheep. As noted elsewhere, there are very few adult cattle, and this is likely to affect the pattern of carcass usage and fragmentation.

Red deer

The smaller red deer assemblage has less than 15 individuals from each phase/phase grouping (Table 10.9) so the data are presented as a summary for all phases; this results in

a lower total MNI of 35 (Figure 10.22). This demonstrates that all parts of the body were brought to the site over time. As for sheep, neck vertebrae and phalanges are less common, again possibly due to fragmentation associated with head-removal and to the smaller size of deer phalanges compared with cattle. Deer head elements are present but are not dominated by mandibles to the same extent as domestic cattle and sheep.

Deer exhibit a high proportion of the earlier fusing prime meat limb bones, including the scapula, humerus, radius, and the late fusing proximal tibia. This suggests greater selectivity in body parts deposited at the site, as would be expected for a population of hunted animals since entire carcasses would not necessarily have been brought back to the settlement from the kill sites. The presence of metapodials and phalanges indicates that elements with low meat value were not removed at hunting sites prior to transportation to the settlement. This may have been because deer metapodials are a valuable resource for creating bone tools, present in the worked bone assemblage (*e.g.* SF 3633; see catalogue in Chapter 3).

Pig

There is a maximum of three pigs represented by MNI in any one phase (Phase 11) (Table 10.9) and a combined

Table 10.9. Relative frequency of major food species (neonates in italics) by phase (MNI)

Phase	Sheep		Cattle		Deer			Pig
	MNI	**Body part**	**MNI**	**Body part**	**MNI**	**Body part**	**MNI**	**Body part**
1–3	9	Mandible	2	Femur/tibia	2	Metatarsal	1	N/A
	1	*N/A*	*1*	*N/A*	*1*	*N/A*	-	-
4–7	12	Radius	5	*Mandible*	2	Humerus/ radius/ metacarpal	1	N/A
	1	*N/A*	*3*	*Astragalus*	*1*	*N/A*	-	-
8	27	Radius	9	Scapula	4	Scapula	2	Radius/ulna
	4	*Humerus*	*4*	*Pelvis*	*1*	*N/A*	-	-
9	62	Mandible	17	Mandible	11	Tibia	2	Atlas/scapula/femur/ astragalus
	12	*Scapula*	*7*	*Mandible*	*3*	*Humerus/ radius*	-	-
10	57	Mandible	17	Mandible	8	Pelvis	2	Mandible/ humerus
	8	*Scapula*	*10*	*Scapula*	*5*	*Pelvis*	-	-
11	74	Radius	17	Mandible	8	Scapula/pelvis	2	Atlas/femur
	6	*Metacarpal*	*8*	*Pelvis*	*4*	*Scapula/pelvis*	-	-
12	80	Scapula	27	Mandible	14	Humerus	3	Humerus
	8	*Humerus*	*7*	*Pelvis*	*3*	*Humerus/ radius/pelvis*	-	-
13	13	Astragalus	8	Mandible	2	Scapula/femur/ tibia	1	N/A
	2	*Humerus/ radius/ tibia*	*2*	*Humerus/ulna*	*1*	*N/A*	-	-
14–16	32	Astragalus	12	Scapula	9	Scapula	2	Tibia
	5	*Tibia*	*4*	*Humerus/ulna*	*4*	*Scapula*	-	-
All phases combined	366		114		60		16	
	48		*46*		*23*		-	

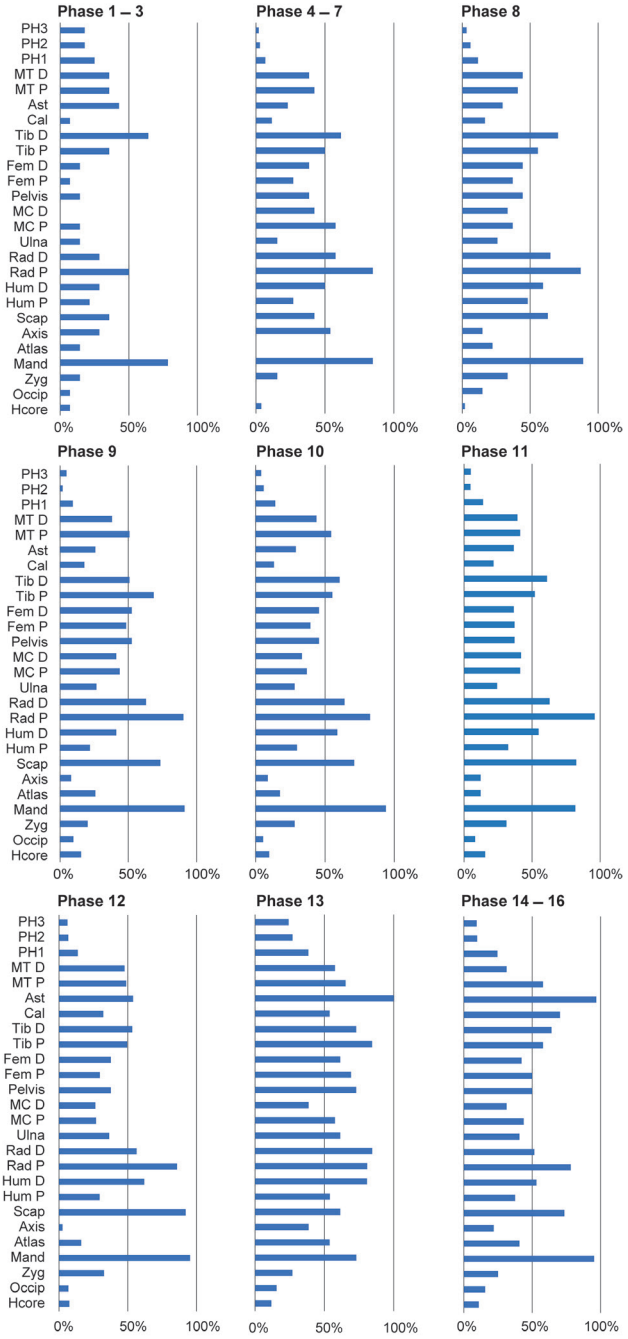


Figure 10.20. Sheep relative abundance of elements by phase

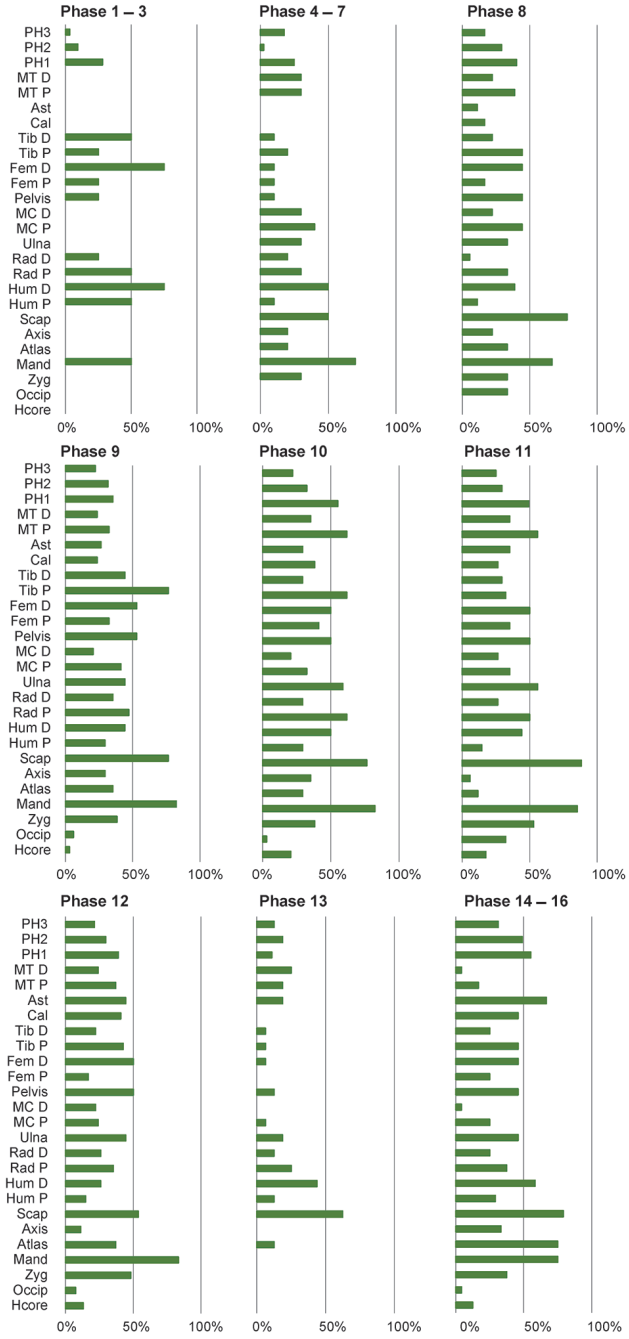


Figure 10.21. Cattle relative abundance of elements by phase

phase total MNI of 11 (Figure 10.23) and the body part distribution will be affected by the small sample. The relative abundance of pig elements for all phases (Figure 10.23) indicates that all body parts are present but in low proportions. The humerus – a prime meat-bearing bone – is the most common and dominated by right-hand elements (11 right:3 left), but all elements are present in similar numbers. Although there is a slightly lower representation of head elements, the presence of all bones suggests that entire animals were kept at the site and that, despite the small number of animals, pork was produced from local animals. The predominance of right-hand side elements is interesting in the light of biases seen at other sites (*e.g.* Llanmaes, Vale of Glamorgan; Madgwick and Mulville 2015).

10.12 Minor species: domestic resources

Dog

There are 375 fragments of dog recorded (Table 10.2). Whilst rarer than most food animals, they are more common than pigs. Dogs appear from Phase 6 onwards (in the Late Bronze Age) with a MNI of one for Phases 6, 8, 9 and 13, and two in Phases 10 (most elements are associated with the fore and hindlimbs of one lame dog), 11 and 14–16.

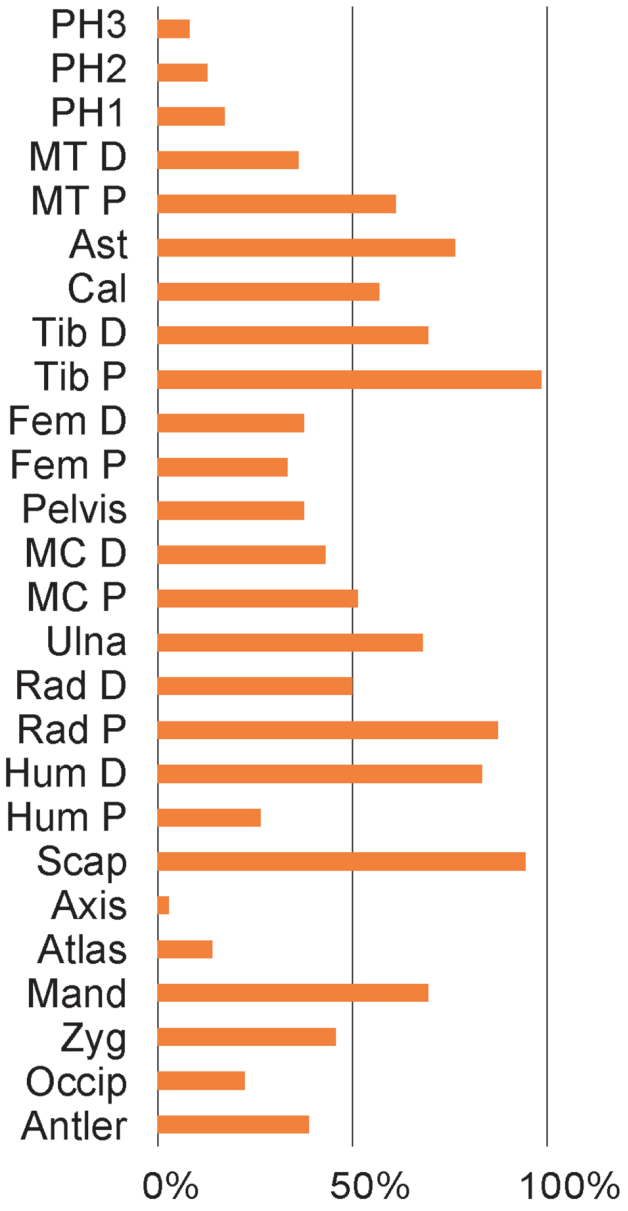


Figure 10.22. Deer relative abundance of elements for all phases

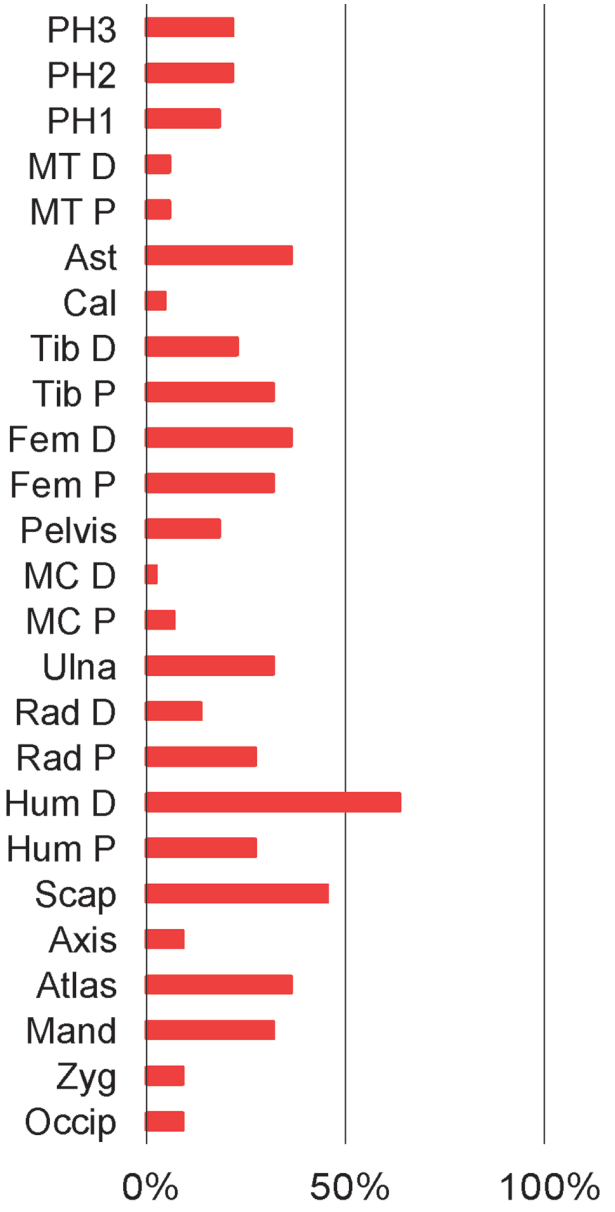


Figure 10.23. Pig relative abundance of elements for all phases

The highest numbers are in Phase 12, where evidence for three individuals (including two dog burials, SF 3376 and SF 3380) was recovered from within House 401.

Overall, a range of elements are present from the skull to the phalanges with the radius the most common element. Figure 10.24 combines all dog data into a single chart with a combined MNI of 5. No sexing information (such as the *os baculum*) was recovered. The only notable side bias was among metapodials (metacarpal 2:3 left:right, metatarsal 17:1). This partly reflects the presence of the right-hand foot bones in skeleton SF 3380 and an articulating separate foot (LAN 87) with only one left-hand metatarsal present. Whilst the recording method does not include loose dog teeth (*e.g.* canines) in quantification estimates, they have been included in descriptions where appropriate, for example in association with skulls, burials or as artefacts (*e.g.* SF 3406).

The presence of numerous articulating elements indicates that either a small number of individual animal burials were disturbed or that limbs, particularly the feet, of canids were treated differently. Only four dog bones bear any butchery marks; marks on an astragalus from a partial burial (SF 3626 in Phase 10; see below) suggests that this animal was skinned. There is also a rib and an ulna from Phase 11 that may be indicative of flesh removal. Some dog bones were worked, with a metatarsal formed into a point (SF 2013 from context 423, a fill layer in the northeastern area) in Phase 12 and a left lower canine made into a pendant (SF 3406 from House 401) in Phase 13.

Dogs are rare on Neolithic sites in the Western Isles. In Orkney, only a few bones have been reported in the larger faunal assemblages from Neolithic settlements, and this is

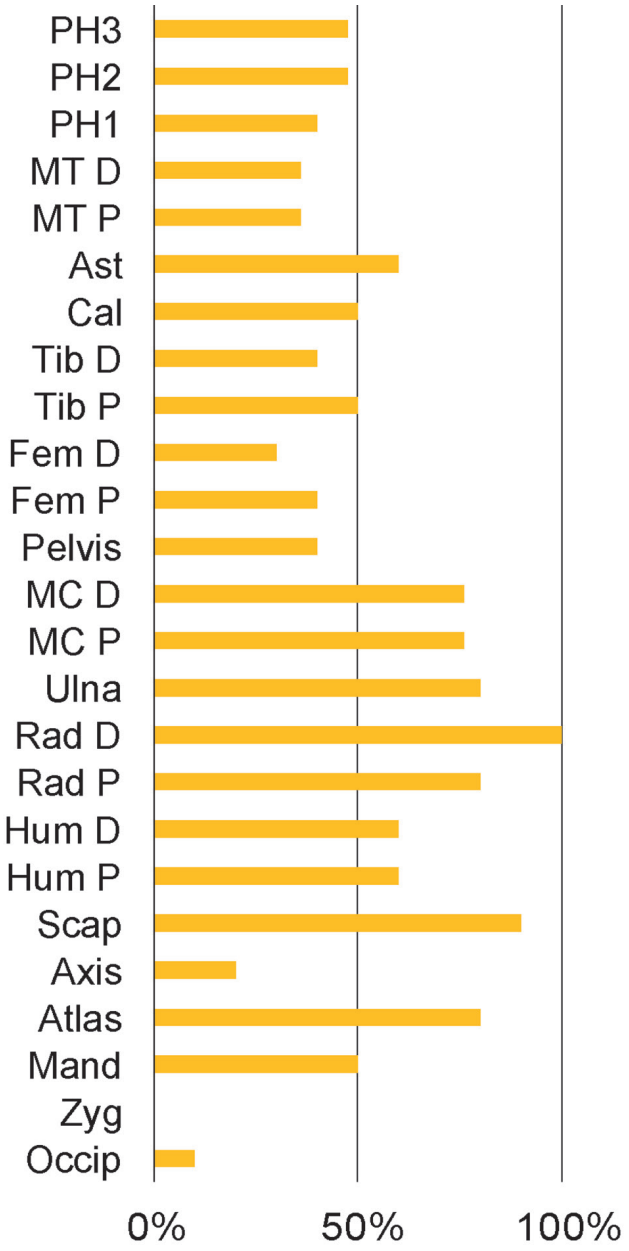


Figure 10.24. Dog relative abundance of elements for all phases

reflected in low levels of canid gnawing; however, they are present in some Orcadian tombs (Fraser 2015: 61, 172, 379). The earliest record of dogs in the Western Isles is a single bone and a tooth from a medium-sized dog from Neolithic Udal, North Uist (Finlay 1984; 2006). Single teeth are reported from Beaker-period Northton, Harris (Finlay 2006), Early Bronze Age Sligeanach, South Uist (Mulville and Madgwick 2012) and Late Bronze Age Udal (Serjeantson n.d.). The small but continuous dog population at Cladh Hallan therefore represents the largest collection of prehistoric canid material in the region and is the first evidence for a substantive population. There is slightly more material from Middle and Late Iron Age sites but with a maximum of only 10 elements. Despite the lack of dog remains, canid gnawed bone is commonly reported at most sites.

The Cladh Hallan animals are therefore unusual in their prevalence and their deposition. There are no other dog burials reported from the Western Isles in prehistory; in Orkney there is a possible disturbed dog burial from the Knowe of Yarso (Platt 1935: 341–3), with seven skeletons from Burray (Davidson and Henshall 1989) and a collection of – now mostly lost – skulls from Cuween (Charleson and Turner 1902: 733, 738). The latter have recently been dated to the end of the Late Neolithic or Chalcolithic (Sheridan 2005: 177) and these, alongside the dog burials at Cladh Hallan, point to a changing significance and abundance of this species. One of the Cuween dogs is described as large (Sheridan 2019) but, without long bone elements, no comparative withers heights can be calculated. Evidence from Cladh Hallan indicates that during the Bronze Age the Western Isles canid population included animals that fall at the largest end of the size range for this period (see below).

In addition to the burials, there are many articulated foot elements – tarsals/carpals, metapodials and phalanges – in the Cladh Hallan assemblage, with five sets recovered from Phase 12, the phase with the dog burials. The presence of these elements and the cut-marks on astragali may represent disturbance of the extremities of fresh articulated limbs/burials, or butchery associated with the use of dog skins, or the deposition of dog paws (as at Neolithic Windmill Hill, Avebury; Serjeantson 2011: 32). Dogs are found with human remains during the Iron Age and Roman periods in southern Britain, including a dog skin possibly used as a shroud (Booth *et al*. 1996).

Ageing

Ageing information indicates the presence of few immature individuals. A single foetal/neonatal humerus suggests that puppies were present at the site, whilst unfused material – a scapula, ulna, several metapodials and phalanges – indicate

Figure 10.25. Right and left maxillary canine wear of dog SF 3380

young animals. There are also fully fused mature animals, for example in the dog burials, indicating animals of over one year. Older, skeletally mature individuals can be aged using tooth wear, as employed in modern wolf studies (Gipson *et al*. 2000). Many loose recovered teeth also show significant wear and are likely to derive from older animals. It is possible to examine wear across the mandible and skull for dog SF 3380 to reveal differential wear across the dental arcades. Whilst the less worn incisors indicate an animal of around 2 years, the highly worn canines (with exposed dentine) and molars suggest an animal of 6–8 years (Figure 10.25).

Significant wear on the front of the maxillary canines and the back of the mandibular canines suggest abrasion between these teeth directly or on an object held between the canines. This type of damage has been linked to stick-chewing, sand in food or chewing due to confinement (Jansens *et al*. 2016: 1118). Isotopic evidence ($\delta^{13}C$) points to predominantly terrestrial food sources but with a small and possibly sand-contaminated marine protein contribution (see Chapter 18). The wear could be linked to changes in skull formation associated with the initiation of selective breeding in dogs at this time, however SF 3380 is the largest dog on site (see below) which suggests there has been little change to body shape. The large Cuween dog is also described as having very worn teeth (Sheridan 2019).

Body parts and butchery

Dog first appears in Phase 6 from the fill of a large pit (2401, beneath the forecourt of House 401) and consists of a pelvis, tibia and maxilla (MNI of 1). In Phase 8, a foetal/neonatal humerus was recovered from a pit (1792, beneath the entrance of House 801) with a loose upper molar in the sand wall core.

In Phase 9, a dog metacarpal came from the inter-floor layer (2210) in House 1370, and a left maxilla was recovered from the floor layer (1369) above it. In addition, a right maxilla was deposited within windblown sand (1149) in House 801. All of these could derive from the same individual. House 401's floors contained small fragments of right scapula, a metatarsal and left radius.

Phase 10 had a minimum of two dogs present. House 1370 yielded a few fragments of mandible, loose canines and foot elements, whilst outside were more loose canines and a couple of leg elements. House 401 contained fore and hindlimbs of what may have been a single, adult, lame dog. Parts of this animal – a right forelimb (radius and ulna; SF 2441) and a left hindlimb (femur to astragalus; SF 3626) – are from context 1443 (a hump in the northwest of floor 1308), with the matching right tibia/fibula (based on size and shape) in context 704 and a right femur found in context 800 (inter-floor fill layers) in Phase 11. A pattern of grooves, eburnation and new bone growth on the humeri and radius indicate that this animal had severe osteoarthritis. Transverse cut-marks across the dorsal surface of the astragalus indicate that the animal was skinned, and/or butchered to divide the carcass. The withers height of SF 3626 is of the size of a Dalmatian or German Shepherd, between 56cm and 61cm tall (see below). Other elements present include a second right humerus, a mandible fragment, an unfused metatarsal and tail vertebra. A loose lower canine from context 1644 (Phase 10 occupation layer, House 1370) shows significant wear and damage.

In Phase 11 there was again a minimum of two dogs, represented by upper left humeri. Within House 401, context 800 contained the right femur of dog SF 3626. Other elements from this layer derive from a front left limb but, as they do not exhibit similar pathology to dog SF 3626, they may derive from a different individual. Floor 655 produced numerous elements including an articulated left forefoot (SF 3490) and repeating front limb elements indicate more than one animal. Butchery marks on an ulna and rib suggest utilisation of the carcass for meat. Some canid remains were recovered from postholes within the house, including a complete right tibia. In the forecourt of House 401 fragments of an occipital and a maxilla in two different contexts indicate the presence of perhaps a single skull. House 1370 and the exterior south area of the site each produced a few elements. A first phalange was pathological with evidence of osteophytes on its distal end.

Phase 12 contained the greatest quantity of dog remains, with a minimum of three individuals present, based on the number of right scapulae. The majority of canid remains come from House 401 and its forecourt. Two articulated skeletons were excavated in pits east and northeast of the hearth (SF 3376 in pit 807 and SF 3380 in pit 1292; see *Key associated bone groups*, below). Only the trunk and front limbs of the smaller dog (SF 3376) were recovered in articulation; its head had been removed before burial. Dog SF 3380 was more complete, with the skull, trunk, forelimbs and left hindlimb present. Evidence of remodelling was found on one of its ribs, suggesting a healed fracture.

Height estimates suggest that dog SF 3376 was 52cm to 53cm high (Labrador size) whilst dog SF 3380 was larger, between 59cm and 69cm (Irish Red Setter size). The former is in the expected height range for canids in the Iron Age (Harcourt 1974: 151) but SF 3380 is exceptionally large for a prehistoric dog (Clark 2006). A smaller right astragalus from fill layer 659 (below the Phase 12 floor) had an osteochondroma lesion on the distal end. This element does not match dog SF 3380 and bears cut-marks associated with skinning/disarticulation.

Articulated fore and hind feet were recovered from within and outside House 401 in Phase 12. Right forefoot elements from the forecourt area (context 457) match the missing paws from the dog SF 3376 but cannot be confidently linked to this specimen. Other parts of right forefoot and left hind feet were found in House 401's floor (595). To the north of House 401, a maxilla was found in a layer north of the abandoned House 1370 (2090, covering pit 2086), with the mandible, and a metatarsal, found in layer 1441 above House 2190 in the south end of the excavated area. Other material from Phase 12 comes from the northeastern part of Area A: a robust occipital,

a mandible with a very worn second molar and an upper canine (context 474) and the worked metatarsal mentioned above (SF 2013, context 423).

In Phase 13 the number of dogs falls significantly, and specimens were found only in House 401, the majority within the inter-floor layer covering the previous floor (663) and contexts 465=585 (floor and hearth). The bones include a right humerus, metapodials, phalanges and a pierced and notched lower left canine pendant (SF 3406), which suggests that some of these teeth may have been sought for decorative purposes. The only other item is a dog premolar found in a stakehole inside House 401 (486).

In Phase 14, five dog elements were recovered – three metacarpals, a complete radius and a dog caudal vertebra – from the inter-floor fill and the floor (463 and 462) of House 401. Phase 15 produced a single metacarpal from House 401. In Phase 16, an ulna and a phalange were deposited in House 640 (in addition to a very worn upper canine, not quantified), whilst finds from within House 150 include an unfused scapula and a small fragment of gnawed ulna.

Cat

The Late Bronze Age cat remains from Cladh Hallan are the earliest recorded from the Western Isles. The elements are few: a vertebra and an unfused right femur from a layer of hearth ash (926) in Phase 9. Within the wider assemblage is a canine (not included in quantification) recovered from a layer (412) outside House 401 in Phase 11. Cats are rare on all British archaeological sites and, given the difficulties in separating species, the elements present at Cladh Hallan cannot be identified as either the larger wildcat (*Felis silvestris*) or the smaller domestic cat (*Felis catus*). Cats, including some larger specimens, are reported from Middle Iron Age insular sites (*e.g.* Sligeanach [Mulville and Madgwick 2012] and Dun Vulan [Mulville 1999: tab. 10.31]) and Late Iron Age Bornais (Mulville and Powell 2012). Domestic cats are thought to have been introduced to Britain in the Iron Age during the third century BC (O'Connor 2007) so the Cladh Hallan bones are likely either to derive from a local wild cat population (whose existence is hard to demonstrate) or to have arrived at the settlement attached to traded pelts.

10.13 Minor species: terrestrial wild resources

Other than red deer, there are few records of wild terrestrial animals with roe deer (*Capreolus capreolus*) and otter (*Lutra lutra*) present in small numbers.

Roe deer

The roe deer identifications remain tentative, with a high proportion of the 29 specimens unfused/young and/or gnawed and/or very fragmentary. Many are only a single zone and could therefore be bones of small sheep. Until further identification (such as by biomolecular techniques) can be undertaken, these identifications should be considered tentative.

Roe deer remains are reported from Phase 6, within pit 2401: an ulna fragment and a metapodial distal epiphysis. Layer 2883 (filling House 3260) in Phase 7 has a possible unfused scapula. House construction contexts in Phase 8 produced a scapula shaft, a humerus epiphysis, a foetal radius, and two fragments of tibia shaft. From Phase 9 there is a small piece of a neonatal mandible, an ulna shaft and a tibia fragment. From Phase 10 there are two relatively complete scapulae – one fused, with a cut-mark, and one unfused – and a calcined calcaneum, whilst an antler beam fragment was identified as belonging to roe deer.

Phase 11's roe deer bones consist of a small fragment of mandible, scapula, a charred calcaneum, an astragalus and a first phalanx. In Phase 12 a sand deposit in the northeastern area (473) contained a gnawed and cut pelvis (zone 5) and a section of metatarsal shaft, whilst layer 470 (peat ash above 473) has a gnawed mandible and a tibia. Other elements in this phase include two left ulnae, one gnawed and a calcaneum.

The scarcity of roe deer remains is hard to reconcile with an endemic population even though they are reported, albeit in the form of a very few fragments, from the Beaker period onwards (Mulville 1999). These include an antler tool from Northton (Finlay 2006) and the neonates recorded in the Cladh Hallan assemblage from Phases 8 and 9. Roe deer are not historically reported in the islands: the closest historic populations were on Skye and other Inner Hebridean isles (*e.g.* Whitehead 1964).

Otter

Otters are represented by 14 specimens, concentrated in Phases 11 and 12. Phase 9 contained a cut humerus shaft and an unfused metapodial in the floor (1311) of House 401. In Phase 11 a trio of complete, fused metapodials were found within a deep sand layer (412) in the southwestern part of Area A. A phalange was recovered from a wall cut fill (726; House 401) and a maxilla (with slightly worn teeth) from a gully fill (753; House 401 forecourt).

Another maxilla was recovered from hearth ash in Phase 12 along with most of a right ulna (from layer 473, peat ash) and a fragment of right femur (from layer 737, east of House 401). Nearby layers 470 (peat ash) and 740 (east of House 401) contained an adult mandible and an external left pelvis respectively. The Phase 12 floor (595) in House 401 contained a right fused metacarpal. In Phase 13, a peat ash layer (that also contained dog bone) produced a single toe bone. In Phase 15 a left molar was also noted (not included in quantification).

Otter is scarce on contemporary Hebridean sites (Mulville and Powell 2012: 194) although they are known to have been exploited historically for their fur. The low numbers of bones from Cladh Hallan suggests that otters were not often targeted but were still considered of some value. The numbers of limb bones, as well as extremities, suggest that occasionally entire carcasses were taken

back to the settlement. The majority were adults and the abundance of head and toe elements, and the cut-marked humerus, are consistent with use of their dense fur, as reported elsewhere in Atlantic Scotland (Fairnell and Barratt 2007).

Minor species: marine wild resources

Seal is the only marine mammal discussed in this chapter (Cetacea are in Chapter 11) and they account for only 0.3% of the mammal assemblage. Both Common Seal (*Phoca vitulina*) and Grey Seal (Atlantic Seal; *Halichoerus grypus*) were identified. The species vary in shape and size but are sexually dimorphic with the result that some specimens could only be assigned to the general category of seal. Small numbers of seal remains were recovered from Phase 7 onwards (Table 10.5), and they are most numerous in the larger assemblages of the later phases.

Over 40 bones were positively identified as Atlantic Seal, 14 as Common Seal and 40 as 'seal' only. Body part distribution for seal is summarised in Figure 10.26 for all phases, with a combined MNI of 3. The presence of cranial and post-cranial elements suggests that some whole seal carcasses were brought to Cladh Hallan and were therefore probably exploited for meat. Seal bones appear to exhibit an unusually high level of gnawing compared to other specimens, but this is difficult to quantify in such a small sample.

Seal: phase descriptions

In Phase 7, three elements of Atlantic Seal consisting of a mandible, an unfused burnt metapodial and an unfused, rodent-gnawed first phalange came from layer 2883 filling House 3260. A couple of seal toes were also recorded. Seal was scattered throughout the house construction features in Phase 8, with an ulna in wall core (2974) within the entrance of House 401 and a seal occipital in the western wall core (1312) of House 401. The double pit (2554) outside House 1370, interpreted as the emptied grave of the female-male composite mummy, contained a seal phalange.

Both seal species were recorded in Phase 9, with remains found across the site, both within and outside the houses. In House 401 there was a fragment of Atlantic Seal mandible and phalanges, with additional seal phalanges and a rib. In House 1370 was a range of Common Seal bone within floor fills, two pieces of right pelvis, broken in antiquity, were recovered from an inter-floor layer (2210) and the floor layer (1369) above it, and a couple of phalanges came from here. In the yard area outside House 801 were mandible fragments of two different seals, one identified as a juvenile Atlantic Seal, and a seal metacarpal.

Seal bone was distributed across the site in Phase 10. House 401 contained Atlantic Seal with a small fragment of the humerus and ulna of a young individual, along with a metapodial and more phalanges and a rib fragment. Fills inside House 1370 produced fragments of both an Atlantic Seal fibula and a Common Seal tibia as well as more seal foot elements – a metapodial and phalange. The forecourt produced a gnawed Atlantic Seal mandible and a couple of rib fragments. Other external contexts produced a fragment of pelvis, two fragment of juvenile femurs, and foot elements.

In Phase 11 Common Seal was found within House 401, with most of a cut-marked, canid-gnawed humerus, a sacrum and more phalanges along with a pelvis and a cut-marked metatarsal identified as seal. From House 1370 came an Atlantic Seal right occipital, a gnawed left pelvis fragment and Common Seal phalanges. From the southern part of Area A, fragments of Atlantic Seal mandible, humerus, pelvis and phalanges were recovered. Finally, a forecourt layer (756) of House 401 produced a Common Seal phalange.

In Phase 12, both species were found within House 401, with Common Seal scapulae and both Common Seal and Atlantic Seal pelves present, as well as a series of articulating phalanges from a single foot. Seal was found in pit fills outside House 1370, comprising a complete adult Atlantic Seal humerus, pelvis fragments and a phalange. Other outside areas held an Atlantic Seal mandible, with other fragments including a sacrum, a fibula fragment, ribs and a charred phalange.

House 401 produced a juvenile Common Seal pelvis in Phase 13, an Atlantic Seal phalange in Phase 14, and a fragment of seal tibia and phalange in Phase 15. Phase 16 in House 401 had small fragments of two seal mandibles, a calcaneum, a few metapodials and numerous phalanges. There are also rib fragments from context 407 (sand filling the abandoned house). Finally, the windblown sand filling House 640 contained a fragment of seal humerus (context 584).

Seal would have been obtained either by hunting, or as the result of incidental encounters, and/or by the scavenging of carcasses washed ashore. The limited ageing evidence of both unfused and fused bone indicates the presence of immature seals which, for Atlantic Seals, may indicate a degree of seasonal exploitation of this species during its autumn breeding season. The small number of animals suggests that they were not the deliberate target of hunting parties. Judging by the presence of a range of bones from most parts of the skeleton, complete carcasses may have occasionally been taken to the settlement.

Seals can be used for a variety of purposes. There is ethnographic evidence from many Inuit groups of the almost total use of the seal carcass (Grigson and Mellars 1987). Seals provide meat, blood, blubber, skins and sinew. The blubber is especially important since it can be used as both food and fuel. Fenton (1978) notes that, in Orkney and Shetland, a good-sized seal could yield over 20 litres of oil. Martin Martin (1716) recorded that seal meat was eaten by 'vulgar' people in the Hebrides. The presence of numerous phalanges and feet elements points to the possible use of seal skins.

Seal is present in small quantities at a range of other Hebridean sites. Seal predominates at the Mesolithic hunter-gatherer site of Oronsay (Grigson and Mellars 1987) but, for later periods, it is only at Dun Vulan

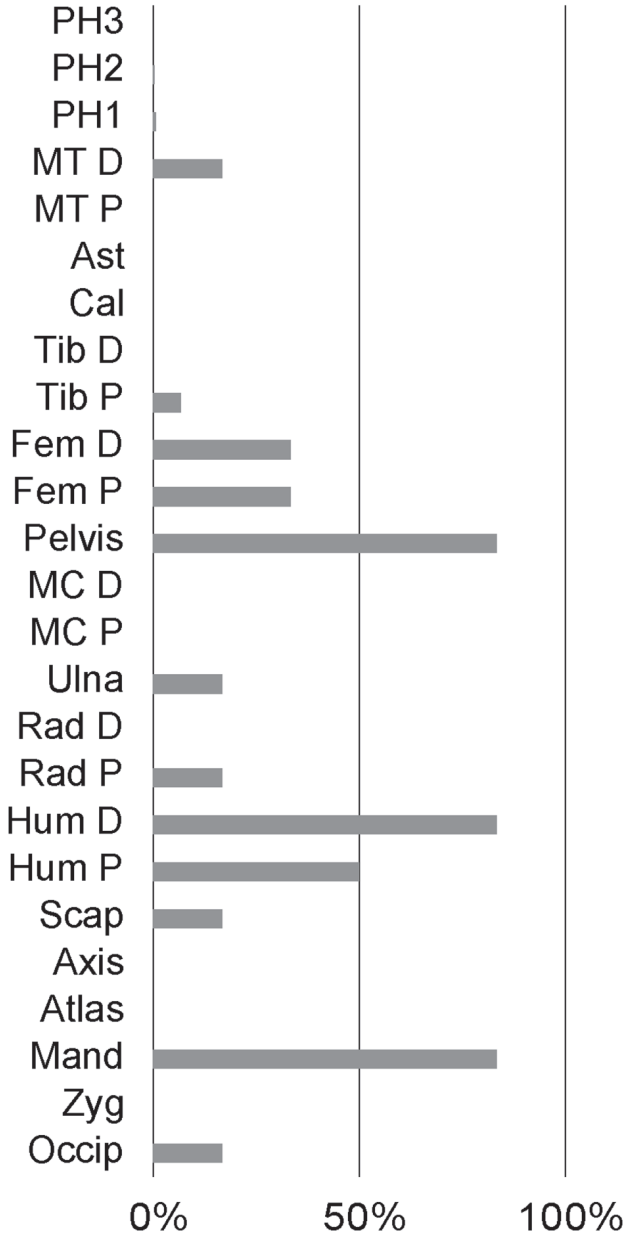


Figure 10.26. Seal relative abundance for all phases

(Mulville 1999) and Northton (Finlay 2006) that more than 10 seal bones are present.

The preference for Grey Seal (Atlantic Seal) has been noted at other Hebridean sites such as Dun Vulan (Mulville 1999) and can be explained by differences in the behaviour of the two species. Common Seals spend most of their time at sea, where they breed and give birth; indeed, the pups can swim from birth (Corbett and Harris 1991). In contrast, Grey Seals come ashore to both give birth and mate in the autumn, and to moult in the spring. The pups do not take to the sea until three weeks after birth. The seals are slow-moving on the ground and can be easily captured and killed. The uninhabited islands off the Outer Hebrides are important breeding grounds for the Atlantic Seal today. Records show that seal-culling for skins and other products occurred in the historic period.

10.14 Articulated bone groups

There are 118 instances of articulated material (Table 10.10) comprising nearly 1,300 specimens (noted in the field [SF number] or during analysis [LAN]). Identified element groups range from complete or near-complete 'skeletons' recovered in articulation to smaller element groups such as associated carpals or tarsals.[5] For comparison and discussion, all bone groups are ascribed to a descriptive category. The fore and hindlimb category indicates an association of more than three long bones (*e.g.* scapula, humerus, radius), the fore/hindfoot categories represent articulating metapodials and/or phalanges, and there are also groups of carpal bones. A number of hock joints (articulating distal tibia and/or astragalus and calcaneum) were noted, in addition to numerous articulating radii and ulnae. In food species, the radius/ulna pairing is the result of the close association of these elements.

The articulations are most common among the abundant food animals (sheep, cattle and deer), with several dog associations, a few of pigs and a single seal instance. The most represented species is sheep – the dominant species – occurring as numerous large and small groups of elements. Sheep are more likely to be consumed in domestic settings since they provide a more manageable amount of meat than cattle (Serjeantson 2011). The articulated and butchered sheep bone deposits at Cladh Hallan are the likely residues of rapidly consumed individual animals and are assumed to be the result of intermittent and significant 'feasting' events.

For the main food species, material representing the deposition of prime meat-bearing elements is restricted. Cattle are represented by a neonatal skeleton, and by an adult femur paired with an adult articulating forelimb, all with evidence of cut-marks. Among the bone groups of sheep, many with evidence of butchery, there are numerous 'burials' and a single forelimb. Both species have deposits of articulated spine elements. Most associations are comprised of elements with low meat value (such as bones of the wrist, ankle or foot). These have been disposed of as waste after butchery without further processing, resulting in numerous articulating groups of phalanges, hocks and carpals. Their presence indicates that many contexts, including interior floor layers, pits, postholes and external fills, were not disturbed after deposition and that this secondary butchery waste was deposited both inside and outside the houses. The abundance of articulations of sheep 'waste' reflects their smaller size, indicating less intensive carcass division and/or fragmentation.

The presence of articulating red deer waste elements, mostly hock joints (with cut-marks on carpals, tarsals and metapodials) and phalanges, indicate that for some animals, the complete adult carcass was taken to the settlement. The dog-associated bone groups show less evidence of butchery or processing; given their rarity, dog articulations are discussed in more detail below.

Table 10.10. Number and type of articulated bone groups by species

Species	Skeleton	Spine/pelvis	Forelimb	Radius/ulna	Carpals	Forefoot	Hindlimb	Neonate femur pair	Hock joint	Lower hindlimb	Hindfoot	Phalanges	Total
Cattle	1	1	2		8			1	2	3	2	12	**32**
Pig				2	1							2	**5**
Deer				3	8	1			5		2	2	**21**
Sheep	8	2	1	7	6	2			9		4	11	**50**
Seal											1		**1**
Dog	2			1		3	1				2		**9**
Total	**11**	**3**	**3**	**13**	**23**	**6**	**1**	**1**	**16**	**3**	**11**	**27**	**118**

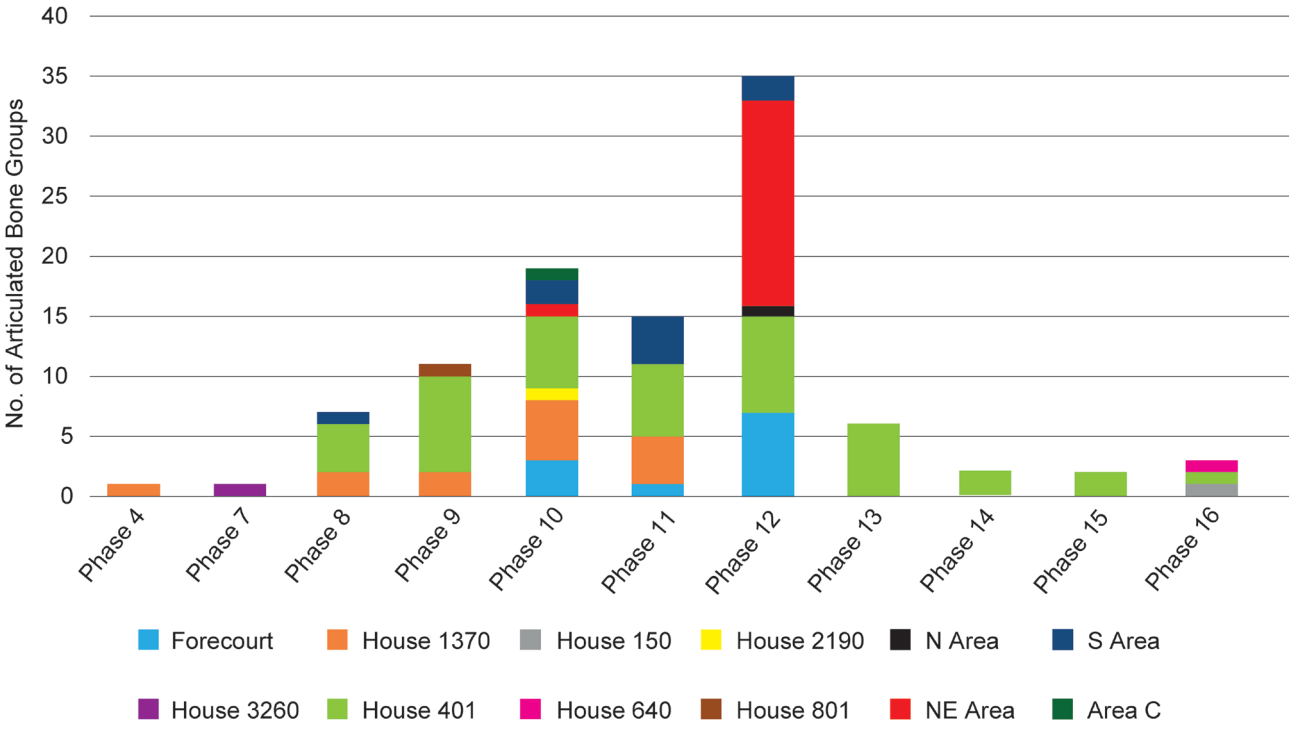


Figure 10.27. Articulated bone groups by phase and area

Articulated bone groups by phase and area

There is a peak in deposition of bone groups during the key occupation Phases 8–12 and it occurred mostly within House 401 (Figure 10.27). The houses and forecourts received depositions of larger groups (many identified *in situ*), often within cut features. The northeastern area beyond the houses (with midden contexts) contained numerous smaller articulations, associated with butchery/waste (*e.g.* associations of carpals or tarsals with metapodials, groups of phalanges). The smaller articulated groups attest to *in situ* secondary butchery waste being deposited both inside and outside houses.

The highest number of individual articulations ($n = 16$) from a single context are from a peat ash deposit (473) in the northeastern area during Phase 12. Other single contexts with large accumulations are the floor layer (1311) of House 401 in Phase 9 with seven deposits, an exterior fill layer (412) in the south of Area A in Phase 11 with five deposits, and a pit (fill 792) in Phase 13, also with five examples.

Key articulated bone groups

Eleven substantial articulated bone groups comprise more than just limb bones: nine sheep, two dogs and a single calf

burial (Table 10.11). The earliest is an articulated female sheep (SF 5177) laid on its side in pit 3324 in the northern part of Area A (below House 1370) in Phase 4 (Figure 10.28). Aged 4 to 6 years, it is almost complete with only a few small elements missing, such as tarsals and a patella, and no indication of butchery or consumption. Histological evidence indicates that this animal was buried enfleshed (see Chapter 20; Mulville *et al.* 2012) and represents a loss of 8kg–10kg of meat. It was associated with cremated bones of an older child/young adolescent (see Chapter 19).

In Phase 8, an articulated group of sheep bones (SF 4761) was deposited in pit 2635 within House 1370. These comprise a pair of largely complete forelimbs with cut-marks on the radius and ulna. In House 401 a sheep (SF 4748), missing only a few hindlimb elements (both femurs and the left tibia) was also placed in a pit (2673). Numerous butchery marks associated with disarticulation and filleting indicate that this carcass was exploited for meat and buried only after being exposed to canid gnawing. Articulating vertebrae were also recovered from pits within the houses. In House 401, four cattle lumbar vertebrae (SF 3829 and SF 4745) were deposited in posthole 2573 and, in House 1370, a sheep's articulated right back foot and five sheep articulating cervical vertebrae (SF 4744) were deposited in pit 2581, which cut the burial pit of the male composite mummy.[6]

In Phase 9, the only large articulated deposit was a partial neonatal cattle skeleton of 0–2 months (SF 3716) deposited in the 'cellar' (1598) of House 401. Elements of the head, spine, fore and hindlimbs, and phalanges were present, and the humerus bore cut-marks. The mandible was present with teeth, a dp4 at tooth wear stage 'a' and M1 visible in crypt (Grant 1982) suggesting a neonatal animal. This animal was identified as male by McGrory *et al*. (2012, sample number SMO4)

There were few groups of articulated material in Phase 10. An adult cattle's left forelimb (over 3.5 to 4 years), from scapula to carpals, with cut-marks (LAN 80) was recovered from layer 840 in House 401's forecourt. Within House 401, a hump in the northwest floor (layer 1443) contained an adult dog's pathological right forelimb (LAN 93; right radius and ulna) and left hindlimb (SF 3626; femur to astragalus) with cut-marks on the astragalus. As mentioned above (see *Dogs*, above), the dog's matching right-hand tibia and fibula (SF 3770) were found within another Phase 10 context (704), with the femur in a Phase 11 context. A lower sheep spine and pelvis was deposited in the floor (1308) of House 401 in Phase 10.

Figure 10.28. Articulated female sheep (SF 5177) in pit 3324 in Phase 4

Phase 11 contained an adult female sheep skeleton (SF 3392) within pit 863 in House 401's forecourt. This animal was represented by its trunk and some of the limbs. Butchery marks, on the pelvis, scapula and spine indicate both filleting and disarticulation prior to deposition. In House 401 a cremated lamb skeleton (LAN 83; immature – maximum of four months old) was deposited in a small pit (778) with both fore- and hindlimbs, vertebrae and ribs present. There was evidence of burning in addition to butchery (cut-marks on humeri and ribs). Two left neonatal cattle femurs (SF 2596), one of which bore cut-marks, lay within floor layers.

Dog elements recovered from two Phase 11 floor contexts may represent parts of dog SF 3626 from Phase 10. A right-hand dog tibia and fibula (SF 3770) were found in a floor-preparation layer (704) in the southern part of House 401, with the matching left hindlimb (SF 3626) as well as a similar-sized right forelimb (LAN 93) coming from layer 1443 (Phase 10; see above). A right femur, possibly from this same dog, was found in the floor-preparation layer (800) in the south of House 401. A pit (1555) above the ruins of House 1370 held much of a newborn lamb (SF 3690) whose navicular and cuboid were not fused.

Phase 12 produced abundant articulated remains. Two adult dog articulated skeletons (SF 3376 and SF 3380) were recovered *in situ* from pits within House 401 (see *Dogs*, above). No butchery was observed on either. One dog (SF 3380 within pit 1292) lay on its front and had most of the skeleton present, apart from the right hindlimb. It is likely that this animal was killed within the pit as coprolites were recovered in association with it. The second dog was close by (SF 3376 in pit 807) and lay headless on its front. Part of this pit was cut by a posthole (819) and hindlimb elements were recovered from the later fill. The skull and associated cervical vertebrae were missing. The orientation of the dog, the presence of smaller extremities (such as phalanges) and the pit dimensions all indicate deliberate removal of the head and not relocation of the body after soft tissue degeneration.

The area above the now-buried forecourt of House 401 contained a pair of fused articulating dog paws represented by a group of left metacarpals (LAN 75; context 480) and right carpals, metacarpals and phalanges (LAN 87; context 457). Additional associated dog remains were found inside and outside the houses. Within House 401, articulating elements of two different left hindfeet were recovered, one from floor layer 595 which produced articulating elements of a left hindlimb (metatarsals 3, 4 and 5; LAN 12 from floor layer 595) and

Table 10.11. Key articulated bone groups

Phase	Context	Find no.	House/area	Feature	Fragments	NISP	Taxon	Age	Sex	Height (mm)	Butchery	Gnawing	Approx. completeness of skeleton Elements present
4	3325	5177	Below 1370	Pit 3324	148	111	Sheep	4-6 years	Female	573, 576, 582, 582, 593, 593, 599, 600	N	N	90% complete, right calcaneum and left patella missing; photo
8	2674	4748	401	Pit 2673	647	102	Sheep	3-4 years	Female	565	D, F	Y	90% head, spine, ribs, limbs (excluding femurs and tibia L.), metapodials, phalanges
	2636	4761	1370	Pit 2635	716	122	Sheep	6-42 months	N/A	N/A	J	N	30% pair of humeri, radii, ulnae and carpals
9	1598	3716	401	Cellar	14	14	Cattle	Neonate	N/A	N/A	F	N	20% vertebrae, humerus, hindlimb elements, phalanges, skull, mandible
11	1556	3690	Above 1370	Pit 1555	309	46	Sheep	Neonate	N/A	N/A	N	N	90% complete, trunk, limbs, phalanges
	855	3392	Forecourt	Pit 863 (in 897)	285	53	Sheep	>42 months	Female	N/A	D, F?	N	25% trunk elements, scapulae, vertebrae, ribs, pelves, left humerus, left femur
	766	LAN 83	401	Pit 778	15	15	Sheep	< 4 months	N/A	N/A	F	Y	(Calcined) 30% fore and hindlimbs, vertebrae and ribs
12	806	3376	401	Pit 807	266	24	Dog	Adult	N	521, 530, 533	N	N	50% pair of forelimbs, ribs and spine (minus axis and atlas); no head
	659/1291	3380	401	Pit 1292	410	112	Dog	Adult	N/A	606, 615, 627	N	N	75% head, mandible, spine, pair of forelimbs, pelves and left hindlimb
13	792	3175	401	Pits 1170/793	206	124	Sheep A	2–3 years and adult	Female	591, 588, 588	D, J	N	70% crania, mandible, left scapula, pair forelimbs, vertebrae and ribs, right pelvis, parts of both hind limbs
					51	51	Sheep B	?Adult	N/A	N/A	N	N	20% vertebrae, ribs, fore and hindlimbs to metapodials
	1115	LAN 41	401	Burial NW	83	78	Sheep	>42 months	N/A	N/A	F	N	50% crania, mandible, upper fore and hindlimbs

Butchery codes (see Mulville *et al*. 2012c) F Filleting, J Jointing, D Disarticulation, N None

further articulating elements (metatarsals 4 and 5) came from a localised peat ash deposit 763 directly above the dog burial, SF 3376, in pit 807. More associated material from the same area of floor 595 included elements from a minimum of two dogs (with scapula, radius, calcaneum and astragalus). Outside the house were more dog forefeet, with articulating right (LAN 87 in sand layer 457) and left (LAN 75 in thick sand deposit 480) carpals, metacarpals and phalange recorded. This same phase contained the dog metapodial worked into a point (SF 2013 from layer 423).

Phases 12 and 13 in House 401 produced a range of relatively complete sheep deposits; some of this material was recognised during excavation as articulating whilst other material was identified later during analysis. Two major groups were recovered from pit 1170,[7] with one higher in the pit fill; overall, the material has an MNI of four. One group comprised articulating vertebrae and ribs, with limb elements, and the second group comprised the majority of an individual sheep with articulating elements from the head to the feet. Other sheep were identified from repeating elements (*e.g*. metatarsals). There are also three additional smaller articulated groups of phalanges (LAN 25, 26, 27) and one group of carpals from pit 1170 that are possibly associated with this material (LAN 76) although there is more than one individual present in this context. The presence of articulating, largely complete bone and butchered elements suggests the rapid processing and deposition of these individuals.

A second group from Phase 13 from pit 1116 was noted during analysis (LAN 41). This again comprises a collection of articulating material from more than one sheep. The material was fragmented, with bones of the head, trunk, upper fore and hindlimbs for one individual, combined with the humerus and femur of a second animal. One animal could be aged to between 2 and 3 years from tooth wear. Cut-marks on the limb bones, sacrum and ribs, as well as the degree of fragmentation, suggest that the more complete individual was processed prior to burial. Two foetal lamb elements (tibia and metapodials) were also present in this group, possibly pointing to the slaughter of a pregnant female during the winter or early spring.

Phase 16 produced three articulating thoracic cattle vertebrae from abandonment layer 108 in House 150 (LAN 80).

Discussion

Dogs and sheep were the main subjects of articulated burials, with further evidence noted of associated material that had been disturbed or dispersed. Dog skeletons may have been subject to redistribution, although the low number and completeness of canid remains has enabled easier identification and matching, with the result that elements from Phase 10 and 11 can be linked together. The ages of animals within the associated bone groups vary: the dog are adults as are the sheep except for a cremated lamb. Among the cattle deposits, there is a neonatal calf and the few articulated cattle elements are all younger individuals, including the vertebral groups.

Most of the sheep in the articulated bone groups were around two years old, a prime age for meat production. The earliest sheep (SF 5177) is unusual in its articulated state, its level of completeness and its lack of butchery. The later food animals were butchered prior to their deposition in various states of completeness. The level of disarticulation and the age of the animals suggests that they were slaughtered for meat and eaten; indeed, if not consumed, their deaths would represent a loss of meat and associated resources for the community.

As noted in Volume 1, the focus of deposition for sheep burials was the northwest quadrant of House 401. A small pit contained the cremated lamb remains (pit 778; see Volume 1: 254, fig. 7.2) and a series of four sheep burials were found in other pits in this quadrant (pit 1170 in and pit 793 in Phases 12 and 13 [see footnote 7] and 1116 in Phase 13; the surface of floor 465 in Phase 13). Other burials were found in House 401's forecourt (Phase 11) and above and below House 1370's southeast quadrant (pit 3324 in Phase 4; layer 1556 in Phase 11).

The incorporation of animal bodies within houses was a common phenomenon during the Iron Age in the Western Isles (Mulville *et al*. 2003; Mulville and Thoms 2005). None of these, however, were fully articulated, therefore the Phase 4 sheep burial at Cladh Hallan represents a unique animal deposit, more reflective of the earlier articulated human burials than the later disarticulated animal bone groups. The cremated lamb (less than 4 months old) is consistent with similar cremated deposits from elsewhere on the islands such as Sollas, North Uist (Finlay 1992).

10.15 Size and shape

Analysis of size and shape in domestic and wild species can provide information on changes driven by natural (*e.g*. climatic fluctuation) or human impacts (*e.g*. habitat destruction, access to grazing or fodder, introduction of new species, hunting patterns) within the landscape of Uist. The sexing information for sheep and cattle (see above) suggests that most adult animals were female so, as result, sexual dimorphism is difficult to identify.

The metrical data from Cladh Hallan are mostly available from the larger assemblages of the later phases, from Phase 9 onwards, and therefore derive from Late Bronze Age to Early Iron Age animals. Analysis of the main species is presented here and the full metrical database for all species will be archived. There are large datasets for some bones such as astragali but fragmentation of other elements means that measurement data for many of the most abundant elements (proximal radius, scapula and distal tibia) are not extensive. For all species, greatest length measurements – needed to calculate withers heights – are rare.

For each food species, where possible, broad size indicators are discussed and compared to the SEARCH/

Cardiff assemblages (*e.g.* withers heights) where Cladh Hallan (CH) is compared with Iron Age (IA) (Dun Vulan, Cill Donnain, Bornais) and Norse (N) assemblages (Bornais and Cille Pheadair) as outlined in section 10.2 *Methodology: comparative datasets*. For all comparisons, numbers in brackets denote number of examples.

To consider longer term changes, measurements of the few individuals from Neolithic Northton, Harris (Finlay 1984) are included, alongside some larger datasets from Neolithic Orkney (Knap of Howar [Noddle 1983], Links of Notland [Armour-Chelu 1992; Fraser 2015]) and key datasets from England (Hambledon Hill [Legge 2008]). This is followed by a comparison of size changes, drawing on both individual and combined (LSI) measurements.

Canid data is included here but, given the small number of individuals, only withers height data are included.

Table 10.12. Sheep SF 5177 withers height estimations

Element	GL (mm)	Withers height (mm)
Humerus	135.9	581.7
Radius	143.4	576.5
Metacarpal	121.3	593.2
Femur	165.0	582.5
Tibia	197.0	593.0
Metatarsal	131.9	598.8
Metatarsal	132.1	599.7
	Minimum	576.5
	Maximum	599.7
	Average	589.3

Sheep

There are over 500 individual elements with measurement data for sheep.

Withers height

The presence of complete elements from single articulated sheep deposits SF 5177 (Phase 4), SF 4748 (Phase 8) and SF 3175 (Phase 13) has allowed the calculation of more than one withers height estimate, with some derived from pairs of elements for other individual animals. A series of height estimates from 580mm to 600mm were produced for SF 5177 (Table 10.12), with the tallest from the metapodials and the shortest from the radius. This suggests that Cladh Hallan sheep had longer lower limbs than the breeds used to create the conversion calculation. Thus, any height estimates will be affected by the element used.

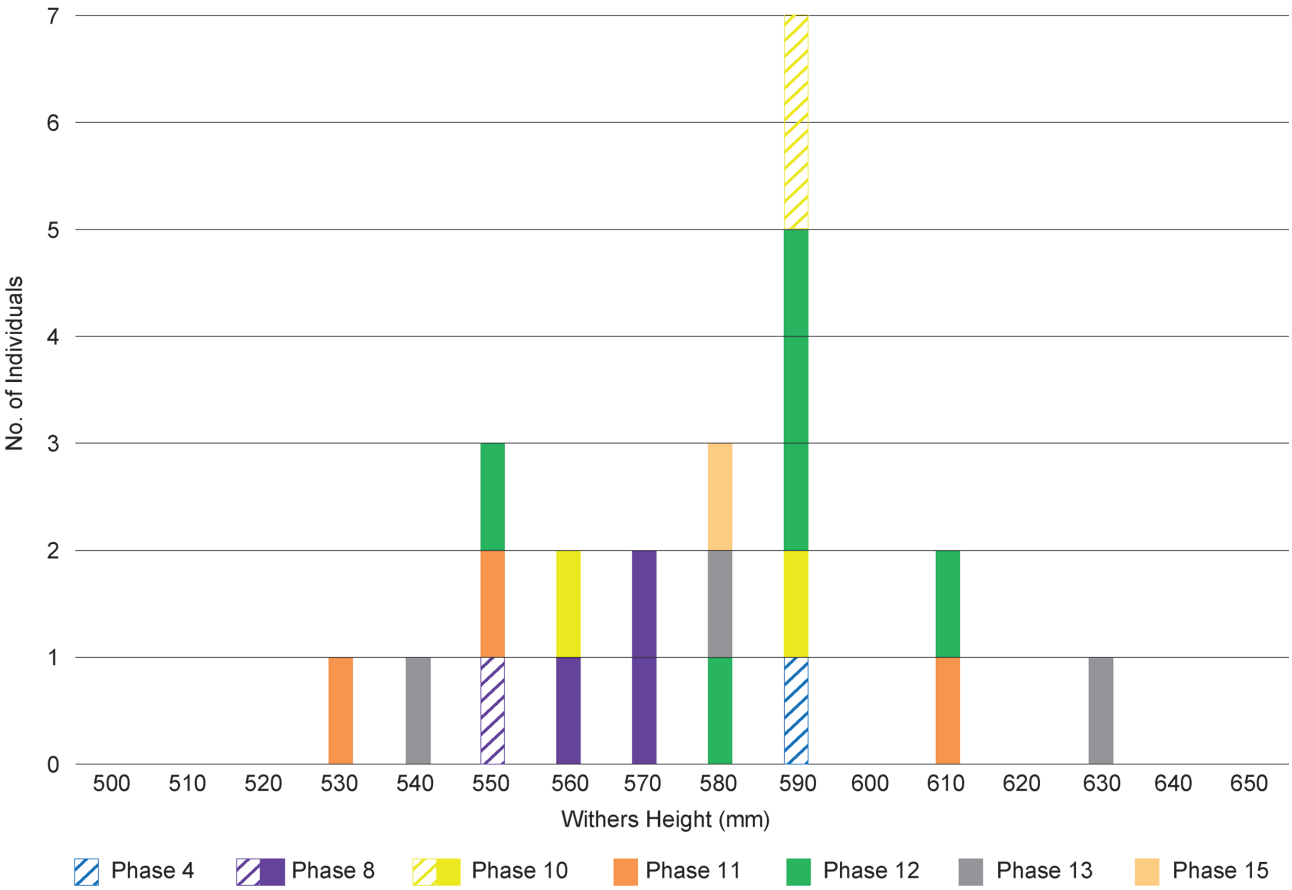


Figure 10.29. Sheep withers height (mm) across phases (pattern segments are single height estimates from the female sheep burials)

When comparing height across the phases (Figure 10.29), the replication of values was avoided by including only one averaged estimate (denoted by patterned segments) for associated bone groups. Overall, the withers height calculations indicate a population with an average height of 580 mm, with a range of 530mm–640mm. All the associated bone groups have been morphologically identified as female (see above), and the Phase 8 individual (SF 4748) is smaller (570mm) than later animals (590mm–600mm). Thus, the few animals above 600mm (the largest female) are likely to be male in an otherwise female-dominated adult herd.

A comparison of Cladh Hallan withers heights with later Uist sheep populations (Figure 10.30) demonstrates a similar range in prehistory, but a decrease in the mean from the Iron Age onwards. There is an increase in the range of withers heights in the Norse period, but the average height remains similar to the Iron Age.

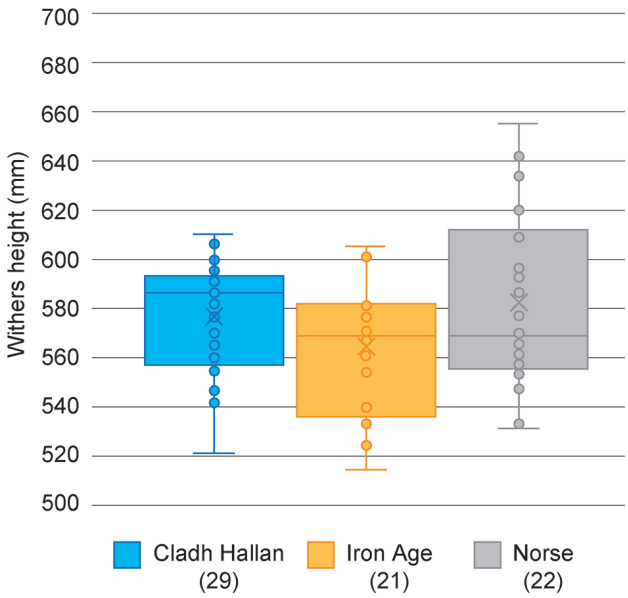


Figure 10.30. Sheep estimated withers height (mm) from comparative sites in the Western Isles. For this and subsequent figures, the Cladh Hallan data are in blue

Individual elements

The Neolithic measurements from the Hebrides and Orkney indicate that these sheep were similar in size to southern British animals at this time, and to the Shetland standard (Table 10.13).

The substantive metrical dataset for sheep astragali, including two measurements from Neolithic Northton, suggests that sheep had become slightly reduced in size on the islands by the Bronze Age (Figure 10.31).

Plotting size and shape ratios for sheep – distal humeri (height of trochlea/breadth of trochlea) and distal tibiae (breadth/depth) (Figure 10.32) – demonstrates that the Cladh Hallan sheep were generally smaller in both dimensions than in later periods.

LSI comparison

The large dataset available for LSI was analysed for length and width dimensions but the breadth dataset was too small for inclusion (Figure 10.33). This comparison indicates that all the prehistoric island sheep were smaller than the standard (modern Shetland sheep) in both dimensions but were more reduced in width. For the main species, sheep show the greatest increase in the mean (and median) for both dimensions over time.

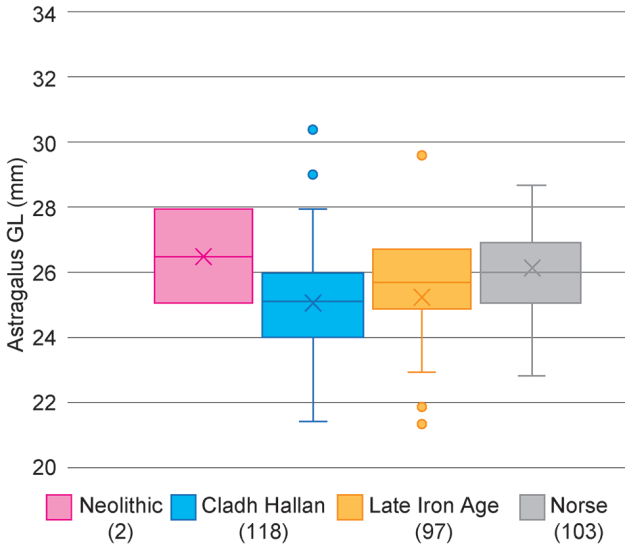


Figure 10.31. Measurements of sheep astragali (GL) from comparative sites in the Western Isles

Table 10.13. Sheep comparative measurements, range and means (mm)

Element	Standard	Hambledon Hill	Links of Notland	Knap of Howar	Northton	CH
Humerus *n*	32	10	59	46		70
Bd (mm)	27.7	27.1–28.2	28.8	27		27.1
Radius *n*	12	3	49	31	1	35
Bp (mm)	27.4	25.7–28.9	29.6	28.1	30	26.09
Tibia *n*	51	11	26	26		14
Bd (mm)	24.3	22.5–24.8	25.5	24.2		22.3

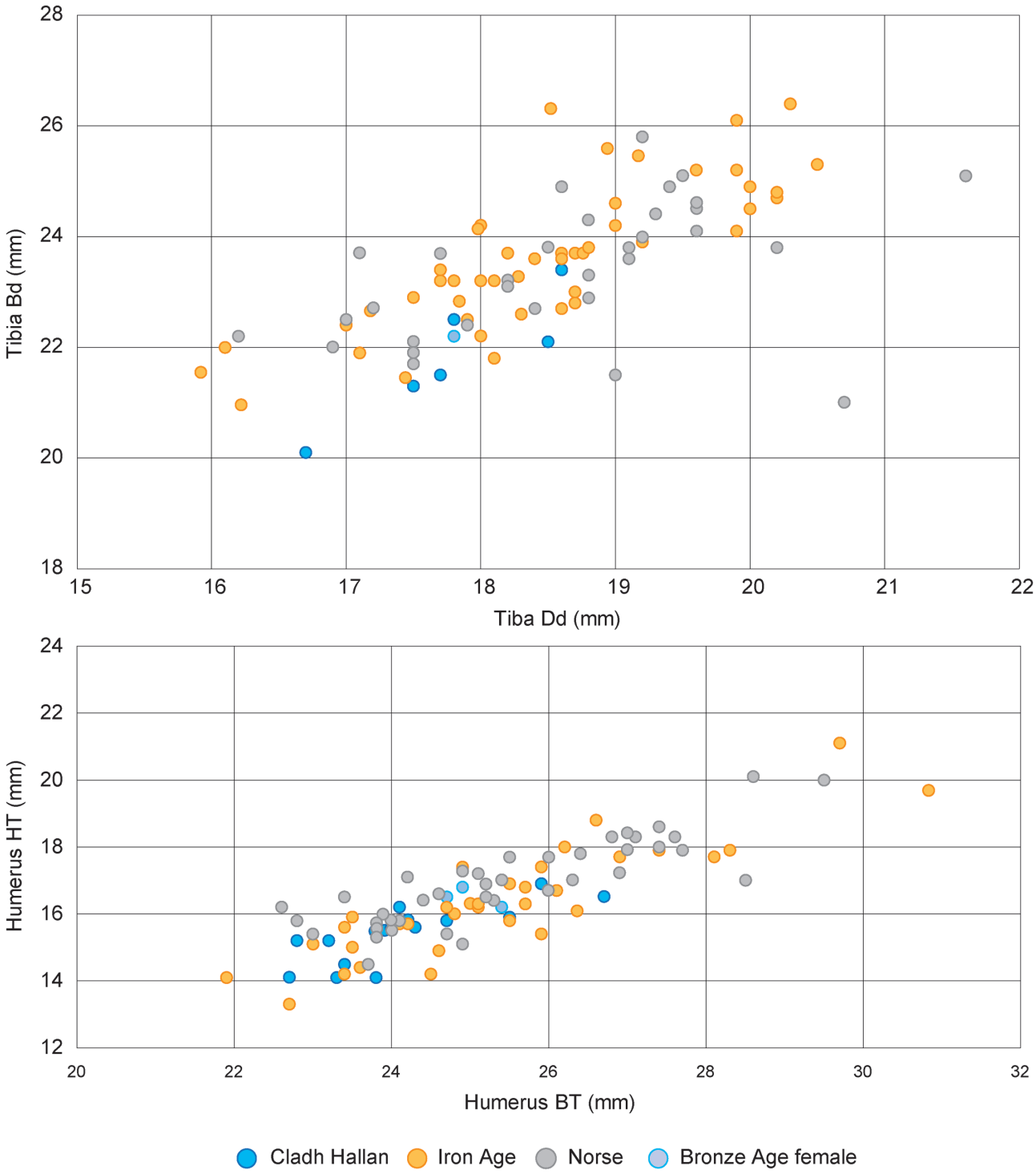


Figure 10.32. Size and shape data for sheep humeri (BT vs HT) and tibiae (Dd vs Bd) from comparative sites in the Western Isles

Cattle

The cattle metrical dataset comprises over 90 individually measured elements.

Withers height

Only two long bones provided greatest length measurements (a metatarsal from layer 473 [Phase 12] and a radius from layer 840 [Phase 10]). The measurement factors for female animals (Matolcsi 1970) were employed to calculate withers heights of 107cm and 108cm. These animals were slightly smaller than modern Dexter cattle (105cm to 115cm; Gidney 2013) and lie in the upper half of the range of comparable data from Uist (98cm–112cm; Figure 10.34).

Individual elements

A range of measurements of Neolithic cattle from Orkney indicates that they were larger in size than equivalents from southern Britain (Neolithic Hambledon Hill) and much larger than the Iron Age standard (Table 10.14). There are

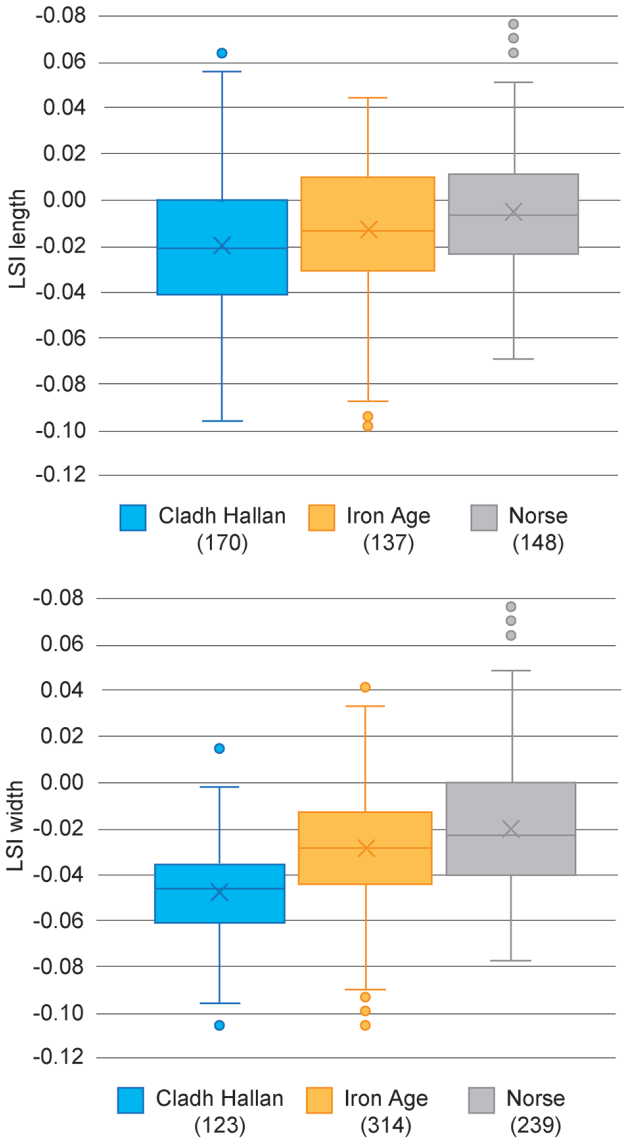


Figure 10.33. Sheep LSI height and width from comparative sites in the Western Isles

hints of the presence of larger cattle on Lewis, with two unusually large phalanges reported amongst the otherwise smaller cattle remains (Finlay 2006). The Cladh Hallan data demonstrate that these Neolithic cattle had become significantly reduced in stature by the Bronze Age although there are individual records of larger elements (see below).

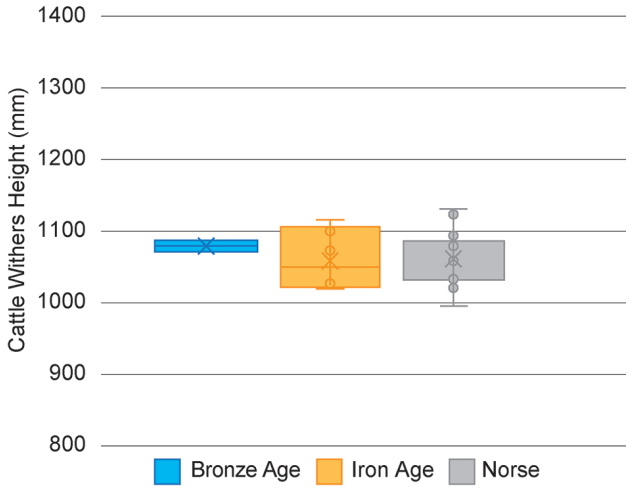


Figure 10.34. Estimated withers heights for cattle from comparative sites in the Western Isles

A comparison of Cladh Hallan scapula measurements (*i.e.* GLP; $n = 20$, 56mm–75mm) with the dataset for the Neolithic and later periods demonstrates a reduction in size from the small Neolithic sample onwards, but there is little change in size ranges after this even though the average is smaller for the Iron Age (Figure 10.35). There is one unusually large example, worked as scapula shovel (SF 2024 from floor 452 in Phase 15) that lies outside the range of other measurements, and could have been traded from elsewhere.

The most substantive metrical dataset is that for the astragali. Plotting different dimensions of individual elements provides data on both shape and size changes. Since the size of the astragalus is related to its weight-bearing role, it is therefore also closely related to the size of the animal. This makes it a particularly useful bone for biometric studies measuring the robustness of the individuals (Johnstone and Albarella 2015).

Plotting the greatest lateral length *vs* distal breadth indicates the presence of a few large animals in all phases; however, the most notable trend is a change in the shape/size of this element across time, with many Iron Age specimens smaller in breadth. The Bronze Age and Norse species are broader (Bd average of 59mm) in relation to their length (average GL is 57mm–58mm for all periods) than the Iron Age animals (Bd of 55mm).

Table 10.14. Cattle comparative measurements, means (mm)

Element	Standard	Hambledon Hill	Links of Notland	Knap of Howar	CH
Humerus *n*		55	15	10	8
BT (mm)	66.5	73.5	77.4	79.7	67.5
Metacarpal *n*		29	5		11
Bd (mm)	54.6	57.9	65		50.9
Astragalus *n*		13	36	9	21
GLl (mm)	59.1	66.1	67.6	68.5	58.6

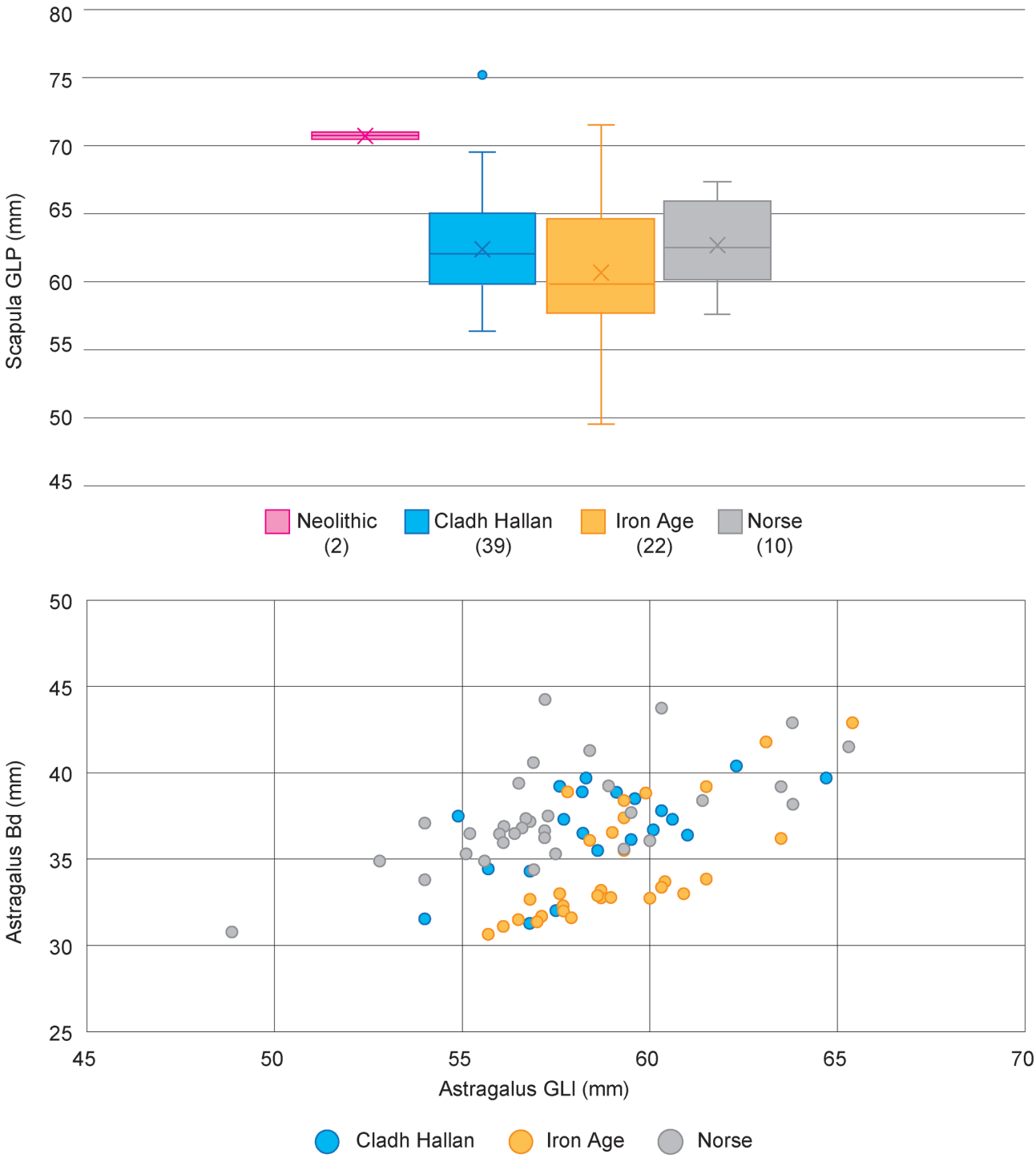


Figure 10.35. Size and shape data for cattle scapulae (GLP) and astragalus (GLl vs Bd) from comparative sites in the Western Isles

LSI comparison

Overall, Uist cattle are slightly shorter than the standard Iron Age length but broader in width. Mean values vary little, with Cladh Hallan's Bronze Age and Early Iron Age animals slightly smaller than those of the Iron Age but slightly larger than those of the Norse period (Figure 10.36).

Red deer

There are over 100 individual elements with measurement data. No complete elements were recovered to provide greatest lengths, the most abundant measurements being those of the distal tibia and the astragalus. There is marked sexual dimorphism in body size between males and females in adult red deer (Mitchell *et al.* 1977; Weinstock 2000). Given the overlap in size between the sexes, however, sexing based on osteometrics can prove uncertain for single bone specimens but comparisons on a population level of the size distributions suggest that both males and females were present at Cladh Hallan (see above).

Individual elements

Astragalus measurements of Neolithic animals from Orkney (Knap of Howar, average 49.2mm [n = 10]; Links of

Noltland, 45.9mm [n = 20]) indicate that they were smaller in size than both the large Mesolithic standard (57.1mm) and the deer of Neolithic southern Britain (Hambledon Hill, 54.7mm, [n = 3]). If similar-sized specimens were present in the Western Isles during the Neolithic they had become significantly reduced in stature by the Bronze Age, even smaller than the modern deer of Rhum (48mm; Noddle 1982).

A comparison of Bronze Age scapula measurements indicates that the Cladh Hallan deer (GLP; *n* = 30, 42mm–55mm) fall within the size range for later Uist deer; there are just five from the Iron Age whilst the Norse animals have the largest range but with no clear evidence for chronological change (Figure 10.37).

The most substantive metrical dataset is provided by the astragali, and plotting different dimensions of individual elements provides data on both shape and size changes (Figure 10.37). The Bronze Age and Norse deer have a similar range (except for one small, possibly immature individual) whilst the Iron Age animals are some of the smallest and largest of the species, reflecting differences in the numbers of males and females procured.

Red deer antler dimensions can provide information on animal size and maturity, alongside their development (see *Red deer antler ageing*, above) as these increase in size as the animal reaches full maturity. The sizes of antlers from Cladh Hallan can be compared with a modern collection of shed antler from North Uist, all of which have eight to ten points, and therefore have developed their bez tine (Figure 10.38). The modern population's antlers are similar in size to those from Cladh Hallan, but the Cladh Hallan antlers show a wider range, suggesting that larger and/or more mature stags were present in the past. As expected, based on other dimensions, the insular deer have a range smaller than comparably sized animals elsewhere in prehistoric Britain: at Durrington Walls and Grimes Graves the antlers range from 103mm to 280mm, with means of 198mm and 212mm respectively (Clutton-Brock 1984).

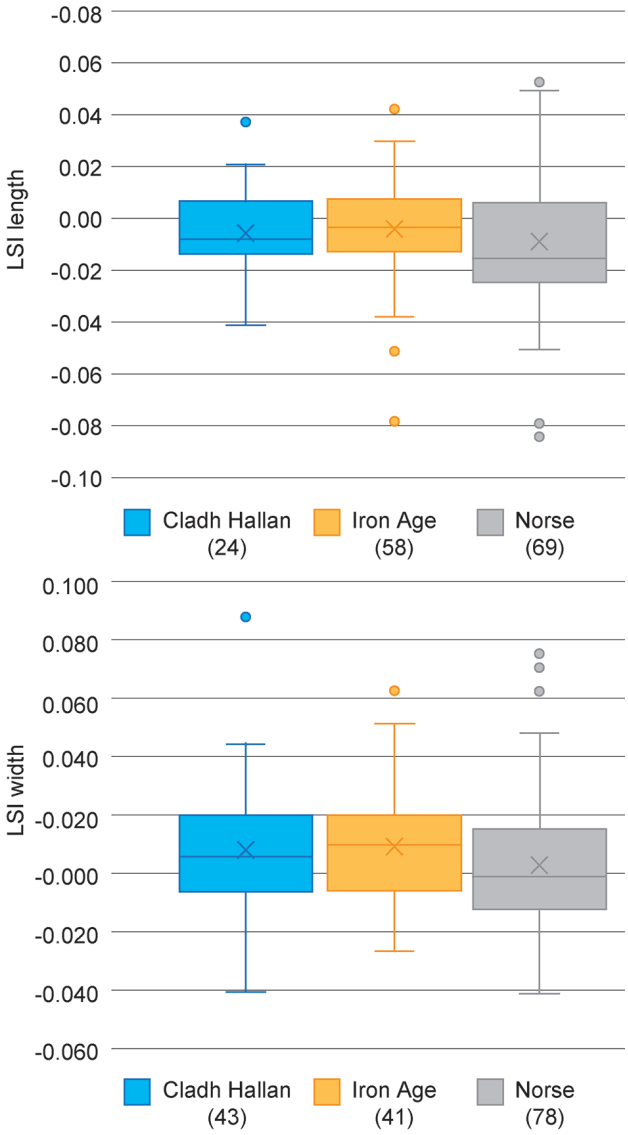


Figure 10.36. Cattle LSI height and width data from comparative sites in the Western Isles

LSI comparison

The LSI comparisons for length and width demonstrate that all the prehistoric Western Isles deer are smaller than the Mesolithic standard (Figure 10.39). This species shows a similar range of size change to sheep, but there is a reduction and then, by the Norse period, a rebound in mean length and width dimensions. Thus, Iron Age deer are smaller in both dimensions, with a greater decrease in width measurements.

Pigs

The small number of pigs, and the lack of mature individuals, at Cladh Hallan has resulted in only 10 measurements for individual postcranial elements (scapula, astragalus) and a few tooth measurements. The dataset for pig astragalus measurements from Neolithic Orkney (Links of Noltland, average 38.9mm [n = 6]; Pool, 39mm [n = 3]) and Cladh Hallan (38.3mm [n = 3]) shows these animals to be slightly smaller than those of the Neolithic southern British standard (40.8mm).

LSI comparison

There is only a small comparative dataset from the SEARCH/Cardiff data (note the inner points in Figure 10.40 have been plotted to demonstrate this) but the data have been included for completeness. Cladh Hallan pig lengths and widths are both smaller than the standard and have a wide range. This may be associated with the presence of sexually dimorphic males and females. All phases have a similar mean length, but there is a reduction in mean width during the Iron Age compared to the other phases.

Data from pig teeth suggest that at least two large, probably male, individuals were present in the Bronze Age (Figure 10.41). As these values lie above the Neolithic standard, these may be wild boar and could have been imported to the island.

Dog

Dog size was compared using withers heights (Figure 10.42). There is a discrepancy in height estimates both between each element in a skeleton and between the methods employed; overall, the Harcourt method (1974) gives a higher estimate than Clark (1995). For example, dog SF 3380's estimates range from 59cm (from the radius) to 69cm (femur). A more recent study provides a range of between 54cm and 63cm for a femur of this length (Migaud, pers. comm.). Given the differing values, a single height measurement is difficult to obtain, and averages have been used for broader comparisons. Overall, estimates of withers height should be considered as indicative rather than absolute. Dogs became more diverse in size from the Iron Age onward (Peto *et al.* 2022) and the differences between the Cladh Hallan dogs may be due to emerging changes in relative bone length.

With an average height of 62cm, the largest Cladh Hallan dog (SF 3380) is amongst the tallest prehistoric dog specimens in Britain, with Neolithic examples ranging from 35cm to 62cm and three other animals above the minimum (42cm) reported for the Bronze Age (Clark 2006). Similar-sized dogs have been recovered from other Iron Age sites; one Iron Age individual at Dun Vulan was estimated to be around 47cm (Mulville 1999: 258), indicating that larger canids were common at this time.

10.16 Meat weights

Given the relative abundance of the main species, it is tempting to see sheep as the most important source of meat. At Cladh Hallan they predominate within structured deposits of butchered and rapidly consumed animals assumed to be associated with intermittent and significant 'feasting' events. It is possible to establish the contribution that the different food animals made to the diet of the inhabitants of Cladh Hallan although such calculations are, at best, an estimate. However, by incorporating information on the age of animals at slaughter, it is possible to consider the contribution that veal/beef, mutton/lamb and venison made to the diet. The contribution of other food components (*e.g.* fat, marrow, blood and offal) should also be acknowledged alongside secondary (*e.g.* dairy) and non-food products.

Food species at Cladh Hallan are smaller than their mainland equivalents (see section 10.14 *Size and shape*, above). Adult cattle stood at just over 1m at their withers, equivalent to a modern Dexter, with sheep averaging half that size, similar in size to modern Shetland sheep.

Existing archaeological estimates suggest adult sheep would provide 30kg of meat (Vigne 1991), Shetland sheep over two years old weigh between 35kg and 60kg and produce between 12kg and 15kg of meat (information from Shetland Sheep Society website), and lambs only weigh 3kg–4kg. For large ungulates, the proportion of meat available on carcasses is estimated at 60% of the live mass (Brugal 2005; Lyman 1979), thus at Cladh Hallan sheep are estimated to have produced a maximum of 14kg of meat from an adult and 1kg from a lamb.

Vigne (1991) suggests that an adult cow would provide *c.* 400kg of meat. A modern two-year-old Dexter has a carcass weight of 145kg to 330kg while a neonatal Dexter calf only weighs between 18kg–22kg (http://www.keenleavaledexters.com.au/about-dexters.html). It is expected that the adult cattle at Cladh Hallan would have each produced in the region of 75kg–165kg of meat (an average of 120kg, given the genetic and morphological bias towards adult females) and 10kg for a calf.

Red deer are sexually dimorphic and show changes in body mass between the seasons caused by the impact of rutting and breeding, with adults ranging from 50kg for breeding females in winter to around 90kg for males in their prime. Any sex bias in the deer dataset has not been quantified and an estimate of 55kg meat weight for adult deer and 3kg for deer calves has been used. No attempt has been made to estimate the meat weight of the Cladh Hallan pigs, as their small numbers will further bias any estimates.

Butchery evidence suggests that neonates of all the main food species were processed to a similar degree as adults (see above) and their relatively large number could have an impact on the quantity of meat produced. For sheep there are few young animals, with fewer than 10% under 1 month of age (this number peaks at 20% in Phase 9, falls during Phases 10–12 and then rises again later), but for cattle and deer this figure is higher. For cattle, nearly 40% of material is from very young animals, ranging from over 25% to nearly 60% (with Phases 1–4, 8 and 10 having the highest proportion). Deer also have a high proportion of neonatal/foetal animals, just over 30% overall; in contrast to cattle, there is a low proportion of young deer present in Phase 8, whilst in Phases 12 and 14–16 there are more.

Neonatal calves will produce about 10kg of meat, or about the same amount as a young sheep, whilst newborn lambs would provide much less (<1 kg). Newborn red deer calves of about 6kg reach 20kg at 3 months and 40kg at 6 months. Using similar figures for meat versus bone as for the domestic stock, it is estimated that newborn deer calves provide only around 3kg of meat, with a figure of around 55kg for an adult (Clutton-Brock and Guinness 1975: 16).

As noted above, there is a high proportion of neonates from Cladh Hallan. Their MNI was calculated based on fusion state and subtracted from the total MNI to provide a rough estimate of adult animals. Then both neonatal and adult MNI were multiplied by the relevant estimated meat weight and combined for each species. There are numerous difficulties with estimating meat weights, as outlined by Vigne (1991), and these calculations can only be considered as approximate contributions of each species and not as accurate estimates of production.

Taking animal size and age into account, the estimated quantity of meat produced by sheep over the period of the site's occupation is about 4500kg, compared with over 8600kg of beef, 2100kg of venison (Figure 10.43) and just over 800kg of pork. Generally, sheep account for

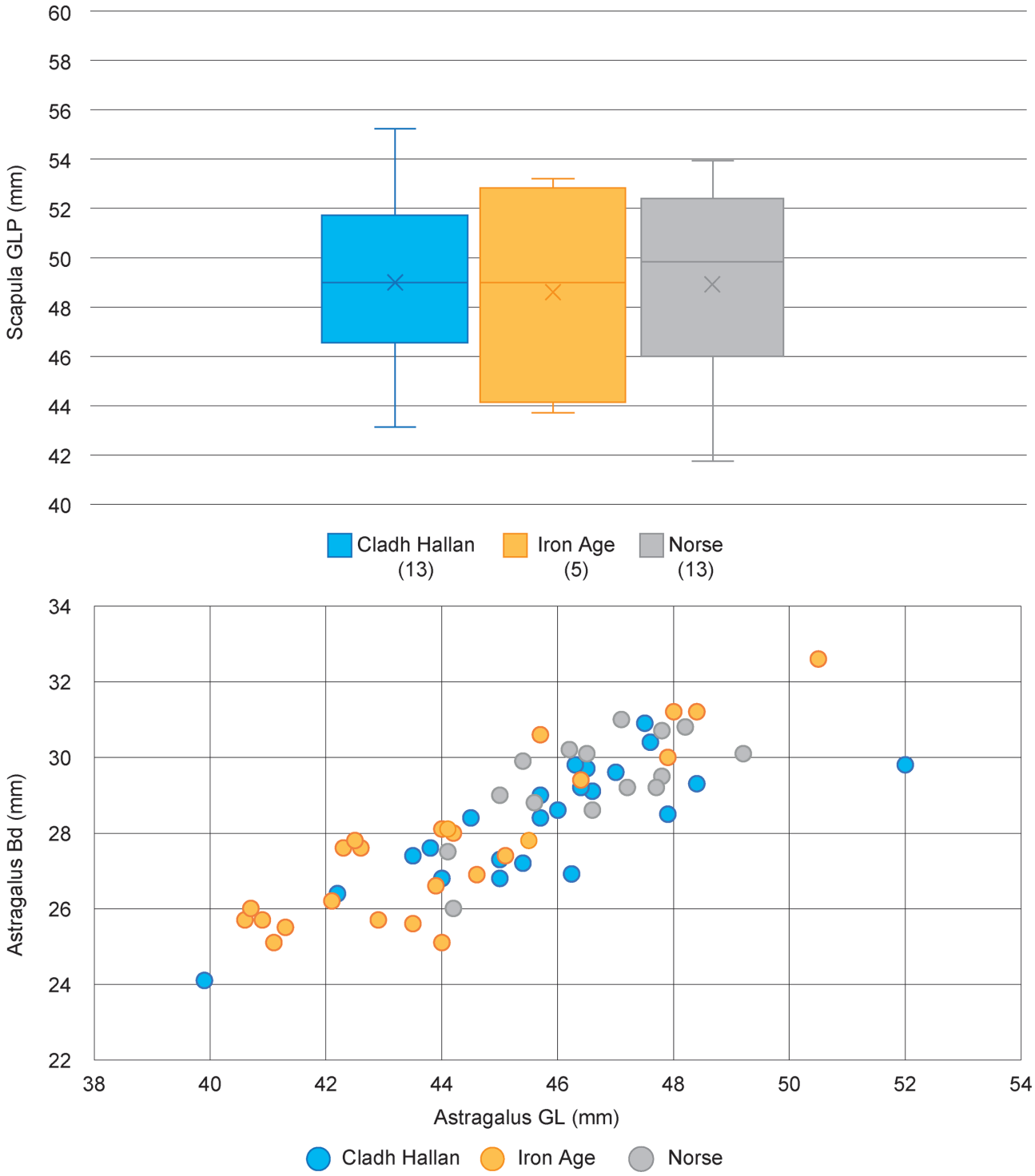


Figure 10.37. Size and shape data for red deer scapulae (GLP) and astragalus (Bd vs GLl) from comparative sites in the Western Isles

between 20% and 40% of meat, cattle between 40% and 60%, and deer between 10% and 20% in each phase with the exception of Phase 13 where cattle provided nearly 90% of the meat. This analysis suggests that, despite the large number of sheep and a high proportion of very young cattle, beef was nevertheless the predominant meat. When milk, meat and other carcass products are combined, it is obvious that cattle played a key role in food production.

10.17 Discussion

The analysis of the Cladh Hallan mammal data (excluding Cetacea) has revealed a wealth of information about the community living at this settlement and their relationship with animals, over hundreds of years. The following discussion brings together this evidence to place Cladh Hallan in context with other sites on Uist and across the

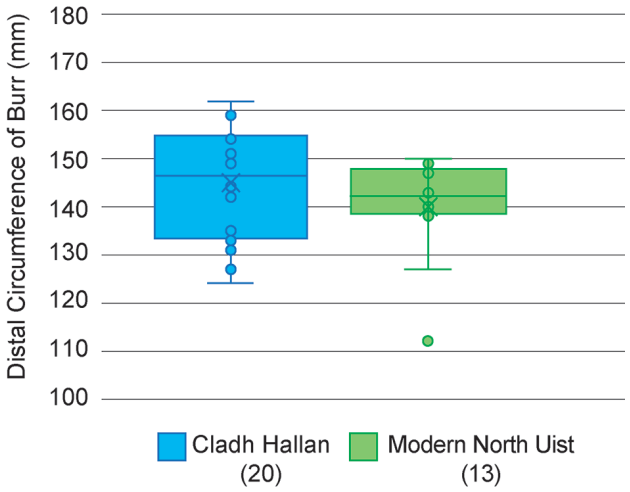


Figure 10.38. Red deer antler distal circumference of burr (mm)

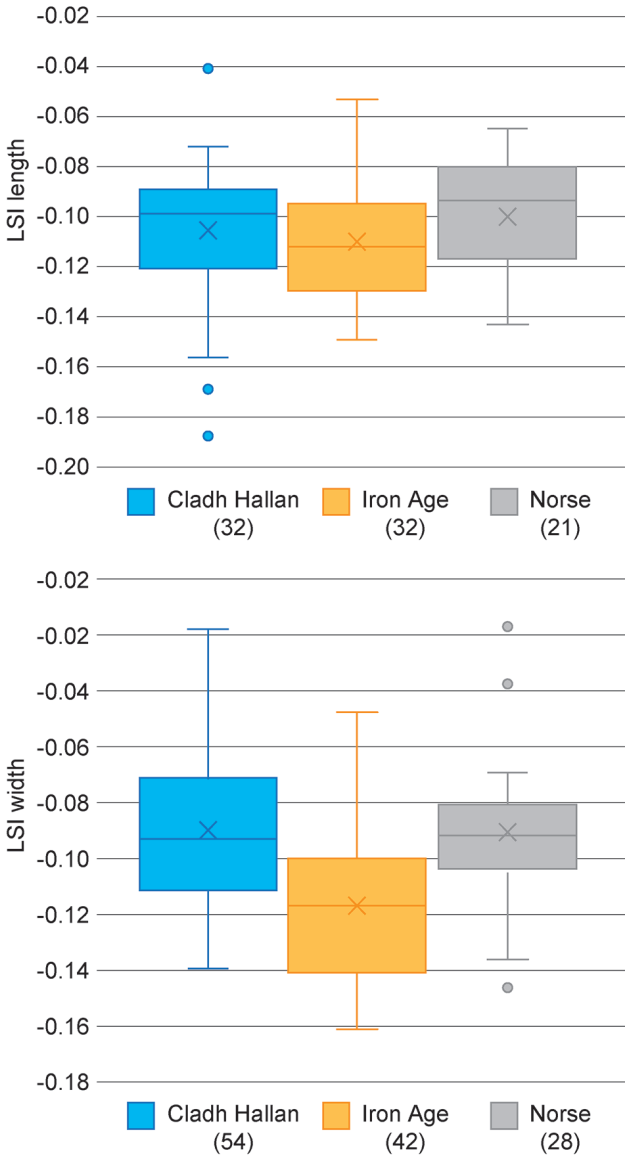


Figure 10.39. Red deer LSI height and width data from comparative sites in the Western Isles

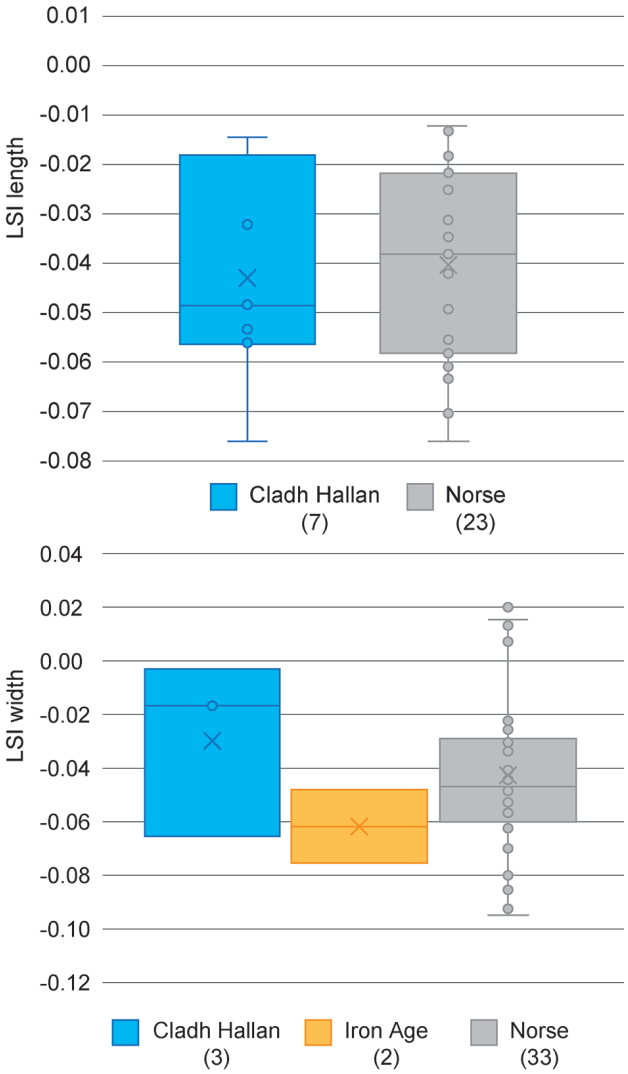


Figure 10.40. Pig LSI height and width for different periods

Western Isles, and to briefly consider the wider trajectory of North Atlantic insular lifeways. The changing emphasis on species, their size and strategies for management and other forms of procurement is discussed.

Relative abundance of food animals in the Western Isles

A comparison of the differing proportions of food animals on Uist and Lewis/Harris provides a chronological overview of faunal exploitation in the Western Isles. These two island groups, Uist and Lewis and Harris, experience a very similar climate, but exhibit differences in landscapes, ecology and topography. For example, Lewis and Harris are a single landmass that makes up about two-thirds of the 3000 sq km area of the Western Isles, whilst Uist is a string of smaller islands, some of which were joined at low tide.

Across the Isles domestic stock were the mainstay of prehistoric farming communities, but the data demonstrate that the choice of species varied (Figure 10.44). In the Neolithic sheep predominate in both the (small)

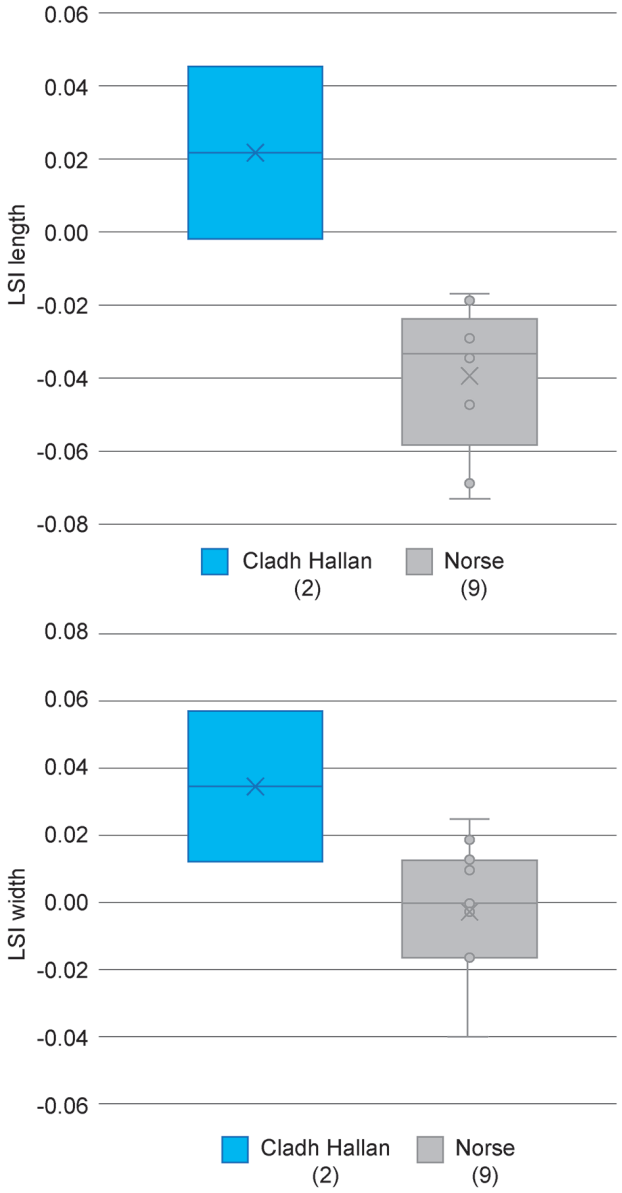


Figure 10.41. Pig lower third molar LSI length and width data from comparative sites in the Western Isles

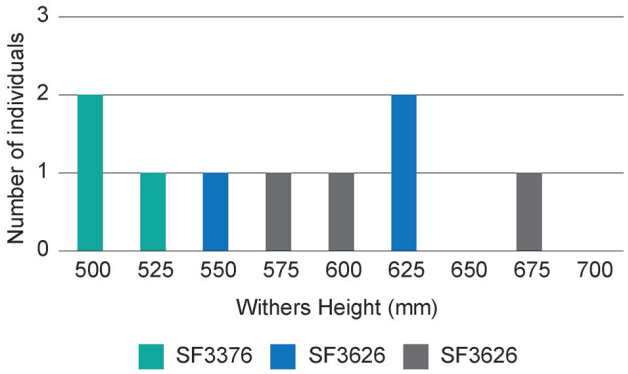


Figure 10.42. Average withers heights estimates for dogs SF 3376, SF 3626 and SF 3380

assemblages, but on Lewis/Harris from the Bronze Age cattle become the most numerous species. After this point the proportion of sheep increases on Lewis and decreases on Uist, with a concurrent change in cattle. Across both island groups pigs are only present in small numbers and never form a major part of the economy or diet (*e.g.* Serjeantson 1990). Pigs were more common on Uist and of increased importance in the Norse phases.

Unusually, insular deer herds thrived alongside domestic species. On all but the smallest islands (*e.g.* Pabbay, Mingulay and Sandray [Mulville and Ingrem 2000; Mulville 2010]), deer were exploited in low numbers from the Neolithic but became more common later. On Lewis and Harris, red deer were utilised in higher numbers (evident in the small Neolithic assemblage from Northton) and in the later, larger assemblages they make up around a quarter of food animal NISP. On Uist, deer made up 6% of the Neolithic Udal food animals, one-tenth of Bronze and Iron Age ones, and about one-twentieth of Norse animals.

Animal size

As seen in section 10.14, estimates of animal size for early periods have to rely on data from the Orcadian assemblages, with later comparisons based on the SEARCH/Cardiff research projects data. Data for Neolithic sheep, mostly from Orkney and a few Uist examples, suggest that they were of comparable size to those in southern Britain at that time, whilst insular Neolithic cattle and pigs were all smaller. On Uist domestic stock reduced in size by the Bronze Age and Early Iron Age; at this point sheep and cattle had withers heights of 58cm and 108cm respectively. Through the Iron Age and Norse periods, Uist sheep dimensions increased in length and width, but after an initial increase cattle size declined during the Norse period. The pig dataset is too small to identify any size trends, but it does indicate the presence of some larger animals.

Similarly, Western Isles red deer were smaller than those of southern Britain in the Neolithic and reduced in size in the Bronze Age. The comparative datasets show that mean red deer size reduced between the period of occupation at Cladh Hallan and the Iron Age in both length and width but increased slightly in the Norse period. There is a similar early size reduction in sheep, cattle and red deer. This could indicate that similar forces were at work for both wild and domestic species, *e.g.* changes in the climate and environment of the islands could have combined to drive down species size. Changes in animal size data can also reflect new herding or hunting practices, often relating to variation in the sex ratios and sexually dimorphic size differences. The later increase in sheep size may relate to a differing economic emphasis, for example an interest in wool production resulting in older animals and more males. The variation in size for red deer could represent a focus on the procurement of animals of a different age or sex, as seen in the ageing data, which may relate to cultural and/or environmental variation.

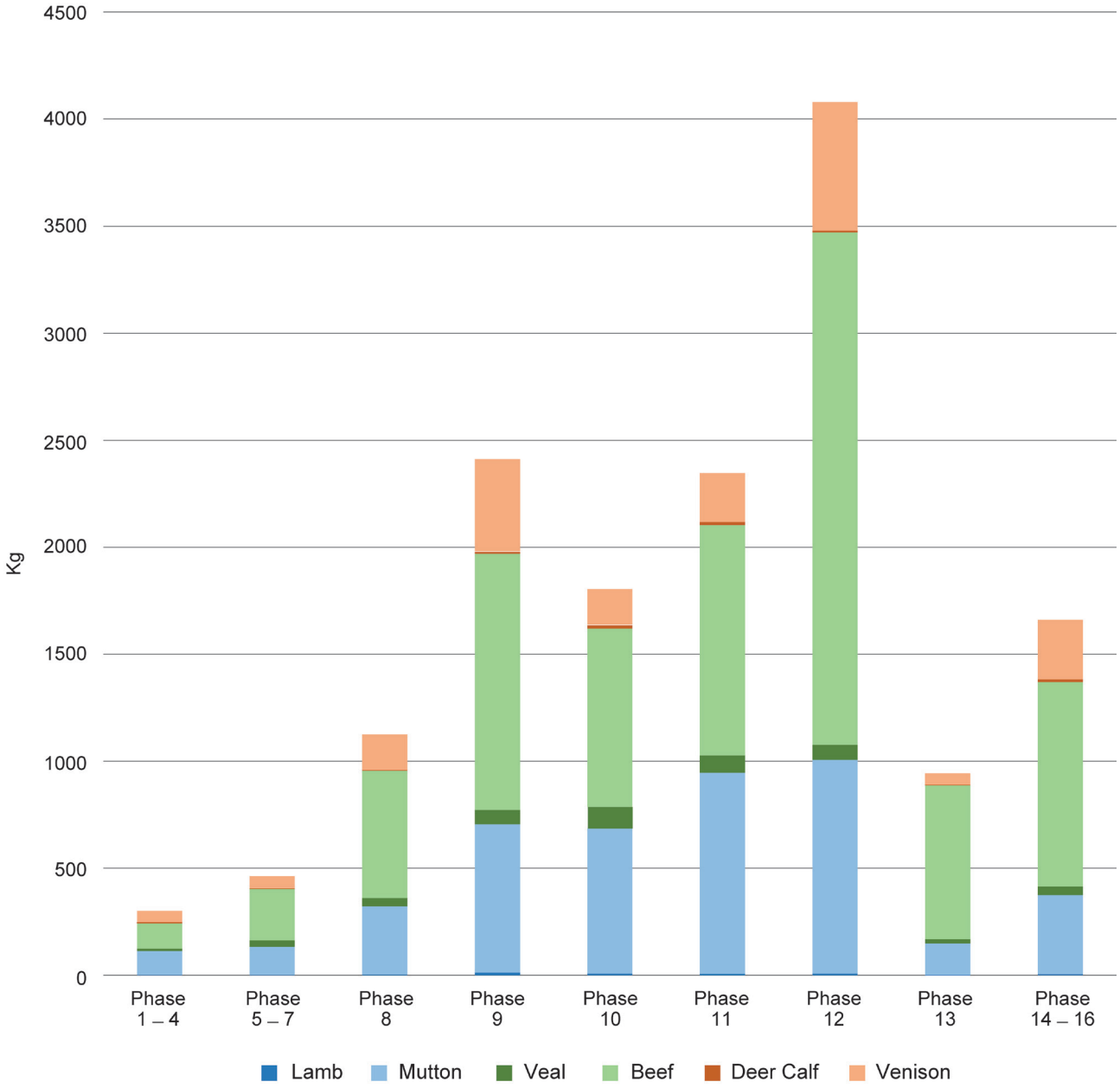


Figure 10.43. Meat weight estimates (kg) by species by phase (veal refers to cattle; calf refers to deer)

Hunting, herding and household animals

The preponderance of different food species and their size in the assemblage provides only part of the overall picture. This section draws on the comparative datasets (*e.g.* dental ageing) from Uist and combines this with other evidence to build a picture of how the island communities interacted with animals.

Detailed comparative dental ageing data is derived from Bronze Age, Iron Age and Norse sites on Uist, excavated as part of the SEARCH/Cardiff research projects. Dental records from Western Isles sites other than on South Uist are either sparse (with little data from the two Neolithic sites in the Western Isles, at Northton, Harris, and the Udal, North Uist [*e.g.* Finlay Aird 2018: 108]) or have been recorded using different systems. The combined dental ageing datasets used in this analysis have around 1,200 records for sheep, 1,000 for cattle and 180 for deer. The rarer pigs provide only very limited dental data. Most of the 'Bronze Age' data from these islands is derived from Cladh Hallan and therefore includes some Early Iron Age material.

Sheep

Age-at-death profiles reveal a stable sheep husbandry strategy throughout the prehistory of Uist. There is little evidence for early sheep deaths at Cladh Hallan, or any other sites, but the fragile neonatal bones of lambs are often present in small proportions. All Hebridean sites have an emphasis on the slaughter of young animals

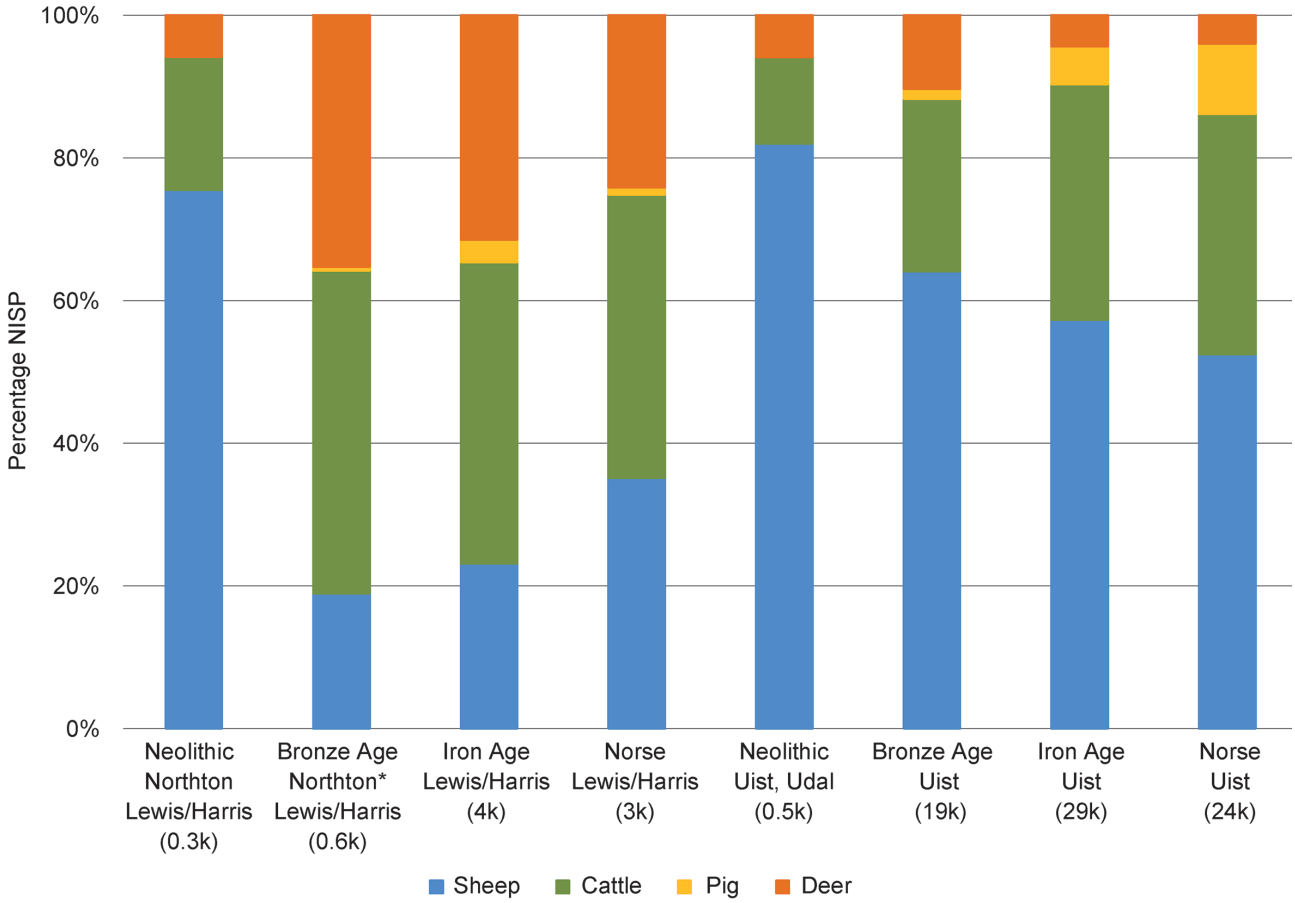


*Figure 10.44. Summary of percentage NISP for different sites and periods (NISP in brackets; *includes red deer antler fragments)*

(up to one year), with a shift in focus to slightly older stock at the Norse sites (Figure 10.45) with peaks in slaughter occurring in the second and fourth to sixth years. The younger animal deaths are likely to have occurred in their first autumn or early winter, when the animals were still benefiting from seasonal grazing. This strategy suggests that during prehistory, whilst meat production rather than sheep milk was valued, many stock were not overwintered.

There is no evidence from Cladh Hallan for strategies that focused on sheep hair or wool acquisition. Some of the earliest evidence for wool in Britain is, however, found in the Bronze Age in Scotland, with wool at Spinningdale, Sutherland, a woollen cord from Sheshader, Lewis, and woollen textiles at Carnoustie, Angus (Haughton *et al.* 2021). These point to the potential for local production, and a small number of spindle whorls were recovered from the site (Phases 13 and 14), though these could relate to the processing of other fibrous materials. Later in the Iron Age, wool was in wide usage (*ibid*). In the Western Isles, however, there is no clear evidence for a change in flock management in prehistory that would indicate any herd manipulation to maximise wool production. Further research into the introduction of woolly sheep, for example by identifying genetic changes in the stock, may shed further light on when wool first arrived on the islands. Later, the Norse focus on older sheep, with fewer animals dying very young, demonstrates an ability to maintain larger flocks over the winter periods, which would increase meat and the potential for wool production.

Cattle

The combined cattle data for Uist demonstrate a similar distinction to that for the sheep between the prehistoric and Norse phases (Figure 10.46). The Bronze Age and Iron Age have a high proportion of very young animal deaths throughout; up to 50% of the population died within a month and only a few of the herd reached maturity. In the Norse period the emphasis shifts markedly with fewer neonates (around 20%), a predominance of deaths in the first winter (50%) and a higher proportion of animals surviving into adulthood and beyond.

The data from Cladh Hallan, and other sites, provide several lines of evidence that can be examined to consider the drivers for this herd demography and to place these early cattle deaths in context. A high proportion of young cattle deaths are reported from prehistoric and historic sites across the North Atlantic region and this has been linked to milk production, vellum production, disease and/or poor husbandry (Craig *et al*. 2005b; Serjeantson and Bond 2007; Dodgshon 2008; McGrory *et al*. 2012; McCormick 2014; Towers 2015). This pattern is most pronounced on the machair sites of Uist, since here the chemical and physical conditions of the substrate preserve evidence of young and

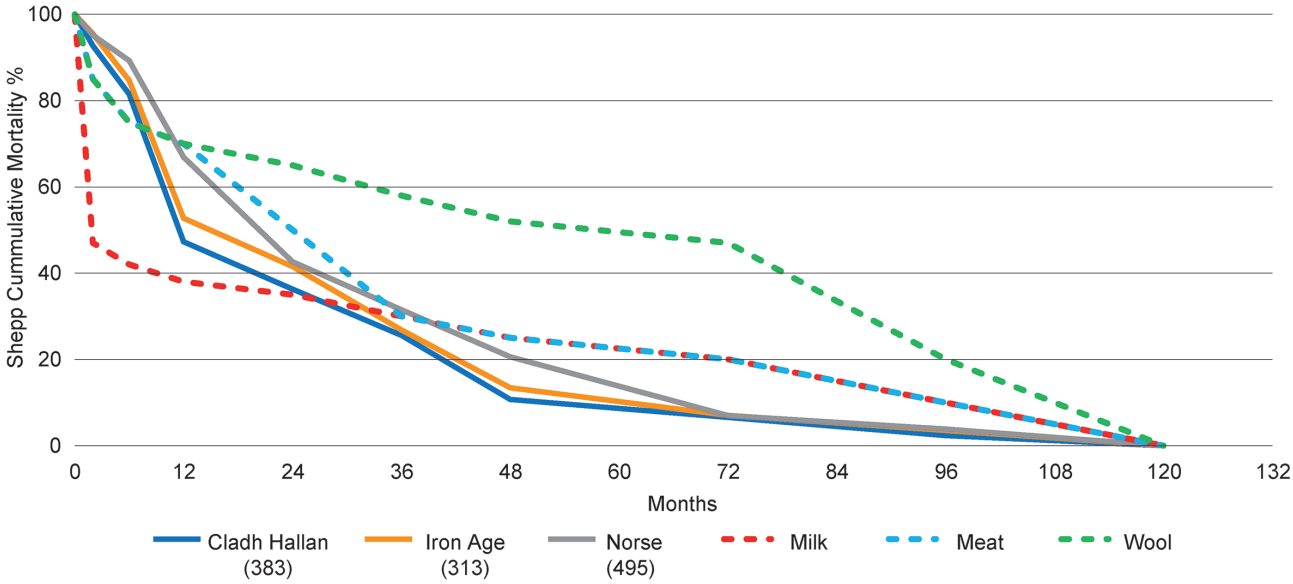


Figure 10.45. Cumulative sheep mortality for different periods compared to production models (after Payne 1973)

fragile faunal remains. Thus, these machair assemblages provide a better representation of living herds but, as a result, the assemblages are hard to compare with sites situated in less benevolent environments.

Natural early mortality in cattle herds is well attested (McGrory *et al*. 2012), so the presence of neonates is expected. The persistent high early mortality levels at these sites suggest that such deaths were common and manageable and, as young calf remains have butchery levels similar to adult cattle, their carcasses were utilised post-mortem. Cladh Hallan provides evidence – from both genetic and/or morphometrical analysis – for a predominance of young male calves in the neonatal deaths. Male calves are both more susceptible to disease (McGrory *et al*. 2012) and are surplus to requirements in most management systems. However, there are ethnographically informed arguments that, in a milk-producing system, it is usual for calves to suckle for a period of around 10 days to let down milk (Halstead 1998). Thus, with over 50% of the calves surviving the first month, lactation could be established in at least half of the herd. Other drivers for the slaughter of young calves may have been the need to manage herd size and structure, or a desire for calf products such as vellum. The need for calfskin is rarely ethnographically attested as a driving factor in cattle management but should be considered as a possibility in the light of the accompanying procurement of very young deer at Cladh Hallan (see below).

At Bronze Age/Early Iron Age Cladh Hallan and later sites, cattle herd structures indicate management to produce milk, and this is supported by the preponderance of dairy fats (but no marine foods signatures) identified from lipid residues within pottery (see Chapter 17). Thus, herds were successfully manipulated to this end, possibly using one of the proposed methods for promoting lactation (calf slaughter, sharing milk *etc*; Mulville 2005).

The volume of milk produced is likely to have been small and seasonally restricted; there is, however, emerging evidence for the prehistoric manipulation of cattle-breeding seasonality, possibly to extend milk production. Whilst seasonal calving (over a three-month period – probably May to July in Britain) prevailed in the Neolithic (sixth to fourth millennia cal BC; Balasse *et al*. 2021), with some exceptions, there is evidence in continental Europe for an extended breeding season from the Bronze Age onwards (*e.g*. Gron *et al*. 2015). This emerging adaptation is tentatively linked to climatic improvements at that time. An examination of seasonality in cattle slaughter has not been undertaken at Cladh Hallan, given the small number of adult mandibles, but preliminary analysis of cementum-banding revealed that some animals appear to have been autumn births (Pike-Tay pers. comm.). Autumn birthing has also been suggested for the later Norse herds in Uist (Griffiths and Mulville 2020).

Roles for the predominantly older female cattle across prehistory include breeding and milk production, and animals may have been employed for traction. The presence of ard-marks in the earliest phases at Cladh Hallan could indicate their use as plough animals, but the light machair soils could also have been tilled by hand.

Pig

Pigs are rare (one tooth fragment: large canine, possible boar) in the small assemblage from Neolithic Northton (Finlay 2006: 75) but become slightly more common from the Beaker period onwards. Elsewhere across the North Atlantic islands, domestic pig is present from the Neolithic but only in small numbers. Comparison is difficult as only a limited number are present from the Bronze Age. The predominance of younger animals persists in the large Iron Age assemblages, with a shifting focus onto older animals

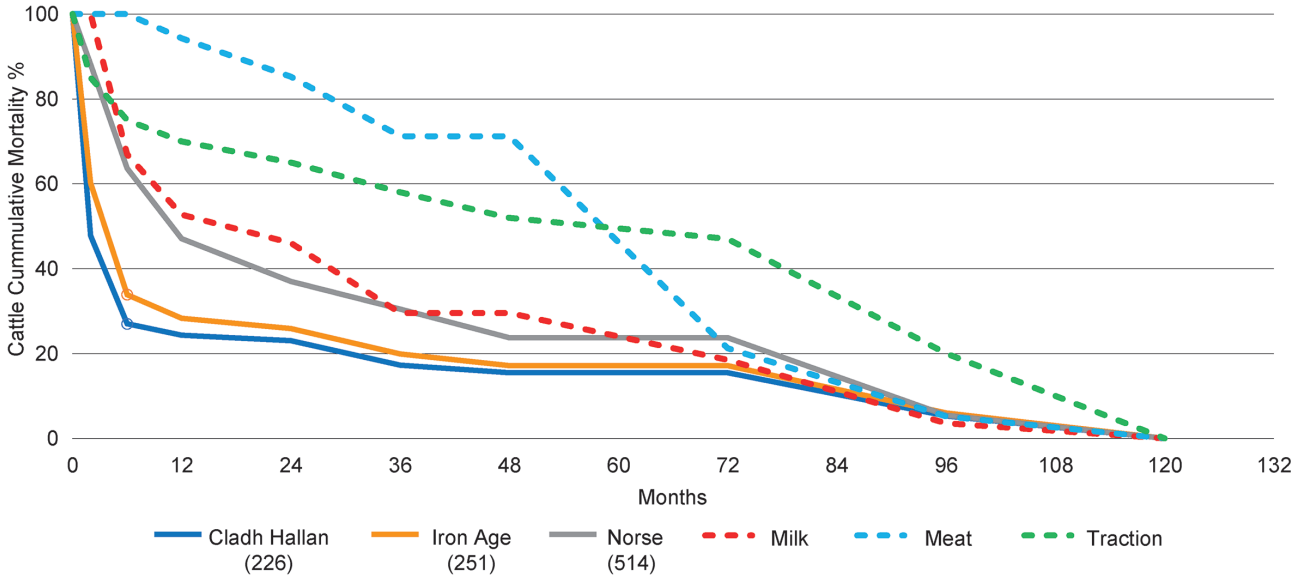


Figure 10.46. Cumulative cattle mortality for comparative sites in the Western Isles compared to production models (after Legge 1992)

and maximising meat production by the Norse period at Bornais (see Figure 10.49).

The few pigs present at Cladh Hallan could be indicative of the importation of pork joints but the presence of all parts of the body and some neonatal bone suggests that they were breeding on the islands at this time, though possibly not before. Genetic analysis would provide more detail on the pig population size and potential movement.

Stock management

Overall, the demographics in prehistory and beyond for sheep, cattle and pig suggest a degree of complexity and intentionality in domestic stock management. This is most clearly demonstrated by the sustainability of a system that managed the deaths of very young calves, alongside natural mortality, and produced milk for millennia.

Domestic animal management and food production at Cladh Hallan predominantly revolved around cattle and sheep, both requiring pasture during the growing season and supplementary fodder in winter. Given the absence of pre-modern field boundaries on South Uist (Mulville and Powell 2012: 233), it's plausible that cattle and sheep roamed freely. While acceptable in winter, such a practice would have posed challenges during crop-growing seasons, potentially leading to conflicts between grazing livestock and arable crops, as discussed in detail by Mulville and Powell (*ibid.*) in relation to the Iron Age and Norse mammal assemblage from the nearby site of Bornais.

The notion of penning livestock at night and relocating some animals to higher ground during the growing season has been proposed, drawing on evidence of transhumance in more recent times (Raven 2012). One drawback of removing animals from crop-growing areas would have been reduced access to readily available manure, a valuable resource for enhancing the fertility of the nutrient-poor machair soils. Additionally, temporary shelters (shielings) would have been necessary for shepherds, cattle herders and the storage of dairy products made from milk. Such a strategy would have optimised grass harvesting in lowlands for winter fodder. Recent efforts to comprehend animal movement by analysing cattle teeth from Norse sites ended with inconclusive findings (Griffiths and Mulville 2020).

In other Atlantic islands, occasional foddering of sheep with seaweed, typically during winter, has been documented (Blanz *et al.* 2022). Cattle and sheep in the Neolithic and Iron Age periods were fed away from the shore front, avoiding a diet comprising saline plants (Jones and Mulville 2016; see Chapter 18). In the Cladh Hallan assemblage, however, sheep exhibit consumption of plants growing in saline conditions, a departure from their typical diet, highlighting the need for further analysis to understand this adaptation.

Stable isotope analysis ($\delta^{15}N$ and $\delta^{13}C$) has revealed that during the Bronze Age pigs had more varied dietary ranges than at other times (see Chapter 18). This variation could relate to seasonal or longer variation in fodder or be the result of pigs being brought in from different locations. During the Iron Age, some of the Uist pigs appear to be fed marine protein, probably fish (Jones and Mulville, 2016). Pigs probably were not left to roam freely given their potentially damaging effects on fragile machair soils (Serjeantson 1990). This is supported by the variation in their diet, and presence of fish, which indicates the small-scale production of pigs. These animals are probably consuming individual household waste rather than being pannaged in herds, and this small-scale production of pigs is seen elsewhere in prehistoric settlements (Madgwick *et al*. 2012).

Red deer

Red deer are abundant, and an examination of the hunting selection strategies provides information on

which individuals and resources were being targeted. The extensive dental dataset (180 records) is large compared to most British assemblages (*e.g.* Carter 1998) and sheds light on practices across time. There is little detailed dental data available from Uist sites other than Cladh Hallan, including the larger assemblages from Norse sites, and none from Lewis/Harris. As a result, it is Bronze Age Cladh Hallan that dominates.

As with cattle, young red deer calves were exploited through time on Uist (Figure 10.47). Mortality in the youngest age classes (under 5 months) ranges from 17% to 39% and is highest in the Bronze Age and Norse periods. Fusion evidence suggests that this pattern is not repeated at other Western Isles sites, even where red deer are present in high numbers, with mostly older animals present (*e.g.* Bostadh and Berie, Lewis; Thoms 2003).

There are few parallels to this pattern of young red deer abundance and mortality. The killing of numerous young red deer calves does not fit with an optimal foraging strategy: a focus on prime (sub-adult/adult) older animals is a more common strategy to maximise venison procurement. Red deer are rare on British sites after the Neolithic and, whilst juvenile animals are present at some Mesolithic sites, calves are extremely rare (*e.g.* Star Carr and Thatcham [Carter 1997; 1998; 2001a; 2001b] and Oronsay [Grigson and Mellars 1987]). The only comparable sites with a high proportion of young calves (aged 0–6 months) are found in Mesolithic Scandinavia and Bosnia at Late Mesolithic sites such as Ringsjöholm (Magnell *et al*. 2020); and Ertebølle sites such as Ringkloster (Rowley-Conwy 1998; Richter and Noe-Nygaard 2003). This pattern of procurement has been related to a demand for the soft and spotted hides of the fawns and, at some sites, this focus on skins is supported by a high frequency of other fur animals such as pine marten (Magnell *et al*. 2020). Elsewhere strategies targeting pregnant females over the winter have been suggested, with one example in Bosnia-Herzegovina where 2% of the population was foetal rather than neonatal (Miracle and O'Brien 1998).

The procurement of red deer calves on Uist was focused on animals that were collected in the first few months after their birth (Figure 10.48). This strategy could relate to the ease of capture for very young animals. Fawns employ bradycardia (freezing) as their main anti-predator defence, hoping to remain concealed (Wass *et al.* 2004). The dams will flee from approaching predators, but young red deer calves remain hidden in sheltered positions, usually in long vegetation (Clutton-Brock and Guinness 1975; Clutton-Brock *et al.* 1982) and could be found and collected for their meat and skins or culled to manage herd size.

The procurement of calves in the late summer and autumn could have coincided with the collection of shed antler. Deer were important as a source of antler and this valuable, renewable, workable resource was used to create numerous artefacts. For example, the sparse early evidence for red deer includes the unusual appearance at Northton, Harris, of a crown antler macehead (Finlay 2006: 74), an artefact otherwise mostly confined to southern England. Antler picks were recovered from Cladh Hallan, in quantities equivalent those reported from the Neolithic sites of Windmill Hill (n = 23) and Avebury (n = 34) (Worley *et al.* 2014) and in the Norse period red deer antler was extensively employed in comb production at Bornais (Sharples and Dennis 2016).

Unlike other species, deer appear in representations across the Isles, as an animal motif on Iron Age Hebridean decorated pottery, as a carved head on a wooden handle from Dun Bharabhat, Lewis (Armit 2006: 239, illus. 7.10)

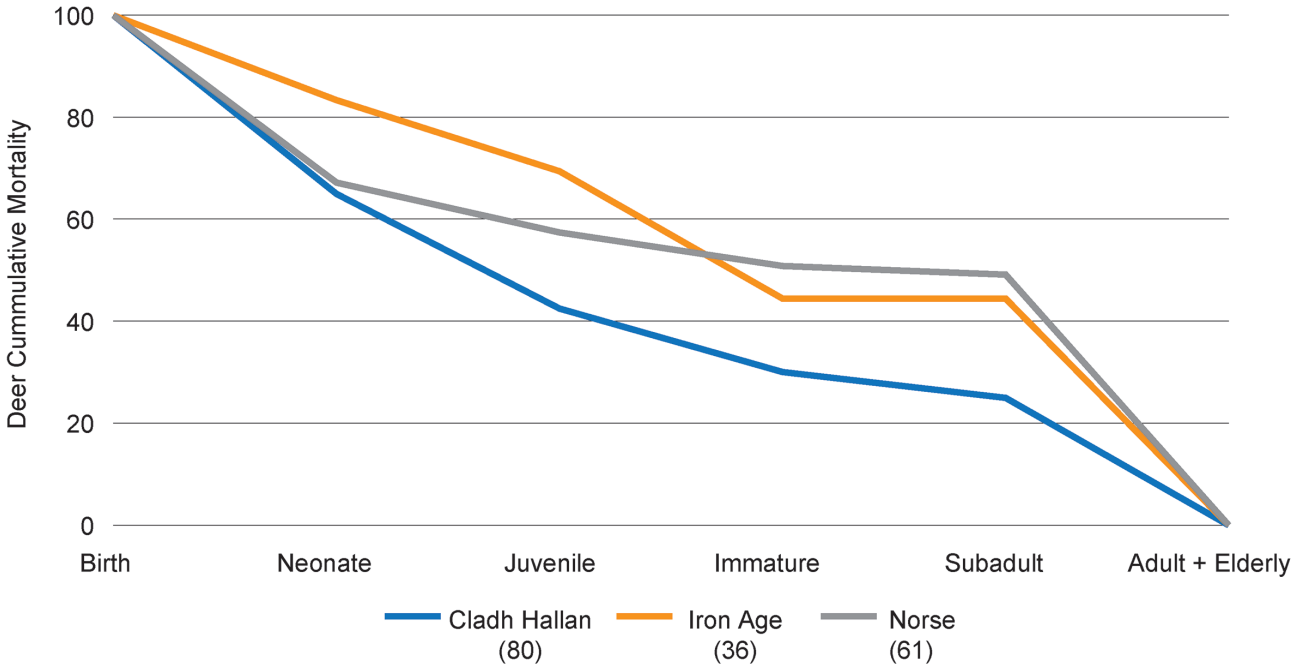


Figure 10.47. Cumulative red deer mortality for comparative sites in the Western Isles

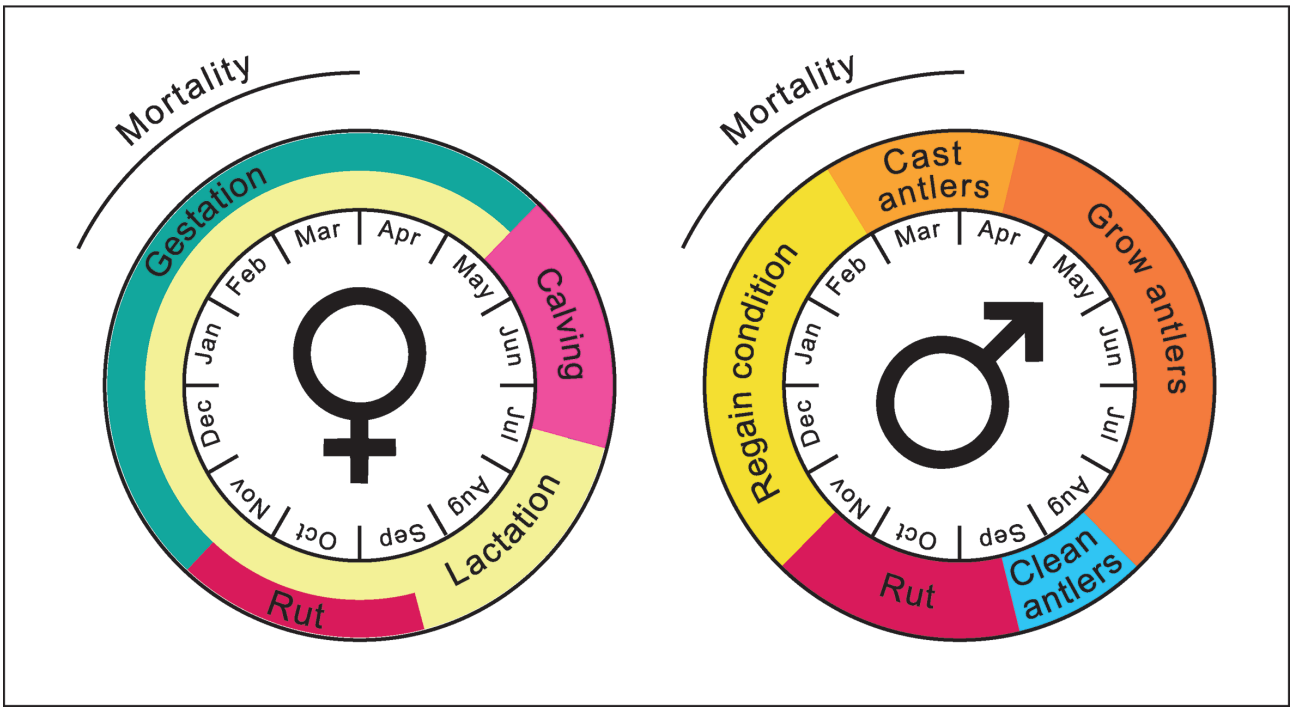


Figure 10.48. The red deer year

and on Norse artefacts (Sharples 2007). Their significance is also highlighted by the incorporation of 17 overlapping adult deer mandibles surrounding a hearth at Iron Age A'Cheardach Bheag, South Uist (Mulville *et al*. 2003). Unlike the other key food species, sheep and cattle, deer mostly appear as butchery/waste associations at Cladh Hallan and not in structured deposits, apart from the placement of some antlers in pits.

The unusual, continued reliance on deer across the Western Isles, and indeed the Northern Isles, has led to speculation on the nature of the insular deer–human relationship (*e.g.* Mulville 2010). Research into colonisation pathways has employed genetic analysis of red deer ancient mitochondrial DNA from across the islands, alongside deer from mainland Britain, Ireland and Scandinavia. The results suggest that deer were imported during the Neolithic, potentially from some distance away (Stanton *et al.* 2016) and from that time onward played a pivotal role in sustainable insular lifeways.

The relative abundance of deer has been linked to the characteristics of the different island groups and environmental constraints (Thoms 2003). McCormick (2007: 163, 165) considered the rich agricultural potential of the extensive machair to be a factor in the lower proportions of this hunted species on Uist compared to Lewis/Harris. McCormick suggested that the lack of good land around the sites of Cnip and Northton on Lewis/Harris increased exploitation of the extensive uplands, resulting in the higher proportion of deer in the bone assemblages. Whilst deer on Uist probably spent much of their time in the uplands, they would have ventured onto the machair, daily or seasonally, as they still do today. Fawns were likely procured from upland breeding grounds, while older individuals were hunted across the landscape. Although no structures associated with deer-hunting are known, topographic features likely aided in the process.

Deer moving through the landscape would have been competitors with domestic stock and consumers of crops. Several authors have argued that the introduction of deer to the islands, their persistence in the light of natural and anthropogenic impacts on the environments, and the on-site presence of neonates all indicate close management and possibly the culling of very young deer to restrict herd size (Clutton-Brock 1999: 113; Noddle 1981; Sharples 2000; Thoms 2003; McCormick 2007: 163–4; Mulville 2010; 2016). The parallels between red deer exploitation and that of cattle – both were prey to culls of their young, required management to protect crops, and inhabited similar areas for at least part of the year – suggests a similar and close relationship with elements of 'domestication'.

These interactions with wild species are highly unusual when viewed from the British mainland and challenge prevailing definitions of post-Mesolithic Britain as a production system dominated solely by domestic foods, with a presumed universal and one-way transition from hunting to farming (Noddle 1981; 1982; Sharples 2000; Thoms 2003; Mulville and Thoms 2005; Armit 2006: 237; Clutton-Brock 1999; McCormick *et al.* 2003; McCormick 2007; Mulville 2010).

Minor species

Dogs, present on the islands from the Neolithic era, were probably kept close to settlements, as suggested by discoveries at Cladh Hallan and elsewhere. The age profile at this, and later sites, suggests some local breeding

since puppy bones are present. Evidence of the dogs' diet is sparse: isotopic analysis indicates a varied diet in the Iron Age, whilst a single Norse dog was commonly consuming fish, shellfish or even marine mammals. Cats, though difficult to differentiate from wild species based on single elements, probably bred at or around Cladh Hallan, like dogs. For both these species, and for pigs, how these small populations were sustained is unclear. Considering the numerous prehistoric settlements on South Uist alone (Parker Pearson 2012a: 25–6, fig. 2.11), it is conceivable that these and later settlements shared animal resources such as breeding stock or engaged in exchange networks involving young animals within or across island groups.

Other land mammals were sporadically gathered from various environments. The rare roe deer may have been traded or lived in the sparse woodland, and otters were occasionally trapped. Seals appear to have only been procured occasionally, and are mostly present as older, injured or unhealthy animals or young pups. Avian (see Chapter 12) and cetacean (see Chapter 11) procurement provides evidence of access to animal communities with wider geographical distribution.

10.18 Conclusion

The large and well-preserved faunal assemblage from the long-lasting settlement at Cladh Hallan demonstrates the presence of a society that focused on farming, supplemented by wild resources. The community raised large flocks of sheep, mostly for meat, and smaller herds of cattle that were employed in both meat and milk production (see Chapter 17). Although less numerous, cattle provided most of the animal protein (meat and milk) in the inhabitants' diet despite an early death for many calves, with lesser quantities of mutton being consumed. Unusually for farming communities, red deer was pivotal in animal exploitation systems, with more venison in the community's diet than pork. Pigs were rarely kept, and their numbers are so low that they may have been occasional imports. Figures 10.49–10.50 show how notably different the pig population of Bronze Age Cladh Hallan was when compared to sites of later periods. Herd demographics indicate that specialised production systems were in place. These systems either drove or managed extremely high levels of neonatal deaths, with unique systems of animal management in which both cattle and red deer calves were exploited.

Canids are unusually common, and a number are also unusually large. The burial of dogs within the houses points to the central role of this species. Sheep were also a feature of household deposition and the focus of occasional important events, where they were killed, eaten and buried in internal pits. Most other mammalian species, including seals, were of minor importance, but the presence of cetacean material within houses again suggests that some sea mammals held special significance (see Chapter 11). The abundant bone and antler artefacts reflect the important of osseous materials from a range of species (see Chapter 3). Skinning evidence points to the use of skins, and it can be assumed that animal fats, alongside meat, tendons, hooves and organs, were all exploited.

The faunal dataset from the site provides detail on continuity and changes in practice during the settlement's occupation and forms the basis for discussion of human

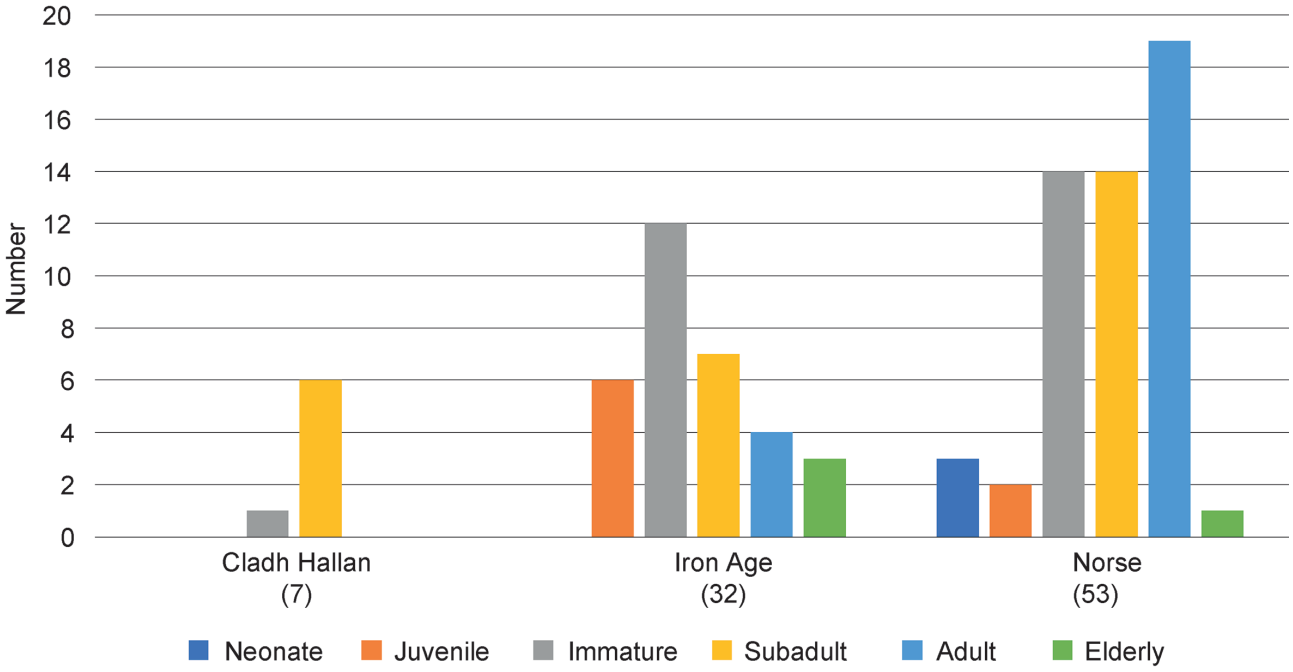


Figure 10.49. Pig dental data (number of mandibles) by age group from comparative sites in the Western Isles

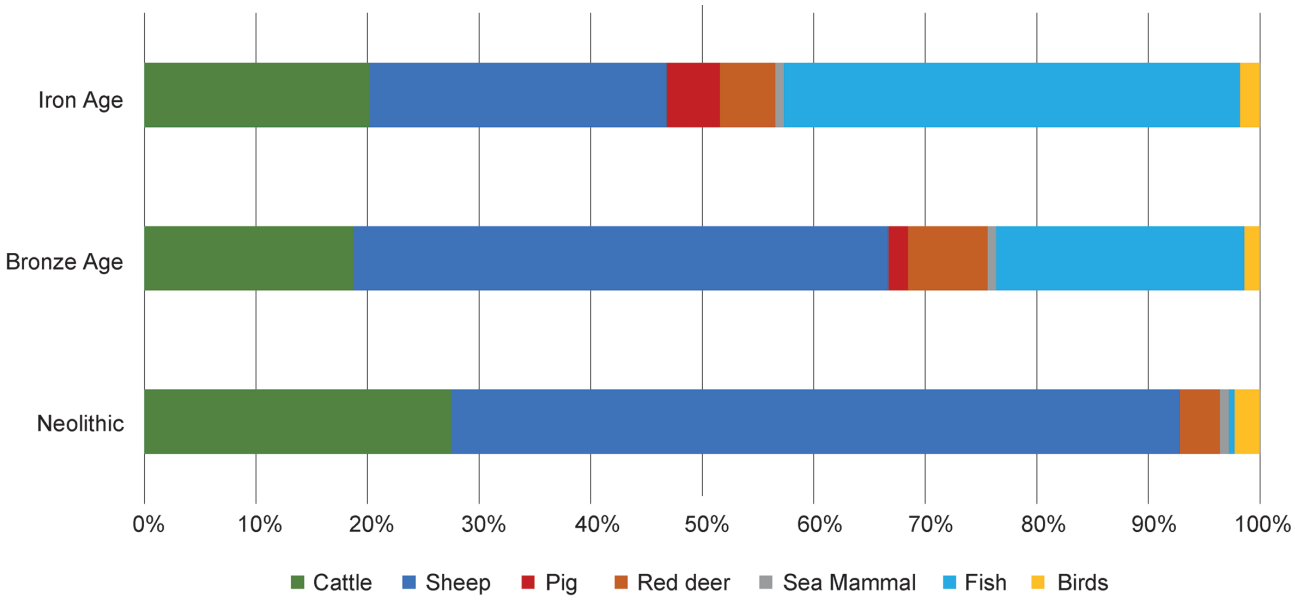


Figure 10.50. NISP proportions of each resource type in the prehistoric Western Isles (after Jones and Mulville 2016)

and animal interactions throughout the Iron Age and into the Norse periods (Figure 10.50). There are minor changes in emphasis within the food production systems, with small variations in the proportions of species and their herd structure over time, but overall, Cladh Hallan and the later sites on Uist provide evidence that the strategy of farming domestic stock alongside the close management of red deer, and the occasional exploitation of other mammalian species, provided a sustainable and resilient system.

Notes

1 The assemblage of cetacean bone is reported in Chapter 11. The assemblage includes worked bone and antler items, which are reported in Chapters 3 and 4.
2 There is one identified reptile bone in the assemblage.
3 The full worked bone assemblage total (n = 879) includes both the definitely worked items and also more than 100 fragments of unworked antler and whale bone, 'imported' to the settlement but not worked (see tables in Chapter 3).
4 The abbreviations for Figures 10.20–10.24 and 10.26 are P = proximal and D = distal, Occip = occipital, Zyg = zygomatic, Mand = mandible, Scap = scapula, Hum = humerus, Rad = radius, Uln = ulna, MC = metacarpal, Pelv = pelvis, Fem = femur, Tib = tibia, Cal = calcaneum, Ast = astragalus, PH = phalanges.
5 See also Chapter 20 for histology of the articulated and partially articulated bone groups.
6 The vertebrae (SF 4744) are definitely sheep, *contra* Volume 1: 93, fig. 4.22. The reader should refer to Volume 1 for the places of deposition of the key bone groups.
7 Pit 1170 belongs to Phase 12 but remains of the same animal were also retrieved from Phase 13 pit 793 immediately above it (see Volume 1: 295, 315, figs 8.6, 8.25, 9.3, 9.6–7). Therefore the remains from these pits are treated as Phase 13.

11 Faunal remains of Cetacea

S. Evans and J. Mulville

11.1 Background

Although cetacean bone occurs on archaeological sites dating to all periods of Scottish prehistory, the analysis and interpretation of these remains has hitherto been limited. The development of new methods of identification and analysis, coupled with the excellent preservation at Cladh Hallan, has provided an opportunity to study one of the largest and best-preserved cetacean assemblages in the UK. The quantities of cetacean bone from Cladh Hallan are far greater than those of published contemporary sites. The possibility therefore exists that cetacean utilisation was greater at this site than elsewhere, presenting a unique opportunity to gain insights into the role of cetaceans in prehistory.

The presence of cetacean bone on settlement sites such as Cladh Hallan can indicate the oil, meat, artefactual and architectural utility of cetacean material. However, a suite of pre- and post-depositional taphonomic factors affect cetacean bone assemblages and their interpretation. The bones of smaller species are more likely to occur at settlements having been transported incidentally in cuts of meat, while those of larger species were often left at shoreline butchery sites unless transported deliberately to a settlement for their value for other purposes, such as use as architectural components, as raw material for artefact production, or for oil extraction. These selection biases affect the archaeological record and its interpretation. Other cetacean resources, such as blubber, sinew and baleen, are generally archaeologically invisible, though historical and ethnographic analogues indicate that these products are likely to have been valued in the past.

Quantification is also problematic and some site activities, such as the deliberate fragmentation of bone for oil extraction and artefact production, pose problems for understanding the number of cetaceans represented in an assemblage. The large size and vast bone (and soft tissue) resources of some of the cetaceans under study further compounds this problem, with the potential for large quantities of fragmented bone to derive from a single animal.

The complexities affecting cetacean bone assemblages create difficulties for comparisons with the remains of other fauna, and factors such as the large size of some cetaceans and their potential relative contribution to prehistoric economies compared with that of smaller species may be masked (Betts and Friesen 2013). Despite these issues, the application of appropriate sampling strategies and new biomolecular and morphological identification techniques can shed light on the utilisation of cetaceans by prehistoric coastal communities.

11.2 Methods

Cetacean bone was recovered by hand and from sieved samples. The sampling strategy, with its particular emphasis on the recovery of remains from floor deposits for all material including cetacean bone, can be found in Volume 1: section 1.6. Material considered here is derived from contexts which were sieved on site for finds recovery with a 10mm mesh. Visual identification in the field of cetacean material was enabled by the presence of a faunal analyst (JAM) on site. Further material was identified visually during the post-excavation process, separated from other mammalian remains and identified, recorded and analysed following the strategies outlined below.

Identification

Species identifications were made from morphological characteristics and by using Zooarchaeology by Mass Spectrometry (ZooMS). The former was used to identify elements that were present in a sufficiently complete form to retain identifiable landmarks, whilst the latter was principally employed on bone fragments and artefacts which lacked these. Taxonomic classifications followed Perrin (1989), with the exceptions of Delphinidae for whom Mead's (1975) classification was used. Where species (or family) identifications were not possible, the bones were recorded as size categories: 'large cetacean', 'medium cetacean' and 'small cetacean'. While this classification is typically used to record cetacean bones, the categories

Table 11.1. Size ranges for cetacean species

Common name	Latin name	Size av. (m)	Max. (m)
Large (*c*. 11m to 30m)			
Blue whale	*B. musculus*	25	29.8
Fin whale	*B. physalus*	21	24
Bowhead whale	*B. mysticetus*	15	19.8
Sei whale	*B. borealis*	15	19.5
Sperm whale	*P. macrocephalus*	15	18.3
Right whale	*E. glacialis*	15	18.3
Humpback whale	*M. novaeangliae*	14.6	17
Gray whale	*E. robustus*	12.2	15
Medium (*c*. 3.5m to 11m)			
Minke whale	*B. acutorostrata*	8	10.7
Northern bottlenose whale	*H. ampullatus*	7.3	9.8
Killer whale	*O. orca*	7	9
Cuvier's beaked whale	*Z. cavirostris*	6.4	7
Gervais's beaked whale	*M. europaeus*	-	6.7
Pilot whale	*G. melas*	4.8	6.3
False killer whale	*P. crassidens*	4.6	6.0
Sowerby's beaked whale	*M. bidens*	5.0	5.5
True's beaked whale	*M. mirus*	5.0	5.3
Blainville's beaked whale	*M. densirostris*	4.8	-
Beluga whale	*D. leucas*	3.9	4.9
Narwhal	*M. monocerus*	4.0	4.7
Gray's beaked whale	*M. grayi*	3.6	4.2
Small (*c*. 1m to 4m)			
Risso's dolphin	*G. griseus*	3.0	3.83
Bottlenose dolphin	*T. truncatus*	3.0	3.8
Pygmy sperm whale	*K. breviceps*	3.0	3.5
White-beaked dolphin	*L. albirostris*	2.75	3.1
White-sided dolphin	*L. acutus*	2.4	2.82
Melon-headed whale	*P. electra*	2.2	2.75
Common dolphin	*D. delphis*	2.1	2.7
Fraser's dolphin	*L. hosei*	2.1	2.7
Striped dolphin	*S. coeruleoalba*	2.4	2.65
Harbour porpoise	*P. phocoena*	1.4	1.89

have not previously been defined (except in Evans 2021). The authors therefore include the table above to standardise definitions (Table 11.1).

Morphological identification

Morphological identification applied the authors' developing morphological guide to all material (Evans and Mulville 2018). In general, morphological identifications were possible only on relatively complete elements. During this study and subsequent research, it became clear, however, that, following the results of ZooMS analysis (see below), some fragmented cetacean bone could also be morphologically identified. This applies specifically to bone from the sperm whale skull: the trabecular structure of this bone is unique and can be identified through visual examination.

ZooMS identification

For a selection of morphologically unidentifiable material, proteomic identification (ZooMS) was employed with samples compared to published index sequences (Buckley *et al*. 2009; 2014). ZooMS analysis of cetacean material cannot support the identification of some species. In this analysis, identifications of Delphinidae and Ziphiidae are limited to family rather than sub-family or species classifications due to the absence of index sequences for

several species (Buckley *et al*. 2014) and the potential for imminent revision of genus and sub-familial groupings within the delphinids (Vollmer *et al*. 2019). Balaenids were identified to family level as there is no published sequence for the bowhead whale and it is indistinguishable from the only other member of the Balaenidae family (the right whale) based on peptides (Buckley *et al*. 2014). As bowhead whales are an ice-edge species, however, it is very unlikely they inhabited Hebridean waters during Cladh Hallan's occupation. It is therefore probable that the material in the assemblage identified as Balaenidae is right whale.

Samples for ZooMS analysis were selected from material from a range of contexts to provide good chronological and spatial sampling, with a focus on indoor deposits. Sampling avoided burnt bone, as this is not suitable for ZooMS analysis as the peptides generally do not survive. Cetacean bone from disturbed deposits, robber trenches and wall core deposits were excluded from sampling, given the possibility that this material originated from earlier or later phases and has the potential to confuse any temporal patterns.

In total, 101 samples of cetacean bone were subject to ZooMS analysis, representing around 8% of the total assemblage. In general, only one sample per context was taken, to avoid the potential issue of sampling different fragments of the same bone. An exception to this was made when sampling cetacean artefacts from the same context as fragments. Additionally, a small number of contexts were chosen for more intensive sampling, to identify species diversity within individual contexts and to test the assumption that bone fragments within the same context are all likely to be from the same species/individual/element. This strategy also aimed to determine whether there were any species preferences evident within the worked bone assemblage. The samples included four pieces of cetacean bone from floor 1311 of House 401 in Phase 9, three samples from floor 2211 of House 1370 in Phase 9 and two samples from floor 455=466=453=479 of House 401 in Phase 15.

Recording strategy

All cetacean bone was recorded and quantified by species and element where possible using morphological and ZooMS techniques. The ability to identify numerous fragments to species using ZooMS provides a quantification challenge and is discussed later.

Modified elements (with signs of deliberate working and shaping and/or usage) and unworked material were recorded to create a complete picture of cetacean exploitation. The former category includes bones used for architectural purposes. Evidence for taphonomic processes (butchery, burning and gnawing) was noted. Measurements for individual elements were recorded following the cetacean morphological identification guide (Evans and Mulville 2018); in addition, the greatest length, width and breadth of artefacts and fragments were measured.

The relative proportions of worked and unworked fragments, unworked and modified elements and artefacts were then calculated and interpreted with reference to likely usage resulting from the different forms.

Quantification

Element and species identifications provide an indication of the quantity of cetacean bone, as the Number of Identified Specimens (NISP). Unlike traditional zooarchaeology, based on morphology, the inclusion of ZooMS species identification of previously unidentifiable fragments and highly worked artefacts adds complexity to quantification. Therefore, although this combination of methods provides an indication of the quantity of cetacean bone present on the site, it has not been possible to compare this quantification data with that of other species. The NISP data do, however, provide a basis for understanding the relative occurrence of different species and provide an estimate of the quantity of cetacean bone by phase and area.

The MNI for each species/order was calculated; the high degree of fragmentation has, however, generally precluded the possibility of morphologically positively identifying more than one individual per species/order in the assemblage.

11.3 The assemblage

A total of 1,285 fragments of cetacean bone were recorded. These range in size from pieces just over 1cm across to entire elements. The majority derives from the Late Bronze Age phases (Table 11.2), with a much smaller assemblage from the Early Iron Age phases, and a few fragments from the Early Bronze Age. Phase 9 produced the highest NISP (see Table 11.8), with the majority of Phase 9 NISP found within the floor layers of House 801 (1150) and House 1370, which account respectively for 11% and 1% of the entire assemblage. Many fragments (6% of the assemblage) were also recovered from the windblown sand (1149) that covered the floor (1150) of House 801 at the end of Phase 9.

Species by phase

A range of species is present in the assemblage (Figure 11.1), with 459 (36%) fragments identified to a taxonomic level higher than the Order Cetacea using a combination of morphological analysis and ZooMS (Table 11.3). Identifications were made using morphology, ZooMS or a combination of both. The combination of ZooMS and morphological identification was used where ZooMS identification effectively removed some taxa from the list of potential identities and morphological analysis of the remaining potential candidates made it possible to hone the identification further. This was possible when the remaining candidate taxa were morphologically dissimilar.

Over three-quarters of all cetacean bone was morphologically identified to species or family (Table 11.6). Overall, sperm whale has the highest NISP (n = 368), with a range of other species (primarily dolphin species) all represented by lower counts. The ability to identify fragments of sperm whale skull based on

Table 11.2. Overview of cetacean bone quantities within the Cladh Hallan assemblage

Period and phase	Cetacean bone count
Early Bronze Age	*7*
3	7
Late Bronze Age	*1164*
4	5
5	1
6	16
7	10
8	205
9	481
10	178
11	161
12	107
Early Iron Age	*94*
13	25
14	25
15	9
16	35
Unstratified	*20*
Grand total	**1285**

the morphology of the bone structure has skewed the dataset toward that species. A wide range of species was identified through ZooMS, including blue and fin whale, humpback whale and sperm whale, and more generic identifications of Balaenopteridae, Balaenidae, Delphinoidea and Delphinidae.

The quantity and range of species vary across the periods of occupation of the settlement. The larger Late Bronze Age assemblages from Phases 7–12 produced evidence of at least 10 different species. Sperm whale is the most frequent (NISP 368), followed by Balaenidae (probably right whale; NISP 10) and humpback whale (NISP 9). All other species, which include blue whale, fin whale, and a smaller Balaenopteridae (either sei or minke whale), killer whale, pilot whale, smaller dolphins (including *Lagenorhynchus* sp., either white-beaked or white-sided dolphins) and large Delphininae (either bottlenose dolphin or Risso's dolphin), were represented by fewer than five recorded fragments.

The smaller identifiable assemblage (NISP 26) from the Early Iron Age (Phases 13–16) comprised only four species. The species composition is very different from the Late Bronze Age material, with blue whale dominating the identified samples (NISP 17) and sperm whale absent. Fin whale was identified (NISP 1) and smaller species including large Delphininae (either bottlenose dolphin or

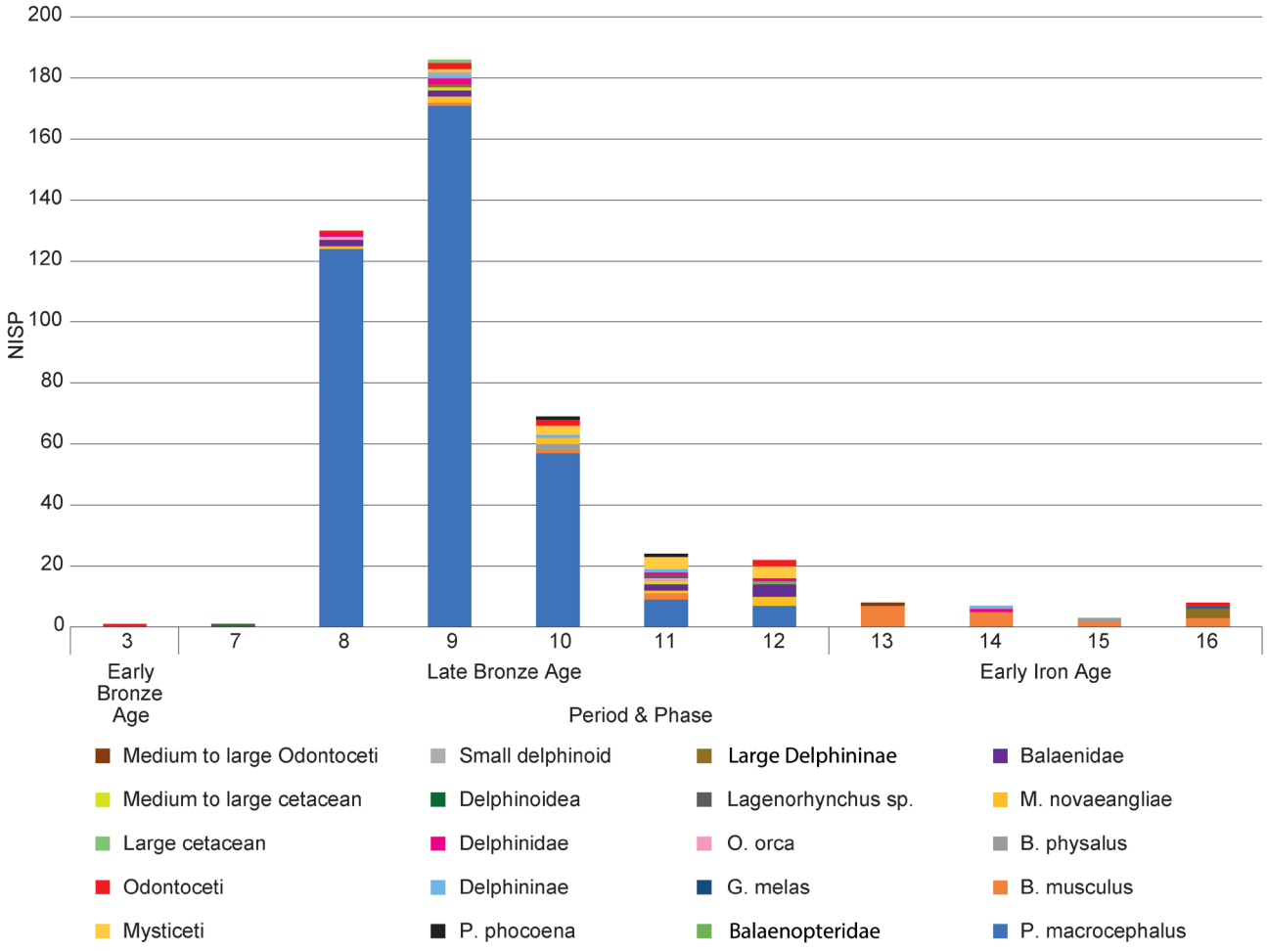


Figure 11.1. Taxonomic identification of cetaceans by period and phase

Table 11.3. Comparison of NISP identification by identification method

NISP	Identification method			%	Total
	Morphology	ZooMS	Combination	*ZooMS*	
Delphininae	1				1
Delphinidae	2	2	2	*67%*	6
Delphinoidea	2	2		*50%*	4
Small delphinoid			1	*100%*	1
Large Delphininae	4		1	*20%*	5
Medium to large Odontoceti	1				1
Odontoceti	11				11
Lagenorhynchus sp.	1				1
B. musculus		21		*100%*	21
B. physalus		3		*100%*	3
Balaenidae		10		*100%*	10
Balaenopteridae		1		*100%*	1
G. melas	1		1	*50%*	2
M. novaeangliae		9		*100%*	9
Mysticeti	6	6		*50%*	12
O. orca	1		1	*50%*	2
P. macrocephalus	327	41		*11%*	368
P. phocoena	1				1
Total	***358***	***95***	***6***	*22%*	***459***
Medium to large cetacean	2				2
Large cetacean	1				1
Cetacea	823				823
Grand total					**1285**

Risso's dolphin; NISP 3) and harbour porpoise (NISP 1) are also present.

Elements

One-third of the material (NISP 415) could be identified to element, with parts of the head, spine, ribs and appendicular skeletons of a variety of species recorded (Tables 11.4–11.5). Some elements are present in an unmodified form, while others have been worked into artefacts or reduced to smaller fragments but retain sufficient characteristics for identification.

The most numerous element(s) were from the maxilla, found in Late Bronze Age Phases 8–12, identifiable from the unusual trabecular structure of the sperm whale skull(s) to which they belonged. This body part is represented by mostly small fragments though some large pieces were also recovered; no complete skulls are present. Sperm whale is additionally represented by a tooth and vertebral epiphyses.

Five teeth were recorded, of which three could be identified to species. In addition to a sperm whale tooth, teeth from killer whale and Delphinoidea were also identified. The remaining two could not be identified beyond the generic Odontoceti category. The sperm whale tooth and killer whale tooth were both from Late Bronze Age deposits (Phases 9 and 11 respectively).

The second most numerous identified elements derive from vertebrae, reflecting the predominance of these within the cetacean body and their common occurrence on Hebridean sites (Mulville 2002). Vertebral remains represent a range of species, with thoracic, lumbar and caudal vertebrae each represented between three and four times, suggesting no preference for particular regions of the spine.

Apart from a blue whale vertebra, discs and process, most vertebrae are from delphinoids. These include a thoracic vertebra of a killer whale, with thoracic and lumber vertebrae of pilot whale, caudal vertebra of *Lagenorhynchus* sp. (either white-sided or white-beaked dolphin), three lumbar vertebrae and a caudal vertebra from a large Delphininae (either bottlenose dolphin or Risso's dolphin) as well as other more generic identifications. Two of these lumbar vertebrae were from the same phase and may represent an articulating portion.

A wider range of species is represented by vertebral epiphyses, including blue whale, humpback whale, sperm whale and delphinoids. The presence of vertebral epiphyses in relatively high numbers (37 were identified

Table 11.4. Cetacean bone elements identified in each phase

Element	Early Bronze Age	Late Bronze Age									*Late Bronze Age total*	Early Iron Age				*Early Iron Age total*	Unstratified	Grand total
	Phase																	
	3	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*		*13*	*14*	*15*	*16*		*U/S*	
Skull fragment						123	164	48	5	2	*342*							**342**
Tooth	1						1		2	1	*4*							**5**
Earbone			1								*1*							**1**
Long bone epiphysis							1				*1*							**1**
Phalange								1			*1*		1			*1*		**2**
Rib							2			1	*3*						1	**4**
Scapula															1	*1*		**1**
Thoracic vertebra						2	1				*3*							**3**
Lumbar vertebra									1		*1*				2	*2*		**3**
Lumbar vertebra (lower lumbar)							1				*1*							**1**
Caudal vertebra							1	1	1		*3*						1	**4**
Vertebra						1	3	3	1	1	*9*							**9**
Vertebral process					1						*1*			1		*1*		**2**
Vertebral epiphysis					1	1	5	3	4	11	*25*	1	4		5	*10*	2	**37**
Unknown	6	5		16	8	78	302	122	147	91	*769*	24	20	8	27	*79*	16	**870**
Grand total	**7**	**5**	**1**	**16**	**10**	**205**	**481**	**178**	**161**	**107**	*1164*	**25**	**25**	**9**	**35**	*94*	**20**	**1285**

Table 11.5. Taxonomic identification of cetacean bone elements

Element	Identification																					Total
	B. musculus	*B. physalus*	Balaenidae	Balaenopteridae	Delphinidae	Delphininae	Delphinoidea	*G. melas*	*Lagenorhynchus sp.*	Large cetacean	Large Delphininae	*M. novaeangliae*	Medium to large cetacean	Medium to large Odontoceti	Mysticeti	*O. orca*	Odontoceti	*P. macrocephalus*	*P. phocoena*	Small delphinoid	Cetacea	
Skull fragment																		342				342
Tooth							1									1	2	1				5
Earbone																					1	1
Long bone epiphysis												1										1
Phalange					1							1										2
Rib										1		1									2	4
Scapula																			1			1
Thoracic vertebra					1			1								1						3
Lumbar vertebra								1			2											3
Lumbar vertebra (lower lumbar)											1											1
Caudal vertebra					1				1		1		1									4
Vertebra	1						1						1		1					1	4	9
Vertebral process	1					1																2
Vertebral epiphysis	5			1	3		1				1	1		1	5		9	4			6	37
Unknown	14	3	10				1					5			6			21			810	870
Total	**21**	**3**	**10**	**1**	**6**	**1**	**4**	**2**	**1**	**1**	**5**	**9**	**2**	**1**	**12**	**2**	**11**	**368**	**1**	**1**	**823**	**1285**

Figure 11.2. Blue whale vertebral epiphyses from Early Iron Age deposits. From left to right SF 2074, 2073, 3171. Farthest right is from context 462 but has no SF number.

from the site) indicates the exploitation of individuals which had not reached full physical maturity.[1] Blue whale epiphyses (which account for five of the epiphyses identified) derive solely from Early Iron Age deposits. The range of sizes present suggests that they derive from different locations along the spine, possibly from a single individual (Figure 11.2).

One fragment of sperm whale vertebral epiphysis was recovered from Phase 9 with three more from Phase 12. Two of the latter (SF 3453 and SF 4826) derived from a single context (1315) and were found to refit (Figure 11.3).

Other elements include ribs, from a humpback whale and fragments identified only as large cetacean and Cetacea. The appendicular skeletons of a small number of cetaceans were also present. Flipper bones, including a phalange and the epiphyseal end of a long bone, from a humpback whale, were identified in Late Bronze Age deposits (Phases 10 and 9 respectively). The humpback whale rib and a vertebral epiphysis were also in Late Bronze Age deposits (Phase 12), possibly all representing a single animal.

Figure 11.3. Sperm whale vertebral epiphysis SF 3453 and SF 4826 (left and right), refitted

Number of individual Cetacea

As noted above, despite the high number of sperm whale fragments and multiple elements from the same species within the same or successive phases (*e.g.* sperm whale and humpback whale within Late Bronze Age deposits and blue whale within Early Iron Age deposits), there is nothing within the dataset to indicate the presence of more than one individual for each species. The only repeating elements are vertebrae and, where they derive from one individual species, most are differing sizes apart from the one set of lumbar vertebrae of a large Delphininae (see above). All are therefore considered to have an MNI of one.

Table 11.6. Quantification of cetacean taxa at Cladh Hallan (NISP)

Taxa	NISP
P. macrocephalus	368
B. musculus	21
Mysticeti	12
Odontoceti	11
Balaenidae	10
M. novaeangliae	9
Delphinidae	6
Large Delphininae	5
Delphinoidea	4
B. physalus	3
G. melas	2
O. orca	2
Medium to large cetacean	2
Balaenopteridae	1
Delphininae	1
Lagenorhynchus sp.	1
Large cetacean	1
Medium to large Odontoceti	1
P. phocoena	1
Small delphinoid	1
Cetacea	823
Total	**1285**

Table 11.7. Burnt cetacean bone by phase

Period and phase	Total no. of fragments	Total no. of burnt fragments	Percentage burnt
Early Bronze Age	*7*	*1*	*14%*
3	7	1	*14%*
Late Bronze Age	*1164*	*47*	*4%*
4	5	0	*0%*
5	1	0	*0%*
6	16	2	*13%*
7	10	0	*0%*
8	205	2	*1%*
9	481	27	*6%*
10	178	6	*3%*
11	161	4	*2%*
12	107	6	*6%*
Early Iron Age	*94*	*7*	*7%*
13	25	1	*4%*
14	25	2	*8%*
15	9	0	*0%*
16	35	4	*11%*
Unstratified	*20*	*0*	*0%*
Grand total	**1285**	**55**	**4%**

However, the longevity of the activity at Cladh Hallan (spanning over a thousand years) suggests that multiple individuals may be present, with the material on site representing only a small fraction of the whales exploited. The absence of whale bone on sites can be linked to the selective transport of utilised elements, a process likely to have affected the remains of larger species (Perkins and Daly 1968). Analysis of aDNA to identify individual specimens would shed further light on the presence of different individuals (*e.g.* Evans *et al*. 2016; UHI 2019b).

Bone modification

Only 4% of bone showed evidence of burning ($n = 55$; Table 11.7). In phases containing over 100 fragments of whale bone, Phases 9 and 12 had the highest proportions (6%).

The relative proportions of unmodified and modified identifiable elements, unworked and worked fragments, and artefacts is shown in Figure 11.4. Much of the material has some form of modification, with evidence of shaping and the production of artefacts. Artefacts were produced from the bones of both large and small species. Unmodified and modified element categories are dominated by delphinoids, while the unworked and worked fragmentary bone is typically derived from the larger species.

Spatial and temporal distributions

Patterns in the spatial and chronological distributions of cetacean bone and species can be examined by phase (Phases 1, 2, 4, 5 and 6 are excluded as no identifications below Order level were achieved; Table 11.8). With standard recovery across the site from sieving of contexts through 10mm mesh, clear patterns are evident relating to the distribution of individual species, and variations in biodiversity on the site.

Species distribution by phase: Late Bronze Age Phases 7 to 12

There is evidence of the widespread use of sperm whale across the site during Late Bronze Age phases. This species is present within most houses and areas (Table 11.8), primarily as fragments of skull in relatively high numbers (Table 11.9). In addition, large pieces of sperm whale skull (maximum size of 420mm by 370mm by 125mm) were found within Phases 8 and 9, some of which (SF 5018) was placed at the entrance to House 1370 in Phase 9. Another sperm whale skull fragment was incorporated (SF 4560) within the capping of a stone-lined cist (2105) within the entrance of House 401 in Phase 8 (see Volume 1: figs 4.37–4.38). In Phase 9 most sperm whale skull fragments derive from House 801, with a sperm whale tooth (SF 4564) set vertically into the inter-floor fill layer of House 1370, and an artefact (SF 3811; see Volume 1: fig. 5.72) created from the skull recovered from a layer (1765) in front of House 1370. All houses produced sperm whale skull fragments throughout

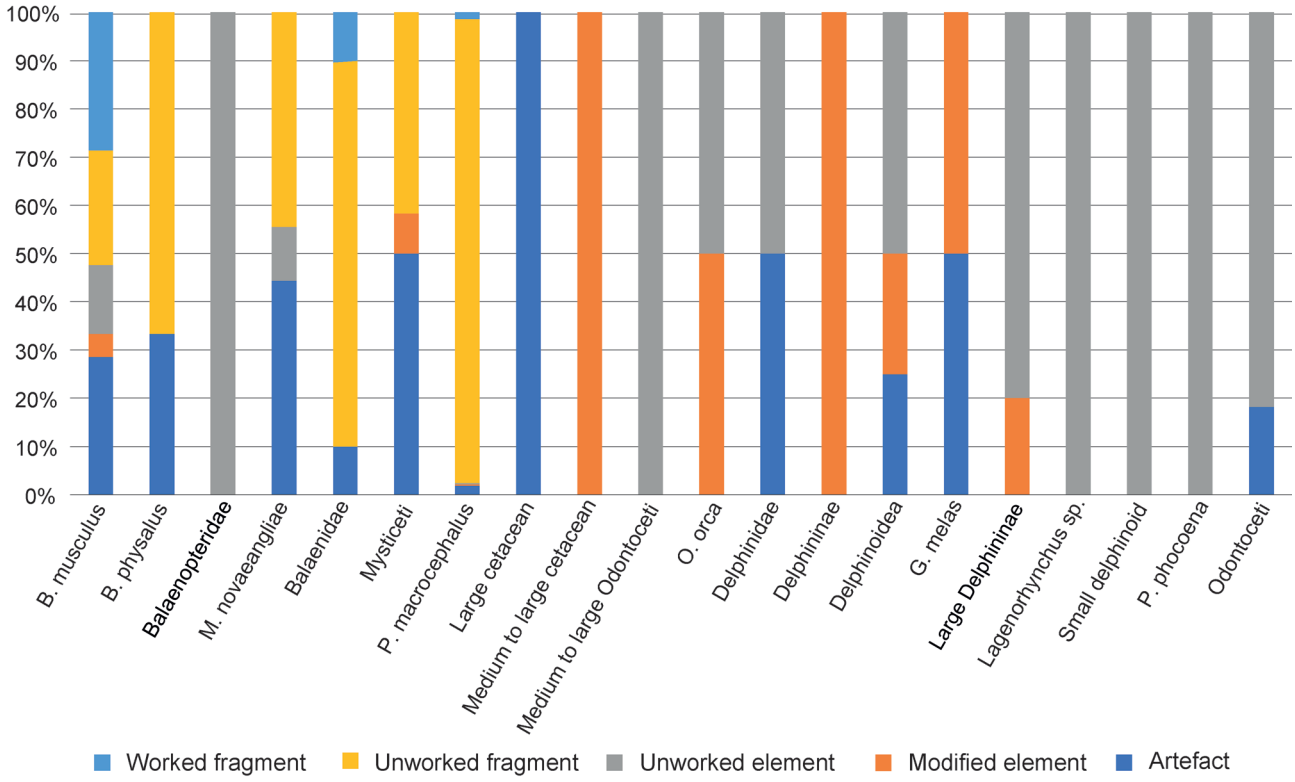


Figure 11.4. Taxa and modifications at Cladh Hallan

their Late Bronze Age occupation (up to and including Phase 12 of House 401).

Humpback whale was recorded in floor 1698 of House 401 in Phase 9 and House 1370's floor in the same phase produced the epiphyseal end of a long bone. Other occurrences of humpback whale include a phalange from layer 840 in the forecourt of House 401 in Phase 10 and an unidentifiable worked bone artefact (SF 3866) in layer 1644 above abandoned House 1370. The epiphysis (Phase 9) and phalange (Phase 10) may both belong to a single humpback whale flipper, possibly indicating elements from a single individual deposited in different areas of the settlement. A rib and vertebral epiphysis were recovered from floor 595 and inter-floor fill layer 1226 respectively within House 401 in Phase 12. Other species are represented as fragments, with Balaenidae, fin whale and blue whale present and small numbers of delphinoid bones within the houses and in adjacent external areas.

Species distribution by phase: Early Iron Age Phases 13 to 16

Blue whale is the dominant species identified in Early Iron Age deposits and was recovered from four houses. Several vertebral epiphyses (SF 2073 and SF 2074) were recovered from floor 462 within House 401 in Phase 14, with a fragment of epiphysis (SF 3171) in the floor layer (632) of House 640 in Phase 16, and a vertebral process in inter-floor fill layer 469 within House 401 in Phase 15.

Species diversity by area

While examples of the same species were found across different houses, a range of species were also found in each interior and exterior area, and most houses demonstrated the presence of multiple species (Figure 11.5 presents the minimum number of species [MNS] per area). In particular, the strategy for ZooMS identification of material not identifiable using morphological methods expanded the species range. Some areas had numerous species in a single phase, house or, in some cases, a single context. This is particularly the case for the larger Late Bronze Age deposits.

There were up to seven different species in a single phase (*i.e.* Phase 11), with five of these recorded within one house (401). Floor 1311 of House 401 in Phase 9 produced evidence of at least three different species, including a fragment of balaenid bone (SF 3149), a perforated vertebral epiphysis from a Delphinidae (SF 4683), a piece of worked bone (SF 4583), possibly representing a disc rough-out from a delphinoid, and a vertebral epiphysis from a sperm whale (SF 4680). The latter was partially burnt but otherwise unmodified.

Likewise, fragments from equivalent floor deposits 466 and 455 within House 401 in Early Iron Age Phase 15 represent a blue whale and a fin whale. Remains from other deposits confirm the presence of multiple species; floor 2211 in House 1370 in Phase 9, for example, produced an MNS of three (sperm whale, humpback whale and Delphinidae).

These results demonstrate a hitherto unrecognised level of species diversity within individual contexts and within

Table 11.8. Spatial and temporal distribution of cetacean species at Cladh Hallan

Phase and area	*B. musculus*	*B. physalus*	Balaenidae	Balaenopteridae	Delphinidae	Delphininae	Delphinoidea	*G. melas*	*Lagenorhynchus* sp.	Large cetacean	Large Delphininae	*M. novaeangliae*	Medium to large cetacean	Medium to large Odontoceti	Mysticeti	*O. orca*	Odontoceti	*P. macrocephalus*	*P. phocoena*	Small delphinoid	Cetacea	Total
Phase 3 total																	*1*				*6*	*7*
House 1370																	1				1	2
NE Area																					3	3
S Area																					1	1
Unknown																					1	1
Phase 4 total																					*5*	*5*
House 2835																					4	4
Unknown																					1	1
Phase 5 total																					*1*	*1*
S Area																					1	1
Phase 6 total																					*16*	*16*
NE Area																					16	16
Phase 7 total						*1*															*9*	*10*
Structure 2477						1															4	5
House 3260																					5	5
Phase 8 total			*2*		*1*							*1*				*1*	*1*	*124*			*75*	*205*
House 1370			1									1						1			14	17
House 401			1													1		58			5	65
House 801					1													65			2	68
NE Area																	1				48	49
S Area																					6	6
Phase 9 total	*1*		*2*		*2*		*1*	*1*		*1*	*1*	*2*			*1*		*2*	*171*		*1*	*295*	*481*
Area C																					1	1

Phase and area	*B. musculus*	*B. physalus*	Balaenidae	Balaenopteridae	Delphinidae	Delphininae	Delphinoidea	*G. melas*	*Lagenorhynchus* sp.	Large cetacean	Large Delphininae	*M. novaeangliae*	Medium to large cetacean	Medium to large Odontoceti	Mysticeti	*O. orca*	Odontoceti	*P. macrocephalus*	*P. phocoena*	Small delphinoid	Cetacea	Total
Entrance to House 1370																		1				1
Forecourt										1								3			43	47
Outside 1370																		1				1
House 1370					1						1	1			1			11			62	77
House 401			2		1		1					1					1	1		1	89	97
House 801	1																	142			50	193
NE Area								1										7			29	37
SE Area																	1	5			21	27
Phase 10 total	*1*	*2*					*1*					*2*	*1*		*3*		*2*	*57*			*109*	*178*
Area C	1																				6	7
Forecourt												1						3			2	6
House 1370		1										1			2		1	6			43	54
House 2190													1					3			13	17
House 401		1													1			41			16	59
NE Area																					6	6
S Area																	1	3				4
SE Area							1														18	19
W Area																		1			5	6
Phase 11 total	*2*		*2*		*1*		*1*	*1*	*1*			*1*	*1*		*4*	*1*		*9*			*137*	*161*
Forecourt							1		1									1			2	5
Above House 1370	1											1			1			2			13	18
House 401	1		2		1			1							2	1		2			89	99
NE Area																					2	2

(Continued)

Table 11.8. Spatial and temporal distribution of cetacean species at Cladh Hallan (Continued)

Phase and area	*B. musculus*	*B. physalus*	Balaenidae	Balaenopteridae	Delphinidae	Delphininae	Delphinoidea	*G. melas*	*Lagenorhynchus* sp.	Large cetacean	Large Delphininae	*M. novaeangliae*	Medium to large cetacean	Medium to large Odontoceti	Mysticeti	*O. orca*	Odontoceti	*P. macrocephalus*	*P. phocoena*	Small delphinoid	Cetacea	Total
S Area													1		1						29	31
W Area																		4			2	6
Phase 12 total			*4*	*1*	*1*							*3*			*4*		*2*	*7*			*85*	*107*
Forecourt																					5	5
Above House 1370															3						8	11
House 401			4	1	1							3			1			7			11	28
N Area																					12	12
NE Area																	2				35	37
S Area																					13	13
Phase 13 total	*7*													*1*							*17*	*25*
House 150	5																				8	13
House 401	2																				9	11
NE Area														1								1
Phase 14 total	*5*				*1*		*1*														*18*	*25*
House 1500	2				1																15	18
House 401	3						1														4	8
Phase 15 total	*2*	*1*																			*6*	*9*
House 401	2	1																			6	9
Phase 16 total	*3*										*3*						*1*		*1*		*27*	*35*
House 150	1																				2	3
House 401											3						1		1		18	23
House 640	2																				7	9
Unstratified											*1*						*2*				*17*	*20*
Grand total	**21**	**3**	**10**	**1**	**6**	**1**	**4**	**2**	**1**	**1**	**5**	**9**	**2**	**1**	**12**	**2**	**11**	**368**	**1**	**1**	**823**	**1285**

Table 11.9. Spatial distribution of sperm whale elements in Late Bronze Age deposits at Cladh Hallan

Sperm whale (NISP)				
Period, phase and area	**Skull fragment**	**Tooth**	**Vertebral epiphysis**	**Total**
Late Bronze Age	*342*	*1*	*4*	*347*
Phase 8	123			123
House 401	58			58
House 801	65			65
Phase 9	164	1	1	166
Entrance to House 1370	1			1
Forecourt	2			2
Outside House 1370	1			1
House 1370	7	1		8
House 401			1	1
House 801	141			141
NE Area	7			7
SE Area	5			5
Phase 10	48			48
House 1370	4			4
House 2190	3			3
House 401	37			37
S Area	3			3
W Area	1			1
Phase 11	5			5
Above House 1370	1			1
W Area	4			4
Phase 12	2		3	5
House 401	2		3	5
Total	**342**	**1**	**4**	**347**

many areas of Cladh Hallan. The intensive sampling strategy has produced data that challenges the assumption that cetacean bones within the same context represent the fragmented pieces of the same bone.

11.4 Discussion

This section considers the evidence for cetacean use (both physical and social) at Cladh Hallan. Understanding the use of Cetacea by communities in the past requires interpretative models different to most faunal analysis. As marine species, they required transportation between acquisition (at sea or on the shore) and settlement sites. Factors beyond meat utility (*e.g.* Mulville 2002) such as artefactual, architectural, oil and social utility have all been recognised as drivers influencing the transport of large bones and may explain the presence of large species on settlement sites (*e.g.* Savelle and Friesen 1996; Whitridge 2002; Monks 2005). Whilst the bones of smaller species may have been transported within cuts of meat (O'Connell *et al*. 1988; Savelle 1995: 141), those of larger species are more likely to have been affected by the 'schlepp effect'. That is, bone was selectively transported for its own value as a resource rather than as incidental riders in cetacean meat (Perkins and Daly 1968).

Social factors also influence how cetaceans were exploited. Strandings of large species and mass strandings both provide vast quantities of resources, typically more than individual households can use or store. Cetaceans are therefore often a shared resource for coastal communities (*e.g.* Baldwin 2008; Kishigami 2013; Evans *et al*. 2016).

Bone modification and spatial distribution can provide indications of the way cetaceans were used on archaeological sites (*e.g.* Savelle and Friesen 1996; Mulville 2002; Monks 2005) and these characteristics are considered here in discussions of cetacean utility. The assemblage from Cladh Hallan provides evidence of the use of cetaceans for meat, oil, artefact production and more social uses. The key patterns of bone modification noted are a dominance of smaller species in the unmodified and modified element categories and larger species in the fragmentary bone categories. Both large and small species were used in artefact production, and cetacean

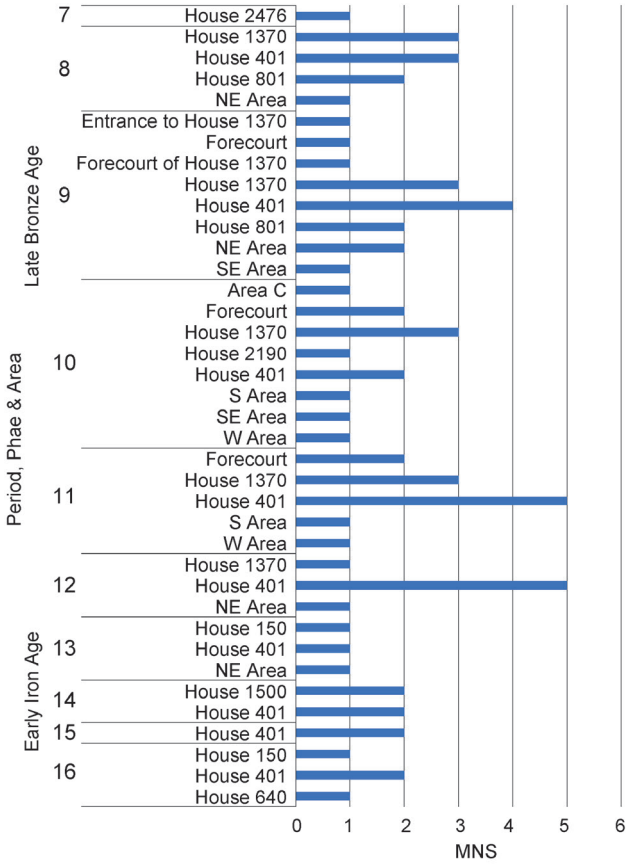


Figure 11.5. Minimum number of cetacean species by phase and area at Cladh Hallan

bone artefacts are discussed in detail alongside those from other animal bones in Chapter 3.

Meat consumption

Evidence for the exploitation of cetaceans for meat comes from the selection of bones with high meat utility (*i.e.* those that are associated with the largest portions of flesh), along with butchery marks. For example, meat utility has been studied within small Odontoceti (Savelle and Friesen 1996: 717) and the lumbar region has been identified as the highest ranking in terms of meat utility, closely followed by the caudal region (*ibid.*), a pattern probably shared with other species. These elements are relatively light and are more difficult to separate from the associated muscle (Friesen and Morrison 2002). An absence of bone modification (*e.g.* artefact production, use as fuel *etc.*) could also suggest that bone was returned in cuts of meat, rather than having been specifically selected as a material.

A range of unmodified or minimally modified elements are present in the Cladh Hallan assemblage, representing at least five different species: killer whale, pilot whale, harbour porpoise and at least two species of Delphininae. Spinal regions with high meat utility are present, with four lumbar vertebrae, and three thoracic and caudal vertebrae from delphinids recorded. The presence of articulating lumbar vertebrae from a small dolphin recovered from House 401 in Phase 16 (mentioned above) supports the assertion that delphinoid vertebrae were probably brought back to site within joints of meat. Additionally, cut-marks observed on the neural spine of a thoracic vertebra from a small cetacean, recovered from Late Bronze Age deposits (Phase 7), and chop-marks on the base of the articulating lumbar vertebrae from the bottlenose dolphin/ Risso's dolphin (Early Iron Age, Phase 16) are likely to demonstrate meat removal.

Surprisingly, ribs from small cetaceans were not identified, even though these elements are closely associated with thoracic vertebrae (Friesen and Morrison 2002). Elements with lower meat utility (Savelle and Friesen 1996) occur less frequently within the assemblage: only a single scapula (the only identification of harbour porpoise) and phalange are recorded, and there are no crania from the smaller species.

These data suggest that delphinoids were valued at Cladh Hallan, in part for their meat utility. Conversely there is no evidence for the selection or use of high meat-utility elements of larger species. Whilst ribs of larger species occur, all are worked, indicating that they are more likely to have been selectively transported back to site for their value as a raw material (*e.g.* Betts 2007). Thus, there is evidence for cetacean meat procurement at Cladh Hallan but, with only a handful of individuals represented, this suggests limited exploitation. This small-scale exploitation of marine mammals corresponds with the wider economic patterns at Cladh Hallan and other Bronze Age and Early Iron Age sites in the Hebrides (*e.g.* Smith and Mulville 2004). Sites of this period demonstrate a focus on terrestrial species, with marine species making only a small contribution to the food economy (Smith and Mulville 2004) or stable isotope and lipid residue data (*e.g.* Cramp *et al.* 2014; Jones and Mulville 2016; see Chapters 17 and 18).

Artefact production

Chapter 3 provides a detailed description of cetacean artefacts, of which only a few can be identified to species or element. Although, the targeting of live cetaceans for artefact production is considered unlikely, the crafting of specific items can involve the selection of particular elements, and occasionally species. A significant portion of whale bone consists of cancellous bone, characterised by a thin layer of compact bone, making it less suitable for intricate artefact craftsmanship. Conversely, certain elements, such as cetacean teeth, were valued mostly for their unaltered characteristics while others, such as cetacean vertebrae, were prized for their inherent shapes (Sjovold 1971; MacGregor 1985; Foxon 1991; Mulville 2005).

At Cladh Hallan a sperm whale tooth (SF 4564) was curated without significant modification and an Odontoceti tooth (SF 3326) was worked, possibly to use as a pendant. Vertebral whale epiphyses, varying in sizes and representing sperm, blue, humpback, and Delphinidae

(*e.g.* SFs 3465, 3678, 4683), underwent different degrees of refinement into discs. Many exhibit smoothness on the unfused surface, shaping and rounding on their outer edges, and the incorporation of central perforations (see Figure 11.3). The lumbar vertebra of a long-finned pilot whale has also been hollowed out to create a vessel (SF 3501). Additionally, there is evidence of the occasional use of ribs from humpbacks and other larger Cetacea (*e.g.* SFs 3159, 4884). Notably, there is no evidence for the utilisation of mandibles, the most densely structured bone within cetaceans, which has been reported from later sites (Mulville 2005).

The data suggest that, in general, artefact production was opportunistic and linked to access to cetacean skeletal remains rather than the targeted procurement of species. At times, however, there appears to be a connection between meat consumption and artefact production: for example, in delphinoids, where vertebral remains indicate this species was used in both meat procurement and in the creation of artefacts.

Oil procurement

Oil procurement was one of the main drivers for the modern commercial whaling industry, with cetaceans being a source of fuel, food, soap and lubricant (van den Hurk 2020: 35). Large amounts of oil can be extracted from blubber, from the crania of Odontoceti (most notably from the spermaceti organ of sperm whales) and as fatty marrow or bone grease (Slijper 1962; Kaufman and Forestell 1986; Betts 2007). Oil is stored in bones where it fills the voids in the trabecular structure (Monks 2005: 139). There is historical and archaeological evidence for extraction by chopping up bone (*e.g.* Hambrecht and Gibbons 2018) and ethnographic parallels in the Faroe Islands, Norway and among Arctic communities (Annandale 1905; Clark 1952; Heizer 1963). The fragmentation of bone at Cladh Hallan may reflect this process, and a consideration of the varying oil content of different taxa and elements can be used to assess evidence for oil extraction.

Higgs *et al*. (2011) studied differences in bone oil content between species and found higher proportions in the bones of large taxa (including Mysticeti and the sperm whale) and lower concentrations in delphinoids (Higgs *et al*. 2011: 11). At Cladh Hallan identified fragmentary bone principally derives from larger species, including sperm whale, blue whale, fin whale, humpback whale and balaenids ($n = 10$). However, these same species were also commonly used in artefact production, with associated waste fragments produced.

The preponderance of sperm whale skull fragments (Table 11.10[2]) suggests a focus on oil production. Within the skeleton oil content is highest within the skull (Higgs *et al*. 2011) with up to 80%–84% of oil within this element (Slijper 1962: 109; Monks 2005: 140). Also, the friable bone structure of the skull makes it less well suited to artefact production, and at Cladh Hallan only a single object was created from this material. The sperm whale skull fragments may also indicate that oil within the spermaceti organ (Watanabe and Suzuki 1950) was targeted. Spermaceti oil was valued during recent history for the bright and clear light it produced when burned (*e.g.* Irwin 2012) and it is likely that these properties would also have been valued in the past. Thus, the predominance of oil-rich bones and bones associated with oil-producing organs suggests that fragmented bones represent oil extraction from cetacean bone.

Burning affects 4% of the cetacean assemblage (Table 11.7; note that due to the different quantification methods, this cannot be compared with the terrestrial mammal assemblage). The burning of oil-rich cetacean bone for use as a fuel source is recorded ethnographically

Table 11.10. Taxa and elements within the unworked and worked fragment categories at Cladh Hallan

Fragments and elements	***B. musculus***	***B. physalus***	***M. novaeangliae***	**Balaenidae**	**Mysticeti**	***P. macrocephalus***	**Cetacea**	**Total**
Unworked fragment	*5*	*2*	*4*	*8*	*5*	*354*	*705*	*1083*
Earbone							1	1
Skull fragment						337		337
Vertebral epiphysis	1				1			2
Unknown	4	2	4	8	4	17	704	743
Worked fragment	*6*			*1*		*5*	*85*	*97*
Skull fragment						3		3
Vertebral process	1							1
Unknown	5			1		2	85	93
Grand total	**11**	**2**	**4**	**9**	**5**	**359**	**790**	**1180**

(*e.g*. Betts 2007) and has been noted on several archaeological sites (Childe 1931; Clarke 1947; Gibbons 2018; Hambrecht and Gibbons 2018). While most of the burnt bone fragments could not be identified, those which could are predominately from sperm whale skull, indicating exploitation as a fuel source.

The connection between cetacean bone and fuel is also apparent within the artefact assemblage. Blubber and oil were both used as a fuel source in the past (recorded historically by Olaus Magnus in the sixteenth century; van den Hurk 2020: 35) and both could have been burnt within two objects interpreted as lamps (in Phases 9 and 10). The first is the only artefact made of sperm whale skull and is a rectangular slab of bone, with a circular burnt black depression (SF 3811). The choice of this raw material appears to have been closely linked to its fuel utility. The absence of other artefacts made from sperm whale skull is likely to reflect the poor quality of this porous and friable material for artefact production. The second lamp is a rounded lump of bone (SF 3711; the element could not be determined), with a circular depression and a darkened area indicative of heating.

Social aspects

As noted above, sperm whale is prevalent within the Phase 8 and 9 houses of the Late Bronze Age, and blue whale during the Early Iron Age. The repeated presence of the same species in more than one house in each phase may indicate that cetacean resources were being shared between the inhabitants. The procurement of a large cetacean such as a sperm whale or blue whale would have provided a substantial amount of fuel, and carcass-processing would have been an intensive task. Historical sources from the Hebrides and beyond indicate that such tasks were typically undertaken by groups larger than an individual household and that aggregations of widespread groups can also occur for the exploitation of a cetacean (Evans *et al*. 2016). The resulting products were often distributed between those involved in the procurement and processing, leading to the distribution of cetacean remains between different groups (Baldwin 2008; Kishigami 2013; Evans *et al*. 2016). The remains from Cladh Hallan may reflect these social processes and demonstrate group cooperation and the sharing of resources between the houses during these periods. There may have been wider sharing of resources with other inhabitants of the Uists also exploiting the same cetacean resources. Unfortunately, few assemblages have undergone taxonomic identification but large cetacean bones are recorded at contemporary sites, *e.g.* a fragment of large cetacean in Late Bronze Age levels at Barvas, Lewis (Barabhas; Cowie and MacLeod Rivett 2010), and a fragment of balaenopterid bone at Northton, Harris (Finlay 2006: 173–4). Whilst these could represent the same animals, based on evidence from modern stranding rates, it is probable that more than a single individual was available for exploitation (*e.g*. Coombs *et al*. 2019). Investigation of contemporary assemblages, including new taxonomic identification criteria from ZooMS and aDNA analysis, could shed light on the potential for resource-sharing (*e.g*. Evans *et al.* 2016; UHI 2019b).

The wider social context of deposition also warrants consideration. The Bronze Age–Iron Age transition in Britain was marked by social and economic upheaval (Needham 2007a). Such periods are frequently associated with a rise in activities associated with the reaffirmation of group bonds through activities such as feasting (*e.g*. Madgwick and Mulville 2015) and other activities such as resource-sharing. The butchery and distribution of a cetacean carcass is comparable to a feasting event in many ways: it represents a distinct event, a windfall of resources, and one which would have required considerable community participation through labour: for Cladh Hallan it probably involved many individuals from the wider contemporary Hebridean community (*e.g*. Baldwin 2008). Genetic analysis of 20 fragments of fin whale from the Iron Age site of The Cairns, Orkney, were found to probably derive from the same animal and are interpreted as remains of feasting during the final occupation and abandonment of the broch (UHI n.d.). Identification of individuals would be required to confirm that the sperm whale and blue whale fragments from Cladh Hallan represent similar events following procurement of these large animals. The butchery of large cetaceans may have provided an opportunity for the reaffirmation of social relationships at a time of upheaval, perhaps leading to the special focus placed on large cetacean species at Cladh Hallan, as physical demonstrations of these social processes. The incorporation of the bones of these cetaceans within the architecture of the site (discussed further below) may have served as deliberate displays and reminders of this socially meaningful event.

While some cetacean resources may have been shared, the remains from Cladh Hallan also demonstrate that multiple different species were present within each house. House 401 had high numbers of species in each phase and it is possible that this higher species diversity represents social processes. Differential access to cetacean resources has been found to relate to status in other areas (*e.g*. Whitridge 1999; 2002; van den Hurk 2020). The low number of sperm whale skull fragments in Phase 9 deposits associated with House 401 is interesting, considering the evidence for social difference and greater access to other cetacean remains. It is possible that, while whale resources may have been shared, this sharing may not have been equal, and the inhabitants of this house may have had preferential access to other oil-rich parts of the whale which may not have left a trace (such as blubber or spermaceti). Ethnographic literature provides ample evidence for blubber possession as an expression of social difference amongst Inuit communities (Rasmussen 1931; Whitridge 1999: 350), and other zooarchaeological studies have demonstrated the presence of these 'invisible' resources through conspicuous absences in the bone record (Betts and Friesen 2013), as suggested here.

This section has demonstrated that the distributions of species may have had social implications. At Cladh Hallan

sharing of cetacean resources likely occurred between the houses, and some may have had preferential access to a larger range of species and particular portions of the whale. These patterns may provide preliminary evidence of social aspects of cetacean exploitation and distribution in prehistoric Scotland. Analysis of material from other sites would provide much needed comparisons enabling these patterns to be further investigated.

Structured cetacean bone deposits

Structured deposits – remains which have been deliberately placed or arranged in a manner not indicative of 'expedient discard' – are taken to demonstrate 'deposition as a meaningful practice' (Richards and Thomas 1984; Bradley 1990; Grant 1991; Wilson 1992; Garrow 2012: 98; Hill 2013) and, where such deposits incorporate faunal remains, they hold great potential for allowing insights into human–animal relationships. Cetaceans are rare but not unknown in structured deposits in the Hebrides. The following sections focus on the interpretation of structured deposits including articulating cetacean remains in addition to those in potential foundation and/or closing deposits, and in structural contexts, such as walls.

Jones (1998) and Mulville (2002) have both studied elements of structured deposition within the cetacean bone zooarchaeological record. Taxonomic identification within the assemblage from Cladh Hallan provides an opportunity to add greater depth to our understanding of human–cetacean interactions (Mulville 2002).

The structured deposits considered here are:

- A thoracic vertebra from a killer whale (SF 5356) from the fill (2907) of a deep posthole (2908) beneath House 401 in Phase 8, found alongside foundation deposits within underfloor pits and postholes (Figure 11.6).
- A sperm whale tooth (SF 4564) found within House 1370 (Phase 9). This large tooth (*c*. 17 cm long) was set vertically on its point, with its root facing northeast, into a fill layer (2210) overlying the first house floor (2211), before the deposition of the next floor layer (1369; Figure 11.7).
- A piece of sperm whale skull (SF 4560, one large and many small fragments), capping an otherwise stone-lined cist in Phase 8, which lay under the entrance to House 401 (Figure 11.7; see Volume 1: figs 4.37–4.38).
- A sperm whale skull fragment (SF 5018) found in the wall at the entrance to House 1370 in Phase 9 (Figure 11.7).

Foundation deposits

While foundation deposits are common on Hebridean sites, bone remains typically interpreted as such are human burials and burials of terrestrial species, in particular sheep, cattle and dog (Mulville *et al*. 2003). Evidence from Cladh Hallan suggests that cetaceans were also incorporated in foundation deposits, with the killer whale vertebra within a foundation posthole and the vertically placed sperm whale tooth underlying a house floor.

Parallels for the killer whale vertebra may be found in deposits that have hitherto been interpreted solely from an architectural or artefactual perspective. At numerous Iron Age sites cetacean vertebrae are found in sub-floor pits and postholes; some are hollowed out, leading to the frequent interpretation of these features as post sockets. At the Middle Iron Age wheelhouse of A'Cheardach Mhor, South Uist, two large vertebrae, with processes partly removed, were reportedly 'set in clay below floor level' (Young and Richardson 1960: 164). The vertebrae were accompanied by stones interpreted as packing material, but were also accompanied by worn hammerstones, a smaller cetacean vertebra and a hammer made of the burr and brow tine of an antler (*ibid.*: 142). The accompanying remains may not, therefore, be fully explained by a functional interpretation of the large vertebrae. The Iron Age wheelhouse at Sollas, North Uist, included around 150 foundation pits, and within one pit (Pit SW15) was a hollowed-out cetacean vertebra, interpreted as a 'cup' (Campbell 1991). While the similarity with A'Cheardach Mhor was noted, the potential for cetacean remains to be present as foundation deposits was not considered. Given the placement of vertebrae at Cladh Hallan, and the relative rarity of cetacean bone in general, it is possible that the evidence from these three sites indicates the use of whales in prehistoric foundation deposits.

There are no known direct parallels in Scottish prehistory for the sperm whale tooth, but such teeth are famously incorporated in later Hebridean artefacts (some of the twelfth-century Lewis chessmen). Worked sperm whale teeth have been found on prehistoric sites from across Europe (Poplin 1983; Corchón and Álvarez-Fernández 2008; Schuhmacher *et al.* 2013; Pétillon 2016) but do not include evidence of deposition in a manner comparable to the remains at Cladh Hallan.

Structural contexts

As noted above, sperm whale bone was employed structurally at Cladh Hallan, within the capping of an otherwise stone-lined cist in Phase 8, under the entrance to House 401 (Figure 11.7) and in the wall at the entrance to House 1370 (SF 5018; Figure 11.7). While these bones have obvious potential as architectural components, given their large size and value as bulk materials (Savelle 1997), the placement of the remains is of interest. Both occur in highly visible locations close to the houses' entrances. Parallels for these finds also exist. At Dun Vulan, South Uist, a piece of sperm whale skull was used to cover a stone-lined drain (Mulville 2002: 41) and wider comparisons can also be drawn with the use of whale skulls over passageways at Skara Brae (Jones 1998: 310).

Meaning

Previous studies of human–animal–landscape interactions have found a connection between deposits or depictions of species and locations (*e.g*. Jones 1998; Whittle 2000; Mulville 2002). Jones (1998) reviewed Neolithic deposition

of animal remains on mortuary and settlement sites in Orkney and demonstrated a connection between sites, species and locations. Eagle remains were deposited at cliff-top mortuary sites, while cetacean bones were excluded from these deposits and, instead, are found only on coastal settlement sites (*ibid.*: 314). Thus, animals deposited at different sites signified aspects of the site's landscape through their occupation of it. Jones interprets this as evidence that 'more powerful animals (were) actively used in reaffirming ideas of place' (*ibid.*) and that 'whales … the largest sea animals … constitute the most obvious aspect of the sea' (*ibid.*). It was also argued that, through incorporation of these powerful species within structured deposits, prehistoric communities may have drawn on this power. Foxon (1991) similarly suggested that use of cetacean tooth pendants at Skara Brae could represent a display of power by their wearers, derived in this case from the analogy of power from their animal origin (rather than through the manner of their acquisition).

While Jones (1998) suggested that whales as a broad category represent the most obvious animal aspects of the sea, the selection of species and body parts for deposition could reflect their iconic characteristics. The presence of remains of large, powerful, predatory species, such as the sperm whales with huge heads and teeth, and the aggressive, distinctive killer whales, may relate to their perceived power in addition to their economic value. More broadly, cetacean species appear to be represented by body parts that directly reflect their characteristics. Sperm whales are represented by a tooth and head elements. The killer whale by a tooth and a thoracic vertebra, the skeletal element that sits in the region of the spine beneath the huge dorsal fin. Whilst only the sperm whale and killer whale are found within structured deposits or architectural contexts in the true sense, other remains also suggest this association. The humpback whale is represented by portions of its flipper, the longest flipper relative to body length in Cetacea. This length, along with the unusual tubercles found along the flipper's margins, make it one of the species' unique physical attributes (Carwardine 2020: 128). This once again parallels the findings of Jones's study (*ibid.*: 315) which reported that eagles from Neolithic Orkney were 'represented by certain elements of the skeleton, such as the wings, head and feet ... which most obviously represent birds'. Likewise, the whales at Cladh Hallan are represented by the feature that most obviously represents them.

Procurement

Cetacean procurement is a complex issue, with the drivers and method of procurement a subject of debate. Active versus passive procurement of these often large and elusive species has been much discussed (*e.g.* Mulville 2005) but it is difficult to address whaling activities based on zooarchaeological evidence alone. However, by combining an understanding of the wider maritime activities of the Cladh Hallan community – gleaned from evidence of fishing and other marine exploitation – with knowledge of the behaviours and habitats of the different

Figure 11.6. Thoracic vertebra from a killer whale from Phase 8 underfloor deposits (roof posthole fill 2907, SF 5356) and a delphinid tooth from Phase 11 (sleeping area 1290 of House 401's floor, SF 3467)

cetacean species, the body parts and products favoured within the assemblage can provide insights to cetacean procurement.

As noted above, archaeological, zooarchaeological and biomolecular evidence indicates that marine exploitation of other species was limited during the Middle to Late Bronze Age and Early Iron Age. The fish, seal and bird bone assemblages indicate a low level of marine exploitation, focused on inshore, nearshore (*e.g.* immature saithe; Chapter 13) and coastal environments (*e.g.* seals; Chapter 10), with some potential for travel further offshore indicated by the gannet remains (Best and Mulville 2013: 423; Chapter 12). Interaction with cetaceans present within these parts of the sea is therefore most likely.

The range of Cetacea at Cladh Hallan includes species from a variety of marine habitats. With no material identified to species in the Middle Bronze Age, it is possible to characterise only the later phases. Cetacea from offshore habitats (sperm, blue and fin whale) predominate in the Late Bronze and Early Iron Age. During the Late Bronze Age inshore species (*e.g.* balaenids) are also present, as well as species that move between the two zones (including humpback and killer whales, pilot whales and large Delphininae [Risso's or bottlenose dolphin]). In the Early Iron Age (Phases 13–15) offshore species (blue whale) predominate, with no direct evidence for species which occur regularly inshore but, by Phase 16, inshore species (harbour porpoise and Risso's dolphin or bottlenose dolphin – well known around South Uist today [HWDT 2018]) – are also present.

Large offshore species: procurement

There is no evidence that the inhabitants of Cladh Hallan actively exploited offshore environments where migrating offshore species, such as the large, fast-swimming sperm, blue and fin whales (*e.g.* Cetacean Rescue and Research Unit n.d.), are typically found today. Historical documents indicate that balaenopterids may have been targeted in Icelandic waters by wounding these large whales, causing them to drift and strand (Lindquist 1994: 28). In Iceland

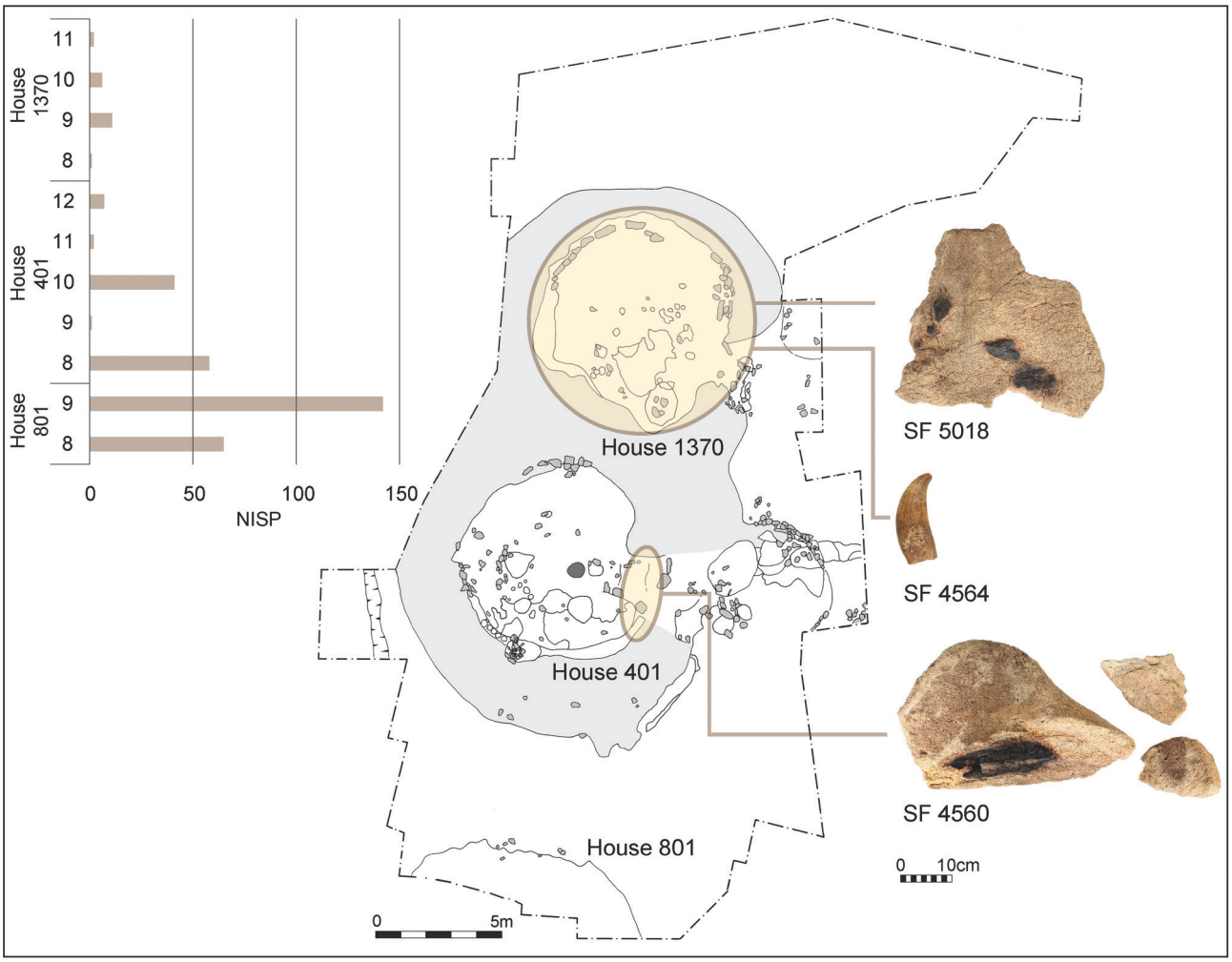


Figure 11.7. Sperm whale in Late Bronze Age Houses 801, 401 and 1370 showing NISP by phase and location of structured cetacean deposits and architectural pieces

these species occur closer inshore and within fjords and thus their recovery would have been more likely than if an animal were wounded in the open ocean. While chance sightings of live individuals which strayed further inshore may have occurred on the Uists, it is highly unlikely that Cladh Hallan's inhabitants, who otherwise only exploited the smallest of marine species (juvenile fish), would have attempted active procurement from boats. Additionally, despite the significance of offshore species and, in particular, the sperm whale (see discussion above), there is as yet no evidence for the procurement of more than the occasional, or single, individual.

Offshore cetaceans would have been encountered by the Cladh Hallan community as stranded individuals, particularly on the west coast, discovered while carrying out other maritime activities such as inshore fishing (Chapter 13), the gathering of marine molluscs, seaweed, driftwood or other strandline resources (Chapter 14). Today sperm whales are frequently found stranded on the long beaches of the west-facing Hebridean coast (Cerón-Carrasco 2005; Coombs *et al*. 2019) and other species may have been more common prior to the decimation of whale populations by commercial whaling. Stranded Cetacea would have represented resource-rich windfalls in the past; sperm whales were historically exploited by Hebridean communities at least as early as the eighteenth century (Baldwin 2008: 71).

Ethnographic evidence provides insights into active engagement with strandings, revealing that a lack evidence for Cetacea hunting does not necessarily equate to passive scavenging (a loaded term with implications relating to the importance of the resource; see Domínguez-Rodrigo 2002). The Tikigaq community of Alaska, for example, have myths that depict whales being lured ashore by music and this connection between music and whales is a key component in the human–cetacean relationship in that community (Lowenstein 1993; Whittle 2000: 251; Sakakibara 2009). This example, while specific to a particular community and location, demonstrates that past communities may have engaged with the procurement process in varied and complex indirect or non-physical ways.

Large inshore species: procurement

Some large species, including the balaenids and humpback whale, may have been encountered during inshore activities such as fishing. Few were procured and the lack of focus on marine resources in the Bronze Age and Early Iron

Age, and absence of relevant equipment, suggests that the necessary skills and technology to hunt inshore species using a 'harpoon and tow' method of whaling were not present. Procurement by trapping within the bays, or via methods that focused on encouraging strandings, was, however, possible. Numerous suitable locations are found on the east coast, but Cladh Hallan is located some distance away, on the sandy west coast. The opportunistic sightings of whales along this coast would be less likely. Trapping and stranding, wherever located, would have required active watching and community co-operation to be successful. Drift whaling is a possibility on the west coast, but these methods would also have involved the use of piercing weapons or projectiles from boats, for which no evidence exists.

A demand for cetacean material could be a driver for procurement (and standardised use of cetacean bone is frequently cited as an argument for active procurement *e.g*. MacGregor 1985; Sjøvold 1971 critiqued by Hallén 1994; Hennius *et al*. 2018). Thus, if the large balaenid and humpback inshore species were targeted, we would expect to see evidence of this in the ways the bone was used. Whilst the artefactual and oil utility of both species was valued at Cladh Hallan, their NISP is lower than that of the sperm and blue whales, and they were less commonly used in artefact production.

Overall, the evidence from contemporary economies, cetacean bone utility and use of the wider landscape indicates that the procurement of large offshore species, and sperm whale, were of more importance. Inshore species were not being targeted, thus all large Cetacea were probably stranded individuals.

Small Cetacea: procurement

The small Cetacea present (NISP 23, MNI 5) include killer whale and pilot whale, large Delphininae (either Risso's dolphin or the bottlenose dolphin), *Lagenorhynchus* sp. (either white-beaked or white-sided dolphin) and the harbour porpoise. All are found in the inshore area, and many occur very close to land, creating opportunities for these species to have been encountered while fishing. Historical evidence indicates that delphinoids were often caught opportunistically or accidentally alongside fishing ventures in later periods (Harvie-Brown and Buckley 1888: 38).

Although multiple species are represented in some phases, the frequency of small cetacean remains suggests that the inhabitants of Cladh Hallan were not practising deliberate and planned dolphin- or porpoise-hunting (*e.g*. Glassow 2005). As small cetacean bone is not noted as being valued for fuel (see *Burning*, above) or for architectural utility, their rarity could be indicative of low-level exploitation or the practice of leaving bones at shoreline processing sites. These ideas can be further explored through analysis of their value as food or as a raw material for artefact production. Cut-marks on vertebrae (from the Phase 7 collapsed wall [2476] of Structure 2477) are associated with meat-removal, pointing to their consumption, and the articulating vertebrae from a large Delphininae (a Phase 16 abandonment layer [407] covering House 401) suggest that joints of meat were returned to the site. As stranded specimens would spoil relatively quickly, with carcasses likely to be in a stage of decomposition (*e.g*. Szabo 2008: 87–9), the use of meat is likely to indicate active procurement or rapid exploitation of freshly dead, stranded animals.

The artefact assemblage from Cladh Hallan does not support systematic and active procurement of delphinoids. There is little evidence for the standardised use of cetacean bone for the manufacture of certain products. Whilst delphinoid epiphyseal bones form part of the artefact assemblage, bones from other species, including deer (Phase 9, SF 4672) and sperm whale (Phase 12, SF 3456), were also worked into discs of the same size and shape as those of smaller cetaceans. The apparent need to fashion bones into circular form (*e.g*. Phase 9, SF 4583) and the use of different species indicated by the size range of delphinoid vertebral discs suggests that suitable cetacean epiphyseal discs were not always readily available. Thus, systematic or regular hunting of delphinoids, which would have led to a regular supply of this material, is therefore unlikely.

The evidence for the procurement of small Cetacea is therefore inconclusive: it is apparent that several species were utilised but how these resources were obtained remains unclear. The mammalian material also includes a range of seal remains, some of which are younger grey seal pups that could have been hunted on land, but there is evidence that older and larger seals were procured (see Chapter 10). Thus, the inhabitants of Cladh Hallan had the capacity to possibly kill larger marine species close to shore but, for both pinnipeds and Cetacea, this appears to have been an occasional activity requiring opportunity, a specific need (*e.g*. seal skin or delphinoid bone/teeth) or possibly dietary choice.

11.5 Conclusion

The 1,285 pieces of cetacean bone recovered from Cladh Hallan mostly derive from the larger assemblages of the Late Bronze Age phases (Table 11.2), with a smaller assemblage from the Early Iron Age phases, and very few fragments from the Early Bronze Age. A range of species are present, with sperm whale dominating the assemblage, and blue whale, fin whale, humpback whale, right whale, pilot whale, killer whale, a range of other delphinids and porpoise represented.

Our evidence indicates the use of cetaceans for meat products, oil, artefacts and architectural purposes. Social factors may also have influenced cetacean procurement, distribution and access. Windfall events such as the procurement of large whales could have marked periods of community sharing and social gatherings such as feasting. Large quantities of bone from key species (*e.g*. sperm whale in the Late Bronze Age and blue whale in the Early Iron Age) may reflect use of individual animals at these events, as has been indicated by aDNA analysis on the Iron Age site of The Cairns, Orkney (UHI n.d.).

Despite the significance of these whales, it is unlikely that the Late Bronze Age and Early Iron Age inhabitants of Cladh Hallan engaged in deliberate and active cetacean procurement. There is no overlap between the habitats of large offshore species, which dominate the assemblage, and the marine environments that would have been frequented during inshore fishing or other marine activities. It is likely that encounters with live sperm whales, blue whales and fin whales were rare. Thus, despite the significance of the sperm whale, the exploitation of stranded individuals is most likely.

Although interactions with live inshore species undoubtedly occurred, the active exploitation of large and small inshore species is also unlikely, given the apparent focus of the economy away from marine resources. The few delphinoid elements present are likely to have come from the exploitation of freshly stranded individuals, or accidental or opportunistic catches. This conclusion is supported by the evidence from the artefact assemblage which indicates that there was not a reliable supply of delphinoid bone.

Whilst low in numbers compared to other species at Cladh Hallan, Cetacea were valued for a wide range of products. Their bones formed a key part of artefact production and, although their value as food and fuel is difficult to estimate, they provided important resources within the wider economy. The structured deposition of cetacean remains makes it clear that these species, and their species characteristics, were recognised and of interest to the inhabitants of the settlement. The large sperm whale tooth planted in the centre of a house and the Odontoceti tooth, possibly used in personal ornamentation, are both evidence of an enduring fascination with these giants of the sea that goes beyond consumption.

Notes

1 Age profiles have not been discussed in detail since rates of fusion of vertebral epiphyses for cetaceans are not fully known, and even in some very old individuals fusion may not be fully complete (Richard Sabin pers. comm.). Studies have also indicated differences between species. Complete fusion along the entire spine has been found to be rare in the harbour porpoise and many specimens retain unfused epiphyses long after sexual maturity. Complete fusion is more common in delphinids (Galatius 2005).

2 The reader should note that Table 11.10 considers worked *fragments* only. Other worked whale bone artefacts are not included here.

12 The birds

J. Best and J. Cartledge†

The avian assemblage from Cladh Hallan consists of 503 bone fragments. Analysis was started by the late Judy Cartledge and Adrienne Powell assessed the assemblage after Judy's death. Julia Best restarted the analysis, identified and recorded the material and reported on the data.

12.1 Recovery

The bird bones were recovered by hand during excavation and by sieving all material through a 10mm mesh. Numerous bulk samples were taken across the site and processed by flotation. Bone from the <10mm fraction is included in this report.

12.2 Identification, recording and quantification

The remains were identified using Cardiff University's reference collection and recorded following Cohen and Serjeantson's conventions (Cohen and Serjeantson 1996). Where specimens needed further taxonomic comparison, reference collections were consulted at Historic England's Fort Cumberland laboratory and the University of Southampton's archaeology department. All the avian material was analysed.

Where species were morphologically indistinguishable (and, for example, overlapping in size) or where the identification was impacted by incompleteness, taphonomy, juvenility *etc*., the bones were assigned to an informative taxonomic grouping (*e.g*. 'razorbill/guillemot', 'small wader'). Where not identifiable to species or group they were assigned to broad size categories (based on Ayres *et al*. 2003: 360–406; Serjeantson 2009: 81–2) and/or likeness (*e.g*. very large bird *cf* gannet):

- very large bird (birds of goose-size and larger);
- large bird (domestic fowl/duck-sized birds, including curlew and tawny owl);
- medium bird (pigeon/partridge-sized birds, including teal, woodcock and godwit);
- small bird (thrush-sized birds); and
- tiny birds (birds smaller than thrushes, such as those of finch size).

Given the problems associated with identifying birds such as geese to exact species, separate groupings have been highlighted together for the NISP (Number of Identified Specimens) to help show frequency more clearly and counteract some biases of identification (see Table 12.2). Categories of confidence (*i.e*. large grey goose *cf* greylag or goose sp.) can otherwise make this hard to see, particularly where only a few elements are distinctively identifiable to exact species. These grouped categories were noted and adjusted for when considering overall abundance and species that have not been grouped.

Two ABGs (associated bone groups) are present in the assemblage. When these are included in the data they are explicitly noted or indicated by an asterisk (*).

Vertebrae and phalanges were recorded when more than 50% of the bones were present. The minimum number of elements (MNE) was calculated as the sum of the most frequently occurring zone of each element for a species, taking side into account. As such, the MNE where presented represents one side of the body, or a central non-repeatable element such as the axis. The minimum number of individuals (MNI) was taken as the highest MNE for each species. The MNIs are in reality likely to be much higher since the remains come from a variety of phases and areas. However, producing MNI by phase and location would have made the assemblages too small to handle effectively and would not have considered the dispersal of bones from one individual across the site.

Measurements were taken following Cohen and Serjeantson (1996) where possible, but the small number of measurable bones per element/species means they have not been considered here. Medullary bone was only recorded in already broken bones. Taphonomic features (primarily butchery, working, burning and gnawing) were recorded for all specimens where present. Ageing data were recorded

for all fragments where possible. The juvenile birds were recorded following Serjeantson (2009: 46) as:

- very young: bone half-ossified or less;
- immature: bone more than half-ossified, porous and unfused (where relevant); and
- subadult: bone full-sized and fused, with fusion line visible (where relevant), slightly porous.

12.3 The avian assemblage

Of the 503 bird bone fragments in the assemblage, 363 could be assigned to species or informative taxonomic grouping, 98 to size grouping/likeness, and 42 to just 'bird'. The majority come from the Late Bronze Age to Early Iron Age settlement but there are a small number from phases dating to before the construction of the row of roundhouses (Table 12.1). An additional 12 fragments were identifiable to species or size grouping but unstratified and as such are excluded from the analysis and not included in the total of 503 fragments. One of these unstratified fragments was worked into a point, indicating disturbance from its original context.

Birds make up approximately 1.7% of the total mammal and bird NISP (size categories excluded for both birds and mammals) and 1.9% with them included. Birds make up around 18% of the total wild mammalian and avian remains recovered (*e.g.* seals, rodents, deer, lagomorphs). When cetaceans and fish are included, birds fall to just over 2% of the wild resources. Birds formed a relatively small but regular component of the animal resources used at Cladh Hallan.

12.4 Phases 1–7: before the roundhouses

Only 16 bird bones were recovered from Phases 1–7, with none from Phases 1, 2, 3 or 5 (Table 12.1). A large grey goose and a butchered curlew/oystercatcher were recovered from Middle Bronze Age House 2835 (Phase 4). A Phase 6 pit produced eight fragments, including a gannet, a large grey goose, a medium wader and a probable great northern diver. None were burnt or gnawed but an unidentifiable 'very large bird' long bone fragment from layer 2417 in pit 2401 was worked into a probable bead. An unidentified immature 'very large bird' is present, which shows some exploitation of avian resources during the breeding season. Phase 7 contexts (House 3260 and Structure 2477) produced six fragments, only one of which was identifiable; this is a great northern diver scapula with butchery, suggesting exploitation of winter visitors. One other 'very large bird' long bone fragment was also butchered, and one unidentified 'very large bird' rib is from a sub-adult.

12.5 Phases 8–16: the roundhouses

This assemblage from the Late Bronze Age and Early Iron Age houses consists of 487 fragments, of which 357 were identifiable to species or useful taxonomic grouping, 90 to size category or to likeness, while 40 were unidentifiable beyond 'bird'. The majority came from the main phases of roundhouse occupation (Phases 9–12) with much smaller numbers from Phase 8 (construction of the roundhouse row) and Phases 13–16 (Table 12.1).

Two ABGs in the form of partial skeletons are present: a gannet with 42 fragments from the area above the ruins of House 1370 in Phase 12, and 13 bones from a pair of starling wings from House 150 in Phase 16. The percentage NISP (Table 12.2) is presented both with and without the ABGs to avoid over-representing the importance of a species. It is important to include them, however, because the wider gannet assemblage from the area of House 1370 is complex, with at least one other gannet represented in the same context (gully fill 1461) by MNE, meaning that multiple partial skeletons may be present. There is a third potential partial skeleton, of a curlew skull/mandible with three fragments, from House 150 in Phase 16, but this was not confidently identified and as such is not considered as an ABG here.

Abundance of species

Seabirds make up the largest proportion of the identified bird remains, accounting for over 50% of the NISP both with (60%*) and without (57%) the ABGs (Table 12.2). Waterfowl form the next largest proportion of the assemblage (17%*, 19%), followed by wading birds (11%*, 13%), with land birds and small passerines forming smaller proportions and raptors being the rarest. The assemblage is diverse, containing at least 35 species.

The actual number of species present is likely to be higher than this conservative estimate, since some identification categories (such as 'small wader') contain more than one species. Many of the exploited seabirds primarily come to land to breed in the spring/summer (such as gannet, razorbill, guillemot, puffin and great auk).

Table 12.1. Number of bird bones (all fragments) by phase, shown with and without ABGs

Number/%	Phase											
	4	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
No. of fragments inc. ABGs	2	8	6	29	78	69	102	158*	10	1	5	35*
No. of fragments excl. ABGs	2	8	6	29	78	69	102	116	10	1	5	22
% total assemblage inc. ABGs	<1	2	1	6	16	14	20	31	2	<1	1	7
% total assemblage excl. ABGs	<1	2	1	6	17	15	23	26	2	<1	1	5

Table 12.2. Avian NISP and MNI in Phases 8–16 (including and excluding ABGs)

Taxonomy	Scientific name	NISP	% NISP inc. ABGs	% NISP excl. ABGs	MNI
Gannet	*Morus bassanus*	104* (62)	*29.1*	*20.5*	5*
Cormorant	*Phalacrocorax carbo*	18	*5.0*	*6.0*	2
Shag	*Gulosus aristotelis*	14	*3.9*	*4.6*	2
Shag/Cormorant	Phalacrocoracidae	4	*1.1*	*1.3*	1
Large Grey Goose *cf* Greylag	*Anser* sp. *cf Anser*	13	*3.6*	*4.3*	2
Goose sp.	*Anser/Branta* sp.	9	*2.5*	*3.0*	1
Brent/Barnacle Goose	*Branta bernicla/leucopsis*	4	*1.1*	*1.3*	1
Small Goose *cf* Black	*cf Branta* sp.	1	*0.3*	*0.3*	1
Swan sp.	*Cygnus* sp.	17	*4.8*	*5.6*	2
Whooper Swan	*Cygnus cygnus*	4	*1.1*	*1.3*	1
Herring/Lesser Black-Backed Gull	*Larus argentatus/fuscus*	10	*2.8*	*3.3*	2
Great Black-Backed Gull	*Larus marinus*	9	*2.5*	*3.0*	1
Gull sp.	Laridae sp.	5	*1.4*	*1.7*	1
Small Gull sp.	Laridae sp.	2	*0.6*	*0.7*	1
Great Auk	*Pinguinus impennis*	14	*3.9*	*4.6*	3
Curlew	*Numenius arquata*	10	*2.8*	*3.3*	2
Small Passerine	Small passerine	10	*2.8*	*3.3*	2
Red Grouse	*Lagopus scotica*	9	*2.5*	*3.0*	5
Puffin	*Fratercula arctica*	8	*2.2*	*2.6*	2
Guillemot	*Uria aalge*	7	*2.0*	*2.3*	1
Fulmar	*Fulmarus glacialis*	6	*1.7*	*2.0*	2
Large Wader *cf* Curlew	*cf Numenius arquata*	4	*1.1*	*1.3*	1
Snipe	*Gallinago gallinago*	4	*1.1*	*1.3*	1
Rock/Stock Dove	*Columba livia/oenas*	4	*1.1*	*1.3*	1
Razorbill/Guillemot	*Alca torda/Uria aalge*	3	*0.8*	*1.0*	1
Razorbill	*Alca torda*	2	*0.6*	*0.7*	1
Carrion Crow / Rook	*Corvus corone/frugilegus*	3	*0.8*	*1.0*	1
Dunlin	*Calidris alpina*	3	*0.8*	*1.0*	1
Great Northern Diver	*Gavia immer*	3	*0.8*	*1.0*	1
Small Wader	Small charadriiform	3	*0.8*	*1.0*	1
Starling	*Sturnus vulgaris*	16* (3)	*4.5*	*1.0*	3*
Crane	*Grus grus*	2	*0.6*	*0.7*	1
Golden Plover	*Pluvialis apricaria*	2	*0.6*	*0.7*	1
Jack Snipe	*Lymnocryptes minimus*	2	*0.6*	*0.7*	2
Oystercatcher	*Haematopus ostralegus*	2	*0.6*	*0.7*	2
Water Rail	*Rallus aquaticus*	2	*0.6*	*0.7*	1
Shelduck	*Tadorna tadorna*	2	*0.6*	*0.7*	1
Large Duck *cf* Mallard	*cf Anas platyrhynchos*	2	*0.6*	*0.7*	1
Large Duck *cf* Shelduck	*cf Tadorna tadorna*	2	*0.6*	*0.7*	1
Red-Breasted Merganser	*Mergus serrator*	1	*0.3*	*0.3*	1
Duck *cf* Merganser sp.	*cf Mergus* sp.	1	*0.3*	*0.3*	1
Teal	*Anas crecca*	1	*0.3*	*0.3*	1
Small Duck *cf* Teal	*cf Anas crecca*	1	*0.3*	*0.3*	1
Duck sp.	Duck sp.	1	*0.3*	*0.3*	1
Black Guillemot	*Cepphus grylle*	1	*0.3*	*0.3*	1

Taxonomy	Scientific name	NISP	% NISP inc. ABGs	% NISP excl. ABGs	MNI
Curlew/Gull	*Numenius arquata/Larus*	1	*0.3*	*0.3*	1
Lapwing	*Vanellus vanellus*	1	*0.3*	*0.3*	1
Lapwing/Godwit	*Vanellus vanellus/Limosa* sp.	1	*0.3*	*0.3*	1
Large Auk *cf* Great Auk	*cf Pinguinus impennis*	1	*0.3*	*0.3*	1
Large Wader	Large charadriiform	1	*0.3*	*0.3*	1
Little Auk	*Alle alle*	1	*0.3*	*0.3*	1
Manx Shearwater	*Puffinus puffinus*	1	*0.3*	*0.3*	1
Raptor *cf* Eagle	*cf* Accipitridae sp.	1	*0.3*	*0.3*	1
Raptor *cf* Buzzard	*cf Buteo buteo*	1	*0.3*	*0.3*	1
Red Grouse/Ptarmigan	*Lagopus scotica/muta*	1	*0.3*	*0.3*	1
Shearwater	*Puffinus* sp.	1	*0.3*	*0.3*	1
Small Wader *cf* Golden plover	*cf Pluvialis apricaria*	1	*0.3*	*0.3*	1
Total		**357* (302)**			

Others such as the shag, cormorant and gulls, as well as waterfowl such as the greylag goose, could have been available year-round.

Gannet is the dominant species within the assemblage, making up nearly a third of the NISP (ABG included) with 104 fragments. Without the ABG, gannet is still the most numerous species by NISP, forming a fifth of the remains. It is possible that other partial skeletons are present in the assemblage but not identifiable as ABGs, artificially inflating their prominence in the NISP. However, their abundance is also visible in the MNI which, in general, reflects the NISP (Table 12.2). Gannet has the highest MNI of 5, jointly with red grouse which has a disproportionately high MNI for the nine bones present. Even when other species are grouped (*e.g*. all geese), their NISP and %NISP are much lower than those of gannet. As the gannet only comes to land to breed, it is most easily caught in the spring/summer (see *Discussion* below).

Cormorant, shag and great auk are the next most frequent individual species, with geese, gulls and swans also common. Most of the swans were only identifiable to 'Swan sp.', with four confirmed whooper swan specimens. The Swan sp. category is likely to contain a mix of mute and whooper swans. Combined, the swans account for 6% of the NISP (7% with ABGs excluded), which is higher than at other South Uist sites such as Bornais, Cille Pheadair and Dun Vulan (Best and Cartledge 2018; Best 2020; 2021). The geese are mainly large grey geese (such as greylags), with smaller numbers of black geese (such as brent and barnacle). Most of the bones identified only to 'Goose sp.' are likely to be large grey geese, but not assignable to the *cf* greylag category due to fragmentation and other taphonomic damage. The ducks include shelduck, teal, red-breasted merganser and probable mallards.

The gulls exploited were mainly larger species (herring/lesser black-backed gull and great black-backed gull) but a few fragments from smaller gulls are present (common gull/kittiwake size).

Other seabirds, including puffin, guillemot and fulmar, are fairly well represented, as are the curlew (a wader) and red grouse (a land bird), but many of the other species have fewer than five identified fragments. These include winter visitors such as the little auk, and large species such as the crane which would have moved through Britain on their winter passage and which may have bred more widely in the past (Albarella and Thomas 2002: 23–5; Best 2014: 302–3; 2021: 270). A range of wader species (such as oystercatcher, snipe, jacksnipe, lapwing, golden plover, and water rail) and seabird species (including razorbill, Manx shearwater, great northern diver and black guillemot) are represented by small numbers of bones as are raptors, corvids and several ducks. This suggests that, whilst certain avian species were intentionally targeted, a wide range of other birds were used opportunistically.

It is also important to note that, whilst today we separate specific species (*e.g*. lesser black-backed gull and great black-backed gull), it does not mean that people did so in the past. Even the population of St Kilda in the early twentieth century, who at that time still relied in large part on seabirds for subsistence and trade, did not distinguish between the shag and the cormorant (Maclean 1992: 90–109; Serjeantson 2009: 5). These two important species (which are year-round residents of the Scottish islands) were all simply referred to as cormorants. Indeed, in 2021 the genus of the shag was changed by the IOC (International Ornithologists' Union) from *Phalacrocorax aristotelis* to *Gulosus aristotelis*, showing how understanding of these species is still changing. As such, several species may have been grouped by their habitat use and behaviour rather than their exact species, meaning that groupings such as 'large duck' or 'small wader' are still useful.

The specimens assigned to size category or likeness align with the identified bone (Table 12.3). The majority

Table 12.3. Avian fragments from Phases 8–16 assigned to size category and/or likeness

Identification category	Frequency
Bird	40
Very Large Bird	36
Large Bird	21
Medium Bird	7
Tiny Bird	7
Very/Large Bird	4
Small Bird	2
Medium/Large Bird	1
Large Bird *cf* Gull	2
Very Large Bird *cf* Gannet	2
Medium Bird *cf* Grebe	1
Medium Bird *cf* Shearwater	1
Medium Bird *cf* Wader	1
Large Bird *cf* Large Duck	1
Very Large Bird *cf* Eagle	1
Very Large Bird *cf* Goose	1
Very Large Bird *cf* Swan	1
Very Large Bird *cf* Swan/Crane	1

are 'very large' or 'large' birds, with several identified as probable gannets, gulls, and waterfowl. The 'very large bird *cf* eagle' is interesting because it has a possible cut-mark on it. Unfortunately, this specimen is too fragmentary and damaged to give a confident identification.

Associated bone groups

The ABGs from the site are not fully clear. A gannet ABG was found in a gully fill (context 1461) from Phase 12, above the by-then abandoned House 1370. It consists of 42 elements that display a degree of articulation (*e.g*. vertebrae, skull and quadrates) and has no repeating elements. Knife cuts were identified on its axis. It appears to be a partial skeleton that is lacking both humeri, ulnae, radii, carpometacarpi, the sternum, synsacrum and some elements of the lower leg (both tarsometatarsi are present and some phalanges but only one tibiotarsus and one femur). Other gannet remains were collected from this context including coracoids, ulnae and radii, but these represent at least two individuals by MNE, and thus cannot be certainly associated with the ABG, although it is probable that some of the elements may come from it. It appears that this context contained either two partial gannet ABGs, or one ABG and a collection of other disarticulated bones from gannets. This in theory could mean that the presence of gannet is inflated in the assemblage. However, even if this whole context were excluded from the frequency counts, the MNI for gannets would still be 5, and the NISP 45, putting it ahead of any other individual species or species grouping.

The other ABG consists of 13 elements from a pair of starling wings recovered from a sand inter-floor fill (layer 162) in the double roundhouse House 150 in Phase 16. This ABG constitutes half of the small assemblage from House 150. There are possible cut-marks on the radii which, even when viewed under a microscope, are inconclusive. However, they indicate that the ABG could be anthropogenic in origin and perhaps suggests that this could have been used as a tool; pairs of wings were used in the past as brushes in the Hebridean islands to keep hearths and griddles clean (Harman 1996: 36). However, given the species and elements present, it is also possible that this was an accidental discard from an avian predator, some species of which leave just the wings and part of the pectoral girdle (*e.g*. the coracoids, which were present in this ABG).

Age

Juvenile bone makes up just 6% of the assemblage with 31 fragments, representing at least 12 separate species (Table 12.4). This is likely to be an underestimate as more than one species of duck, for example, may be present. The species represented demonstrate that both resident birds (such as shag, cormorant, gulls and waterfowl) and breeding-season visitors to land (*e.g*. the great auk, fulmar, puffin, razorbill, guillemot and gannet) were all exploited during their spring/summer breeding season (see the main discussion below for seasonality and nesting).

Some of the juvenile birds may have been caught away from the nest; razorbills and guillemots, for example, rear partially fledged young in seaborne 'rafts', and the now extinct great auk is likely to have also followed this strategy (Houston *et al*. 2010; Best and Mulville 2016: 658–9). Other species are more likely to have been taken from the nest environment including puffin, shag, cormorant, gannet and some gulls. Several of the juvenile bones are from sub-adults, meaning that these birds are almost mature, and perhaps targeted around fledging (Table 12.4). However, immature and very young birds are present. Of note are two bones identified as 'very large bird *cf* gannet' which are both between the stages of very young and immature, meaning that these birds were likely taken from the nest. There is also a sub-adult gannet specimen, potentially indicating that gannet nests were visited at different points of the breeding season. Juvenile gannets are comparatively rare in the Scottish island material (Best 2014). Experimental work conducted by Serjeantson (1998: 30–1; 2009: 36–7) on modern gugas indicated that, at the time of fledging, the gannet chick is ossified skeletally and of adult size, with only very minor indicators of immaturity such as slightly less well-developed articular ends. If gannets were captured just prior to fledging (when at their largest and fattiest, and with downy feathers), there would be little archaeological evidence of juvenility.

The presence of immature duck, snipe and shag/cormorant specimens indicates likely nest-based capture and that the summer was an important time of fowling even for resident species that may be found year-round on South Uist. This is supported by the recovery of eggshell from the floors of Houses 801 and 401 in Phase 9 and House

Table 12.4. Juvenile bird bone from Phases 8–16

Phase	Taxonomy	Element	Location	Juvenility
8	Large Wader *cf* Curlew	Tibiotarsus	NE Area	Subadult
	Large Wader *cf* Curlew	Ulna	NE Area	Subadult
	Large Wader *cf* Curlew	Tarsometatarsus	NE Area	Subadult
9	Bird	Bone fragment	Forecourt	Immature
	Gannet	Tibiotarsus	NE Area	Subadult
	Guillemot	Tibiotarsus	House 1370	Immature/Subadult
	Gull sp.	Humerus	House 1370	Immature/Subadult
	Medium/Large Bird	Long bone fragment	House 1370	Immature
	Razorbill/Guillemot	Humerus	House 1370	Subadult
	Shag	Carpometacarpus	House 801	Subadult
	Very Large Bird	Synsacrum	House 801	Immature
10	Medium Bird	Tibiotarsus	Forecourt	Immature
	Duck *cf* Merganser sp.	Coracoid	House 1370	Subadult
	Razorbill/Guillemot	Femur	Area C	Immature
	Very/Large Bird	Tibiotarsus	House 401	Very Young
11	Duck	Tarsometatarsus	House 1370	Immature
	Goose	Furcula	Forecourt	Immature/Subadult
	Large Bird	Tibiotarsus	Forecourt	Very Young/Immature
	Large Bird *cf* Large Duck	Femur	Forecourt	Very Young/Immature
	Shag	Radius	House 1370	Immature/Subadult
	Snipe	Tarsometatarsus	House 1370	Immature
	Very/Large Bird	Long bone fragment	House 401	Immature
	Very Large Bird *cf* Gannet	Tibiotarsus	House 401	Very Young/Immature
12	Great Auk	Humerus	House 401	Subadult
	Fulmar	Humerus	N Area	Subadult
	Large Bird	Phalanx of foot	NE Area	Immature
	Puffin	Humerus	House 1370	Subadult
	Shag/Cormorant	Tarsometatarsus	NE Area	Immature
	Very Large Bird	Phalanx of foot	House 401	Immature
16	Tiny Bird	Tibiotarsus	House 150	Subadult
	Very Large Bird *cf* Gannet	Tibiotarsus	House 401	Very Young/Immature

401 in Phase 11 (see Volume 1: 134, 154, 272, figs 5.11, 5.48, 7.30), showing that birds were used for both egg and meat resources in the breeding season. Many of the species captured (such as the gannet, cormorant, shag, razorbill, guillemot, puffin and some gulls) can lay again if their egg or eggs are taken, meaning that multiple harvests could be reaped of eggs and then of the young birds (Maclean 1992: 92; Serjeantson 2001: 51).

Unlike the combined Phase 8–16 assemblage of all ages, the juvenile fragments are dominated by leg elements rather than wing, in particular by the tibiotarsus and tarsometatarsus (Table 12.4). These are some of the last bones to fuse in the avian body (Cohen and Serjeantson 1996: 7; Serjeantson 2009: 40), suggesting that Cladh Hallan's inhabitants were potentially choosing to exploit the older juveniles, particularly of the large bird species. If this is the case, then there is not necessarily an under-representation of wing elements or other parts of the body from the juveniles since they could be present in the assemblage but already fused and indistinguishable from adults.

Knife cuts are present on a young gannet, a great auk, one large bird, two very large birds and possibly a razorbill/guillemot. Three juvenile bones exhibit rodent gnawing marks, including the butchered gannet, indicating that other animals were able to access the remains after human processing and disposal. There is perhaps a greater focus on juvenile birds in Phases 9 and 11 (10% and 8% of the phase assemblages) but the small assemblage size makes comparison difficult.

Sex

No sexually diagnostic features are present in the assemblage (*e.g.* medullary bone or spurs). Male

grouse, unlike other galliform species, do not typically have spurs on their tarsometatarsi; possible sexual dimorphism has, however, been noted in the red grouse from Cladh Hallan. Although the bones are too abraded to take an accurate measurement of their length (GL), the approximated lengths of four tarsometatarsi, when compared with a range of male and female reference specimens, indicate that two plot with the females and two with the males.

Data by phase and location

Whilst the relatively small size of the avian assemblage prevents detailed locational and temporal analysis, some patterns are visible. The majority of the bird bone came from house interiors in Phases 8–16, implying that processing, consumption and some deposition took place within the house environment. This includes structures erected in Phases 11–12 over the ruins of House 1370. It would have been relatively easy for bird bone to be accidentally, or intentionally, incorporated into the sandy floors and surfaces. In total, 66% came from house interiors, 6% from House 401's forecourt and 28% from other areas (Figure 12.1, Table 12.5). Bones exhibiting anthropogenic modifications (butchery marks and working) were found in most areas of the site that produced bird bone (see *Modification and taphonomy* below). It is likely that some bird bone material was intentionally kept in the houses for making tools, and 68% of the worked bird bone also came from the house interiors.

In Phases 8–12 the range of species exploited shows an enduring focus on gannet, cormorant, shag, great auk, swans, geese and gulls. Seabirds dominate these phases and waterfowl are also important, whilst waders and some land birds were repeatedly exploited in small numbers. The houses and forecourt produced a similar range of species but there is less diversity in the other areas. Gannet is most numerous in Phase 12 (by NISP and as a proportion of the assemblage) and, in this phase, is concentrated in the activity area over House 1370, both with and without the ABG being included.

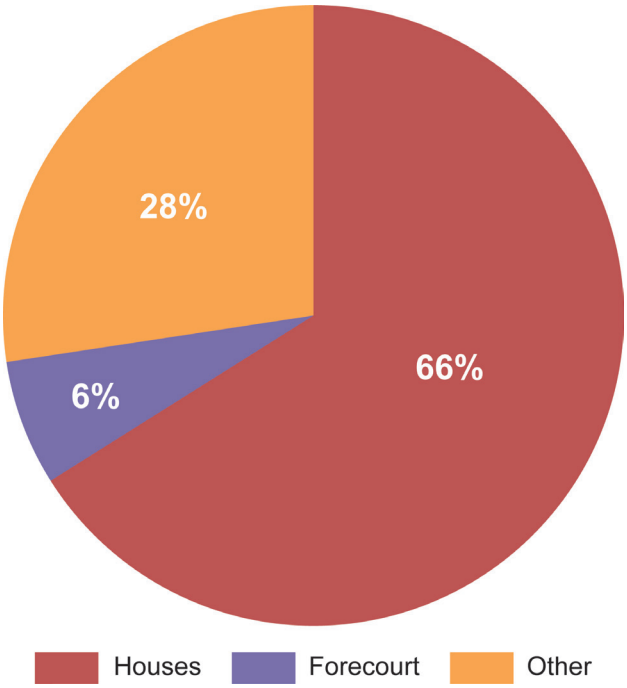


Figure 12.1. Percentage of avian assemblage by location type in Phases 8–16

Table 12.5. Number of avian fragments (all levels of identification) from Phases 8–16 by phase and location

Location	Phase									Total
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Forecourt	1	3	2	14	11					**31**
House 801	6	13								**19**
House 1370	1	24	30	33	72*					**160**
House 401	11	14	11	22	28	10	1	5	5	**107**
House 2190			6							**6**
House 640									4	**4**
House 150									26*	**26**
NE Area	9	8		1	25					**43**
N Area					19					**19**
NW Area					1					**1**
S Area	1		6	30	2					**39**
SE Area		14	6	1						**21**
W Area			2	1						**3**
Area C		1	6							**7**
Area D		1								**1**
Total	**29**	**78**	**69**	**102**	**158***	**10**	**1**	**5**	**35***	**487**

The avian assemblage from Phases 13–16 (Early Iron Age) has a higher proportion of small passerines, which may represent non-anthropogenic inclusions. Many of the main species are represented but potentially with less focus on summer-breeding seabirds (gannet and the auk family are only represented by one bone each) and a greater use of avian resources available at multiple points of the year from habitats around the settlement. Only two juvenile bones are present in Phases 13–16, which may support this interpretation; the small number of bird bones from these phases means that this should, however, be considered with caution. Interestingly, the great auk is absent from these later phases, perhaps suggesting that exploitation may have been affecting its presence and population size even at this early date (see main discussion below).

Table 12.6. Avian NISP by phase (Phases 8–16, including ABGs)

Taxonomy	Scientific name	Phase									NISP
		8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Gannet	*Morus bassanus*	4	15	5	9	70	1				104
Cormorant	*Phalacrocorax carbo*	1	2	4	4	6	1				18
Shag	*Gulosus aristotelis*	3	2	2	4	2				1	14
Shag/Cormorant	Phalacrocoracidae				1	2				1	4
Large Grey Goose *cf* Greylag	*Anser* sp. *cf Anser*		1	1	10			1			13
Goose sp.	*Anser/Branta* sp.				2	4	1		1	1	9
Brent/Barnacle Goose	*Branta bernicla/leucopsis*		2		1	1					4
Small Goose *cf* Black	*cf Branta* sp.			1							1
Swan sp.	*Cygnus* sp.	1	5	4	5	1			1		17
Whooper Swan	*Cygnus cygnus*					4					4
Herring/Lesser Black-Backed Gull	*Larus argentatus/fuscus*	1	3	2	1	1				2	10
Great Black-Backed Gull	*Larus marinus*	1	3	2	1	2					9
Gull sp.	Laridae sp.		2	1	1	1					5
Small Gull sp.	Laridae sp.					2					2
Great Auk	*Pinguinus impennis*	3	1	1	5	4					14
Curlew	*Numenius arquata*	1	2	1	3					3	10
Small Passerine	Small passerine		1	2		2	1			4	10
Red Grouse	*Lagopus scotica*		1	2	4	2					9
Puffin	*Fratercula arctica*	1		5	1	1					8
Guillemot	*Uria aalge*	1	1		4	1					7
Fulmar	*Fulmarus glacialis*		1		1	3	1				6
Large Wader *cf* Curlew	*cf Numenius arquata*	4									4
Snipe	*Gallinago gallinago*		1		2	1					4
Rock/Stock Dove	*Columba livia/oenas*			1		2				1	4
Razorbill/Guillemot	*Alca torda/Uria aalge*		1	1			1				3
Razorbill	*Alca torda*		2								2
Carrion Crow/Rook	*Corvus corone/frugilegus*				1	1	1				3
Dunlin	*Calidris alpina*			1	1				1		3
Great Northern Diver	*Gavia immer*			1		1				1	3
Small Wader	Small charadriiform				1	1			1		3
Starling	*Sturnus vulgaris*				2					14	16
Crane	*Grus grus*		1	1							2
Golden Plover	*Pluvialis apricaria*				2						2
Jack Snipe	*Lymnocryptes minimus*			1		1					2
Oystercatcher	*Haematopus ostralegus*				1					1	2
Water Rail	*Rallus aquaticus*					1				1	2
Shelduck	*Tadorna tadorna*			1		1					2

(Continued)

Table 12.6. Avian NISP by phase (Phases 8-16, including ABGs) (Continued)

Taxonomy	Scientific name	Phase									NISP
		8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Large Duck *cf* Mallard	*cf Anas platyrhynchos*	1			1						2
Large Duck *cf* Shelduck	*cf Tadorna tadorna*				1					1	2
Red-Breasted Merganser	*Mergus serrator*				1						1
Duck *cf* Merganser sp.	*cf Mergus* sp.			1							1
Teal	*Anas crecca*			1							1
Small Duck *cf* Teal	*cf Anas crecca*			1							1
Duck sp.	Duck sp.				1						1
Black Guillemot	*Cepphus grylle*		1								1
Curlew/Gull	*Numenius arquata/Larus*	1									1
Lapwing	*Vanellus vanellus*				1						1
Lapwing/Godwit	*Vanellus vanellus/Limosa* sp.		1								1
Large Auk *cf* Great Auk	*cf Pinguinus impennis*					1					1
Large Wader	Large charadriiform			1							1
Little Auk	*Alle alle*				1						1
Manx Shearwater	*Puffinus puffinus*			1							1
Raptor *cf* Eagle	*cf* Accipitridae sp.					1					1
Raptor *cf* Buzzard	*cf Buteo buteo*		1								1
Red Grouse/Ptarmigan	*Lagopus scotica/muta*			1							1
Shearwater	*Puffinus* sp.					1					1
Small Wader *cf* Golden plover	*cf Pluvialis apricaria*			1							1
Phase NISP		**23**	**50**	**47**	**73**	**121**	**7**	**1**	**4**	**31**	**357**

Elemental distribution

Element abundance has been explored by broad element counts for the whole assemblage (Figure 12.2), by MNE for the most common species with a NISP of 5 or above (Table 12.7), and by count for size categories (Table 12.8). The recovery of bones from very small and tiny birds in the processed samples indicates that preservation is generally excellent. This is further supported by the partial gannet skeleton which retains 22 of its vertebrae (including the axis and pygostyle), skull, quadrates, fibula and a proportion of its phalanges. Whilst it is possible that the sieving scale could have limited the recovery of small elements even for larger birds in hand-collected material, the hand recovery of small bone fragments and species such as small waders indicates that the impact of this is negligible, and that recovery was very thorough.

The bird bone assemblage includes elements from all parts of the body. An element count shows that wing elements dominate the assemblage as a whole, particularly the humerus which alone accounts for nearly 18% of the bones assignable to skeletal element. Major limb bones are well represented for key species and minor ones, particularly the humerus, ulna, radius and tibiotarsus. The element count for the whole assemblage indicates that this is then generally followed by the tarsometatarsus, coracoid, femur, carpometacarpus and scapula. Some elements such as vertebrae, phalanges and small skull fragments can be challenging to identify to species, whilst others such as the synsacrum and sternum break easily and are, as a result, more difficult to identify. The presence of some sterna, synsacra and phalanges in the size categories such as 'very large bird' and 'large bird' indicates that more are present than have been identified to species for key birds such as the gannet, shag, cormorant and waterfowl (Table 12.8). However, given their relative numbers, these bones and elements such as vertebrae and skull are underrepresented, and this is unlikely to be related to recovery. The majority of the vertebrae come from the gannet ABG, potentially suggesting that, although whole birds entered the site, parts of them were disposed of differently, or experienced differential preservation that has left them under-represented in the assemblage when not part of an ABG. As such, the element profile suggests that birds were taken to the site as entire carcasses and processed there, although some removal of the head and feet at the kill sites cannot be ruled out. This pattern is consistently visible in the main habitation phases.

For the most commonly exploited species, the MNEs (Table 12.7) reflect the patterns identified by the element count, demonstrating that the frequency of, for example, the humerus is not a product of greater fragmentation. The inclusion of the partial gannet skeleton does not increase the total species MNI which is five with or without the ABG. Like the counts, the MNE shows an abundance of wing

Table 12.7. MNE for main avian species, including gannet ABG, in Phases 8–16. This is calculated for species (or key groups) with a NISP of 5 or above

Element	Gannet*	Cormorant	Shag	Shag/Cormorant	Goose sp.	Large Grey Goose *cf* Greylag	Brent/Barnacle Goose	Great Black-Backed Gull	Herring/Lesser Black-Backed Gull	Gull sp. including Small	Swan sp.	Whooper Swan	Great Auk	Curlew	Puffin	Guillemot	Razorbill + Razorbill/Guillemot	Red Grouse	Fulmar	Large Ducks
Skull	1													1						
Quadrate	2																			
Axis	1																			
Premaxilla	1																			
Maxilla	1													1						
Mandible	1	1			1									1						
Furcula	1	1			1	1		1					1							
Coracoid	2	1				2		1			1		1	1	1		1		1	1
Scapula	2	2		1			1						1			1			1	
Humerus	5	2	2		1	2	1	1	1	2	2		3	1	2	1	1	1	1	1
Ulna	5	1	1		1	1	1	1	1				1						2	
Radius	5	2	1			1			1	2	2			2	1	1				
Carpometacarpus	2		1		1						1	1	1			1		1		
Proximal phalanx major digit	5									1		1					1			1
Distal phalanx major digit	2											1								
Proximal phalanx minor digit	1																			
Wing digit					1															
Sternum	2																1			
Synsacrum			1								1									
Pelvis					1	1					1									
Femur	1		1			1	1		1		2		2		1		1			1

(Continued)

Table 12.7. MNE for main avian species, including gannet ABG, in Phases 8–16. This is calculated for species (or key groups) with a NISP of 5 or above (Continued)

Element	Gannet*	Cormorant	Shag	Shag/Cormorant	Goose sp.	Large Grey Goose *cf* Greylag	Brent/Barnacle Goose	Great Black-Backed Gull	Herring/Lesser Black-Backed Gull	Gull sp. including Small	Swan sp.	Whooper Swan	Great Auk	Curlew	Puffin	Guillemot	Razorbill + Razorbill/Guillemot	Red Grouse	Fulmar	Large Ducks
Tibiotarsus	2		1					1	2		2		1	2	2	2		1		1
Tarsometatarsus	2		1	1		1												5	1	1
Posterior phalanx of foot	1			1																
Phalanx of foot	1																			
Cervical vertebrae	14																			
Thoracic vertebrae	10			1																
Sternal rib	2																			

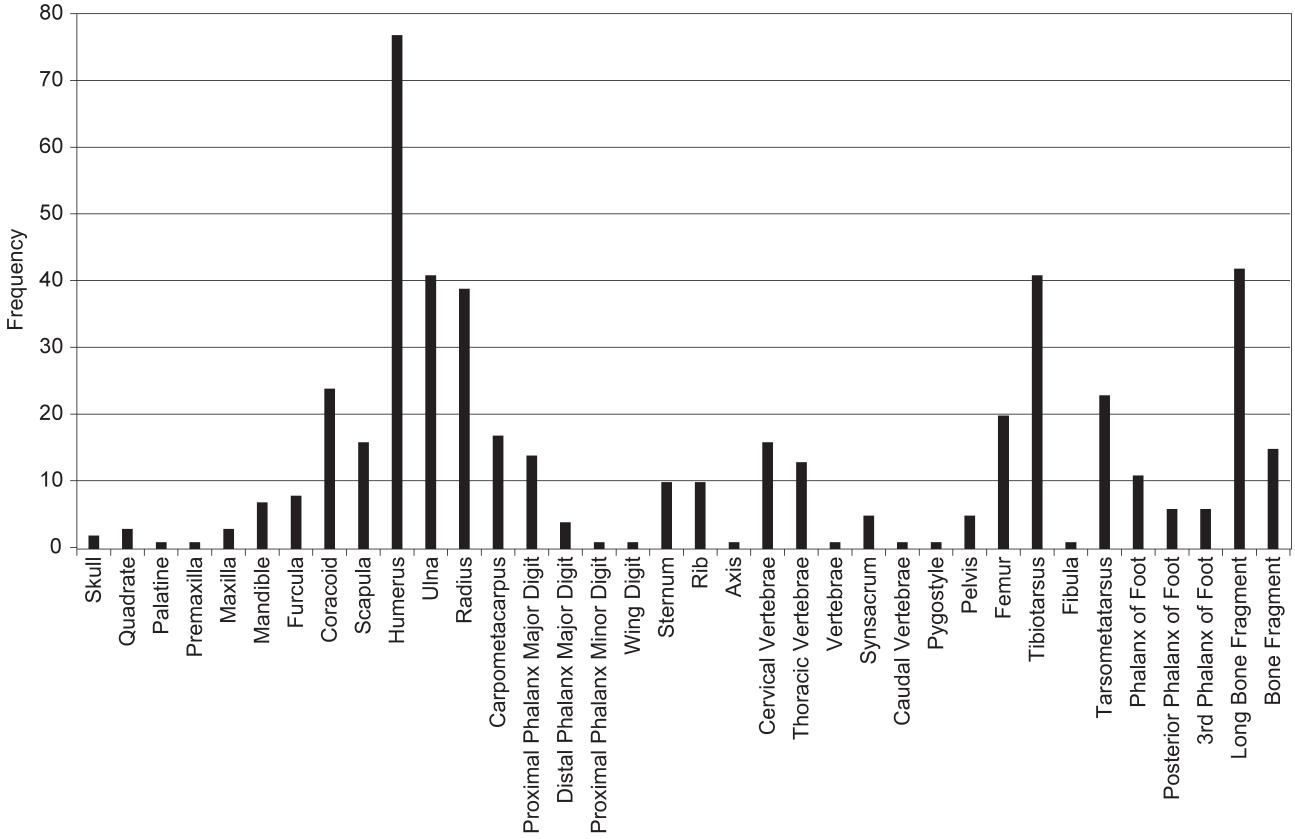


Figure 12.2. Element count for avian assemblage (all fragments) in Phases 8–16

Table 12.8. Element count for size categories and fragments only identified as 'bird' in Phases 8–16

Element	Very Large Bird	Very Large/ Large Bird	Large Bird	Medium/ Large Bird	Medium Bird	Small Bird	Tiny Bird	Bird
Scapula	1		1					
Humerus	6		2					
Ulna	3		1		1			
Radius	1		3		2			
Sternum			3					
Rib	3	1	1					1
Cervical vertebrae	2							
Thoracic vertebrae	2							
Synsacrum	2				1			
Caudal vertebrae	1							
Vertebrae			1					
Pelvis			2					
Femur			2		1			
Tibiotarsus	2	1	5		1		1	
Tarsometatarsus					1		1	
Posterior phalanx of foot	2		1					
Phalanx of foot	6		1				1	1
3rd phalanx of foot					3	1	1	
Long bone fragment	9	2	1	1			3	26
Bone fragment	2					1		12

long bones with the humerus being the most consistent frequently occurring element; however, the tibiotarsus is again well represented, often occurring as frequently as the radius or ulna (Table 12.7). For many of the key species, this is then followed by the coracoid, femur, scapula and tarsometatarsus in smaller numbers. There is relatively low representation of sterna, ribs, pelves, synsacra and vertebrae for many of the main species even when fragments in the size categories are considered (Tables 12.7–12.8; Figure 12.2). Skulls and lesser phalanges are also rare. The preferential survival of the main wing and leg long bones over these elements may be influenced by robusticity and density (bulk density, volume density, cortical thickness *etc*.) which can also impact on differential preservation between the different long bones, although this is complex and varies by species (Bovy 2002: 970–6; Cruz 2005: 69–81; Serjeantson 2009: 153–64).

The lower representation of the femur (a meat-bearing bone) by count and MNE compared to the abundant tibiotarsus and wing long bones may suggest removal of parts of the bird that were not intended for consumption such as the wings, the lower legs and feet. Meat-bearing bones of the axial skeleton and the upper leg may have been disposed of differently or subjected to different taphonomic processes such as cooking (which could have weakened them). The low numbers of axial elements, femora and tarsometatarsi within the size categories show that their representation is not due to identification bias. This does not, however, fully explain the prevalence of the tibiotarsus, which would have been meat-bearing in many of the key species. Studies have indicated that the femur and tarsometatarsus are among the least dense avian long bones, in contrast to the tibiotarsus (Serjeantson 2009: 153–64). It is thus likely that bone density-based preservation, processing, and deposition all had an impact on elemental abundance.

These depositional practices appear to include the waste being subjected to animal gnawing, perhaps resulting in the destruction of specific elements (*e.g*. sternum, femur). It is also worth noting that the palmate and totipalmate webbed feet of seabirds and waterfowl generally require fairly long cooking for easy human consumption, which may weaken the bones (in some modern dishes enough that the bones can be chewed up), and they could be easily gnawed and digested by canids, thus destroying the tarsometatarsi and phalanges. Indeed, duck and goose feet are still regularly sold for dog consumption.

Table 12.9. Taphonomic characteristics of the avian assemblage in Phases 8–16

n/%	Butchered	Burnt	Gnawed
Frequency	79	7	36
% assemblage	*16.2*	*1.4*	*7.4*

Given the large number of worked bird bones from Cladh Hallan (see *Butchery and working* below), which is high compared to other Scottish island sites (Best 2014), it is also likely that some parts of the skeleton were kept as raw materials, increasing their presence in the assemblage.

Modification and taphonomy: butchery, working, burning and gnawing

The avian assemblage from Phases 8–16 contains bones modified by butchery, burning and gnawing showing *post-mortem* alterations by human and animal agents (Table 12.9).

Burning

Burning was observed on only seven fragments (Table 12.10), accounting for just over 1% of the assemblage. This low incidence of burning on bird bone correlates with other Outer Hebridean assemblages, including Cille Pheadair and Bornais (Cartledge and Serjeantson 2012; Best and Cartledge 2018: 474; Best 2021: 268). Burning primarily occurred on large birds, but one tiny bird was charred (with a small patch of calcining), perhaps indicating disposal or accidental incorporation into a fire. Some of the charring occurs in small patches on the articular ends of the larger birds (*e.g*. a swan humerus and a curlew/gull femur), indicating that these are cooking marks on fleshed birds rather than burning during waste disposal within a fire.

Gnawing

Just over 7% of the assemblage shows evidence of gnawing by rodents or carnivores. Gnawed fragments are present in the houses, the forecourt, and in other areas of the site, as well as across the temporal range of occupation. The carnivores were mainly canids, although the spacing

Table 12.10. Burning characteristics of the avian assemblage in Phases 8–16

Phase	Taxonomy	Element	Location
8	Bird	Long bone fragment	NE Area
	Curlew/Gull	Femur	NE Area
9	Gull	Radius	House 1370
	Tiny Bird	Tarsometatarsus	House 801
11	Cormorant	Mandible	House 1370
	Large Duck *cf* Shelduck	Proximal phalanx of the major digit	House 1370
	Swan	Humerus	S Area

of one set of punctures may indicate that cats (though rare; see Chapter 10) also had access to the remains. A diverse range of species was gnawed, including seabirds, waterfowl, waders and land birds. Gnawing occurred most frequently on long bones and coracoids, but was also noted on two carpometacarpi, a mandible, synsacrum and a proximal phalanx of the major digit (wing). The humerus and coracoid have the highest incidence of gnawing on the main skeletal elements (expressed as a percentage of the total number of these elements) at 14% and 21% respectively, and the one gnawed synsacra forms 20% due to the element's rarity. In contrast to the mammalian assemblage, a higher proportion of the avian bones exhibit rodent gnawing rather than carnivore, but there are several specimens with probable and possible carnivore gnawing marks, potentially raising the proportion with canid modification. The birds gnawed are principally large species and canid gnawing occurs only on large or very large birds. These points, and the presence of a digested crane tibiotarsus, support the suggestion that that some avian elements were completely destroyed by carnivore consumption.

Interestingly, gnawing was noted on 11 fragments that also display butchery marks. This demonstrates that the gnawed bones are the remains of post-human processing, rather than birds naturally occurring in the area. There is also extensive rodent gnawing on a possible worked bone (a cormorant ulna from a floor [1204] above House 1370 in Phase 11). The gnawing data in general suggests that, after processing and/or human consumption, bones were not buried or disposed of in inaccessible areas but remained in and around the houses, where they were subject to both rodent and canid gnawing.

Butchery and working

Around 16% of the total assemblage showed some form of human modification by tools (16% total assemblage, 17% taxonomically identified assemblage). This is notably higher than the typical butchery frequencies for comparable avian assemblages such as: 6% Cille Pheadair, 3%–8% Shiant Isles (multiple periods), 5% Bornais Mound 1, 8% Bornais Mounds 2 and 2a, 2% Bornais Mound 3 (Cartledge 2005: 177; Best and Mulville 2010: 87–95; Cartledge and Serjeantson 2012: 298; Best and Cartledge 2018: 477; Best 2020: 573; 2021: 269).

Knife cuts are present on 57 fragments, bone-working on 19, and working and separate knife marks on three. There are an additional 12 fragments with possible knife cuts, and two bones with possible working that is obscured by other taphonomic damage.

Most phases and locations produced modified bone (except House 640 in Phase 16 and the tiny avian assemblage from Phase 14 which has only one fragment), demonstrating that birds modified and consumed by humans ended up in a variety of places (Table 12.11). The western area behind the roundhouses produced only a worked bone, with no other butchery, but the assemblage from here is composed of only three fragments. Phase 9 has the highest occurrence of butchery as a proportion of this phase's assemblage, as well as the second highest proportion of worked bones (Table 12.11). Phase 8 (construction of the row of roundhouses) has the highest proportion of worked bone. Interestingly, there is no worked bird bone from Phase 13 onwards and, whilst this is probably partly a factor of the small assemblage sizes (particularly when the starling ABG in Phase 16 is taken into account), it may reflect a decline in the use of bird bone for tools, given that three were recovered from the small Phase 8 assemblage.

Knife cuts occurred on a wide range of elements but particularly the humerus (19 fragments) followed by the tibiotarsus and radius (seven fragments) and ulna (six fragments). A diverse range of species were butchered, mainly seabirds, but also waterfowl, waders and land birds such as the rock/stock dove and red grouse (Table 12.12). The species range suggests that birds were being processed for food at all times of the year, with cut-marks appearing on breeding-season visitors, juvenile birds (including the great auk and gannet) and winter visitors such as the great northern diver. Two out of the three great northern diver bones were cut (Phases 10 and 16), implying exploitation of these species supplemented the wider resource base when other subsistence resources may have been less plentiful. This pattern appears to be present throughout the site sequence as the great northern diver from Phase 7 was also cut (see section 12.4 above). A butchered crane humerus shows utilisation of a rare species, whilst knife

Table 12.11. Occurrence of modifications on bird bone by phase expressed as counts observed and proportion of the phase assemblage in Phases 8–16

Modification	Phase								
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Knife cut	3	18	10	10	13	1	0	1	1
Worked	3	6	4	4	2	0	0	0	0
Knife cut and worked	0	1	0	2	0	0	0	0	0
Total *n* fragments in phase	29	78	69	102	158*	10	1	5	35*
% of phase assemblage cut	*10.3*	*24.4*	*14.5*	*11.8*	*8.2*	*10.0*	*0.0*	*20.0*	*2.9*
% of phase assemblage worked	*10.3*	*9.0*	*5.8*	*5.9*	*1.3*	*0.0*	*0.0*	*0.0*	*0.0*

Table 12.12. Knife-cut butchery frequency in the avian assemblage by species and element in Phases 8–16

Taxonomy	Humerus	Radius	Tibiotarsus	Ulna	Coracoid	Scapula	Carpometacarpus	Proximal phalanx major digit	Mandible	Furcula	Sternum	Axis	Caudal vertebrae	Femur	Phalanx of foot	Long bone fragment	Total
Gannet*	2	3	1	3	2			1			1	1					**14**
Cormorant	2	2				1			1								**6**
Swan sp.	2		2											1			**5**
Very Large Bird	1												1		1	2	**5**
Great Auk	2					1	1										**4**
Goose sp.	1			1													**2**
Great Black-Backed Gull					1					1							**2**
Great Northern Diver			1		1												**2**
Large Bird	1		1														**2**
Large Grey Goose *cf* Greylag	1			1													**2**
Shag	1			1													**2**
Very Large/Large Bird			1													1	**2**
Carrion Crow/Rook								1									**1**
Crane	1																**1**
Curlew		1															**1**
Gull sp.	1																**1**
Herring/Lesser Black-Backed Gull			1														**1**
Lapwing/Godwit		1															**1**
Large Duck *cf* Mallard	1																**1**
Puffin	1																**1**
Red Grouse	1																**1**
Rock/Stock Dove							1										**1**
Very Large Bird *cf* Swan/Crane	1																**1**
Bird																1	**1**
Total	**19**	**7**	**7**	**6**	**4**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**4**	**60**

cuts on a puffin humerus and curlew radius demonstrate processing of smaller birds. The cut-marks on the axis of the ABG gannet may indicate skinning or splitting of the bird carcass but not head-removal since the skull is present.

Unsurprisingly, knife cuts are most common on the abundant elements of frequently occurring species. However, when knife cut frequency is considered as a proportion of each element's abundance, the humerus (25%), radius (18%), tibiotarsus (17%), coracoid (17%) and ulna (15%) were still butchered much more frequently than elements such as the sternum (10%), femur (5%) and tarsometatarsus (0%). Similarly, knife cuts occur on 33% of the cormorant remains, 29% of the great auk and swan sp. bones, 22% of great black-backed gull and goose sp. remains, 21% of the gannet bones (minus the ABG and its butchery), and between 20% and 14% for other gulls, large grey geese and shag. This indicates that butchery frequency is not just a factor of relative species abundance but represents the increased processing needed for large (often fatty) seabirds, and also large waterfowl.

Disarticulating cuts are present on articular surfaces, particularly on the proximal ends of humeri and radii, suggesting the removal and disarticulation of the wing in a range of species. For example, the proximal ends of a curlew and a gannet radius from Phase 9 were cut (from the northeastern part of Area A and from House 801 respectively). The distal end of a juvenile large bird tibiotarsus from House 401's forecourt in Phase 11 was cut, indicating removal of the foot. Cuts upon a carrion crow/rook proximal phalanx (of the major wing digit) are

consistent with feather removal (Cartledge and Grimbley 1999), demonstrating that the corvid presence was the result of human agency, and raising the likelihood that other species were also exploited for their feathers. Cuts were noted on the mid-shaft of some wing elements (including a gannet ulna from context 1756, a Phase 9 context outside House 1370), implying that meat or feathers were being removed from larger birds' wings (Serjeantson 2009: 130–44). The mid-shaft area of the tibiotarsus was cut only on sizeable birds such as swan, gannet, great northern diver and large gulls, perhaps suggesting meat removal for these larger species.

The cuts observed are probably from preparing a bird for cooking and consumption, but also from preparing skeletal materials for bone-working. Figure 12.3 shows a cut-mark on the distal end of a shag humerus that was then worked to a fine point and has extensive polish (SF 5981). A swan humerus with extensive polish has a disarticulating cut on the proximal articulation, and a distal goose ulna with shaping (probably for use as an awl) was also cut near the articular surface.

The 22 worked bird bones are predominantly points and awls made from the straightest cylindrical bones of large seabirds and waterfowl (Table 12.13). The ulna is the element most frequently chosen for working (eight fragments) followed by the humerus (five fragments), radius and tibiotarsus (two fragments), and carpometacarpus (one fragment). Shag is the species most represented in the worked assemblage (four specimens), followed by great black-backed gull, swan and large grey geese. Gannet, cormorant, fulmar and duck are also represented. Seven worked bones are not identifiable beyond size category but, from their substantial size, they probably belong to the species already represented. As noted in Chapter 3, some of the specimens are awls while others are only defined as points, and at least one may be a pin. Several have extensive polish. Bird bone is well suited for making points because its structure enables sharp and shaped points to be created with relatively little working. The articular ends of the ulna and humerus in particular appear to have functioned as a convenient handle.

The amount of worked bird bone at Cladh Hallan is high for Scottish island avian assemblages, with this representing the largest number identified from sites in the Uists, and forming one of the largest recorded from the Scottish islands (a slightly conservative approach is taken here as some excavations did not always employ identification of worked bone to taxa and would need revisiting). In South Uist, Bornais Mounds 2 and 2a produced over 3,200 bird bones, but only seven specimens from the site's large worked bone assemblage were identified as bird bone (as needles and needle cases) and just four others had potential

Figure 12.3. Examples of worked bird bone awls and points. Top left: SF 5981 from context 1458 – knife cut on left of image. Top right: SF 3461 from context 1306. Bottom left: From context 1790 (no SF number assigned). Bottom right: SF 3959 from context 655

Table 12.13. Species and element characteristics of the worked bird bone in Phases 8–16 (see Chapter 3 for worked bone specifics). Two potential worked specimens are also included

Phase	SF no.	Context	Location	Taxonomy	Element	Comments
8	4866	2416	House 401	Large Duck *cf* Mallard	Tibiotarsus	Bone point
	4928	1930		Very Large/Large Bird	Long bone fragment	Polished splinter fragment
9	-	1150	House 801	Great Black-Backed Gull	Ulna	Point/awl
	5570	1150		Bird	Long bone fragment	Bone point
	-	1790	NE Area	Fulmar	Ulna	Bone point
	-	1311	House 401	Swan sp.	Humerus	Polished shaft, separate cut proximal articulation
	-	1311		Shag	Humerus	Polished fragment
	4769	2210	House 1370	Very Large Bird	Humerus	Point: awl
	4806	2210		Large Bird	Long bone fragment	Pin or point
10	-	902	Area C	Gannet	Ulna	Point: awl
	4693	2426	W Area	Great Black-Backed Gull	Tibiotarsus	Point: awl
	3736	1600	House 401	Small Goose *cf* Black	Ulna	Point: awl
	3624	1308		Very Large Bird *cf* Goose	Humerus	Bone point
	3871	1644	House 1370	Shag; Puffin	Ulna; Femur	Bone point; Possible working and rodent gnawing
11	5981	1458	House 1370	Shag	Humerus	Bone point. Separate cut on distal end
	-	1547		Very Large Bird	Radius	Shaped: probable bone point
	-	1204		Cormorant	Ulna	Extensive rodent gnawing and possible working
	-	518	Forecourt	Very Large Bird	Ulna	Point/awl
	-	412	S Area	Large Grey Goose *cf* Greylag	Ulna	Shaped: probable awl. Separate cut on distal end
	3362	412		Swan sp.	Carpometacarpus	Point: awl
	3959	655	House 401	Large Grey Goose *cf* Greylag	Ulna	Point: awl
12	3461	1306	House 401	Shag	Humerus	Point: awl
	3951	738	Forecourt	Cormorant	Radius	Shaped: probable bone point

working modifications (Best 2014; Smith and Sharples 2021: 495–531). Cille Pheadair produced one definite bird bone point, an awl-like implement also made from a shag humerus (Best and Cartledge 2018: 474), and Bornais Mound 1 produced a bird bone pin (Sharples 2012a: 133). Dun Vulan has only one clearly worked bird bone, a tube with a lattice pattern (Parker Pearson and Sharples 1999: 217, fig. 6.31). Beyond South Uist, awls/points have also been found at Mesolithic Cnoc Coig (Oronsay) and Sand (Wester Ross), Neolithic Skara Brae (Orkney), Neolithic and Bronze Age Tofts Ness (Orkney), Late Bronze Age and Early Iron Age Jarlshof (Shetland), Iron Age Scalloway (Shetland), Iron Age Midhowe broch (Orkney), and Iron Age Foshigarry (North Uist) among other sites (Best 2014: 668–77).

In addition to use as awls, the points and pins made of bird bone probably also secured clothing. Martin Martin, who visited St Kilda in 1697, wrote that 'the men at this day wear a short doublet reaching to their waste [waist], about that a double Plait of Plad, both ends joined together with the bone of a fulmar' similar to those shown in Figure 12.3 (Martin 1753: 56).

12.6 Discussion: contextualisation of the avian assemblage

The bird remains from Cladh Hallan represent resource utilisation that was both focused and diverse. The diverse range of species represented by only a few bones suggests opportunistic fowling of birds when encountered, in addition to the targeted capture of certain species and at specific points in the year, such as the gannet during the breeding season. This shows a logical and flexible use of natural resources in South Uist and perhaps further afield. This pattern is visible at many Scottish island sites whose avian assemblages frequently have a seabird focus and are often dominated by one or two particular species (which vary from site to site) but also include a range of species apparently exploited in small numbers (Best 2014; Best and Mulville 2014).

The range of species at Cladh Hallan also indicates that avian resources were collected from multiple areas of the landscape. This would have necessitated a range of capture methods probably including netting, noose and rod, snares and hand capture (Baldwin 2005: 115–61).

The gannet is one of the birds most commonly exploited in large numbers across Scottish island sites, geographically and temporally (Serjeantson 2013; Best 2014). They are highly pelagic, spending most of their life at sea and moving long distances to feed. As such, although gannets can be found in the waters off South Uist for much of the year, they only come to land to breed. Their preferred breeding locations are cliffs and offshore stacks where they nest in large colonies.

Today there is no suitable habitat in South Uist for cliff-nesting seabirds that only come to land to breed, such as the gannet, but also the razorbill and guillemot (Serjeantson 2001: 44, 46–8; Cartledge and Serjeantson 2012: 227). Despite this, gannets are also fairly prominent at Norse Cille Pheadair, Norse Bornais Mounds 2 and 2A, and Iron Age Dun Vulan with guillemot also being very numerous at the latter (Best and Cartledge 2018; Best 2020; 2021; Cartledge and Grimbley 1999: 283–7). Gannet is also well represented at the Udal in North Uist, particularly in the Late Iron Age and Norse phases (Serjeantson 2013).

The prevalence of gannet in the Cladh Hallan assemblage suggests a number of possible scenarios: that they bred more widely in the past, or were caught at sea, or were captured beyond the immediate vicinity of the site. Gannets (and other species) may have been caught from the water, either intentionally or whilst fishing; this is, however, often a more challenging capture environment. New gannet colonies have recently appeared in Scotland (*e.g*. Noup Cliff on Westray, which now has a substantial population of around 1,500 breeding pairs), and occasional pairs and small groups are known. For example, gannets have been trying to breed since 2007 on Berneray (on the southern tip of the Outer Hebrides, also known as Barra Head). The first known chick in this location hatched in 2011 and has been followed by other nests and fledglings (Mavor *et al*. 2008; Murray *et al*. 2015; JNCC 2021).

As such, it is probable that gannets were available to the inhabitants of Cladh Hallan in locations where they are now no longer present, and these locations may have included some within or close to South Uist. However, trips may also have been made further afield, to locations with known large gannet colonies such as St Kilda itself, or to other areas where cliff-nesters (such as razorbill and guillemot) have been archaeologically and historically recorded, including the southern islands of the Outer Hebrides (such as Mingulay, Pabbay and Berneray), the Shiant Isles, Haskeir and the stacks of Haskeir Eagach (Buxton 1995; Best and Mulville 2010; Best 2014). Martin (1716: 66) describes the Haskeir rocks as abundant with populations of puffins, shags and guillemots, and other writers record razorbills too (Harvie-Brown and Buckley 1888: 100–7, 157). These are only about seven (nautical) miles northwest of North Uist and would have been easily accessible by boat for capturing birds (Martin 1716: 60–71; Serjeantson 2013: 91).

The gannet is one of the most greasy, fatty birds and this, combined with its size and colony-based breeding habits, may have made it particularly worth the effort and risk of fowling (Maclean 1992: 68, 98–103). Even today, the men of Ness in the Isle of Lewis travel annually to the rock of Sula Sgeir to catch and preserve the nearly mature youngsters. These are called guga and are considered a delicacy. The gannet's frequency at Cladh Hallan and the presence of juvenile bone does support capture at a breeding site, but whether this was at a more distant large colony or a now unknown smaller nesting site cannot be firmly concluded.

Cormorant and shag, both resident species in South Uist, could have been found on the rocky areas of the island's

coastline year-round. The Monach Isles (not far off the west coast of North Uist) also support breeding populations of shags and cormorants, as do some of the southern islands such as Mingulay and Sanday, meaning that these species may also have been captured during fowling trips (Hepburn *et al*. 1977: 31; Buxton 1995: 14; Stroud *et al.* 2001a: 55; JNCC 2021). Both species return to land each night to roost and, whereas cormorants do come inland to fresh water, shags are more exclusively marine (Webb *et al.* 1990: 124; Stroud *et al.* 2001a: 47–51). Both these species are among the most consistently exploited in the Outer Hebrides and the wider Scottish islands through time (Best 2014; Best and Mulville 2014: 394; Serjeantson 2014). Interestingly, a greater use of cormorant than shag at Norse Bornais correlates with an increasing use of waterfowl such as geese and may therefore be related to more exploitation of freshwater areas, or a fluctuation in populations (Cartledge and Serjeantson 2012: 228; Best 2020; 2021). The relatively equal numbers of cormorant and shag at Cladh Hallan, the juvenile bones, and the substantial waterfowl presence indicate that they were probably taken from the nest in summer and from a variety of locations at other points in the year. Cormorants and shags are higher altricial birds, meaning that they remain on the nest for a long period of time, and their skeleton ossifies fully soon after fledging at about 70 days old (Serjeantson 2009: 11–12, 36–8). The presence of immature and sub-adult bones indicates that capture may have been targeted around fledging time, a practice that is recorded historically in the Scottish islands for other species.

As noted, the abundance of swan remains is comparatively high at Cladh Hallan compared to other South Uist sites. It also appears to be the largest number recorded (by count and by assemblage proportion) from all Hebridean sites, barring Mesolithic Cnoc Coig where the Bewick remains have been identified as possibly intrusive (Nolan 1986; Best 2014). Whilst mute swans and greylag geese are today present in the Hebrides year-round, the whooper swan and the brent and barnacle geese are primarily winter visitors, although they can also be seen on passage. Today the Monach Isles and North Uist's machair and islands are Special Protection Areas for wintering barnacle geese (Stroud *et al*. 2001b: 327, 346). A significant number of resident mute swans currently moult at Loch Bi (Bee) on South Uist in late summer, and historical sources (Harvie-Brown and Buckley 1888: 101) record large numbers of whooper swans wintering on the same loch. During the moult, flight is limited, providing different capture opportunities for these large, powerful birds. The resident populations of certain waterfowl (such as the greylag geese) are bolstered in winter by the arrival of wintering flocks from other areas such as Iceland (Gray 1871: 340; Owen and Salmon 1988: 37–8; Stroud *et al*. 2001a: 88–9). Therefore, whilst resident geese (and ducks) were captured during the breeding season, as evidenced by the juvenile bone remains, a seasonal influx of birds could have made waterfowl a key target for winter fowling around inland water.

For the greylag goose and for gulls such as the herring and the lesser black-backed (who will share colonies together), the machair would have been an ideal nesting environment and one where they could have been found feeding at several points of the year (Heinzel *et al*. 1992: 150; Stroud *et al*. 2001a: 354; Cartledge and Serjeantson 2012: 232–3). Gulls could also have been captured from inland water, from shingly skerries, and from around the middens of settlements. The great black-backed gull tends to nest in small colonies and is less likely to nest on sand dunes and grassy slopes than the herring and lesser black-backed gulls, preferring stacks and rocky shore areas (Stroud *et al*. 2001a: 362)

Whilst most of the birds in the assemblage appear to have been used for food, feathers and osseous materials, they may have also been killed to protect resources. Historical sources document large flocks of feeding greylags posing a threat to crops and pasture on the machair (Martin 1716: 73; Harvie-Brown and Buckley 1888: 98). Great black-backed gulls were historically noted to be prolific stealers of eggs and were even known to kill lambs (Gray 1871: 489).

The great auk could physically access only certain locations, such as gently sloping rocky shores where it bred. Several suitable environments could have been found near to Cladh Hallan. Its relatively prolific presence at Cladh Hallan shows summer exploitation of this visitor when the birds were most vulnerable. They only came ashore to breed but, being flightless and ungainly on land, they were easy prey and provided a lot of meat per kill. They laid a solitary egg and, if this was taken or lost, it could not lay again (Serjeantson 2001: 48–51). The presence of great auk in the avian record suffers a notable decline by the Late Iron Age and Early Norse period, and unsustainable over-exploitation appears to have been a major factor in its decline and eventual extinction (Serjeantson 2001: 48–51; Best 2014; Best and Mulville 2016). Avian data from across the Western and Northern Isles (Best 2014) indicate that the great auk was regularly exploited by fowlers from the Mesolithic to the Middle Iron Age. However, there is a large decline in great auk numbers and site distribution by the Late Iron Age (*ibid*.). In South and North Uist, evidence from sites including Dun Vulan, the Udal, Bornais and Cille Pheadair shows that whilst the bird was exploited commonly in prehistoric periods, numbers decreased in the later Iron Age layers, and in the Norse period it is conspicuous by its absence (Cartledge and Grimbley 1999; Serjeantson 2003; 2013; Cartledge 2005; Cartledge and Serjeantson 2012; Best and Cartledge 2018; Best 2020; 2021).

There are moderate numbers of fulmar at Cladh Hallan (although perhaps not enough to be the products of dedicated fowling trips), including a sub-adult. These birds could have been taken when fishing, or from breeding grounds further afield with other cliff-nesting seabirds such as gannet. However, the fulmar is a very flexible nester and could have bred in South Uist. They possess about half a pint of oil which they spit as a defence

mechanism when scared and, although foul-smelling, it is high in calories and vitamin A, making it a valued resource in historic Scottish island communities (Heinzel *et al*. 1992: 24; Maclean 1992: 94; Best 2014: 468–9). Fulmars are present at their breeding sites for most of the year, being absent only for a couple of months in the autumn/winter. Although they are highly pelagic and roam widely, they can be found all year round in the waters around Britain (Martin 1753: 30–1; Maclean 1992: 92–4; Stroud *et al*. 2001a: 32). The fact that they appear in moderate numbers on many Outer Hebridean sites, with three sub-adult bones from Norse Cille Pheadair, supports the likelihood that they were nesting in or around South Uist (Best and Cartledge 2018). This could suggest a wider past breeding distribution, prior to the nineteenth-century expansion of its historically constricted breeding range (JNCC 2021).

Many small waders such as the golden plover populate muddy shores and marshes, while others such as the curlew favour moors, sand dunes and damp grassland (Heinzel *et al*. 1992: 32, 122, 138). Burrow-nesting species such as the puffin, Manx shearwater and shelduck may have made their nests in the machair dunes or on grassy slopes or may have been taken from island tops further afield. It is most probable that these birds were captured in the burrow when more easily accessible (Baldwin 2005: 124–8). Land birds such as the red grouse, carrion crow/raven, rock/stock dove, starling and raptors could have been found in open country, heather moors, rocky cliffs or ledges as well as on agricultural land.

The inhabitants of Cladh Hallan made use of a variety of avian species, habitats and fowling seasons to supplement their food economy (meat, fat/oil, and eggs), to acquire feathers and to provide raw materials for points and awls. Although few in number, by comparison with the large mammalian assemblage, the exploitation of birds still formed an intrinsic part of life at the site.

13 The fish

C. Ingrem

13.1 Methods

All site deposits were sieved through 10mm mesh. More importantly for the recovery of fish bone, however, all of the floor deposits and environmental samples were processed by flotation using 1mm mesh. The residues were then sieved through 10mm mesh to remove the larger artefacts and ecofacts whilst the remaining residue was sub-divided and a proportion sorted. The fish assemblage is therefore composed of three categories of material: that over 10mm recovered by sieving on site, that over 10mm recovered by flotation, and a fraction of the material between 10mm and 1mm recovered by flotation. The site-sieved component was excluded from analysis as it is not possible to calculate density for this category of material since the number of litres of soil excavated is unknown.

Given the large quantity of fish bone recovered, it was decided to focus analysis on the house floors as these were less likely to contain windblown and other secondary deposits. Occupation floors were divided into 0.50m grid squares for the purposes of excavation and sampling with the selection of sub-samples for analysis aimed at investigating the spatial distribution of fish bones across the floors.

The fish bones were identified and recorded with the aid of the author's comparative material and a low power (×10) binocular microscope. All fragments were recorded to species and anatomical element where possible (with the exception of ribs and fin spines) to produce a basic fragment count of the number of identified specimens (NISP). Unidentifiable fragments in the >10mm sample were also counted and those in the <10mm material were estimated.

The proportion of an element represented by each fragment was recorded as <25%, 25%–50%, 50%–75% and 75% according to completeness. Where possible, elements were sided. The minimum number of individuals (MNI) was determined according to the frequency of the most numerous element (excluding specimens <50% complete) and divided by the number of times that it occurs in the skeleton. When calculating MNI for saithe (*Pollachius virens*), vertebrae were divided by the number present in an individual skeleton based on the figures of Barrett (1997). Otoliths were excluded from the calculation of the MNI as their chemical composition differs from that of bone. The projected NISP (PNISP) has been calculated by multiplying the number of bones in each sample by the fraction of that sample that was sorted. This has allowed the density of fish bones to be estimated by dividing the PNISP of each sample by the number of litres of soil floated.

The state of preservation was recorded as good, medium and poor. Evidence of damage caused by burning and gnawing was recorded and, although it is not possible to determine the agent responsible for the latter, it is quite likely that the modifications have resulted from human chewing.

Measurements taken during recording follow the guidelines of Morales and Rosenlund (1979). In addition, size was visually categorised with the aid of the reference specimens. In the interests of comparative studies, the visual size categories follow those used by Cerón-Carrasco (1999) as follows: very small (<150mm), small (150mm–300mm), medium (300mm–600mm), large (600mm–1200mm) and very large (1200mm–*c*. 2000mm).

Given the comprehensive recovery strategy employed at Cladh Hallan, it is unlikely that either species or anatomical representation has suffered from size-related bias associated with recovery. In addition, almost all the fish bone is in good condition and the high proportion of identifiable material in the >10mm assemblage (average 71%) and in the <10mm samples (average 39%) is an indication of the extremely good preservation afforded by the calcareous shell sand from which the assemblage was recovered.

Although species or anatomical representation is unlikely to be seriously biased by the factors mentioned above, variation in the diagnostic properties of individual bones may affect their identifiability, resulting in

certain bones being less visible than others. In addition, density-related survival is likely to have played a role, especially with regard to cartilaginous species such as the elasmobranchs and other taxa possessing poorly calcified bones such as salmonids and, as a result, these may be under-represented.

13.2 Data

A total of 16,958 fragments of fish bone from the <10mm samples were examined, of which 39% are identifiable (Table 13.1i). The majority of the fish bone is from Phase 9 deposits, particularly two floors (1369 and 2211) in the northern house (House 1370), floor 1311 in the central house (House 401) and floor 1150 in the southern house (House 801). A considerable amount also came from two house floors associated with Phase 10 whilst a relatively small quantity is from miscellaneous deposits and floor layers belonging to other phases. A small number of specimens (n = 38) came from the >10mm samples of which 71% are identifiable (Table 13.1ii), most of which belong to the Phase 9 floor layers.

The remains of saithe (*Pollachius virens*) dominate the <10mm assemblage in all phases (Table 13.1i). A wide range of other taxa are represented but only the right-sided flatfish Pleuronectidae spp (plaice/flounder/dab/halibut *etc*.) comprise more than one percent of the identifiable assemblage. A considerable number of specimens could only be identified as small cod/hake family fish (Gadidae/Merlucciidae spp) and most of these probably belong to saithe. In contrast, most of the bones in the >10mm assemblage belong to large gadoid fish, ballan wrasse (*Labrus bergylta*) and flatfish, with saithe absent (Table 13.1ii).

Table 13.1. Taxa representation of fish according to phase (NISP) i) <10mm

Species	Phase										Total	
	2	*4*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*16*	*n*	*%*
Clupea harengus					7	1	2	3		1	14	*<1*
Salmonidae spp						1				1	2	*<1*
Anguilla anguilla					7	4	1	2	3	14	31	*<1*
?Anguilla anguilla						1			1		2	*<1*
Merlangius merlangus						3					3	*<1*
Trisopterus luscus					1						1	*<1*
Pollachius pollachius					1						1	*<1*
Pollachius virens	1	13	148		3797	734	330	91	29	268	5411	*82*
?Pollachius virens					3						3	*<1*
Pollachius spp					2						2	*<1*
Gadus morhua					2						2	*<1*
Merluccius merluccius					2						2	*<1*
Gaidropsarus vulgaris			1								1	*<1*
Small gadid		2	13	1	451	145	36	9		11	668	*10*
?Small gadid					2						2	*<1*
Large gadid					1						1	*<1*
Gadidae spp					240	2	5				247	*4*
Dicentrachus labrax					1						1	*<1*
Trachurus trachurus					1						1	*<1*
?Scad/mackerel			1								1	*<1*
Labrus bergylta										2	2	*<1*
Labridae spp					5	1		1			7	*<1*
?Labridae spp					1						1	*<1*
Pholis gunnellus					4		2	1			7	*<1*
?Pholis gunnellus										1	1	*<1*
?Crenimugil labrosus					1						1	*<1*
Platichthys flesus					7	1	1		5	6	20	*<1*
Pleuronectes platessa					14	2	3			4	23	*<1*
Pleuronectedes spp			2		49	10	7	2	2	5	77	*1*
?Pleuronectedes spp						1					1	*<1*

(Continued)

Table 13.1. Taxa representation of fish according to phase (NISP) i) <10mm (Continued)

Species	Phase										Total	
	2	*4*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*16*	*n*	*%*
?Glyptocephalus cynoglossus					1						1	*<1*
Flatfish					21	2	1	1	1	3	29	*<1*
?Flatfish								1			1	*<1*
Unidentifiable	2	122	114	3	7827	1189	496	258	250	130	10391	
Total	**3**	**137**	**279**	**4**	**12448**	**2097**	**884**	**369**	**291**	**446**	**16958**	
Total identifiable	***1***	***15***	***165***	***1***	***4621***	***908***	***388***	***111***	***41***	***316***	***6567***	
% identifiable	*33*	*11*	*59*	*25*	*37*	*43*	*44*	*30*	*14*	*71*	*39*	

Table 13.1. Taxa representation of fish according to phase (NISP) ii) >10mm

Species	Phase						Total *n*
	7	*8*	*9*	*10*	*12*	*13*	
Elasmobranch			1				1
Gadus morhua				1			1
Molva molva			1				1
Large gadid			4				4
?Large gadid	1						1
Labrus bergylta		3	4				7
Pleuronectes platessa			3				3
Pleuronectedes spp			7		1		8
Flatfish						1	1
Unidentifiable			7	1		3	11
Total	**1**	**3**	**27**	**2**	**1**	**4**	**38**
Total identifiable	***1***	***3***	***20***	***1***	***1***	***1***	***27***
% identifiable	*100*	*100*	*74*	*50*	*100*	*25*	*71*

Almost all the bones from all phases belong to small (150mm–300mm total length) or very small fish (<150mm total length; Table 13.2).

Phase 2: Collared Urn layer (Area C; 1930–1695 cal BC)

Two samples were examined from a Phase 2 midden but only one contained an identifiable fish bone, a quadrate belonging to a small saithe (Tables 13.1i and 13.3a).

Phase 4: Middle Bronze Age House 2835 (1370–1250 cal BC)

The samples examined from Phase 4 deposits were taken from the floor layer of House 2835 and include 15 identifiable fragments, all of which belong to saithe or small gadid (Table 13.1i). All the bones are vertebrae, of which both abdominal and caudal regions of the body are represented (Table 13.3a). The density of identifiable fish bones is low (Table 13.5i), with a highest concentration of 1.33 fragments per litre of soil and the mean for the floor being only 0.43 per litre.

Phase 7: Structure 2477 and House 3260 (1125–1050 cal BC)

One hundred and sixty-five identifiable fish bones were examined from samples taken from a compact clay layer (2476) on the floor of the 'cigar-shaped house' beneath House 801 (Structure 2477) and the floor layer (3305) of the tiny roundhouse (House 3260). Most belong to saithe (n = 148) although three-bearded rockling (*Gaidropsarus vulgaris*), flatfish and probably scad (*Trachurus trachurus*) or mackerel (*Scomber scombrus*) are also represented (Table 13.1).

Most of the saithe bones are vertebrae from the abdominal and caudal regions of the body although the head and appendicular regions are represented by a few bones (Table 13.3a). A minimum of two individual fish are represented by cranial and abdominal bones and three by caudal vertebrae (Table 13.3b). Twenty-one per cent of

Table 13.2. Estimated size of fish according to phase (%NISP)

Size	Phase										Total
	2	*4*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*16*	
Very large					<1						<1
Large			1		<1	<1			2		<1
Medium			2	75	1	1	2	4	5	1	2
Small/medium					<1		<1	2			<1
Small	100	82	52	25	53	26	93	92	90	98	54
Very small		18	46		46	73	5	1	2		44

Table 13.3a. Anatomical representation of saithe (NISP)

Element	Phase									Total
	2	*4*	*7*	*9*	*10*	*11*	*12*	*13*	*16*	
Vomer				14	2					16
Ethmoid				1						1
Posttemporal				20	1				3	24
Basioccipital				26	4	3			3	36
Parasphenoid				8					1	9
Articular			3	51	9				4	67
Dentary				42	6	2			3	53
Ectopterygoid				4						4
Maxilla			1	62	9	2		1	7	82
Palatine				12	3					15
Premaxilla			1	60	12	5			2	80
Quadrate	1			43	3	2		1	1	51
Ceratohyal				2	2					4
Epihyal				2	1	1				4
Hyomandibular				14	3					17
Interopercular				1	2				1	4
Opercular				2	1				1	4
Preopercular				1		1				2
Symplectic				3						3
Urohyal				3						3
Lower pharyngeal					1					1
Cleithra				6					2	8
Scapula				1						1
Supracleithra			1	99	10	5	2	1	2	120
Anterior abdominal vertebra		6	15	437	73	26	9	5	23	594
Posterior abdominal vertebra		3	32	925	259	102	29	7	110	1467
Caudal vertebra		4	82	1420	281	160	41	11	98	2097
Vertebra fragment			13	404	44	17	10	3		491
Otolith				134	8	4			7	153
Total	**1**	**13**	**148**	**3797**	**734**	**330**	**91**	**29**	**268**	**5411**

the bones are crushed in a manner suggestive of chewing (Table 13.4).

The average density of fish bone on the floor of Structure 2477 is two specimens per litre although one sample is noticeably richer with a density of 9.3 bones per litre (Table 13.5ii). The average density of fish bone on the floor of House 3260 is low, with the highest density at only 1.1 per litre.

Table 13.3b. Saithe: minimum number of individuals represented by selected elements i) based on NISP

Element	Phase							
	4	*7*	*9*	*10*	*11*	*12*	*13*	*16*
Vomer			13	2				
Posttemporal			9	1				2
Basioccipital			25	3	3			3
Articular		2	22	4				2
Dentary			12	2				1
Maxilla		1	29	5	1		1	4
Premaxilla			24	6	3			1
Quadrate			19	2	1		1	1
Hyomandibular			6	2				
Opercular			1	1				1
Cleithra								1
Supracleithra		1	49	5	3	1	1	1
Abdominal vertebrae	1	2	58	14	6	2	1	6
Caudal vertebrae	1	3	43	9	5	1	1	3

ii) based on projected NISP

Element	Phase							
	4	*7*	*9*	*10*	*11*	*12*	*13*	*16*
Vomer			85	12				
Posttemporal			22	4				2
Basioccipital			65	12	17			3
Articular		2	73	18				2
Dentary			39	8				1
Maxilla		1	113	22	6		2	4
Premaxilla			86	31	9			1
Quadrate			50	10	5		4	1
Hyomandibular			18	2				
Opercular			3	2				1
Cleithra								1
Scapula			1					
Supracleithra		1	161	14	6	2	1	3
Abdominal vertebrae	1	2	252	58	25	4	2	6
Caudal vertebrae	1	3	173	32	16	3	1	3

Table 13.3c. Distribution of otoliths belonging to saithe in Phase 9 deposits (NISP)

Floor	Context				Total
	1150	1369	1690	1705	
1150	24				24
1311			3	57	60
1369		50			50
Total	**24**	**50**	**3**	**57**	**134**

Phase 8: construction of Houses 801, 401 and 1370 (1095–1020 cal BC)

The fish bones examined from Phase 8 deposits, associated with construction of the three main houses, are from a pit (2746) and a posthole (2516). Four specimens are from the <10mm component but only one is identifiable and this belongs to a small gadid; three bones came from the >10mm material and all belong to ballan wrasse (*Labrus bergylta*).

All the remains are cranial bones with small gadid represented by a pterotic and wrasse by a hyomandibular and two lower pharyngeal bones. The density of fish bone is extremely low in this phase with only 0.03 fragments

Table 13.4. Taphonomy for Cladh Hallan fish bones

Phase	Crushed		Cut		Burned	
	n	*%*	*n*	*%*	*n*	*%*
7	35	*21*				
9	349	*8*	1	1	206	*4*
10	61	*7*			4	*<1*
11	41	*11*			3	*1*
12	8	*7*			1	*1*
16	17	*5*			3	*1*
Total	**511**	***8***	**1**	**1**	**217**	***3***

Table 13.5. Density of identifiable fish bone according to sample and context (projected NISP per litre of soil) i) Phase 4. Truncated floor of Middle Bronze Age House 2835

Floor 2835	
Sample	**Density**
5043	0.29
5044	0.13
5045	1.33
5060	0.47
5062	0.67
5067	0.24
5069	0.17
5078	0.17
Mean density	*0.43*

ii) Phase 7. Floor 2476 of Structure 2477 and floor 3305 of House 3260

Floor 2476		Floor 3305	
Sample	**Density**	**Sample**	**Density**
5003	2.25	5097	0.13
5005	9.30	5098	0.31
5009	0.48	5101	0.43
5014	0.57	5102	0.90
5019	0.56	5105	0.33
5021	0.33	5106	1.11
5024	0.50	5107	0.27
5028	0.22	5109	0.50
5031	1.07	5113	0.50
5034	0.20		
Mean density	*2*		*0.50*

iii) Phase 8

Sample	Fill (2746) of pit 2551	Fill (2516) of posthole 2517
	Density	**Density**
5000	0.15	
3526		0.03

iv) Phase 16

Sample	Density
4351	1.05
4551	1.20
4558	1.13
4568	0.67
4573	2.36
4586	1.45
4592	5.07
4606	0.50
4614	1.11
4616	0.50
4620	0.80
4626	0.50
4628	0.58
4639	2.00
4668	0.86
Mean density	*1.32*

per litre in the probable posthole and 0.15 specimens per litre in the pit (Table 13.5iii).

Phase 9: Floor layers 2211 and 1369 in House 1370, floor layer 1311 in House 401 and floor layer 1150 in House 801 (1075–1005 cal BC)

A total of 12,448 fish bones were examined from <10mm samples recovered from Phase 9 deposits of which 37% are identifiable (Table 13.1i). Most of the remains belong to saithe although a wide range of taxa are represented, with herring (*Clupea harengus*), eel (*Anguilla anguilla*), bib (*Trisopterus luscus*), pollack (*Pollachius pollachius*), cod (*Gadus morhua*), hake (*Merluccius merluccius*), bass (*Dicentrachus labrax*), scad (*Trachurus trachurus*), wrasse, butterfish (*Pholis gunnellus*), flounder (*Platichthys flesus*) and plaice (*Pleuronectes platessa*) all present in small numbers. In addition, a further 20 identifiable specimens came from the >10mm component, including a few bones belonging to elasmobranch, ling (*Molva molva*) and ballan wrasse (Table 13.1ii).

Anatomical representation includes bones from all parts of the saithe skeleton (head, shoulder, abdomen and tail) which are present in considerable numbers (Table 13.3a). Vertebral elements are particularly numerous although, when the number of times that each element occurs in a skeleton is taken into account, a minimum of 29 individual fish are represented by the maxilla, 49 by supracleithra, 58 by abdominal vertebra and 43 by caudal vertebrae (Table 13.3bi). When the calculation is based on projected NISP, these discrepancies are greatly increased (Table 13.3bii) with a minimum of 113 fish represented by maxillae, 161 by supracleithra, 252 by abdominal vertebrae and 173 by caudal vertebrae.

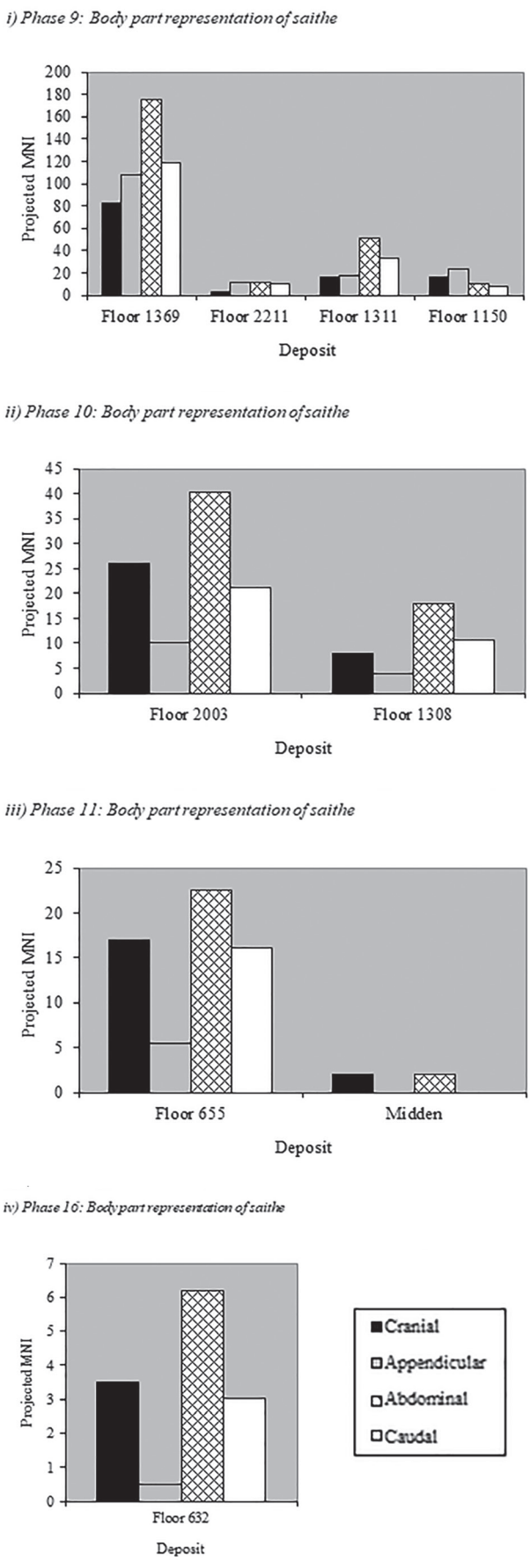


Figure 13.1. Body part representation of saithe (projected MNI): i. Phase 9; ii. Phase 10; iii. Phase 11; iv. Phase 16

A considerable number of otoliths, all belonging to small saithe, were recovered from the floor layers assigned to this phase (Tables 13.3a and 13.3c) and represent a minimum of 45 individual fish.

The minimum number of individuals represented by selected elements has been calculated from the projected NISP for each floor layer in order to investigate possible variations in the body parts present (Table 13.6). Representation of the various regions of the body is shown in Figure 13.1 and indicates that House 401's Phase 9 floor (1311) produced an assemblage in which the abdominal region is better represented than the tail, shoulder or head. This same pattern is apparent for the second Phase 9 floor layer (1369) of House 1370 where the head is quite poorly represented even though a good number of cranial bones are present. Bones from the head are also under-represented in House 1370's earliest floor layer (2211) whilst, in the assemblage recovered from the Phase 9 floor layer (1150) of House 801, the head and shoulder regions are better represented than any other parts of the fish.

There is considerable variation in the density of identifiable fish bone recovered from the house floors and this is illustrated in Figure 13.2, in which the density of identifiable fragments per litre of soil in the individual samples has been plotted according to their location. The sample containing the highest density of fishbone came from the northern house (House 1370) where an area just west of centre in floor 1369 produced 110 fragments per litre whilst fairly high densities were also recovered from areas to the east and northeast (Figure 13.2ii). Floor layer 2211 produced lower densities, with the densest deposit (33 fragments per litre) recovered from the southwestern part of the floor and moderate densities occurring in the northeast (Figure 13.2i). In the central house (House 401), floor 1311 produced a considerable amount of fish bone with the highest density (41 bones per litre) recovered from a sample taken from the centre of the house; however, a considerable amount of material was spread across the floor particularly on the western side (Figure 13.2iii). In the southern house (House 801), a similar density (44 fragments per litre) was present in a sample recovered from the centre of floor 1150, with moderate densities recovered from the southwestern and southeastern areas (Figure 13.2iv).

Eight percent of the bones are crushed in a manner suggestive of chewing by humans and 4% are burnt, mostly calcined or charred (Table 13.4). A single bone – an anterior abdominal vertebra belonging to saithe – displays evidence for butchery in the form of a cut-mark.

Phase 10: Floor layer 1308 in House 401 and floor layer 2003 in House 1370 (1035–970 cal BC)

Two thousand and ninety-seven specimens were examined from the <10mm samples recovered from Phase 10 deposits, of which 43% are identifiable (Table 13.1i). Most of the bones belong to saithe, although herring,

Table 13.6. Minimum number of individuals (saithe) represented in Phase 9 deposits i) based on NISP

Element	House 1370		House 401	House 801	Midden
	Floor 1369	Floor 2211	Floor 1311	Floor 1150	NE area
Vomer	9			4	
Posttemporal	4		4	2	
Basioccipital	11	1	5	8	
Articular	14	1	2	5	
Dentary	5	2	2	3	
Maxilla	15	2	7	5	1
Premaxilla	17		3	5	
Quadrate	11	1	2	5	1
Hyomandibular	4	1		2	
Opercular	1			1	
Supracleithra	23	8	9	11	
Abdominal vertebra	31	8	13	5	1
Caudal vertebra	22	6	9	4	1

ii) based on projected NISP

Element	House 1370		House 401	House 801	Midden
	Floor 1369	Floor 2211	Floor 1311	Floor 1150	NE area
Vomer	75			10	
Posttemporal	9		7	6	
Basioccipital	38	1	10	16	
Articular	53	2	8	11	
Dentary	27	3	4	6	
Maxilla	83	2	16	11	2
Premaxilla	69		7	11	
Quadrate	37	1	3	9	1
Hyomandibular	14	1		3	
Opercular	2			1	
Supracleithra	107	12	18	24	
Abdominal vertebra	175	12	51	10	4
Caudal vertebra	119	10	33	8	3

salmonid, eel, whiting (*Merlangius merlangus*), wrasse and flatfish are all present in small numbers. Two bones came from the >10mm component but only one – a posterior abdominal vertebra belonging to cod – is identifiable (Table 13.1ii).

According to the NISP figures, the assemblage is dominated by vertebrae with relatively few cranial or appendicular elements present (Table 13.3a). Calculation of the minimum number of saithe present based on projected NISP supports this and indicates that a minimum of 58 fish are represented by abdominal vertebrae (Table 13.3b). Head and tail bones show a similar representation when MNI is considered, with 32 fish represented by caudal vertebrae and 31 by premaxillae. Appendicular elements have the lowest frequency with only 14 individuals represented by the supracleithrum (Table 13.7).

The fish bone assemblage from Phase 10 floor 2003 in House 1370 is slightly larger than the assemblage from floor 1308 in House 401, comprising 435 specimens, whilst that from floor 1308 is made up of 235 bones. Most of the remains from both houses belong to saithe and the abdominal region of this fish is better represented than any other part of the body, whilst the appendicular region is the least well represented (Figure 13.1ii). Head bones have a better representation than tail bones in the assemblage from the northern house floor (2003) whereas the opposite is the case in the material recovered from floor 1308 in the central house (Figure 13.1ii).

Seven percent of the remains have been crushed in a manner suggestive of human chewing and less than 1% are burnt (Table 13.4), mostly charred.

The density and spatial distribution of the identifiable fish bone recovered from the house floors is shown in Figure 13.3. The highest densities came from the northern house (floor 2003) with values of 49 fragments per litre occurring in a sample taken from the western area, and similar densities are seen in samples taken from more central and eastern areas (Figure 13.3i). None of the samples taken from the central house were particularly rich with only 11 identifiable fragments per litre in a sample from the northwest of the floor being the highest; low densities were found across the floor and three samples in the southern area contained only five or more bones per litre (Figure 13.3ii).

Phase 11: Floor layer 655 in House 401 (1010–775 cal BC)

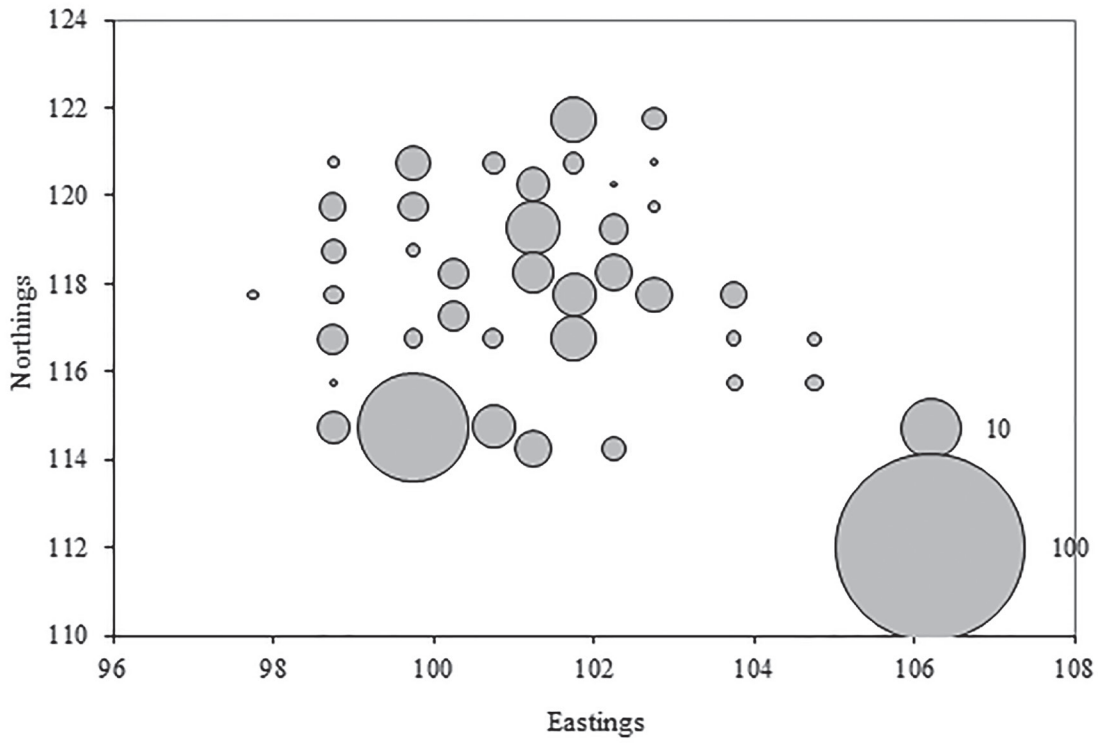
The assemblage from Phase 11 deposits consists of 884 fragments from the <10mm samples of which 44% are identifiable (Table 13.1i). In addition to saithe, several other taxa are present including herring, eel, butterfish and flatfish.

The saithe assemblage is dominated by vertebrae although a few cranial bones are present (Table 13.3a). The calculation of MNI from the projected NISP indicates that 25 fish are represented by the abdominal region, 17 by cranial bones, 16 by caudal vertebrae and six by appendicular elements (Table 13.3b).

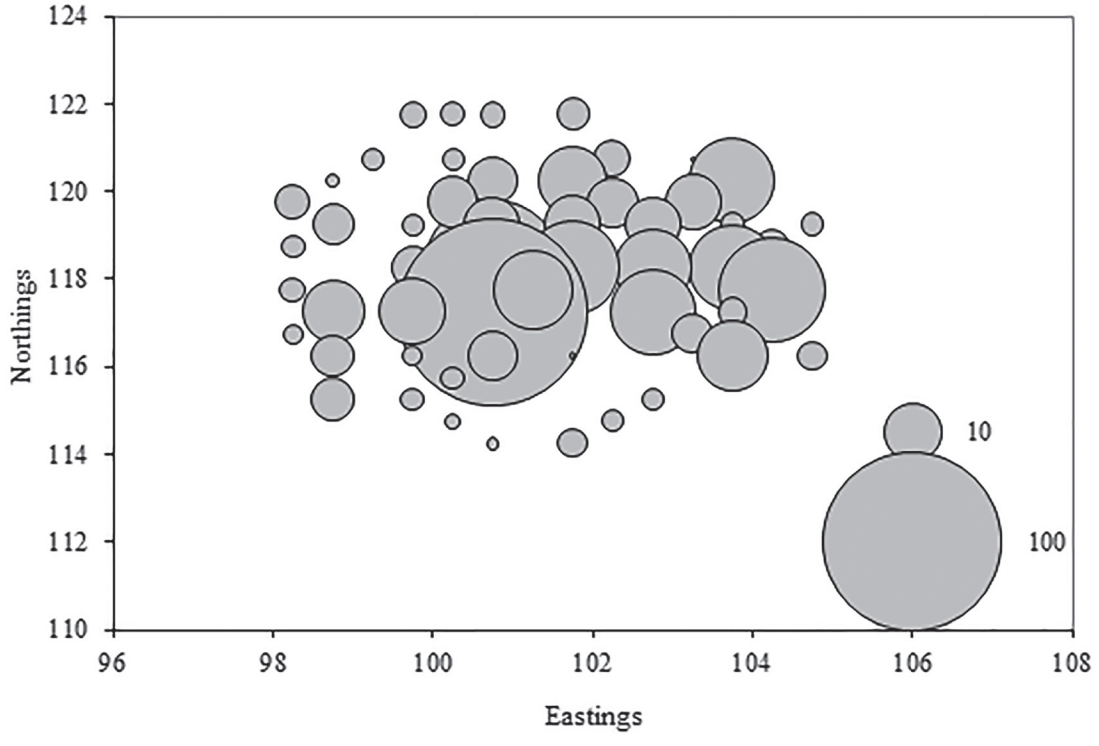
Eleven percent of the bones are crushed, probably as a result of having been chewed (Table 13.4). The incidence of burning is low with only 1% of the bones affected.

Most of the assemblage is derived from the Phase 11 floor (655) of the central house (House 401; Table 13.8). Consideration of body-part representation in the house floor assemblage indicates that the abdominal region is once again better represented than any other part of the body although heads and tails are quite numerous. A small amount of material comes from midden deposits and this consists entirely of cranial and abdominal elements, a pattern which probably reflects the small sample size rather

i) Northern house first floor 2211



ii) Northern house second floor 1369



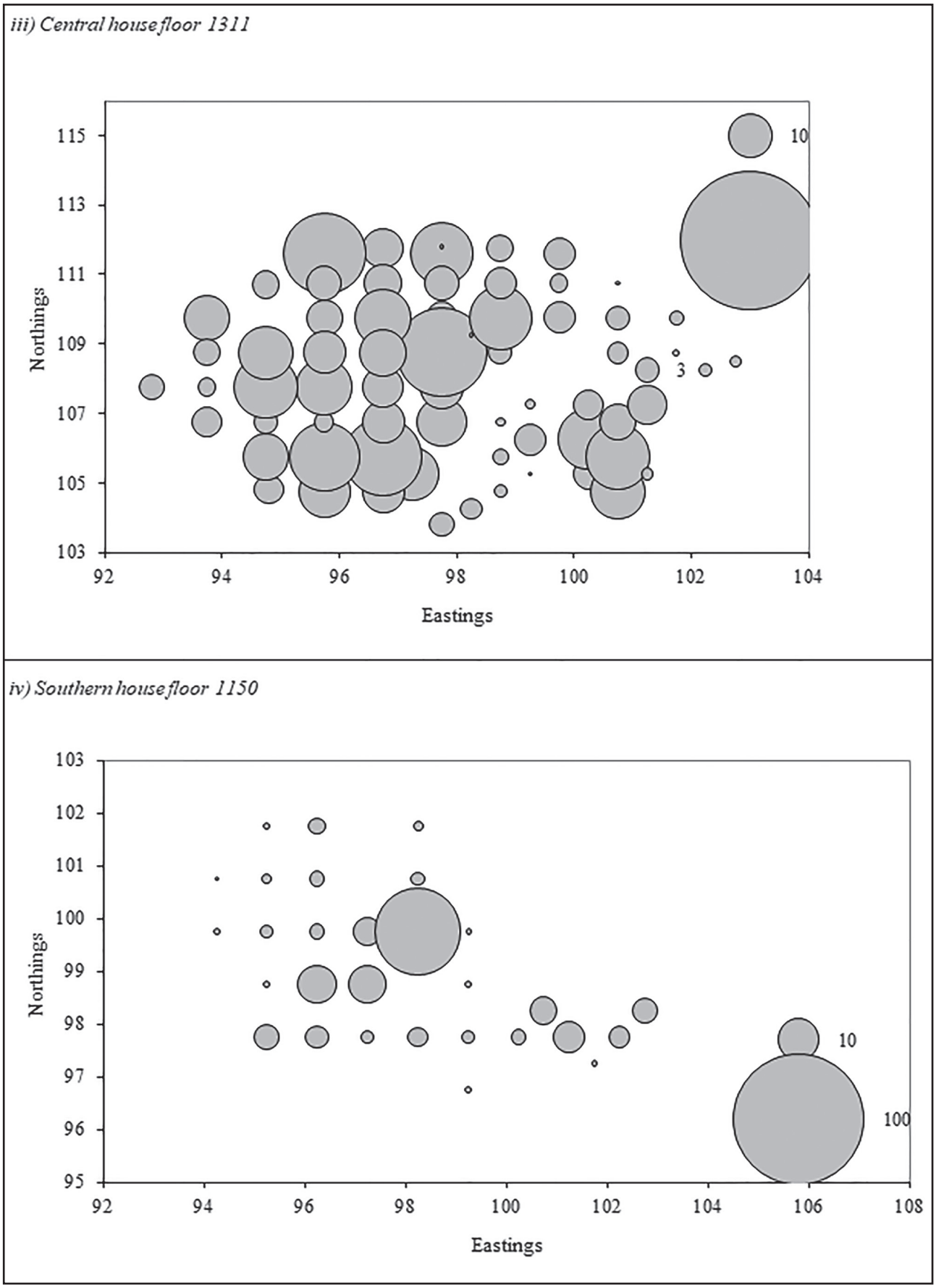


Figure 13.2. Density of fish bones in Phase 9 floor layers (fragments per litre): i. 2211; ii. 1369; iii. 1311; iv. 1150

Table 13.7. Minimum number of individuals (saithe) represented in Phase 10 floor deposits i) based on NISP

Element	House 1370	House 401
	Floor 2003	Floor 1308
Vomer	1	1
Posttemporal	1	
Basioccipital	3	
Articular	4	1
Dentary	2	
Maxilla	4	1
Premaxilla	5	1
Quadrate	2	
Hyomandibular	1	1
Opercular	1	
Abdominal vertebra	9	5
Caudal vertebra	5	3

ii) based on projected NISP

Element	House 1370	House 401
	Floor 2003	Floor 1308
Vomer	4	8
Posttemporal	4	
Basioccipital	12	
Articular	16	2
Dentary	8	
Maxilla	20	2
Premaxilla	26	5
Quadrate	10	
Hyomandibular	1	2
Opercular	2	
Supracleithra	10	4
Abdominal vertebra	40	18
Caudal vertebra	21	11

than indicating that bones from the caudal and appendicular regions were originally absent.

None of the samples were particularly rich in fish bones although specimens came from most areas of floor 655 (Figure 13.4i). The highest density (7 fragments per litre) came from the northern area and a similar density was seen in a sample taken from the southern part of the floor.

Phase 12: Floor layer 595 in House 401 (800–745 cal BC)

Three hundred and sixty-nine fish bones were examined from the <10mm samples taken from the Phase 12 floor (595) in the central house and midden deposits, of which 30% are identifiable (Table 13.1i). The majority of the remains belong to saithe, with herring, wrasse, butterfish and flatfish all present in small numbers. A single flatfish bone came from the >10mm samples (Table 13.1ii).

Apart from two bones from the appendicular region (both supracleithra), all the saithe bones are vertebrae (Table 13.3a). According to the projected NISP figures, a minimum of two individuals is represented by appendicular bones, four by abdominal vertebrae and three by caudal elements from the house floor, and one fish is represented solely by abdominal and caudal vertebrae in samples recovered from the midden deposits (Table 13.9).

A few bones display evidence suggestive of chewing (7%) and 1% are burnt (Table 13.4). The densities of fish remains are low in both the floor and the midden deposits. Floor samples produced less than four fragments per litre although, once again, small numbers of bones were found in most areas of the floor (Figure 13.5i). Midden deposits had even lower densities of less than two fragments per litre.

Phase 13: Floor layer 465 in House 401 (775–655 cal BC)

Two hundred and ninety-one pieces of fish bone <10mm were examined from the Phase 13 floor layer (465) in the central house (Table 13.1i). Relatively few specimens (14%) are identifiable and, apart from saithe, only eel and flounder are present. A single flatfish bone came from the >10mm samples (Table 13.1ii).

Abdominal and caudal vertebrae are almost equally represented and the appendicular region is represented by a supracleithrum (Table 13.3a). There are no concentrations of fish bone in floor 465; the richest sample contains only two fragments per litre of soil and the mean density for this phase is just 0.67 per litre (Figure 13.6).

Phase 16: Floor layer 465 in House 401 and floor layer 632 in a double roundhouse (House 640; 635–535 cal BC)

Four hundred and forty-six specimens were examined from the <10mm samples recovered from the final phase of occupation, and a large proportion (71%) are identifiable. Most belong to saithe although herring, salmonid, eel, ballan wrasse and flatfish are once again present in small numbers.

The saithe assemblage is dominated by vertebrae although some cranial and appendicular bones are also present (Table 13.3a). Most of the remains examined came from floor 632 in House 640 and only a few are from the southern edge of floor 465 in House 401. Calculation of the minimum number of individuals represented in floor 632 is based on the projected NISP figure and indicates that the abdominal region of the body is better represented than either the head or tail (Table 13.10, Figure 13.1iv).

A few bones (5%) are crushed in a manner suggestive of chewing and a small proportion (1%) are burnt (Table 13.4). Once again, no dense concentrations of fish bone were found (Figure 13.6) although one sample (4592) produced 5 fragments per litre compared with an average of 1.32 for this phase.

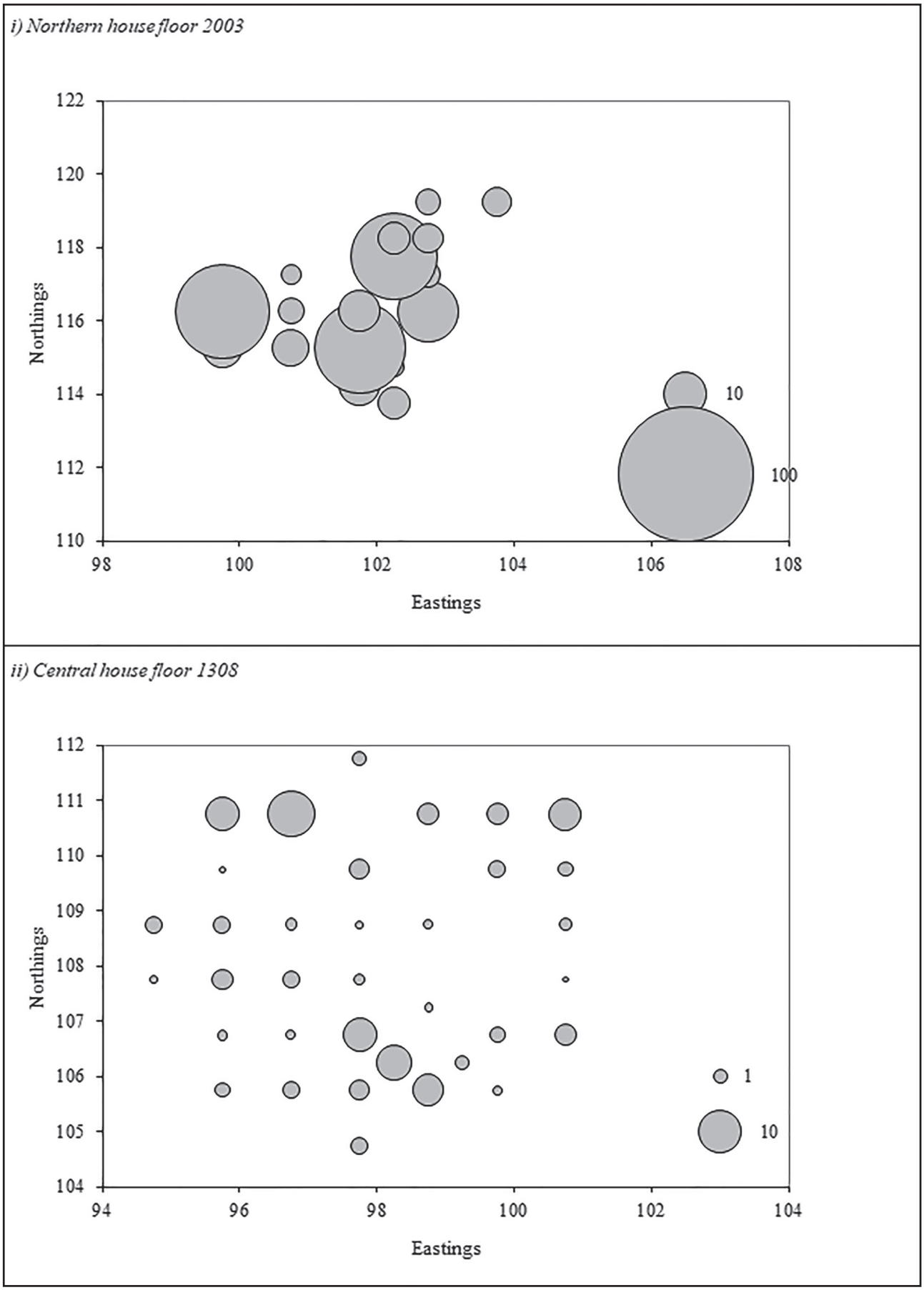


Figure 13.3. Density of fish bones in Phase 10 floor layers (fragments per litre): i. 2003; ii. 1308

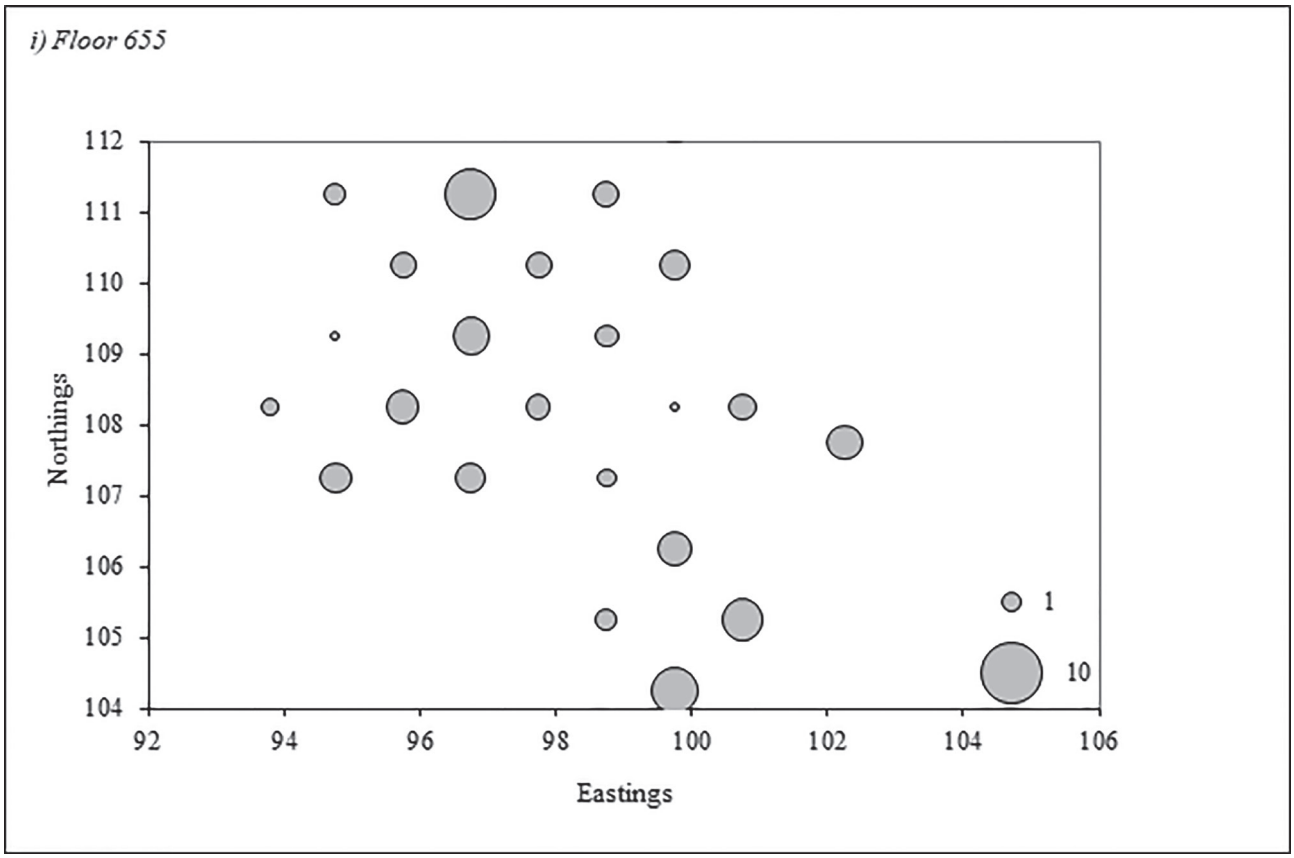


Figure 13.4. Density of fish bones in Phase 11 floor layer 655 (fragments per litre)

Table 13.8. Minimum number of individuals represented in Phase 11 floor deposits i) based on NISP

Element	Floor 655
Basioccipital	3
Maxilla	1
Premaxilla	2
Quadrate	1
Epihyal	1
Preopercular	1
Supracleithra	3
Abdominal vertebra	5
Caudal vertebra	5

ii) based on projected NISP

Element	Floor 655
Basioccipital	17
Maxilla	6
Premaxilla	7
Quadrate	5
Supracleithra	6
Abdominal vertebra	22
Caudal vertebra	16

13.3 Discussion and interpretation

There is little doubt that the majority of the fish brought to Cladh Hallan throughout its occupation were saithe – of small and very small size – and their large numbers, particularly in Phase 9 deposits, leave little doubt that young saithe were deliberately targeted and frequently eaten. Saithe are common in northern inshore waters and usually form small shoals with small, young fish found close inshore amongst weed-covered rocks and in open bays. Most of the saithe at Cladh Hallan are less than 300mm in length: with an average annual growth rate of 150mm during their first three years, most of the fish in the assemblage must have been in their first and second years (Wheeler 1969: 274). In northern waters the majority of second-year fish remain inshore (*ibid.*), suggesting that the majority of saithe at Cladh Hallan were caught in the inshore zone. Bones belonging to other types of fish are relatively scarce but all can – at least occasionally – be caught in inshore waters and the more common of them (eel, wrasse and flatfish) are commonly found near the shore.

Evidence for the exploitation of immature saithe has been noted at several Iron Age settlements in the Western Isles, including two sites on South Uist – the broch at Dun Vulan (Parker Pearson *et al*. 1999) and the wheelhouse at Cill Donnain (Parker Pearson and Zvelebil 2014). The Dun Vulan assemblage comprises a significant quantity of material (Cerón-Carrasco 1999) and is particularly

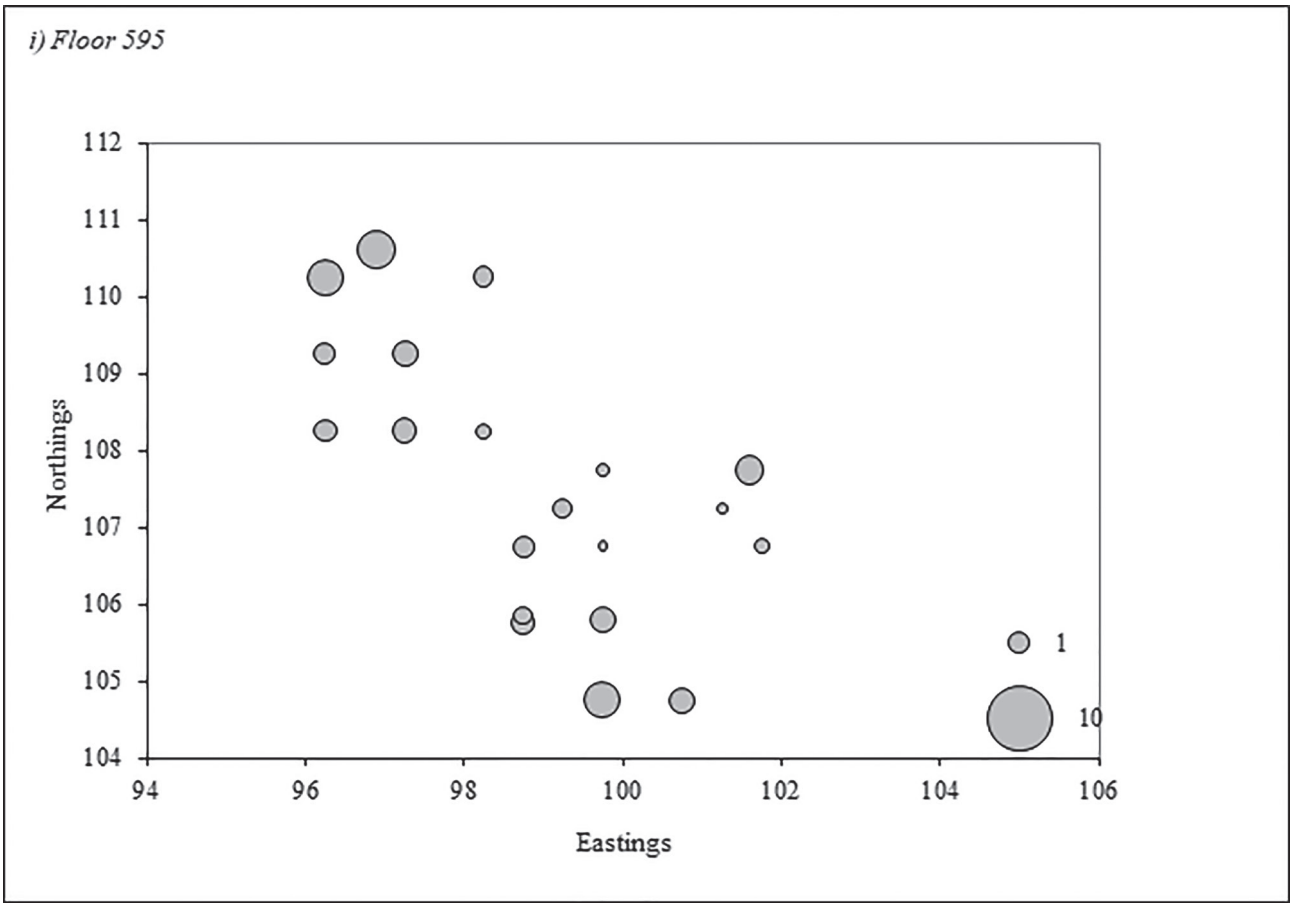


Figure 13.5. Density of fish bones in Phase 12 floor layer 595 (fragments per litre)

Table 13.9. Minimum number of individuals (saithe) represented in Phase 12 floor deposits (based on PNISP)

Element	Floor 595
Supracleithra	2
Abdominal vertebra	4
Caudal vertebra	3

suitable for comparison with the Cladh Hallan fish remains because of similarities in recovery methods and the use of the same fish-size categories. At both sites, immature saithe were the main species exploited and there is further evidence from assemblages recovered from contemporary sites in North Uist, such as Sollas (Finlay 1991), Hornish Point and Baleshare (Cerón-Carrasco 1999), to suggest that this pattern is typical of Iron Age assemblages in the region. It is thought to represent exploitation of the immediate environment, a strategy also evidenced at Iron Age settlements on the islands of Pabbay, Sandray and Mingulay where the assemblages are dominated by inshore species including immature saithe (Mulville and Ingrem 2000).

Saithe have been known by many names (coley, coalfish, sillock, piltock) according to geographical location and the age of the fish (Fenton 1978). Martin (1995: 8) believes this demonstrates the importance placed on them throughout history as a result of their abundance and dependability, and the relative ease with which they could be caught compared to erratic, offshore fish such as herring. Methods of capture known from more recent times include the use of *pocknets* (bag-shaped nets attached to a metal hoop suspended from a long pole) from rocky shores. With a diameter of 1m–3m, a *pocknet* could catch up to half a hundredweight of fish (*ibid.*). Another method involved the use of rod and line and could be practised from either the shore or from small boats using limpets as bait; some rocks were particularly well-suited as casting points and, as a result, became known as traditional *craigseats* (*ibid.*). Where saithe were shoaling, large quantities of fish could also be caught using seine nets from the beach (*ibid.*). All the above methods involve fairly low risk and little investment in technology as they could be carried out from the shore or close to it.

The saithe assemblage recovered from Cladh Hallan tends to be dominated by vertebrae, a pattern easily explained as being at least partly due to the dense, robust nature of these bones, making them the most likely elements to survive in an identifiable form. Preservation at the site is excellent, however, and, despite their more fragile nature, cranial bones are generally well-represented throughout the site's occupation, suggesting that it was common practice for whole fish to be brought to the settlement. Despite this there are some discrepancies in body-part representation

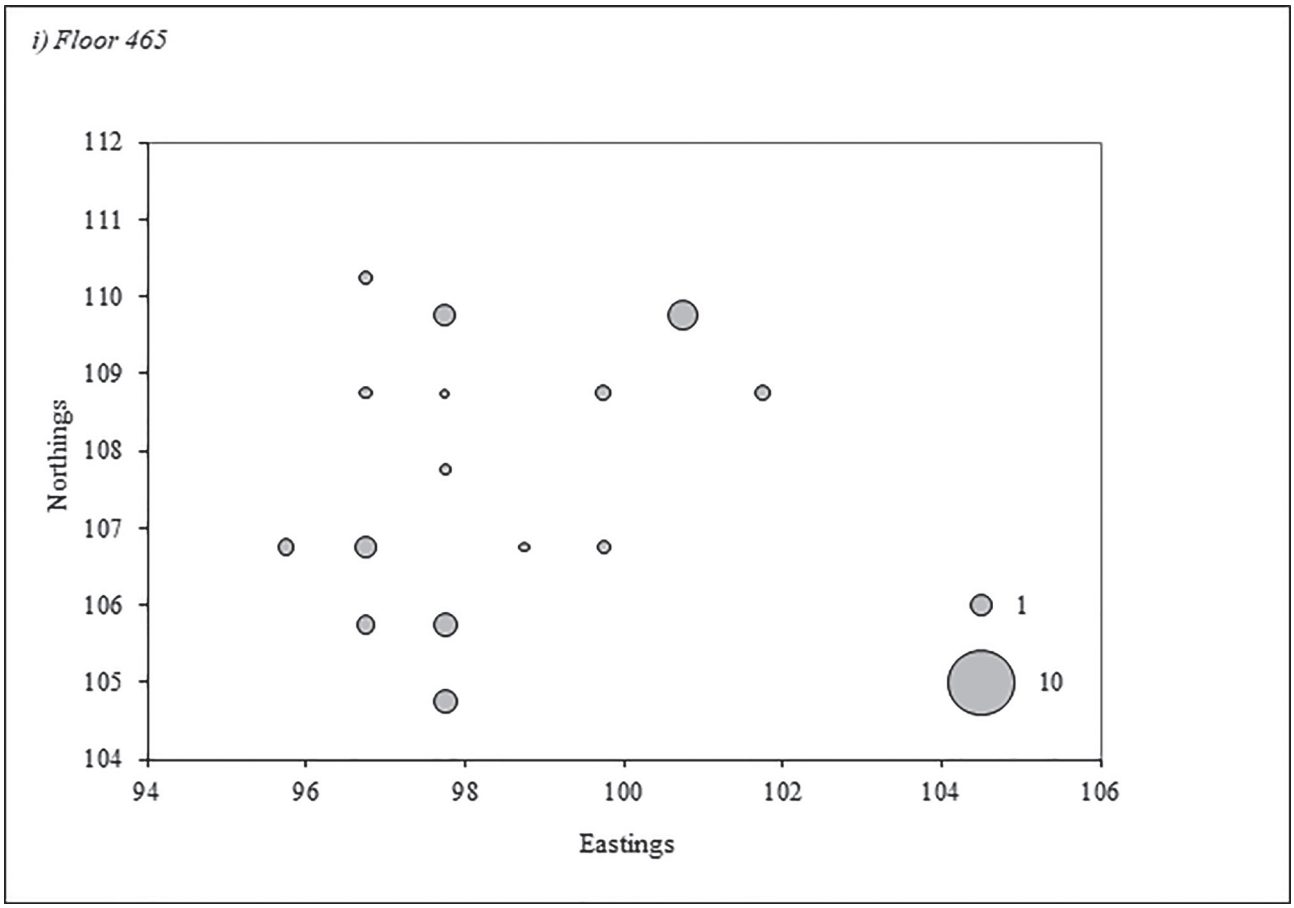


Figure 13.6. Density of fish bones in Phase 13 floor layer 465 (fragments per litre)

that do not appear to be related solely to bone density. In the assemblages recovered from the Phase 9 floors of Houses 401 and 1370 (the central and northern houses), a comparatively high number of abdominal vertebrae were recovered, suggesting that the main body of the fish was originally present in higher numbers than either the head or tail region. This type of pattern can be explained if some of the fish were brought into the house with their head and tails missing, perhaps in a pre-prepared form ready for cooking and consumption. In contrast, the floor in the southern house (House 801) produced an assemblage in which head and shoulder regions are better represented than either the abdomen or tail, suggesting that this deposit contains a greater proportion of waste from food preparation. An over-representation of the abdominal region is also apparent in the assemblages from Phase 10 (floor 2003 in the northern house and floor 1308 in the central house), Phase 11 (floor 655 in the central house) and Phase 16 (floor 632 in the double roundhouse), suggesting that some fish continued to be brought into the houses in a pre-prepared form.

At Dun Vulan, a scarcity of cranial bones was thought to be the result of fish being partially processed at the catch site (Cerón-Carrasco 1999). Recent documentary records (Martin 1995: 10) provide evidence that saithe caught in South Uist were commonly dried in the sun to provide winter provisions, and it is almost certain that surplus fish caught in prehistoric times would have been similarly treated. When curing whitefish, they are generally decapitated and split in half, thereby increasing the surface area to expedite the drying process. This practice results in cranial bones being discarded at the processing site whilst bones that remain with the fillets, such as vertebrae, are deposited close to the place of consumption. If some of the fish eaten at Cladh Hallan had been partly processed at the catch site and/or subjected to this type of drying process, it would account for the low frequency of head bones in many of the house floors. Similarly, the relative abundance of cranial bones in House 801 during Phase 9 may be the result of some fish being processed here but consumed elsewhere.

More difficult to explain is the low representation of the appendicular region that is apparent from Phase 10 onwards. This is unlikely to result from methods of fish preparation or processing activities since the shoulder region would be expected either to remain with the fillets or to be removed with the heads. There are relatively few bones in the appendicular region and most are relatively thin, fragile elements that can be difficult to identify, particularly to species level, when fragmented. The supracleithrum is probably the most robust element in this group and generally preserves well. However, measurements recorded on the Cladh Hallan specimens indicate that most have a greatest breadth between 1mm and 1.2mm, with only two specimens being smaller (greatest

Table 13.10. Minimum number of individuals (saithe) represented in Phase 16 floor deposits (based on PNISP)

Element	Floor 632
Basioccipital	3
Articular	2
Dentary	1
Maxilla	4
Premaxilla	1
Quadrate	1
Opercular	1
Cleithra	1
Supracleithra	1
Abdominal vertebra	6
Caudal vertebra	3

breadths of 0.5mm and 0.4mm) whilst a considerable number have a breadth between 1.2mm and 1.5mm. The scarcity of bones <1mm is probably the result of smaller specimens slipping through the 10mm sieve mesh and, consequently, the low representation of appendicular bones could result from a combination of preservation and recovery bias.

In addition to the flesh, saithe have traditionally been valued for their liver oil which can be extracted by heating and used as fuel for lamps and for the treatment of leather (Martin 1995: 10). A small proportion of bones from most phases have been burnt and, whilst it is quite possible that the oil was valued, it is equally likely that at least some fish-bone waste was disposed of by burning and that some may have been deliberately used as fuel. A small proportion of vertebrae recovered from various phases is crushed in a manner suggestive of chewing (Wheeler and Jones 1989: 75) and consequently it is probable that at least part of the spine remained with the fillets throughout the processes of butchery, food preparation and consumption.

A surprising number of saithe otoliths were recovered from the Phase 9 floors, surprising because they are relatively scarce in other phases. Fish bone is unlikely to survive in acidic conditions but otoliths, being composed principally of calcium carbonate, are particularly sensitive to soil conditions. This was noted at sites in Orkney and Caithness where at Robert's Haven, for example, the soil pH is 7.1–8.8 and otoliths were well represented, whilst at Earls Bu, with a soil pH of 6.6–7.7, they did not survive despite the recovery of significant quantities of fish bone (Barrett 1997). Otoliths are clearly only likely to survive in alkaline soils; local differences in sediment type, the presence of roots, and exposure to weather can result in intra-site differences in survival and condition. At Cladh Hallan, they tend to be present in Phase 9 deposits in similar numbers to appendicular and vertebral bones. This suggests that the soil conditions here are conducive to preservation, rather than their survival being the result of unusual processing activities.

There is no evidence to suggest that fish waste was routinely removed from the houses and deposited in the middens, given the relatively low density of fish bone in deposits other than house floor layers. The density of fish bone in these floor layers is extremely variable but is generally low in the phases preceding and succeeding the main period of occupation of the three houses. During the first major phase of occupation (Phase 9) the highest concentrations were recovered from the later floor (1369) of the northern house, where a particularly rich sample was found in an area close to the centre of the house. Evidence for centrally placed hearths in both floors makes it extremely likely that this is where food was cooked and consumed. Relatively high densities were also found to the east and northeast of the central area, suggesting that the disposal of food waste inside the house was not confined to a single location. It seems that fewer fish were brought into the northern house during the earlier Phase 9 occupation although low-density scatters were found across the floor. Fish bone was also scattered across the floors of the central and southern houses in which, as with the second floor of the northern house, the highest concentrations came from the central area and probably derive from activities carried out near the hearth. Judging by the density of fish bones from the house floors in Phase 10, fish continued to be eaten in greater numbers in the northern house than in the central house. Concentrations of fish bone, albeit lower than those from the previous phase, were found in the central, western and eastern areas of the northern house's floor. Again, this suggests that the disposal of waste from food preparation and consumption may not have been confined to a single location. After Phase 10, either fewer fish were consumed or waste from food preparation and consumption was deposited elsewhere.

13.4 Conclusion

The fish assemblage recovered from Cladh Hallan provides clear evidence for the deliberate exploitation of immature saithe. A similar pattern has been noted at several Iron Age sites in the Western and Northern Isles of Scotland and it is evident that this type of fish procurement strategy, with its focus on a single species, has its roots in the Bronze Age. All the fish present at Cladh Hallan, including the immature saithe, could have been caught easily from the shore, or close inshore using small boats, lines and nets – methods of fishing that involved little risk and required only simple technology. Such small-scale exploitation would have been aimed at meeting domestic requirements although any surplus fish would almost certainly have been dried and consumed when other resources were in short supply. Chronological variation in the density of fish bone raises the possibility that the quantities of fish brought to the settlement varied over time although it is clear that immature saithe were the fish most commonly eaten at Cladh Hallan throughout its occupation.

14 Marine molluscs

H. Smith and M. Parker Pearson

As well as the three main species, *Patella* spp (limpets), *Littorina littorea* (L.) (edible winkle or common periwinkle) and *Cerastoderma edule* (L.) (edible cockle), there are very low numbers of other shellfish. These are, in decreasing order of frequency, edible mussels (*Mytilus edulis* [L.]), razor shells (*Ensis* spp), whelks (*Buccinum undatum* [L.] and *Neptunea antiqua* [L.]), and scallops (*Pecten maximus* [L.]), with a handful of common otter shells (*Lutraria lutraria* [L.]), edible oysters (*Ostrea edulis* [L.]), bivalves (*Astarte sulcata* [da Costa] and *Dosinia exoleta* [L.]), and single specimens of sea urchin (Echinoidea), *Caecum glabrum* (L.), *Jujubinus clelandi* (L.), *Littorina obtusata* (L.) and *Nucella lapillus* (L.).

These proportions are similar to those from other excavated South Uist settlements of the later prehistoric and Norse periods except that cockles are among the minor species (<1%) elsewhere (Sharples and Light 2012; Law in Sharples 2012b; Bell and Godden 2014; Smith and Parker Pearson 2018; Law 2021). The reason for this is the absence of cockle habitats along South Uist's west coast except for a seawater strand east of the Cladh Hallan–Cille Pheadair machair settlements (Parker Pearson 2012a: 21, fig. 2.4). Even this strand became transformed into a series of brackish or freshwater lochs during or after the Middle Iron Age, causing the cockles to disappear from there (Parker Pearson and Sharples 2019: 6, 512). Cockles are also absent or scarce on other prehistoric sites in the Western Isles such as Cnip, Isle of Lewis (Cerón-Carrasco 2006), and the Udal, North Uist (Smith 2018). However, an assemblage comparable to that from Cladh Hallan, with cockles as the main species after limpets and winkles, was recovered from the Early Bronze Age and Middle Iron Age site of Kilellan Farm, Islay, in the Inner Hebrides (Evans 2005).

14.1 Retrieval

Excavators at Cladh Hallan were instructed to collect the less abundant species by hand during excavation and from the 10mm sieve. There are, however, likely to have been variations in on-site collecting so the recovery of mollusca from flotation samples provides a more systematic sample of the numbers and varieties of species represented. Most of the flotation samples derive from floor layers within houses, thereby skewing the type of context best represented. When flotation samples are considered against hand-collected specimens, the main species (mussel, razor shell, whelk and scallop) are the most commonly found in both groups except that scallops and whelks are over-represented in the hand-collected material. This is no doubt due to the size and shape of scallop shells and whelks, making them the most visual and distinctive of the marine mollusca. In contrast, the smaller shells such as *Littorina obtusata*, likely to have been brought into the settlement unintentionally on seaweed, are most likely under-represented from the hand-collected sample.

Taphonomic processes may have affected the survival of certain species. John Evans (2005: 173) has warned that mussel and crab may have originally been present in greater numbers at Kilellan Farm, Islay, but had been largely destroyed because of their fragile shells.

14.2 Variation through time

There is some variation in species proportions through time. Scallops are the most numerous species in Phase 8 and are also common in Phases 9, 10 and especially 11, thereafter declining until Phases 15 and 16. They are absent from Phases 13 and 14. Mussels are absent before Phase 9 but are thereafter a major proportion of the less abundant species in all phases except Phase 11. Whelks occur in large proportions throughout. Most of them are specimens of *Neptunea antiqua* but seven are *Buccinum undatum*. Razor shells are also found throughout but are not present before Phase 8. Oysters are among the least common species and are found only in Phases 9, 12, 13, 14 and 16. Since these last phases have relatively small assemblages of the less abundant species, the rise in oyster shells towards the end of the sequence is probably a significant one.

There are 46 fragmentary pincers of *Cancer pagurus* (edible crab) from Cladh Hallan. They are evenly distributed through Phases 3, 4, 5–7, 8, 9, 10, 11, 12 and 16. Except for a single find from floor 1204 (above House 1370 in Phase 11), only two come from house floors. Both are from House 1370, from against the southeast wall in floor 2211 and from close to the north wall in floor 1369. Crab remains do not survive well on prehistoric machair sites due to the fragility of their shells and so their numbers are probably under-represented (Evans 2005: 173). Nonetheless, the claws are fairly robust and their small numbers from deposits over many centuries at Cladh Hallan suggest that they were not a significant part of the diet. It seems most likely that many or even all of these remains arrived on site in seaweed or other marine materials brought from the shore.

A single, small piece of coral was recovered from the site, no doubt collected on a local beach. It was found in floor 1311 of House 401 (Phase 9), one of the notably unusual finds to come from the floor's northeast quadrant which include copper-alloy artefacts, an unusually early piece of iron, human remains and fragments of a fine-ware pot.

14.3 Habitat and edibility

Of the three common shellfish, winkles and limpets are abundant on intertidal rocky shores (Hayward and Ryland 1990: 650, 659) and would have been gathered from the rocky promontories exposed at low tide along South Uist's west coast. Cockles live in the mid- to low-tide zone in sand or sandy mud (*ibid*.: 759). The former sea strand which is now Loch Hallan was a cockle beach and many of the sand-dwelling species may have come from this location to the immediate east and southeast of Cladh Hallan. Other species likely to be found on the shallow sand bottom of the west coast are razor shells (in sand on the lower shore and shallow sublittoral; *ibid*.: 778), *Astarte sulcata* (offshore in mud or gravels with mud shell or sand; *ibid*.: 752), *Dosinia exoleta* (in muddy or shelly gravel from the lower shore to the sublittoral zone; *ibid*.: 766), *Caecum glabrum* (on sublittoral sand or sandy mud; *ibid*.: 672), *Lutraria lutraria* (in soft substrata from the lower shore to the sublittoral zone; *ibid*.: 770) and scallops (in offshore sand; *ibid*.: 748).

Mussels can be found on the upper shore to the shallow sublittoral (*ibid*.: 744) and could have been collected from the rocky promontories of the west coast as well as from the rugged east coast. Oysters are found on the lower shore and deeper (*ibid*.: 749) while whelks live in the sublittoral zone of rocky shores below low tide (*ibid*.: 685–6). The remaining species are as likely to have come from the island's east coast as the rocky outcrops on the west. *Nucella lapillus* is abundant on inter-tidal rocky shores (*ibid*.: 684) and *Jujubinus clelandi* lives on sublittoral stone or gravel bottoms (*ibid*.: 654) while sea urchins live on rocky coasts in the low-tide and sublittoral zones (*ibid*.: 860).

Most of the less abundant species from Cladh Hallan are edible. Mussels, oysters and scallops are well-known delicacies, and razor shells are also good eating when fried in butter for half a minute. Common otter shells (*Lutraria* spp) can be steamed open and fried (Davidson 1980: 237). Whelks are more tricky but just as edible; the muscular foot has a rubbery texture and harvesting requires special knowledge since whelks can absorb toxins from the bivalves that they eat (*ibid.*: 213) but they are still popular fare in eastern English seaside resorts. Sea urchins were described in 1688 in Orkney as eaten 'oft instead of butter' (*ibid.*: 250) but today are more popular as food on the Continent. Of the three abundant species, cockles can be eaten raw or cooked and winkles are normally boiled in salty water and extracted from their shells with a pin. Limpets are rarely eaten today but have long been a feature of Scottish cuisine, being boiled, fried, griddled or even cooked on the ground beneath a heap of burning straw (*ibid.*: 210). Davidson describes how their juice can be mixed with oats or used to make limpet sauce. He also provides a Colonsay recipe for limpet stovies, in which two quarts of limpets are boiled with potatoes and flavoured with pepper, salt and butter to form a stew which is left above the peat fire to simmer for over an hour (*ibid.*: 447). Remove the pepper and substitute barley for potatoes, and this could be a Bronze Age dish.

14.4 Modification of seashells

Despite the culinary possibilities, it is highly unlikely that any of the less abundant species served as food for the inhabitants of Cladh Hallan. The entire assemblage of less abundant species from all phases is so small that it could be consumed at a single sitting by a small family group. Much more likely is the scenario of seashells being collected dead from the beach and brought to the settlement to be used as children's playthings and as unmodified tools.

Five of the whelks are modified. Two *Buccinum undatum* (SF 5452 from layer 467 and SF 5453 from layer 2222) have paired holes in their penultimate whorl, as does a *Neptunea antiqua* (SF 5451 from layer 2139) whilst two *Neptunea antiqua* shells (SF 5449 from floor layer 1933 and SF 5450 from layer 800) have single holes in their last whorl. A similar find with five holes is known from the Early Bronze Age settlement of Gwithian in Cornwall, where it was found in a gully at the front of the house (Nowakowski 2006: 16–17). Only one of the perforated whelks from Cladh Hallan was recovered from within a floor layer, in the northwest quadrant of layer 1933 in the entrance area at the front of House 401. Large whelk shells were used in Shetland as lamps, suspended by string and filled with fish oil (Davidson 1980: 212) but the holes and lack of evidence for burning suggest another purpose, perhaps connected with entry and exit to and from the house.

The only other shell to exhibit any modification is a drilled *Littorina* shell (SF 4636) from the southwest quadrant of floor 1311 of House 401 (Figure 14.1).

Figure 14.1 A drilled Littorina *shell (SF 4636) from floor 1311 of House 401*

14.5 Spatial distribution and use of seashells

The spatial distribution of less abundant species within house floors provides a good indication of how these shells were used. They are almost entirely absent from the food-producing areas in the southeast quadrants of the roundhouses except for single scallop shells in floors 1150 and 1311 of Houses 801 and 401 (Phase 9) and in floor 655 of House 401 in Phase 11, a common otter shell in floor 1392 (Phase 11) and a mussel shell and a razor shell in floors 1369 and 2211 respectively of House 1370. Scallop shells are otherwise found only in the southwestern area of House 401 (three in floor 1311 and one in floor layer 593) except for a single flat shell from immediately north of the water tank and hearth in Phase 11 floor 655. The most impressive scallop shell from the site is a 150mm-wide specimen (SF 5454) found in the fill (3159) of a small pit (3158) with a large limpet and an unworked stone within a deliberately broken pot buried beneath the southeast quadrant of House 1370 (Phase 8). This shell is likely to have been used as a scoop or a dish.

Other species are distributed very differently to the scallops. In Phase 9 floor 1311 of House 401, the mussels, razor shells, whelks and an oyster are largely restricted to the west and north of the house, particularly within the sleeping platform around the northwest and north. The single sea urchin, however, comes from the southwest. In floor 1150 of House 801, the northwest is similarly where the shells other than the scallops were found. In House 1370 the less abundant species are concentrated in the north and northwest in floor 2211 and in the west, northwest and north in floor 1369 above.

Scallop shells are recorded in ethnographies of the Western Isles as being used in dairying, for skimming off the cream at the top of the milk. The contextual evidence from Cladh Hallan supports this interpretation of scallop shells as utensils used in food preparation in the southeast of the house but they were probably also used in other work activities within the southwest. The total absence of scallop shells from House 1370 is notable and suggests that such activities involving scallops may not have taken place within it. We should also note the declining use of scallop shells through time at Cladh Hallan.

Mussel shells, razor shells and whelk shells appear to have been deposited mostly within the sleeping areas of Houses 401, 801 and 1370. They are best interpreted as children's playthings, brought dead from the beach and dropped or secreted amongst the bedding.

Perhaps the most unusual and enchanting deposit of seashells at Cladh Hallan was a cache of 14 Arctic cowries (*Trivia artica* [Pulteney]) including at least five *Trivia monacha* ([da Costa]; Hayward and Ryland 1990: 678) from floor 1311 of House 401. They were found within a single half-metre sampling square just southwest of the hearth. Four of them have tiny holes but these are probably accidental. This little group of shells was presumably kept in a small bag and ended up on the floor within the seating area around the hearth. They may have been playthings, keepsakes, curiosities or charms and were probably gathered nearby where they were washed up on the shore from their low water and sublittoral habitats. A single Arctic cowrie (SF 5587) was recovered from floor layer 2003 of House 1370, west of the hearth.

14.6 Conclusion

The Cladh Hallan shellfish assemblage is of low diversity, as are those from other later prehistoric settlements in the Uists. The same is true of the Mesolithic to Iron Age site of Kilellan Farm, Islay, in the Inner Hebrides where Evans concluded that shellfish were collected on a casual basis and formed only a minor supplement to the conventional diet of meat, dairy and cereals (Evans 2005: 173). Of the 15 types of marine mollusc found at Kilellan Farm, ten are also found at Cladh Hallan. Only limpets, winkles and cockles are present in any significant numbers at Cladh Hallan to indicate that they were eaten. The remainder, despite most of the species being edible, were most probably collected dead and used as playthings or modified and unmodified tools. This interpretation is supported by the spatial distribution of less abundant species within house floors, in which only scallop shells appear to have been used as tools within the food-producing and working areas of the southeast and southwest quadrants of the roundhouses. The little cache of Arctic cowries from southwest of the hearth in House 401 may have been kept in a bag as a charm or a child's keepsake. The consistent associations of the other species with the sleeping areas in the northwest and north parts of the house floors supports the hypothesis that these other shells were also children's playthings.

Catalogue of modified seashells

SF 4636 context 1311 (E95.74 N105.98). A small shell (*Littorina obtusata* [Linnaeus]), 11mm × 7mm, part of whose top has been ground flat so as to break through the shell with a small hole D2mm × 1mm. It could be a shell bead but its method of manufacture (grinding rather than drilling) and the lack of any similar examples from Cladh Hallan makes this unlikely.

It was found in the southwest quadrant of Phase 9 floor 1311 of House 401.

SF 5449 context 1933 square 3788. A large *Neptunea antiqua* shell with a single oval perforation (7mm × 5mm) through its last whorl. A larger hole is probably accidental damage.

SF 5450 context 800. A large *Neptunea antiqua* shell with a single oval perforation (9mm × 6mm) through its last whorl.

SF 5451 context 2139. A large *Neptunea antiqua* shell with two oval perforations (8mm × 7mm and 7mm × 6mm) through its penultimate whorl. A third hole is probably accidental damage.

SF 5452 context 467. A large *Buccinum undatum* shell with two oval perforations (10mm × 6mm and 8mm × 6mm) through its penultimate whorl.

SF 5453 context 2222. A large *Buccinum undatum* shell with two oval perforations (10mm × 8mm and 7mm × 6mm) through its penultimate whorl. A third hole through its last whorl is probably accidental damage.

SF 5454 context 3159. A large, unmodified *Pecten maximus* shell, W150mm, L127mm, T28mm. Its contextual association within a complete but broken pot makes it most likely to be an unmodified artefact.

SF 5475 context 1311 (E97.25 N106.75). Fourteen Arctic cowries (*Trivia artica* [Pulteney]) of which at least five are the slightly larger *Trivia monacha* (da Costa), being over 10mm × 8mm. The largest is 13mm × 9mm and the smallest is 8mm × 5mm. Four have accidental holes through their shells; one of these and another shell are broken but the remainder are whole. Since they were not strung, their concentration within a single half-metre sampling square suggests that they were kept in a bag or container.

SF 5587 context 2003 (E99.75 N116.75). A single, unmodified Arctic cowrie (*Trivia artica* [Pulteney]).

15 Non-marine molluscs

N. Thew and M. Law

15.1 Aims and methods

In the machair sites of the Western Isles the calcareous shell sands that constitute the majority of the sediments provide excellent conditions for the preservation of mollusc shells. Studies of molluscan faunas from a number of archaeological sites with blown sand deposits have already shown that they are able to provide useful information about past environments and human activities (Thew 2003; Law and Thew 2015; 2017). The primary aims for the study of the mollusc shells from Cladh Hallan were therefore to investigate faunal variations across the site that may be due to site formation processes and land-use practices, and to see how past environments may have changed through time. This analysis is given added importance by the fact that Cladh Hallan is the first Late Bronze Age site in the Western Isles where molluscan research of this type has been undertaken.

Flots were made available from bulk sediment samples that had been processed for archaeobotanical analysis using flotation. Shells from non-floating sample residues were not included in the analysis, which is likely to have introduced biases as discussed below. The sample flots selected for examination were drawn from:

- Phase 2 layers (Early Bronze Age) in Area C;
- Phase 9 house floors (Houses 401 and 1370), the yard and forecourt (1680 and 1933) in Area A and midden deposits in Area C (Late Bronze Age);
- Phase 10 midden deposits in Area C and windblown sand (1299) in Area A;
- Phase 11 contexts in Area A; and
- Phase 12 deposits in Area A (final Late Bronze Age and Early Iron Age).

The spatial distribution of samples across the Phase 9 house floors is shown in Figures 15.1 and 15.2.

Shells were identified in 2011 with the help of the reference collection at the School of History, Archaeology and Religion, Cardiff University. All complete shells, as well as apical and other diagnostic fragments, were identified and counted. Nomenclature follows Anderson and Rowson (2020). As an aid to interpretation, identified taxa were assigned to Ecological Groups devised by Thew (*cf* Thew 2022). The principal ecological sources used were Evans (1972), Kerney and Cameron (1979), Kerney (1999), Davies (2008) and Welter-Schultes (2012). The dataset was revisited in 2021, incorporating new dating information.

Diversity indices and de-trended correspondence analysis were calculated for all samples that had more than 30 shells (Hill and Gauch 1980). Shells were excluded if they were either recent and intrusive (translucent or still bearing a proteinaceous periostracum) or were allochthonous marine gastropods. All statistical analyses were carried out using PAST 4.08 (Hammer *et al.* 2001).

As only flot material was examined, this may have introduced a serious bias into the assemblages, as some species with larger or more fragile shells or which have whorls that expand rapidly are less likely to be recovered through flotation. By contrast, smaller species, especially those that are tightly coiled, are much more likely to float. Thomas and Zapata (2017) tested the likelihood of species being recovered by flotation on a set of samples from north-central Spain but were unable to identify a straightforward relationship between shell shape and buoyancy. Nevertheless, as shells from flots have already been analysed from several other sites in the Western Isles, such as Baleshare, Balelone, Hornish Point and Newtonferry on North Uist (Thew 2003) and Bornais on South Uist (Thew and Law 2021), direct comparison with these sites is possible.

15.2 Area C – Bronze Age midden layers (Phases 2, 9 and 10)

Four samples were examined from a sequence of Phase 2 sandy layers that date from the Early Bronze Age (Table 15.1). The rather poor faunas suggest the fairly rapid accumulation of windblown sand, interrupted by episodes of greater stability when the surface was colonised by short-sward grassy vegetation that may have been grazed. This is in keeping with evidence elsewhere in the Western Isles which shows that windblown sand began to accumulate

Table 15.1. Molluscs from Area C midden layers in Phases 2, 9 and 10

Period		Early Bronze Age			Late Bronze Age			Late Bronze Age		
Context description		Area C - midden layers near House 150			Area C - W Section midden layers			Area C - E Section midden layers		
Context number		1058	1056	1055	1054	913	908	928	926	924
Phase		2	2	2	2	9	9	9	9	9
Sample number		4537	4536	4535	4534	4076	4075	4083	4082	4081
Sediment description		dark brown sand	dark brown sand	dark brown sand + bone + pottery	mottled dark brown sand + bone + pottery	white wind-blown sand	orange-brown sand	brown-black sand + bones	orange sand (= 908?)	orange sand (= 908?)
Dating				1960–1740 cal BC (barley grain 3555 ± 35 BP)				1395–1010, 1270–1000, 1130-910 cal BC (bone 2960 ± 75, barley grains 2920 ± 35, 2860 ± 35 BP)		1080–935, 1060–935 cal BC (barley grains 2830 ± 35, 2815 ± 35 BP)
Ecological group	Species									
4	*Discus rotundatus*									
6	*Cochlicopa lubrica*					1	3	10		
	Oxychilus alliarius							1		
	Punctum pygmaeum									
	Vertigo substriata							1		
	Vitrina pellucida								1	
7	*Cepaea hortensis*									
	Nesovitrea hammonis									
8	*Cochlicopa lubricella*		1	1				1		
	Lauria cylindracea							1		
9	*Pupilla muscorum*	1		4	3	85	27	20	16	3
	Vallonia costata			1	1	5				
	Vallonia excentrica			3	5	5	5	6	2	
	Vertigo pygmaea					5	1	2	1	1
10	*Cochlicella acuta*						6			1
	Helicella itala	1*					1			
11	*Leiostyla anglica*						1			
12	*Euconulus alderi*									
	Galba truncatula								1	
Total Molluscs		1	1	9	9	101	44	42	21	5
Number of Species		2	1	4	3	5	7	8	5	3
Marine molluscs	unident. marine shell frags.									

(Continued)

Table 15.1. Molluscs from Area C midden layers in Phases 2, 9 and 10 (continued)

Period		**Late Bronze Age**				**Late Bronze Age**				
Context description		Area C - W Section midden layers				Area C - E Section midden layers				
Context number		904	903	902	901	923	931	922	921	
Phase		10	10	10	10	10	10	10	10	
Sample number		4073	4072	4071	4070	4080	4079	4078	4077	
Sediment description		grey-brown sand	whitish shell sand	grey-red-brown sand	light grey-brown sand	grey sand + freq. bone	whitish shell sand + bones	white wind-blown sand	orange peat ash	
Dating						1030–920 cal BC (bone 2870 ± 35 BP)	1010–845 cal BC (bone 2835 ± 35 BP)			
Ecological group	Species									
4	*Discus rotundatus*								1	
6	*Cochlicopa lubrica*	4	2	23	21	8	10	8	77	
	Oxychilus alliarius						2			
	Punctum pygmaeum							1	2	
	Vertigo substriata							1	5	
	Vitrina pellucida		1	10		1				
7	*Cepaea hortensis*					1				
	Nesovitrea hammonis			1		1				
8	*Cochlicopa lubricella*	2		2	5			1	61	
	Lauria cylindracea	2	1	1				1	39	
9	*Pupilla muscorum*	21		32		14	9	20	125	
	Vallonia costata	1					1	1	17	
	Vallonia excentrica	3	3	5		2	2	19	220	
	Vertigo pygmaea	1		1		1	2	1	24	
10	*Cochlicella acuta*	9	2			9	2		1	
	Helicella itala						1			
11	*Leiostyla anglica*	1								
12	*Euconulus alderi*							1		
	Galba truncatula	6								Totals
Total molluscs		50	9	75	26	37	29	54	572	1085
Number of species		10	5	8	2	8	8	10	11	19
Marine molluscs	unident. marine shell frags.	x	x	x			x	x		
	Notes rec. = recent intrusive shell	3 burnt *G. truncatula*	2 rec. *V. excentrica*		1 rec. *C. lubrica* 4 rec. *C. lubricella*					

during the Neolithic period at Northton, Harris (Evans 1971), while at Sligeanach, South Uist, Beaker period and Early Bronze Age layers with ard-marks were repeatedly buried by blown sand (Evans *et al.* 2012; Sharples 2012b; Law and Thew 2017). By contrast, Beaker period and Early Bronze Age levels at Northton, Harris (labelled 'Beaker I' and 'Beaker II'; Evans 1971), and Manish Strand, Ensay (Spencer 1974), have faunas indicative of notably more shaded conditions. Despite the presence of domestic rubbish within the layers at Cladh Hallan, there are no signs among the mollusc faunas for 'middening', in the sense of fresh organic waste being deposited to stabilise fragile sandy surfaces. At Rosinish, Benbecula, contemporary layers with ard-marks were associated with domestic waste that may have been used to stabilise the land surface (Shepherd and Tuckwell 1977; Guttman *et al.* 2005), although there is no direct evidence for the dumping of fresh organic material. A single shell of *Helicella itala* found in layer 1058 is certainly intrusive, as this species did not appear in the Western Isles until considerably later (see below).

In Area C's Late Bronze Age midden layers of Phases 9 (five contexts) and 10 (eight contexts) molluscan diversity is fairly low, with marginally more species during Phase 10 that reach a maximum of 11 taxa in layer 921 (Table 15.1). The faunas are dominated by Group 9 open ground species, especially *Pupilla muscorum*. This species was common in the Western Isles during the Bronze Age but has declined since the Early Iron Age and is now only found living on North Uist (Waterston 1981). In mainland Britain *Pupilla* is indicative of short-sward dry grassland, although it can also be found in floodplain environments (Davies 2008: 175) which is in keeping with the sometimes dry but often rather damp grassland of the machair. In some contexts, relatively high numbers of *Pupilla*, together with the presence of open-ground species such as *Vertigo pygmaea* and *Vallonia excentrica* that require more stability, indicate rather stable short-sward grassland that may have been grazed by sheep/goats. The presence of *V. excentrica*, together with significant numbers of the Group 6 species *Cochlicopa lubrica*, matches the molluscs present in the machair grassland at Cladh Hallan today (Law 2018). In addition, the presence of Group 4, 6 and 7 taxa such as *Discus rotundatus*, *Cepaea hortensis*, *Punctum pygmaeum*, *Vertigo substriata* and *Vitrina pellucida* shows that, at times, tall herbs were able to flourish, revealing somewhat moister and more shaded conditions. Fragments of marine molluscs in one Phase 9 sample and five from Phase 10 appear to have been brought in with windblown sand, as they are abraded and unidentifiable.

The presence of animal bones, charred cereals and broken pottery in several samples is linked to the dumping of domestic waste. Shells of the omnivorous Group 6 snail *Oxychilus alliarius* in Area C's midden layers 928 and 931 are in keeping with the dumping of fresh organic waste as part of a 'middening' strategy to stabilise fragile land surfaces (Thew 2003; Law and Thew 2015; 2017) but the paucity of this species suggests that only modest quantities of fresh organic waste were being deposited.

Although often present in low frequencies on Bronze Age sites, the significant numbers of *Lauria cylindracea* in layer 921 may be linked to the nearby presence of walled structures to the east of the excavated area in Area C (perhaps in Area B or its surrounds; see Volume 1: chap. 2). This species often lives in rupestral habitats (Paul 1976; 1992) and seems to have been favoured by large blocks from collapsed buildings in Beaker-period levels at Ensay (Evans 2004: 368); it was also associated with stone-built structures in some Iron Age contexts at Baleshare and Hornish Point (Thew 2003: 170).

Specimens of *Cochlicella acuta* and *Helicella itala* in these samples are almost certainly intrusive, as these two species are known to have been late arrivals in the Western Isles (see below). Their presence is linked with archaeological evidence for significant stratigraphic disturbance during the Phase 13 construction of House 150 during the Early Iron Age (775–655 BC; see Volume 1: chap. 14). Such an age for these intrusive shells is in keeping with dating evidence for their arrival elsewhere in the Western Isles (Thew 1989; 2003; Law and Thew 2015; 2017).

There are marsh snails from Groups 11 and 12 in two contexts from Phase 9 (layers 908 and 926) and two from Phase 10 (layers 904 and 922). *Leiostyla anglica* is typical of shaded marshy habitats, while *Euconulus alderi* and *Galba truncatula* tend to live in more open marshy locations. These shells may have been carried in as 'floaters' during episodes of flooding from Loch Hallan that lies to the east of the site, as indicated by marsh snails found at other machair sites such as the Iron Age settlements at Baleshare and Hornish Point (Thew 2003; Law and Thew 2015; 2017), or may possibly have been brought to the site within reeds, sedges and rushes gathered from the edge of Loch Hallan for bedding, matting, or possibly for animal stalling, and then discarded on the midden. In support of the latter possibility, three of the *Galba* from layer 904 are burnt, while the unbroken nature of these shells favours flooding as an explanation. *Leiostyla anglica* was once rather common in the Western Isles but it dislikes habitat instability and has long been in decline throughout the British Isles (Kerney 1999). In the Western Isles it is rare in archaeological sites, including Neolithic, Late Bronze Age and Early Iron Age levels at Northton (labelled 'Iron Age I' and 'Iron Age II'; Evans 1971) and an Early Iron Age level at Baleshare (Thew 2003), and is today only found living on Harris and Barra (Waterston 1981). *Euconulus alderi* is no longer present in the Western Isles, although it can still be found living in northwest Scotland, including the Isle of Skye (Kerney 1999).

15.3 The earliest floor of House 1370 (Phase 9)

Some 28 samples were analysed from the earliest floor layer (2211) of Late Bronze Age House 1370 in Area A (Figure 15.1), as well as two samples from House 1370's outside area (layers 1790 and 1765). They comprise

Figure 15.1. Location of samples with analysed snails from House 1370's floor layer 2211. Shaded shapes represent stones, unshaded shapes are voids in the layer (redrawn from original)

low numbers of snails from few species (Table 15.2), suggesting that some shells may have been brought in with clean windblown sand used to prepare the floor surface. However, the presence of *Vallonia excentrica* and *Vertigo pygmaea*, which are typical of more stable grassland habitats, indicates that some snails are likely to have been associated with turves used to roof the house or possibly to construct internal features.

The single shells of *Clausilia bidentata* (sample 4082) and *Lauria cylindracea* (sample 3728) were found near the internal wall of the house. As both taxa are known to have often been rupestral within machair sites (Evans 1979; Law and Thew 2015; 2017), where they fed on epiphytes such as algae that require sunlight, this may imply that they were living on the wall during an episode when the house was not in use.

The shells of *Oxychilus alliarius*, present in two samples, may have been taking advantage of fresh organic material within the house, possibly used for bedding and matting. Moreover, shells of the marsh snail *Galba truncatula*,

found in two samples, may well have been brought into the house in reeds, sedges and rushes gathered from the edge of Loch Hallan to the east of the machair area.

Well-preserved marine gastropods, present in three samples, would have been brought into the house with seaweed, as seen at a number of other sites in the Western Isles from the Late Bronze Age onwards (Pain and Thew 2003; Law and Thew 2015; 2017). Unidentifiable fragments of marine molluscs were introduced within windblown sand.

Most of the shells from sample 3985 have a glossier appearance and seem to be intrusive, in keeping with the presence of a *Cochlicella acuta* shell and evidence for later disturbance in the floor plan. Like the *Cochlicella* shells from the midden contexts, this example may date from Phases 13 to 16.

The samples from the outdoor deposits (layers 1790 and 1765) have only low numbers of shells from very few species, which may have been introduced within windblown sand used to prepare the outside surface. Shells from winkle species (*Littorina* sp.) in both contexts were brought in with seaweed.

15.4 The earliest floor of House 401 (Phase 9)

A total of 33 samples and five sample columns were analysed from the earliest floor layer (1311) of this Late Bronze Age house (Figure 15.2). Unlike the contemporary floor from House 1370, both shell frequency and faunal diversity are far more variable, with between 0 and >200 individuals and 0 to 14 species.

Once again, Group 9 open-ground taxa are dominant, especially *Pupilla muscorum* (Tables 15.3a to 15.3c). While the poorer samples from both the spatial sampling and the five columns have assemblages that resemble those from windblown sands, the more diverse samples with higher counts include *Vertigo pygmaea*, *Vallonia excentrica* and several species from Groups 3, 4, 6 and 7, indicating stable grassland with patches of tall herbs. Such a suite of species can only have been introduced with turves cut from the machair, which may well have been used for roofing or to prepare low features inside the house such as bed platforms.

Within the columns, the presence of more diverse and abundant faunas at different levels within the deposit is in

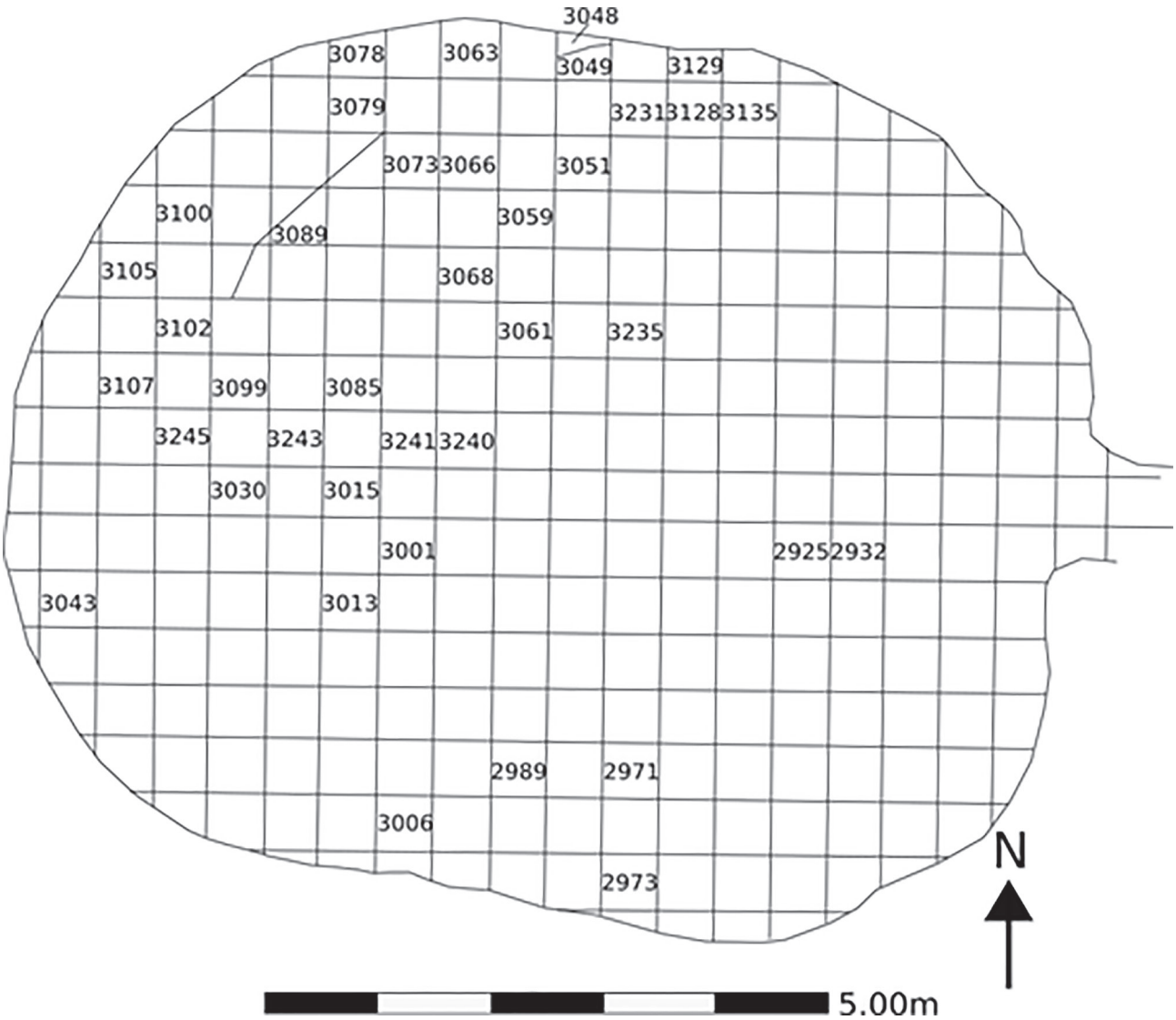


Figure 15.2. Plan of House 401 floor 1311 showing samples with analysed snails (redrawn from original)

Table 15.2. Molluscs from Phase 9 of House 1370 in Area A

Period		**Late Bronze Age**													
Context location		Area A – earliest Floor layer of House 1370													
Context number		2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211
Phase		9													
Sample number		3728	3743	3745	3747	3750	3756	3758	3762	3764	3770	3968	3969	3981	3985
Context description		sandy floor layer													
Dating		1390–1115, 1255–1045 cal BC (barley grains 3000 ± 40 BP, 2915 ± 40 BP)													
Ecological Group	Species														
4	*Clausilia bidentata*														
6	*Cochlicopa lubrica*					1	1				1				2
	Oxychilus alliarius														
8	*Cochlicopa lubricella*					1		1		1					
	Lauria cylindracea	1													2
9	*Pupilla muscorum*		1	7		3	3	14	15		1	1	3	2	2
	Vallonia costata							1	1						
	Vallonia excentrica			2		2		3	1		1				2
	Vertigo pygmaea														3
10	*Cochlicella acuta*														1
12	*Galba truncatula*				1										
Total Molluscs		1	1	9	1	7	4	19	17	1	3	1	3	2	12
Number of Species		1	1	2	1	4	2	4	3	1	3	1	1	1	6
Marine molluscs	*Littorina saxatalis*														
	Littorina sp. juvenile														
	Risssoa cf. *parva*								2						1
	unident. marine shell frags.														
	Notes rec. = recent intrusive shell														2 rec. *V. pygmaea*
KEY	*shells with a fresher surface that may be intrusive or have had different preservational condition*														

Period		Late Bronze Age																
Context location		Area A – earliest Floor layer of House 1370														Forecourt Hse 1370		
Context number		2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	2211	1790	1765	
Phase		9																
Sample number		3999	4006	4016	4026	4032	4034	4043	4044	4052	4078	4082	4089	4090	4099	3114	3068	
Context description		sandy floor layer														mottled light grey-brown sand	green-brown sand	
Dating		1390–1115, 1255–1045 cal BC (barley grains 3000 ± 40 BP, 2915 ± 40 BP)																
Ecological Group	Species											1						
4	*Clausilia bidentata*							1	1				1	1	1		1	
6	*Cochlicopa lubrica*	1						1										
	Oxychilus alliarius																1	
8	*Cochlicopa lubricella*																	
	Lauria cylindracea		1	1	1	2		1	2		1			1	1	1	10	
9	*Pupilla muscorum*																	
	Vallonia costata										1	1						
	Vallonia excentrica									1		3						
	Vertigo pygmaea																	Totals
10	*Cochlicella acuta*											2						
12	*Galba truncatula*	1	1	1	1	2	0	3	3	1	2	7	1	2	2	1	12	121
Total Molluscs		1	1	1	1	1	0	3	2	1	2	4	1	2	2	1	3	11
Number of Species																1		
Marine molluscs	*Littorina saxatalis*																10	
	Littorina sp. juvenile						1											
	Risssoa cf. *parva*													x		x		
	unident. marine shell frags.																	
	Notes rec. = recent intrusive shell																	

Table 15.3. Molluscs from Phase 9 of House 401 in Area A: a. floor 1311; b. general; c. floor 1311 columns

Period		**Late Bronze Age**																	
Context Description		Area A – earliest Floor layer House 401																	
Context Number		1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1624	1624
Phase		9																	
Sample Number		3006	3030	3043	3059	3061	3063	3079	3079	3085	3100	3107	3129	3135	3231	3241	3245	2971	2973
Sediment Description		numerous small sand lenses (including added wind-blown sand) with turf and peat ash																	
Dating		10 dates from 1265–1015 to 1125–950 cal BC on carbonised barley grains																	
Ecological Group	Species																		
3	*Aegopinella pura*																		
4	*Clausilia bidentata*															1			
	Discus rotundatus									1									
6	*Carychium tridentatum*													2					
	Cochlicopa lubrica	1			6	1	9	2	1	3	2	9	1	19		2	3	1	
	Oxychilus alliarius						17	3	2	3	3	6	2	15	2				1
	Punctum pygmaeum													1					
	Vitrina pellucida													3					
7	*Cepaea hortensis*		1			1	1	1	5		5						3	1	
	Nesovitrea hammonis									1						1			
	Vitrea contracta		1	1			2								1				
8	*Cochlicopa lubricella*		1			1	14		4		1	2		9					
	Lauria cylindracea	1					9		3	1	1	3		2					
9	*Pupilla muscorum*	1		3	19		105	19	189	25	50	2	25	99	4	14	23	2	
	Vallonia costata	1			2		2		3	1	4	2		18	2	1		1	
	Vallonia excentrica			2	3	2	2	2	10	2	10		1	47	12	1	2		
	Vertigo pygmaea				1				1		2			7			3		
10	*Cochlicella acuta*	2		1										2					
	Helicella itala		1																
11	*Vertigo antivertigo*													1					
12	*Galba truncatula*													2		1	1		
	Total Molluscs	6	4	7	31	5	161	27	218	37	78	24	29	227	21	21	35	5	1
	Number of Species	5	4	4	5	4	9	5	9	8	9	6	4	14	5	7	6	4	1

Period		Late Bronze Age																	
Context Description		Area A – earliest Floor layer House 401																	
Context Number		1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1624	1624
Phase		9																	
Sample Number		3006	3030	3043	3059	3061	3063	3079	3079	3085	3100	3107	3129	3135	3231	3241	3245	2971	2973
	Littorina saxatalis		1		1		4			3			1	2					
	Rissoa cf. *parva*				1	1	2	1		3	1	1				6	1		
	unident. marine snail						1									1			
	Notes rec. = recent intrusive shell	1 burnt *Pupilla*		1 rec. *V. excentrica*					1 rec. *C. lubricella*					1 1 rec. *O. alliarius* 4 rec. *C. lubricella* 2 rec. *V. excentrica* 4 rec. *V. pygmaea*					
KEY	*shells with a fresher surface that may be intrusive or have had different preservational condition*																		

(Continued)

Table 15.3. Molluscs from Phase 9 of House 401 in Area A: a: floor 1311; b: general; c: floor 1311 column (continued)

Period		**Late Bronze Age**															
Context Description		Area A – earliest Floor layer House 401															
Context Number		1690	1690	1690	1690	1698	1698	1704	1704	1704	1705	1705	1705	1705	1706	1775	
Phase		9															
Sample Number		2989	3001	3013	3015	2925	2932	3048	3102	3105	3049	3051	3066	3089	3078	3099	
Sediment Description		numerous small sand lenses (including added wind-blown sand) with turf and peat ash															
Dating		10 dates from 1265–1015 to 1125–950 cal BC on carbonised barley grains ash															
Ecological Group	Species																
3	*Aegopinella pura*				1												
4	*Clausilia bidentata*			1	3												
	Discus rotundatus				4												
6	*Carychium tridentatum*																
	Cochlicopa lubrica			2	4			1			3	1		4	6	2	
	Oxychilus alliarius			1						3	1			8	4	3	
	Punctum pygmaeum																
	Vitrina pellucida																
7	*Cepaea hortensis*			1									1	3			
	Nesovitrea hammonis											1				1	
	Vitrea contracta				1							1					
8	*Cochlicopa lubricella*										1				1		
	Lauria cylindracea	1			1						2						
9	*Pupilla muscorum*		1	5	10	2		12			47	23		12	2	6	
	Vallonia costata										2	1					
	Vallonia excentrica				2			3	1	2		1		2	1	1	
	Vertigo pygmaea							1								2	
10	*Cochlicella acuta*					1											
	Helicella itala																
11	*Vertigo antivertigo*																
12	*Galba truncatula*				1									1			Totals
	Total Molluscs	1	1	10	27	3	0	17	1	5	56	28	1	30	14	15	1146
	Number of Species	1	1	5	9	2	0	4	1	2	6	6	1	6	5	6	21
Marine molluscs	*Littorina saxatalis*				4		1	2			3			2		1	
	Rissoa cf. *parva*			1				3			2						
	unident. marine snail													1		1	
Marine worm	*Spirorbis* Notes rec. = recent intrusive shell							1 rec. *V. excentrica*		1 rec. *V. excentrica*				1 rec. *V. excentrica*			
KEY	*shells with a fresher surface that may be intrusive or have had different preservational condition*																

Context description		Area A – earliest Floor layer House 401 – Late Bronze Age																				
Context number		1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	
Phase		9																				
Sample number		3073 /3	3073 /5	3073 /6	3073 /7	3073 /8	3073 /9	3073 /10	3073 /11	3073 /12	3073 /13	3128 /1	3128 /2	3128 /3	3128 /4	3128 /5	3128 /6	3128 /7	3128 /8	3128 /9	3128 /10	
Ecological Group	Species																					
6	*Cochlicopa lubrica*	1		2	5	2				1	1	1		1		3		1	1	4		
	Oxychilus alliarius				1															1		
	Vertigo substriata				1																	
7	*Cepaea hortensis*		2	1																		
	Nesovitrea hammonis				1																	
8	*Cochlicopa lubricella*																				3	
	Lauria cylindracea				1	2					2											
9	*Pupilla muscorum*	12	17	20	12	12	9	7	25	45	82	1		4	4	9	2	4		30	86	
	Vallonia costata				1				2		1				1	3					1	
	Vallonia excentrica				1			2	15	1	5			1		5				4	3	
	Vertigo pygmaea		1	1	2				1		1											**Totals**
12	*Galba truncatula*								1													
Total Molluscs		13	20	24	25	16	9	9	44	47	92	2	0	6	5	20	2	5	1	39	93	**472**
Number of Species		2	3	4	9	3	1	2	5	3	6	2	0	3	2	4	1	2	1	4	4	**12**
Marine molluscs	*Littorina saxatalis*	1																				
	Rissoa cf. *parva*	3		1	1				1		1		1	1				1		1	1	
Marine worm	*Spirorbis*																					
	Notes			3-banded *Cepaea*							carbonised birch seed, mosses											

(Continued)

Table 15.3. Molluscs from Phase 9 of House 401 in Area A: a: floor 1311; b: general; c: floor 1311 column (continued)

Context description		**Area A – earliest Floor layer House 401 – Late Bronze Age**															
Context number		1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	1311	
Phase		9															
Sample number		3235 /2	3235 /3	3235 /4	3235 /6	3235 /7	3235 /8	3240 /1	3240 /2	3240 /3	3243 /2	3243 /4	3243 /6	3243 /8	3243 /10	3243 /11	
Ecological Group	Species																
3	*Aegopinella pura*														1		
6	*Cochlicopa lubrica*		1						1		1	3		1			
	Oxychilus alliarius											10		1	1		
7	*Vitrea contracta*											2					
8	*Cochlicopa lubricella*											1					
	Lauria cylindracea									1		2					
9	*Pupilla muscorum*	2	12	1	3	9	3		10	3	3	22	5	8	9		
	Vallonia costata	2							3			1		1			
	Vallonia excentrica										1	2	2	3	2	1	
	Vertigo pygmaea											1	1				
11	*Vertigo antivertigo*											1					**Totals**
12	*Galba truncatula*												2				
Total Molluscs		4	13	1	3	9	3	0	14	4	5	45	10	14	13	1	**139**
Number of Species		2	2	1	1	1	1	0	3	2	3	10	4	5	4	1	**12**
Marine molluscs	*Littorina* cf. *littorea*											1					
	Littorina obtusata											1					
	Littorina saxatalis		1					1		2							
	Rissoa cf. *parva*								1	4			1				
Marine worm	*Spirorbis*									1							

keeping with this complex floor layer being described as made up of numerous small lenses, including turves, peat ash and lenses of clean sand (see Volume 1: chap. 5). This suggests that, while the house was in use, the floor was regularly added to, including clean windblown sand, old roof turves and domestic waste. Indeed, there are eight samples with marsh snails (*Galba truncatula* and *Vertigo antivertigo*) which may have been brought in with reeds, sedges and rushes gathered from Loch Hallan as both species can still be found living there (Law 2018); in the case of sample 3135 they seem to have been introduced in turf cut from the machair. Marsh snails have also been documented from an Iron Age roundhouse at Cnip, Lewis (Cerón-Carrasco 2006).

Many samples include shells from *Oxychilus alliarius*, indicative of fresh organic material within the house that probably included plant material for bedding and matting but may also have involved bone waste. Moreover, more than half of the samples include marine gastropods as well as shells from *Spirorbis* (polychaete worms), both of which were brought in with seaweed.[1] A burnt *Pupilla* shell from the south of the house (sample 3006) may be associated with use of peat as fuel on the hearth. The inhabitants of House 401 may therefore have had a rather different approach to their living space than those of House 1370, with the latter seeming to favour regular cleaning (*cf* Volume 1: chap. 13), while the former may simply have raised the floor level.

In contrast to the fauna from House 1370, the specimens of *Clausilia bidentata* in House 401 seem to have been living with other shade-demanding species among tall herbs before turves were cut from the machair. By contrast, while some of the *Lauria* were certainly associated with such stable and shaded conditions, other samples such as 2989, 3006 and 3107 were poor in fauna and the *Lauria* may have been living as rupestral snails on the internal wall of the house.

Of considerable interest are samples with low numbers of preserved shells that nevertheless have fairly diverse faunas (samples 3015, 3073/7, 3085, 3100, 3241, 3243/4). As discussed below with the diversity indices (Section 15.9), this is a clear sign of the loss of shell material, which is a probable indicator of trampling within the house.

All the shells belonging to the species *Cochlicella acuta* and *Helicella itala* are notably glossier and seem to be intrusive, possibly due to disturbances during the subsequent Phases 13 to 16.

Of note is a shell from the Group 3 species *Aegopinella pura*, which is typical of more densely shaded conditions. In addition to Early Bronze Age, Late Bronze Age and Early Iron Age levels at Northton, Harris ('Beaker II', 'Iron Age I' and 'Iron Age II'; Evans 1971), this species is present in a Beaker-period level at Manish Strand, Ensay (Spencer 1974), an Early Iron Age level at Rosinish (Vaughan 1976) and at post-Medieval Udal (Spencer 1974). Recent

Table 15.4. Molluscs from the forecourt floor 1933 of House 401 in Phase 9

Context description		**Area A – external Floor near House 401 – Late Bronze Age**									
Context number		1933	1933	1933	1933	1933	1933	1933	1933	1933	
Phase		9a									
Sample number		3306	3308	3315	3317	3319	3786	3789	3796	3825	
Context description		grey-brown sand									
Ecological Group											
6	*Cochlicopa lubrica*	1			3	1	1	5		4	
	Oxychilus alliarius		1		1	1	1	3			
	Vitrina pellucida									1	
7	*Cepaea hortensis*					1					
8	*Cochlicopa lubricella*	2		1		1	1	1			
	Lauria cylindracea				1	2		1			
9	*Pupilla muscorum*	3	6	7	15	31	7	8	1	28	
	Vallonia excentrica				2	1	2	2	1	2	
	Vertigo pygmaea				2	1					**Totals**
10	*Cochlicella acuta*							1			
Total Molluscs		6	7	8	24	39	12	21	2	35	**154**
Number of Species		3	2	2	6	8	5	7	2	4	**10**
Marine molluscs	*Littorina saxatalis*								1		
	Rissoa parva	1			1	1		1			
	unident. marine snail					1		1		1	
	Notes rec. = recent intrusive shell					1 rec. *L. cylindracea*					
KEY	*shells with a fresher surface that may be intrusive or have had different preservational condition*										

surveys have only recorded this species on Harris, Barra and Mingulay (Waterston 1981; Kerney 1999; Robinson *et al.* 2015), showing that it has significantly declined in the Western Isles as a result of the loss of scrubby woodland, which used to be much more widely spread across the Western Isles (Brayshay and Edwards 1996). Similarly, *Carychium tridentatum* was present at a number of Beaker-period and Early Bronze Age sites across the islands but then became much rarer and, although it was present at Northton until the Early Iron Age ('Iron Age II'; Evans 1971), at Iron Age Horgabost, Harris,[2] and at Norse period Mound 2A at Bornais, South Uist (Thew and Law 2021), it is known today only from isolated locations on Harris and Barra (Waterston 1981; Kerney 1999).

15.5 The forecourt floor in the entrance of House 401 (layer 1933, Phase 9)

Nine samples were examined from layer 1933, a forecourt floor surface in the entrance of House 401 (Table 15.4). These are largely dominated by open-ground molluscs rich in *Pupilla muscorum*, with several samples having poor faunas suggesting a significant input from windblown sand. The presence of shells from *Vertigo pygmaea*, *Vallonia excentrica* and species from Groups 6 and 7 in several other samples, however, indicates either that at times this area was covered by fairly stable short-turf grassland or there was an input from cut turf. The presence of *Oxychilus alliarius* in five of the samples again suggests the regular presence of fresh organic waste. Shells from small marine gastropods in six of the samples indicates the frequent presence of seaweed, with *Rissoa parva* being common in the holdfasts of *Laminaria* spp algae (tangle or oarweed; Fretter and Graham 1978), which was historically used for fertiliser. This forecourt area might, therefore, have been used to mix together organic waste, domestic refuse and seaweed before this was spread on fragile surfaces around the settlement, both to stabilise and to fertilise them.

15.6 The yard surface (layer 1680) outside Houses 401, 801 and 1370 (Phase 9)

Some 21 samples were analysed from the yard surface (1680) of the area immediately east of the Late Bronze Age Houses 401, 801 and 1370 (Table 15.5). The poor numbers and low diversity in these samples, coupled with the predominance of Group 9 open-ground species dominated by *Pupilla muscorum*, are typical of windblown sand deposits, although the presence of *Vertigo pygmaea* and *Vallonia excentrica* in some samples, together with the Group 6 taxon *Punctum pygmaeum* and the Group 7 species *Cepaea hortensis*, indicates that at times there was greater surface stability, with short-sward grassy vegetation. The presence of *Lauria cylindracea* in samples with few shells suggests that they were probably living as rupestral snails on the outside of the nearby house structures (*cf* Law and Thew 2017: 90). There is no evidence for fresh organic waste, but shells from marine gastropods attest to the presence of seaweed, possibly being dried and prepared for use as a fertiliser.

15.7 Windblown sand (1299) covering the yard area (Phase 10)

Seven samples were examined from a windblown sand layer (1299) that covered the yard surface (1680) at the start of Phase 10 (Table 15.6). The faunas have low numbers of shells from few species, similar to aeolian shell sands from sites elsewhere in the Western Isles (Law and Thew 2015; 2017). Nevertheless, the presence of shells from *Vertigo pygmaea* and *Vallonia excentrica* suggests that, at times during the accumulation of these sands, the machair surface became sufficiently stable to be colonised by short-sward grassland. The presence of *Oxychilus alliarius* and marine gastropods suggests that fresh organic waste and seaweed was probably being added in an attempt to increase surface stability. The shells of *Lauria cylindracea* in samples 3120 and 3179 are likely to reflect the nearby presence of walled structures – the three roundhouses 401, 801 and 1370.

15.8 Area A – Late Bronze Age and Early Iron Age contexts (Phases 11 and 12)

Three contexts from Phase 11 and nine from Phase 12 were sampled from various locations in Area A to study deposits dating to the final phase of the Late Bronze Age and the start of the Early Iron Age (Table 15.7). From Phase 11, layer 412 is a windblown sand that covered much of Area A, while layer 471 is a localised windblown sand layer from the forecourt of House 401, which was still occupied. Both are poor faunas, typical of aeolian deposits, although the presence of *Vertigo pygmaea* and *Vallonia excentrica* in layer 412 shows that accumulation was slowed at times by a cover of short-sward grassy vegetation. A layer of black silty material (518) had no shells except for unidentifiable fragments of marine shells from windblown sand, and two marine gastropods brought in with seaweed.

From Phase 12 contexts deposited at the very end of the Late Bronze Age, a windblown sand (738), present across much of Area A, and the succeeding sandy layers (742, 741 and 740) produced faunas that are unusual as they have relatively high frequencies of *Cochlicopa lubrica*, *C. lubricella*, and *Vallonia excentrica*. In the Western Isles these are characteristic of relatively stable, moderately moist grassland (Evans 1972: 163), indicating that accumulation rates would have been relatively modest due to a covering of short-sward, possibly grazed grassy vegetation. The presence of *Oxychilus alliarius* and a peak in *Vallonia costata* in layer 742 is likely to reflect the deposition of fresh organic waste to stabilise and fertilise the surface.

Table 15.5. Molluscs from the front yard 1680 in Phase 9

Context description		**Area A – Forecourt/yard area of Houses 401, 801 and 1370 – Late Bronze Age**																					
Context number		1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	
Phase		9																					
Sample number		2779	2788	2789	2805	2807	2811	2823	2826	2828	2839	2840	2841	2844	2854	2855	2856	2857	2858	2868	3877	3879	
Ecological Group																							
6	*Cochlicopa lubrica*		1										1	1						1			
	Punctum pygmaeum	1																					
7	*Cepaea hortensis*																			1			
8	*Lauria cylindracea*	1									1				1		1			1			
9	*Pupilla muscorum*	48	8	3	2	3				3		2	3							8	10	1	
	Vallonia costata																			2			
	Vallonia excentrica	14	1				1			1		2	1	1				1		7	1		
	Vertigo pygmaea				1							1								1			
10	*Cochlicella acuta*							1							1	1							**Totals**
	Helicella itala															1							
Total Molluscs		64	10	3	3	3	1	1	0	4	1	5	5	2	2	2	1	1	0	21	11	1	**141**
Number of Species		4	3	1	2	1	1	1	0	2	1	3	3	2	2	2	1	1	0	7	2	1	**10**
Marine molluscs	*Lacuna* sp.	1																					
	Littorina sp.	1																					
	Littorina saxatalis									1	1							2	1				
	Rissoa parva	3																			1		
	Notes rec. = recent intrusive shell				*V. pygmaea* has poorly-developed teeth																		
KEY	*shells with a fresher surface that may be intrusive or have had different preservational condition*																						

Table 15.6. Molluscs from windblown sand layer 1299 in the front yard in Phase 10

Context description		**Area A – wind-blown sand covering the Forecourt area – Late Bronze Age**							
Context number		1299	1299	1299	1299	1299	1299	1299	
Phase		10a							
Sample number		3179	3180	3181	3185	3191	3210	3211	
Sediment description		grey-blue wind-blown sand							
Ecological Group	Species								
6	*Cochlicopa lubrica*			1					
	Oxychilus alliarius	1							
8	*Lauria cylindracea*	11					1		
9	*Pupilla muscorum*			1		1			
	Vallonia excentrica		1		2				Totals
	Vertigo pygmaea			1					
Total Molluscs		12	1	3	2	1	1	0	20
Number of Species		2	1	3	1	1	1	0	6
Marine molluscs	*Littorina saxatalis*							2	
	Rissoa parva					1			

The charcoal-rich layers of contexts 1442 and 1449, located at the south end of the excavated area, may be outside floors. Their poor snail faunas, which are likely to have been blown or washed in from the surrounding surfaces, indicate relative stability.

The sandy deposits of layers 473, 1999 and 1975 in the northeastern area of the site date from the beginning of the Early Iron Age. Although fairly poor, their faunas suggest that rates of sand accumulation would have been relatively modest due to a covering of fairly moist grassy vegetation with some tall herbs. The presence of *Oxychilus alliarius* indicates that fresh organic waste was deposited to stabilise and fertilise the surface. Given the low shell frequencies relative to species diversity in these layers, as well as in layer 740, it seems likely that some shell loss may have taken place, possibly due to trampling.

Unlike the earlier contexts sampled from this site, the condition of the shells of *Cochlicella acuta* and *Helicella itala* present in the very final contexts from the Late Bronze Age and the start of the Early Iron Age suggests that they may well be *in situ*. If true, this would provide valuable dating evidence for these two biostratigraphic markers by suggesting that they first arrived in South Uist around 800/700 BC.

Of interest is the presence of the marsh snails *Zonitoides nitidus* and *Galba truncatula* in contexts from Phases 11 and 12. These may have been introduced in discarded reeds, sedges and rushes, or may have been introduced as 'floaters' during episodes of flooding from the nearby loch. In the Western Isles today, *Zonitoides nitidus* is only known living on Lewis (Waterston 1981).

15.9 Diversity indices

Diversity indices give a representation of the number of species within a sample and the relative frequency of each species. These indices were calculated for the 27 samples with more than 30 snails (Figure 15.3, Table 15.8). Shells that are recent intrusions (and marine species) are excluded from the analysis.

The Shannon index is more applicable to random samples from communities with known numbers of species, whereas Brillouin is best suited to small populations or fully censused assemblages. The difference between the Shannon and Brillouin indices has been found to be an indicator for the 'completeness' of a sample (Law 2017), with lower values implying more 'complete' assemblages while higher values suggest a loss of shell material. This value is lower than 0.1 in nine of the samples, with five of these coming from the Phase 9 House 401 floor 1311 (samples. 3079, 3135, 3073/12, 3073/13 and 3128/10), all of which come from the northern part of the house. Although faunal variations between samples are fairly marked, it nonetheless appears that these samples give a reasonably complete picture of the past environment. The highest value within floor 1311 is for sample 3085, which was taken more centrally within the house where trampling might have caused more shells to be crushed.

The difference value is also low for the Phase 9 midden deposits 921 and 913, for yard surface 1680 (sample 2779), and for the Phase 12 contexts 738 and 742, again suggesting relatively complete assemblages with minimal shell loss or taphonomic mixing, which is perhaps surprising given that layer 738 is windblown sand. By contrast, values are fairly high for the Phase 9 midden layer 928 and the Phase 10 midden layers 922 and 904, all in Area C (associated with the double roundhouse House 150), that have relatively low shell frequencies relative to species diversity, which again suggests that individuals are missing from the assemblage, possibly as a result of trampling by sheep/goats as all three contexts suggest short-turf grazed grassland.

Table 15.7. Molluscs from various contexts in Area A in Phases 11 and 12

Period		**Late Bronze Age**			**final Late Bronze Age**				**final LBA?**	**Early IA?**	**Early Iron Age**			
Context description		Area A - S zone wind-blown + cultivation layer	Area A - Hse 401 forecourt wind-blown	Area A - S of Hse 401 forecourt possible hearth	Area A - E Section				Area A - S zone possible outside floors		Area A - NE zone			
Context number		412	471	518	738	742	741	740	1442	1449	473	1999	1975	
Phase		11a	11b	11b	12a	12a	12a	12a	12	12	12b	12b	12b	
Sample number		4678	4102	4200	4676	4674	4673	4672	2467	2465	4105	3299	3296	
Sediment description		yellow-grey sand + some bone + pottery	grey-brown sand + whitish sand	black sand	grey wind-blown sand	light brown-grey sand	dark grey-black sand	light grey-beige sand	orange-brown silty-sand with charcoal flecks	dark orange-brown silt with charcoal flecks	red-brown sand	dark brown sand	red-brown sand	
Dating		below Floor 655 (dated 970–830 cal BC, bone 2815 ± 35 BP)			1055–820 cal BC (bone 2789 ± 47 BP)						over layer 474 (bone 815–760 cal BC, 2590 ± 35 BP) 785–590 cal BC (bone 2525 ± 35 BP) under layer 470 (bone 795–660 cal BC, 2545 ± 35 BP)		over layer 470 685–540, 665–415 cal BC (barley grains 2560 ± 35, 2465 ± 35 BP)	
Ecological Group	Species													
4	*Discus rotundatus*										1		1	
6	*Cochlicopa lubrica*	1			41	12		2	1		4			
	Oxychilus alliarius					2					3		1	
	Vertigo substriata												1	
7	*Cepaea hortensis*									1				

(Continued)

Table 15.7. Molluscs from various contexts in Area A in Phases 11 and 12 (Continued)

Period		Late Bronze Age			final Late Bronze Age				final LBA?	Early IA?	Early Iron Age			
Context description		Area A - S zone wind-blown + cultivation layer	Area A - Hse 401 forecourt wind-blown	Area A - S of Hse 401 forecourt possible hearth	Area A - E Section				Area A - S zone possible outside floors		Area A - NE zone			
Context number		412	471	518	738	742	741	740	1442	1449	473	1999	1975	
Phase		11a	11b	11b	12a	12a	12a	12a	12	12	12b	12b	12b	
Sample number		4678	4102	4200	4676	4674	4673	4672	2467	2465	4105	3299	3296	
8	*Cochlicopa lubricella*	1			18	5		1		1	1			
	Lauria cylindracea					1							1	
9	*Pupilla muscorum*		1		4			1	1		2	1	1	
	Vallonia costata	1	1		1	16		1			1			
	Vallonia excentrica	1	1		18	70	1	6		1	8	2	4	
	Vertigo pygmaea	1								1				
10	*Cochlicella acuta*						1	2						
	Helicella itala							2			1	1		
11	*Zonitoides nitidus*							1						Totals
12	*Galba truncatula*	1	1											
Total Molluscs		6	4	0	82	106	2	16	2	4	21	4	9	256
Number of Species		5	3	0	5	6	2	8	2	4	8	3	6	15
Marine molluscs	*Rissoa parva*			2										
	unident. marine shell frags.			x	x						x	x		
	Notes rec. = recent intrusive shell				1 rec. *V. excentrica*			3 rec. *V. excentrica*		5-banded *Cepaea*			1 burnt *L. cylindracea* 2 rec. *V. excentrica*	

Table 15.8. Statistical data for the diversity indices in Figure 15.3

Context	913	908	928	1311									1705		1680	1933		904	902	922	921	738	742
Sample	4076	4075	4083	3059	3063	3079	3085	3100	3135	3245	3073/11	3073/12	3073/13	3128/9	3128/10	3243/4	3049	3089	2779	3319	3825	4073	4071	4078	4077	4676	4674
Phase	9																					10				12	
Context type	midden	midden	midden	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	hse floor	fore-court	fore-court	fore-court	midden	midden	midden	midden	w-b sand	sand
No. of Taxa	5	7	8	5	9	9	8	8	13	6	5	3	6	4	4	10	6	5	4	8	4	10	8	10	11	5	6
No. of Individuals	101	44	42	31	161	217	37	77	216	35	44	47	92	39	93	45	56	28	64	38	35	50	75	54	572	81	106
Shannon	0.657	1.328	1.557	1.196	1.271	0.6194	1.315	1.295	1.673	1.244	1.001	0.2055	0.4915	0.7629	0.3426	1.618	0.7303	1.357	0.7016	0.8362	0.7344	1.881	1.491	1.619	1.721	1.209	1.147
Brillouin	0.5765	1.082	1.263	0.9577	1.163	0.5662	1.001	1.115	1.58	0.9846	0.88	0.1634	0.4264	0.6569	0.3001	1.371	0.5781	1.155	0.6141	0.6546	0.5821	1.547	1.309	1.334	1.675	1.123	1.031
Shannon-Brillouin	0.0805	0.246	0.294	0.2383	0.108	0.0532	0.314	0.18	0.093	0.2594	0.121	0.0421	0.0651	0.106	0.0425	0.247	0.1522	0.202	0.0875	0.1816	0.1523	0.334	0.182	0.285	0.046	0.086	0.116
Simpson	0.2871	0.5994	0.7	0.4086	0.55	0.381	0.539	0.5588	0.7225	0.558	0.5579	0.08239	0.2018	0.3866	0.1427	0.6993	0.2948	0.7015	0.3953	0.3296	0.3529	0.778	0.7099	0.7	0.7688	0.6478	0.543
Fisher's Alpha	1.105	2.346	2.93	1.687	2.058	1.895	3.139	2.245	3.039	2.084	1.452	0.7139	1.437	1.117	0.8504	3.986	1.703	1.772	0.9458	3.093	1.164	3.759	2.267	3.61	1.932	1.178	1.683

Of the various indices, Fisher's Alpha seems to be the most strongly influenced by the relative numbers of taxa and individuals. Points on the graph where this varies independently of other indices may thus be strong indicators of compositional fidelity (low Fisher's Alpha value) or of shell destruction and/or taphonomic mixing (high Fisher's Alpha value). The values of Fisher's Alpha are fairly high for Area C's Phase 9 midden contexts 928 and 908, and Phase 10 midden layers 904 and 922, where there may have been trampling during grazing by sheep/goats, but it is low for context 921, a sample in which all the other indices reach their peak values, suggesting that there was very little shell destruction. Similarly high values for some samples from the floor of House 401 may be linked to human trampling.

15.10 De-trended correspondence analysis

De-trended correspondence analysis is a technique that can organise data, in this case the samples with more than 30 individuals, along axes that account for the variation between them. Each axis is given an 'eigenvalue' that describes the amount of variation they represent. In this case, the ordination accounts for relatively little variation (Figure 15.4), with Axis 1 accounting for 11.2%, and Axis 2 representing 2.4%. This is likely to be due to the rather low degree of variability between samples, with most being dominated by Group 9 open-ground taxa, especially *Pupilla muscorum*.

In Figure 15.4, the two Phase 12 samples form a distinct group, as they have relatively high frequencies of *Cochlicopa lubrica* and *Vallonia excentrica*, but rather low numbers of *Pupilla muscorum*. Similarly, Phase 10 midden contexts 922 and 921in Area C also have high numbers of *C. lubrica* and *V. excentrica* that offset the dominance of *Pupilla*. It would appear, therefore, that the factor driving variation along Axis 1 is the degree to which *Pupilla* dominates an assemblage. Accordingly, the floor deposits of House 401 (contexts 1311, 1705) and the forecourt (1933) and yard immediately east of the houses (1680) form a broad group to the left of the ordination, although there is some variability. Within this group, context 1311/sample 3135 is something of an outlier, as it has a relatively high number of *Pupilla* but it is part of a much more diverse assemblage due to this sample probably including turf cut from the machair.

15.11 Conclusions: the molluscan evidence for human activities, site formation processes and environmental change

Cladh Hallan is one of a number of Bronze Age sites in the Western Isles for which non-marine molluscan data are now available, and a picture of land-use practices and environmental change is emerging. The Early Bronze Age faunas from Phase 2 have parallels with those at Sligeanach (Evans *et al.* 2012) where two thick windblown sand

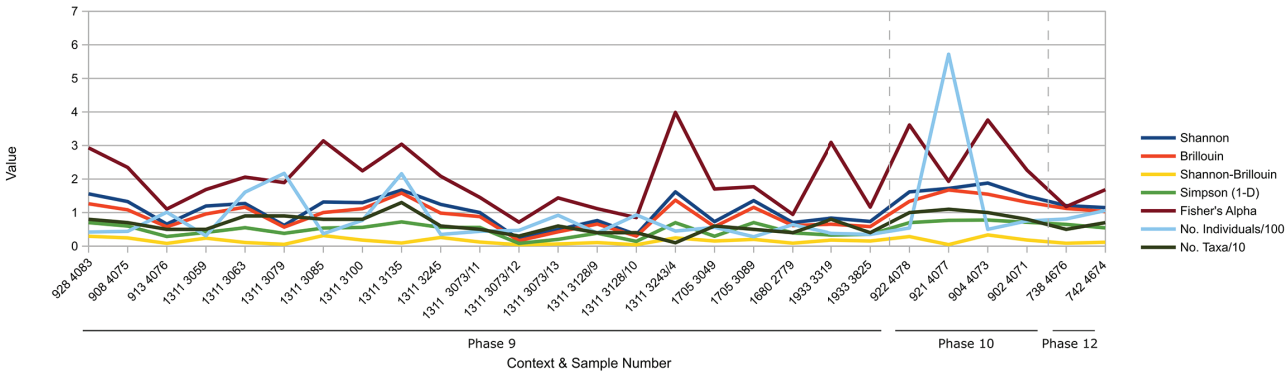


Figure 15.3. Diversity indices for samples with >30 shells from deposits at Cladh Hallan

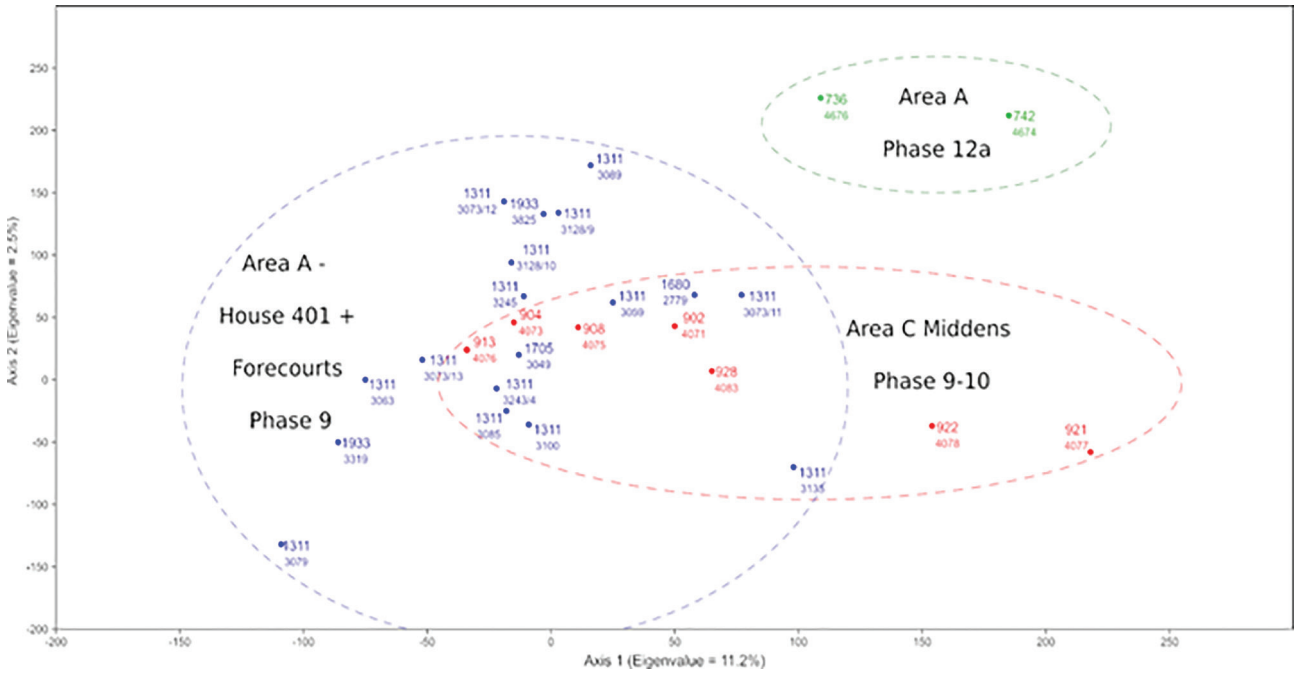


Figure 15.4. De-trended correspondence analysis for samples with >30 shells from deposits at Cladh Hallan. Context numbers are in a larger font, sample numbers in a smaller font

deposits were followed by fairly poor faunas dominated by *Pupilla–Vallonia*, which show some stability and patchy grassland before the establishment of more stable grassland conditions (Faunal Zones 2–3 and top of 4–5 in Column 9076, Faunal Zones 1–2 in Column 9071), and a similar faunal succession can be observed at the top of Section 1 at Rosinish (Vaughan 1976). At Ensay, there is evidence for increased sand accumulation beneath the Beaker-period levels (189cm–119cm) and again before the Early Bronze Age midden deposit (57cm–47cm; Spencer 1974; Evans 2004), with both layers being followed by stable well-vegetated conditions; the same sequence can be observed at Northton, where both the Beaker-period and Early Bronze Age levels ('Beaker I' and 'Beaker II') were underlain by clean windblown sand before greater stability ensued (Evans 1971).

During the Late Bronze Age at Cladh Hallan, the regular presence of windblown sand, either as localised patches or as thicker layers that covered substantial parts of the site, shows that the accumulation of aeolian sand continued to be a major problem, while the erosion of fragile sandy surfaces may also have created difficulties. Nevertheless, the molluscan faunas from Phases 9 to 12 show that episodes of instability were regularly interrupted by intervals with greater stability, when the surfaces around the houses were colonised by rather stable grassland, sometimes with tall herbs suggesting that it was allowed to lie fallow, but at other times typical of grazed short-turf grassland.

One approach to countering the constant problems of shifting sand and surface instability is to use midden material and/or seaweed to fertilise and consolidate the fragile surfaces. The presence of *Oxychilus alliarius* shells provides evidence for the deposition of fresh organic waste within the area around the houses, which seems to have begun during the Late Bronze Age at Cladh Hallan and Baleshare (Law and Thew 2015; 2017). The use of seaweed to fertilise and stabilise fragile land surfaces appears to have been widespread within the British Isles and further afield

(Bell 1981; Smith 1994; Mooney 2021), due in part to its richness in potassium and nitrogen (Smith 2012) and to a positive impact on the rooting and germination of crops grown on the machair (Thorsen *et al.* 2010). The presence of rather well-preserved small marine gastropods is an indicator for the spreading of seaweed that is attested at a number of sites in the Western Isles, beginning in the Late Bronze Age at Cladh Hallan and Baleshare, becoming more common at Iron Age sites such as Baleshare, Hornish Point and Balelone (Pain and Thew 2003) and continuing at Norse to medieval sites such as Bornais and Newtonferry (Law and Thew 2015; 2017). At Cladh Hallan, marine gastropods indicative of seaweed are present in a variety of contexts from Phases 9, 10 and 11, suggesting that it was gathered for several purposes, including for use as a fertiliser and possibly for animal fodder in the exterior contexts. The latter use for seaweed is favoured for Freswick Links in Caithness (Murphy and Rackham 1995).

Within Houses 401 and 1370 the molluscs provide evidence, especially for House 401, for turves being cut from the machair and brought in for roofing and also to prepare low internal features such as bed platforms (see Volume 1: chap. 5). These turves were cut from areas where the grassland was stable and well-developed, allowing a reasonably thick root mat that made the turf easier to transport and better for roofing. The presence of small marine gastropods shows that seaweed was brought into the houses, to use for food seasoning, possibly for fuel (although there are no burnt marine shells) and perhaps for animal fodder if young or sick animals were brought into the houses during times of inclement weather. Shells from marsh snails show that reeds, rushes and/or sedges were brought into the houses, gathered from a marshy loch edge. The presence of shells from the omnivorous snail *Oxychilus alliarius* indicates that there was fresh organic material available within the houses, which probably consisted of the brought-in plant material but may also have included bone waste. There is evidence among the assemblages for the loss of shell material, especially towards the centres of the houses, which is a clear indicator of trampling. Interestingly, the inhabitants of Houses 401 and 1370 may have had rather different approaches to their living space, with the inhabitants of House 1370 seeming to favour regular cleaning, while those from House 401 simply allowing waste to accumulate then raising the floor level by bringing in clean sand.

Marsh snails in the Phase 9–10 midden deposits from Area C and the Phase 11–12a contexts from Area A that also lie outside built structures, might also have been introduced in reeds, rushes and/or sedges subsequently discarded as organic waste. Alternatively, they may have been carried in as 'floaters' during episodes of freshwater flooding: 'The machairs of the Uists and Barra have a close association with the water-table. Winter rainfall raises the level of the water-table on the machair, leading to localised flooding in low areas and forming inland lochs, often just behind the beach dune ridge' (Scottish Environment Protection Agency 2015). Molluscan evidence for flooding has already been documented from several other machair sites, including Beaker-period and Early Bronze Age contexts at Northton and Ensay, Iron Age levels at Baleshare, Hornish Point and Balelone, and Norse to medieval deposits at Bornais, Newtonferry and the Udal (Thew 2003; Law and Thew 2015; 2017).

A notable feature of later prehistoric sites on the Hebridean machair is the arrival and subsequent dominance of the helicid snails *Helicella itala* and *Cochlicella acuta* (Thew 1989; 2003; Law and Thew 2015; 2017), which seem to have appeared during the final Late Bronze Age and the Early Iron Age respectively. The Cladh Hallan samples largely predate these arrivals and, instead, show the earlier dominance on the machair of the *Pupilla–Vallonia* fauna already documented from a number of other Bronze Age sites. The low numbers of *Cochlicella* and *Helicella* present at Cladh Hallan are mostly more recent and intrusive, although some shells from Phase 12 that date from the end of the Late Bronze Age and the start of the Early Iron Age may be early arrivals. If true, this would imply that these important biostratigraphic marker species both arrived in the Western Isles around 800/700 BC, before subsequently becoming a common or dominant element among machair molluscan faunas during the Early Iron Age.

On a biogeographical note, the Late Bronze Age snail faunas from Cladh Hallan include several species that have become rare within the Western Isles. These include *Aegopinella pura*, *Carychium tridentatum*, *Clausilia bidentata*, *Pupilla muscorum*, *Vallonia costata*, *Leiostyla anglica* and *Zonitoides nitidus*, which can no longer be found on South Uist today (Waterston 1981), as well as *Euconulus alderi* which has totally disappeared from these islands (Kerney 1999). Of these, *Pupilla muscorum* and *Vallonia costata* deserve special mention as, during Neolithic and Bronze Age times, they were both extremely common within the Western Isles.

Notes

1 The presence of *Spirorbis* is discussed in Volume 1 and the reader should consult the index to that volume to find the spatial distribution plots of *Spirorbis* retrieved from flotation residues.

2 Law and Thew (2012) *The Snails from Horgabost, Harris*. Unpublished manuscript for two contexts from this first century AD site.

16 The carbonised plant remains

H. Smith and S. Colledge

16.1 Methods

Sample selection and contexts represented

The site was sampled extensively during excavation, including bulk samples for flotation, plus specialist samples for chemical analysis, micromorphology and lipid analysis. All floor layers were retrieved in their entirety as bulk samples on a 50 × 50 cm grid for flotation, as described in the first volume of Cladh Hallan (Parker Pearson *et al*. 2021) and as applied to excavations nearby at Cille Pheadair (Parker Pearson *et al*. 2018) and Bornais (Sharples 2005; 2012a). This was to ensure that all small artefacts, microfauna and microflora were recovered and enabled analysis and comparison of the spatial distribution of the materials. It was not feasible to analyse all archaeobotanical material recovered from flotation and, therefore, a sub-selection of samples was made.

The samples were selected to represent as many phases and context types as possible in order to analyse spatial and temporal distributions of plant remains across the Cladh Hallan site. Samples from twelve phases are included and eight different context types. In total, 808 samples were examined for their plant remains; this represented a total of 11,598 litres of soil from bulk samples.

Most of the samples studied derived from house floor deposits, as the central hearths provided greater potential for charred plant remains to be preserved. Early house floors include samples from the floor of House 2835 (Phase 4), floor 3305 from Structure 3260 and floor 2476 from the cigar-shaped Structure 2477 (Phase 7). The largest house floors are from the three main roundhouses. Samples are included from House 1370's floors 2211 and 1369 (both Phase 9) and 2003 (Phase 10), from House 401's floors 1311 (Phase 9), 1308 (Phase 10), 655 (Phase 11), 595 (Phase 12) and 465 (Phase 13), and from House 801's floor 1150 (Phase 9). Finally, samples are also included from floors of the two double roundhouses: floor 632 of House 640 (Phase 16) and areas of floor from House 150 (Phases 13 and 16) in Area C.

Other context types analysed as part of the study include the yard area (Phases 9 and 10) in front of the three main roundhouses, House 401's forecourt (Phases 9 and 10), layers of midden (Phases 3, 9 and 10), cremation deposits (Phase 3), pit and posthole fills (mostly from Phases 6 and 8) and wall core (Phase 8).

Samples for the analysis of plant remains were selected evenly on a (broadly) 1 in 4 basis from the 50 × 50 cm grids across house floors and surface areas, in order to maximise details of the spatial distribution but minimising the sheer volume of samples that would be studied if the complete floors were analysed. In general, the floor volumes were largest in Phase 9, the main occupation phase at the site, after which the houses were remodelled and the floors decreased in volume each time. The house floors of Phases 4 and 7 were also small.

The size of sample ranged from less than 1 litre to greater than 100 litres, which reflected the diverse nature of the contexts and sediments on the site. The samples were mostly sandy in composition and so the processing of such huge samples was possible.

Processing methods

The majority of the plant remains at Cladh Hallan were charred. A very small number were mineralised although, as some of these appeared to be modern intrusive material, they are not included in the tables. The samples were processed during all fieldwork seasons at a nearby farm on South Uist using a standard flotation tank. Sieves of 1mm and 300 μm were used to separate the fractions into the coarse flots (>1mm) and fine flots (>300 μm). Heavy residue, including any plant material that would not float, was collected in a 1mm mesh. Sample flots and residues were air dried at the same location.

As most carbonised remains were retrieved in the coarse and fine flots, these were analysed in their entirety. The residues were often very large and time-consuming to sort through. As a compromise, where necessary a fraction was

extracted for examination by random splitting (as described in Sharples 2012a: 28–9). The numbers of items retrieved from sorting the fraction were multiplied according to the fraction size in order to estimate the number of items from the whole residue. Coarse flots and fine flots were sorted and analysed by Kelly Reed (the majority) and Helen Smith, and samples from floor 465 were analysed by Emma Graham, as part of a dissertation project. Heavy residues were sorted by students and postgraduates at Bournemouth University. Samples were examined using a low-powered stereo microscope at ×15 to ×100 magnification. All materials identifiable as plant remains were removed and analysed, with categories including cereal grains, chaff components, wild seeds, root and tuber fragments (*i.e.* parenchyma from vegetative storage organs), seaweed and fragments of burnt peat or other amorphous organic material (usually classed as 'burnt organic matter').

In general, the level of preservation of the plant material was poor, with many items distorted, fragmented or with damaged surfaces. The absence of diagnostic characteristics often limited the level of identification to genus or family. Identifications were confirmed where possible by use of a modern seed reference collection.

16.2 Number, density and range of plant remains

The assemblage is composed of both cultivated and wild species and a summary of taxa, counts and the frequency of occurrence in samples (or ubiquity scores) for the whole assemblage is shown in Table 16.1. A total of 15,155 items were recorded from all 808 samples. The frequency of remains by phase is generally a reflection of the number of samples analysed and therefore density of items is a more useful measure (Table 16.2).

The overall density of plant remains from the site is very low, only 1.3 items/litre (based on all identifiable and unidentifiable crop remains and wild plant items from all 810 selected samples; Table 16.2). This figure reflects the predominant number of samples across the whole site with very low numbers of plant remains. The majority of samples (n = 395) have fewer than 1 item/litre of all quantifiable remains (cereal and wild plant remains combined), with 96 samples having no plant remains at all (Figure 16.1). In contrast, only a small number of samples (35 out of the 808 studied) have densities of 5 or more items/litre. Some 336 of all samples (42%) have no wild plant remains, compared to 141 samples (17%) with no cereal remains. There are, however, some individual samples with very high densities of material, such as in 75.38 items/litre in Phase 10 (Table 16.2).

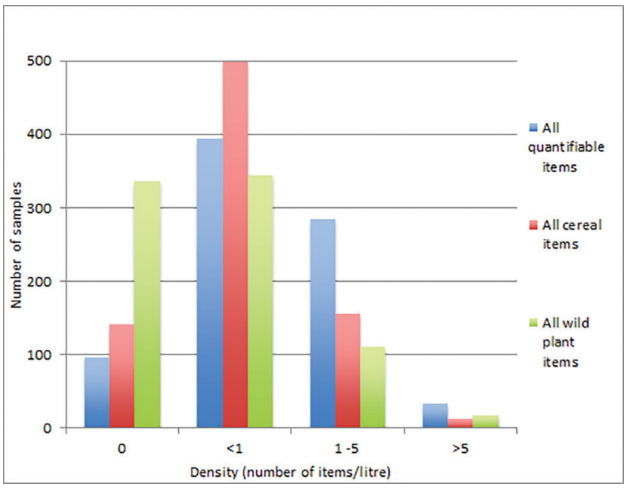


Figure 16.1. Histogram of densities of all plant material, cereal items and wild plant items by number of samples across the whole site

Crop species

The crop plants present in the assemblage are hulled barley (*Hordeum vulgare*), naked barley (*Hordeum* cf *vulgare* var. *nudum*), wheat (*Triticum* sp.) and flax (*Linum* cf *usitatissimum*'; Table 16.1). Cereals are predominantly represented by grain, comprising 61% of all quantifiable plant remains (and 98.7% of all cereal items) analysed, and occur in all phases (Table 16.2). Chaff items, which comprise rachis internodes, culm fragments, culm nodes and bases, occur in very small numbers (making up only 0.7% of all quantifiable plant remains in the assemblage (Table 16.2).

Barley grains occur in every phase examined. Both hulled (*Hordeum vulgare)* and naked barley (*Hordeum* cf *vulgare* var. *nudum)* were identified from morphological characteristics. Grains that showed definite characteristics of naked barley grain were recorded as such, in order to determine the presence of naked barley at the site over time. Poor preservation meant that most barley grains were recorded as *Hordeum vulgare* indeterminate hulled/naked, although many of these did have characteristics suggestive of hulled barley Similarly, some twisted (lateral) grains were present which indicates the presence of six-row barley, although the poor preservation made it impossible to reliably determine the proportion of straight to twisted grains (and differences in the recording of hulled and twisted barley grains made counts impossible to compare).

Barley rachis internodes were identified and, where preservation was suitable, the morphology of the rachis internodes indicated six-row barley. It is likely that the indeterminate cereal rachis internode fragments also belong to *Hordeum* sp., given the predominance of barley across the site. Similarly, although the culm items are unidentifiable to genus, it is likely that these derived from barley given the low frequency of wheat grains at the site.

Wheat grains (*Triticum* sp.) are present in trace numbers in a small number of samples and phases (1.6% ubiquity across the site, in five of the 12 phases; Tables 16.1 and 16.2). Identification was restricted to genus owing to poor preservation. Owing to the very small number of grains it can be assumed that these represent a weed of the barley crop.

Flax (*Linum* cf *usitatissimum* and *Linum* sp.) is represented by seeds, which occur in very small numbers –

Table 16.1. Summary table of all taxa found in 808 samples analysed (all phases combined). Hordeum *var.* nudum *listed separately, and also included as part of 'all* Hordeum*'. Wild plant taxa listed in alphabetical order by family*

	Counts*	Presence	Ubiquity %		Counts	Presence	Ubiquity %
Cereal grain				**Cereal chaff**			
Hordeum cf. *vulgare* (var. *nudum*)	378	104	13	*Hordeum* cf. *vulgare* rachis internode frags/cereal indet. rachis internode frags	38	24	3
Hordeum cf. *vulgare* (h/n)	3330	529	65	Cereal culm	28	10	1.2
All *Hordeum* spp combined	3708	544	67	Cereal indet. culm node frag	37	6	0.7
Triticum sp. indet	13	13	1.6	Cereal indet. culm base	14	3	0.4
Cereal indet	5452	582	72	**All culm fragments combined**	**79**	**15**	**1.8**
Potential crop plants							
Linum cf *usitatissimum/Linum* sp	51	30	3.7				
Wild species							
Arenaria serpyllifolia	4	2	0.2	*Bromus* sp.	12	10	1.2
Brassica cf. *rapa*	2	2	0.2	*Phalaris* sp.	9	9	1.1
cf. *Brassica/Sinapis* sp.	37	21	2.6	cf. *Phleum/Phalaris* sp.	1	1	0.1
Brassicaceae indet.	2	2	0.2	*Phleum* sp.	78	54	6.7
total Brassicaceae	41	24	3.0	Poaceae spp.	22	93	11.5
Stellaria media/Stellaria cf. *media*	258	53	6.5	Poaceae indet.	145	78	9.6
Spurgula cf. *arvensis*	32	9	1.1	Poaceae indet. culm node	42	21	2.6
Caryophyllaceae indet.	26	18	2.2	Poaceae indet. culm fragments	36	14	1.7
Caryophyllaceae/Amaranthaceae indet	13	12	1.5	*Plantago* sp.	10	8	1.0
Amaranthaceae indet.	27	14	1.7	*Polygonum* sp./*P. aviculare*	54	23	2.8
Chenopodium sp.	27	21	2.6	**Polygonum/Rumex indet. combined**	94	58	7.2
Atriplex spp	3	3	0.4	cf. Potamogetonaceae indet.	60	38	4.7
total Amaranthaceae indet	62	33	4.1	Potentilla sp.	16	14	1.7
Carex spp	486	148	18.2	Rosaceae indet.	7	5	0.6
cf. Cyperaceae indet.	262	95	11.7	cf. Ranunculus spp	21	20	2.5
Cyperaceae kernel	2	2	0.2	cf. Solanaceae	1	1	0.1
Empetrum nigrum	1	2	0.2	*Urtica* sp./*U. dioica*	11	10	1.2
Erica sp.	73	28	3.5	Viola sp.	1	4	0.5
Ericaceae indet.	42	6	0.7	**Total wild identifiable**	**2009**	**371**	**45.7**
cf. *Erica flowering parts*	8	3	0.4	**Indet-charred seeds**	**3802**	**409**	**50.4**
total *Erica* sp./Ericaceae indet	123	34	4.2	**Total wild ID and indet**	**5811**	**480**	**59.2**
cf. *Euphorbia* sp.	2	2	0.2	Root frags charred		37	4.6
Fabaceae cf. *Medicago*	13	2	0.2	cf. seaweed frags		62	7.6
Fabaceae indet.	2	2	0.2	indet. tuber		21	2.6
cf. *Fumaria* sp.	3	3	0.4	indet. seed pod		3	0.4
Galium sp.	6	5	0.6				
cf. *Montia fontana*	18	4	0.5				
Papaver sp.	1	1	0.1				

* Counts include whole seed and equivalent to whole seeds (by taking the largest number of either embryo or apical end).

Table 16.2. Counts and densities of cereal and wild plant items by context and phase

Phase	**2**	**3**	**4**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**16**	**Total whole assemblage**	**Percentage**
Context	**Area C, EBA**	**cremations**	**Floor 2835, features**	**Pit 2401**	**floors 3305, 2476**	**sub-floor features**	**floors 1369, 2211. 1311, 1150; yard, midden**	**floor 2003, 1308; forecourt, yard, midden**	**floor 655; forecourt**	**floor 595; forecourt**	**floor 465; House 150**	**floor 632; House 150**		
Number of samples	3	9	27	4	33	36	360	119	69	36	75	37	808	
total litres	54	189	305	61	400	393	5368	1468	1190	312	1367	493	11598	
COUNTS														
Hordeum cf. *vulgare* (naked) grains	*0*	*1*	*32*	*0*	*35*	*2*	*92*	*98*	*102*	*9*	*4*	*3*	*378*	
Hordeum vulgare h/n/Hordeum spp grains	8	27	68	5	185	35	1218	710	520	115	350	89	3330	
Triticum sp. grains	0	0	4	0	2	0	4	0	2	0	0	1	13	
Cereal indet. grain	10	10	50	4	55	42	3062	1124	590	167	221	117	5452	
Total cereal grain	18	38	154	9	277	79	4376	1932	1214	291	575	210	9173	**61**
Total cereal chaff	0	17	3	0	3	2	83	4	3	0	2	0	117	**0.7**
Total cereal items	**18**	**55**	**157**	**9**	**280**	**81**	**4459**	**1936**	**1217**	**291**	**577**	**210**	**9290**	
Linum sp.	**0**	**0**	**3**	**0**	**1**	**2**	**32**	**10**	**3**	**0**	**0**	**0**	**51**	**0.3**
Wild plant items identifiable	0	228	153	1	65	3	911	305	103	37	104	102	2012	
Wild indeterminate seeds	0	41	163	3	167	3	2266	585	113	151	224	86	3802	
Total Wild ID and indet.	**0**	**269**	**316**	**4**	**232**	**6**	**3177**	**890**	**216**	**188**	**328**	**188**	**5814**	**38**
Total all quantifiable items	**18**	**324**	**476**	**13**	**513**	**89**	**7668**	**2836**	**1436**	**479**	**905**	**398**	**15,155**	
DENSITY														
Mean density cereal items	0.3	0.3	0.5	0.1	0.7	0.2	0.8	1.3	1.0	0.9	0.4	0.4	0.8	
Mean density wild ID & Indet	0.0	1.4	1.0	0.1	0.6	0.0	0.6	0.6	0.2	0.6	0.2	0.4	0.5	
Mean density all quantifiable items	0.3	1.7	1.5	0.2	1.3	0.2	1.4	1.9	1.2	1.5	0.7	0.8	1.3	
Highest density all plant items	*0.6*	*12.8*	*4.7*	*0.4*	*5.9*	*2.9*	*21.5*	*75.4*	*8.0*	*37.0*	*19.4*	*3.9*		
RELATIVE PROPORTIONS														
% all cereal items	**100**	**17**	**33**	**69**	**55**	**93**	**58**	**68**	**85**	**61**	**64**	**53**	**62**	
% wild plant items	**0**	**83**	**67**	**31**	**45**	**7**	**42**	**32**	**15**	**39**	**36**	**47**	**38**	

a total of 51 charred seeds from all samples (and two mineralised seeds from floor 2003), making up 0.3% of all plant material (Table 16.2) with limited ubiquity across the site, occurring in 3.7% of samples (Table 16.1).

Wild plants

The remains of wild plants were mostly represented by charred seeds, with occasional occurrences of seed pods, tubers, roots and stems. Small fragments of charred seaweed were also present. Items were identified to species or genus where possible, although poor preservation frequently prevented this.

The percentage presence of wild plant taxa in the whole assemblage (across all phases) is given in Table 16.1. The range of taxa includes plants from different ecological regions but all within easy reach of the site. Those taxa with the greatest percentage presence in the assemblage are sedges (*Carex* spp, 18% ubiquity; Cyperaceae indeterminate, 11.5% ubiquity) and grasses (*Poaceae* indeterminate, 11% ubiquity; *Phleum* sp., 7% ubiquity; indeterminate grass seeds, 9.5% ubiquity). Also present in a large number of samples are knotgrasses (*Polygonum/Rumex* sp., 7% ubiquity) and chickweed (*Stellaria media*, 6.5% ubiquity). Present in a smaller number of samples are cabbage/rape and charlock (*Brassica* sp./*Sinapis* sp.), goosefoot and oraches (Amaranthaceae indeterminate), heather (*Erica* sp.), plantain (*Plantago* sp.), buttercups (*Ranunculus* spp), cinquefoil, (*Potentilla* sp.), nettles (*Urtica* sp.) and possibly pondweed (cf Potamogetonaceae indeterminate).

Some of these plants may have been deliberately collected for food (*e.g*. leafy green vegetables or berries) or functional purposes (*e.g*. heather and sedges) and there are plants that may have arrived at the site accidentally, most likely amongst the cereals as weeds or with fuel or on people's feet. For many of the plants found at the site the potential for multiple explanations of their presence makes interpretation difficult. The variations in frequency of different weed types are presented in the tables and figures according to context and what the difference and similarities may reflect will be discussed in more detail later.

16.3 Densities of cereal grains, chaff and wild plants

As previously mentioned, the density of material across the whole site is very low, with a mean of 1.3 items/litre. When the mean densities of material (all quantifiable items) are looked at by phase there is some variation around this mean value, although not by a great deal (Table 16.2). Phases 2, 6 and 8 have the lowest mean densities. Samples from Phases 6 and 8 are from pits and postholes whereas samples from Phase 2 are all from the Early Bronze Age midden samples.

Most phases, however, include samples from more than one context type, for example Phase 9 includes house floors, yard areas, the forecourt and various midden layers, which makes it difficult to evaluate the mean density value for the whole phase. In Figure 16.2 the plots of mean density of all quantifiable plant remains for all contexts are presented, from Phase 2 through to Phase 16. There is no obvious trend over time but there are noticeable outliers to the mean density of material, both high and low. To provide additional detail, in Figure 16.3 plots of the density of cereal grains against chaff and wild plant items are presented by context. In general, the mean densities of cereal grains for each context are higher than for wild plant items. In addition, there is a notable absence of chaff in most contexts or, if it is present, the values are very low.

The highest mean density of all plant items (5.58 items/litre) is from floor 2003 in Phase 10 of House 1370 (Figure 16.2). Several other house floors and floor areas also have a density on or above the site mean: floor 2835 in House 2835 (Phase 4), floor 2476 in Structure 2477 (Phase 7), floors 2211, 1369, 1311 and 1150 all in the main Phase 9 roundhouses (the main occupation horizon), floor 655 (Phase 11), floor 595 (Phase 12) and the forecourt to House 401 in Phase 10 (Figure 16.2).

It is unsurprising that the main house floor layers have mean densities of plant remains above the site average, given that most charring is likely to occur in the house hearths. All of these house floors have similar mean densities of cereal grains (except floor 2003 with a much higher density). For all except floors 1311 and 2835, the mean density of cereals is higher than that of wild plant items (Figure 16.3), consistent with cooking activities around the hearth. Floor 1311 is a very large floor with cereal- and wild-plant rich samples in and around the hearth (and to the southwest, suggesting sweeping or trampling). It has a low mean density of cereal grains (although the actual number is 1,297 grains) and it also has more chaff than other floors (67 items). A particular concentration of chaff near the hearth included rachis internodes, culm fragments, culm nodes and bases, pointing to uprooted stems. There is also a high number of rhizome fragments in floor 1311, most of which occurred with the concentration of chaff items. Culm fragments are more fragile than culm nodes and are therefore less likely to survive. Arable weeds may have been harvested with the cereals and so the high numbers of their seeds may indicate the remains of a single event.

With the exception of floor 2003, the mean densities of all plant remains from the house floor samples are low, which is most likely due to the variability across individual floors and the inclusion of very large samples from areas of the floor such as the sleeping platforms as well as plant-rich hearth samples. Examples of the higher densities of material from hearths include 21.5 items/litre from floor 1311's hearth and 30 items/litre from floor 2003's hearth.

The high mean density of plant remains for floor 2003 of House 1370 in Phase 10 is exceptional and may relate to how the house was being used at this stage, having been remodelled after a severe influx of windblown sand. There is no evidence of craft activities in the house and it may have been used as an ancillary building although mammal bone debris around the hearth suggests that the space was at least being used for cooking and/or eating

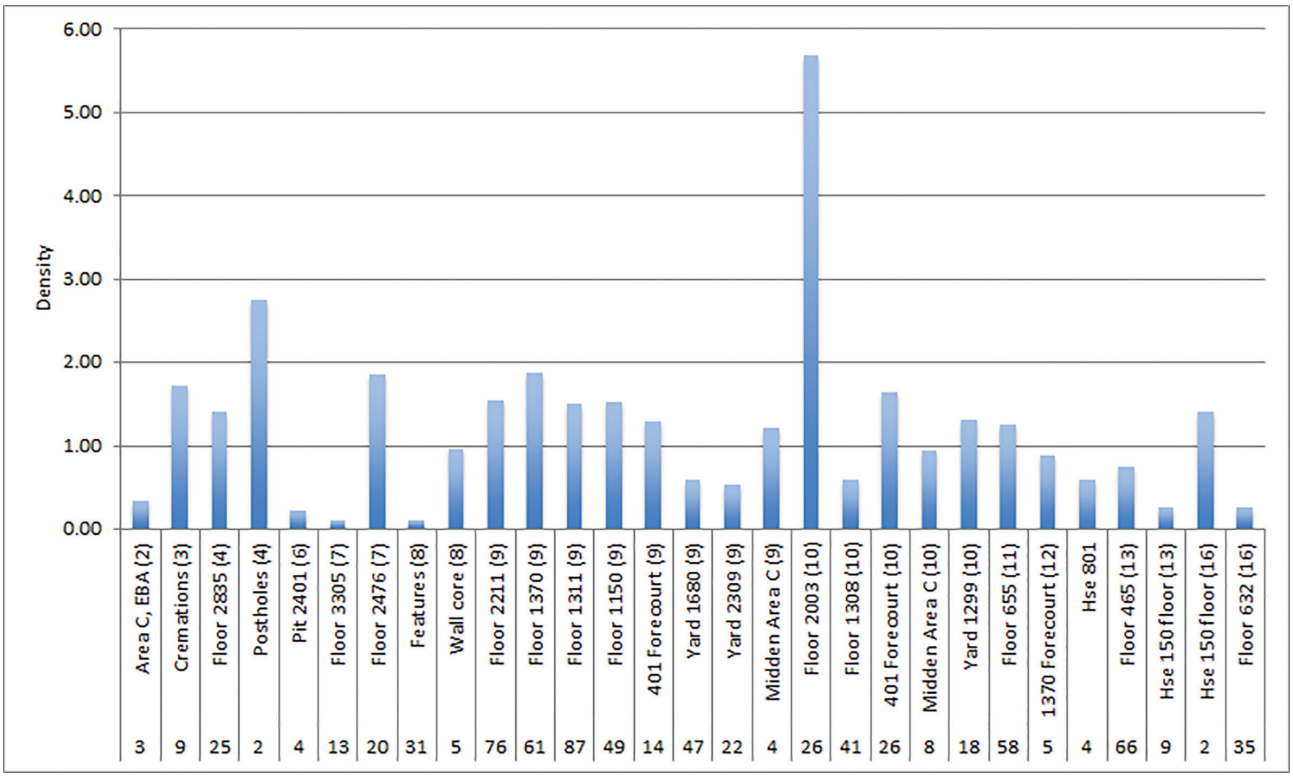


Figure 16.2. Densities of all quantifiable plant items by context; the phase is given in brackets and the number of samples is at the base of each column

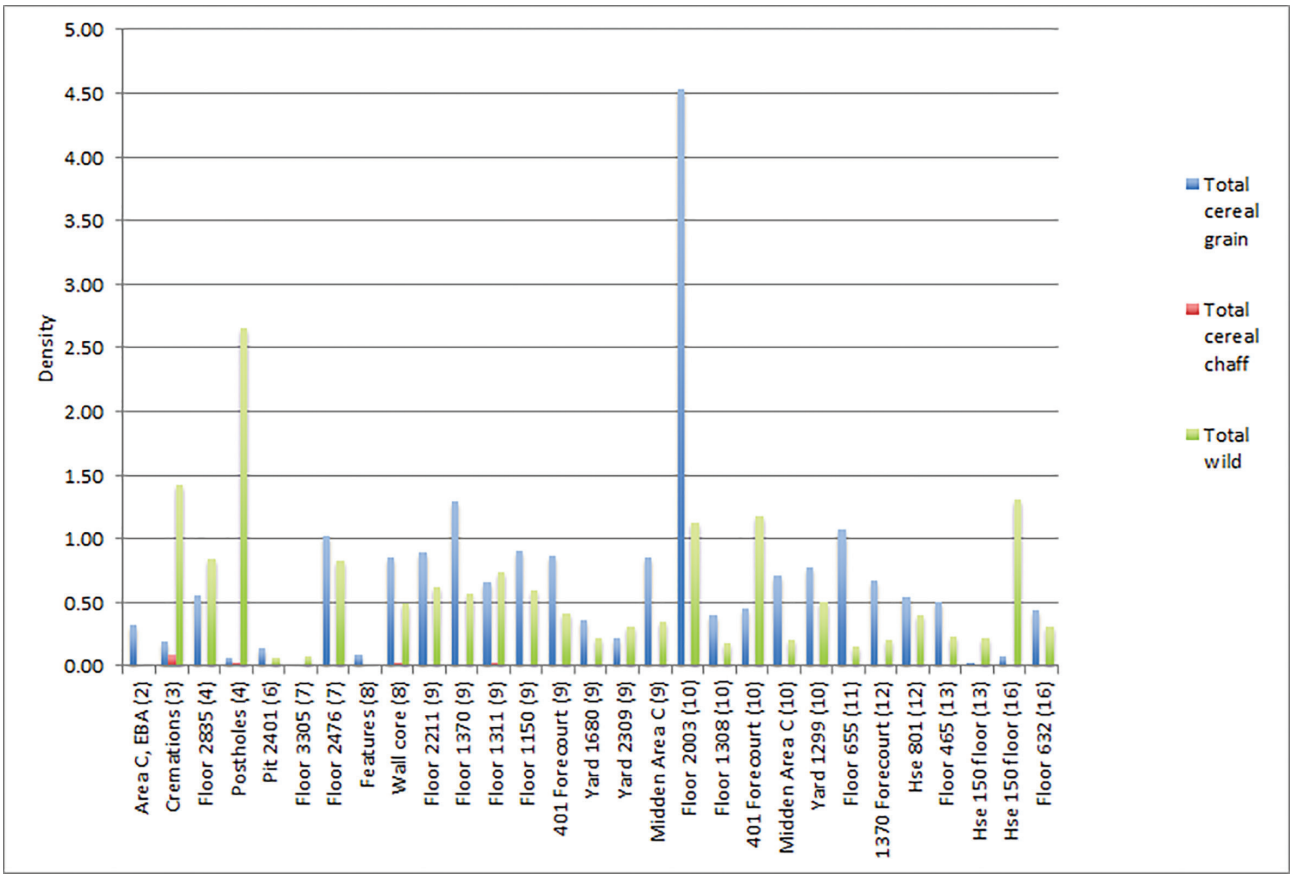


Figure 16.3. Densities of cereal grains, chaff and wild plant items by context; the phase is given in brackets

(see Volume 1: 240). The high density of plant remains and especially cereal grains from the floor as a whole (1,286 grains; 4.5 grains/litre; Figure 16.3) in the samples around the hearth support this (although the paucity of chaff – only two rachis internode fragments – does not point to crop processing or any specialised function that an ancillary building might be used for). Floor 2003 is much smaller than in other roundhouses, occupying only the southern part of the house, and it is a relatively thin floor. The small volume of the samples from this floor, when compared to the large-volume samples from the earlier floors, will be a factor causing the higher mean density of material.

Floor 1308 in House 401 is contemporary with floor 2003 and, in contrast, it has a much lower density of plant material than floor 2003 and the other main house floors (Figure 16.2). This is consistent with the low density of ceramics and other materials from floor 1308 in Phase 10. The densities of cereal grains and wild plant remains are not particularly high around the hearth as in other floors.

Apart from occupation layers, other contexts with densities above the site mean are the Early Bronze Age cremation deposits in Phase 3 (1.7 items/litre) and features associated with the area immediately inside the doorway of House 2835 in Phase 4 (2.8 items/litre).

The Phase 3 cremation deposits are very different to most of the other contexts in the assemblage owing to the very low density of cereal items (0.3/litre) compared to wild plants (1.4 items/litre; Table 16.2 and Figure 16.3). This is reflected in the high relative proportion of 83% wild plant items. In addition, these deposits have a high mean proportion of chaff items compared to other contexts (5%, including rachis internodes, culm fragments and culm nodes), although the number of items is still relatively small (Table 16.2). The straw and wild plant seeds are likely to reflect materials deliberately used in the pyre (see section on wild taxa). The density of material from the Phase 3 cremation deposits is low, considering that this material derives directly from an episode of burning (albeit one distinct event, unlike a hearth with repeated uses). Many taphonomic processes will determine what might be charred (*e.g.* whilst still retaining overall gross morphology and diagnostic surface features) as opposed to burned completely (*e.g.* reduced to ashes): for example, the temperature of the fire, the nature of the fuel/material being burned and any disturbance and destruction of the material before burial.

The doorway features in Phase 4 also have a much greater proportion of wild plant remains compared to cereal items (Figure 16.3); they comprise 96% wild plants with only a small proportion of cereal grains and a small amount of chaff. The floor (2835) that these features are adjacent to is also dominated by wild plant items (although a smaller proportion of 60%), and a small amount of chaff. The similarity in the composition of these two contexts reflects the likelihood of material mixing between them and it also sets these Phase 4 samples apart from nearly all the later phases and contexts.

Samples from floor 3305 of House 3260 have the lowest mean density of plant remains. This was a peculiar structure without a proper floor, as reflected by the paucity of plant material (1 item per 10 litres). Other contexts with similarly low densities of plant remains are pit 2401 from Phase 6 and the sub-floor features in Phase 8. The latter include a selection of the numerous pits and postholes, dug across Area A prior to the main phase of roundhouse construction, plus a few samples from the sand-filled wall cores of the three Phase 8–9 roundhouses. They are mostly devoid of material and give no insight into any activity relating to the use of plants.

Only three samples were available from the Phase 3 Early Bronze Age midden deposits in Area A and these had very limited amounts of material (fortunately, grain that could be used for dating). The Phase 9 and 10 midden, yard and most of the forecourt contexts have densities of material below the site mean. The exception is House 401's forecourt in Phase 10 (context 857). This area has a very small single sample tucked away at the very edge of the deposit, with the highest density of wild plant material (75/litre). It has no cereal remains and the range of wild taxa is limited, comprising mainly heather (*Erica* sp.), which formed an unusual concentration, most likely representing a single event.

The different contexts included in the analysis can be grouped broadly according to the density of cereal grains, wild plant items and chaff. House floors, middens and forecourt areas have higher densities of cereal grains compared to the pits and postholes examined and yard areas.

16.4 Species ubiquity and density variation over time

Crop species

The variation in the ubiquity of the crop plants and wild plant items (as a whole) throughout the occupation of the site is shown in Figure 16.4 (this omits Phases 2, 3, 6 and 8 which have very few samples and would have distorted the chart). The ubiquity scores were calculated for each taxa by phase (*i.e.* for any one phase, the number of samples in which a given taxa occurs as a percentage of the total number of samples for that phase).

Barley (indeterminate hulled/naked) is the dominant crop species in all phases and its ubiquity increases slightly over time. Barley grains that were identified as naked barley are plotted separately. The ubiquity of naked barley is highest in Phase 4 and decreases over time to very low levels in the later phases. Based on numbers of grains in different contexts, naked barley is mainly present in the house floors and some midden deposits, which supports the movement of rubbish out of houses to the middens. Of the floors, it occurs in higher numbers in 2835 (Phase 4), 2476 (Phase 7), 2003 (Phase 10) and 655 (Phase 11) and becomes limited after Phase 11. In all cases the densities are very low.

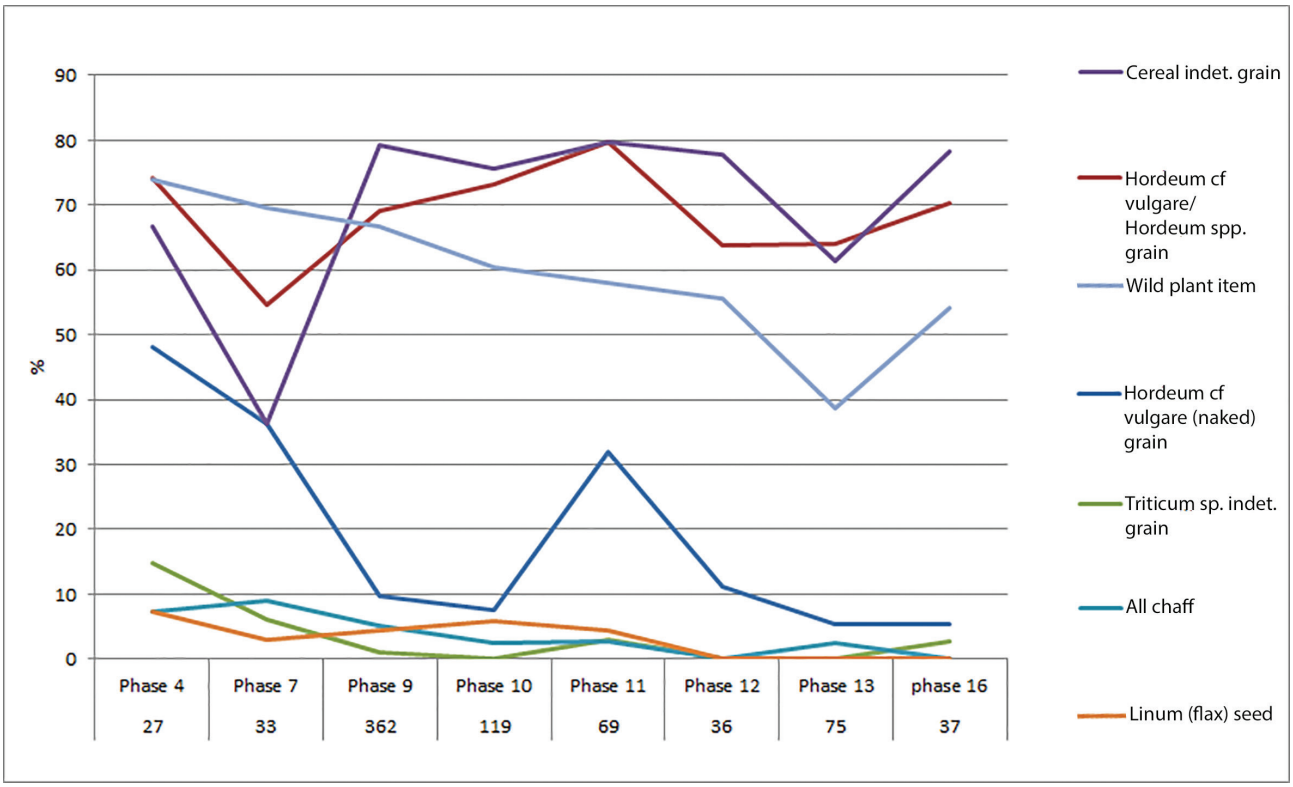


Figure 16.4. Ubiquity plot for all contexts by phase (omitting Phases 2, 3, 6 and 8 due to low sample size and material count)

Wheat (*Triticum* sp.), flax (*Linum* cf *usitatissimum*/cf *Linum* sp. combined) and chaff items are present in a limited number of samples, and there is a general decrease in presence over time. This culminates in a complete absence of all of these taxa in Phase 12, with isolated occurrences in Phases 13 and 16.

The numbers of flax seeds are very low and they occur from Phase 4 through to Phase 11 and mostly in house floors (especially Phase 9) and midden layers. This may reflect the movement of material from houses to middens. The presence of two flax seeds in wall core samples (Phase 8) plus the comparable mean densities of cereals and wild plant items in floor contexts, midden (Phases 9 and 10) and the wall core samples could reflect the use of floor or midden material as wallcore. The presence of flax at the site is interesting but it is very difficult to determine if it was being grown locally.

Weeds and wild plants

As discussed previously, the wild plant remains were limited in number and in the taxa present, and much of the material was poorly preserved. These have been summarised by context, owing to the very large number of samples and the very low numbers of items and they are also summarised for each phase. The ubiquities for different taxa for the whole site are presented in Table 16.1 and these are displayed in Figure 16.5.

Wild plant items dominate samples in Phase 4 and show a gradual decrease in presence in later phases except for a small upturn in Phase 16, from floor samples in House 150 in Area C. These samples are limited and do not represent an entire floor so it is difficult to compare them to the earlier floors.

A general decrease can be seen in the presence of wild plant remains from Phase 3 to the end of the site, as indicated by the ubiquity values for all wild plant items combined (Table 16.3; see Figure 16.3 for some phases). Some phases have either no wild plant taxa (Phase 2) or very low numbers of items (Phase 6 and 8). When ubiquity scores for different taxa are plotted according to phase, the picture for change through time is unclear so there is no overall chronological trend. The wild plant assemblage can be summarised as a few dominant taxa present in low numbers in a lot of the samples, and most frequently in house floors. The floors with the largest number and range of taxa are floor 2476 (Phase 7), floor 1369 and 1311 (Phase 9), floor 2003 (Phase 10) and floor 655 (Phase 11). There are very few wild plant remains from the midden, forecourt and yard samples and virtually none from the pit and postholes analysed from Phase 6 and 8.

As can be seen in Figure 16.5, the most commonly occurring taxa are sedges (*Carex* spp and *Cyperaceae* indeterminate), grasses (*Poaceae* spp) and chickweed (*Stellaria media*). Heather (*Erica* sp.) and knotgrass (*Polygonum/Rumex* indeterminate) also occur frequently. Pondweed (*cf* Potamogetonaceae indeterminate) is recorded in several samples although this is unusual and poor preservation may have resulted in misidentification.

In most cases, sedge and grass seeds were identified only to genus which restricts the amount of information that can

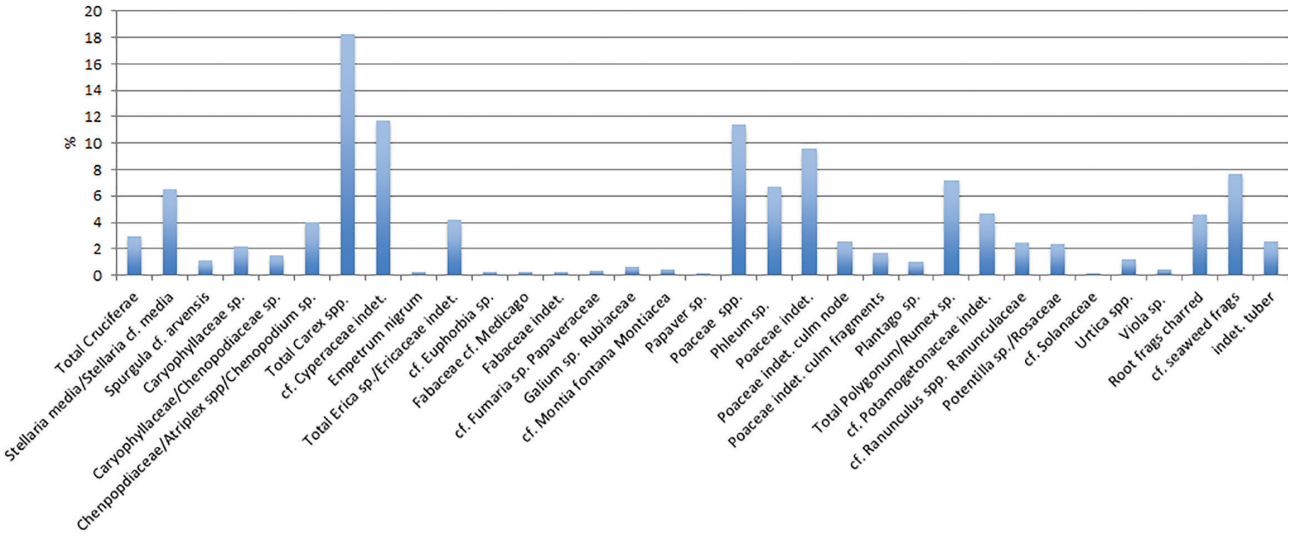


Figure 16.5. Percentage presence of wild taxa (ubiquity) for all samples; species are arranged alphabetically although some are grouped

Table 16.3. Cereal, chaff, flax and wild plant items ubiquities, by phase

	Phase 2	Phase 3	Phase 4	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13	Phase 16
Number of samples	3	9	27	4	33	36	360	119	69	36	75	37
Cereal grains												
Hordeum cf. *vulgare* spp (h/n)/*Hordeum* sp.	67	33	74	25	55	33	68	73	80	64	64	70
Hordeum cf. *vulgare* (var. *nudum*) grain	0	11	48	0	36	6	10	8	32	11	5	5
Triticum sp. indet grain	0	0	15	0	6	0	1	0	3	0	0	3
Cereal indet grain	67	56	67	50	36	28	77	76	80	78	61	78
Cereal chaff												
Hordeum cf. *vulgare* rachis internode fragments/ cereal indet. rachis internode frags	0	22	0	0	0	0	5	2.5	3.0	0	0	0
All culm	0	11	11.0	0	9	2.8	1.4	0	0	0	2.7	0
All chaff combined	0.0	22.0	7.4	0.0	9.0	2.7	5.2	2.5	2.8	0.0	2.6	0.0
Linum cf. *usitatissimum*/cf. *Linum* sp.	0	0	7.4	0	3.0	2.8	4.5	5.8	4.3	0	0	0
Wild plant items	0	100	74	50	70	8	67	61	58	5	39	54

be gleaned about where in the landscape they may have originated. They could represent grassland or moorland as could heather and crowberry (*Empetrum nigrum*) or taxa with preferences for damp ground such as blinks (*Montia fontana*) and some buttercups (*Ranunculus* spp). Sedges and grasses are the dominant taxa in house floors, and these could easily have been brought in as useful plants for floor coverings and roofing material or within peat used as fuel, collected from the moorland or heath.

The house floors are also typified by weeds of agriculture such as chickweed (which occurs in the highest numbers), and other taxa in smaller numbers, including cabbage/turnip (*Brassica/Sinapis* spp), goosefoot (*Chenopodium* sp.), knotgrass and docks (*Polygonum/Rumex* spp), corn spurrey (*Spurgula cf arvensis),* plantain (*Plantago* sp.), buttercup (*Ranunculus* spp), bedstraw (*Galium* sp.) nettle (*Urtica dioica*), thyme-leaved sandwort (*Arenaria serpyllifolia*) and violet (*Viola* sp.). Some of these indicate particular types of land: chickweed, corn spurrey, plantain, knotgrass, dock and nettle prefer disturbed ground that is well-manured, typical of cultivated land. Equally they could flourish on

waste ground or pasture, but a plausible route into the houses is as weeds of cultivation.

Some of the plants provide an indication of possible areas for cultivation through preferences or tolerances of certain soil types, although the level of detail is reduced by the limits to identification of the plant material. The site is located on the broad undulating strip of calcareous sandy machair on the west coast of the island, which would have provided ample areas suitable for cultivation. It is free-draining but with pockets where seasonal flooding can occur, especially on the lower-lying eastern flank of the plain, where it gives way to lochans and merges with the rough grassland to the east where the ground is more acidic and peaty in character. More detail on the land types local to the site is available from previous publications (Smith and Colledge in Parker Pearson *et al*. 2018; Smith 2012).

Of the plants in the assemblage, wild turnip (*Brassica rapa*) has a preference for well-drained and fertile soil, either neutral or alkaline, indicative of machair where it flourishes today. Thyme-leaved sandwort, which occurs in low numbers, is also a common machair plant and can tolerate dry and very alkaline soils while chickweed, which is common in the assemblage, does not grow well in acidic soils. Violet is also present in assemblage (although in low numbers) and is a common plant of the machair and arable fields today.

Corn spurrey can grow well in a range of soils (light, sandy soils and sandy loam) and, importantly, it prefers soils that are slightly acidic (Stace 1991; Bond 2007). The machair is generally alkaline, being formed of comminuted shells, but there are areas with higher moisture and organic content and lower pH, especially the pockets of lower-lying ground in the undulating plain and towards the eastern side of the machair bordering the lochans. The calcifuge tendencies of corn spurrey confirm that such areas were available.

Floor 1311 has the largest number of corn spurrey seeds (27) compared to other contexts along with the largest number of chickweed seeds (162), in both cases in samples by the hearth. Corn spurrey can grow to be quite tall whereas chickweed is a low-growing, common weed of fields that could easily have been brought in with cereal stems (such as those found near the hearth), especially if uprooted as suggested by the culm bases that were recovered from hearth samples in this floor. Chickweed may also have been deliberately collected as it has many medicinal properties, traditionally being used for making ointments or poultices to treat inflammation or for making a tea to treat insomnia (Beith 1995).

Several of the taxa found in floor contexts that occur as weeds of cultivation also have nutritional, edible leaves such as dock and sorrel, knotweed, brassicas, goosefoot and nettle. Nettle was traditionally an important part of the diet in spring, taken to purify the blood after the winter. The first young shoots would be used as a pot-herb, to make a broth (*càl deanntaig*) sometimes mixed with a little oatmeal (Beith 1995).

Leaves for food could be picked at any time and, as with many green vegetables, they would have been more appetising when young and not necessarily when the plants were in seed. The frequency of seeds, therefore, may not reflect how much other parts of those plants were being used. It is possible that seeds were accidentally brought back to the settlement caught on collected leaves or other plant materials. The mature plants would be quite large (in the case of *Brassica* species and goosefoot) and therefore less likely to be accidentally harvested alongside the cereal crop, although all could easily grow alongside the cereals as weeds.

It is possible that the seeds of dock, sorrel, knotweed and goosefoot were deliberately collected for food as these too can be eaten, either boiled to make a porridge or ground into a type of flour. Crowberry (*Empetrum nigrum*), which would have grown on the moorland, is present in the assemblage (only in Phase 13 in floor 465). It is represented by only one seed but it is very likely that, if berries were being picked, they may have been eaten during collection.

The Phase 3 cremation deposits have a relatively large number of wild plant items considering the small number and volume of samples compared to some of the floors (although the mean density of wild plant items is still very low at 1.4 items/litre). The cremation deposits have the highest proportion of wild plant items in relation to cereal items (where they reach 83%). The deposits are dominated by sedge, rhizome and tuber fragments, and heather (including flowering parts), plus high numbers of chickweed. Present in lower numbers are seeds of knotgrass (*Polygonum* spp), rose family (Rosaceae indeterminate), blinks (*Montia fontana*) and legumes, possibly medick (Fabaceae *cf Medicago*), together with fragments of seaweed. These taxa were recovered alongside a few cereal remains.

The large number of sedges, rhizome fragments and heather seeds may result from their incorporation in peat which was used alongside other sources of fuel. They might indicate a turfy peat, although the fuel used at Cladh Hallan was found to vary from studies on ash residues taken from the hearth in House 401, with earlier layers indicating well-humified peat and later layers a fibrous peat turf (Peters *et al*. 2004). In general, the high temperatures required in a funeral pyre (unlike a domestic hearth) would mean that a lot of plant material would be burnt away completely. Smaller items may have filtered to the edges of the fire where the heat was less intense (Boardman and Jones 1990) and some of the more delicate components, such as culm fragments and heather flowers, may have survived in this way or in the embers of the fire.

The presence of taxa in the cremation deposits that could be arable weeds may again reflect items brought in with some of the cereal remains. Chickweed occurs in higher numbers than other crop weeds (for example wild turnip, plantain, blinks and knotgrass). This range of taxa is not dissimilar to those found in Bronze Age cremation deposits at Olcote, Isle of Lewis (Church 2005). Two of the cremation deposits from Cladh Hallan (3257

and 3255) included just five seeds from the rose family (Rosaceae indeterminate). Cremation deposits 3307 and 3257 produced legume seeds possibly of medick (Fabaceae *cf Medicago*). Plants in the genus *Medicago* can display flowers and set seed simultaneously, although there is no evidence to suggest deliberate collection of flowers in this case. Likewise, although flowering parts of heather were in amongst the samples (also in 3307, 3257 and 2793), these may have been incorporated in the assemblage as peat rather than being collected as flowers; it is impossible to say.

Heather flowers produce an intense smell in the summer through to early autumn, with seeds forming shortly afterwards in autumn. Flowering heather shoots and stems were used for bedding, with the flower heads uppermost providing not only a springy layer to lie on but also the added benefit of the sweet aroma from the flowers. In 1582 George Buchanan described the benefits of the Highland custom of using heather shoots in this way. The flowers were used traditionally to make a poultice for insomnia and to treat coughs, as a diuretic and as an ointment for rheumatism (Beith 1995). They were also used for their flavour to make tea and drinks such as ale (*fraoch*) or mead which was taken as a tonic (Beveridge 1911; Beith 1995; Darwin 1996). Pennant in 1776 describes how ale was often made by mixing two thirds of young 'heath' tips with one third of malt. There is even reconstructed brewing of ale from evidence of residues of a plant 'mash', using recipes which incorporated heather, based on the composition of lipid residues and pollen analyses from several archaeological sites in Scotland (Cullen 2011).

Other of the taxa recovered from the cremation deposits may have had medicinal or herbal uses. Owing to the poor preservation of the remaining wild plant items, and restrictions to genus only, it is not possible to say more about where they may have grown or why they were included in the cremation pyres.

16.5 Cultivation and collection

The assemblage is very limited with regard to what can be ascertained about the agricultural practices at Cladh Hallan. Barley is dominant throughout, most likely six-row barley; the true proportions of naked barley to hulled barley were difficult to ascertain owing to poor preservation. Barley is the dominant cereal at other Neolithic and Bronze Age sites in the Outer Hebrides. Naked six-row barley dominates at Neolithic/Beaker Allt Chrisal on Barra (Boardman 1995) and the Beaker site at Rosinish (Shepherd 1980). The infrequency of wheat at Cladh Hallan suggests it is a weed of the barley crop. Emmer wheat was present at Rosinish (2.9%) but not at Allt Chrisal.

The ecological preferences of certain weed taxa point to the use of the machair for cultivation, which would be the most attractive land to use because the light soils would be easy to work with the tools that were most likely available (red deer antler for ploughs and cow scapulae for digging). It is certainly described in glowing terms in many of the historical accounts with regard to the fertility of land and the great return in yield.

The location and character of machair would, however, have presented a range of challenges to the farmers of Cladh Hallan. The thin top soil with a low organic content is easily leached of nutrients and adding fertiliser not only benefits the fertility but also adds necessary humic material that helps to stabilise the soil surface. The machair plain is separated from the shore on the west by an active sand dune system. It is not uncommon for a sand dune to be blown open in very ferocious weather and shift huge quantities of sand inland. This could send a deposit of sand onto fields overnight. The problems of dune erosion were noted in Lewis by James Hogg in his 1803 tour: 'a dry spring wind always opens them [sand dunes], and lays the whole of the crops of grass or corn adjacent, several feet deep in sand' (1888: 111). There is one such hiatus at Cladh Hallan between Phases 9 and 10 with thick deposits of wind-blown sand accumulating against the houses and inside House 1370. If there had been a similar catastrophic event such as that described historically, it could have caused all the settlement's cultivable land to be lost. There are plenty of areas on the machair further away from the coast which would minimise the effects of such sand blow and, further inland, the soil is generally more humus-rich. The problem faced in these areas, instead, is the water table's rising up in wetter seasons (Smith and Colledge 2018).

Regardless of these problems, the machair is a good place to grow crops with sufficient variability to find the best suite of conditions. Barley is well-suited to growing in these areas because it is a less demanding cereal than wheat and can tolerate the short growing season of the islands and the salinity of the coastal environment.

The other plant of economic value at the site is flax. This is found only in small numbers, just from Phase 4 through to Phase 11, occurring almost exclusively in the house floor deposits, with the exception of a few seeds in midden and wall core. The low number of seeds makes it difficult to determine whether flax was being grown locally or brought in to the site from elsewhere. Strong evidence for local cultivation of flax is available from the Norse-period sites of Cille Pheadair (Parker Pearson *et al.* 2018) and Bornais mound 3 (Sharples 2005). Flax was recovered from the Late Iron Age site of mound 1 at Bornais (Sharples 2012a) but there is insufficient evidence to say categorically that it was being cultivated locally (Summers and Bond in Sharples 2012a). The local cool and coastal climatic conditions and well-drained soils are ideal for flax and there are wild plants in the assemblage that are associated with flax as cultivars: for example, docks and knotgrasses (*Rumex/Polygonum* sp.), cabbages and mustard (*Brassica/Sinapis* sp.) and corn spurrey (*Spergula arvensis*; Bond and Hunter 1987). Furthermore, flax is present on Bronze Age sites across Britain and on Neolithic sites in Scotland such as Balbridie (Fairweather and Ralston 2015).

The wild plant taxa found at Cladh Hallan could be weeds brought in accidentally but many of them may have been deliberately collected for food or useful materials.

There are no hazel (*Corylus avellana*) nut shells at Cladh Hallan which, given their hard outer shell, would have charred had they been thrown into the fire. Hazel nut shells are found at Allt Chrisal (Boardman 1995) along with a wider range of fruit seeds in comparison to the single seed of crowberry from the Cladh Hallan samples. Several plants may have been collected as leafy vegetables (docks, cabbage, nettle *etc*.). It is impossible to tell whether the weed seeds found inside houses came in with crops accidentally or had been collected. The dominance of sedge in the assemblage is likely to represent remains of peat as fuel or materials collected for their versatility around the house and settlement.

Sedge and grass seeds are present in relatively large numbers compared to many of the other wild taxa. Most sedges and grasses flower in late spring to summer, with fruits ripening in later summer to autumn, depending on the species. Those found in the assemblage may have arrived at the settlement as weeds amongst the crops but may have been deliberately collected for bedding and/or flooring and roofing or for making useful objects. There are several records of bent grass being used traditionally to make sacks, ropes, peat baskets, horse collars, bridles, mats and even chairs (Beveridge 1911; Fenton 1986; Laing 2000; Martin 1716; Shaw 1955). The bent grass described by Beveridge which 'abounds upon the sand-hills at the north and west shores' of North Uist (1911) is marram grass (*Ammophila arenaria*) which commonly grows in sand dunes on the Islands, giving South Uist its Gaelic name *Tir a'mhurain* or the Land of Bent Grass (Shaw 1955: 79).

Roots of glaucous sedge (*Carex flacca*) were considered to be very strong and particularly useful because they could grow up to six or eight feet (1.8m–2.4m) in length. Beveridge (1911) describes a conical net (Gaelic *tàbh*) made from these roots with a one-inch mesh, designed to trap fish when placed in a dam. The same roots were used to make strong animal tethers (Walker 1764–1771). Glaucous sedge can grow in a variety of habitats; it is tolerant of different soils but is common in damp grasslands and machair. The root grows just below the surface of the soil in a lateral network that would have made it possible to uproot. Root fragments are found on the site although it was not possible to determine if these are sedge or grass and they may have been part of fuel such as peat brought to the site.

Heather plants also had many traditional uses in the Outer Hebridean islands. The long woody stems were used in thatching, and Beveridge (1911) describes for North Uist how heather laid over marram grass (or 'bent grass') was believed to be the most durable material for thatch, although rushes and iris leaves were also often used. Durable rope made from heather was preferred for tying the thatching down and heather rope was also used to make small poaching nets, which must have required a great deal of manual dexterity (Beveridge 1911).

The landscape around the site is very varied, owing to the drastic differences in topography, geology, soils and climate. This, in turn, influences the flora growing naturally and what can be cultivated. The analysis of the assemblage at Cladh Hallan has thrown more light on this period in the settlement history of the island. Interesting details have emerged about distribution of materials inside buildings and possible differences in activities related to use of plants. The evidence from the cremation deposits at the site also provides a better understanding of materials used for the cremation process.

17 Organic residue analysis of pottery residues

L. Cramp, R. Evershed, G. Taylor and O.E. Craig

The exploitation of resources in antiquity, especially in areas that are considered to be environmentally marginal, such as the Western Isles of Scotland, has generated significant debate. During the last decades, new analytical techniques applied to organic residues recovered from ceramic vessels have significantly increased our knowledge of dietary and cultural practices throughout British prehistory (Copley *et al.* 2003; Roffet-Salque *et al.* 2017). Organic residues can be broadly defined as a complex mix of biomolecules, including carbohydrates, proteins and lipids, which are all major constituents of food. Biomolecular analysis, especially of lipids, can identify a wide range of resources including animal products, plant waxes and oils, resins, tars and beeswax. Importantly, the distinction between milk and milk products and animal carcass fats within ceramic vessels in antiquity has been established (Dudd and Evershed 1998). This has been one of the most significant developments in organic residue analysis techniques applied to archaeological ceramic vessels from the Neolithic (Copley *et al.* 2003).

In this investigation, biomolecular and stable isotope analyses of lipids are used to support the faunal assemblage data, and together imply that dairying was practised extensively at least during the Bronze and Iron Age in the Western Isles. Analyses of over 60 ceramic vessels excavated from Late Bronze Age and Early Iron Age contexts at Cladh Hallan are presented here; these data have already been published (Craig *et al.* 2005; Cramp *et al.* 2014) but are integrated here for the first time.

17.1 Faunal evidence and dairying

The high prevalence of cattle and sheep in the faunal assemblage from Late Bronze Age and Early Iron Age Cladh Hallan illustrates the importance of domestic animals in the settlement's economy. One consistent feature of the cattle assemblage is the high incidence of juvenile bones (see Chapter 10). This pattern is also observed in earlier and later periods across a wide geographical area, including the Orcadian Neolithic (Noddle 1983). The absence of similar mortality patterns in other domesticated species such as sheep suggests that the killing of juvenile cattle was part of a considered agricultural strategy that could have taken the form of dairying (Payne 1973; Legge 1981). Dairying exploits the resources of adult female cattle whilst sacrificing young calves. Additionally, dairying is more efficient in terms of land usage in comparison to meat production and is well documented for the Western Isles in recent history (MacDonald 1811). Faunal assemblage data from Cladh Hallan, Iron Age Dun Vulan and Norse-period Cille Pheadair all suggest that dairying was practised throughout later prehistory and beyond (Smith and Mulville 2004).

Paradoxically, dairying is a demanding farming practice that reduces the total herd number and could be considered to have been a risky strategy in prehistory. The environmental marginality of the Western Isles has led to the suggestion that high juvenile cattle mortality was the result of poor husbandry practices and paucity of fodder (McCormick 1998). Furthermore, new-born calves are nutritionally demanding of their mothers and their deliberate slaughter would thus provide milk for human consumption. The complexity of herd management, differences in the economic significance of modern-day to ancient cattle, husbandry practices and the incompleteness of archaeological assemblages therefore raises many questions and issues to be debated (Halstead 1998).

17.2 Organic residue analysis

The application of lipid residue analysis to investigate the origin and emergence of dairying has been successfully applied at many prehistoric British and European sites (Evershed *et al*. 1994; 2008; 2022; Copley *et al*. 2003). As a result, compound-specific stable isotope analysis of organic food residues is now an essential technique in the classification of pottery function. Degraded animal fats have been shown to be preserved in archaeological vessels

in relatively high abundances and are fairly resistant to processes of degradation (Evershed 1993). Fats obtained from ruminants and non-ruminants are isotopically distinct (Dudd *et al.* 1999) due to differing metabolic pathways (Christie 1981) and dietary food sources. Furthermore, milk is isotopically distinct from adipose fats, again due to complex metabolic routing pathways.

Fresh milk contains a range of fatty acids including C_4–C_{20} branched, unsaturated and saturated fatty acids (Christie 1981). The distribution of fatty acids contained within milk can vary according to fodder type, seasonality and health of the animal (Chilliard *et al.* 2001; Bauman and Griinari 2003; Roffet-Salque *et al*. 2017). The detection of milk in ceramic vessels involves the stable isotope measurement of fatty acids, specifically octadecanoic acid ($C_{18:0}$) and hexadecanoic acid ($C_{16:0}$; Dudd and Evershed 1998). In milk, the isotopic difference between $C_{18:0}$ and $C_{16:0}$ is due to the inability of the mammary gland to biosynthesise $C_{18:0}$ (Christie 1981; Mather and Keenan 1998). Whilst a significant proportion of the $C_{18:0}$ fatty acid in adipose fats is biosynthesised *de novo* from dietary acetate, in the mammary gland it is instead obtained from dietary fats, principally from plants by the dehydrogenation of unsaturated $C_{18:1}$, $C_{18:2}$ and $C_{18:3}$ compounds within the rumen, as well as remobilisation of adipose fatty acids. In comparison, $C_{16:0}$ can be partly obtained by *de novo* synthesis within the mammary epithelial glands (Mather and Keenan 1998). The different biosynthetic origins for $C_{16:0}$ and $C_{18:0}$ fatty acids in ruminant milk are expressed in the stable isotope signatures of these compounds (Dudd *et al.* 1999). In milk, the $\delta^{13}C$ value of $C_{18:0}$ fatty acid is isotopically depleted by *c*. 3.3‰–6.5‰ in comparison to the $C_{16:0}$ fatty acid due to the enhanced contribution of isotopically depleted dietary fats to the $C_{18:0}$ fatty acid, whereas in adipose fats a greater proportion of the $C_{18:0}$ is derived from *de novo* biosynthesis of less isotopically depleted dietary acetate. Thus, the stable isotope values of $C_{16:0}$ and $C_{18:0}$ show a smaller discrepancy by *c.* 1‰–3‰ (Christie 1981).

The differences between the $C_{16:0}$ and $C_{18:0}$ stable isotope values are expressed as $\Delta^{13}C$, where $\Delta^{13}C = \delta^{13}C_{18:0} - \delta^{13}C_{16:0}$. Significantly, $\Delta^{13}C$ is maintained regardless of the absolute $\delta^{13}C$ values of the individual fatty acids in milk, which are correlated to the amount of C_3/C_4 fodder in the animal's diet (Craig *et al.* 2005; Dunne *et al*. 2012). Therefore $\Delta^{13}C$ of fatty acids extracted from archaeological ceramic vessels not only provides a reliable means of discriminating the different origins of the residue (ruminant milk fats; ruminant adipose fats and non-ruminant fats) but also provides an indicator of the isotopic composition of the animal's diet.

In addition to terrestrial resources, bones of fish, seals and cetaceans, and marine shells were recovered at Cladh Hallan (see Chapters 11, 13 and 14) so it is evident that some food from the sea was also being consumed and hence potentially prepared in pots. Whilst the fatty acids from marine species will exhibit relatively high $\delta^{13}C$ values and $\Delta^{13}C$ values (Cramp and Evershed 2014; see reference ranges in Figure 17.2), the relatively low content of $C_{18:0}$ in aquatic fats means that episodes of mixing will rapidly mask an aquatic contribution. Diagnostic biomarkers forming from the degradation of distinctive long-chain, unsaturated fatty acids can still be detected, however, even at very low concentrations. Selected residues were therefore also screened at high sensitivity to detect the possible presence of markers for aquatic resources in the pots (Copley *et al.* 2004; Hansel *et al.* 2004; Cramp and Evershed 2014).

Another plausible component of the ceramic residues is that of plant-derived lipids such as plant oils, waxes and tree resins. These can be detected through lipid residue analysis with various degrees of precision. Unfortunately, the majority of plant staples such as cereals and pulses are relatively low in lipid and therefore difficult to identify when mixed with lipid-rich animal products. While cereal-specific biomarkers have been identified in pottery (Hammann and Cramp 2018; Hammann *et al.* 2022), these will only likely survive under anoxic conditions (Hammann and Cramp 2018) and this usually requires more specific extraction, purification and detection methods that were not deployed here. However, biomolecular analysis of the lipid composition of residues may nonetheless yield more generic plant-derived lipids, including wax esters, *n*-alkanes and plant-derived steroidal compounds.

17.3 Ceramic vessels sampled

Over 74,000 sherds were excavated from Cladh Hallan (see Volume 1: chap. 15). The ceramic vessels from Cladh Hallan were mainly large, coarse-ware bowls and jars made from clay with inclusions of Lewisian Gneiss. The exterior surfaces of sherds are smooth with very few indentations or visible motifs.

The Cladh Hallan potsherds selected for analysis came predominantly from House 401 (the central house), House 1370 (the northern house) and House 150 (the double roundhouse in Area C). Sherds were found as broken sherds or even smashed vessels on floor layers within houses or as broken sherds from middens and outdoor surfaces near the houses. Within House 401, contexts were selected from the first to third phases of Late Bronze Age occupation (Phases 9–11; contexts 1308, 1310, 1392, 1705 and 655). Also included is a near-complete vessel from the fill (1423) of a pit in the house's wall from the interface between Phases 10 and 11. From outside the entrance of House 1370, a sherd was sampled from a layer (1749) dating to Phase 9.

Potsherds from floor 1308 (Phase 10) of House 401 came from the northeast and southeast, the latter being the house's cooking area. In addition, an assemblage of pottery was sampled from the final occupation layer (409) in House 401 (Phase 16). Also sampled from Phase 16 were ceramic sherds of reconstructable vessels from abandonment layers of windblown sand (108 and 172) in the double roundhouse (House 150) in Area C, with other sherds from layers 130, 180 and 119 within that house.

A few sherds from House 1370 were from layers (1644 and 1203) containing smashed vessels in the southern half of the house, on the interface of Phases 10 to 11. In addition, a whole pot was sampled from a pit fill in the wall footings of House 1500 (Phase 12) at the south end of Area A near the ruined House 801. Full descriptions of ceramic material obtained from each context are given in Table 17.1.

17.4 Experimental methodology

Sample preparation prior to lipid extraction

During excavation, sherds were air-dried and wrapped in aluminium foil to prevent contamination from plasticisers. Excavated sherds were lightly brushed to remove soil and adhering material prior to storage. In the laboratory,

Table 17.1. List of pottery sherds sampled from Cladh Hallan

Phase	Sherd	Context	SF no.	Context description	Vessel form/function (if known)
16	ch1001b	108		Fill inside House 150	Short thick-walled jar
16	ch1001b	108		Fill inside House 150	Short thick-walled jar
16	ch1001c	108		Fill inside House 150	Short thick-walled jar
16	ch1007a	108		Fill inside House 150	Large thick-walled jar
16	ch1009a	108		Fill inside House 150	Large thick-walled jar
16	ch1012	108		Fill inside House 150	Large thick-walled jar
16	ch1014a	108		Fill inside House 150	Large thick-walled jar
16	ch1015a	108		Fill inside House 150	Large thick-walled jar
16	ch1017a	108		Fill inside House 150	Large thick-walled jar
16	ch2048b	409		Fill inside House 401	Large thick-walled jar
16	ch2048d	409		Fill inside House 401	Large thick-walled jar
16	ch2049b	409		Fill inside House 401	Large thick-walled jar
16	ch2049e	409		Fill inside House 401	Large thick-walled jar
15	ch2061b	452		Floor of House 401	Large thick-walled jar
15	ch2061d	452		Floor of House 401	Large thick-walled jar
11	ch2145a	655		Floor of House 401	
11	ch2147a	655		Floor of House 401	
11	ch2162a	655		Floor of House 401	
11	ch2189a	655		Floor of House 401	
11	ch2232a	655		Floor of House 401	
11	ch2244a	655		Floor of House 401	
11	ch2251a	655		Floor of House 401	
11	ch2270a	655		Floor of House 401	
10	ch2330a	1308		Floor SE quad House 401	
10	ch2332a	1308		Floor SE quad House 401	
10	ch2337a	1308		Floor SE quad House 401	
10	ch2338a	1308		Floor SE quad House 401	
10	ch2340a	1308		Floor SE quad House 401	
10	ch2374a	1308		Floor SE quad House 401	
10	ch2403a	1308		Floor SE quad House 401	
10	ch2405	1308		Floor SE quad House 401	
10	ch2410a	1308		Floor SE quad House 401	
10	ch2567a	1308		Floor SE quad House 401	
10	ch2577a	1308		Floor SE quad House 401	
10	ch2578a	1308		Floor SE quad House 401	
10	ch2578b	1308		Floor SE quad House 401	
10	ch2578c	1308		Floor SE quad House 401	
10	ch2581a	1308		Floor SE quad House 401	

Phase	Sherd	Context	SF no.	Context description	Vessel form/function (if known)
11	ch3481c	1203		Fill outside House 1370	Thin-sided bowl
10	ch3521c	1308		Floor of House 401	Narrow tubular cooking vessel
10	ch3521f	1308		Floor of House 401	
11	ch3542b	1423		Pit fill in House 401	Large bowl with mending hole
12	ch3630b	1439		Windblown sand, S area, House 801	Large bucket-shaped vessel
9	ch3804b	1705		Floor of House 401	Large bucket-shaped vessel
10	CH-1	1310	3680	Fill inside House 401	
9	CH-2	1749	3786	Fill outside House 1370	
16	CH-3	108	1017	Fill inside House 150	Pot A
11	CH-4	1423	3542	Pit fill in House 401	
10	CH-5	1644		Fill inside House 1370	Pot no. 3
11	CH-6	1392	3534	Floor of House 401	
11	CH-7	1423	3542C	House 401, pit fill	
11	CH-8	1203	3481B	Fill outside House 1370	
11	CH-9	1423	3542B	House 401, pit fill	
16	CH-10	409	2049	Fill inside House 401	
9	CH-11	1705	3804	Floor of House 401	
16	CH-12	130		Fill inside House 150	
16	CH-13	180		Fill inside House 150	
16	CH-14	180	A	Fill inside House 150	
10	CH-15	119		Fill outside Area C	
16	CH-16	108	1014	Fill inside House 150	Pot G
16	CH-17	108	1004	Fill inside House 150	Pot D
16	CH-18	108	1012	Fill inside House 150	Pot C
16	CH-19	108	1004	Fill inside House 150	Pot I
10	CH-20	172	1022	Fill outside Area C	Pot E

sherds were further cleaned using a modelling drill (Dremel), which removed surface contamination from residual soil and that potentially introduced by the handling of the sherd during excavation. Ceramic sub-samples were removed either through drilling (carried out at low speeds to minimise loss of material as dust particles and to maintain a low temperature at the point of contact) or through removal of a cleaned fragment of the sherd, which was then crushed to powder using a mortar and pestle. Approximately 3g–5g of ceramic powder was produced through drilling and the powder was sealed in a glass tube and stored at −20ºC until analysis. Pottery chunks removed with a chisel were crushed immediately prior to lipid extraction.

Lipid extraction

Extraction procedures for all pottery analysed followed broadly the same procedures, with minor deviations. Procedure 1 involved the weighing of approximately 1g–2g of powdered ceramic into a glass tube and the addition of an internal standard *n*-tetratriacontane (20µg) to each tube for the purposes of quantification. Lipids were extracted from the powdered ceramic using 30ml of 2:1 *v/v* mix of chloroform and methanol. The tube was ultra-sonicated for 30 minutes with 10ml aliquots of solvent; the solvent was then removed to a round-bottom flask and the procedure repeated three times. The solvent extract was reduced to a lower volume (~1ml) by rotary evaporation, removed to a small vial and gently dried under nitrogen. Samples were then re-dissolved in hexane, transferred to pre-weighed vials and gently dried under nitrogen. The total lipid extracts were re-dissolved and split into two vials to enable separate derivatisation for two separate analytical techniques, high-temperature gas chromatography (HT-GC) and gas chromatography mass spectrometry (GC-MS). Derivatisation protocols for HT-GC, GC-MS and gas chromatography-combustion-isotope ratio mass spectrometry (GC-C-IRMS) to produce fatty acid methyl esters (FAMEs) are described below.

For procedure 2, followed for sherds CH-1–CH-20, again *c*. 1g–2g of powdered ceramic was weighed into a glass vial and 20µg internal standard added to each sample. Lipids were extracted using 2 × 10ml chloroform/methanol (2:1 *v/v*). The solvent was reduced to 3ml

using a gentle stream of nitrogen. Prior to HT-GC and GC-MS analysis, aliquots (*c.* ¼) were filtered through a silica column to remove particles and more polar molecules. These were then derivatised using 40µl *N,O*-bis(trimethylsilyl)trifluoroacetamide (70°C, 1 hr) and dissolved in 100µl hexane for analysis. Trimethylsilylated samples were first run in full-scan mode (*m/z* 50–650) and then using selected ion monitoring (SIM), scanning for the two cleavage fragments and $[M\text{-}15]^+$ ions for the most common positional isomers of C_{18}–C_{22} dihydroxy fatty acids (DHYAs).

For compound-specific stable carbon isotope analysis, aliquots were hydrolysed using 0.5 M NaOH/MeOH, then acidified to pH3 and after the addition of 3ml of double-distilled DCM-extracted water, free fatty acids extracted using 3 × 3ml $CHCl_3$. Free fatty acids were then methylated using 100µl boron trifluoride-methanol (14%, 75°C, 1 h) and extracted using 3 × 2ml $CHCl_3$. Fatty acid methyl esters (FAMEs) were analysed using a GC-MS fitted with a polar column, with the MS operated in full scan (*m/z* 70–650) and SIM (*m/z* 105, 262, 290, 318 and 346 to determine APAAs) modes. The $\delta^{13}C$ values of individual fatty acids were determined using GC-combustion-isotope ratio MS (GC-C-IRMS), with all samples run in duplicate and an external standard every four runs. The $\delta^{13}C$ values were derived according to the following expression and are relative to the international standard vPDB: $\delta^{13}C‰ = ((R_{sample} - R_{standard})/R_{standard}) \times 1000$ where $R = {}^{13}C/{}^{12}C$. The $\delta^{13}C$ values were corrected for the carbon atoms added during methylation using a mass balance equation (Rieley 1994).

17.5 Results

Biomolecular analysis of organic residues.

HT-GC and GC-MS analyses served to quantify and identify a range of compounds in the lipid extracts from the archaeological potsherds. In total, 63 potsherds were analysed for the presence of lipid residues using HT-GC. Figure 17.1 shows a typical HT-GC chromatogram from an extracted archaeological potsherd. Out of the 63 potsherds from Cladh Hallan that were solvent extracted and analysed using HT-GC, 32 contained appreciable amounts of lipids (>5µg g^{-1}), which represents approximately 51% of the total sampled assemblage. A full description of all lipid compounds detected in the Cladh Hallan assemblage organic residues through subsequent GC combined with MS is given in Table 17.2.

The most abundant lipid species found in extracted material from the potsherds were $C_{18:0}$ and $C_{16:0}$ saturated fatty acids, with decreased amounts of unsaturated $C_{18:1}$. The relatively high abundance of saturated fatty acid species, especially $C_{18:0}$, suggests that these lipids were of animal origin (Christie 1981; Enser 1991). Caution should be exercised when interpreting relative fatty acid concentrations since shorter-chain fatty acids will exhibit greater solubility in water during burial. However, the overall lipid distributions, including high concentrations

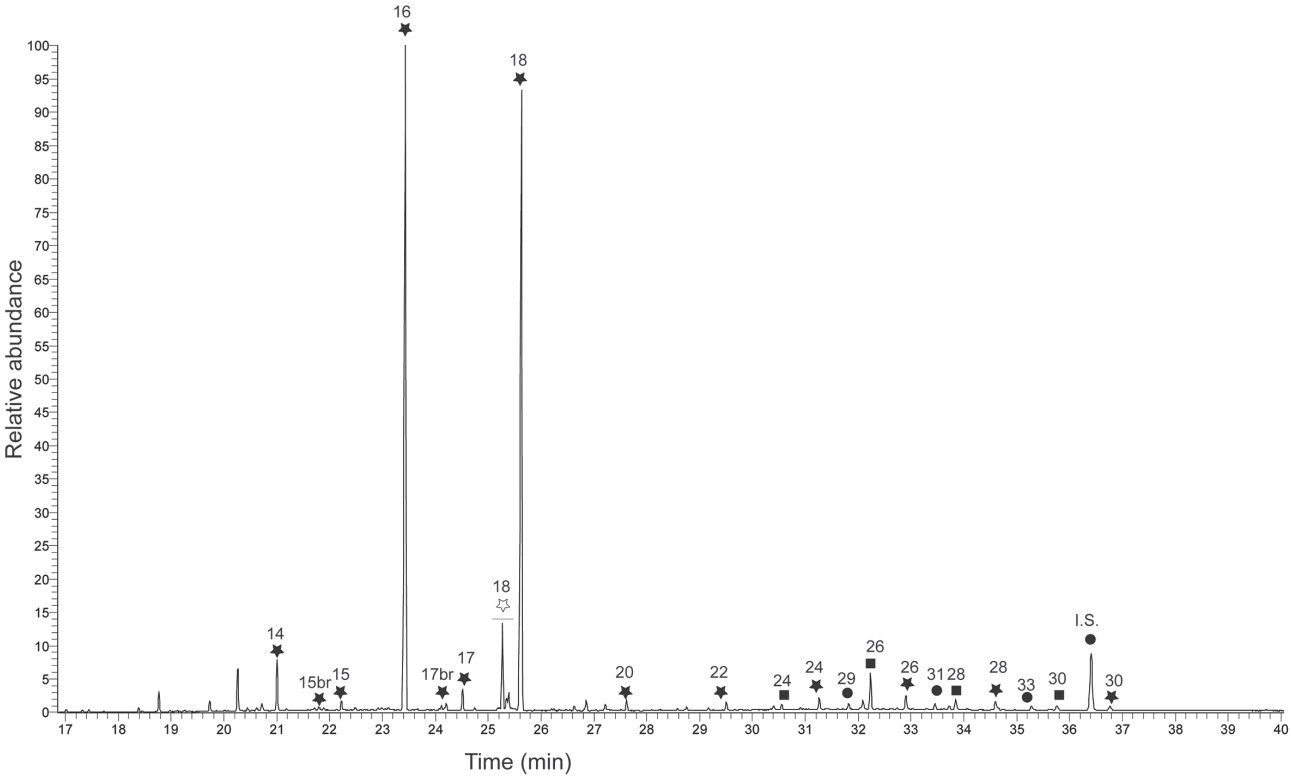


Figure 17.1. Partial gas chromatogram of a trimethylsilylated TLE from sherd CH−8, showing a degraded animal fat with traces of plant wax. Stars show free fatty acids, squares n-*alkanols and circles* n-*alkanes, with the carbon chain length given above. Filled shapes are saturated whilst unfilled are monounsaturated. I.S. = internal standard (C_{34}* n-*alkane)*

*Table 17.2. Total lipid content, lipid composition and single compound stable carbon isotope analysis determinations from the pottery analysed from Cladh Hallan. ** denotes sherds where high sensitivity screening for aquatic biomarkers (long chain APAAs and long chain dihydroxy acids) was performed. None were detected*

Sherd	Lipid conc. (μg g^{-1}) Tr = trace (<5 μg^{-1})	$\delta^{13}C_{16:0}$ ‰	$\delta^{13}C_{18:0}$ ‰	$\Delta^{13}C$ ($\delta^{13}C_{18:0} - \delta^{13}C_{16:0}$)	Lipid composition** FAs – free fatty acids (br – branched, OCN – odd carbon number). DAGs – diacylglycerols, TAGs – triacylglycerols, K – ketones, OH – *n*-alkanols, A – *n*-alkanes. Number indicates carbon chain length/number of acyl carbon atoms and mx. indicates 'maximising at'. tr – traces. n.d.–not detected	Interpretation
ch1001a	280	–28.7	–33.9	–5.2	FA (16,18)	Ruminant dairy fat
ch1001b	?	–26.3	–33.2	–6.9	FA (16,18)	Ruminant dairy fat
ch1001c	Tr				n.d.	
ch1007a	Tr				n.d.	
ch1009a	?				FA (16,18)	
ch1012	100	–26.9	–30.3	–3.4	FA (16,18)	Ruminant dairy fat
ch1014a	?	–25.6	–32.4	–6.8	FA (16,18)	Ruminant dairy fat
ch1015a	180	–26.1	–31.2	–5.1	FA (16,18), MAGs, DAGs, TAGs (48–54)	Ruminant dairy fat
ch1017a	?	–26.9	–30.0	–3.1	FA	Ruminant dairy fat
ch2048b	Tr				FA (16,18)	
ch2048d	Tr				FA (16,18)	
ch2049b	Tr				n.d.	
ch2049e	Tr				n.d.	
ch2061b	Tr				n.d.	
ch2061d	Tr				n.d.	
ch2145a	Tr				FA (16,18), MAGs, DAGs, TAGs	
ch2147a	190	–27.1	–31.4	–4.3	FA (16,18), MAGs, DAGs, TAGs (48–54)	Ruminant dairy fat
ch2162a	?	–26.5	–32.1	–5.7	FA (16,18), MAGs, DAGs, TAGs	Ruminant dairy fat
ch2189a	?	–27.3	–34.0	–6.7	FA (16,18)	Ruminant dairy fat
ch2232a	Tr				tr FA (16,18), tr MAGs	
ch2244a	Tr				n.d.	
ch2251a	Tr				n.d.	
ch2270a	Tr				n.d.	
ch2330a	Tr				FA (16,18)	

(Continued)

*Table 17.2. Total lipid content, lipid composition and single compound stable carbon isotope analysis determinations from the pottery analysed from Cladh Hallan. ** denotes sherds where high sensitivity screening for aquatic biomarkers (long chain APAAs and long chain dihydroxy acids) was performed. None were detected (Continued)*

Sherd	Lipid conc. (µg g^{-1}) Tr = trace (<5 µg g^{-1})	$\delta^{13}C_{16:0}$ ‰	$\delta^{13}C_{18:0}$ ‰	$\Delta^{13}C$ ($\delta^{13}C_{18:0} - \delta^{13}C_{16:0}$)	Lipid composition** FAs – free fatty acids (br – branched, OCN – odd carbon number). DAGs – diacylglycerols, TAGs – triacylglycerols, K – ketones, OH – *n*-alkanols, A – *n*-alkanes. Number indicates carbon chain length/number of acyl carbon atoms and mx. indicates 'maximising at'. tr – traces. n.d.–not detected	Interpretation
ch2332a	100	–27.3	–31.7	–4.4	n.d.	Ruminant dairy fat
ch2337a	Tr				n.d.	
ch2338a	100	–26.6	–32.3	–5.6	FA (16,18), MAGs	Ruminant dairy fat
ch2340a	?	–26.5	–31.4	–4.9	FA (16,18)	Ruminant dairy fat
ch2374a	?				FA (16,18), MAGs	
ch2403a	Tr				n.d.	
ch2405	190	–26.3	–30.6	–4.3	FA (16,18)	Ruminant dairy fat
ch2410a	Tr				n.d.	
ch2567a	190	–24.9	–29.36	–4.4	FA (16,18), MAGs, DAGs, TAGs (48–54)	Ruminant dairy fat
ch2577a	220	–26.5	–31.7	–5.2	FA (16,18), tr MAGs, DAGs, tr TAGs	Ruminant dairy fat
ch2578a	2000	–26.8	–32.1	–5.3	FA (16,18), MAGs, DAGs, TAGs (48–54)	Ruminant dairy fat
ch2578b	Tr				tr FA (16,18)	
ch2578c	Tr				n.d.	
ch2581a	100	–26.5	–31.4	–4.8	FA (16,18), TAGs	Ruminant dairy fat
ch3481c	Tr				n.d.	
ch3521c	Tr				n.d.	
ch3521f	Tr				n.d.	
ch3542b	Tr				n.d.	
ch3630b	Tr				n.d.	
ch3804b	Tr				n.d.	
CH-1	7				n.d.	
CH-2**	57	–26.2	–28.5	–2.3	FA (14–18, inc. br and OCN, 18:1), DAGs (32–36), TAGs (46–54)	Ruminant adipose fat
CH-3**	70	–27.7	–29.0	–1.4	FA (16–18, inc. br and OCN, 18:1), tr. TAGs (48–54)	Ruminant adipose fat
CH-4**	134	–27.6	–32.6	–4.9	FA (14–30, inc. br and OCN, 18:1), OH (22–30, mx. 26), A (29–33, mx. 31)	Ruminant dairy fat; traces plant wax
CH-5**	107	–27.7	–33.0	–5.3	FA (14–18, inc. br and OCN, 18:1), DAGs (32–36), TAGs (44–54)	Ruminant dairy fat

Sherd	Lipid conc. (µg g^{-1}) Tr = trace (<5 µg^{-1})	$\delta^{13}C_{16:0}$ ‰	$\delta^{13}C_{18:0}$ ‰	$\Delta^{13}C$ ($\delta^{13}C_{18:0} - \delta^{13}C_{16:0}$)	Lipid composition** FAs – free fatty acids (br – branched, OCN – odd carbon number). DAGs – diacylglycerols, TAGs – triacylglycerols, K – ketones, OH – *n*-alkanols, A – *n*-alkanes. Number indicates carbon chain length/number of acyl carbon atoms and mx. indicates 'maximising at'. tr – traces. n.d.–not detected	Interpretation
CH-6**	26	–26.7	–32.5	–5.7	FA (14–18, inc. br and OCN, C18:1), DAGs (32–36), TAGs (44–54)	Ruminant dairy fat
CH-7	17					
CH-8**	75	–25.9	–28.7	–2.7	FA (14–30, inc. br and OCN, 18:1), OH (22–30, mx. 26), A (29–33, mx. 31)	Ruminant adipose fat; traces plant wax
CH-9	29				n.d.	
CH-10	Tr				n.d.	
CH-11	Tr				n.d.	
CH-12**	272	–27.2	–31.8	–4.6	FA (14–18, inc. br and OCN, 18:1), tr. DAGs (34–36), TAGs (48–54)	Ruminant dairy fat
CH-13	59				FA (16–18; 18:1), tr. TAGs	
CH-14	11				FA (16–18; 18:1), TAGs (50–54)	
CH-15	Tr				n.d.	
CH-16**	21	–27.3	–30.9	–3.6	FA (14–18, inc. br and OCN, 18:1), tr. DAGs (32–36), TAGs (44–54), K (31–35)	Ruminant dairy fat
CH-17**	37	–28.2	–31.3	–3.0	FA (14–18, inc. br and OCN, 18:1), tr. DAGs (32–36), TAGs (46–54)	Ruminant adipose fat
CH-18	Tr				FA (16–18)	
CH-19	Tr				n.d.	
CH-20	Tr				n.d.	

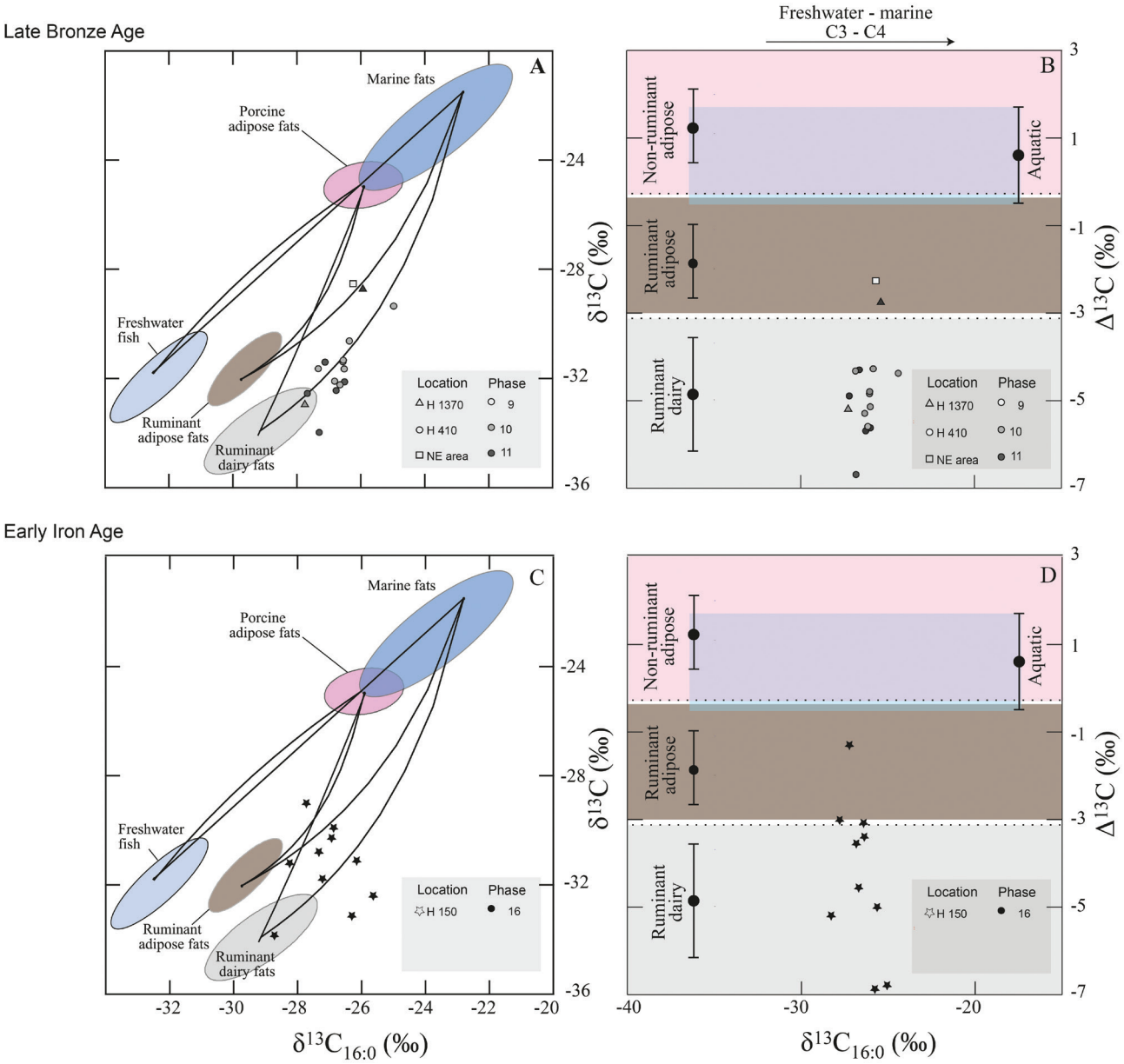


Figure 17.2. Scatter plots of compound-specific stable carbon isotope determinations from Cladh Hallan absorbed pottery residues. A and C show $\delta^{13}C_{16:0}$ plotted against $\delta^{13}C_{18:0}$, with terrestrial animal confidence ellipses (1 s.d.) derived from modern terrestrial reference fats published in Copley et al. *2003 and marine and freshwater ellipses from modern UK and North Sea aquatic fats (mammals, fish, shellfish and crustaceans; Cramp and Evershed 2014). B and D show $\delta^{13}C_{16:0}$ plotted against $\Delta^{13}C$ ($\delta^{13}C_{18:0} - \delta^{13}C_{16:0}$) with ranges on the y axis derived from modern reference fauna as before. Plotting the $\Delta^{13}C$ value removes local environmental effects on absolute fatty acid $\delta^{13}C$ values*

of $C_{18:0}$ fatty acid and characteristic distributions of mono-, di- and triacylglycerols indicate that the residues were predominantly of animal origin. The identification of branched and odd chain fatty acids indicates a possible ruminant source for these lipids although contamination with bacterial lipids is also a plausible theory to explain the presence of these compounds (Mottram *et al.* 1999).

Triacylglycerols (TAGs) and their hydrolysis products diacylglycerols (DAGs), and monoacylglycerols (MAGs) were observed in one-third of the Cladh Hallan potsherds. The low abundance of these species, in a limited number of sherds, suggests that lipid hydrolysis by either chemical or enzymatic reactions was almost complete. The distributions of TAGs (C_{44}–C_{54}) from Cladh Hallan reveal the presence of lower molecular weight TAGs in some cases. Lower molecular weight TAGs are indicative of milk fats although selective hydrolysis of shorter chain compounds can occur (Dudd *et al.* 1998). Thus TAG distributions are not sufficient to conclusively identify the origin of lipids contained within potsherds.

Despite the fact that the preserved residues are dominated by degraded animal fats, traces of even-carbon number long-chain fatty acids, even-carbon number long chain *n*-alkanols and odd-carbon number long chain

n-alkanes were detected in two Late Bronze Age residues (CH-4 [pit fill 1423 from House 401] and CH-8 [fill 1203 from outside House 1370]). These fingerprints can be interpreted as traces of degraded plant epicuticular waxes in these pots.

Single-compound stable carbon isotope analysis of organic residues

Following confirmation using HT-GC and GC-MS that animal fats were present in potsherd samples from Cladh Hallan, compound-specific stable isotope techniques were employed to differentiate between ruminant and non-ruminant adipose fats and dairy fats (Dudd and Evershed 1998). GC-C-IRMS was performed on a total of 26 sherds from Cladh Hallan to determine the $\delta^{13}C$ measurement of $C_{16:0}$ and $C_{18:0}$ FAMEs. Not all sherds containing fatty acids were analysed using GC-C-IRMS due to very low abundance (<50 ng of C) or lack of sample quantity to obtain an accurate isotope measurement.

All stable carbon isotope values for $C_{16:0}$ and $C_{18:0}$ FAMEs from Cladh Hallan are given in Table 17.2. The identification of milk fats involves the determination of $\delta^{13}C_{16:0}$ and $\delta^{13}C_{18:0}$ and calculation of the $\Delta^{13}C$ ($= \delta^{13}C_{18:0} - \delta^{13}C_{16:0}$). The determination of $\Delta^{13}C$ values enables the distinction between ruminant dairy, ruminant adipose and non-ruminant adipose animal fats to be ascertained. Importantly, $\Delta^{13}C$ is maintained regardless of the absolute $\delta^{13}C$ value of individual fatty acids in animal tissues and hence reflects metabolic origins and is not influenced by dietary or environmental variability (Dudd and Evershed 1998; Copley *et al.* 2003; Dunne *et al.* 2012).

Residues from the majority of potsherds from Cladh Hallan demonstrate a significant relative depletion in $\delta^{13}C_{18:0}$ values compared to $\delta^{13}C_{16:0}$ ($\Delta^{13}C = \leq -3.3‰$), and nearly all ($n = 22$) can therefore be securely assigned a predominantly dairy origin. A few residues ($n = 4$) can be ascribed to a ruminant non-dairy carcass (meat) origin.

However, considerable heterogeneity exists within the measured values from different potsherds, with the $\delta^{13}C_{16:0}$ values ranging from −28‰ to −24‰ and $\delta^{13}C_{18:0}$ values ranging from −34‰ to −29‰. Large variations were also observed in the $\Delta^{13}C$ values, ranging between −3.3‰ and −6.5‰. Mixing of a range of different products with milk may adequately explain these differences although other hypotheses including differential foddering and inter-species variation are also plausible. All $\Delta^{13}C$ values determined for Cladh Hallan are illustrated in Figure 17.2.

17.6 Discussion

The evidence presented here suggests that dairying played an important role at Cladh Hallan and indeed throughout prehistory on South Uist. Lipid residue analysis has been shown to complement the faunal assemblage data extremely well, which suggests that distinctive kill-off patterns for young juvenile cattle may provide a good proxy for identifying dairying practices. As these kill-off assemblage patterns have been seen at earlier and later archaeological sites over a wider geographical area, it is likely that cattle-based dairying was well established in the Western Isles by the end of the Neolithic (Noddle 1983; Halstead 1998). The evidence of dairying suggests a thorough knowledge of cattle husbandry practices and land management. Dairying would have provided an important, continuously exploited food resource that was potentially part of a larger mixed-farming economy.

The ceramic assemblage at Cladh Hallan consists of large bucket-shaped jars and smaller bowls in mostly coarse fabrics. The number of sherds investigated in this study represents only a very small proportion (>0.05% of the total assemblage) from a small number of contexts, which may limit our overall knowledge. All ceramic vessels in this investigation were deemed suitable for a range of domestic uses and most showed signs of exterior sooting or interior blackening, implying that they had been used for cooking. In this investigation, absorbed lipids from the majority of potsherds sampled were identified as a milk residue by GC-C-IRMS. The sampling strategy at Cladh Hallan compared multiple contexts of deposition, including pots discarded on the floors of houses, pots thrown into an abandoned double roundhouse and pots thrown out of the houses onto middens and external surfaces. Organic residue analysis demonstrates that there is no significant variation between context of disposal and presence of milk residues. The sherds from which the four non-dairy residues are identified do not exhibit any spatial or chronological grouping, but come from different phases and different areas of the settlement.

The assemblages included for analysis span Phases 9–12 and 16, covering Late Bronze Age and Early Iron Age occupation of the houses. The prevalence of dairy products in vessels from both Late Bronze Age and Early Iron Age phases of occupation is apparent, with relatively few residues of solely non-dairy (ruminant adipose *i.e.* meat) origin from any phase. However, a greater degree of mixing of dairy products with ruminant carcass products in the pots can perhaps be suggested for the Early Iron Age pottery residues (Figure 17.2).

The considerable isotope heterogeneity observed is suggested to be due to food products in pots being used for milk, although this may have occurred over sequential uses. Furthermore, the supplement of different fodders for animals may also alter the $\delta^{13}C$ values of the fatty acids obtained from milk samples. Variation in pastures or fodders could, therefore, partly explain the large variation of $\delta^{13}C$ fatty acid values recovered from the Cladh Hallan pottery. Cattle may have grazed on different pastures at different times of the year, whilst climatic changes and animal health could potentially affect isotope fatty acid measurements (Christie 1981). Alternatively, the large range of isotopic values in the analysed FAMEs from potsherds may be more consistent with the supplement of $\delta^{13}C$-enriched fodders, such as marine plants. The supplement of marine products such as seaweed and fish waste can be fed directly to animals or indirectly as crop

fertiliser. Ethnographic evidence and modern-day farming practices suggest that seaweed was regularly used to fertilise the machair soil (Martin 1716; *cf* Chapter 15).

The interpretation of organic residue analyses must consider how food was used in terms of daily lifestyle. For example, the occurrence of milk residues in potsherds in comparison to other food substances, such as plants and vegetables, may over-represent its actual relative importance. Plants and vegetables are relatively lipid-poor and may leave less distinguishable markers that degrade quickly after initial use during cooking or are lost by leaching into the surrounding soil during burial (Regert *et al.* 1998). Alongside dairy products, low concentrations of plant-derived biomarkers arising from degradation of leafy plants were also observed (in CH-4 [pit fill 1423 in House 401] and CH-8 [fill 1203 in House 1370], both at the Phase 10–11 interface dating to *1015–930 BC at 95% probability*). The plant biomarkers were detected only in

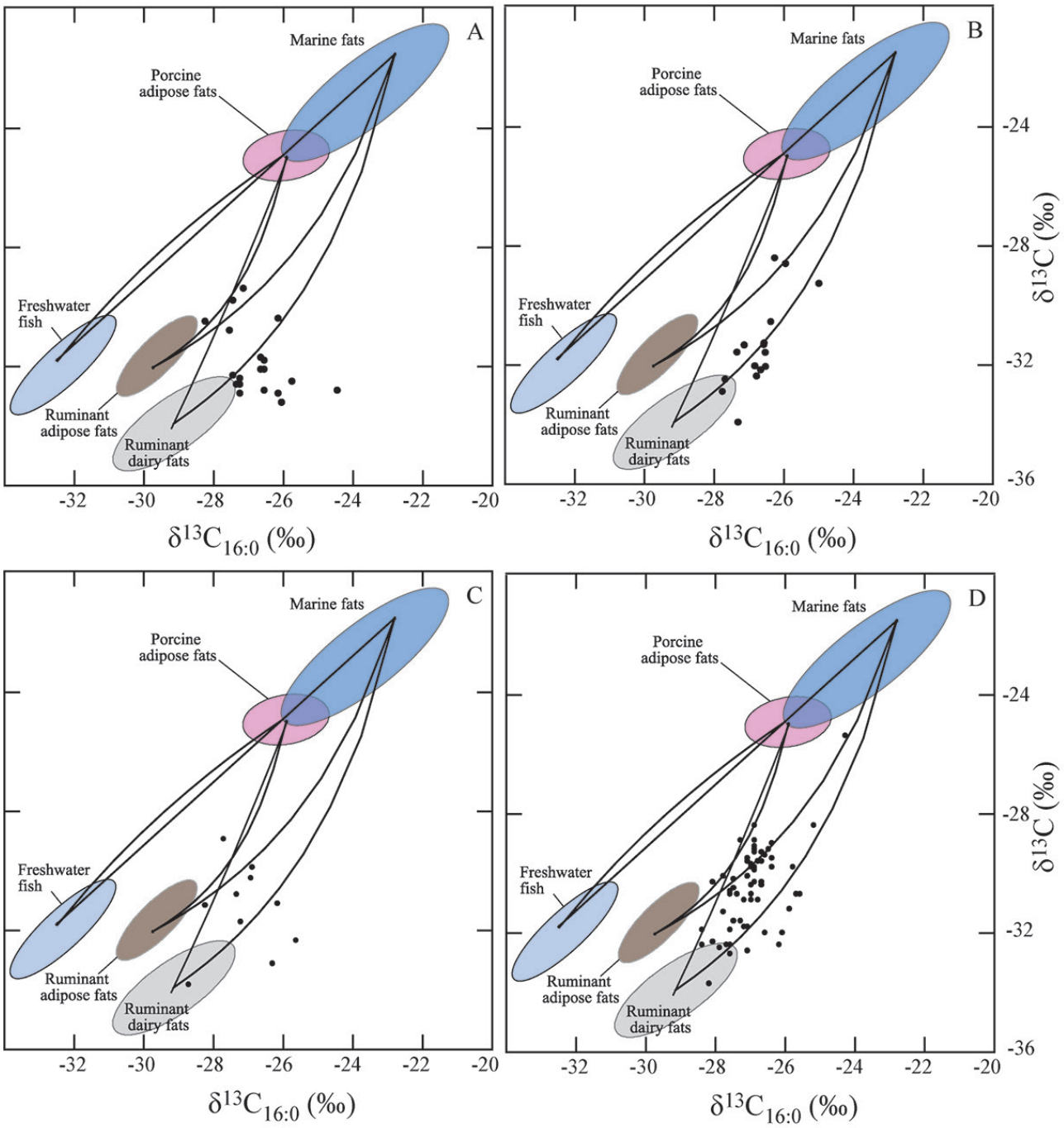


Figure 17.3. Scatter plots of compound-specific stable carbon isotope determinations from previously absorbed pottery residues from the Outer Hebrides (Cramp et al. *2014). Confidence ellipses are as in Figure 17.2. A - Neolithic pottery (Dunasbroc, Loch Olabhat, Bharpa Langais), B - Late Bronze Age pottery (Cladh Hallan), C - Early Iron Age pottery (Cladh Hallan), D - Middle-Late Iron Age pottery (Baile Sear, Bornais, Dun Vulan)*

Late Bronze Age sherds and not those of the Early Iron Age; the sample numbers are, however, too small to draw conclusions from this.

It is notable that, despite the prominence of ruminants at Cladh Hallan, predominantly ruminant carcass product-derived residues were detected in very few potsherds. This may suggest that the meat from these animals was being processed for consumption in a different way. However, the variation in $\Delta^{13}C$ values of absorbed fatty acids cannot rule out mixing of milk with small quantities of meat and possibly fish products, either in gruels or broths in the pot. The external sooting of the sherds does suggest that the pot contents were heated rather than just stored or collected. It is debatable whether heating could have served as a sterilisation process, possibly prior to preparing soured milk, curds and whey, butter or cheese. Finally, if milk were a special food consumed only at infrequent times of ritual and ceremonial significance, then certain deposits such as those of near-complete vessels, might derive from such practices and thus be unrepresentative of daily patterns of consumption. Ethnographic evidence has suggested that milk can be used as a waterproof sealant (Gibson 2002), although this signal would become mixed with subsequent uses of the vessel (*e.g*. Miller *et al.* 2020). Additionally, organic residue analysis of external surfaces from potsherds does not result in the detection of fatty acids.

The results in this investigation suggest that dairying played a major role in the prehistoric agricultural strategy in South Uist. This suggestion that dairying was a productive and well-maintained farming strategy is, however, at odds with the perceived marginality of the Western Isles (McCormick 1998). It should be noted that the concept of marginal areas and marginal environments is subjective. Increased crop production of floral species such as oats and rye, especially during the Norse period, coupled with evidence of food storage rooms, suggests that cattle were well-fed even during the long winter months (Sharples and Parker Pearson 1999; Smith and Mulville 2004). Therefore, the argument that juvenile deaths were due to lack of fodder does not hold for the Norse period (McCormick 1998). In addition to winter foddering, the provision of winter shelters for cattle is also implied if dairying was an important economic activity throughout the year. The antiquity of byre-stalling as far back as the Middle Iron Age is unclear although rectangular buildings at Allasdale, Barra (Young 1952) and Clettraval, North Uist (Scott 1948) have been interpreted as byres or barns. Similar structures with roughly paved floors were found at Dun Vulan although they are considered unsuitable for cattle (Parker Pearson and Sharples 1999). However, the presence of cattle dung at Dun Vulan (Parker Pearson and Sharples 1999), along with shed deciduous teeth recorded from a number of other sites (Halstead 1998), does suggest some containment of cattle. Soil micromorphological analysis of house floors at Cladh Hallan reveals that Houses 1370 and 401 were occasionally used for penning ruminant herbivores (see Volume 1: chap. 13). Whether this was occasional, overnight, only for inclement weather or for the whole winter is at present unknown. Further investigation involving bile acids, plant biomarkers and lipid distribution in soils from byre contexts may help elucidate the antiquity of indoor stalling (Bull *et al.* 1999).

These data can be situated within the wider, previously published dataset of organic residues from prehistoric sites in the Outer Hebrides. Organic residues from Neolithic sites in the Uists and Isle of Lewis likewise demonstrate a preponderance of dairy residues although with some vessels clearly reserved for meat products (Cramp *et al.* 2014; Hammann *et al*. 2022). The Cladh Hallan pottery residues are the only Bronze Age potsherds currently analysed from the Outer Hebrides but, if anything, they demonstrate even greater emphasis on processing of dairy products, at least for these vessels sampled. Analyses of pottery organic residues of Early Iron Age date from the Outer Hebrides are limited. These findings can also be considered against Late Iron Age pottery residues from elsewhere in the Outer Hebrides, including Dun Vulan (South Uist), Dun Arnistean (Isle of Lewis) and Bornais (South Uist; Figure 17.3). These residues similarly reveal a significant proportion of dairy products but much greater evidence for ruminant carcass product processing by this point in time (Cramp *et al*. 2014).

17.7 Summary

A biomolecular approach has securely identified evidence for dairying occurring throughout at least the first millennium BC in the Western Isles. Organic residue analysis has revealed widespread use of the Bronze Age and Early Iron Age pottery from Cladh Hallan for dairy products, in line with that observed from other prehistoric sites in the Outer Hebrides. Interestingly, again consistent with Neolithic pottery vessels from the region, there is no evidence for processing of aquatic resources in the pots. There is some sign of greater mixing of animal carcass and dairy products in pots by the Early Iron Age, a possible prelude to a much wider use of pots for meat products by the Late Iron Age in the Western Isles.

18 Isotope analysis of human and animal remains

O.E. Craig, G. Taylor, J. Jones, J.I. Griffith and C. Snoeck

18.1 Stable isotopes

Oliver E. Craig, Gillian Taylor and Jennifer Jones

Introduction

Carbon and nitrogen stable isotope analysis was conducted on the human remains, described in Chapter 19, in order to provide insights into long-term dietary histories of some of the inhabitants of Cladh Hallan. This type of analysis is particularly suited to determining the relative contribution of marine and terrestrial foods in the diet and has been widely applied to prehistoric skeletal remains from coastal northern European sites. Past stable isotope research has focused both on determining chronological changes in diet at the population level corresponding to gross economic transitions (*e.g*. Tauber 1981; Richards *et al.* 2003; Barrett *et al*. 2004) and examining dietary variability within specific populations (*e.g*. Richards *et al.* 1998; Privat *et al.* 2002; Jay and Richards 2006). Here we will explore the significance of the stable isotope data from the Cladh Hallan humans through comparison with data from some of the Cladh Hallan fauna and from other sites in the Outer Hebridean islands. Considering the coastal locations of these sites, determining the relative contribution of marine foods is a key aim of this research.

The $\delta^{13}C$ and $\delta^{15}N$ stable isotope analysis of animal bone collagen is vital as a baseline for the interpretation of human stable isotope values but can also be a valuable tool for understanding past animal management strategies, and the use of wider landscapes in terms of grazing locations, foddering locations and even species ecologies.

The stable isotope analyses of faunal remains at Cladh Hallan were undertaken to:

- Provide insights into the management of domestic species at the site, in particular the use of the shorefront in the context of grazing and foddering strategies.
- Provide initial insights into the ecology of birds found at the site.
- Compare management strategies to those observed in other contemporary island sites.

Background: stable isotope analysis and palaeodietary reconstruction

Stable isotopes are atoms of the same element that exhibit different masses. The isotopic ratio of elements often varies between foods. When foods are consumed their atoms, with distinctive isotope ratios, are synthesised into the consumer's tissues, including bone. The analysis of isotope ratios in these tissues, *post mortem*, using a mass spectrometer, enables an individual's diet to be reconstructed. Stable carbon and nitrogen isotope analysis of human bone collagen (a bone protein) is the technique most frequently used for palaeodietary reconstruction. Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios in human bone collagen provide an average dietary record of the individual *c*. 5–10 years prior to death. Studies have also suggested that bone collagen isotopes predominantly reflect the protein portion of diet, although this is modulated by overall nutritional status (see Jim *et al.* 2005; Hedges 2006). Carbon isotope ratios vary principally according to the ecosystem that foods are derived from. Carbon isotopes from marine organisms, and therefore consumers of marine foods, are enriched in the heavier isotope (^{13}C) and thus have less negative $\delta^{13}C$ values compared to most terrestrial food consumers. However, consumers of terrestrial C4 plants (mainly tropical sedges and grasses) are also enriched in ^{13}C relative to C3 plants (most temperate grasses and dicotyledonous plants), providing a possibility of overlap with marine consumers. Nevertheless, we can effectively rule out C4 plants from the list of foods available to the prehistoric Hebridean islanders. Therefore, in this geographical region, high relative amounts of ^{13}C provide good evidence of marine consumption.

Stable nitrogen isotope ratios indicate the trophic level of the consumer and are enriched by *c*. 3‰ in the heavier isotope (^{15}N) with increasing trophic level.

Therefore, nitrogen isotopes also provide a good basis for discriminating marine from terrestrial food consumers as marine foods are usually at a higher trophic level and thus more enriched in ^{15}N. Nitrogen isotopes can also be used to discriminate herbivores from carnivores. It is worth noting that isotope ratios in the same foodstuffs may vary geographically and temporally; accurate reconstruction of diet is therefore achieved by measuring stable isotope ratios in bone collagen from associated faunal remains. However, associated plant materials are not generally available from archaeological sites and thus assumptions have to made by considering isotope ratios in modern plant materials and archaeological herbivore bone collagen. Carbon isotope values of consumers are also slightly enriched in the heavier isotope (by *c*. 1‰) compared with the foods they consume, *i.e*. by trophic level.

Background: stable isotope analysis and animal management

The stable isotope values of animals can be affected by the environmental conditions that they experience, such as consumption of vegetation grown in saline environments or affected by sea spray (Virginia and Delwiche 1982; Britton 2008), alongside other factors including altitude, geology and aridity (Ambrose and DeNiro 1986; Heaton 1986; Sealy *et al.* 1987). Human activity can also play a role in affecting the stable isotope values of animals as a result of manuring of crops (Bogaard *et al*. 2007). Stable isotope analysis has been effectively used in the Scottish islands to explore changes in animal management strategies through time, and the use of different fodder and grazing locations in different temporal periods (Jones and Mulville 2016; 2018). Differences in isotopic values between species can reveal the management practices used, and whether animals were treated in the same way. Comparisons with wild fauna can help to understand how domestic species were being managed.

Materials and methods

Seventeen human samples (14 bones and three teeth) from Cladh Hallan were submitted for radiocarbon dating at SUERC AMS laboratory at East Kilbride (Table 18.1). High molecular-weight collagen was extracted from bone and teeth samples and measured for ^{14}C. As part of this analysis, $\delta^{13}C$ and $\delta^{15}N$ values were obtained from the same samples.

A total of 41 new animal specimens were analysed from Cladh Hallan as part of doctoral research by Jones (2013), comprising red deer, cattle, sheep, pigs and a series of bird bones (Table 18.2). Of these, five specimens did not contain sufficient collagen for analysis. These newly generated data were combined with the results of previous analysis undertaken by Mulville *et al*. (2009), in addition to those generated during the radiocarbon-dating process. In total, 73 results were available for interpretation (Table 18.2).

The collagen from the animal bone samples was extracted at Cardiff University's Bioarchaeology Laboratory. Bone fragments weighing between 0.7g and 0.9g were drilled and cleaned using aluminium oxide air abrasion. Samples were demineralised in 0.5 M HCL at 6°–8° C for between three and ten days. Specimens were washed three times using deionised water before being gelatinised in a weak acidic solution (pH 3 HCl) at 70° C for 48 hours. Samples were filtered using 5µm–8µm biological filters (Evergreen Scientific, California, USA). Isotopic analysis of specimens was undertaken at the University of Cambridge's Dorothy Garrod Laboratory for Isotopic Analysis.

The extracted collagen was combusted using an ECS 4010 elemental analyser (Costech, Milan, Italy), coupled to a Delta V Plus isotope ratio mass spectrometer (Thermo Fisher Scientific, Bremen, Germany). The $\delta^{13}C$ values and $\delta^{15}N$ values are reported relative to the VPDB and AIR standards. All data discussed in this study have C:N values between 2.9 and 3.6, suggesting well-preserved *in vivo* collagen (DeNiro 1985). The Mann–Whitney U test was used for statistical analysis, with a post hoc Holm–Bonferroni correction (Holm 1979) using the ecological statistical programme 'PAST' (Hammer *et al*. 2001). A *p* value of .05 or less was deemed to be indicative of a statistically significant result.

Results from the human specimens

The $\delta^{13}C$ and $\delta^{15}N$ data and radiocarbon dates for 17 human specimens from Cladh Hallan are given in Table 18.1, along with comparable data from other sites in the Western Isles obtained from various radiocarbon dating programmes. All the sites lie on or near to the coast in the fertile low-lying machair environmental zone. The human specimens analysed comprise the remains of nine adults and six children (out of a total of nine adults' bones and six children's bones). Collagen samples with carbon to nitrogen ratios (C:N) between 2.9 and 3.6 are considered suitable for producing accurate $\delta^{13}C$ and $\delta^{15}N$ measurements (DeNiro 1985). All the reported C:N values fall within this range except sample CH2613. In addition, C:N values were not reported in all cases as the measurements were not routinely made during the course of the AMS-dating procedure. For this reason, it is hard to determine accuracy and precision of all the stable isotope values from these sources and large errors (up to 1‰) are probably to be expected.

The results of the human stable isotope analysis from Cladh Hallan are plotted with the faunal data in Figure 18.1. In Figure 18.2, the $\delta^{13}C$ and $\delta^{15}N$ stable isotope values are compared with other data from South Uist including several adult remains from the Iron Age broch of Dun Vulan (Parker Pearson and Sharples 1999), an unstratified fragment of an adult's skull recovered from Sligeanach, Cill Donnain (Sharples 2012b, an adult female buried in a Pictish cairn at Cille Pheadair (cal AD 640–780, with a second date of cal AD 428–579; Parker Pearson *et al*. 2018) and unstratified adult remains recovered from Ardivachar Point (cal AD 605–655; Sharples *et al*. 2005b: 147) and Polochar (cal AD 250–390; Sharples *et al*. 2005a: 148). In Figure 18.3, radiocarbon dates for all the published human remains from the Western Isles have been calibrated

Table 18.1. Human bone stable isotope data from Cladh Hallan and other prehistoric sites in the Western Isles

Site name	SF/SK no.	Context	Skeletal element	Age/sex	$\delta^{15}N$	$\delta^{13}C$	C:N	AMS reference	Radiocarbon years BP	Calibrated years BC (2σ)
Cladh Hallan	4907	Grave fill 2598	Bone	Adult 30+/M	10.8	−19.9	3.3	GU-9838	3105±50	1500–1260
	2613	Grave fill 2611	Bone	Adult/F&M	11.4	−19.5	2.8	GU-9839	3025±55	1420–1110
	2638	Grave fill 2598	Bone	Adult 40+/M	9.9	−19.9	3.1	GU-9837	3305±55	1740–1450
	2638	Grave fill 2598	Bone	Adult 30–50/M	10.8	−19.9	n/a	GU-9854	3105±50	1500–1260
	4904	Area A	Bone	Adult/-	10.5	−19.4	3.2	GU-9822	3300±45	1400–1055
	4905	Area B	Bone	Adult/-	11.8	−19.3	3.0	GU-9823	1875±45	AD 20–AD 250
	4752	2748	Bone	Adult/F (belongs to SK 2613)	11.4	−19.5	n/a	GU-9842	3040±50	1420–1120
	4908	2544	Bone	Adult/F	10.1	−20.2	n/a	GU-9843	3295±50	1690–1450
	4909	2106	Bone	Adult/-	5.9	−19.1	n/a	GU-9844	2865±55	1160–990
	3473	1320	Tooth	Adult/-	10.5	−19.4	n/a	GU-9845	3170±50	1540–1290
	2045	473	Tooth	Adult/-	10.8	−19.7	n/a	GU-9846	insufficient collagen	
	2792	2738	Bone	Young child 1.5-3y/F	8.6	−18.8	n/a	GU-9841	3070±50	1450–1190
	3107	465	Tooth	Older child *c.* 8-12y	10.8	−19.1	n/a	GU-9825	2710±70	1030–770
	2188	2166	Bone	Neonate/F	12.2	−18.9	2.9	GU-9836	2905±50	1070–970
	2727	2563	Bone	Older child/ juvenile 10-14y/?F	10.6	−22.2	n/a	GU-9840	2845±50	1200–890
	4906	U/S Area C	Bone	Older child/ juvenile 9-12y/M	9.7	−19.5	3.4	GU-9824	3205±50	1610–1390
	4910	465	Bone	Neonate/-	9.3	−16.1	n/a	GU-9847	2390±60	760–380
Dun Vulan		29/21	Tooth		9.2	−21.0	n/a	GU-9826	1950±55	60–AD 220
		20/12	Bone		9.5	−20.6	n/a	GU-9827	2055±55	210–AD 70
		729	Bone		6.3	−21.2	3.4	GU-9829	1800±45	AD 80–AD 350
		779	Bone		10.7	−19.1	3.1	GU-9830	2090±50	350–AD 30
		776	Bone		11.4	−18.8	3.1	GU-9832	2040±50	210–AD 90
		772	Bone		9.1	−18.9	3.1	GU-9833	2115±55	360–AD 10
		795	Bone		11.4	−19.1	3.2	GU-9834	1990±60	170–AD 130
Sligeanach		U/S	Bone		11.2	−20.3	3.4	GU-9835	1530±45	AD 420–AD 620
Cille Pheadair		908	Bone		10.7	−21.8	n/a	GU-9848	1325±45	AD 640–AD 780

Site name	SF/SK no.	Context	Skeletal element	Age/sex	$\delta^{15}N$	$\delta^{13}C$	C:N	AMS reference	Radiocarbon years BP	Calibrated years BC (2σ)
Ardivachar, S.Uist		n/a	Bone		10.2	−21.1	3.1	GU-9159	1415±35	AD 570–AD 665
Polochar, S.Uist		n/a	Bone		10.8	−19.6	3.2	GU-9160	1720±35	AD 240–AD 410
Cnip, Lewis			Bone			−18.3	n/a	GU-3485	1150±50	AD 720–AD 1020
			Bone			−20.8	n/a	GU-3489	1150±50	AD 720–AD 1020
			Bone			−21.0	n/a	GU-3487	1180±50	AD 690–AD 980
			Bone			−18.3	n/a	GU-3486	1200±50	AD 680–AD 970
			Bone			−17.0	n/a	OxA-9604	1332±40	AD 640–AD 780
			Bone			−20.7	n/a	GU-3488	3360±50	1770–1510
An Corran, Boreray			Bone			−19.4	n/a	OxA-8803	1815±40	AD 80–AD 330
			Bone			−19.4	n/a	OxA-8802	1875±45	AD 20–AD 250
Galson, Lewis			Bone			−21.1	n/a	GU-7400	1770±60	AD 120–AD 410
			Bone			−20.4	n/a	GU-7401	1850±50	AD 50–AD 330
			Bone			−19.0	n/a	OxA-9606	1984±36	60–AD 120
			Bone			−19.9	n/a	OxA-9607	3995±45	2630–2340
			Bone			−19.3	n/a	OxA-9605	2031±35	170–AD 60

Table 18.2. Animal bone stable isotope data from Cladh Hallan

Context	Species	Skeletal element	Sample no.	$\delta^{13}C$ ‰	$\delta^{15}N$ ‰	C:N	Reference
731	Red deer	Metacarpal	CHJ01	No collagen	No collagen	No collagen	Jones 2013
473	Red deer	Metacarpal	CHJ02	−21.3	5.4	3.3	Jones 2013
738	Red deer	Scapula	CHJ03	−21.8	4.4	3.3	Jones 2013
470	Red deer	Humerus	CHJ04	−21.3	4.3	3.3	Jones 2013
473	Red deer	Radius	CHJ05	−21.3	5.0	3.4	Jones 2013
473	Red deer	Tibia	CHJ06	−21.4	5.1	3.3	Jones 2013
659	Red deer	Tibia	CHJ07	−21.5	4.3	3.3	Jones 2013
473	Red deer	Metatarsal	CHJ08	No collagen	No collagen	No collagen	Jones 2013
473	Red deer	Tibia	CHJ09	−22.4	6.2	3.4	Jones 2013
473	Sheep/goat	Radius	CHJ10	−20.2	6.8	3.3	Jones and Mulville 2016
473	Sheep/goat	Tibia	CHJ11	−20.9	6.8	3.3	Jones and Mulville 2016
470	Sheep/goat	Ulna	CHJ12	−20.1	6.6	3.3	Jones and Mulville 2016
473	Sheep/goat	Tibia	CHJ13	−20.1	5.6	3.3	Jones and Mulville 2016
473	Sheep/goat	Radius	CHJ14	−20.7	6.7	3.4	Jones and Mulville 2016
473	Sheep/goat	Tibia	CHJ15	−20.7	4.9	3.3	Jones and Mulville 2016
470	Sheep/goat	Ulna	CHJ16	−19.9	7.9	3.4	Jones and Mulville 2016
473	Sheep/goat	Tibia	CHJ17	No collagen	No collagen	No collagen	Jones and Mulville 2016
473	Cattle	Metacarpal	CHJ18	−21.6	5.3	3.2	Jones and Mulville 2016
474	Cattle	Metacarpal	CHJ19	−21.5	5.2	3.3	Jones and Mulville 2016
473	Cattle	Metatarsal	CHJ20	−21.5	5.3	3.2	Jones and Mulville 2016
473	Cattle	Metatarsal	CHJ21	No collagen	No collagen	No collagen	Jones and Mulville 2016
731	Cattle	Metatarsal	CHJ22	−21.7	6.3	3.3	Jones and Mulville 2016
738	Cattle	Scapula	CHJ23	No collagen	No collagen	No collagen	Jones and Mulville 2016
473	Cattle	Metatarsal	CHJ24	−21.7	5.8	3.3	Jones and Mulville 2016
721	Cattle	Radius	CHJ25	−21.3	6.0	3.3	Jones and Mulville 2016
738	Pig	Humerus	CHJ26	−19.8	10.2	3.2	Jones and Mulville 2016
473	Pig	Metapodial	CHJ27	−20.4	7.5	3.2	Jones and Mulville 2016
731	Pig	Femur	CHJ28	−22.3	7.5	3.2	Jones and Mulville 2016
473	Red deer	Radius	CHJ29	−21.9	4.5	3.3	Jones and Mulville 2016
412	Great Auk	Humerus	JJ68	−14.2	12.4	3.4	Jones 2013

Context	Species	Skeletal element	Sample no.	$\delta^{13}C$ ‰	$\delta^{15}N$ ‰	C:N	Reference
2082	Great Auk	Humerus	JJ69	−14.5	12.6	3.4	Jones 2013
474	Cormorant	Humerus	JJ70	−11.2	15.9	3.4	Jones 2013
1310	Cormorant	Humerus	JJ71	−13.1	15.7	3.4	Jones 2013
1461	Gannet	Ulna	JJ72	−13.5	14.3	3.3	Jones 2013
1461	Gannet	Ulna	JJ73	−13.9	12.7	3.3	Jones 2013
655	Greylag/bean goose	Humerus	JJ74	−12.9	16.4	3.4	Jones 2013
755	Greylag/bean goose	Humerus	JJ75	−20.9	5.7	3.3	Jones 2013
2020	Swan	Tibiotarsus	JJ76	−14.9	6.6	3.4	Jones 2013
412	Swan	Tibiotarsus	JJ77	−16.9	5.4	3.5	Jones 2013
2863	Herring gull	Tibiotarsus	JJ78	−14.0	16.5	3.4	Jones 2013
2189	Herring gull	Tibiotarsus	JJ79	−13.4	14.5	3.4	Jones 2013
	Cattle			−20.1	4.9		Mulville *et al*. 2009
	Cattle			−21.1	5.8		Mulville *et al*. 2009
	Cattle			−21.7	5.8		Mulville *et al*. 2009
	Cattle			−22.3	4.7		Mulville *et al*. 2009
	Cattle			−22.1	4.6		Mulville *et al*. 2009
	Cattle			−21.7	5.8		Mulville *et al*. 2009
	Cattle			−21.7	4.1		Mulville *et al*. 2009
	Cattle			−21.9	4.9		Mulville *et al*. 2009
	Cattle			−21.8	5.2		Mulville *et al*. 2009
	Sheep			−21.7	4.7		Mulville *et al*. 2009
	Sheep			−22.1	4.2		Mulville *et al*. 2009
	Sheep			−21.1	5.5		Mulville *et al*. 2009
	Sheep			−20.6	4.4		Mulville *et al*. 2009
	Dog			−19.0	10.3		Mulville *et al*. 2009
	Dog			−18.8	10.5		Mulville *et al*. 2009
	Sheep			−19.9	6.3		Mulville *et al*. 2009
	Sheep			−20.4	5.4		Mulville *et al*. 2009
	Sheep			−21.1	5.3		Mulville *et al*. 2009
	Cattle		GU-14167	−20.9	4.4	3.4	Mulville *et al*. 2009

(Continued)

Table 18.2. Animal bone stable isotope data from Cladh Hallan (Continued)

Context	Species	Skeletal element	Sample no.	$\delta^{13}C$ ‰	$\delta^{15}N$ ‰	C:N	Reference
	Sheep		GU-14168	−20.3	5.0	3.2	From radiocarbon dating
	Dog		GU-14169	−19.2	7.4	3.3	From radiocarbon dating
	Dog		GU-14170	−19.9	8.8	3.2	From radiocarbon dating
	Sheep		GU-14171	−20.5	4.6	3.6	From radiocarbon dating
	Sheep		GU-14172	−20.1	6.4	3.3	From radiocarbon dating
	Cattle		GU-14173	−20.8	4.9	3.4	From radiocarbon dating
	Cattle		GU-14208	−20.7	5.1	3.3	From radiocarbon dating
	Dog		GU-14210	−20.4	9.3	3.2	From radiocarbon dating
	Cattle		GU-14211	−20.5	6.2	3.3	From radiocarbon dating
	Sheep		GU-14212	−20.6	6.8	3.4	From radiocarbon dating
	Cattle		GU-14213	−21.1	6.3	3.4	From radiocarbon dating
	Cattle		GU-14214	−20.1	5.0	3.5	From radiocarbon dating
	Sheep		GU-14217	−19.7	6.8	3.6	From radiocarbon dating
	Sheep		GU-14219	−20.4	6.0	3.5	From radiocarbon dating
	Sheep		GU-14221	−20.2	6.4	3.2	From radiocarbon dating
	Sheep		GU-14222	−21.0	7.3	3.2	From radiocarbon dating
	Sheep		GU-14223	−21.0	7.5	3.3	From radiocarbon dating
	Sheep		GU-14329	−19.0	7.2	3.5	From radiocarbon dating

*Grey colour denotes where information is unavailable

using the OxCal program (Bronk Ramsey 2001) with atmospheric data from Reimer *et al.* (2004) and plotted against $\delta^{13}C$ values.

Discussion: human diet

Estimating the marine contribution to the human diet

To estimate the marine contribution to the diet of the individuals recovered from Cladh Hallan, it is first necessary to establish the local marine and terrestrial theoretical end-points (*i.e.* the isotope values corresponding to 100% marine and 100% terrestrial diets in the Western Isles for the approximate period). These data may be ascertained by considering the isotope values of associated archaeological faunal remains with known diets. The terrestrial end-point is easily estimated from a range of measurements made on terrestrial herbivores (*i.e.* cattle, sheep, red deer) which produced a consistent $\delta^{13}C$ value of −21‰ ±1‰ (Table 18.2). The human terrestrial carbon end-point is therefore *c.* −20%, allowing for a 1‰ enrichment in the heavier isotope due to the trophic effect. However, no stable isotope measurements were made on marine fauna from Cladh Hallan although remains of seals, whales and marine fish are present in the faunal assemblage (see Chapters 10, 11 and 13). However, isotope values from a seal phalange from the nearby site of Dun Vulan were available and Richards and Mellars (1998) have previously published isotope values for seal bones from a Mesolithic site on Oronsay in the Inner Hebrides. Also a single measurement was made on an auk bone (Alcidae spp) from Dun Vulan (Parker Pearson and Sharples 1999: table 9.1). All these measurements are in broad agreement, suggesting that a theoretical isotopic marine end-point for humans of −12‰ to −13‰ is reasonable.

Nearly all the carbon stable isotope values from the humans at Cladh Hallan are close to the terrestrial end-point (−20‰; allowing for a 1‰ enrichment in the heavier isotope due to the trophic effect). One value of −22‰, belonging to a juvenile (10–14 years old), does not fit within the limits defined by considering the animal values and is anomalous. The majority of values range from *c.* −19‰ to −20‰ which therefore indicates that dietary protein was derived from predominantly terrestrial sources. However, interestingly a number of the adults have $\delta^{15}N$ values that are elevated by more than 3‰ (*i.e.* one trophic level) compared with the terrestrial herbivores (Figure 18.1). Consumption of high trophic-level freshwater fish may explain these data; the site is located within a few miles of some large lochs. Alternatively, the high $\delta^{15}N$ could be explained by consumption of omnivorous pigs, although this is unlikely as pigs were not a major food resource at Cladh Hallan (see Chapter 10) and two of the three pigs that were measured had a $\delta^{15}N$ value that was only slightly

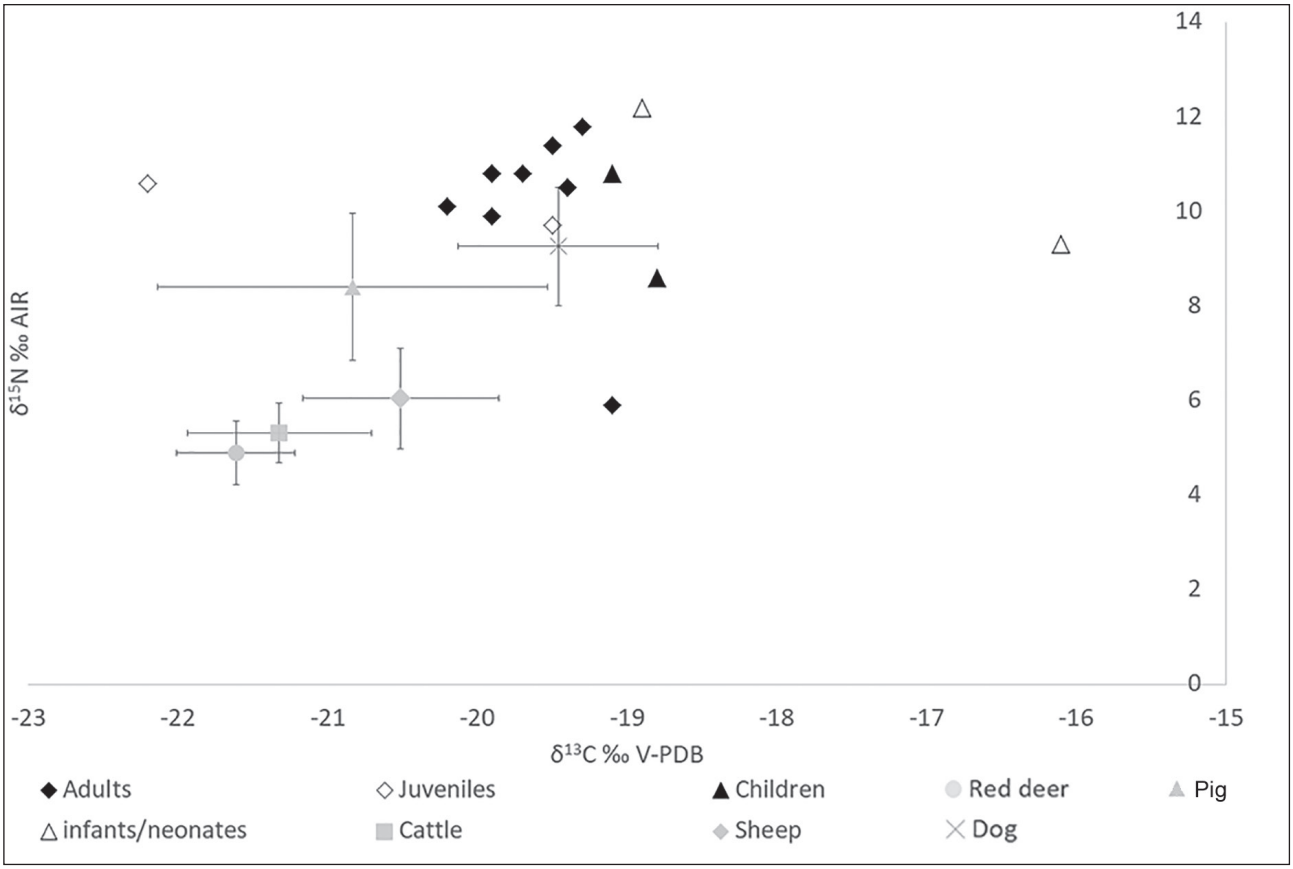


Figure 18.1. Stable carbon and nitrogen isotope values for humans and mammals from Cladh Hallan

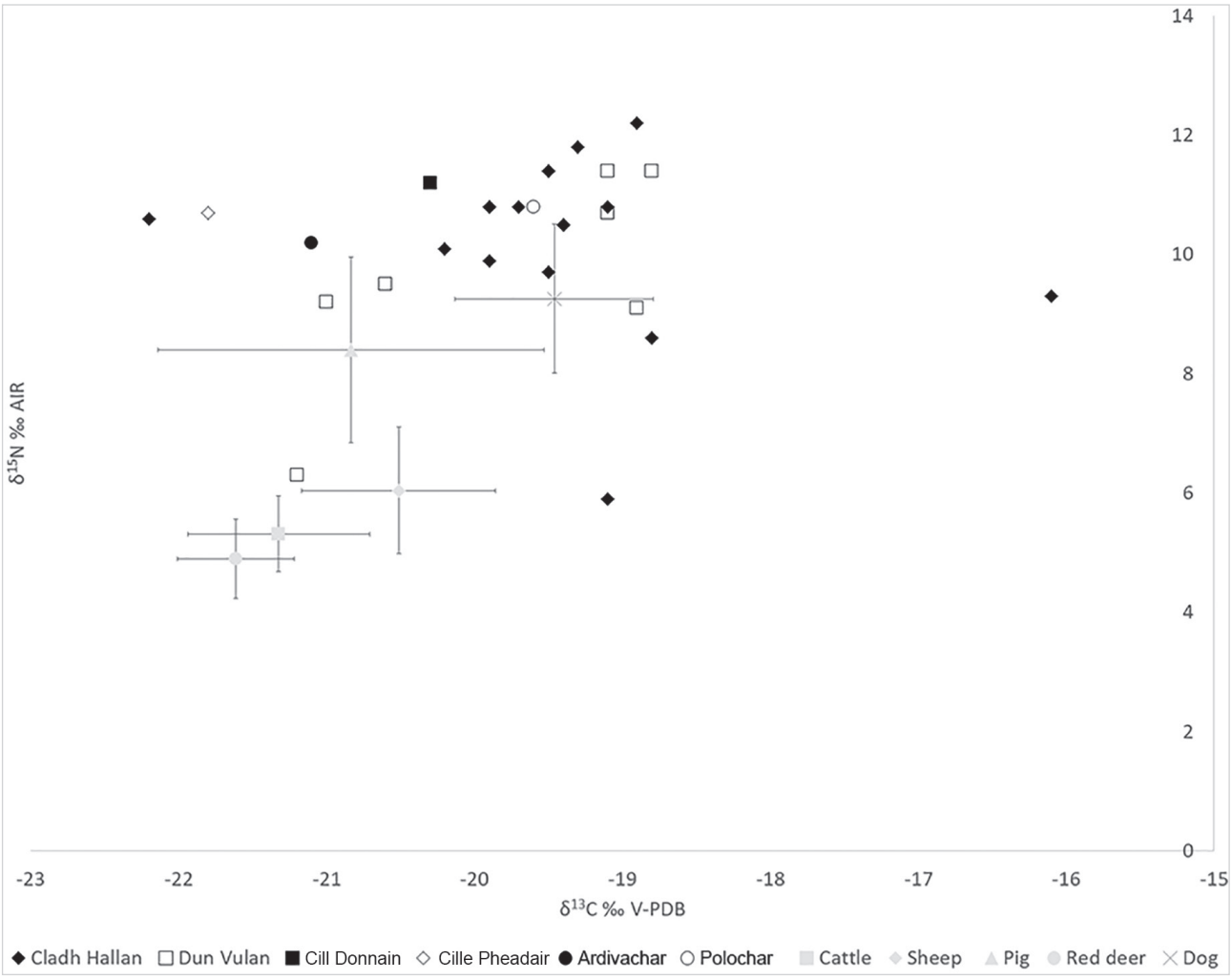


Figure 18.2. Stable carbon and nitrogen isotope values for all sampled humans in the Western Isles and Cladh Hallan mummies (additional data obtained from date lists provided by Mike Parker Pearson and Niall Sharples)

elevated compared with the herbivores (Figure 18.1). Therefore, some input of marine fish may explain the relatively high $\delta^{15}N$ values in the human samples, despite the light $\delta^{13}C$ values which indicate a terrestrial diet.

An explanation for this discrepancy is that carbon from small but significant amounts of marine foods (<20%) is not registered in bone collagen (see Hedges 2004; 2006; Milner *et al.* 2004 for a discussion). Certainly, without further investigation – perhaps involving analysis of single collagen amino acids – it would be wrong to rule out altogether the Cladh Hallan population's exploiting marine foods, especially given the site's (admittedly modest) fish bone assemblage (see Chapter 13). Also notable is that one sample (SF 4910; Table 18.1) – a neonate – has carbon isotope values that are greatly elevated compared to the other humans. As neonatal carbon stable isotope values should be similar to their mothers', the neonate's mother must have had a diet relatively rich in marine foods (SF 4910 was destroyed by AMS so cannot be re-verified as human).

In general, similar carbon and nitrogen isotope values have been reported at other prehistoric and historic sites in the Western Isles (Table18.1, Figures 18.2–18.3). Significantly, none of these samples have stable isotope values even close to the $\delta^{13}C$- and $\delta^{15}N$-enriched values from Late Mesolithic humans living on Oronsay, who were heavily dependent on marine resources (Richards and Mellars 1998). When the $\delta^{13}C$ values are plotted against calibrated radiocarbon dates for all sampled prehistoric humans in the Western Isles (Figure 18.3), there is no consistent pattern, although the heaviest values (most marine) fall in the Late Bronze Age/Early Iron Age. However, we stress that, even during this period, the values indicate predominantly terrestrial diets.

Estimating the contribution of other foodstuffs to diet

If we exclude marine fish as a significant dietary source, then the $\delta^{15}N$ values reveal that most people living at Cladh Hallan must have relied heavily on meat and/or milk of herbivores. Nevertheless, one of the adults (SF 4909; Table 18.1) had a significantly lower $\delta^{15}N$ value, indicating a much greater proportion of plant foods in the diet. Such values are rare considering that plant foods are

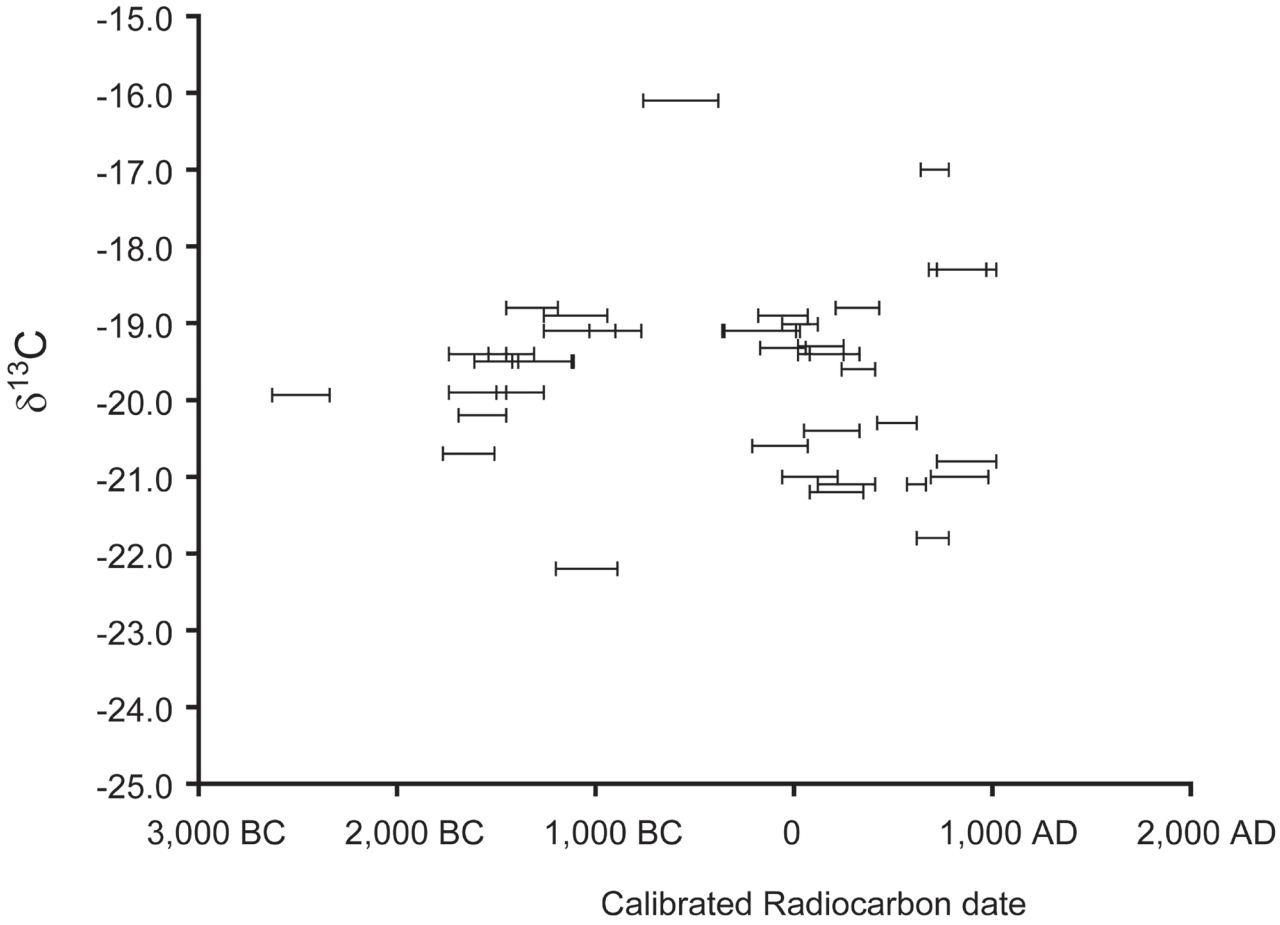


Figure 18.3. Stable carbon isotope values plotted against calibrated radiocarbon dates for all sampled humans in the Western Isles in the last 5,000 years (additional data obtained from Historic Scotland radiocarbon database: http://www.historic-scotland.gov.uk/wwd_carbondatingsearch)

relatively protein-depleted compared to meat or milk and, therefore, are not usually noticeable unless extremely high amounts are consumed. It is interesting to speculate why the long-term diet of this adult is so different from the others (Figure 18.1) and may indicate the deliberate avoidance of or restricted access to meat which was readily available to other members of the population and even to the dogs at Cladh Hallan. A similarly low $\delta^{15}N$ value was also obtained from the humerus of an older adult from Dun Vulan (SF 1082 in context 729; Chamberlain in Parker Pearson and Sharples 1999: 288–9).

Variation within the human population at Cladh Hallan

There are not enough data to examine in depth the role of age and sex behind isotope differences at Cladh Hallan. One of the children (SK 2792; 1.5–3-year-old girl) has a slightly lower $\delta^{15}N$ value signifying a greater consumption of plant foods. The other children and juveniles had diets similar to the adults. The measurements made on dentine from two adult teeth (SF 3473, SF 2045; Table 18.1) also reflect diet during childhood rather than in later life as this tissue turns over much more slowly than bone collagen. The sample from the neonate (SK 2188) has a high $\delta^{15}N$ value and was therefore probably feeding on his or her mother's milk prior to death; nursing infants derive their carbon and nitrogen from their mother's milk and therefore their isotope values are relatively elevated in comparison to their mothers (*e.g.* Schurr 1997).

Results and interpretation of the faunal stable isotope analysis

The $\delta^{13}C$ and $\delta^{15}N$ values of individual animals analysed from Cladh Hallan are shown in Figure 18.4. The sheep generally have higher $\delta^{13}C$ and $\delta^{15}N$ values than the cattle, and statistically significant differences were observed between the two populations ($\delta^{13}C$ p = < .001, $\delta^{15}N$ p = .013). Sheep and cattle have similar metabolisms and are expected to be isotopically indiscernible if consuming the same diet (Hofmann 1989; Van Soest 1994). The difference in values observed between these two species at Cladh Hallan suggests that the two species were not managed in the same way.

The slightly elevated $\delta^{13}C$ and $\delta^{15}N$ values for sheep are characteristic of a saline dietary influence. There is evidence of sheep feeding on seaweed and marine plants in Orkney

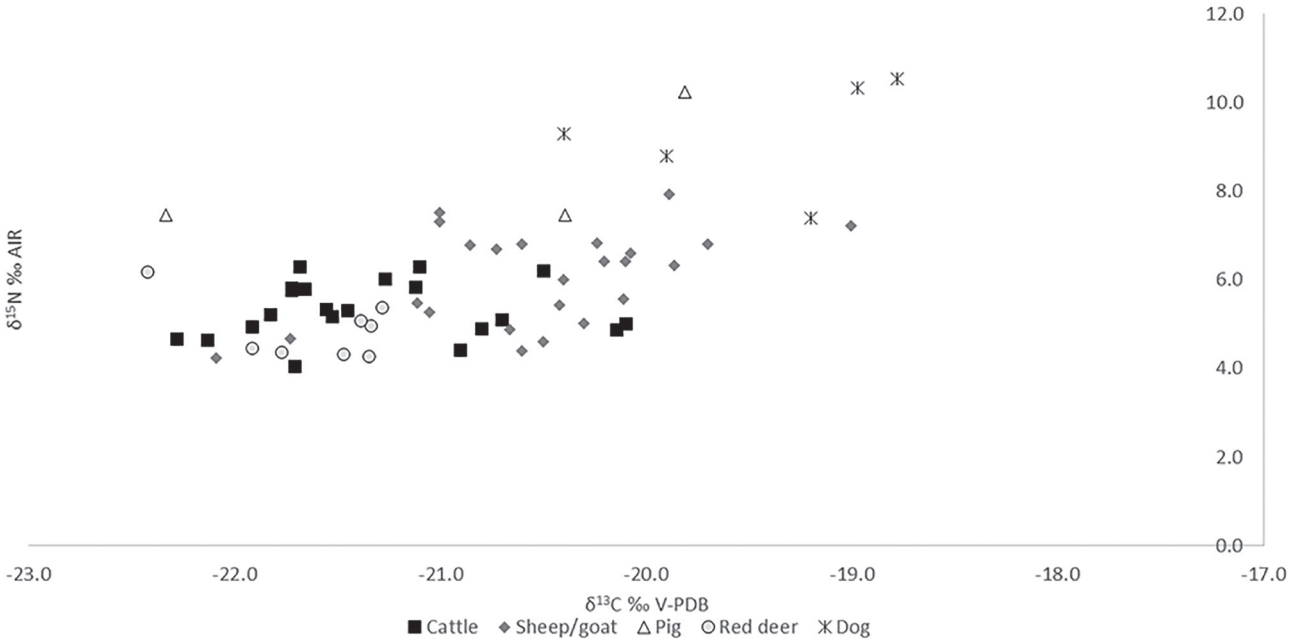


Figure 18.4. Bone collagen $\delta^{13}C$ and $\delta^{15}N$ values of mammalian fauna analysed from Cladh Hallan

from the Neolithic onwards (Balasse *et al*. 2006; 2009; Jones and Mulville 2016), and analysis of neonatal sheep bones from Orkney has suggested that pregnant ewes were fed seaweed during the winter months prior to giving birth (Schulting *et al*. 2017), indicating seasonal use of seaweed as a foddering source. The isotopic signatures at Cladh Hallan are not as pronounced as those seen for seaweed-consuming individuals in Orkney, indicating that feeding on vegetation influenced by sea spray effect is more likely than direct consumption of seaweed. This suggests that the Cladh Hallan sheep were either kept on pastures that were closer to the sea, or that they were being foddered with crops that were growing in shorefront locations.

The cattle are distributed within the plot in a similar location to the wild red deer, and the $\delta^{13}C$ and $\delta^{15}N$ values of these two species are statistically similar with no differences observed between populations ($\delta^{13}C$ p = .404, $\delta^{15}N$ p = .136). This in turn suggests that the cattle and red deer were consuming similar diets and may indicate that the cattle herds were mainly being kept away from coastal pastures, perhaps grazing further inland, and nor were they feeding on crops influenced by salinity.

The dogs (Figure 18.4) have isotopic values that demonstrate a lot of dietary variety. Three have elevated $\delta^{13}C$ values that could be indicative of an infrequent aquatic component to their diet, such as occasional consumption of fish, an interpretation supported by these individuals also having higher $\delta^{15}N$ values. A fourth dog has a slightly lower $\delta^{15}N$ value, at a similar level to the herbivores, suggesting a diet that was dominated by plants, and two of the dogs have a higher $\delta^{15}N$ indicative of consumption of terrestrial protein. This variety in the values observed among the dogs suggests that they were not all eating the same foods, and were potentially owned by different households, being fed scraps from food waste that resulted in their different isotope values.

The pigs also demonstrate a high level of variation in their stable isotope values. One individual has a $\delta^{15}N$ value of 10.2‰, suggesting that its diet included animal protein. The other two pigs have values similar to the herbivores, characteristic of a diet predominantly composed of plant matter. This diversity in values among the pigs is typical of animals with different diets, managed separately as individual animals, potentially indicating more ad hoc management of this species.

The $\delta^{13}C$ and $\delta^{15}N$ values for bird bones from Cladh Hallan are shown in Figure 18.5. As expected, the sea birds all have isotopic signatures indicative of marine protein. The cormorants and herring gulls were all feeding at a trophic level above the gannets and great auks. This suggests that they were targeting larger fish that occupy a higher trophic level. The two swans analysed have values indicative of a diet of predominantly aquatic vegetation, suggesting that they were inhabiting coastal areas and consuming the plants growing there.

The greylag/bean goose specimens analysed have very different diets. One individual has lower $\delta^{13}C$ and $\delta^{15}N$ values, typical of a terrestrial plant-based diet. The other has a very strong marine isotopic signature, suggesting that it was consuming fish protein. Assuming that the species identification of both individuals is correct, this signature suggests that they were routinely consuming very different foods. Our knowledge of the modern-day ecology of greylag and bean geese, available from the RSPB, suggests that both species consume vegetation, including grasses and cereals. It is possible that the individual with the terrestrial plant-based diet may have been trapped whilst on migration, whereas the individual with the strong marine

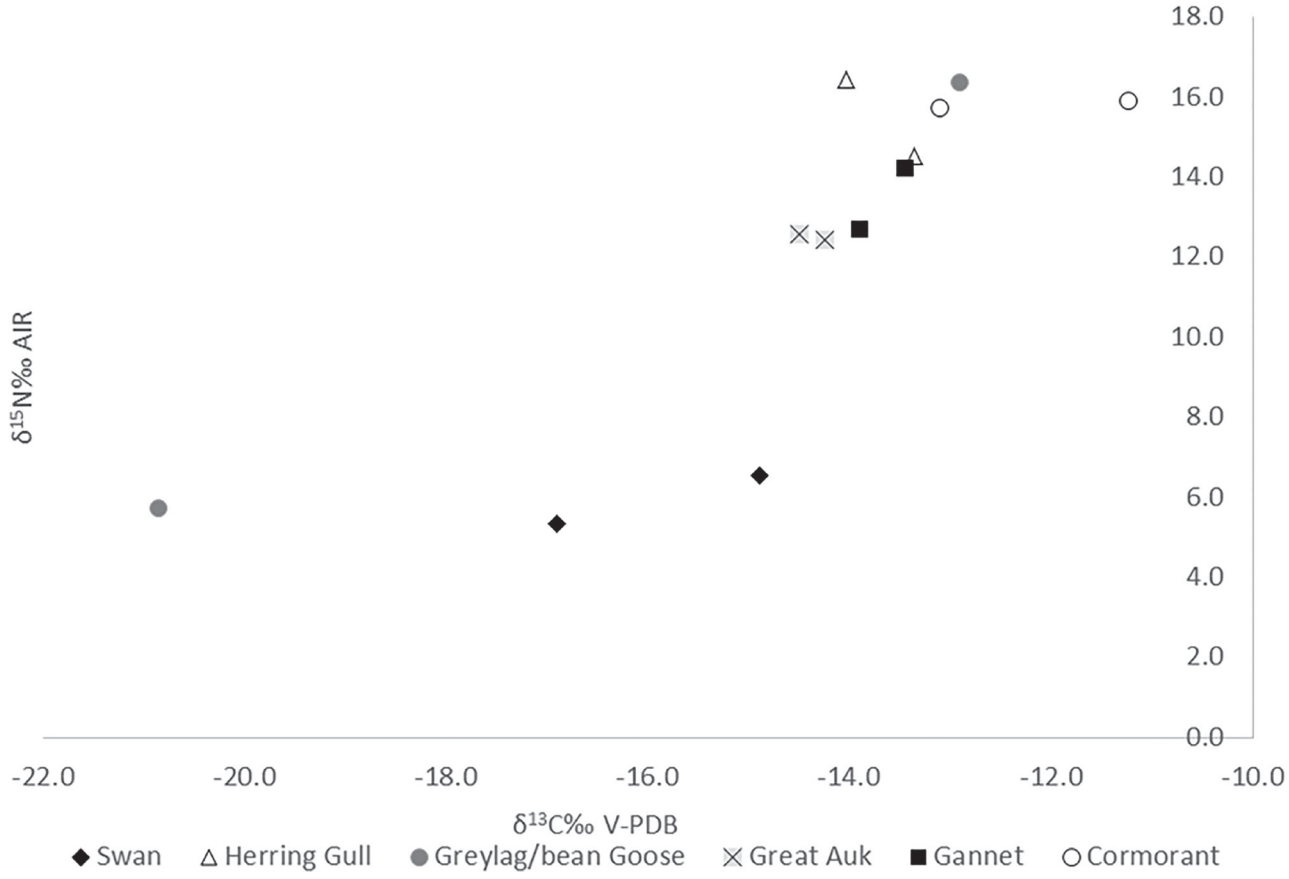


Figure 18.5. Bone collagen $\delta^{13}C$ and $\delta^{15}N$ values from bird specimens analysed from Cladh Hallan

protein signature could have been more local to the islands and had access to their marine resources. These results are tentative but give initial insights into the procurement of bird species at Cladh Hallan, and their ecology in prehistory.

Discussion: comparisons with faunal remains from other Bronze Age insular sites

To date, there are few Bronze Age sites with rich faunal assemblages from the Scottish islands to provide comparative isotopic collections, making the Cladh Hallan specimens particularly important for understanding how animals were being managed at this time. Several specimens from Bronze Age levels at Sligeanach, South Uist, and from Bronze Age occupation levels at Tofts Ness in Orkney (Jones and Mulville 2016) are available for comparison (Figure 18.6). In general, $\delta^{15}N$ values from Orcadian specimens are generally higher than those from the Western Isles, likely linked to a baseline difference between the two island groups in prehistory (Jones *et al*. 2012).

Unlike the herbivores studied from Cladh Hallan, the limited number of cattle and sheep from Sligeanach show a similarity in their values, suggesting that they shared a similar diet, and were potentially being managed in the same way in terms of the fodder provided and the pasturing locations used. This differs markedly from animal management strategies at Cladh Hallan, where sheep and cattle were fed on different sets of resources. This dietary partitioning of cattle and sheep at Cladh Hallan is also seen at the site of Tofts Ness in Sanday, Orkney, suggesting that the two species were also treated differently there. Shorefront resources appear also to have been used in Orkney during the Bronze Age, suggesting that this was an important part of the landscape for animal management (Jones and Mulville 2016). The data available to date suggest that, during the Bronze Age in the Scottish islands, herbivores were not all managed in the same way, and each settlement potentially had different approaches towards fodder provision and grazing locations.

Unlike the Cladh Hallan pigs, the pig analysed from Sligeanach has a lower $\delta^{15}N$ value, indicative of a predominantly herbivorous diet whereas the Cladh Hallan pigs were consuming at least some terrestrial protein. This hints at management at the household level or even the individual pig, with the animals being fed on food scraps, as is also observed in the Iron Age and Norse period in South Uist (Jones and Mulville 2016; 2018).

Conclusion

The isotope analysis of the humans at both Cladh Hallan and other prehistoric sites in the Western Isles reveals that they had, almost without exception, predominantly terrestrial diets. This finding is perhaps surprising given

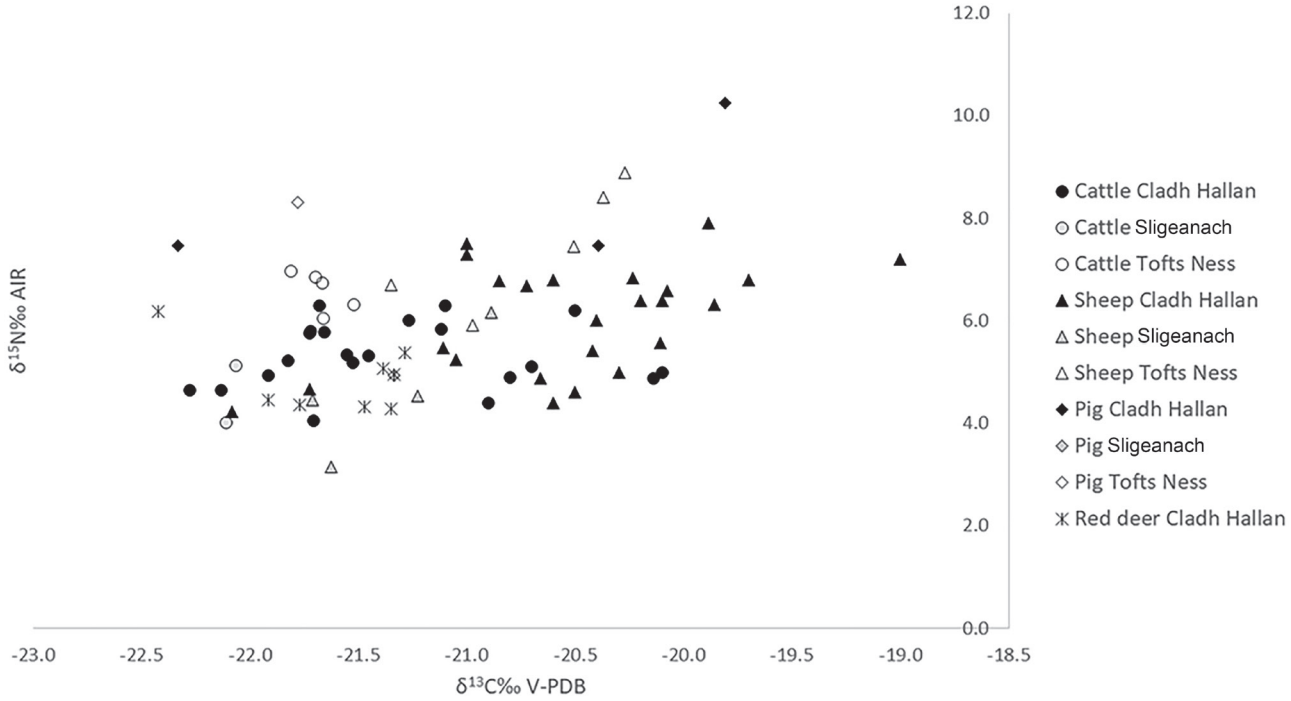


Figure 18.6. Stable carbon and nitrogen isotope values for Cladh Hallan faunal specimens depicted alongside Bronze Age faunal remains analysed from Sligeanach (South Uist) and Tofts Ness (Sanday, Orkney)

the proximity of the sea and tidal sea-lochs which must have presented an abundance of easily obtainable and replenishable marine foods. However, the identification of sophisticated agricultural and animal husbandry practices, as highlighted by the identification of dairying at Cladh Hallan and other sites (see Chapter 10), indicates an alternative and equally attractive exploitation strategy and lifestyle. Food from cultivated plants and reared animals was supplemented, probably seasonally, by wild foods, including some marine products. Overall, human stable isotope values from later prehistoric and early historic sites in the Western Isles are very consistent. Nevertheless, stable isotope analysis does not provide any information on precise dietary composition, in terms of the types of animals or plants that were consumed, which could have been quite varied.

Stable isotope analysis of the faunal remains from Cladh Hallan provides insights into the diets and management of the domesticates reared at the site during the Bronze Age. The stable isotope values of cattle and sheep suggest that management strategies were adapted to suit the needs of individual species, indicating perhaps that the inhabitants of Cladh Hallan had a good understanding of successful agricultural practices.

Shorefront resources appear to have been used in the management of sheep, echoing patterns seen in Orkney during this period (Jones and Mulville 2016). This has not been identified isotopically for the Neolithic of the Western Isles (Jones and Mulville 2016), suggesting that more nuanced animal management strategies were introduced during the Bronze Age, perhaps to ensure survival of animals over the winter months. The use of shorefront and estuarine resources has been noted at other Bronze Age coastal locations in Britain, including the Severn estuary (Britton *et al*. 2008), and was not necessarily a phenomenon restricted to Scottish islands. Future incremental tooth analysis of both cattle and sheep, such as applied by Balasse *et al*. (2006; 2009), should provide a more detailed understanding of seasonal differences in diet of both species, and potential changes in foddering strategies and pasturing locations at different times of the year. Similarly, analysis of neonatal animal remains should provide insights into the treatment and management of pregnant animals during the difficult winter months, as has been successfully applied to Neolithic specimens from Orkney (Schulting *et al*. 2017).

The household management of pigs, revealed by the highly varied diet of the pigs analysed at Cladh Hallan, appears to have been a strategy used in other parts of Bronze Age Britain. Noted at Llanmaes in south Wales and Potterne in southern England, it is indicative of ad hoc management (Madgwick *et al*. 2012). Pig management in the Western Isles appears to have varied in relation to site function and the culinary and economic purpose of the animals. In the Western Isles during the Iron Age, the inclusion of marine food in pig diets may have been linked to their use as a feasting resource (Jones and Mulville 2016), whilst on the manorial estate of Earl's Bu in Orkney during the Norse period the consistency in pig diets is indicative of more centralised management for their use across the wider estate (Jones and Mulville 2018). At Cladh Hallan, the more ad hoc feeding strategies are indicative of piecemeal

pig management, rather than specialisation or centralised management, and suggest that pigs were being reared for occasional and infrequent consumption, as reflected by their limited representation in Cladh Hallan's zooarchaeological record (see Chapter 10).

18.2 Strontium isotopes

Jacob I. Griffith and Christophe Snoeck

Introduction

Five burned bone samples of skull fragments from contexts 2793a (sub-adult), 2793b (young–mature adult), 3255 (adult), 3307 (young adult) and 3325 (older child/juvenile) were selected for strontium (Sr) isotope and Sr concentration analyses (Table 18.3), to assess whether these individuals are likely to be of local origin or not.

Materials and methods

Pre-treatment of calcined bone

Soil and the outer layers of the bones were removed using a Dremel equipped with a diamond drill. After this step, it appeared that the sample from context 3255 was charred and not fully calcined and could not be used for these analyses. The remaining four calcined bone fragments (*c*. 50 mg) were rinsed three times with Milli-Q water. For each rinsing, the samples were placed for 10 minutes in an ultrasonication bath. Calcined bone fragments were treated with 1M acetic acid for 3 to 10 minutes in the ultrasonication bath and then rinsed with Milli-Q water and given 10 minutes ultrasonication (Snoeck *et al*. 2015). The samples were then left overnight in an oven at 50°C. Once dry, the samples were crushed using a mortar and pestle.

Strontium isotope and concentration analyses of calcined bone

About 15mg of calcined bone powder was used for strontium isotope analyses, placed in a Teflon beaker and digested in 1mL of sub-boiled 14M HNO_3. After complete dissolution, the samples were left on a hotplate at 100°C until dry. Strontium was extracted from the samples and purified following the protocol described in Snoeck *et al*. (2015) and both concentrations and isotope ratios measured on a Nu Plasma 3 MC-ICP Mass Spectrometer (PD017 from Nu Instruments, Wrexham, UK) at the Archaeology, Environmental Changes & Geo-Chemistry (AMGC) Research Group of the Vrije Universiteit Brussel (VUB) following Gerritzen *et al.* (2024). During the course of this study, repeated measurements of the NBS987 standard yielded $^{87}Sr/^{86}Sr$ = 0.710248 ± 0.000018 (2SD; n = 12), which is consistent with the mean value of 0.710252 ± 0.000013 (2SD for 88 analyses) obtained by TIMS (Thermal Ionization Mass Spectrometry) instrumentation (Weis *et al*. 2006). All the sample measurements were normalised using a standard bracketing method with the recommended value of $^{87}Sr/^{86}Sr$ = 0.710248 (Weis *et al.* 2006). Procedural blanks were considered negligible (total Sr (V) of max 0.02 versus 7–8V for analyses; *i.e*. ≈ 0.3%). For each sample the $^{87}Sr/^{86}Sr$ value is reported with a 2SE error (absolute error value of the individual sample analysis – internal error). A matrix matched standard NIST SRM1400 was also measured and returned a $^{87}Sr/^{86}Sr$ value of 0.713113 ± 0.000034 (2SD; n = 7) corresponding well with previous studies (0.713120 ± 0.000033; Lazzerini *et al*. 2021) and a concentration of 219 ppm ± 3% RSD (n = 7) which is a bit lower than the reported value of 248 ppm.

Results and conclusion

Four of the five cremated human skull fragments are very high in Sr and have $^{87}Sr/^{86}Sr$ values close to 0.7092 showing a strong marine signal, which can be expected for a coastal site. The fifth sample (from context 3255) was not suitable for analysis.

The values of the four samples that produced results are very similar to those from tooth enamel of unburnt human remains at Cladh Hallan. As Montgomery has pointed out for the three Cladh Hallan skeletons whose tooth enamel she analysed (in Parker Pearson *et al*. 2005: 540), the evidence points to all these individuals – inhumed and cremated – as having been native to the Outer Hebrides.

Table 18.3. Human bone Sr isotope and concentration results from Cladh Hallan, incorporating previous results for tooth enamel from three of the skeletons analysed by Janet Montgomery (Parker Pearson et al. *2005: tab. 2)*

Sample no.	Funerary treatment	Element	Age/sex	$^{87}Sr/^{86}Sr$	2SE	Sr ppm
CH01_3307	Cremated	Skull	Young adult	0.709348	0.000007	363
CH01_2793a	Cremated	Skull	Sub-adult	0.709268	0.000006	516
CH01_3325	Cremated	Skull	OC/Juvenile	0.709345	0.000009	356
CH01_2793b	Cremated	Skull	YA-MA, ?F	0.709275	0.000007	498
CH01_3255	Cremated	Skull	Adult	Not suitable for analysis		
CH01_SK 2613	Inhumed	LM2	Adult male	0.709276		295
		LC1	*ditto*	0.709354		223
CH01_SK 2638	Inhumed	LM2	Adult male	0.709264		299
CH01_SK 2727	Inhumed	LM2	10–14 year-old, ?F	0.709588		201
		RC1	*ditto*	0.709619		217

19 The human remains

C. Willis

Archaeological excavations at Cladh Hallan revealed a series of inhumation burials, cremation deposits and dispersed disarticulated bones that span a broad temporal range from the Beaker period to the Iron Age. The two main clusters of funerary and mortuary activity occurred during Phase 3 (*1800–1310 cal BC*), with the formation of a cremation cemetery and two cremation platforms, and then again in Phase 8 (*1095–1020 cal BC*) with the (re) burial of four inhumations beneath the floors of the three main roundhouses in the north–south row.

Dispersed cremated human bones were also recovered from Phases 4, 6 and 9. The unburnt disarticulated bones form a large group of special finds and derive from Phases 3–16 in Area A, with a smaller group from Area C in Phases 10, 13 and 16. A handful of unstratified bones were also recovered, from across Areas A, B, C and D (see the preface for an overview of the areas that make up the site, and the sequence of construction across the phases of its occupation). In total, unburnt bone was recovered from 49 contexts and cremated bone was recovered from 33 contexts. Overall, a minimum total of 17 unburnt individuals and 11 cremated individuals were recovered from across the settlement (Figures 19.1–19.8).

The inhumation burials and disarticulated bones have been analysed by successive researchers at different stages in the project: the unstratified skeleton SF 4906 (from Area C) was first analysed by both Beth Rega and Mouli Start (2004), and then later by Andrew Chamberlain. The remaining five skeletons were analysed by Brian Dean (2001) and again later by Andrew Chamberlain. Geoff Craig contributed to the dental study of the composite skeleton SK 2638. The cremation deposits and dispersed cremated bone fragments were first analysed by Mouli Start (2004); however, the final phase of the project concluded with a complete osteological re-examination of all the unburnt and all the cremated human remains by Christie Willis.

Samples of unburnt and cremated bone were subject to a programme of radiocarbon dating (see Volume 1: chap. 14) and stable isotope analyses (see Chapter 18), in addition to testing unburnt bone samples for aDNA and mercury intrusion porosimetry (HgIP; Parker Pearson *et al*. 2005), small-angle x-ray scattering (SAXS) and histological analyses (see Chapter 20). The radiocarbon dated samples reveal continuous funerary and mortuary rites pertaining to deceased individuals (Tables 19.1–19.2) signifying a long and complicated interaction with the dead of Cladh Hallan.

19.1 Methods

All human skeletal and cremated remains from Cladh Hallan were assessed according to the English Heritage guidelines (Mays *et al.* 2004), the recommendations by BABAO and the Institute of Field Archaeologists (Brickley and McKinley 2004) and the standards issued by the CIfA and BABAO (Mitchell and Brickley 2018). The purpose of the osteological analyses was to determine the levels of skeletal preservation and to extrapolate, wherever possible, demographic information, as well as recording pathological lesions in order to identify evidence for injury or illness. The cremated remains were separated from the non-human material (*e.g*. faunal remains, charcoal, and fuel ash slag).

The state of preservation for the inhumation burials was assessed according to the degree of erosion and abrasion on the bone surfaces (McKinley 2004: 16). This system uses a grading scale from stages ‘0’ to ‘5+’ that records the absence or severity of natural abrasions and erosion to produce a single overall score for each skeletal element. The recovery of the Cladh Hallan skeletal remains included flotation of the entire grave fill to ensure that the smaller bones were not lost. The degree of preservation with regard to cremated bones was also assessed using the same grading system; however, changes to crystallinity during the cremation process render the bones more durable and therefore the scoring system can also provide an indication of the burial environment and differing mortuary and funerary practices.

The assessment of the completeness of inhumed skeletons is achieved by recording the quantity of recovered skeletal elements and expressing this as a

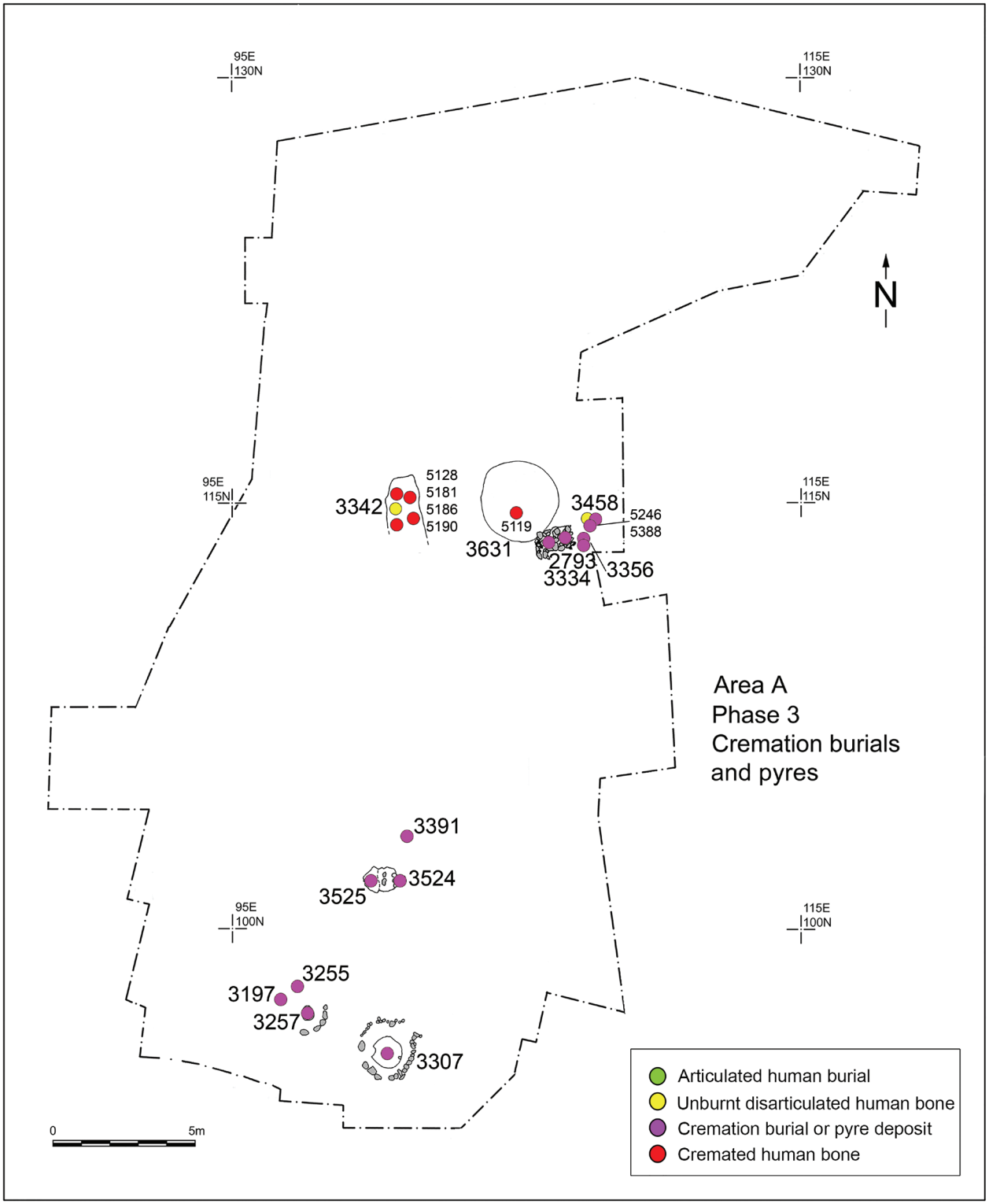


Figure 19.1. The cremated and unburnt human remains from Phase 3 in Area A. The circular shapes used to denote bone location are not to scale but are used here to illustrate how widespread the bones are throughout the site. For SF 4906 and other disarticulated bones recovered from Area C, see Figure 19.65

category of completeness from 0–25% (incomplete) and up to 76%–100% (complete; Mays *et al.* 2004). Completeness is also visually expressed through a skeletal inventory form, which documents the degree of fragmentation, condition, pathological lesions and sampling of the bones. This is not possible with cremation deposits as they often incorporate less than 50% of the bones left over after a cremation (McKinley 2000: 408; McKinley and Bond 2001: 284). Of this, *c.* 30%–50% of the bones may be identifiable to specific skeletal elements. The shortage

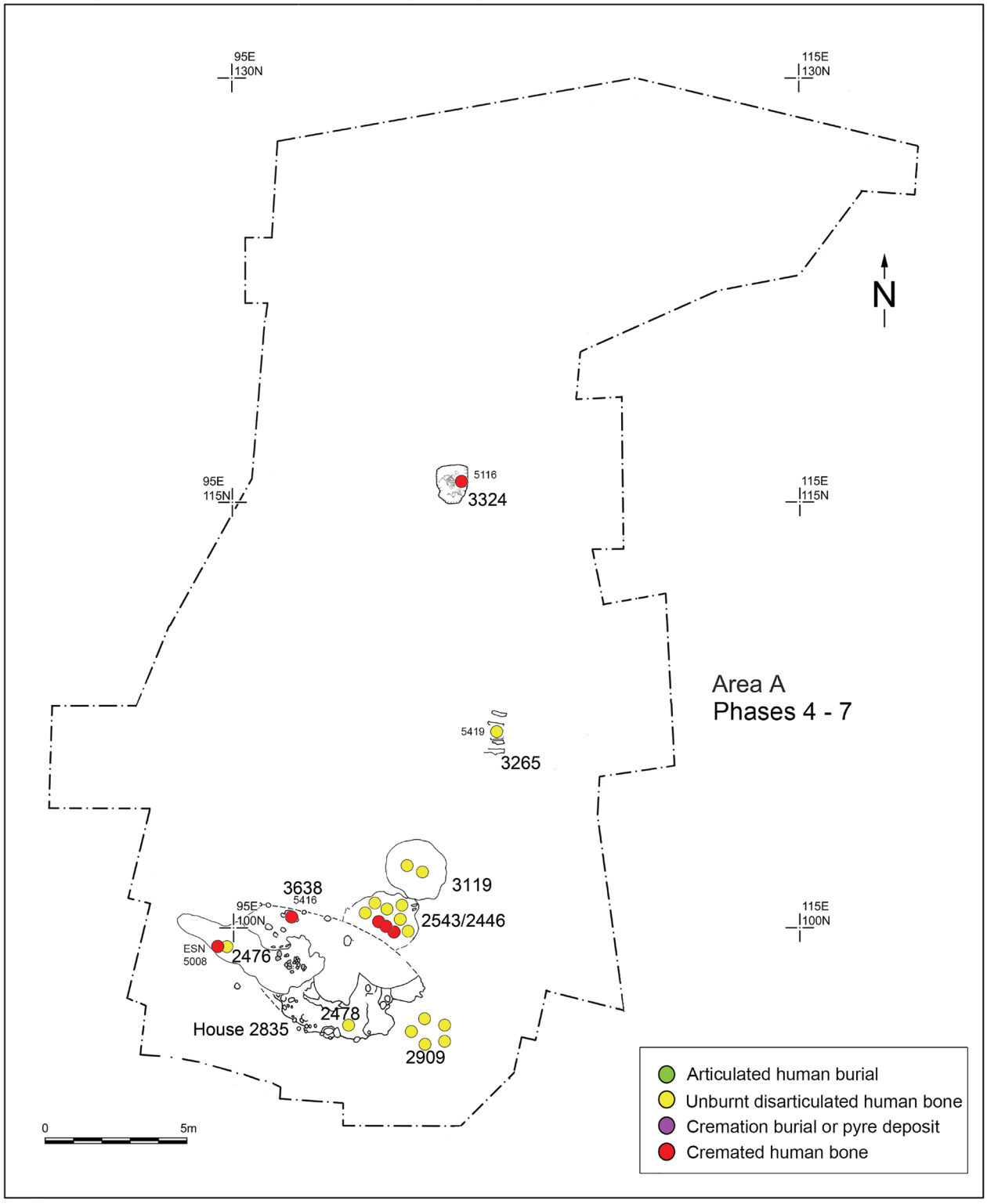


Figure 19.2. The cremated and unburnt human remains from Phases 4–7 in Area A

of identifiable bones, together with the degree of bone fragmentation, has a major impact on the quantity and quality of information provided by osteological analysis. Indeed, analysis becomes increasingly more difficult as bone fragment sizes decrease. Therefore, the cremated skeletal inventory summarises the presence or absence of the main skeletal elements (Table 19.3). It is also used to investigate whether specific bones were being deliberately selected for cremation, for collection from the pyre or for the deposition of bones for burial.

Soil acidity and bioturbation may also affect cremated bones and therefore the quantity of bones recovered from an archaeological excavation should not be viewed as the quantity of bones originally deposited. The completeness

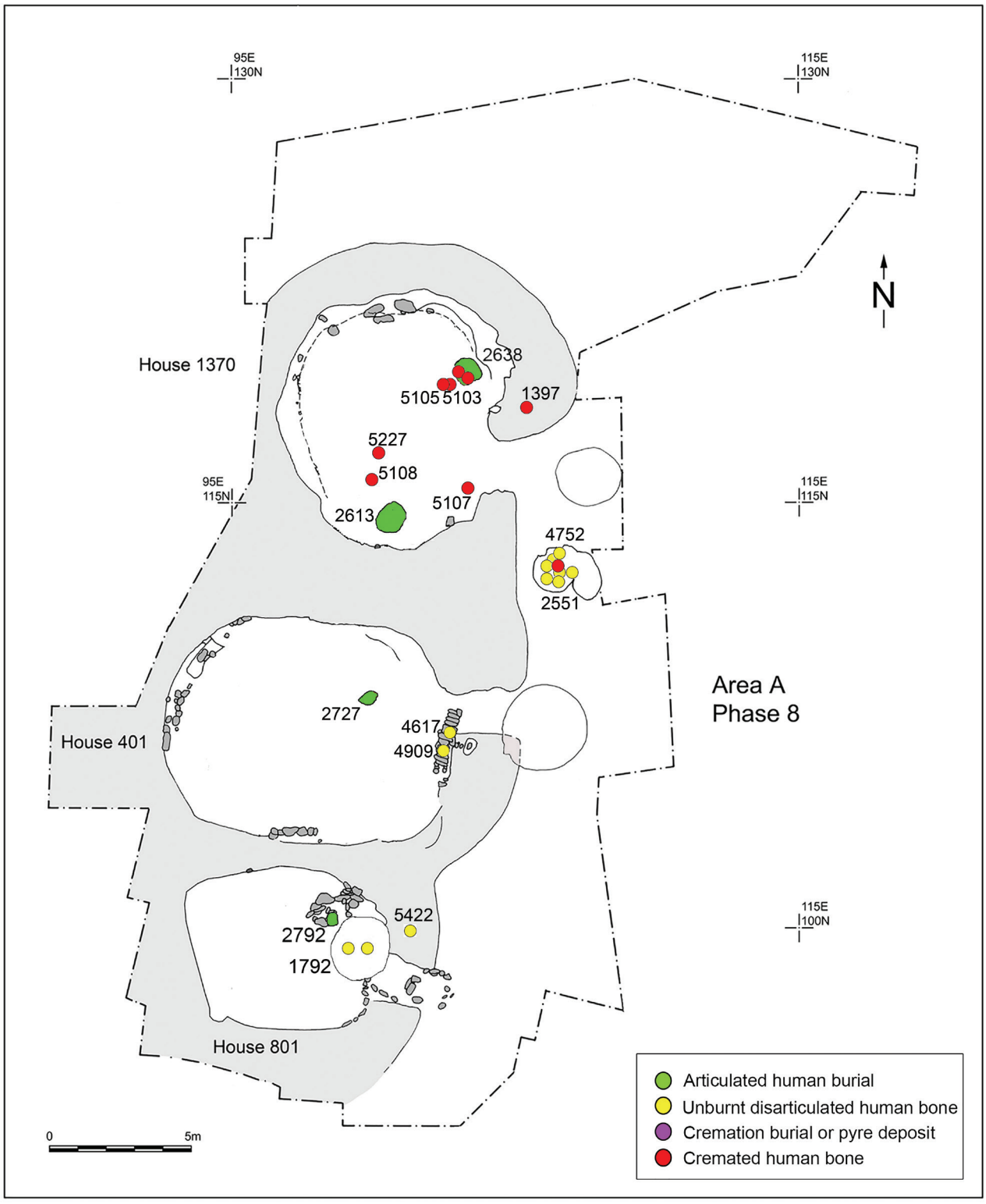


Figure 19.3. The cremated and unburnt human remains from Phase 8 in Area A

system cannot be used for disarticulated or dispersed material and therefore only the articulated skeletons and formal cremation deposits have been assessed for completeness.

The minimum number of individuals (MNI) is assessed in order to determine not only the number of individuals, but also whether the burials/deposits were discrete or if any remains had become intermingled. MNI is derived by counting the most frequently represented skeletal elements recovered from each context as well as counting any age-related and sex-related differences within each burial/deposit.

Methods used to determine age at death come from dental eruption and development (Moorrees *et al*. 1963;

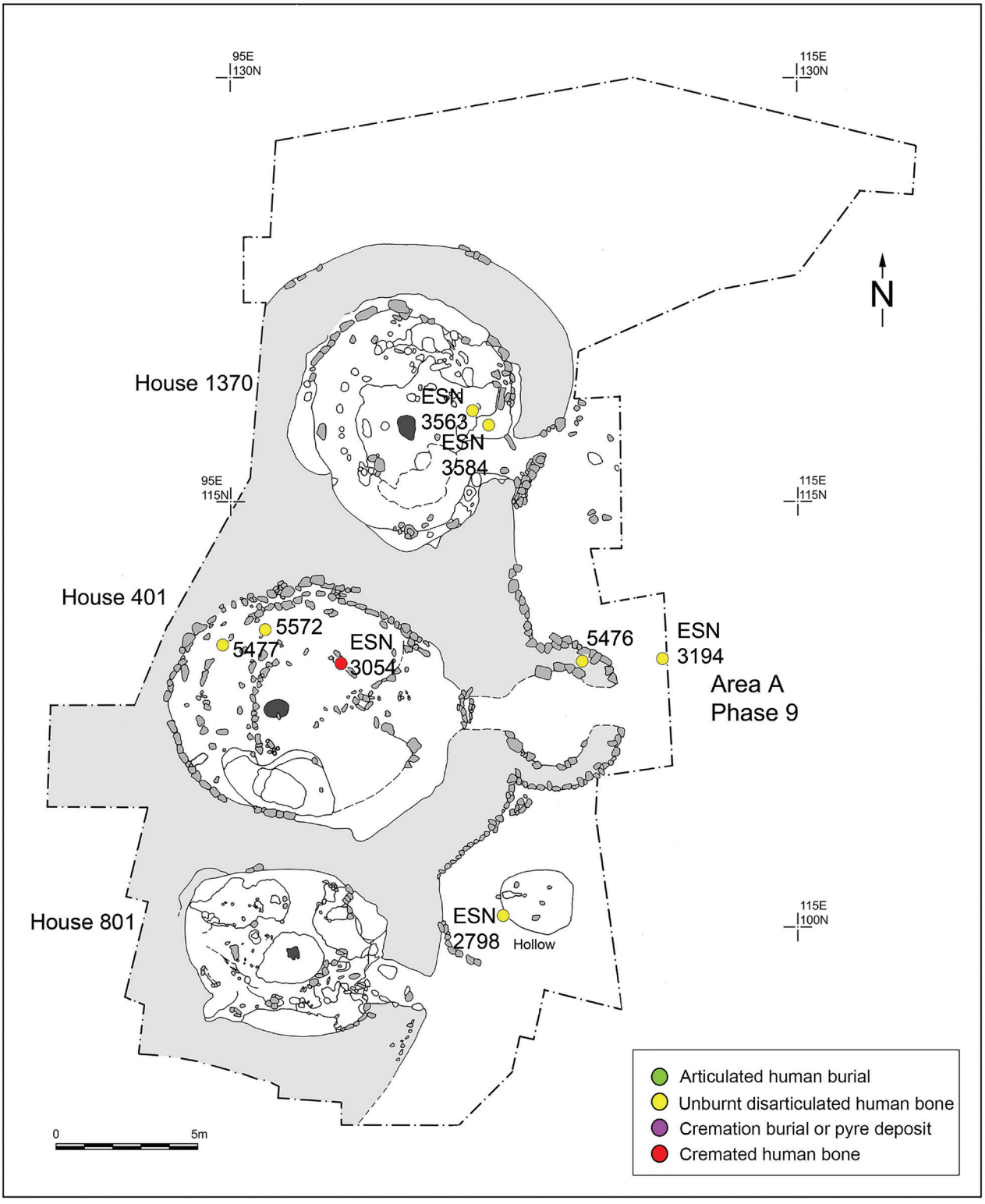


Figure 19.4. The cremated and unburnt human remains from Phase 9 in Area A

Smith 1984; Ubelaker 1989; AlQahtani *et al*. 2010; 2014), changes in the auricular surface of the pelvis (Lovejoy *et al.* 1985), cranial suture closure (Meindl and Lovejoy 1985), epiphyseal union (Schwartz 2007), pubic symphysis changes (Brooks and Suchey 1990) and long bone lengths of the sub-adults (Scheuer and Black 2000). The ageing methods applied to cremated remains are often problematic due to the incomplete nature of the deposit, as the methods rely on physiological changes in skeletal elements that are evident at certain stages in life. Therefore, the methods are reliant on these diagnostic bones surviving the cremation process, being picked up from the pyre debris and then buried (McKinley 2000: 411). As such, cremated individuals are usually organised into

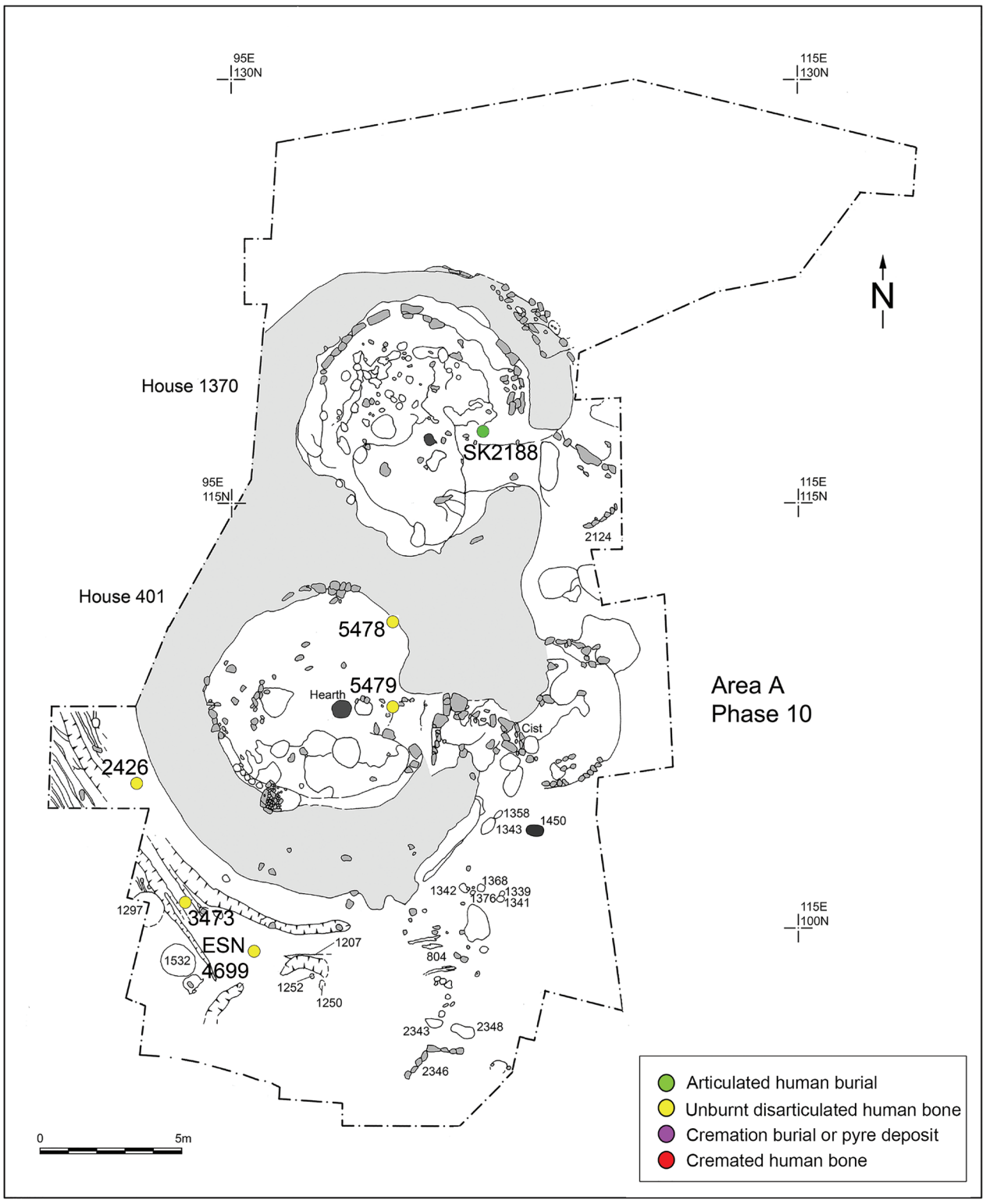


Figure 19.5. The human remains from Phase 10 in Area A

very broad age categories of 'infant', 'child' and 'adult' but, in some instances, a more accurate age estimation of individuals may be achieved if diagnostic bone fragments are recovered (Table 19.4).

Biological sex was determined through the morphological characteristics of the adult pelvis (Phenice 1969; Feremback *et al.* 1980; Schwartz 1995) and adult skull (Schwartz 1995; Ferembach *et al.* 1980). It is difficult to determine sex from cremated remains as the determination relies on the survival of the sexually dimorphic traits, which are frequently not recovered during excavation. Determining the biological sex of sub-adults is also seen as unreliable since the morphological characteristics required for osteological observation have

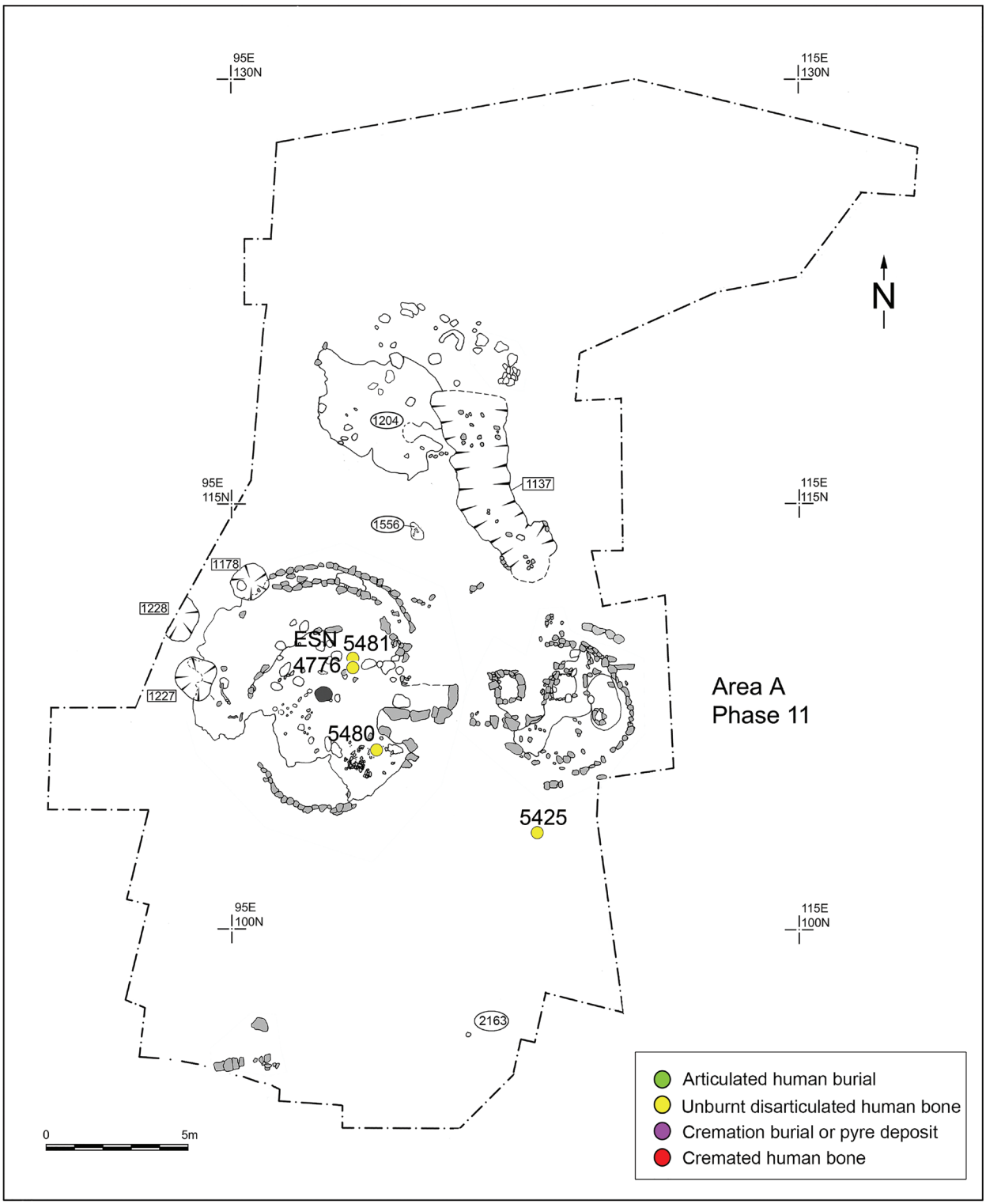


Figure 19.6. The human remains from Phase 11 in Area A

either not yet become fully developed or are inconsistent when taking into consideration the varying growth rates between males and females. Therefore, wherever possible, sub-adults are sexed as 'possible male' (?M) or 'possible female' (?F) rather than being given firm determinations.

Stature is estimated based on the measurements of complete long bone lengths from adult skeletons, using the regression equations of Trotter and Gleser (1952). Where possible, measurements from metrical data are also combined with the biological sex of those long bones (Steele and Bramblett 1988) for a more accurate estimation of stature. For sub-adults, stature is consistently underestimated since children grow at different rates depending on environmental conditions, dietary availability

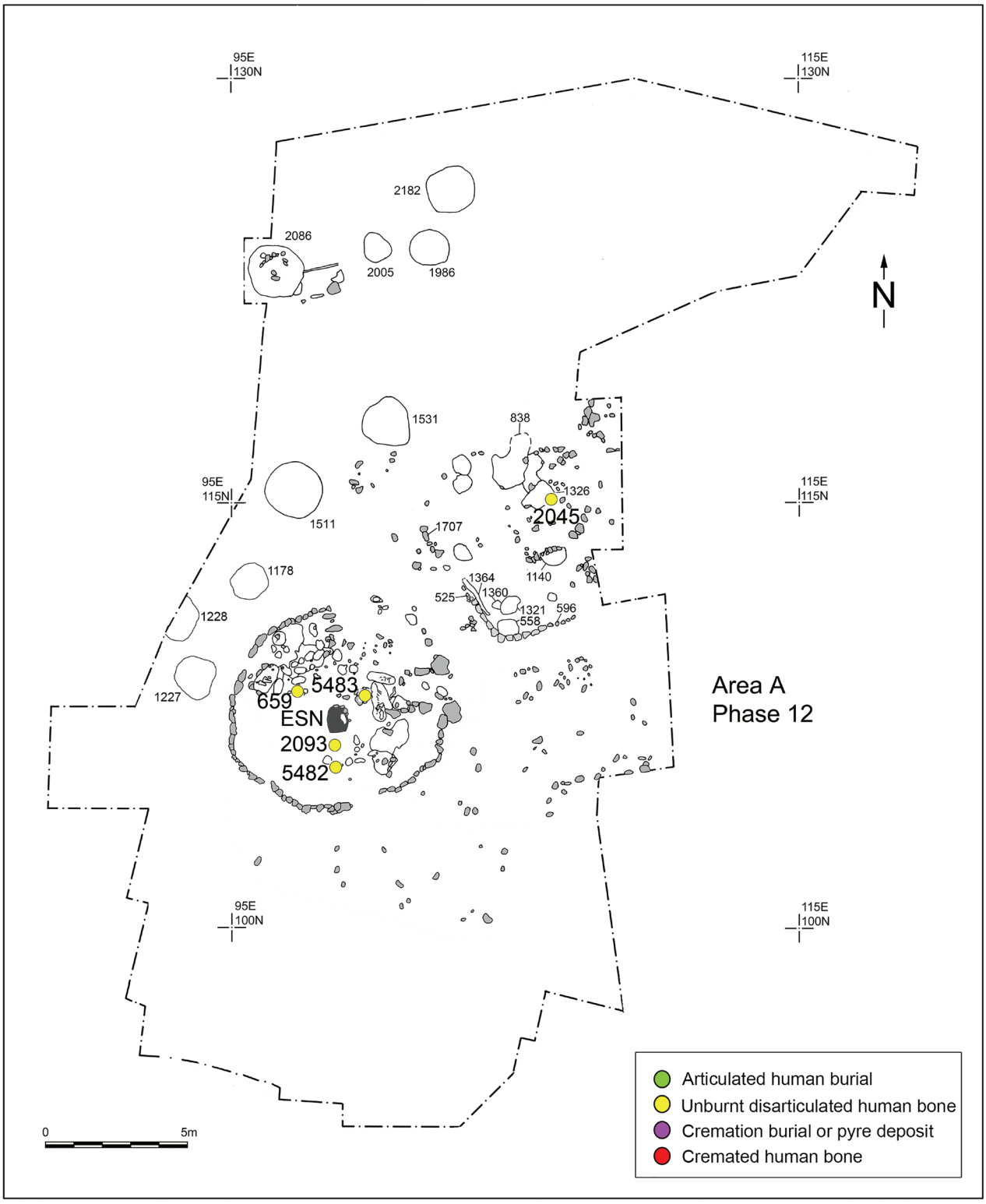


Figure 19.7. The human remains from Phase 12 in Area A

and pathological conditions and, as such, stature will not be estimated for the children at Cladh Hallan. In addition, stature cannot be determined for cremated remains due to their fragmentary condition and the degree of shrinkage that occurred during the cremation process.

The inhumations were also analysed for cranial and post-cranial non-metric traits, which are anomalies found within a normal human skeleton. These traits may be genetically inherited but their value in assessing relationships, population affinity and micro-evolutional trends is a matter of ongoing academic debate (Saunders 1989; Buikstra and Ubelaker 1994). The presence/absence of each trait was recorded but some traits for sub-adults may be age- or sex- specific and should not considered

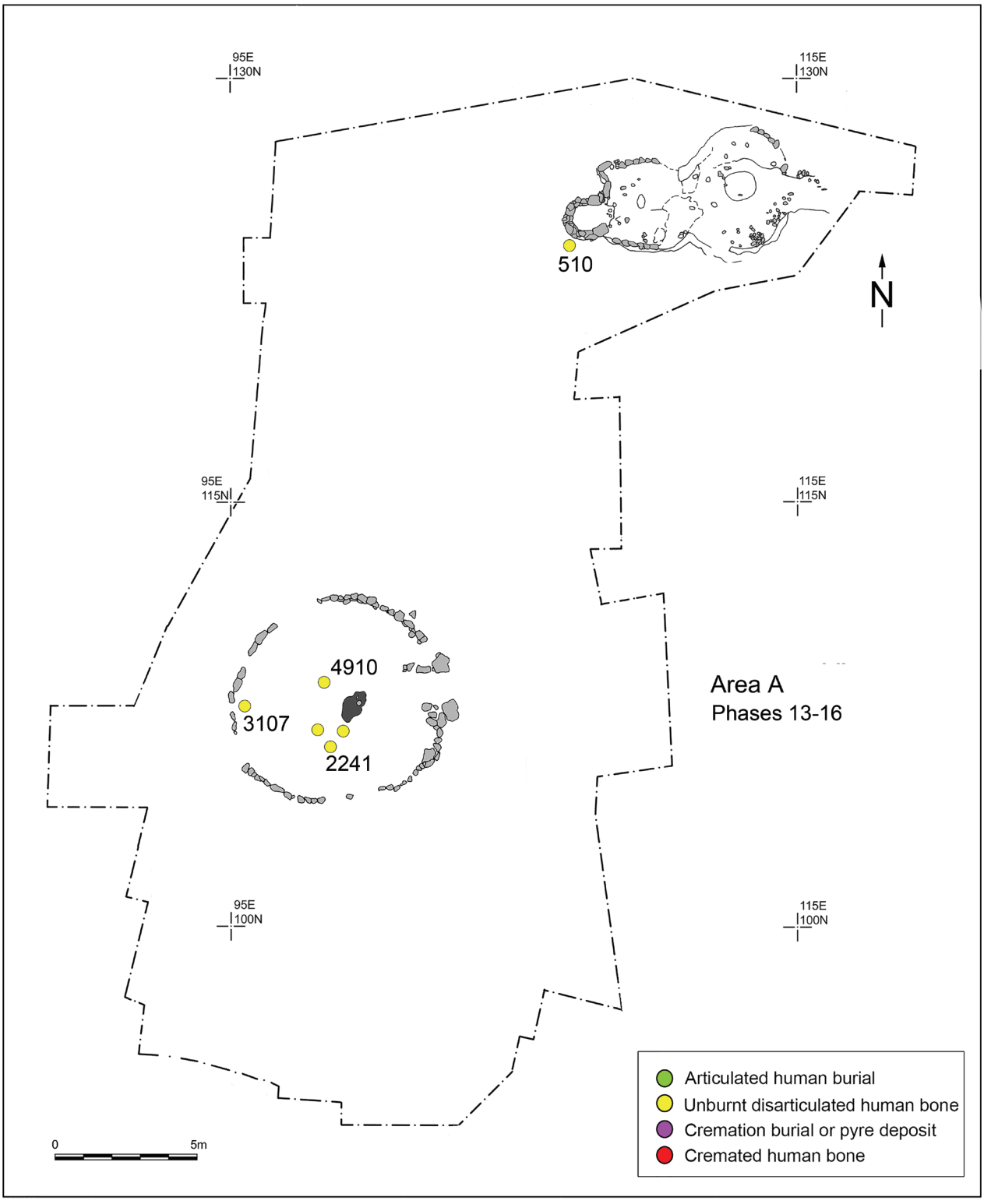


Figure 19.8. The human remains from Phases 13–16 in Area A

a reliable reflection of the population or familial kinship since the trait may not have yet developed.

During the cremation process, bones also go through a process of dehydration and oxidation in which the organic material within the bones is burned away while the hydroxyapatite crystals dehydrate through rises in pyre temperatures (McKinley 2000; 2004). The varying levels of oxidation indicate the effectiveness of the cremation, and their recording is based entirely on observing macroscopic changes to the bones (Table 19.5). Traditional indicators of 'green' or fleshed bones observed after the cremation process include cracking, curved transverse fracturing,

Table 19.1. The phasing of the inhumations (SK#s) and unburnt disarticulated bones (SF#s) from Cladh Hallan that are associated with radiocarbon dates

Skeleton no.	Area	cal BC (at 95% probability)	Radiocarbon lab code and BP determination	Phase of death	Phase of (re) burial
SF 4908	Pit under House 801	*1735–1445 human skull*	AA-49344; 3295±50 BP	2–3	6
SF 4906	South of Area C	*1610–1385 male child*	AA-48585; 3205±50 BP	3	-
SF 4904	Area B	*1400–1055 human phalanx*	AA-48583; 3300±45 BP	3–6	-
ESN 5008	Structure 2477	*1420–1225 H. vulgare* *1260–1045 H. vulgare*	SUERC-10821; 3070±35 BP SUERC-10820; 2925±35 BP	-	7
SK 2613	House 1370	*1435–1260 Ind #1* *1300–1125 Ind #2* *- Ind #3*	SUERC-13804; 3090±35 BP weighted mean -	3–4 5–6 -	8 8 8
SK 2638	House 1370	*1495–1275 Ind #1* *1500–1225 Ind #2* *1615–1420 Ind #3*	weighted mean AA-48598; 3105±50 BP weighted mean	3–5 3–5 3	8 8 8
SK 2727	House 401	*1160–1005 female? child*	weighted mean	6–8	8
SK 2792	House 801	*1445–1195 female child*	AA-48600; 3070±50 BP	3–6	8
SF 5422	Wall core, House 801	*1190–1040 deer tibia* *1095–1050 OSL*	SUERC-10803; 2850±35 BP OSL-12; 2290±210 BP	-	8
SF 4909	Stone cist fill 2106	*1160–995 human? scapula*	AA-48602; 2865±55 BP	-	8
SF 3473	Fill of pit, above House 801	*1535–1295 adult's tooth*	AA-48603; 3170±50 BP	3–4	10
SK 2188	House 1370	*1065–975 female neonate*	AA-48596; 2905±50 BP	10	10
SF 4776	Floor, House 401	*970–830 deer bone*	SUERC-10789; 2815±35 BP	-	11
SF 2045	East of House 1370	*795–660 deer tibia*	SUERC-10801; 2525±35 BP	-	12
SF 3107	Floor 465, House 401	*1030–770 child's tooth*	GU-9825; 2710±70 BP	-	13
SF 4910	Floor 465, House 401	*760–380 disartic. neonate*	GU-9847; 2390±60 BP	-	13
Grid sq. 112/16	House 150, Area C	*705–545 H. vulgare* *730–540 H. vulgare*	SUERC-10861; 2532±35 BP SUERC-10862; 2490±35 BP	-	13
SF 4905	Area B	*AD 25–250 human phalanx*	AA-48584; 1875±45 BP	-	-

Table 19.2. The phasing of the cremation deposits and cremated dispersed bones from Cladh Hallan that are associated with radiocarbon dates

Deposit	Area	cal BC (at 95% probability)	Radiocarbon lab. code and BP determination	Phase of death	Burial phase
3197	Stone ring 3256	*1415–1235 H. vulgare* *1425–1250 H. vulgare*	SUERC-10818; 3040±35 BP SUERC-10819; 3050±40 BP	-	3
3255	Stone ring 3256	*1620–1450 crem. bone*	SUERC-10716; 3270±35 BP	3	3
3257	Stone ring 3256	-	-	-	3
3307	Stone ring 3306	*1740–1530 crem. bone*	SUERC-10717; 3375±35 BP	1–3	3
3458	Pyre debris near 3558	-	-	-	3
2793	Platform 3558	*1750–1535 crem. bone* *1880–1620 crem. bone*	SUERC-10718; 3380±35 BP SUERC-10722; 3430±35 BP	1–3	3
3334	Platform 3558	-	-		3
3325	SF 5116 in pit 3324	*1390–1215 sheep*	SUERC-13805; 3085±35 BP	3–4	4

Table 19.3. The main skeletal elements from cremation deposits used when assessing completeness

Cranium	Ribs	Phalanges: hand	Femur	Phalanges: foot
Maxilla	Humerus	Cervical vertebrae	Patella	Vertebrae fragments
Mandible	Ulna	Thoracic vertebrae	Tibia	Upper limb fragments
Teeth	Radius	Lumbar vertebrae	Fibula	Lower limb fragments
Clavicles	Carpals	Sacrum	Tarsals	Hand/foot fragments
Scapula	Metacarpals	Pelvis	Metatarsals	UID long bones/spongy bones

Table 19.4. Definitions of the age categories (after Buikstra and Ubelaker 1994)

Category	Age range
Foetal	Conception to 40 weeks *in utero*
Neonate	Birth to 1 month
Infant	1 month to 1 year
Young child	1 year to 5 years
Older child	5 years to 12 years
Juvenile (adolescent)	12 years to 20 years
Young adult	20 years to 35 years
Mature adult	35 years to 50 years
Older adult	50+ years
Sub-Adult	<20 years
Adult	20+ years

delamination, fissuring and warping. These patterns suggest a high organic content when the bones were burnt; in other words, they were cremated almost immediately after death while 'dry' bones are less susceptible to deep cracking and splitting and have very little fracturing and warping patterns. Some authors suggest that the specialist can distinguish between fleshed corpses as represented by 'green bone' patterns of cracking and warping, and de-fleshed corpses as represented by 'dry bone' patterns (Buikstra and Ubelaker 1994). However, results of experimental reconstruction show that bone de-fleshed and burnt soon after death still cracks with a 'green bone' pattern (McKinley and Bond 2001).

The degree of oxidisation of the organic material in cremated bones also correlates with pyre temperatures during the cremation process, thus reflecting the efficiency of the cremation (Shipman *et al.* 1984; McKinley 1989; 2004; Holden *et al*. 1995a; 1995b; McKinley and Bond 2001; Symes *et al.* 2008). This efficiency is readily observed in terms of varying bone colouration on cremated bone fragments from white, indicating fully oxidised (>800°C), to hues of blue and grey, indicating incomplete oxidisation (*c.* 600°C), and black indicating charred bones (*c.* 400°C; Table 19.6).

Temperature varies considerably within a burning pyre and the maximum temperature reached by one bone fragment does not necessarily reflect the temperature affecting the entire corpse. The highest temperatures are achieved at the centre of the pyre, while lower temperatures are reached at its edges. Indeed, a range of colours can be noted on a single cremated skeleton and directly corresponds to external factors such as the position of the body on the pyre, the quantity and quality of fuel used during cremation, the availability of oxygen, the duration of the cremation process and the weather conditions (McKinley 2008; Walker *et al*. 2008). Any changes in these factors will influence the outcome of the cremation process and, in turn, its efficiency in cremating a corpse. Combustion grades can also be used to correlate colour changes in response to temperature but they also consider the impacts of soft tissue coverage and cortical bone thickness during the cremation process (Table 19.7).

Therefore, the observed colouration recorded for the Cladh Hallan cremated bones indicates the length of time and maximum temperatures reached by the pyre during the cremation process. It has been argued by some researchers (*e.g.* Thompson 2004; Devlin and Herrmann 2008) that bone colouration is not a wholly reliable method for determining pyre temperature, which is better calculated by measuring the crystallinity index (CI) using Fourier transform infrared spectroscopy (FTIR) or X-ray diffraction. Though there are concerns regarding bone sampling issues and influencing variables that hamper general acceptance of this method (Thompson *et al*. 2011; Thompson 2015), used in combination, these methods will have positive implications for the interpretation of cremated bones in the archaeological record. At the time of analysing the bones from Cladh Hallan, these methods were not, however, yet available but should be considered as an avenue for future research.

Measurements of maximum fragment length were taken with digital Sylvan S_Cal Pro callipers (IP67). Bones from both the 10mm and 5mm sieve fractions were recorded in millimetres (mm) to two decimal places. Endecotts laboratory test sieves were used with certified 10mm, 5mm and 2mm apertures, in addition to a base sieve to catch any material smaller than 2mm. Bone fragmentation is observed by measuring the maximum bone length from each of the sieve fractions and should be regarded as post-depositional size rather than pre-burial size (McKinley 1994b: 341). While cremated bones may be deliberately fragmented prior to deposition, natural fragmentation during the cremation process and movement on the pyre as

Table 19.5. Observations on cremated long bone fragments by comparing patterns between fleshed (green) and skeletal (dry) bones

Reference	Green/fleshed bone	Dry bone
Baby 1954	Deep checking, diagonal transverse fracturing, warping	Superficial checking, fine longitudinal striae and splintering, no warping
Wells 1960	Longitudinal splitting, tubular curling	-
Binford 1963	Deep transverse fracturing, fractures curved and serrated, warping	Straight cracking, superficial checking, no curved fractures
Webb and Snow 1974	Retention of endosteum	Cracking or checking
Ubelaker 1978	Curved transverse fracturing, irregular longitudinal splitting, marked warping	Cracking, longitudinal splitting
Thurman and Willmore 1981	Diagonal fractures without checking, transverse fractures through bone, warping	-
Heglar 1984	Reticulated cracking, oblique ring fractures, warping	-
Buikstra and Swegle 1989	Deep longitudinal fissures, transverse splitting	Cracks, fissures, and splits shallower and less extensive

Table 19.6. Changes in bone colour due to rises in the pyre temperature (after Shipman et al. *1984; Holden* et al. *1995a; 1995b)*

Stage	Temperature	Colour
1	20–285°C	Neutral white, pale yellow, yellow
2	285–525°C	Reddish-brown, dark grey-brown, neutral grey, reddish-yellow
3	525–645°C	Neutral black, medium blue, some reddish-yellow
4	645–940°C	Neutral white, light blue-grey, light grey
5	940+ °C	Neutral white, medium grey, reddish-yellow

it collapses will also occur. After cremation, any additional movement, transportation, handling, or changes to the burial environment will also further fragment the bones. It is therefore difficult to confidently identify deliberate fragmentation of cremated remains, but the maximum bone fragment size will provide information regarding funerary and mortuary rites. Cremated human bone from archaeological sites within Britain has an average maximum length of 45.2mm, with the largest fragment measuring 134mm in length (*ibid.*). Cremated remains within urns have greater protection during deposition and are likely to produce larger fragment sizes in contrast to un-urned and disturbed cremated remains; none of the cremated remains from Cladh Hallan were enclosed in urns and therefore their fragment sizes are a direct reflection of their exposure within the burial environment.

Total deposit weight can indicate the minimum number of individuals and the type of funerary deposition. Undisturbed deposit weights are often interpreted as a reflection of the number of bones collected from the pyre and the number of bones deposited for burial. The cremated bones from Cladh Hallan, both the dispersed and the more formal deposits, from each of the 10mm, 5mm, 2mm and base sieve fractions, were weighed on a Fisher Scientific SG-602 digital balance in grams (g) recorded to two decimal places. In calculating the total weight, only the 10mm, 5mm and 2mm weights are combined together – the base weight consists of sand, bone dust, sediment and debris that can throw off exact bone weight. British archaeological cremations of human adults average 1,636g in weight but deposits can range widely from a few grams to over 2,000g (McKinley 1994b; Gonçalves *et al*. 2013; Willis 2021).

The deposition of cremated bones, in terms of total bone weight, will also reveal the type of deposit. A 'small token deposit' that constitutes *c.* 100g or less of cremated fragments (*c.* 1–2 'handfuls') can be considered as a symbolic representation of the deceased (Willis 2021). The second type is a 'large token deposit' and is the physical representation of the deceased and consists of up to *c.* 100g to *c*. 350g, or approximately 1/4 of the expected weight of a complete adult cremation. For heavier cremations, the term 'partial cremation' is used to describe deposits of *c.* 450–850g of cremated bone – or half of the expected weight of an adult cremation – while 'complete/full cremation deposit' is used to describe deposits exceeding *c.* 900g in weight.

19.2 The cremated human remains as an assemblage (deposits and dispersed)

The cremated human remains from Cladh Hallan derive from an Early–Middle Bronze Age (Phase 3) cremation cemetery in the southern half of Area A in which six cremation burials were organised into three main areas

Table 19.7. Combustion grades based on bone colouration from a modern crematorium (modified from Wahl 2008: 168, table 9.1; after Chochol 1961; Malinowski and Porawski 1969)

Grade	Colour	Temperatures	Observations
I	Yellowish-white	0–200°C	Like fresh unburnt bone
	Ivory	*c.* 250°C	First shrinking ~1%–2%
	Glassy light grey		-
I–II	-		Roots of teeth brown to dark brown. No change to tooth crowns
II	Brown	*c.* 300°C	-
	Dark brown		-
	Black	*c.* 400°C	Incomplete combustion; charring of organic substances
III	Grey	*c.* 550°C	Internal bone still black sometimes
	Milky light grey to bluish-grey		-
III–IV	-		Roots of teeth milky-grey to grey Tooth crowns are black with micro cracks
IV	Milky white	*c.* 650–700°C	Chalky surface
	Matt cretaceous	*c.* 750°C	Bone calcined, continuous shrinking
V	Old white	*c.* >800°C	Hard and brittle
	Cream-coloured		Beginning of heat cracks and deformations
	Brownish, greyish, ochre		Outside colour corresponding with soil conditions; internal bone fractures always white; spongy bone sometimes yellowish-ochre; unerupted crowns of teeth survive; average shrinking 10%–12%; maximum shrinking <25%

(Figure 19.1). The first area, at the southern end of the excavated area, contained cremation burial 3307, which was placed on top of a small platform of flat stones within an arc of stones (3306). The second area consisted of three deposits of cremated bone (3197, 3255 and 3257) laid within a ring of stones (3256), approximately 1.40m northwest of cremation 3307. Further north, a third area contained a stone pyre platform (3558) upon which two cremation deposits (3334 and 2793) were identified. Near this cremation platform were two further scatterings of pyre debris: 3458 and 3356 (see Volume 1: figs 2.15, 2.27).

Three separate spreads of pyre debris (3524, 3525 and 3391) were recovered from an area north of stone ring 3306 (see Volume 1: figs 2.15, 2.17, 2.21). These spreads were within proximity of each other although 3391 was disturbed by later Phase 6 and Phase 8 activity, which may explain why only one cremated bone fragment was recovered (SF 5241).

In addition to the cremation burials and pyre debris, dispersed cremated bone fragments were also recovered from a wide variety of contexts throughout the site including Phase 3 gully 3435 (containing five cremated bones and two unburnt bones) and an early Phase 3 pit (3631; see Figure 19.1; Volume 1: fig. 2.10) containing two cremated bones. The pit's southeastern edge was eventually covered by the later Phase 3 cremation platform (3558). From Phase 4 contexts, dispersed cremated bone was recovered from a posthole in House 2835 and from a pit below House 1370, which contained an articulated female mature sheep skeleton. Under the entrance of House 801 a large Phase 6 pit, frequently re-cut produced cremated bone fragments. The cremated remains from Phase 8 came from a variety of locations within House 1370. This phase was also assigned to a cremated bone recovered from pit 2551 outside the entrance to House 1370 and to a fragment of cremated first cervical vertebra from outside House 1370, but they are both redeposited from the adjacent pyre debris dating to Phase 3. A single cremated bone was recovered from Phase 9 though its location is currently unknown.[1]

All the cremated bones from Cladh Hallan derive from funerary activity in Phase 3, with the dispersed cremated bone fragments retrieved from contexts of later phases having been disturbed from their original contexts by subsequent site activity during Phases 4, 6, 8 and 9. The pyre debris from contexts 3524, 3525 and 3596 has been missing since their initial excavation and have never been analysed by an osteologist. They will be excluded from any further discussion within this chapter.

Minimum number of individuals (MNI)

A minimum of eight cremated individuals were identified from the six main cremation deposits (see Table 19.22). There are no repeating skeletal elements or sex-related differences from these contexts; however, deposits 3197 and 2793 contained two individuals, based on age-related differences, while the remaining deposits each contained one individual. The eight areas of scattered pyre debris (see Tables 19.23, 19.26) probably derive from one or more individuals within the cremation deposits. Most of

these scatters are not counted towards the overall MNI of the site, with the exception of pyre debris 3458 as it contained cremated bone fragments of an adult and of a foetus (Figure 19.9): the few fragments of adult bones are discounted as probably deriving from one of the main adult cremation burials, but no other deposit contained foetal bones. Similarly, the few fragments of cremated human bone (3325) recovered with the articulated skeleton of a mature female sheep (SF 5177) in pit 3324 are those of an older child/young adolescent and, while the bone fragments are probably displaced from the nearby cremation platform, there are no other individuals within this age category so this is considered to be a unique individual.

Pit 3631, an early Phase 3 feature, contained a cranial fragment (SF 5119, fill 3233). This bone is considered to be an additional individual as it is very early in Phase 3 and cannot derive from any of the late Phase 3 cremations. A small quantity of unburnt human bone fragments was also recovered from a few of the contexts containing cremated bones, but these are discussed in Section 19.2 and again in Section 19.3 (see Phase 3). These unburnt bones do not figure in the overall MNI count of cremated individuals.

The overall MNI for the cremated individuals at Cladh Hallan is eleven: there are eight individuals from the main deposits, one from the pyre debris, one from the sheep pit and one from the early-Phase 3 pit.

Age at death

Age at death is broadly determined for the eleven cremated individuals in that five adults, one infant–young child, one young–older child and a sub-adult were identified from the six main deposits, a foetus/neonate from amongst the pyre debris, a partially charred mature to older adult from the early Phase 3 pit, and an older child/juvenile from the pit containing an articulated sheep skeleton (Table 19.8)

There is an almost even distribution between the number of children (n = 5) versus the number of adults (n = 6) cremated and buried. Prehistoric populations

Table 19.8. Age at death from each of the cremation contexts containing unique individuals

Location	Deposit	Age category
Stone ring (3306)	3307	Young adult
Stone ring (3256)	3197a 3197b	Infant/young child (7.5mths–1.5yrs) Adult
	3255	Adult
	3257	Young to older child
Stone platform (3558)	3334	Adult
	2793a 2793b	Sub-adult Young to mature adult
Pyre debris	3458	Foetus/neonate
Pit 3324	3325	Older child/juvenile
Pit 3631	3233	Mature to older adult

Figure 19.9. The foetal/neonate bones from pyre debris 3458 in which some rib fragments, vetebral bodies and processes, and femoral shafts were identified along with a very small ear bone (the incus seen left of the skull fragments) which may have belonged to a separate individual. The 1p coin provides a scale

are expected to have moderate to high mortality rates (Chamberlain 2006) but the high child mortality rate at Cladh Hallan (45% of the identifiable cremated individuals) would have had a profund impact on the community as this would have meant that few individuals reached adulthood (Figure 19.9).

Biological sex

The lack of diagnostic morphological features from the cremated bones at Cladh Hallan has meant that it is not possible to determine biological sex for most of the individuals. A right petrous bone was recovered (in sample 5390 from context 2793b on the stone platform) with a 66.5° angle, indicating a possible female (Ahlbrecht 1997; Graw and Wahl 2003; Norén *et al*. 2005; Akansel

et al. 2008; Waltenberger *et al*. 2023). In the past few years, research has moved away from using cremated petrous bones as the sole means of sexing archaeological populations (*e.g.* Gonçalves *et al*. 2015; Duquesnel Mana *et al*. 2016; Thompson *et al*. 2023). Rather, this method should be applied in conjunction with other techniques used to determine sex (*e.g.* Depierre 2022; Masotti *et al*. 2013; 2019).

Pathological lesions

Cremation deposit 3255 contained a maxillary molar exhibiting a carious lesion at the junction of the root and crown (Figure 19.10). No cremated bone from the other deposits has evidence for health or disease. This is in part due to loss of such evidence during the cremation process but also due to the token amount of cremated bone recovered from each deposit.

Preservation and completeness

The cremated bones are all graded at '0' as the surface morphology is clearly visible with no surface modifications, softness or chalky cortex. This grade indicates that the burial environment was favourable (non-acidic soil) with no differing mortuary practices between the deposits. This suggests that the more formal cremation burials did not consist of material redeposited from different soil environments or resulting from differing mortuary rites.

In contrast, all of the cremated bone assemblages are incomplete in terms of a general lack of representation from the broad skeletal groups (Table 19.9). On average, skulls represent 47% of the cremated bones while long bones (both upper/lower limbs and the unidentifiable long bones) represent 45.3% of bone fragments. Very few fragments of vertebrae (1.6%), sacrum (0%), pelvis (0.2%) and scapula (0.05%) were identified and only a small amount of unidentifiable trabecular bone (average 5.0%).

Figure 19.10. A carious lesion on the maxillary molar of cremation deposit 3255

Three contexts contained a MNI of two individuals: the foetus/neonate deposit (3458) contained a single cremated adult long bone fragment, the infant/young child deposit (3197) contained only a few cremated bone fragments of an adult, while the young to mature adult deposit (2793b) contained a small quantity of sub-adult bones. These additional individuals are either intrusive bone fragments, deriving from repeated use of the same pyre location or are a small, but deliberate, addition to the main deposits.

Table 19.9. Summary of the fragmentary division per generalised skeletal group. Note that 3458a is the foetus/neonate from the pyre debris while 3458b is an adult (this adult is not tabulated here as it may derive from one of the main adult cremation deposits so only the foetal bones are represented)

Location	Deposit	Age	Skull	Axial	Upper limb	Lower limb	UID long bones	UID spongy bones
Stone ring (3306)	3307	Young adult	44.2%	4.1%	10.0%	10.1%	25.9%	5.7%
Stone ring (3256)	3197a 3197b	Infant/young child Adult	62.7% 0.0%	0.0% 0.0%	0.0% 79.0%	3.8% 6.2%	11.9% 14.8%	21.6% 0.0%
	3255	Adult	65.5%	3.1%	0.2%	0.0	26.4%	4.8%
	3257	Young to older child	36.7%	0.8%	37.4%	7.3%	17.8%	0.0%
Stone platform (3558)	3334	Adult	27.2%	5.9%	6.9%	0.0%	54.6%	5.4%
	2793a 2793b	Sub-adult Young/mature adult	88.6% 35.6%	2.4% 6.5%	3.0% 7.9%	1.0% 11.7%	5.0% 31.4%	0.0% 6.4%
Pyre debris	3458a*	Foetus/neonate	24.5%	8.8%	0.0%	12.0%	38.4%	16.3%
Pit 3324	3325	Older child/juvenile	79.4%	3.1%	0.0%	0.0%	17.5%	0.0%
Pit 3631	3233	Mature/older adult	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Figure 19.11. The charred distal phalange of a foot from 3197 indicative of the bone reaching a maximum pyre temperature of only c. 400° for a short amount of time

During excavation, it was noted that cremation deposit (3255) was destroyed on its north side by later features (see Volume 1: 41) and the deposit weight, quantity of skeletal elements and fragmentation are thus all affected.

The two zones of pyre debris (southern and central; see Figure 19.1) contained a tiny amount of cremated material: skull bones and a scapula fragment were identified in a thin layer of pyre debris (3356) while only a single skull fragment from 3391 was recovered amongst a large spread of charcoal and peat ash. At the time of excavation, the now-missing pyre debris (3524 and 3525) was noted to only contain 'a few calcined bones' amongst flat spreads of peat ash and charcoal (see Volume 1: 41) while a layer of red-brown peat ash with 'a small quantity of cremated bone fragments (3596)' (*ibid*: 47) was also observed. This reveals that the cremated bones were carefully recovered when the cremation process was complete so that the pyre sweepings/debris contained the remnants of the burnt pyre with hardly any bone within the ashes.

Dehydration: shrinkage, warping and fissuring

The incomplete and fragmentary condition of the bones has limited the amount of analysis pertaining to dehydration at the time of cremation; however, the observed cremated bone fragments are curved, with checked cracks on the bone surfaces as well as deep transverse fracturing, longitudinal fissuring and warping. These patterns indicate that the bones were fleshed/green with a high degree of organic content, and that the corpse/body parts were cremated shortly after death. There is no evidence for cut-marks on any of the recovered bones.

Colour and the efficiency of the cremation process

Three deposits (3255, 3197a and 3257) contained some cremated bone fragments with a white external cortex and black internal matrix, signifying the organic material was not efficiently burned during the cremation process. This colouration is often called 'quick burn' and occurs when the bones have reached a very high temperature of over 940°C (as indicated by the white cortex) but the pyre was allowed to burn out soon afterwards: high temperatures were not maintained for long enough to effectively remove all organic material within the internal structure of the bones. While complete oxidisation of the bones did not occur, it was sufficient to burn away all soft tissues and organs, leaving behind burnt cremated bones.

Four cremation deposits (2793a, 2793b, 3458 and 3325) were all efficiently cremated as the bone fragments are varying colours of greyish-white, yellowish-white and dark white. The pyres were kept at temperatures above 940°C for a long period of time. However, a few small bones from each of these deposits are entirely black (combustion grade II), indicating that these bones reached a maximum pyre temperature of only *c.* 400°C. Different scenarios may have occurred that explain the colouring: the bone fell through the pyre and thus away from the high heat, they were added into the pyre as it was cooling down (*e.g.* as a fleshed body part), they were from an earlier cremation in which the cremated bones were not completely recovered from amongst the pyre debris, or these bones were deliberately added into the deposit at the time of burial and represent another unique individual within that context. Two of these deposits (2793 and 3458) contain a MNI of two individuals within each, so it is feasible that an additional/residual individual is also included within the deposit.

Similarly, the bone fragments from two of the cremation deposits (3334 and 3197b, from the central and southern cremation zones respectively) exhibit two differing colour and pyre temperature groups: approximately half of the cremated bones are light brownish-white to light greyish-white, indicative of a high pyre temperature of at least 940°C, while the remaining bones are black to white-black (quick burn) indicative of a low, and perhaps separate, pyre temperature (Figure 19.11). While a range of colours within and between cremation deposits is typical from Bronze Age sites within Britain (Figure 19.12; McKinley 1997b; 2015), these are extreme colour differences which normally indicate two or more separate individuals. Cremation 3197b is already a second individual (an adult), but the different bone colouration does not derive from 3197a (an infant/young child) as these bones are also from an adult. Thus, these bone fragments are likely to be residual bones from a previously used pyre site or a deliberate addition of a token number of bones of a third individual within the deposit.

Deposit 3233 contained a large brown skull fragment in which the organic material within the diploë has mostly burned away yet the external surface remains a consistent brown colouration with no cracking, warpage or fissuring (Figure 19.13).

Figure 19.12. Colour variation between skull bones from 3255 exhibiting colours of black, yellowish-brown, brown, dark to light greys, greyish-white and white

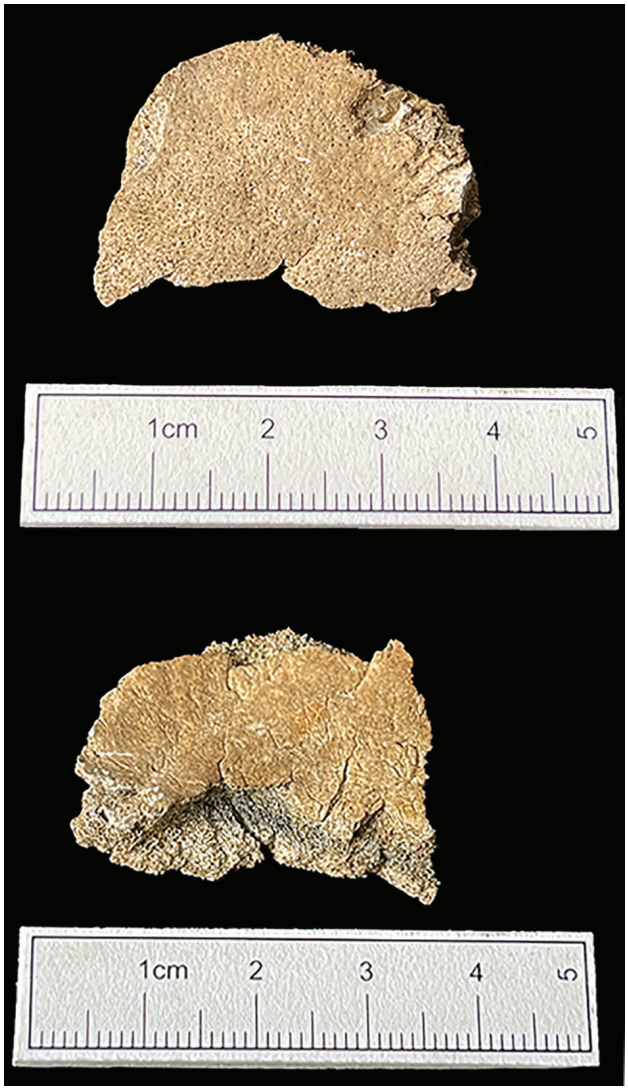


Figure 19.13. The external (top) and internal (bottom) skull fragment SF 5119 from 3233 exhibiting the internal light grey diploë and smooth external surface

A small assortment of unburnt and charred animal bones was noted within some deposits (see Table 19.14). These may represent deliberate inclusions of animal meat into the pyre as offerings and/or represent the remnants of feasting after which food remains were thrown into the burning pyre.

Weight

Most of the cremated remains from Cladh Hallan (Table 19.10) fall below expected averages, in that the majority of the recovered adult bones represent less than 5% of the expected weight (1,636g) of an archaeological, complete cremation burial. Deposit weights should not be viewed as the quantity of bone collected from the cooled pyre, but rather the quantity of bones chosen to be deposited at the time of burial (Willis 2021: 81). This does not negate the amount of bone that may have been lost within the burial environment, especially if the soil is particularly acidic, but it is clear that all of these deposits constitute a token amount of cremated bone.

The largest quantity of cremated bone is 274.6g and derives from deposit 2793 on the cremation platform 3558, containing a minimum of two individuals, but forms only 15% of the expected weight of an adult cremation. The smallest 'deposits' derive from the pyre debris and the dispersed bones from pits – these bones would normally be discounted but, as they contain unique individuals, they are included here and, unsurprisingly, they constitute less than 1% of the expected cremation weight.

The deposits that represent more than one individual only contained a very small quantity of bones: the young to mature adult remains from 2793b weighs 250.83g with the addition of 23.72g from a sub-adult (2793a). Similarly, the foetus/infant from 3458a weighs 5.10g but only one adult bone weighing 0.09g was recovered.

The most frequently represented skeletal element is the cranium, followed by the ribs and teeth (Table 19.11). Many of the axial bones, such as the vertebrae and pelvis, are not adequately represented while the maxilla, clavicles, sacrum and patellae are not represented at all. Very few long bones were included in the deposits; noticeably, fragments of femur, tibia and humerus are only found in a few deposits. These bones are easily identifiable (and are not in the 'UID long bone' category) so their complete absence for the majority of unique individuals is surprising.

Despite the low quantity of cremated bones recovered from each deposit, the skeletal elements present do reveal a high level of small-bone recovery from the cooled pyres: tooth roots, hand/foot bones and other very small bones have been identified. The areas of pyre debris/debris scatter also contain very little in terms of cremated bones, charcoal and other debris which supports meticulous bone recovery from the cooled pyres.

Overall, the selection of bones appears random rather than the result of deliberate retention of specific skeletal element; there is, however, one exception. There is an indication of deliberate deposition of specific bones, in that cremation 3255 has an unusually high number of teeth (Figure 19.14). During the cremation process the roots of

Table 19.10. Total weight of the cremation deposits and pyre debris containing unique individuals. Note the deposit weight from the 2005 osteological analysis is different to the weight calculated in 2024; this is probably due to samples taken for radiocarbon dating and also due to not including the bone dust and sediment from the base sieve for the later calculations. Interpretations will be conducted from the 2024 weights. Note that 3458b is not counted towards the MNI as it probably derived from one of the adult cremation deposits but is included here to show that the majority of the pyre debris consists of baby bones rather than adult ones. Also note that deposit 3255 was disturbed on its north side by later features, so its original deposit weight is unknown

Location	Deposit	Age	2005 weight	2024 weight	% of expected weight of a cremated adult	Total weight of the deposit
Stone ring (3306)	3307	YA	193.50g	130.38g	8.0%	130.38g
Stone ring (3256)	3197a 3197b	Inf–YC Adult	6.65g	1.34g 0.81g	- 0.05%	2.15g
	3255	Adult	115.90g	72.86g	4.5%	72.86g
	3257	YC–OC	12.20g	9.01g	-	9.01g
Stone platform (3558)	3334	Adult	-	4.08g	0.3%	4.08g
	2793a 2793b	Sub-adult YA–MA	71.40g 279.10g	23.72g 250.83g	- 15.3%	274.55g
Pyre debris	3458a 3458b	Foe–Neo (Adult)	10.00g	5.10g (0.09g)	- (0.0%)	5.19g
Pit 3324	3325	OC–Juv	-	7.65g	-	7.65g
Pit 3631	3233	MA–OA	-	4.26g	0.3%	4.26g

Table 19.11. Weight (g) for each of the skeletal elements for all cremation deposits. Note that, due to the low numbers of recovered vertebrae, they have not been separated out into cervical/thoracic/lumbar categories, and the metacarpals/metatarsals and the phalanges of the hands and feet have been combined for ease of reading (UID LB: unidentifiable long bones; UID SB: unidentifiable spongy bones)

Skeletal element	2793a	2793b	3255	3458a	3458b	3307	3197a	3197b	3257	3334	3325	3233
Cranium	21.02	89.25	43.08	1.25		57.44	0.79		2.85	1.11	6.07	4.26
Maxilla												
Mandible									0.28			
Teeth		0.78	4.61			0.13	0.05		0.18			
Clavicles												
Scapula		0.59				0.40						
Ribs	0.36	9.3	2.26	0.13		4.60			0.07			
Humerus		11.68				11.29			2.31			
Ulna	0.27	5.34				0.82			1.06			
Radius	0.43	2.31	0.15			0.47		0.64				
Hands		0.45								0.28		
Vertebrae	0.21	7.03		0.32		0.75				0.24	0.24	
Sacrum												
Pelvis		7.12										
Femur		16.54		0.48		12.16			0.35			
Patella												
Tibia		2.95		0.13								
Fibula		2.80				1.01			0.31			
Feet	0.23						0.05	0.05				
UID LB	1.20	78.65	19.27	1.96	0.09	33.71	0.16	0.12	1.60	2.23	1.34	
UID SB		16.04	3.49	0.83		7.49	0.29			0.22		
Total	**23.72**	**250.83**	**72.86**	**5.10**	**0.09**	**130.27**	**1.34**	**0.81**	**9.01**	**4.08**	**7.65**	**4.26**

Figure 19.14. An example of the level of recovery from the cooled pyre: these are tooth fragments from 3255

fully erupted adult teeth are protected within the alveolar bone of the mandible and maxilla, with the enamel crowns shattering in the heat. Many of the teeth will fall out as the jaw bones break apart, ending up within the coals at the base of the pyre, while others will remain within the fragments of jaw. These bones and teeth would have been recovered from the cooled pyre but, in the case of 3255, *only* the teeth were buried with skull fragments (skull fragments form 65.5% of the deposit weight) and some unidentifiable long bone fragments (26.4% of the deposit weight). Maxillary or mandibular bones were not recovered, and the skull fragments are small. It is therefore unlikely that a token deposit would naturally include such a high number of teeth and scarcely any other skeletal elements. The teeth have probably been kept apart from the rest of the cremated skeleton upon collection from the pyre and only a handful of miscellaneous cremated bones were included when these teeth were deposited. Conversely, it is also possible that only the skull was cremated on the pyre (and that the long bone fragments are residual from a re-used pyre or a deliberate addition of another individual); however, if this scenario is correct then only a token amount (43g) of skull bones were included and not the entire skull.

Fragmentation and maximum fragment size

The largest bone fragment from each deposit was measured (Table 19.12). These bones all derive from the 10mm sieve except 2793a which is from the 5mm sieve fraction. The average length is 38.46mm for an adult and 25.91mm for a child, with an overall average of 32.74mm; these fall slightly below the expected average of 45.2mm for cremated bone in Britain (McKinley 1994). These low measurements are not unusual in that un-urned deposits may be subjected to taphonomic processes, continued site activity and soil acidity, which can contribute to reducing bone size.

Fragmentation can only be calculated for the two deposits containing the highest quantity of cremated bones (2793 and 3307) as interpretation would be biased if the very low deposit weights were also included. For both these deposits, the majority of the cremated bones were recovered from the 10mm and 2mm sieve fractions although there is relatively little difference between the 5mm and 2mm sieve fractions from 3307 (Table 19.13).

The higher than expected weights from the 2mm sieve fractions may indicate natural or deliberate fragmentation but may also reflect a bias due to low deposit weights. For example, when compared to an average 1,636g adult cremation, the 2mm sieve fraction of 2793b contains only

Table 19.12. Maximum bone lengths for each unique individual

Location	Context	Age	Maximum length (mm)	Skeletal element
Stone ring (3306)	3307	YA	37.54	Humerus
Stone ring (3256)	3197a 3197b	Inf–YC Adult	18.63 32.93	Cranial UID long bone
	3255	Adult	55.39	Rib
	3257	YC–OC	25.81	Humerus
Stone platform (3558)	3334	Adult	19.10	Cranial
	2793a 2793b	Sub-Ad YA–MA	27.67 51.44	Cranial Ulna
Pyre debris	3458a 3458b	Foe–Neo (Adult)	27.40 -	Humerus -
Pit 3324	3325	OC–Juv	30.02	Cranial
Pit 3631	3233	MA–OA	34.37	Cranial
		Adult average:	38.46mm	
		Child average:	25.91mm	
		Overall average:	*32.74mm*	

Table 19.13. Total weight distribution between the sieve sizes of cremations 3307 and 2793. The grey highlighted rows further separate the weights from the two individuals from 2793a and 2793b

Context	10mm	5mm	2mm	<2mm	Overall total (without base sieve <2mm)
3307	51.55g (39.5%)	38.65g (29.7%)	39.46g (30.8%)	(0.61g) -	130.27g
2793	128.57g (46.8%)	48.93g (17.8%)	97.05g (35.4%)	(1.26g) -	274.55g
2793a	21.02 (88.6%)	0.00g -	2.7g (11.4%)	- -	23.72g
2793b	107.55 (42.9%)	48.93g (19.5%)	94.35g (37.6%)	(1.26) -	250.83g

5.8% of cremated bone. It is difficult to infer deliberate or natural fragmentation when only 15% of bones form the deposit. Additionally, deposit 2793 contains a MNI of two individuals which again alters interpretation as the sub-adult bones (2793a) will be naturally smaller in size when compared to the adult bones (2793b).

Pyre and pyre technology

There is evidence of two pyre sites at Cladh Hallan. The first was located at the south of Area A, within the ring of stones (3306) where a central small platform of flat stones (3463) was positioned (see Volume 1: figs 2.18–2.19). The flat stones had black surfaces, and the adjacent sand was scorched. The platform was entirely covered by a domed cremation deposit (3007) consisting of charcoal, compact peat ash, black soot and the cremated bones of a young adult and was capped by a thin deposit of unburnt peat (see Volume 1: 39). Pyre debris was not identified during osteological analysis. If the individual in deposit 3307 was indeed cremated on this stone platform, then only 7% of a cremated adult (130.27g) was left behind while the remaining bones were collected and taken elsewhere.

The second pyre site, in the east-centre of Area A, was a rectangular platform of flat slabs (3558) which were placed on top of some dispersed adult cremated bones (3596, missing from the archive; see Volume 1: figs 2.21, 2.25–2.26). A cremation deposit (2793) laid on top of the platform consisted of charcoal, peat ash, black soot and the cremated remains of at least two individuals. Fuel ash slag was identified amongst the cremated bones (2793; SF 4246); it derives from silica-bearing sand and is formed by fusion of the silica with materials from the pyre when temperatures are in excess of 900ºC (Henderson *et al*. 1987a; 1987b). The very high temperatures required to produce slag also match the yellowish-white bone colouration observed on the bones from 2793, which must have been burnt at a similar pyre temperature over a long period of time to achieve this colouration. Fuel ash slag was also excavated from a charcoal-rich spread of pyre debris (3356) but no additional pieces were found during osteological analysis (see Chapter 9 and the index to Volume 1 for the full distribution of fuel ash slag at Cladh Hallan).

During excavation, some of the other cremation deposits were noted to consist of pyre debris such as charcoal, peat ash and black soot. The cremated bones within these deposits must have been hand-collected during excavation, as pyre debris was not included with the cremated bones submitted for analysis, with the exception of 3257 and 3197. Burnt twigs/roots were identified in the material from 3257 (SF 5094; Table 19.14). This was another domed cremation deposit placed within a hollow of the second stone ring (3256) 1.40m northwest of cremation 3307. The deposit consisted of burnt peat ash, charcoal, black soot and the cremated bones of a young to older child (see Volume 1: 43). Another cremation deposit (3197) lay against the perimeter of stone ring 3256 in a slight hollow and contained cremated bones of an infant/young child and an adult, charcoal, black soot and peat ash (*ibid.*). A few flakes of charcoal were recovered during osteological analysis.

A small spread of ash, charcoal and cremated bones (3458; two individuals) northeast of the east-central cremation platform (3558) is probably dispersed pyre debris. Another spread east of the platform consisted of a lower deposit of charcoal-rich sediment (3356) containing cremated bone and fuel ash slag, and an upper deposit (3355) containing burnt and unburnt black stones and three unworked pieces of pumice (see Volume 1: 47). All of these pyre deposits probably derived from the pyre on the stone platform. No additional pyre debris was found during analysis.

Two of the now-missing cremation deposits (3524 and 3525) consisted of thin, flat spreads of charcoal, cremated bones and peat ash (see Volume 1: fig. 2.21). They lay on either side of a similarly thin but larger deposit (3496) of charcoal and sand, but with no burnt bone (*ibid*.: 49). North of these deposits was a large spread of organic material (3391) that included a single cremated skull fragment (SF 5241). A small, partially burnt piece of wood was also recovered from the 'upper' unstratified part of this context.

Despite the identification of the *in situ* remains of at least two pyres, very little pyre debris was present. This indicates two possible scenarios: either the pyre sites were left exposed for a period of time before being covered, in which case the wind blew away some of the pyre material. Or, once the bones were collected from the cooled pyre,

the debris was manually cleared/swept from the site for deposition elsewhere. Certainly, deposit 3496, consisting of charcoal and sand between the two missing cremations, and the spread of sand and ash (3391) just to the north, are both pyre sweepings. With regard to the cremation deposits which consisted of peat ash, charcoal, black soot and cremated bones, there is again only a small amount of pyre debris. This indicates that the cooled bones were carefully hand-collected from the site of the pyre rather than being scraped/swept up, and only small quantities of the bones were then deposited.

The artefacts accompanying the cremated bones

Artefacts were recovered from almost all of the main cremation contexts and from some of the pyre debris with the exception of the adult deposit (3334) which was not associated with anything, despite being spread on the stone pyre platform (Table 19.14). There does not appear to be any particular pattern as to the type of artefact, but shells, burnt animal bones, worked animal bones/bone tools and worked flints were rarely included. Pottery appears to be the most common, followed by unburnt animal bone and unburnt human bone. There are also no real differences between artefacts associated with a single deposit and artefacts associated with a multiple deposit (Figure 19.15).

In order to examine artefact differences between broad age categories, only the deposits with single individuals are included. This is due to the uncertainty as to whether an artefact was associated with a child as opposed to an adult within the deposits containing multiple individuals. When the individuals from multiple deposits are excluded, there are slightly more artefacts associated with adults than with children (Figure 19.16). This sample too may be slightly skewed, however, as only one child deposit and four adult deposits can be included in this analysis.

19.3 The unburnt individuals (articulated and disarticulated)

Four of the inhumations are dated to Phase 8, the construction phase of the row of roundhouses in Area A. Beneath the northeast quadrant of the southernmost house (House 801), a female child inhumation (SK 2792) lay within a small oval pit (2737). The skeleton of another child (SK 2727) was recovered from a small oval pit (2564) beneath the northeast quadrant of the central house (House 401). To the north, two inhumations lay beneath House 1370: an adult (SK 2613) buried in an oval pit (2612) beneath the southern edge of the house, and a second adult (SK 2638) in an oval pit (2597) beneath the northeast quadrant. In Phase 10 an infant (SK 2188 in pit 2167) was buried in a posthole (2165) in House 1370's northeast quadrant.

Table 19.14. The cremation contexts (including dispersed cremated bone contexts) associated with grave goods and/or artefacts

Context	Age category	Unburnt animal bone	Cremated animal bone	Worked bone/bone tools	Shell fragments	Pottery sherds	Worked flints/stones	Unburnt human bone	Notes
3197	Inf–Adult	•				•			Pot (SF 5412); MNI × 2 cremated
3255	Adult		•		•				Burnt antler; 2× unburnt shell frags
3257	YC–OC	•			•	•			Unburnt mouse bones; 5× plain body sherds; 1× rim from a small bowl; burnt twigs
3307	YA					•			3× plain sherds
2793	Sub-A YA–MA	•	•					•	Unburnt incisor and charred mandibular frags from animals; unburnt human fibula frag; MNI × 2 cremated
3458	Foe–Neo Adult							•	MNI × 2 cremated; unburnt adult bone
Gully 3435	Adult			•		•	•	•	Fill contained 2× worked flints; 1× worked bone; body sherds of a plain vessel; rim sherd of a plain bowl-shaped vessel; cremated bones; unburnt human humeral fragments
3233	MA–OA					•			Pit contained a single cremated bone and 9× sherds of Cordoned Urn-style pottery
3355, 3356	-					•			Spread of charcoal-rich sediment with cremated bone, burnt and unburnt stones, 3× unworked pumice and sherds from both a bowl and another vessel

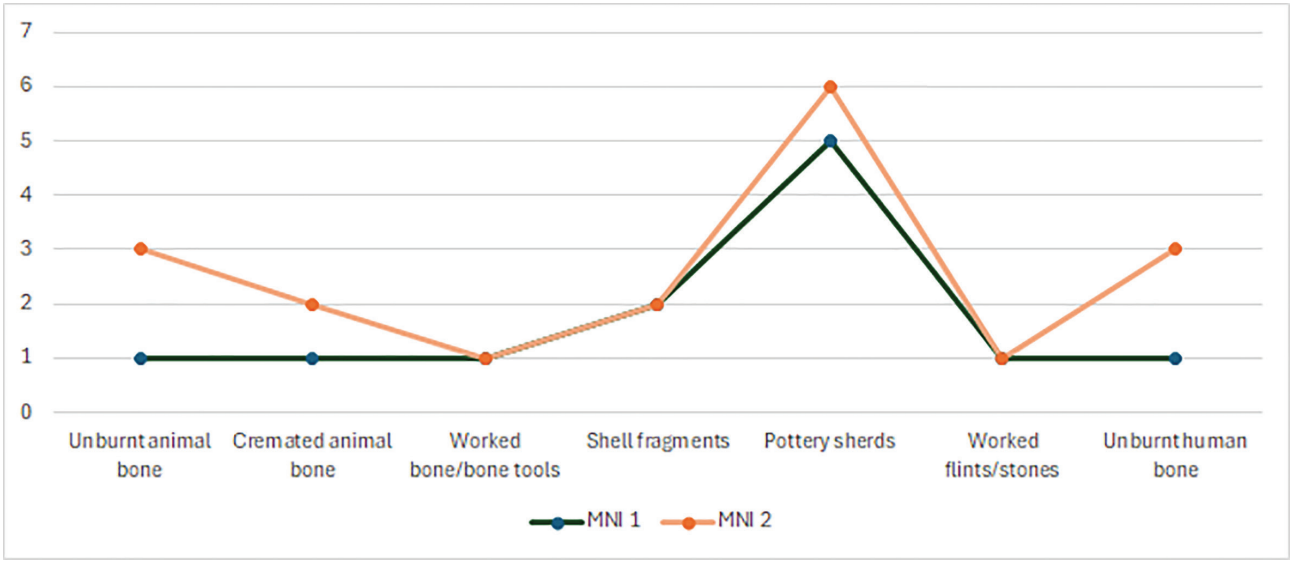


Figure 19.15. Artefacts associated with deposits containing a single individual and deposits that contain at least two individuals regardless of age at death

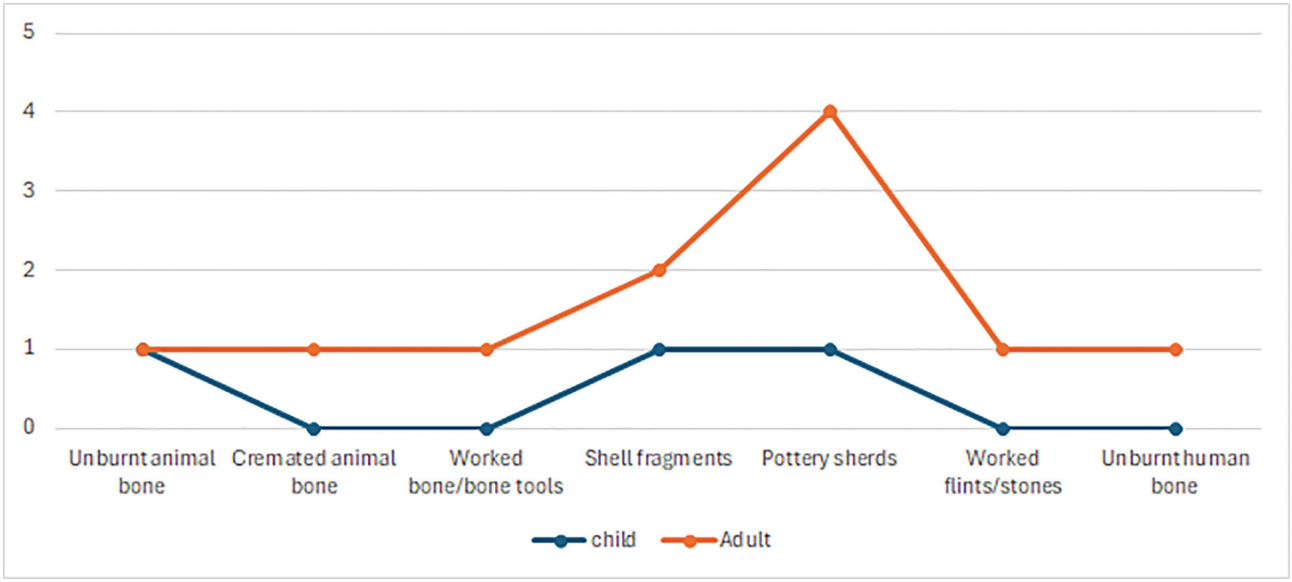


Figure 19.16. Artefacts associated with children and with adults from the main cremation deposits. These numbers do not pertain to the number of items within each deposit, but rather the number of deposits that contain the artefact. Note that this figure does not include the deposits containing a MNI of two as it is unknown which individual is associated with which artefact

A partial skeleton (SF 4906) was recovered by workmen from the surface of the sand quarry immediately south of Area C. The skeleton was in a disturbed area, in a disarticulated state. No other contextual information is known about this individual. Radiocarbon dating places this skeleton in Phase 3 (see Table 19.1).

Loose and disarticulated bone fragments were recovered from a wide variety of contexts. Some of the bone fragments are in the same contexts as cremated bone fragments (Phase 3) but these probably derive from later phases of activity and have intermingled with the cremated remains.

The reader should note that this chapter does not discuss the histological analysis of the remains, nor is there space to summarise all the previously published research that interprets some of the bodies buried at Cladh Hallan as having been preserved or mummified elsewhere, between death and the moment of their final burial beneath the house floors. For information on this area of analysis, please consult Volume 1 (particularly chapters 4 and 14) as well as Chapters 20 and 23 of this volume; those chapters provide references to the relevant literature.

Preservation

Most of the articulated skeletons are scored between '1' with slight and patchy surface erosion (SK 2613, SK 2188,

and SF 4906) and '2', presenting more surface erosion with deeper surface penetration (SK 2638 and SK 2792). These results are as expected, given the protection afforded to the individuals buried in the alkaline shell sand of the machair beneath the foundations of the roundhouses. SF 4906, recovered from the south of Area C, is in excellent condition with a perfect skull.

In contrast, SK 2727 is scored at '5', with extensive erosion across entire bone surfaces with modification to its profile rendering these bones very fragile. Histological analysis has recorded '0' for the OHI scale (very poorly preserved) and '0' on the birefringence index (poor integrity of collagen/mineral bond; see Chapter 20). This poor level of preservation is quite different to the other inhumations and is probably due to this burial being deep enough to have been affected by periodic waterlogging due to a fluctuating water table at this depth (see Volume 1: fig. 4.11).

The disarticulated human bones were not formally scored though most are well preserved with a lack of surface modification on the bones. This observation is not surprising as the disarticulated bones were recovered within protected areas of the site, along with most of the articulated human remains.

Completeness and fragmentation

Five inhumations are complete: most of the skeletal elements are present, though many of the small bones from the hands and feet were not recovered. While SK 2613 and SK 2638 are composite skeletons, they nevertheless contain all the major skeletal elements with no repeating bones and are each considered to be a complete skeleton (though the composite individuals themselves are not complete!).

The sixth skeleton (SF 4906) is *c.* 75% complete, which is higher than expected given that he was disinterred accidentally during sand quarrying southeast of Area C. Technically, SF 4906 should be considered a 'disarticulated skeleton' as no contextual information regarding burial position, orientation or grave exists. He is counted here within the 'articulated' category, however, due to the excellent condition of the bones, the relatively high quantity of skeletal remains recovered, and the probability that he was formally buried as opposed to being a bundle of disarticulated remains.

Similarly, the near-complete skeleton of a 38–40-week gestation foetus/stillborn (SK 2241) was recovered, together with two infant bones and three adult bones, from dry-sieving of floor layer 462, a deposit thick with animal bones, antlers picks and bone and stone tools. There is no other burial information regarding this context (in Phase 14) and this baby is considered to be 'disarticulated' since it is unknown if the bones were formally placed on the floor, were disinterred at a later phase as a result of continued activity within the house, were introduced within sand imported into the house, or were deliberately scattered amongst the debris on the floor.

The skulls of four of the skeletons (SK 2613, SK 2727, SK 2792 and SK 2188) are heavily fragmented while the skulls of SF 4906 and SK 2638 are complete. Fragmentation of the post-cranial skeletons occurred in the forearms of SK 2188, the vertebrae, hips and lower limbs of SK 2638, the arms, hips and legs of both SK 2613 and SK 2792, and the majority of the skeletal elements from SK 2727.

Minimum number of individuals (MNI)

A minimum of 10 individuals was identified from the six inhumation burials and at least 10 individuals from the disarticulated remains (see Table 19.15). There are no repeating skeletal elements from the inhumations, but there are age- and sex-related differences between these contexts. Both SK 2638 and SK 2613 are composed of composite skeletons of at least three individuals in each: SK 2638 consists of the cranium (individual #1) which does not articulate with the mandible (individual #2) and the post-cranial skeleton of a third individual.

Interestingly, the left fibula of SK 2638 is not the same size or shape as the right fibula – the right side is shorter and has a much smaller articular facet for the talus and exhibits lipping around its margins. It is also in worse condition to that on the left side, which is bigger with no lipping and with excellent preservation. These vast differences between the two fibulae may indicate another (fourth) individual or the fibula of someone already represented by either the cranium or mandible.

Osteologically, there is no obvious indication that SK 2613 is a composite skeleton; however, the majority of the post-cranial skeletal elements exhibit severe degenerative joint diseases on both left and right sides *except* for the right scapula, the left and right humeri, right radius, both left and right pelvic bones, right fibula and all of the right foot bones (see pathological section below for further information). Due to the severity of osteoarthritis on all of the other bones, this raised the possibility that SK 2613 could also be a composite skeleton and aDNA analysis was requested. The skull, right humerus and left femur were sampled by Kerry Brown (University of Manchester) and the results revealed that those skeletal elements are from three different individuals (Hanna *et al*. 2012). It is currently unknown which of the remaining bones are from which individual and, as such, the division of this composite skeleton will be based solely on the aDNA results (see Figure 19.28).

The burial of SK 2727 (a child) contained an additional adult radial head, which probably derives from one of the disarticulated adult skeletons scattered across the site. Similarly, the grave of SK 2613 contained a left I_2 that does not derive from the mandible of this composite skeleton. The radial head and the additional incisor are not counted towards the overall MNI of this site. Future aDNA testing on these disarticulated bones within the inhumation burials may indicate the level of relatedness to the formal burials or to one/some of the disarticulated individuals.

A minimum of 10 disarticulated individuals have been identified through age-related differences and skeletal element repetition. Only five disarticulated bones and two teeth have been radiocarbon-dated as most of the other human bones are associated with either dated animal bones or grains. Of course, these associated dated materials will

only indicate when the human bones were last handled/disturbed and not when the individual died. A renewed radiocarbon-dating program for the unburnt human remains therefore might augment the number of disarticulated individuals present at Cladh Hallan.

In total, there is a minimum of 20 inhumed individuals; the vast majority, however, are identifiable from either disarticulated bone fragments recovered from across the site or from specific skeletal elements taken from other deceased individuals to make up composite individuals. Of the 20 individuals, only four have not been disturbed after death/burial (SK 2188, 2727, 2792 and probably SF 4906).

Age at death

There are four children and six adults within the inhumed burials and eight children and two adults make up the disarticulated individuals (Table 19.15). SK 2638 is a composite skeleton of at least three individuals with differing isotopic values, different radiocarbon results for the skull, mandible and torso, and also differentiating dentition for the mandible and maxilla. SK 2613, as previously mentioned, is another composite skeleton of at least three individuals (Parker Pearson *et al*. 2007; Hanna *et al*. 2012). Skeleton 2727 is an older child but was interred with the disarticulated radial head of an adult. The radial head is not counted towards MNI as it may derive from one of the other disarticulated adults rather than from a unique individual. The remaining inhumations (SK 2188, SK 2792 and SF 4906) comprise a single individual in each burial.

A minimum of 10 disarticulated unburnt individuals have been identified by age-related differences, and one instance by a duplicated skeletal element. Combined, the articulated and disarticulated skeletal remains produce an attritional life table distribution (Figure 19.17) in which age-specific mortality is highest amongst the youngest age groups, falls to a minimum during adolescence and early adulthood, and then rises again during the oldest age groups (Chamberlain 2006: 25; Caughley 1966). The number of disarticulated adults may be underrepresented because, without duplicating skeletal elements or multiple age- or sex-related differences, it is difficult to separate out unique individuals based on a few fragments of undiagnostic bone. Children, on the other hand, have narrower age categories and unique individuals can be more readily identified.

Overall, there are 12 sub-adults and eight adults: four children and six adults are articulated, and eight children and two adults are disarticulated. Children represent 60% of the population, and 50% (n = 6) of them died within their first year of life. Mature and older adults represent 75% (n = 6) of the adult population. These trends follow expected mortality rates for prehistoric populations and the high infant mortality would have had a huge impact on the Cladh Hallan community.

Biological sex

The six adult individuals (from the two composite skeletons) and the four children were sexed, though due to the difficulties in determining biological sex of sub-adults, these data are only tentative except for the six that have been aDNA sequenced (Table 19.16). The composite

Table 19.15. Summary of the age at death for each unique individual

Location	Skeleton/deposit	Age
House 1370	SK 2638	Ind 1: OA Ind 2: MA Ind 3: MA
	SK 2613	Ind 1: MA Ind 2: Adult Ind 3: MA–OA
	SK 2188	Neonate
House 401	SK 2727	OC (10–14 years)
House 801	SK 2792	YC (1.5–3 years)
Area C	SF 4906	OC (9–12 years)
Multiple locations: (disarticulated)	183, 242, 510, 659, 1233, 2554	Ind 1: Foetus (18–24 weeks gest.) Ind 2: Foetus (>28+ weeks gest.)
	462, 465	Ind 1: Neonate Ind 2: Neonate
	462, 1680	Ind 1: Infant Ind 2: Infant
	242, 1369, 2204/2205	OC
	119, 242, 655	Juv–YA
	2394, 2909, 3119, 4024	YA–MA
	655, 1369	MA–OA

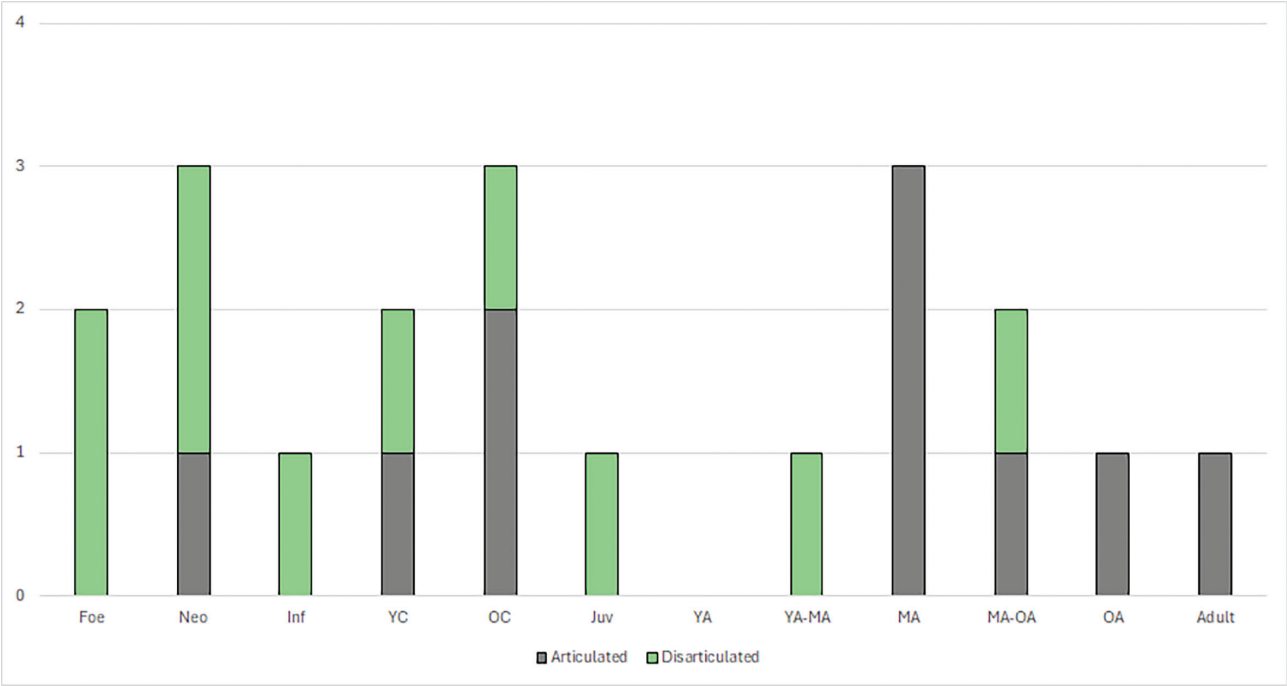


Figure 19.17. Age at death distribution for the articulated (in grey) and the disarticulated (in green) individuals

skeleton SK 2638 derives from male individuals while the composite skeleton SK 2613 derives from one male and two female individuals. SF 4906 is a male while SK 2792 and SK 2188 are female (all aDNA sequenced) and the other child (SK 2727) is a possible female.

Sex determination of the disarticulated remains relies on fragmentary morphological characteristics and, unfortunately, there are no repeated sex features. In context 2428, a right proximal ulna was noted to be very large, with thick cortical bone and robust musculoskeletal stress markers, which indicates a possible male individual. Other male features derive from a skull fragment (3265) and a right petrous bone (1413), which has also been aDNA sequenced and its sex calculated at the molecular level using two separate methods, confirming a male individual (Tom Booth pers. comm.). In context 2544, a fragment of a thin left lateral margin of an upper eye orbit and left zygomatic bone from pit 2543 indicates a possible female individual.

In total, six males and six females are identifiable amongst both the articulated and disarticulated human remains, of which five males and three females are adults and one possible male and three possible females are children (Figure 19.18).

Table 19.16. Biological sex determinations from the articulated skeletons and disarticulated remains

Location	Skeleton no.	MNI	Skeletal element	Sex determination
House 1370	SK 2638	Ind 1	Cranium	Male
		Ind 2	Mandible	Male
		Ind 3	Pelvis	Male
	SK 2613	Ind 1	Cranium	Male
		Ind 2	Humerus (right)	Female
		Ind 3	Torso, lower limbs	Female
	SK 2188	1	-	Female
House 401	SK 2727	1	-	?Female
House 801	SK 2792	1	-	Female
Area C	SF 4906	1	-	Male
Multiple locations (disarticulated)	2428 3265 1413	1	Proximal R ulna Skull R petrous bone	Male
	2544 803	1	Eye orbit L zygomatic	Female

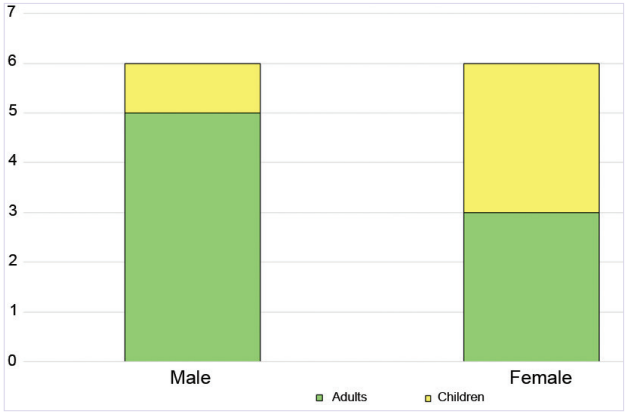


Figure 19.18. Identifiable biological sex of articulated and disarticulated adults and children

Stature

The two adult articulated skeletons were measured for stature but, as they are both composite skeletons of at least three individuals, the estimation of stature is not attributable to the skeleton as a whole. The measurements of the humerus and the femur can be used to determine the stature of the individual who makes up the post-cranial skeleton of SK 2638.[2] For SK 2613, the right humerus and left femur are known to derive from two different individuals and their measurements can therefore be used to estimate the stature of two of the (minimum of) three individuals who make up this composite skeleton (Table 19.17). The lower limb bones of SK 2613 are fragmented and were not used to estimate stature for individual #3 although metrical measurements supported 'female' sex (Steele and Bramblet 1988; Bass 1971).

Stature for Bronze Age males ranges from 167cm to 177cm with a mean of 172cm (5ft 6in) while females range between 154cm and 161cm with a mean of 157.5cm (5ft 2in), an increase in height from the Early Neolithic period of almost 3cm (Roberts and Cox 2003: 86). Individual #3 from SK 2638 is a 167.4cm-tall (5ft 5in) male and falls on the low end of the range for expected stature. In contrast, individual #2 from SK 2613 is a 163.0cm-tall (5ft 3in) female and individual #3, also female, is 166.0cm tall (5ft 4in) – both are much taller than expected. This may be due to having measurements from only the upper limbs rather than from the lower limbs. The taller stature of Bronze Age individuals has been explained as the result of a higher caloric intake when compared to the Early Neolithic period (Roberts and Cox 2003: 86) although the near-total replacement of Britain's population by people with steppe-derived ancestry at the end of the Neolithic may also account for this (Olalde *et al*. 2018).

Non-metric traits

Non-metric traits are often considered to be variants that may reveal familial inheritance but issues regarding age/sex differences, asymmetry and inter-trait correlations mean that these traits may be population-specific and are difficult to compare and contrast with other populations (Buikstra and Ubelaker 1994: 85). As part of the data collection, 33 primary non-metric traits were collected from each of the inhumed skeletons (Table 19.18).

The skeletons from Cladh Hallan contain very few non-metric traits, of which only three are shared between individuals: the left supraorbital notch is present in SF 4906, SK 2638 and SK 2613, while the right supraorbital notch is present in SK 2638 and SK 2727. The right supraorbital foramen is present in SK 2638 and SK 2613 while the accessory transverse foramina in the seventh cervical vertebrae is a shared trait between SK 2638 and SK 2792. Due to the young ages of SK 2792 and SK 2188, the absence of non-metric traits may be a lack of development/growth rather than a complete 'lack' of the trait(s).

Skeletal health and disease

Degenerative joint disease (DJD) is seen in 15% of individuals from Cladh Hallan (n = 3/20) and is comparable to other Bronze Age sites, where 16.9% of individuals are recorded as displaying some form of DJD (Roberts and Cox 2003: 79). An increased workload has been considered to be the cause for the degenerative changes seen in the joints of Bronze Age as compared with Neolithic people in Britain (*ibid*.: 77–8).

SK 2638 (individual #3) has DJD and Schmorl's nodes on both the inferior and superior surfaces of T7–T8, T10–T11 and L1–L3, on the superior surfaces of T9, L4–L5, and on the inferior surface of T6, osteophytosis (lipping) at the edges of the vertebral bodies of T3–T6, T8, T12 and L1–L2, bone remodelling at the right costal facet of T12 and degenerative changes to C3–C4. Periostitis is located on the sternal ends of both clavicles, slight osteophytosis around the right glenoid, non-specific infection on both left and right acetabulums (but no infection of the femoral heads), slight osteophytosis on the right distal fibula and a body growth on the left femur's distal-medial condyle (but a concave facet on the right femur's distal-medial condyle). There is also very pronounced curvature at each deltoid (humerus), indicating a musculo-skeletal stress marker for repetitive activity.

SK 2613 (individual #3) has severe bilateral osteoarthritis (perhaps rheumatoid arthritis) with severe degenerative changes and eburnation to both the left and right sides of most of the post-cranial skeletal elements, pronounced musculo-skeletal stress markers on the femur, gout/gouty arthritis on the left cuboid/calcaneus articular facets, left calcaneus, left talus, left proximal first metacarpal and right fourth metacarpal. Individual #1 (from SK 2613) has temporomandibular joint disorder on the right mandibular condyle and a pronounced mylohyoid attachment.

There are no pathological lesions on any of the articulated or disarticulated sub-adult skeletal material. Both composite adult skeletons exhibit degenerative changes that are due to age-related wear and/or repeated mechanical stress on the joints.

Table 19.17. Measurements of the adult long bones for stature from the unique individuals within the two composite skeletons (L = Left, R = Right)

Skeleton no.	Skeletal element	Measurement (mm)	Sex	Left bone length (mm)	Right bone length (mm)	Stature (cm)
SK 2638	Ind 1: cranium	-	-	-	-	-
	Ind 2: mandible	-	-	-	-	-
	Ind 3: post-cranial	Humeral head L: >37.53 R: >39.62	?	Humerus: 303 Ulna: >267 Radius: 245 Femur: - Tibia: 358 Fibula: >305	Humerus: 306 Ulna: 271 Radius: >238 Femur: 445.7 Tibia: - Fibula: 335	L: 164 R: 165 L: - R: 174 L: 171 R: - L: - R: 167.5 L: 169 R: - L: - R: 161.5
		Femoral head L: 44.76 R: 46.82	M			
		Fem bicondylar width L: 79.91 R: -	M			
Male average for Individual #3:						*167.4cm*
SK 2613	Ind 1: skull	-	-	-	-	-
	Ind 2: humerus	Humeral head L: 42.3 R: -	F	Humerus: 300	Humerus: -	L: 163 R: -
	Ind 3: torso, lower limbs	Femoral head L: - R: 41.5	F	Ulna: 248 Radius: 230 Femur: - Tibia: - Fibula: -	Ulna: - Radius: -Femur: - Tibia: - Fibula: -	L: 166 R: - L: 166 R: - L: - R: - L: - R: - L: - R: -
		Fem bicondylar width L: 73.8 R:-	F?			
Female average for Individual # 2:						163.0cm
Female average for Individual #3:						166.0cm

Dental health and disease

Four of the 10 articulated inhumations from Cladh Hallan display some form of dental disease, much higher than is recorded for other Bronze Age sites, where the average prevalence rate for dental disease is 28% (Roberts and Cox 2003: 81). This is a slight increase of 1.8% from the Neolithic prevalence and could reflect greater access to carbohydrates as a result of agricultural intensification, an increase in consumption of cereal crops and a decrease in oral hygiene (*ibid*: 85).

Among the individuals from Cladh Hallan, partial to complete resorption of the alveolar sockets as a result of *ante mortem* tooth loss (AMTL) is noted for four individuals (SK 2638 [individuals #1 and #2], SK 2727 and SK 2613 [individual #1]), in which a combined total of 18 mandibular and maxillary teeth were lost prior to death. A small abscess on the left mandible and another small abscess on the left maxilla from SK 2613 is surrounded by periodontal disease. SK 2613 also has a single carious lesion at the junction between the left M_2's root and crown.

Mild to moderate calculus on maxillary and mandibular teeth is noted in SK 2613, SK 2638, SK 2727 and SF 4906. The majority of the calculus is concentrated on the buccal and lingual sides of the teeth, while that of SK 2727 is contained on the buccal side only. Enamel hypoplasias are observed on SK 2613 (n = 4 teeth affected) and SK 2727 (n = 7 teeth affected); the number of enamel hypoplasias per tooth from SK 2727 varies from one line to three lines, indicative of repeated periods of stress over several years as these adult teeth developed within the alveolar bone.

Slight to moderate occlusal wear of the teeth is noted in SK 2613, SK 2638 and SF 4906, while overcrowding of the left and right lower canine of SF 4906 and the left lower canine of SK 2727 are also observed. The canine from SK 2727 is slanted towards the labial side of the mandible. Interestingly, SK 2613 has a misalignment within the maxilla; this scissor occlusion resulted in an overbite and an overjet of the maxillary incisors.

The disarticulated teeth show a pattern of dental health similar to that of the articulated inhumations. Slight wear on the occlusal surfaces was the most common feature, followed by one instance of heavy calculus, one enamel hypoplasia, one carious lesion and one accessory tubercle on a maxillary incisor.

Post mortem manipulation

Post mortem manipulation of at least six individuals created two composite adults, both buried beneath the northern house (House 1370; see Figure 19.3). SK 2638 possessed a complete set of mandibular teeth (individual #2) while all of the maxillary teeth (individual #1) were lost *ante mortem*. This has led to almost complete alveolar resorption of the left and right sides of the maxillary bone. Since the mandible has a complete set of teeth, the maxilla should have possessed functioning upper dentition. Yet the maxillary teeth are completely absent in the skull with which the mandible was associated. The mandibular molars have substantial build-up of dental calculus on the lingual sides but a complete lack of calculus on the occlusal surfaces due to the attritional forces of what would have been the associated maxillary dentition.

Table 19.18. The non-metric traits (after Buikstra and Ubelaker 1994) whereby 'X' = trait is absent; '√' = trait is present; 'NP' =that area of bone was not recovered. The different colours represent the different individuals within each composite skeleton (SK 2638: green = individual 1; blue = individual 2; orange = individual 3. SK 2613: purple = individual 1; yellow = individual 2; red = individual 3)

Non-metric trait	SF 4906		SK 2613		SK 2638		SK 2727		SK 2792		SK 2188	
	L	R	L	R	L	R	L	R	L	R	L	R
1. Metopic suture	x		x		√		x		x		x	
2a. Supraorbital notch present	√	x	√	x	√	√	x	√	x	x	x	x
2b. Bridging of supraorbital notch	√	√	x	√	√	√	x	x	x	x	x	x
3. Infraorbital suture	x	x	NP	x	√	√	x	x	x	x	x	x
4. Multiple infraorbital foramina	x	x	NP	x	x	x	NP	x	x	x	x	x
5. Zygomatico-facial foramina	x	x	x	x	2	x	NP	NP	x	x	x	x
6. Parietal foramen	x	x	x	x	√	√	NP	NP	x	x	x	x
7a. Ossicle at Pterion	x	x	x	x	x	x	NP	NP	x	x	x	x
7b. Ossicle in coronal suture	x	x	x	x	x	x	NP	NP	x	x	x	x
7c. Ossicle at Bregma	x	x	x	x	x	x	√	√	x	x	x	x
7d. Ossicle at Sagittal	x	x	x	x	x	x	x	x	x	x	x	x
7e. Ossicle at Lambda	x		x		x		x		x		x	
7f. Ossicles in lambdoid suture	√	√	x	x	x	x	NP		x	x	x	x
7g. Ossicle at asterion	x	x	x	x	x	√	NP	NP	x	x	x	x
7h. Ossicle in occipito-mastoid suture	x	x	x	x	x	x	NP	NP	x	x	x	x
7i. Ossicle at parietal notch	x	x	x	x	x	x	NP	NP	x	x	x	x
8. Inca bone	x		x		x		NP		x		x	
9. Posterior condylar canal open	x	x	NP	NP	NP	NP	√	√	x	x	x	x
10. Divided hypoglossal canal	x	x	NP	NP	x	x	x	x	x	x	x	x
11.Direction of flex.for sup. sagittal sulcus	Not visible		Bifurcate		Not visib.		Left		x		x	
12. Incomplete foramen ovale	x	x	NP	NP	x	x	NP	NP	x	x	x	x
13. Open foramen spinosum	x	x	NP	NP	x	x	NP	NP	x	x	x	x
14. Pterygo-spinous bridge	incomplete		NP	NP	x	x	NP	NP	x	x	x	x
15. Pterygo-alar torus	incomplete		NP	NP	x	x	NP	NP	x	x	x	x
16. Tympanic dibiscence	√	√	NP	NP	x	x	NP	NP	x	x	x	x
17. Auditory torus	x	x	x	x	x	x	x	x	x	x	x	x
18. Mastoid foramen sutural	√	√	NP	NP	x	√	x	x	x	x	x	x
19. Number mental foramen	1	1	1	1	1	1	1	1	x	x	x	x
20. Mandibular torus	x		NP		x		x		x		x	
21. Mylohyoid bridge	x	x	x	x	x	x	NP	NP	x	x	x	x
22. Posterior atlas bridging	NP	NP	x	x	x	x	x	x	x	x	x	x
23. Transverse foramen bipartite	x	x	x	x	√	√	x	x	x	√	x	x
24. Septal aperture on distal humerus	x	x	x	x	x	x	NP	x	x	x	x	x

Additional research has revealed that the nitrogen ($\delta^{15}N$) isotope ratios of samples taken from both the skull and mandible are incompatible with those of the sampled tibia, indicating that the tibia is from another, third individual (see Volume 1: chap. 14). Three separate individuals therefore made up the composite skeleton of SK 2638, which was buried in a fully articulated position probably 100 years after death (*ibid*.).

The *post mortem* manipulation of SK 2613 is more extensive than that of SK 2638. During excavation of SK 2613, it was noted that several skeletal elements were missing from the inhumation: the left knee joint consisting of the distal end of the femur, patella and the proximal ends of the tibia and fibula, and also the distal end of the right radius were absent. The left knee joint and right distal radius could only have been removed prior to burial since the right leg and right hand, which were laid over the missing left knee joint, remained undisturbed upon archaeological excavation (see Figure 19.28 and Volume 1: fig. 4.19).

Just outside House 1370, a pit (2551) was dug and filled during the period of construction and initial use of the house, around the eleventh century BC (see Volume 1: 95–100). Near the base of the pit, fill layer 2748 consisted of red peat ash and domestic debris and is associated with debris fallen in from the adjacent and earlier cremation pyre (compare Figure 19.1, in which the slabs of the Phase 3 cremation platform 3558 are shown shaded grey, with the location of pit 2551 in Figure 19.3). Pit fill 2748 also contained the missing left distal femur and left proximal tibia of SK 2613. This left knee joint was still in its anatomical articulation, although not as flexed as the main body (see Volume 1: fig. 4.30). The break pattern to the shafts of the distal femur and proximal tibia perfectly fit the break pattern of the proximal femur and distal tibia of SK 2613. Furthermore, the pathological lesions of the left knee joint (degenerative joint disease in the form of extensive lipping and eburnation to all the condyles) match those found on the right knee joint of SK 2613.

The missing left patella and right distal radius of SK 2613 were recovered from another fill layer (2732) of the same pit, stratigraphically about 0.50m above the knee joint.. The left patella has similar pathological lesions (lipping around the edges of the facets) to that of the right patella of SK 2613, while the break pattern of the right distal radius perfectly matches the break pattern of the right proximal radius of SK 2613.

In addition to the removal of long bones from the post-cranial skeleton of SK 2613, both upper lateral incisors had also been removed from the maxilla and placed in each hand: the left tooth in the left hand and the right tooth in the right hand. The two teeth would have been placed in the hands prior to the commencement of decomposition of the body since the hands remained clenched around the teeth and were undisturbed prior to excavation – but a surplus phalanx on the second finger of the left hand was visible during excavation (see Volume 1: fig. 4.19). Typically, an individual possesses one metacarpal and three phalanges per finger; however, the excavation of SK 2613 revealed four phalanges within the second finger. The finger bones appear to have been *in situ,* so the position of this phalanx has several possible explanations.

The finger bone was moved during *post mortem* manipulation of this composite skeleton (being dislodged from the hand and then replaced in an approximate but not exact position before burial).

The bone could belong to yet another different individual and was placed with SK 2613, to replace a portion of a finger lost from the hand during the *post mortem* manipulation of the body. It seems unlikely, however, that this very small bone derives from a different individual: it is more probably from the individual who contributed the majority of the post-cranial skeleton to SK 2613, just not in its correct anatomical position. Note that there is no extra finger bone within the skeletal inventory.

Sex determination of SK 2613 has revealed a female pelvis, female long bones and a male skull; furthermore, aDNA from the skull and teeth (T-haplotype), the humerus (H-haplotype) and the femur (T1-haplotype) has confirmed that three separate individuals formed this composite skeleton (Hanna *et al*. 2012). Moreover, the skull dates to *1435–1260 BC* and is probably several decades older than the post-cranial skeleton which dates to *1300–1125 BC* despite this burial being in an anatomically correct and gently contracted position.

Unusually, only two cut-marks were observed on the composite skeletons, both from SK 2613. The first is a 10.39mm-long cut on the right trapezium (Figure 19.19). The cut-mark is 1.17mm wide at the edge of the bone but tapers down to nothing, similar to the end of a blade cut. The other cut-mark is better described as a nick, on the right navicular and is 4.16mm in length (Figure 19.20). Neither of these cut-marks resembles damage from roots and the marks are the same colouration as the rest of the bone, signifying they were not caused during excavation in 2001. The absence of cut-marks is an indication that these bodies were not dismembered when fresh to create composite bodies. It supports the argument that the composite skeletons derive from bodies that were mummified and subsequently dismantled; mummification made it possible to remove some of the body parts from a corpse, without having to use bladed tools, while keeping most of the body in articulation (see Chapter 20, this volume, and Volume 1 for the literature on mummification at Cladh Hallan).

Figure 19.19. The cut-mark on the right trapezium of SK 2613

Figure 19.20. The small nick on the right navicular of SK 2613 (just to the upper left of the centre)

The body of the 1½–3-year-old child (SK 2792) may also have been subject to *post mortem* manipulation. The radiocarbon date for death (during Phases 3–6) is much earlier than the date of construction of the house floor above the child's grave in Phase 8 (see Volume 1: 84–7, 422, 444). The manipulation of a partially articulated body, the very shallow depth of the grave pit beneath the house floor, and the location of the body beneath House 801's northeast quadrant (echoing the location of sub-floor burials beneath Houses 401 and 1370) all suggest that, like the composite bodies, this body was initially buried elsewhere, and then exhumed centuries later to be reburied beneath the construction layers of House 801. The child's spine, sacrum and pelvis were articulated while the left humerus, ulna and metacarpals, as well as the right ulna, appeared to be in the expected crouched position (*ibid.*: fig. 4.7). At some point, it appears that the skull, right humerus and lower limbs came away from the main body and then at (re)burial, the skull was placed on the spine. It is very likely that this child's body was at least partially held together between the time of her death in Phase 3–6 and her eventual burial probably 200–350 years later (see Volume 1: 444).

With an OHI score of 2 (Oxford Histological Index; see Chapter 20) sitting between composite skeleton SK 2613 (with an OHI score of 0) and composite skeleton SK 2638 (with OHI scores of 4 and 5, depending on the skeletal element), it appears that SK 2792 bridges the gap between the two OHI trajectories. Additionally, while microscopic analysis cannot confirm or deny 'mummification', as is argued for SK 2613 and SK 2638, the associated signals are similar to those seen on an individual from Canada Farm, Dorset, where it appears the inhabitants may have been experimenting with Skeleton F3 (Tom Booth pers. comm.; Booth *et al*. 2015; Smith *et al*. 2016). It is possible that this is what is seen in SK 2792, a failed attempt at mummification that led to the poor preservation of the bones, and after which the skull, right humerus and lower limbs fell away from the main body at some point prior to (re)burial.

The artefacts accompanying the unburnt bones

Artefacts were recovered in association with two of the inhumed burials, 14 of the disarticulated contexts and 10 of the features that contained disarticulated human bones (Tables 19.19–19.20). Almost all of the formal burials did not contain any grave goods or associated artefacts; exceptions include the child burial SK 2727 from which an adult radial head was recovered and the composite adult burial SK 2613 which had a quern fragment (SF 5244) among the stones packed behind the body (see Chapter 6; Volume 1: 92). For the most part, the disarticulated bones were not formally deposited but were dispersed within fills or mixed with other artefacts and debris. There does not appear to be any particular pattern as to the type of artefact associated with human bones but shells, burnt animal bones, flint flakes, worked bone and bone tools were rarely included. Pottery appears to be the most common, followed by cremated human bone, unburnt human bone and unburnt animal bone.

The types of object deposited with cremated remains and buried with inhumed bone are almost identical. This signifies that grave goods were not predicated on the type of funerary or mortuary rite but rather on the deceased individual (Cooper *et al.* 2022: 68, fig. 3.04), with the living choosing specific objects to accompany the dead. In some instances, the incorporation of fragments of human bone into wall cores or leaving them scattered across floors or forecourts may have been another way of infusing structures with the spirit of the ancestors for protection, or the (re)incorporation of the dead back into the living community, or a form of *memento mori* kept by the living. Other fragments of bone may have been regarded as debris, with no knowledge of their identity, and were thus left lying around or mixed in with other discarded bits of animal bone, broken pottery sherds and worked flint. These discarded fragments of human bone may then have been either accidentally or deliberately incorporated into soils used to fill postholes/stakeholes.

An example of the various artefacts recovered from a fill is double pit 2551, located just outside the entrance to House 1370 (see Table 19.42; Volume 1: fig. 4.30). Here, fill 2748 contained a bone pin (SF 4753) recovered next to the knee joint of SK 2613, a complete pumice rubber (SF 5064) next to a smashed pot (SF 4755), other animal bones, shells, small stones and a cremated human cervical vertebra. The femur and two carbonised grains of *Hordeum* sp. from fill 2748 produced dates between the fourteenth and twelfth centuries BC. A cattle bone from the fill layer above (2746) dates to the twelfth–eleventh centuries BC, while two carbonised grains of *Hordeum vulgare* from pit fill 2741 (stratigraphically above fill 2746) produced dates from the mid-twelfth to eleventh centuries BC. From one of the latest fills of pit 2551 (2732), the right distal radius and left patella (again from SK 2613) were recovered, above which, in fill 2554, was a foetal left femur, some cremated bone fragments and a pottery sherd. Pit 2551 and its re-cut are interpreted as the reopened grave from which the mummified female, represented as the torso and lower limbs of SK 2613 (Individual #3), was exhumed (see Volume 1: chap. 4).

19.4 Detailed analyses of the human remains from each phase of activity

The following sections place the human remains in the phase of activity at Cladh Hallan during which they were buried. Note that this is *not* their date of death, which may have been several decades, if not centuries, prior to (re) burial. Information regarding burial/grave measurement, description/consistency of fills, and orientation can be found in Volume 1. Human remains were not recovered

Table 19.19. The human bone contexts (articulated and disarticulated) associated with grave goods and/or artefacts

Context	Age category	Unburnt animal bone	Cremated animal bone	Pottery pots/sherds	Shell fragments	Unburnt human bone	Cremated human bone	Worked flints/stones	Worked bone/bone tools	Flint flakes	Other
SK 2727	OC					•					
SK 2613	Adult							•			Quernstone fragment
2551	Adult	•		•	•		•	•	•		Bone pin, pumice tool
3342	Adult			•			•	•	•		
3265	Adult										Intrusive clay metal-working mould
3119	MA–OA			•							Polishing stone
2544	Adult						•				
2204/2205	OC	•									
2394	MA–OA			•	•		•				
2398	Adult	•		•	•						
2554	Foetal			•			•				
2732	MA–OA					•					
2748	MA–OA					•					
473	Adult	•									

Table 19.20. The floor (Fl), forecourt (Fo), wall core (WC) and stone structure (SS) associated with unburnt human bones and other artefacts

Context	Context associated with	Unburnt animal bone	Cremated animal bone	Pottery sherds	Unburnt human bone	Cremated human bones	Worked flints/stones	Worked bone/bone tools	Flint flakes	Other
2476	WC	•	•	•	•	•	•	•		Ash, flat stones
1680	Fo			•	•					Clay, pumice, pebbles
1369	Fl	•			•		•		•	Pumice
1191	Fl	•			•					
803	WC	•			•		•	•	•	Worked pumice
659	Fl	•		•	•			•		
655	Fl	•			•					
465	Fl				•			•		
462	Fl	•			•			•		Stone counter
Area B	SS				•				•	Fired-clay ball

from the first two phases of activity at Cladh Hallan, dating to the Beaker period and Early Bronze Age.

Phase 3 (1800–1310 cal BC)

The first evidence for inhumation and cremation rites at Cladh Hallan dates to the third phase of activity, with the construction of a small cremation cemetery and two pyres in Area A, a stone structure with a disarticulated human bone in Area B, and a formal, but heavily disturbed, inhumation burial in Area C. A summary of the Phase 3 cremated bones can be found in Tables 19.22–19.23, while a summary of the unburnt bones is found in Tables 19.24–19.25.

Area A (early Phase 3)

An early Phase 3 partially cremated skull fragment of a mature adult (SF 5119) was recovered from one of the upper layers of pit 3631 beneath the future House 1370's entrance (see Figure 19.1; Volume 1: fig. 2.11).

Area A (later Phase 3)

A cremation cemetery, located at the southern end of Area A, consisted of six cremation burials organised into three main areas (see Figure 19.1): burial 3307 within an arc of stones (see Volume 1: fig. 2.18), burials 3197, 3255 and 3257 laid within a stone ring, and a stone pyre platform with two cremation deposits (3334 and 2793) on top with two further scatterings of pyre debris nearby. Cremated bone fragments were recovered from other areas of pyre debris (see Table 19.23) as well as from a U-shaped gully (3435) which would eventually have the southern wall of House 1370 constructed over it (see Volume 1: fig. 2.24).

Cremation deposit 3307

This cremation was deposited on top of a small stone platform (3463; probably the site of the pyre; see above) inside a ring of stones (3306; see Volume 1: figs 2.16–2.20). There are 130.38g of cremated bones from an individual estimated as a young adult due to open cranial sutures, permanent teeth and a fused phalange.

The skull accounts for 44.2% of this deposit while the upper and lower limbs account for 46% (see Table 19.11); most of the cremated bones were retrieved from the 2mm sieve and may either be deliberate fragmentation or the 'dregs' from a bag of collected bone when emptied onto the platform. The largest fragment from the 10mm sieve is a humerus measuring 37.54mm; another humeral fragment from the 5mm sieve measures 26.20mm.

A lot of black organic material remains in the internal bone matrix, with cortical bone ranging in colour from black and dark grey to some a light grey. Three plain sherds were also recovered but were not heavily burnt so these had not been placed in the burning pyre.

Cremation deposit 3197

A cremation deposit located 1.40m northwest of cremation 3307, on the western side of a robbed-out stone ring (3256; see Volume 1: figs 2.16–2.18) is considered to be a satellite burial. A MNI of two individuals are identified: 3197a is a 7.5 month to 1.5-year-old infant/young child, aged by an upper deciduous canine crown (AlQahtani 2009) along with the general size of the long bone fragments. The second individual, 3197b, is estimated as an adult due to a fused phalange, a radial fragment and a small amount of long bone fragments.

The adult phalange is charred (see Figure 19.11) but most of the bones from the 5mm sieve belonging to both 3197a and 3197b are dark grey to light grey in colour, indicative of a mostly efficient cremation. Some fragments from the 2mm sieve have an external white cortex with black internal bone, indicating that these bones reached a high temperature for a short amount of time.

In total, the deposit weighs 2.15g (of which 1.34g are infant bones and 0.81g are adult bones) and the largest cremated fragment is 18.8mm, from 3197a from the 5mm sieve. The deposit also contained unburnt animal bones, some small pieces of charcoal and a potsherd (SF 5412).[3]

Cremation deposit 3255

This deposit was situated against the northwest perimeter of the stone ring (3256) and is considered to be a satellite burial. It consists of 72.86g of cremated bone despite being disturbed by later features. The one adult within this deposit has a carious lesion on a maxillary molar (see Figure 19.10).

A rib fragment has a maximum bone length of 55.39mm, followed by a skull bone with a maximum size of 25.93mm. There is a lot of different colour variation within fragments deriving from the same skeletal elements (*e.g.* the cranial fragments range from black and dark grey to light grey and white; see Figure 19.12) but there are some black (charred) bones, a few that are brownish-white, some that are white externally with a black interior, with the remaining bones a dark to medium grey, signifying a mostly effective cremation.

An unusually high number of teeth are identified (see Figure 19.14) which may indicate the deliberate addition of a specific skeletal element to the burial rather than a random assortment of bone. The skull and teeth account for 65.5% of the deposit, with small, unidentifiable long bones accounting for 26.4%. The deposit also contained a piece of burnt antler, charcoal and two unburnt shell fragments.

Cremation deposit 3257

Cremation 3257 was buried within the arc of stones (3256) northwest of cremation 3307. It consists of 9.01g of cremated bones of a young/older child, identified by a developing permanent tooth crown. The largest bone fragment is a humeral shaft 25.81mm in length (10mm sieve) while an ulna fragment measures 21.35mm (5mm sieve). The majority of the bones have a light grey outer cortex with internal black matrix, indicative of high pyre temperatures over a short period of time.

The deposit was accompanied by two small unburnt rodent vertebrae and a shell fragment, six plain sherds

(which were not heavily burnt so had not been placed on the pyre) and some burnt twigs. During Phase 6 an exploratory pit (2837) was dug into the northeast side of this deposit and into the base of the cremation (see Phase 6, below). Cremated bone fragments noted in pit fill 2852 indicate the deposit was disturbed by this activity, which could partly account for the low quantity of cremated bone.

Cremation deposit 3334

This cremation deposit was recovered on the stone pyre platform (3558) in the east-central area of Area A (shaded grey in Figure 19.1) and consists of a small deposit of 4.08g of adult cremated bone on the western part of the platform. Age was estimated based on the fused adult phalanx of the hand as well as the general size and robustness of the bones.

The longest bone fragment derives from the skull (19.10mm in length; 10mm sieve) and an unidentifiable long bone fragment measures 13.91mm (5mm sieve). Colouration is mostly light brownish-white but there are a few fragments with a white cortex and black internal matrix. No artefacts were associated with this deposit.

Cremation deposit 2793

This deposit lay over layer 3334 on the stone pyre platform (3558). Two individuals were identified within this 274.6g deposit: a sub-adult aged between 1 and 13 years (2793a) and a young to mature adult female (2793b). While the sub-adult remains consist of 23.7g of bone, there are very few morphological characteristics by which to determine a more precise age estimate; however, 2793b includes an auricular surface with no billowing or signs of macroporosity and an unfused cranial suture, commonly associated with individuals who are young to mature adults. Dental casting of the right internal auditory meatus revealed a 66.5° angle, indicating that this adult is a possible female.

The longest bone is from the adult (2793b), measuring 51.4mm, while the child's largest fragment is a piece of cranium measuring 27.67mm. The majority of the bones are highly fragmented and derive from the 2mm sieve (similar to cremation 3307). Most of the bones from both individuals are dark grey, a few fragments are light grey and four teeth are charred. Overall, these individuals were efficiently cremated.

Cremation deposit 2793 also contained a shell fragment, an unburnt animal incisor, charred mandibular animal fragments, fuel ash slag and an unburnt human fibula fragment.

The dispersed cremated bones

Loose fragments of cremated bone were recovered from a wide variety of contexts; these have been summarised in Table 19.23.

Area B (Phase 3)

North of Area A, Area B was excavated in order to investigate a stone structure exposed by quarrying and wind erosion. The structure was a possible field wall or the heavily disturbed remains of a house wall; the finds included an unburnt hand phalanx of an adult, dated to *1400–1055 cal BC* (AA-48583; 3300±45 BP). The bone was sent for radiocarbon dating prior to osteological analysis so no other observations can be made.

Area C (Phase 3): Skeleton SF 4906

Five metres southeast of Area C (the location of double roundhouse House 150; see preface), the mostly complete skeleton of a child (SF 4906) was discovered during sand quarrying works. It is the only surviving skeleton of a small group of four or more which were rumoured locally as having been revealed by workmen during quarrying of the settlement mound (see Volume 1: 10). Since the burial was not excavated by archaeologists, it is not known whether it was a formal inhumation, or a pit filled with disarticulated bones. Given the excellent preservation of the bones and general completeness, a detailed analysis was conducted.

SF 4906 is dated to *1610–1380 cal BC at 95% probability* (GU-9824; 3205±50 BP) and is thus earlier in date than the phalanx from Area B but may be contemporary with some of the later cremation burials in Area A. Its date range is similar to that for the tibia of SK 2638 and overlaps with those for the skull and mandible of SK 2638 and the skull of SH 2613.

Only one individual is represented in this burial as it contains no repeating skeletal elements and the morphology of the bones is consistent for an individual of the same age. The skeletal remains of SF 4906 are in excellent condition and are the best preserved of all the inhumations recovered at Cladh Hallan. The bones are smooth with minimal modification or damage to surface morphology and as such, are scored at grade 1. The skull is perfectly preserved and attests to the exceptional degree of preservation in this area and the protection it was afforded from extreme of temperatures and moisture by the sandy substrate in which it was interred. The full skeletal inventory of SF 4906 is shown in Table 19.21 with visual representation in Figure 19.21. One animal long bone fragment was identified with this inhumation.

The skull of SF 4906 is in near-perfect condition with only the right lacrimal suffering some *post mortem* damage. All the upper limbs were recovered during excavation except for the left humerus and radius. Both left and right clavicles and scapulae, along with seven right and 10 left ribs were identified; however, the hyoid, sternum and manubrium are missing.

The spinal column is in excellent condition, with three cervical, seven recently fused thoracic and three lumbar vertebrae noted. The sacrum, pelvis and the majority of the lower limbs are absent. However, the left and right proximal femoral epiphyses, the left and right diaphyseal femoral shafts, the left diaphyseal shaft of the fibula, and the right talus were all recovered. Three unfused proximal phalanges were also found.

Table 19.21. Skeletal inventory of SF 4906: a '√' indicates the bone is present and a 'blank' indicates the bone is absent

CRANIUM								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Present*	*Absent*
Parietal	√	√	Maxilla	√	√	Nasal	√	
Temporal	√	√	Zygomatic process	√	√	Lacrimal	√	
Occipital	√	√	*Pars petrosa*	√	√	Inf. nasal concha	√	
Pars lateralis	√	√	Tympanic ring	√	√	Ethmoid	√	
Pars basilaris	√		Lesser wing	√	√	Vomer	√	
Frontal	√	√	Greater wing	√	√	Concha	√	
Zygomatic/malar	√	√	Post-sphenoid	√		Aud. ossicles		
Mandible	√	√	Palatine	√	√	Hyoid		

AXIAL								
Bone	*Present*	*Absent*	*Bone*	*Present*	*Absent*	*Bone*	*Present*	*Absent*
Manubrium			Sternum			Xiphoid		
Ribs: right	1 2	3 4 5	6 7 ~~8 9 10~~	~~11 12~~	Total R: 7	Rib epiph		
Ribs: left	1 2	3 4 5	6 7 8 9 10	~~11 12~~	Total L: 10	Rib epiph		

VERTEBRAE								
Centum					*#?*	*Total*	*Neural arches*	*Left*	*Right*
Cervical	~~1 2~~	3 ~~4 5~~	6 7		-	3	Cervical	fused	
Thoracic	1 ~~2~~	3 ~~4~~ 5	6 ~~7~~ 8 9 ~~10~~	~~11~~ 12	-	7	Thoracic	Recently fused	
Lumbar	1 2	3 ~~4 5~~			-	3	Lumbar	fused	
Sacral	~~1 2~~	~~3 4 5~~			-	0	Sacral		
Coccyx	~~1 2~~	~~3 4~~			-	0	Coccyx		
Dens	~~Present~~	Absent	Atlas post. arch	~~Present~~	Absent		#? Neural arches	0	

UPPER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Scapular blade	√	√	capitulum		√	Scaphoid		
coracoid epiph			lat. epicondyle			Lunate		
glenoid epiph			med. epicondyle			Triquetral		
acromial epiph			Radial diaph		√	Pisiform		
Clavicle	√	√	prox. epiph			Trapezium		
med. epiphyses			dist. epiph			Trapezoid		
lat. epiphyses			Ulnar diaph	√	√	Capitate		
Humeral diaph		√	prox epiph			Hamate		
head		√	dist epiph					

HAND				
Bone	*Left*	*Right*	*No side*	*Total*
Metacarpal diaph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
head epiph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
base epiph	~~1~~	~~1~~	-	0
Phal: prox diaph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	3	3
prox epiph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
Phal: inter diaph	~~2 3 4 5~~	~~2 3 4 5~~	-	0
prox epiph	~~2 3 4 5~~	~~2 3 4 5~~	-	0
Phal: dist diaph	1 2 3 4 5	1 2 3 4 5	-	0
prox epiph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0

(Continued)

Table 19.21. Skeletal inventory of SF 4906: a '√' indicates the bone is present and a 'blank' indicates the bone is absent (Continued)

LOWER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Ilium			Pubis			Talus		
Ant inf iliac spine epiph			Femur	√	√	Calcaneus		√
Ant sup iliac spine epiph			capital fem epiph	√		epiph		
Ant crest epiph			Gr trochanteric epiph	√	√	Cuboid		
Post crest epiph			Les trochanteric epiph			Navicular		
Acetabulum			dist fem epiph			Cuneiform med.		
Sup acetab epiph			Patella			Cuneiform inter.		
Ant acetab epiph			Tibia			Cuneiform lat.		
post epiph (acetab)			prox tibial epiph					
Sup epiph (acetab)			dist tibial epiph					
Ischium			Fibula	√				
Ischial tube epiph			prox fibular epiph					
Ramal epiph			dist fibular epiph					

FOOT				
Bone	*Left*	*Right*	*No side*	*Total*
Metatarsal diaph	1 2 3 4 5	1 2 3 4 5	-	0
head epiph	2 3 4 5	2 3 4 5	-	0
base epiph	. ǂ	1 2 3 4 5	-	0
Phal: prox diaph	1 2 3 4 5	1 2 3 4 5	-	0
prox epiph	1 2 3 4 5	1 2 3 4 5	-	0
Phal: inter diaph	2 3 4 5	2 3 4 5	-	0
prox epiph	2 3 4 5	2 3 4 5	-	0
Phal: dist diaph	1 2 3 4 5	1 2 3 4 5	-	0
prox epiph	1 2 3 4 5	1 2 3 4 5	-	0
Unidentifiable MC/MT heads: 0	MC/MT prox phals: 0	MC/MT inter phals: 0	MC/MT distal phals: 0	

SF 4906 has a complete mandibular dental arcade in which all the permanent teeth are erupted except for the third molars (of which three remain unerupted and one has just started to erupt out of the alveolar crypt). The majority of the maxillary teeth have been lost *post mortem* (Figure 19.22). There is only a slight amount of wear on the occlusal surfaces of the mandibular incisors, the first molar and the first maxillary molar. There are moderate amounts of dental calculus on all teeth, concentrated around the cement–enamel junctions and heaviest along the lingual aspect of the mandibular teeth and the buccal aspect of the maxillary teeth. This low level of dental calculus, together with the lack of carious lesions, could suggest a diet high in meat but low in sugary or starchy substances.

There is slight anterior crowding of the mandibular teeth, with the left and right canines rotated mesio-distally to approximately 20°–25° (Figure 19.23). In addition, the maxillary left third molar is positioned on the distal aspect of the maxillary alveolus, which could have resulted in malocclusion if the individual had lived after their eruption.

SF 4906's age at death was determined using the right radius measuring 188mm long (10–10.5 years), the right ulna at 205mm (11 years), the right humerus at 239mm (10 years) and the left clavicle at 100mm (9–10 years) in length. Scapular length and width provide an age estimation of 9–10 years. Dental eruption and development provide an estimated age range of

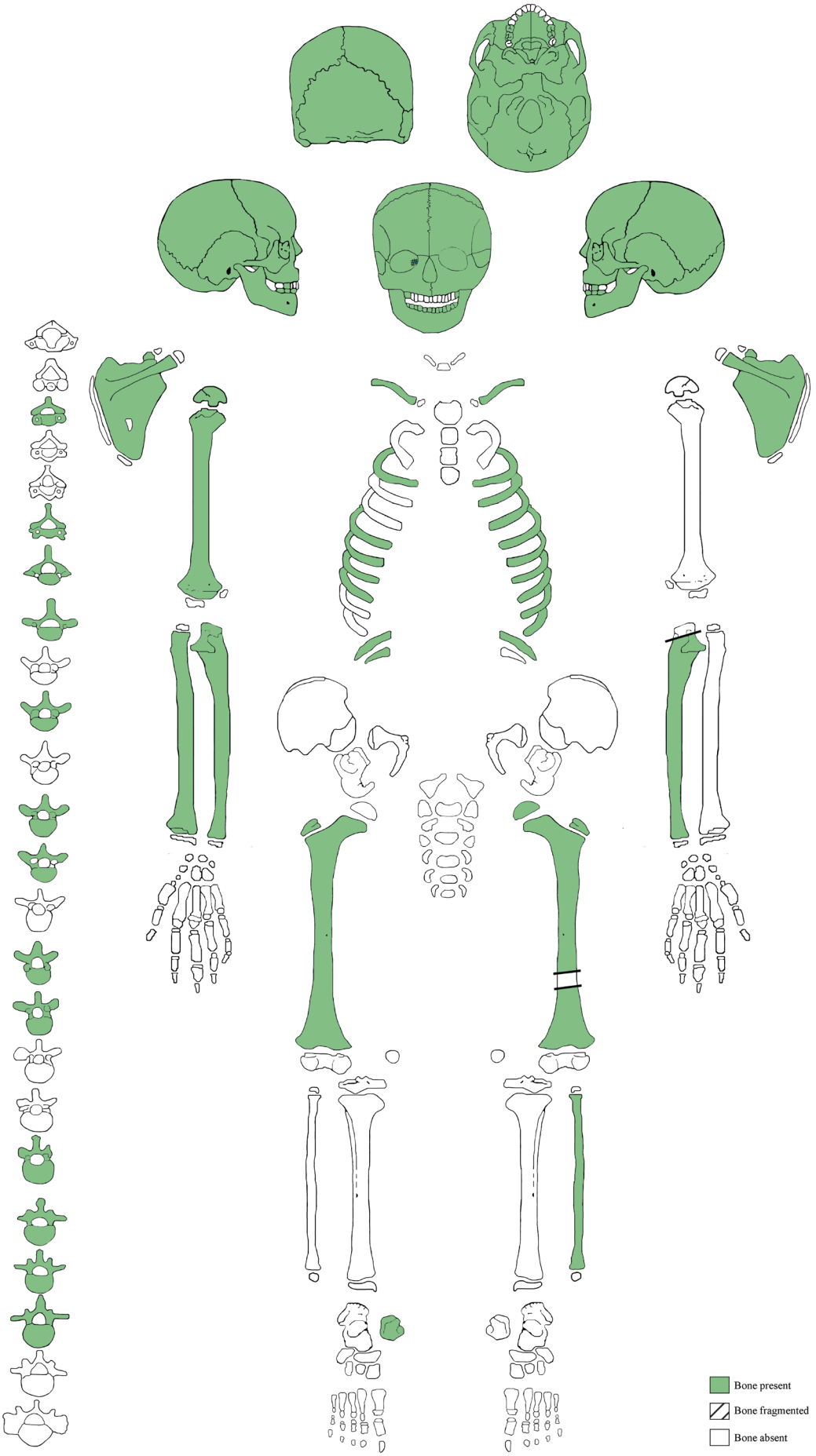


Figure 19.21. The visual skeletal inventory of SF 4906

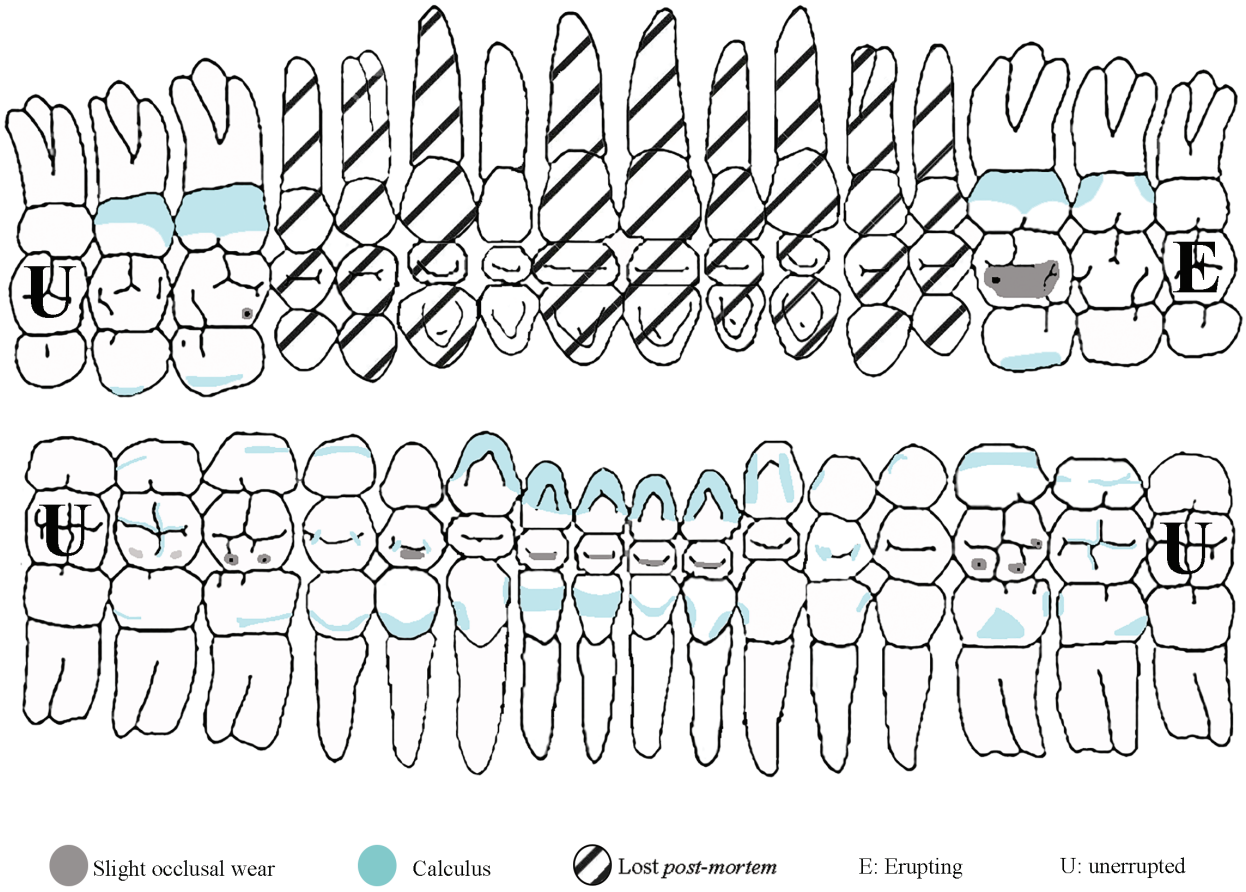


Figure 19.22. The visual dental inventory of SF 4906

Figure 19.23. Anterior crowding of the left and right mandibular canines which have rotated mesio-distally, from SF 4906

12 years ± 36 months. Overall, SF 4906 has an age range of 9–12 years, and is in the broad category of 'older child'.

Although the pelvis is absent, the skull is in perfect condition: using the methods set out by Feremback *et al.* (1980) and Schwartz (2007), this individual can be identified as a possible male due to the supraorbital ridges and glabellar profile, which are moderately prominent, and the inclined frontal slope. The mastoid processes are large and vertical, and the temporal ridges are marked. The angle of the mandible is perpendicular with a slightly everted edge, typical of a male.

The third cervical vertebra (C3) displays a marked asymmetry of the superior articular facets, the left being 30% larger than the right, with slight granulation where the bone surface is responding to a pathology (Figure 19.24). Asymmetrical irregularities continue in the right inferior articular facet of C6 and in the left superior articular facet of C7, although both are not as marked as C3. The right superior articular facet of C7 also exhibits slight granulation on the surface. Unfortunately, the other four cervical vertebrae were not recovered so the extent of the degeneration cannot be established; however, asymmetrical irregularities and the slight granulations suggest an early-onset non-inflammatory but chronic aetiology such as adolescent idiopathic scoliosis.

Phase 4 (1370–1250 cal BC)

Phase 4 is defined by a thin layer of windblown sand, which covered the cremation cemetery and the two stone

Figure 19.24. Asymmetry of the cervical vertebrae from SF 4906. Top: the superior articular facets of C3. Middle: Asymmetrical irregularities on the inferior articular facets of C6. Bottom: The superior articular facets of C7

rings, and the construction of the earliest house (House 2835). Despite the covering of sand, cremation deposit 3257 remained exposed on the surface and served as the location for the hearth of the house. A series of postholes were dug in the house; a single cremated humeral fragment was recovered within the fill of posthole 3637 (Table 19.26). The posthole was dug close to Phase 3 cremation burial 3255 and may have served a dual purpose, being both part of the house structure and a marker for the stone circle and the cremations that lay below. Indeed, the layer of windblown sand was shallow enough to suggest that the sand accumulated over a short period of time, so the location of the cremations would have been known to the builders. House 2835 was probably short-lived or used infrequently and its position on top of three cremation burials suggests that it could have been a sort of spirit house or place to connect with the ancestors rather than a domestic dwelling (see Volume 1: 79).

In the north-central area of Area A, 15m north of House 2835, cremated human bone was recovered from the burial of a mature female sheep (SF 5177) in pit 3324 (see Figure 19.2). The sheep burial predates the construction of House 1370 and the cremated bone probably originated from the nearby early Phase 3 pit 3631 or the later Phase 3 cremation platform (3558; see Figure 19.1).

Phase 5 (1300–1060 cal BC)

During Phase 5, House 2835 was abandoned and another thin layer of windblown sand covered the southern end of Area A. The area was subsequently ploughed, with ard-marks scraping the surface of the house floor and hearth. An adult femoral fragment was recovered from one of the ard furrows (2478; Table 19.27). The ard-marks also extended underneath the eastern wall core and doorway of House 401, where a fragment of an adult skull (SF 5419, a possible male) was recovered along with a clay metalworking mould fragment from ard furrows.

At the south end of Area A, disarticulated adult bones were recovered from a thin layer of sand (2909) that had built up on top of the cultivated soil (Table 19.27). One of the bones is the distal head of a first metacarpal; it is in poor condition (grade 3), indicating that it was previously in an unstable burial environment before deposition. The other disarticulated bones associated with this first metacarpal are well preserved. Also from layer 2909 is a thoracic vertebral body with degenerative changes on the inferior and superior surfaces. It exhibits osteophytes around the left side vertebral margins, calcification of the intervertebral disc with mild eburnation to the right side of the calcification, and a series of drainage holes in a trench-like (2.6mm long) pattern following the internal margin of the inferior surface of the vertebral body (Figure 19.25). Given the extent of pathological conditions, this individual is a mature to older adult.

Table 19.22. Summary of the formal cremation deposits from Phase 3

Area	Ctxt	MNI	Age	Sex	Wght (g)	Max. size	Colour	cal BC (95%)	Sample	Lab no.	BP	Grave inclusions	Notes
Stone ring (3256)	3197	2	Inf–YC	-	1.37	18.79mm radius	Dark to light grey with some 'quick burn'	*1415–1235* *1425–1250*	*H. vulgare* *H. vulgare*	SUERC-10818 SUERC-10819	3040±35 3050±40	Unburnt animal bones, charcoal, pot SF 5412	Western side of the robbed-out stone ring (3256); satellite burial.
			Adult	-	0.81	-	Dark to light grey, 1× charred phalanx	-	-	-	-		
	3255	1	Adult	-	72.86	55.39mm rib	Black, dark to medium grey, 1× brownish-white	*1620–1450* *1535–1415*	Crem bone *H. vulgare*	SUERC-10716 SUERC-10850	3270±35 3210±35	Piece of burnt antler, charcoal, 2× unburnt shell fragments	Against NW perimeter of stone ring (3256); satellite burial post-dates the stone ring; deposit was disturbed by later features; 1× carious lesion on maxillary molar.
	3257	1	YC–OC	-	9.01	25.81mm humerus	Dark to light grey; some white; some with black organic material in diploë	-	-	-	-	6× plain sherds, unburnt mouse bones, 1× shell frag; carbonised twigs	Within an arc of stones (3256), 1.4m NW of Cremation 3307.
Stone ring (3306)	3307 [5115]	1	YA	-	130.38	37.54mm humerus	Dark grey; some black	*1740–1530*	Crem bone	SUERC-10717	3375±35	3× plain body sherds	Within a ring of stones (3306) on top of a stone platform (3463)

Area	Ctxt	MNI	Age	Sex	Wght (g)	Max. size	Colour	cal BC (95%)	Sample	Lab no.	BP	Grave inclusions	Notes
Cremation platform area (3558)	3596	-	-	-	-	-	-	-	-	-	-	-	**Missing post-ex.** Platform stones (3558) covered this layer of peat ash and a small quantity of cremated bones.
	3334	1	Adult	-	4.08	19.10mm skull	Light brownish- white	-	-	-	-	-	Deposit beside the stone platform (3558)
	2793	2	1yr– <13yr	-	71.40	-	Dark grey	-	-	-	-	Fuel ash slag, unburnt animal incisor, 1× unburnt human fibula fragment	This layer was on top of both cremation (3334) and stone platform (3558) and contained black soot, ash and charcoal considered to be pyre debris.
			YA–MA	-	279.10	51.44mm ulna	Dark grey	*1750–1535* *1880–1620*	Crem bone Crem bone	SUERC-10718 SUERC-10722	3380±35 3430±35		

Table 19.23. Summary of the pyre debris and dispersed cremated human bone fragments from Phase 3

Location	Pit	Ctxt	SF no.	Age	Sex	Wght (g)	Bone ID	Colour/max. length	Notes
Gully 3435 (below House 1370 and House 401)	-	3223	5128	Adult	-	2.52	Tibial shaft	Light grey	Gully fill cut by two postholes (3339 and 3451) and the stone-lined burial pit (2612) of SK 2613 beneath House 1370 in Phase 8. The gully (3436-3342-3223) also contained two worked flints (SFs 5245, 5251), a piece of worked bone (SF 5191) and sherds of pottery.
		3341	5181	-	-	0.43	Cranial and rib fragments	Yellowish-white	
		3342	5186	Adult	-	5.34	Cremated UID long bones, humeral shaft fragments	Light brown	
			5190	Adult	-	1.96	Humeral shafts	Yellowish-white	
		3436	5386	Adult	-	0.34	Skull fragment	Blue	
Pyre debris from crem. platform (3558)	-	3458	5246	Foe/Neo	-	1.02	Femoral diaphysis fragment	Light grey to white	2 × C (1 × I). A small spread of ash, charcoal and cremated bones, probably dispersed pyre debris. Contemporary with pyre debris from 2793. This ash spread also contained an unburnt adult (1 × I).
			5388	Adult	-	8.98	UID long bones	Light yellowish-brown; max length 27.40mm (adult humerus)	
Pyre debris	-	3524	-	-	-	-	-	-	**Missing post-ex.** Cremation lay N of stone ring (3306) in layer of peat ash and charcoal pyre debris.
Pyre debris	-	3525	-	-	-	-	-	-	**Missing post-ex.** Cremation lay N of stone ring (3306) in layer of peat ash and charcoal pyre debris.
Pyre debris north of (3524) and (3525)	-	3391	5241	-	-	0.39	Cranial fragment	Light grey	A spread of charcoal and sand (1.4m E-W x 0.9m N-S) contained a single cremated skull fragment. Eventually covered by Phase 8 wall core of Houses 801 and 401.
Pit 3631 (below House 1370)	3631	3233	5119	MA-OA	-	4.26	Cranial fragment	Brown	Fill of pit situated at NE edge of cremation platform (3558). Still some light grey organic material within the diploë; fusing cranial sutures. This pit (and bone) is early Phase 3.
Pyre debris near platform 3558	-	3356	5198	-	-	1.13	Acromion and cranial fragments	Yellowish-white 14.13mm max length (acromion)	These cremated frags are late Phase 3 as they derive from the nearby cremation platform's pyre (3558). This spread of pyre debris contained fuel ash slag, cremated bones and pottery sherds.
			5202	-	-	3.37	Skull fragments, UID long bones	Yellowish-white	

Table 19.24. Summary of the inhumation from Phase 3

Location	SF no.	MNI	Age	Sex	Date	Grave goods	Notes
5m SE of Area C	4906	1	9–12 years (OC)	M?	*1610–1385 cal BC* (AA-48585; 3205±50 BP)	1× animal long bone fragment	Disturbed through quarrying and incomplete. This was not archaeologically excavated, so unknown if formal inhumation burial or a pit of disarticulated bones. This inhumation is earlier than the disarticulated hand phalanx from Area B, but may be contemporary with some of the later cremation burials in the southern part of Area A.

Table 19.25. Summary of the unburnt disarticulated human bones from Phase 3

Location	Ctxt	SF no.	Age	Sex	Bone ID	Notes
Gully 3435	3342	-	-	-	-	Associated with cremated fragments
Pyre debris from platform 3558	3458	-	Adult	-	UID long bone fragment	This unburnt bone was recovered within a spread of pyre debris and cremated bones. It is probably intrusive.
Stone structure in Area B	-	4904	Adult	-	Phalanx (hand)	Dated to *1400–1055 cal BC* (AA-48583; 3300±45 BP). Other finds include a phalanx of a foot (SF 4905; Table 19.55) which is much later in date: *cal AD 25–250* (AA-48584; 1875±45 BP), a small fired-clay ball (SF 2015), two flint flakes and grains of carbonised seeds (for which two radiocarbon dates are contemporary with the phalanx).

Table 19.26. Summary of the dispersed cremated human bone from Phase 4

Location	Pit	Ctxt	SF no.	Bone ID	Wght (g)	Age	Sex	Colour	Notes
House 2835	3637	3638	5416	Humeral fragment	0.67	Adult	-	Greyish-white	This posthole was located near cremation burial 3255 (Phase 3)
Below House 1370 (SE corner)	3324	3325	5116	Cranial fragments, 3× vertebral facets, UID long bone fragments	7.65	OC–Juv	-	Yellowish-white, 2× blue-white	Recovered with an articulated mature sheep skeleton (SF 5177) dating to *1390–1215 cal BC* (SUERC-13805; 3085±35 BP).

Table 19.27. Summary of the disarticulated unburnt human bones from Phase 5

Location	Ctxt	SF no.	Age	Sex	Bone ID	Notes
Ard-marks above remains of House 2835 (South end of Area A)	2478	-	Adult	-	Frag. of femoral shaft	This bone fragment was recovered in one of the ard furrows (2478) which ran in an east-west direction. May have been part of the same cultivation event as the ard-marks below House 401 (3265)
Ard-marks below the doorway and eastern wall core of House 401	3265	5419	Adult	?M	Small skull fragment, v. thick/robust	Associated with an intrusive clay metalworking mould fragment (SF 5722) and incorporated into ard furrows in 3265. May have been part of the same cultivation event as the ard-marks over House 2835 (2478)
Southern end of Area A	2909	-	Adult/ MA–OA	-	Frag of a rib shaft, distal 2nd hand phal. (poor preservation: gr. 3), left distal 1st metacarpal, distal phal of hand and a thoracic vertebral body	Three Phase 6 postholes cut into Phase 5 yellow sand layer (2909) which had built up on top of the plough-soil. The postholes formed an irregular semicircle *c.* 5m across and may have formed a temporary unroofed structure.

Figure 19.25. Degenerative joint disease on a disarticulated thoracic body (2909) from Phase 5 (top image: the inferior surface; middle image: the superior surface). The bottom image is a femoral head (SF 5423; 2394) from Phase 6, with slight lipping around the margin and a tubercle growth on the bottom right near the fovea capita (bottom)

Phase 6 (1250–1060 cal BC)

A pit (filled by 3119, see Figure 19.2) contained an inverted partial pot, rim sherds from three vessels, and a polishing stone along with an assortment of disarticulated unburnt human bones. The bones derive from a probable mature to older adult due to a fusing cranial suture (Tables 19.28–19.29).

A large pit (2543) was dug in the area where House 801's entrance and northeast corner would later be positioned in Phase 8, close to the Phase 3 cremation burials. The fill (2544) contained unburnt human skull fragments, of which one is from a probable adult female, a right patella exhibiting slight new growth formation on the medial articular facet, and fragments of cremated bone. Cremated fragments from the left radius, femur, skull, humerus, ulna, fibula and 12th rib, as well as unidentifiable long bone and spongy bone, have a combined weight of 15.8g (SF 5113), deriving from an adult. Further cremated bone (SF 5118) consists of an ulnar notch and coracoid process of an adult, and a small fibular shaft of a younger sub-adult.

Pit 2543 was subsequently cut by pit 2446, which contained a right femoral head (SF 5423) from a mature to older adult, whose age is estimated by slight lipping around the margin of the head and a tubercle growth near the fovea capita (Figure 19.25). A left femoral shaft and fragments of a first metatarsal, a thoracic vertebra and an occipital skull were also recovered within this pit fill (2394), along with pottery, shells and a cremated human skull fragment (also SF 5423). Below fill 2394, a sandy fill (2398) contained a fragment of a mandible with three molars (SF 5424).

An exploratory pit (2837) was dug through the ard-marks and truncated the floor of House 2835, with tunnelling extending to the southwest under one of the stones from the stone ring until it located the base of Phase 3 cremation burial 3257 (see above), which lay directly beneath the Phase 4 hearth (see Volume 1: fig. 3.17). Fragments of cremated bone were recovered from the fill (2853) of both the tunnel and the exploratory pit, indicating that the cremation deposit was disturbed by the tunnelling activity. It is unknown how much cremated bone, if any, was taken when the cremation burial was located; however, it does appear that the tunnelling was a deliberate act to retrieve the cremated bones as the deposit was already marked by House 2835's hearth (*ibid*.: 66, 79). This suggests long-term oral memory regarding the burial location and/or identity of the child whose cremated remains were deposited there during Phase 3.

Phase 7 (1125–1050 cal BC): Structure 2477

This short-lived structure, which does not appear to have been a dwelling, was constructed in Phase 7 and was built over in Phase 8 by House 801 (see Volume 1: 66–8). An adult left proximal femur and a small, cremated bone fragment (both from environmental sample square [ESN] 5008) were recovered from a layer interpreted as being a collapsed turf wall (2476; Table 19.29).

Table 19.28. Summary of the unburnt disarticulated human bones from Phases 6 and 7

Location	Ctxt	SF no.	Pit	Age	Sex	Bone ID	Pathology	Notes
Sand layer under wall core (2831) of House 401	3119	5106	-	MA–OA	-	Skull fragment (fusing suture)	-	Pit located NE of pit 2543, 2.1m dia x 0.5m deep. An inverted partial pot and polishing stone (SF 5111) at bottom of pit.
		5421	-	Adult	-	Intermediate phal. of the foot, frag. of the left calcaneus	-	
Large pit under entrance of House 801 (former Phase 3 pyre site)	2544	4908	2543	Adult	-	Right parietal and small misc. skull fragments	-	Large, round-bottomed pit 2.3m dia. x 1.2m deep, recut as pit 2446. The fill (2544) also contained cremated bones (SF 5113 and 5118). One of the skull fragments dates to *1735–1445 cal BC* (AA-49344; 3295±50 BP) and is considered to have died *c.*100 years prior to its burial in pit 2543.
				Adult	-	Right patella	Slight new growth formation on medial articular facet	
				Adult	F?	Upper left lateral eye orbit	-	
Recut of large pit under entrance of House 801 (former Phase 3 pyre site)	2394	5423	2446	MA-OA	-	Right femoral head	Lipping around the margin of the head and tubercle growth near the fovea capita	The first recut [2446] of pit 2543 also contained large quantities of pottery and shells and a cremated human skull fragment (also SF 5423). Fill 2394 lies on top of sand layer 2398. The second recut of pit 2543 is Phase 8 pit 1792; see Table 19.42.
			2446	Adult	-	Left femoral shaft, distal 1st metatarsal frag., transverse process of thoracic vertebra, occipital skull frag.	-	
	2398	5424	2446	Adult	-	Mandible fragment with three molars	-	Sandy layer directly beneath 2394 (within pit 2446, the first recut of pit 2543).
A turf layer of Structure 2477 (Phase 7)	2476	ESN 5008	-	Adult	-	Left proximal femur	-	Associated with cremated human bone, butchered animal and marine bone, pottery, ash, flat stones and hide-working tools. Two grains are dated to *1420–1225 cal BC* (SUERC-10821; 3070±35 BP) and *1260–1045 cal BC* (SUERC-10820; 2925±35 BP). Structure 2477 was a small temporary house with a west entrance: the bone was recovered from the western part of layer 2476.

Table 19.29. Summary of the dispersed cremated human bone from Phases 6 and 7

Location	Ctxt	SF no.	Pit	Bone ID	Wght (g)	Age	Sex	Colour	Notes
Large pit under entrance of House 801 (former Phase 3 pyre site)	2544	5113	2543	L. distal radius, cranial frags, humerus, ulna shaft, fibula, 12th rib, UID long bones, UID spongy bones	15.8	Adult	-	Medium grey to brownish-grey (efficiently cremated)	Fill (2544) associated with the unburnt bones (SF 4908: skull fragments, left upper eye orbit and a right patella).
		5118		Coracoid process, ulnar notch	2.12	Adult	-	Medium grey to brownish-grey (efficiently cremated)	
				Fibular shaft	1.11	Sub-adult	-		
Recut of large pit under entrance of House 801 (former Phase 3 pyre site)	2394	5423	2446	Cranial fragment	-	Juv-YA	-	Whitish-grey	Also contained five fragments of unburnt bones (SF 5423).
A turf layer of Structure 2477 (Phase 7)	2476	ESN 5008	-	UID cremated bone fragment	-	-	-	-	Associated with an unburnt left proximal adult femur (see Table 19.28). Missing post-sampling.

Phase 8 (1095–1020 cal BC)

In this construction phase for the north–south row of three roundhouses, two inhumations were recovered from House 1370, one from House 401, and another from House 801 as well as an assortment of disarticulated unburnt bones from a variety of contexts (see Figure 19.3).

Skeleton SK 2792

The remains of SK 2792 were found in the fill (2738) of a small grave pit (2737) in the northeast quadrant of House 801 (see Volume 1: fig. 4.7). The skeleton was mostly disarticulated, with only the vertebrae and pelvis in articulation on a south–north orientation, with the skull placed in the south and facing northeast (see *Post mortem manipulation*, above). The skeleton is dated to *1445–1195 cal BC (at 95% probability*). The child was buried before the floor of House 801 was laid. That floor dates to *1095–975 cal BC (at 89% probability*; see Volume 1: 84–7, 123, 444), indicating that SK 2792 died during Phases 3–6 but was buried in Phase 8.

SK 2792 is a single inhumation with no duplicating skeletal elements and the morphology of the bones is consistent for an individual of the same age. The skeletal remains are very fragile but are in a good state of preservation. The skeleton is scored at grade 2 due to some surface erosion with slightly moderate but patchy penetration (Brickley and McKinley 2004). The full skeletal inventory of SK 2792 was made (Table 19.30) along with a visual skeletal representation (Figure 19.26) and a visual deciduous dental inventory (Figure 19.27).

The majority of the cranial bones of SK 2792 are complete, with only the right parietal and portions of the left temporal bones fragmented. All unfused bones of the sphenoid, the *pars basiliaris*, and the left and right *pars temporalis* are present, along with the mandible and most of the maxilla. The eye orbits and portions of the malar bones are absent.

The axial skeleton is well represented, with the majority of the scapulae surviving (only the superior border of the right blade is missing, along with the majority of the left blade). Both clavicles are present, though in fragments, and the majority of the ribs were recovered with 10 right and 11 left rib heads. All vertebrae are present and consist of unfused bodies and arches of the cervical and thoracic portions, but arches in the lumbar and sacral regions are absent.

The pelvic girdle contains the unfused left and right ilia, ischia and pubis bones. The long bones are mostly fragmented but in good condition. Both radii and patellae are absent. A number of epiphyses are present, but their eroded condition compromises any confident identification. There are six unfused proximal phalanges, one unfused distal phalanx and nine unfused metatarsals/metacarpal bones. All carpal and tarsal bones are absent.

The dentition of SK 2792 is in excellent condition (Figure 19.27). The deciduous maxillary left first incisor and the deciduous mandibular left and right first were lost *post mortem*. There is the slightest occlusal wear on both crown tips of the deciduous maxillary second incisors.

Due to the fragmented condition of most of the long bones, only two are complete enough for estimating age at death. The diaphyseal lengths of the left femur (158.00mm) and the right tibia (130.00mm) give an age at death of 1.5–2 years for each bone (Maresh 1970 adapted by Scheuer and Black 2000). The left deciduous mandibular canine has a single root length at R_C with a mean age estimate of 2 years, while the right permanent mandibular canine has a root length at Cr ½ with a mean age of attainment of 2.1 years (Moorrees *et al*. 1963). Dental eruption and development (Ubelaker 1989) give an age range of 3 years ± 12 months. These combined methods provide an overall age at death of 1.5–3 years, within the broad category of a young child.

Determining biological sex is problematic; however, it is observed that the greater sciatic notch is wider than 90º and the shape of the iliac blade is not markedly 'S-shaped', both indicating that SK 2792 may be female.

Only the non-metric trait of a right accessory transverse foramina was observed in the seventh cervical vertebrae (see Table 19.18). The development of non-metric traits in infants may reflect developmental processes and therefore their significance may be problematic. This trait is also shared with SK 2638 and could tentatively indicate a familial link between one (or more) of the individuals from SK 2638 and SK 2792. No pathological lesions or dental abnormalities were observed on the skeletal elements of SK 2792.

Skeleton SK 2613

The skeletal remains of SK 2613 were recovered in a tightly flexed position in pit 2612 underneath the floor in the south of House 1370 (see Volume 1: fig. 4.19). The location of SK 2613 is unique among the inhumed human remains recovered from Cladh Hallan: it was located in the southern quadrant of the house while all the other burials were in the northeast quadrants of the houses.

SK 2613 was buried on its left side in a tightly crouched and fully articulated position. However, the left knee (consisting of the distal femur and proximal tibia) and an intermediate phalanx of the foot were recovered separately from a fill layer (2748) of a pit (2551) outside the house. Also recovered from pit 2551 from a later fill (2732), were the left patella and the distal end of the radius (see *Post mortem manipulation*, above). A maxillary lateral incisor had been placed in each hand (the left incisor from SK 2613's skull in the left hand and the right incisor in the right hand).

At the time of excavation, there was no indication that this individual was a composite made from separate people; however, the skull, left femur and right humerus are from at least three different individuals, confirmed by both osteological analysis and aDNA testing (Hanna *et al*. 2012). In some past publications and reports, SK 2613 is referred to as a 'female'; however, as SK 2613 is now known to be a composite of both male and female individuals, it is no longer accurate to refer to it as 'female'.

Table 19.30. The skeletal inventory of SK 2792 whereby '√' indicates that the bone is present; 'frag' indicates that the bone is too fragmented for side identification; and a blank square indicates that the bone is absent

CRANIUM								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Present*	*Absent*
Parietal	√	frags	Maxilla	√	√	Nasal	√	
Temporal	√	√	Zygomatic process			Lacrimal	√	
Occipital	√	√	*Pars petrosa*	√	√	Inf. nasal concha	√	
Pars lateralis	√	√	Tympanic ring			Ethmoid	√	
Pars basilaris	√		Lesser wing	√	√	Vomer	√	
Frontal	√	√	Greater wing	√	√	Concha	√	
Zygo/malar			Post-sphenoid	√		Aud. ossicles	R incus	
Mandible	√	√	Palatine	√	√	Hyoid	√	

AXIAL								
Bone	*Present*	*Absent*	*Bone*	*Present*	*Absent*	*Bone*	*Present*	*Absent*
Manubrium			Sternum			Xiphoid		
Ribs: right	1 2	3 4 5	6 7 8 9 10	11 12	Total: 10	Rib epiph		
Ribs: left	1 2	3 4 5	6 7 8 9 10	11 12	Total L: 11	Rib epiph		

VERTEBRAE								
Centum					*#?*	*Total*	*Neural arches*	*Left*	*Right*
Cervical	1 2	3 4 5	6 7			7	Cervical		
Thoracic	1 2	3 4 5	6 7 8 9 10	11 12		12	Thoracic		
Lumbar	1 2	3 4 5				5	Lumbar		
Sacral	1 2	3 4 5				5	Sacral		
Coccyx	1 2	3 4				0	Coccyx		
Dens	Present	Absent	Atlas post. Arch	Present	Absent		#? Neural arches	0	

UPPER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Scapular blade	√	√	capitulum			Scaphoid		
coracoid epiph.			Lat. epicondyle			Lunate		
glenoid epiph.			Med. epicondyle			Triquetral		
acromial epiph.			Radial diaph			Pisiform		
Clavicle	√	√	prox. epiph.			Trapezium		
med. epiphyses			dist. epiph.			Trapezoid		
lat. epiphyses			Ulnar diaph	√	√	Capitate		
Humeral diaph	√	√	prox epiph			Hamate		
head	√	√	dist epiph					

HAND				
Bone	*Left*	*Right*	*No side*	*Total*
Metacarpal diaph	1 2 3 4 5	1 2 3 4 5	-	0
head epiph	1 2 3 4 5	1 2 3 4 5	-	0
base epiph	1	1	-	0
Phal: prox diaph	1 2 3 4 5	1 2 3 4 5	-	0
prox epiph	1 2 3 4 5	1 2 3 4 5	-	0
Phal: inter diaph	2 3 4 5	2 3 4 5	-	0
prox epiph	2 3 4 5	2 3 4 5	-	0
Phal: dist diaph	1 2 3 4 5	1 2 3 4 5	-	0
prox epiph	1 2 3 4 5	1 2 3 4 5	-	0

LOWER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Ilium	√		Pubis	√	√	Talus		
Ant inf iliac spine epiph			Femur	√	√	Calcaneus		
Ant sup iliac spine epiph			capital fem epiph			epiph		
Ant crest epiph			Gr trochanteric epiph			Cuboid		
Post crest epiph			Les trochanteric epiph			Navicular		
Acetabulum	√	√	dist fem epiph		√	Cuneiform med.		
Sup acetab epiph			Patella			Cuneiform inter.		
Ant acetab epiph			Tibia	√	√	Cuneiform lat.		
Post epiph (acetab)			prox tibial epiph					
Sup epiph (acetab)			dist tibial epiph					
Ischium	√	√	Fibula	√	√			
Ischial tube epiph			prox fibular epiph					
Ramal epiph			dist fibular epiph					

FOOT				
Bone	*Left*	*Right*	*No side*	*Total*
Metatarsal diaph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
head epiph	~~2 3 4 5~~	~~2 3 4 5~~	-	0
base epiph	. ~~1~~	~~1 2 3 4 5~~	-	0
Phal: prox diaph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
prox epiph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
Phal: inter diaph	~~2 3 4 5~~	~~2 3 4 5~~	-	0
prox epiph	~~2 3 4 5~~	~~2 3 4 5~~	-	0
Phal: dist diaph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
prox epiph	~~1 2 3 4 5~~	~~1 2 3 4 5~~	-	0
Unidentifiable MC/MT diaphyseal shafts: 9	MC/MT prox phals: 6	MC/MT inter phals: 0	MC/MT distal phals: 1	

A minimum of three individuals are represented within the composite skeleton of SK 2613. No single element is repeated, and the muscle attachments and pathological lesions of both right and left sides are comparable with each other. Examination of the morphological features used to determine biological sex has revealed that the skull is male while the hip bones are female. While it is common to have both male and female traits in a single skeleton, aDNA testing has confirmed these findings and has also revealed the presence of a third individual, from the humerus. Initial osteological examination of the mandible and its corresponding temporomandibular joint raised the possibility of a fourth individual: the mandible is slightly wider than the cranium and severe eburnation to the mandibular head does not have any corresponding damage to the mandibular fossa on the temporal bone. However, an intra-articular disc separates the joint into upper and lower sections, so changes in only the lower (mandibular) compartment is possible (Tony Waldron pers. comm.). Furthermore, the occlusal wear patterns for both mandibular and maxillary left and right molars articulate perfectly together, indicating they belong to the same individual.

The skeletal remains of SK 2613 have only slight abrasion to the surface of the cortex. The bones are scored as grade 1 according to the guidelines of Brickley and McKinley (2004). A full skeletal inventory of SK 2613 was conducted (Table 19.31) along with a visual skeletal representation (Figure 19.28) and a visual dental representation (Figure 19.29). While considered to be a single articulated burial within the grave cut, the skeleton is a composite of at least three individuals: individual #1 consists of the skull; individual #2 consists of the right humerus (as supported by aDNA); and individual #3 consists of the remaining skeletal elements.

The skull is complete but in a very fragmented condition. Both left and right clavicles and the manubrium were

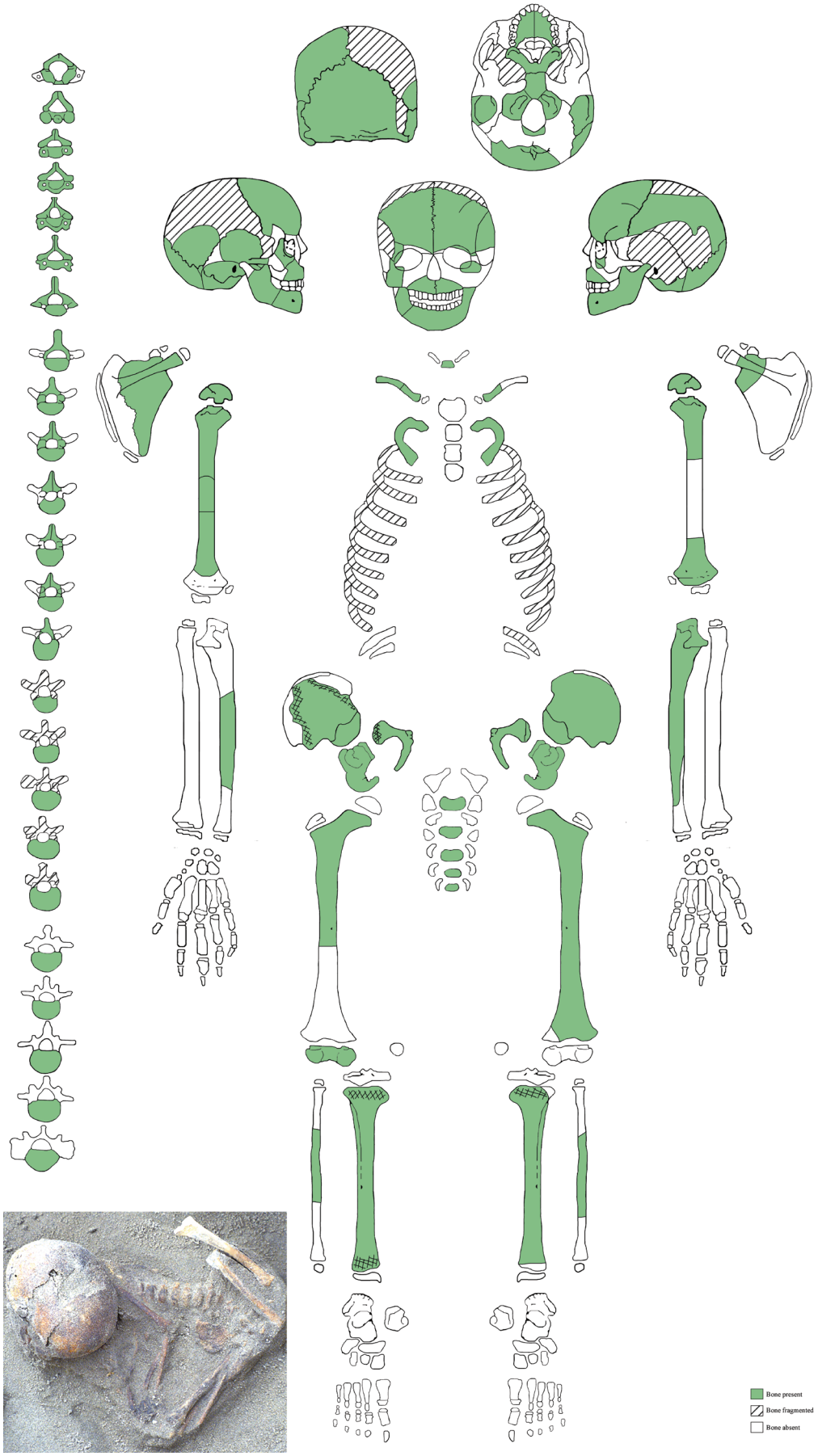


Figure 19.26. The visual skeletal inventory of SK 2792 indicating the presence (coloured) and absence (uncoloured) of bones; bones shown as hachured are present but heavily fragmented

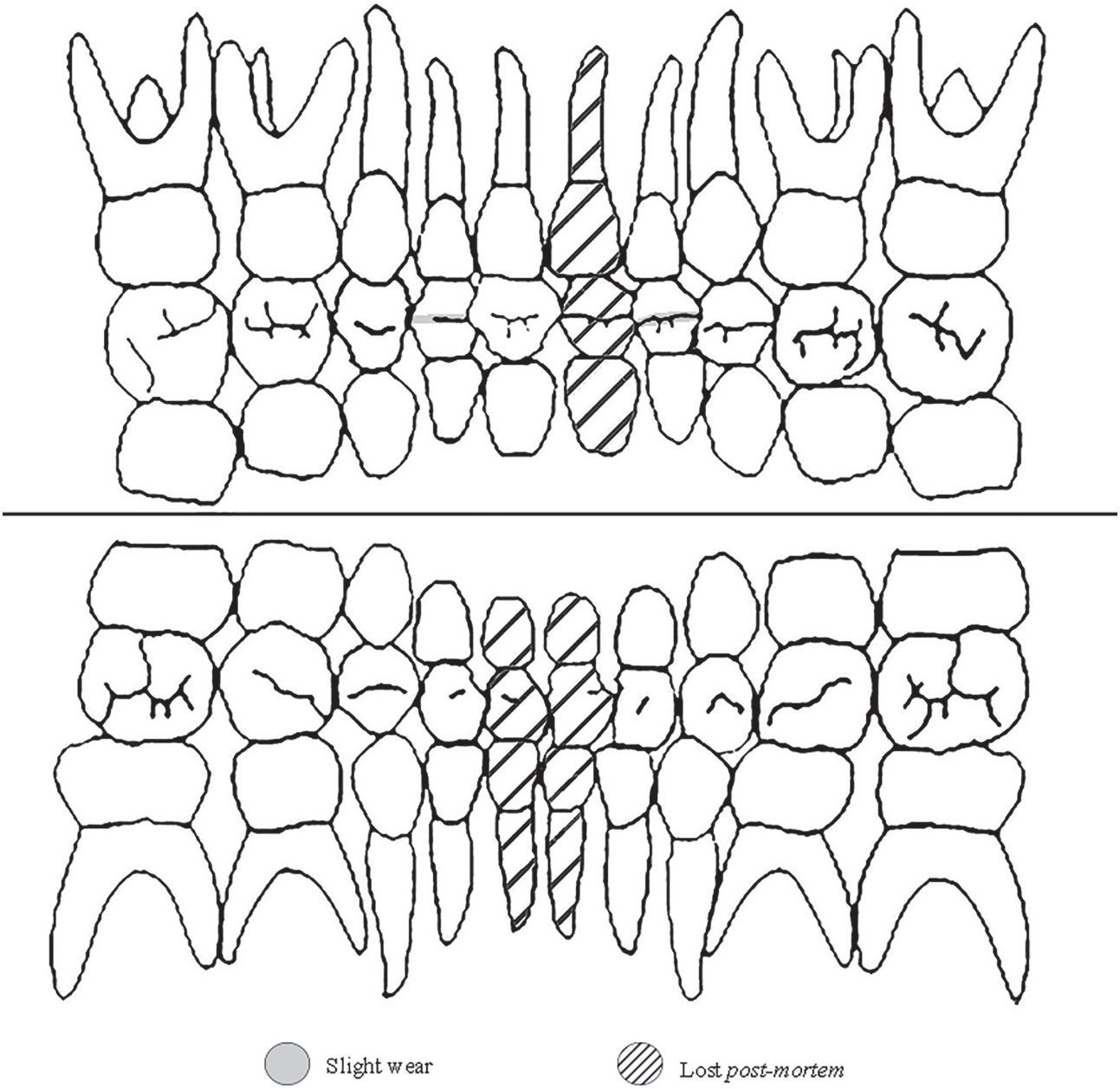


Figure 19.27. The visual inventory of the deciduous dentition of SK 2792

recovered, along with the majority of both scapulae though most of the blade from the right side is absent. All the long bones of the arms were recovered; the right humerus, radius and ulna have *post mortem* breaks while the left side is completely devoid of any breaks. The rib shafts are fragmented, but 12 right and 11 left rib heads are identified. All the metacarpals were recovered, along with six proximal phalanges and one intermediate phalanx of the hand. No distal phalanges were found.

All the vertebral bodies, including the sacrum but not the coccyx, were recovered although some of the spinous and transverse processes were broken prior to excavation. The left and right hip bones are present but both the pubic bones are absent. All the long bones of the legs are present although the proximal heads of the fibulae are absent. All the tarsals, metatarsals and proximal phalanges were found, along with six intermediate and two distal phalanges of the foot.

The dentition is in great condition and consists of 24 teeth: 14 maxillary (the left M^3 was lost *ante mortem* while the right M^3 tooth and associated maxillary bone are absent) and 10 mandibular (the right M_3, M_2, I_2, I_1, and left I_1 and M_3 were lost *ante mortem*). Three maxillary teeth (right M^2, and left C and M^2) were sent for aDNA sampling.

The left distal femur and left proximal tibia were recovered fully articulated in fill layer 2748 of pit 2551 (Figure 19.30), while the right distal radius and left patella were recovered in pit fill 2732 above it (Figures 19.33 and 19.35). The breaks to the femur, tibia and radius occurred when the bones were dry, evidently a long time after death. Unfortunately, the left proximal femur was sent for sampling before it was noticed that its other half, including

Table 19.31. Skeletal inventory for SK 2613 whereby '√' indicates that the bone is present, and a blank square indicates that the bone is absent/not identified

CRANIUM																		
Bone	*L*	*R*	*Bone*	*L*	*R*	*Bone*	*Present*	*Absent*										
Parietal	√	√	Maxilla	√	√	Ethmoid		√										
Temporal	√	√	Mandible	√	√	Vomer		√										
Occipital	√	√	Nasal			Sphenoid	√											
Frontal	√	√	Lacrimal			Aud. ossicles		√										
Zygomatic/malar	√	√	Inf. nasal concha			Hyoid		√										
Palatine	√	√																
AXIAL																		
Bone	*Present*							*Absent*								*Bone*	*Present*	*Absent*
Manubrium	√															Sternum		√
Ribs (right)	1	2	3	4	5	6	7	8	9	10	11	12	#?:					
Ribs (left)	1	2	3	4	5	6	7	8	9	10	11	~~12~~	#?:					
VERTEBRAE																		
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*				*#?*	*Total*	
Cervical	√	√	√	√	√	√	√									-	7	
Thoracic	√	√	√	√	√	√	√	√	√	√	√	√				-	12	
Lumbar	√	√	√	√	√											-	5	
Sacrum	√	√	√	√	√											-	5	
Coccyx																-	0	
UPPER LIMB																		
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*										
Scapula	√	√	Scaphoid	√		Trapezium	√	√										
Clavicle	√	√	Lunate		√	Trapezoid	√											
Humerus	√	√	Triquetral			Capitate	√											
Ulna	√	√	Pisiform			Hamate		√										
Radius	√	√	+ 2× small fragments of carpal bones															
HAND																		
Bone	*Left*					*Right*					*No side*	*Total*						
Metacarpal	1	2	3	4	5	1	2	3	4	5	-	10						
Proximal phal.	1	2	3	4	5	1	2	3	4	5	-	10						
Intermediate phal.	2	3	4	5		2	3	4	5		-	1						
Distal phal.	1	2	3	4	5	1	2	3	4	5	-	0						

LOWER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Ilium	√	√	Tibia	√	√	Cuneiform med.	√	√
Acetabulum	√	√	Fibula	√	√	Cuneiform inter.	√	√
Ischium	√	√	Talus	√	√	Cuneiform lat.	√	√
Pubis			Calcaneus	√	√			
Femur	√	√	Cuboid	√	√			
Patella	√	√	Navicular	√	√			

FOOT												
Bone	*Left*					*Right*					*No side*	*Total*
Metatarsal	1	2	3	4	5	1	2	3	4	5	-	10
Proximal phal.	1	2	3	4	5	1	2	3	4	5	6	6
Intermediate phal.	2	3	4	5		2	3	4	5		6	6
Distal phal.	1	2	3	4	5	1	2	3	4	5	2	2

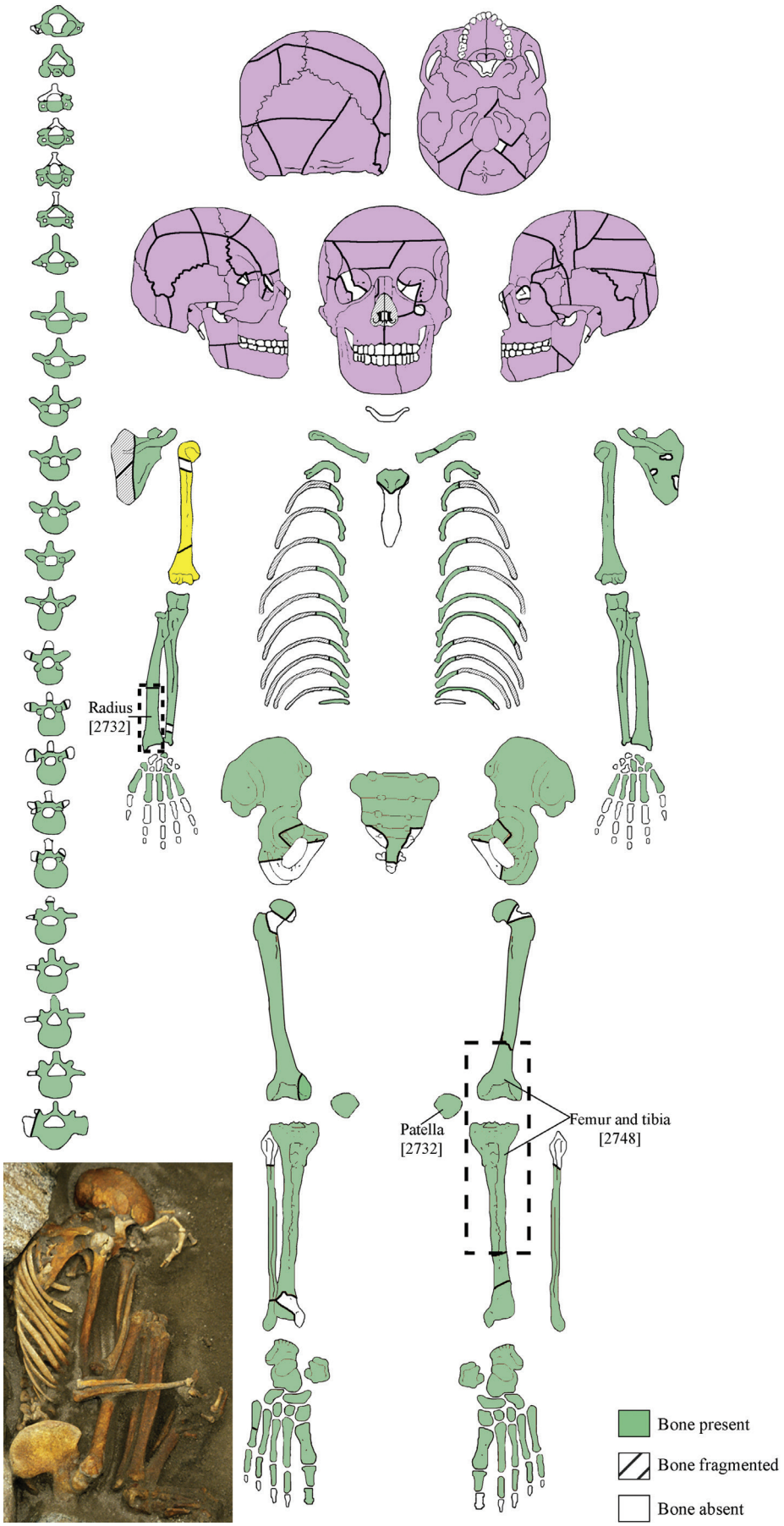


Figure 19.28. The visual skeletal inventory of composite SK 2613. The first individual is coloured purple while the second individual is yellow (as indicated by aDNA results). The third individual is coloured in green

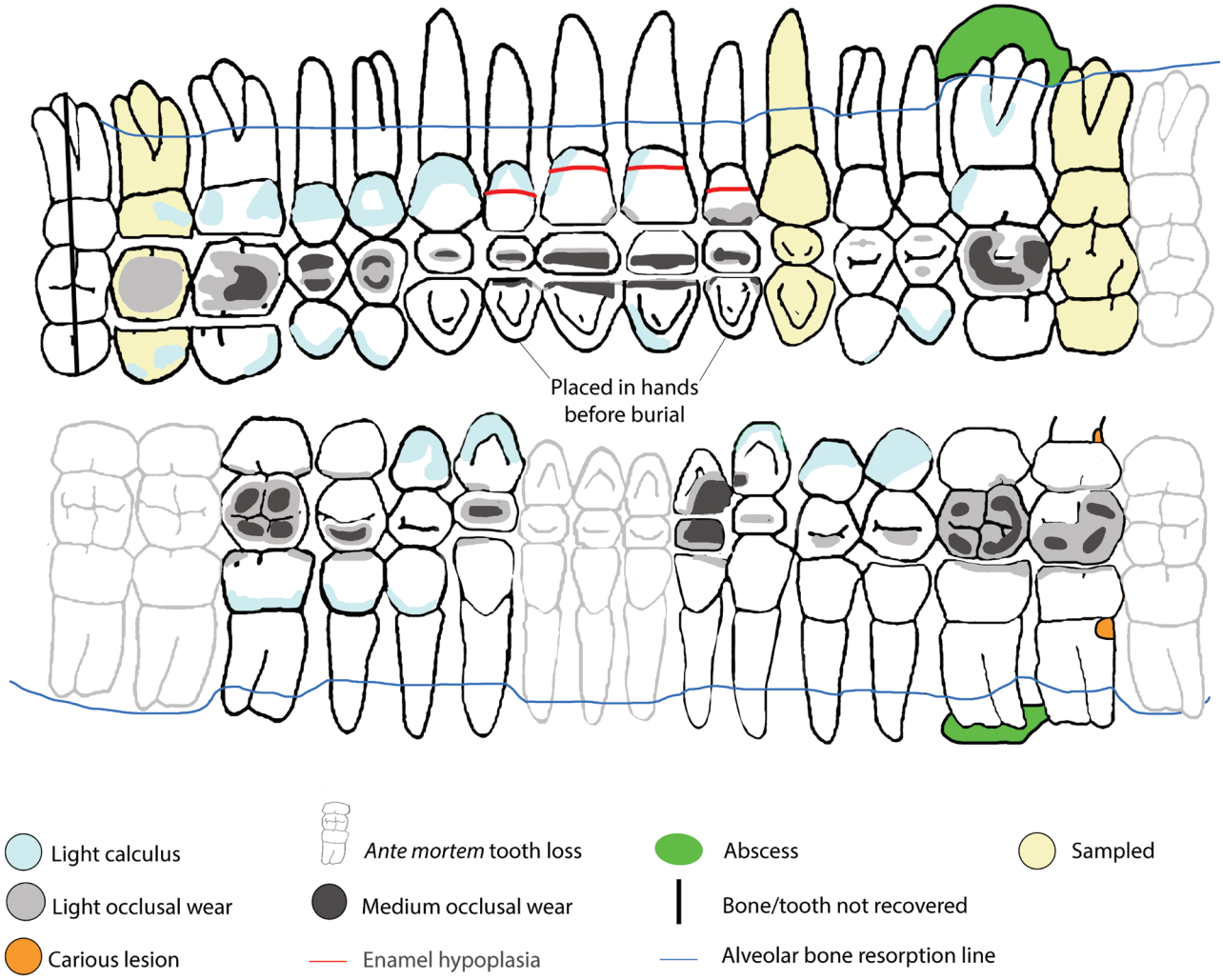


Figure 19.29. The visual dental inventory of SK 2613. Note that the teeth coloured in yellow were sent for aDNA sampling prior to conducting a visual recording of the teeth

the proximal tibia, came from pit 2551. However, the two tibial halves fit together perfectly (Figures 19.31–19.32). The pathological conditions of both the left and right knee joints are shared symmetrically, indicating that the knee joint from the pit does indeed belong to SK 2613. As mentioned above, pit 2551 is interpreted as a previous resting place of the female post-cranial skeleton of SK 2613. The pit's later re-cut is interpreted as the re-opening of the burial pit to exhume the (mummified) body. During this removal of the body, the knee joint, the radius and the patella were left behind in the original grave in pit 2551 (see Volume 1: chap. 4).

Also recovered from pit 2551, from fill layer 2748, was an intermediate foot phalanx. At present, this bone cannot be confirmed as deriving from SK 2613; however, six intermediate phalanges were recovered from SK 2613, raising the probability that this toe bone may have accidently or deliberately been left behind when the 'mummy bundle' was removed from the pit and reburied under House 1370.

While most of the dentition was recovered, two maxillary lateral incisors had been extracted after death and placed into each clenched hand at the time of the body's re-burial beneath House 1370 (see Volume 1: fig. 4.19). The right incisor was placed in the right hand while the left incisor was placed in the left hand. Thus at reburial, the female individual #3 held the two incisors from the male individual #1 in her hands, with his skull on her torso.

As described in *Post mortem manipulation* above, a phalanx on the second finger of the left hand appears to have been out of position when the skeleton was excavated. Typically, an individual possesses one metacarpal and three phalanges per finger; however, excavation of SK 2613 recorded four phalanges on the second finger. As mentioned above, this movement of a finger phalanx from its anatomically correct position may have occurred during the exhumation of the body from its previous grave in pit 2551, if, for example, a phalanx fell out of the 'mummy bundle' and was popped back into the area of the hand before or during the body's reburial (perhaps echoing the intermediate foot phalange that was left within the pit). From the skeletal inventory, it does not appear that this 'extra' phalanx came from a different individual; rather, it is from SK 2613, just not in its correct anatomical position.

Figure 19.30. The left knee joint belonging to SK 2613, who was buried under House 1370, was recovered from pit 2551

Figure 19.31. The left tibia of SK 2613 when the proximal and distal halves are joined together

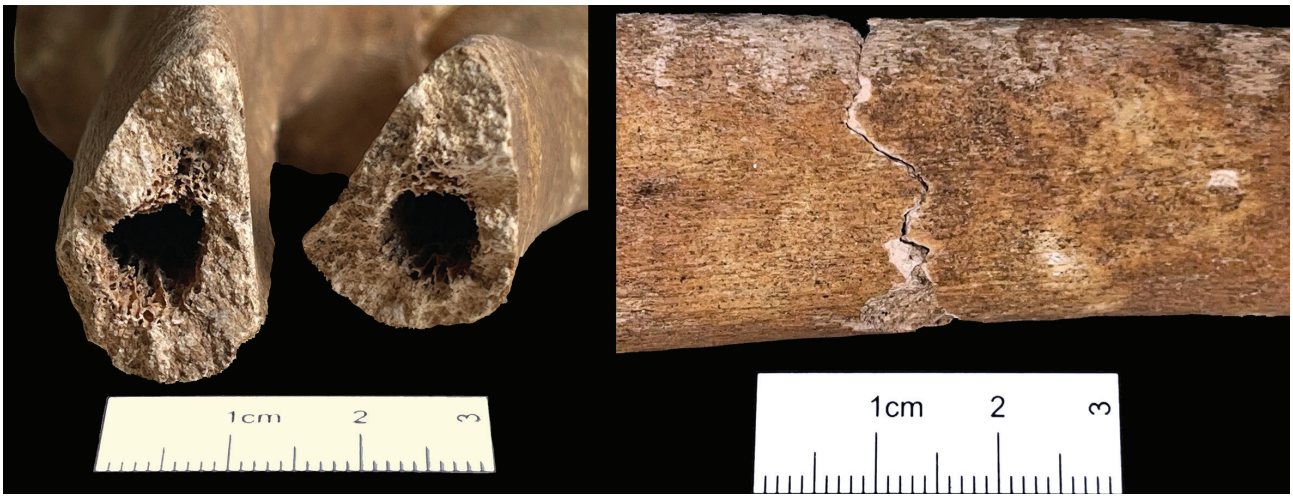


Figure 19.32. Left image: the break of the left proximal and distal tibial shaft from SK 2613; Right image: close-up of the post mortem *break in the tibial shaft*

Figure 19.33. The right radius from SK 2613 in which the distal end (left side of the break) was recovered in fill 2732 of pit 2551. The proximal end (right side of the break) was recovered in articulation with the composite skeleton

Recovered from the same fill as SK 2613 was a left mandibular second incisor (Figure 19.36). This incisor is from a mature to older adult and is heavily worn. The mandible of individual #1 reveals that its left M_2 was lost *ante mortem* due to the alveolar resorption of the tooth root; however, the heavy wear on the loose lower incisor does not correspond with the occlusal wear on the upper incisor and therefore this extra incisor does not derive from individual #1.

As previously mentioned, two cut-marks were observed on the right trapezium and on the right navicular of SK 2613 (see Figures 19.19–19.20). The first cut-mark on the trapezium is 10.39mm long by 1.17mm wide at the edge of the bone but then narrows down to nothing. The second cut-mark is more of a nick on the navicular and is 4.16mm. These are the only two cut-marks found on any of the human remains at Cladh Hallan and cannot be from root damage or post-excavation damage.

Age at death was established for all three composite individuals: the skull (individual #1), the humerus (individual #2) and the pelvis (individual #3; Table 19.32).

Age of individual #1 – the skull: The degree of occlusal wear on both the mandibular and maxillary molars (Miles 1962; Smith 1984) reveals moderate wear of the enamel surfaces with no dentine exposure. Both the left and right maxillary first molars provide an age range of 34–38 years, while the second maxillary molars provide an age range of 36–40 years. The left and right mandibular first molar provides an age range of 34–38 years. This gives an overall age range of 34–40 years (average 37 years), which places this individual in the mature adult age category. Age was obtained by observing the degree of closure to five ecto-cranial and five latero-anterior sutures. The framework for age estimation is based on a scoring system from '0' (no closure) to '3' (complete closure) which is then converted into a broad age category (Meindl and Lovejoy 1985). The composite scores are calculated and then compared to a table which provides a broad age range. The composite score from the ectocranial vault is 18, which converts to an age range of 30–71 years with a mean age of 51.5 years. The composite score for the lateral-anterior sutures is 3 which converts to an age range of 23–68 years with

Figure 19.34. Close-up of the post mortem *radial break from both sides of the radius*

Figure 19.35. Left: the right patella recovered with the composite skeleton; right: the left patella recovered from fill 2732 of pit 2551. Both patellae are from SK 2613

a mean age of 41.1 years. This provides an overall age range of 23–71 years (the average is 47 years) and places the skull in the mature adult age category. By combining the results of the two methods, individual #1 is a mature adult with an average age of approximately 37-42 years at the time of death.

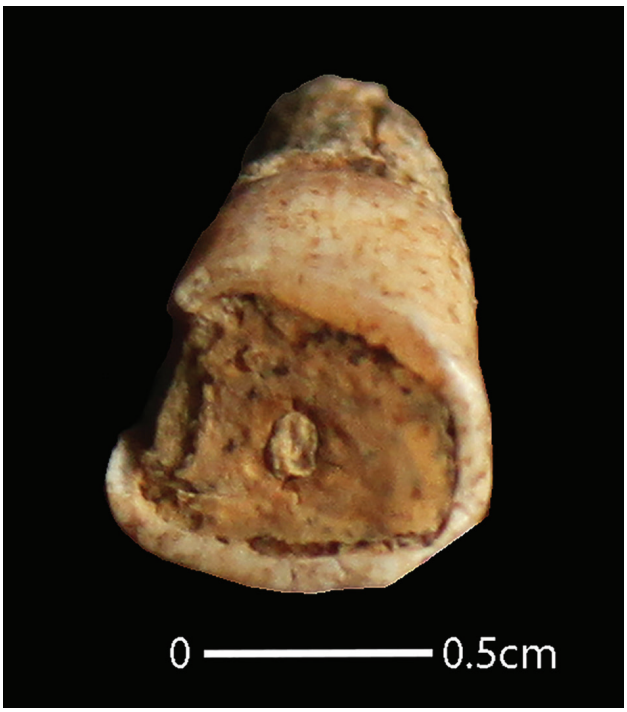


Figure 19.36. The additional left I^2 recovered from the same fill as SK 2613

Table 19.32. Summary of age at death of SK 2613

Individual	Element	Age range	Age category
Individual #1	Skull	23–71 years (average: 47 years)	Mature adult
	Mandible	34–40 years (average: 37 years)	Mature adult
Individual #2	Humerus	-	Adult
Individual #3	Auricular surface	45–60 years (average: 52.5 years)	Older adult
	Auricular surface	29–81 years (average: 51.4 years)	Older adult
	Osteoarthritis to the long bones	35 years+	Mature to older adult

Age of individual #2 – the humerus: There is currently no method to determine a more precise age at death for adults based on long bones.

Age of individual #3 – the pelvis: The auricular surface of the ilium undergoes visible age-related changes to the bone (Lovejoy *et al*. 1985), with the left auricular surface of SK 2613 scored at stage 6 (45–49 years) and the right auricular surface scored at stage 7 (50–60 years) due to a significant loss of granulation. This granulation was replaced by dense bone but has no transverse organisation. Age-related changes at the apex are moderate and increasing irregularities in the margins were observed. These stages provide an age range of 45–60 years with a mean age of 52.5 years. This estimation is further supported by using the method of Buckberry and Chamberlain (2002) in which the auricular surface is scored at 12. This puts the individual in 'age stage IV' which converts to an age range of 29–81 years with a mean of 51.4 years. By combining the results of the two ageing methods of the pelvis, individual #3 is an older adult with an average age of approximately 52 years at the time of death.

Biological sex was also determined from the three composite individuals of SK 2613 and is summarised in Table 19.33.

Sex of individual #1 – the skull: The cranium was examined to determine biological sex (Feremback *et al.* 1980; Krogman and İşcan 1986; Loth and Henneberg 1996; Schwartz 2007). Male traits present include prominent supraorbital ridges and glabella, and a quadrangular orbital outline with rounded edges. The mastoid process is large and vertical, and the nuchal area is ridged with a very large external occipital protuberance. The parietal tuberosities are absent and the mandible has a moderate projecting mental protuberance. All observable traits of the mandible are male including a broad mandibular ramus, a projecting and large mental protuberance and a perpendicular angle with everted edges. A very few female traits were observed, such as a smooth nuchal area and an indistinct canine eminence; however, the overall traits determine that individual #1 is a male.

Sex of individual #2 – the humerus: The left humeral head is 42.3mm in diameter which is indicative of a female (Steel and Bramblet 1988: 164).

Sex of individual #3 – the pelvis: The pelvis and sacrum are in good condition, with almost all morphological characteristics present (Phenice 1969; Feremback *et al*. 1980; Krogman and İşcan 1986; Schwartz 1995) although both the pubic bones are missing. The female traits include a U-shaped, obtuse greater sciatic notch, a present preauricular sulcus, a small anterolateral acetabulum, an anterior sacral curvature which extends from S3 to S5, and a sacral auricular surface which extends from S1 to S2. Two male traits were observed: a large ischial tuberosity and the narrow body of the first sacral vertebra. Overall, the traits for the pelvis and sacrum determine that individual #3 is female.

Due to the composite nature of SK 2613, stature can only be determined on the long bones attributed to individual #3. The measurements of the left humerus, ulna and radius were taken (Table 19.34) as all other long bones were either fragmented or were missing a small portion of their shaft. Using the measurements charts developed by Trotter and Gleser (1952), the combined average of the upper long bones produces an estimated height of 162.3cm (5ft 3in) for this mature to older adult female.

The non-metric traits on the cranium of SK 2613 consist of a left supraorbital notch, a right bridging of supraorbital foramen and a bifurcate flexure of the sagittal sulcus. They are markedly different from those found on the remains of SK 2638 and this may provide some information towards

Table 19.33. Summary of the results from determining biological sex

Individual	Element	Sex: left side	Sex: right side
Individual #1	Skull	Male	
	Mandible	Male	
Individual #2	Humeral head	Female	-
Individual #3	Pelvis (incl. sacrum)	Female	Female
	Femoral head	Female	Female
	Femoral condyles	Female	Female

Table 19.34. Stature estimation of individual #3, SK 2613

Bone	Side	Measurement	Female stature
Humerus	Left	300mm	159cm
Ulna	Left	248mm	164cm
Radius	Left	230mm	164cm
		Average	*162.3cm*

Figure 19.37. Right: temporo-mandibular joint disease of SK 2613 in which the right head of the mandible has been worn away (circled in red). Left: the base of the cranium in which there is no corresponding osteoarthritic changes to the mandibular fossa/articular eminence (circled in red)

interpreting genetic links between these two individuals (see Table 19.18).

Pathology for individual #1 – the skull: Temporo-mandibular joint osteoarthritis (TMJOA) has affected the synovial joint through the loss of the lower intra-articular disc which separates the joint in two. This has caused erosion and flattening of the mandibular head, porosity, and a reduction of joint space (Rando and Waldron 2012: 46; Figure 19.37). It does not have any corresponding osteoarthritic changes to the mandibular fossa/articular eminence on the skull, but this is considered to be normal (Tony Waldron pers. comm.).

Figure 19.38. A carious lesion on the left mandibular second molar of SK 2613

Figure 19.39. The left cranium of SK 2613 in which there are two abscesses, periodontal disease and ante mortem *tooth loss*

Seven teeth were lost prior to death, indicated by the absence of the tooth and by alveolar resorption in the maxillary and mandibular bones. A single line of enamel hypoplasia was noted on both maxillary left and right incisors, indicative of a period of stress (*e.g.* illness or nutritional deficiency) during childhood when the adult teeth were forming inside the alveolar bone. A carious

Figure 19.40. Wear on SK 2613's maxillary incisors due to the scissor occlusion. Also visible in this image is the overcrowding of the left second incisor which created a different wear pattern on its labial surface

Figure 19.41. Corresponding wear on the lingual surfaces of SK 2613's left mandibular canine and second incisor due to the scissor occlusion

lesion was observed on the distal surface of the left M_2 (Figure 19.38). Two small abscesses were noted: one at the roots of the left maxillary M^1 and one below at the roots of the left mandibular M_1 (Figure 19.39). Periodontal disease surrounds the maxillary abscess from the third premolar to the second molar but remains localised around the mandibular abscess of the first molar.

Individual #1 of SK 2613 has a misalignment within the maxilla, causing the incisors to vertically overlap the corresponding mandibular dentition in an overbite. This has resulted in an overjet of the maxillary incisors whereby they protrude horizontally out on an angle. The combination of overbite and overjet is known as a scissor occlusion (Hillson 2002: 114; 2005: 283; Kaifu *et al*. 2003) and it has caused moderate wear between the mesial and distal surfaces of the left and right maxillary medial incisors and the right maxillary lateral incisor (Figure 19.40). Only corresponding wear was noted on the lingual surfaces of the left mandibular second incisor and canine (the left I_1 and right I_1 and I_2 were lost *ante mortem*; Figure 19.41). The left maxillary I^2 is also over-crowded and is situated behind the maxillary I^1, a position which has, along with the scissor occlusion, contributed to the double wear pattern caused by continuous attrition with the right mandibular I_2 and canine.

There is moderate occlusal wear to the mandibular and maxillary molars (see *Age determination of individual #1*, above) as well as slight calculus on the buccal and lingual surfaces of the maxillary teeth and only the lingual surfaces of the mandibular teeth.

Also noted are the preservation differences between the lateral maxillary incisors (Figure 19.42). Both of these teeth were removed after death, one being placed into each hand. However, the left I^2 shows more weathering to the

Figure 19.42. The two lateral maxillary incisors of SK 2613, which were extracted after death and deliberately placed into each hand. Note the marked difference in preservation and the slanted wear pattern to the crowns of the teeth. The faint lines visible in this image are enamel hypoplasias

surface of the tooth root and more wear to the tooth crown than that of the right I^2.

Pathology for individual #2 – the humerus: None.

Pathology for individual #3 – the remaining skeleton: Most of the skeletal elements exhibit evidence of moderate to severe osteoarthritis in which the majority of lesions are bilateral, suggesting rheumatoid arthritis (Figure 19.43). Rheumatoid arthritis (RA) is a chronic, non-suppurative, systemic inflammatory disease of the synovial joints and connective tissue (Aufderheide and Rodrigues-Martin 1998; Ortner 2003). It is an autoimmune disease and people with RA experience more chronic symptoms in colder climates and from eating certain foods (Roberts and Manchester 1995). In 2005, radiographs of the affected joints were taken at the Royal Hallamshire Hospital in Sheffield. Despite extensive degenerative changes to the bone surfaces such as osteophytosis and eburnation, very little evidence of RA was found. Two RA specialists from Sheffield were consulted and shown both the skeleton and the X-rays. In their opinion, they could neither confirm nor deny the presence/absence of RA in SK 2613.

Although both consultants noted the advanced bilateral degenerative changes to the joints, it is peculiar that the finger bones of SK 2613 do not display any typical signs of RA, since early lesions usually develop in the small joints, in particular the hands, where the interphalangeal and the metacarpophalangeal joints are affected in 85% of cases (Ortner 2003: 562). This may indicate that the hands derive from another individual, especially considering that individual #2 is represented by a humerus. Interestingly, the knees are the most frequently affected large joint in people with RA, followed by the temporal-mandibular joint (TMJ) (*ibid*.), both of which are degenerative joints affecting SK 2613 but in which the TMJ is from individual #1 and the knee joints derive from individual #3.

Osteoarthritis (OA) is found on both the manubrium and sternal ends of the left and right clavicles and corresponds to the degenerative changes also found on the proximal end of the manubrium and the left and right first rib ends. Degenerative changes around the radial facet of the left and right proximal ulnae are also noted. There is slight lipping around the glenoid fossa of the left scapula, around the distal end of the left radius, the left and right lesser trochanter, and the left distal fibula.

There is extreme OA of cervical vertebrae C2–C7, including curled osteophytosis (lipping) around the anterior margins of the vertebral bodies and degradation of the inferior and superior bodies with pitting and porosity to the surfaces. There is minor lipping on the facet for the dens within the anterior arch on C1 (Figure 19.44).

It is also noted that C1 and C2 do not articulate well together: the inferior articular facets of C1 (which are large and round) do not match the superior articular facets of C2 (which are small and oblong). Additionally, the space for the intervertebral disc is noticeably wider than the intervertebral disc space between C2–C7. These abnormalities may be a response to the OA pathological lesions but there is also the possibility that C1 derives from individual #1 and C2 onward derive from individual #3.

Interestingly, there is absolutely no degradation on the inferior body of C7 (compared to the heavily pitted superior surface and osteophytosis around the superior margin) or in thoracic vertebrae T1–T9. But there is osteophytosis around the anterior margin of thoracic bodies T10–T12, which then continues into the lumbar vertebrae (Figure 19.45).

The degenerative changes were next observed in the superior and inferior facets of lumbar vertebrae L1–L5 (Figure 19.46) and extending into both superior articular facets of first sacrum (S1) and the right auricular surface of the sacro-iliac joint (Figure 19.47). The cartilage degeneration of the facet joints of L1 to S1 would have restricted spinal movement, such as bending and lifting.

Extensive lipping is present in both left and right knee joints (Figures 19.48–19.49); both femora and the tibiae exhibit extensive eburnation on the lateral condyles, resulting in a polished and porous joint surface. There is hyperostosis in both patellae, with the lipping extending 4mm–5mm beyond the margin of the apex from the posterior aspect (see Figure 19.35).

There is slight lipping on the left calcaneus and the left talus, slight eburnation on the left cuboid and the articular facet of the left calcaneus, as well as a drainage hole on the left cuboid – all of which may suggest gouty arthritis of the left foot (Figure 19.50).

Both left and right *linea aspera* of the femora are very pronounced, suggesting a repetitive heavy activity affecting the *vastus lateralis*, *vastus medialis* and *vastus intermedius* muscles (three of the four quadriceps muscles) which attach from the *linea aspera* to the patella and then onto the proximal tibial tuberosity. The quadriceps function to extend the legs at the knee joints, which are severely affected by osteoarthritis.

The middle anterior surface of the left radius is larger than the right side. This musculo-skeletal area is affected by the *flexor pollicis longus* muscle and is responsible for flexing the thumb. There are no noticeable differences between the left and right ulnae.

Skeleton SK 2638

The skeleton of SK 2638 was found in a tightly flexed burial within the fill (2598) of a pit beneath the northeast quadrant of House 1370 (see Volume 1: fig. 4.23). During post-excavation analysis, it was noted to be a composite skeleton composed of body parts from at least three different individuals: the skull from one individual, the mandible from a second individual, and the torso from a third. This is the same composite pattern as is found in SK 2613 who was also buried beneath House 1370 but in the southern part of the house.

Radiocarbon determination has revealed the skull dates to *1495–1275 cal BC* (AA-48606; 3105±50 BP and AA-52379; 3135±55 BP), the mandible to *1500–1225 cal BC*

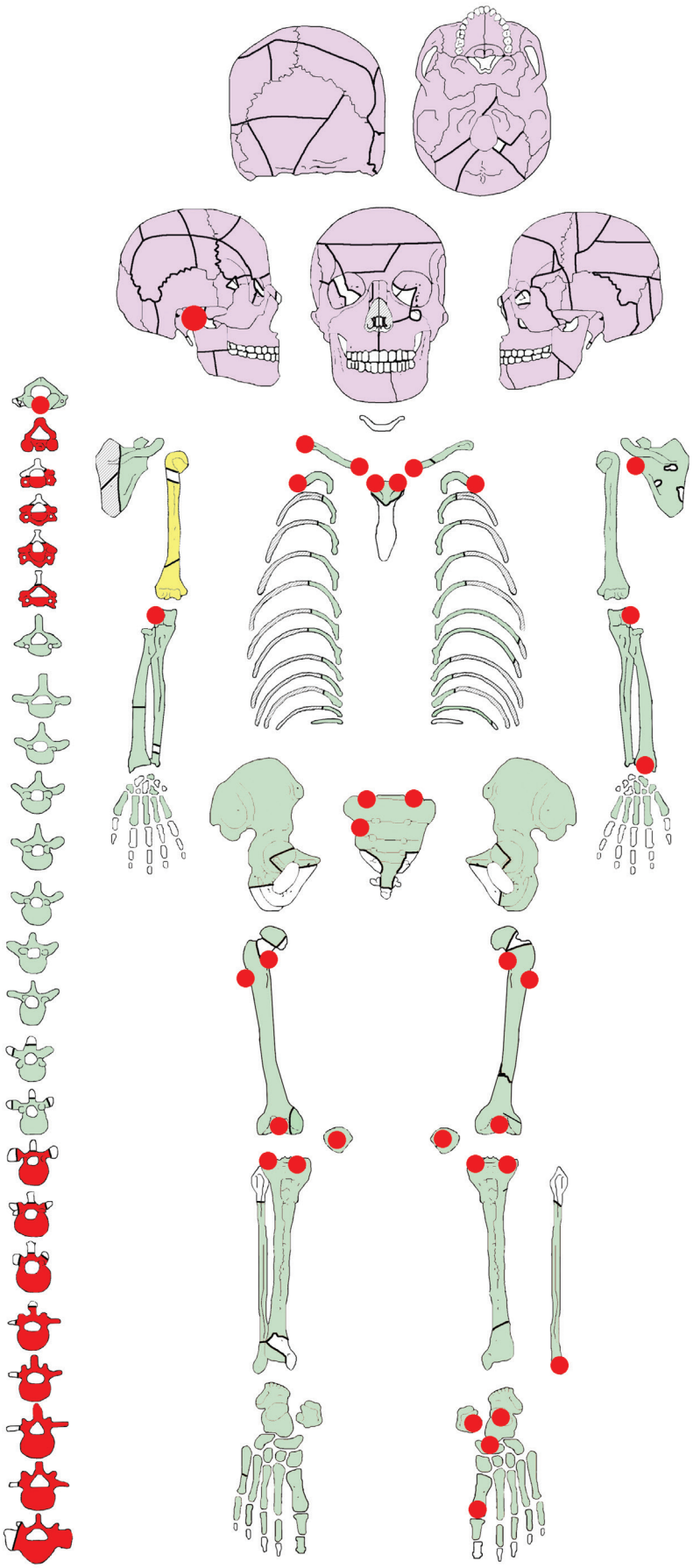


Figure 19.43. The visual distribution of pathological lesions (in red) from SK 2613: purple-coloured bones represent individual #1; yellow-coloured bone represents individual #2; the green bones represent individual #3

Figure 19.44. Degenerative changes on cervical vertebrae C1–C7 from SK 2613, including curled osteophytosis around the anterior margins and porosity of the vertebral bodies. Examples: top right: the superior aspect of C3; bottom right: the superior aspect of C7

Figure 19.45. Slight osteophytosis on the bodies of thoracic vertebrae T10–T12 of SK 2613

(AA-48598; 3105±50 BP), and the tibia to *1615–1420 cal BC* (AA-48597; 3305±55 BP and AA-52378; 3155±60 BP; all dates at 95% probability). The interment of the composite body in its burial pit predates the laying-down of floor 2211 in House 1370; the stratigraphic model shows that the date of death of the individuals making up the composite body is *155–375 years* (at 95% probability) before the floor was laid. Each individual would therefore have been dead for centuries before final deposition beneath the floor of House 1370 (before it was laid) yet the composite body was buried in a fully articulated and flexed position. Study of bone diagenesis (see Chapter 20) indicates that the torso was mummified soon after death.[4]

The skeletal remains of SK 2638 are in very good condition but are extremely fragile and the ends are brittle. The ribs were intact at the time of burial but are now very fragmented, indicating they were supported in the damp, sandy burial environment but fell apart once removed and dried. There is some surface erosion, with deeper penetration at the proximal and distal ends of the long bone shafts, especially in the lower limbs and pelvis, which contributes to the brittleness of the bones.

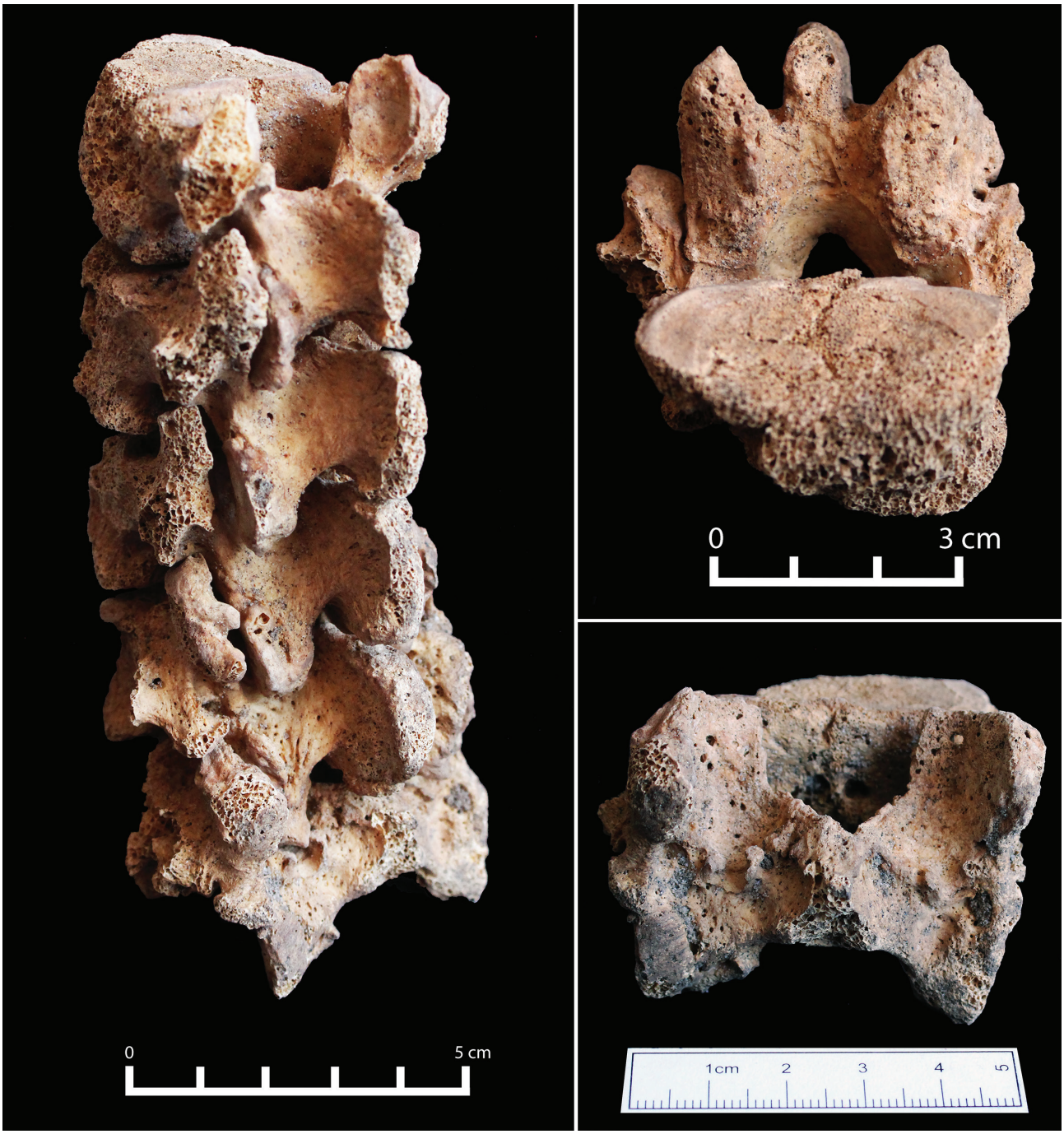


Figure 19.46. Left: degenerative changes to the superior and inferior facets of lumbar vertebrae L1–L5 of SK 2613. Top right: the inferior view of L4. Bottom right: the superior view of L5

The bones are therefore scored at grade 2 (Brickley and McKinley 2004).

The full skeletal inventory of SK 2638 is shown in Table 19.35, with a visual representation in Figure 19.51. Archaeological excavation of this inhumation recovered the majority of the smaller skeletal bones in full articulation, indicating the composite skeleton was at least partially fleshed (mummified) when buried. Two cremated bone fragments were also identified from the grave fill (2598) for SK 2638.

The skull of SK 2638 is well-preserved, with some damage to the zygomatic bones and processes. The internal nasal bones appear to be intact with the exception of the ethmoid and vomer, which are absent. The mandible is missing part of the left mandibular ramus and condyles. Both scapulae were recovered, though the lateral borders of the scapulae are missing. Fragments of the manubrium and sternal body were identified, along with fragments of the rib shafts and 11 right and seven left rib heads. The upper limbs are in very good condition, with only the right radial head and styloid process of the left ulna absent.

All of the cervical, thoracic and lumbar vertebrae were identified; although a number of the spinous and transverse processes had separated within the burial environment,

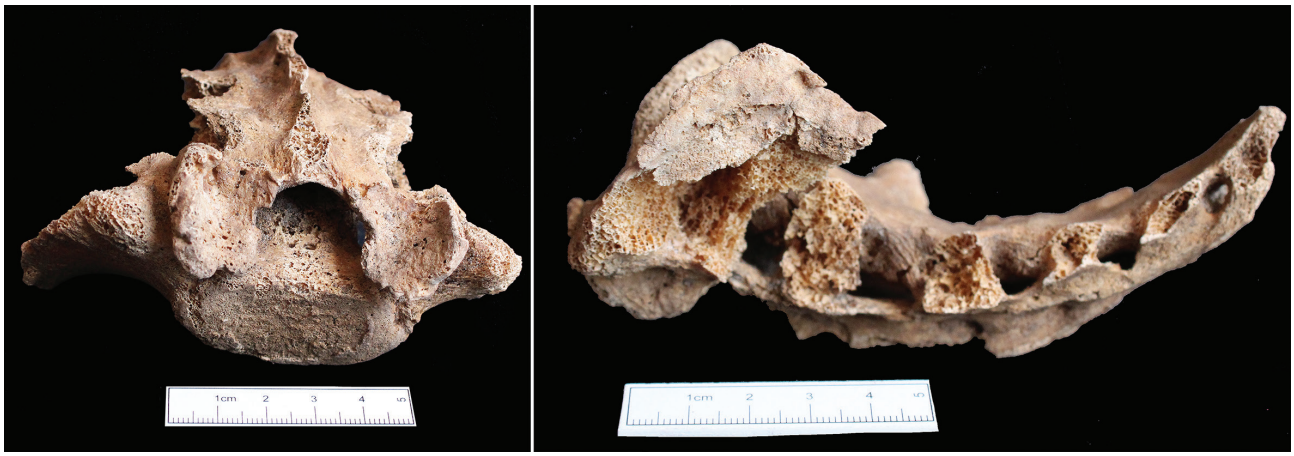


Figure 19.47. Left: degenerative changes on the superior articular facets of the sacrum of SK 2613; right: the right auricular surface of the sacro-iliac joint

Figure 19.48. Extensive lipping to both left and right distal femoral condyles of SK 2613, resulting in extensive eburnation on the lateral condyles with polish and porosity to the joint surface

these had clearly been fused at the time of death. Only a small fragment of the first sacral vertebra was noted, the remainder of the sacrum being either too fragmented for identification or not recovered. The superior portion of the ilia and the pubic bones from both left and right pelvises were not recovered. The lower limbs have some surface damage to the proximal and distal ends, which has rendered them brittle. The majority of the bones from the hands and feet were recovered, with the greater part of the carpals and tarsals identified. The only elements that are underrepresented are those of the intermediate and distal phalanges of the hands and the feet.

Interestingly, the left fibula does not match the right fibula: the right fibula has a much smaller articular facet for the talus and exhibits some signs of lipping on its borders. The left side, on the other hand, is very robust with no pathological lesions. This would not be unusual except that the right side is in much poorer condition in terms of preservation, with brittle ends, while the left side is very solid and in great condition. The differences in size, robustness and preservation indicates that one of these fibulae may not derive from individual #3.

The dentition is in good condition (Figure 19.52). The majority of the mandibular teeth are present, with heavy

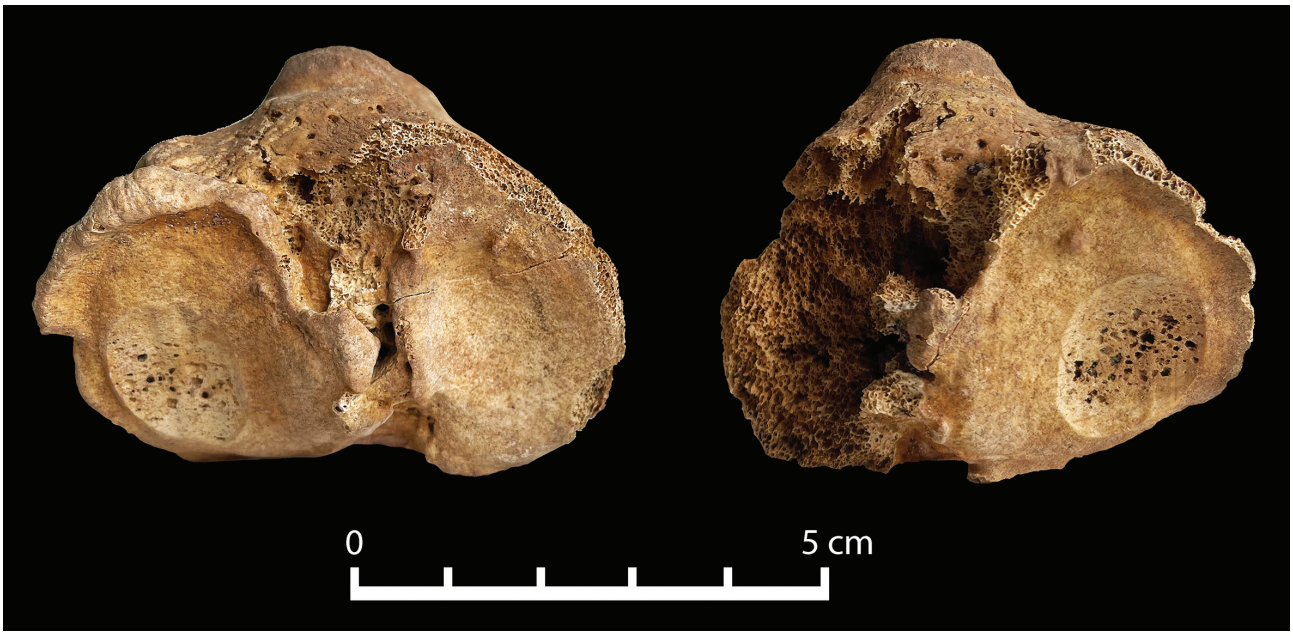


Figure 19.49. Extensive lipping to both left and right proximal tibial lateral condyles of SK 2613, resulting in extensive eburnation with polish and porosity to the joint surface

Figure 19.50. Degenerative changes on the left calcaneus and the drainage hole (and eburnation) on the left cuboid of SK 2613

wear to most of the occlusal surfaces, while most of the maxillary teeth were lost *ante mortem*. The only tooth that is present is the upper right canine as the lateral incisor was lost *post mortem*. The left M_2 was sent for isotopic sampling.

Since SK 2638 is a composite of at least three individuals, age at death can only be assessed based on the skeletal elements attributed to each separate individual. In addition to the methods previously discussed to determine age at death (see 'SK 2613', above), the fusion of the medial epiphysis of the clavicle (Owings 1981; Owings Webb and Myers Suchey 1985) was also used to determine age.

Age of individual #1 – the cranium: Most of the cranial sutures are clearly unfused/open. Results from scoring the ectocranial vault is 4, which indicates an age range of 22–48 years, with an average age of 34.7 years. The result from scoring the lateral-anterior sites is 2, indicating an age range of 25–49 years, with an average of 36.2 years. This provides an overall age range of 22–49 years (average 35.5 years) and places the skull in the young to mature adult age category. Determining age based on the maxillary teeth is not possible as the majority were lost *ante mortem* (and may have been deliberately extracted at any age rather than lost due to dental conditions) and the right C and I^2 were lost *post mortem*.

Age of individual #2 – the mandible: The degree of occlusal wear on the mandibular molars was recorded using Miles' (1962) method. The left and right M_1 indicate an age range of 34–39 years while the right M_2 and M_3 are 29–34 years each. The left M_3 is more worn than the right and provides an age range of 43–48 years. This gives an overall age range of 29–48 years with an average of 38.5 years. This places individual #2 into the mature adult age category.

Age of individual #3 – the post-cranial skeleton: Age-degenerative changes to the auricular surface of the pelvis are similar to those from stages 5 and 6 (Lovejoy *et al*. 1985) in which the striae are almost completely absent with a marked loss of transverse organisation and a replacement of dense bone. Slight changes at the apex have occurred, with increased irregularity of the margins and slight retro-auricular activity. These phases suggest an age range of 40–49 years (mean age of 44.5 years), placing these skeletal elements in the mature adult age category. Buckberry and Chamberlain's method (2002) produces a composite score of 10, placing SK 2638 in stage III with an age range of 16–65 years (mean of 37.9 years), also in the category of mature adult.

The three individuals predominately fall into the mature adult category (Table 19.36), indicating a deliberate

Table 19.35. Skeletal inventory of SK 2638 whereby '√' indicates that the bone is present, and a blank square indicates that the bone is absent/not identified

CRANIUM									
Bone	*L*	*R*	*Bone*	*L*	*R*	*Bone*	*Present*	*Absent*
Parietal	√	√	Maxilla	√	√	Ethmoid		
Temporal	√	√	Mandible	√	√	Vomer		
Occipital	√	√	Nasal			Sphenoid	√	
Frontal	√	√	Lacrimal			Aud. ossicles	L incus	
Zygomatic/malar			Inf. nasal concha			Hyoid	√	
Palatine								

AXIAL															
Bone	*Present*	*Absent*											*Bone*	*Present*	*Absent*
Manubrium	√												Sternum	√	
Ribs (right)	1	2	3	4	5	6	7	8	9	10	11	12	#?:		
Ribs (left)	~~1~~	2	3	4	5	6	7	8	~~9~~	~~10~~	~~11~~	~~12~~	#?:		

VERTEBRAE														
	1	2	3	4	5	6	7	8	9	10	11	12	#?	Total
Cervical	√	√	√	√	√	√	√							7
Thoracic	√	√	√	√	√	√	√	√	√	√	√	√		12
Lumbar	√	√	√	√	√									5
Sacrum	√													1
Coccyx														0

UPPER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Scapula	√	√	Scaphoid		√	Trapezium	√	√
Clavicle	√	√	Lunate	√	√	Trapezoid	√	√
Humerus	√	√	Triquetral	√	√	Capitate	√	√
Ulna	√	√	Pisiform	√		Hamate		√
Radius	√	√						

HAND												
Bone	*Left*					*Right*					*No side*	*Total*
Metacarpal	1	2	3	4	~~5~~	1	2	3	4	5	0	9
Proximal phal.	1	~~2~~	~~3~~	4	5	~~1~~	~~2~~	~~3~~	4	5	2	7
Intermediate phal.		2	3	4	~~5~~		2	3	4	~~5~~	1	7
Distal phal.	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	6	6

LOWER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Ilium	√	√	Tibia	√	√	Cuneiform med.	√	√
Acetabulum	√	√	Fibula	√	√	Cuneiform inter.	√	√
Ischium	√	√	Talus	√	√	Cuneiform lat.	√	√
Pubis	√	√	Calcaneus	√	√			
Femur	√	√	Cuboid		√			
Patella	√	√	Navicular	√	√			

FOOT												
Bone	*Left*					*Right*					*No side*	*Total*
Metatarsal	~~1~~	2	3	4	5	1	2	3	4	5		9
Proximal phal.	1	2	3	4	5	1	2	3	4	5		
Intermediate phal.		2	3	4	5		2	3	4	5		
Distal phal.	1	2	3	4	5	1	2	3	4	5		1

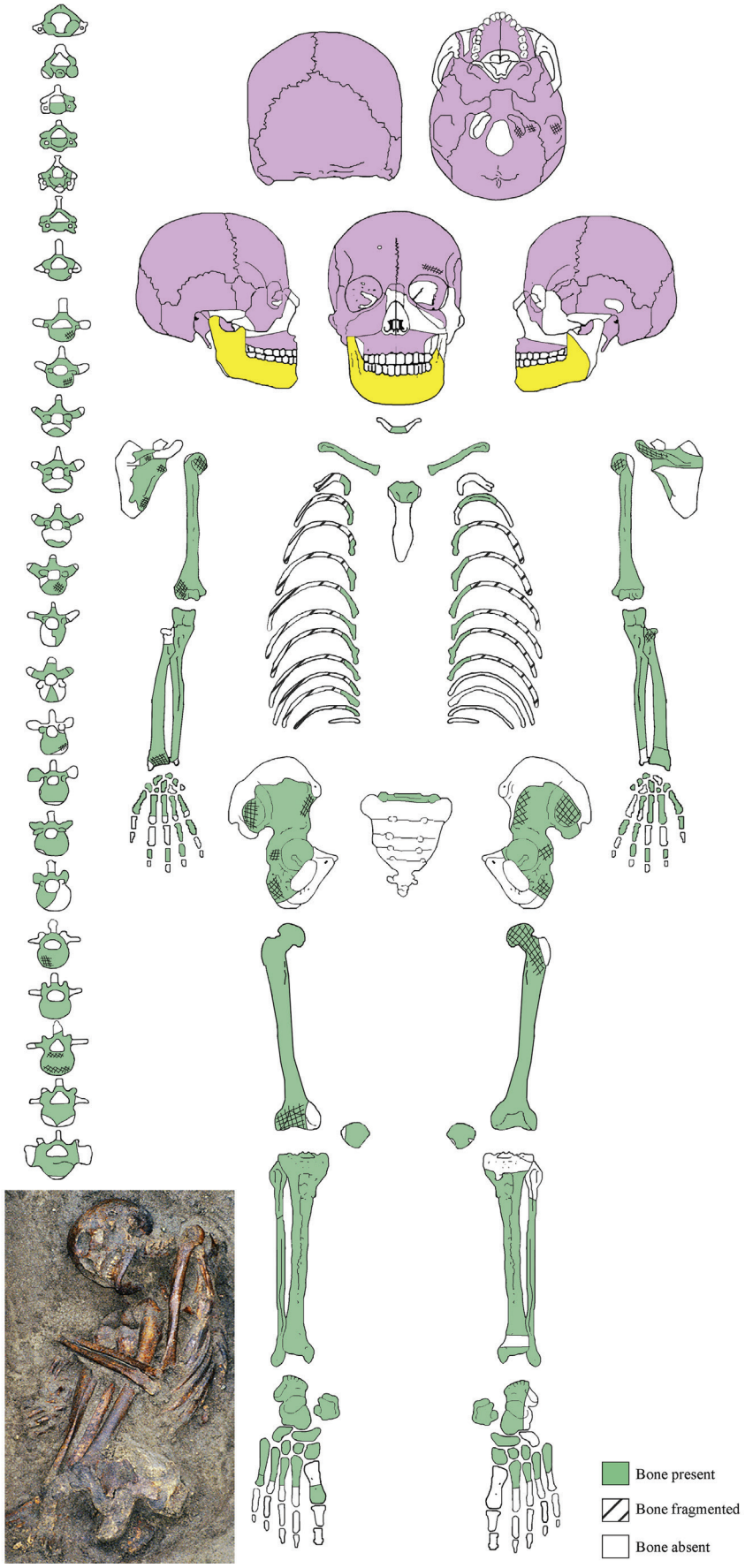


Figure 19.51. The visual skeletal inventory of SK 2638 indicating the presence (coloured) and absence (uncoloured) of bones. As this is a composite skeleton of at least three individuals, the first individual is coloured purple while the second individual is coloured yellow. Green indicates bones which belong to at least one more individual

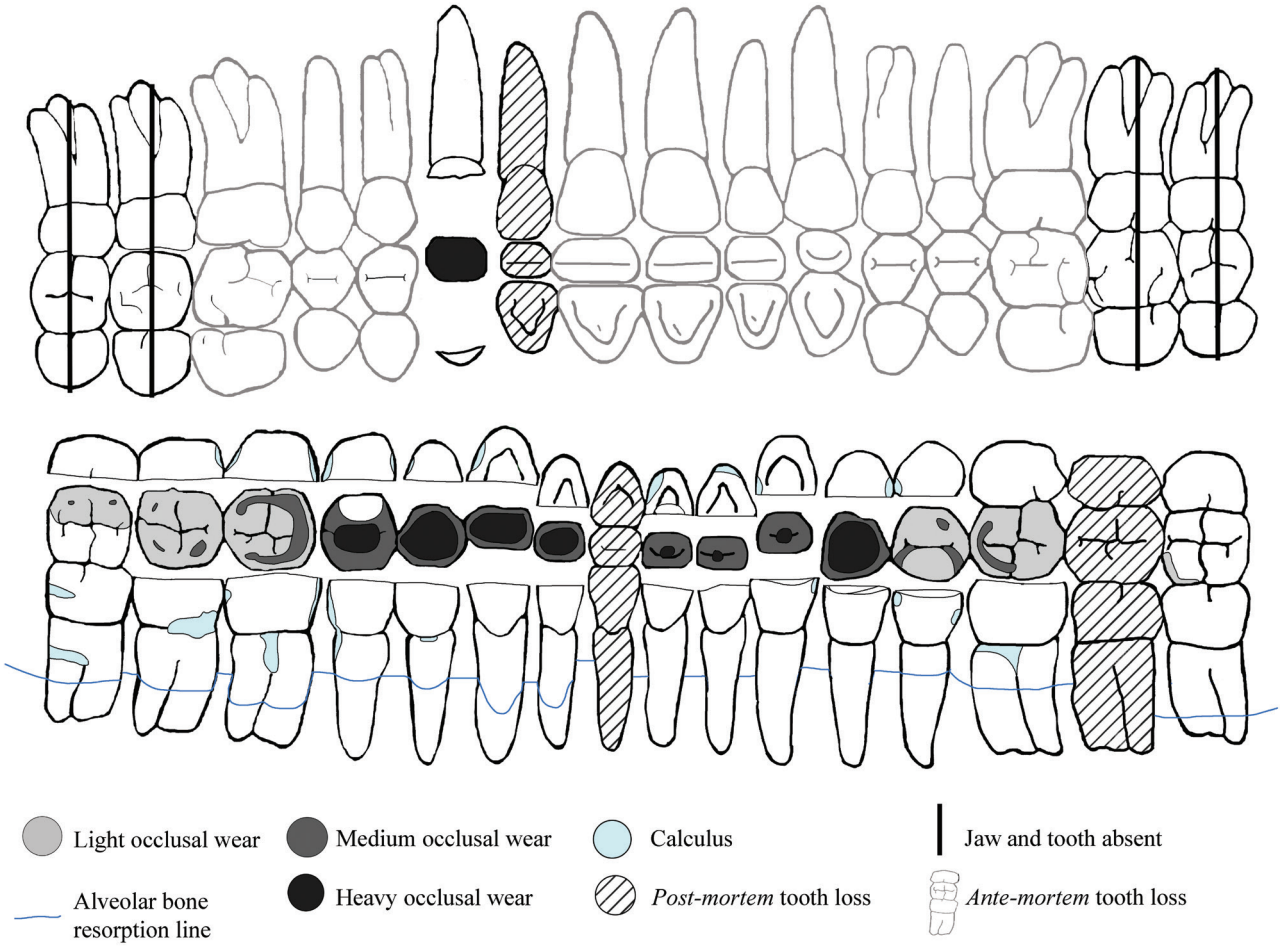


Figure 19.52. The visual dental inventory of SK 2638

selection of same-aged individuals to create the composite inhumation of SK 2638.

Sex of individual #1 – the cranium: The cranium is in very good condition, with the majority of all morphological characteristics present. However, sex is rather ambiguous since both male and female traits are observed. Female traits include slight temporal ridges, a small external occipital protuberance of a small nuchal area, and slight supraorbital ridges. Male traits are the inclined frontal slope of the cranium, the prominent glabella, the rounded quadrangular orbital outlines, very large and vertical mastoid processes, and absent frontal and parietal tuberosities. The overall shape of the cranium is gracile: although this is a typically female trait, Bronze Age males are also known to have had gracile skeletal bones. As there are more male features than female, the cranium has been assessed as belonging to a probable male.

Sex of individual #2 – the mandible: The mandible is 'male' in that the mandibular ramus is broad and slightly flexed at the level of the molars, the mental eminence is large and projecting, and the lower margin of the mandible is thick. The only female trait is the obtuse angle of the mandible.

Sex of individual #3 – the pelvis: Surface erosion on the pelvis has affected most of the morphological sites used to record sex; however, the narrow and acute sciatic notch, the absent preauricular sulcus, the wide auricular surface, and the large lateral acetabulum indicate a male individual.

Discriminant functions were also used to determine the biological sex of SK 2638. Using the method of Steele

Table 19.36. Summary of results from determining age at death of SK 2638

Individual	Element	Age range	Age category
Individual #1	Skull	22–49 years (average: 35.5 years)	Young to mature adult
Individual #2	Mandible	29–48 (average: 38.5 years)	Mature adult
Individual #3	Auricular surface: method 1	40–49 years (average: 44.5 years)	Mature to older adult
	Auricular surface: method 2	16–65 years (average: 37.9 years)	Young to mature adult

and Bramblett (1988:227), measurements of the femoral head revealed that the left side (44.76mm) is 'male' while the right side (46.82mm) is 'female'. The measurements of the humeral heads (*ibid.*: 164) reveal that both the left (37.53mm) and the right side (39.65mm) are 'male'. The measurement of the femoral bicondylar width (Bass 1971: 173) reveals that the left side (79.91mm) is also 'male'. The combined data from the femur and humerus, therefore, indicate that the long bones are those of a male.

In summary, biological sex from the composite three individuals of SK 2638 are all male, with only one instance of a female measurement on the right femoral head (Table 19.37).

The stature of SK 2638 can only be determined on the long bones, which are currently attributed to individual #3; stature for the other individuals making up this composite skeleton cannot be determined. Measurements of the long bones were taken and, using the charts developed by Trotter and Gleser (1952), the combined average was calculated (Table 19.38). Individual #3 was approximately 167.4cm (5ft 5in) tall.

The non-metric traits observed on the cranium of SK 2638 consist of a metopic suture, both left and right supraorbital notches, supraorbital foramen, infraorbital sutures and parietal foramen (see Table 19.18). Also noted was a left zygomatico-facial foramen, a right asterionic bone and a mastoid foramen present at the occipito-mastoid suture. These non-metric traits are different from those observed on SK 2613 and may indicate the lack of a genetic link between the two individuals who provided the skulls. An accessory transverse foramen was also observed in the vertebrae, a trait which is also shared with SK 2792.

Pathology of individual #1 – the maxilla: The maxilla is mostly complete except for the alveolar bone containing both left and right M^3 which was not recovered. The right I^2 was lost either *peri* or *post mortem*, the right maxillary canine is present but heavily worn, and the remaining maxillary teeth were all lost *ante mortem* with complete resorption to the alveolar bone (Figure 19.53). The loss of teeth during individual #1's life could have been through decay, trauma and/or deliberate extraction.

Pathology of individual #2 - the mandible: The mandible is mostly complete, with only the left M_2 and right I_1 lost *post mortem* (Figure 19.54). Dentine exposure due to heavy

Figure 19.53. Ante mortem *tooth loss and almost complete alveolar resorption of the maxilla of SK 2638, except for the right canine and the lateral incisor which was lost* post mortem

Figure 19.54. Dentine exposure on the mandibular incisors and canines from SK 2638

Table 19.37. Summary of the results from determining biological sex

Individual	Element	Sex: right side	Sex: left side
Individual #1	Skull	Male	
Individual #2	Mandible	Male	
Individual #3	Auricular surface	Male	Male
	Femoral heads	Female	Male
	Femoral bicondylar width	Male	Male
	Humeral heads	Male	Male

Table 19.38. Stature estimation of Individual #3 from SK 2638

Bone	Measurement	Male stature
Left humerus	303	164cm
Right humerus	306	165cm
Right ulna	271	174cm
Left radius	245	171cm
Right femur	446	167.5cm
Left tibia	358	169cm
Right fibula	335	161.5cm
	Average	*167.4cm*

tooth wear is observed on the incisors and canines, with little occlusal wear to the molars, suggestive of a repetitive activity utilising only the front teeth. Slightly heavier tooth wear was noted on the left side of the mandibular teeth, indicative of preferential chewing on the left side.

Slight calculus is noted around the base of the molar crowns but a complete lack of calculus on the occlusal surfaces indicates continued mastication with the corresponding maxillary molars. However, the maxillary molars (as noted above) were lost quite a while before death and could not have removed calculus from the occlusal surfaces of the mandible molars. Therefore, the two jaws have incompatible dentitions, indicating that they derive from two different individuals: the mandible required a functioning maxilla with complete upper dentition in order to wear down its surfaces and to maintain occlusal hygiene of its lower teeth.

Pathology of individual #3 - the post-cranial elements: There is slight periostitis on the left and right sternal ends of the clavicle and around the right glenoid fossa of the scapula, new bone formation on the left and right crease of the acetabulum but no corresponding lesions on the femoral heads, and slight lipping on the auricular surface for the talus on the distal right fibula.

There is a small bony growth on the left medial femoral condyle measuring 20.21mm × 13.49mm × 3.28mm, while on the right medial femoral condyle there is a concave facet measuring 17.66mm × 10.90mm × 3.85mm (Figure 19.55).

Osteoarthritis is observed from C3 to C7, T3–T6, T8, T12 and L1–L2 (Figure 19.56). Schmorl's nodes are present on both superior and inferior surfaces of L1–L3 vertebral bodies, with the largest on T11 measuring 27.38mm long × 17.42mm wide × 3.25mm deep, and on L2 measuring 15.43mm long × 7.07mm wide × 4.14mm deep. There is also some extensive bone remodelling on the right costal rib facet of T12.

Figure 19.55. A small bony growth on the left medial condyle and a concave facet on the right medial condyle from SK 2638

Figure 19.56. Examples of osteoarthritis in the spinal column of SK 2638: left is a Schmorl's node on L2. Top right is degenerative changes in C5. Bottom right is another Schmorl's node on T11

Skeleton SK 2727

The crouched remains of SK 2727 were recovered from the northeast quadrant underneath the floor of House 401 (see Volume 1: fig. 4.11). SK 2727 is an older child (10–14 years), probably female, and is dated to *1160–1005 cal BC* (at 95% probability; weighted mean of AA-49343, 2845±50 BP and AA-52514, 2940±40 BP). This child's body was not preserved and the death of SK 2727 is modelled as occurring *1–140 years (at 95% probability)* before the construction of the house floor (1311) beneath which it lies (see Volume 1: 444); the child may therefore have been newly deceased when it was buried, presumably as a foundation burial for House 401.

SK 2727 is a single inhumation with no repeating skeletal elements and the morphology of the bones is consistent with them all belonging to the same individual. The burial also contained one disarticulated radial head of an unknown adult. The skeletal remains are in relatively poor condition, with heavy erosion and some root damage across the surfaces of the bones. The poor condition is due to the burial's greater absolute depth (at 3.40m OD) compared to the other burials which has caused it to be continuously saturated with rising ground water during the winter months. The bones are extremely fragile and crumble to the touch. As a result, the bone structure is scored at grade 5 according to the BABAO standard (Brickley and McKinley 2004).

A full skeletal inventory of SK 2727 was compiled (Table 19.39), along with visual representations of the bones (Figure 19.57) and teeth (Figure 19.58). Despite the fragmentary condition of the bones, all the major skeletal elements were identified.

The frontal and lower occipital cranial bones (including the left greater wing of the sphenoid) are mostly complete; however, the parietal, temporal and upper occipital bones are severely fragmented. The top of the cranium, including the left and right parietal with the sagittal suture (71.9mm by 69.7mm; SF 4352) was recorded separately during excavation before it was evident that it belonged to SK

Table 19.39. The skeletal inventory of SK 2727 whereby '√' indicates the bone is present; 'frag' indicates the bone is too fragmented for side identification; and a blank square indicates the bone is absent

CRANIUM								
Bone	*L*	*R*	*Bone*	*L*	*R*	*Bone*	*Present*	*Absent*
Parietal	√	√	Maxilla	√	√	Ethmoid	frag	
Temporal	√	√	Mandible	√	√	Vomer	frag	
Occipital	√	√	Nasal	frag	frag	Sphenoid		
Frontal	√	√	Lacrimal	frag	frag	Aud. ossicles		
Zygomatic/malar			Inf. nasal concha	√	√	Hyoid		
Palatine	frag	frag						

AXIAL																
Bone				*Present*				*Absent*						*Bone*	*Present*	*Absent*
Manubrium														Sternum		
Ribs (right)	1	2	3	4	5	~~6~~	~~7~~	~~8~~	~~9~~	~~10~~	~~11~~	~~12~~	#?: frags			
Ribs (left)	1	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	~~8~~	~~9~~	~~10~~	~~11~~	~~12~~	#?: frags			

VERTEBRAE														
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*#?*	*Total*
Cervical	√	√	√	√	√	√	√							7
Thoracic													7	7
Lumbar		√		√										2
Sacrum	√	√												2
Coccyx														0

UPPER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Scapula		√	Scaphoid			Trapezium		
Clavicle	√	√	Lunate			Trapezoid		
Humerus	√	√	Triquetral			Capitate		
Ulna	√	√	Pisiform			Hamate		
Radius	√	√						

(Continued)

Table 19.39. Skeletal elements from SK 2727 whereby '√' indicates the bone is present; 'frag' indicates the bone is too fragmented for side identification; and a blank square indicates the bone is absent (Continued)

HAND									
Bone	*Left*					*Right*					*No side*	*Total*
Metacarpal	1	2	3	4	5	1	2	3	4	5		0
Proximal phal.	1	2	3	4	5	1	2	3	4	5		0
Intermediate phal.		2	3	4	5		2	3	4	5		0
Distal phal.	1	2	3	4	5	1	2	3	4	5		0

LOWER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Ilium	√	√	Tibia	√	√	Cuneiform med.	√	√
Acetabulum	√	√	Fibula	√		Cuneiform inter.		√
Ischium	√	√	Talus	√	√	Cuneiform lat.		√
Pubis			Calcaneus	√	√			
Femur	√	√	Cuboid	√				
Patella	√	√	Navicular	√	√			

FOOT												
Bone	*Left*					*Right*					*No side*	*Total*
Metatarsal	1	2	3	4	5	1	2	3	4	5	frags	-
Proximal phal.	1	2	3	4	5	1	2	3	4	5		0
Intermediate phal.		2	3	4	5		2	3	4	5		0
Distal phal.	1	2	3	4	5	1	2	3	4	5		0

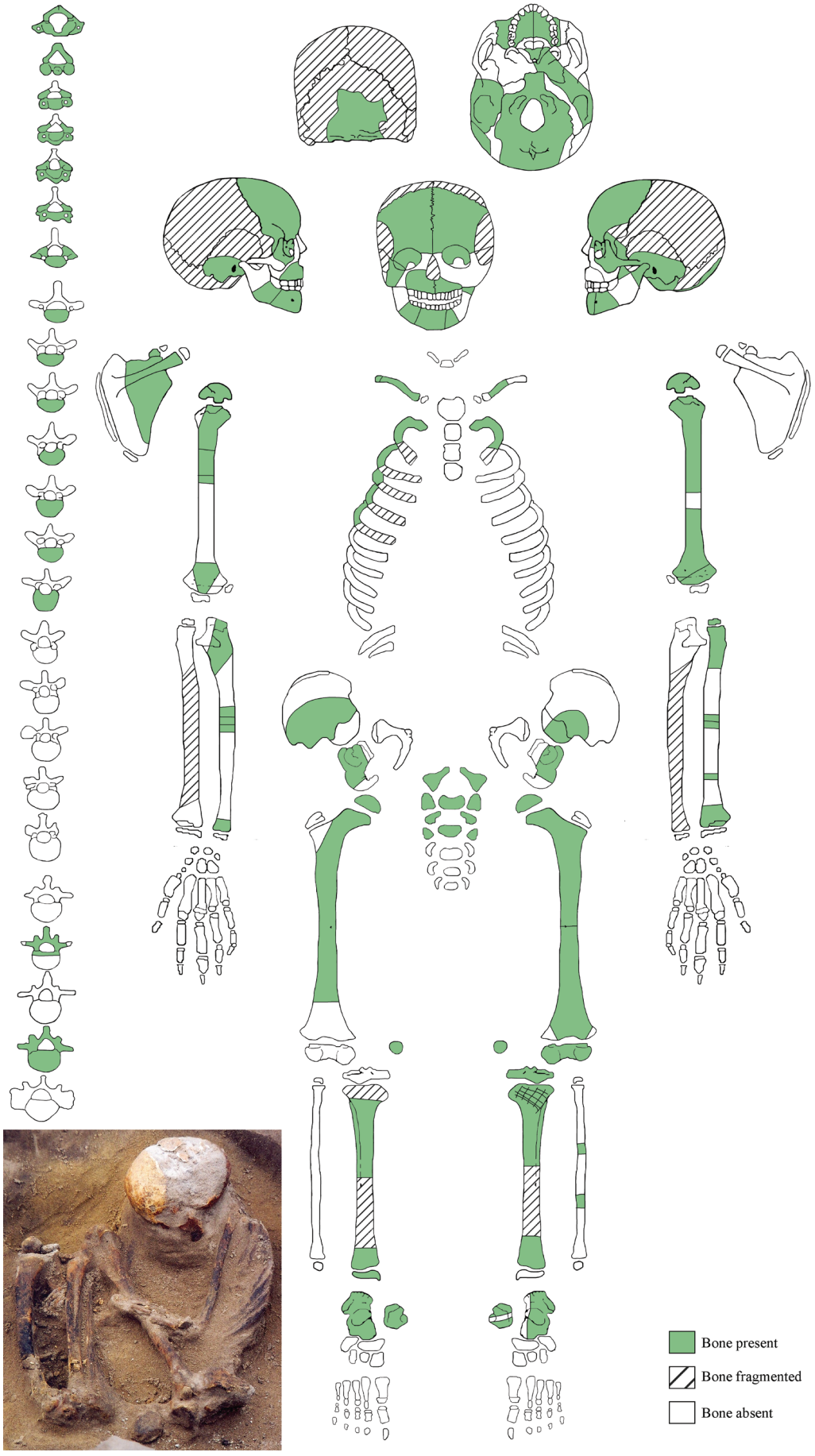


Figure 19.57. The visual skeletal inventory of SK 2727 indicating the presence (coloured) and absence (uncoloured) of bones

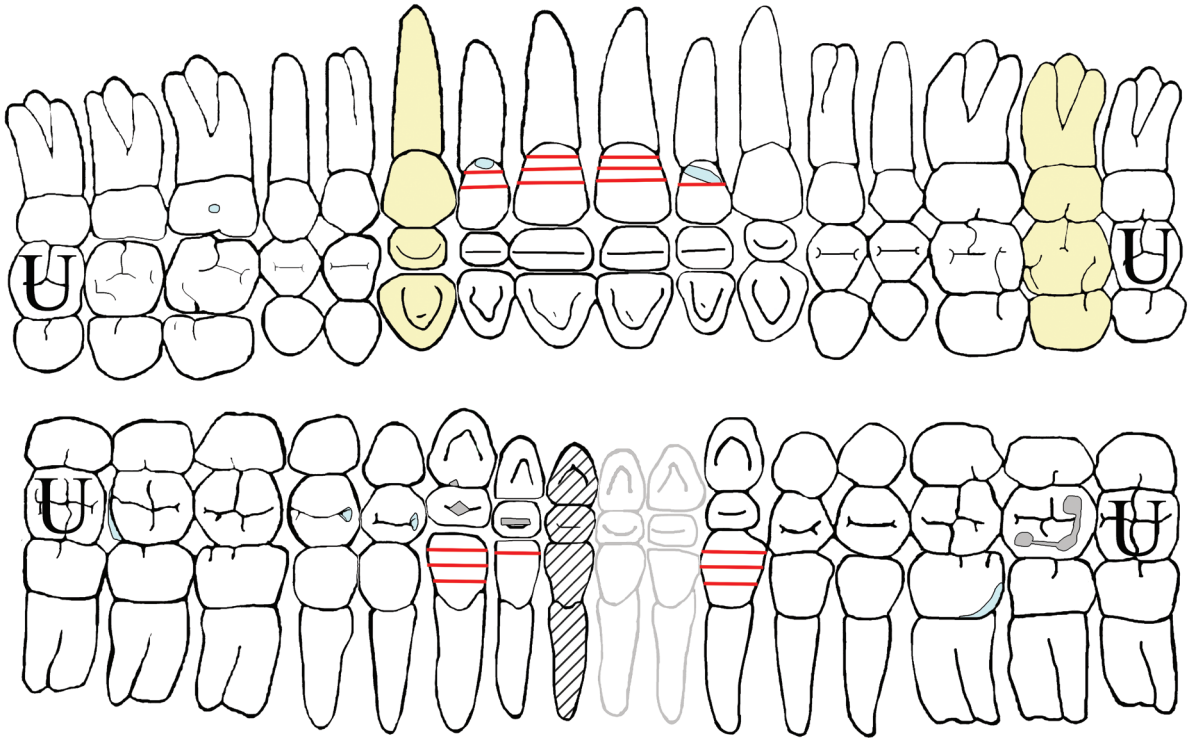


Figure 19.58. The visual dental inventory of SK 2727; for the key, see Figure 19.22

2727. The dentition of SK 2727 is in excellent condition, with only the left M^2 and the right I_1 lost *post mortem* and the left I_1 and I_2 lost *ante mortem.*

The axial skeleton consists of fragmented rib shafts with an additional single left and five right rib heads, and fragments of the unfused ilium and ischial bones. Only a large fragment of the right scapula, consisting of the glenoid fossa, the diaphysis of the coracoid process, and the superior portion of the blade, was identified, in addition to both left and right shafts of the clavicle. Most of the vertebral column consists of crumbling and fragmented bodies. The cervical vertebrae are in the best condition and all seven are represented. The thoracic vertebrae are difficult to place in numerical order, but seven individual bodies exhibiting rib facets were identified. Only two lumbar vertebrae were identified, of which L4 is intact. The first two segments of the sacrum were recovered, with no fusion between S1 and S2. The pelvis is unfused and consists of portions of both left and right ilia and ischia.

The long bones are extremely fragmented, with the proximal unfused epiphyses and fragmented diaphyseal shaft bones of the humeri identified. The right radius and the left ulna survive only as small fragments; however, the left radius (consisting of the unfused proximal epiphysis and fragments of the diaphysis) and the right ulna (consisting of fragments of the diaphysis and the unfused distal epiphysis) are mostly intact. The unfused proximal and distal epiphyses, and an almost complete diaphyseal shaft of the left femur were noted, along with the unfused proximal head and proximal diaphyseal shaft of the right femur. Both left and right patellae were recovered and are complete. The left unfused proximal epiphysis and both distal unfused epiphyses of the tibiae are identifiable while the diaphyseal shafts are fragmented. Small fragments of the left fibular shaft were noted. The phalanges, metatarsals and metacarpal bones of the hands and feet were difficult to identify or assign anatomical siding with confidence due to their fragmentary condition. There are no carpal bones but the majority of the tarsal bones were identified.

Age at death is estimated from long bone length, the rate of bone fusion and by tooth development (Table 19.40). Long bone length was used, in combination with other methods, to provide an estimation for age at death. The left humeral diaphyseal length is 244mm, which is 9.5–10.5 years of age (Ubelaker 1985; Hoppa 1992). The left diaphyseal femur is 313mm, giving a younger estimate of 8–10 years; however, this lower age may be due to the fragmented condition of the bone, resulting in a skewed measurement and should be discounted.

The normal stage for the fusion of hip bones during childhood development is 13–15 years of age; however, the hip bones of SK 2727 are unfused so are indicative of being younger than 13 years old (Schwartz 1995). The humeral diaphyseal shaft is unfused to the distal epiphysis and, as this bone typically fuses between 14–15 years of age, it is indicative of SK 2727 being younger than 14 years old. The right clavicle, though broken in two, provides a measurement of just over 102.21mm, providing an age estimation of 10–11 years (Black and Scheuer 2001: 252).

Table 19.40. Summary of results from determining age at death of SK 2727

Element	Measurement	Age of fusion	Age range
Left diaphyseal humerus	244mm	-	9.5–10.5 years
Right clavicle	102.21mm	-	10–11 years
Unfused hipbones	-	13–15 years	<13 years
Distal humerus	-	14–15 years	<14 years
Permanent M_2	-	-	12 years ± 36 mos
Permanent M_2	-	-	12.5–13.5 years

SK 2727 has erupted second permanent mandibular molars and a broken opening in the alveolar bone above the developing crown for the third molar, placing the stage of dental development of SK 2727 at 12 years ± 36 months (Ubelaker 1989) and 12.5 to 13.5 years (AlQahtani 2009; see also Figures 19.60–19.61). In combining all the age estimates, SK 2727 was approximately 10–14 years of age and is an older child–young juvenile.

Assessing the biological sex of pre-pubescent individuals is problematic because many of the morphological indicators used to determine sex have not yet fully developed and are often inconsistent when taking into consideration the varying growth rates between males and females. However, whilst the degree of skeletal fragmentation of the skull and pelvis of SK 2727 inhibits any reliable analysis, the angle of the mandible (Schwartz 1995) is obtuse and smooth-edged while the lower margin of the mandibular corpus (Feremback *et al.* 1980) is thin. The shape of the maxillary palate (Schwartz 1995) is small and short and contains a parabolic arch. Based on the morphological observations of the mandible and maxilla, SK 2727 is a probable female.

SK 2727 has very few visible non-metric traits but this may be due to the degree of fragmentation to the skull. SK 2727 has a right supraorbital notch, a left and right bregmatic bone and condylar canal, a left flexure of the sagittal sulcus, and a single mental foramen (see Table 19.18). Very minor porosity in the left eye orbit (Figure 19.59) suggests cribra orbitalia, a condition most frequently attributed to anaemia (iron deficiency). Corresponding porosity was not observed in the right eye orbit.

Figure 19.59. Mild porosity in the left orbital bone (circled in red) of SK 2727 potentially indicating cribra orbitalia

Evidence of enamel hypoplasias, which are linear lines formed by the arrest of developing adult teeth during times of childhood stress (*e.g.* war or famine) or malnutrition, is visible, on the left and right maxillary first incisors (Figure 19.60) and on both mandibular canines (Figure 19.61). Two enamel hypoplasias are noted on the right maxillary lateral incisor, and one enamel hypoplasia on both the left maxillary lateral incisor and on the mandibular right lateral incisor.

Other dental conditions consist of *ante mortem* tooth loss of the first and second left mandibular incisors which has resulted in completed alveolar resorption of the tooth sockets. As a result, the crown of the left canine slanted medially towards the resorbed alveolar bone (Figure 19.61). There is slight wear on the maxillary front lingual teeth with corresponding wear on the mandibular buccal teeth due to the teeth continuously coming into contact with each other during mastication. There are also small deposits of calculus noted on seven maxillary and mandibular teeth (see Figure 19.58).

Figure 19.60. The enamel hypoplasias on the maxillary labial teeth of SK 2727 as indicated by the red dashes

Figure 19.61. The enamel hypoplasias on the mandibular labial teeth of SK 2727 as indicated by the red dashes

The disarticulated bones

Disarticulated unburnt human bones were recovered from a wide variety of contexts across the site such as within wall cores, on the surface of the forecourt, in a stone cist and in pit fills (Table 19.42). Fragments of cremated human remains, discussed above, were also recovered within House 1370 and beneath House 801, outside the entrance to House 1370 and Structure 2477. The cremated bones are almost certainly all from Phase 3, probably disturbed or dispersed during activity in Phase 8 (Table 19.43). Similarly, the unburnt individuals represented by the disarticulated bones probably did not all die during Phase 8, rather their bones/bone fragments are associated with either the activity taking place during this phase or with artefacts that have been radiocarbon-dated (see Table 19.1). It is for this reason that the minimum number of individuals cannot be counted within each phase, but rather calculated overall on repeated skeletal elements or age/sex differences.

The double pit (2551)

Referred to as the 'cremation pit' during excavation, this double pit (2551=2508=2553) is later than the Phase 3 cremation platform (3558) outside the entrance to House 1370 (fig. 4.30 in Volume 1). It cut through the cremation platform and is treated as part of Phase 8 activity (the construction of the row of roundhouses). Potentially, the pit was first dug at any time during Phases 6–8 for the first burial of individual #2 of SK 2613. The history of the post-cranial female individual #2 is complex (see Volume 1: 95–100, 435–6, 443). She died *1300–1125 cal BC* but the body was preserved. The date at which the preserved body was buried is provided by radiocarbon-dated material from the fills of her grave, pit 2551. The pit was then recut in Phase 8, *110–200 years (at 68% probability)* after her burial, when the 'mummy bundle' was exhumed. The post-cranial skeleton was then reburied in pit 2612 in Phase 8, with the skull of another individual, before the laying of the floor of House 1370. The Phase 8 recut of pit 2551 created a feature that is referred to in the site stratigraphy as a 'double pit' (see Figure 19.3; Volume 1: fig. 4.30).

As described above (see *Post mortem manipulation*), during the exhumation of post-cranial SK 2613 from pit 2551, the left knee joint (the distal femur and proximal tibia) was snapped off the preserved body and remained, still in articulation, within pit fill 2748, along with the intermediate phalanx of the foot (SF 4752) and a cremated first cervical vertebra (atlas) fragment. Artefacts from fill 2748 of the double pit consist of a complete bone pin (SF 4753), recovered next to the knee joint, and a complete pumice rubber (SF 5064), both of which may be from the original burial, left behind when the preserved post-cranial skeleton of SK 2613 was exhumed. Note that it is impossible to know whether the skull of SK 2613 (from

individual #1; date of death *1435–1260 cal BC*) was buried in pit 2511. The creation of the composite body may have happened before this first burial (while the preserved bodies were curated above ground), or during the burial in the grave pit, or not until the final deposition below House 1370 in Phase 8. The depositional history of the skull has to remain an open question. A moderate quantity of pottery was also recovered in pit fills 2746 and 2748 but they do not form any substantial portions of a complete vessel, so it is unknown if these sherds should be considered grave goods.

Approximately 300mm above, in pit fill 2732, the patella of the left knee joint was recovered, with the broken-off distal end of the right radius. Within the final fill of the pit (2554; above fill 2732) a left proximal diaphyseal femur of a foetus was recovered within dispersed cremated bone fragments. The cremated remains are probably redeposited from the adjacent Phase 3 pyre debris. In total, 15.8g of cremated bone from adult crania, left distal radius, ulna, humerus, 12th rib, fibula and unidentifiable long bones/ spongy bones are identified.

House 1370

Located southwest of the central hearth, pit 3377 (fill 3378) contained a bone disc, broken polished stones, a sherd, clay, animal bones and a cremated cranial fragment (SF 5227). Other small features throughout the house also revealed other cremated bone fragments of an unerupted right permanent premolar of a young to older child (SF 5103), an unidentifiable long bone fragment (SF 5105), a cranial fragment (SF 5107) and a fragment of a femoral shaft (SF 5108).

House 401

During Phase 8, a stone-lined and slab-covered cist (2105) was constructed at the entrance to House 401. The cist was almost filled to the top with sand and only a few animal bone fragments and two fragments of human bone were recovered: a scapula (SF 4909) and an unfused distal epiphysis of an intermediate phalanx (SF 4617) belonging to an older child. The scapula dates to *1160–995 cal BC* (AA-48602; 2865±55 BP) and has an unusually low $\delta^{15}N$ value of 5.9, consistent with herbivores. Originally identified as a human scapula prior to sampling, the stable isotopic results raised the possibility that it was mis-identified, and it was decided to err on the side of caution and label the scapula as animal. However, the scapula was identified by Prof. Andrew Chamberlain and it is entirely possible that some people during the Bronze Age consumed little or no animal protein, so the scapula should be considered as 'human'.

House 801

An adult left malar bone of a possible female was deliberately deposited within the wall core at the west end of House 801. The bone, along with a large quantity of other artefacts (considered to be refuse) was associated with a deer tibia which is dated to *1190–1040 cal BC* (SUERC-10803; 2850±35 BP).

Most of the upper layers of the Phase 6 pit 2543 (recut as pit 2446) were removed by pit 1792 during Phase 8. Fill 2428 of pit 1792 contained a fragment of an adult thoracic vertebra and acetabulum, as well as a right proximal ulna of a possible male adult.

Phase 9 (1075–1005 cal BC)

Activity during Phase 9 consisted of the initial phase of inhabitation of the three roundhouses (see Volume 1: 122). A stone cist was built across the doorway of House 401 and a walled circular forecourt was built to its east (see Figure 19.4).

The disarticulated bones

The disarticulated unburnt bones from Phase 9 (Table 19.44) consist of six teeth: a deciduous tooth (SF 5477) was recovered from the earliest floor of House 401 while another deciduous tooth (SF 5476) was recovered from the yard surface (1680) under the forecourt. The permanent incisor (ESN 3194) of a juvenile was also recovered in the yard area, east of House 401. A right deciduous upper first incisor (ESN 2798) of a 7.5–10.5-month-old female infant was recovered from the yard area (1680) further south between Houses 401 and 801. Very few other artefacts were recovered from the yard area.

On the floor surface of House 1370 a right maxillary second molar (ESN 3584) of a young adult and a right deciduous maxillary canine (ESN 3563) of an older child were found. The molar had slight wear to the occlusal surface but heavy root resorption (Figure 19.62). The affected roots are sharp and jagged in appearance and the pathology/root resorption has also affected the internal area of the inferior surface of the molar. There is no corresponding maxillary bone to determine the cause or extent of this dental pathology. The maxillary deciduous canine belonging to an older child (ESN 3563) has slight wear but heavy calculus on the labial side of the tooth (Figure 19.63).

A single cremated bone fragment (from ESN 3054) of the distal end of a proximal phalanx of a hand was recovered from floor 1311 in the northeast quadrant of House 401, immediately over the burial of SK 2727 (Table 19.45; see Volume 1: 149). Finally, it should be noted that burnt bone fragments from layer 926 of the Phase 9 midden in Area C are actually animal and not cremated human bones as erroneously stated in Volume 1 (*contra* Volume 1: 195).

Phase 10 (1035–970 cal BC)

By Phase 10, windblown sand from at least two separate sand-blows accumulated across most of Area A (see Volume 1: 205). These sandy deposits, which were up to 400mm deep in places, were never cleared away. Rather, the inhabitants lived on top of the new sandy layers, leading to the loss of House 801 as a habitable structure. Sand was deliberately imported into House 401 and a new floor was constructed and the walls rebuilt.

Table 19.41. Summary of the inhumations from Phase 8

Location	SK no.	MNI	Age	Sex	Pathology	Date	Grave goods	Notes
House 801	2792	1	1½–3 yrs	?F	-	*1445–1195 cal BC*	-	Largely disarticulated
House 401	2727	1 +1	10–14 yrs (OC)	?F	Calculus, AMTL ×2, 3× EH, cribra orbitalia?	*1160–1005 cal BC* (weighted mean)	1× adult radial head	Crouched position within fill (2563) of a small oval pit (2564).
House 1370	2613	3	Ind 1: 34–40 yrs	M	TMJOA, overbite, 2× abscesses, periodontal disease, AMTL ×7, caries ×1	*1435–1260 cal BC* (SUERC-13804; 3090±35 BP)	1× left I_2	Composite skeleton of at least 3 individuals. Buried in a tightly crouched position on its left side. The left distal femur and left proximal tibia recovered from layer (2748) in pit (2551) outside House 1370. Left patella and right distal radius were recovered from a later fill (2732) within the same pit. Left and right maxillary lateral incisors placed in each hand. Extra phalanx in first finger. Mismatched left and right distal fibulae. 2× cut-marks.
			Ind 2: Adult	F	-	*1300–1125 cal BC* (weighted mean)	-	
			Ind 3: 45–60 yrs	F	Osteoarthritis, eburnation, osteophytosis	-	-	
	2638	3	Ind 1: 22–49 yrs	M	AMTL, alveolar resorption	*1495–1275 cal BC* (weighted mean)	-	Composite skeleton of at least 3 individuals, buried in a tightly crouched position in its right side. The mandible (Individual 2) is also recorded in the site archive as SF 4907.
			Ind 2: 28–48 yrs	M	Heavy occlusal wear, calculus	*1500–1225 cal BC* AA-48598; 3105±50 BP)	-	
			Ind 3: 40–49 yrs	M	Periostitis, new bone formation, osteoarthritis	*1615–1420 cal BC* (weighted mean)	-	

Table 19.42. Summary of the unburnt disarticulated human bones from Phase 8

Location	Ctxt	SF no.	Pit	Age	Sex	Bone ID	Pathology	Notes
Stone cist at entrance to House 401	2204/ 2205	4617	Cist 2105	OC 8-10yrs	-	Distal epiphysis of the intermediate phalanx	-	Sand layer below fill 2106. Associated with animal bone dating to *1160–995 cal BC* (AA-48602; 2565±55 BP).
	2106	4909		-	-	Fragment of acromion of scapula	-	This bone fragment was originally identified by A. Chamberlain and was sent for radiocarbon dating and isotope analysis; however, the low $\delta^{15}N$ value of 5.9 is consistent with it deriving from a herbivore/vegan. The radiocarbon date is *1160–995 cal BC at 95% probability* (AA-48602; 2865±55 BP).
Wall core of House 801	803	5422	-	Adult	?F	Left zygomatic (malar) bone	-	Wall core at the west end of the house, contained deliberate deposits of refuse within the wall: a burnt worked stone (SF 5422), bone tools (SF 5207, SF 5079, SF 5212 and SF 5208), a worked whale bone (SF 5080), worked pumice (SF 5229 and SF 5230), and flint flakes (SF 5276 and SF 5277). An articulating deer tibia provided a date of *1190–1040 cal BC at 95% probability* (SUERC-10803; 2850±35 BP) and an OSL sample was dated to *1095–1050 cal BC at 95% probability* (OSL-12; 2990±210 BP).
Pit 1792 below entrance to House 801	2428	5420	1792	Adult	-	Transverse process of thoracic vertebra, small frag. from left acetabulum	-	Layer in second recut [1792] of pit 2543 (Phase 6), containing sherds of a small fineware bowl
				Adult	?M	Right proximal ulna	-	Very large and robust

(Continued)

Table 19.42. Summary of the unburnt disarticulated human bones from Phase 8 (Continued)

Location	Ctxt	SF no.	Pit	Age	Sex	Bone ID	Pathology	Notes
Double pit 2551, outside entrance of House 1370 (2551=2508=2553)	2554	-	2551	Foetus	-	Left proximal diaphysis of femur	-	Uppermost layer 2554 sealed beneath the second surface 2309 (Phase 9) of House 1370's entrance. Some cremated bone fragments were also recovered though these are probably redeposited from the adjacent pyre debris from Phase 3.
	2732	-	2551	MA-OA	-	L patella	Osteophytes around margin	These bones articulate with and belong to SK 2613 buried beneath House 1370. They were recovered in the layer above pit fill 2748 in which the articulated distal femur and prox. tibia of SK 2613 were found.
				A	-	Right radial shaft and misc. radial frags	-	
	2748	4752	2551	MA-OA	-	L distal femur	Deg. lipping around distal condyles; eburnation on lateral (posterior) condyles	Recovered in articulation with each other (patella is in layer 2732 above this one). These elements articulate and belong to SK 2613, buried beneath House 1370. This femur dates to *1420–1120 cal BC* (GU-9842; 3040±50 BP).
				MA-OA	-	L proximal tibia	DJD around medial and lateral condyles; eburnation on lateral surfaces	
				Adult	-	Intermediate phalanx of the foot	-	Phalanx (SF 4752) not in articulation with the knee joint, but prob. fell out of the mummy bundle when it was exhumed and reburied in House 1370: part of SK 2613.
				Adult	-	Frag of glenoid	-	Not from SK 2613

Table 19.43. Summary of the dispersed cremated human remains from Phase 8

Location	Pit	Context	SF no.	Bone ID	Wght (g)	Age	Sex	Colour	Notes
Outside House 1370	2551	2748	-	Cervical vertebra #1 (atlas) fragment	1.99	Adult	-	Greyish-white	Double pit containing bones of SK 2613 outside of House 1370
	2551	2554	-	Fragments of cranium, radius, ulna, fibula, rib and other bones	15.8	Adult	-	Greyish-white	
House 1370	3101	3102	5103	Unerupted right permanent premolar	0.34	YC-OC	-	White with some black soot on occlusal surfaces	
	3156	3157	5105	UID long bone	0.32	Juv-Ad	-	Greyish-white	
	3168	3169	5107	Cranial fragment	1.06	Juv-Ad	-	Greyish-white	
	3180	3177	5108	Femoral shaft	1.14	-	-	Yellowish-white	
	2597	2598	-	2× UID long bone fragments	1.63	Adult	-	White	Recovered from the fill of SK 2638
	3377	3378	5227	Cranial fragment	0.11	-	-	Light greyish-white	Pit 3377 was located SW of the central hearth of House 1370. The fill (3378) contained animal bones, a bone disc (SF 5205), a single sherd and a broken polished stone (SF 5196)
	-	1397	-	UID long bones	3.78	Adult		1× black, 2× dark grey, 3× light greyish-white	1× insufficiently cremated with lots of organic material in the matrix, the rest are efficiently cremated. Deposit within sand wall core of House 1370 (prob. displaced from the Phase 3 cremation platform 3558)

Figure 19.62. The right maxillary second molar of a young adult (ESN 3584) with root resorption

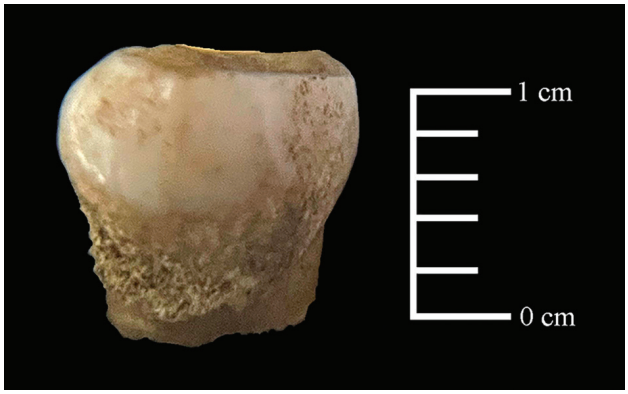


Figure 19.63. The right maxillary deciduous canine of an older child (ESN 3563) with heavy calculus

Skeleton SK 2188

The skeletal remains of a neonate baby were recovered from the northeast quadrant of House 1370, buried in a shallow pit (2167). The burial pit was cut into the upper part of the fill of a large posthole (2165) which had formerly held the northern of the two entrance posts into the house (see Volume 1: fig. 6.33). The neonate was laid on its front with the feet to the northwest and the head to the southeast, looking south-southeast. SK 2188 is dated to *1065–975 cal BC at 95% probability* (AA-48596; 2905±50 BP). The baby was either stillborn or died shortly after birth and examination of the pelvis (Schutkowski 1993) indicates this skeleton could be a possible female. No observable non-metric traits or pathological lesions are noted (see Table 19.18).

The skeletal remains of SK 2188 are in good condition, with some intermittent surface flaking to the exterior cortex, which is attributed to the dry and sandy burial environment. The slightly patchy surface erosion results in the bones being scored at grade 1 (Brickley and McKinley 2004). The full skeletal inventory of SK 2188 is shown in Table 19.46, with visual representations in Figure 19.64. A summary of SK 2188 is provided in Table 19.48.

The majority of the cranial bones are fragmented; however, the *pars basilaris*, left and right *pars lateralis*, and the left and right zygomatic bones are complete. Fragments of the unfused sphenoid, ethmoid, the left and right temporal bones and the mandible are present. All the deciduous maxillary and mandibular tooth buds were recovered despite the absence of most of the maxillary bones.

The axial skeleton is well represented, with the majority of the scapulae (only the left and right lateral borders of the blades are missing) being identified. The scapular end of the left clavicle, nine right ribs, seven left ribs and all unfused portions of the pelvic girdle were recovered. All vertebrae are present and consist of unfused bodies and neural arches from the cervical, thoracic, and lumbar regions together with four unfused sacral bodies.

The long bones are in very good condition, with only the forearms exhibiting a limited degree of fragmentation across one radial and both ulnar shafts. All diaphyseal shafts of the left and right long bones of the upper and lower limbs were recovered; however, the epiphyses of these long bones and both patellae were not recovered. Most of the bones from the hands and feet are well represented (n = 62) but are difficult to side anatomically due to the young age of this individual. Both left and right calcanei and tali were identified along with six other tarsal bones, which were difficult to identify any further due to their lack of development and growth.

Despite the excellent bone recovery and preservation of this individual, it is worth noting that the majority of the maxillae, palatine, nasal bones and internal eye sockets were not recovered. Since these bones are thin, their absence may be due to the body having been placed on its front, so the majority of the head weight was directly on these fragile bones and thus crushed them over time. There is no evidence of this individual having been disturbed after burial nor are the soil conditions a factor as other delicate bones from this individual survived the burial environment.

Foetal long bone length and dental development were used to determine the age of death of SK 2188 (Table 19.47). The diaphyseal lengths of the upper limbs and lower limbs provide an age range of 40–42 weeks foetal (Maresh 1970 adapted by Scheuer and Black 2000; Fazekas and Kósa 1978). Similarly, dental development provides an age range of 40 weeks foetal to two weeks post-birth [mean: birth] (AlQahtani 2009) and birth (Moorrees *et al.* 1963; Ubelaker 1989), indicating that this individual was either a full-term stillborn or died very shortly after birth.

It is difficult to accurately estimate biological sex as morphological traits have not yet developed in pre-pubescent individuals; however, using the criteria set out by Schutkowski (1993), SK 2188 could be a possible female. This is based on the angle of the greater sciatic notch, which is over 90º, and the anterior shape of the iliac blade which is less marked than the S-shape associated with males.

Table 19.44. Summary of the unburnt disarticulated human bones from Phase 9

Location	Context	SF/ESN no.	Age	Sex	Bone ID	Pathology	Notes
Floor of House 1370	1369	ESN 3584	YA	-	Right M^2	Slight wear; root resorption due to pathology	Floor constructed *c. 1090–1005 cal BC* and used for continuous indoor penning of livestock with a small sleeping area. Artefacts include animal bone, antler, pumice, flint and stone tools for hide-working and other crafts.
		ESN 3563	OC	-	Right maxillary dC	Slight wear, heavy calculous on labial side, root resorption	
Yard surface outside House 401 and House 801	1680	ESN 3194	OC–Juvenile	-	Permanent incisor	-	Recovered near a single fragment of a quernstone (SF 5441) in the yard area
		ESN 2798	Inf. (7.5–10.5 mths)	-	Right dI^1 (deciduous upper first incisor)	Slanted wear on distal side	Age (AlQahtani 2009). Very few artefacts recovered from the yard and forecourt areas.
Yard surface under forecourt of House 401	1680	ESN 3209/ SF 5476	<Child	-	Deciduous tooth	-	Yard surface from the early part of Phase 9, prior to construction of the circular forecourt. Missing post-sampling.
Earliest floor of House 401	1311	ESN 3054	-	-	Metacarpal	-	Associated with a cremated phalanx (Table 19.45). Missing post-sampling.
		ESN 3094/ SF 5477	<Child	-	Deciduous tooth	-	Associated with a large quantity of pottery. Tooth missing post-sampling.

Table 19.45. Summary of the dispersed cremated human bone from Phase 9

Location	Ctxt	SF/ESN no.	Bone ID	Wght (g)	Age	Sex	Colour	Notes
House 401	1311	ESN 3054	Distal end of proximal phalanx (hand)	1.63	Adult	-	Light grey	Completely oxidised. Same context as an unburnt deciduous tooth of a child.

The neonate baby was buried either as a closing deposit for the house's first phase of use (end of Phase 9) or as a re-dedication for its rebuilding in Phase 10.

The disarticulated bones

Four teeth and one femur fragment were recovered from Area A (Table 19.49). Two teeth came from above the ruins of House 801: a right maxillary lateral incisor (ESN 4699) from a mature adult, with moderate wear and one enamel hypoplasia, and, from a robber pit, a right mandibular second molar (SF 3473) from an adult. The mandibular molar dates to *1535–1295 cal BC* (AA-48603; 3170±50 BP). Two deciduous teeth were recovered from the Phase 10 floor (1308) in House 401 (SF 5478 and SF 5479) and were sent off for testing prior to analysis. A fragment of an adult femur was found west of House 401. A juvenile skull bone was recovered from the midden in Area C.

Phase 11 (1010–775 cal BC)

Very few human remains were recovered from this phase (Table 19.50): an adult molar from south of the forecourt, and two teeth (from two different people) from House 401 (see Figure 19.6). The right petrous of a male from fill layer 1413 in House 401 shares genomes with other Bronze Age Scottish individuals (Tom Booth pers. comm.).

Phase 12 (800–745 cal BC)

Only a single house, House 401, was occupied during this phase, but other features include two groups of pits, one on the site of the former House 1370 and the other in the northern part of Area A. By the end of Phase 12, these pits were filled in and the area was ploughed over. Deciduous teeth and disarticulated foetal bones were recovered from within House 401 and an adult premolar from east of the ruins of House 1370 (Figure 19.7; Table 19.51).

Phase 13 (775–655 cal BC)

In Area A, activity during Phase 13 was entirely restricted to House 401, which had been rebuilt and refloored. Remains of two individuals, a neonate and a child, were recovered from within House 401 (see Figure 19.8; Table 19.52).

Additional human remains were found in the newly constructed double roundhouse (House 150), about 100m to the northwest in Area C, dating to *775–650 cal BC* (Figure 19.65). In a charcoal layer across the house, a radial fragment of a 18–24-week-old foetus, a rib shaft of a juvenile/young adult, and a toe/finger bone belonging to an older child (<14 years) were recovered. Preservation of the rib and metacarpal/metatarsal bones is poor and are both very fragile to touch, indicating a more hostile burial environment.

Phase 14 (740–605 cal BC)

At the start of Phase 14, House 401 was rebuilt. Floor 462, with a modelled construction date of *755–595 cal BC* (see Volume 1: 443) was a substantial surface on which lay a large quantity of artefacts, animal bone fragments, tools and a few disarticulated human bones (see Figure 19.8; Table 19.53). These artefacts were left on the floor when the house was again abandoned at the end of Phase 14.

An incomplete skeleton of a 38–40-week foetus was recovered during dry-sieving (Figure 19.66), along with a right rib and right malar bone of an infant, an adult vomer and nasal concha, an adult scapular spine and miscellaneous animal bone fragments (all associated with SK 2241). The foetus is in fragmented condition and its burial context is unknown; however, measurements of the left tibial diaphysis (66.63mm) provide an age estimate of 38–40 weeks foetal (Scheuer and Black 2000: 416) which is further supported by measurements of both ischia, pubic bones and ilia, indicating that it was a full-term foetus/stillborn.

Phase 16

In this last phase at Cladh Hallan disarticulated bones were deposited at the two structures still in use, the double roundhouses of House 150 in Area C and House 640 at the north end of Area A (see Figure 19.8; Table 19.54). Within House 150, a pelvic fragment of a mature adult was recovered in the west room, while in the east room cranial fragments of a foetus or neonate were found (see Figure 19.65).

Unstratified

A handful of disarticulated unburnt human bones (Table 19.55) and cremated human bones (Table 19.56) were recovered from unstratified contexts. Like all of the other dispersed cremated bones, it is likely that at least two of the latter derive from Phase 3 although the right molar from Area D is 40m south of Area A's Phase 3 cremation cemetery and, in any case, is likely to belong to Phase 9 (see Volume 1: 191–4).

Table 19.46. The skeletal inventory of SK 2188 whereby '√' indicates that the bone is present, and a blank square indicates that the bone is absent/not identified

CRANIUM								
Bone	*L*	*R*	*Bone*	*L*	*R*	*Bone*	*Present*	*Absent*
Parietal	√	√	Maxilla		small frag	Nasal		
Temporal	√	√	Zygomatic process	√	√	Lacrimal		
Occipital	√	√	*Pars petrosa*	√	√	Inf. nasal concha		
Pars lateralis	√	√	Tympanic ring			Ethmoid	small frag	
Pars basilaris	√		Lesser wing	√		Vomer		
Frontal	√	√	Greater wing	√	√	Concha		
Zygomatic/malar	√	√	Post-sphenoid	√		Aud. ossicles	R malleus R incus	
Mandible	√	√	Palatine			Hyoid		

AXIAL								
Bone	*Present*	*Absent*	*Bone*	*Present*	*Absent*	*Bone*	*Present*	*Absent*
Manubrium		x	Sternum			Xiphoid		
Ribs: right	1 2	3 4 5	6 7 8 9 ~~10~~	~~11~~ ~~12~~	#: -	Rib epiph		
Ribs: left	1 2	3 4 5	6 7 8 9 10	11 ~~12~~	#: -	Rib epiph		

VERTEBRAE								
Centum						*Neural arches*	*Left*	*Right*
Cervical	1 2	3 4 5	6 7		#?:	Cervical		
Thoracic	1 2	3 4 5	6 7 8 9 10	11 12	#?:	Thoracic		
Lumbar	1 2	3 4 5			#?:	Lumbar		
Sacral	1 2	3 ~~4~~ ~~5~~			#?:	Sacral		
Coccyx	~~1~~ ~~2~~	~~3~~ ~~4~~			#?:	Coccyx		
Dens	~~Present~~	Absent	Atlas post. arch	Present	~~Absent~~	#? Neural arches	54 in total	

UPPER LIMB								
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*
Scapular blade	√	√	capitulum			Scaphoid		
coracoid epiph.			lat. epicondyle			Lunate		
glenoid epiph.			med. epicondyle			Triquetral		
acromial epiph.			Radial diaph	√	√	Pisiform		
Clavicle			prox. epiph.			Trapezium		

(Continued)

Table 19.46. The skeletal inventory of SK 2188 whereby '√' indicates that the bone is present, and a blank square indicates that the bone is absent/not identified (Continued)

med. epiphyses			dist. epiph.			Trapezoid		
lat. epiphyses			Ulnar diaph	√	√	Capitate		
Humeral diaph	√	√	prox epiph			Hamate		
head			dist epiph					

HAND												
Bone	*Left*					*Right*					*No side*	*Total*
Metacarpal diaph	1	2	3	4	5	1	2	3	4	5		10
head epiph	1	2	3	4	5	1	2	3	4	5		0
base epiph		1										0
Phal: prox diaph	1	2	3	4	5	1	2	3	4	5		-
prox epiph	1	2	3	4	5	1	2	3	4	5		0
Phal: inter diaph		2	3	4	5		2	3	4	5		-
prox epiph		2	3	4	5		2	3	4	5		0
Phal: dist diaph	1	2	3	4	5	1	2	3	4	5		-
prox epiph	1	2	3	4	5	1	2	3	4	5		0

LOWER LIMB									
Bone	*Left*	*Right*	*Bone*	*Left*	*Right*	*Bone*	*Left*	*Right*	
Ilium	√	√	Pubis	√	√	Talus	√	√	
Ant inf iliac spine epiph			Femur	√	√	Calcaneus	√	√	
Ant sup iliac spine epiph			capital fem epiph			epiph			
Ant crest epiph			Gr trochanteric epiph			Cuboid			
Post crest epiph			Les trochanteric epiph			Navicular			
Acetabulum	√	√	dist fem epiph			Cuneiform med.			
Sup acetab epiph			Patella			Cuneiform inter.			
Ant acetab epiph			Tibia	√	√	Cuneiform lat.			
post epiph (acetab)			prox tibial epiph						
Sup epiph (acetab)			dist tibial epiph						
Ischium	√	√	Fibula	√	√				
Ischial tube epiph			prox fibular epiph						
Ramal epiph			dist fibular epiph						

FOOT												
Bone	*Left*					*Right*					*No side*	*Total*
Metatarsal diaph	1	2	3	4	5	1	2	3	4	5		10
head epiph		2	3	4	5		2	3	4	5		-
base epiph	.	1				1	2	3	4	5		0
Phal: prox diaph	1	2	3	4	5	1	2	3	4	5		2
prox epiph	1	2	3	4	5	1	2	3	4	5		0
Phal: inter diaph		2	3	4	5		2	3	4	5		-
prox epiph		2	3	4	5		2	3	4	5		0
Phal: dist diaph	1	2	3	4	5	1	2	3	4	5		2
prox epiph	1	2	3	4	5	1	2	3	4	5		0
Unidentifiable MC/MT heads: 19 MC/MT prox phals: 4; MC/MT inter phals: 13; MC/MT distal phals: 8												

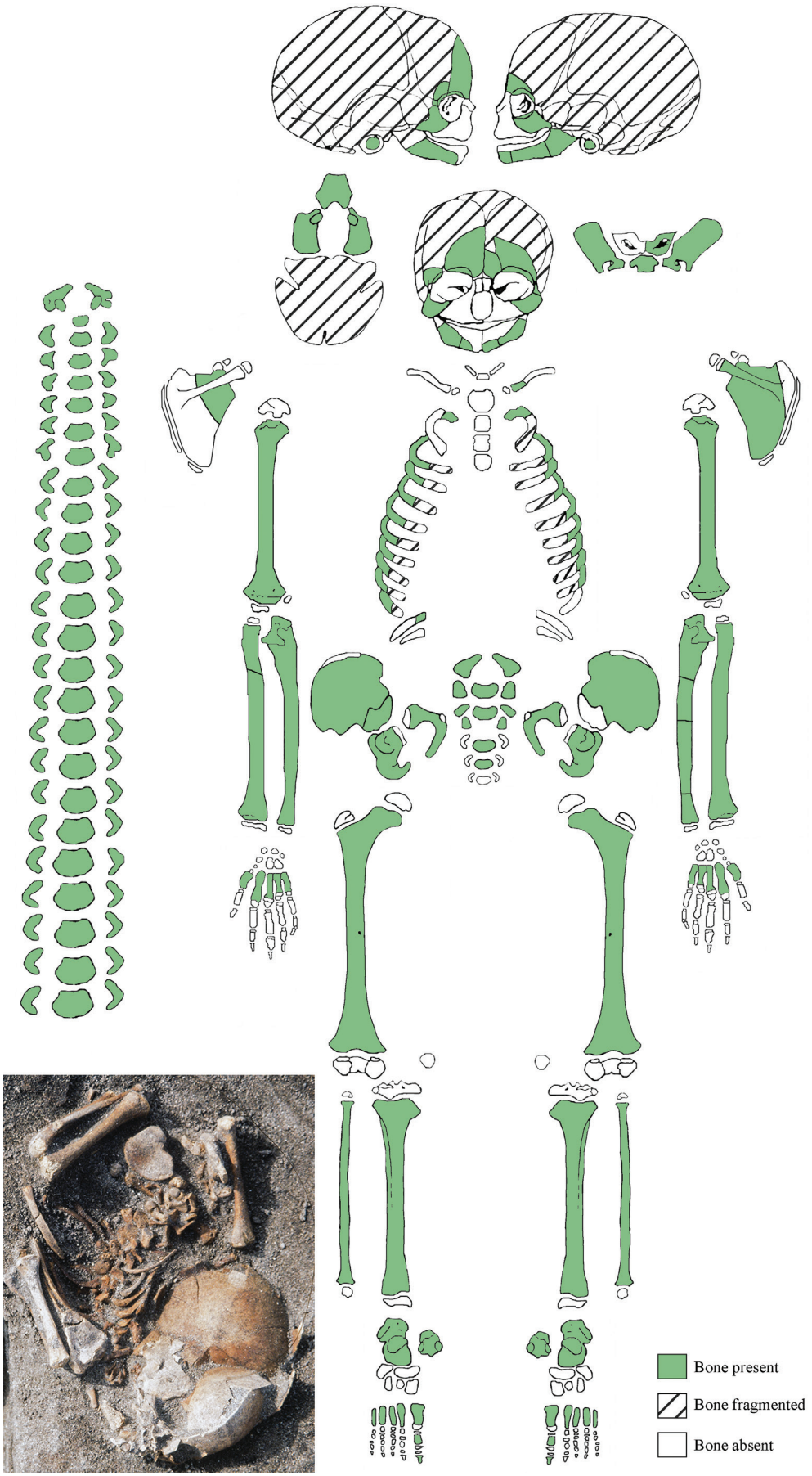


Figure 19.64. A visual skeletal inventory of SK 2188. Note that most of the metacarpal and metatarsal bones were recovered along with a few unidentifiable carpal and tarsal bones

Table 19.47. Age at death estimation of SK 2188 using diaphyseal length and dental development

Bone	Diaphyseal length	Age
Right humerus	65.18mm	40 weeks foetal
Right ulna	61.09mm	41 weeks foetal
Left radius	52.53mm	40–42 weeks foetal
Right femur	74.72mm	40 weeks foetal
Left tibia	65.00mm	40 weeks foetal
Right fibula	63.05mm	41 weeks foetal
Dental development	-	Birth

19.5 Discussion

Cremation

Cremation was the dominant funerary rite during the British Late Neolithic and into the Early Bronze Age (Willis 2021) and was presumably reserved for those considered worthy of this time-consuming mortuary practice. Since wood was required to construct and maintain cremation pyres, and since there was only a limited availability of wood on the island of South Uist (Parker Pearson and Smith 2012), alternative fuel sources such as driftwood, dried seaweed, dried peat and/or dung may have been used to maintain the pyres at Cladh Hallan during Phase 3 of its occupation.

This would have been a labour-intensive process, not only to collect and dry the fuel materials, but also committing the hours required to keep the pyre burning at high temperature until all soft tissues were burned away. This may be the reason why many of the cremated bones show evidence of 'quick burn' or are black with organic material remaining in their cortex; the pyre would have been stoked to a high temperature but not maintained for a significant period of time due to the limited supply of fuel.

Food was probably consumed during the cremation rite (as mentioned previously, charred and partially burned animal bone fragments were identified within the cremation deposits). After the pyre cooled, the cremated bones were sorted and collected from the debris and then deposited either at one of the stone rings or the stone platform.

McKinley (1997b) has argued that partial deposits of cremated remains are the result of careless bone recovery and therefore represent individuals of low status, while larger bone deposits are indicative of more effort being made at the pyre to collect the bones, thus denoting higher status. This argument cannot be applied to the cremations at Cladh Hallan as all of the deposits demonstrate care and attention afforded to the deceased, despite their being token deposits. The identification of small bones, such as those of the hands, feet and teeth, in the assemblage reveals the meticulous efforts taken in prehistory to ensure complete collection of all the cremated bone fragments.

All the cremation deposits are considered to be small, token deposits (less than 100g), with the exception of cremation 2793 which is a large pyre deposit. For the most part, these deposits only constitute a handful or two of cremated bones, a symbolic representation of the deceased. Furthermore, some of the deposits contained multiple individuals and yet only a small portion of each individual was buried. This raises possibilities regarding curation/storage and the retention of cremated individuals in containers, their deposition at different locations, the division of bones between mourners as a form of *memento mori* or for burial elsewhere, or the storage of cremated bone in pits for removal at a later date (Willis 2021).

As noted elsewhere, some deposits contained bones with evidence of drastically different pyre temperatures when compared to the other bones from the same contexts: this is a likely indicator that one or more individuals were added to the main cremation deposit prior to burial. Thus, while the 'second' individual cannot be discerned through age-/sex-related differences within the bones, they are perhaps visible in the extreme differences in pyre temperatures.

Additionally, some of the dispersed cremated bones were recovered within pits. These may represent deliberate exhumation of previous cremation burials: the remains in the pit fills may be the remnants of cremated bones that had evaded exhumation or were deliberately left behind. In particular, pit 3631 contained only a few early Phase 3 cremated bone fragments within its fill, which was then covered by late Phase 3 pyre debris from the nearby cremation platform. The exhumation of human remains from pits would also explain why these pits appear to be 'empty' but for a few small fragments of bone.

Exhumation and/or storage may also explain why some of the cremated bone fragments are very small. The maximum bone lengths derive from a rib at 55.39mm (3255) and from an ulna 51.44 (2793b), thus exceeding the archaeological average of 45.2mm (McKinley 1994b).

Table 19.48. Summary of the articulated unburnt skeleton from the Phase 9/10 interface in House 1370

Location	SK no.	MNI	Age	Sex	Pathology	Date	Grave goods	Notes
House 1370	2188	1	Neonate	?F	-	*1065–975 cal BC* (AA-48596; 2905±50 BP)	-	A shallow pit (2167, filled with 2166) cut into a large posthole (2165) of which the post was removed during phase 9. A 40-week-old stillborn/ neonate

Table 19.49. Summary of the unburnt disarticulated human bones from Phase 10

Location	Ctxt	SF/ESN no.	Pit	Age	Sex	Bone ID	Pathology	Notes
Sand deposit above ruins of House 801	418	ESN 4699	-	MA	-	Right I^2 (permanent upper second incisor)	moderate wear with one enamel hypoplasia	-
Fill of a robber pit dug into ruins of House 801	1320	3473	1319	Adult	-	Right M_2	-	Mounted and thin sectioned. Dated to *1535–1295 cal BC* (AA-48603; 3170±50 BP)
Against the NE wall of House 401	1308	5478	-	Child	-	Deciduous tooth	-	-
Against the north side of interior entrance to House 401	1308	5479	-	Child	-	Deciduous tooth	-	-
Behind House 401	2426	-	-	Adult	-	Left proximal femur	-	Recovered with unburnt juvenile animal bone fragments
Sandy layer in the midden of Area C	119	-	-	Juv–YA	-	Right malar bone	-	Not fused, bigger than OC malar bones

Table 19.50. Summary of the unburnt disarticulated human bones from Phase 11

Location	Ctxt	SF no.	Age	Sex	Bone ID	Pathology	Notes
Black sand, possible outdoor fireplace south of forecourt, SE of House 401	518	5425	Adult	-	Molar	-	-
Floor layer below floor 655, SE quad of House 401	1392	5480	Child	-	Deciduous tooth	-	Floor 655 is associated with a red deer metacarpal dated to *970–830 cal BC* (SUERC-10789; 2815±35 BP); floor's construction modelled as *995–860 cal BC (95% probability)*
Floor 655, NE quad of House 401	655	ESN 4776	YA	-	Right I_1 -lower first incisor	Enamel accessory tubercle and slight wear	
Fill layer below floor 655, NE quad of House 401	1413	5481	Adult	M	Right petrous bone	-	aDNA sampled: U5a1a2b; R1b1a1b1a1 = Bronze Age Scottish genomes (McCann & Cassidy 2023).

Table 19.51. Summary of the unburnt disarticulated human bone from Phase 12

Location	Ctxt	SF/ESN no.	Pit	Age	Sex	Bone ID	Notes
Sandy layer, east of ruins of House 1370	473	2045	-	Adult	-	Right PM^2 -upper second premolar	Thin-sectioned and mounted. Insufficient collagen for radiocarbon dating (GU-9846). Associated with red deer tibia dating to *795–660 cal BC* (SUERC-10801; 2525±35 BP)
Fill layer below floor 595, House 401	659	-	-	Foetus	-	Small, unident. diaphy-seal long bone fragment	This layer also included large quantities of pottery sherds, animal bones, bone tools and worked antler
Floor layer 595, House 401	1191	5482/ ESN 2074	-	Child	-	Deciduous tooth	Recovered south of the hearth of House 401. Floor 595 is associated with an articulated dog metatarsal which dates to *810–765 cal BC* (SUERC-10790; 2250±35 BP at 95% probability).
Fill of water tank, House 401	1385	5483	-	Child	-	Deciduous tooth	Recovered northeast of the hearth of House 401.
Sand layer, House 401	1233	ESN 2093	Posthole 1232	Foe >28 wks gest.	-	Right scapular fragments	-

However, the majority of the cremated bones from the other deposits are below 30.00mm, with the shortest being 18.63mm (a skull fragment from deposit 3197), indicative of some sort of fragmentation occurring either while the bones were still hot and/or resulting from repeated handling and transport of the bones prior to burial. Un-urned and/or disturbed cremations (such as those from Cladh Hallan) have smaller fragment sizes compared to urned cremations. Indeed, un-urned Early Bronze Age cremations are not common but they are a Late Neolithic tradition that appears to have continued or re-appeared at Cladh Hallan during Phase 3.

The combined age at death for both cremation and inhumation potentially reveals high childhood mortality rates in that 57% are children (n = 17) who died before reaching adulthood (n = 13 adults). However, these numbers are biased for several reasons: firstly, the cremated remains reflect not only those who the living chose to bury but also the small quantities of bone for each deposit. This means that token deposits may have contained multiple adults (or indeed, multiple children) but without age-related differences or duplicating skeletal elements it is very difficult to separate unique individuals out of a few grams of cremated bone.

Secondly (and similarly to the first point), adults are probably under-represented in the MNI derived from the analysis of the disarticulated unburnt bone assemblage as very few age- or sex-related differences or repeating skeletal elements were recovered despite adult bone fragments appearing in so many contexts. Finally, it must be stressed that Cladh Hallan is only partially excavated, in that only three out of a possible six to eight roundhouses have been excavated (see Volume 1: 17), and cremated and inhumed bones are also likely to have been buried or deposited within and around these other houses.

For the disarticulated remains, their MNI, ages at death and number of sexed adults are likely to increase if every bone were to be subjected to radiocarbon dating and aDNA sequencing. Most of the bones have been categorised into their phases based on their association with dated artefacts, but this only reveals the date the final activity took place and *not* the date of death.

Post mortem manipulation

Osteological observations reveal how *post mortem* manipulation of both SK 2613 and SK 2638 was a deliberate act, in which individuals and body parts, intentionally mummified soon after death, were subsequently combined into composite bodies. This process has been discussed elsewhere (Booth *et al*. 2015; Parker Pearson *et al*. 2005; 2007; Parker Pearson 2023) and in this and the previous volume with regard to radiocarbon dating, aDNA testing, isotopic analysis, bone diagenesis and archaeological evidence.

A few of the disarticulated bones and fragments were recovered from pits and may represent the left-overs from deliberate exhumations. We do not know whether the people of Cladh Hallan left them behind deliberately

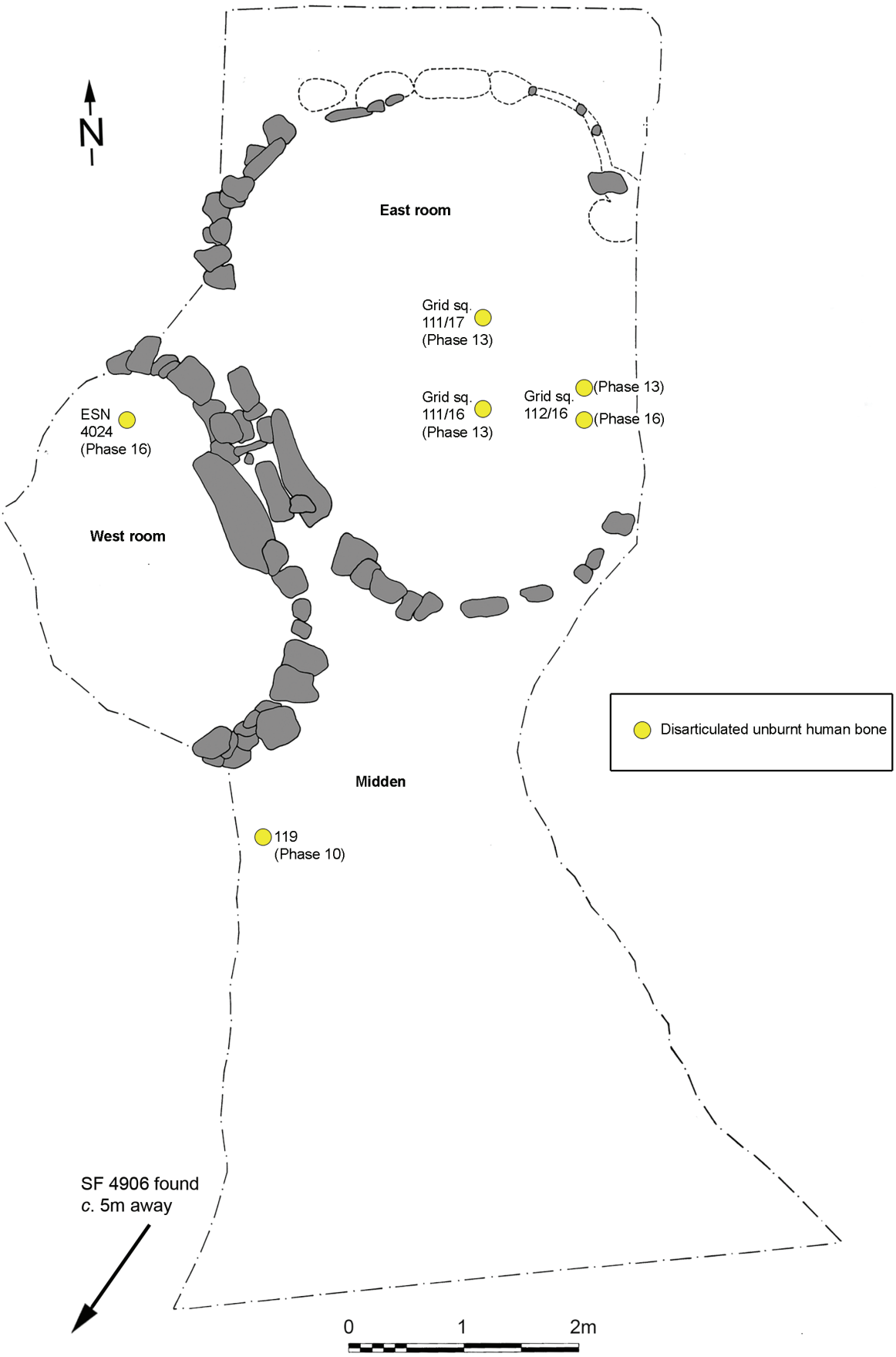


Figure 19.65. A plan of Area C which illustrates the disarticulated human bone recovered from the Phase 10 midden, and the disarticulated human bones from the Phase 13–16 House 150. The approximate location of SF 4906 (Phase 3) is also indicated

Table 19.52. Summary of the unburnt disarticulated human bone from Phase 13

Location	Ctxt	SF/ESN no.	Age	Sex	Bone ID	Notes
Charcoal layer across floor 241, House 150, Area C	242	Grid sq 111/16	Foe >18 to 24 wks gest.	-	Radial diaphysis fragment (mid-shaft), right ulnar diaphysis	Mid-shaft length: 26.67mm = >20 weeks gestation; Diaphyseal length: 26.65mm = >18 weeks gestation
		Grid sq 111/17	Juv–YA	-	Distal end of rib shaft	Very small frags with degraded erosion (some skull and trabecular bone frags cannot be ID'd further or aged. Rib has poor preservation of cortex (grade 5)
		Grid sq 112/16	OC–Juv <14 yrs	-	Unfused distal end of a fragmented diaphysis of a metacarpal or metatarsal	Very degraded preservation and fragile to the touch
NW quad, floor of House 401	465	4910	Neonate	-	Left humerus	SF 4910 dates to 760–380 cal BC and SF 3107 to 1030–770 cal BC. Artefacts from the floor include scapula shovels, antler picks and worked antler.
		3107	Child	-	Deciduous molar	

or simply failed to retrieve them. For instance, pit 2543 contained human bones that are significantly older than the date of the digging of the pit (see Volume 1: 73). Additionally, the post-cranial remains of one of the mummy burials (individual #2 of SK 2613) under the floor of House 1370 conjoin with bones left in the double pit (2551) outside that house, making it very probable that the female mummy was exhumed from that pit prior to its being dismantled and rebuilt with a male head and other elements (see Volume 1: 79). Pit-digging, therefore, was a significant activity between Phases 3 and 8, in which some or even all pits were dug to exhume both the inhumed and the cremated dead for removal elsewhere. This may have been a form of cemetery clearance prior to the construction of the roundhouses in *1080–1020 cal BC*, or a mortuary practice in which portions of the deceased were returned to the world of the living before discard or reburial elsewhere. The incorporation of human bones in contexts significantly later than the death of those individuals appears to have been fairly common during the British Bronze Age (Brück 1995). It is estimated that such reburial or discard occurred within two generations of death, in other words, within living memory (Booth and Brück 2020).

Several observations can be made regarding *post mortem* manipulation. Firstly, the bones of SK 2613 were not green/fleshed when the left knee joint and distal radius were snapped off: the bones were dry when they were broken off from the main skeleton. They were also still in articulation with each other at the time of archaeological excavation. Secondly, there are almost no cut-marks on any of the bones (except for two: see Figures 19.19–19.20). This may be indicative of an in-depth knowledge of human anatomy and also of careful precision when detaching body parts in order to accurately reattach them to a different individual. Thirdly, the exhumation of individuals who died decades and centuries beforehand suggests long-term memory of who these people were, why they were important to the community, and where their graves were located prior to exhumation.

Indeed, there is some evidence that graves were marked. Stakehole 2132 was positioned right on top of burial pit 2597 containing SK 2638. Stonehole 2147 was located just to the northeast of the burial pit containing SK 2613. Posthole 2165 in the northeast quadrant of House 1370 contained the burial of SK 2188. A group of three human teeth (from two adults and a child) were placed directly above the grave of SK 2727. Finally, posthole 2735 was cut into the burial pit of SK 2792 but then extended 0.20m northwards until a portion of the skull was revealed, as if someone was searching for the body. While it is plausible that graves were accidently discovered during construction (and later rebuilding) of the roundhouses, the mummy bundles were nevertheless interred before the laying-down of the earliest house floors as composite foundation deposits.

Finally, it is clear from the MNI of the small number of disarticulated remains that at least 10 individuals are

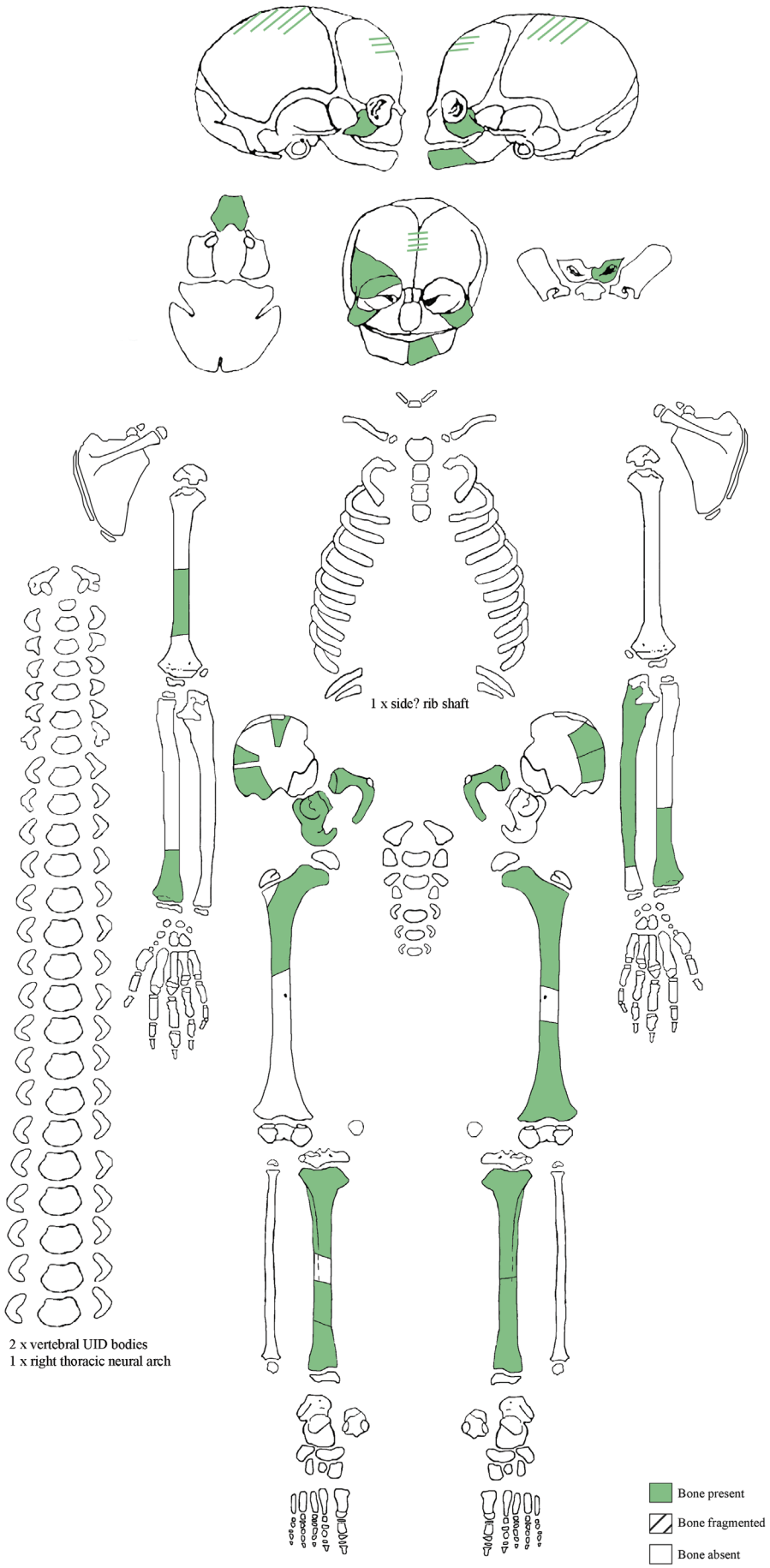


Figure 19.66. The visual skeletal inventory of the 38–40-week foetus (SK 2241)

Table 19.53. Summary of the unburnt disarticulated human bone from Phase 14

Location	Ctxt	SK no.	Age	Sex	Bone ID	Notes
Floor of House 401	462	2241	38–40 wk-foetus/ stillborn	-	Fragmented crania and nasal bones, sphenoid, L mandibular frag, three vertebral bodies, dist. L and R radius, prox. L ulna, L and R ilium, R ischium, L and R pubis, L and R fragmented femora and L and R fragmented tibiae	Recovered from among animal bone fragments probably during dry-sieving (ESN 4122?). Burial context for the foetus is unknown. Also associated with the foetus are infant and adult bones. This floor also contained a substantial quantity of artefacts *e.g.* bone points, stone counter and animal bone/ antler tools. Modelled date of the floor: *755–595 cal BC*.
			Inf	-	R rib and R malar bone	
			A	-	Vomer frag, nasal concha frag and scapular spine frag.	

Table 19.54. Summary of the unburnt disarticulated human bone from Phase 16

Location	Ctxt	SF no.	Age	Sex	Bone ID	Notes
Phase V, sandy layer, west room of House 150, Area C	154	ESN 4024	MA	-	Auricular surface (pelvis) fragments	Stage 3–4 (mature adult 30–39 years) age estimation due to granularity and some macroporosity (Lovejoy *et al*. 1985).
Phase III, Upper floor layer, east room of House 150, Area C	183	Grid sq 112/16	Foe/Neo	-	Frags of cranium	Two carbonised grains date to *705–545 cal BC* (SUERC-10861; 2532±35 BP) and *730–540 cal BC* (SUERC-10862; 2490±35 BP)
From the surface outside the niche (543) of House 640	510	-	Foe 16–24 wks gest.	-	Frag. of a proximal femoral diaphysis, frag. of a left proximal tibial diaphysis	Diaphyseal fragment length: 21.21mm = >18 weeks gestation; Diaphyseal fragment length: 20.92mm = >16 weeks gestation.

Table 19.55. Summary of the unstratified unburnt human bones

Location	Ctxt	SF no.	Age	Sex	Bone ID	Notes
Sand outside House 401	400	-	Adult	-	Misc. skull fragments including a frontal frag	This is likely to be from Phases 13–16
Area B	u/s	4905	Adult?	-	Foot phalanx	*25 cal BC–cal AD 250* (AA-48584; 1875±45 BP. Considered to be residual due to the date.

Table 19.56. Summary of the unstratified cremated human bones

Location	Ctxt	Wght (g)	Age	Sex	Colour	Bone ID	Notes
Area D	-	0.40	OC–Juv	-	White	Unerupted right M_1 permanent crown	Roots have not yet developed on the crown
Area A	Middle	5.82	YC–OC	-	Yellowish-white in colour	Femoral fragment, unfused epiphysis (young to older child), UID long bone frag	-
Area A	Lower	15.07	Adult	-	White in colour	Skull, tibial and humeral shaft fragments	-

Table 19.57. The number of contexts associated with each disarticulated skeletal element. Note, this table does not include the bones left behind from SK 2613 nor the disarticulated but almost complete foetus SK 2241 from House 401

Bone	# of contexts	Bone	# of contexts	Bone	# of contexts
Cranium	13	Humerus	2	Pelvis	2
Mandible	1	Ulna	1	Femur	6
Teeth	16	Radius	1	Patella	1
Clavicles	0	Hands	6	Tibia	1
Scapula	2	Vertebra	3	Fibula	0
Ribs	4	Sacrum	0	Feet	3

represented by mere handfuls of their bones. One wonders where the remainder of the skeletal elements are located (Table 19.57). What happened to the greater mass of their skeletons? It would seem from this near-absence of many skeletal elements that interactions with corpses (fleshed and/or unfleshed) continued long after death.

Cladh Hallan was a setting for widespread funerary and mortuary rites which were integrated into the domestic world of the house, with the remains of the dead being visible on a daily basis. As well as partially decomposing corpses or fleshed bones lying about before removal for cremation or disposal, if the artificial preservation of bodies continued alongside other forms of funerary activity, there may well have been mummy bundles curated above ground, left in various states of disarray with some bones falling away from the preserved bodies.

Notes

1 Editor's note. A small number of bone fragments were lost from the site archive, during *e.g.* the radiocarbon dating programme, before the assemblage was passed to Dr Willis. Her text and tables indicate those bones that she was not able to examine, for which the whereabouts are currently unknown.

2 Note the caveat above concerning the fibulae of this post-cranial skeleton: it is possible that more than three individuals are represented in SK 2638.

3 A note in the 2002 small finds book for deposit 3197 (SF 5114) suggests that this deposit of just 2.15g of cremated bone is possibly only part of what was a larger deposit. The note from 2002 raises the possibility that other material from this context may be missing, lost during post-ex. before the osteological analysis began.

4 For a full discussion of the possible scenarios in which a composite body was kept in full articulation for hundreds of years before burial, see Volume 1: chap. 4 and other work on mummification cited in Chapters 20 and 23 of this volume.

20 Histological analysis of human and animal bone: exceptional taphonomies, exceptional histories?

R. Madgwick, T.J. Booth and J. Mulville

Histological analyses of human remains from Cladh Hallan were undertaken for the original study by Parker Pearson *et al.* (2005) and as part of a University of Sheffield Master's thesis (Summerfield 2004). Summerfield (2004) also looked at a sample of animal bones from Cladh Hallan. Additional histological results from the Cladh Hallan fauna were described by Mulville *et al.* (2011). A sample of one of the Cladh Hallan skeletons (SF 2638) has since been examined histologically using micro-computed tomography (micro-CT; Booth *et al.* 2016). Substantial work on the use of histological analysis for investigating taphonomy has taken place since the original histological studies were conducted, and the results have never been combined, contextualised and discussed in a single publication. Here we draw together the results of varied histological investigations of human and animal bone from Cladh Hallan and discuss taphonomic interpretations in light of recent research.

20.1 Materials and methods

Undecalcified human bone thin sections were produced from seven individuals excavated from Cladh Hallan (Parker Pearson *et al.* 2005; Mulville *et al.* 2011). These samples include the cranial vault, mandible and femur of the adult male composite skeleton (SF 2638) recovered from beneath House 1370 (Table 20.1). Prior to the histological analysis, radiocarbon dating, osteological analysis and stable isotope analysis of these bones suggested that they had each come from a discrete individual and had been combined to produce a composite body (Parker Pearson *et al.* 2005; 2007). Thin sections were also produced from a femur of a second composite adult (SF 2613) buried under House 1370, a humerus of the largely disarticulated 1½–3-year-old child (SF 2792) from beneath House 801, a humerus of the articulated 10–14-year-old (SF 2727) from House 401 and a femur from the unstratified but near-complete skeleton of a 9–12-year-old male child (SF 4906) from Area C (see Volume 1: 49).

The faunal sample comprised a range of articulated and disarticulated material recovered beneath or associated with the two main roundhouses (Houses 401 and 1370). The articulated material comprised 10 deposits (seven sheep, two dogs and one cattle sample) in varying levels of articulation and completeness (Table 20.2). Sex could be determined for four of the sheep (SF 5177 [in context 3325], SF 4748 [in context 2674], SF 3175 [in context 792] and SF 3392 [in context 855]), all of which were female. Six disarticulated fragments (two each of sheep, cattle and red deer) were analysed to compare with the articulated samples. In addition, one disarticulated sheep fragment recovered in association with an articulated deposit was sampled to explore patterns of treatment within the context. In Table 20.2 and in the following results and discussion, these samples have been divided into four categories: A. articulated without butchery, B. articulating with butchery, C. partially articulated limbs, D. disarticulated.

For human samples, a piece of bone (*c.* 20mm × 10mm), capturing either the entire transverse cross-section (mandible and cranial bones) or an area extending from the periosteal surface to the medullary cavity (long bones), was cut from each bone using a hacksaw (Summerfield 2004) or Dremel with rotary diamond wheel (Mulville *et al.* 2011). All bone samples were embedded in epoxy resin. Each human sample was placed into a mixture of 10ml of resin and one drop of accelerator and placed in an evacuation chamber to cure. Thin sections 50–100 microns thick were cut from these samples using a Leitz 1600 annular saw microtome and mounted onto glass slides under a glass coverslip using Euparal.

For faunal samples, a transverse cross-section of bone (*c.* 20mm × 10mm), extending from the periosteal surface to the medullary cavity in long bones, was cut using a Dremel with rotary diamond wheel attachment (Mulville *et al.* 2011). The rough, cut surface was mounted on a glass support slide using EPO-TEK epoxy resin. Once cured, the exposed surface was ground flat using a PetroThin grinding machine, impregnated with EPO-TEK and allowed to cure. To remove surface resin, the slide was reground and hand-finished using glass plates and silicon carbide grit (1200 grit size) and then cleaned using an ultrasonic bath. This

prepared surface was mounted on a frosted glass slide using EPO-TEK and allowed to cure for one hour. The support slide was cut off and the entire sample ground to 50 µm using PetroThin and hand-finished to 30 µm on glass plates. Finally, each sample was polished on a Kent lapping machine using 1 µm diamond paste.

All slides were viewed using a transmitted light microscope fitted with a polarising filter at 50×, 100×, 200× and 400× magnification. Preservation of bone microstructure was assessed using the Oxford Histological Index (OHI; Hedges *et al.* 1995; Millard 2001). This is an ordinal score of microscopic bone degradation ranging from 0 (very poorly preserved) to 5 (comparable to fresh bone). The polarising filter facilitates the assessment of birefringence, which is related to the integrity of the collagen–mineral bond, providing another gauge of bone degradation. Birefringence was measured using the Birefringence Index (BI; Jans *et al.* 2002: 346–7). Occurrences of microfissures, staining and inclusions were recorded qualitatively. During faunal analysis the periosteal, central and endosteal zones were scored separately.

Assessment of microbial bioerosion is particularly important for understanding the taphonomic history of bones and bodies (Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007; Turner-Walker and Jans 2008; Hollund *et al.* 2012; 2018; Booth *et al.* 2015; 2022; Booth 2016; Booth and Madgwick 2016; Brönnimann *et al.* 2018; Bricking *et al.* 2022) and has proved of value in reconstructing prehistoric mortuary practices in Scottish islands (Tudor *et al.* 2025). Alteration of internal bone microstructures by microorganisms is the most common form of diagenesis observed in archaeological bones (Turner-Walker *et al.* 2002). The precise microorganisms responsible for particular types of bioerosion have yet to be identified, but the morphology of bioerosion is indicative of two main types: non-Wedl and Wedl (Hackett 1981). The morphology of non-Wedl bioerosion strongly suggests that it is produced by bacteria (Yoshino *et al.* 1991; Jackes *et al.* 2001; Turner-Walker *et al.* 2002; Kendall *et al.* 2018; Turner-Walker 2019). Wedl tunnelling in bone from terrestrial environments has been linked to fungi, although this relationship is disputed (Kendall *et al.* 2018; Turner-Walker 2019).

Patterns of bacterial bioerosion in bones from archaeological contexts and real-time taphonomic experiments have often suggested that bacterial attack primarily relates to early taphonomy in a way that reflects the manner of soft tissue loss (Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007; White and Booth 2014; Booth 2016; Kontopoulos *et al.* 2016), though this has been questioned (Turner-Walker 2019; Turner-Walker *et al.* 2023; see also Booth *et al.* 2024). For instance, bone from articulated burials, which were presumably buried intact soon after death, tend to show high levels of bacterial attack. Disarticulated bones, particularly those from butchered fauna, tend to show little or no bacterial tunnelling. Also, bones from burial environments that affect soft-tissue decomposition, such as waterlogged or anoxic environments, tend to show lower levels of bacterial attack (Turner-Walker and Jans 2008; Booth 2016). There is, however, no relationship between bacterial bioerosion and other environmental variables in predominantly aerobic burial environments (Nielsen-Marsh *et al.* 2007; Booth 2016; Brönnimann *et al.* 2018). These observations suggest that rapid removal of soft tissue or inhibition of early bacterial decomposition hinders osteolytic bacteria. This may be because osteolytic bacteria are intrinsic to an organism and migrate into the body during putrefaction. Some experimental research has demonstrated that the timing of bioerosion is unpredictable and factors such as microenvironment, climate and health status may all have an impact (Mavroudas *et al.* 2023). Discussions are ongoing as to the contribution of intrinsic and soil bacteria to patterns of bioerosion, as theoretically either might produce the observed relationship between bacterial bioerosion and early taphonomy.

20.2 Results and discussion

Human remains

Histological preservation amongst the samples is highly variable, with two modes at the extremes of the OHI scale (Table 20.1; Figure 20.1). Bacterial bioerosion was responsible for the variation in histological preservation in all cases, and predominantly responsible for the variation in BI. All the human remains sampled here came from similar burial contexts composed of free-draining alkaline machair sands (Parker Pearson *et al.* 2005). It is unlikely that any contexts were waterlogged for significant lengths of time *post mortem* or over the period of deposition.[1] Therefore the burial environment is unlikely to have had a significant effect on bacterial bioerosion of bone. The variability in bacterial attack seen in the bones from Cladh Hallan contrasts with the invariability of burial environments which, in and of itself, suggests that there was no correlation between local environment and patterns of bioerosion, consistent with results from previous studies of bone diagenesis (Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007; Booth 2016; Brönnimann *et al.* 2018). Therefore this variability is likely to be related to early taphonomic trajectories rather than the depositional environment, though micro-environmental variation and the impact of exogenous bacteria cannot be entirely discounted.

The bimodal pattern of bacterial attack seen in the remains from Cladh Hallan is replicated in human remains dating to the Bronze Age more generally, suggesting that at least two distinct taphonomic trajectories are represented (Booth *et al.* 2015). Bones from the three individuals forming the composite SF 2638 and the disarticulated femur from Area C show no or only low levels of bacterial attack (Figures 20.2 and 20.3). Outside of anoxic or waterlogged environments, these patterns of attack are more often found in bones that have been exposed to only low levels of soft-tissue decomposition. This could occur as a result of exogenous agents such as invertebrates or other humans having rapidly removed the flesh, inhibition of early decomposition through mummification practices, or deposition in inhibiting environments (*e.g.* anoxic or waterlogged; Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007;

Table 20.1. Results of the histological analysis of human bones

Skeleton	Element	Type	Age	Sex	Context	Bioerosion	OHI	BI	Microfissures	Staining	Inclusions
SF 2638	Cranium	Composite skeleton	Adult	M	House 1370 Phase 8	Non-Wedl	4	0.5	At periosteal surface	Yellow-orange at periosteal and endosteal surfaces	Opaque Black/ brown
SF 2638	Mandible	Composite skeleton	Adult	M	House 1370 Phase 8	Non-Wedl	5	0.5	At periosteal surface	Yellow-orange throughout, enhanced at periosteal.	Opaque Black/ brown
SF 2638	Femur	Composite skeleton	Adult	M	House 1370 Phase 8	Non-Wedl	4	0.5	At periosteal surface	Pinkish-orange staining around MFD	None
SF 2316	Femur	Composite skeleton	Adult	F	House 1370 Phase 8	Non-Wedl	0	0	None	Yellow-brown at periosteal surface and Haversian canals	None
SF 2792	Humerus	Largely disarticulated skeleton	~3y	F?	House 801 Phase 8	Non-Wedl	2	0.5	None	Pinkish-brown at periosteal surface and around Haversian canals	Opaque Black/ brown
SF 2727	Humerus	Articulated skeleton	10–14y	F?	House 401 Phase 8	Non-Wedl	0	0	None	Yellow-brown throughout	Opaque Black/ brown
SF 4906	Femur	Disarticulated skeleton	9–12y	M	Area C U/S (?Phase 3)	None	5	1	Throughout	Yellow-brown at periosteal surface and around osteons	None

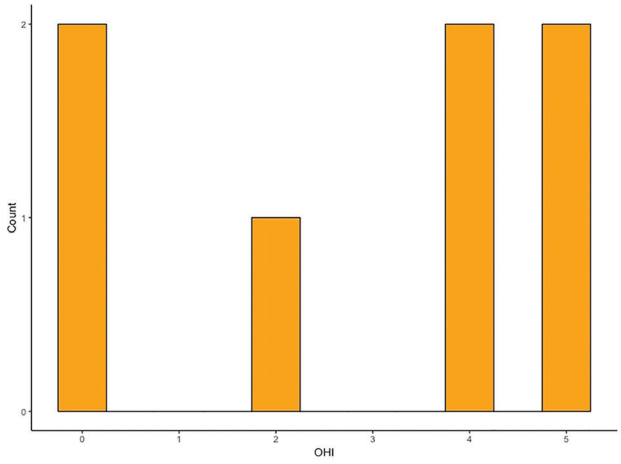


Figure 20.1. Histogram of OHI scores for human bones from Cladh Hallan. OHI scores were variable but broadly bimodally distributed at the extremes of the scale

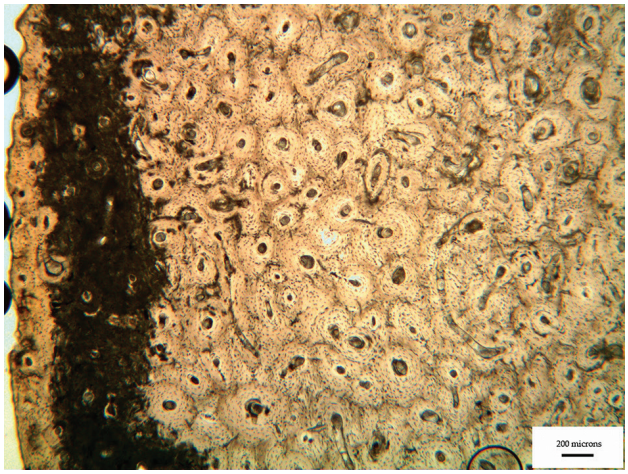


Figure 20.2. Micrograph of a transverse thin section of the SK 2638 femur at 40× magnification. An intense band of bacterial tunnelling can be observed just below the periosteal surface, which is stained orange. The rest of the bone microstructure is well-preserved

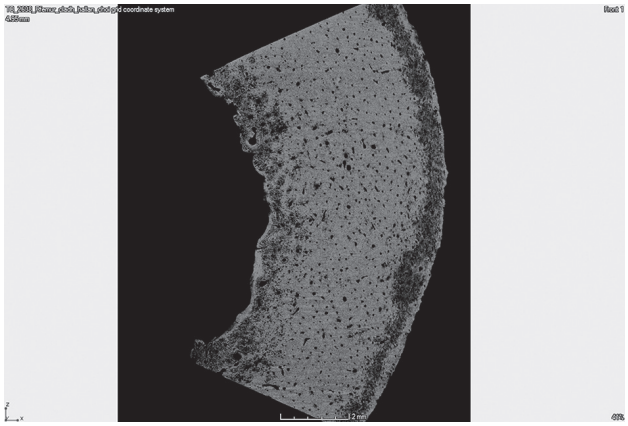


Figure 20.3. Virtual transverse cross-sectional slice through the SK 2638 femur, produced from micro-CT scans. Bands of bacterial bioerosion (darker areas indicating less dense bone) can be seen in sub-periosteal and sub-endosteal zones. The rest of the bone microstructure is well-preserved

Turner-Walker and Jans 2008; Fernández-Jalvo *et al.* 2010; White and Booth 2014; Booth *et al.* 2015). The level of skeletal articulation seen in the body parts that make up the composite skeleton SF 2638 suggests it is unlikely that they were rapidly defleshed, as this would have resulted in the rapid disarticulation of bones. *Bona fide* mummies (*i.e.* those still retaining preserved soft tissue) are the only ancient articulated skeletons which consistently produce bones showing little or no bacterial bioerosion (Booth *et al.* 2015). Therefore the patterns of bacterial attack in the bones of SF 2638, combined with the degree of skeletal articulation, are best explained by bodies having been partially or fully mummified, only for the preserved soft tissue to have then decomposed post-burial (Parker Pearson *et al.* 2005; 2007). Given that most bones from *bona fide* mummies are free from bacterial bioerosion, the presence of bacterial bioerosion in the bones of SF 2638 suggests that the method of preservation may not have been particularly efficient (Booth *et al.* 2015). This is consistent with suggestions that the Cladh Hallan bodies may have been preserved by temporary immersion in a peat bog. Soft-tissue preservation in bodies recovered from bogs is notoriously inconsistent, suggesting that decomposition can progress variably in these environments (Fischer 1998).

All the bones of SF 2638 that we examined showed similar exceptional patterns of periosteal micro-fissuring. One of the ways in which this can occur in bone is through deposition in an acidic environment (Turner-Walker and Peacock 2008). This micro-fissuring is therefore consistent with analysis of changes to the mineral structure of bone from SF 2638, suggesting that it was exposed to an acidic environment (Parker Pearson *et al.* 2005; 2007). In the Bronze Age the nearest acidic environment to Cladh Hallan would have been a peat bog; these results therefore provide further support for the suggestion that SF 2638 had been mummified by being intentionally placed in a bog for a short while.

The SF 4906 femur was recovered from an unstratified part of the site (Area C). The absence of bacterial bioerosion on this element means it is possible that this bone also came from a body that had been mummified and subsequently disarticulated. Without evidence for the persistence of soft tissues, or cutmarks suggesting defleshing, however, it is simplest to suggest that this bone comes from a body that was excarnated (taken here to mean sub-aerial exposure). This conclusion is tentatively supported by the absence of bacterial bioerosion of SF 4906, suggesting that its taphonomic history is slightly different to that of SF 2638. The distribution of micro-fissures throughout the SF 4906 sample is also different to what we observe in the bones of SF 2638 and consistent with sub-aerial weathering (Smith *et al.* 2002).

Bones from SF 2727, SF 2792 and SF 2613 show high levels of bacterial attack (OHI <3) suggesting that they have been exposed to extensive soft-tissue decomposition. This pattern of bioerosion is consistent with what is observed in skeletons that have been subject to primary burial

soon after death (Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007; White and Booth 2014; Booth 2016). This result is consistent with expectations for SF 2727, the complete, articulated skeleton of a 10–14-year-old child which, while lying in a flexed posture, showed no notable signs of *post mortem* manipulation (Parker Pearson *et al.* 2005; 2007). The OHI score for SF 2792 is within the range for bones from articulated burials. It is notable that SF 2792 shows slightly higher levels of preservation than SF 2727, given that SF 2792 was almost wholly disarticulated (except for its pelvis and vertebrae) and produced an anomalously old radiocarbon date. Together, these observations suggest that their taphonomic histories differed and that the grave of SF 2792 may not represent this young child's primary depositional context.

The OHI score of 2 for SF 2792 is consistent with intermediate scores allocated to a proportion of the skeletons recovered from pits in Danebury Iron Age hillfort, Hampshire (Booth and Madgwick 2016). The lack of real-time experimental data on what might cause this intermediate level of bacterial bioerosion means it is difficult to be sure as to what *post mortem* treatment could explain these scores. At Danebury, the complementary taphonomic evidence suggests that deposition of intact bodies in sheltered environments such as mortuary houses or covered pits is likely to be responsible. These types of environments would protect bodies from rapid defleshing by invertebrates to some degree and reduce the levels of soft-tissue decomposition to which the bones were subjected. SF 2792 may have been originally left to decompose in a sheltered environment such as a mortuary house or covered pit. In this scenario, the near-complete disarticulation of the SF 2792 skeleton suggests that, wherever it was kept before burial, it was not tightly wrapped.

The extensive bacterial bioerosion we see in the femur of SF 2613 is surprising given the evidence for intense *post mortem* manipulation: this was also a composite body that had formerly been mummified (Parker Pearson *et al.* 2005; 2007; Hanna *et al.* 2012). This result also seems to contrast with mercury intrusion porosimetry (HgIP) analysis of the same skeleton which suggests that bioerosion had not commenced (Hanna *et al.* 2012: 2775). Hanna *et al*. do not specify which bone from SF 2613 was analysed using HgIP, and it is unclear whether this analysis was performed on the femur that was examined histologically. Bacterial bioerosion can vary between bones and teeth from the same skeleton (Hanson and Buikstra 1987; Jans *et al.* 2004; Hollund *et al.* 2015). The cause of this variation is unclear. Proximity to the gut as the potential source of osteolytic bacteria and variability in ratios of cortical, trabecular bone and osteonal bone affecting bone porosity have been cited as possible explanations (Jans *et al.* 2004; Kendall *et al.* 2018). Levels of bacterial bioerosion in tooth dentine may be expected to be particularly low compared to those in bone, as dentine is harder and less porous than bone and presumably less vulnerable to diagenesis. However, a histological study of archaeological long bones and teeth from the same individuals found that, while levels of bioerosion were lower in the teeth than in bone, the difference from bone was not as extreme as that inferred for the skeletal elements of SF 2613 (Hollund *et al.* 2015). It is therefore unlikely that the discrepancy in the results from histology and HgIP of SF 2613 are down to intra-skeletal variation in bioerosion. Given that DNA analysis confirms that SF 2613 was also a composite body, it is possible that the histological analysis and HgIP were performed on bones from different individuals with divergent taphonomic histories (Hanna *et al.* 2012). In this case, the bone analysed using HgIP may have come from a body that had been subject to treatment that reduced the levels of soft-tissue decomposition to which it was exposed, such as mummification, while the femur analysed histologically came from a body exposed to extensive soft-tissue decomposition, through primary burial or deposition of the body in a sheltered environment.

An alternative explanation for the discrepancy in histological and HgIP results for SF 2613 can be found in parallels with a series of Middle Bronze Age skeletons recovered from a ring ditch at Canada Farm, Dorset (Booth *et al.* 2015; Smith *et al.* 2016). These skeletons were recovered complete and in articulation but showed extensive evidence for *post mortem* manipulation in the form of cutmarks and drill holes at articular ends of bones. Histological analysis of three of these skeletons showed high levels of bacterial attack, suggesting that they had been exposed to extensive soft-tissue decomposition (Booth *et al.* 2015; Smith *et al.* 2016). This was in contrast to the primary burial at the centre of the ring ditch (F1) which was a complete, mostly articulated skeleton, showing little indication of *post mortem* manipulation, and yet was entirely free from bacterial attack, suggesting that this body had been formerly mummified. The extensive evidence for the manipulation and probable retention of the satellite burials above ground may suggest that there had been unsuccessful or partially successful attempts to mummify these bodies, which ultimately led to the bones still being subject to significant soft-tissue decomposition. Something similar may have happened to the body represented by SF 2613's femur. This would be consistent with the suggestion that the Cladh Hallan community was using peat bogs to mummify their dead, a process in which the extent of preservation would be highly unpredictable (Booth *et al.* 2015). The same kinds of staining and inclusions were found in all samples, although at different intensities/frequencies. Given that all bones come from similar depositional environments in shell sand, this suggests that these patterns of staining and inclusion are characteristic of long-term deposition in these machair sands.

Faunal remains

Histological preservation in the faunal samples is also highly variable. Each sample was assigned OHI scores for the endosteal, midcortical and periosteal surfaces. There is a clear bimodal distribution of results, with all

samples being very well (OHI: 4–5) or very poorly (OHI: 0–1) preserved, similar to the human bones that have been assessed histologically (Table 20.2, Figure 20.4). None of the assessed zones had mid-ranging scores of 2 or 3, although one sample (the dog in context 806) differed in having contrasting endosteal and periosteal scores and would therefore have a mid-ranging score if assessed as an entire section. As with the human sample, bacterial bioerosion was the cause of poor preservation. All samples derive from free-draining machair sand and therefore the general burial environment is considered unlikely to have impacted on variations in preservation, although micro-environmental differences may have had an impact. Variation in pre-depositional treatment is considered most likely to be the driver of the differing levels of microstructural preservation. The articulation level and macroscopic evidence for pre-depositional treatment, particularly butchery, provide indications of practices that may have affected variation in preservation. Therefore samples are discussed in four categories: A. fully articulated skeletons with no butchery; B. articulated with some butchery evidence; C. partially articulated limbs; and D. disarticulated fragments. Animals are described in the text by their context numbers.

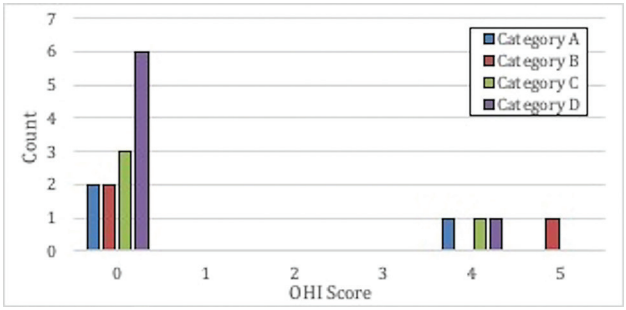


Figure 20.4. Distribution of OHI scores across the four categories (A: articulated, no butchery; B: articulating, butchered; C: partially articulated limb; D: disarticulated)

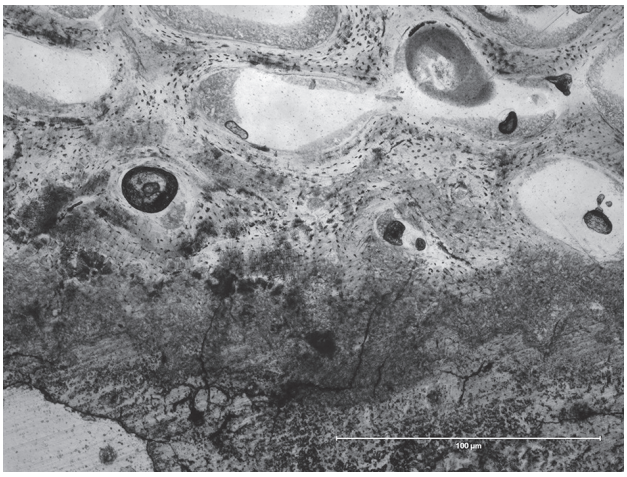


Figure 20.5. Micrograph of the dog humerus (context 806) in thin section, with the endosteal surface at the top of the image (micrograph taken by C. Clarke)

Category A – articulated deposits with no butchery

Samples assigned to this category comprise one adult female sheep and two dogs[2] and are assumed to have been deposited fully fleshed. The sheep (SF 5177) from context 3325 was deposited whole in a pit in Phase 4 and had OHI scores of 0. The larger dog (SF 3380 from pit 1292) was lying on its front in a pit and was largely complete, except for the right hindlimb. This specimen was used as a comparator for bone porosity for the human burials and demonstrates a higher degree of degradation than the composite male (burial SF 2638; Parker Pearson *et al.* 2005, 2007). It also shows worse histological preservation than all three elements sampled from the composite male, scoring 0 compared to 4/5. This suggests that both animals were swiftly buried fully fleshed with *in-situ* collagenolytic gut bacteria causing bioerosion to the corpses' microstructure. The well-preserved histology of the composite male human (SF 2638) suggests that exogenous soil bacteria within the burial context cannot be responsible for the degradation.

The smaller dog (SF 3376 in context 806), found close to the dog in pit 1292, was also lying on its front in a pit. This skeleton was cut by a later posthole, removing the hindquarters; some of these elements were recovered from this feature's fill. The skull and associated cervical vertebrae were missing from the undisturbed skeleton, and the pit was too small to have ever accommodated these elements in articulation. Although no butchery was observed, the pit dimensions and the presence of the smaller extremities, such as phalanges, all suggest deliberate removal of the head, rather than its loss as a consequence of soft-tissue degeneration prior to burial. Histological analysis of this dog's humerus shows contrasting patterns of preservation on the inner and outer surfaces (Figure 20.5); due to the bone's thin cross-section, the central zone was not assessed. The periosteal surface was poorly preserved, with extensive micro-fissuring and bacterial attack and a lack of birefringence. By contrast, the endosteal surface is very well preserved, with full birefringence and clearly observable osteocyte lacunae.

There is a clear and relatively sharp interface between the areas of good and poor preservation, suggesting the arrest of microbial attack. This contrasting pattern of preservation is comparable to that reported in the adult male (SF 2638) femur from Cladh Hallan (Parker Pearson *et al.* 2005; 2007; Summerfield 2004). It may be suggestive of a rapid change in environment sometime after burial. Although soil chemistry and hydrology can alter over time (Turner-Walker and Jans 2008: 277), it is highly unlikely that any such change could have been sufficiently rapid to produce this pattern, which is unlikely anyway in the free-draining sand of South Uist's machair. It is possible that this animal was killed elsewhere, that decay commenced and was then arrested by moving its corpse to a different, preserving environment prior to final burial.

For the adult male composite skeleton (SF 2638), observed changes in microporosity and crystallinity have led to the suggestion that this preservative environment was

Table 20.2. Sample details and results from the histological analysis of animal bone

Phase	Category	Context	House/area	Feature	Taxon	Age/fusion	Butchery	Gnawing	Sampled element	Articulated	Approximate completeness of skeleton and/or elements present	Hist. Index: endosteal zone	Hist. Index: central zone	Hist Index: periosteal zone	Birefringence Index	Comments
12	A	806	401	Pit 807	Dog	Adult	N	N	Humerus	Y	50%. No skull or mandible, (no axis or atlas). Forelimbs, ribs and spine	4	n/a	0	0.5	Non-Wedl; microfissures at periosteal surface.
12	A	1291 /659	401	Pit 1292	Dog	Adult	N	N	Femur	Y	75%. Skull, mandible, spine, majority of forelimbs, pelves and left hind limb	0	0	0	0	Non-Wedl
4	A	3325	1370	Pit 3324	Sheep	4–6 years	N	N	Femur	Y	90%. Only right calcaneum and left patella missing	0	0	0	0	Principally non-Wedl; large microfissure in central zone. Possible Wedl on periosteal surface.
12/13	B	792	401	Pit 1170	Sheep	2–3 years	D, J	N	Femur	Y	70%. Skull, mandible, thoracic & lumbar vertebrae, left scapula, both sides humerus, radius & ulna, right pelvis, both hind limbs	5	5	5	1	
8	B	2674	401	Pit 2673	Sheep	3–4 years	D, F	Y	Radius	Y	90%. Head, spine, ribs, limbs (excl. femurs & left tibia), metapodials & phalanges	0	0	0	0	Non-Wedl; microfissures at periosteal surface.
11	B	855	Fore court	Pit 863 (in pit 897)	Sheep	>42 months	D, F	N	Humerus	Y	25%. Trunk elements, scapulae, vertebrae & ribs, pelves, left humerus & femur	1	0	0	0.5	Non-Wedl
8	C	2636	1370	Pit 2635	Sheep	6–42 months	J	N	Humerus	Y	30%. Pair of humerus/radius/ ulna & carpals	0	0	0	0	Non-Wedl; microfissures on endosteal surface and central zone.
12	C	473	NE Area	Ash deposit	Sheep	<5–7 months	N	N	Metatarsal	Y	Right lower hindlimb group, navicular cuboid, medial cuneiform, metatarsal & phalanges	0	0	0	0.5	Non-Wedl; microfissure on periosteal surface.

(Continued)

Table 20.2. Sample details and results from the histological analysis of animal bone (Continued)

Phase	Category	Context	House/area	Feature	Taxon	Age/fusion	Butchery	Gnawing	Sampled element	Articulated	Approximate completeness of skeleton and/or elements present	Hist. Index: endosteal zone	Hist. Index: central zone	Hist Index: periosteal zone	Birefringence Index	Comments
12/13	C	792	401	Pit 1170	Sheep	>2 years	N	N	Metatarsal	Y	20% vertebrae, ribs, fore and hindlimbs to metapodials	4	5	4	0.5	Very slight non-Wedl on endosteal surface.
15	C	452	401	Burnt deposit	Cattle	Fused?	N	n/a	Radius	Y	Radius, ulna and carpals	0	0	0	0.5	Non-Wedl; microfissures on endosteal and periosteal surfaces
8	D	2674	401	Pit 2673	Sheep	unfused dist	N	n/a	Radius	N	Isolated element	0	0	0	0.5	Non-Wedl
11	D	467	Fore court	Pit 1498	Cattle	N/A	N	n/a	Tibia	N	Isolated element	0	0	0	0.5	Non-Wedl; microfissure on endosteal surface.
11	D	468	Fore court	Pit 1498	Red deer	N/A	N	n/a	Radius	N	Isolated element	0	0	0	0.5	Non-Wedl; microfissure on endosteal surface.
11	D	655	401	Floor	Sheep	N/A	N	n/a	Humerus	N	Isolated element	4	4	4	1	Slight non-Wedl
11	D	1290	401	Floor	Cattle	N/A	N	n/a	Metatarsal	N	Isolated element	0	0	0	0	Non-Wedl; microfissures on endosteal surface and central zone.
11	D	1290	401	Floor	Red deer	N/A	N	n/a	Radius	N	Isolated element	0	0	0	0	Non-Wedl; microfissure on endosteal surface.
11	D	1447	Fore court	Pit 897	Sheep	N/A	N	n/a	Tibia	N	Isolated element	0	0	0	0.5	Non-Wedl; microfissures on endosteal and periosteal surfaces

a peat bog (Parker Pearson *et al.* 2007). Similar research has not been conducted on the dog but a rapid change of environment to one in which bacteria could not attack the bone seems likely. Deposition in a bog prior to final deposition is a plausible scenario in South Uist where wetlands are common.

An alternative possible explanation, assuming osteolytic bacteria are linked to bacteria associated with soft-tissue decomposition, is that the dog was left to decompose on the ground for a short time, long enough for the head and cervical vertebrae to detach from the body before the remains were finally buried. In this scenario the inhibited bacterial bioerosion that we see in the bone may be attributable to defleshing by exogenous factors, particularly invertebrates, limiting the level of bacterial soft-tissue decomposition to which the bones were exposed (Fernández-Jalvo *et al.* 2011; White and Booth 2014; Booth 2016; Kontopoulos *et al.* 2016). This scenario would depend on the plausibility of a short period of exposure having sufficiently inhibited bacterial bioerosion linked to soft-tissue decomposition, which is difficult to gauge in the absence of experimental evidence. In either scenario, combined with the evidence of the deliberate removal of the head, this indicates diverse and complex modes of pre-depositional treatment. It is clear that animals that, at first glance, appear to be in a similar state were not subject to the same depositional practices.

Category B – articulating deposits with butchery

This category comprises three articulated sheep deposits. Relatively complete collections of articulating material are generally indicative of the deposition of material still joined by connective tissue. However, butchery evidence (accompanied by gnawing in one instance) suggests the careful collection of dissociated or partially articulated remains prior to deposition. Sheep SF 4748 from context 2674 is largely complete, with only a few missing hind limb elements. Disarticulation and filleting marks show that this carcass was exploited for meat whilst canid gnawing demonstrates that it was at least briefly exposed.

The second sheep (SF 3392 from context 855) comprises the trunk and part of the limbs and, again, butchery marks indicate both disarticulation and filleting. Both sheep skeletons show very poor histological preservation, with very little preserved microstructure and micro-fissures in SF 4748. This is consistent with the deposition of remains with some soft tissue, with gut bacteria having migrated and attacked the microstructure. This contrasts with the evidence for carcass division and meat removal and is best explained by the deposition of offal that harbours collagenolytic gut bacteria along with the skeletal remains. Exogenous soil bacteria cannot, however, be discounted from involvement.

The other sheep (SF 3175 in context 792) showed similar levels of completeness and butchery but differed in exhibiting well-preserved histology (Figure 20.6). The fill of this pit consisted almost entirely of tightly packed bones, derived mostly from this burial, with little associated sediment (see Volume 1: fig. 9.6). An articulated lower right hind limb from this context was also analysed (see category C). The majority of sampled faunal remains from Cladh Hallan show poor histological preservation, an unusual pattern in histological research, and therefore this well-preserved specimen warrants further consideration. The associated hind limb group (see category C) shows similar patterns of preservation. Equifinality complicates interpretation. The well-preserved histology may be the product of an unusual burial microenvironment, with little sediment matrix, providing a setting in which bacteria did not thrive. Alternatively, it could be that both deposits, despite being in articulation, may have been fully eviscerated and defleshed prior to deposition, meaning that gut bacteria were not present in the deposit. A further possibility is that this pit represents a secondary burial environment after both sets of remains had been initially deposited in an anoxic environment where bacteria could not attack the bone. It is not possible to establish which of these scenarios took place, but the unusual nature of the burial environment, coupled with the exceptional patterns of preservation in the context of the Cladh Hallan faunal samples, makes this latter explanation tempting.

Category C – partially articulated limbs

This group includes three articulated sheep limbs and a cattle limb. Two largely complete forelimbs of a sheep (SF 4761) with butchery marks associated with separation at the joint were recovered from context 2636. These surely represent an intentional deposit, rather than waste discard. None of the other category C deposits exhibit evidence of butchery. The other two sheep deposits include right lower hind limbs, a metatarsal and tarsals associated with the category B sheep deposit SF 3175 in pit 1170, and tarsals, metatarsals and phalanges from context 473. These deposits of meat-poor extremities could be primary waste.

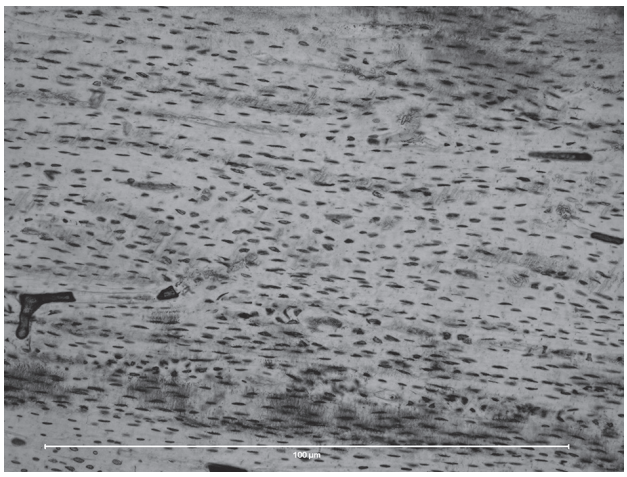


Figure 20.6. Micrograph of the metatarsal of sheep SF 3175 (context 792) in thin section showing the central zone of the compact bone (micrograph taken by C. Clarke)

The cattle deposit (context 452) consists of a left radius, ulna and carpals; potentially a group discarded prior to full processing, rather than an intentional deposit, though such instances are rare at Cladh Hallan.

With the exception of the remains from SF 3175 (context 792), associated with the well-preserved category B skeleton, all limb deposits showed very poor histological preservation (with all zones scoring 0). Very little birefringence was observed in the samples. It is unlikely that these remains were deposited with offal, and the extremities would have held little meat.

There is a lack of experimental research to determine how rapidly gut bacteria migrate around the body after death, but it is possible that this occurred prior to disarticulation and therefore endogenous bacteria could have attacked the bone prior to deposition. However, experimental research in Texas suggests that, in that environmental zone at least, bacterial attack can be far slower (Mavroudas *et al.* 2023). Alternatively, it is possible that exogenous bacteria from the soil were responsible for the poor preservation, or that bacteria from offal had permeated the burial environment and become more widespread (Turner-Walker 2019). The articulating elements from SF 3175 show very similar levels of macroscopic preservation and completeness to the other deposits but contrast greatly in terms of their histology. Although not as well preserved as the associated butchered skeleton, each zone scored 4 or 5, and birefringence was also present across most of the section. This atypical preservation may relate to the unusual character of the depositional environment, as the pit fill was made up almost entirely of bone, with little sedimentary matrix.

Alternatively, the skeleton and limb in this deposit may have been subject to a particular pre-depositional mode of treatment that prevented bacterial attack. Initial deposition in a bog provides a possible interpretation in the context of the environment of South Uist, but other forms of soft-tissue preservation would also have inhibited bacterial activity. Although some of the Category C deposits may represent primary butchery waste, their intentional burial still represents a non-normative mode of deposition, as most animal bone would have become disarticulated through stewing, exposure or scavenging. These deposits could represent token sacrifices such as foundation or re-foundation deposits, reducing the real loss to the community by using meat-poor elements instead of whole skeletons.

The cattle limb (452) is inconsistent with primary waste, and its poor histological preservation suggests fleshed deposition. This could be spoiled meat or, perhaps more likely given its location, a foundation deposit representing a small sacrifice by the community.

The two largely complete forelimbs of a sheep (SF 4761 from context 2636) differ from other Category C deposits in their completeness and are also inconsistent with primary waste. Analysis of butchery shows that the limbs were divided into consumable portions but were placed in close articulation on deposition. It is tempting to suggest that this represents a sacrificial foundation deposit. The poor histological preservation (Figure 20.7) is consistent with fleshed deposition, without any of the special treatment that may have been afforded for the deposits in context 792 (pit 1170), but intent is clear. Overall, it seems that the articulated limbs have been treated in different ways and cannot be regarded as a homogeneous group, in spite of their similar macroscopic appearance.

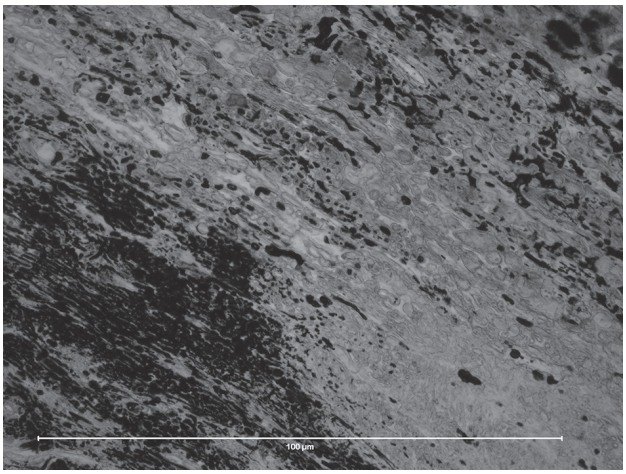


Figure 20.7. Micrograph of a forelimb of sheep SF 4761 (context 2636) in thin section showing the central zone of the compact bone (micrograph taken by C. Clarke)

Category D – disarticulated fragments

The disarticulated samples were analysed primarily to provide a baseline for the Cladh Hallan depositional environment and to establish whether exogenous, as well as endogenous, bacterial attack occurred at the site. These isolated fragments appear to be the ordinary waste of butchery and consumption. They are likely to have been subject to a significant level of processing, cooking and/or sub-aerial exposure, and macroscopic and histological analysis should reflect this.

Surprisingly, six of the seven samples exhibited poor micro-structural preservation regardless of context type, location, species or element. These six also showed little evidence of birefringence, with a total absence in two specimens. The dominance of poorly preserved remains was not expected but is paralleled by Summerfield's (2004) work on Cladh Hallan material. As highlighted above, the bulk of previous research suggests that endogenous gut bacteria are primarily responsible for bioerosion. There is no reason to assume that these remains were deposited with offal or soft tissue and this therefore raises the possibility that exogenous soil bacteria have attacked the bone microstructure.

Isotope analysis has demonstrated consistently excellent collagen yields from Cladh Hallan bone material (Jones and Mulville 2016; Mulville *et al.* 2009), suggesting that most remains were not intensively cooked, which would have led to collagen loss. Further research on the

relationship between collagen preservation and microbial attack is required, however, to elucidate whether this may be partially responsible for the patterning. The excellent collagen preservation would mean that the remains were attractive to collagenolytic bacteria, but it is difficult to discern whether these agents of bioerosion derive from the soil or associated offal. Given the range of contexts, it seems unlikely that all specimens were deposited with meat/offal and therefore degradation by exogenous bacteria seems likely. Turner-Walker (2012) has suggested that variability in levels of bacterial bioerosion in bones from different species may reflect differences in bone porosity, with osteolytic soil bacteria struggling to exploit denser bones from larger animals. This scenario does not, however, explain the patterns of bioerosion observed in this dataset.

Two category D specimens are particularly worthy of further discussion. A disarticulated radius from context 2674, associated with the category B sheep skeleton SF 4748 from the same pit, demonstrates similarly poor histological preservation, with both radii from this context having OHI scores of 0 across all zones, and little evidence of birefringence. This is another example of deposits from the same context in different states of articulation showing the same pattern of histological preservation. Equifinality complicates interpretation, as this could result from the endogenous bacteria of the articulated deposit migrating to associated material or, alternatively, from soil bacteria in the depositional environment attacking all bone.

A sheep humerus from a house floor (context 655) was exceptional in exhibiting very well-preserved histology, with OHI scores of 4 in all zones and full birefringence. Macroscopically, this was the most poorly preserved specimen, showing extensive evidence of sub-aerial exposure (stage 2 weathering). Sub-aerially exposed, disarticulated specimens would be expected to show good histological preservation, given the absence of gut bacteria. However, the fact that this specimen is anomalous suggests that floor 655 may be unusual, either in the absence of exogenous collagenolytic bacteria or in the absence of offal in the deposit.

The prevalence of specimens with poor microstructural preservation, regardless of context, taxon or articulation level, suggests that soil bacteria may be at least partially responsible for the patterns of degradation. The potential impact of soil bacteria remains hotly debated (*e.g.* Booth *et al.* 2024; Turner-Walker 2019; Turner Walker *et al.* 2023), but it may be the case that certain environments are conducive to collagenolytic soil bacteria while, in others, soil bacteria are most likely to be responsible for bioerosion (Morales *et al.* 2018). The machair sands of Cladh Hallan are unusual in a British context and may provide one such environment. Similarly high levels of bacterial bioerosion have been observed amongst disarticulated animal bones from Danebury hillfort (Booth *et al.* 2022). Soil conditions at Danebury are very different to those at Cladh Hallan, but potentially there may be similarities – such as their calcareous character – which would help explain these signatures.

20.3 Summary

Inference of early *post-mortem* treatment from histological analysis of bone diagenesis is a developing field and, as with all forms of taphonomic analysis, interpretive difficulties and problems of equifinality persist. The results of the histological analysis of bones from Cladh Hallan defy easy interpretation because the results run counter to patterns of bacterial bioerosion that have been observed across other archaeological sites and have been linked to the early stages of deposition (Bell *et al.* 1996; Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007; Booth 2016; Brönnimann *et al.* 2018). The data provide clear evidence for some degree of structure in the deposition of both faunal and human remains and add to the very limited corpus of prehistoric faunal histotaphonomic data from Britain (see Booth *et al.* 2022; Bricking *et al.* 2025).

At Cladh Hallan, butchered, disarticulated animal bones have often been extensively bioeroded, whereas normally these remains tend to show little or no bacterial bioerosion (Jans *et al.*, 2004; Nielsen-Marsh *et al.* 2007; Morales *et al.* 2018). Articulated human and animal bones from aerobic archaeological environments conventionally show high levels of bacterial bioerosion (Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007; Booth 2016) but at Cladh Hallan levels of bacterial attack across articulated skeletons are highly variable. Variability in depositional contexts affecting either soil microbiomes and/or bacterial bodily decomposition (*e.g.* anoxic environments) can sometimes help to explain variability in bone bioerosion (Turner-Walker and Jans, 2008) but the depositional environments at Cladh Hallan are aerobic and uniform in their composition (machair sand).

Complementary analysis of some of the human remains provides additional evidence of relatively exceptional treatment of some of the human bodies, namely mummification (Parker Pearson *et al.* 2005; 2007; Hanna *et al.* 2012). Patterns of bacterial attack on all other human samples are broadly consistent with their depositional circumstances; *i.e.* articulated skeletons show high levels of bacterial attack, suggesting primary burial, and disarticulated bones show low levels of bacterial attack, indicating excarnation or defleshing.

Evidence for exceptional treatment of human remains in certain contexts at Cladh Hallan may hint that exceptional practices could also be responsible for contradictory taphonomic signatures in the faunal assemblage, but this cannot be taken for granted. In these cases we have to speculate as to whether other unknown factors contributed to patterns of bone bioerosion. One possibility is that butchered animal bones were often buried surrounded by discarded offal and decomposing soft tissue, which either infected bones with osteolytic putrefactive gut bacteria or made bones more attractive to osteolytic soil microorganisms.

An alternative possibility is that machair soils produce specific microenvironments that variably affect the proliferation of the osteolytic soil microbiome. At the very least, the results from the faunal material, both in terms of the histological analysis and more traditional taphonomic indicators such as state of articulation, indicate that treatment of animal bone at Cladh Hallan was complex and highly variable. Combined with the similarly variable taphonomic signatures observed in the human remains, these results suggest that complex systems of thought and belief were involved in the *post mortem* treatment and deposition of both human and faunal remains at Cladh Hallan in the late second and early first millennia BC.

Notes

1 The depth of child burial SK 2727 is such that it was the one skeleton susceptible to seasonal rises in the water table but the bones show high levels of bacterial attack rather than the low levels expected from waterlogged environments. Since it shows no signs of *post mortem* manipulation, any effects of waterlogging are negligible.

2 See Chapter 10.14 *Articulated bone groups* for full information on samples in categories A, B and C.

21 Ancient DNA survival analysis of faunal remains

V.E. Mullin

It is widely considered that the field of ancient DNA (aDNA) has its origins in the sequencing of mitochondrial DNA (mtDNA) from the extinct quagga (Higuchi *et al.* 1984). With improvements in sequencing technology and aDNA retrieval, the applications of aDNA have become more wide-reaching since the beginnings of the field of study. Ancient DNA is utilised for many purposes, from species identification (Yang *et al.* 2004; 2005) and molecular sexing (Park *et al.* 2015; Skoglund *et al.* 2015) to population genomics and selection (Gamba *et al.* 2014; Librado *et al.* 2017; Daly *et al.* 2018).

Inferring past genetic variation and demographic events from modern-day genomes can be challenging, especially for domesticates that have undergone human-mediated migrations and recent breed formation (Kijas *et al.* 2009; Speller *et al.* 2013; Decker *et al.* 2014; Lenstra *et al.* 2014). Therefore, ancient DNA offers the scientific community a chance to directly study genetic variation in the past. Unfortunately, the study of aDNA is complicated by the *post mortem* degradation of DNA (Lindahl 1993). Ancient DNA is characterised by short, fragmented, damaged and easily contaminated sequences (Hofreiter *et al.* 2001). The breakdown by microorganisms and nucleases helps to reduce the size of the DNA sequences, while chemical degradation such as deamination and depurination causes changes in the coding sequences (Pääbo *et al.* 2004). For these reasons, the recovery of aDNA from archaeological assemblages can be challenging and should be carried out in specialist laboratory conditions (Cooper and Poinar 2000).

The purpose of this study was to assess DNA survival within faunal remains at Cladh Hallan.

21.1 Materials and methods

Fourteen petrous bones morphologically identified as *Bos taurus* and *Ovis aries* and one petrous bone of *Cervus elaphus* were sampled for DNA preservation (Table 21.1). The petrous portion of the temporal bone was chosen, as the chances of DNA survival are greater in this bone element than others, as first demonstrated by Gamba *et al.* (2014).

All sample preparation, extraction and library preparation were performed in a dedicated ancient DNA laboratory in the Smurfit Institute of Genetics, Trinity College Dublin. Standard aDNA protocols were used throughout the process (Cooper and Poinar 2000; Pääbo *et al.* 2004).

For each sample, 0.09–0.3g of bone powder was subject to DNA extraction as first described by Yang *et al.* (1998), later modified (MacHugh *et al.* 2000; Gamba *et al.* 2014), and using a two-stage extraction (Orlando *et al.* 2011). Double-stranded libraries were constructed from 16.25 µL–30 µL of DNA extract based on the protocol of Meyer and Kircher (2010) with modifications as reported in Gamba *et al.* (2014). Briefly, blunt-end repair was performed using NEBNext® End Repair Module (New England Biolabs Inc.) and during the final step of adapter fill in *Bst* activity was arrested through heat inactivation (20 minutes at 80°C). Indexing of PCRs was performed as set out by Daly *et al*. (2018) and libraries were screened on an Illumina MiSeq™ platform at TrinSeq (Trinity Genome Sequencing Laboratory, Trinity College Dublin, Ireland) using 50bp single-end sequencing and a PhiX control at 1%.

Raw sequence reads were processed through a pipeline prior to analysis (Daly *et al*. 2018). Where multiple extraction steps were sequenced, reads were aligned separately and merged downstream. Sequence reads were aligned using the Burrows–Wheeler algorithm (BWA; version 0.7.5; Li and Durbin 2009) to the *Bos taurus* genome (bosTau6) or the *Ovis aries* genome (Oar_v3.1) or *Cervus elaphus* (CerEla1.0). Samtools (version 0.1.19; Li *et al.* 2009) was then utilised to filter reads for duplications and a mapping quality of 30.

Ancient DNA carries signatures of *post mortem* deamination, characterised by an increase of cytosine to thymine misincorporation. These substitutions are clustered toward the termini of the read due to the acceleration of deamination of cytosine at single-stranded overhangs, creating the pattern of cytosine to thymine at the 5' termini of the reads, and therefore a reciprocal pattern of guanine to adenine misincorporation at 3' end (Brotherton *et al.* 2007; Ginolhac *et al.* 2011). This chemical signature of

aDNA can be utilised to assess the degree of deamination present and therefore to judge the authenticity of the aDNA. The programme MapDamage has been developed to assess the degree of misincorporation at the 5' and 3' read ends (Jónsson *et al.* 2013). MapDamage (2.0) was therefore performed to access the damage patterns present in the samples.

Molecular sex was determined by examining the relationship of the number of aligned reads per chromosome relative to the length of the chromosome. The ratio of reads aligned to the X chromosome versus its length was then utilised to estimate the sex of each sample (Park *et al.* 2015; Daly *et al.* 2018).

Three samples (VEM179, VEM178 and VEM146) were directly radiocarbon-dated at the ^{14}Chrono Centre, Queen's University Belfast. Samples were calibrated using OxCal v4.3.2 (Bronk Ramsey 2017) using the IntCal13 atmospheric curve (Reimer *et al.* 2013).

Table 21.1. Results for the 15 specimens sampled for ancient DNA survival. For each sample the Trinity College Dublin laboratory name, genetic species ID, archaeological context, phase and area are denoted. Three samples were radiocarbon dated at the ^{14}Chrono Centre, and calibrated using OxCal v4.3.2 (Bronk Ramsey 2017) using the IntCal13 atmospheric curve (Reimer et al. 2013). Total number of sequenced reads, number and percentage of reads aligned to the reference genome, number and percentage of filtered reads (removal of duplicates and mapping quality of 30) and molecular sex are quoted for each sample

Phase	Lab name	Species	Context	Area	Date BP	Date cal BC	UBA No.
4	VEM159b	*Cervus elaphus*	3209	House 2835			
6	VEM179	*Bos taurus*	2423	NE Area	2856 ± 33	1119–923	UBA-34262
8	VEM150	*Ovis aries*	462	House 401			
8	VEM178	*Bos taurus*	2746	NE Area	2823 ± 34	1087–899	UBA-34263
9	VEM174	*Ovis aries*	2405	W Area			
11	VEM147	*Ovis aries*	1414	House 401			
11	VEM148	*Bos taurus*	1413	House 401			
11	VEM160	*Bos taurus*	412	S Area			
11	VEM161	*Bos taurus*	1423	House 401			
11	VEM169	*Bos taurus*	1445	House 401			
11	VEM175	*Ovis aries*	2408	NE Area			
12	VEM146	*Bos taurus*	738	Forecourt	2789 ± 47	1054–826	UBA-29054
12	VEM149	*Bos taurus*	731	N Area			
14	VEM151	*Ovis aries*	1436	House 150			
14	VEM168	*Bos taurus*	462	House 401			

Lab name	Total reads	Aligned reads	% Endogenous aligned	Filtered reads	% Endogenous post-filtering	Sex
VEM159b	1,043,352	606,336	58.11	332,170	31.84	Male
VEM179	810,766	661,390	81.58	439,925	54.26	Female
VEM150	390,728	333,859	85.45	242,480	62.06	Male
VEM178	822,946	727,589	88.41	478,603	58.16	Female
VEM174	612,455	187,534	30.62	130,957	21.38	Male
VEM147	455,845	343,982	75.46	195,619	42.91	Female
VEM148	107,758	75,109	69.70	45,959	42.65	Female
VEM160	1,830,660	1,542,266	84.25	976,313	53.33	Female
VEM161	1,689,270	979,688	57.99	628,020	37.18	Female
VEM169	505,626	393,731	77.87	258,104	51.05	Female
VEM175	402,744	145,444	36.11	91,499	22.72	Female
VEM146	789,302	703,104	89.08	466,946	59.16	Female
VEM149	276,764	229,932	83.08	146,588	52.96	Male
VEM151	443,770	347,380	78.28	251,609	56.70	Female
VEM168	432,061	350,383	81.10	227,502	52.66	Female

21.2 Results and discussion

Endogenous DNA

DNA was successfully extracted and sequenced from all the samples, with endogenous percentages > 20% (Table 21.1) and damage patterns associated with aDNA (Figure 21.1) (Jónsson *et al.* 2013). Morphological identification was correct in all but one sample.

Typically, archaeological bone contains very little endogenous DNA, with most of the total DNA content formed of environmental microbial DNA (Orlando *et al.* 2015). However, the relatively high endogenous percentages demonstrated in the Cladh Hallan samples are not unique – of note is a 70% Denisovan sample from the Denisova cave site in the Altai mountains (Meyer *et al.* 2012). Moreover, the bone element used here has previously been demonstrated to yield higher endogenous DNA percentages than alternative skeletal elements (Gamba *et al.* 2014). These endogenous DNA percentages are comparable to values previously published for well-preserved petrous portions of the temporal bone from European sites (Gamba *et al.* 2014; Cassidy *et al.* 2016; Frantz *et al.* 2016; Martiniano *et al.* 2016).

Nonetheless, the use of the petrous does not guarantee aDNA survival as the *in situ post mortem* environment is important for DNA survival, with DNA preservation varying between sites and within a single assemblage (Table 21.1; Ottoni *et al.* 2009). While temperature, and temperature stability, are key to the longevity of DNA (Lindahl 1993; Smith *et al.* 2003), there are other factors that may affect the rate of decay, including *post mortem* modification variously by cooking, species of microorganisms in the soil, salt content, pH and the availability of oxygen and free water (Lindahl 1993; Ottoni *et al.* 2009; Campos *et al.* 2012). Furthermore, rapid loss of DNA has been shown to occur in the first year of death (Campos *et al.* 2012) and, while this loss may be associated with putrefaction of soft tissue, it may also be associated with the taphonomic environment of the individual sample. Moreover, endogenous DNA content is known to vary within a single sample (Rasmussen *et al.* 2014). Thus, it is unsurprising that there is variation in the endogenous content of the samples from Cladh Hallan. Variation in endogenous DNA content notwithstanding, these levels of preservation do allow for the inclusion of these samples in further population genetic studies.

Molecular sex

The molecular sex analysis of the domesticate samples demonstrates a predominance of females over males, especially in cattle (eight out of nine are female; Table 21.1). Although these results are from a small sample size covering a variety of phases, it is interesting that the majority of cattle petrous bones sampled were female. Whilst age could not be assessed for this study, the molecular sex results are still of note and the possibility of the use of herd management strategies is tentatively considered. Herd management strategies have traditionally been studied by zooarchaeologists via kill-off patterns. This entails calculating the relative representation of different

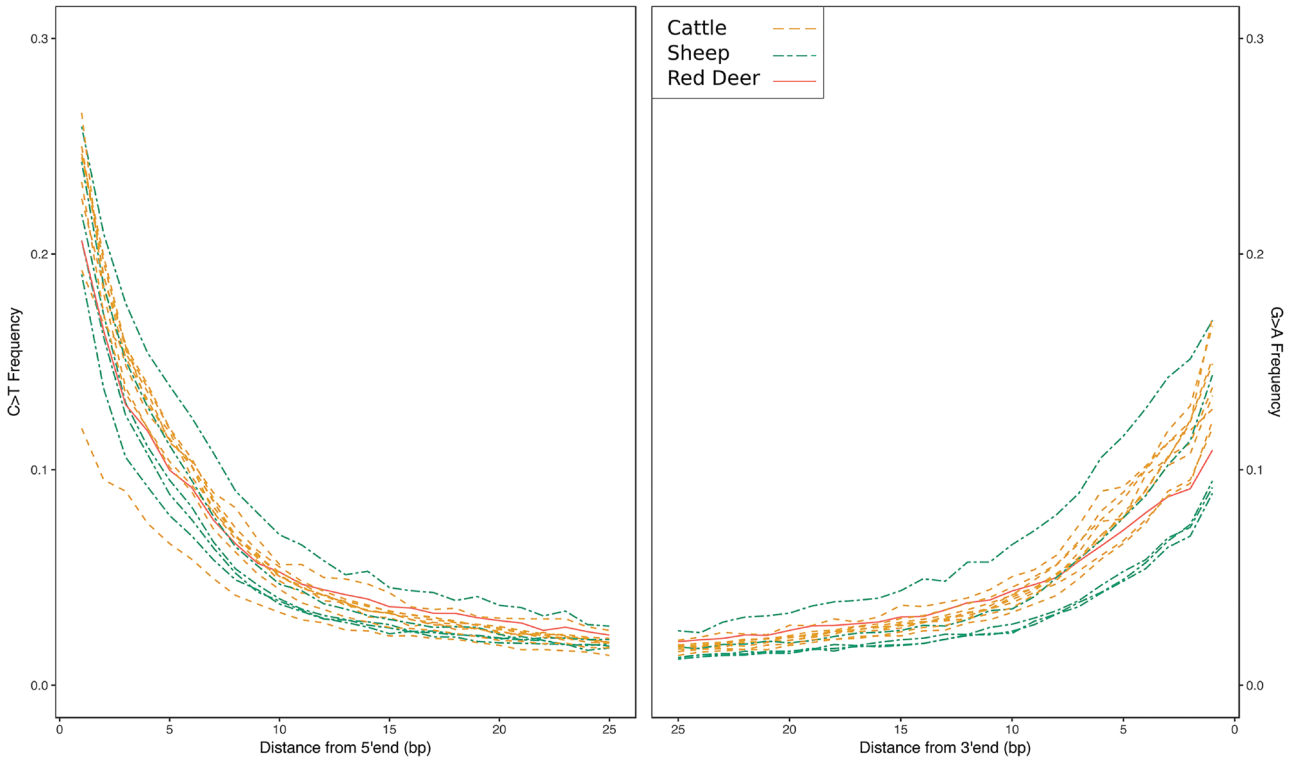


Figure 21.1. DNA damage pattern results for all samples demonstrate the increase in deamination towards the end of the sequencing. Checking for these damage patterns in ancient DNA sequencing reads is a widely used method for validation of genuine ancient DNA. Line type and line colours are according to species

age-groups and the sex of the bones (Payne 1973; Svensson *et al.* 2008; McGrory *et al.* 2012).

For cattle, the kill-off pattern for different management strategies differs for beef and dairy herds. The pattern for a beef herd would involve the slaughter of cattle of both sexes at 19–36 months of age, while a dairy herd would see a slaughter of surplus calves less than six months old, with a sex ratio of two males for every female among the slaughtered calves (Payne 1973; Svensson *et al.* 2008; McGrory *et al.* 2012). Within a dairy herd there would thus be a predominance of females over males beyond the 6-month age group. While age profiles for the aDNA samples could not be calculated, they show a majority of females of both cattle and sheep in the samples from Cladh Hallan. Furthermore, faunal analysis suggests that Cladh Hallan's cattle herd was indeed managed for dairying (see Chapter 10), which these sexing results would loosely support.

21.3 Conclusion

In conclusion, endogenous DNA was successfully extracted and sequenced from all 15 samples from Cladh Hallan, resulting in data for nine cattle, five sheep and one red deer. Endogenous percentages were high for aDNA, with all samples demonstrating authentic aDNA damage patterns. In addition, molecular sexing reveals a predominance of female domestic animals in the sample. The good preservation of aDNA in these samples bodes well for further sequencing and subsequent population genetic analysis of the Cladh Hallan assemblage.

22 Coprolites

M. Parker Pearson

Some 1.3kg of coprolites were recovered from excavations at Cladh Hallan, all but one item coming from contexts in Area A and all limited to Phases 3–5, 8–13 and 16. Coprolites and fragments were recovered on site during sieving through 10mm mesh and also during flotation as heavy residues with 1mm mesh. They are considered to be canine, on the basis of morphology and size (Figure 22.1), although single stools from the upper and lower floor layers of House 1370 in Phase 9 (ESN 3540 from 1369 and ESN 3967 from 2211) may be of human origin. Whilst an impressive range of scientific analyses is possible for the study of ancient coprolites (*e.g*. Shillito *et al*. 2020), and the study of coprolites from the nearby Norse site of Cille Pheadair has yielded useful results on the small mammals and fish consumed by the dogs in that settlement (Williams and Ingrem 2018), only a contextual analysis is presented here. The potential is there, however, for future studies of the assemblage in the Cladh Hallan archive.

22.1 Distributions by phase

The chronological distribution of coprolites correlates broadly with the presence of canine remains in the different chronological phases, with most present in Phases 8–13 when faunal remains of dogs are also numerous (Table 22.1; see also Table 10.5). However, while numbers of dog bones rise progressively from Phase 8 to Phase 12, the period with most canine bones and coprolites, there is a temporary decline in the quantity of coprolites in Phase 11 before the highest quantity of faeces in Phase 12.

While a few dog bones were present in Phases 14–16, no coprolites were recovered from this end of the sequence except in House 640 (Phase 16) which may have been a smokery or steam room (Table 22.2). This absence of coprolites from House 401 during the final phases of occupation may indicate that dogs were no longer present in or around the house and that the 10 dog bones recovered from these last three phases may be residual. At the start of the sequence, coprolites were present in Phases 3, 4 and 5, indicating the presence of dogs even though none of their bones were deposited. Conversely, the earliest dog bones at Cladh Hallan are from Phase 6 whereas their coprolites are absent from Phases 6 and 7.

Coprolites from Phase 4 are few and derive from a posthole fill and floor layer of House 2835 (see Volume 1: 56–7, fig. 3.9). This is the earliest instance of a recurrent association of coprolites with occupation deposits – especially floor layers – within the houses at Cladh Hallan. As discussed in Volume 1, the contextual and soil micromorphological evidence together suggest that dog faeces accumulated on house floors at the end of each cycle of inhabitation at abandonment (*ibid*.: 248–50, 410, 412; for details of coprolite distribution, the reader may also make use of the index to Volume 1).

In Phase 5, 20.2g of coprolites were recovered from a thin layer of sand (2909) accumulated over a ploughsoil.

Table 22.1. Weights of coprolites in each phase compared with dog NISP

Material	Phase																Total
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	
Dog bones	0	0	0	0	0	3	0	1	6	24	44	271	16	5	1	4	375
Coprolites (g)	0	0	4	3.4	20.2	0	0	34.3	40.4	214.3	36.7	921.5	22.3	0	2	1.8	1300.9

Table 22.2. Weights of coprolites by context type in each phase

Phase	Context type	Weight (g)	Context numbers
3	S area pit	4	3286
4	House posthole	3.4	3210
5	Fill below house	20.2	2909
8	Wall core	16.2	803, 1930, 2571
8	Cut features	18.1	1663, 2394
9	House floors	18.1	1150, 1311, 1369, 2211
9	Inter-floor	14.5	2210
9	Postholes	5.1	2173, 2217
9	NE area fill	2.7	1790
10	Area C midden	39.2	132
10	Forecourt fills	110.9	853, 887, 889, 1102, 1305
10	House fills	52	1205, 1310
10	House posthole	0.6	1606
10	SE area posthole	11.6	1338
11	Forecourt fills	17	879
11	House fills	11.3	1414, 1423, 1582, 1609
11	South area	4.1	412
11	Gully fill	4.3	1547
12	House floor	38.7	595
12	Forecourt fills	26.5	743, 1322
12	Dog burial	80	1291
12	NE area fill	123.5	470, 473, 558, 572, 579, 834, 2000
12	N area fill	60.5	731, 1990
12	S area fill	520.3	2011, 2084
12	House inter-floor fill	72	659
13	Floor	9.8	465
13	House fills	3.5	512, 522
13	Posthole in house	9	634
15	Fill in House 401	2	433
16	Fill in House 640	0.5	645
16	Floor in House 640	1.3	656

A semi-circle of postholes cut into layer 2909 may have supported a light timber structure here over a Phase 3 cremation burial (3256). Perhaps this structure offered temporary shelter for dogs although the presence of disarticulated, unburnt human bones from layer 2909 hint at this as a formerly sacred or significant space encroached into by dogs.

In Phase 8, 34.3g of coprolites were recovered from construction contexts for the row of three roundhouses (see Volume 1: 104). The vast majority of these came from the wall cores and cut features of the southern building, House 801, with just a single instance from the basal layer of House 401. Since House 801 was built over layer 2909, it is possible that that sand deposit was the original context from which these stools were incorporated into wall core material and pit fills. A single dog bone from Phase 8 does, however, indicate that dogs were around at this moment in the settlement's development.

In Phase 9, 40.4g of coprolites were recovered from the floors of all three roundhouses (see Volume 1: 128, 153, 175–6, figs 5.15, 5.45, 5.50, 5.78, 5.81) though the largest quantity (14.5g) came from the inter-floor fill (2210) between the upper and lower floors of House 1370. Only one stool (SF 3885) came from outdoors, in the fill (1790) of a hollow in the northeast of Area A.

In Phase 10, 214.3g of coprolites were recovered from a wide variety of contexts. Some of these are fragments from the floor (1308) of House 401 (see Volume 1: 223, fig. 6.28) but the vast majority of stools and fragments were found in fill layers of House 401 (22.7g; *ibid*.: 214), its forecourt (110.9g; *ibid*.: 217) and in House 1370 (25.5g). The high numbers of coprolites in the forecourt of the central house suggest that this was an area where dogs gathered or were tethered. Elsewhere in this phase, coprolites were found in the southern part of Area A, in the abandonment fill of House 2190 and in an outdoor posthole (1339). Some 39.2g were recovered from a midden layer (136) within Area C, the only occurrence outside Area A.

In Phase 11, quantities drop to 36.7g. A few fragments were found in House 401's floor 655 (see Volume 1: 263, fig. 7.27) but most (17g) were from fill (879) in the forecourt (SF 3918). Other coprolites came from inter-floor fills of the two main houses (401 and 1370) and from outdoor features such as pits and a gully.

In Phase 12, a colossal 921.5g of coprolites coincide with the presence of two dog burials and two dog bone groups in this phase, as well as numerous disarticulated dog bones (Tables 10.5, 10.10). Nine stools (80g) lay in the pelvic area of one of the buried dogs (SF 3380 in pit 1292), evidently evacuated from its anus though whether at the time of death or afterwards is uncertain (see Volume 1: 289–90, fig. 8.14). A further 38.7g were recovered from the floor (595) of House 401 (SF 3301; *ibid*.: 296, fig. 8.28), 72g from inter-floor fill 659 (ESN 3380) and 26.5g from the house's forecourt (*ibid*.: 303). Outside House 401, 118g of coprolites came from layers in the northeast of Area A (*ibid*.: 304) and another 60.5g from the north of Area A. Layers at the south end of Area A produced 525.8g, most of this (500.9g) from a layer of compressed coprolites (2011) within the filled-in hollow of House 2190 (*ibid*.: 249, 281, fig. 8.4).

In Phase 13, quantities dropped to 22.3g, all derived from House 401, either from floor 465 (SF 3337, SF 3344; *ibid*.: 315, 320, fig. 9.15), from fill layers 512 and 522, and from the fill of posthole 633 (SF 3304, SF 3347; *ibid*.: 314). After this, the only faecal material is a single stool from House 401 in Phase 15 (see Figure 22.1) and a small amount (1.8g) from House 640 at the north end of Area A during Phase 16.

Figure 22.1. A canine coprolite (ESN 4065) from a fill layer (433) within House 401 in Phase 15

22.2 Discussion

In the urban world of today, most dogshit is not left as primary deposits, being either cleaned by public services or hand-collected in disposable bags by dog owners. It is certainly the case that the inhabitants of Cladh Hallan moved canine faeces, most demonstrably in Phase 12 when they accumulated a huge dump – only part of which was excavated as layer 2011 at the south end of Area A. Other deposits incorporated into fill layers either inside or outside the houses could also be the result of purposive disposal of this noxious material. It is also notable that outdoor surfaces such as the front yard (layer 1680) were entirely clear of faeces. As noted in Volume 1, some sort of clearing-up seems to have taken place outside as part of a waste management strategy and it is tempting to see this as the husbanding of a resource, either as fertiliser or, more likely, for tanning of animal hides (*ibid*.: 248–9).

Perhaps the contexts that provide the closest indications of where faeces formed primary deposits, and thus cast light on those areas to which dogs had access or even where they were tethered, are the floors within the houses. As noted above, these are likely to have been soiled with excrement during floors' abandonment. An interesting aspect of this is the substantial quantity of faeces found within the forecourt structure at the entrance of House 401. Coprolites occur here within Phases 10–12, all in fill layers indicating that they were buried rather than lying on surfaces. They could have been ejected from the house's interior but the relative lack of other domestic debris in the forecourt layers suggests that dogs may well have defecated in or around the forecourt, with the stools being then buried by the occupants in the conveniently soft sand here. This would make a plausible case for dogs having been kept in the forecourt building, perhaps as the place where they slept.

22.3 Conclusion

As noted in Chapter 10, the dogs at Cladh Hallan are unusual both in their prevalence and their deposition. The quantity of their skeletal remains is matched by the quantity of their faecal deposits, which are most prolific in Phases 8–12 during the eleventh–mid-seventh centuries BC. Many of the coprolites and fragments are likely to have been deposited on indoor floors during moments of abandonment within the houses' cycles of use and renewal. Yet the largest deposits, notably from within the ruined House 2190 at the south end of Area A, reveal that dog faeces were collected in selected zones. This was most likely for use in tanning or perhaps as fertiliser for the fields. Finally, the concentration of coprolites within the forecourt of the central roundhouse could indicate that this is where dogs were bedded, at least during Phases 10–12.

23 Cladh Hallan in its context

M. Parker Pearson

Between 1988 and 2002, excavations were carried out at Cladh Hallan in response to sand quarrying. This site consists of a series of eight settlement foci, within an area of 10ha, dating from the Beaker period (*c*. 2400–1850 BC) to the Early Iron Age (*c*. 750–500 BC). The sites sit within a deep deposit of ocean-derived shell sand which formed in the Late Neolithic after *c*. 3000 BC.

Late Bronze Age to Early Iron Age settlements are numerous on South Uist's machair (the grassy plain of the west coast), with 17 sites located in three areas: at Cladh Hallan in the south end of the island, between Cill Donnain (Kildonan) and Staoinebrig (Stoneybridge) in the middle of the west coast, and at Machair Mheadhanach and Hornish Point at the north end (Parker Pearson 2012a). There has been a certain amount of investigation of the Cill Donnain complex, consisting of small-scale excavations of a Late Bronze Age settlement at Cill Donnain (Parker Pearson and Zvelebil 2014), an Early Iron Age site beneath the broch of Dun Vulan (Parker Pearson and Sharples 1999: 50–2), and a group of Early Iron Age settlement mounds on Sligeanach machair (Sharples 2012b).

The prehistoric settlements investigated at Cladh Hallan survive as a group of sand mounds, of which the most intensively investigated (Area A) is 80m in diameter and 3m high. Limited excavations were also carried out on two smaller mounds to the north (Area B) and northwest (Area C).

Excavations in Area A between 1995 and 2002 revealed the northern half of a settlement of roundhouses arranged in a line running north–south. The three Late Bronze Age roundhouses of this north–south row that were fully excavated were built as a single unit, with shared walls, and may have been the northern end of a long row of about six to eight houses. The roundhouses with sunken floors provided excellent stratigraphic preservation, enhanced by the long-term build-up of deep sand layers over these settlements. The preservation of soft floor layers within the houses has permitted detailed analysis of patterns of domestic activity during occupation and at abandonment. Analysis of the floors entailed spot-sampling for phosphates, nitrogen and magnetic susceptibility on a 0.50m grid and flotation of the entire floor layer, divided into 0.50m × 0.50m squares (Smith *et al.* 2001). The roundhouses succeeded a sequence of Early and Middle Bronze Age occupation that included a Beaker-period cultivation soil, a Middle Bronze Age cremation cemetery and a Middle Bronze Age house.

23.1 Summary of the occupation sequence

Beaker-period cultivation: Phase 1 (*c.* 2000–1775 cal BC)

The earliest evidence of human activity on this part of South Uist's machair is a cross-ploughed cultivation soil (3449 and 2827) with ard-marks (Figure 23.1; see Table 1 in the Preface). It contained sherds of Beaker pottery, decorated with horizontal lines and chevrons, mostly incised but with single examples of comb-impression and fingernail decoration. This first phase of activity at Cladh Hallan is dated towards the end of the Beaker period in Britain (Needham 2005).

A number of Beaker sherds and two arrowheads, one barbed-and-tanged of flint and the other tanged and of slate, were found in later stratigraphic contexts, no doubt residual. At an unknown location in the vicinity of Area A 'just beneath the modern Daliburgh graveyard', T.C. Lethbridge (1954: 180–1) recorded a profusion of 'barbed and tanged arrow-heads of flint, minute thumb scrapers and microlithic barbs'. There is no further evidence of Beaker-period activity at Cladh Hallan though it is likely that settlement remains lie preserved beneath the dunes in proximity to the cultivation layer.

South Uist, and the Western Isles more generally, has probably the best-preserved evidence in Europe of Beaker houses and field systems. On South Uist, sites have been investigated at South Glendale (also recorded as Gortan;

Barber 2003), Sligeanach (Sharples 2012b), Cill Donnain machair (Hamilton and Sharples 2012) and Machair Mheadhanach (*ibid*.). About 500m south of Area A, three small mounds (sites 57, 225 and 226; Parker Pearson 2012a) could be the remains of houses dating to this period. Survey results from the Uists suggest that Beaker settlements may have been numerous along the island's west coast (Hamilton and Sharples 2012: 210–11; Parker Pearson 2012a: fig. 2.10).

Elsewhere in the Western Isles, nearly 20 settlement sites have been located and plans of excavated houses of this period are known from Rosinish, Benbecula (Shepherd 1976; Shepherd and Tuckwell 1977), Northton, Harris (Simpson *et al*. 2006: 85–154) and Dalmore, Lewis (Sharples 1983). Sharples' study of the dates of Beaker occupation in the Western Isles suggests most are after 2200 BC (Sharples 2009) although earlier dates are likely (Sheridan in Sharples 2012b: 231).

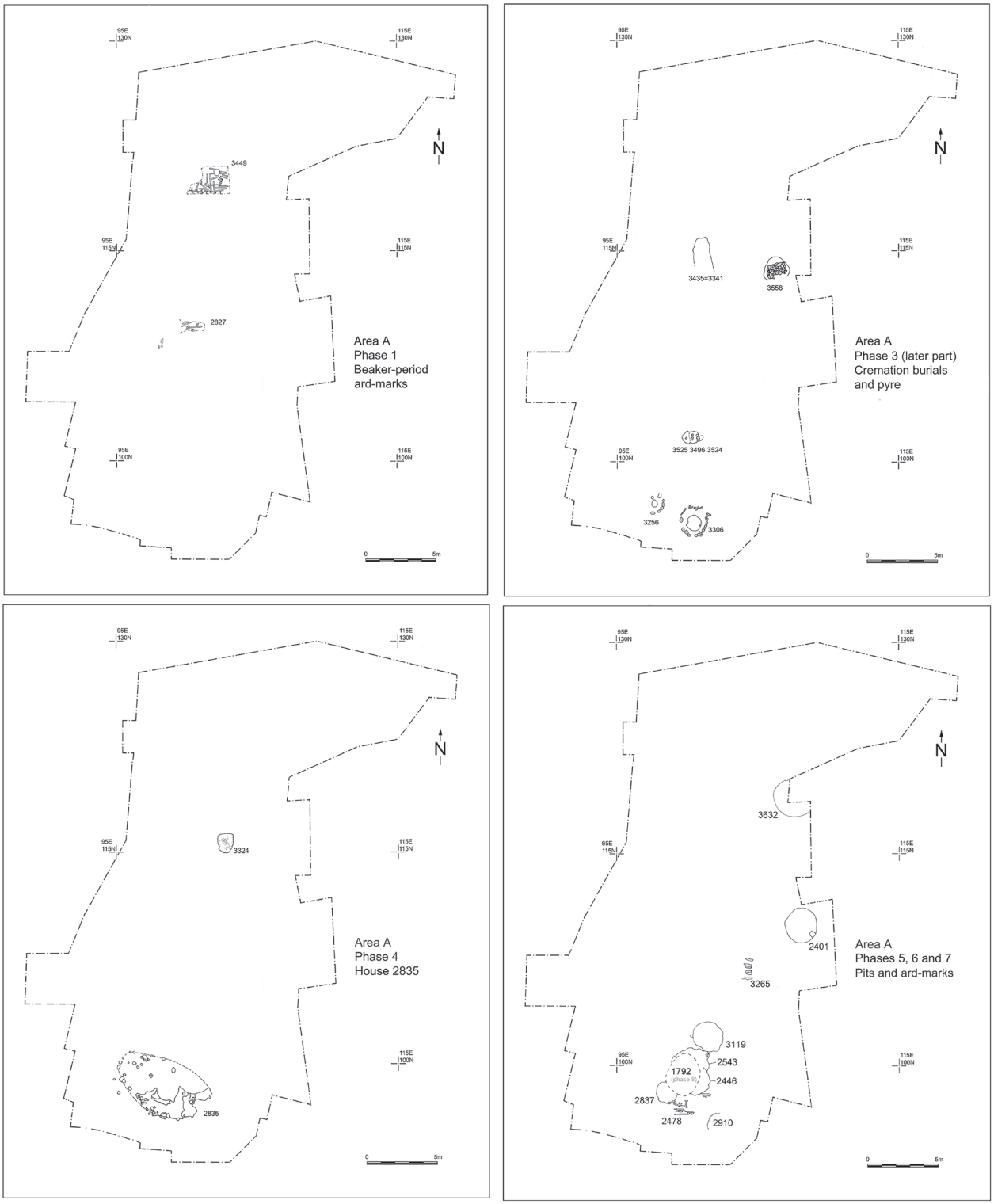


Figure 23.1. Cladh Hallan Area A in Phases 1–7

The Cordoned Urn phase: Phase 2 (start 2045–1745 cal BC, end 1890–1655 cal BC)

Cordoned Urn pottery was recovered from two areas of Cladh Hallan, probably from settlement remains. Within Area C, a series of stratified layers dating to *1960–1745 cal BC (at 95% probability)* contained Cordoned Urn sherds decorated with impressed cord and impressed circle motifs. Unfortunately, these layers were encountered at the base of deep sections exposed by sand quarrying so there was no opportunity to examine the spatial dimension of these deposits.

Within the northeast sector of Area A, Cordoned Urn sherds with impressed dots and circles were found as residual material in later layers. It seems that the stratified deposits from which they originated have been destroyed in this part of the Cladh Hallan complex but a pit (3631) may be a surviving feature from this phase. The pit (3631) was re-cut and the fills of this re-cut feature (3232) contained Cordoned Urn sherds. However, the initial fill (3552) of this pit contained an undecorated, near-complete bucket-shaped vessel, and it appears that this Plain Ware style was used alongside Cordoned Urn pottery in Phase 2 whilst constituting thereafter the sole ceramic style in use until the end of Cladh Hallan's occupation in Phase 16.

Wedderspoon's 1912 report of finds from Cladh Hallan (see Volume 1: chap. 1) described three cremation burials in probable Cordoned Urns at a location likely to lie within about a hundred metres of Area A. His description of herring-bone decoration on two of the urns corresponds with cord-impressed motifs on the Cordoned Urn pottery from the settlement layers within Area C.

Whilst Cordoned Urn cremations in cemeteries or small groups are common in Scotland and Ireland, their associated settlements are not. Excavated examples include Downpatrick in Ireland (Pollock and Waterman 1964) and Cill Donnain in South Uist, just 6km north of Cladh Hallan (Parker Pearson and Zvelebil 2014). Neither Cladh Hallan nor Cill Donnain produced suitable samples for radiocarbon dating the period in which Cordoned Urns were in use but the Cordoned Urn style is elsewhere dated to *c.* 1900–1400/1300 BC (Sheridan 2003: 207), the later part of the Early Bronze Age and the Middle Bronze Age.

The cremation cemetery: Phase 3 (start 1890–1655, end 1395–1270 cal BC)

Five cremation burials were deposited within the southern end of Area A over a period of *225–690 years (95% probability)*, starting in *1940–1540 cal BC (95% probability)* and finishing shortly before *1380–1185 cal BC (95% probability)*. They are thus likely to be broadly contemporary with Wedderspoon's urn burials, perhaps part of the same Early–Middle Bronze Age cemetery. Phases 2 and 3 could represent a single phase of activity at Cladh Hallan, spanning the transition from decorated Cordoned Urn styles to Plain Wares, from the later part of the Early Bronze Age through the Middle Bronze Age.

The largest and most elaborate of the cremation burials was that of a young adult (3307, dating to *1735–1530 cal BC at 95% probability*) accompanied by three unburnt, plain sherds, set on a surface of flat stones that originally formed the base of a cremation pyre. The cremation deposit was covered by a small dome of peat and surrounded by a ring of stones. The stones were arranged with beach pebbles on the seaward side and stream-rolled stones on the landward side – a symbolic microcosm of its surrounding landscape.

To the west, a second cremation burial (3257) had a similar form but with a smaller circumference. This was the grave of a young to older child, accompanied only by six unburnt, plain sherds. None of the stones in its ring were beach pebbles. This grave was later singled out by construction of the hearth of a structure on top of it and by digging into the deposit of cremated bones (and robbing them) after that structure's destruction (see Volume 1: chap. 2).

A third cremation burial (3197) was placed immediately west of the second, consisting only of a deposit within a small pit of the remains of an infant together with a few fragments of an adult (*contra* Volume 1: 41, 427; superseded by Christie Willis's subsequent analysis; see Chapter 19). This deposit contained some unburnt animal bones and two carbonised barley grains from this deposit date to *1425–1250 cal BC*. Another 'satellite' burial (3255, with a cranial fragment dating to *1620–1450 cal BC*) was placed on the northwest side of the second 'stone ring' burial; it contained the bones of an adult, a piece of burnt antler and a carbonised barley grain dating to *1535–1415 cal BC (at 95% probability)*.

Almost 20m north of this group of cremation deposits lay the rectangular base of a 1.65m-long cremation pyre, oriented east-northeast–west-southwest, consisting of a surface of flat stones in association with spreads of pyre debris consisting of charcoal, ash, cremated bones and fuel ash slag (much of this debris spread several metres from the pyre platform and was incorporated into later deposits in, around and under the northern roundhouse, House 1370). This pyre may have sat within a small penannular ditched enclosure, indicated west of the pyre by a curving ditch with an entrance on its north side.

A sequence of three burnt deposits on the pyre culminated in a deposit that included an adult and a sub-adult (2793), providing dates of *1750–1535 cal BC* and *1880–1620 cal BC*.

About 100m north, within Area B, an unburnt human hand phalanx dating to *1400–1055 cal BC (at 93% probability)* was found unstratified in spatial association with a crude stone wall and other unstratified finds of a fired clay ball and two flint flakes.

Small cremation deposits of the Early–Middle Bronze Age are not well known in the Western Isles. Instead, burials have been investigated within larger monuments in the form of kerb cairns such as those on Vatersay (Merrony 2000; Branigan 2000).

The Middle Bronze Age House 2835 (Phase 4; start 1395–1270 cal BC, end 1370–1175 cal BC) and its destruction (Phase 5; end 1310–1080 cal BC)

All the cremation burials at the south end of Area A were covered with windblown sand, except for the western (3257) of the two stone-ringed burials. This burial formed the base for a hearth near the centre of a small post-built structure (House 2835), 6.70m southeast–northwest and up to 4.10m southwest–northeast. This boat-shaped structure, constructed in *1380–1175 cal BC (at 95% probability)*, may have been more of a temporary shelter than a fully inhabited dwelling.

Since it was not possible to obtain a radiocarbon date for the cremation burial (3257) under the hearth, we cannot be sure how much time elapsed between this child's death and construction of the hearth on top of the buried remains. Finds from the floor layer of House 2835 include Plain Ware sherds, animal bone and burnt cereal grains, mostly from just inside the doorway or south of it, as well as a pumice rubber, a polished circular pebble, struck flint and two pieces of raw clay perhaps residual from pottery-making. Two of the house's posts survived as burnt stumps within their postholes and it appears that the building was burnt down after removal of its wall posts but not of these two entrance posts.

Pits, ploughing, Structure 2477 and House 3260: Phases 5–7 (start *c.* 1370–1080 cal BC, end 1150–1050 cal BC)

After abandonment, House 2835 was covered by a thin layer of windblown sand that was cultivated with east–west ard-marks. This ploughing was probably quite extensive across Area A, surviving as pockets in certain areas. After ploughing, a pit was dug through the floor of House 2835, immediately north of its hearth, and a small extension was tunnelled under the hearth and into the cremation burial beneath.

Six other large pits were dug in a line, northeast–southwest, three of them subsequently re-cut. All appear to have been backfilled soon after digging out and they were largely devoid of finds; however, three contained small quantities of human remains, some of them cremated and others unburnt disarticulated bones. It is possible that these remains are the residues of processes of separation and substitution in which both cremation and inhumation burials were reopened to remove their remains. This would be dramatically evident in Phase 8 with double pit 2551 and its contents (see below).

A slightly sunken structure, the 'cigar-shaped house' (Structure 2477), 5.40m southeast–northwest, was then built at the west end of the demolished House 2835 in Phase 7 (*start 1150–1050 cal BC, end 1150–1050 cal BC*). There were no surviving structural features such as walls or postholes, except for a line of stones on edge. The more deeply hollowed and narrow northwest end of this structure had the appearance of stepping down into an entrance. The wider southeast end contained a smashed pot but no hearth. Interpretation of Structure 2477 is hampered by its truncation by House 1150 (Phases 8–9) but it may have been a temporary shelter, possibly with turf walls.

Immediately south of Structure 2477 lay another small and temporary structure (3260), probably constructed later but still in Phase 7. This was much more akin to a roundhouse even though it was only 4.20m across. The semi-circular edge of this house projecting out of the south baulk of the excavation trench was presumably the northern half of a sunken-floored circular building, dug 0.70m into the sand and lined with stones to form an interior wall face three courses high. Its entrance was on the east side. There was no hearth in the exposed area of this structure and the thin sand floor contained very few artefacts or micro-debris. The only features beneath the floor layer were a stakehole and a deep but empty, vertically sided pit in the centre of the floor. Like Structure 2477, House 3260 gives the impression of having been a small, temporary shelter; it differs from Structure 2477, however, in having architectural characteristics found in the row of three roundhouses built on top of and to the north of these two structures in Phase 8.

The purpose of the three buildings of Phases 4–7 (Houses 2835, 2477 and 3260) is difficult to establish. All were small and insubstantial and the latter two did not possess hearths on their sunken floors. Perhaps they are best understood as shelters within the cemetery where mourners could gather. They might even have been shrines and/or used as storage houses for mummified corpses although only Structure 2477 contained any human remains, an adult femur fragment.

Construction of the row of roundhouses: Phase 8 (start 1130–1020 cal BC, end 1095–1015 cal BC)

The character of Area A changed considerably in Phase 8 with the construction of a north-northeast–south-southwest row of three sunken-floored roundhouses in *1080–1020 cal BC (95% probability*; Figure 23.2). They were actually sub-rectangular in plan: the southern house (801) was 7m east–west by 5.80m north–south, the middle house (401) 9.70m east–west by 8.30m north–south, and the northern house (1370) 8m north–south and 6.80m east–west. All had central hearths and stone-faced walls with sand cores that conjoined as party walls. The middle house (House 401) was sunk deepest into the sand and the southern house (House 801) was shallowest. The roof of the southern house was supported on a square arrangement of four posts. It is difficult to identify the roof postholes in the two larger houses because of extensive pit-digging beneath their floors but their roofs may have been supported on two parallel rows of posts (8-poster in House 401 and 10-poster in House 1370) to form a pair of three-aisled buildings.

The likely presence of more roundhouses to the south of the three excavated houses (Houses 801, 401 and 1370) could be ascertained with some certainty. The wall core of

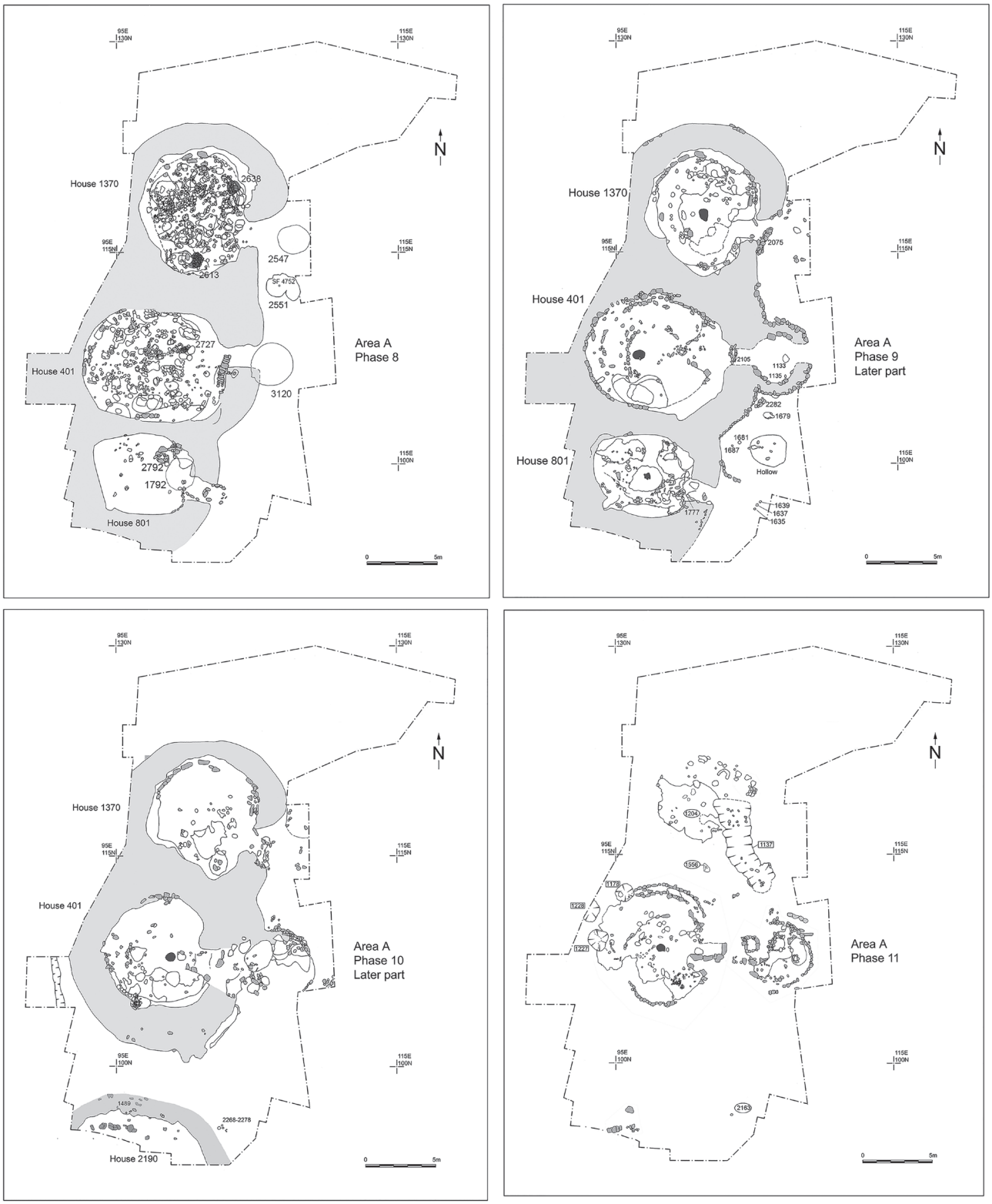


Figure 23.2. Cladh Hallan Area A in Phases 8–11

House 801 thickened on its southwest side, indicative of sharing a party wall with a building (subsequently destroyed in Phase 10 by construction of a later roundhouse, House 2190). Also, excavations in Trench D (at the southern end of the settlement mound, 40m away) revealed part of a sunken-floored building that was in use in Phase 9. Thus there were probably at least four roundhouses, if not as many as six, seven or even eight, in this north-northeast–south-southwest row.

Among the mass of small pits beneath the floors of Houses 401, 801 and 1370, four were graves. That beneath House 801, in its northeast quadrant, contained the body of a 1½–3-year-old female child which was disarticulated except for the pelvis and spinal column, indicating that she

had been dead for some time before burial. Her radiocarbon date of *1445–1195 cal BC* (*at 95% probability*) indicates that death occurred at least a century before the house was built. This young girl's diet was different from that of most of the other people buried at Cladh Hallan in that her low $\delta^{15}N$ isotope value indicates greater consumption of plant foods as opposed to animal protein.

The burial under the northeast quadrant of House 401 was that of a child (SK 2727), probably female, aged 10–14 years. Although her tooth enamel's strontium, lead and oxygen isotope compositions (Parker Pearson *et al.* 2005: table 2) are consistent with having been raised in the Western Isles of Scotland – like the other six people buried at Cladh Hallan whose remains could be analysed for strontium isotopes – her unusually negative $\delta^{13}C$ isotope value (–22‰) marks her apart from the rest of the population, suggesting an even more terrestrial-based, non-marine diet than others. Three episodes of enamel hypoplasia in her teeth are the result of periodic stress. Together with possible cribra orbitalia (often indicative of anaemia), this suggests that she may have been in poor health for at least part of her short life. Her date of death is consistent with the date of the houses' foundation in *1080–1020 cal BC (95% probability*; see Volume 1: 444–5) so she probably died at the time that the houses were being built. It is possible that she was a human sacrifice required for the foundation of the roundhouse settlement.

In the northern roundhouse (House 1370), one inhumation was buried beneath the northeast quadrant but the other was placed beneath the floor on the house's south side.[1] The skeleton in the northeast was that of three males assembled to create one 'body' – the skull of one individual, the mandible of another and the torso and limbs of a third. These were arranged in anatomically correct positions in a tightly contracted body bundle. The body's *post mortem* decay had been arrested, consistent with the preservation of soft tissue for some time after death. In addition, all three skeletal components had been exposed before burial to an acidic environment, most likely in a peat bog. The body parts from this burial are much older than the date of their deposition in *1080–1020 cal BC*: the mandible dates to *1500–1225 cal BC* and the torso is likely to be older, dating to *1615–1420 cal BC*.

The second burial beneath the northern roundhouse was similarly a composite skeleton, consisting of a male head on the torso of a female. In addition, ancient DNA analysis attributes the right arm to a third individual (Hanna *et al*. 2012). The skeleton was in an anatomically correct position, not quite as tightly contracted as the other and not as heavily stained. With the head dating to *1435–1260 cal BC* and the body to *1300–1125 cal BC*, it is probable that the head is many decades older than the other body parts. Again, the composite body was already old when it was buried beneath the house.

The female torso and lower limbs from this burial can be matched with an articulated left knee joint found within a double pit (pit 2551) outside the northern roundhouse. This was detached from the female corpse long after death and suggests that her already mummified body was exhumed from this pit – her original grave – in the eleventh century cal BC when the roundhouses were built. There is no indication of where her head went but her headless mummy was fitted with a second individual's head, also likely mummified.

The two composite skeletons beneath the northern house are composed collectively of body parts from at least six separate formerly mummified individuals whose other remains are unaccounted for. Some of these may have originally been buried in the area designated for the roundhouses and thus subsequently exhumed, or they may have been kept above ground until required for these likely foundational burials.

Additional, disarticulated fragments of human remains were also deposited in the roundhouses' construction contexts: in the wall cores of House 801 and 401, in pits beneath the floor of House 401 and in the stone-lined cist beneath that house's doorway. This latter item, a fragment of a scapula (SF 4909), has an unusually low $\delta^{15}N$ isotope value indicative of a vegan-like reliance on plant foods to the exclusion of animal protein in the diet. The dietary variation from the norm of both this individual and of the children buried under Houses 401 and 801 suggests that they may have been of a different social status or from a different community to others whose remains were deposited at Cladh Hallan.

Other features beneath Houses 401 and 1370 contained unusual deposits that may have been foundation offerings. In House 1370 two pits contained smashed pots and the ribs of a sheep. A deposit of disarticulated sheep ribs was found within House 401, one of whose postholes also contained a length of articulated cattle spine. A rather different deposit from within the wall core of House 401 was a large saddle quern, deliberately broken before burial. A fragment of a quern was found in the grave of the composite female–male mummy beneath House 1370, and another broken quernstone was incorporated into the wall of that roundhouse. The querns' associations with foundational contexts are discussed below.

Initial occupation of the three roundhouses: Phase 9 (start 1095–1015 cal BC, end 1045–985 cal BC)

The three roundhouses were initially occupied in the eleventh century BC. Internal furnishings, size of the interior and patterning of debris on the floors reveal that each house had a distinct character and range of activities.

House 801 was the smallest, least furnished and most modestly inhabited. Its main internal furnishings consisted of a central hearth, an earthen bench and small stone niche south of the hearth, and a small (3.30m × 2m) sleeping platform northwest of the hearth. Artefacts and micro-debris were relatively sparse across its floors, especially pottery sherds, suggesting that food was not cooked in this house in any quantity. However, the food remains

include bones from heads and tails of saithe, elements normally absent from the rest of the relatively modest Cladh Hallan fish bone assemblage. This suggests that initial preparation of the catch may have been carried out by House 801's occupants.

A scatter of tools and debris, tightly constrained in the southwest part of the house, indicates that craftworking, particularly processing of animal hides, was carried out in that spot. Perhaps this was a household dependent on the main roundhouse (House 401), either as kin (younger or more elderly relatives) or as enslaved or retained subjects. It is possible that this household had to cook within the main house for that household, accounting for the low quantities of cooking refuse within House 801. Probably before the end of Phase 9, House 801 was dismantled and many of its wall stones were removed before its interior filled with windblown sand.

House 401, in contrast, had a complex and eventful occupation sequence in this initial phase. Within its entrance a substantial quantity of refractory material – clay moulds from bronze-casting – had been deposited prior to the construction of a small, circular, stone-walled forecourt. These mould and crucible fragments had been removed from the house's interior where metalworking had been carried out on the north side of the central hearth at or shortly after the house's construction. A second episode of bronze-casting took place shortly before the final deposits on House 401's floor in this phase. The metalworking evidence is discussed below.

As well as the cellar, the central hearth and the cist across the doorway, House 401's initial internal features included a raised surface within the southeast as well as a larger raised platform in the north and northwest. This sleeping platform was over 10sq m, providing shared space for many people to sleep in. In contrast, the raised surface in the southeast was covered with waste deposited here from cooking on the central hearth, predominantly pottery sherds along with animal bones, small grinding stones and scapula 'spoons' or spatulae.

During Phase 9, House 401's interior wall faces were rebuilt twice and its interior space was re-organised, with a new doorway area recessed with a pair of hornworks. The entrance passage was lengthened and led from the interior to the circular forecourt or anteroom through which the roundhouse was now entered. New roof supports were arranged in two concentric circles, as the plan of the roundhouse was transformed from sub-rectangular to oval. Two small water basins were installed, one of them east of the central hearth and the other to its north.

The quantity and variety of discarded tools and debris across House 401's floor was substantial. Whereas mammal bone fragments were especially concentrated in a 'toss and drop' zone around the western edges of the hearth, bone tools, pumice, potting clay, struck flint and polishing stones were densest in the southwest quadrant of the house, indicating that a range of activities including hide-working, potting and working of bone and wood was carried out here. The north and especially the northeast were largely devoid of artefacts except for struck quartz and some red deer antler pieces.

This northeast quadrant of House 401 was, however, the location for a series of unusual depositions including burnt and unburnt human hand bones, a fine-ware pot (one of the very few such vessels in Cladh Hallan's enormous ceramic assemblage), a fragment of coral, a small curved fragment of iron and two bronze blades which were left on the surface of the thick floor layer (1311) that had accumulated during Phase 9. All of these are unusual. Whilst the coral's provenance cannot be determined, the iron artefact – apparently from this eleventh-century BC context – represents one of the earliest pieces of iron in Britain and is potentially an import from southern or southwest Europe. The bronze bladed tools are unparallelled but may have been tanged spokeshaves; they form a closing deposit for this phase of the roundhouse's occupation. Exactly when in Phase 9 the other items within this northeast quadrant were deposited cannot be determined but they point to this area of the house having been of possibly spiritual significance as a shrine or sacred space where exotic, rare and symbolically charged items might be placed.

House 1370 was not quite as large as House 401. Although similar in shape and with an east-facing entrance, its longer axis was rotated at 90° to the other two roundhouses. It also differed from them in that its floor was convex rather than concave, forming a slight dome at the apex of which the hearth was positioned. There was much less debris on this floor than in House 401, and artefacts were not concentrated in any particular zone or quadrant as they were in Houses 401 and 801. Whilst a small sleeping area could be identified in the north of the house from the telltale layer of white sand, this roundhouse had few of the signs of permanent and intensive inhabitation seen in the other two dwellings. Instead, its occupants – at least for some of the time – included domestic animals, presumably young cattle and sheep.

During this phase, House 1370's floor was renewed, by importing sand onto the old surface and creating a new floor surface. The distribution of much of the refuse close to the walls suggests that efforts were made to keep the floor clear of waste debris. A dismantled, unfired pot and quantities of potting clay in the southeast of the house indicate that the inhabitants made coarse-ware ceramics. Mould debris on the north side of the central hearth was the result of an episode of bronze-casting though the mould fragments are too eroded to establish what items were cast.

Late in Phase 9 or at the beginning of Phase 10, a female neonate (SK 2188; *1065–975 cal BC*) was buried in the northeast of House 1370, near the earlier grave of the male composite mummy. Also towards the end of Phase 9, the house's doorway was blocked by a low stone wall across its entrance.

All three roundhouses in this phase had special deposits placed on their floors at abandonment, prior to the floor being covered with sand and then the laying of a new floor. In all cases these deposits were placed in the northeast quadrant. In House 401, the closing deposit consisted of the

two bronze spokeshave-like tools. In House 1370 it was a piece of a copper-alloy bracelet. In House 801 it consisted of two coarse stone tools – a hammer and a cleaver.

The ground surface of the outdoor area or yard east of the houses was fully preserved beneath a deep layer of windblown sand. Surprisingly, it was largely clean of debris, indicating that craftworking activities, of the sorts identified within the house interiors, had not taken place outside the doorways. It is also interesting that this space was devoid of household refuse, which was presumably taken further away from the entrances of the houses, possibly as far as the midden in Area C, 100m to the northwest.

Quantities of artefacts and debris increased dramatically overall with the construction of the roundhouses in Phase 8 and their occupation during Phase 9. The pottery assemblage for these phases includes large quantities of jars and bowls, varying in size from 12cm to 22cm in diameter. Bowls form just over a third of the assemblage, with open, closed and cylindrical jars at a quarter, a fifth and a fifth respectively. A third of the vessels had flat rims, a pattern continuing from Phase 3, with tapered rims declining to a fifth. Footed bases were now common, with protruding footed forms slightly less so. Although these Plain Wares are largely undecorated, a few had surface treatment in the form of wiping or brushing and the application of dots and occasional incised lines, mostly around and near the rim.

The majority of those pots from Phases 9 to 16 sampled for lipid residues reveal that they had contained dairy products, perhaps mixed with barley to make porridge; meat must have been cooked in a different way since ruminant adipose fats were detected in very few of the vessels sampled.

Faunal remains consist primarily of bones of cattle and sheep, with smaller proportions of red deer calves and pigs. Half of all cattle were killed in their first month, especially young males, indicative of a dairying economy as suggested by the lipid residues on ceramics. Deer calves were presumably caught in their upland breeding grounds during May–July while sheep were mostly slaughtered in their first autumn or early winter. There is no evidence that sheep were reared for wool production and spindle whorls, presumably associated with the spinning of wool, were not in use before Phase 12. Cattle were reared on pastures away from the coastline whereas the diet of sheep included saline vegetation; the stable isotope values probably result from the animals' occasional grazing along the foreshore. Pigs were kept in small numbers and their varied diets suggest that they were probably fed on household waste.

Barley was the main crop cultivated at Cladh Hallan, with carbonised grains present throughout all phases of the site from the cremation deposits (Phase 3) onwards. Wheat was not grown as a cereal crop but was probably a weed of cultivation. The same may be the case for flax which, despite its economic value, was present only in very small quantities, disappearing after Phase 12. Other weeds of cultivation include chickweed, wild turnip, goosefoot, knotgrass and corn spurrey; their varying preferences and tolerances for different soil types are consistent with the Cladh Hallan farmers' fields of barley being located on different terrains: the dry, alkaline machair as well as on the damper soils inland towards the machair's eastern edge.

Among the carbonised plant remains, the wild plant species, many of them weeds of cultivation, could have had a range of uses. Sedges and grasses were useful materials for flooring and roofing. The leaves and seeds of dock and sorrel, knotweed and goosefoot are edible while heather flowers have also been used in traditional medicine to treat coughs, insomnia and rheumatism as well as being used to flavour ale or mead. Chickweed has been used as a poultice to treat inflammation and as a tea for insomnia. Flowering heather shoots and stems could have made sweet-smelling bedding. Heather, sedges and grasses have also traditionally provided raw materials for making ropes, sacks, nets and mats. Of course, many of their burnt residues most likely derive from peat, brought into the houses to burn on the hearth. Whether collected as plants or as peat these species were brought from areas of moorland and heath 1km–8km to the east.

The immediate landscape surrounding Cladh Hallan also provided a variety of resources. As in Phases 1 and 5, the area was periodically ploughed from Phase 9 onwards, either with ards or with antler picks (or both) to break the thin grass cover. Such activities may have contributed to the episodes of sand instability that threatened the integrity of the short-turf grassland. These infields were presumably manured with organic waste from the houses as well as with seaweed, which was also brought indoors, presumably to be used as fuel (as dry tinder for peat fires) or food-seasoning. It may also have been used as fodder, though for sheep and pigs rather than cattle. The thin turfs from the machair provided materials for sleeping platforms and roofing.

An interesting feature of the sleeping platforms in both House 401 and 1370 is that these two turfed, raised areas were positioned above deep deposits of sand mixed with stone rubble and set into curved hollows that followed the northwest and northern edge of the roundhouse's interior. At first, these semi-circular 'ring ditch' features beneath the sleeping areas seemed inexplicable, especially because they deepened towards the inner wall face, but perhaps they were created as a 'damp-proof course' to keep this part of the house as dry as possible. There was no such feature, however, beneath the sleeping area in House 801.

The sea was also a source of food and sustenance. Fish remains were most common in Phase 9. These were mostly young saithe, caught in the inshore zone and prepared for eating by removal of their heads and tails, a deposit of these extremities being found within House 801. The most commonly collected shellfish were winkles and limpets gathered from the rocky promontories of the west coast, and cockles dug from the sands of the tidal strand of Loch Hallan to the east of the settlement. Bone fragments from cetaceans were especially common in Phases 8–12, revealing limited exploitation of dolphin meat and likely use of blubber and oil from sperm whale and other cetaceans for providing bright, clear indoor lighting.

Other cetacean species utilised include fin and humpback whale as well as porpoises (bones of blue whale make an appearance in the Early Iron Age). Their bones were used as domestic fittings, as structured deposits and as a variety of artefacts: lamps, blades and a mortar.

Bones from a variety of species of birds reveal varying levels of their exploitation, both for food and for raw materials including bones for tools such as points and presumably feathers for ornamentation and possibly for tools such as light brushes. They also provided meat, fat, oil and eggs. Although birds form a tiny proportion of all the wild species (including marine as well as terrestrial) at Cladh Hallan, at least 35 species are represented. The most common bird remains are of gannet, followed by cormorant, shag and the now-extinct great auk but the assemblage includes waterfowl, passerines and land birds including raptors.

Tools were made of bone, antler, flint, quartz and other types of stone. These include bone spatulae, plate-like discs and a variety of points, awls and blunt points, the latter three types forming a third of the bone assemblage and used for the working of bone, hide and wood. Red deer antler had a wide range of uses as picks, toggles, handles and points. One of these points from within House 401 may have been used to finish newly cast bronze artefacts.

Struck flint and quartz were very common in Phases 8–9 but less than half of those tools sampled have any use-wear. Most of those that do were used to work bone and wood and were used for cutting and scraping hard materials though not softer substances such as plants or meat. The coarse stone assemblage includes saddle querns, grinders, pestles, sharpeners, cleavers, hammers and scrapers as well as a variety of pecked and drilled items. Pumice artefacts have a variety of facets and were used for many tasks, from cleaning hides to abrading wooden and bone tools and materials.

The hides of cattle, deer calves and young sheep were no doubt the raw materials for manufacture of a variety of garments, the leather being pegged down and stretched, scraped with pumice rubbers and then polished with smoothing stones. It is possible that the leather-making process included tanning in which dog excrement was used to treat the skins. Dogs were being bred at Cladh Hallan from Phase 9 onwards, declining in Phase 13, and would have been used for herding animals as well as guarding the homestead. The quantities of their coprolites in and around the forecourt of House 401 (increasing in Phases 10–12) suggest that they were mostly kept outside the house interiors, milling about around the main house's entrance. Remains of a juvenile wild cat from the Phase 9 levels of the midden in Area C raise the possibility that kittens were also being kept and possibly even bred.

In summary, it appears that activities in all three roundhouses were principally domestic in nature although House 1370 had features of an ancillary building since it sheltered both people and animals. The sizes of sleeping areas were proportional to house sizes, and it is a reasonable assumption that the three households were of different sizes. House 401 was pre-eminent in every way, particularly through its architecture (notably the circular forecourt building) and its association with metalworking debris. We may infer that a family group inhabited this central roundhouse, with a smaller subsidiary group in House 801 reliant on the main house and perhaps engaged in House 401 in preparing and cooking the inhabitants' food.

As summarised in Chapter 5 of Volume 1 (see also Parker Pearson 2025), the arrangement of the three houses suggests social inequality: the casting of weapons, tools and ornaments within House 401 with only a single casting episode located elsewhere (in House 1370), the closing deposits of bronze tools on the floor of House 401 and a bracelet fragment in House 1370, contrasting with the two coarse stone tools in similar contexts within House 801. Certain people also wore ornaments of gold, represented by the gold-plated penannular ring presumably lost in the sand.

Nucleation of households: Phase 10 (start 1045–985 cal BC, end 1015–930 cal BC)

This phase can be dated to the later eleventh–early tenth centuries cal BC. The ruins of House 801 were now buried beneath a deep layer of windblown sand which served as a stratigraphic boundary across the entirety of Area A. Into this windblown sand were dug a series of narrow gullies defining the southern edge of House 401, separated from a small semi-circular ditched feature to the south.

The gullies around House 401 are very similar to those encircling an Early Iron Age stone-walled roundhouse at Tofts Ness, Orkney, where they are interpreted as drip gullies for the roof overhang (Dockrill *et al*. 2007: 77). A similar interpretation can be proposed for House 401, with the ends of the roof timbers extending beyond the outer wall face rather than resting on the inner wall head (as they would have to have done on the party walls of Phases 8–9).

Houses 401 and 1370 were re-built and now formed a single modular unit. This pairing of roundhouses has been noted elsewhere in British later prehistory (Ellison 1981; 1987; Woodward 2002; Sharples 2010) so it is instructive to see it evident at Cladh Hallan. House 401 continued to be used as a domestic residence but House 1370 took on the appearance of a workshop or ancillary building, with no evidence for a sleeping area. Both houses were constructed in a new architectural style, circular in plan with internal roof posts possibly arranged in a U-plan open to the east.

House 1370's inter-phase face-down female neonate burial (SK 2188) could have been a closing or foundation deposit; it lay in the northeast quadrant, buried face-down in the void left by a withdrawn roof-supporting post from the previous Phase 9. There was no such liminal deposit in House 401; the cellar was filled in and a new stone-lined cist was inserted across the entrance.

House 401 retained its forecourt, and the floor inside the roundhouse was again covered with large quantities of tools and domestic debris. The uneven floor of House 1370 included a hollow on its south side that was filled with the smashed sherds of many pots at the end of this

phase; quantities and varieties of other artefacts, though, were restricted. A similar event of dumping quantities of freshly broken pots occurred at the end of this phase in House 401 when a pit was dug through the dismantled south wall face and filled with broken vessels. Two pots from this interface between phases contained lipid residues deriving from degraded leafy plants, the only such examples from the site.

In the later part of Phase 10, a large roundhouse (House 2190) was built to the south of House 401, clipping the southern edge of the ruined House 801. With an internal diameter of 10m, this new roundhouse was larger than both House 401 and House 1370, perhaps signalling a shift in status within the settlement. House 2190 was only partially exposed: most of the structure is still *in situ*, deeply buried beneath the large dune at the south of the excavated area.[2]

Most of the activities of Phases 8–9 continued in this phase. Significant changes included the use of House 401's southwest quadrant for the keeping of storage pots (*i.e.* pots without sooting). Of course, storage pots could have been kept in this part of the house in Phase 9 and not been broken before their removal from the house – what we see in Phase 10 is the result of breakage of such vessels, either the result of accident or end-of-life breakage. Hide-working also appears to have declined within House 401 in this phase although basketry continued. Quantities of struck flint declined in Phases 10–11. The relative lack of artefacts and debris from the house floors in this phase contrasts with the quantities from Phase 9, given that in each of these phases the houses were probably in use for a similar length of time.

Amongst the ceramics, the greatest change from Phase 9 was in vessel form: pots became slightly stockier and open jars became more common than bowls, a pattern that would remain constant until Phase 16.

Houses 401 and 1370 appear to have formed a module of a main dwelling and a smaller, ancillary dwelling. If House 801 had served as a domicile for servants or the enslaved in Phase 9, perhaps that function passed to House 1370 in Phase 10. House 1370 was still used for craft activities but without the intensity seen in previous phases of occupation.

Within Area C, 100m to the northwest of Houses 401 and 1370, midden waste continued to be dumped in Phase 10 but not subsequently and this area then remained unused until the construction of a double roundhouse in Phase 13. If Area C was indeed the location of the main midden for the roundhouses in Area A until Phase 10, this could partially explain the commencement of middening much closer to the roundhouses in Phase 12, in the area within the northeast of Area A.

Paired houses: Phase 11 (start 1015–930 cal BC, end 815–765 cal BC)

Phase 11 (tenth–early eighth centuries cal BC) included the re-building of House 401 and continued use of an increasingly ramshackle House 1370. The two roundhouses were linked by a hollow way leading from the northeast-facing doorway of House 401's forecourt 'antechamber' to the east-facing doorway of House 1370. There was a small hearth in the western part of House 1370 but no sign of walls or roof posts.

House 401 was now 8.30m in diameter, larger than it had been in Phase 10 but smaller than in its earliest phase. The house was now more oval in plan, with its longest diameter north–south. Its roof-bearing postholes formed a C-shaped arrangement as they had done in the preceding phase. The entrance passage was even more inturned than in Phase 10, with piers on either side inside the doorway. This can be paralleled with the plan of the phase 1b roundhouse at Eilean Olabhat, North Uist, although that example dates much later, to the fourth–first centuries BC (Campbell *et al*. 2008).

The floor of House 401 was covered in debris as in previous phases but there were few fixtures or furnishings other than the central hearth and the large, raised sleeping platform in the north and northwest. The most unusual deposit was a small pit with cremated sheep bones north of the hearth. Within the rebuilt forecourt and entrance passage, three pits were dug; two were ringed with stones and their vertical sides and flat bottoms give them the appearance of grain storage pits. The third pit contained an unusual setting of small upright stones – a miniature stone circle – and a deposit of sheep bones.

Ceramic changes include the appearance of Y-shaped rims although these are less than 10% of rim types, the most common still being flat rims. Pot widths in Phase 11 fall into a bimodal distribution of 10cm–16cm and 16cm–24cm. Open jars now rose to about 40% of the assemblage, with bowls and cylindrical jars at about a fifth each and closed jars at around 10%.

Other minor changes in the material assemblage are evident in Phase 11. This was the last time that bronze-casting was carried out on the floor of House 401, most likely at the transition from Phase 10 to Phase 11. This was also the last phase in which struck quartz was present, being largely absent thereafter. Nor are there any polisher stones although these would return in subsequent phases. Use-wear on bone tools reveals that hide-working as well as basketry continued and the appearance of new types of artefacts may indicate a widening of activities. The earliest bone needle at Cladh Hallan appears to belong to this phase, used in stitching leather or other textiles. A gaming counter and carved antler side-plates and pegs are indicative of possible leisure activities. A fragment of an unfinished shale bangle from Phase 11 heralds increased variety in forms of personal ornamentation.

The roundhouse at the bronze–iron transition: Phase 12 (start 815–765 cal BC, end 780–720 cal BC)

Phase 12 dates to the first half of the eighth century cal BC, the period in which the British Iron Age can be considered to start. By now, House 1370 had gone as had the forecourt building of House 401 (Figure 23.3). The only features in Area A other than House 401 were a group of bowl-shaped pits to the north, probably used for sand extraction, and an

L-shaped setting of stones apparently delimiting an area to the northeast of House 401. The area north of House 401 was ploughed, with east–west ploughmarks sealed beneath a thick layer of red peat ash that covered much of the northern half of the settlement mound.

House 401 was re-built in a circular (or rather hexagonal) plan, measuring just 7m in interior diameter, again with a C-shaped arrangement of roof supports. Its internal features included a stone water tank, made partly of broken quernstones, east of the central hearth. Beneath the floor were two dog burials, one placed across the entrance area in the east and the other – missing its head – to its north.

This was the last phase in which certain types of artefacts were in active use, notably quernstones, bone spatulae, bone

Figure 23.3. Cladh Hallan Area A in Phases 12–15

discs and a wide variety of coarse stone tools. Conversely, Phase 12 saw the start of new activities alongside a decline in hide-working. The presence of the first of several bone spindle whorls, together with bone needles, marks the establishment of spinning and weaving at Cladh Hallan, presumably wool-based rather than just exploiting vegetal textiles. A brief resurgence in the quantity of struck flint in Phase 12 could indicate a shortage of metal tools at this point at the end of the Bronze Age. There is no evidence for bronze-casting at any point within Phase 12 and the few mould and crucible fragments are almost certainly residual from earlier contexts of metalworking.

Ceramics continued the trends seen in Phase 11 and earlier, with open jars approaching half of the assemblage and bowls declining to 20%. More than a third of rims were flat and nearly half of bases were footed.

In many ways, the end of Phase 12 marks a major change in the character of dwelling and associated activities at Cladh Hallan. From here onwards, House 401 was no longer a purely domestic or permanently inhabited dwelling. It and associated structures were most likely peripheral to the settlement nucleus which was established elsewhere, possibly within the unexcavated southern half of the main Cladh Hallan settlement mound.

The Earliest Iron Age roundhouse and construction of the double roundhouse 150: Phase 13 (start 780–720 cal BC, end 750–610 cal BC)

Phase 13 (mid-eighth–mid-seventh centuries cal BC) is represented by the final re-build of House 401's stone wall faces. The interior wall face incorporated a double aumbry in the southeast wall but otherwise the interior was devoid of above-ground features except for the central hearth. The only unusual deposits were two small pits north of the hearth containing the disarticulated bones of sheep.

In Area C, a double roundhouse (House 150) was constructed by digging its foundations into the sequence of midden layers that had accumulated in Phases 9–10. Its west room contained a hearth and a stone-lined water tank and there was a hearth in the centre of the slightly larger east room. This building's purpose appears not to have been domestic – there is no evidence for a sleeping area – and it may have served as a sweat lodge or smoke-house. A similar building has been excavated at Ceann nan Clachan, North Uist, dating to 770–400 cal BC (Armit and Braby 2003).

The ceramic repertoire of this phase exhibits a marked change from previous phases, not so much in style changes as in quantities and vessel sizes. Pottery was now scarcer than before though this also reflects the fewer contexts dating to this and later phases. Vessel forms were generally limited to jars of varying sizes and very large bowls; the small bowls so characteristic of Late Bronze Age Cladh Hallan were now much rarer. Bowls are now a third of the assemblage, a proportion not seen since Phase 9, whilst open jars form nearly half of it. The decline in quantities of sherds implies that much of the inhabitants' food was cooked elsewhere. The absence of a sleeping platform also indicates that the roundhouse may now have been used only for daytime activities.

There was a steady decline in activities such as hide-working, textile manufacture and potting. Two postholes in the south of House 401 can be interpreted as supports for a vertical loom (although the first clear evidence of a loom at Cladh Hallan is a doughnut-shaped stone loomweight from Phase 16). Whale bone fragments decline in this phase, dropping to less than a quarter of what they had been in Phase 12. Smaller cetaceans are largely absent from the assemblage; bones from a blue whale suggest that it was stranded nearby around this time. The disappearance of quernstones in this phase further emphasises House 401's transition to an increasingly ancillary building without sleeping or cooking facilities. Despite this change in activities, the house continued as a place of ritual. Three special deposits of disarticulated sheep bones, all in the symbolically charged northeast quadrant, continued a practice of such ritual deposits.

Finally, three pins (two in copper alloy and one in bone), a copper-alloy disc and two pierced ornaments (a dog tooth pendant and a drilled fish bone) reveal that items of adornment were proportionally more common than they had been in previous phases although there were no traces of any shale bangles or beads as recovered from Phases 11–12.

Other settlement deposits from this period have been investigated in South Uist in the Sligeanach area of Cill Donnain (mounds 17 and 22–26; Sharples 2012b) and at Dun Vulan (Sharples and Parker Pearson 1999: 50–2), both just five miles north of Cladh Hallan.

Two Early Iron Age roundhouses: Phase 14 (start 750–610 cal BC, end 725–575 cal BC)

In Phase 14 (late eighth–seventh centuries cal BC), House 401 was re-floored but its walls remained substantially unchanged except for the western interior wall face. A sheep skull was buried beneath the floor of the east entrance but there were few other internal features other than the central hearth and a possible interior partition in its southwest. It was occupied for probably less than 35 years, one of the shortest of its phases of occupation.

About 10m southeast of House 401, another roundhouse (House 1500) was built at a slightly higher elevation within the settlement mound. Much of this house's floor was destroyed by modern sand extraction but enough survived to show that it was used for working hides. There were also pit deposits of potting clay and of entire pots, one beneath the floor and the latter under the west wall.

House 401 contained a large assemblage of tools on its floor, not only for hide-working but also antler picks and tools for spinning, woodworking and bone-working. There was also an unusual composite artefact made from antler plates and bone pegs. Substantial quantities of animal bones were scattered across House 401's floor, and amongst them were human bones, from a neonate whose unusually positive

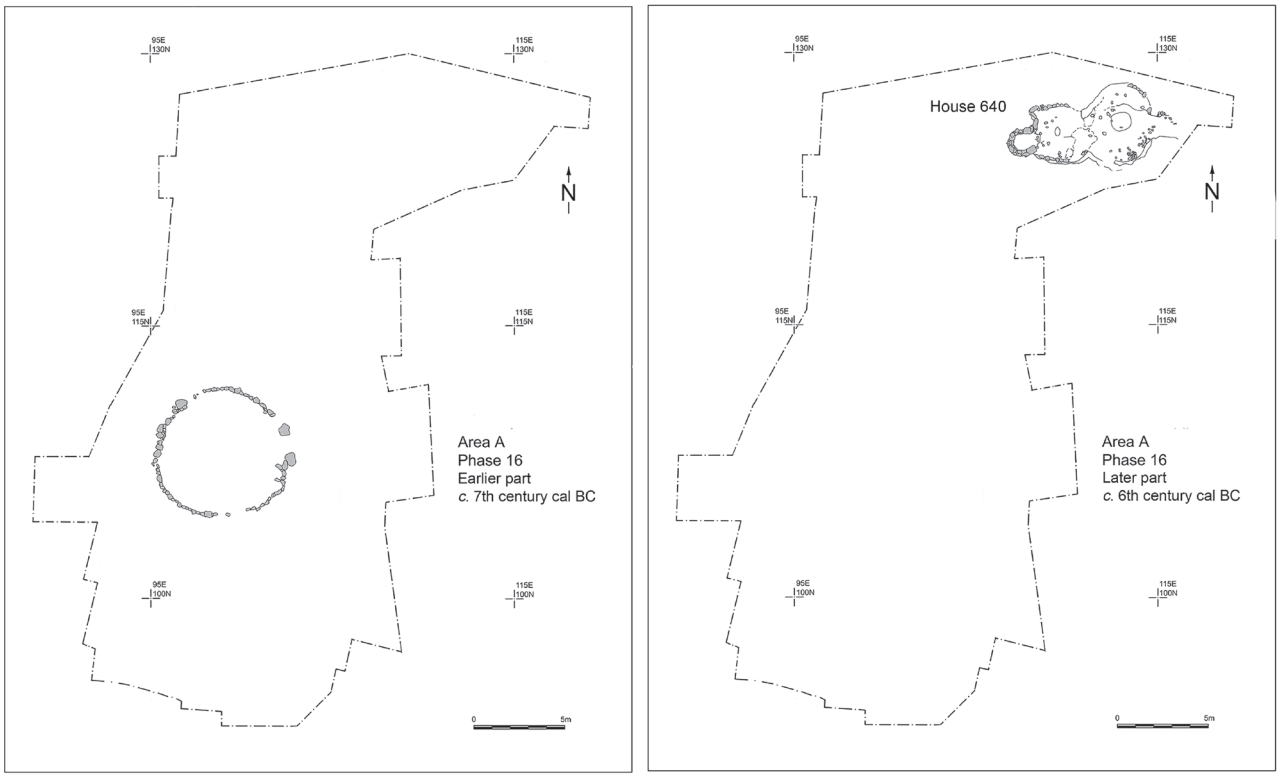


Figure 23.4. Cladh Hallan Area A in Phase 16

$\delta^{13}C$ isotope value reflects its mother's diet as more dependent on seafood than any other individual at Cladh Hallan.

The roundhouse in decline: Phase 15 (start 725–575 cal BC, end 680–545 cal BC)

House 401 was rebuilt in Phase 15 (mid-seventh–early sixth centuries cal BC) and its estimated lifespan of 35 years matches that for Phase 14. Its interior was furnished with a central hearth and, in the southeast quadrant, a stone-lined fire pit. This could indicate a change in cooking practices, separating the fire for cooking from the central hearth. Among the various tools left on the house floor were surprising numbers of antler picks/rakes and scapula shovels, probably used for digging and cultivation. However, the range of craftworking activities declined in this phase alongside greater use of House 401 as a store for these likely agricultural implements.

Abandonment of the roundhouse and building of a smokehouse or steam-room: Phase 16 (start 680–545 cal BC, end 640–580 cal BC)

House 401's last period of use (late seventh–mid-sixth centuries BC) consisted of a circle of stones forming the outline of a roundhouse but with no evident floor, the sunken hollow of the house interior now being filled to ground level with midden material (Figure 23.4). Thus its final stage seems to have been as a representation of a house in plan rather than an actual building. Its interior was filled with a thick deposit of midden which included an iron fragment, probably from a circular disc.

House 150, the double roundhouse in Area C, was abandoned (Figure 23.5). As its roofless interior filled with windblown sand, 12 pots were smashed and their near-complete fragments thrown into the building. Shortly before abandonment, the east room had served as a workshop for bronze-casting: although copper-alloy droplets were recovered, there was no trace of the moulds other than a single fragment.

A second double roundhouse, House 640 at the northeast corner of Area A, was occupied perhaps as late as *545–390 cal BC (81% probability)*; it may well have replaced the ruinous House 150. Its larger east room contained a hearth, accompanied by quantities of fire-cracked rock. The small cell at its west end, the most solidly built part of the structure, was heavily sooted from the smoke that must have been generated here; this entire end cell was then filled with fire-cracked stones after House 640 fell into ruin. Even more similar than House 150 to Ceann nan Clachan in North Uist (Armit and Braby 2003), it may have served as a sweat lodge and/or smoke-house.

23.2 Dynamic interplay between the dead and the living

Building on the dead

The Cladh Hallan sequence of funerary constructions followed by roundhouse occupation raises questions

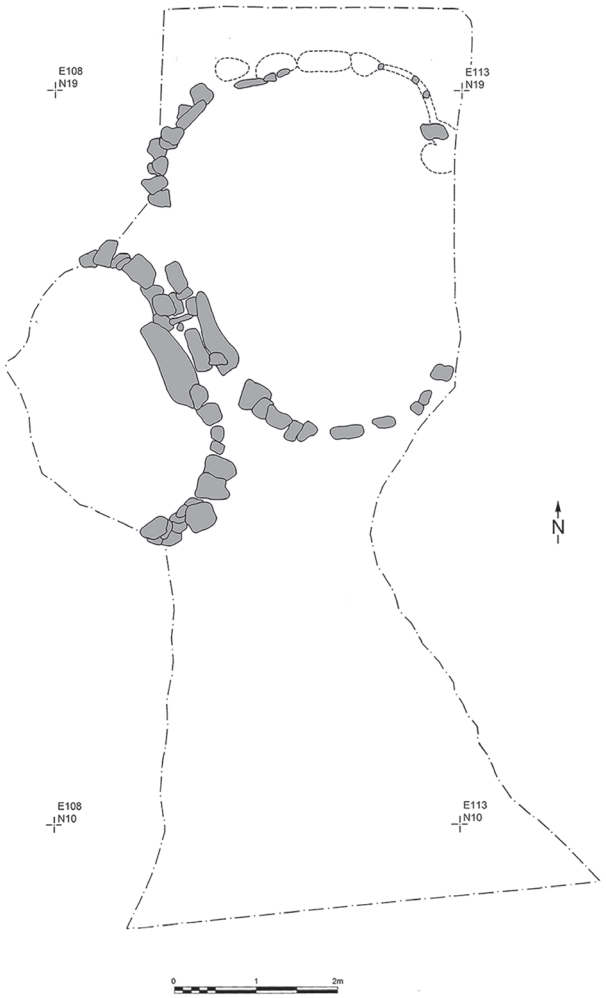


Figure 23.5. Cladh Hallan Area C in Phases 9–16

about this community's long-term relationship with the dead (Parker Pearson 2023). Whilst builders within contemporary European culture might seek out cleared ground, at Cladh Hallan the Late Bronze Age roundhouse-builders sited themselves upon the remains of the dead; they could have continued to build on the ruins of their nearby Middle Bronze Age settlement (in the environs of Area C) or they could have sought out an untouched area of the extensive machair plain around them, yet they chose to build upon an Early–Middle Bronze Age cemetery.

Similar funerary-to-settlement sequences have been identified at Caltragh, Co. Sligo (Danaher 2007) and Gwithian (Nowakowski 2009: 121). In the latter case, Jacqui Nowakowski notes that 'it is perhaps no surprise that the spheres of the living and the dead are in close physical proximity' since curation of their physical remains within the domestic realm was a developing regional trait (*ibid*.). Bob Johnston (2001) has also drawn attention to the use of Bronze Age clearance cairns and field boundaries in various parts of Britain as repositories for human remains, a theme echoed at Cladh Hallan with its evidence for periodic cultivation alongside deposition of human remains.

For a relatively small area of archaeological investigation, Cladh Hallan has produced a remarkable assemblage of burnt and unburnt human remains. None have been found in the Beaker-period or Cordoned Urn levels (Phases 1 and 2) but Wedderspoon's (1912) discovery of cremation burials within herringbone-decorated urns at Cladh Hallan indicates that there is probably a Cordoned Urn cemetery somewhere in the vicinity (see Volume 1: 6).

The cemetery of six Early–Middle Bronze Age cremation burials, two pyre sites and scatters of pyre debris from Area A in Phase 3 (see Figure 19.1) have produced remains from a minimum number of 11 individuals – six adults and five sub-adults. This compares with an MNI of 10 individuals from Cladh Hallan's six inhumation burials and at least 10 from the disarticulated remains.

The two pyre sites appear to have been used differently. The southern one formed the base of a single cremation burial surrounded by a ring of stones (3306), presumably a one-off event for that burial, whereas the northern pyre platform (3558) was reused at least twice and contained remains from three individuals. To the west of this pyre platform, a stretch of gully (3435=3341) may have formed the terminal of a penannular ditch enclosing the platform. Among the fragments of cremated bone from its fills was a fragment of unburnt human bone (context 3342). This and another fragment from pyre debris (3458) are the only unburnt human bones from Phase 3 in Area A (in addition, there is an adult finger bone from Area B). These may derive from one or more disarticulated corpses, either disturbed from their burial locations or exposed above ground.

The tiny quantities of cremated bones within the Phase 3 burials are small even by Bronze Age standards (McKinley 1997b) and indicate that most of the products from the pyre were disposed of elsewhere, with only a symbolic handful being reserved for burial. Whether this missing majority of cremated bones was scattered, thrown in the sea, eaten or disposed of by some other means can only be guessed at.

Cremated human bones are restricted to four instances in Phases 4–7, all in the southern part of Area A. Since these are contexts stratigraphically above the Phase 3 cremation cemetery, it is most likely that the bone fragments are residual from these burials. The same is not likely to be the case for the scatter of unburnt human bone fragments in the same location from Phases 5–7 (see Figure 19.2). These are all from adult individual(s) and many were found in pit fills and plough furrows. The date for a skull fragment from pit fill 2544 appears to be much older than its context, and perhaps some or all of these fragments derive from one or more disturbed or exhumed inhumations.

Around Area C a group of four or more inhumations was disturbed by sand quarrying; only one of these (SF 4906) was salvaged and dates to *1610–1320 cal BC*, contemporary with Phase 3. These burials may have formed a small inhumation cemetery located 100m northwest of the contemporary or near-contemporary cremation cemetery in Area A.

Foundations incorporating the dead within the row of roundhouses: Phase 8

From construction deposits for the row of roundhouses in Phase 8, cremated bone fragments came from within House 1370 (see Figure 19.3). These are best interpreted as disturbed and residual from the Phase 3 cremation platform. Fragments of unburnt human remains accompanied cremated pieces in the sequence of inter-cutting Phase 6 and 8 pits beneath the entrance to the southern roundhouse (House 801), possibly deriving from one or more disturbed or exhumed inhumations.

Fragments of unburnt human bone were also recovered from contexts that might be considered as symbolically foundational of the roundhouse row. Two of these – a fragment of a child's finger and a fragment of a scapula – were recovered from the fill of the stone-lined cist (2105) beneath the entrance of House 401. An adult skull fragment from the wall core at the front of House 801 might also have been deposited there as a foundation offering although it could derive from the same source as the bone fragments from this part of the site in Phase 5–7 contexts. The same can be said for the cremated long-bone fragments from within the wall core of House 1370, as residual from the cremation platform.

A strong case can be made for the unburnt human bones within the fill (2748) of a double pit (2551) on the south side of the pyre platform as being the remnants of an exhumed inhumation. The majority of the bones from the fills of the double pit derive from the female of the two mummified torsos from Cladh Hallan, notably left leg bone fragments articulated at the knee. The pit's double or figure-of-eight plan is interpreted as caused by the cutting of a robbing pit into the side of a grave pit to remove the female mummy buried there a century or so earlier (see Volume 1: chap. 4). The pit's upper fill (2552 = 2554) contained an unburnt bone fragment from a foetus.

At least three of the four Middle–Late Bronze Age inhumations (made up of body parts from at least eight individuals) under the Phase 9 floors – the two composite bodies and the mostly disarticulated skeleton of a 1½–3-year-old – are of individuals who died long before roundhouse construction. They reveal some chronological overlap with the last of the cremation deposits. In the case of the two adult mummies, the bodies were recomposed from multiple individuals, one of whom, as mentioned above, had previously been buried in double pit 2551. The partially decalcified surfaces of their bones indicate that mummification was probably achieved by immersion in the acidic environment of a peat bog (Parker Pearson *et al*. 2005). Not only is there evidence that peat bogs were being exploited for peat at this time (Branigan *et al*. 2002) but the remains of a contemporary bog body dating to *1416–1217 cal BC* (*at 95% probability*; SUERC-49187; 3059±34 BP) have been recovered from a peat cutting near Seann Tom, Habost in the Ness district of the Isle of Lewis (Cowie *et al*. 2011: 25, no. 14; Sheridan *et al*. 2013). This heavily decalcified skeleton of a probable male of 15–18 years included hair and organic matter and is the earliest identified bog body from Scotland.

A key question about the two composite bodies is why it was felt necessary to combine body parts from different individuals in a single skeleton. One reason may be that parts from different individuals were combined to represent and embody different ancestral strands or lineages of the community who built and subsequently inhabited the row of three roundhouses. At the time of writing, we await the results of ancient DNA analysis to establish whether this is likely. The recombining of body parts also raises questions about the construction of new identities from multiple 'dividuals'. Were these particular body parts symbolically charged or were they merely replacements for lost or damaged portions: such could be the case for the male composite skeleton, for which a complete mandible with a complete set of teeth was appended to the cranium of a man with a toothless maxilla. Similarly, was the female–male mummy deliberately created as an 'intersex' composite 'dividual' or was the biological status of the body parts of little significance?

Evidence for composite, multi-individual burials in prehistory is surprisingly rare but this lack of evidence may be partly due to the fact that analytical techniques are only now making their identification possible. At Cnip Headland in the Isle of Lewis, a small group of burials dating to 1770–1620 cal BC shows evidence of curation long after death, either by exposure or dismembering (Lelong 2018). In one instance (clusters 2 and 3 in Area C), the bones of an adult, a sub-adult and an infant were found together although largely in disarticulation. At Pommerœul in Belgium, a Late Neolithic skeleton (grave 26; *c*. 3100–2600 BC) had been reassembled from the body parts of multiple individuals (Veselka *et al*. 2024). More bizarrely, a Roman-period cranium was also added to this composite body.

Although three of the burials beneath the sunken floors of the Cladh Hallan roundhouses pre-date their construction, the burial of a child under House 401 is close enough in date to its construction to have been contemporary with that event. This is the one burial beneath the roundhouses that shows no evidence for *post mortem* manipulation so there is the possibility that this child died shortly before building began. As discussed above, she could have been a human sacrifice for the roundhouses' foundation.

In addition to the inhumations beneath the houses, one of the cremation burials was referenced beneath an earlier building at Cladh Hallan. The hearth of the post-built House 2385 was located directly on top of the burial of the cremated remains of a child. That this was significant is demonstrated by the later digging of a pit underneath the hearth and up into the cremation deposit to remove cremated bones, some of which were found in the pit's backfill. It is unlikely that this was mere idle curiosity since the cremation burial could not be seen in the side of the pit from which a small tunnel was dug into the burial; it implies some knowledge of what lay beyond the edge of the pit and below the hearth of the abandoned house.

The settlement was essentially founded on the remains of the dead, and one of these deceased children continued to play a role for the living in providing material remains for re-circulation. House 2385 also incorporated human remains into its foundations in the form of a fragment of cremated bone deposited within a posthole in the north wall of the house.

We might ask what drove the inhabitants of Cladh Hallan to incorporate the remains of their ancestors into their houses. Were they using the dead to legitimate a new place of the living? Was this use of the dead the result of a crisis? We know that the region must have suffered a climatic downturn after 1159 BC, when tree rings record a sequence of 18 years of poor tree growth in Ireland and beyond (Baillie 1999). Certainly, we cannot dismiss the possibility that the use of the dead was a response to disaster, part of a battle for survival in what had become an inhospitable environment. That date for the climatic downturn falls within the Cladh Hallan sequence broadly after the cremation cemetery and before the construction of the settlement, around the time when the young girl (SK 2727 under House 401) died. Thus the climatic events recorded in the tree-ring data could correspond with a disjuncture at Cladh Hallan.

The Cladh Hallan sequence demonstrates a theme recognised elsewhere in Britain and Ireland, of dwellings becoming more substantial and deeply founded, interpreted as the development in the Middle Bronze Age of a long-term relationship with place (Barrett 1994a: 95–6; 1994b: 146–53; Brück 1999a: 160). This can be pinpointed to Phase 7, in the late twelfth–early eleventh centuries BC, when a new style of sunken-floored architecture with stone-faced walling (House 3260) replaced the surface-built, timber-walled style of House 2835 in Phase 4 (fourteenth–early twelfth centuries BC).

John Barrett (1994a: 95–6) has explained this new domestic mode of monumentality, replacing the cemetery with the house and settlement, as presenting the physical manifestation of biographical continuity and Cladh Hallan exhibits both aspects – locational and monumental – of this wider process of constructing continuity.

Human remains in the domestic sphere

In Britain from the Middle Bronze Age through the Iron Age, human remains were regularly deposited within domestic spaces (Wilson 1981; Wait 1985; Brück 1995; Roth 2016; Lamb 2022). A century ago, Maud Cunnington described such finds from her excavations at All Cannings Cross, Wiltshire as 'detached pieces of humanity' (Cunnington 1919: 25; cited in Armit 2012: 8). Cunliffe (1992) and Bradley (2005: 205) have discussed such commemoration of the dead as relating to the agricultural cycle. More recently, Ian Armit has argued that 'the Iron Age body and its component parts had the power to mediate between the day-to-day world of the living and the supernatural world of ancestors, spirits and deities' (Armit 2012: 223) and that they acted as 'metaphors for more abstract ideas, such as fertility, luck, or health' (*ibid*.: 224).

Discussion about the significance of these deposits of articulated and partially articulated skeletons as well as loose remains has debated whether they were trophies, or taken from executed captives, or from human sacrifices, or from ordinary members of the community (Cunliffe 1992; Carr and Knüsel 1997; Craig *et al*. 2005). In addition, researchers have drawn attention to the contexts of burial (Wilson 1981; Wait 1985; Roth 2012): distinctions between inside and outside, front and back, left and right, as well as locations with regard to the cardinal points and features such as thresholds. Cladh Hallan is very useful for understanding the depositional circumstances of human remains, providing an insight into their significance for the living.

After the foundation of the roundhouse row, fewer human remains were deposited during the next five centuries of occupation. The human remains from Phase 9 are mostly single teeth, either deciduous from children or permanent teeth of older children or young adults (see Figure 19.4). Most likely they derive from living individuals rather than from the mouths of the dead. The one exception in Phase 9 is a cremated fragment of a finger bone from the floor (1311) of House 401; this is most likely a deliberate deposit rather than a residual disturbance from the Phase 3 cremation deposits since it is well away from those earlier locations and also it was located amongst the other special deposits within the house's northeast quadrant, directly over the burial of the 10–14-year-old probable female.

The human remains from Phase 10 (see Figure 19.5) are similarly dominated by single teeth. These are deciduous teeth from the floor (1308) of House 401 and two permanent teeth from within the ruins of House 801. One of these (SF 3473), from the fill (1320) of a robber trench along House 801's inner wall face, was found with part of the mandible still attached, indicating that this tooth came from a corpse and not a living person. Its radiocarbon date of *1535–1295 cal BC* indicates that its adult owner was probably alive during Phase 3 and that it is residual within its Phase 10 context.

Along with the female neonate (SK 2188) buried in House 1370 during the interface between Phases 9 and 10, other human remains from Phase 10 consist of an adult femur fragment from a sand layer (2426) behind (west of) House 401, and a juvenile/young adult skull fragment from the midden in Area C.

Single teeth are again the most common human remains from Phase 11, from the floor (655) of House 401 and from a hearth area outside its entrance (see Figure 19.6). An adult male skull fragment was incorporated in the fill layer (1413) imported into House 401 to provide a base for its floor (655).

As well as three teeth from layers within House 401 and above the ruins of House 1370, foetal remains were recovered in Phase 12 from a posthole and a fill layer in House 401 (see Figure 19.7). In Phase 13 a neonatal bone and a deciduous tooth were recovered from the floor of House 401 (see Figure 19.8). The double roundhouse (House 150) in Area C was constructed in Phase 13 and

one of its earlier floors (242) had bone fragments from three individuals, one of them a foetus, scattered across it (see Figure 19.66).

Similar finds of human remains were retrieved from the floor of House 401 in Phase 14 (see Figure 19.8). One of these was the disarticulated skeleton of a foetus or stillborn neonate. The others were fragments of bones of infant(s) and adult(s). Foetal or neonate bones were also recovered from Phase 16, within House 150 (together with fragments of an adult pelvis) and just outside the other double roundhouse (House 640).

In summary, the human remains from the roundhouses' occupation (Phases 9–16) are mostly the vestiges of domestic tragedies – minor ones of tooth loss and major ones of miscarriage, stillbirth and infant death. Other bones, placed on house floors or deposited within sand fills, show continued recycling of the remains of the dead although the actual locations of their owners' final resting places are unknown.

Mummification in the British Bronze Age

Finally, a few words need to be said about mummification in the British Bronze Age. Prior to the discovery of the composite skeletons at Cladh Hallan in 2000, the notion that *post mortem* preservation of soft tissues might be a component of prehistoric mortuary practices in Britain or indeed anywhere in northern Europe was unheard of. Yet the practice of embalming is recorded from the pre-Roman Iron Age; Posidonius' account from around 100 BC of Gaulish practices of embalming the heads of enemies with cedar-oil and keeping them in a chest to display to visitors, was copied by Diodorus Siculus and Strabo (see Armit 2012: 26 for a discussion).

Within Britain, recent excavations in southern England have revealed six tightly crouched Middle Bronze Age skeletons from Down Farm 80 and Canada Farm 09 that may have undergone soft-tissue preservation prior to burial; in addition, two of the Canada Farm skeletons have drill holes in their long bones, suggestive of stringing together of the limbs (Green 2000: 112–13; Smith *et al*. 2016). Their dates in the sixteenth–fourteenth centuries BC are similar to those for some of the Cladh Hallan body parts. A recent, unpublished discovery of a stone-covered adult burial within a Middle Bronze Age settlement at Ronaldsway Airport in the Isle of Man is described thus: 'Bones were mostly articulated, but the mandible, hands and fingers were not, suggesting that the body was not fully fleshed and had been moved from elsewhere' (Pitts 2008: 7).

Application of the analytical techniques developed on the two Cladh Hallan composite bodies to other burials has shown evidence for *post mortem* halting of decomposition on Bronze Age skeletons from seven sites across Britain, suggesting mummification using a variety of methods including fireside-drying of the corpse, as in the case of remains from the Isle of Sheppey (Booth *et al*. 2015). The earliest of these instances of mummification is a Beaker-period burial from Canada Farm (Smith *et al*. 2016).

It is just possible that similarly crouched Bronze Age mummies survive with soft tissue intact. A young adult male bog body found in 2005 at Derrycashel, Co. Roscommon is missing its head and one of its legs but it had been laid in a crouched position, unusual for bog bodies in general. Two radiocarbon dates of 1430–1290 cal BC and 1100–950 cal BC, providing an estimated mean value of 1450–1050 cal BC, place it in the same period as the Cladh Hallan mummies (Nora Bermingham and Mary Cahill pers. comm.; Mulhall 2005).

It seems likely that these Bronze Age ancestors of the inhabitants of Cladh Hallan were maintained and presented within the domain of the living, as fleshed and whole individuals, at least for a time. Identities and personal histories may have been recalled decades, if not centuries, after death. We do not know if their heads and other body parts were removed and replaced during their curation above ground or at the time of burial, or what meaning to ascribe to the composite nature of the preserved bodies. The people of Cladh Hallan may have had a profound knowledge of long-term history embodied in their dead. Cyclical concepts of time were interwoven with complex understandings of linear time, which stretched back possibly over tens of generations. These people had a developed sense of ancestral history, materialised in part by dwelling within a house upon the remains of ancient dead.

Social structure

Ancient DNA is revealing patterns of biological descent and relatedness among prehistoric populations of both people (*e.g*. Hanna *et al*. 2012) and domesticated animals. An ongoing analysis by the Crick Institute of ancient DNA from Cladh Hallan's human skeletal material should answer questions about relatedness among the individuals who make up the composite bodies, as well as between the possibly sacrificed child (SK 2727) beneath House 401 and the remainder of the community.

In terms of social structures of inequality at Cladh Hallan, the presence of weapon moulds and metalwork, notably the gold ring as well as the piece of iron in an eleventh-century BC context, suggests a degree of wealth, power and long-distance connections that may not necessarily have been shared by many settlements in the islands or more widely across western Scotland (Parker Pearson 2025). In addition, House 401's circular forecourt building is highly unusual, an almost unique feature in the British Bronze Age. The shared walls of the three roundhouses imply that they functioned as a modular unit, with the inhabitants of two apparently subordinate or subsidiary houses potentially providing labour – whether enslaved, dependent, or servant – for those living in the central house (see below).

A cautious estimate is that the three Cladh Hallan roundhouses of Phase 9 may have been inhabited *in toto* by a group of about 14 people of various ages and statuses, most probably functioning as a central household with dependents. This central house on its own was large enough for a good-sized family unit. Those in authority at Cladh

Hallan had access to gold and exotic items. They also had the ability to commission the casting of sets of bronze tools, weapons and ornaments which, in Phase 9, included two swords, possibly for two individuals of warrior status.

If the composite preserved bodies buried beneath the floor of the northern roundhouse embodied a concern with ancestry – hopefully to be clarified by further genetic analysis – then such instancing of the ancestral past in the present may have served to legitimate the inhabitants' authority within the wider community. The potential child sacrifice under the central roundhouse hints at socially sanctioned power over life and death and the possibility that some were enslaved, growing up in conditions of near-starvation. Cladh Hallan's inhabitants may or may not be classifiable as a chiefly lineage living with its dependents but their social differentiation extended well beyond dimensions of age and gender (Parker Pearson 2025).

23.3 Cycles of building and re-building: house histories, architecture and ritual

Ritual, symbolism and everyday life in later prehistory

Although the Cladh Hallan excavations were limited in spatial extent, compared to the landscape-sized excavations of sites such as Corrstown (Co. Derry/Londonderry), Kintore (Aberdeenshire) and Ronaldsway (Isle of Man), the quality of bone preservation and the exceptional survival of house floors, walls and other features within deep stratigraphic sequences provide a useful key for interpreting the truncated remains of roundhouses in other places and for asking questions about use of domestic space, daily life, social organisation and architectural development. In particular, it provides an opportunity to explore themes and to ground-truth hypotheses developed by various scholars of later prehistory (*e.g.* Fitzpatrick 1994; Brück 1995; 1999a; 1999b; 2006; Bradley 2005; Sharples 2010).

Over the last 25 years, it has become apparent that roundhouses were far more than mere dwellings or functional spaces in which to shelter from the elements and raise families. Questions of cosmology, ritual and structured deposition have been asked of settlement organisation, roundhouse architecture, household activities and portable material culture. From a cross-cultural perspective, LaMotta and Schiffer's (1999: 25) review of formation processes on house floors concludes that ritual deposition has been overlooked by archaeologists and requires particular attention. For prehistoric Europe, Bradley argues that archaeologists 'have seen ritual as something that happens beyond the limits of everyday life… quite separate from the concerns of daily life' (Bradley 2005: 35). Yet ritual activity can be investigated in domestic contexts; for example, in the manner of deposition where a degree of formality may be indicative that people imbued those items with a greater significance (*ibid.*). Cladh Hallan's unusually high level of preservation and long chronological sequence allow us to address these and related issues concerning the nature of dwelling and ritual in later prehistory.

House sizes

In size the Cladh Hallan roundhouses (Table 23.1) are generally smaller than the average for Late Bronze Age roundhouses in Britain (just over 50sq m) and Ireland (48sq m; Ginn 2016: 99). Within Scotland, Bronze Age roundhouse interiors generally occupy 50–80sq m (Kruse *et al*. n.d.). Houses 801, 1370 and House 401's Phases 11–16 are thus well below the average. House 401 is the exception, with an extra 10sq m for its forecourt structure in Phases 9–10. Even so, when compared to the roofed floor areas of Late Bronze Age roundhouses in Ireland, it is by no means among the largest, which have floor areas of 80–130sq m (Ginn 2016: fig. 6.4).

House 401's forecourt 'antechamber' is an unusual architectural feature hard to match elsewhere in Bronze Age Britain and Ireland. It can be compared with the porches of Irish Middle Bronze Age houses; however, these are not only several centuries earlier but also D-shaped rather than circular in plan (Ginn 2016: 103–4). The closest comparison may be a Middle Bronze Age roundhouse with a second circular structure in front of it at Stansted, Essex (Cooke *et al*. 2008: 40, fig. 4.9). This building (Roundhouse 1) could be a house and 'antechamber', slightly larger than House 401 and its forecourt building, or it could be a roundhouse replaced by a smaller roundhouse directly in front of its entrance – there is no way of knowing which. In any case, the Stansted site is much earlier (*c*. 1700–1300 BC) than Phases 8–9 at Cladh Hallan.

The Cladh Hallan houses belong to a roundhouse tradition found elsewhere in Scotland as well as Ireland. The Scottish Late Bronze Age corpus is usefully summarised by Suddaby (2013: 63–6; see also Ashmore 2001), with notable sites including Green Knowe (Scottish Borders; Jobey 1981), Carn Dubh (Perthshire; Rideout 1995), Kiltaraglen (Skye; Suddaby 2013) and Kintore (Aberdeenshire; Cook and

Table 23.1. Floor sizes of the Cladh Hallan roundhouses

Phase	Building	Floor size (sq m)	Forecourt size (sq m)
9	House 401	64	10
10		52	
11		44	
12		44	-
13		38	
14		44	
15		40	
16		38	
9	House 1370	43	
9	House 801	30	

Dunbar 2008) as well as other sites in Skye, Wester Ross and Sutherland (Kruse *et al*. n.d.). Ginn (2016) has compiled an extensive study for Irish roundhouses of all periods within the Bronze Age.

Household activities and modules

Although David Clarke's socio-economic model of domestic life at the Iron Age lake settlement of Glastonbury (Clarke 1972) has since proved to be inconsistent with the evidence from that site (Coles and Minnit 1995), it laid the ground for conceptualising and problematising the nature of the household and domestic unit in British later prehistory. In 1981 Ann Woodward (Ellison 1981) published a scheme for Middle Bronze Age settlements as being composed of four types of structure: major residences (including a porch, status items, fine and coarse wares, tools for production, maintenance and textile-working), ancillary buildings (smaller and more oval, associated with coarse wares, querns and scrapers), animal shelters (with worn floors and few finds) and weaving huts.

The Woodward hypothesis has been successfully applied to settlements such as Black Patch, East Sussex (Drewett 1982; Russell 1996; Sharples 2010: 181–2), Trethellan Farm, Cornwall (Nowakowski 1991), and Thorny Down, Wiltshire (Ellison 1987) amongst others. Brück's re-analysis of Middle Bronze Age settlements led her to elaborate on the Woodward model, taking into account the blurring of distinctions that she noted between major and ancillary household assemblages (1999a: 151). Her re-analysis can be termed the 'house life cycle hypothesis', which factors in changes in function during a house's lifetime such as from major residence to animal shelter as it decayed, or variations in its use because of the social and economic needs of its inhabitants. Brück also proposed that the life cycle of the Middle Bronze Age residential house might mirror that of its inhabitants, the dwelling becoming abandoned when the head of the household died (*ibid*.).

As the sequence at Cladh Hallan shows, the three conjoined houses of Phases 8–9 can be interpreted as a major residence (House 401) flanked by an ancillary residence (House 801) and a second ancillary residence in which animals were occasionally stalled and activities such as potting were carried out (House 1370). None of the houses exhibit evidence for sole use as animal shelters or weaving huts, although such uses were accommodated at certain times among the range of activities within the roundhouses.

Towards the end of the Late Bronze Age (Phases 10–11), the settlement cluster was re-organised: the major residence (House 401) remained conjoined with an ancillary house (House 1370) but, with House 801 dismantled, it was physically separated from a large (unexcavated) roundhouse to the south, which could represent a separate modular unit. In this phase, the format of paired roundhouses (Houses 401 and 1370) corresponds very closely to Woodward's major residential and ancillary types. Thereafter (Phases 12–16) the roundhouse stood largely in isolation (not enough of House 1500 survived to tell if it was either an ancillary house or another residence). Later in the occupation sequence, the two double-roomed houses (Houses 150 and 640) were non-residential, special-purpose buildings, associated with heated-stone technology. The earlier of these (House 150) was turned into a copper-alloy casting workshop in its later stage of use; otherwise there is little evidence for changes in function within the closely dated phases of occupation. Interestingly, Brück's house life cycle hypothesis for changes in function holds true for House 401 in Phases 13–16.

The relatively tight dating of the house sequence also provides an opportunity to compare house longevity with human life cycles. With a sequence of eight builds in House 401 over some 400–500 years (*395–515 years at 68% probability*) and with no evidence for any long-term breaks in occupation, it is likely that this roundhouse was occupied for 15–18 generations (each generation being estimated as 27 years). Thus the house was re-built on average every 50–60 years, or about every two generations. It would thus seem that it was rebuilt less frequently than the death of the household head. That said, it is possible that rebuilding of the roof – not detectable from the archaeological evidence – could have been undertaken on a generational schedule.

Roundhouse size has been noted to change between the Middle Bronze Age and the Iron Age in southern Britain, with a tendency towards large roundhouses at the bronze–iron transition which then became smaller in the Middle Iron Age from 400 BC onwards (Sharples 2010: 196–7). Niall Sharples has interpreted this as a rise then a decline in the significance of the house as an arena for social interaction (*ibid*.). John Barrett (1989) and Roger Thomas (1997) have suggested that the rise of the large house marked a transition from exogamous to endogamous marriage patterns, as the separate male and female spaces in major and ancillary spaces within earlier paired dwellings were coalesced into a single large roundhouse. These hypotheses about house size and marriage patterns are useful contributions to the newly begun reconsideration of Iron Age society as matrilocal (Cassidy *et al*. 2025).

The Cladh Hallan sequence certainly conforms to the picture presented by Sharples, with the two largest roundhouses being House 401 in Phases 8–9 and House 2190 in Phase 10, both with internal diameters of around 10m. The smallest roundhouses used as dwellings are ancillary dwelling House 801 in Phases 8–9 and main dwelling House 401 in Phases 10–16, when it was generally about 7.50m in diameter internally.

Yet how should this size shift be interpreted at Cladh Hallan? Phases 8–9 are the moment when the main dwelling (House 401) had two potentially dependent adjoining roundhouses; perhaps the household, as represented by inhabitants of three conjoined houses, was at its largest and numbering about 12–15 individuals (say, two in House 801, four in House 1370, and eight in House 401, based on the sizes of sleeping areas). This may represent an extended family with dependents, headed by a senior family member. Thereafter, the sleeping area of the main residence, House 401, remained about the same size in

later phases even though the house was smaller; thus there may have been the same number (say, eight) sleeping in House 401 in Phases 10–16 but without the dependents in conjoining houses. Perhaps this represents a change in systems of clientage, servitude, kinship or marriage (from polygamous or polyandrous to monogamous), changing to a more nuclear-family based organisation of the household.

Superimposition and rebuilding

In 1999 Joanna Brück pointed out an important distinction in traditions of roundhouse building between the Middle Bronze Age and the Late Bronze Age in southern Britain (1999a: 146). Houses in the Late Bronze Age were frequently renewed upon the very spot where they stood, in contrast to Middle Bronze Age patterns of relocation and short lifespans. Since then, Sharples has demonstrated that this long-term adherence to a specific spot for rebuilding continued into the Early Iron Age (2010: 208–28).

This change from the Middle Bronze Age to the Late Bronze Age can also be found in Ireland, contrasting sites such as Corrstown with Late Bronze Age–Early Iron Age house sequences at the royal sites of Navan, Co. Armagh (Waterman 1997) and Dun Ailinne, Co. Kildare (Johnston and Wailes 2007).

The stratigraphic sequence at Cladh Hallan provides us with a clear sequence of superimposition from Phase 8 to Phase 16, especially for House 401, allowing us to perceive details not normally visible in less well-preserved cases where only truncated cut features survive. Thanks to Cladh Hallan's deep stratigraphy, it is possible to tease apart successive rebuilding episodes. It is interesting that there is no evidence of windblown or water-washed sand infill within House 401, indicating that it was never abandoned or left open to the elements for any length of time between each phase of occupation.[3]

One of the most interesting aspects of the renewal of House 401 (and House 1370) is that a part of the old internal wall face was always incorporated into the new. Thus it was not simply that the precise same spot should be used but that part of the old continued unmodified within the new build. This notion of retaining or reusing the old did not, however, extend to remnants of even earlier construction phases so there was relatively little accretion of antiquity in each preserved section of walling; it cannot, be compared, for example, with one of today's historic buildings which exhibit long chronological ranges of rebuilds within the standing fabric.

Each episode of rebuilding often prompted a series of acts beyond those of raising the floor level, replacing the roof, and rebuilding the interior wall. When House 401 was initially rebuilt in the second part of Phase 9, just three short stretches of its interior walling were left *in situ*, at the west, north and south. A small pot was placed beneath the west wall of this new phase. It was also during the second part of Phase 9 that a formal circular antechamber was constructed over the forecourt, and a new stone cist was sunk into the floor across the doorway, just east of an earlier cist.

When House 401 was rebuilt in Phase 10, walling was retained in the north and as a single stone in the south wall. Stone walls were retained as internal divisions within the house in its east and west. During rebuilding (between Phases 9 and 10), a large pit was dug through the line of the dismantled south wall face, filled with smashed pots and covered by the wall of the Phase 10 house. In Phase 11, sections of the house's south, north and east wall faces were retained, and a deposit of deer antlers and smashed pottery was left within the house's west side. In Phase 12 the south wall was retained, and in Phase 13 the west and east walls.

In Phases 14 and 15, from the late eighth to early sixth century BC, the floor of House 401 was renewed but the wall faces remained unchanged. In Phase 16 the west half of House 401's wall face was renewed and the east side retained. In House 1370, the northeast part of the wall was retained in both Phases 10 and 11. In summary, there does not seem to have been a preference for preserving a particular side or direction within each new build.

One of the most intriguing aspects of each rebuilding in both roundhouses is the way in which the new build was always slightly off-centre (by up to a metre or so) from the previous one. Sections of the existing wall might be reused but not invariably; it was more important to reset the location of the house and its hearth so that the rebuild was off-centre. We realised during excavation that this asymmetrical re-positioning was more than merely a series of whimsical or accidental misalignments when we discovered just how much sediment needed to be dug out in order to move the house's centre of gravity by this small distance: rebuilding on the same spot would have been far easier since it would have been much less effort to have constructed the new building within an already defined circular space within the existing wall core.

This long-term structuring of space in the Late Bronze Age–Early Iron Age is not simply an issue of continuity of place: a household can re-locate within a hundred metres or less of its previous dwelling and still maintain continuity with its yards and fields. This phenomenon of superimposition is a more deeply symbolic concern with the unchanging nature of the house across the transitions of the house's life and rebirth. To paraphrase a saying, 'the house is dead, long live the house'.

Sharples (2010: 224–6) has suggested that the change to repeated rebuilding on the same location across southern Britain after the Middle Bronze Age was related to changing patterns of inheritance and landholding. The previous pattern of relocation may have involved the dispersal of adult children from the house into new homes, leaving the parents or original inhabitants to remain there until their deaths, at which point the house would be demolished or abandoned (Brück 1999a: 149–50). In such a situation, the children would not have been entitled to inherit the farm since land ownership was organised at a level beyond the individual household. Both Brück and Sharples draw upon Andrew Fleming's argument that land in the Middle Bronze Age was owned and farmed communally by communities of multiple households (Fleming 1988).

Niall Sharples notes that the subsequent change to superimposition in the Late Bronze Age coincided with the appearance of large roundhouses, both aspects emphasising their symbolic significance. 'The immediate reconstruction of the house implies that the location, and association with the previous household, was important. The new owners inherited or acquired a position of influence by the act of re-construction and perhaps the physical appropriation of the timbers of the old house. The new owners may have been the descendants of the original occupants, who were moving back to their old home… but this need not be the case. It could be that a more distant relative aspired to lead the community and that they made their aspirations known by the act of occupation and rebuilding' (Sharples 2010: 229).

This point about potential contestation is an interesting one because the offspring of a single household may well have been more numerous than the original occupants, thus most of those offspring would have no choice but to move elsewhere. The symbolic significance of the long-lived house would thus have bolstered a system of inheritance in which only one of the offspring received the major share, thereby discouraging partible inheritance and encouraging or embodying a system such as primogeniture. Such a process might well be linked with a kinship system promoting hierarchy based on ancestral descent in which certain families could demonstrate, genealogically and architecturally, their direct line to a founding ancestor and their individual household's control over formerly communal land. Again, these are ideas that can be re-examined through the lens of matrilocality.

Sunwise ordering of activities

During the 1990s a series of publications emphasised the symbolic significance of aspects of roundhouse architecture and use that had been previously thought to have had more mundane and functional purposes (Hingley 1990; Fitzpatrick 1994; Parker Pearson and Richards 1994; Hill 1995; 1996; Parker Pearson 1996; 1999; Oswald 1997; Giles and Parker Pearson 1999). We can group most of these notions together as the 'Fitzpatrick hypothesis'.

In 1994 Andrew Fitzpatrick published his 'sunwise' model of house use, arguing from a single excavated multi-phase example at Thatcham, Berkshire, that the ordinary Iron Age roundhouse faced east towards the rising sun and that its internal organisation reflected the diurnal round of activities, with eating and food preparation in the southeast, other daytime activities in the southwest and, as the sun descended below the horizon, sleeping on the north side of the house (see also Fitzpatrick 1997). The model could be elaborated so that, if the house were rotated 180° so that the doorway faced west, the food area should lie in the northwest and the sleeping area in the south.

Orientation

Al Oswald examined the evidence for house orientations and argued that the majority of doorways were arranged so as to face the rising sun rather than being oriented simply to protect the house interior from the prevailing westerly winds (1997). This concern with facing east was also shown to be present in burial orientations and entrances of enclosures and hillforts, neither likely to be influenced by wind direction alone (Hill 1996; Parker Pearson 1996b; 1999).

These theories of orientational symbolism have been challenged by revivals of the functional model, in which the east or southeast-facing doorway is explained as a means of maximising sunlight and solar warmth entering the house, affording its inhabitants maximum protection from the prevailing westerly winds and providing light for interior activities within the entrance area (Pope 2007; Webley 2007). These approaches have themselves been challenged in a detailed study of roundhouse orientations and internal layouts in southern Britain (Sharples 2010: 197–237).

The Cladh Hallan settlement itself, together with other Iron Age examples from the Western Isles, provides evidence of why the functional interpretation of wind and sunlight direction is an insufficient explanation. All three roundhouses (Houses 401, 801 and 1370), two double roundhouses (Houses 150 and 640), and two small houses (Houses 2835 and 3260) have broadly east-facing doorways. Only one structure (Structure 2477) is likely to have had a west-facing entrance but this is uncertain. By the later part of Phase 9, House 401 was entered via an antechamber and narrow passageway that would have excluded almost all natural light from the house's interior.

More widely within the Western Isles, not all roundhouses faced east or southeast (*e.g.* Scott 1947; Young 1952; Armit 2006). Although Middle Iron Age wheelhouse doorways predominantly opened to the east or southeast (11 cases), four face north, northeast or southwest and seven face west (Armit 2006: 250; for a fuller discussion, see Parker Pearson and Zvelebil 2014). Thus as many dwellings' doorways were positioned towards the prevailing westerlies – no small matter in the Outer Hebrides – as away from them. When we include the fact that many of these buildings are located on exposed hillsides and other locations open to the west winds, the explanation of wind avoidance can only work with special pleading that half of the population must have been too stupid to stay out of the wind – it clearly cannot stand as a viable explanation of doorway orientation.

The 'sunwise' model of roundhouse life

Before we started digging the main site at Cladh Hallan, we drew up an interpretive scheme of roundhouse life, incorporating both repetitive social practices and a series of temporal metaphors (see Volume 1: fig. 1.20). The model derived from Fitzpatrick's formulation based on Thatcham (Fitzpatrick 1994; 1997), from Early Iron Age House 3 at Longbridge Deverill Cow Down, Wilts. (Hawkes 1994; see Giles and Parker Pearson 1999) and from the study of Middle Iron Age roundhouses (200 BC–AD 300) in the Western Isles (Parker Pearson and Sharples 1999).

Although the truncated nature of most British roundhouse sites prevents a proper analysis of floor surfaces to reveal activity patterning, a number of well-preserved Iron Age examples can be identified, notably: Haddenham, Cambs. (Evans and Hodder 2006), Meare, Somerset (Gray and Bulleid 1953), Kintore roundhouse 26 (Cook and Dunbar 2008: 93–5), Maiden Castle, Dorset (Sharples 1991; 2010: 216–17), Danebury, Hants. (Cunliffe 1995: 185–92; see also Sharples 2010: 218–19), Mingies Ditch, Oxon. (Allen and Robinson 1993: 54–9), Pimperne, Dorset (Harding *et al*. 1993) and Worth Matravers, Dorset (Graham *et al*. 2002; see also Sharples 2010: 220–2). Sharples' review of many of these examples concludes that most exhibit differential occupation between their left and right sides, broadly supporting the Fitzpatrick hypothesis (Sharples 2010: 222).

As work started at Cladh Hallan, we modified Fitzpatrick's diurnal model by conflating the southern half of roundhouses into an undifferentiated 'daytime' area, removing his southeast/southwest distinction which places a specific 'eating and cooking' area in the southeast and storage together with sleeping on the north side (see Volume 1: fig. 1.20b). This diurnal model was the basis for considering the house as a metaphor of the life cycle, with birth symbolised in the southeast quadrant and death in the northeast, so that the doorway represents a liminal threshold between the beginning of life and its end (see Volume 1: fig. 1.20c). We also predicted that the sunwise direction for daily and life cycles would also be employed for directing movement around the house. Finally, the axial symmetry of the house was also considered as embodying concepts of seniority and sacredness: our model designated the area opposite the doorway as a location for offerings and as the place of the most senior member of the household (see Volume 1: fig. 1.20d).

Our simplification of Fitzpatrick's tripartite plan (eating in the southeast, living in the southwest, and sleeping in the north; Volume 1: fig. 1.20a) into a binary south–north split into living and sleeping areas (Parker Pearson and Sharples 1999: fig. 1.10b; Volume 1: fig. 1.20b) was refuted by the evidence from Cladh Hallan. After excavation, we found that Fitzpatrick's original model (Volume 1: fig. 1.20a) was a *closer* match for 12 of the 15 Cladh Hallan house floors than our modification of his model.[4] We were also able to refine his model by identifying a likely sacred area in the northeast quadrant as well as clarifying that the southeast quadrant was the kitchen area but not where people sat to eat. Instead, the frequently observed clustering of animal bone fragments around the west, south and north of the central hearth recalls the 'toss and drop' zone identified by Lewis Binford (1978) around Nunamiut hunters' fireplaces. Thus we conclude that people ate while sitting around the hearth, leaving open the view eastwards towards the doorway.

Sunwise movement

To establish how people moved around within a roundhouse requires outstanding levels of preservation of house floors. The excavators of the Haddenham roundhouse in Cambridgeshire were able to infer sunwise movement into the house from the position of paths of movement and internal barriers (Evans and Hodder 2006). There is also evidence for sunwise movement into the Cladh Hallan roundhouses. The most convincing is from House 801, in which a crude line of stones was bedded into the floor surface on a northeast–southwest alignment immediately inside the house at the end of the entrance passage (see Volume 1: chap. 5). For anyone entering the house, movement was directed to the south, and the floor immediately on the southeast side of these stones was heavily churned and divoted. The stones may well have been visible in the weak natural light of the doorway and the artificial light from the peat fire. Of course, this stone row raises the question of whether leaving the house was a matter of 'unwinding' counter-sunwise but there was a suitable gap at the north end of the stones that could indicate an 'exit' route.

In House 401 there was only a slight degree of differential wear on the south side of a small, centrally placed water tank east of the hearth in Phase 12, but in House 1370 the area of greatest wear was clearly from the entrance passage into the southeast part of the house, whereas the wear from the northeast quadrant to the door was relatively slight. Like the trampling in House 801, this differential wear on the sandy floors might have resulted from greater erosive damage being done by wet feet coming into a house as opposed to dry feet going out.

Spatial arrangement of activities: consistent patterning through time

The Fitzpatrick hypothesis of the ordering of activities is supported by the distribution of artefacts within the floors of the Cladh Hallan roundhouses, as documented in Volume 1. This is also the case for the arrangements of artefacts left on top of floors, either immediately prior to refurbishment (the covering of the old floor layer with a fill layer before laying a new floor) or at a house's abandonment.

The Fitzpatrick model is strongly supported by the discovery of raised sleeping platforms within several of House 401's floors and of similar turf layers in the primary floors of Houses 801 and 1370, in all cases only in the northern half. Whereas House 401's successive sleeping platforms were in the northwest quadrant and extended over the edge of the northeast, House 801's was confined to the northwest quadrant whilst House 1370's covered the central part of the north side.

The variations in architectural plan through time (successively sub-rectangular, oval and circular) contrast with the consistent employment of the same use of space. Not only was the hearth always central to the house but activities were consistently arranged around it in the same way. In Houses 801 and 401 the artefacts and micro-debris within the floor layers have been plotted to show that cooking and food preparation were carried out in the southeast, that craft activities such as hide-working were carried out in the southwest, that the sleeping platform

was positioned in the northwest and north, and that the northeast remained generally clean and free of detritus. As mentioned above, House 1370 was used rather differently: generally, there was no clear spatial division of activities and the quantities of debris were much less.

The pattern of activities divided into quadrants around the central hearth was clearly observed in Phase 9 within House 401. This floor built up to a depth of about 0.30m at its centre during a prolonged period of use in which a myriad of ephemeral re-surfacings, small features and timber uprights were installed. The floor of the southeast quadrant was raised above the rest of the roundhouse floor and was packed and strewn from top to bottom with sherds of all sizes. Even the postholes in this quadrant contained large quantities of sherds. These may be considered as debris from cooking pots used and broken in this quadrant.

The southwest quadrant contained a 'cellar', empty other than for a deposit of cow bones and hammerstones; it is interpreted as a storage area and may have been covered by planks. The floor in the southwest quadrant contained substantial quantities of tools and working debris, particularly bone points, worked pumice and smoothed stones for polishing and burnishing. Carbonised plant remains further indicate crop processing activities in this part of the house. Carbonised fragments of twisted cordage also survived on the south side of the hearth. Our interpretation is that, as predicted by the Fitzpatrick model (Fitzpatrick 1994), cooking was carried out in the southeast quadrant whereas craftworking, especially the processing of calfskin and deerskin, was performed in the southwest quadrant.

The surface of the northwest quadrant was raised by a thick layer of clean sand and turf on top of stones, forming what would have been a turf-covered platform *c.* 2m wide, curving along the wall into the northeast quadrant. There was also a drain against the northwest wall and another curved gully beneath the floor in this quadrant. We interpret this raised area as a sleeping platform; high concentrations of nitrogen in this area could result either from infants' urine or from the organic content of the turf. Other than a few small sherds, the only pottery from the northern half of the house was a smashed deposit with burnt material, placed against the north wall.

The northeast quadrant in Phase 9, like that in all other house floors' northeast quadrants, was remarkably bare – the cleanest area in the house – with just a few pieces of worked stone and antler compressed into its matrix.

In Phase 10 this basic arrangement remained the same but in Phase 11 the zone of craft activities shifted from the southwest to the western end of the house, possibly because of a collapse in the southwest wall. In Phase 12 the zone of craft activities was back in the southwest quadrant but in Phase 13 it was concentrated in the south of the house, close to the cooking area. It remained in the south and southwest in Phases 14 and 15.

Beneath the northeast quadrants of Houses 401, 801 and 1370 lay the human burials interred before the row's foundation in Phase 8. Between Phases 9 and 10, a baby (SK 2188) was buried face-down in a posthole (from which the post had been removed) in the northeast quadrant of House 1370.

In Phase 12, two dogs were buried under the northeast quadrant of House 401, together with two disarticulated sheep burials and a sheep cremation. The smaller of the two dogs had been decapitated prior to burial but there was no indication of trauma on the skeleton of the other.

Overall, the spatial patterning of activities within the house contrasts with the hypothesis that tasks such as craftworking and cooking would have been performed in the entrance area, to make optimal use of any daylight within the house (*contra* Pope 2007). Nor was there any evidence for working outside the doorways of any of the houses: no debris lay on the well-preserved outdoor yard surfaces. Instead, the arrangement of interior space and activities conforms well with the expectations of the Fitzpatrick hypothesis. Food preparation was in the southeast, corresponding with the sun's position in the morning. Other daytime tasks, involving bone, pumice and stone tools for hide-working, were performed in the south, southwest and west. The sleeping platforms, recognisable as raised, level areas of machair turfs, were in the north, corresponding with the sun's transit below the northern horizon.

The sunwise model can be modified as a result of the Cladh Hallan excavations: there are aspects of this hypothesis that have not been confirmed by the material evidence. Items placed against or under the southwest wall as well as against or under the west wall may have been special offering deposits. The north wall was also regularly used for small deposits of burnt material. Secondly, the interior space for storage seems to have been the southwest quadrant rather than the north (as predicted in the reworking of the Fitzpatrick model by Parker Pearson and Sharples 1999: fig. 1.10.b), with the exception of House 401's forecourt, whose northern half was used in Phase 11 for flat-bottomed storage pits. Thirdly, the predicted arrangement of seniority – looking across the hearth to the doorway – could not be assessed given the want of evidence either for or against.

From a twenty-first-century perspective, the unusually well-defined zones within these roundhouse floors may appear a little unexpected. In our own lives, activities around the house are rarely so carefully regulated; we can eat in bed, repair a motorbike in the kitchen,[5] do the ironing in front of the television, or otherwise use domestic space in ways unintended by architects and designers. So why is there so little evidence for similarly chaotic and quixotic behaviour in the Cladh Hallan floors? Discussing European later prehistory more generally, Richard Bradley has suggested that the reason this level of orderliness can be detected archaeologically is because of the cultural conventions under which it was formed: 'The reason why some deposits can be interpreted today is that they resulted from behaviour that required a certain degree of formality. They achieved this because on particular occasions *those very actions were ritualized*.' (Bradley 2005: 208–9, original emphasis).

Bradley also explains why the manifestations of domestic life described by the Fitzpatrick hypothesis appeared in Britain's Late Bronze Age, coinciding with the transition to superimposition and re-building *in situ*: both developments emphasised the annual cycle of the seasons, continuity across the years and generations, and a cyclical conception of time (Bradley 2005: 56, 206). Whilst Bradley suggests that deposition within roundhouses emphasised divisions of space rather than divisions of time (*ibid.*: 206), the fine-grained Cladh Hallan sequence allows us to see that divisions of time were indeed marked by depositional events such as burying whole pots or smashed pots in pits dug after the demolition of a house's walls but before their re-building. Bradley is, however, certainly correct in terms of the greater degree of emphasis on spatial division.

Metaphorical relationships with the body – transformation through fragmentation

A model developed in the closing stages of the Cladh Hallan excavations (and before post-excavation analysis provided us with any results in this area) was based on Brück's proposal, derived from a study of southern English Later Bronze Age settlement debris, that certain types of 'rubbish' were specially broken and deposited to mark particular moments in the life cycles of both houses and their inhabitants. She interprets deposits of smashed pottery and broken quernstones, for example, not as casual 'rubbish' but as metaphors of the transformation of human bodies after death. She also considers that the life cycles of houses and settlements have close metaphorical relationships to the life cycles of their inhabitants. For example, certain metal artefacts left on house floors can be interpreted as 'closing' deposits at the 'death' of a roundhouse (Brück 1999a: 152; 1999b: 334; Nowakowski 2001).

Since Brück's discussion of these topics, recent excavations have produced further food for thought about the existence and nature of structured deposition on later prehistoric settlements. From their investigation of the later Bronze Age settlement at Broome, Beds., Brudenell and Cooper (2008) have critiqued the sometimes simplistic adoption of the idea of structured deposition, and they argue that a fuller appreciation of the complexity and variability of deposition helps to construct contextually specific histories of depositional practice. Adrian Chadwick has followed this up with an excellent review of the subject. He summarises the current state of understanding: '"Placed" deposits and ritualised acts were not distinct from everyday discard, but were merely different points on a continuum of practices all influenced to a greater or lesser degree by social and cosmological beliefs' (Chadwick 2012: 303).

Excavators at Corrstown noted that at least two of the houses produced groups of smashed pots from contexts at the back of each house (Ginn and Rathbone 2012: 248). Despite being surprised by the general lack of evidence for structured deposition on that site, Ginn and Rathbone provide a useful list of other Irish sites with suspected examples of structured deposition of a variety of materials and artefacts (*ibid.*: 247). Whilst the Corrstown settlement was mysteriously devoid of quernstones, ten were found in the small settlement at Caltragh, Co. Sligo, mostly within the ruins of two of the roundhouses (Danaher 2007: 84–5).

In Scotland, the large, multi-period settlement at Kintore, Aberdeenshire, produced 57 whole and fragmentary quernstones, many of them forming structured deposits in pits and postholes (Engl in Cook and Dunbar 2008: 223–5). Elsewhere in Scotland, Rob Engl has identified further potential cases of structured deposition of quernstones at Lairg, Sutherland (McCullagh and Tipping 1998: 44), Dalladies, Kincardineshire (Watkins 1980: 157–9) and Blairgowrie, Perthshire (Thorneycroft 1933: 195).

At Cladh Hallan we can recognise a series of structured deposits from various stages of house use, though mostly from abandonment, and involving quernstones, coarse stone tools, whole and smashed pots, red deer antlers, cattle scapulae and copper-alloy artefacts. The body metaphor model proposed by Brück is well supported by the Cladh Hallan evidence. For example, House 1370 has the strongest funerary associations and is also the main focus of smashed pottery and querns on the site. The other large deposits of smashed pottery come from abandonment layers within houses and from a classically liminal setting – a pit dug between demolition and construction of House 401's walls during the Phase 10–11 transition.

The small southern house (House 801), only half the size of its neighbour, was the locus of relatively little pre-floor foundational ritual activity. Unlike the other two houses, there were no bronze artefacts or fragments in the floors of House 801, and its closing deposits were tools of stone and not metal.

In contrast, House 401 had altogether different associations. As well as its variety of foundation deposits, it was the focus for deposition of hundreds of fragments of clay refractory material for making bronze swords, spearheads, tools and ornaments. Many fragments were found inside the house where casting took place[6] but the majority came from an outdoor 'floor' layer, outside the front door, belonging to Phase 9, which preceded the construction of the covered circular forecourt building; other casting fragments were recovered from later layers within this forecourt area. Most of this bronze-working debris at the house's entrance was deposited on its north side. It was not deposited fresh from casting but was collected as secondary refuse from the central hearth and placed here as a foundation deposit.

A similar scenario of deposition of clay refractory debris is documented at the tenth-century BC enclosed ringfort of Springfield Lyons, Essex (Needham and Bridgford 2013). Two large deposits of debris from clay moulds for casting bronze swords were found in ditch terminals on the north sides of the east and west entrances. Their temporal and spatial deposition, as well as the deposits' secondary character, are directly paralleled with the slightly earlier context at Cladh Hallan. Needham and Bridgford note that

this association with entrances may also hold for a similar deposit from the Middle Bronze Age hillfort of Norton Fitzwarren, Somerset (Ellis 1989). Further examples of liminal locations within entrances or boundaries are provided in Chapter 1.

The northerly house, House 1370, is very different from the other two. The pre-foundational pyre to its east hints at a pre-existing relationship of this location with death rituals, reprised in Phase 8 with the burial of the two composite bodies and continuing at the house's re-founding in the Phase 9–10 transition when an infant was buried in the northeast quadrant. If the life cycle metaphor can be extended homologically to the roundhouse terrace as a whole, this association with death could potentially relate to House 1370's northeastern position within the roundhouse row. This house can also be singled out for its large quantities of smashed pottery and quernstones. As well as two pits beneath the foundations filled with broken pots (see Volume 1: chap. 4), there were successive large deposits of broken pottery throughout the sequence of occupation, culminating in two large dumps at the end of Phase 10 (see Volume 1: chap. 6). All these pot deposits were in the southern half of the house, as were three broken saddle querns. Of particular interest is a set of three newly made but unfired pots smashed and stacked immediately inside the south side of the doorway. The fabric of these dismantled and unfired vessels, uniquely and in contrast to the fired pottery, contains no added inclusions. The experiencing of House 1370's internal space was also profoundly different from that of the other two houses: its hearth lay not at the centre of a depression but at the apex of a domed floor whose edges were considerably lower than its central area.

House 1370 thus provides an interesting corroboration for Brück's notions of pot and quern fragmentation being associated metaphorically with people's deaths. The other contexts for large deposits of smashed pots in the settlement were liminal or closing events: the abandonment of the Early Iron Age double roundhouse in Area C (House 150), the dismantling and rebuilding of House 401 between its second and third phases, and the smashed pots left on abandoned floors within House 401. Small fragments of querns were also found on abandoned floor surfaces but, other than the three in House 1370, large fragments occur only as foundation deposits or reincorporated into the stone water tanks within House 401.

The pattern of deposition of saddle querns at Cladh Hallan bears some examination. Firstly, not a single 'rubber' (also known as a 'top stone' or 'muller') was found at Cladh Hallan; a rubber-sized stone was found on top of a quern in the wall core of House 401 but it is unworked. Like the coarse stone hammers and grinders, many quernstones were found in foundation deposits, especially within the sand core of the party walls, where their presence was immaterial to the wall's structural solidity. The one mentioned above was the largest and had been intentionally broken prior to deposition. Their placing within house walls conforms with Richard Hingley's observation that saddle querns were often deposited within boundary contexts in later prehistoric Scotland (Hingley 1992: 32). A quern fragment was found in the grave fill of the female–male composite body (SK 2316), further supporting Joanna Brück's hypothesis of a homologous relationship of querns to human bodies.

As well as the whole and smashed pots in inter-house deposits mentioned above, House 150 was 'closed' with a mass of smashed pots. The second build of House 1370 (end of Phase 10) was closed with a large deposit of smashed pots in the hollow on its south side. At the end of Phase 11, House 401's cooking area was strewn with smashed pottery, although this could merely be broken vessels left prior to rebuilding.

Throughout the sequence of House 401, we noticed a number of postholes filled with a red deer antler after the post had been withdrawn. In Phase 9, variations on this theme included sheep/goat horns, a length of cattle spine and a cattle rib, all placed vertically in disused postholes, perhaps as symbolic replacements of the withdrawn timber posts. Towards the end of the sequence in House 401, unusually large numbers of antlers and cattle scapulae were left on its floors or buried in shallow pits within the house: 35 red deer antlers and 25 cattle scapulae were deposited on the floors or in pits and postholes beneath them.

There were 'closing' deposits on the abandoned floors in the northeast quadrants of Houses 801, 401 and 1370 at the end of Phase 9. In House 401, a pair of broken copper-alloy artefacts was laid on the surface of the floor at the moment when it went out of use, immediately before it was covered by the make-up layer laid down before the second floor. House 1370 produced a broken copper-alloy bracelet, and House 801 two hammerstones. The significance of small bronze items as closing deposits in the 'death' of a roundhouse has been noted for other parts of Britain in the Later Bronze Age (Brück 1999a: 154; Ladle and Woodward 2003; 2009).

In the case of Cladh Hallan, it is interesting that these three bronzes are all broken whereas the other small copper-alloy artefacts from the site, thought to have been losses or casual discards, are all intact. This suggests that the 'closing' pieces were broken deliberately, perhaps so that the other parts of them could be treated differently. Louis Nebelsick (2000: 169) has suggested that such division of bronzes, normally seen in 'scrap' hoards, could represent a division into a divine and human share. Following the logic that cyclical notions of time may have been important in this period, we might speculate that the retained halves were melted down and recycled.

It is also worth mentioning David Fontijn's observation about the nature of deposition of bronze artefacts in settlements in the Netherlands because it can be equally well applied to Britain and Ireland (Fontijn 2003; Bradley 2005: 110). He notes that in the Netherlands, ornaments and sickles are found within Bronze Age settlements whereas axes, spears and swords are found typically in watery contexts and rivers. The Fontijn hypothesis of settlement distance is well supported at Cladh Hallan: although House

401 has moulds for a wide variety of weapons, tools and ornaments, only ornaments and small tools were actually deposited in the settlement. In contrast, spears and swords are known from watery contexts in the Uists at Cairinis and Iochdar respectively (see Chapter 2).

23.4 Multi-generational lifeways: economy and production, cuisine and consumption

Metalwork and metalworking

House 401 was the focus for deposition of over 400 clay mould fragments of Late Bronze Age swords, spearheads, axeheads, razors, one or more socketed knives and ornaments in the form of a bracelet and pins. Some of these were found where the casting took place on the north side of the central hearth inside the house in its lowest three floors (Phases 9–11) but the majority came from the forecourt and its environs where they were most densely concentrated on its north side. Episodes of bronze-working can be linked to moments of construction and renewal of House 401, first during the Phase 8–9 transition, then in the Phase 9–10 transition and finally in the Phase 10–11 transition. An episode of bronze-casting was also carried out during the later part of Phase 9 within House 1370.

Bronze-working in Area A at Cladh Hallan ended before Phase 12, the beginning of the Iron Age; the small quantities of clay refractory debris from this and later phases within Area A are most likely to be residual material redeposited. However, a series of bronze-castings were undertaken in House 150 during Phase 13 (*start 780–720 cal BC, end 750–610 cal BC*).

There is no convincing evidence for ironworking at Cladh Hallan. Yet two pieces of iron were recovered, one from the floor of House 401 in Phase 9 (after *1070–950 cal BC* and prior to *1045–985* cal BC) and the other from a fill layer within the same building in Phase 16 (*695–535 cal BC*). The very early date for the artefact from Phase 9 is well before any evidence for ironworking in Britain so it may well be an imported item. A piece of haematite found in Phase 12 deposits (see Chapter 2) is scant evidence for ore procurement.

Bronze artefacts were deposited in a variety of contexts. Two possible spokeshaves and a bracelet were placed as closing deposits on the floors of the north and middle houses at the end of Phase 9. Another tanged chisel was also deposited in the middle house at this time. The only gold ornament was a gold-plated penannular ring (otherwise known as a 'hair-ring' or 'ring money'), dropped outside the doorway of House 1370 in Phase 9. Between Phases 11 and 13, five rings, bracelets and pin shafts (or fragments thereof) appear to have been dropped and lost on the settlement.

Pottery manufacture

Potting clay was found throughout Area A, especially on the floors of Houses 401 and 1370. In some instances the original forms of the clay buns have survived intact or largely so. A dismantled unfired pot was left beside the interior wall of House 1370. Imprints in the fired clay of some of the pots reveal small fingertips, suggesting that women and/or children were involved in making pots. There is no indication of where the pots were fired, presumably in short-lived bonfire kilns.

Cuisine

Cladh Hallan's Plain Ware ceramic assemblage mostly consists of a range of undecorated bowls and squat jars. Their sherds were deposited in large quantities from Phase 8 onwards. For phases earlier than Phase 12, the assemblage consists of three different sizes of jar (small, medium and large), three different sizes of bowl (small, large and super-sized), and a small number of dishes. Smaller vessels became less common after Phase 12, when vessel forms were largely restricted to jars of varying sizes and super-sized bowls. Sooting patterns on small and large bowls indicate that there was no distinction between the use of large bowls and jars for cooking and the smaller vessels for eating. Whether food was cooked in the small bowls and dishes or simply warmed cannot be ascertained. However, the presence of these small bowls between Phases 8 and 12 indicates that they were an important constituent of the culinary process, presumably for individual servings provided from the communal cooking pot.

Lipid residues in pots are principally derived from dairy products and less so from animal proteins. It is most likely that barley gruel or porridge was prepared and served in these pots and that, whilst meat was stewed, it was more often cooked by methods such as roasting that did not require the use of ceramics.

The farming economy

Cladh Hallan was an agricultural community whose main crop was barley and whose animal resources were principally cattle, sheep, red deer and pig. The neonatal kill pattern for cattle indicates dairying rather than a meat strategy, a pattern similar to that found later at Dun Vulan and other Middle Iron Age sites. The recovery of bovine casein amongst the protein residues from pots (see Chapter 17) and the high levels of animal protein inferred from ^{15}N isotope levels in human bones corroborate this interpretation.

Marine food resources would have been plentiful and yet Cladh Hallan's inhabitants did relatively little fishing. Isotopic values of $\delta^{13}C$ for the human remains indicate that most people stuck to a largely terrestrial diet, although crabs and shellfish (cockles, winkles and limpets) were gathered from the foreshore, and meat from birds and seals may have occasionally augmented the diet. Cetacean oil and blubber could have been used for lighting and their bones were crudely carved as artefacts and architectural features but the animals themselves were probably not hunted. One of the few contexts in which fish bones were found in any quantity is the southern half of the floor of House 640, one of the two double roundhouses. Although it possessed a central hearth in its east room, a large stone niche at the west end of the west room was heavily burnt and sooted

in a manner consistent with its use for drying and smoking food products. It was one of the last buildings at Cladh Hallan, being constructed and used around 500 BC.

Craftworking: hides and textiles, bangles and beads

Different lines of evidence converge to indicate a range of products produced by Cladh Hallan's inhabitants. Probably the most abundant, which have paradoxically left no trace, are the garments made from hides (and, in the later phases, textiles) that have vanished because of their organic composition. Faunal remains, artefact types and their patterns of use-wear provide strong circumstantial evidence of leather-working. Other indications are less certain, such as the possibility that dog faeces were collected for tanning of hides.

As already discussed in this and previous chapters in both volumes, the co-location of bone points, pumice rubbers and polishing stones, especially in the southwest quadrants of house floors, can be explained as the residue of hide-working, during which stretched skins would have been pegged on wooden frames, fat and hairs removed with the pumice rubbers, and the skins softened with polishing stones. This is corroborated by the patterns of use-wear on the bone points. The culling of young cattle and deer would have provided soft and supple skins to be made into clothing as well as bags and containers.

The various non-perishable artefacts associated with textile production – spindle whorls and a loomweight – do not appear until after the beginning of the Iron Age, from Phase 12 onwards. It is interesting that numbers of hide-working tools declined in Phase 12, suggesting that this may have been a substantial change in fashion at Cladh Hallan. This new ability to produce cloth may also have been accompanied by new forms of ornament, such as the shale bangles and beads which appear from Phase 11 onwards. A couple of the bangle fragments are from unfinished pieces, suggesting that some may have been manufactured at Cladh Hallan even though the raw material was most likely imported.

Overall, the picture of economic production is one of self-sufficiency, whether of food or other products such as clothing, metalwork, ornaments and ceramics. It is hard to point to any of these home industries as geared to export.

23.5 The end: decline and environmental change in the final LBA–EIA (windblown sand encroachment, climatic deterioration, shift in settlement locations in the EIA, wider settlement decline across Britain)

Encroachment of windblown sand was a near-constant problem for later prehistoric communities along the Outer Hebrides' west coast. Early Bronze Age stratigraphic sequences and molluscan assemblages reveal major incursions of sand alternating with phases of stabilisation. The same is true for Late Bronze Age Cladh Hallan, except that the sand-blow events were interrupted by periods of greater vegetational stability. This stability could have been achieved by depositing organic waste and seaweed to consolidate grassland, perhaps accompanied by a fallow system.

Yet sand encroachment may not have been the main reason why the Cladh Hallan settlement shrank in size and changed its character to buildings of non-domestic purpose. Climate change may have played a role, with evidence for another climatic downturn across Britain in the early first millennium BC, specifically in 850–550 BC (Barber *et al*. 2003; Dark 2006). It is possible that Cladh Hallan's infields became too degraded and infertile to support intensive cultivation, leading to the relocation of settlement elsewhere but not necessarily far away. The cluster of Early Iron Age settlements at Sligeanach, Cill Donnain (Sharples 2012b), could be one such instance, possibly being a settlement relocation to the south of the substantial Late Bronze Age settlement at Cill Donnain (Parker Pearson and Zvelebil 2014).

Towards the end of the Early Iron Age, the settlement pattern along the length of South Uist appears to have changed dramatically, with the establishment of brochs within lochs. Wheelhouses were constructed across the machair and, by the Middle Iron Age, the landscape was filling up with more densely packed settlements and settlement clusters along the machair and growing numbers of roundhouses on the blackland and moorland soils of the island's interior and east coast (Parker Pearson 2012a).

23.6 Cladh Hallan in its regional context

The cemetery and burial practices

The long-term processes of treating the dead between the Bronze Age and the Norse period in the Western Isles have been described elsewhere (Mulville *et al*. 2003) and require only a summary.

Inhumation burials are known in the Western Isles from the Early Bronze Age, with examples from Cnip Headland (Armit and Dunwell 1992; Armit 1996; Close-Brooks 1996), Rosinish machair (Crawford 1978) and Allasdale dunes on Barra (Thompson 2008). Early–Middle Bronze Age cremation burials are known not just at Cladh Hallan but also from kerbed cairns on South Vatersay (Branigan 2000; Merrony 2000). Thereafter, it is difficult to identify cemeteries for the remainder of the Bronze Age in these islands, and most of our evidence comes from disarticulated bones on settlement sites such as Cladh Hallan.

Disarticulated unburnt human bones continued to be deposited within certain settlements into the Middle and Late Iron Age throughout Atlantic Scotland (Armit and Ginn 2007; Tucker and Armit 2009). They are present at, for example, the broch of Dun Vulan (see below; Parker Pearson and Sharples 1999), and the wheelhouses at

Cill Donnain (Parker Pearson and Zvelebil 2014), Sloc Sàbhaidh, North Uist (Rennell and McHardy 2008) and Cnip (Armit 2006) but are absent from the wheelhouses of Bornais Mound 1 (Sharples 2012a) and Cille Pheadair (Lethbridge 1952).

Of the human bones from the Cnip wheelhouse, the most intriguing is a cranium dating to 1540–1410 cal BC, over a thousand years earlier than the wheelhouse (Armit 2012: 225). Armit has suggested that the most likely origin of this already ancient skull is the Early Bronze Age cemetery about 200m away (*ibid*.) but the two radiocarbon dates for burials in that cemetery place them broadly before 1500 BC. He may be right that it is improbable for a skull to have been curated for 60 generations, but the Cladh Hallan examples of composite, mummified bodies are clear evidence that unusual methods of curation were being practised in the Middle Bronze Age – we cannot rule out such a scenario for the Cnip skull.

The only other foundation burial equivalent to those at Cladh Hallan is the partially butchered skeleton of a probable boy aged about 12, dating to 170 BC–AD 20, whose bones were buried in four separate pits beneath the northeast quadrant of a Middle Iron Age roundhouse at Hornish Point on the northern tip of South Uist (Barber *et al*. 1989; Barber 2003; Armit 2012: 204–7). Although the incomplete remains were interpreted as being a partially decomposed corpse perhaps washed up on the beach, Armit has suggested that this was a deliberate killing associated with the construction of the roundhouse (Armit 2012: 207).

Formal cemeteries seem to have been absent from the Western Isles during the Later Bronze Age and Early Iron Age, during the main period of Cladh Hallan's occupation. Inhumation cemeteries then re-appeared in the Middle and Late Iron Age at sites such as Galson, Lewis (Neighbour *et al*. 2002) and Boreray (Badcock and Downes 2000). An isolated skull fragment from north of Cill Donnain wheelhouse is dated to cal AD 420–640 at 95% probability and possibly comes from a burial (Parker Pearson and Zvelebil 2014: 6). More certainly, the inhumation of a woman within a stone cist covered by a square cairn at Cille Pheadair dates to cal AD 640–780 at 95% probability (Parker Pearson *et al*. 2018: 33) though there is now a second date of cal AD 428–579 (Niall Sharples pers. comm.). It is interesting that her corpse had been interfered with in the grave perhaps months after death, when her sternum was removed (Parker Pearson *et al*. 2018: 30).

Inhumation burials are also known from the Norse period such as those from Cnip (Dunwell *et al*. 1995). The only human remains from Norse-period settlements consist of single teeth. At the Norse-period settlement of Cille Pheadair, there were five deciduous teeth, all but one naturally shed. The fifth probably came from a dead child aged 4–5 years (Parker Pearson *et al*. 2018: 514–15). This is the only exception to an otherwise complete absence of human remains on Norse-period sites in South Uist. Such an absence may be explained by the adoption of Christianity, after which *post mortem* body manipulation declined or was prohibited. The feet of the woman buried in the Cille Pheadair cairn were aligned approximately on midwinter sunset, indicating that her burial rites were not Christian (Parker Pearson *et al*. 2018). However, a simplistic equation of changing mortuary rites with religious conversion may not be supportable: there is too little evidence on which to decide. Nonetheless, the pre-Viking Late Iron Age does appear to represent the end of a tradition of *post mortem* re-use of human remains which was flourishing at Cladh Hallan over a millennium earlier. Whether that practice occurred in the Beaker period and before is unknown until machair settlements from that time are excavated.

Dun Vulan's human remains: mortuary treatments in the Middle and Late Iron Age

The one prehistoric settlement in South Uist with a suitably large assemblage of disarticulated human remains to compare with Cladh Hallan is the Iron Age broch and associated structures at Dun Vulan, 9km to the north. Since publication of the excavation monograph (Parker Pearson and Sharples 1999), further radiocarbon dates have been obtained for some of these bone fragments, allowing a reassessment of the use of body parts in depositional activities within and outside the broch (se also Chapter 18 for comparison of the isotopic results). No cremated bones were found at Dun Vulan but nine contexts produced disarticulated unburnt human bones (Parker Pearson and Sharples 1999). Seven radiocarbon determinations have been obtained from human bones found in two contexts within the broch (two skull fragments) and four contexts outside it (three skull fragments, a mandible fragment and a humerus).

All but one of the five skull fragments from Dun Vulan date to the period of the broch's construction in the Middle Iron Age, around the later second to first centuries BC, although all were found in contexts deposited after construction. Two skull fragments from the lower layers (20 and 29/21) of the broch's wall chamber were deposited in the first century AD; one was relatively fresh with its date of 60 cal BC–cal AD 220 but the other was probably one or two centuries old, at 180 cal BC–cal AD 60. Other skull fragments may also have been curated, for up to five centuries in some cases, prior to deposition. In one case, in Building B, a fragment of human mandible, dating to 110 cal BC–cal AD 130, was buried as a foundation deposit in the stone-lined 'drain' of a rectangular building in use after the third–fourth centuries AD and abandoned in the fifth–sixth centuries AD.

The remaining human bones from Dun Vulan appear to have come from 'closing' deposits, two of which – in Buildings B and C – date to the Late Iron Age (AD 400–800). Undiagnostic fragments and a single adult humerus, dating to cal AD 80–350, form part of a closing deposit (layer 729) on the floor of a dwelling (Building C) which was abandoned in the fifth–seventh centuries AD. The unusually low $\delta^{15}N$ isotope value of 6.3‰ from this humerus is well below those of all the other South Uist

samples and indicates a diet largely free of animal proteins; its identification as human (Chamberlain in Parker Pearson and Sharples 1999: 289) seems secure.

The abandonment layer (779) of Building B at Dun Vulan contained an adult skull fragment (a right parietal). This dates to 350 cal BC–cal AD 30 and comes from a context which dates to the late fifth–early seventh centuries AD. Building A, the other rectangular storage building at Dun Vulan, was closed with a deposit (layers 776 and 772) containing three skull fragments and a finger bone. Although this layer was not dated, the one immediately above (layer 763) produced a date in the first–fourth centuries AD. Once again, the skull fragments in layers 776 and 772, dating respectively to 210 cal BC–cal AD 90 and 360–0 cal BC, are considerably older than the contexts in which they were found.

In comparison with Cladh Hallan, the most evident difference in depositional practices is that human remains were found in 'closing' deposits at Dun Vulan, something that is documented from Cladh Hallan in Phase 16 only by a handful of bone fragments in its latest deposits, associated with Houses 640 and 150 which were probably abandoned in *545–390 cal BC* and *630–415 cal BC* respectively (see Volume 1: 391). The high proportion of skull fragments to other bones at Dun Vulan is also greater than that found at Cladh Hallan, suggesting a greater concern with curating skulls in preference to other parts of the skeleton. In summary, both sites show evidence of long-term curation of human bones – principally entire corpses at Cladh Hallan and skulls at Dun Vulan.

Cladh Hallan and its roundhouses in wider context

The Late Bronze Age and Iron Age settlements of the Western Isles are among the best-preserved in Britain and Ireland. Until the 1990s, knowledge of the Late Bronze Age and Early Iron Age (*c*. 1300–500 BC) in the Western Isles was restricted to three bronze hoards and a handful of Late Bronze Age and Early Iron Age settlements (Crawford 1986: 8–9; Armit 1996: 99–105, 173–5; Harding and Dixon 2000; Barber 2003). Since then, there have been discoveries of Early Iron Age structures at Ceann nan Clachan, North Uist and Gob Eirer, Lewis (Armit and Braby 2003; Church *et al*. 1998) and publication of the excavation of the Early Iron Age roundhouse at Eilean Olabhat, North Uist (Armit *et al*. 2008: 32–45). The dense distribution of settlements of this period on South Uist alone has been mentioned at the beginning of this chapter and in chapter 1 of Volume 1 (see also Parker Pearson 2012a: 25–6).

Looking further afield, the Cladh Hallan settlement can be considered within a North Atlantic zone that incudes Ireland, mainland Scotland and the Northern Isles of Orkney and Shetland. Ian Armit has described the first millennium BC in northern Britain as changing from a Late Bronze Age society led by a martial elite controlling the distribution and production of bronze (1200–700 BC) into a more inward-looking, localised society (700–200 BC) drawing power from control of the land (Armit 2005: 85–6). This model of social change is well substantiated by the Cladh Hallan sequence, but it is worth examining the wider world of Atlantic and Irish Sea communities during this period.

The constructional method of building thick-walled roundhouses with wall faces enclosing a core can be most closely paralleled in Orkney at Early Iron Age sites such as Tofts Ness (Dockrill *et al*. 2007), Bu (Hedges 1987), Quanterness (Renfrew 1979), Howe (Ballin Smith *et al*. 1994), Skaill (Buteux 1997), Pierowall (Sharples *et al*. 1985) and St Boniface (Lowe 1998). Close parallels can also be drawn in certain aspects of material culture such as the predominantly plain pottery (MacSween in Dockrill *et al*. 2007: 273–5), the large assemblages of expedient bone tools (Davies in Dockrill *et al*. 2007) and the pumice and coarse stone tools (Clarke 2006; Smith in Dockrill *et al*. 2007). In addition, sites such as Tofts Ness and Howe demonstrate the practice of rebuilding the roundhouse within the footprint of the previous dwelling, a tradition that was taken to extreme lengths at Cladh Hallan where House 401 was renewed seven times over a period of about 500 years.

Similar close comparisons can be drawn with Shetland. The roundhouse settlement of Jarlshof (Hamilton 1956) produced an assemblage of metalworking moulds similar to those from Cladh Hallan. Pottery and other portable material culture from this and other Late Bronze Age settlements such as Mavis Grind (Cracknell and Smith 1983) and Sumburgh (Downes and Lamb 2000) also exhibit similarities with the Cladh Hallan assemblage.

Most of the excavated settlements in the Northern Isles are single houses, located in a dispersed pattern very different to the clustering at Cladh Hallan in its Phases 8–11. It is worth considering whether this pattern is chronological rather than geographical. Late Bronze Age Cladh Hallan (Phases 8–12) is more like Late Bronze Age Jarlshof as a collection of roundhouses, and Early Iron Age Cladh Hallan (Phases 13–16) is more akin to the single roundhouses of the Orcadian Early Iron Age. Coupled with the evidence for settlement dispersal at the beginning of the Early Iron Age in the Cill Donnain area of South Uist (Parker Pearson 2012a), this lends strength to a model of change from nucleated hamlets or villages towards isolated farmsteads across the Northern and Western Isles.

In mainland Scotland, settlements spanning the Late Bronze Age–Early Iron Age transition include the impressively large site of Kintore, Aberdeenshire (Cook and Dunbar 2008). Here, however, the modular structure of groups and lines of roundhouses in the Late Bronze Age continued into the Early Iron Age. Nor is there a tradition of rebuilding in the footprint of the previous dwelling, a practice that is rare on the Scottish mainland.

Cladh Hallan's gold-plated penannular ring is most probably from Ireland, the centre of the geographical distribution of these ornaments (Eogan 1997; Varndell 2001: fig. 3) and many of the architectural and material

styles at Cladh Hallan can be found in the Irish Middle–Late Bronze Age. The oval or sub-rectangular plans of the roundhouses are comparable to house plans throughout Ireland (Doody 2000) and there are entire settlements excavated in recent years at sites such as Corrstown (Ginn and Rathbone 2012), Ballybrowney, Co. Cork (Cotter 2005), Caltragh, Co. Sligo (Danaher 2007), and Killoran, Co. Tipperary (Gowen *et al*. 2005). In particular, House 1 at Caltragh, dating to 1680–1260 cal BC, is very similar in plan, size and orientation to Cladh Hallan's House 401 in Phases 8–9 during the eleventh–early tenth centuries BC. It even has a semi-circular 'ring ditch' acting as a damp-proofing feature on its north side. Unfortunately the erosion of any floor surfaces, the small assemblage of pottery, flints and quernstones, and the poor preservation of bone at Caltragh prevent closer comparison with Cladh Hallan.

Similar lack of bone preservation and loss of house floors hamper understanding of the very large open settlement of Corrstown, Co. Derry/Londonderry (Ginn and Rathbone 2012), occupied broadly from 1550–1300 BC until 1170–760 BC, with its main phase beginning 1360–1250 BC (thus immediately pre-dating the Cladh Hallan roundhouses). Yet the sub-surface features of its 74 roundhouses include oval house plans, semi-circular internal 'ring ditches', and circular and C-plan arrays of internal posthole rings. Absent, however, is the rectilinear post arrangement of roof supports found in the Phase 8 roundhouses at Cladh Hallan.

Furthermore, the houses of the remarkably large Corrstown settlement can be divided into pairs and small groups, which Ginn and Rathbone (2012: 224) identify as forming standard domestic units. This chimes with the identification of similar multiple-household units identified in Britain from Reading Business Park in the south (Brossler *et al*. 2003: 122) to Kintore in the north (Cook and Dunbar 2008), and which are so clearly evident at Cladh Hallan.

The large ceramic assemblage from Corrstown also permits comparison with Cladh Hallan. Its decoration includes applied cordons in the Cordoned Urn tradition, as found in Phase 2 at Cladh Hallan, but other decorative features such as horizontal indentations below rims, grooves and burnishing are not characteristic of the Cladh Hallan assemblage in any phase. Whilst the worked flint from Corrstown compares closely with that from Cladh Hallan, the other stone artefacts do not; coarse stone tools are almost entirely lacking there and, instead of clay moulds for metalworking, Corrstown has a handful of stone moulds.

With no bone preserved at Corrstown, comparison in terms of animal bones, human remains, and bone and antler tools is impossible. The absence of this major component may be partly responsible for the excavators' lament that there is no convincing evidence for structured deposition on the site (Ginn and Rathbone 2012: 247–50). However, just from the ceramics alone, the deposition of quantities of freshly broken vessels at the back of the house in various instances chimes with similar positioning of complete and broken pots under the back walls at Cladh Hallan. One suspects that, had the bone component of the assemblage survived, there would have been more such instances of structured deposition. Nonetheless, the absence of quernstones is very noticeable, especially when contrasted with relatively large numbers from Caltragh.

As discussed above, Joanna Brück (1999a) has drawn attention to the likely symbolic significance of quernstone deposition and her arguments are certainly supported by the evidence from Cladh Hallan; perhaps the considerable variability in terms of where, when and how quernstones were (or were not) deposited on settlements reflects geographically and culturally diverse ways of treating a profoundly practical item that was uniformly symbolically loaded across Britain and Ireland.

Corrstown would have been one of the settlements closest to the Western Isles, just a few days' sail away, and it looks increasingly likely that Ireland and the Outer Hebrides were in close contact for the exchange of metals as well as styles and ideas. The quantity and character of mould fragments from the Late Bronze Age phase of the fortified clifftop site of Dún Aonghasa in the Aran Islands off Ireland's west coast are strikingly similar to Cladh Hallan. Objects cast included a sword, two spears, three axeheads, a knife or two, and pins and bracelets (O'Carroll in Cotter 2013). Perhaps this represents the range and proportions of metal weapons, tools and ornaments required by each small community across the western Britain Isles.

Within the same Irish Sea 'province', we should also consider the Isle of Man, with the excavation of a large settlement at Ronaldsway, dating from *c*. 1500–800 BC (Pitts 2008 cited in Rathbone 2013: 39). These roundhouses were constructed in a similar way to those on the machair of the Western Isles, by digging down to create a sunken-floored building with an inner wall face of beach stones. Similar methods of sunken-floored construction were employed at the Middle Bronze Age settlement of Trethellan Farm, Cornwall (Nowakowski 1991) and more than 20 such hollow-set roundhouses of this period have been found elsewhere in Cornwall (Jones *et al*. 2015: 178–83).

23.7 Conclusion: house histories, architecture and ritual in later prehistory

The settlement at Cladh Hallan has produced convincing evidence which supports, *inter alia*, various hypotheses concerning deliberate building on the dead, deliberate incorporation of human remains, modular household organisation, deliberate superimposition of re-built roundhouses, sunwise ordering of internal space, and metaphorical relationships of material culture with the body (Table 23.2).

Ritual was not something separate from or unusual within the domestic realm but the very medium through which traditions were handed on and changes initiated. The Cladh Hallan houses were constructed for living above

Table 23.2. Hypotheses for interpreting practices of building and dwelling in the Middle Bronze Age–Late Iron Age of Britain and environs

Hypothesis	Author	Brief description	Duration
Building on the dead	Parker Pearson this volume	Locating a settlement in a locale previously used for burial	MBA–EIA
Incorporation of human remains	Wilson 1981; Wait 1985	Deliberate placement of human remains in domestic space	MBA–LIA
Modular household organisation	Ellison 1981	Dividing major residences from ancillary houses	MBA–LIA
Superimposition	Brück 1999a	Re-building a new house on the foundations of the old	LBA–EIA
Sunwise ordering of internal space	Fitzpatrick 1994	Activities within house ordered by the passage of the sun	LBA–LIA
Material metaphors and the body	Brück 2006	Structured deposition relating to life cycle of people and houses	MBA–LIA
Bronze deposition by distance	Fontijn 2003	Ornaments and tools in settlements, weapons and axes further away	MBA–LBA
Ritual violence toward offerings	Nebelsick 2000	Special deposits of broken bronzes, half for humans and half for divinities	MBA–LBA

the dead, sharing the same spaces with the dead, and the inhabitants' activities were routinised in ways that are far from our own experiences of dwelling. As Richard Bradley has advised for understanding later European prehistory in general, the simple dichotomy between ritual and functional says more about our own society than about the prehistoric past: '[r]itual and domestic life went together throughout the prehistoric sequence and it is wrong and – more than that – it is impossible to separate them now' (Bradley 2005: 119, 210).

Even though we may interpret the role of cyclical notions of time as significant for the inhabitants of Cladh Hallan, theirs was not a static or entirely cyclical world. The roundhouses went through relatively rapid changes in architectural style over their 400–500 years of building and re-building. The consistent employment of the same use of space over a considerable period of time within House 401 and in the other roundhouses contrasts with clear variations in architectural form and material associations of particular buildings through time. If the spatial arrangement of activities was non-negotiable and fixed regardless of context and time, then the architecture itself was subject to rapid changes in fashion.

What may have been developing in the Western Isles and the northwestern and northern edges of Britain was a regional ideology of a 'house' society (Carsten and Hugh-Jones 1995) in which the roundhouse itself was increasingly an arena of symbolic demonstration and elaboration, eventually culminating in the considerable mass and height of the stone-walled brochs and the elaborate interiors of wheelhouses of the Iron Age in the later centuries BC and early centuries AD. At Cladh Hallan we see intimations of this later massiveness in house architecture, with the thickening of the front wall of House 401, increasing through its many phases to a final width of 3m, albeit in sand rather than in stone.

Whilst the Cladh Hallan settlement needs to be understood in its local and regional context, particularly with regard to the Western Isles and Ireland, its sequence and organisation have many resonances with Bronze Age–Iron Age settlements across the British and Irish world of roundhouse life. Even in a period of diverse regional styles of architecture and material culture, Cladh Hallan's houses provide further corroboration for hypotheses developed and applied in other parts of Britain and Ireland. In other words, this was not a remote, marginal and therefore atypical settlement in terms of large-scale trends, processes and organisational principles. For future researchers interested in advancing our knowledge of roundhouse life in Britain and Ireland, the machair settlements of the Western Isles are one of the very best places to look in terms of high-quality preservation and survival.

Finally, we might ask ourselves a simple question: why round? With the exception of a few Iron Age sites in Brittany and Normandy (Godard 2013), the 'roundhouse' is a peculiarly British and Irish phenomenon, dating to a time when the rest of Europe was building houses in rectilinear shapes. When viewed from the Continent, round houses appear to be a very curious regional style in contrast to the simple rectangular and longhouse forms found in the rest of northern and central Europe.

Perhaps we should be looking for an explanation in cosmological rather than purely pragmatic terms, as Anthony Harding, Niall Sharples and Richard Bradley advise (Harding 1999: 28; Sharples 2010: 187–91; Bradley 2012). This circular architecture was almost certainly

indigenous in inspiration, drawing upon the monumental architecture of earlier periods, notably the Neolithic–Early Bronze Age henges, stone circles, timber circles and round barrows. To give Niall Sharples the last word[7]: 'the role [that] the timber buildings had in measuring time, in the Late Neolithic and Early Bronze Age, was used as a template to create a domestic house that would chart and control time in the Middle Bronze Age. The circular structure of both buildings mirrors perceptions of the sky… enables orientations and celestial events to be documented… and allows daily, monthly and yearly cycles to be easily observed' (2010: 191).

Notes

1 Note that all burials beneath the house floors were interred before the construction of the floor. The grave pits do not cut the floors – the burials are sealed by the floors.

2 The dune face was stabilised against rabbits and wind erosion in the years after the excavation ended but the machair is a fragile environment so this and other houses at Cladh Hallan may one day be exposed by storms.

3 Inter-floor layers of sand brought in to cover the old floor and form a foundation for the new floor were initially interpreted during excavation as clean, windblown sand but it later became apparent that these layers were neither clean nor wind-deposited.

4 The three exceptions are the eighth and last phase of House 401 (which had a floor but no hearth), the double roundhouse in Area C (whose southeast quadrant was used for bronzeworking), and House 1500 in the southeast corner of the site (only its southwest corner could be excavated since its northern half was destroyed by quarrying and its southeast quadrant remains unexcavated in the unthreatened zone beyond the quarry's southern limit).

5 In memory of Jon Humble, much-missed.

6 Casting took place in a transition between phases of the house's occupation, when the roof must have been off (see Section 23.4 below).

7 I always do. Thank you Niall, for persuading me to go to South Uist all those years ago and for your unwavering interest and support. You beat me to the end with getting Bornais finished – this final volume of our Uist excavations is a chance to say how important you have always been. And what a great time we all had.

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