

PART 10

Animals

'Like it or not, this rich site had been stressed and re-assessed in some form or other almost annually; the archaeological pack has chased after the only juicy bone apparently available, gnawing at it and extracting the marrow of its information base.'

(Schadla-Hall 1988, 27)



CHAPTER 23

Faunal Remains: Results by Species

Becky Knight, Nicky Milner, Terry O'Connor, Ben Elliott,
Harry K. Robson, Mike Buckley, Piotr Witkowski, Sophy Charlton,
Oliver Craig and Matthew Collins

Introduction

The faunal remains from the original excavations were studied by Frederic Fraser and Judith King of the then Department of Zoology, British Museum (Natural History), and the bird bones were identified by Marjorie Platt of the Royal Scottish Museum, Edinburgh. The collection was noted as being important because it contained several animals now absent from the fauna of this country and there was enough material to give an impression of the composition of the fauna at the start of the postglacial period in Yorkshire (Clark 1954, 70).

Clark, in his synthesis chapter, highlights the importance of red deer, roe deer, elk, aurochs and pig [*sic*] in terms of their relative abundance and suggests that it is likely that the 'total bag' of these species would have been twice as much. In doubling these figures and then converting to dead weight, clean carcass weight and calories, he suggested that a group of four families (comprising an active man, a moderately active woman and three children) could live off this food supply (approximately 50,000 kg) for 6 1/4 years (Clark 1954, 16). However, it was noted that it cannot be assumed that all the meat was consumed on site and some could have been dried for use elsewhere.

We now know that the nature of occupation was highly complex: the site is much larger than previously thought, it spans c. 800 years and the faunal remains that survive are only likely to be a small percentage of what was used and deposited. In addition, we know that Clark did not retain everything: bone, antler and flint appear to have been purposefully deposited in several parts of the backfill which will have skewed previous analyses. What had been collected was then dispersed across a number of museums mainly around England, but also farther afield, which makes it harder to re-examine.

The faunal remains found in the recent excavations at Star Carr are generally in fairly poor condition (Chapter 22). Nevertheless, even some of the really badly preserved bones have revealed important data using both traditional zooarchaeological techniques, as well as biomolecular approaches such as Zooarchaeology by Mass Spectrometry (ZooMS) and stable isotope analysis. Our recent excavations have resulted in the discovery of some new species to add to Clark's list. In addition, the open area excavation, 3D plotting, application of GIS and the dating programme allowed us to take a new approach and consider the variability of the data through time and across space (see Chapter 7).

Figure 23 (page 193): Fracturing long bones for marrow extraction (Copyright Aimée Little, CC BY-NC 4.0).

How to cite this book chapter:

Knight, B., Milner, N., O'Connor, T., Elliott, B., Robson, H. K., Buckley, M., Witkowski, P., Charlton, S., Craig, O. and Collins, M. 2018. Faunal Remains: Results by Species. In: Milner, N., Conneller, C. and Taylor, B. (eds.) *Star Carr Volume 2: Studies in Technology, Subsistence and Environment*, pp. 195–254. York: White Rose University Press. DOI: <https://doi.org/10.22599/book2.i>. Licence: CC BY-NC 4.0

The faunal remains from 2004–2010 were initially assessed by Sarah Viner, Rachael Parks and Cluny Johnson (reports in the ADS) but the whole assemblage has been reanalysed by BK who has been the faunal remains specialist since 2012 and was onsite throughout the 2013–2015 seasons. A large quantity of sediment was also sampled for flotation (see Chapter 15) and a significant quantity of bone fragments were retrieved from this, though much remains unidentified to species or element. This chapter begins by outlining the original assemblage and subsequent reinterpretations. It then presents the methodologies used in examining the faunal assemblage. An overview of taphonomic factors is given, followed by an overview of the quantification of species across the site. The different species are then detailed in turn, in terms of spatial distribution, elements, age and sex where possible, seasonality where possible, modifications by carnivores and humans, palaeopathology, and the MNI. The faunal remains data have been collated on a spreadsheet which is available via the ADS and spatial data is available allowing all specimens which have been 3D recorded to be plotted (<https://doi.org/10.5284/1041580>).

The original assemblage and subsequent reinterpretations

In the faunal remains chapter in the original monograph (Clark 1954), the total number of identified specimens (hereafter NISP) were not provided but the minimum number of individuals (hereafter MNI) per species were listed (Table 23.1) with the note that no human or fish remains were found. A description of the remains for each species was given and the discussion drew attention to the size of some species, notably red deer which were much larger than modern Scottish counterparts. In addition, Clark requested that the analysts should consider the season of occupation (Clark 1972, 22). This was determined, based on red deer, elk and roe deer antlers and when these are shed, with the conclusion that people must have inhabited the site during the winter until spring, notably April.

Common name	Scientific name	MNI
Common crane	<i>Grus grus</i> (Linnaeus, 1758)	1
? White Stork	<i>Ciconia ciconia</i> (Linnaeus, 1758)	1
Red-breasted merganser	<i>Mergus serrator</i> (Linnaeus, 1758)	1
Red-throated diver	<i>Colymbus stellatus</i> (Pontoppidan, 1763)	1
Great crested grebe	<i>Podiceps cristatus</i> (Linnaeus, 1758)	1
Little grebe	<i>Podiceps ruficollis</i> (Pallas, 1764)	1
Lapwing	<i>Vanellus vanellus</i> (Linnaeus, 1758)	1
Buzzard	<i>Buteo buteo</i> (Linnaeus, 1758)	1
Duck (size of pintail)	<i>Anas acuta</i> (Linnaeus, 1758)	1
Wolf	<i>Canis lupus</i> (Linnaeus, 1758)	2
Fox	<i>Vulpes vulpes</i> (Linnaeus, 1758)	2
Pine marten	<i>Martes martes</i> (Linnaeus, 1758)	2
Badger	<i>Meles meles</i> (Linnaeus, 1758)	1
Hedgehog	<i>Erinaceus europaeus</i> (Linnaeus, 1758)	1
Pig [sic]	<i>Sus scrofa</i> (Linnaeus, 1758)	5
Elk	<i>Alces alces</i> (Linnaeus, 1758)	11
Red deer	<i>Cervus elaphus</i> (Linnaeus, 1758)	80
Roe deer	<i>Capreolus capreolus</i> (Linnaeus, 1758)	33
Aurochs	<i>Bos primigenius</i> (Bojanus, 1827)	9
Hare	<i>Lepus cf. europaeus</i> (Pallas, 1778)	1
Beaver	<i>Castor fiber</i> (Linnaeus, 1758)	7

Table 23.1: Mammals and birds identified by Fraser and King (Clark 1954).

During Clark's original excavations, the finds were hand collected and there was no sieving protocol implemented. This methodology will have influenced the recovery rate of smaller species and more delicate elements, as acknowledged by Legge and Rowley-Conwy (1988, 12) in their reanalysis. Also, it is clear that Clark had a selection process for the finds although this is never outlined in his publications. Through the rediscovery of finds in the backfill during the most recent excavations (see also Chapter 7), it appears that Clark mainly kept elements that were complete or large fragments of bone and antler that were easily identified to species. Butchered fragments were kept, but only if they could be identified to species and element. Smaller fragments of bone and antler, or elements such as ribs that were difficult to identify to species, were not retained.

In the 1970s, a number of re-evaluations of the data were carried out. Because red deer antlers had been used for making artefacts such as barbed points, it was suggested that red deer antler should be discounted from analyses (Jacobi 1978; Caulfield 1978; Pitts 1979; Grigson 1981), which radically reduced the MNI of red deer. Pitts (1979) noted that the roe deer shed antler had not been used for making tools and so could be used for calculations of MNI. As noted in Chapter 2, this led to a study undertaken by Legge and Rowley-Conwy (1988) in which all of the faunal material from Clark's excavations, including material housed in various museums around the country, was re-assessed. This primarily set out to re-examine the bones from the large mammals: aurochs, elk, red deer, roe deer and wild pig [*sic*] (Legge and Rowley-Conwy 1988).

Their re-quantification of the bones changed the MNI for all of these species (Figure 23.1). Their work excluded red deer antler (shed and unshed), but also roe deer antler (38 left and 39 right) on the basis that virtually all have been broken out of the skull and if they are taken into account a very extreme and unlikely sex ratio is arrived at (Legge and Rowley-Conwy 1988, 10). It is suggested that the roe deer antler may have been collected for an unknown purpose. In addition, the representation of elk increased due to some bones having previously been identified as aurochs. There is no explanation as to why the MNI for aurochs increased, but this is perhaps a result of the corpus of Danish aurochs being published since the original faunal assessment, as noted by Legge and Rowley-Conwy (1988, 10). The wild pig [*sic*] decreased by an MNI of one because a mandible had been re-identified by Sebastian Payne as bear (Legge and Rowley-Conwy 1988, 10).

In addition, other important analyses were undertaken which changed the species list to some degree. Harrison (1987) re-examined the Star Carr birds. Nine bird species were identified in the original analysis by Platt, but Harrison states that of these nine, four 'appear to be invalid' (Harrison 1987, 141) (Table 23.2). Harrison disagreed with the identification of white stork (*Ciconia ciconia*) as this was based on a fragment of long

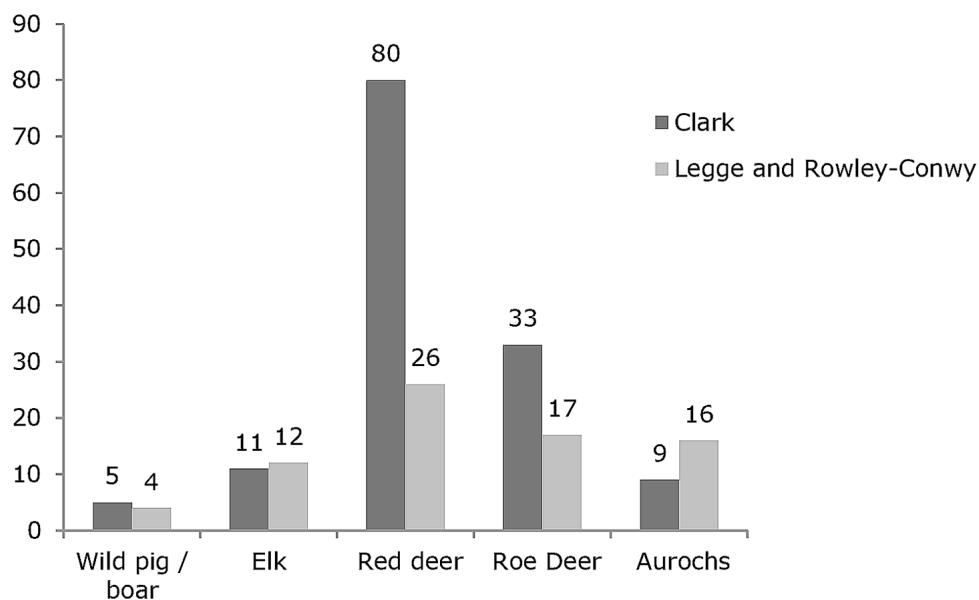


Figure 23.1: Differences in the MNI between the analyses presented in Clark (1954, 15) and Legge and Rowley-Conwy (1988, 9) (Copyright Star Carr Project, CC BY-NC 4.0).

Common name	Scientific name	Element	Side
Red-throated diver	<i>Colymbus stellatus</i>	Distal humerus	Right
		Ulna	Left
Great crested grebe	<i>Podiceps cristatus</i>	Tibiotarsus	Left
Little grebe	<i>Tachybaptus ruficollis</i>	Ulna	Right
Brent goose	<i>Branta bernicla</i>	Humerus shaft	Left
Red-breasted merganser	<i>Mergus serrator</i>	Tibiotarsus	Right
		Tibiotarsus	Left
		Carpometacarpus	Left
Common scoter	<i>Melanitta nigra</i>	Ulna	Left
Common crane	<i>Grus grus</i>	Humerus	Right
		Humerus	Left
		Ulna	Right
		Ulna	Left

Table 23.2: Birds reclassified by Harrison (1987).

bone midshaft only, and he revised this identification to ‘indeterminate’ (Harrison 1987, 141). There were several other identifications which Harrison changed: the common buzzard (*Buteo buteo*) humerus midshaft was re-identified as Brent goose (*Branta bernicla*); the pintail (*Anas acuta*) carpometacarpus was reassigned to red-breasted merganser (*Mergus serrator*) and the lapwing (*Vanellus vanellus*) ulna was re-assigned to common scoter (*Melanitta nigra*).

There has been much discussion about whether wolf or domesticated dog was found at Star Carr. Fraser and King (1954, 72) reported wolf; however, Degerbøl’s (1961) and Benecke’s (1987) analyses make it clear that they are domestic dogs, and a further dog right femur was found in the collection by Rick Schulting (Schulting and Richards 2009, 499).

A further notable addition to the record is brown bear (*Ursus arctos*). An upper left canine was found from this species by Tot Lord, who visited the excavations before Clark’s trenches were backfilled (Dark et al. 2006, 191). In particular, he searched the deposits next to the birch trees in cutting II and found items by pushing his hands into the soft sediment at the base of the sections. In doing this he felt a skull but could not retrieve it; however, he was able to extract a tooth from it (Edwards et al. 2014). During our excavations we expected to find this skull; however, despite excavating all around cutting II there was no sign of it and the conclusion is that it has either demineralised (if it was on the east side—SC24 only contained two pieces of jellybone) or that it was retrieved by someone else. Two other brown bear bones have since been identified: as already noted, a broken mandible previously identified as wild boar (Legge and Rowley-Conwy 1988, 10) and an axis vertebra (Noe-Nygaard 1983). It has been suggested that the brown bear skull, mandible and axis vertebra possibly belong to the same animal (Dark et al. 2006).

Methods

Introduction

A number of traditional zooarchaeological methods were used to assess taphonomy, taxa, quantification, ageing, sexing, palaeopathology and seasonality. In addition, a range of biomolecular techniques were used: ZooMS to aid in the identification of taxa, and stable isotope analysis to assess diet for deer. In addition, aDNA was attempted on the bones of dog and wolf (by Greger Larson and team, University of Oxford) and beaver (by Melissa Marr, Danielle Schreve and Ian Barnes, Royal Holloway and the Natural History Museum); however, no positive results were produced, thought to be due to the poor preservation environment for aDNA at the site.

Taphonomy

The faunal remains excavated from the dryland areas of the site were found to be in a particularly poor condition: specimens were very desiccated, fragmentary and fragile and exhibited a high frequency of root damage. Due to these factors, almost half (49%) of the specimens could not be identified to species or element, although this is fairly typical for material found within these types of sediments and of this age. The bones from the wetland part of the site exhibited a range of problems including demineralisation, lamination and concretion of minerals as set out in Chapter 22 which also provides the methodology used in analysing the varying states of preservation.

All bones were analysed for evidence of natural taphonomic changes such as weathering and exposure, root or bioturbation damage and trampling, but also for evidence of modification: (1) anthropogenic modifications such as charring, cut marks or butchery evidence; (2) modifications made by animals such as uneven (ragged-edged) breakage, gnaw marks, crushing or cracking and tooth impressions (Lee Lyman 1994). The anatomical location of these modifications on each of the elements was described in detail and added to the faunal database. Elements with particularly clear or unusual evidence were then selected for photography. Identification of the causes of the modifications was also noted; for example, classic percussion damage for marrow extraction (Noe-Nygaard 1977) and longitudinal splitting for bone tool production (David 2005). In terms of the animal modification evidence, attempts were made, where possible, to identify the species responsible by examining any clear tooth impressions or gnawing patterns. Some species, such as canids and felines, tend to favour particular elements and the pattern of gnawing can be very distinctive (Haynes 1983): for example, dogs have a tendency to drag their teeth over the surface of a bone creating tooth scores and gouges and rodents leave parallel tooth scores (O'Connor 2000).

Taxa identification

The species or genus was assessed using the University of York zoological reference collection and the atlas of Quaternary mammals (Pales and Lambert 1971a; 1971b; Pales and Garcia 1981a; 1981b) by BK and TOC. In addition, measurements were taken where possible in order to try to differentiate between red deer and elk using von den Driesch (1976). However, this was sometimes problematic due to the large size of the red deer and the post-depositional changes that have occurred to a large quantity of the remains.

It was not possible to identify the species or genus of a large number of specimens, particularly those on the dryland because they were severely degraded. When species could not be determined, specimens were categorised to family level (e.g. *Cervid* sp., *Bovid* sp.), category (e.g. bird sp., ungulate sp.) and size (large, medium or small mammal). The composition of bird bones is very different to that of mammals as they are usually very gracile, lightweight and have a very different internal structure, making them much easier to identify as bird, though not necessarily to species.

It was possible in some cases to get to family level using size, robusticity and internal matrix detail of the bones. However, the majority of the material categorised to family level came from the application of ZooMS. A total of 280 bones were sampled and analysed by MB from the dryland excavations carried out in 2007 and 2008. In addition, a further 60 bones were analysed by PW and MC from the dryland excavations carried out in 2013 and 2014. Only specimens from the dryland were sampled for ZooMS because this is where identification using traditional methods was most challenging due to the deterioration of the bone.

Collagen, the dominant protein in mineralised tissues, is known to persist with extraordinary longevity and can be examined using ZooMS (Buckley et al. 2009), whereby peptides are fractionated using C18 ZipTip® pipette tips, and analysed by Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry (MALDI-ToF MS). This method introduces the sample into the mass spectrometer as an air-dried co-crystallised acidic mixture of peptides and a coloured matrix. Under vacuum, the multiple samples spotted onto the plate are each in turn volatilized by a laser shot at the crystals. The energy is absorbed by the matrix within the crystals, causing it to partially decompose and volatilise. This pulse of energy also lifts the co-crystallised peptides off the plate and adds a proton, giving them a positive charge. These charged peptides are then accelerated by an electric field and guided down a flight tube, which assesses the mass of each peptide by its time of flight to reach a detector, peptides with lower mass arriving earlier than those with higher mass.

A small amount of each sample was removed and placed in an eppendorf micro-centrifuge tube. Then 200 µl of 0.1M sodium hydroxide (NaOH) was added to the sample to remove tannins and other chromophoric

compounds. The sample was then vortexed and centrifuged. The NaOH was removed, and 200 µl of 50mM ammonium bicarbonate solution (NH_4HCO_3) pH 8.0 (AmBic) was added in order to 'rinse' the sample. The eppendorfs were then vortexed briefly before being centrifuged again for one minute. This rinsing process was repeated twice more. 75 µl of AmBic was then added to the samples. Next, 1 µl of trypsin solution was added to each of the 'second' eppendorfs. These were then incubated for four hours at 37 °C. Following incubation, the samples were centrifuged, and 1 µl of 5% TFA solution was added to each to terminate trypsin activity. Peptides were then extracted from the sample solution using C18 ZipTip® pipette tips and eluted with 50 µl of conditioning solution. Then 1 µl of sample was spotted onto a Bruker ground steel target plate, following which 1 µl of matrix was added on top. Each sample was spotted in triplicate and the plate was then run on the Bruker Ultraflex.

Quantification

NISP and MNI were used in quantifying this material with the aim of calculating relative abundance of animals, or parts of animals, deposited at the site. Weights were not recorded because the deterioration of the deposits have affected the faunal remains so much that weight calculations would not be comparable across site, or with other sites, and would therefore be meaningless.

NISP is defined as the number of identified specimens. Usually the term 'specimens' refers to either a single bone, or a group of fragments originally derived from a single bone that could be refitted together. These calculations are used to illustrate the relative numbers of each element in order to assess which elements are abundant and which elements appear to be missing from the assemblage. For this analysis it was decided to include individual fragments in the NISP values; however, the potential bias of high fragmentation through working bone into tools was taken into account when discussing the dominance of different taxa within the assemblage.

MNI is defined as the minimum number of individuals. This was calculated using the most abundant skeletal element for each species within the assemblage, sorting into left and right specimens, and identifying repeating areas of the element. Age and size of the element were also taken into account in the calculations where possible.

As set out above, there has been much debate about whether to include antler in the quantification of deer from the site. In this study, the calculations of both NISP and MNI include unshed antler which still retained some attached crania, but do not include shed antler, as this material may have been collected from elsewhere and brought to the site for making artefacts. Similarly, bone and antler tools such as barbed points, bodkins and bone chisels are not included in these calculations because these artefacts might have been mobile within the landscape and may have been curated over significant periods of time. For convenience here, even though antler is of course a specialised form of bone, the terms 'bone' and 'antler' are used as separate categories.

Ageing, sexing and palaeopathology

In terms of age assessment, the two main methods used were epiphyseal fusion and tooth development. In general, as an animal ages the bone surfaces become more sculptured, muscle attachments become more pronounced and epiphyseal fusion occurs which obliterates the sutures. The presence of these characteristics can therefore add additional support for differentiation between adult and juvenile remains. Studies by Lesbre (1897–8), Grigson (1982), Purdue (1983) and Fanden (2005) investigated epiphyseal fusion in a number of different taxa, and these studies have been used to assess age for the Star Carr faunal remains. For tooth development, studies by Severinghaus (1949), Habermehl (1961), Briederman (1965), Matschke (1967), Silver (1969) and Hillson (2005) have been used for the different taxa. For some species it is also possible to use tooth wear data to aid with estimations of age (Severinghaus 1949; Aitken 1975; Brown and Chapman 1991a; Brown and Chapman 1991b; Hewison et al. 1999); where possible, these methods of analysis have been applied in this study.

Sex assessment is generally much more difficult to establish, especially in assemblages of archaeological animal bone of this age, due to deterioration and fragmentation. Sexing of the pelves could not be carried out because although some fairly complete specimens were found, the detail was obscured by concretions on the bone surfaces or exploded bone caused by salt crystals, or they had been compressed, warped or highly

demineralised (Chapter 22). The canine teeth of pigs and wild boars were assessed as these show marked sexual dimorphism, allowing the sex identification of mandibles and maxillae. Metric analysis of the bones for size comparisons to published datasets of comparable species is another way to aid sex identification; however, this is highly dependent on good preservation levels (Klein and Cruz-Urbe 1984). Legge and Rowley-Conwy (1988) made measurements of the astragalus, metacarpal, scapula and humerus, measuring the width of the distal end (Bd) and the thickness (Dd) after von den Driesch (1976). However, due to issues of compression, demineralisation and bloating this was not possible for the majority of bones recovered during the recent excavations. Only the astragalus of aurochs could be assessed in this way. In addition, calculations for age and sex were not possible for bones from the dryland due to poor preservation and high fragmentation of the material.

Palaeopathological changes can be assessed by looking for bone modification, either in terms of the bone structure or appearance of an element. There are many different ways in which pathologies can exhibit themselves on a skeleton. Arthropathies are pathologies of the joint, and this can encompass arthritic changes such as lesions on the articular surfaces or osteophyte formation (bony lipping or spurs occurring at the joints) and changes caused by rapid weight gain or uneven weight distribution across the limbs such as osteochondrosis (localised articular lesions caused by malformation of subchondral bone), for example. Various diseases can also exhibit themselves within the skeleton, such as periodontal disease which can affect the mandible and maxilla, causing a widening of the tooth sockets, and can result in the eventual loss of teeth. Trauma to the skeleton can also be exhibited and recorded, for example healed breaks, blunt force traumas or evidence of human damage such as projectile perforations. Very few specimens exhibit evidence of pathological alterations (n=7) and the evidence is often very subtle. The majority of instances are healed fractures on ribs (n=4) which are a result of wounding, possibly from red deer rutting, or possibly from a hunting incident. One of the large mammal ribs with a healed break just below the proximal head also exhibits an area of eburnation (polish) to the articular surface of the rib head. This is generally associated with bone rubbing on bone and is a diagnostic feature of osteoarthritis.

Seasonality assessments

The interpretation of seasonal occupation of the site is, for the most part, reliant on the ability to assess the age and development stage of the animal remains found there. By using information such as tooth development and epiphyseal fusion to age the faunal remains, it is often possible to estimate the age at death, and from this the time of year these animals died through an understanding of breeding and birthing patterns. For example, red deer in Britain tend to begin mating in September/October each year and their gestation period is typically around eight months. The young are therefore born in May/June (Dobronika 1988). Combining this information with the data gathered from age assessment at death, it should be possible to approximate the season of death. Other methods used to interpret seasonality information include the development and shedding of deer antler (which today in Britain occurs between March and April), and the combination of age data and seasonal migration patterns of certain species such as birds.

Stable isotope analysis

Carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope analysis was undertaken on five faunal remains from the assemblage. One dog (*Canis familiaris*) and four red deer specimens were sampled; one of the latter was taken from a worked antler frontlet. Analysis followed a modified Longin collagen extraction protocol using ultra-filtration (30kDa MWCO) on c. 100–200 mg of bone (Brown et al. 1988; Richards and Hedges 1999; Colonese et al. 2015). The analysis was undertaken in order to contribute to the existing isotopic dataset for the site. Interest was particularly focused on comparison of the isotope values generated here with those previously obtained from the site (e.g. Schulting and Richards 2000; 2002a; 2002b; 2009), which have resulted in much debate surrounding potential movement of human populations between the coast and inland during the Early Mesolithic (Clutton-Brock and Noe-Nygaard 1990; Day 1996b; Schulting and Richards 2002a; Dark 2003; Schulting and Richards 2009). We also aimed to investigate the potential of any isotopic differences between the individual elements of red deer and the antler frontlet.

Samples were initially cleaned manually using a scalpel, and then were demineralised in 0.6 M aq. HCl solution at 4°C, and the resulting insoluble fraction was gelatinised in pH3 HCl for 48h at 80°C. The supernatant solution was then ultrafiltered (30kDa MWCO, Amicon) to isolate the high molecular weight fraction, which was then lyophilised. Purified collagen samples (1 mg) were analysed in duplicate by Elemental Analysis Isotope Ratio Mass Spectrometry (EA-IRMS) on a Sercon GSL analyser coupled to a Sercon 20-22 Mass Spectrometer at the University of York. Accuracy was determined by measurements of international standard reference materials within each analytical run. These were IAEA 600 $\delta^{13}\text{C}_{\text{raw}} = -27.9 \pm 0.1$, $\delta^{13}\text{C}_{\text{true}} = -27.8 \pm 0.1$, $\delta^{15}\text{N}_{\text{raw}} = 0.6 \pm 0.1$, $\delta^{15}\text{N}_{\text{true}} = 1.0 \pm 0.2$; IAEA N2 $\delta^{15}\text{N}_{\text{raw}} = 20.5 \pm 0.1$, $\delta^{15}\text{N}_{\text{true}} = 20.3 \pm 0.2$; IA Cane, $\delta^{13}\text{C}_{\text{raw}} = -11.8 \pm 0.1$; $\delta^{13}\text{C}_{\text{true}} = -11.6 \pm 0.1$. The overall uncertainties on the measurements of each sample were calculated based on the method of Kragten (1994) by combining uncertainties in the values of the international reference materials and those determined from repeated measurements of samples and reference materials. These are expressed as one standard deviation (1σ). In addition, a homogenised bovine bone extracted and analysed within the same batch as the samples produced the following values; $\delta^{13}\text{C} = -22.9 \pm 0.1$; $\delta^{15}\text{N} = 7.0 \pm 0.2$. The overall mean value among 50 separate extracts of this bone sample produced values of $\delta^{13}\text{C} = -23.0 \pm 0.7$ and $\delta^{15}\text{N} = 6.7 \pm 0.4$. Stable isotope values are presented here relative to the internationally defined standards of VPDB for $\delta^{13}\text{C}$ and AIR for $\delta^{15}\text{N}$.

Collagen quality fell within reported ranges (DeNiro 1985; van Klinken 1999). Collagen yields were calculated from retentate samples only, following ultrafiltration. Variability was seen in the yields obtained from the samples, from 22.5% in the one dog sample, but ranging from 2–12% for the deer samples; however, all samples exhibited acceptable atomic C:N ratios of between 3.3–3.4.

Taphonomic analysis

Introduction

Chapter 22 sets out the results of the bone degradation at Star Carr. In sum, the bone found on the dryland is very friable which has resulted in serious difficulties for the zooarchaeological assessment. It was possible to identify some specimens to taxa using ZooMS but other standard methods such as identification of elements, anatomical distributions, sexing and ageing proved problematic. Some of the bone that does survive appears to have been quickly buried within the sediment following deposition. Any bone which had not been immediately buried is likely to have been subject to a variety of taphonomic factors such as clearing, dog-gnawing and trampling. It is impossible to quantify how much bone has completely deteriorated from this part of the site but it is highly likely that we are only seeing a very small percentage of what was originally there.

As seen in Chapter 22, the bone from the wetland has been subjected to high levels of acidity though this varies in strength across the site. The bone found in Clark's area was better preserved than elsewhere (the Clark backfill assemblage and the material obtained during the most recent excavations), perhaps because the bone was deposited as a dump, which might have helped buffer the acidity, and it was also surrounded by less acidic/near neutral backfill. In addition, these bones were probably deposited in shallow water, meaning they were less prone to other destructive factors such as dogs and trampling. Preservation in other areas of the wetland varies significantly and the presence of 'jellybone' (see Chapter 22) suggests much bone has probably disappeared completely due to the high levels of acidity. Even in the small pocket of less-acidic sediment to the south of the detrital wood scatter it is important to note that severely deteriorated bone has been found (Chapter 22).

The only evidence of natural taphonomic occurrences is the rounding and smoothing of the edges of bones. For the most part this is found within the waterlogged deposits of Clark's area ($n=18$) and Clark's backfill ($n=8$) and is likely the result of water flowing over the bones. There are also four specimens from the dryland which exhibit similar rounding, and this will occur when sediment moves over exposed bone, or bone is left lying exposed on the ground surface for a while (Klein and Cruz-Urbe 1984).

Anthropogenic factors

The different types of taphonomy related to anthropogenic factors were examined by area (Table 23.3). In Clark's area, most signs of modification are present, bar heating, and here percussion breaks are present on 39%

of the bone found. The prevalence of anthropogenic modification in this area is most likely due to the large numbers of bone found as opposed to a real pattern: loss of bone elsewhere on site means the areas are not directly comparable. Spiral fractures and percussion breaks are found in all areas of the site and are the result of people using heavy objects, such as stones or rocks, to break into the central cavity of the bones in order to retrieve the marrow (Figures 23.2 and 23.3). Although it should be possible to achieve this goal by producing



Figure 23.2: Photograph of an example of a percussion breakage, and clear percussion point, on the faunal remains from Star Carr (red deer radius <109242>) (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).



Figure 23.3: An example of longitudinal splitting on a red deer tibia <110290> (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).

only one break, there are several examples of fractures occurring to both ends of a long bone, removing both the proximal and distal articular ends. For these specimens it appears likely that after the marrow was extracted, the long bone was prepared for tool production.

Marks created by cutting or scoring are rarely found, with the majority of examples coming from Clark's area, probably due to better conditions in this area. A large number were found on ribs (n=54): there was no clear patterning, with cut marks occurring along the full length of the rib, and they occur on the ventral and dorsal aspects, suggesting they represent a mixture of both skinning and dismembering activities. Cut marks have also been observed around the joints and along the midshaft of long bones, providing evidence of muscle and ligament removal during dismemberment, and on the cortical bone surfaces of crania and antler frontlets, providing evidence of skinning.

Bones which have been longitudinally split are found from most areas of the site, with the exception of the western platform and to the north of Clark's area, though due to small numbers of bone in these areas this is unlikely to be a significant pattern. The percentage of split bone is always under 10%. This type of modification was predominantly found on long bones (n=65; 90.3%), and is part of the process of bone tool manufacture.

In terms of human modification, Clark's area exhibits all of the different types of human interaction with the most common forms being for marrow extraction (percussion breaks and spiral fractures) (Table 23.3). Both of these techniques can also be seen in all areas across the site. Interestingly, both Clark's backfill and the detrital wood scatter assemblages exhibit a similar range of activities to Clark's area, but in smaller numbers.

Evidence of heating (in the form of blackening, charring or calcination) is lacking from large areas of the site (Figure 23.4). Due to the conditions of the bone and the staining from the peat it is very difficult to identify signs of heating; however, a total of 500 fragments of bone (43 hand collected bones and 447 from flotation) exhibit evidence of heat exposure. Of these remains, the majority were found on the dryland (n=486), 11 were found in Clark's area and three in Clark's backfill. Of the dryland heat affected specimens, the main concentration is from within and around the eastern structure (n=431).

The affected specimens were found to exhibit evidence of having been heated to varying degrees (Table 23.4): burnt/blackened (n=84), charred (n=170) and calcined (n=246), suggesting fires of varying different heat intensities and durations. The material from the dryland mainly consists of bone that was intensely heat exposed (calcined), but there is evidence of bone from the full range of heat exposures. In terms of the material from Clark's area, 11 fragments exhibit evidence of heating, and they also illustrate the full range of colour change.

		Clark's		Wetland							
	Detrital wood scatter (n=160)	Clark's area (n=560)	Clark's backfill (n=331)	Central platform (n=24)	Eastern platform (n=34)	Western platform (n=20)	Wood peat (n=157)	Marl (n=11)	Bead area (n=13)	Test pits (n=11)	Dryland (n=601)
Spiral fractures	13 (8.1)	99 (17.7)	36 (10.9)	3 (12.5)	6 (17.6)	3 (15)	11 (7)	3 (27.3)	3 (23.1)	6 (54.5)	33 (5.5)
Percussion breaks	18 (11.3)	219 (39.1)	66 (19.9)	6 (25)	9 (26.5)	3 (15)	14 (8.9)	2 (18.2)	5 (38.5)	2 (18.2)	12 (2)
Cut marks	1 (0.6)	93 (16.6)	18 (5.4)								2 (0.3)
Longitudinally split	2 (1.3)	23 (4.1)	15 (4.5)	1 (4.2)	3 (8.8)		8 (5.1)	1 (9.1)			17 (2.8)
Groove-and-splinter	5 (3.1)	3 (0.5)	3 (0.9)	4 (16.7)	3 (8.8)	3 (15)	4 (2.6)				2 (0.3)
Worked (antler)	5 (3.1)	2 (0.4)	5 (1.5)	1 (4.2)	2 (5.9)	1 (5)	1 (0.6)				

Table 23.3: Total number (and percentage) of the types of taphonomy exhibited for the excavated faunal remains within each area of the site.

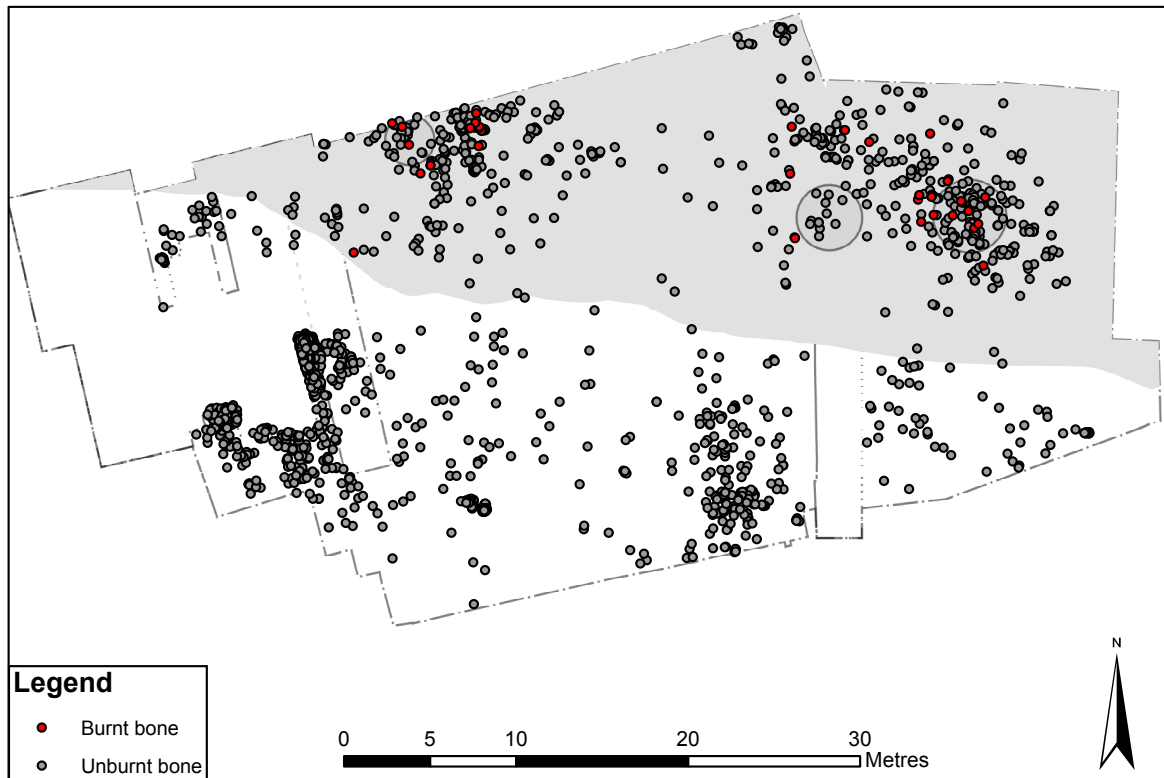


Figure 23.4: Plot showing the number and distribution of the hand-collected heat-affected bone compared to unburnt bone (Copyright Star Carr Project, CC BY-NC 4.0).

Area	Feature	Burnt (blackened)	Charred (black/grey)	Calcined (white)
Eastern structure	Central hollow	49	148	175
	Posthole [169]	1	15	28
	Posthole [185]			3
	Pit [177]			3
	Surrounding area	3	2	4
Central structure	Pit [336]	19		6
	Posthole [382]			
	Surrounding area			1
Northern structure	Posthole [358]			
	Posthole [459]			1
	Surrounding area	1		1
West of northern structure	Posthole [462]			9
Western structure	Central hollow	2		
	Surrounding area	1		14
Clark's area	Clark's baulk	7	3	1
Clark's backfill	Backfill	1	2	

Table 23.4: Number of fragments of bone exhibiting evidence of heat exposure (excavated and bone recovered from flotation).

		Clark's		Wetland							
	Detrital wood scatter (n=160)	Clark's area (n=560)	Clark's backfill (n=331)	Central platform (n=24)	Eastern platform (n=34)	Western platform (n=20)	Wood peat (n=157)	Marl (n=11)	Bead area (n=13)	Test pits (n=11)	Dryland (n=601)
Tooth impressions	1 (0.6)	14 (2.5)	7 (2.1)						1 (7.7)	1 (9.1)	
Tooth scores	3 (1.9)	12 (2.1)	4 (1.2)						1 (7.7)	1 (9.1)	
Uneven breakage	4 (2.5)	20 (3.6)	2 (0.6)	1 (4.2)					1 (7.7)	1 (9.1)	

Table 23.5: Total number (and percentage) of the animal modification exhibited for the excavated faunal remains within each area of the site.

The focus of these heat affected fragments of bone around the different structures on the dryland is very interesting. The eastern structure contains the most evidence, particularly within the central hollow, suggesting the presence of a hearth within the structure or possibly distribution of fire ash across the structure floor during hearth clearance. The other possibility is that the structure may have burnt down; however, this probably would have resulted in greater quantities of burnt material in this area. The heat-affected bone may also be the result of cooking, but gentle heating for marrow extraction purposes, bone waste disposal and accidental heating cannot be discounted.

Modifications by animals

Three types of modification by animals have been observed: tooth impressions, tooth scores and uneven breakage (which is often associated with one or both of the other two characteristics). A total of 50 specimens exhibit these modifications and they are found across the entire site (Table 23.5).

Long bones are the most common elements affected (n=19), along with ribs (n=9) and podial elements (n=8). The remainder are all represented by elements that could be considered to be waste products of butchery and are not meat-bearing (vertebrae, pelvis, scapula), so may be easily scavenged from a processed carcass. Interestingly, one red deer antler frontlet from Clark's area (<116888>; Chapter 26) also exhibits tooth impressions and score marks consistent with a small amount of carnivore activity.

The majority of modifications were consistent with wolf or dog gnawing: chewing concentrated on the ends of long bones (Figure 23.5) or the edges of fragments, and on elements at the joints such as the podial elements; and tooth impressions and tooth scores at the edges of elements (Figure 23.6) (Shipman 1981, in Lyman 1994). There is one exception: a wild cat humerus (<116175> has tooth impressions around the edge of the proximal articular surface consistent with feline teeth, possibly another wild cat, or mustelid teeth.

The detrital wood scatter, Clark's area, north of cutting III (the bead manufacturing area), test pits and Clark's backfill all provide evidence for all three types of modification, with additional evidence of uneven breakage from the central platform. Given that dog bones have been found on site, it is not surprising that such evidence exists. The lack of evidence from other areas is more likely to be a factor of taphonomy due to deterioration than a real pattern: the numbers of bone found in the wetland is relatively small and the bone from the dryland is badly degraded and unlikely to show such modifications. The fact that this evidence does survive in some places suggests that bone was subject to animal gnawing, and there is a strong likelihood that much bone was destroyed during the occupation of the site through this process.

Discussion

A number of different factors have influenced the preservation of bone from Star Carr. The damage caused by the acidification of the deposits is impossible to quantify; however, because a number of 'jellybones' have been found and some areas have produced very small quantities of faunal remains (such as the western platform), the likelihood is that significant quantities may have been lost in some areas.



Figure 23.5: Photograph of the uneven (ragged-edge) breakage associated with carnivore gnawing on the proximal head of an ulna <109243> found in the area of the detrital wood scatter (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).



Figure 23.6: Photograph of carnivore gnawing on a red deer navicular-cuboid <108662>, from the detrital wood scatter, with clear tooth impressions (on the articular surface) (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).

On the dryland there is also evidence of severe deterioration of the bone because here the site is not water-logged; this is fairly normal for dryland sites of this period, and the level of degradation is likely to be more or less consistent across the area. However, other factors caused by both humans and animals, such as fragmentation through trampling, working bone for tools and processing it for food, and gnawing by dogs, all have further negative impacts on preservation. From the data it is not possible to assess how significant these actions were, but they are likely to have had an impact across the site.

In sum, as with most sites, we have to interpret the faunal remains data knowing that we are looking at a very partial record. Not only have we excavated less than 10% of the site (potentially missing material deposited in other areas), but the assemblage has been partially destroyed by acidity in the wetland, oxidation on the dryland, carnivores and a multitude of human actions in the Mesolithic period related to consumption practices, tool making and deposition of remains in various parts of the landscape. It is with these caveats in mind that the faunal remains analysis was undertaken.

Results

Overall quantification

NISP by taxa

A total of 2414 specimens of bone and antler were found from the site (Figure 23.7). Of these, 1925 archaeological bone and antler specimens were recovered through excavation on site (Figure 23.8), and 489 small fragments were recovered from flotation of soil samples. A further 12 have not been included in the analysis since they are undoubtedly intrusive (mole, rabbit, modern cattle, modern dog), or were found within re-deposited upcast from the nearby River Hertford.

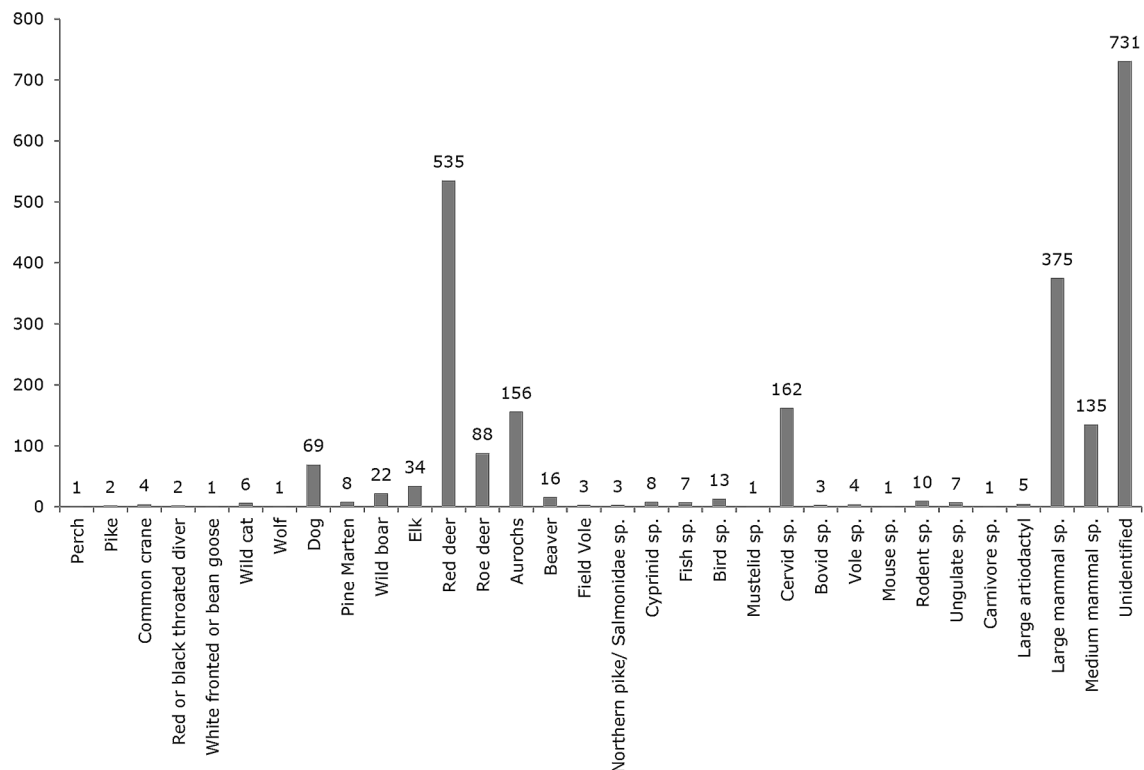


Figure 23.7: NISP of the taxa for the whole site (hand excavated and flotation) (Copyright Star Carr Project, CC BY-NC 4.0).

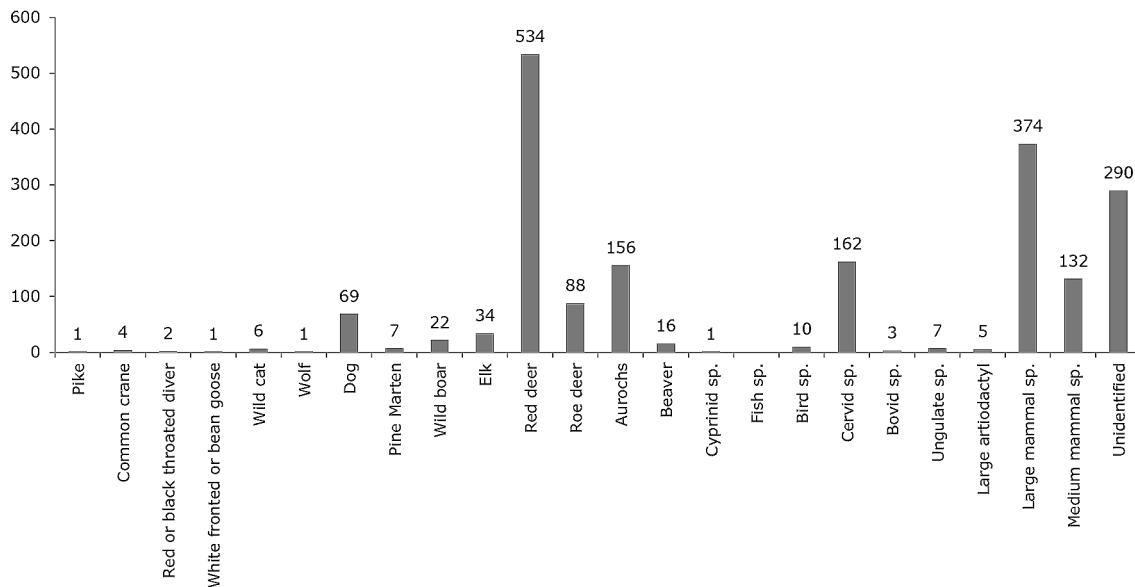


Figure 23.8: NISP for taxa from the hand-excavated faunal remains (not including flotation remains) (Copyright Star Carr Project, CC BY-NC 4.0).

A total of 16 species were identified, 12 of which had been found previously, and four of which were new: wild cat (*Felis silvestris*), field vole (*Microtus agrestis*), northern pike (*Esox lucius*) and European perch (*Perca fluviatilis*). The fish species are particularly significant because of the debate concerning the apparent lack of fish remains at Star Carr (Wheeler 1978). It is also noteworthy that microfaunal remains such as field vole, which have never been recovered before from Star Carr, have now been discovered through flotation.

The NISP values illustrate the dominance of red deer remains within this assemblage, followed by aurochs, and then roe deer (Figure 23.8). Dog is also dominant; however, this is represented by one almost complete skeleton which has the effect of skewing the results. In contrast, several species were represented by only a small number of remains: wolf, wild cat, pine marten, beaver, common crane, red- or black-throated diver and white-fronted or bean goose.

The NISP data also shows large numbers of cervid species, large mammals and unidentified bones (Figures 23.7 and 23.8). There were a total of 510 specimens that could only be categorised as medium or large mammals due to fragmentation and poor preservation: 506 excavated and four found during flotation. Of the 510 specimens, 375 were identified as belonging to large mammals (374 excavated and one from flotation) and 135 as medium mammals (132 excavated and three from flotation). There were also 162 specimens that could only be identified as cervid species (Figure 23.8). A further 731 could not be assigned to either species or general category and so were labelled 'unidentified' (290 from excavated deposits and 441 fragments from flotation) (Figure 23.7).

Of the 489 fragments of bone found through flotation, the majority of specimens were found from the eastern structure, the central structure, the possible northern structure and Clark's area. Seven fragments can be identified to species: perch, northern pike, pine marten, red deer and field vole (Figure 23.9). There are also a number of fragments that can only be identified to family, genus or medium/large mammal (n=41) and the majority (n=441) were unidentified, either due to the small size of the fragments or due to taphonomic processes affecting the preservation.

The category of 'cervid species' includes specimens that could be elk, red deer or roe deer. Of the elements identified only as cervid species, a large number were identified by ZooMS, mainly due to the bone fragments being either too poorly preserved or too small to identify macroscopically. This is reflected by the large number of specimens that were identified as 'cervid species' by ZooMS but could not be identified to element (n=78) (Figure 23.10).

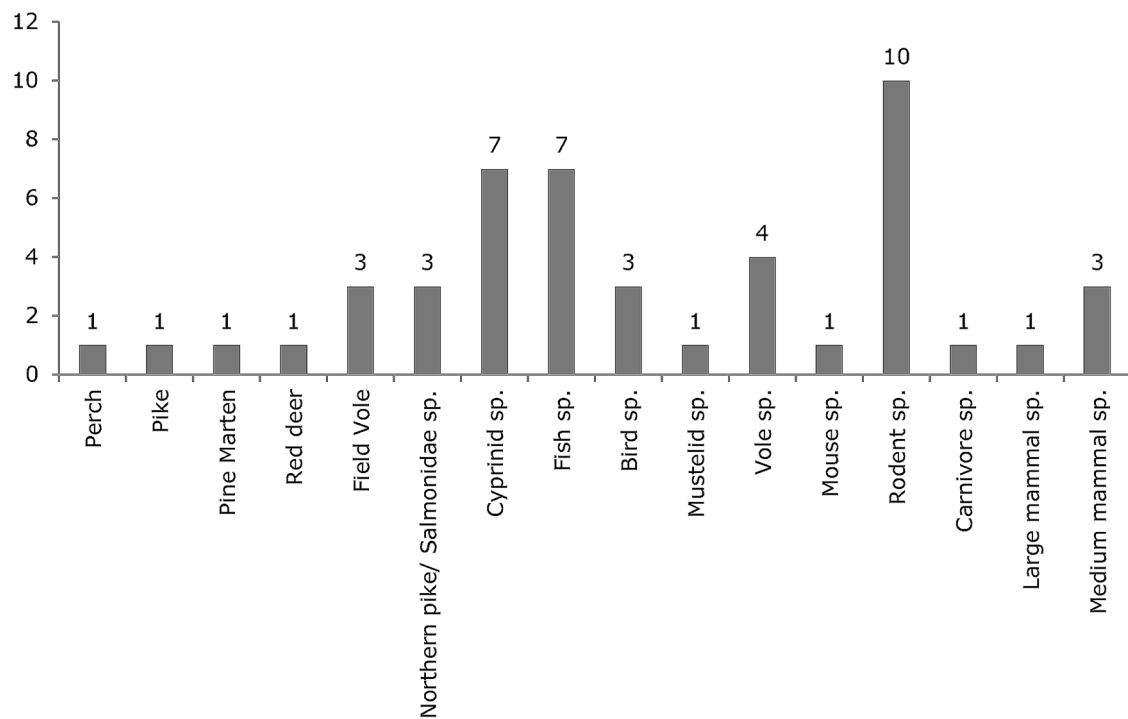


Figure 23.9: Number of fragments recovered by flotation and sieving of soil samples and identified to taxa (Copyright Star Carr Project, CC BY-NC 4.0).

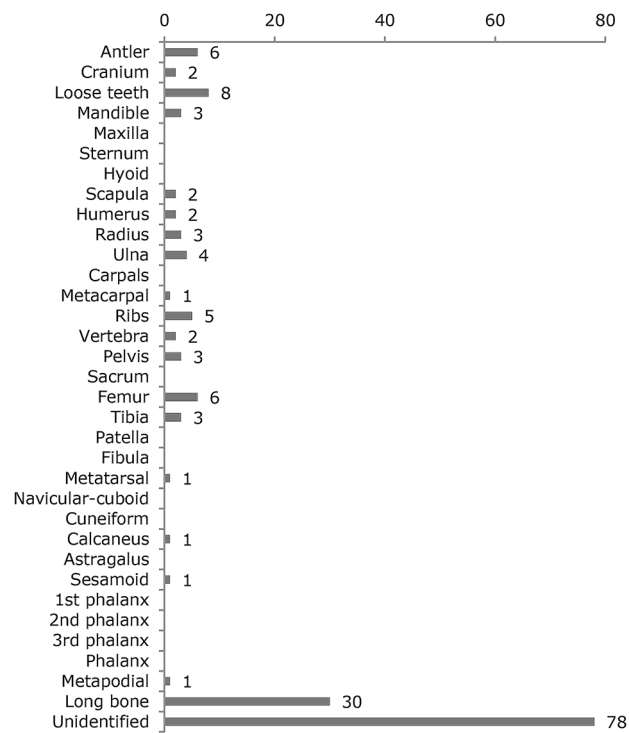


Figure 23.10: NISP of the elements for the cervid species category (Copyright Star Carr Project, CC BY-NC 4.0).

The category of ‘large mammal’ includes specimens where it was not possible to distinguish between elk, red deer and aurochs. This category (Figure 23.11) was represented by a range of elements, with the majority identified as ribs (n=173) and long bone fragments (n=65).

A similar pattern can be seen for the elements that can only be identified as ‘medium mammal species’ (Figure 23.12). This category includes roe deer, wild boar, dog, wolf and wild cat. A range of elements can be identified for this category, the most dominant being ribs (n=83) followed by long bone fragments (n=18).

Although not much can be said about these three broad categories due to the large number of taxa they include, it is important to note the abundance of ribs and long bones, suggesting some of these elements will be missing from the taxa they represent: ignoring these elements when discussing the individual species creates a biased view of the assemblage. Unfortunately this is likely to have been the case in past analyses for this dataset (e.g. Clark 1954; Legge and Rowley-Conwy 1988), due to the large proportion of these types of elements that were found in Clark’s backfill.

In terms of the flotation specimens, a range of different elements were represented with the majority being identified as fragments of loose teeth (Figure 23.13) from species of rodent (field vole: n=3, rodent species: n=5, vole species: n=3), fish species (cyprinid species: n=2, pike/salmon species: n=3), carnivore species (n=1) and red deer (n=1). In terms of the vertebrae fragments, most belong to cyprinid species (n=4) and fish species (n=3), with one identified as perch. The majority or ribs are identified as rodent species (n=3) but also fish species (n=2), cyprinid species (n=1), mustelid species (n=1) and medium mammal (n=1).

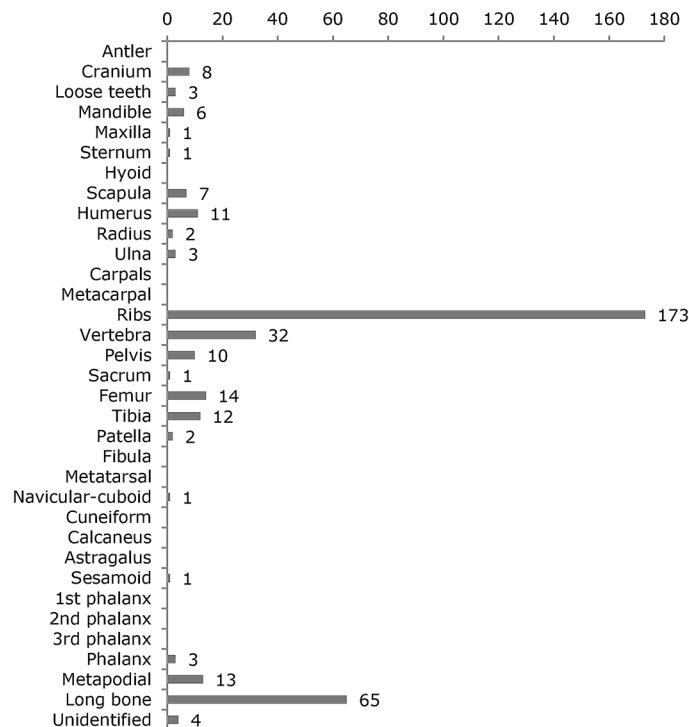


Figure 23.11: NISP of the elements for the large mammal category (excluding flotation data) (Copyright Star Carr Project, CC BY-NC 4.0).

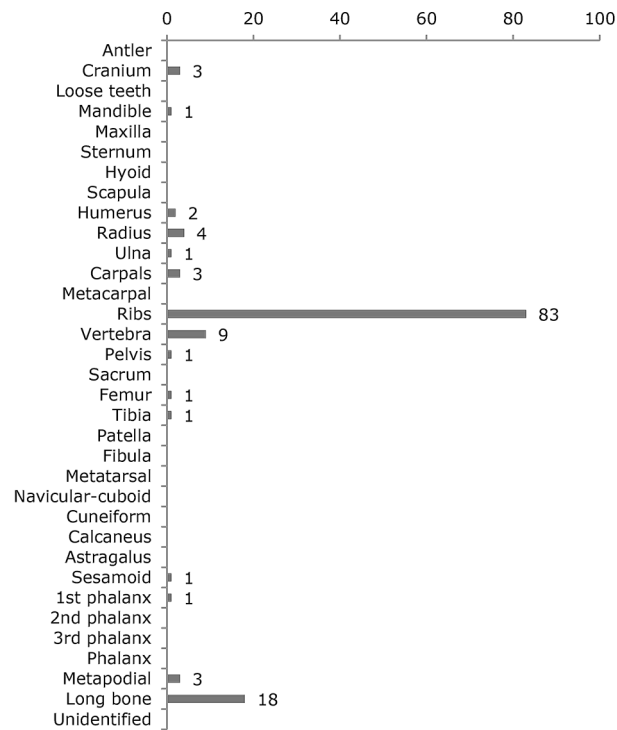


Figure 23.12: NISP of the elements for the medium mammal category (excluding flotation data) (Copyright Star Carr Project, CC BY-NC 4.0).

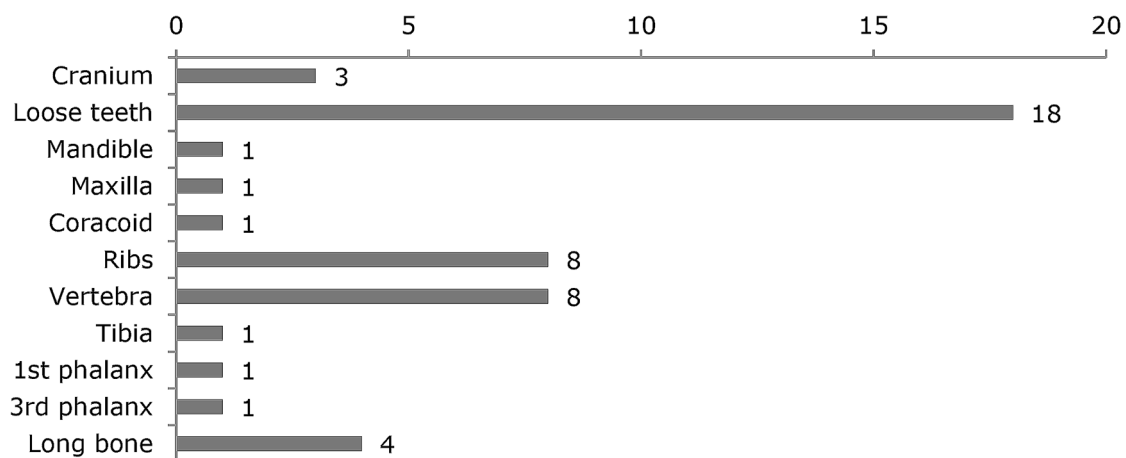


Figure 23.13: Number of fragments of bone identified to element from the flotation samples (Copyright Star Carr Project, CC BY-NC 4.0).

Results by species

Fish

In total, 21 fish remains have been recovered from the site; however, it is likely that these represent only a fraction of the overall assemblage. In Clark's area, there was better preservation than elsewhere allowing for the recovery of six fish remains. Two of these were found by hand during the excavation of the reed peat (312) and were located approximately 5 m away from one another (Figure 23.14; Figure 23.15). The remainder were recovered through bucket flotation in the laboratory from basal deposits in Clark's area and from the fill of the hollow of the eastern dryland structure (context 149).

Of the 21 remains, 14 could be identified to family or species (Table 23.6). The assemblage was dominated by Cyprinidae (the majority of British freshwater fish species including carps and minnows), followed by northern pike/Salmonidae (*Esox lucius* L., 1758/salmons, trouts, chars and whitefishes), northern pike and European perch (*Perca fluviatilis* L., 1758). There were 12 postcranial elements and nine cranial elements.

Although identification was attempted to genus and species, 11 specimens from two families could not be further identified. Of these two families, two Salmonidae species and nine Cyprinidae species have been previously identified in contemporaneous faunal assemblages throughout Northern Europe (Aaris-Sørensen 1976; Richter 1982; Zabilska-Kunek 2014; Zabilska-Kunek et al. 2015): brown trout (*Salmo trutta* L., 1758), Atlantic salmon (*Salmo salar* L., 1758), white bream (*Blicca bjoerkna* L., 1758), common bream (*Abramis brama* L., 1758), Crucian carp (*Carassius carassius* L., 1758), common carp (*Cyprinus carpio* L., 1758), asp (*Aspius aspius* L., 1758),

Trench	Context	Skeletal element	Taxon
SC23	149	Unknown vertebra	cf. Cyprinidae
SC23	149	Pharyngeal tooth	Cyprinidae
SC23	149	Caudal vertebra	Cyprinidae
SC23	149	Rib	Cyprinidae
SC23	149	Caudal vertebra	Cyprinidae
SC23	149	Premaxilla	<i>Esox lucius</i>
SC23	149	Tooth	<i>Esox lucius</i> /Salmonidae
SC23	149	Tooth	<i>Esox lucius</i> /Salmonidae
SC23	149	Tooth	<i>Esox lucius</i> /Salmonidae
SC23	149	Vertebral fragment	<i>Perca fluviatilis</i>
SC23	149	Vertebral fragment	Unidentifiable
SC23	149	Vertebral fragment	Unidentifiable
SC23	149	Vertebral fragment	Unidentifiable
SC23	149	Rib/spine	Unidentifiable
SC23	149	Rib/spine	Unidentifiable
SC34	312	Pharyngeal bone with tooth	Cyprinidae
SC34	312	Pharyngeal tooth	Cyprinidae
SC34	312	Posterior abdominal vertebra	<i>Esox lucius</i>
SC34	Basal deposits	cf. posterior abdominal vertebra	Cyprinidae
SC34	Basal deposits	Unknown	Unidentifiable
SC34	Basal deposits	Unknown	Unidentifiable

Table 23.6: Contextual information and skeletal elements of the various fish identified in the assemblage.

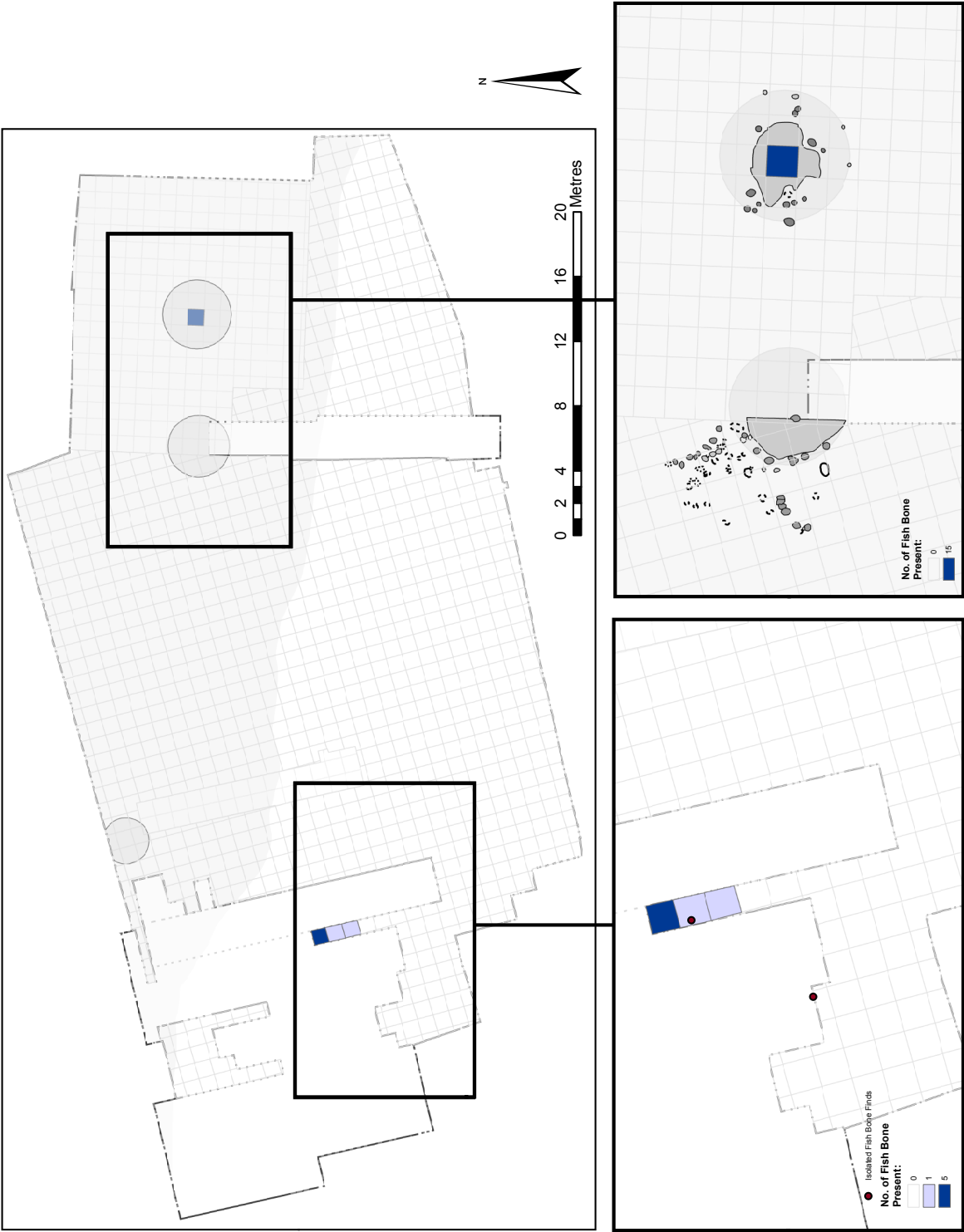


Figure 23.14: Location of the fish remains on site (Copyright Star Carr Project, CC BY-NC 4.0).



Figure 23.15: Photograph of the northern pike posterior abdominal vertebra in situ. Scale: 9.1 mm across the greatest cranio-caudal length of the centrum (Copyright Harry Robson, CC BY-NC 4.0).

ide (*Leuciscus idus* L., 1758), roach (*Rutilus rutilus* L., 1758), common rudd (*Scardinius erythrophthalmus* L., 1758) and tench (*Tinca tinca* L., 1758).

The identified species spectrum consisted of freshwater fish. Northern pike and European perch are often termed stationary freshwater fish although they can also reside in weakly brackish waters. In general, they commonly occur in stagnant or gently flowing reaches of a river (Brinkhuizen 2006).

An estimation of total fish length (TL) was attempted for all specimens that were identified to the family or species. By estimating TL it is possible to determine whether or not the assemblage was anthropogenically or naturally derived. For example, if numerous species ranging in size are represented in a given assemblage, an argument in favour of a natural death assemblage can be put forward. However, if the assemblage is dominated by one species that are generally similar in size, the assemblage can be interpreted as anthropogenic, and the data probably represents the 'selective killing of fish of a certain size' (Noe-Nygaard 1995, 170). In addition, since TL is inter- and intra-species specific, size estimates can add weight to seasonality. For instance, the European eel (*Anguilla anguilla*) is sexually dimorphic; thus if a size frequency diagram demonstrates that the majority of eels were over 0.55 m in total length, then it can be argued that females were probably targeted during their autumnal migrational run (since males do not exceed 0.5 m) (Tersch 2003).

Given the incompleteness of the specimens it was only possible to estimate the TL for seven of the specimens. Based on comparison with modern skeletons of known taxa, one northern pike specimen was estimated to be <0.2 m in TL, whilst the posterior abdominal vertebra was estimated to have derived from an individual with a TL of c. 0.7 m (Robson et al. 2016). In addition, it was possible to estimate the TL for four of the Cyprinidae specimens. Based on comparison with modern skeletons of known taxa, these are estimated to have derived from specimens that were <0.2 m in TL. Furthermore, it was estimated that the one European perch specimen in the assemblage was derived from an individual that was <0.1 m in TL (Robson et al. 2016).

Whilst preservation on site was variable, it is unlikely to have impacted TL. The one pike posterior abdominal vertebra was in a very good state of preservation and had not been subjected to compression or warping.

On the other hand, the majority of the fish remains recovered from within the structure were calcined, which is likely to have affected their structure and size. For these reasons broad estimates (i.e. 0.1 m increments) were employed. Overall, the majority of the fish remains derived from small individuals, <0.2 m, with the exception of the pike posterior abdominal vertebra. Although the sample size is very small, the fish sizes coupled with the microwear analysis on the flint (Chapter 8; Robson et al. 2016) demonstrate that the assemblage was anthropogenically derived. Moreover, the data are comparable with the assemblage from the broadly contemporary Early Mesolithic site of Friesack IV (Robson 2016).

Birds

Overview

Fraser and King (1954) did not state the NISP values for birds present in the assemblage, though it was noted that not more than one individual of each species was represented. The current analysis found 20 bird specimens (2 from flotation): common crane (n=4), red-/black-throated diver (n=2), white-fronted/bean goose (n=1) and 13 specimens that can only be identified as belonging to bird species (n=7), large bird species (n=4), medium bird species (n=1) and small bird species (n=1). Of the 20 bird specimens, the majority were found within Clark's area (n=12), with the remainder being found within Clark's backfill (n=4), the dryland (n=3) and a 2005 test pit SC10 (n=1) (Figure 23.16).

It should be noted that during Clark's excavations, a section cut through a bird bone was found, thought to probably represent a bead (Clark 1954, 164). Of the 20 bird bones found here, seven demonstrate signs of human modification: six demonstrate evidence of percussion breaks or spiral fractures; the seventh was found on the dry land and was charred. One of the large bird bones has a cut mark. The breakage of these bones is

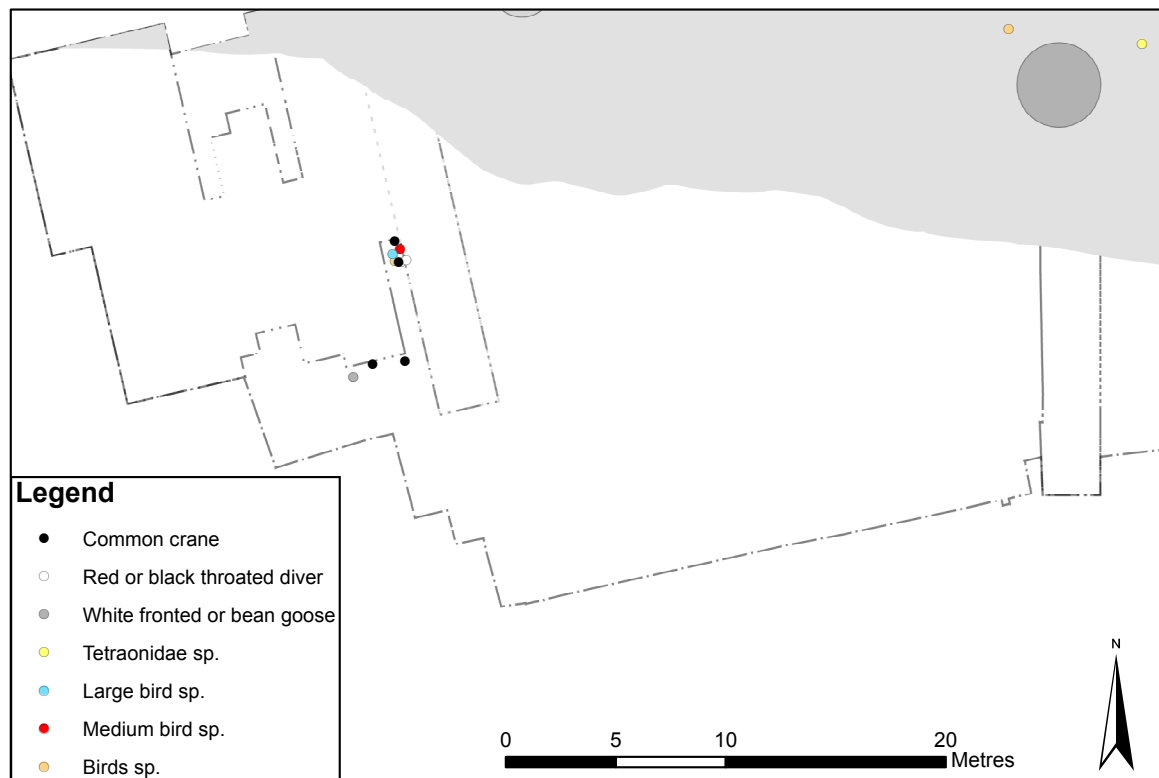


Figure 23.16: Spatial plot of the birds found at Star Carr within the main area of excavation (Copyright Star Carr Project, CC BY-NC 4.0).

unusual because there is no marrow in bird bones, so there is the possibility that they are being prepared for bead manufacture.

There is also evidence of what appears to be a healed break to the midshaft of a large bird humerus, which could have occurred in a number of ways; for example related to human action, carnivore action or as a natural accident.

White-fronted or bean goose

The one specimen of goose was found in Clark's area (Figure 23.16). It is identified as the midshaft of an ulna, but due to the partial nature of this element it is not possible to identify the species and it could derive from either a white-fronted or bean goose. The specimen was humanly modified: both the proximal and distal articular ends of the specimen are lacking and the breakage is very uneven and ragged, possibly suggesting a percussion and snapping action. It is not possible to age and sex this specimen. In terms of seasonality, both of these species of geese are migratory birds: today, these geese are only present in this country in the winter but Early Holocene distributions may have been markedly different given the climate data for this site (Chapter 18).

Red- or black-throated diver

Red-throated diver was found in the original assemblage (Clark 1954, 70). The current analysis produced two specimens of diver, consisting of a partial humerus and radius, from within Clark's area (Figure 23.16), but due to the partial nature of the elements it is not possible to identify to species. Both elements exhibit human modification: the humerus represents the proximal half of the element and the distal end has been removed by a percussion break (Figure 23.17); the radius represents the distal half and the proximal end has been removed by a spiral fracture. It is not possible to age or sex these remains. In terms of seasonality, both species of diver are migratory birds and today both species can be found in Scotland and Northern Ireland during the summer months for breeding and around the UK coastline in winter; however, again it is difficult to assess the Early Holocene distribution.

Common crane

Common crane was found in the original assemblage (Clark 1954, 70). A further four specimens were found within Clark's area (Figure 23.18): a partial radius, one complete and one partial carpometacarpus, and a frag-



Figure 23.17: Removal of the distal end of diver humerus <116486> by a percussion break (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).



Figure 23.18: Spiral fracture to one end of a common crane tibiotarsus midshaft <115281> (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).

ment of tibiotarsus. The MNI is one. Two of the specimens appear to be humanly modified; one carpometacarpus is missing both its proximal and distal articular ends and the breakage appears to have been caused by percussion, and the fragment of tibiotarsus midshaft has spiral fracture breakage to one end. Unfortunately, due to the fragmentary nature of the elements represented, it is not possible to age or sex these remains. In terms of seasonality, common crane became extinct in the UK in the 1600s, but in recent decades European birds have begun to repopulate East Anglia (Brand, pers. comm. 2016). These populations are not migratory; however, cranes on the continent migrate and spend summer in the north and winter in the south (Svensson et al. 2008).

Carnivora

Wild cat

Given the chronological period in which these remains were associated, it was possible to discount domestic cat and therefore six specimens of wild cat were found. Four of these were recovered from Clark's area and two from the dryland (Figure 23.19). The two elements from the dryland are distal phalanges, both of which are burnt and calcined, and were found next to a spread of burnt flint on the peripheries of the western structure. The wild cat assemblage found in Clark's area consists of a right humerus and radius, a sacrum and a second metacarpal (Figure 23.19), which might even represent one leg, particularly as these remains were found no more than 1.5 m apart at the northern end of the baulk. It is not possible to ascertain whether the phalanges on the dryland are part of the same animal but given that the western structure may date to the same period as the deposition in Clark's area the MNI is one (Figure 23.20).

The wild cat remains from Clark's area are very well preserved. On the proximal head of the humerus, there are some very subtle tooth marks around the edge of the articular surface (Figure 23.21). The size and shape of these tooth marks seem to suggest that they may have been made by another wild cat or a mustelid. The partial radius appears to have suffered from a possible percussion break; however, modern damage has unfortunately obscured the clarity of this modification.



Figure 23.19: Spatial plot of wild cat (Copyright Star Carr Project, CC BY-NC 4.0).

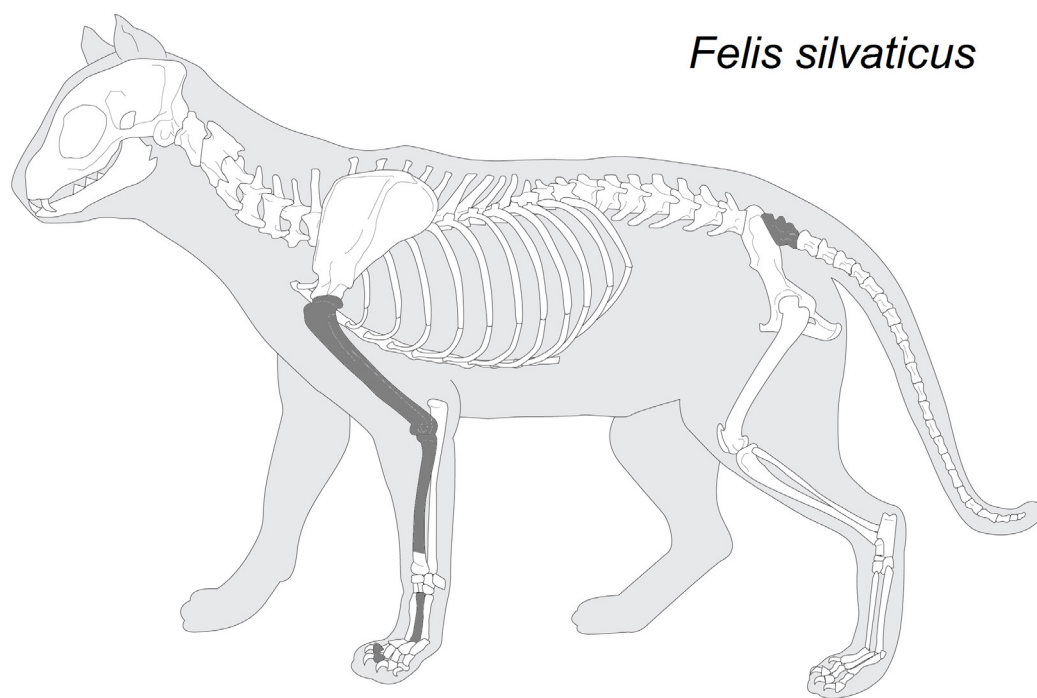


Figure 23.20: Element representation for wild cat (Copyright Archeozoo.org/M. Coutureau 1996. Adapted by Becky Knight).



Figure 23.21: Photograph of a tooth mark to the edge of the proximal head of the humerus <116175> (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).

Wolf

One wolf specimen was found in Clark's area (Figure 23.22), and this was identified as a right second metatarsal from an adult animal. This specimen is attributed to wolf on the basis of its size and length-breadth proportions, considering the size and morphology of other canid remains from the site. The distal head is missing, and the breakage appears to have been caused by percussion damage; however, there is also a small amount of excavation damage to the anterior break edge. Not much can be inferred from this one element, though it is of interest because no other wolf remains have been found from the site: the remains identified as wolf from Clark's excavations were later reassigned to dog.

Dog

Overview

An almost complete skeleton of a dog was found within the peat above the marl (Figure 23.23). Although it was found at the base of the wood peat (310), the date obtained on the left canine (OxA-33678; Figure 17.16) dates it to the 90th century cal. BC (Chapter 17). Unfortunately the preservation of the remains is poor with demineralisation and compression of the bones and teeth; in particular, the teeth enamel was splitting and peeling away from the root.

Elements

The majority of the elements were represented (Figure 23.24; Figure 23.25); however, some of the elements from the extremities of the animal were missing, including the majority of the podial elements. Given that these are the smaller, more delicate elements, this may be as a result of the process of degradation. In addition, some elements may have been moved by water at the time of decomposition.

The skeleton was positioned in two separate groupings about 0.5 m apart. Some of the elements of the two groupings were still found to be semi-articulated: from group 1 the humerus, radius and ulna, and the vertebrae were semi-articulated; within group 2, the humerus, radius and ulna, and the femur and tibia were semi-articulated (Figure 23.26; Table 23.7).



Figure 23.22: Spatial plot of wolf (Copyright Star Carr Project, CC BY-NC 4.0).



Figure 23.23: Spatial plot of dog (Copyright Star Carr Project, CC BY-NC 4.0).

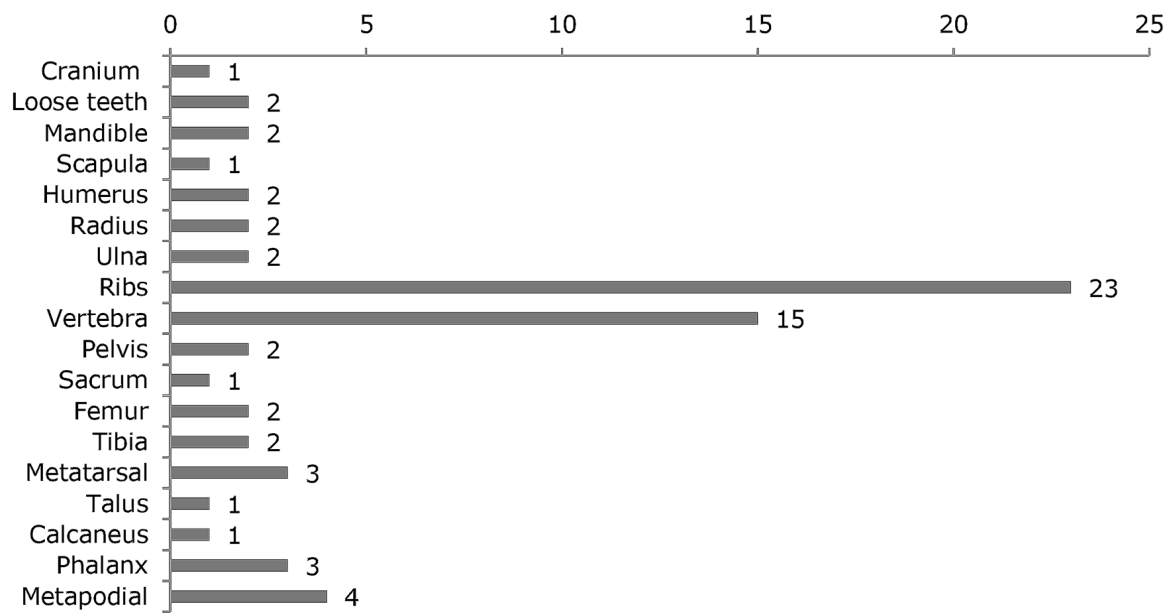


Figure 23.24: NISP of elements represented in the dog skeleton (Copyright Star Carr Project, CC BY-NC 4.0).

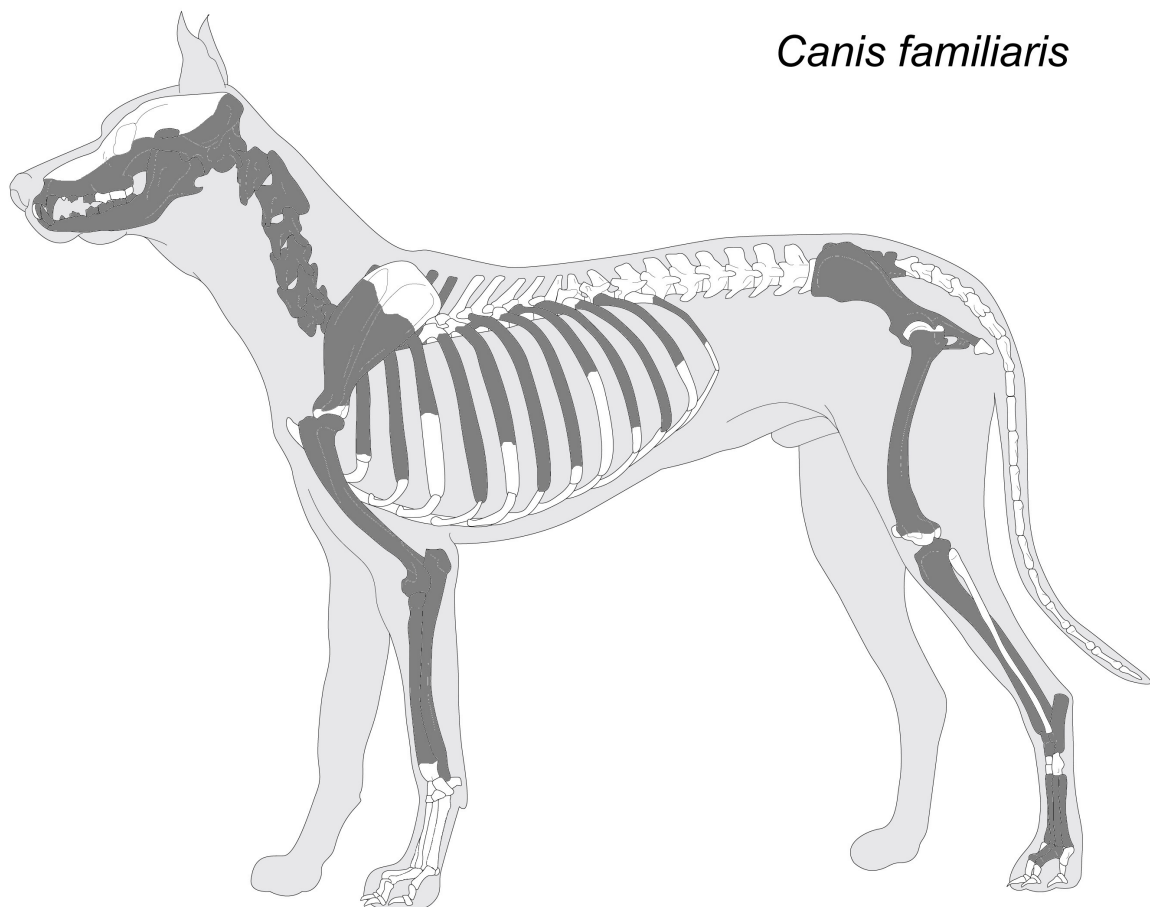


Figure 23.25: Element representation for dog (Copyright Archeozoo.org/M. Coutureau and V. Forest 1996. Adapted by Becky Knight).



Figure 23.26: Photograph of the in situ dog skeleton (group 1= left, group 2= right) (Copyright Star Carr Project, CC BY-NC 4.0).

Group 1	Mandible	2	Group 2	Cranium	1
	Premolar	1		1st molar	1
	Humerus	1		Scapula	1
	Radius	1		Humerus	1
	Ulna	1		Radius	1
	Atlas	1		Ulna	1
	Axis	1		Pelvis	1
	Cervical vertebrae	9		Femur	2
	Thoracic vertebrae	4		Tibia	2
	Ribs	22		Calcaneus	1
	Pelvis	1		Talus	1
	Sacrum	1		Metatarsal	5
				Phalanges	3
				Metapodials	4

Table 23.7: NISP and element distribution of the dog skeleton between the two separate groupings of bone.

This assemblage does not look as if the skeleton has split in half because each group of elements contains a mix of front and back parts of the dog. Given that group 1 is more tightly packed and in basic anatomical position, it seems likely that the bones in group 2 have moved to some degree: here the cranium and some forelimb bones are found with some hind limb bones. This is most likely to be water action: the water would have been flowing in that direction, out of the lake and towards the west. Given the context (shallow water reed swamp environment) and examination of the sediment on site, it is unlikely to have been a formal burial. The dog may have died a natural death in the lake or was placed within the water once it had died.

Age

Only the mandible is complete enough to aid with the age estimation: although the maxilla is present, a large number of teeth are either missing or are too degraded to be assigned. The left side of the mandible contains complete adult dentition. However, the right side contains only partial dentition: the incisors are missing and the third molar has not erupted. It is not possible to make any observations on the tooth wear due to the demineralisation and delamination of the enamel. Although the third molar from the left mandible is fully erupted, the third molar from the right side is still in the crypt. Therefore, based on the dentition, this animal would have been between six and seven months old at death (Silver (1969) and Habermehl (1961) in Hillson (2005)). Due to a combination of the individual being immature and the poor preservation of the bones, it was not possible to assess the size or robustness of the animal.

Isotope values

Due to the lack of human remains on British Mesolithic sites, dogs have previously been used as an analogue for both human diet and movement (e.g. Noe-Nygaard 1988; Fischer et al. 2007; Guiry 2012). This has extended to dog specimens from the Vale of Pickering both at Star Carr and Seamer Carr (e.g. Clutton-Brock and Noe-Nygaard 1990; Day 1996b; Schulting and Richards 2002a; Dark 2003; Schulting and Richards 2009). Both the initial $\delta^{13}\text{C}$ and subsequent $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ isotopic analysis of dog remains from Seamer Carr yielded values suggested to indicate some degree of marine resource consumption, and therefore potentially reflective of seasonal movements from the coast to the Vale of Pickering (Clutton-Brock and Noe-Nygaard 1990; Schulting and Richards 2002a), although this interpretation has resulted in significant debate (Day 1996b; Dark 2003; Schulting and Richards 2009). Conversely, isotopic analysis of dog remains from Star Carr have thus far indicated no evidence of the consumption of marine resources, and instead have been suggested to reflect a diet based upon terrestrial resources, with some possible freshwater protein input (Schulting and Richards 2002a; 2009).

One left rib sampled from the skeleton found during this excavation yielded sufficient amounts of collagen of suitable quality for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotope analysis (Table 23.8) and exhibited isotopic values comparable to those previously reported for dog remains from Star Carr (Schulting and Richards 2002a; 2009). These results also indicate that this dog was unlikely to have consumed significant quantities of marine protein (Table 23.8; Figure 23.27).

The elevated $\delta^{15}\text{N}$ values of the dog remains from Star Carr have previously been interpreted as being indicative of a degree of freshwater resource and/or aquatic bird consumption, or possibly of low levels of marine protein (Schulting and Richards 2002a). The $\delta^{15}\text{N}$ value of 10.5‰ for the newly excavated Star Carr dog falls in line with these previous interpretations. In particular, when we consider the available isotope values for terrestrial herbivores from Star Carr (Table 23.11; Schulting and Richards 2009), it can be seen that the dog values fall more than a trophic level (3–5‰) above these, therefore indicating that there must be additional protein source(s) in the diets of the dogs. Given the isotopic data already available for the site, it seems most probable

Sample No.	Element	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	C:N	Collagen yield
108261	Rib	-20.3 ± 0.1	10.6 ± 0.2	3.4	22.5%

Table 23.8: Carbon and nitrogen stable isotope data of the dog.

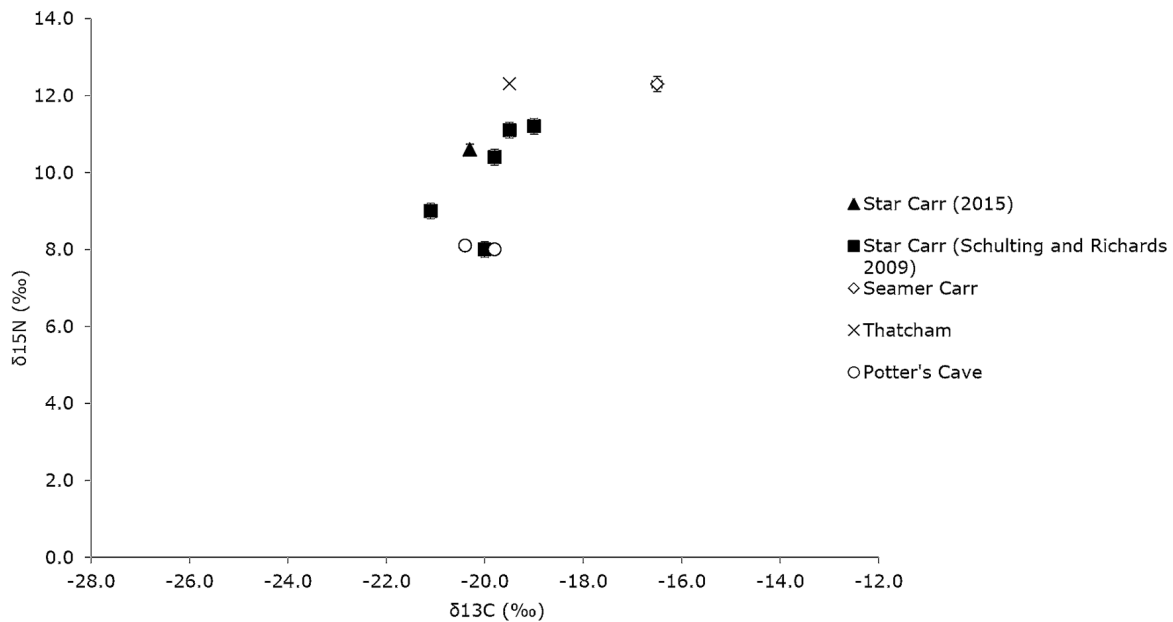


Figure 23.27: Dog isotope data from several British Mesolithic sites (data compiled from Schulting and Richards 2000; 2002a; 2002b; 2009; this study) (Copyright Star Carr Project, CC BY-NC 4.0).

that the Star Carr dog analysed here consumed a non-marine diet which comprised a degree of freshwater resource consumption. This therefore also lends weight to the hypothesis put forward by Schulting and Richards (2009) that movements to and from the Vale of Pickering and the coast were possibly not a particularly regular occurrence. Alternatively, perhaps, dogs did not often accompany people to the coast.

Pine marten

Pine marten was found in the original excavations (Fraser and King 1954, 71) and included cranial elements, long bones and ribs, with an estimation of at least two animals. A total of seven specimens of pine marten were recovered from the recent excavations: six from Clark's area and one from the detrital wood scatter (Figure 23.28). The element from the detrital wood scatter is the right side of a mandible, and from Clark's area there is a left radius and ulna, one lumbar vertebra and one caudal vertebra, the left half of a pelvis and a left tibia (Figure 23.29). Although all of the remains are well preserved, there is no clear evidence of human or animal modification.

It is not possible to combine the data from the original excavations with those from the recent excavations because not all the elements were sided in Fraser and King's report. In terms of the recent excavations, the MNI is one, as all the remains represent fully developed elements; however, as one specimen derives from the detrital wood scatter which is dated to much earlier than Clark's area (Figure 17.20), the MNI can be adjusted to two.

Artiodactyl

Wild boar

Overview

Wild boar was identified in the original assemblage (Clark 1954, 74) and re-examined by Legge and Rowley-Conwy (1988) who counted 22 fragments and estimated an MNI of four. In the recent excavations, a

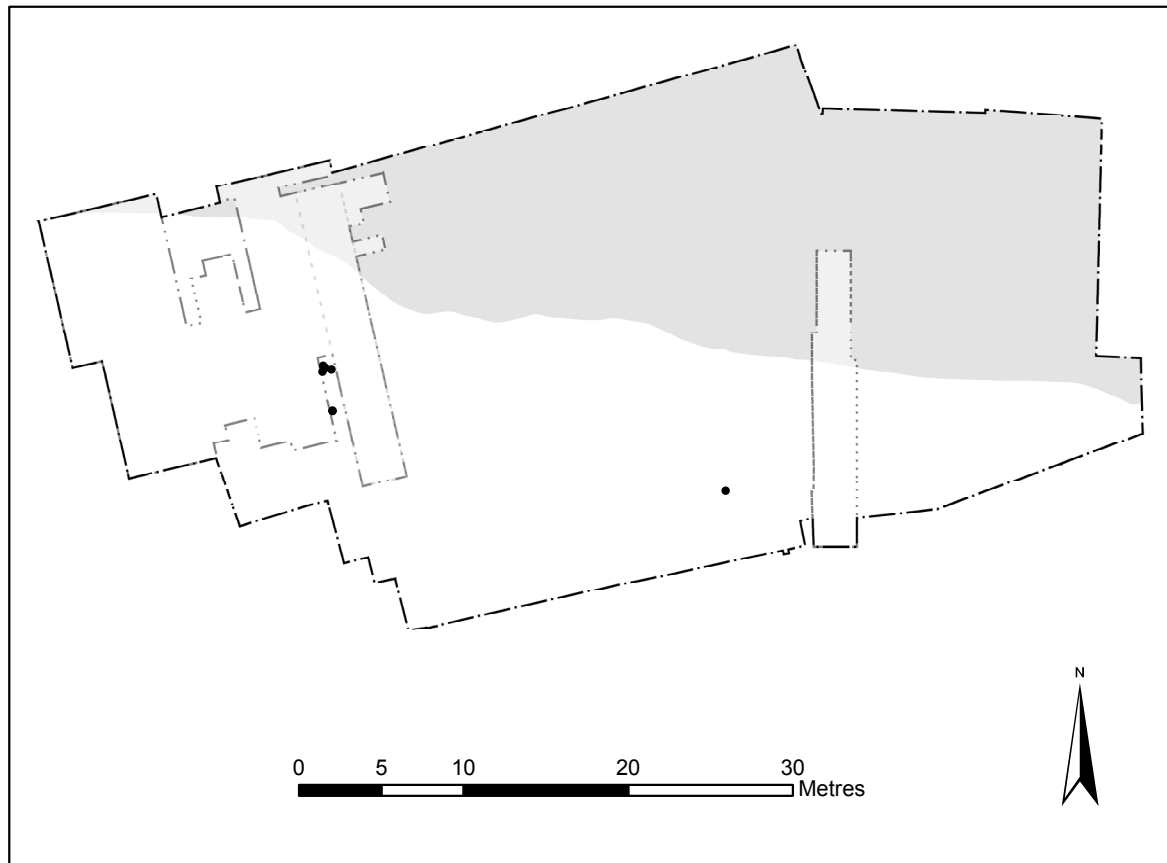


Figure 23.28: Spatial plot of pine marten (Copyright Star Carr Project, CC BY-NC 4.0).

Martes martes

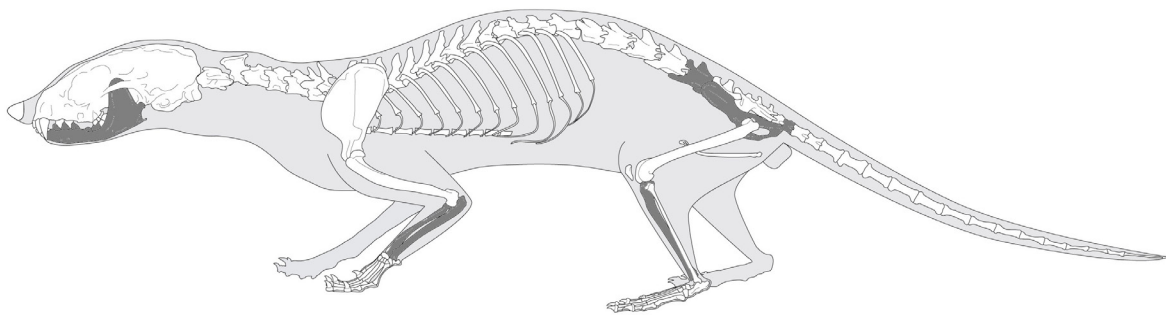


Figure 23.29: Element representation of pine marten (Copyright Archeozoo.org/M. Coutureau 2015. Adapted by Becky Knight).

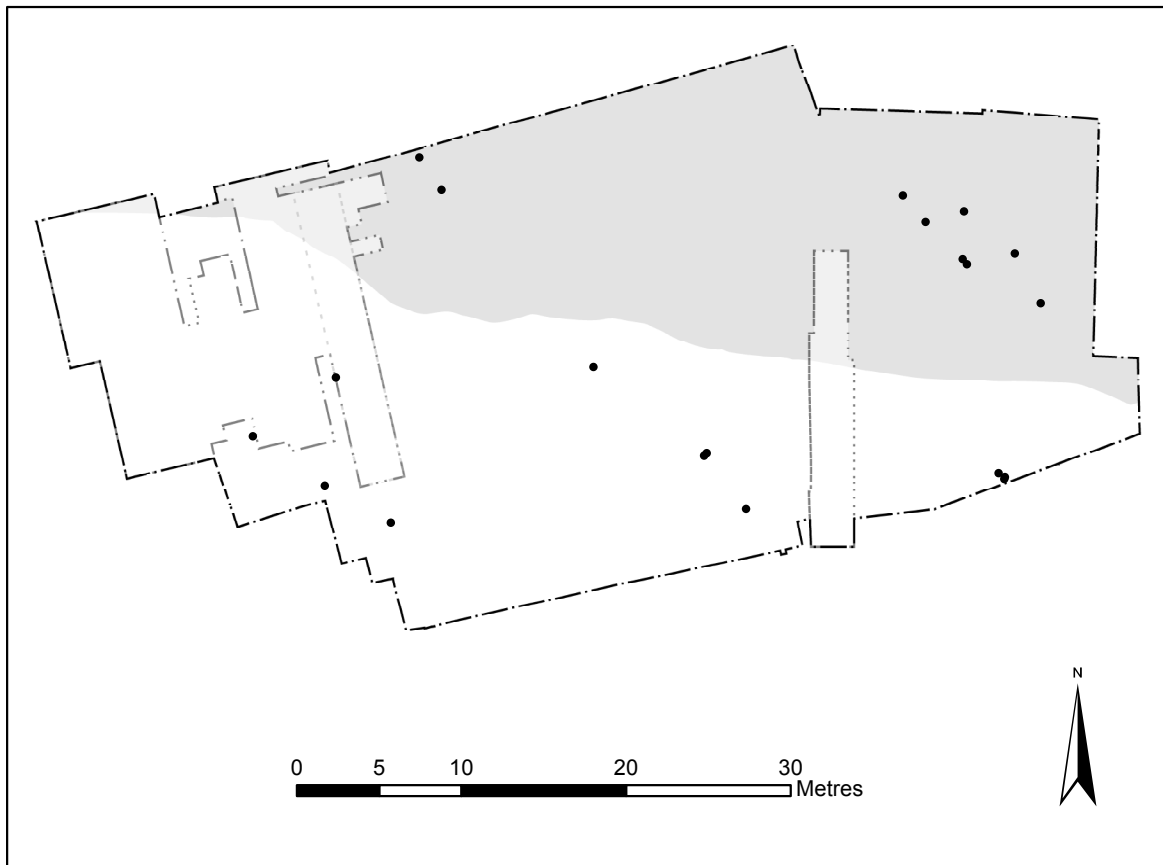


Figure 23.30: Spatial plot of wild boar (Copyright Star Carr Project, CC BY-NC 4.0).

further 22 specimens have been found across the site (Figure 23.30): three on the southern edge of the eastern platform, three in the detrital wood scatter, one above the western platform, four in Clark's area, a concentration of eight around the eastern dryland structure and two on the peripheries of the western dryland structure. Six specimens originating from the dryland have been identified to species through ZooMS but cannot be identified to element.

Elements

Mandibles and loose teeth, scapulae and hind leg bones have been identified but the small number of specimens make it difficult to identify any significance in their spatial patterning (Figures 23.31 and 23.32). In terms of missing elements, the cranium, torso and front limbs were almost completely absent, apart from two scapulae (Figure 23.31). This is very similar to the results of Legge and Rowley-Conwy (1988, table 1E). However, it should be noted that there are a large number of rib elements that can only be identified as belonging to medium mammals, some of which may be wild boar, and therefore we cannot necessarily assume that torso elements are missing.

Age and sex

Two specimens were used to aid in ageing the wild boar: an unerupted first incisor and an unfused femur (Table 23.9). The first incisor was a loose tooth find, it had no wear on the occlusal surface and it appears

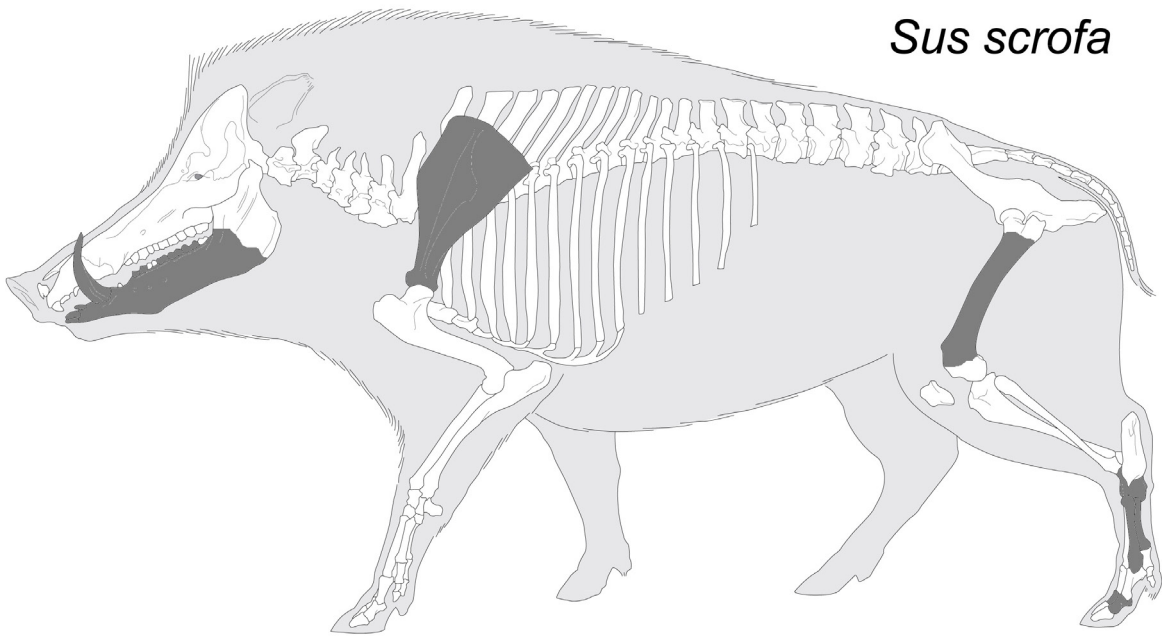


Figure 23.31: Element representation of wild boar (Copyright Archeozoo.org/M. Coutureau 2003. Adapted by Becky Knight).

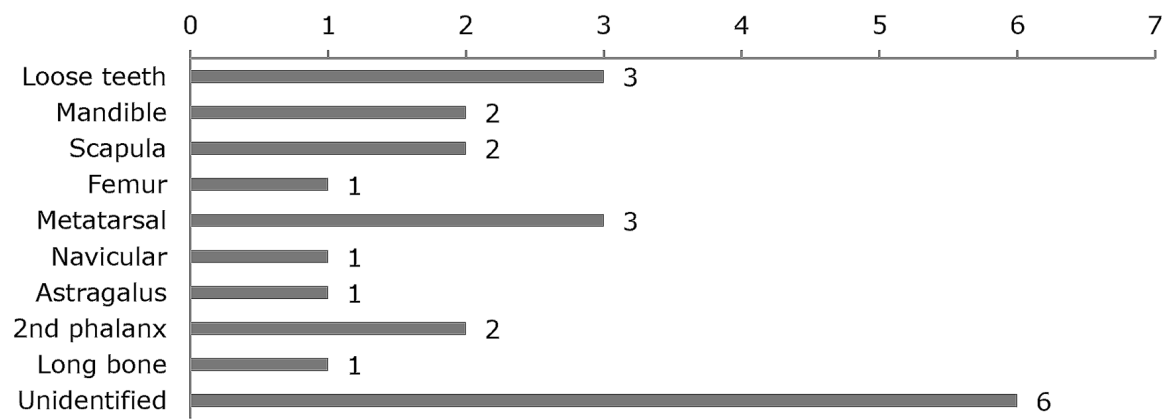


Figure 23.32: NISP values of wild boar (Copyright Star Carr Project, CC BY-NC 4.0).

Element	NISP	Age range
First incisor	1	14–16 months
Femur (prox.) / (dist) epiphyses	1	36–42 months

Table 23.9: Wild boar maximum age ranges when eruption and fusion are complete. Tooth development based on Briederman (1965) and Matschke (1967), and bone fusion based on Lesbre (1897–8).

to be only partially developed and is likely to have been an unerupted tooth. The femur is only represented by the midshaft, which is gracile and small and missing both the proximal and distal epiphyses. The lack of any evidence for fusion having begun on the femur suggests that this element belonged to an animal less than 3.5 years of age: the small size cannot be explained by sexual dimorphism as bone development is incomplete. However, it should be noted that due to the small amount of information available about the timings of epiphyseal fusion in pigs and wild boar, estimations of age from this method should be treated with caution.

The other wild boar remains all appear to be fully developed and the scapulae and metapodials fully fused (with the fusion lines obliterated). This corresponds to the two specimens which Legge and Rowley-Conwy (1988, 44) noted as being from dentally mature animals. Overall, there appears to be both young adult and adult wild boars in the assemblage. It was not possible to sex the majority of the remains; however, the presence of a partial mandible with large canines (which was found amongst the timbers of the western platform; Chapter 7) would suggest that the remains of at least one adult male are present at the site.

Modification

There is no evidence for modification by carnivores on these specimens. In Clark's area, of the four specimens found, three show evidence of human modification. The mandible has been broken using a percussion break, beneath the tooth row, for marrow extraction or to remove the canine. The distal end of the second phalanx has been removed by a percussion break for marrow extraction. The scapula exhibits ephemeral cut marks around the posterior aspect of the glenoid, which is likely to be the result of cutting through ligaments to separate the forelimb (a major meat-bearing limb) from the carcass. From around the eastern platform there are two third and one fourth metatarsal which exhibit percussion breaks at the distal ends; however, these are small elements with very little marrow.

MNI

The most dominant elements within the assemblage are metatarsals and loose teeth. Based on metatarsals an MNI of one is calculated; however, taking into account the age profiles provided by the incisor and femur, an MNI of two can be posited: a juvenile piglet of under a year and a fully developed adult. As the juvenile incisor was found on the dryland around the eastern structure, this is less likely to correspond with the juvenile femur from the detrital wood scatter, which could increase the MNI to three. However, as the dating of the dryland has a degree of uncertainty to it, the MNI should remain at two. If the MNI results are added to Legge and Rowley-Conwy's (1988, 9) MNI of four (from the left mandibles), the presence of a juvenile increases the overall MNI for the site to five.

Elk

Overview

Within the waterlogged areas, the elk remains were generally spread across most of the trench, with the majority located in Clark's area (Figure 23.33). Elk was identified in the original assemblage (Clark 1954, 76–79) and re-assigned by Legge and Rowley-Conwy (1988) who noted 247 fragments and an MNI of 12. In comparison, only 34 specimens have been identified from across the site during the recent excavations (including six from Clark's backfill).

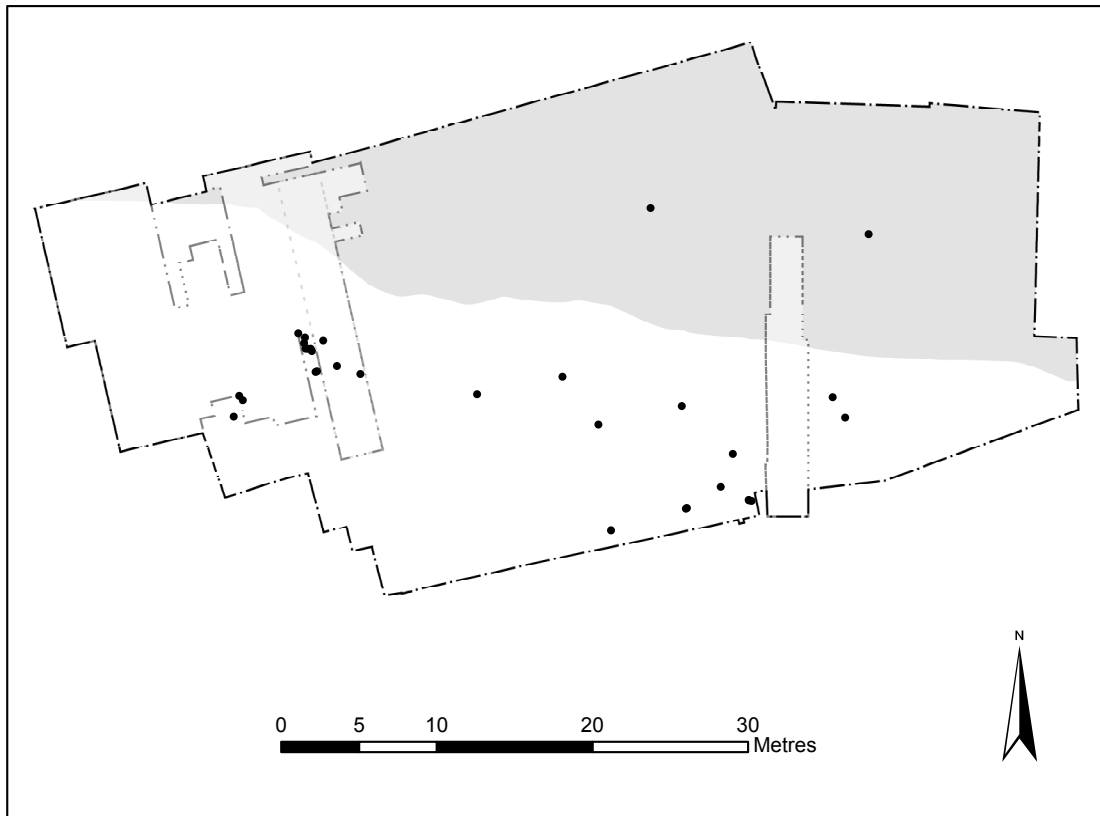


Figure 23.33: Spatial plot of elk specimens (Copyright Star Carr Project, CC BY-NC 4.0).

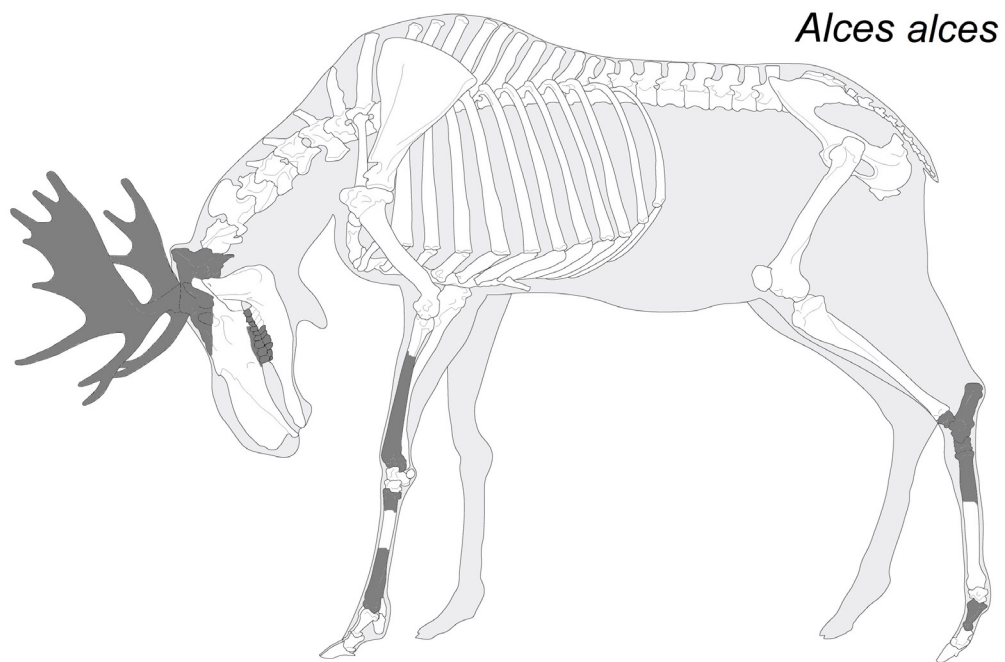


Figure 23.34: Element representation of elk (Copyright Archeozoo.org/M. Coutureau and J. Treuillot 2013. Adapted by Becky Knight).

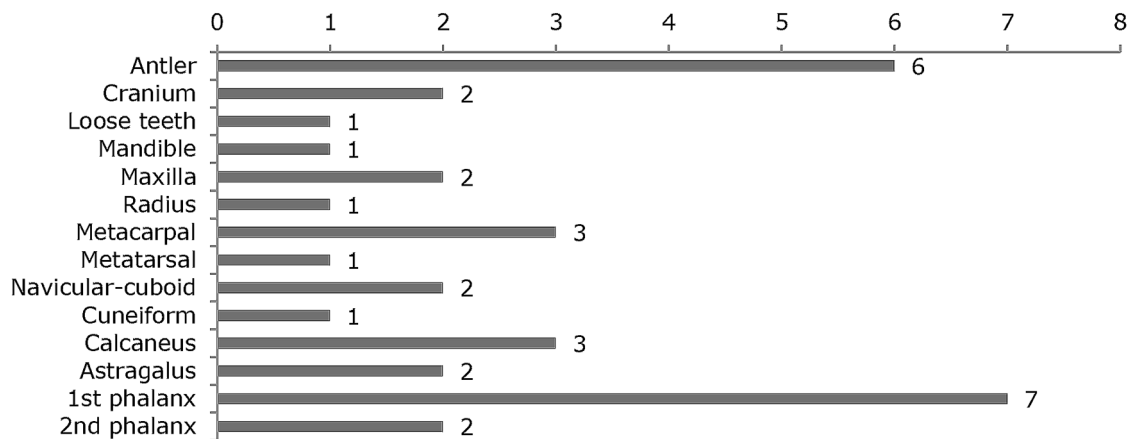


Figure 23.35: NISP for elk (Copyright Star Carr Project, CC BY-NC 4.0).

Elements

A range of elements are represented; however, the majority belong either to the skull or are leg bones (Figure 23.34; Figure 23.35). There is a distinct lack of long bones and also elements associated with the torso (such as vertebrae, ribs and pelvis), although as noted previously, most of the ribs found at the site have not been assigned to species. This pattern of element representation is different to the patterning observed by Legge and Rowley-Conwy (1988, table 1B) where most elements of the skeleton were found; however, their sample size was much larger.

Age and sex

In terms of the age profile for the elk remains, only one element possesses developmental information. The specimen, a calcaneal tuberosity epiphysis, is unfused and missing on the calcaneus of one elk specimen. According to Purdue (1983) this element fuses between the ages of 1.6–2.4 years, and so this gives a maximum age of 2.4 years for this animal. Legge and Rowley-Conwy (1988, 44) also noted that of the 10 elk jaws found, nine retained third molars, and in seven cases these were at a relatively early wear stage suggesting a high proportion of young adults in the cull.

It was not possible to sex the remains. Legge and Rowley-Conwy (1988, 63) also found this because the animals, in early dental maturity, exhibit little dimorphism. However, the inclusion of elk antler within this assemblage identifies that male animals are present.

Modifications

There are no signs of carnivore modification with these specimens. In total 16 specimens have evidence of human modification. Within the detrital wood scatter an astragalus exhibits a small round hole suggestive of a possible projectile puncture wound. In addition, a palmate portion, one antler fragment and metacarpal have been humanly modified but only the metacarpal is modified by both a percussion break and spiral fracture, likely for marrow extraction.

A piece of antler found by the western platform exhibits evidence of groove-and-splinter working. There was also one specimen of elk found above the eastern platform and this is a partial metatarsal; the distal half of the

element has been removed by a percussion break and there are clear radiating fractures from the percussion point. This would have been carried out for marrow extraction.

In Clark's area, the proximal end of a radius and the proximal end of a metacarpal have been removed by a mixture of percussion breaks and spiral fractures for marrow extraction. There are also four first phalanges, one second phalanx and a navicular-cuboid that have been broken open by spiral fractures and percussion breaks for marrow extraction: it is interesting to note that 'although there is relatively little marrow within these, what is present is tasty' (Speth 2010, 34). One of the first phalanges also has cut marks just above the break edge on the posterior aspect of the midshaft which probably occurred during skinning.

In Clark's backfill, the proximal end of a first phalanx and the proximal end of a second phalanx has been removed by percussion breaks and spiral fractures for marrow extraction. The first phalanx also exhibits cut marks just below the break edge which probably occurred during skinning.

Seasonality

A neonatal left maxilla of an elk was noted by Noe-Nygaard (1975), coming from an animal no more than a few weeks old and using modern analogy thought to represent a summer death. Legge and Rowley-Conwy (1988, 31–32) found that one mandible with tooth wear gave an indication of season and was probably killed later in the year, in September or October, though if the animal had been late born it would have been killed in November or December. An elk skull with shed antlers was originally taken to indicate midwinter occupation (Fraser and King 1954), but this was reinterpreted by Legge and Rowley-Conwy (1988, 31) who stated that the elk could have been killed anytime between December to late April/May. No seasonality of death could be ascertained from the faunal remains recovered from the recent excavations.

MNI

Although the most dominant element according to NISP was the first phalanx, it is very difficult to side these elements and so they cannot be used for calculations for MNI. Antler is also not used for calculations of MNI and so the calcanei have been used. Three specimens were found: two left and one right. Two specimens belong to adult animals, one left and one right element, and these were found in the detrital wood scatter. The final calcaneus (young adult) was found within Clark's area and is represented by a partial element with an unfused distal epiphysis. These data suggest two individuals. Legge and Rowley-Conwy (1988, 9) provided an MNI of 12 (left astragali); however, as elk has been found in the detrital wood scatter, which is dated much earlier compared to Clark's area (Figure 17.20), the MNI for the site can be raised to 13.

Red deer

Overview

Red deer was identified in the original assemblage (Clark 1954, 79–86) and re-examined by Legge and Rowley-Conwy (1988), who found 541 fragments and calculated an MNI of 26 (based on the left mandible). A total of 535 specimens of red deer were identified in the recent assemblage, including 73 specimens that were found within Clark's backfill. Red deer specimens were found across the entirety of the site (Figure 23.36). The largest concentrations are within the detrital wood scatter and within Clark's area. On the dryland there are several smaller concentrations of remains: around the eastern structure and around the western structure, and along the shore edge.

Elements

Red deer is the most dominant species from Star Carr and is represented by the most diverse range of elements (Figures 23.37 and 23.38), as was identified by Legge and Rowley-Conwy (1988, table 1A). Antler is the most

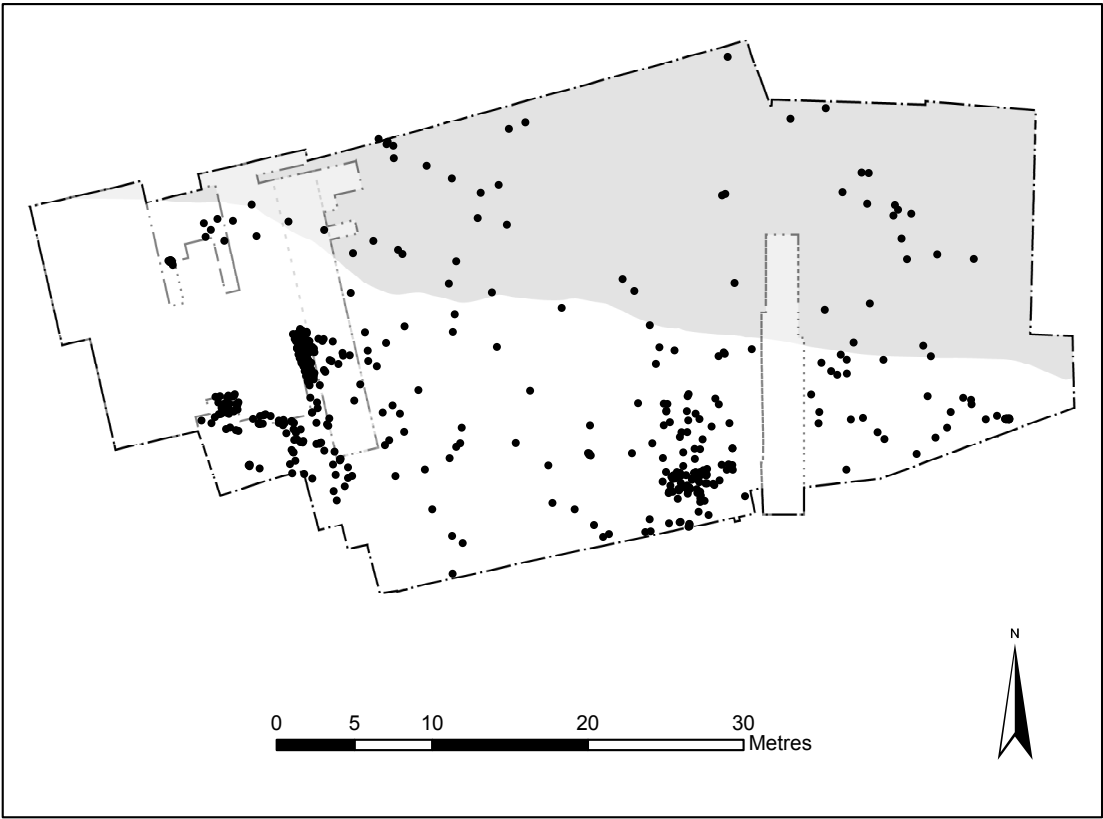


Figure 23.36: Spatial plot for red deer (Copyright Star Carr Project, CC BY-NC 4.0).

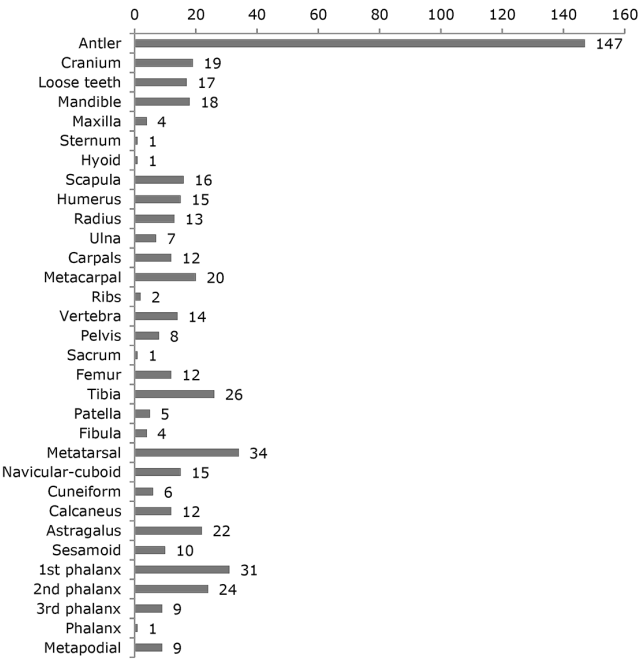


Figure 23.37: NISP values for red deer (including backfill and flotation finds) (Copyright Star Carr Project, CC BY-NC 4.0).

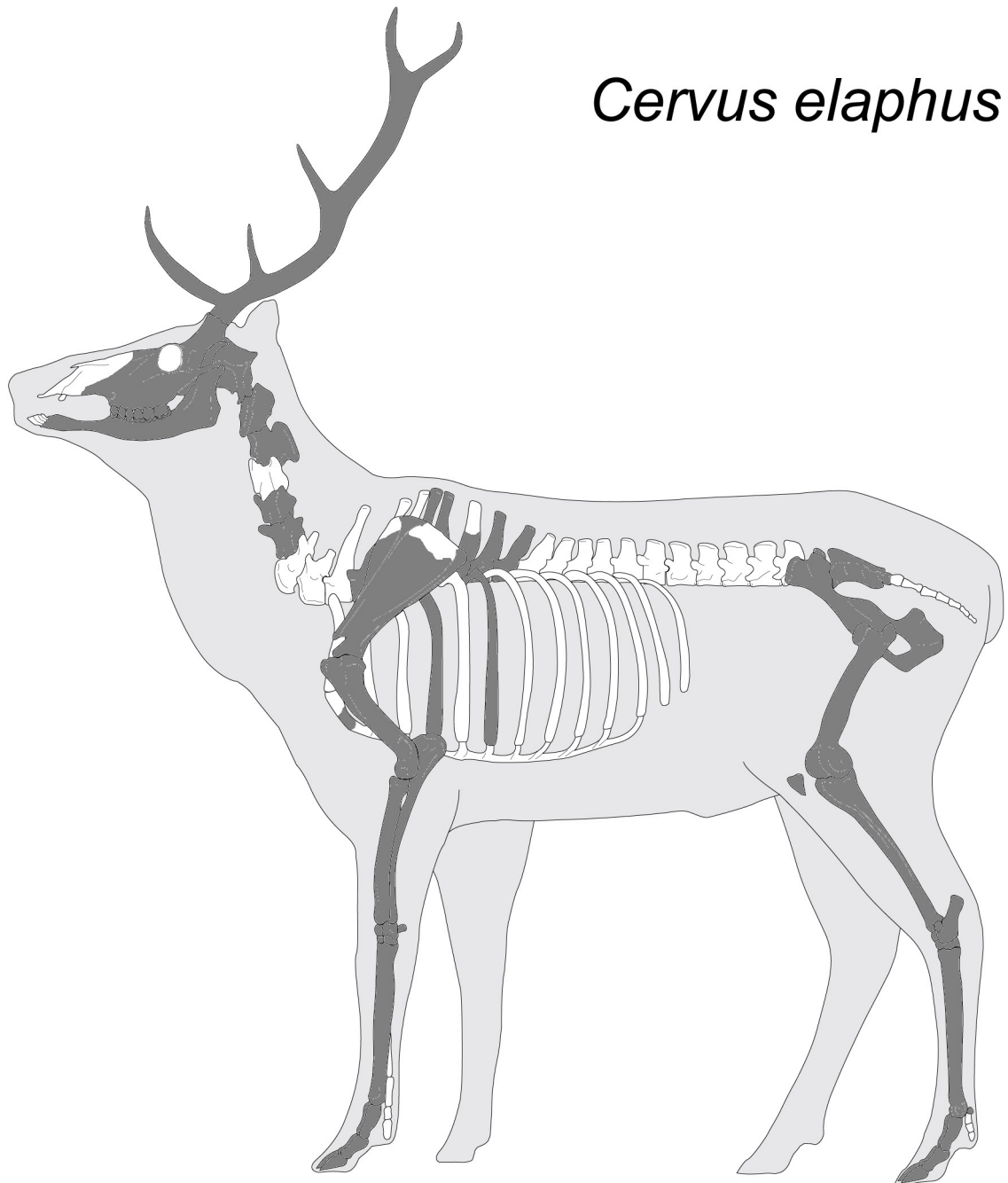


Figure 23.38: Element representation of red deer (Copyright Archeozoo.org/J.-G. Ferrié 2004. Adapted by Becky Knight).

dominant element (NISP=147), with the most dominant skeletal element being metatarsals (NISP=34). Elements that are only represented by a small number of specimens (five or less) are the maxilla, sternum, hyoid, rib, sacrum, patella, fibula and cuneiform. Ribs appear to be lacking but they are difficult to identify to species, even when having been analysed using ZooMS, and so they may have ended up in categories such as 'cervid species' or 'large mammal species'.

Age and sex

Of the 22 mandibles that Legge and Rowley-Conwy (1988, 42–44) used for ageing, the age profile spanned 2–9 years with 15 (60%) falling into the three to five year classes. In terms of attempting to calculate the age profile for the recently excavated red deer remains, nine bone specimens were used. One of the mandibles and the ulna come from the detrital wood scatter, and the rest are from Clark's area. There are a range of ages represented suggesting there were at least five different individuals represented across the two areas.

In the detrital wood scatter, two specimens provide age data (Table 23.10). The first individual is represented by a partial mandible with mixed dentition: deciduous third and fourth premolars and a permanent adult first molar. Using data generated by Severinghaus (1949) for white-tailed deer, this mandible closely matches two mandibles that were aged between three to four months. In addition, a partial ulna with a missing and unfused proximal epiphysis was found 0.4 m from the mandible but has a different age: this is estimated to be no older than 26–42 months/2.2–3.5 years.

In Clark's area seven specimens exhibit age data (Table 23.10). Two mandibles show a similar age: a partial left mandible with a partially erupted permanent third molar which match mandibles of the age 11–12 months in Severinghaus' (1949) study, and a partial right mandible with deciduous second, third and fourth premolars and permanent adult first and second molars which match mandibles of the age 12–13 months. These were found c. 5 m apart and may or may not be from the same animal. A further partial mandible containing a deciduous fourth premolar with the permanent fourth premolar partially erupted out of the crypt, a permanent first and second molar and a partially erupted permanent third molar match mandibles of the age of 18–19 months (1.6–1.7 years of age). There are three specimens with an age maximum of 26–29 months/2.2–2.5 years: two metacarpals with unfused distal epiphyses and a partial calcaneus with an unfused proximal epiphysis. One further specimen, a distal tibia with a partially fused distal epiphysis, has a maximum age of 26–42 months/2.2–3.5 years.

In terms of sex assessment, Legge and Rowley-Conwy (1988, 58) used measurements from animals of known age and sex from the Isle of Rhum to establish sex assessment for the Star Carr red deer. They concluded that there was a roughly even sex ratio among the Star Carr red deer, contrary to previous interpretations that relied heavily on the antler data. They also noted that the common age class was three year olds (n=10); however, most of the antler has come from animals of four years old and above (Fraser and King 1954, 80) and so much of the antler must have been brought to site (Legge and Rowley-Conwy 1988, 58).

For the recently excavated assemblage it was not possible to measure the specimens with any accuracy due to the deterioration and warping and thus the datasets could not be compared. However, at least two females can be identified within the assemblage from the cranial remains. Both appear to be adult individuals in terms of size, robustness and development, and so it is unlikely they represent young male animals.

Element	NISP	Age range	Seasonality
Detrital wood scatter			
Mandible (dp3/4, M1)	1	3–4 months	Aug/Sept = mid-late summer
Ulna (proximal)	1	26–42 months (2.2–3.5yrs)	
Clark's area			
Mandible (partial eruption M3)	1	11–12 months	April/May = mid-summer
Mandible (dp2,3,4, M1, M2)	1	12–13 months (1–1.1yrs)	May/June/July = mid-summer
Mandible (dp4, partial eruption P4, M1, M2, partial eruption M3)	1	18–19 months (1.6–1.7yrs)	Nov/Dec = mid-winter
Metacarpal (distal)	2	26–29 months (2.2–2.5yrs)	-
Calcaneus (proximal)	1	26–29 months (2.2–2.5yrs)	-
Tibia (proximal—partial fusion)	1	26–42 months (2.2–3.5yrs)	-

Table 23.10: Age estimation of the Star Carr red deer remains using epiphyseal fusion after Purdue (1983) and tooth eruption after Severinghaus (1949).

Seasonality

The seasonality of the red deer has been much debated. It was originally proposed by Clark (1954, 1962) that people were based at Star Carr in the winter, following the red deer as they migrated to the North York Moors in the summer. It has since been suggested that red deer would not have migrated in this area (Legge and Rowley-Conwy 1988, 38). There is evidence from the work of Legge and Rowley-Conwy (1988, 38) that the young deer were killed in the late spring and summer and they state 'it is reasonable to assume that the adults were too'. More recently, Carter (1998) carried out analysis of the red deer mandibular ramus of red deer from the site and showed that one red deer younger sub-adult would have been killed in early winter, and another in the winter or spring. A further pairing of rami may be a late summer kill or an autumn/winter death.

From the recently excavated remains, using the age estimations of the younger individuals, it is possible to provide further seasonality data. This can only be based on the data gathered from dental development as this tends to be a more reliable age indicator (Purdue 1983). Red deer rut and begin mating around September/October each year, and the gestation period typically has a duration of around eight months with animals being born in May/June (Dobronika 1988). From this, three mandibles suggest a summer death (one in the detrital wood scatter and two in Clark's area), but a fourth suggests that it was killed in the winter (from Clark's area) (Table 23.10).

Modifications

There are four red deer elements (scapula, ulna, navicular-cuboid and metatarsal) which come from within the detrital wood scatter which exhibit evidence of carnivore modification in the form of uneven breakage with associated tooth marks and tooth scores. From Clark's area, there are seven specimens with evidence of modification by carnivores (a scapula, axis vertebra, tibia, astragalus, cuneiform, metatarsal and an antler frontlet), with uneven breakage associated with tooth impressions and tooth scores. In Clark's backfill three specimens (femur, calcaneus, metatarsal) exhibit uneven breakage, tooth scores and tooth impressions. Within test pit SC20 one tibia specimen has been broken, and exhibits tooth scores and tooth impressions.

Overall, 186 specimens (not including antler) from across the site have been modified by humans, in some cases exhibiting a number of different types of evidence. In terms of percussion breaks and spiral fractures, for the extraction of marrow, there are 10 specimens from the detrital scatter, 21 in the wetlands, 93 in Clark's area, eight on the dryland, 20 in the backfill and four in test-pits. This processing has been carried out mainly on long bones (98) but also on phalanges (37), mandibles (13), pelves (3) and cuneiform (1). Although most of this has probably been carried out for marrow, it is unlikely that the percussion breaks on the pelves would have been for this purpose. In terms of longitudinal split bone (n=24) for the production of tools, there is one from the detrital wood scatter, seven from the wetland, 10 from Clark's area; two from the dryland, and four from the backfill. Of these, 23 are long bones, of which 18 are metapodials, and one is a phalanx. Finally, cut marks are also evident: two from the detrital wood scatter, 27 from Clark's area, and three from the backfill. However, it should be noted that most of the cut mark evidence is exhibited on ribs categorised as cervids or large and medium mammals.

Palaeopathology

An interesting pathology was noted on a red deer skull with heavy remodelling to the cortical bone surface of the frontal and parietal bones (Figures 23.39 and 23.40). The cortical bone surface on the frontal bone undulates and clearly still had active bone remodelling occurring. It appears that the cause of this may have been the tearing of muscles that run across the surface of the cranium which help to support the weight of the head and antlers. The likelihood is this will have occurred during the rut. The porous nature of the bone surface suggests that there may have also been some infection associated with this damage. There is also some remodelling of the skull around the parietals with deep grooves in the skull, again associated with the muscles supporting the antlers, suggesting that this individual may have been an older individual with particularly large and heavy antlers, producing the need for highly developed muscles and anchor points on the cranium for these muscles.



Figure 23.39: Red deer cranium <116020> with active remodelling and infection of the cortical bone across the entirety of the frontal bone (Copyright Neil Gevaux, CC BY-NC 4.0).



Figure 23.40: Red deer cranium <116020> with remodelling of the skull and pronounced muscle attachments on the parietals (Copyright Neil Gevaux, CC BY-NC 4.0).

MNI

The element with the highest NISP value is antler; however, this is not used for calculations of MNI (Legge and Rowley-Conwy 1988, 9) and so the second most abundant element is the metatarsal, NISP=31 (not including examples in the backfill). Of these, nine were sided to the left and 13 to the right, whilst the other nine could not be sided. It should be noted that these are fragmentary remains and cannot be used directly for MNI counts: the specimens were examined to find repeating ends in order to calculate the MNI.

Nine specimens were found in the area of the detrital wood scatter, which has been dated as one of the earliest activity areas of the site and of these there are three repeating right distal ends of the metatarsal establishing an MNI of three. The final 22 specimens were found across both the dryland and within the waterlogged deposits. As there are six repeating proximal ends of the metatarsals, the MNI here is six individuals. Taking into consideration the distribution of these elements across the site, the total MNI for red deer is nine individuals.

Sample No.	Element	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	C:N	Collagen yield
108590	Thoracic vertebra	-22.3 ± 0.1	3.9 ± 0.2	3.3	4.0%
108594	Radius	-22.3 ± 0.1	3.8 ± 0.2	3.3	11.1%
108589	Second phalanx	-22.3 ± 0.1	4.3 ± 0.2	3.3	5.5%
103625	Skull (frontlet)	-21.4 ± 0.1	3.5 ± 0.2	3.3	2.5%

Table 23.11: Carbon and nitrogen stable isotope data for the red deer samples analysed in this study.

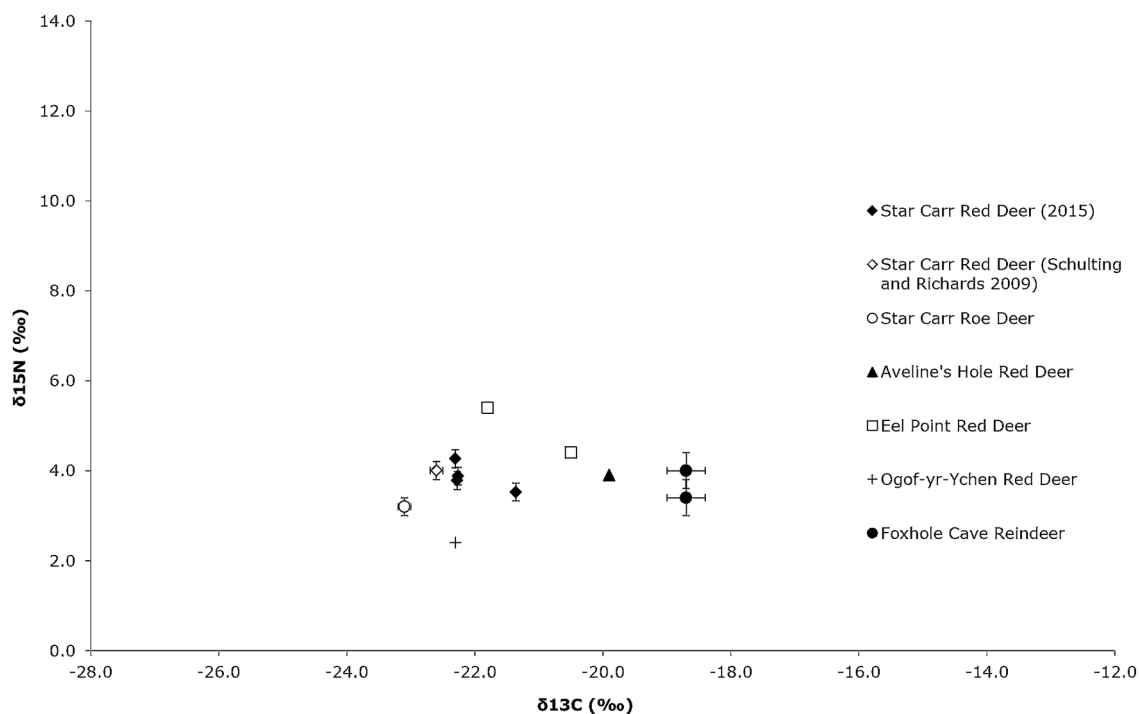


Figure 23.41: Red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and reindeer (*Rangifer tarandus*) isotope data from several British Mesolithic sites (data compiled from Bowen et al. 2000; Schulting 2005; Schulting and Richards 2002b; 2009; Schulting et al. 2013; this study) (Copyright Star Carr Project, CC BY-NC 4.0).

During their reanalysis, Legge and Rowley-Conwy used the mandible to calculate MNI, and identified 26 left specimens. During the most recent excavations within Clark's area, a total of four left mandibles were identified. By combining this data, the total MNI for red deer from this area of the site is 30 individuals.

Isotope data

The patterning of semi-articulated red deer bones in the detrital wood scatter, in close proximity to an antler frontlet (see Chapter 7), posed the question of whether these remains were derived from the same animal. As a way of addressing this question, isotopic analysis was undertaken on three of the bones and the frontlet. The four red deer samples yielded sufficient amounts of collagen of suitable quality for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotope analysis (Table 23.11), and exhibit isotope values comparable to those previously reported from the site (Schulting and Richards 2009; Figure 23.41).

Interestingly, no significant difference was seen between the isotopic values of the disarticulated deer remains and antler frontlet sampled. This therefore suggests that the deer utilised for frontlets were not (isotopically) distinct from those utilised for other purposes (e.g. as a food or raw-material resource). Furthermore, the isotopic values obtained from the four skeletal elements fall within the error expected by replicate analysis of a single individual (Pestle et al. 2014).

The isotopic values generated from the newly excavated red deer remains are also directly comparable to previous deer values obtained from Star Carr, and can also be seen to be broadly comparable to data obtained from deer at other British Mesolithic sites (Figure 23.41). However, whilst similar in terms of $\delta^{15}\text{N}$ values, the Star Carr deer appear to be slightly more depleted in $\delta^{13}\text{C}$ than deer at other British Mesolithic sites (Figure 23.41).

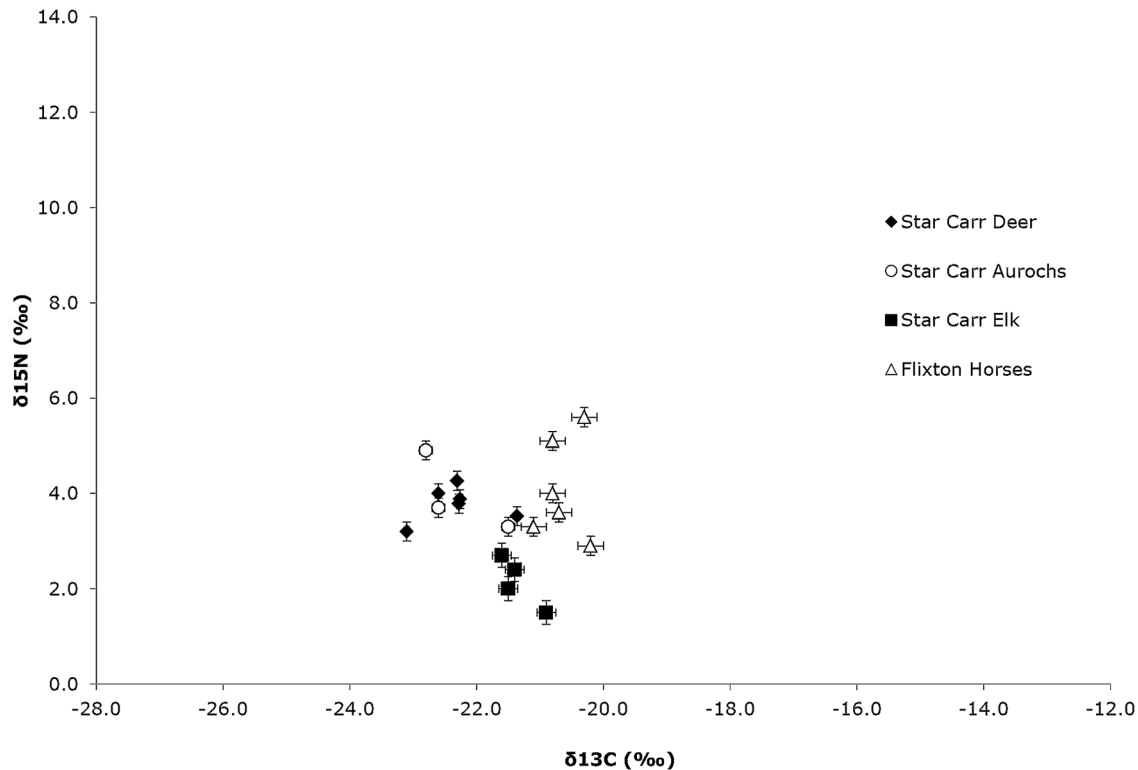


Figure 23.42: Red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), aurochs (*Bos primigenius*), elk (*Alces alces*) and wild horse (*Equus ferus*) isotope data from Star Carr and Flixton Island 2 (data compiled from Stevens and Hedges 2004; Schulting and Richards 2009; this study) (Copyright Star Carr Project, CC BY-NC 4.0).

More depleted $\delta^{13}\text{C}$ values in fauna have previously been suggested to represent a diet derived from dense woodlands, rather than from more open habitats, representing a 'canopy effect' (Van der Merwe and Medina 1991; Noe-Nygaard et al. 2005; Drucker et al. 2008). The hypothesis that deer species at Star Carr may have favoured more closed, forested environments has also previously been proposed by Schulting and Richards (2009); however, a study by Stevens et al. (2006) on red deer has shown that a $\delta^{13}\text{C}$ canopy effect is not always present in fauna inhabiting different environments, and as such should be treated with caution.

When we compare the Star Carr red deer with the other terrestrial herbivores from the site, and the horses sampled from the nearby Long Blade site at Flixton Island Site 2, there is somewhat of a division between the deer and the other terrestrial species, particularly elk and horses (Figure 23.42). The deer appear to be consistently more depleted in $\delta^{13}\text{C}$, which may indicate the consumption of different plant resources between the species, grazing in slightly different environments or occupying different ecological niches. This is not surprising given that site 2 on Flixton Island is earlier in date and would have had a different environment to that at Star Carr (Blockley et al. 2018).

Roe deer

Overview

Roe deer were identified in the original assemblage (Clark 1954, 79–86) and re-examined by Legge and Rowley-Conwy (1988, 9), who identified 103 fragments and estimated an MNI of 17, based on right mandibles. A total of 88 specimens were identified from the recent excavations, spread across the site, with a concentration

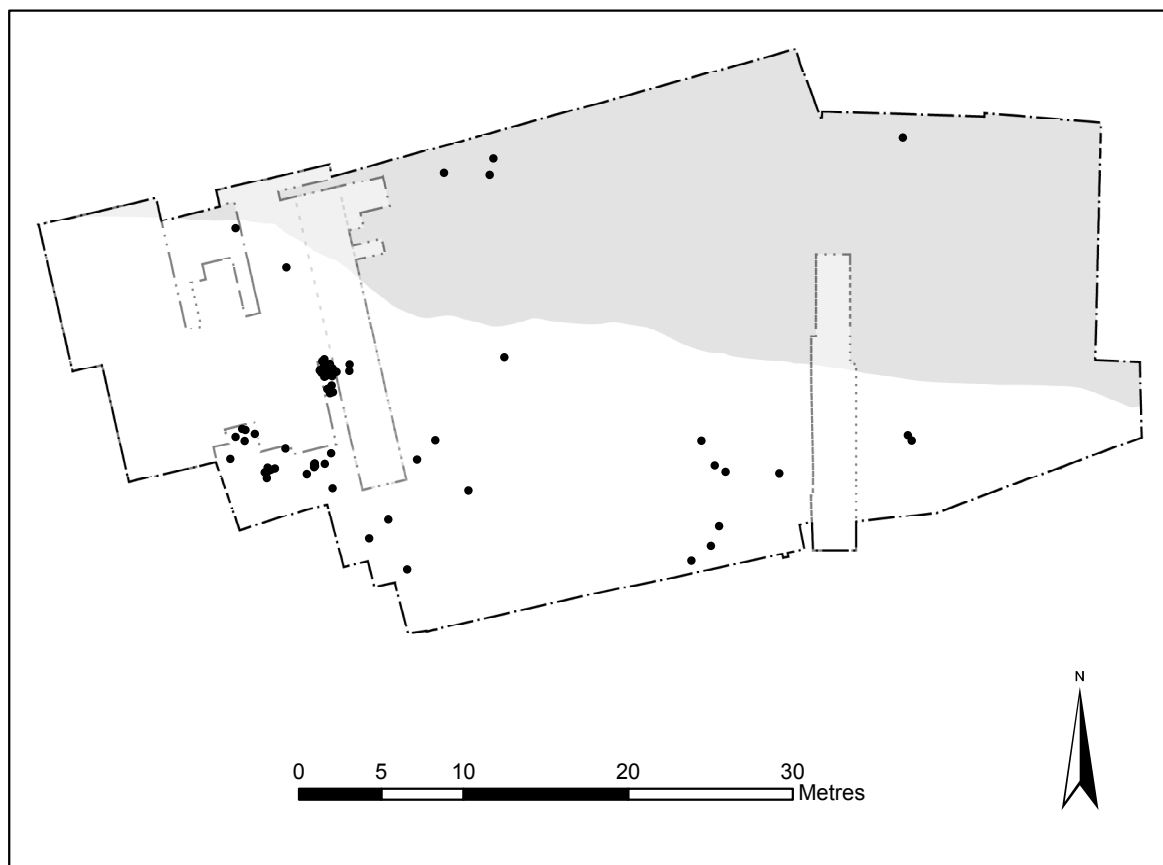


Figure 23.43: Spatial plot of roe deer (Copyright Star Carr Project, CC BY-NC 4.0).

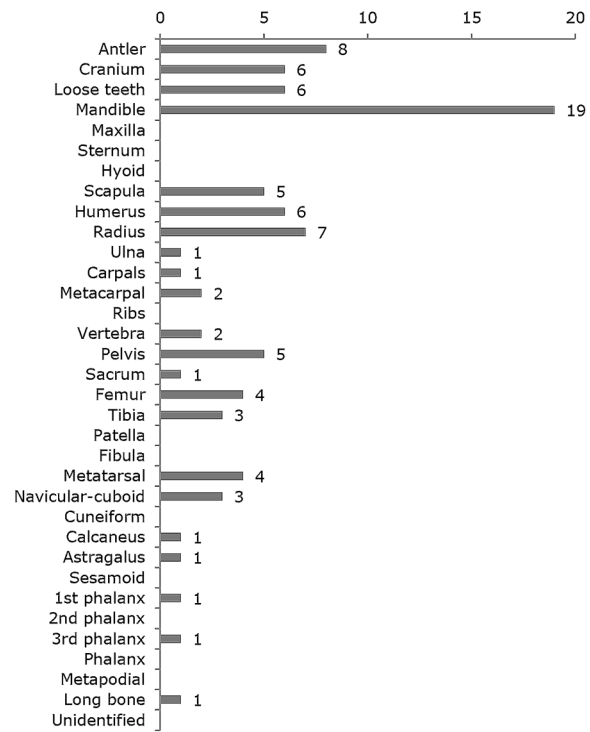


Figure 23.44: NISP for the roe deer in the assemblage (Copyright Star Carr Project, CC BY-NC 4.0).

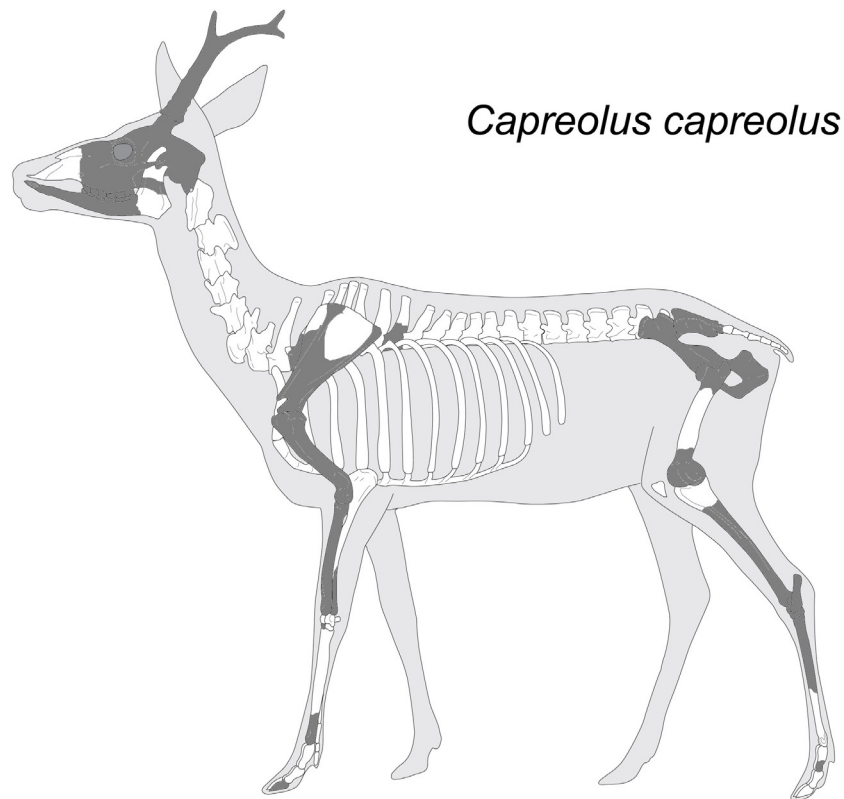


Figure 23.45: Element representation for roe deer (Copyright Archeozoo.org/J.-G. Ferrié 2005. Adapted by Becky Knight).

of 52 in Clark's area, eight in the detrital wood scatter, eight in the wetland, four in the dryland and 16 from Clark's backfill (Figure 23.43). A range of elements are represented, with the most common being mandibles.

Elements

Although the NISP of the roe deer from the site suggests there are no maxillae represented, one was still attached to a roe deer skull and represents the only example in the assemblage (Figures 23.44 and 23.45). Underrepresented areas of the body include elements from the torso (such as vertebrae and ribs) and also smaller elements such as carpals, tarsals, phalanges, patellae and fibulae. These elements are smaller in size and could have easily moved by taphonomic processes such as water, sediment movement or bioturbation. They are also less robust elements and so may degrade and disappear more quickly than some of the more robust elements. Equally, some of these elements such as the foot bones may have been left on hides. However, this patterning of element representation is similar to that found by Legge and Rowley-Conwy (1988, table 1D), particularly in terms of the dominance of mandibles and the lack of maxillae. Ribs may appear to be lacking, but they are difficult to identify to species and may have been assigned as medium mammals.

Age and sex

In this study, mandibles are used to calculate the age profiles of the roe deer. However, eruption is of very little use for aging older roe deer as all of the teeth tend to erupt within the first year (Aitken 1975); therefore, this method can only identify individuals less than a year in age. Also, all of the mandibles containing permanent dentition appear to have little to no occlusal wear. Only one specimen has the mixed dentition of part deciduous, part permanent teeth. The surviving teeth are deciduous third and fourth premolars and permanent first and second molars. This suggests that one individual was less than one year in age based on tooth development of roe deer by Severinghaus (1949).

Legge and Rowley-Conwy (1988, 40) identified a total of 21 roe deer mandibles that could be aged using tooth development criteria by Aitken (1975). They estimated that 45% of the animals (10 mandibles) represented animals aged approximately one year of age, whilst 19% were aged to two years. Using these methods it was not possible to identify, with any accuracy, animals from older age categories. Carter (1997), used radiographs to further investigate this question and found that seven mandibular rami from Star Carr roe deer could be aged to approximately 10–11 months. It was noted by Legge and Rowley-Conwy (1988, 42) that roe deer females tend to give birth from two years of age, and often have twins, meaning that the natural population has a high proportion of young.

In terms of sex assessment, Legge and Rowley-Conwy (1988, 59) collected measurements from the scapula and distal humerus, the two most dominant elements, in order to examine the extent of sexual dimorphism using carcass weights from Prior (1968). However, there was little division between the measurements and any differences emphasised by the measurements were coincidental and not related to sexual dimorphism. Due to the fragmentary or modified nature of the majority of the roe deer remains from the recent excavations, there were few complete elements from which measurements could be obtained. However, as Legge and Rowley-Conwy (1988) noted, the difference between the sexes for roe deer is minimal and so the lack of metrics is inconsequential.

Modification

Three specimens have evidence of carnivore modifications: a pelvis from the detrital wood scatter, a scapula from Clark's area and a femur from Clark's backfill. These show a mixture of uneven breakage associated with tooth impressions and tooth scores.

A total of 44 bone specimens exhibit evidence of human modification: two metatarsals and a mandible in the detrital wood scatter; 11 long bones, 10 mandibles, one scapula and one first phalanx in Clark's area; one humerus, one radius, one femur and one tibia in the wetland; and four mandibles, one humerus, one radius, one femur and one metatarsal in Clark's backfill. The evidence consists of a combination of percussion breaks and spiral fractures created during the process of marrow extraction. In terms of longitudinally split bones, thought to be created in the process of tool manufacture: one metacarpal and one metatarsal were found from

Clark's area, a tibia was found in the wetland and a metatarsal was recovered from Clark's backfill. Only three specimens, two crania and one mandible, exhibit cut marks from skinning, and they are all from Clark's area. In addition, a radius from the dryland was calcined. This specimen was found in the same area outside the western structure as the calcined wild cat phalanges.

Seasonality

The seasonality data from Legge and Rowley-Conwy (1988, 22–30) points to a late spring and summer kill from dental development of 13 roe deer mandibles. In addition, 63 unshed antlers were used with caution to suggest kills between April and November. However, Carter (1997) examined 12 mandibular rami using radiography and concluded that these animals were being killed in the late winter and early spring. No further analysis for seasonality has been undertaken from the recently excavated assemblage.

MNI

Mandibles are used in the calculations of MNI for roe deer. Seven specimens can be sided as right, five sided as left and one cannot be sided. Twelve of the mandibles contain teeth. The majority of the elements exhibit permanent adult dentition apart from one which has a mixture of deciduous and permanent teeth. Using these data, an MNI of six is established (five adults and one young adult) as it is possible to refit two of the right mandibles to one specimen. Two of the mandibles were found above the detrital wood scatter and the remaining four were found in Clark's area. Legge and Rowley-Conwy (1988, 9) had an MNI of 17, also based on right mandibles. By adding together our two groups of mandibles, the total roe deer MNI for the site is 23 individuals.

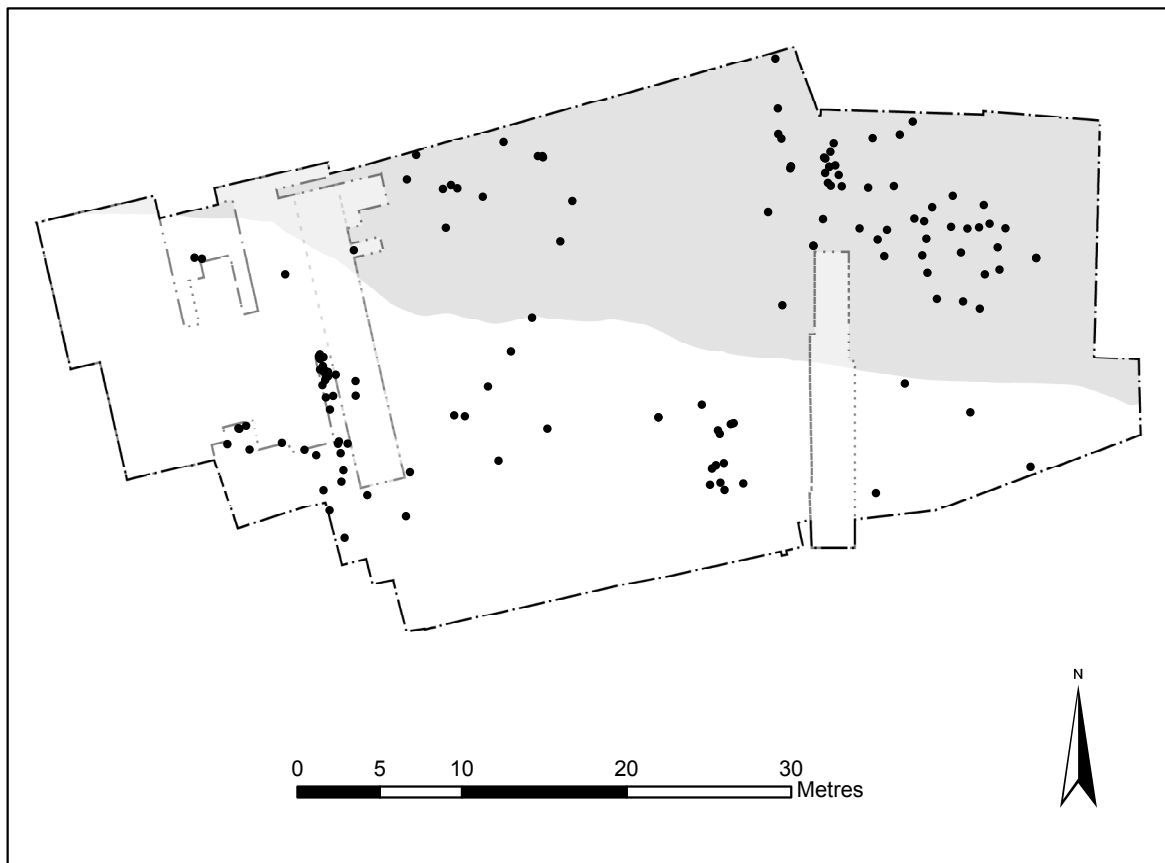


Figure 23.46: Spatial plot of aurochs.

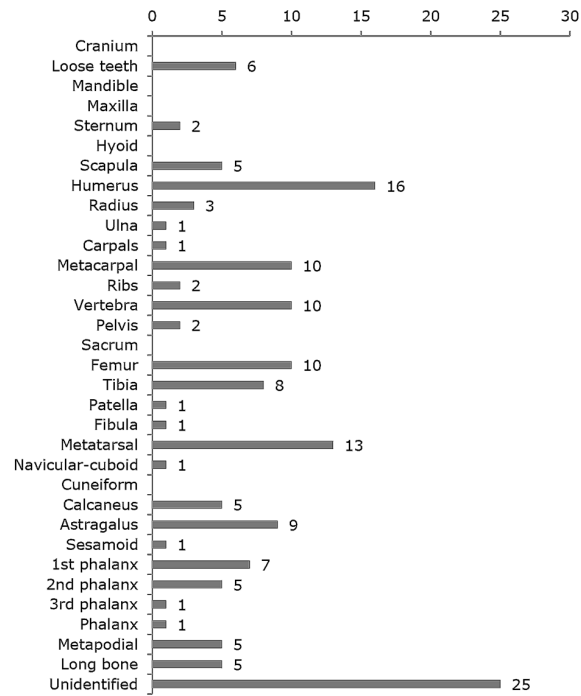


Figure 23.47: NISP for aurochs (Copyright Star Carr Project, CC BY-NC 4.0).

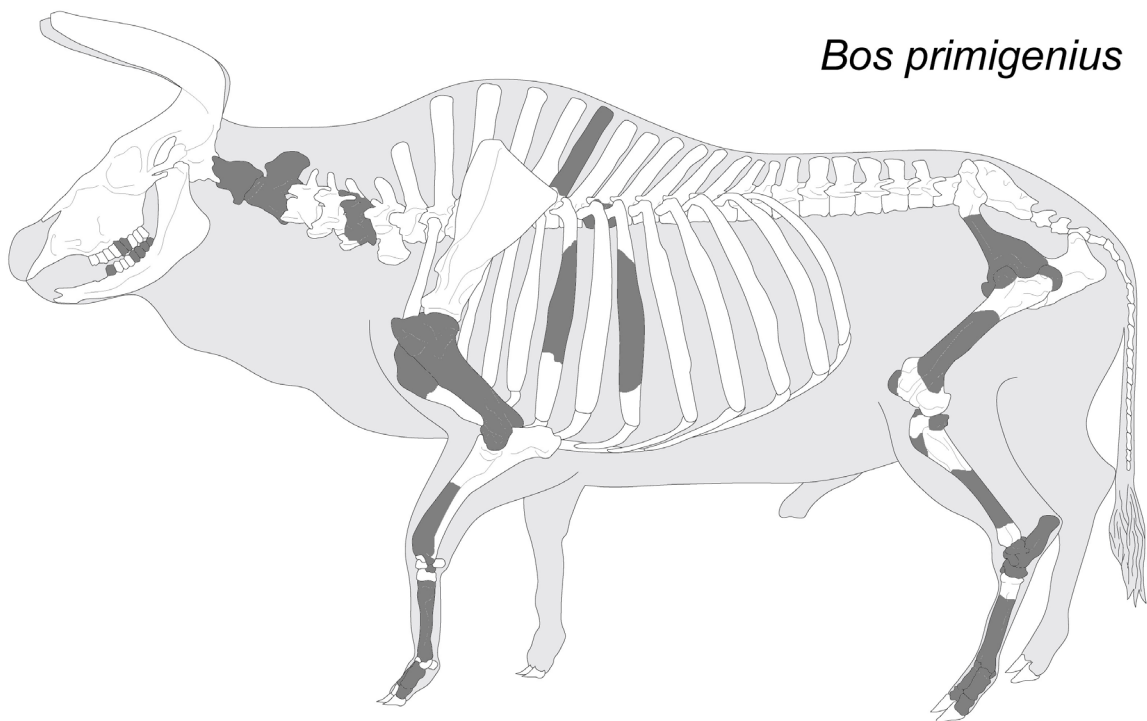


Figure 23.48: Element representation of aurochs (Copyright Archeozoo.org/M. Coutureau 2009. Adapted by Becky Knight).

Aurochs

Overview

Aurochs bones were identified in the original assemblage (Clark 1954, 79–86) and re-examined by Legge and Rowley-Conwy (1988, 9) who identified 174 fragments and provided an MNI of 16. A total of 156 aurochs specimens have been identified from the recent excavations (Figure 23.46) (Copyright Star Carr Project, CC BY-NC 4.0).

Elements

A wide range of elements are represented, with the most common being the humerus (Figures 23.47 and 23.48). Some elements are missing from the assemblage: cranial elements, hyoid, mandible, maxilla, ulna, sacrum and cuneiforms. However, these were found in the original excavations (Legge and Rowley-Conwy 1988, table 1C). There are also 25 fragments from the dryland that have been identified as aurochs using ZooMS but cannot be identified to element due to poor preservation or small size.

Age and sex

Legge and Rowley-Conwy (1988, 44) state that a single aurochs mandible with permanent teeth in wear suggest a relatively old individual. From the recently excavated assemblage, the majority of elements are too incomplete or too fragmentary to retain the developmental information required to gauge the age. However, age estimates have been made for a number of specimens using Grigson (1982), and although this is based on domesticated cattle, it is useful for a general guide to the development stages for this taxon.

The majority of the elements appear to be from large and robust adult animals; however, there are also nine elements that have unfused epiphyses, and one element that exhibits partially fused epiphyses (axis inferior vertebral body epiphysis) (Table 23.12) from which five separate individuals of different ages can be identified. The first is represented by an unfused distal end of a second phalanx. Fusion for this element occurs between 1.3–1.6 years of age, and therefore this specimen has a maximum age of 1.6 years. The second is represented by an unfused distal epiphysis of a metapodial. Fusion for this element occurs between 2–2.5 years of age, giving a maximum age of 2.5 years. The third individual has a maximum age of three years due to the unfused proximal calcaneal epiphysis. There are three specimens that are identified as having fusion between 3.5–4 years of age (a humerus with an unfused proximal epiphysis, a femur with an unfused proximal epiphysis and a tibia with an unfused proximal epiphysis), and so it is possible that all of these elements represent one individual; the fourth individual with a maximum age of four years. The fifth individual is

Element	NISP	Age range
Second phalanx (distal)	1	1.3–1.6 yrs
Metapodial (distal)	1	2–2.5 yrs
Calcaneus	1	3 yrs
Humerus (proximal)	2	3.5–4 yrs
Femur (proximal)	2	3.5–4 yrs
Tibia (proximal)	1	3.5–4 yrs
Axis vertebra (inferior vertebral body epiphysis)	1	4–5 yrs

Table 23.12: Summary of the age ranges associated with the unfused aurochs remains from Star Carr, using Grigson (1982).

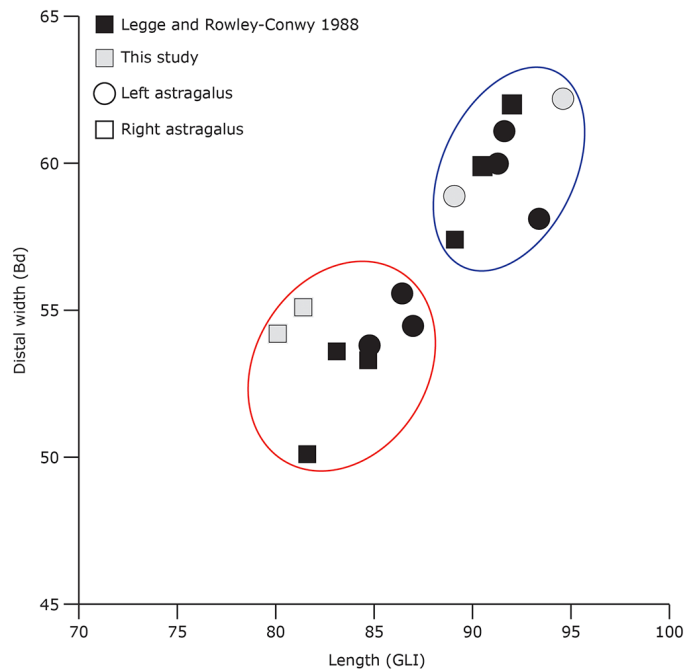


Figure 23.49: Metric comparison of the right (square) and left (circle) aurochs astragali data illustrating sexual dimorphism (males within the blue ellipse, females within the red ellipse) (Copyright Star Carr Project, CC BY-NC 4.0).

represented by an axis vertebra with a partially fused inferior vertebral body epiphysis, and a maximum age of five years.

Due to the fragmentary nature of the remains few specimens can be measured, except for four astragali, making it possible to do a comparative analysis with Legge and Rowley-Conwy's (1988, 46) data in order to establish evidence for sexual dimorphism. They found that from measurements on 13 astragali, seven were males, and among 15 metacarpals, 10 were males. In this study, plotting our astragali measurements against Legge and Rowley-Conwy's data, there are two more male specimens and two more female specimens (Figure 23.49).

Modifications

A total of 13 specimens exhibit evidence of carnivore modifications, 10 from Clark's area (six long bones, a cervical vertebra, a scapula, an astragalus and a first phalanx), one from the wetland (a calcaneus) and two from Clark's backfill (a radius and a femur). These all exhibit uneven breakage associated with tooth impressions and tooth scores.

A total of 65 specimens exhibit evidence of human modification. In terms of evidence of marrow extraction, there are 61 specimens, nine in the detrital wood scatter, 22 in Clark's area, 11 in the wetland, 10 in the dryland, eight in Clark's backfill and one in a test-pit. There are 13 specimens that are longitudinally split, likely for tool production: one in the detrital wood scatter (metatarsal), five in Clark's area (humerus, two metatarsals, a one first and one second phalanx), two in the wetland (humerus and femur), four from the dryland (three humeri and one metatarsal) and one from Clark's backfill (metacarpal). Only five specimens exhibit cut marks: three from Clark's area (scapula, sternum and humerus), one from the dryland (thoracic vertebra) and one from the backfill (metatarsal), and these are likely to have been produced through skinning.

Palaeopathology

There is also one aurochs metatarsal with a healed lesion to the midshaft which appears to be spherical in shape. This is likely to be the result of a long-healed perforation or projectile wound. There is only a small amount of thickening to the outer surface of the affected area, and there is no associated deformity or excessive thickening, pitting or pock marking of the cortical bone surface to suggest disease or active healing. The internal surface of the medullary cavity also appears to be normal, further supporting that it is unlikely to be caused by disease. Due to the small size and shape of the affected area, it could be suggested that it is the result of a long-healed perforation, albeit caused by either human or natural causes such as trauma, or perhaps even the result of a possible projectile wound.

MNI

The humerus is the most dominant element. As there are four repeating fully developed distal articular ends, one right and three left, the MNI for aurochs is three. When looking at these remains spatially, two of the left distal humeri and the one right distal humerus were located above the central platform, and the third left distal humerus was found within Clark's area. As the peat above the central platform may be of a similar date to Clark's area, the MNI remains at three. Legge and Rowley-Conwy (1988, 9) provided an MNI of 16 based on metacarpals.



Figure 23.50: Spatial plot of beaver (Copyright Star Carr Project, CC BY-NC 4.0).

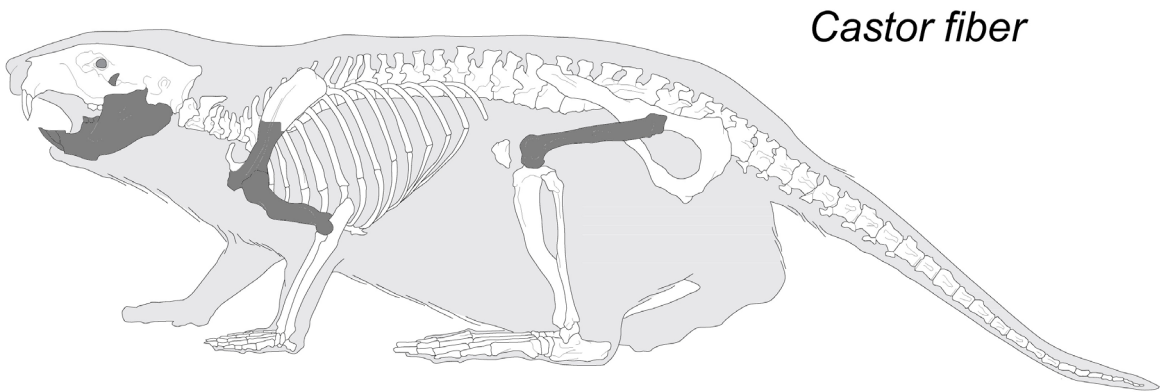


Figure 23.51: Element representation of beaver (Copyright Archeozoo.org/M. Coutureau 2003. Adapted by Becky Knight).

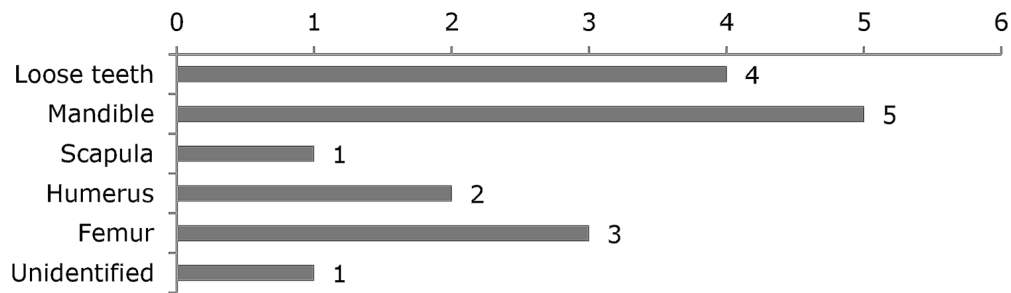


Figure 23.52: NISP of beaver in the assemblage (Copyright Star Carr Project, CC BY-NC 4.0).

Rodentia

Beaver

Overview

Fraser and King (1954, 73–74) noted that beaver is fairly well represented in the collection with an estimate of at least seven animals represented. In the recent excavations, 15 specimens have been identified, which mainly derive from Clark’s area and the dryland (Figure 23.50). On the dryland, these remains are represented by one fragment that has been identified by ZooMS (but could not be identified to element), and teeth and mandibles.

Elements

Beaver is represented by four loose teeth and five mandibles, as well as a scapula, two humeri and two femora (Figures 23.51 and 23.52). This correlates with what was found in Clark’s excavation, which includes jaw bones, two humeri, four radii, four ulnae, six pelvic bones, eight femora, 10 tibia, one sacrum and six lumbar vertebrae (Fraser and King 1954, 73–74). It is important to note that this pattern of element representation in terms of the presence of large and distinctive incisors is unlikely to be a result of excavation bias or sampling strategy, as



Figure 23.53: Two of the beaver mandibles (<116813> left and <115878> right) with similar modification to remove the ascending ramus, and fragmentary incisors (left to right: <117547>, <116164> and <115881>) (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).

small and more gracile remains have been recovered for other species (for example roe deer loose teeth, wild cat phalanges, pine marten caudal vertebrae and small fragments of fish remains).

Age and sex

In terms of age assessment, one humerus has a proximal epiphyses which is unfused and missing. According to Fandén (2005) this element remains unfused between the ages of three months and 6.4 years. A complete femur is fully fused; fusion is complete in this element by eight years of age, therefore this individual could have been 8+ years old. It was not possible to sex these remains.



Figure 23.54: Polish just below the dental arcade on the mandible <115878> and on the buccal side of one of the molars, possibly suggesting the use of leather binding to create a tool from the mandible (Photograph taken by Paul Shields. Copyright University of York, CC BY-NC 4.0).

Modifications

There is only one specimen with evidence of animal modification: a beaver femur from Clark's backfill exhibits uneven breaks and associated tooth impressions and tooth scores. In terms of human modification evidence, six specimens exhibit percussion breaks, and they consist of four mandibles (two from Clark's area, one from the wetland and one from the dryland), an incisor (from Clark's area) and a humerus (from Clark's area). The breakage pattern to the mandible is similar for all four specimens, with percussion breakage to remove the ramus, and two exhibit breakage around the incisor tooth socket, possibly for the removal of the incisor itself (Figure 23.53). Although the removal of the ascending ramus is associated with marrow extraction in other similar elements of red deer, as there is no breakage along the jawline below the tooth row for the beaver mandibles, this breakage is unlikely for this purpose. This modification may therefore be related to the creation of beaver mandible tools, or for purposeful removal of the incisor from the mandible. Additionally, the presence of polish to the bone surface just below the dental arcade on mandible <115878> (Figure 23.54) on both the buccal and lingual sides suggests leather binding may have been applied to create a handle out of the mandible in order to use the incisor, possibly for woodworking. There are a number of archaeological examples, especially from Russia, of beaver incisors being utilised for decorative purposes or as a tool either whilst still within the mandible or loose and hafted into antler (Zhilin 1997; Lozovskaya and Lozovski 2015). All of the loose beaver teeth are incisors and all are fragmentary (Figure 23.53). There is no clear sign of hafting as seen in the Russian examples but dehafting may have taken place, or leather may have been used for holding them.

MNI

During their original analyses, Fraser and King (1954) identified 71 specimens of beaver; 15 loose teeth and 56 elements. The elements included one maxilla (with a complete set of teeth), 14 pieces of mandibles (eight right, six left rami of the lower jaw), 12 loose incisors, 3 loose molars, two humeri, four radii, four ulnae (two right, two left), six pelves (three right, three left), eight femora (one right, seven left), ten tibiae (three right, seven left), one complete sacrum and six lumbar vertebrae. Interestingly, the majority of the long bones (NISP=22) were found to derive from immature animals with one or more epiphyses unfused and missing. It is unclear which element was used to calculate the MNI, but they suggest that at least seven animals were represented, with the majority being immature individuals (Fraser and King 1954, 74). It is not clear why the rami were not used to give an MNI of 8, unless they were perhaps fragmentary.

For the assemblage described here, the most common element is the mandible, which consists of five specimens found in several locations: two on the dryland, one near the eastern platform and two within Clark's area. Four mandibles are sided as right and one as left, all of which contain permanent teeth in wear; this provides an MNI of four.

If the results from the most recent excavations are combined with Fraser and King (1954), based on the presence of mandibles, an MNI of 12 is estimated for the entire assemblage: four right mandibles from the recent excavations and eight right mandibles (rami) from those undertaken by Clark; however, without examining the original collection we cannot be sure that this does not double count some of Clark's specimens, if they were fragmentary.

Field vole

A total of three field vole specimens were found on the dryland, and they are all represented by fragments of loose teeth. The teeth are the easiest way to differentiate between the different species of vole, and they were found during the flotation of soil samples taken from the central hollow of the eastern structure during the 2008 excavations. All three teeth appear to have been charred. It is unlikely that these teeth were intentionally brought into the structure, and given that they are charred, it is likely that they occur here by accident; possibly a vole was caught in a fire. There is very little that can be said about this species due to the small number of remains found; however, they are of interest as microfaunal remains have not been found at the site previously.

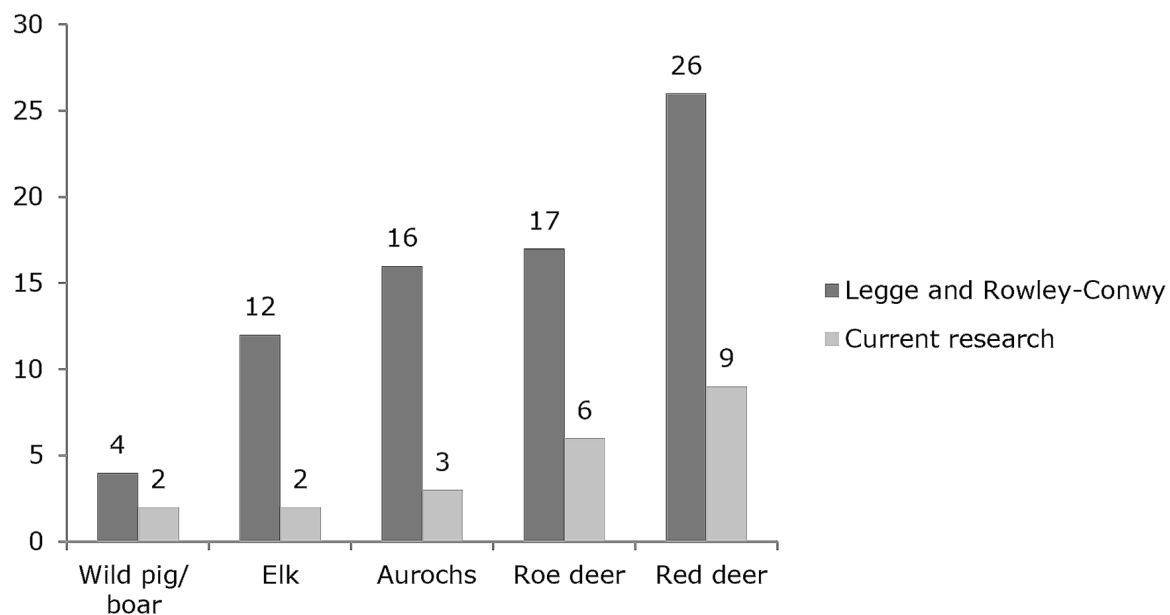


Figure 23.55: MNI comparison between Legge and Rowley-Conwy analysis and the current research (Copyright Star Carr Project, CC BY-NC 4.0).

Common name	Clark 1954	Degerbøl 1961	Harrison 1987	Legge and Rowley-Conwy 1988	Tot Lord	Present study	Overall
Northern pike						X	X
European perch						X	X
Common crane	X		X			X	X
White stork(?)	X		✕				
Red-breasted merganser	X		X				X
Red-throated diver	X		X				X
Black-throated diver						?	?
Great crested grebe	X		X				X
Little grebe	X		X				X
Lapwing	X		✕				
Buzzard	X		✕				
Duck (size of pintail)	X		✕				
Brent goose			X				X
Common scoter			X				X
White-fronted or bean goose						X	X
Bear					X		X
Wild cat						X	X
Pine marten	X						X
Fox	X						X
Wolf	X	✕				X	X
Badger	X						X
Dog		X					X
Hedgehog	X						X
Roe deer	X						X
Red deer	X						X
Elk	X						X
Pig	X						X
Aurochs	X						X
Hare	X						X
Beaver	X						X
Field vole						X	X

Table 23.13: Revised list of taxa from Star Carr showing the presence (X) or absence of species. The names in red represent those species that are present in the amalgamated assemblages taking into account re-analyses of the material. ✕ denotes taxa that have been re-analysed and classified as something else.

Discussion

The data presented here provides some important new insights into the faunal assemblage at Star Carr. ZooMS as a complementary method has also provided additional information regarding species, allowing us to identify more of the dryland specimens, and although the cervids cannot be distinguished, the method identified significant quantities of aurochs within the assemblage. The recent excavations at the site have yielded four previously unidentified species: northern pike, European perch, wild cat and field vole. There may also be a black-throated diver (though it may be a red-throated diver) and there is a new species of goose (white-fronted or bean). There appears to be both a dog skeleton and a wolf bone, which brings wolf back into the list following previous re-evaluations of dog to wolf. There are also a number of rodent specimens from flotation samples which cannot be identified to the genus and species.

Overall, with all the corrections to the data over the years, there now appears to be 26 species identified from Star Carr (the potential black-throated diver has not been included in this total) (Table 23.13), as opposed to the 21 first identified (Fraser and King 1954). The fish bones are particularly noteworthy because there has been much debate as to why fish was not found previously at the site (Wheeler 1978): evidence has now been found both from the wetland (in Clark's area) and on the dryland as calcined bones demonstrating fish were being caught, processed and discarded on site (see also Robson et al. 2016).

It is interesting to note that of the MNI of the five most represented species (red deer, roe deer, aurochs, elk and wild boar) there is very similar pattern to Legge and Rowley-Conwy's (1988) data in terms of order of prevalence (Figure 23.55). This is probably due to the fact that a large proportion of the recent data also comes from Clark's area, although it should be noted that red deer appears to predominate in most areas of the site.

Legge and Rowley-Conwy (1988) hypothesised that the assemblage (as represented by Clark's excavation) was strikingly similar to that of a Nunamiut hunting camp. This pattern was based on the presence of mandibles, upper forelimbs and limb extremities, with the assumption that the upper rear limbs are transported back to a different residential base (Legge and Rowley-Conwy 1988). However, from our dataset we can see that femora are present. A number of them are classed as 'large mammal' because most are fragments due to breakage for marrow extraction, and many were found in the backfill. We now know that Clark did not collect many unidentifiable specimens and his assemblage had been handpicked, which skewed the dataset; this therefore throws doubt on the notion of this site being a hunting camp.

The seasonality assessment has also changed since the analysis of Legge and Rowley-Conwy (1988). It should be noted that all seasonality assessments are reliant on the use of modern analogues for the season of birth, the migration patterns of birds and the shedding of antler (Milner 1999; 2005). There is often some degree of variation in this data; for instance, some species can give birth over several months, which means the anchor point is moveable, and there is some variability in terms of the timing of tooth eruption and the development of wear patterns. However, what we do not know is how much further variability there might have been in the past, particularly for this site where we have clear evidence for significant fluctuations in climate (Chapters 4, 9 and 18). The changes in temperature inevitably would have affected the behaviour of animals, and we should be mindful that, for instance, bird migration patterns might have been significantly different.

What is clear is that there now appears to be evidence from Clark's area for animals that have been killed in all four seasons. Legge and Rowley-Conwy (1988, 38) made the point that game was probably accessible at all times of the year: none of the major species show a marked tendency to migrate. However, because at that stage no winter kill stages were present in their dataset, they suggested that a year-round settlement was unlikely. Red deer skulls with antler shed are likely to be spring (Legge and Rowley-Conwy 1998, figure 7), with a concentration of roe deer mandibles and maxilla argued to be indicative of May/June deaths. Further summer evidence comes in the form of neonatal red deer, red deer maxilla, red deer mandibles, a neonatal elk and summer migratory birds (Grigson 1981). An elk mandible suggests an autumn kill, possibly alongside some red deer mandibles. However, Carter (1997; 1998) has since demonstrated that both roe deer and red deer exhibit evidence for winter kills and one of the red deer mandibles assessed as part of this study also suggests a winter kill.

It is also important to consider the nature of the dataset. The seasonality data have always been based on the material from Clark's assemblage. We now know that this is part of a larger picture and this deposition may have taken place over a short period of time (Chapter 17). The only other seasonality data from the rest of the site is from the detrital wood scatter, where the evidence from one red deer mandible suggests a kill in the summer. This simply suggests that a deer was killed in the summer during the earliest occupation of the site but does not necessarily mean that occupation did not happen in other seasons.

Conclusions

This new data provides some important changes to our understanding of the faunal assemblage at Star Carr, with new species, as well as a re-evaluation of both the site type, as assessed by faunal remains, and seasonality. As Legge and Rowley-Conwy (1988, 7) state: 'no bone report is ever in a full sense a final report. Conclusions will always be subject to modification, and identifications to rechecking, as new methods and skills are developed.' They go on to say that having come to different conclusions to those of Fraser and King, they do so in the knowledge that their identifications and conclusions will also be subject to change, 'possibly in much less than the 30 years that have elapsed since the appearance of the original bone report.' It is now almost 30 years since their report, and in fact little has changed with the exception of Carter's (1997; 1998) work on age and seasonality. However, the recent excavations have thrown more light on Clark's area as well as new areas of the site: we also anticipate that this new dataset will generate further re-evaluations, new conclusions and new debate.