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# Flesh on the Bones: Animal Bodies in Atlantic Roundhouses

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## *Introduction*

This paper presents results from the preliminary analysis of a group of unusual animal 'burials' associated with the Late Bronze Age settlement at Cladh Hallan, on the Western Isles, Scotland. This analysis draws on previous multi-factorial research undertaken on the human burials at this site (Parker Pearson *et al*. 2005, 2007) and through the application of similar techniques to the animal burials, aims to provide an improved understanding of the modes of pre-depositional and depositional treatment enacted on individual animals. In contrast to the analysis of disarticulated faunal remains these complete burials have the potential to provide high quality information on particular animals lives (births, management, care and handling), deaths (slaughter, butchery, consumption) and burial. Only a small percentage of the animals consumed at the site were selected for deposition as articulated remains and by comparing the different modes of treatment for these animals with the characteristics of the main faunal assemblage, a better understanding of the significance of different species, their exploitation and deposition is possible. This study represents only one line of enquiry in a broader project to model the interaction between humans, animals and the wider environment in the Hebrides (e.g. Smith and Mulville 2004) based on data from the numerous excavations undertaken by the Sheffield Environmental Archaeological Research Campaign in the Hebrides (SEARCH) and allied projects.

## *Background*

The Outer Hebrides, or Western Isles, are a chain of more than 100 islands and small skerries located about 70 kilometres (43 miles) west of mainland Scotland (see Figure 16.1). These Isles have a rich archaeological record with evidence for human occupation from the Mesolithic onwards (Parker Pearson *et al.* 2004). From late prehistory onwards the island settlement architecture is dominated by Atlantic Roundhouses and these are often accompanied by extensive middens (Armit 1996, Parker Pearson *et al.* 2004). Many of these sites are located on the calcareous shell sand '*machair*' environment of the west coast and are characterised by deeply stratified deposits that offer an excellent preservational environment for faunal material. A series of excavations on the Isles have produced extensive faunal assemblages that indicate an economy focused on sheep, with cattle of secondary importance and the regular exploitation of wild terrestrial, marine and avian resources (Smith and Mulville 2004). Whilst the majority of faunal remains are recovered from the middens, the islands are unusual in that animal bodies, often interpreted as sacrificial offerings or foundation deposits, are found buried under and within domestic structures from the Late Bronze Age onward (Campbell 1991, 2000; Curle 1944, 1948, p. 21; Dawson pers comm; Mulville *et al.* 2003; Parker Pearson *et al.* 2005, 2007; Parker Pearson and Sharples 1999, pp. 137, 288).

## *The Site*

This paper focuses on the long-lived site of Cladh Hallan, on South Uist where activity begins with a cremation cemetery dated to 1940–1450 cal BC (95% probability) and continues with the construction and occupation of a series of roundhouses from the late 12th to early 10th century BC until the early 7th to early 6th century BC (Parker Pearson *et al.* 2005, 2007; Marshall pers comm). A series of human and animal burials were interred immediately prior to and during the roundhouse phases. Detailed analysis of the human burials combined the techniques of osteoarchaeology, histological analysis, radiocarbon dating, mercury intrusion porosimetry (HgIP), FTIR spectroscopy and Small Angle X-ray Scattering (SAXS) analysis of crystallinity to reveal contrasting levels of preservation and varied modes of treatment. This multi-factorial analysis revealed the presence of two articulated composite skeletons made up of body parts from different individuals who died some time apart and also had evidence for soft tissue preservation (Parker Pearson *et al.* 2005, 2007). The implications from these findings of curation, deliberate preservation and post-mortem manipulation of remains, have altered the perception of mortuary rites in Hebridean prehistory and the techniques employed have the potential to reveal similar details on the peri- and post-mortem treatment of the animals burials. For example, were the apparently articulated animal carcasses buried enfleshed or as stripped bones, are there any composite animal burials and is there any evidence for the preservation of soft tissue?

For the human burials a combination of osteological and histological analyses proved to be the best tool for describing taphonomic trajectories, providing information on processing, preservation and secondary deposition. Histological analysis, which is rarely applied to faunal remains, assesses the preservation of micro-structural features (i.e. the Haversian system) and uses the extent of microbial and fungal attack to provide detail on the burial environment and the peri- and post-mortem treatment of specimens. Histological preservation is affected by the array of physical, chemical and biological agents encountered in the depositional environment (Garland 1987, 121, Hedges *et al.* 1995; Jans *et al.* 2004; Turner-Walker and Jans 2008; Turner-Walker and Peacock 2008) and in most environments microbiological decay commences within a short time of death (Millard 2001, p. 640) with changes in structure observed within three months (Bell *et al.* 1996). If microbial attack initiates it will generally progress to completion with the result that bone is generally either very poorly or very well preserved (Hedges *et al*. 1995, p. 203). It is rare for areas of contrasting preservation to be observed on a single element. In cold and/or anoxic environments such as bogs, microbial attack is prevented, whilst in warm, moist aerobic environments micro-organisms thrive and bones invariably exhibit poor histological preservation.

Peri- and post-mortem practices are also important, for example the processing or cooking of an animal carcass will alter histological preservation. Entire cadavers tend to exhibit poorer micro-structural preservation, with a higher degree of porosity and microbial attack, than disarticulated remains. This is thought to result from collagenolytic gut bacteria entering and attacking the bone system from the blood supply (Bell *et al.* 1996; Janaway 1996; Jans 2005; Jans *et al.* 2004; Turner-Walker *et al.* 2002). Thus the bleeding, gutting and butchery of animal carcasses should affect micro-structural preservation by removing bacterial agents of decay. At the other end of the processing spectrum, cooking may also make bone less attractive to collagenolytic bacteria through a reduction in the organic fraction although some cooking methods (e.g. roasting) can themselves obliterate the Haversian system resulting in poorly preserved microstructure. Thus for animal remains buried in similar environments, bones from entire, unbutchered animals should exhibit a greater degree of histological decay than disarticulated and butchered bone whilst cooked bone may or may not be affected.

To the authors' knowledge, despite the obvious potential of histological analysis, no analogous studies on animal burials have been carried out and previous research has tended to consider faunal remains merely as human analogues. Initially this was the case at Cladh Hallan, where comparative analysis revealed a generally high degree of destruction in disarticulated, unstratified cattle and sheep bone, as well as in the majority of human remains (Summerfield 2004). However when a small sample of animal burials were examined in a pilot project, examples of well preserved histology were noted (Brown 2008). As a result, further research on a wider range of animal burials was initiated with the aim of elucidating the degree to which specific social practices and general depositional environment are responsible for patterns of histological preservation/degradation. Combining osteoarchaeological with histological analysis will facilitate a reconstruction of the biographies of the buried animals and where possible determine their modes of pre-depositional and depositional treatment, which can in turn be contrasted with the human burials. Issues to be investigated include the selection criteria for the buried animals, the presence of composite animal burials, whether apparently articulated animal carcasses were buried enfleshed or as stripped bones and any evidence for the preservation of soft tissue. A secondary aim of this research is to

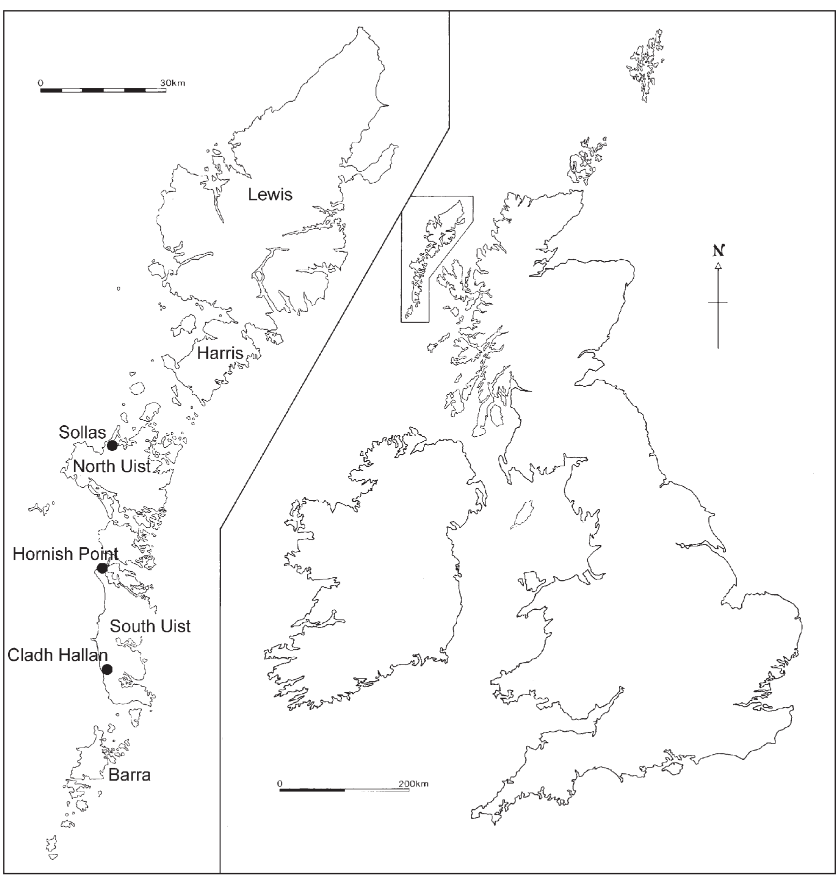


*Figure 16.1: Map showing the location of main sites mentioned in the text.*

assess the applicability of histological analysis for reconstructing depositional histories.

## Materials and Methods

The examination of the animal burials combined traditional macroscopic analysis with histological analysis of disarticulated and articulated faunal remains. No further measurements of bone porosity or crystalline structure were undertaken.

### *The Sample*

Analysis focused on a range of articulated faunal deposits and disarticulated material recovered from underneath and associated with two of the roundhouses (401, 1370) at Cladh Hallan. The articulated material comprised of a number of animals in varying levels of articulation and completeness and represents the majority of articulated faunal deposits at the site. Two disarticulated fragments, each of sheep, cattle and red deer from a range of contexts were also analysed to provide a comparison to the articulated remains. Additionally, in one instance a disarticulated sheep fragment recovered in association with an articulated deposit was sampled to provide indications of the preservational attributes of a specific micro-environment. No pig specimens or disarticulated dog elements were analysed as few were recovered from Cladh Hallan. Although samples of control specimens were small and cannot be seen as reliable indicators of preservation across the site as a whole they do provide some measure of differences relating to processing, species and context type. It is not known if any of the samples had been cooked, as the identification of cooked bone (rather than burnt) bone requires further detailed analysis (see Koon *et al.* 2010).

### *Methods of Analysis*

#### *Macroscopic*

Identification of species, element and collection of data on age, sex and size was carried out at Cardiff University following the methodology of Cardiff Osteoarchaeology Research Group (Mulville 2005, pp. 40–41). The majority of material was identified as articulated in situ and allocated a unique find number. At the analysis stage, for each find group the body parts present, bone measurements, fusion stage and manual fitting of putatively adjacent elements, were used to confirm the presence of a partial or complete skeleton and to distinguish between individuals where more than one was represented. In addition a small number of articulations were identified during analysis.

Detailed macroscopic analysis was restricted to articulated deposits, rather than control samples. Material was examined using a 10× or 20× hand lens as required under a 60 watt lamp. Weathering was recorded following Behresmeyer (1978). To reveal patterns of processing and meat exploitation, butchery marks were recorded in detail with regard to location and purpose. Particular care was taken in differentiating between knife cuts and trampling striations following Andrews and Cook (1985).

#### *Histological*

A section of long bone from each sample was removed and polished into a thin section slide. Off-cuts were removed using a diamond wheel, and dried on a hotplate. The rough cut surface was mounted on a glass support slide using Epotek epoxy resin. Once cured, the exposed surface was ground flat using a Petrothin grinding machine, impregnated with Epotek 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 Epotek and allowed to cure for one hour. The support slide was cut off and the entire sample ground to 50µm using Petrothin and hand finished to 30µm on glass plates. Finally the sample was polished on a Kent lapping machine using 1µm diamond paste.

Using a Leica DMEP microscope, the samples were examined under 100×, 200× and 400× magnification in both polarised and transmitted light. The periosteal, central and endosteal zones were scored using the histological index (after Hedges *et al.* 1995; Millard 2001, see Table

| *Category* | *Ctx* | *Phase* | *Find no* | *Sample No.* | *House/ Area* | *Feat.* | *Taxon* | *Age/Fusion* | *Sex* | *Height (mm)* | *Butchery* | *Gnawing* | *Sampled Element* | *Articulated* | *Approx. Completeness of skeleton and/or elements present* | *Hist. Index: Endosteal Zone* | *Hist. Index: Central Zone* | *Hist. Index: Periosteal Zone* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 806 | 12 | 3376 | 3 | 401 | Pit 807 | Dog | Adult | Male | 528 | N | N | Humerus | Y | 50%. No skull or mandible, (no axis or atlas). Forelimbs, ribs and spine. | 4 | n/a | 0 |
| A | 1291 659 | 12 | 3380 | 17 | 401 | Pit 1292 | Dog | Adult | Male | 616 | N | N | Femur | Y | 75%. Skull, mandible, spine, majority of forelimbs, pelves and left hind limb | 0 | 0 | 0 |
| A | 3325 | 7 | 5177 | 7 | 1370 | Pit 3324 | Sheep | 4-6 years | Female | 587 | N | N | Femur | Y | 95%. Only right calcaneum and left patella missing | 0 | 0 | 0 |
| B | 792 | 13 | 3175 | 8 | 401 | Pit 793? | Sheep | 2-3 years | Female | 589 | D,J | N | Femur | Y | 80%. Skull, mandible, thoracic & lumbar vertebrae, left scapula, both sides humerus, radius & ulna, right pelvis, both hind limbs | 5 | 5 | 5 |
| B | 2674 | 8 | 4748 | 5 | 401 | Pit 2673 | Sheep | 3-4 years | Female | 565 | D, F | Y | Radius | Y | 90%. Head, spine, ribs, limbs (excl. femurs & left tibia), metapodia & phalanges | 0 | 0 | 0 |
| B | 855 | 11 | 3392 | 2 | Fore court | Pit 863 | Sheep | >42 months | Female | n/a | D, F | N | Humerus | Y | 25%. Trunk elements, scapulae, vertebrae & ribs, pelves, left humerus & femur | 1 | 0 | 0 |
| C | 2636 | 8 | 4761 | 1 | 1370 | Pit 2635 | Sheep | 6-42 months | N/A | N/A | J | N | Humerus | Y | 30%. Pair of Humerus/radius/ ulna & carpals | 0 | 0 | 0 |
| C | 473 | 12 | 2043 | 6 | NE Area | Ash deposit | Sheep | < 5-7 months | N/A | N/A | N | N | Metatarsal | Y | Right lower hindlimb group, navicular-cuboid, medial cuneiform, metatarsal & phalanges | 0 | 0 | 0 |
| C | 792 | 13 | 3175 | 9 | 401 | Pit 793? | Sheep | >2 years | N/A | 593 | N | N | Metatarsal | Y | Right navicular-cuboid, medial cuneiform & metatarsal | 4 | 5 | 4 |
| C | 452 | 15 | 2061 | 4 | 401 | Burnt deposit | Cattle | Fused? | N/A | N | N | N/A | Radius | Y | Radius, Ulna and Carpals | 0 | 0 | 0 |
| D | 2674 | 8 | 4748 | 10 | 401 | Pit 2673 | Sheep | unfused dist | N/A | N/A | N | N/A | Radius | N | Isolated element | 0 | 0 | 0 |
| D | 467 | 11 | n/a | 14 | Fore court | Pit 1498 | Cattle | N/A | N/A | N/A | N | N/A | Tibia | N | Isolated element | 0 | 0 | 0 |
| D | 468 | 11 | n/a | 15 | Fore court | Pit 1498 fill | Red deer | N/A | N/A | N/A | N | N/A | Radius | N | Isolated element | 0 | 0 | 0 |
| D | 655 | 11 | n/a | 12 | 401 | Floor | Sheep | N/A | N/A | N/A | N | N/A | Humerus | N | Isolated element | 4 | 4 | 4 |
| D | 1290 | 11 | n/a | 16 | 401 | Floor | Cattle | N/A | N/A | N/A | N | N/A | Metatarsal | N | Isolated element | 0 | 0 | 0 |
| D | 1290 | 11 | n/a | 11 | 401 | Floor | Red deer | N/A | N/A | N/A | N | N/A | Radius | N | Isolated element | 0 | 0 | 0 |
| D | 1447 | 11 | n/a | 13 | Fore court | Pit 897 | Sheep | N/A | N/A | N/A | N | N/A | Tibia | N | Isolated element | 0 | 0 | 0 |

*Table 16.1: Details of samples and results of macroscopic and histological analysis. Withers heights were calculated following Harcourt (1974) and Teichert (1975). In the butchery column 'F' refers to filleting, 'J' to jointing and 'D' to disarticulation. Deposit 3376 has no histological index values for the central zone due to the element having a very narrow cross sectional area.*

| Index | Approximate % of intact bone | Description |
|---|---|---|
| 0 | < 5 | No original features identifiable, except that Haversian canals may be present |
| 1 | < 15 | Haversian canals may be present, small areas of well preserved present or lamellae structure is preserved by the pattern of destructive foci |
| 2 | < 50 | Some lamellate structure is preserved between the destructive foci |
| 3 | > 50 | Some osteocyte lacunae preserved |
| 4 | > 85 | Bone is fairly well preserved with minor amounts of destruuctive foci. |
| 5 | > 95 | Very well preserved, virtually indistinguishable from modern bone. |

*Table 16.2: Descriptions of histological index scores (from Millard 2001).*

16.2). Details of the character of microbial attack (following Hackett 1981) and the level of birefringence were also recorded but are not reported here.

## Results

The osteological and histological results for all of the seventeen articulated and disarticulated samples are presented in Table 16.1. Osteological analysis of the relatively complete burials within the sample revealed that sheep were the most commonly selected animals with seven sheep, two dogs and a single cattle deposit present. The sheep are deposited throughout the sites occupation history starting with 5177 in 1440–1255 BC (93% probability) and concluding with 3175 in phase 13 between 705–575 BC (95% probability), whilst the two contemporaneous dog burials occur late in the sequence (810–540 BC) (Marshall pers comm.). The sheep were predominantly adult females of average height for the Isles (see Mulville 1999), the majority of which had been butchered. The two dog skeletons were both large adult males, whilst the single cattle limb was also from an adult animal. Although this research is focused on larger groups of articulated material it is still noteworthy, particularly for the butchered animals, that many of the skeletons are nearly complete.

For ease of discussion the seventeen samples have been divided into categories based on the osteological evidence for articulation and butchery. These are A: articulated complete or semi-complete individuals without recorded butchery, B: articulated complete or semi-complete individuals with recorded butchery, C: articulated limbs or parts thereof, D: disarticulated fragments.

### *Category A – Articulated deposits with no butchery*

Samples assigned to this category comprise one adult female sheep and two dogs of differing sizes; all were recovered in articulation and in the absence of any butchery are assumed to have been uncooked. Sheep 5177 preceded house construction, and was placed on her side in a pit (Figure 16.2); this skeleton was almost complete, with only a few small elements, such as tarsals and a patella, missing. The larger dog (3380) was lying on its front in a pit and had most of the skeleton present, excepting the right forelimb. It is likely this animal was killed *in situ* as coprolites were

*Figure 16.2: Plan of sheep burial (5177).*

recovered in association with it. This specimen was used as a comparator for bone porosity for the human burials and demonstrated a higher degree of degradation than the composite male (burial 2638 in Parker Pearson *et al.* 2005, 2007). Both of these animals show osteological characteristics suggestive of the swift burial of entire, fleshed individuals and the results from histological analysis indicate poor preservation in all zones (scores of 0) suggestive of the presence of *in situ* collagenolytic gut bacteria.

The second dog (3376), found close to dog 3380, was also lying on its front in a pit. This skeleton was cut by a later posthole, removing the hindquarters, and 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 (Figure 16.3). 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


*Figure 16.3: Photograph of dog burial (3376). (Photo: Mike Parker Pearson).*

than its loss being a consequence of soft tissue degeneration prior to burial.

Histological analysis of this dog's humerus showed contrasting patterns of preservation on the inner and outer surfaces with a clear interface; due to the thin cross section the central zone was not assessed. The periosteal surface was poorly preserved with a ragged edge resulting from post-depositional degradation. The darkened areas of the cortex indicate microbial attack with angular black cracks representing infiltrated micro-fissures (Figure 16.4). In contrast, the endosteal surface is well preserved, with histological features such as osteocyte lacunae clearly observable and only minor areas of bacterial attack (Figure 16.5). Areas of reduced mineralisation, demonstrated by lower electron reflectivity (i.e. a dull grey colour) (Turner-Walker and Jans 2008, p. 231), were visible within this well preserved zone. This contrast in preservation across the bone suggests an arrest in microbial attack.

*Category B - Articulated deposits with butchery*

This category comprises three butchered articulated sheep deposits. Relatively complete collections of articulating material are generally taken to be indicative of the deposition of material still joined by connective tissue; however in all three cases there is osteological evidence for processing (accompanied in one case by gnawing) which suggests the careful collection of dissociated remains and deposition in individual pits.

Sheep 4748 was largely complete, with only a few missing hind limb elements. Butchery indicative of disarticulation and filleting provides evidence that this carcass was exploited for meat whilst canid gnawing suggests it was, at least briefly, sub-aerially exposed. The second sheep, (3392), is less complete, comprising the trunk and part of the limbs and again butchery marks indicate both disarticulation and filleting. For both these sheep the sampled elements exhibit very poor histological preservation (see Table 16.1 and Figure 16.6), consistent with that expected from bones accompanied by soft tissue (Bell *et al.* 1996; Janaway 1996; Jans *et al.* 2004; Jans 2005; Turner-Walker *et al.* 2002), but this explanation is at odds with the evidence for secondary and tertiary butchery (carcass division and removal of meat). These results suggest that the histological preservation is dictated by burial environment.

The skeleton of the third sheep (3175) showed similar levels of completeness and butchery but differed in that it exhibited well preserved histology

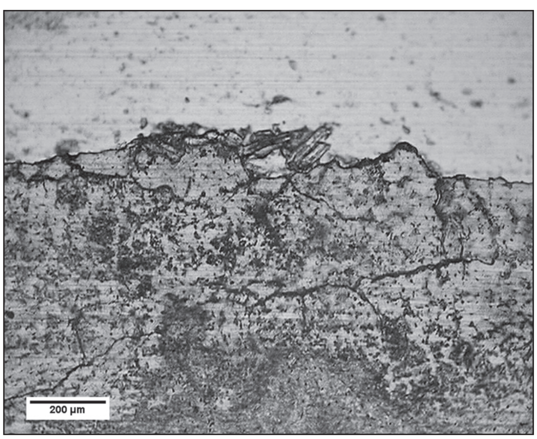


*Figure 16.4: Periosteal zone of humerus from dog burial (3376) showing micro-fissuring, swathes of microbial attack and a loss of microstructural features.*

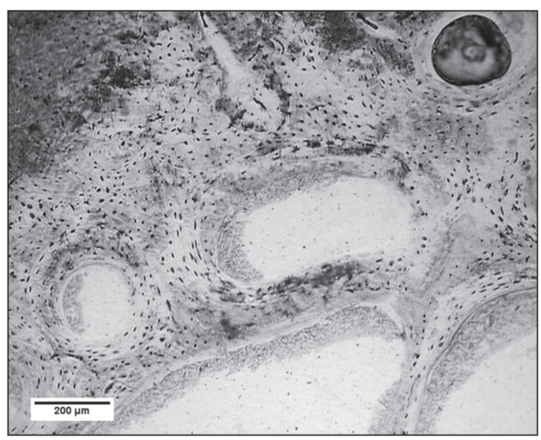


*Figure 16.5: Endosteal zone from dog burial (3376) showing well preserved histology. The large holes in the matrix occur naturally in bone's cancellous structure, one of which has become darkened through the infiltration of resin from the production of the slide.*

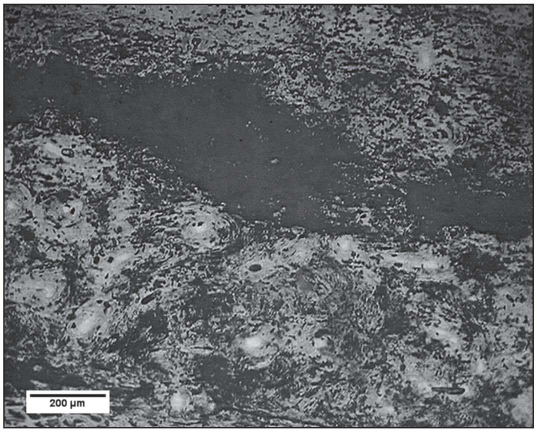

*Figure 16.6: Central zone from sheep deposit (3392) showing very poorly preserved histology and extensive microbial attack.*

in all zones of the sampled femur. The fill of this pit (792), consisted almost entirely of tightly packed bones, derived mostly from this burial, with little associated sediment. An articulated lower right hind limb from this context was also analysed (see category C).

*Category C – Partially Articulated Limb Groups*

This group includes three articulated sheep limbs and a cattle limb. Find group 4761 comprises two largely complete forelimbs of a sheep, with butchery marks associated with their removal from the carcass. This pair of limbs is similar to the category B deposits in that they have been processed and placed in a discrete deposit rather than being deposited routinely. None of the other category C deposits exhibit evidence of butchery. The two other sheep limbs are consistent with primary waste. Both are lower hind right limbs, the first, found in association with the category B sheep skeleton (3175), comprises of an articulating metatarsal and tarsals. The second (2043) includes all elements distal of the astragalus. The cattle deposit (2061) consists of a left radius, ulna and carpals; this restricted range of elements may be an incidental deposit, but full processing of the limb would be expected.

These isolated limbs are unlikely to have been accompanied by offal, or to have been cooked and as such may show a difference in preservation. However with the exception of the limbs associated with group 3175, the deposits in this category generally exhibit poor histological preservation. This suggests that in this environment the presence of *in situ* gut bacteria is not the only important factor dictating the microscopic preservation of bone. In contrast the metatarsal/tarsals from 3175 demonstrate the same excellent preservation as the associated sheep skeleton. This atypical histology may relate to the unusual character of the depositional environment, as noted above the pit fill was made up almost entirely of bone.

*Category D – Disarticulated fragments*

The disarticulated control samples are likely to have been subject to a significant level of processing and weathering and macroscopic and histological analysis should reflect this. The majority exhibited poor micro-structural preservation regardless of context type, location, species or element. Two elements are worthy of further discussion. Sample 10, a disarticulated radius, demonstrated the same poor histological preservation as the associated category B sheep skeleton (4748).

Sample 12, a sheep humerus, recovered in a house floor was the only exception to the pattern of poor preservation. This element was macroscopically the most poorly preserved element, with cortical flaking, weathering and erosion noted; however, it showed excellent histological preservation (score 4 for all zones). The element had clearly been sub-aerially exposed prior to incorporation into a subterranean deposit. It is possible that the collagen degraded during this period making the bone less susceptible to microbial attack once buried.

## Discussion

The presence of articulated animal remains at any site is noteworthy, the accepted norm would be for animals to be butchered and consumed and their remains dispersed, as is the case for the majority of the Cladh Hallan assemblage. Why particular animals are selected for differential treatment can be first examined through a comparison with the disarticulated faunal remains. At Cladh Hallan the abundance of sheep burials is related to their general importance as livestock although they are more predominant in the burials than they are in the general assemblage. On the other hand the small number of cattle articulated groups (one part limb deposited latest in the sequence – phase 15) and the complete absence of articulated deer are at odds with their economic role; at Cladh Hallan cattle and deer are more numerous than dogs. Pigs are rare overall and remain absent from any articulations. The size, age and sex data for sheep suggests that the deposits represent female breeding stock, of average stature and killed either at or just past their prime. They were somewhat older than most of the main assemblage, where the largest mortality peak occurred between 6 and 12 months. The presence of the dog burials is unusual, as dogs are rare within Hebridean assemblages and are never found as burials (unlike elsewhere in Britain, see Hill 1995; Morris 2009). It is also interesting to note that the larger of the dogs, at 61 to 63cm, is amongst the tallest of all British prehistoric dogs (Clark 2006).

Whilst standard osteological analysis provides excellent evidence for peri- and post-mortem practices it was hoped that the histological evidence would add more detail, particularly with reference to indicating whether remains were defleshed or enfleshed on burial. The results indicate no clear relationship between histological and butchery evidence, instead it appears that the norm is that all bone, both processed and unprocessed, suffers a high degree of histological damage. The majority of bone within each category shows significant damage, even for remains obviously defleshed and processed. With this in mind, it is the histologically well preserved remains that are of most interest. This section of the discussion considers each of the categories in turn and whilst a full contextual and comparative analysis of the faunal burials at Cladh Hallan is beyond the scope of this paper, it uses all available evidence to discuss the biographies of these animals.

In category A the two contemporaneous dog burials, deposited late in the sequence, showed different modes of peri and post-mortem treatment. Whilst osteological evidence indicated that neither articulated skeleton was butchered, the histological analysis revealed contrasting level of microstructural preservation. Dog 3380 conformed to the expected pattern for a minor, unexploited, non-food species with substantial histological damage suggesting the dog carcass was enfleshed on burial and became subject to a significant level of microbial attack (e.g. Jans 2005; Jans *et al.* 2004; Turner-Walker *et al.* 2002). However, in dog 3376 there is a contrast in preservation between the periosteal and endosteal areas similar to that reported in the adult male femur from Cladh Hallan (Parker Pearson *et al.* 2005, 2007; Summerfield 2004), suggesting that decay was initiated but later arrested. In both cases the distinct interface between areas of good and poor preservation is indicative of a rapid change in environment sometime after burial. Although soil chemistry and hydrology can alter over time (Turner-Walker and Jans 2008, p. 277), it is highly unlikely that this would be sufficiently rapid to produce this pattern. The alternative is that this animal was killed elsewhere, decay initiated and then arrested through a move to a different, preservative environment prior to final burial. For the adult male from Cladh Hallan, observed changes in microporosity and crystallinity led to the suggestion that this preservative environment was a peat bog (Parker Pearson *et al*. 2007). Without undertaking similar research on this canid it is only possible to be confident of a change in burial environment which could include specific treatments to enhance preservation. Possible scenarios include wind-drying, heat-drying, tanning, pickling, or bog deposition prior to final burial (Parker Pearson *et al.* 2005, p. 541). For the dog, the only further evidence is areas with reduced levels of mineralisation in the well preserved endosteal zone. These could point to deposition in an environment with a low pH or the chelating action of sphagnum (i.e. a bog) (Painter 1995; Turner-Walker and Jans 2008), but as this does not correlate with the final depositional environment of the pits, it would have to relate to an earlier phase in the taphonomic history of the remains. Combined with the evidence of the deliberate removal of the head, this provides support for diverse modes of pre-depositional treatment concerning this dog.

As with dog 3380, the other category A deposit, sheep 5177, was subject to microbial attack throughout the bone matrix, consistent with being buried fully enfleshed and having only a single phase in its depositional history. However, unlike the dog, the loss of this food animal would represent the substantial loss of approximately 9 to 13kg of meat to the community (Finlay 1984). Although the animal was close to prime meat age, thereby emphasising the potential sacrifice, it cannot be discounted that it died through disease and was therefore not deemed fit for consumption. However, its context of deposition argues against this.

Evidence suggests that the three relatively complete Category B sheep (articulated but butchered) were all processed in similar ways, with marks indicative of disarticulation on all three deposits, with two also displaying evidence of filleting. The articulated, fairly complete state of the burials (especially 3175 and 4748) suggest that after processing (and presumably meat exploitation), bones were collected and re-articulated in burial, although it is plausible that they remained attached by remnant soft tissue, in spite of the disarticulating butchery marks. Both 4748 and 3792 showed homogeneously poor levels of histological preservation, with 3175 being very well preserved throughout. With poorly preserved remains the norm at Cladh Hallan, the excellent preservation of this deposit is intriguing. This may be is a product of a unique burial microenvironment (see Category B results), where the tight packing of disarticulated bones, provided excellent preservational conditions (with little sediment matrix) and is supported by the good preservation of the associated hind limb group. Alternatively, as noted above for the well preserved dog, these patterns could relate to different modes of pre-depositional treatment with elements either placed within an environment conducive to good preservation (e.g. an anoxic environment) or transformed prior to deposition, for example by cooking. The latter would result in a substantial loss of collagen, making elements less attractive to agents of histological decay. It was hoped that the histological analysis of material of the processed articulating remains (Category B) would provide essential information on the presence or absence of associated soft tissue. However the contradictory evidence for poor preservation in both fully articulated and disarticulated remains means that no conclusions can be drawn from the similarly preserved Category B remains. Instead, constructing depositional histories for these animals continues to largely rely upon standard zooarchaeological techniques.

Reconstructing biographies from the far less complete category C group is more difficult. Although only one of the four deposits exhibited butchery evidence their incompleteness confirms that they underwent a substantial degree of processing prior to burial. Element representation indicates that two of the four deposits, both from sheep (3175 and 2043) may well be primary waste, as they comprise no major meat-bearing elements. Although deposit 2043 is poorly histologically preserved, as would be expected for an articulating limb buried at least partially fleshed, its intentional burial does represent a non-normalised mode of deposition. This is the case as primary waste would usually be discarded indiscriminately and disarticulated through scavenging agents such as canids. Deposit 3175 is different in that it is deposited alongside a more complete sheep and displays the same excellent level of histological preservation as the more complete Category B sheep (also find no. 3175). As stated above the excellent preservation may relate from pre-depositional practice but could alternatively result from the exceptional nature of the context. The cattle limb (2061) is unlikely to be primary waste as the radius is a major meat-bearing element and therefore full processing would be expected. The lack of other evidence and poor histological preservation (which is the norm at the site), make further interpretation speculative, but unless the meat was spoilt it would represent a moderate sacrifice to the community. The two largely complete forelimbs of a sheep (4761) differ from other Category C deposits in their completeness and cannot be regarded as primary waste. The poor histological preservation is of limited interpretative value, however interestingly, butchery shows that elements were jointed (divided into more easily consumable portions), but were again placed in close articulation in deposition. This may indicate a symbolic sacrifice to the community, whereby meat was exploited but the skeletal remains were re-articulated to show a concern for the deposition of complete limbs.

Further along the processing spectrum, the degree of exploitation apparent within the bulk of the faunal remains, representing typical food waste, is hard to discern. The poor histological preservation of the disarticulated bone, demonstrated both here and in Summerfield (2004), is unlikely to be due to the presence of gut bacteria but could reflect other post-mortem processes such as cooking (e.g. a mode of processing that did not exact a substantial loss of collagen may have been favoured). Alternatively, the local machair environment may produce conditions particularly conducive to microbial attack. Bones are invariably well preserved and isotopic research has demonstrated excellent collagen yields (Mulville *et al.* 2009), which may make bones more attractive to collagenolytic bacteria. However, further research on the relationship between collagen preservation and microbial attack is required in order to elucidate whether this may be partially responsible for patterns. In addition it would be of interest to undertake histological analysis at the nearby site of Hornish Point (see below), where the evidence suggests a greater degree of carcass processing and marrow extraction.

Integrated evidence of articulated faunal deposits at Cladh Hallan clearly demonstrates a high level of complexity and diversity in practices. The modes of pre-depositional treatment and depositional practice do not show clear patterns pertaining to specific taxa and do not vary according to chronological phase. Practices are clearly multifarious, although it is interesting that red deer were not favoured for deposition despite being common in the domestic assemblage, therefore suggestive of a separate status (Mulville and Thoms 2005). However, this could also be explained functionally, as larger animals such as red deer and cattle (for which only a single articulated limb was recovered) would represent greater sacrifices to the community and require greater effort to bury. Further issues have been raised by the integrated analysis. For example, in light of the emphasis on re-uniting individual animals after processing the assumption that carcasses of food animals without obvious butchery marks were not exploited for meat may be incorrect. Nor were all of the butchered and reunified animals necessarily fully processed and/or cooked. Unfortunately histological analysis has in this instance not provided a means by which to resolve these issues.

The reconstructed life histories of the animals at Cladh Hallan can be compared with those available from standard osteological analyses of the articulated fauna recovered beneath the later wheelhouses lying to the north at Hornish Point and Sollas (Figure 16.1) (Barber *et al.* 1989, Campbell 1991, 2000). About one hundred years after the last burial at Cladh Hallan, the skeleton of a 12 year old boy along with two cattle and two sheep, was placed in four pits underlying the wheelhouse at Hornish Point. Then at around 100 AD a total of 85 animal burials (and cremations) were deposited at Sollas within numerous pits in the wheelhouse floor. Articulated animal remains at these sites included sheep, a larger proportion of cattle and a small number of pigs (Barber *et al.* 1989; Finlay 1984). Deer on the other hand are not deposited as burials at any site and have a special significance in the Western Isles (Mulville *et al.* 2003, p. 32; Mulville and Thoms 2005). At Hornish Point the cattle and sheep were slaughtered when prime meat animals, in their second or third year, and interpreted as the remains of feasts associated with extended funerary rites (Barber *et al*. 1989, p. 777). At Sollas the age profile differs with the 31 cattle and 54 sheep dominated by neonates, described as incidental deaths appropriated as foundation deposits (Finlay 1984); the remaining material derived from a wide age range but included a number of prime meat animals.

The three sites have similarities in the peri- and post- mortem treatment of animals. At Hornish Point and Sollas individual animals were also placed in pits as both unprocessed and processed carcasses. At Hornish Point the cattle and sheep burials bore evidence of dismemberment and filleting, with the cattle also showing signs of skinning and marrow extraction and some canid gnawing (Barber *et al.* 1989). Additionally the boy was subject to pre-depositional processing, being chopped through the spine with further division of the partially decomposed body prior to burial (Barber *et al.* 1989, p. 775). At Sollas individual butchery descriptions for each animal are not available but Finlay (1984) noted that many burials were missing heads and feet and/or showed butchery marks associated with carcass division and processing, identical to material recovered within the floors/midden. In all of these cases there appears to have been a concern with keeping the skeletal components of individual animals separate for burial, even when the contemporaneous processing and deposition of multiple animals occurred. For example, at Hornish Point, where division of the boy suggests that the four pits were filled simultaneously, the two cattle were placed in separate pits with even small splinters recovered and placed with the relevant burial (Barber *et al.* 1989, p. 775).

The major difference between the three sites is the greater emphasis on cattle within the later articulated groups, although overall relative abundances remain similar. This suggests that cattle become a more appropriate animal to bury, despite the loss of more resources to the community. Indeed in the Late Iron Age both cattle and deer remains also become the focus of different acts of structured deposition focused on hearths (Mulville *et al.* 2003). Otherwise all three sites appear to be part of long running tradition that can be traced from the pre-house sheep burials at Cladh Hallan to the repeated deposition of numerous animals, both as burials and cremated remains, at Sollas. Atlantic roundhouses show internal structuring of deposits which is considered to have cosmological significance (Parker Pearson and Sharples 2004) and the deposition of selected animals within these structures affirms the importance of the home as the focus for ritual activity.

## *Conclusion*

Animal burials at Hebridean sites are unique within later British prehistoric traditions, both in their incorporation within houses, the intensity of deposition and in the choice of species. At Cladh Hallan the majority of burials were of sheep, the most common food species, with cattle, deer and pig rarely or never incorporated. The majority of these articulated remains were exploited prior to burial and the re-integration of individual bones points to a concern with individuality that is played out through history at later sites. The identification of the contemporaneous burial of two, almost complete, dogs within the centre of the house represents a unique example of animal deposition. The combination of zooarchaeological and histological techniques has provided new insights into animal depositional practices. The recognition of non-normative practices in the unique dog burials, both subjected to very different modes of treatment, is startling. This suggests that unusual practices of post-mortem manipulation were applied to both human and animal remains. Dogs are considered to have a unique relationship with humans and the size, treatment and placement of these animals confirms their special status. Further detailed contextual analysis of the animal burials, incorporating the full range of faunal, artefactual and spatial information forms the subject of future papers.

The comparative approach has also demonstrated that histological analysis is a complex and problematic line of enquiry for reconstructing the peri- and post-mortem treatment of animals. Results firmly support the findings of Hedges *et al.* (1995, p. 203), in that the majority of samples are either well or poorly preserved in all zones of the bone, with an emphasis on the latter. Therefore if microbial attack commences, it generally permeates the entire bone. Due to the plethora of factors affecting histological preservation, it does not on its own provide a tool for the reconstruction of modes of treatment, as equifinality represents a substantial barrier to confident interpretation. However, it represents a useful complementary source of evidence when combined with other lines of enquiry. In particular, it has the potential to identify remains which have been subject to more complex, non-normalised modes of pre-depositional and depositional treatment (e.g. dog 3376).

This research also demonstrates the need for detailed comparative sampling to provide information on the preservational characteristics of the local environment. Further research integrating these analyses with measurements of microporosity and crystalinity (Parker Pearson *et al*. 2005) and with Transmission Electron Microscopy (Koon *et al*. 2010) has the potential to add further detail to on treatment of faunal remains and the effect of cooking on bone histology.

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