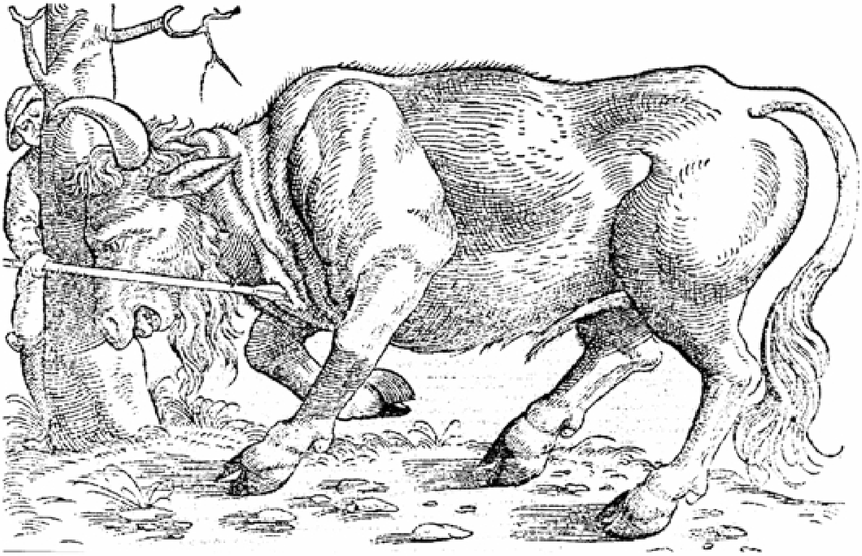
Animals in the Neolithic of Britain and Europe

Neolithic Studies Group Seminar Papers 7

Edited by Dale Serjeantson and David Field



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Foreword

This book presents the proceedings of a seminar organised under the Neolithic Studies Group (NSG), forming part of an ongoing series of NSG seminar papers. The NSG is an informal organisation comprising archaeologists with an interest in Neolithic archaeology. It was established in 1984 and has a large membership based mainly in the UK and Ireland, but also including workers from the nations of the Atlantic seaboard. The annual programme includes two or three meetings spread throughout the year and includes seminars held in London and field meetings at various locations in north-west Europe.

Membership is open to anyone with an active interest in the Neolithic in Europe. The present membership includes academic staff and students, museums staff, archaeologists from government institutions, units, trusts and amateur organisations. There is no membership procedure or application forms and members are those on the current mailing list. Anyone can be added to the mailing list at any time, the only membership rule being that names of those who do not attend any of four consecutive meetings are removed from the list (in the absence of apologies for absence or requests to remain on the list).

The Group relies on the enthusiasm of its members to organise its annual meetings and the two co-ordinators to maintain mailing lists and finances. Financial support for the group is drawn from a small fee payable for attendance of each meeting.

Anyone wishing to contact the Group and obtain information about forthcoming meetings should contact the co-ordinators at the following addresses:

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Preface

The papers collected together here follow from the Neolithic Studies Group seminar held at the British Museum on 10th November 2003 on the subject of *Animals in the Neolithic*. The presentations and discussion at the meeting were enthusiastically received and we were encouraged to bring the contributions together for publication and dissemination to a wider audience as a volume in the Neolithic Studies Group seminar series. This book includes most of the papers delivered and debated at the meeting and others contributed later.

When we first started to plan to bring together a group of people interested in animals in the Neolithic for a seminar of the Neolithic Studies Group in 2003, we did so knowing that there had been no general book or collection of papers on Neolithic animals, something rather surprising in view of the central role of animals in the Neolithic of Europe. We set out to cover the range of current approaches to animals in the Neolithic, and to encompass as wide a geographical scope as possible in Europe. In particular, we aimed to ensure that both wild and domestic animals were discussed and that their social as well as economic roles were given appropriate attention. The only limitation imposed on the contributors was that the papers should focus on Neolithic Europe. As a result the papers are refreshing in their range of perspectives. We welcomed papers on theoretical topics as well as studies of individual Neolithic assemblages which have not up to now been published. Two important individual deposits, the aurochs from Holloway Lane and the canid from Staines Road Farm, both – co-incidentally – from sites not far apart in West London – are also discussed.

We much regret that some of the participants in the original meeting were not able in the end to contribute to this book. The absence of papers by Julie Bond, Mark Copley, Caroline Grigson, Andrew Jones, A. J. Legge, Anna Mukherjee and Anne Tresset is a great loss, but the topics presented by these authors have been (or will shortly be) published elsewhere. Umberto Albarella, a discussant at the meeting in 2003, has rounded off the volume with a commentary on the papers which puts them into the perspective of changing views of animals in the Neolithic of Europe.

Just as this book was going to press the contributors were shocked and saddened to hear of the death of Andrew Sherratt. One of his most innovative contributions to prehistory was in defining the 'Secondary Products Revolution' twenty years ago: this was the change which took place when animals ceased to be kept solely for meat and skins, but began to be valued for what they provided while still alive, especially traction, milk, and wool. Many of the papers in this book refer explicitly or implicitly to this change; in particular, Andrew Sherratt's ideas and encouragement were a great inspiration for research of Valasia Isaakidou, which is discussed in Chapter 8. New methods of analysis have shown that the 'revolution' identified by Sherratt started earlier and took place over a much longer period than he originally envisaged, but, as Umberto Albarella says in Chapter 12, the concept 'was a hugely stimulating idea for more than twenty years'. Andrew Sherratt's thought provoking presence and ideas will be missed by everyone who studies prehistoric Europe and we would like to dedicate this book to his memory.

Acknowledgements

We would like to thank the co-ordinators of the Neolithic Studies group for arranging the meeting and Gill Varndell of the British Museum for hosting the session. The British Museum made us very welcome. The participants in the seminar, both speakers and discussants, deserve our thanks for their enthusiasm and input on the day itself and we are especially grateful to those who have written papers for this volume and have responded willingly and promptly with our editorial requirements and queries.

Dale Serjeantson and David Field
October 2005

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William Cunnington and his Butcher

David Field

INTRODUCTION

During the early years of the 19th century, in response to medical advice that he should 'ride out or die', William Cunnington, a draper and cloth merchant of Heytesbury, Wiltshire, embarked on what must then have been viewed by many as a most bizarre pursuit: that of investigating and digging into the earthen mounds that were widely scattered on the local chalk Downs. As a result, between 1800 and 1809 he discovered, recorded and excavated 18 of the 53 or so long barrows that have since been documented across Salisbury Plain. Most were within easy daily travelling distance of his home, situated on the valley slopes around the upper reaches of the River Wylye (Figure 1.1) and probably well known to him or his friends as features within the local landscape.

Records of his work are preserved in a series of letters to his benefactors and supporters, the local MP, H. P. Wyndham, J. Britton and R. C. Hoare. They not only describe the discovery of skeletons and other finds, but also the stratigraphy and structural features that were encountered, characteristics which we generally associate with more recent archaeological recording. (Folios of separate copies are at the Society of Antiquities, London, and Devizes Museum and here referred to as Soc of Ants London Ms 217 and Cunnington Ms Devizes respectively: see Eagles and Field 2004; Cunnington 1954; 1975 for further details). Many of these finds were subsequently published by R. C. Hoare in 1810 in the first of his folios on *Ancient Wiltshire*. Apart from Stukeley's comments about pyriform barrows near Avebury (Stukeley 1743), little was known about long barrows, and Cunnington's explorations were at the cutting edge of antiquarian investigation. Given the medical advice, to him the pursuit must have seemed as good as any.

THE EXCAVATIONS

Cunnington's initial efforts were unassuming. In 1800, he dug a small trench into the centre of a long low mound that lay a little more than a kilometre north of his home just beyond the limits of Heytesbury Park. Located within Heytesbury North Field, the shallow nature of the mound may have been the result of an earlier episode of cultivation, although, even if this were so, at 1metre in height, a significant portion of the superstructure had survived. He found the result to be inconclusive, but it did reveal a deposit of dark

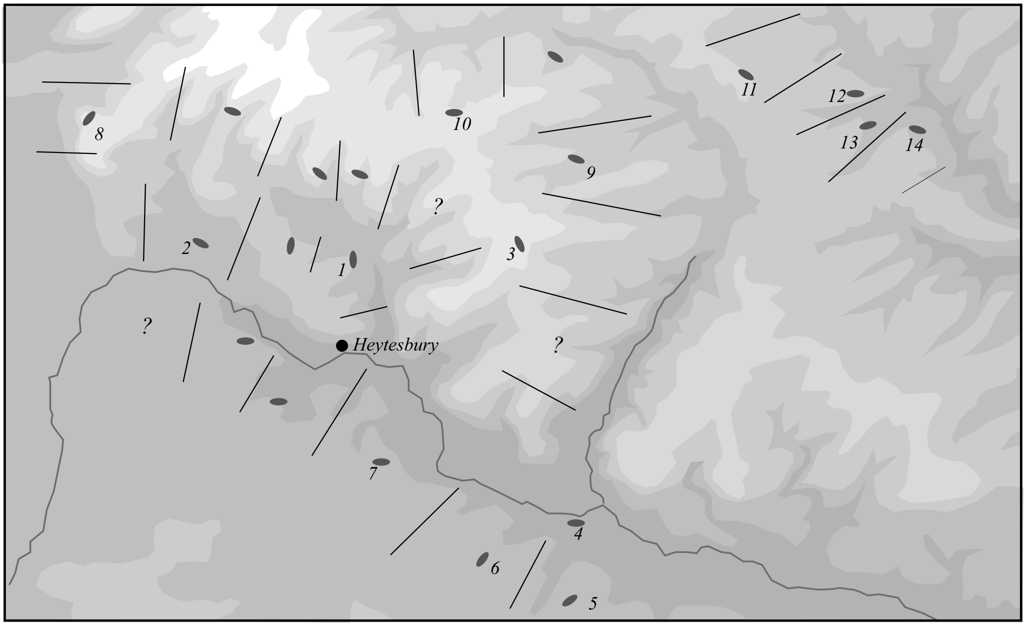

Figure 1.1: Long barrows around Heytesbury in Wiltshire, with hypothetical territories based on access to the River Wylie and its tributary. Those dug into by William Cunnington are numbered: 1 Heytesbury North Field, 2 King Barrow, 3 Knook Barrow, 4 Sherrington Barrow, 5 Stockton, 6 Boyton, 7 Corton, 8 Arn Hill, 9 Knook Down, 10 Boles Barrow, 11 Tilshead Lodge, 12 Old Ditch, 13 White Barrow, 14 Silver Barrow, although there is a question concerning the status of the latter

earth at the base and a number of human skeletons that provided support for the theory held by Wyndham, that the long mounds were built to cover the dead from battles (Cunnington R 1975, 12). Later, in 1804, and with the experience of having excavated similar barrows, he returned and placed two more trenches in the mound, this time towards the wider end. At the base of the mound a pit – Cunnington called it a cist – was encountered, neatly cut into the chalk, filled with soil but devoid of finds, all sealed by a conical cairn, a mound of sarsen, flints, chalk and earth. Adjacent to the pit lay more human bones *'crossing each other in every direction'* (Cunnington Ms Devizes Book 3, 45; McOmish *et al* 2002 fig. 1:11). The components encountered were seen to be repeated in various combinations in other long barrows elsewhere on Salisbury Plain, though often with the bones resting on a pavement of flints rather than an earthen or chalk floor.

In the autumn of 1800, having dug his first trench into the Heytesbury Field long barrow, Cunnington made his way to Boreham, near Warminster, 3 km from Heytesbury, where he cut into a massive long mound known as King Barrow. Some 4.5 metres in height, this dwarfed his earlier undertaking. He was puzzled by his finds, so returned nine years later, just as he had to the Heytesbury mound.

Cunnington was astonished at the amount of animal bone encountered within the matrix of the mound: *'pieces of Stags Horns, animal and human bones, boars tusks'* and the *'entire* *skeleton of a horse'*. Almost *'the whole of the floor'* beneath the mound was found to be *'covered with animal bones of almost every description* …(all amongst) … *charred wood some of which adhered to the bones half cremated by fire…'*. On October 30th he recorded that nearly 'half a peck' (4.5 litres) of animal bones were found and the following day more bones of horse and pig, as well as *'a piece of ivory 8½" long, like the point of an elephant tooth'* . After re-visiting the site in 1809, he recorded that in an internal circular earthen mound covering the floor *'we found an immense quantity of animal bones, some of oxen, but mostly of swine'*. Cunnington was evidently concerned by this large quantity of animal bone and wrote *'How are we to account for such a profusion of animal bones...'* (Soc of Ants London Ms 217/volIV, folio 76: Cunnington Ms Devizes Books 3, 26–7; 4, 76 and 11, 21–22).

As a cloth merchant, Cunnington could not be expected to be too knowledgeable about such bones. He had clearly been talking to his butcher, for by 1802 he was referring to *'what the butchers call the core, or inside of the horns'*. He reported taking the head and horns of a large bovid from the long barrow at Knook to his butcher, who pronounced it to be *'larger than any he ever saw of the ox kind'*.

There is no record of who the butcher was, but he was evidently sometimes baffled by Cunnington's finds and must have realised that even his knowledge was limited. After retrieving animal bones from the floor beneath Sherrington Barrow in 1804, Cunnington wrote *'My butcher says that the teeth are not the teeth of any animal he knows'* (Cunnington Ms Devizes Book 1, 51; for the Sherrington excavation also see Lambert 1806a and b). As a result of this bewilderment he had previously wondered of the animal in Knook Barrow whether *'some of the gentlemen belonging to the Board of Agriculture might tell what kind of ox it was'* (Cunnington Ms Devizes Book 3, 33–4). Between them, they were clearly able to recognise cattle, pig and horse bones and red deer antler. It was the butcher who was responsible for recognising that some of the animals were of an unusual nature.

CATTLE

Cattle appear to form a prominent component of the fauna mentioned in the accounts. At Sherrington Barrow, situated immediately adjacent to the River Wylye, bones were found in one of the pits at the base. This is the only example of bones or any other artefact being recovered from one of these pits. '*In this one, an ox skull*' was found together with a small antler (Cunnington Ms Devizes Book 1, 51). The deposit does not appear to represent the debris of feasting or settlement, but would appear to be a more akin to a placed deposit. Close to the cist at Knook Barrow, '*lay horns of oxen*' over burnt human bones (Cunnington Ms Devizes Book 3, 44–45), but most of the rest of the material appears to derive from the overlying cairns or round mounds or from the matrix of the long mound itself. In the clay of the round mound observed by Cunnington to underlie King Barrow, '*was an immense quantity of animal bones, some of oxen*' (Hoare 1810, 73). At Knook Barrow, the skull of the large *Bos* was discovered immediately under the turf and effectively resting on, or almost on, the flint and ?sarsen cairn (Eagles and Field 2004). The butcher's observation that it was larger than any ox that he had seen suggests that it was probably from an aurochs, *Bos primigenius*. The left horn was burnt '*almost to* *a coal'* though the rest of the skull was reported as being well preserved (Cunnington Ms Devizes Book3, 33–34). At the east end of Boles Barrow, and presumably beyond the human skeletons found on the pavement, '*we found the Heads and Horns of seven or more oxen*' (Cunnington Ms Devizes Book 3, 29–32). Invariably it is the skulls and horn cores that are reported as being deposited, in one case in a pit and in another on top of the cairn, while in a third a group of skulls was placed in a focal position at the east end.

PIG

Pig was reported as being recovered from two long barrows, Sherrington and King Barrow. At Sherrington, a skeleton was recovered, evidently from the floor at the base of the mound, though the precise stratigraphical position is not entirely clear (Cunnington Ms Devizes Book 1, 51). How complete this was is difficult to say, but the description implies it was partly articulated. Much pig was also recorded at King Barrow, both on the floor, in the round mound, and in the matrix of the overlying long mound. On October 31st, when the floor was reported to be '*almost red by the action of fire*', he found bones of '*swine'* (Soc of Ants London Ms 217/vol IV folio 76; Cunnington Ms Devizes Books 3, 26–27; 4, 76 and 11, 21–22). '*In uncovering this floor we were surprised to find that as we approached the edge of the barrow, the clay and earth which covered the floor rose 3 feet in height like another tumulus, and ten or twelve feet in diameter; amongst this clay was an immense quantity of animal bones, ... mostly of swine'* According to Cunnington, boar tusks were frequently encountered throughout the fabric of the mound.

HORSE

There is only one report of horse remains, at King Barrow, and there is some doubt about its precise context. A complete skeleton was recorded just above the floor in the northeast of the trench and further bones were reported later. None of the possible finds of horse bones from early or middle Neolithic contexts elsewhere in Britain has been confirmed as Neolithic (see Pollard and Serjeantson this volume). Cunnington noted the position of the find in his later note, referring to a sketch plan (Eagles and Field 2004), which indicates that it must have been found near to the edge of the mound, in which case it might easily have been an intrusive burial.

DEER

The only reported finds of deer were pieces of antler. One small 'deer horn' was noted as being deposited in a pit at Sherrington Barrow, where, as referred to above, it was found deposited along with a bovid skull (Cunnington Ms Devizes Book 1, 51). Antler was present on the floor at Knook Barrow, and '*horns of deer*' were also reported as being found near the cist (Cunnington Ms Devizes Book 3, 44–45). At King Barrow, Cunnington reported on November 5th, 1804 that he had encountered '*…a pavement of burr stones'* (probably broken sarsen) … and close to the same spot a few days later '… *a kind of Skeleton*' with '*a piece of Stags Horn near it*'. Here also '*pieces of Stags Horns*' were frequently encountered throughout the fabric of the mound. He commented that the antlers were remarkably large and the tips of some firm and white like ivory (Cunnington Ms Devizes Book 11, 21–22). Antler was also occasionally reported as being found in the matrix of long mounds elsewhere. At Knook '… *on the top of the barrow, immediately under the turf were found several pieces of Stags Horn*', at Boles Barrow '*stags horns*' were found alongside the *Bos* skulls (Cunnington Devizes Book 3, 44–45), while at White Barrow nothing was found beyond '*a few pieces of staghorns*' (Cunnington Ms Devizes Book 3, 39–43). Close to the base of the Old Ditch Long Barrow, Cunnington reported '*charred wood and small pieces of stags horns*' and in a footnote observed that these were '*chiefly the horns of red deer*' (Cunnington Ms Devizes Book 3, 39–43). Higher in the same mound, a (presumably) secondary cremation was accompanied by '*several very large antlers and fragments of charred wood*'.

BIRDS

Cunnington (or his butcher) was able to recognise bird bones amongst the mammals, as he recorded the presence of birds on the floors and pavements amongst the charred wood and ashes. At King Barrow '*even the bones of birds*' were noted as present amongst an array of other bones on the floor of the barrow (Soc of Ants London Ms 217/volIV, folio 76: Cunnington Ms Devizes Books 3, 26–7; 4, 76 and 11, 21–22); on the pavement at Knook '*bones of birds*' (Cunnington Ms Devizes Book 3, 33–4); at Old Ditch Long Barrow an – '*abundance of bones of bird*' and a little higher in the mound there a '*shovel full of bones of small birds deposited together*' (Cunnington Ms Devizes Book 3, 39–43). Larger birds were also present. On the floor of the Sherrington barrow, for example, were the bones of – '*a large bird*' (Cunnington Ms Devizes Book 1, 51), while on the pavement at Knook – '*some of which appeared like the bones of an Heron ...*' (Cunnington Ms Devizes Book 3, 33–34). Given the similarity with crane, there is a possibility of misidentification, as both species have similar beaks and long legs, though cranes are altogether larger. Either species would have been present by the River Wylye, not too far distant. In the early years of the 19th century, bone identification was in its infancy and Cunnington would not have known that cranes as well as herons were once present in the British Isles.

The finds of larger birds recall the deposition of part of a White-tailed eagle, along with other animal bones, in the southern ditch at the Coneybury henge, near Stonehenge (Maltby in Richards 1990, 150–154). The birds deposited in the barrows could have been caught for food, or for their feathers; feathers of the heron (or the crane) have a striking appearance, which may have proved an attraction to the local human population. However, the incorporation of birds within the monument suggests that there may have been a symbolic motive. It is difficult to interpret the skull of a phalarope, found with a stone axe between two antlers, tines pointing inward, at the base of a shaft at Grimes Graves as a mundane deposit (Barber *et al* 1999, 66) and similarly the White-tailed eagles found at the Orkney tomb of Isbister (Hedges 1983). Perhaps the birds represented here imply some totemic interest (*cf.* also Jones 1998).

The '*small birds deposited together*' and the '*abundance of bones of bird*' may well derive from pellets deposited by owls or other birds. Similar finds have been made in other prehistoric burial mounds. Three Bronze Age cairns in the north of England near Shap contained hundreds of bones of small vertebrates, including birds, which are thought to have been from pellets ejected by raptors which took shelter in the cairn (Huntley and Stallibrass 1995, 115–117).

THE RELATIONSHIP OF HUMAN AND ANIMAL BONES

The incidence of animal and human bones as described by Cunnington in the fourteen long barrows that he excavated between 1800 and 1809 is summarised in Table 1.1. Five mounds have neither animal nor human bones recorded; the lack of comment presumably indicates that the trenches were not extensive enough to encounter significant finds. Of the remainder, there are nine that contained human remains and five with animal bones. It is of interest that at King Barrow animal bones predominated over human remains in all the contexts described: on the floor, in the internal mound, and in the matrix of the barrow. Similarly, beneath the east end of the enormous Old Ditch Long Barrow, animal bones were present amongst the ashes and charred wood at the east end (Cunnington Ms Devizes Book 3, 39–43). However, by contrast, there was no animal bone from the

Table 1.1: Incidence of animal and human bones as described by Cunnington in fourteen Wiltshire long barrows excavated between 1800 and 1809

	Animal	Bos	Sus	Birds	Cervus	Equus	Human
King Barrow	*		*	*	*	*	*
Sherrington	*	*	*	*	*		
Corton							*
Boyton							
Stockton							*
Old Ditch	*						*
Tilshead Lodge							
White Barrow							
Boles Barrow	*	*					*
Arn Hill							*
Silver Barrow							*
Knook Down							
Knook Barrow	*	*		*			*
Heytesbury							*

similar deposits at the west end. Instead, a pavement of flints supported human bone, including three skeletons, among the charred wood and ashes, two side by side and a third placed across their heads.

At Sherrington Barrow, animal bones, including the skeleton of a pig, dominated the finds amongst the ashes on the floor (Cunnington Ms Devizes, Book 1, 51) and *no* human bones were reported, while at Knook both human *and* animal bones were reported as being amongst the charred wood and ashes (Cunnington Devizes Book 3, 33–34). On the strength of this presence of bone, animals appear to have played a significant role in the actions played out at these monuments. These bones, of course, might and probably do represent more than one event, but on the face of it, with odd human bones amongst the animal, the activity appears to be one that at times treated humans and animals in a similar manner.

In contrast to both King Barrow and Knook Barrow, there was little or no burning at Boles Barrow. Instead the remains were treated in a rather different way: there were disarticulated humans on the central pavement, as at Heytesbury, but cattle skulls – at least seven – segregated at the east end (Cunnington Ms Devizes Book 3, 29–32).

On only one occasion, at Sherrington, is there any record of finds from the pit beneath the barrow and here it contained an ox head and small piece of antler. Cunnington thought that the animals might have been *'sacrificed over the cist prior to the erection of the barrow'*.

CONCLUSION

Cunnington's trenches were often relatively small in relation to the size of the mounds. Many were originally placed at the centre of the mound, but towards the end of his investigations it became clear to him that activity chiefly occurred at the wider end. The reason that he revisited some mounds was that it was evident that he must have missed important evidence. Given that the interest of his contemporaries lay in the human remains, particularly where they might support the idea that such monuments represented 'battle' barrows, it would be of no surprise if faunal data had gone unrecorded.

Indeed the variety of contexts in which animal bone was recorded, particularly on the pavements and floors, appears to indicate that human and animal bone were sometimes subject to the same or similar processes. At Boles Barrow, human bones were scattered across the pavement and *Bos* skulls apparently piled at one end. At King Barrow, the processes provide contrast, but here burnt and fragmented human and animal remains were more integrally mixed together, the '*floor of the barrow covered with animal, human and even the bones of birds, pottery, Stags Horns – charred wood some of which adhered to the bones half cremated by fire* ...'(Cunnington Ms Devizes Book 11, 21–22). Some of this might be the remnants of feasting or other funereal ceremonies, but the impression is obtained that human and animals were treated in an identical way with similar processes being undertaken. If anything some animals were afforded special reverence, for example, the placing of *Bos* in certain foci.

The two monuments on the highest part of the chalk down stand out as different in form from the others: Boles Barrow and Knook Barrow are both of dramatic parabolic profile. The cattle skulls in these do not appear to be casually buried or discarded; rather they appear to be placed or specially curated deposits, or to adorn certain part of the monument. At Boles Barrow, the cattle skulls were massed together at the east end, though it is not clear whether they lay over or beneath the cairn. On *top* of the cairn at Knook, the head and horns of a large *Bos* were recovered. The position bears some comparison with a similar find at Fussells Lodge, a little further to the east, where a *Bos* skull was also found on top of a cairn. With the skulls acting as a signpost, it is even possible that some of these cairns are zoomorphic in nature. The form of many when seen in profile resemble a prone beast and elsewhere, as for instance the effigy mounds of Ohio in the United States (eg Birmingham and Eisenberg 2000, 100–141), it is not unknown for mounds to resemble animals. The horned forecourts of many monuments lead to a conclusion that part of these structures symbolically reflected the Neolithic preoccupation with cattle. The plan of the Fussell's Lodge cairn has a remarkably animal-like outline (Figure 1.2) and Ashbee (1966) coincidentally referred to one part of it as the tongue. However, this interpretation rests on slender evidence, and this paper is not the place to pursue it.

The interesting point about all this is in the pioneering nature of Cunnington's observations. Some 200 years ago, the *earliest* excavations of Neolithic monuments provided what amount to the *earliest* animal bone reports. These may be rather sparse on detail when compared to modern accounts, for the scientific study of animals in museums and other institutions had not then commenced. However, as this volume bears witness, Cunnington's legacy was enduring and to this day the study of animals continues to play an integral role in the study of the Neolithic.

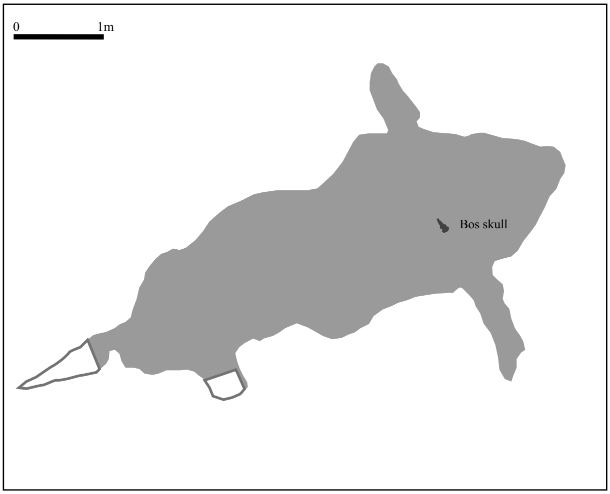

Figure 1.2: The cairn at Fussell's Lodge (adapted from Ashbee 1966) with the Bos *skull placed on the summit. A later 'head and hooves' burial was also recovered from the long barrow ditch at the site.*

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Chapter 2

Neolithic Wild Game Animals in Western Europe: the Question of Hunting

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INTRODUCTION

The major publication on the wild faunas of Neolithic Europe to appear during the last 10 years is that by Arbogast *et al.* (2001) on the '*Role et Statut de la Chasse dans le Néolithique ancien danubien*'. Focusing on a 600 year period of the Early Neolithic, 5500–4900 BC, the volume covered what might well be described as the final activity of the European Holocene hunter-gatherer. In contrast, this chapter looks at the broadly-defined Middle to Later Neolithic of Western Europe between *c.*4900 and 3800 BC (6000 and 5000 BP), a period which has received considerable attention over the last 10 years as part of the Global Palaeovegetation Mapping Project, BIOME 6000 (Prentice and Webb 1998). The chapter is not a detailed survey of faunal assemblages across Europe; it is, rather, a study in regional variation at the macro scale, which allows us to place individual sites within their local context. The micro-scale regional approach requires more detailed examination of the numerous smaller regions and their faunal collections and these individual site assemblages will be considered at a later date. The chapter is also not an exercise in tracing the spread of farming across Europe. Instead, it looks at the Middle and Later Neolithic when we can accept that farming in its broadest sense is an established component of the subsistence economy in most parts of Europe. Our aim is to consider the importance of wild game and the nature of hunting at this time.

Methods and Techniques

The chapter considers broad-scale patterning among faunal assemblages during that part of the Neolithic which by and large coincides with the late Atlantic and early Sub-Boreal periods (Marambat 1995, 27). In particular it considers the significance of five wild game species which are more often associated with the Mesolithic of Western Europe, red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), boar (*Sus scrofa*), aurochs (*Bos primigenius*) and horse (*Equus caballus/ ferus*). At 6000 BP much of Western Europe could be categorised as 'Temperate deciduous broadleaf forest' (Huntley 1990; Prentice *et al.* 1996; Cheddadi *et al.* 1997), but this general category included the Mixed Oak Forest at La Lède du Gurp (Grayan-et-L'Hôpital, Gironde, France) (Marambat 1995, 49: fig. 12), the Mixed Temperate/Humid deciduous forest found between 5800 and 4900 BP along the Cantabrian coast of northeast Spain (Issar 2003, 37), and the Birch/Oak woodland in

Galicia (NW Spain) (Santos *et al.* 2000). Thus the environmental conditions during the sixth millennium BP vary considerably in Europe, both spatially and chronologically. Here I shall consider whether the frequencies of the wild animals were equally variable.

Data

In order to detect large-scale regional and/or continental trends in species frequencies at archaeological sites, a large amount of data was collected and recorded systematically in a form which was easy to use and manipulate. Where possible data were taken from sites which are reliably dated and which have direct evidence of human use of fauna, such as cut-marks visible on bones. Only quantitative data were recorded. This meant that a unit of quantification had to be selected and used throughout. Given the fact that most publications providing quantitative data set out NISP figures (Number of Identifiable SPecimens per taxon), it was decided to use bone counts or NISP, converted to percentage values, with a minimum sample size of 200 bones for a multi-species assemblage and 400 bones for a single-species assemblage. Thus %NISP for individual species and grouped wild taxa (%NISPwild) are employed. Values were calculated to two decimal points.

Where possible, the absolute dates were recorded, though it was occasionally necessary to be slightly flexible. Where reliable absolute dates are not available for important assemblages, average estimates are used, based either on other dated sites in the same immediate area (<1km away) yielding identical cultural material or an average of 'surrounding' layers at the same site. In the case of a three-layer site, with layers A dated, layer B undated, and layer C dated, the arithmetic mean of dates A and C is assigned to B. Although not ideal this provided a means of using data from undated levels.

Also essential in a study of this nature were the locational data. In this case latitude and longitude co-ordinates were employed, where possible extracted from site reports, the journal Radiocarbon and other publications. All co-ordinates were checked against *The Times Atlas of the World* (Bartholemew 1955, 1956), so as to avoid perpetuating any mislocations. French sites were also checked to commune, their location being obtained from the IGN web site (http://www.ign.fr).

All the data were compiled as an MS Excel spreadsheet which was imported into other software for specific purposes. Where chronological trends in the data were concerned, patterns were traced by plotting species frequencies against radiocarbon dates; 'moving average' plots were employed in order to track trends which might otherwise remain undetected due to the occurrence of outliers among the data. The sites were considered as a complete dataset and as broadly-defined regional sub-sets divided in terms of latitude. A north-south divide was adopted in the study, which runs along the 50 degree north parallel. It was chosen as an arbitrary, half-way division between northern and southern extremes, 65 and 35 degrees north respectively. The area was then divided into 5 degree latitude bands from 35 to 55 north, with an additional band between 55 and 65 degrees north, a region from which there are fewer sites.

When plotting spatial patterns in species frequencies it soon became apparent that the occurrence of isolated atypical assemblages was causing some confusion, although such sites are, in fact, frequently those which might well prove to be of greatest interest. In order to be able to trace general patterns at a macroecological scale a smoothing technique was used. Exceptional sites were highlighted graphically by a change of symbol or shading. In the maps shown here sites are indicated by open (often overlapping) circles.

The data have been smoothed using a Kriging geostatistical estimation technique, a weighted moving-average interpolation method which minimizes estimation variance (Isaaks and Srivastava 1990). This means that sites where there are atypically high or low frequencies of a species are prevented from distorting the overall trend. For this reason, it is not claimed that sites with substantially higher or lower frequencies of a certain species or group of species do not occur within a broadly defined band or region on a map. Employing values from more than 900 sites provides a broadly representative sample, although there are a few gaps which result from lack of data. However, general trends in species frequencies can be estimated from contour plots.

RESULTS

The average percentages for the five species considered are shown in Table 2.1 and percentages for ibex (*Capra ibex*) are also included. The plot of %NISP wild across Western Europe (Figure 2.1) shows percentages averaging in excess of 60 per cent in some areas of SW France and NE Spain. Indeed the percent of wild species reaches 100 per cent at Marizulo III and IV (Pais Vasco, Spain) and over 99 per cent at Roucadour C (Lot, France). However these regional values are based on a relatively small number of

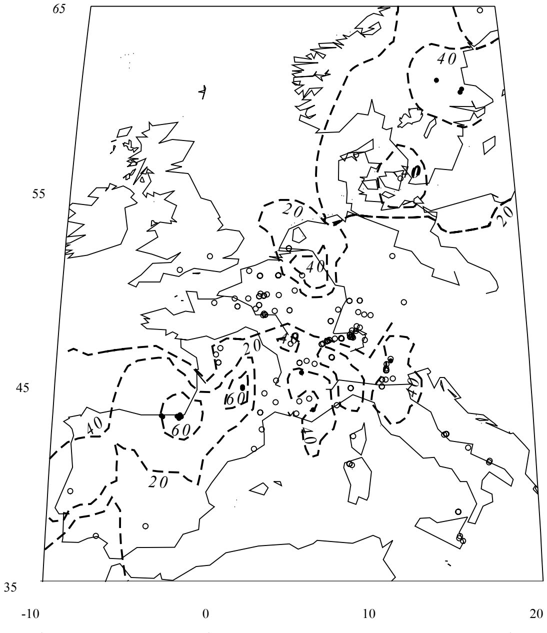

Figure 2.1: Geographical distribution of wild fauna across Western Europe during the sixth millennium BP. Numbers refer to the percentage of fragments (% NISP) as defined in the text. Open circles show sites.

sites (7). Elsewhere in Europe high values (40 per cent or more) are found, but they are isolated cases amongst a series of lower-value sites. The total wild species count is positively correlated with the major individual taxa, red deer, roe deer, boar, horse, bison, and aurochs, but it is the red deer which is the primary species. The correlations between red deer %NISP and %NISPwild exceed 0.600 (Pearson r=0.615, Spearman rho=0.639). Red deer is thus the major wild species in the assemblages. The remainder of this chapter will be concerned with the patterning that can be observed in the spatial distribution of the individual species and will discuss the extent to which the patterns reflect the survival of hunting in Europe and whether hunting was sustainable when farming became the predominant subsistence mode.

Red deer

Although there are a few occurrences of very high frequencies of red deer (>80% NISP) in Western Europe during the first half of our period, frequencies are on average slightly higher during the later part, when the mean value NISP is 11.13 per cent in comparison to 11.75 per cent (see Table 2.1). The average figures however conceal marked regional and chronological fluctuations. At Herriko Barra (N. Spain) red deer represents more

Table 2.1: Average frequencies of major wild taxa from European Neolithic sites. Data shown by region and 100 year period.

	aurochs	boar	chamois	horse	ibex	red deer	roe deer
6TH MILLENNIUM	1.782	3.247	0.088	0.211	0.136	11.872	2.511
north of 50N	0.780	3.429	0.000	0.267	0.000	8.128	1.660
south of 50N	2.067	3.195	0.112	0.196	0.174	12.936	2.753
5499 to 5000 BP	1.440	3.381	0.122	0.221	0.181	11.931	2.129
5999 to 5500BP	2.437	2.989	0.023	0.192	0.050	11.758	3.241
5000 to 5099 BP	1.191	3.292	0.013	0.070	0.013	14.094	2.074
5100 to 5199 BP	2.329	3.173	0.058	0.321	0.096	10.846	1.548
5200 to 5299 BP	0.942	5.816	0.025	0.285	0.361	15.329	5.368
5300 to 5399 BP	0.692	0.501	0.342	0.017	0.000	8.355	0.915
5400 to 5499 BP	0.100	2.881	0.827	0.476	1.079	4.824	0.405
5500 to 5599 BP	1.994	3.080	0.000	0.042	0.075	7.686	0.660
5600 to 5699 BP	3.302	5.608	0.140	0.351	0.087	12.459	1.455
5700 to 5799 BP	0.181	0.553	0.000	0.000	0.015	5.896	3.945
5800 to 5899 BP	0.000	0.157	0.000	0.063	0.000	13.543	0.529
5900 to 5999 BP	4.103	2.592	0.000	0.472	0.000	20.269	10.177

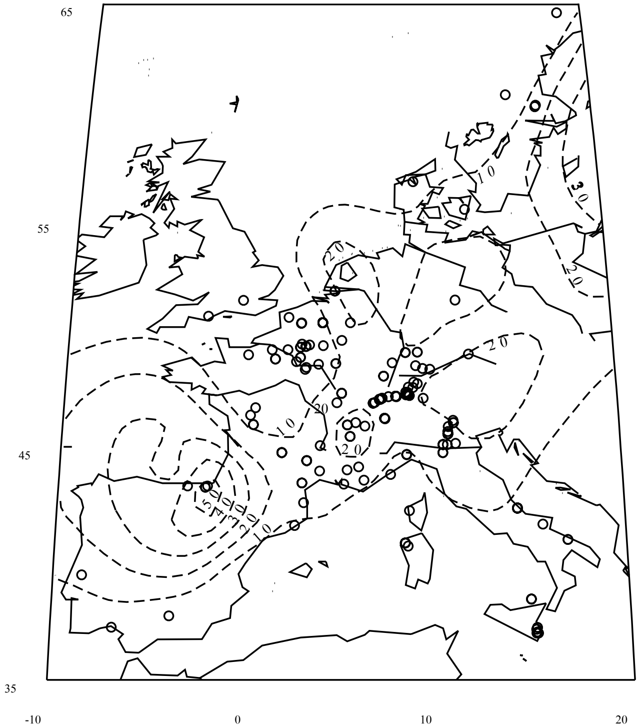

Figure 2.2: Geographical distribution of red deer frequencies across Western Europe during the sixth millennium BP, as Figure 2.1.

than 92 per cent of the faunal assemblage at 5960BP. At the same time (also 5960BP) red deer reaches 80.2 per cent at Vieille Eglise (Thuy) in the Savoie region of France. However, regional mean values for the period as a whole are much lower, approximately 8 per cent in the north and 13 per cent in the south. There are broadly defined spatial patterns observable among red deer assemblages (Figure 2.2), with higher frequencies found at sites in the Alpine zone, south west France and Spain, in areas of probable Mixed-Oak-Forest and Mixed Temperate Deciduous Forest (Issar 2003; Marambat 1995).

Boar and roe deer

Boar and roe deer are less important than the red deer but consistently form 5–10 per cent of the regional fauna. Mean values of both species are considerably lower than for red deer: roe deer averages 2.7 per cent in the south, 1.7 per cent in the north, and boar 3.2 per cent and 3.4 per cent respectively. Both are localised (Figures 2.3a, b), found primarily where woodland cover was maintained and where clearance, which expanded significantly during the sixth millennium, was at a minimum. Average values across Europe are highest during the middle of the period (Table 2.1), with mean values between 5600 and 5699 BP in excess of 5 per cent.

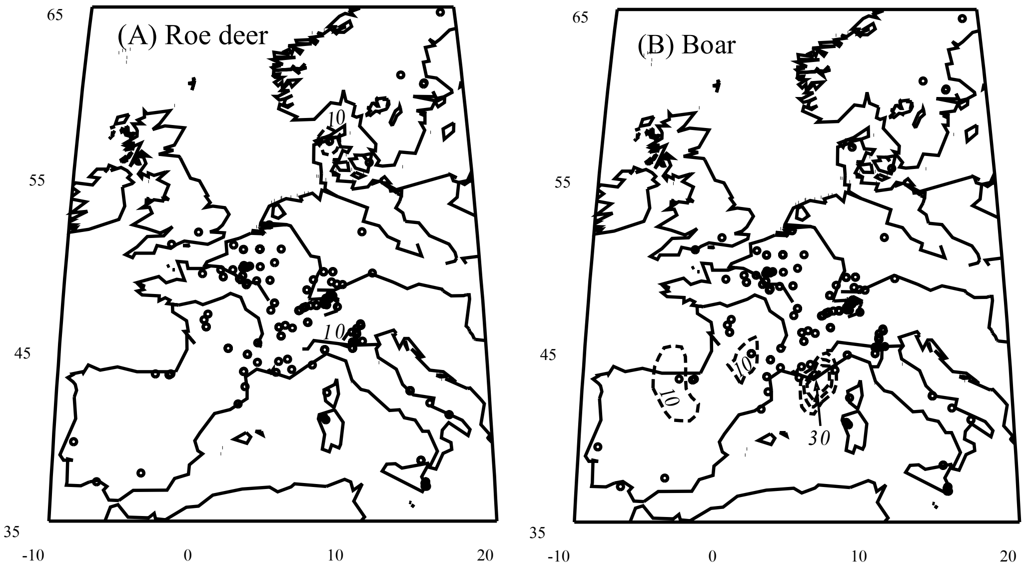

Figure 2.3: Sites with (A) roe deer and (B) boar across Western Europe during the sixth millennium BP, as Figure 2.1.

Although boar occurs in some quantity at a number of sites in both the northern and southern regions it is most abundant in the 40 to 45 degree belt. At Fonbrégoua in southern France, for example, wild boar represents over 90 per cent of the fauna at about 5050 BP; in Sicily at Riparo della Sperlinga di S Basilio II (*c.*5600 BP) it makes up more than 53 per cent of the assemblage; and at Trou de la Heid à Comblain-au-Pont (Belgium) the figure at *c.*5500 BP is 80 per cent.

Roe deer occurs in low numbers throughout much of Europe at frequencies of under 10 per cent at over 94 per cent of sites, with an average of 2.5 per cent in the sixth millennium BP. Its peak regional abundance values are in the southern Alps and northern Italy (e.g. at the sites of Soman and Vhò) (Figure 2.3a). The highest average values occur during the first 100 years of the sixth millennium BP (Table 2.1). In the Northern Tyrol today it is one of a group of species which regularly occur together, consisting of roe deer, red deer, ibex and chamois (Hamr 1985, 106). Where the roe deer is abundant during the Neolithic, percentages range from 10 to over 40 per cent, but these are isolated occurrences and make up only 5 per cent of the database. The roe deer is a pioneer species commonly associated with biotic communities at an early stage of succession. It is frequently found in 'young woodlands or other disturbed habitat which offer a rich ground vegetation' (Putnam 1986, 113). Where the boar and roe deer occur together foraging may be occurring close to human activity. Such environments are usually young, open deciduous woodland in which light easily reaches the floor. We might well be describing areas in the forest or woodland cleared by Neolithic farmers for cultivation and stock breeding.

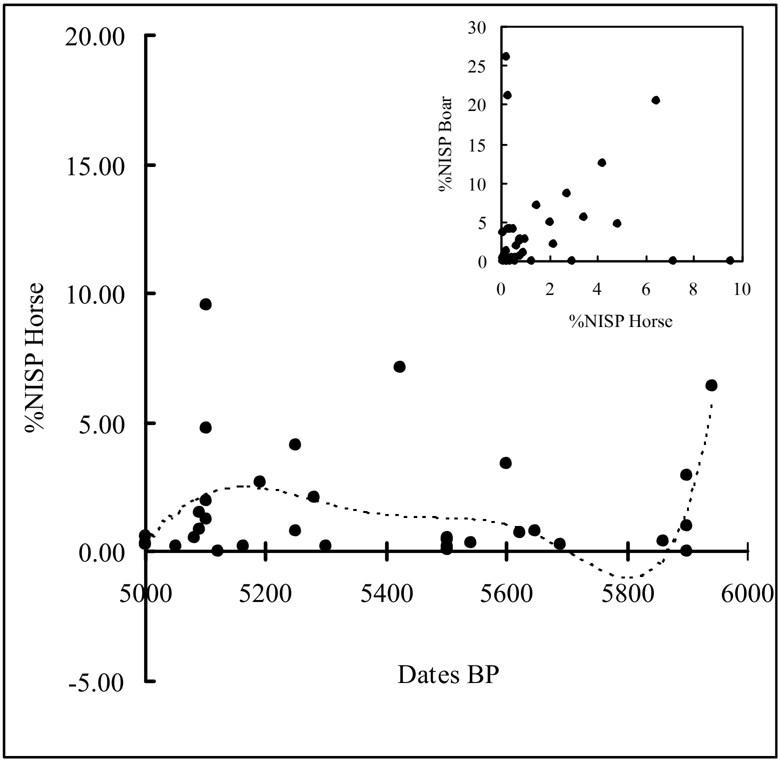

Figure 2.4: Percentage (NISP) of horse between 6000 to 5000 BP. The inset chart shows the relationship between horse and wild boar during the sixth millennium BP.

Horse

The %NISP of horse is shown in Figure 2.4. The horse is frequently considered to be one of the species which either disappeared completely at the end of the Upper Palaeolithic or declined so markedly that it became insignificant during the first half of the Post-Glacial until its re-introduction its domestic form. In a recent discussion of the (largely French) archaeology of the horse, the authors identify the lack of archaeozoological data from the period between *c.*8000 and 3000 BC as a major problem in the study of the origin of domestication of the horse in Europe (Arbogast *et al* 2002). In part this lack of data is because research attention has been given to the appearance of domestic species associated with the Neolithic and the concomitant, assumed, decline of hunting. Thiébault (2001, 40) explains the quasi-disappearance of the horse from faunal assemblages from post Upper Palaeolithic to Neolithic sites as directly attributable to the emerging deciduous forests which favours the other large herbivore species of the period, and raises the possibility that just a few individuals survived and adapted to this new environment. This suggestion is supported by the relationship between records of horse and boar. As the inset in Figure 2.4 shows, in general there is a positive correlation between numbers of horse and boar, although there are outliers which do not follow the main trend. Given the tendency of the boar to occupy areas of woodland cover and to avoid areas of deep snow and harsh frosts (Bjärvall and Ullström 1986, 176), the finds might suggest that the horse at this time was a severely localised population taking (winter ?) refuge in wooded valleys. There is no relationship between finds of roe deer and horse. As already stated above the roe deer is a pioneer species of young woodland and disturbed habitat. Where the boar and horse are found together we may be looking at established woodland refuges.

The horse is not therefore absent during the Neolithic of Western Europe, but frequencies are indeed very low during the sixth millennium, with mean values north and south of 50 degrees latitude of only 0.3 and 0.2 per cent respectively (Table 2.1). Between 5000 and 5500 BP the mean value is 0.2 per cent and between 5500 and 6000 BP it is fractionally lower. However, it is not rare in all sites. The peak for horse is at the site of Roucadour (Lot, France) where in couche C (Chasséen) the species represents over 6 per cent of the fauna, and in the contemporary couche A1 it is more important at 26 per cent (Lesur *et al.* 2001). There are also (undated) Neolithic sites in the Loir-et-Cher department where frequencies of horse reach 40 to 75 per cent (Cabard 1987). These high percentages are not found elsewhere in Europe. Benecke (1994, 341–48) lists a few examples of West and Central European Neolithic assemblages with in excess of 10 per cent horse, but most are single-figure frequencies. In general however the horse is found regularly only in the Iberian Peninsula (Morales-Muniz *et al.* 1998), but even there frequencies are low at individual sites. The numbers increase only during the Eneolithic (Morales-Muniz *et al* 1998, 80–82). In Germany, Switzerland and Austria average figures are also below 1 per cent (see Benecke 1994, 346–7, table 21), while frequencies in the Netherlands and Belgium are similarly low.

Aurochs

The aurochs is the largest of the wild game species present during the sixth millennium. There are some sparse and widely scattered sites with high frequencies (>30%NISP) in France (Roucadour and Planches-près-Arbois), Germany (Bruchsal-Scheelkop and Regensburg-Pürkelgut) and Italy (Razza di Campegine). However, the average for the sixth millennium is less than 2 per cent (Table 2.1). Where frequencies peak (Figure 2.5a) the sites are in wide or narrow valleys associated with rich valley woodland vegetation. Furthermore the distribution of this species shows a marked correlation with boar (see Figure 2.5b in which the two distributions are superimposed). Calculation of the Spearman Rank Value Correlation Coefficient for these two species yields a value of 0.435. Although this value is not high, the correlation is higher than with any other species in the database.

DISCUSSION

The data and maps have revealed the relative abundance of the main wild herbivores on archaeological sites, but what do they tell us about hunting during the Neolithic period? It is clear that wild game was abundant or relatively abundant across much of Western Europe. Hunting does not disappear, and wild animals continued to be used after the

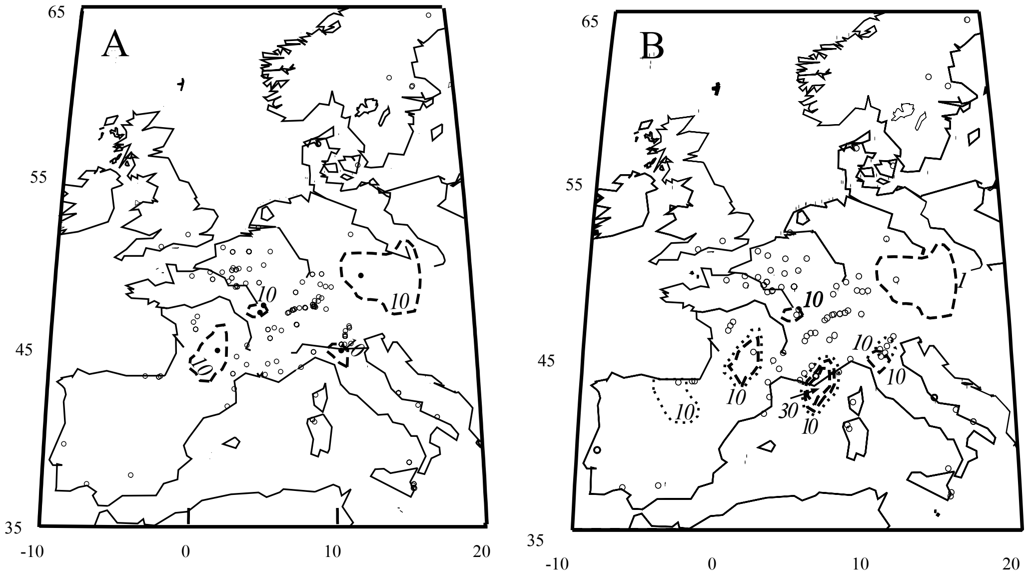

Figure 2.5: Geographic distribution of (A) aurochs and (B) aurochs and boar across Western Europe during the sixth millennium BP, as Figure 2.1.

end of the Mesolithic. In short, carcases have been obtained and processed for a purpose, and for this the animals will probably have been hunted. The patterning also tells us that the importance of hunting varies across Western Europe through space and time, with a tendency for average values to be higher in the south than the north, but hunting does not, as one might expect, decline systematically in importance over time.

Neolithic faunal assemblages almost always contain a mixture of wild and domestic species, which occur in varying and contrasting frequencies. It is clear that an abundant wild faunal resource base was available in the local environment and it was exploited in a significant way, even if hunting no longer formed the basis for a primary subsistence strategy. There are various possible explanations for this co-occurrence of wild and domestic animal species in the Neolithic of Europe. Some of these are summarised here.

Primary hunting

This includes the situation in which hunting has not yet been overtaken by farming/stockbreeding/pastoralism. The possibility that hunting was a major component of the subsistence at these sites should not be ignored. This could account for a high percentage of wild game in early Neolithic sites but in fact game makes up in excess of 75% NISP at more than 13 per cent of Middle and later Neolithic sites.

Mixed hunting and farming

The same agricultural group may carry out varying proportions of each activity; in more than 62 countries today wild game and fish provide more than 20 per cent of the rural diet animal protein, even among 'agricultural peoples' (Kelly 1995). Among some groups the percentage remains much higher, with wild resources forming an important element of the local subsistence economy. At more than half of the sites of the sixth millennium wild game exceeds 20 %NISP. At these sites a seasonal reliance on hunting is a possibility which needs to be considered, for it may not be worthwhile killing domestic livestock which have been carefully bred and maintained throughout the year where wild game was available.

Exchange hunting
Hunted game may be exchanged for other items, food or otherwise. This method of acquiring food from wild animals could explain the very low frequencies of wild species in assemblages which relate more directly to husbandry and agricultural activity.

Replacement hunting
In some situations hunting replaces agriculture as the primary animal economy, for reasons such as severe climatic change or a failure of the 'harvest' of domestic animals.

Protection
The protection of people and domestic stock would have been achieved by killing carnivores such as wolf, bear and fox which threatened domestic livestock, for wildlife is largely uncontrolled and might have been considered to be a pest. Furthermore, limiting the size of the local carnivore population reduces competition for resources (Robinson and Bennett 2000). During the Palaeolithic and Mesolithic, the wolf (*Canis lupus*), fox (*Vulpes vulpes*) and brown bear (*Ursus arctos*) would have remained competitors for resources and, during the Neolithic and later, would also have been a threat to domestic livestock. As a result, many of the large and medium-sized carnivores recorded at archaeological sites may have been killed as a result of attempts to restrict livestock depletion due to predation. Finally, the hunting of local herbivores reduces the risk of damage to and loss of crops in the area (Bennett and Robison 2000, 500).

Non-subsistence hunting – the religious, symbolic and ideological
Game taken only in small numbers characterises hunting which is not related to fulfilling dietary needs. Examples are trophy hunting, sport, 'rites of passage' and 'blooding'. At this time, as both food and raw materials were increasingly derived from domestic livestock, hunting may have begun to reflect social and cultural traditions rather than subsistence. Prestige may be accrued through hunting and killing animals not reared as domestic stock and this can lead to increased social status in the community. Evidence for a symbolic role for hunting is seen in the remains of wild game animals placed carefully or strategically in graves, as in the Neolithic tombs in the Paris Basin (Sidéra 2000). Hunting equipment was present in in graves in Cerny in the southern Paris Basin but not in the Grossgartach burials in Alsace (Tresset 1997, 311; Duhamel *et al.* 1997). Arrowheads were found in half of the Cerny burials but in only 7 per cent in Grossgartach burials. This may point to a continuation of hunting in the Paris Basin, though the fauna from sites in the two areas is dominated by remains of domestic animals. At the Cerny sites of Chatenay 'Les Patures' and Gours aux Lions domestic animals made up 94 and 97 per cent of the fauna while at the Grossgartach sites the frequency is between 88 and

100 per cent. In the Passy cemetery in the Cerny group several graves contained red deer bones and antler pieces (Duhamel *et al.* 1997, 397–448). Wild game and/or hunting equipment in this context may be a marker of status or it may reflect a religious belief which features the 'animals of the forest' as primary actors or as representatives of the gods; the 'wild' may appease the ancestors whom the deceased is soon to meet in a way that domestic stock can not. Wild game may be considered a naturally replenishing resource which the deceased can exploit on his or her journey to the afterlife when there is no access to the domestic stock which must be maintained by mortal man.

Each of these impulses for hunting may have been present at different times and at different sites. Even at a low level, hunting must be sustainable, even if it decreased as farming and pastoralism increased and if its relative role in the subsistence strategy changed. How sustainable was hunting in Western Europe in the changing ecological, economic and social environment of the middle and late Neolithic? Unsustainable hunting results in resource depletion, since the density of the prey population decreases as the rate of loss of prey exceeds natural mortality. More time and energy have to be expended as the yield from hunting declines. This would have been particularly true among the farming and stock-breeding communities of the Neolithic, as time spent on hunting could more efficiently be spent on an activity more profitable for food production. Hunting can also result in a decline in body size of the prey species and reduce the age at which animals reproduce for the first time (Bennett and Robinson 2000, 500). This results in lower future production of wild game, production upon which the sustainability of hunting depends, and a change in the overall composition of the local wildlife population.

If the harvesting of game is to be sustained, game must not be allowed to decline in number sufficiently to damage stock availability. If exploitation exceeds replenishment then the population levels fall and hunting is no longer sustainable. Where exploitation exceeds replacement, local extinction may result. It is almost certain that the role of the species in the ecosystem will change and this will have significant consequences on the environment as a whole (Bennett and Robinson 2000, 502). Before reaching the point of extinction the local game population may, through excessive hunting, reach a density at which it is no longer of interest to the hunter as a regular food resource. The species may be taken on occasion, but will no longer have as significant and regular, let alone abundant, role to play in the subsistence strategy. This may have been the case in the decline of the horse during the early-middle Holocene in Western Europe.

Ideally for sustainability, hunting will have little or no impact on the local wildlife/game population. It will occur where yield warrants the effort expended. Thus farmers are more likely to hunt local game populations which are relatively dense, e.g. during the rut, when deer congregate and are in good condition. Open deciduous forests such as were present in parts of Middle and Later Neolithic Western Europe would have had a higher biomass of harvestable species than would closed coniferous forests (Bennett and Robinson 2000, 504). However, increasing human population density and reduced forest cover may result in a lower local game population and therefore a decline in potentially sustainable hunting. Low prey densities do not, however, necessarily mean that hunting becomes unsustainable (Robinson and Bennett 2000, 6). The key to sustainability is that production must equal or exceed the harvest. A wild animal population must satisfy the social and economic needs of the people using the resource and be able to withstand the exploitation.

Where game is easily exploited due to ease of access for the hunters hunting pressure may well increase. Where access is difficult game population levels will not decrease to the same extent. Game will continue to thrive; population declines may be attributable to other, non-human, factors. Difficulty of access to these mountain-dwelling species might explain the rare finds of ibex and also of chamois in the Neolithic as well as their continued population in the Alps and Pyrenees today.

Species which adapt well to disturbed environmental conditions such as forest clearings, field and settlement edges may be more resilient to hunting. Thus the woodland or forest-dwelling boar and the pioneer species roe deer adapted to clearings associated with settlements which had rich ground vegetation and both were regularly hunted. High reproductive capacity goes some way towards guaranteeing future generations and a sustainable harvest. Likewise species such as roe deer, which can easily colonise one area from another, appear to be resilient to hunting pressure, and the hunting of these will therefore give the impression of being a sustainable activity. Game may be killed in an area only to be replaced by others of the same species taking up residence where the original population no longer exists. This will be interpreted in the archaeological record as continued sustainable hunting or exploitation.

Whereas hunter-gatherers frequently move across their landscape and territory in response to moving game, an increase in sedentism, such as we see in the Neolithic, meant that such movement was no longer undertaken on a regular basis. The hunting of migratory game was therefore no longer sustainable on a long-term basis. Hunting of the type commonly proposed for the Palaeolithic and Mesolithic of Western Europe is thus no longer seen. Traditional hunting territories must have disappeared, while the technology and techniques involved in hunting, and the associated strategic planning, must have been lost. Instead hunting becomes a smaller component of the subsistence strategy. This is evident in the low frequencies of bones of wild game animals in the many Neolithic assemblages dominated by larger domestic species. Sites with higher frequencies appear to be specialist hunting camps; they are located in key positions at which game was exploited for specific purposes for a short period of time, perhaps seasonally, as at Molino Casarotto (Fimon, Italy) and Roucadour C (France) where there was more than 90 per cent and 99 per cent of wild animals respectively.

In conclusion, given the relative importance of wild game at some sites and in some areas of Western Europe during the Middle/Late Neolithic, it is unlikely that any of the key species was over hunted to a point of local extinction. Population levels may have declined to a point at which the hunt was no longer worthwhile for subsistence purposes, but hunting survived at a low level as sport, display, or a *rite de passage*. From this time onwards the only subsistence hunter would have been the poacher, the illegal taker of game or fish, first mentioned some five thousand years ago in the Epic of Gilgamesh (Norden 1997, 144). The subsistence hunter became the sportsman. From the early Neolithic onwards in Europe and beyond hunting changed from a subsistence activity to one which was concerned with economic, societal and recreational realms.

NOTE

The research of which this paper is a part concerns changing patterns in post-Mesolithic hunting strategies in Europe. Its origins lie in work undertaken for the Human Diversity Project (King's College Research Centre, Cambridge, 1995–1998) in which a database of archaeological cultures dated between 35,000 and 5000 BP was compiled. Only a fraction concerned the evidence for economic strategies; however, the continuing role of hunting as a subsistence strategy during the Neolithic soon became clear. This led to a decision to investigate further and to consider the role of hunting in later prehistory. More about the project is available at http://www.bgc.mpg.de/bgc_prentice/projects/biome6000/index.html. The software used in this research was SYSTAT 10, produced by Systat Software Inc.

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The Bear, the Wolf, the Otter and the Weasel: Carnivorous mammals in the Dutch Neolithic

J. T. Zeiler

INTRODUCTION

Skeletal remains of wild carnivorous mammals are frequently found in Neolithic sites in the Netherlands. In most cases they are from small and medium-sized species such as polecat (*Mustela putorius*), wild cat (*Felis silvestris*), otter (*Lutra lutra*) and fox (*Vulpes vulpes*). Remains of other carnivores, both large and small, such as wolf (*Canis lupus*), lynx (*Lynx lynx*), stoat (*Mustela erminea*) and weasel (*Mustela nivalis*) are surprisingly rare. Here, the possible causes of this phenomenon are discussed by presenting a review of the occurrence of carnivorous mammals in the Dutch Neolithic in relation to the environmental conditions and human behaviour. It must be stressed that nearly all Neolithic sites with preserved organic remains are situated in the low-lying Holocene landscape of the western and central parts of the Netherlands. The few data from the higher Pleistocene parts all come from humid contexts like bogs and river valleys. Therefore our view of the distribution of the wild fauna in the Neolithic is not complete.

In this contribution the data are used from a selection of 25 sites, dating from Early to Late Neolithic (Table 3.1, Figure 3.1). The sites were selected on the basis of variations in the environment, size, site function and chronology. They can be divided into three groups, according to their environment.

1. Sites in the freshwater marshland in the Holocene delta of the rivers Rhine and Meuse. These are: Hardinxveld-Giessendam De Bruin (Overstegen *et al.* 2001), Hoge Vaart (Laarman 2001), P14 (Gehasse 1995), Swifterbant S3 and Hazendonk (Zeiler 1997), Vlaardingen and Hekelingen I (Clason 1967) Hekelingen III (Prummel 1985), Barendrecht (Zeiler 2000), Molenaarsgraaf and Ewijk (Clason 1977, 1990). Except for Hazendonk, which was situated on a river dune, all sites are settlements on levees and stream ridges of (tidal) creeks or rivers. The levees, dunes and stream ridges were covered with rich mixed deciduous forests and were surrounded by a landscape of carrs alternating with open areas and lakes.
2. Sites on the coastal barriers and Older Dunes along the west coast: Voorschoten-Boschgeest and Leidschendam (Groenman-van Waateringe *et al.* 1968), Wateringen (Raemaekers *et al.* 1997), Ypenburg (De Vries 2004) and Schipluiden (also known as Harnaschpolder; Zeiler in press). The dunes and coastal barriers were originally covered with deciduous forests; to the east the area was bordered by vast swamps.
3. Sites in the saline and brackish environments (tidal flats and salt marshes) in the northwest: Zeewijk (De Vries 1996), Molenkolk I and II, Keinsmerbrug, Mienakker and Slootdorp (also known as Bouwlust; Lauwerier 2001; Van Heeringen and Theunissen 2001), Aartswoud

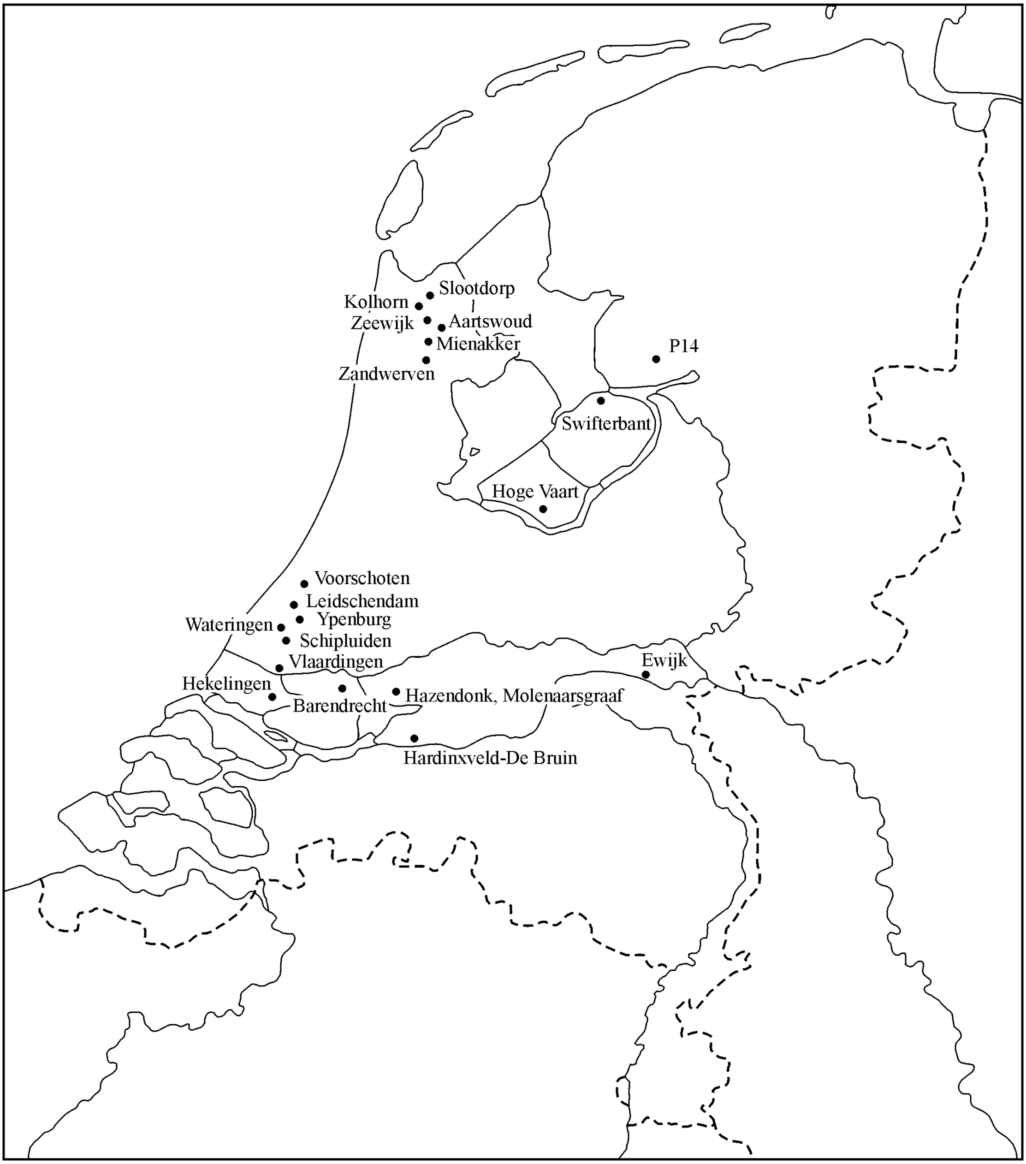

Figure 3.1: Location of Neolithic sites in the Netherlands. Drawing by S. Tiebackx.

> (Gehasse 2001) and Kolhorn (Zeiler 1997). Zandwerven lay on a dune, while the other settlements were all situated on levees bordering creeks. The landscape in this area was open and treeless, except in the vicinity of Slootdorp where deciduous forests were present.

It must be stressed that there are differences between the sites in collection methods. In many cases the bone material was collected both by hand and by sieving, while in some (especially older) excavations no sieving took place. This was the case in Hekelingen I, Ewijk, Molenaarsgraaf, Voorschoten-Boschgeest, Leidschendam and Wateringen. The same applies to Zandwerven, whereas in the other sites in the same area (Kolhorn, Keinsmerbrug, etc.), the material was exclusively collected by sieving.

Most sites mentioned here are considered (semi-)permanent settlements, but some (Hardinxveld-Giessendam De Bruin, Hoge Vaart and Mienakker) are most likely extraction camps which were used in different seasons. In the case of Hazendonk and Vlaardingen-2b phase at Barendrecht the character of the habitation is not clear.

The faunal spectra of the sites reflect different stages of transition from a hunter-gatherer economy to an economy based on stock-breeding and crop cultivation. Although by the end of the Neolithic this transition was more or less completed, it was by no means a straightforward process. It seems to be correlated not only with chronological and cultural changes, but also with environmental conditions. The data strongly suggest that if conditions were favourable for both the keeping of domestic stock and crop cultivation, people switched to an economy based almost completely on husbandry and agriculture, even if other groups continued to rely to a great extent on hunting. This is illustrated most clearly by the sites belonging to the Vlaardingen culture (Middle Neolithic B, 3400–2900 cal BC). At Ewijk, located on a broad stream ridge in the eastern river area, hunting played only a minor role in the meat supply. The same applies to Zandwerven in the northwest and – to a somewhat lesser extent – to the sites on the dunes and coastal barriers along the west coast: Voorschoten-Boschgeest and Leidschendam. These are all good examples of the sites of the component of the Vlaardingen group that concentrated more on food production. At Zandwerven this was not only apparent from the faunal spectrum (although the number of identified bones is small), but also from the ard marks which showed that crops had been grown at the site itself (Bakels and Zeiler 2005). By contrast, hunting was far more important at the contemporaneous Vlaardingen-sites located on small levees and river dunes in the freshwater area (Vlaardingen, Hekelingen I and III and Hazendonk). Here conditions seem to have been unfavourable for crop cultivation and the inhabitants relied on both husbandry and hunting for their meat supply (Zeiler 1997). Also in the saline and brackish environments there were groups that relied to a great extent on hunting, as the case of Slootdorp shows. Again, environmental factors, i.e. the presence of woods in the vicinity, seem to have played a role.

OCCURRENCE OF CARNIVOROUS MAMMALS

The proportion of wild carnivorous mammals in the total number of identified mammal remains varies from site to site (Table 3.1). Apart from taphonomic factors and differences in collecting methods, these variations can be explained by the differences in subsistence economy – i.e. in the relative importance of hunting – and the environmental conditions.

As mentioned earlier, at most sites in the freshwater areas hunting played an important role in the meat supply of the inhabitants. At these sites remains of carnivorous mammals are well represented. On the contrary, at Ewijk and Molenaarsgraaf, where stock-breeding was the main source of animal protein, carnivores are either absent or very scarce. Surprisingly enough the same applies to the Vlaardingen-phase at Barendrecht, although

Table 3.1: Number of identified remains of mammals, wild mammals (excluding small rodents and insectivores) and wild carnivorous mammals in 25 Dutch Neolithic sites. See Fig. 1 for location of sites. Keinsmerbrug and Molenkolk (not on Figure 1) are situated in the same micro-region as Kolhorn, Aartswoud, Mienakker, etc. Key: ENB Early Neolithic (4900–4100 cal BC), MNA Middle Neolithic A (4100–3400 cal BC), MNB Middle Neolithic B (3400–2900 cal BC), LNA Late Neolithic A (2900–2450 cal BC), LNB Late Neolithic B (2450–2000 cal BC).

Site / landscape	Period	Otter	Badger	(Pine) marten	Polecat	(Other) Mustelids	Wild cat	Lynx	Fox	Wolf	Brown bear	Seals	Total wild mammals	Total mammals
Freshwater marshes														
De Bruin, phase 3	ENB	118	-	-	1	-	7	-	1	-	-	1	493	609
Hoge Vaart	ENB	10	14	11	-	-	1	-	-	-	4	-	695	1523
P14	ENB/ MNA	15	1	5	1	-	1	-	-	-	1	-	633	1084
Swifterbant S3	MNA	598	-	-	3	-	1	-	2	-	6	1	1367	4042
Hazendonk														
- phase Hazendonk-1/-2	MNA	51	-	-	-	-	-	-	-	-	-	-	124	167
- phase Hazendonk-3	MNA	43	-	-	1	-	-	-	-	-	-	-	394	490
- phase Vlaardingen-1b	MNB	57	1	5	-	-	1	-	3	-	3	-	411	524
- phase Vlaardingen-2b	LNA	57	1	1	2	-	4	-	2	-	-	-	532	690
Hekelingen I	MNB	4	-	7	-	-	8	-	-	(2)	1	-	278	509
Hekelingen III	MNB	21	-	10	4	1	4	-	-	2	5	4	695	1315
Vlaardingen	MNB	26	-	21	14	-	20	-	-	-	4	3	1349	2369
Ewijk	MNB	-	-	-	-	-	-	-	-	-	-	-	20	307
Barendrecht 20-58														
- phase Potbeaker	LNA	95	-	1	3	-	11	-	1	-	-	-	165	846
- phase Vlaardingen-2b	LNA	2	-	-	-	-	-	-	-	-	-	-	23	76
Molenaarsgraaf	LNB	-	-	-	-	-	-	-	-	-	1	-	16	257
Coastal barriers / older dunes														
Wateringen	MNB	7	-	-	-	-	3	-	-	-	-	1	24	656
Ypenburg	MNB	7	-	-	3	-	7	-	1	-	-	7	112	636
Schipluiden	MNB	199	-	4	15	1	39	3	2	4	11	8	4085	9669
Voorschoten-Boschgeest	LNA	-	-	-	-	-	-	-	-	-	1	1	78	432
Leidschendam	LNA	-	-	1	-	-	-	-	-	-	-	2	54	463
Tidal flats / salt marshes														
Slootdorp	MNB	1	-	1	-	-	-	-	-	-	-	-	422	639
Zandwerven	MNB	-	-	-	-	-	-	-	-	-	-	-	1	49
Zeewijk	LNA	-	-	-	-	-	-	-	-	-	-	2	2	67
Mienakker	LNA	-	-	-	-	2	-	-	-	-	-	88	93	891
Aartswoud	LNA	-	-	-	-	-	-	-	-	-	1	-	18	650
Keinsmerbrug	LNA	-	-	1	1	-	-	-	-	(1)	-	2	6	217
Molenkolk I	LNA	-	-	-	-	-	-	-	-	-	1	-	14	23
Molenkolk II	LNA	-	-	-	1	-	-	-	-	-	-	-	1	105
Kolhorn	LNA	3	-	1	10	1	1	-	1	-	-	1	88	501

bones of wild mammals are relatively well represented in the faunal spectrum. At most sites with a fair amount of carnivorous mammals, otter is the most numerous, followed by (pine) marten (*Martes cf. martes*), polecat and wild cat. Fox, badger (*Meles meles*) and seals (Phocidae) are much less common, and both wolf and small Mustelids are only found occasionally. Of the large carnivores, brown bear is the most common, while lynx is absent at all sites. Considering the environmental conditions, the many occurrences of otter are not surprising. The finds of seal bones at De Bruin, Swifterbant, Hekelingen III and Vlaardingen indicate that there must have been a connection with the sea through rivers or creeks.

Compared to the freshwater area, hunting was less important at the sites on the coastal barriers and the Older Dunes, with the exception of Schipluiden. Consequently this site is the richest in remains of carnivorous mammals. It also has the highest number of species, which can at least partly be attributed to the large number of identified remains. Again, otter is the most common species, followed by wild cat and polecat. Schipluiden is one of the few sites where bones of wolf were found, and it is the only site with remains of lynx. With a skull from the Roman site of Valkenburg (Van Bree and Clason 1971) and a yet undated (and unpublished) mandible from the IJsselmeerpolders it is the third find of this species in the Netherlands, and the first official record from a prehistoric context.

As in the freshwater marshes, the numbers of fox and small Mustelid bones are low. Schipluiden is the only site where – among the material from the 4 mm sieve – weasel (*Mustela nivalis*) was found. (Pine) marten seems to have been far less common in comparison. Perhaps the woods on the levees and stream ridges in the freshwater area provided better conditions for these animals than those on the coastal barriers and Older Dunes. The low numbers of seal remains are quite surprising in view of the location. It seems that at all sites the coast was exploited only on an extensive basis.

In most sites located in the saline and brackish areas (tidal flats and salt marshes) of the northwest, hunting played a minor role in the meat supply. This will partly have been due to the fact that the majority of the sites can be dated to the Late Neolithic. Besides, the open and treeless landscape will have been unfavourable for many wild species. Consequently, remains of both large and small carnivores are scarce. Just as at the sites on the coastal barriers and Older Dunes, seals are poorly represented; the exception of Mienakker, where 88 seal bones were recovered, points to a special activity at this site. The other site with a fair amount of wild carnivores is Kolhorn, where seven species are represented. One of these is stoat (*Mustela erminea*), the only find known so far for the Neolithic. Slootdorp is also a special case; it is the only of the sites discussed here that was located in the vicinity of a wooded area, so one might expect a higher number of carnivores here, but the large number of bones of wild mammals are from red and roe deer, and indicate special hunting activities.

DISCUSSION AND CONCLUSIONS

The occurrence of wild carnivores in Dutch Neolithic sites is influenced both by the environmental conditions and the type of subsistence economy. However, this does not always explain why a certain species is absent or rare. The poor representation of seals in the coastal areas (with the exception of Mienakker) must be explained by human behaviour rather than from environmental conditions. The same applies to the small Mustelids, which are known so far from only one find of each of stoat and weasel. In view of their (sub)recent distribution it is hard to imagine that this is due to the rarity of these species. If we suppose that the reason for hunting them was their fur, it would appear that because of their small size people preferred to hunt larger fur animals such as otter and beaver. On the other hand, the population densities of otter and beaver might have been higher in comparison to the small Mustelids, especially in the freshwater area, which would have made it easier to catch them.

Whereas the fox is present in all three environments, the badger only appears in some sites located on river dunes and sand ridges in the freshwater area; the species is absent in the coastal sites. This seems to correspond with its distribution around AD 1900 and that is considered a reliable reflection of its former distribution (Broekhuizen *et al.* 1992).

Historic sources (see e.g. Schrijnemakers 1989) mention the occurrence of wolves and wolf hunts even in recent times in different parts of the Netherlands: the northern province of Friesland (17th century), the region of The Veluwe (Central Netherlands; 18th century) and the southern province of Limburg (19th century). As for the brown bear, it is known from historic sources that it occurred in the Netherlands into medieval times (10th–11th century AD); in Belgium the brown bear survived until the 12th century AD (Ervynck 1993). In view of this, the scarcity of wolf bones in Neolithic sites is striking. Apparently, for one reason or another, the species was only hunted occasionally. As for the lynx there are no historic records of its occurrence in the Netherlands. Probably it always was a rare animal before it finally disappeared from the Dutch fauna, if it was present at all. All the finds known so far are cranial elements and could thus come from hides that were imported from outside the present day territory of the Netherlands.

If one looks at the distribution of the skeletal elements of the other species, it appears that in most cases both cranial and postcranial parts (including long bones, vertebra, etc.) are well represented, indicating slaughtering in the settlement. Furthermore, cut marks indicate that a number of species were not only hunted for their fur, but also for their meat. This applies to otter, fox, badger, grey seal and brown bear (Zeiler 1997). However, for brown bear, the distribution of skeletal elements is different. In most of the species there is no clear preponderance of cranial over postcranial elements and vice versa, but more than half of the remains of brown bear are cranial elements (including loose teeth). Among the finds of postcranial bones, 11 out of 16 are lower limb bones, i.e. phalanges or metapodials. Only in Hazendonk (phase Vlaardingen-1b), Hekelingen III and P14 other bones are present: patella, lumbar vertebra, humerus, tibia and femur. Thus it appears that most remains of brown bear come from hides or furs with the head and feet still attached, whether they represent locally hunted animals or were imported. It is likely that the hides, claws and teeth had a special status or a religious or ritual significance in Neolithic society. One could also speculate that, because of its special status, bear meat was only eaten on special occasions. The only example so far of cut marks indicating consumption – the lumbar vertebra from Hazendonk – gives no answer to that question.

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Dogs and Wolves in the Neolithic of Britain

Kate M. Clark

INTRODUCTION

The data for the study of Neolithic dogs and wolves in Britain is characterised by a very limited body of material, especially for wolves. When Harcourt published his findings on prehistoric and early historic dogs in 1974, a work which remains as the reference standard for dog size and morphology in British archaeology, he concluded that, in the Neolithic, 'the general uniformity suggested that there was a single freely interbreeding and uncontrolled population'. A re-examination of Neolithic dogs by Clutton-Brock in 1977 led her to support this conclusion, and little has been published since then to challenge this view. This paper looks again at Harcourt's statement, and at the new data that have appeared since 1977, in the light of recent studies of the effect of uncontrolled dogs on modern wolf populations. The underlying question that these later works raise for the Neolithic is this. Are there in fact two freely interbreeding and uncontrolled populations, the dog and the wolf, and is the hitherto invisible Neolithic wolf actually apparent in the dog? The domestic dog first appears in the British archaeological record some 10,000 years ago and, as all species of *Canis* (wolf, coyote, jackal and dog) are reproductively compatible, there is always opportunity for interbreeding between dogs and wolves where these species occupy the same environment and are not prevented from mating. This paper discusses the implications of this in Neolithic Britain.

THE NEOLITHIC DOG IN BRITAIN

In 1974, when Harcourt published his survey, he had tracked down the corpus of measurable Neolithic dog bones existing at that time; it comprised 37 long bones and six skulls. The long bones could have derived from as few as eight individuals and they include the two skeletons from Windmill Hill (Smith 1965, 142–145) and Easton Down (Stone 1935), and two partial skeletons from Maiden Castle (Jackson 1943).

The skulls were remarkably similar in size and morphology. The limb bones produced a shoulder height range of 37 to 49 cms using the factors of Harcourt (1974), with the exception of one tibia with a length of 211 mm from the Nympsfield long barrow (Clifford 1938) and a radius with a length of 187 mm from an unspecified site. These two large bones suggested animals standing some 62 cms in height. The Nympsfield specimen was considered to be a dog on the grounds of its size, diminution of articular ends and feeble development of the muscle attachments, but there is no further comment on the radius.

In Harcourt's opinion, there is a general uniformity in the main body of the group which indicates a single uncontrolled population, and he suggested that the gap between the main group of his sample and the two large outliers might in future be filled with the discovery of further material. His prediction proved to be well-founded; by 1995 material from a further six individuals had been recovered from Grimes Graves (Burleigh *et al* 1977), Quanterness (Clutton-Brock 1979), Coneybury Henge (Maltby 1987), Stonehenge perimeter ditch (primary fill) (Serjeantson 1995) and Staines Road Farm (Clark 1996) and all of them were above the shoulder height maximum of 49 cms for his main sample, ranging from 51 to 58 cms. In addition to these an atlas was recovered from the lower secondary fill of the Stonehenge perimeter ditch (Serjeantson 1995). This bone can also be a useful indicator of stature in animals known to be skeletally mature as its length correlates to the length of the humerus (Clark 1996), and in this case it suggests an animal standing some 71 cms at the shoulder, an impressively large animal which may well be a wolf. It is an interesting point that of the eleven distinct individuals from known sites, the five recovered from non-ceremonial sites (e.g. pits, mines) are shorter in stature (44–52 cms) than those from henges, barrow or chambered tomb (53–71 cms).

The updated Neolithic group therefore represents a continuum of stature between 37 and 62 cms, excluding the probable wolf from Stonehenge. This indicates a much greater degree of variability in Neolithic dogs than previously assumed. Indeed, this variation in height of the dog population in Britain is not exceeded until the Late Iron Age, and then the range extension is only at the lower end (Figure 4.1).

In the British Bronze Age, which admittedly has an even smaller sample than the Neolithic, the variation is more constrained, between 43 and 62 cms at the shoulder. However, Mazzorin and Tagliacozzo (1997; 2000) have recently published a survey of

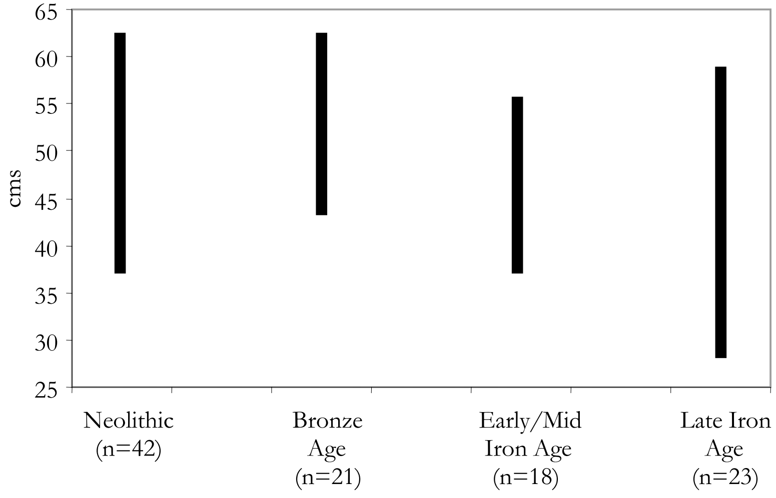

Figure 4.1: Range of estimated shoulder heights of dogs from prehistoric Britain.

morphological and osteological developments in prehistoric dogs of Italy. For the Neolithic they have a sample size of 34, similar to the British sample, and produce a height range of between 36 and 56 cms. For the Bronze Age they have an impressive sample of 137 specimens, representing a range between 36 and 62 cms. It may well be that as we increase our British Bronze Age collection we may also see these shorter animals.

Stature, however, is only one aspect of variability and it is in the skulls that we can seek the real level of morphological diversity and, with the larger animals, make a confident identification of wolf or dog. Measurable skull material survives less well than limb bones, but Harcourt's original six skulls have been augmented by a further five, one from Grimes Graves (Burleigh *et al* 1977), one from Staines Road Farm (Clark 1996) and three from Newgrange (van Wijngaarden-Bakker 1974).

AN ANOMALOUS CANID

The measurements for all eleven Neolithic skulls from Britain are shown in Table 4.1. There is a notable uniformity in all but the specimen from Staines Road Farm. The remains of this animal have been described elsewhere (Clark 1996), and originally a conservative conclusion was drawn that this was likely to be a small wolf. However, in the light of recent studies on modern wolf populations there are other explanations which can be considered for this anomalous Neolithic canid.

The Staines Road Farm canid was recovered in 1989 from a Neolithic ring ditch excavated at Shepperton by the Surrey Archaeological Unit (Hunt *et al* 2002, 68; Surrey County Archaeological Unit in prep.). The ditch was roughly oval, measuring about 21.5 m x 23 m with an entrance causeway in the north-east. On the northern section were two

Table 4.1: Selected skull measurements of British Neolithic dogs. Key: 1 nasion to prosthion, 2 maximum palatal width, 3 maxillary cheek tooth row, 4 width at canine alveoli, 5 mandibular cheek tooth row, 6 length mandibular carnassial alveolus, 7 length maxillary premolar row, 8 length mandibular premolar row. Measurement 1 according to Harcourt (1974); measurements 2 to 8 according to von den Driesch (1976), 44–45.

	1	2	3	4	5	6	7	8
Easton Down	83.0		60.0	36.0	67.0	20.0		
Dowel Cave	85.0	55.0	64.0	39.0	71.0	21.6		
Maiden Castle I			61.0		68.0			
Maiden Castle II			64.0		69.0			
Windmill Hill I	87.0		65.0	36.0	71.0	20.8		
Windmill Hill II	82.0	50.0	58.0	32.0	64.0	19.7		
Newgrange							48.6	
Newgrange						24.0		42.1
Newgrange						21.9		35.2
Grimes Graves	83.5	64.5	64.5	37.0	69.4	21.6		
Staines Road Farm	110.2	69.2	75.7	43.6	84.4	22.6	58.0 R 52.8 L	46.1

human burials, and deliberate placements at the base of the main fill on the southern run of the ditch included a number of antler picks, red ochre, part of an inverted Mortlake bowl, and the skull and mandible of the adult canid with associated ribs and an atlas fragment. The deposition is dated to the mid fourth millennium BC. Some 11 m away from the canid skull were complete second and fifth metacarpals and from them we can estimate the stature at around 58 cms (Clark 1995). It is possible these are from the same animal.

It was clear that this skull was significantly larger than any recovered so far, particularly in the length of the muzzle and the cheek tooth rows. On first inspection, however, it did not immediately seem to be from a wolf because of the relatively small size of the carnassial alveoli and other teeth. There are three metrical tests that are commonly applied to distinguish between wild and early domestic canids: the relative length of the upper carnassial (Clutton-Brock 1963), the degree of tooth crowding in the jaws (Degerbøl 1963: Clutton-Brock 1963: Wijngaarden-Bakker 1974), and the snout width index (Harcourt 1974). It was possible to apply each of these tests to the Staines Road Farm skull.

In wolves the length of the upper carnassial exceeds the sum of the length of the two molars; in dogs the summed molar lengths exceed or are equal to the carnassial. In this Neolithic specimen the carnassial exceeds the summed molars by 10.2 per cent.

Domestic dogs have shorter maxillae and mandibles than their wild counterparts, and this reduction is a remarkably speedy process, as it takes place in wolves raised in captivity. Diminution in tooth size however is far slower and more constrained. The space available to accommodate the teeth is therefore less in dogs, hybrids and 'tamed' animals and this can be assessed metrically by calculating the summed lengths of the individual premolars with the length of jaw available for their development. This tooth crowding index is greater in domestic dogs than wild canids. In the Staines Road Farm skull the index is 79 for the upper jaw right, 91 for the upper left, and 86 for the mandible. The range of tooth crowding indices for other British Neolithic dogs is 107 to 109 for the upper jaw, and 91 to 103 for the lower.

The snout width index expresses the width of the muzzle relative to its length. Domestication, or even taming, produces a shortening of the muzzle without a concurrent narrowing, and so wild canids have a narrower snout relative to length. The Staines Road Farm animal has an index of 39.6 which can be compared with the snout width index range for other Neolithic dogs, which is 39.1 to 45.8. The specimen from Windmill Hill has the narrowest muzzle relative to length.

Thus, in two of the tests the Staines Road Farm animal appears to be a wild canid, and the third test could identify a wolf born or reared in captivity, a domestic dog, or a hybrid. However, in addition to the metrical characteristics of this skull there are pathological manifestations which must also be taken into account. There is a marked asymmetry in the upper dental arcade and abnormal development of the canine in the mandible, and it may be that this asymmetry is a result of massive traumatic injury to the front of the head (Figures 4.2 and 4.3). There is a well-healed depressed fracture of the frontal region, and another on the maxilla. Both injuries were sustained long before death, and if they occurred when the animal was juvenile, there may have been disturbance to the development of the skull. The dental anomaly, however, occurs on the right hand

Figure 4.2: Dorsal view of cranium of Neolithic canid from Staines Road Farm, Surrey.

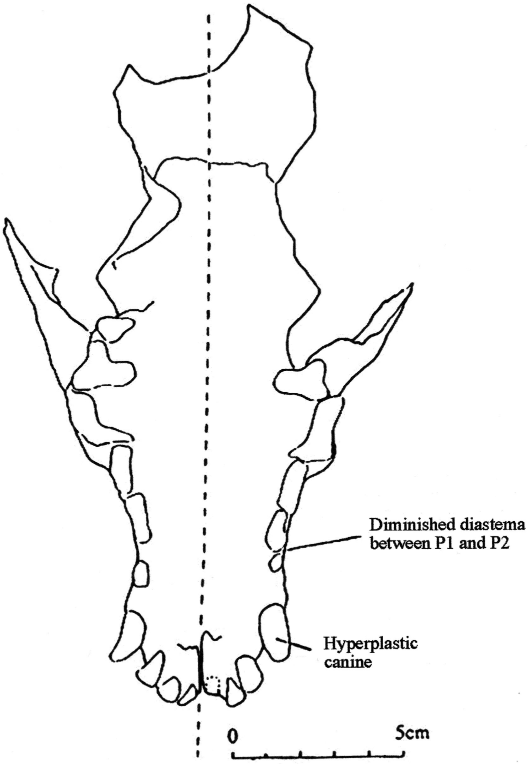

Figure 4.3: Outline of the skull of the canid showing its dental asymmetry.

side and all the traumatic injuries have been sustained on the left. Furthermore, an identical congenital abnormality has been described in an F_1 (first generation) dog-coyote hybrid (Mengel 1971).

THE POTENTIAL FOR HYBRIDISATION IN THE BRITISH NEOLITHIC

The question of potential hybridisation in the past within *Canis* is a contentious issue. Worldwide there have been very few archaeological specimens which have been interpreted as possible hybrids (Olsen 1985, 29) and none in Britain. The most abundant archaeological finds are from sites in Wyoming, where a number of canid skulls were reassigned from *C. lupus* to wolf/dog hybrids on the basis of discriminant function analysis (Walker and Frison 1982). Nevertheless hybridisation is an issue that has attained a higher profile in recent years, mainly due to two factors. The first is the publication of new work on mitochondrial DNA (Vilà *et al* 1997) which suggests that the divergence of wolf and dog occurred over 100,000 years ago but that there was subsequent and repeated genetic interchange (this conflicts with the archaeological record by some 85,000 years), followed by Vilà and Wayne's earlier somewhat contradictory assertion that significant introgression (the introduction of genes from the gene pool of one species into another) of dog markers into wild wolf populations has not yet occurred (Vilà and Wayne 1999). The second is the ecological concern for the survival of a number of threatened modern wolf populations in the face of potential interbreeding with domestic dogs.

The debate that has ensued is lively, complex and often confusing. Crockford (2000) has argued that infrequent but recurrent hybridisation is likely to have occurred throughout the prehistoric periods in the Northern Hemisphere, but workers often disagree on the hybridisation effects on modern wolf populations and the situation is even more fluid for archaic studies. Because mitochondrial DNA is passed by maternal inheritance, only one side of the picture is visible, and this is compounded by whether the interbreeding is unidirectional or not, i.e. whether the wild partner is always the male or female, and whether this is dictated by the differing oestrus patterns of female wolves and dogs. Female wolves have an annual oestrus in late winter and whelp in late spring; female dogs are on heat at six monthly intervals and this can occur at any time of the year. Male wolves are only in breeding condition for about two months in late winter, whereas male dogs are constantly fertile and sexually active. Furthermore it has been observed (Mengel 1971) that F_1 wolf/dog hybrids of both sexes retain the annual breeding cycle of the wild parent, but with the timing displaced by some three months, so that the young are born in the winter. This would pose a severe disadvantage to F_2 progeny born in the wild, exacerbated by the fact that male F_1 parents appear to retain the dog characteristic of not participating in the rearing of the young. Would therefore the female progeny of a domestic bitch be able to integrate and mate within a wolf group? And would the progeny of either sex be able to assimilate into the domestic environment or compete in the wild? These and many more factors will influence introgression. We can address none of them directly for the Neolithic because we have virtually no information on the contemporary wolf population.

However, there are studies of modern populations which give us a background against which we can view the Neolithic dog. For example, Clutton-Brock and Kitchener (2000) investigated the skulls of Arctic wolves collected during the 19th and early 20th centuries and found that they were significantly larger than more recent specimens. Skulls recovered between 1930 and 1950 were morphologically similar to a known F_1 wolf/dog hybrid, but after 1950 skulls reverted to the original wolf type. Clutton-Brock suggested that the change to hybrid form occurred through interbreeding with dogs of fur trappers who were forced into the area during the period from the Depression to the end of World War II to hunt the declining numbers of Arctic foxes. Clutton-Brock's conclusions from this work and from other studies of wolf populations were that 'subtle human-induced changes in wolf environments may occasionally tip the balance towards encouraging high levels of hybridisation. These changes include increased mortality due to disease, deliberate extermination, declines in natural prey populations, and habitat loss or modification'.

DISCUSSION

The conditions favourable to hybridisation are likely to pertain in the Neolithic in Britain with the incursion of humans and their associated dogs into wolf habitats. Colonisation will have resulted in changes to wolf environments as described by Clutton-Brock. However, as demonstrated in the Arctic wolf studies, reversion to original wolf skull shape after a period of hybridisation is remarkably quick, and in early dog populations with their more varied morphology it may be even more difficult to identify anomalous animals other than the F_1 hybrid. These first generation animals have particular behavioural characteristics that may preclude their integration into the existing domestic group. F_1 hybrids have been shown to lack the instinctive fear of humans but to retain a high level of aggression, and they are very difficult to confine or restrain. Indeed, it has been suggested that the traditional mythology surrounding the wolf as a predator of human beings has arisen through encounters with hybrids and not with pure bred wolves (Steinhart 1995, 313–4).

Gloyd (1992) commented on the visual and behavioural characteristics of dog-wolf hybrids when discussing the dilemma of veterinary surgeons in the United States faced with requests for vaccination of such animals. Veterinarians have to learn to recognise hybrids because vaccines are not licensed for use in wolf hybrids, and because the keeping of hybrids is prohibited in seven states and is permitted only under licence in a further sixteen. Gloyd quotes the curator of Folsom City Zoo in describing wolf/dog hybrids as having 'low head carriage and a slinking gait, tufts of hair on the cheeks, fully haired inner ears, longer bones and a narrow chest'. He also quotes the Humane Society of the United States which outlined the behaviour of these hybrids as including 'latent and unpredictable predator instincts that cannot be eliminated in the span of a few generations, strong territorial mating instincts, social pack instincts, hybrid vigour, digging instincts, and a tendency to escape enclosures'.

Studies of modern wolf and wolf/dog hybrids suggest that F_2 hybrid generations are unlikely to succeed on any significant scale in the wild due to the shift in oestrus pattern and winter whelping. In association with dogs, however, these barriers are diminished. It is tempting to surmise that if F_1 hybrid remains have been, or are in the future, recovered from British Neolithic sites they are likely to represent the progeny of a female dog and male wolf, have been born within a 'domestic' environment and thus have had a greater chance of subsequent reproduction. Although we might expect that wolves (and also wild hybrids, which may not have been visually distinct from wolves) would have been killed by humans and used for fur, meat or 'ritual' purposes, in fact the number of wolves in Neolithic assemblages is so small as to suggest that this was not generally the case. It could therefore be argued that it is unlikely that wild-born hybrids will appear in Neolithic assemblages. However, finds from Neolithic sites are biased towards the ceremonial rather than domestic sites, and the animal bone assemblages may therefore reflect particular rather than general practices. It has been argued strongly (Crockford 2000) that the evidence of hybridisation between other domestic and wild species, and between closely related wild species, indicates that the female partner is almost always the domestic or, in the case of two wild species, the smaller and less aggressive partner.

Deliberate hybridisation and backcrossing to produce larger and stronger dogs cannot be ruled out. There is documentary evidence for this in Inuit culture and among North

American Plains Indians which has been discussed by Clutton-Brock (2000) and Crockford (2000). On the other hand, the results of opportunistic copulation between male wolf and female dog will only become apparent as the pups mature and demonstrate their superior size and aberrant behaviour and consequently demand a higher level of control in order to keep and restrain them. In either case a deliberate human decision is required to produce or to retain the animal. The accidental or natural assimilation of an F_1 hybrid into a domestic, albeit uncontrolled, group is unlikely to occur, although integration into a feral group would pose few problems.

On the question of control, the traumatic lesions exhibited by the possible hybrid from Staines Road Farm are worthy of comment. Startling head injuries in dogs are not uncommon in archaeological material, although they are usually seen after the 1st century AD, but the severity of this trauma suggests that the animal had to survive a significant period of incapacity or poor performance which may well have rendered it unviable in the wild. There are also more minor lesions in the remains; a fragment of one of the ribs exhibited a healed fracture and two other rib fragments have infective lesions. All these injuries could well result from human efforts to control and restrain the animal, and the fact that it survived suggests that those efforts were successful.

CONCLUSION

To summarise, it can be suggested that for the Neolithic period, current evidence indicates a wider range of variability in stature, and possibly morphology, in dogs than previously thought. Indeed, it brings into question the assumption that Neolithic dogs comprise a single interbreeding population. Environmental conditions conducive to wolf/dog hybridisation existed. It is also likely that any F_1 hybrids would have been the progeny of male wolf and female dog, and would display physiological and behavioural characteristics which differentiate them from the maternal group. Subsequent hybrid generations would have an increasing dog component and assimilate successfully into domestic populations. The limited data currently available suggest that larger animals may be associated with ceremonial deposits and that these include a possible wolf/dog hybrid.

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Sheep in the Garden: The Integration of Crop and Livestock Husbandry in Early Farming Regimes of Greece and Southern Europe

Paul Halstead

INTRODUCTION

The faunal record from Neolithic sites in Greece exhibits four characteristics that, to varying degrees, are paralleled in neighbouring regions, but contrast with some recent models emphasising the gradual and piecemeal adoption of farming and the residential mobility of early farmers in various parts of Europe (e.g., Whittle 1997; Thomas 1999). First, in Greece, remains of wild animals (and, on the admittedly limited available evidence, wild plants) are consistently and strikingly scarce in Neolithic, especially earlier Neolithic, assemblages (von den Driesch 1987; Halstead 1996, 28–29 table 1; 1999). In this part of Europe, therefore, the transition from foraging to farming seems to have been both wholesale and rapid. Secondly, available evidence for seasons of slaughter of domestic animals suggests that most (perhaps all) known Neolithic settlements in Greece were occupied by at least some people throughout the year (Halstead 2005). Thirdly, with the exception of the earliest levels at Franchthi (Figure 5.1) where the absence of cattle (Payne 1975) may be due to limited sample size or a restricted range of activities represented by excavated deposits within the cave, remains of sheep, goats, cattle and pigs appear to be ubiquitous in Neolithic deposits (Halstead 1992). Neolithic communities in Greece thus seem to have relied on an unfashionably consistent 'package' of domestic animals (and cereal and pulse crops). Fourthly, a strikingly recurrent feature of earlier Neolithic faunal assemblages from north and south Greece alike is a clear predominance of sheep bones over those of cattle, pigs and goats (e.g., Boessneck 1962; Isaakidou 2004).

These aspects of the Neolithic faunal record have been interpreted in both cultural and practical terms. On the one hand, game-poor/sheep-rich faunas at Early Neolithic (EN) sites in Greece and the west Mediterranean have been viewed as the hallmark of colonising (east Mediterranean) farmers, while gradual or piecemeal displacement of wild animals by domesticates and claims for residential instability have been cited in support of (selective) adoption of farming by indigenous foragers (e.g., Childe 1957; Lewthwaite 1986; Bernabeu *et al.* 1995, 256–60; Thomas 1991, 13; Vigne and Helmer 1999; Vigne 2000, 161 fig. 3; Barnett 2000, 104–05). On the other hand, variability in the ratio of wild to domestic animals (e.g., Jarman 1971; Binder 2000, 137) or in the relative proportions of different domesticates (e.g., Halstead 1996, 31 fig. 2), and arguments for seasonal

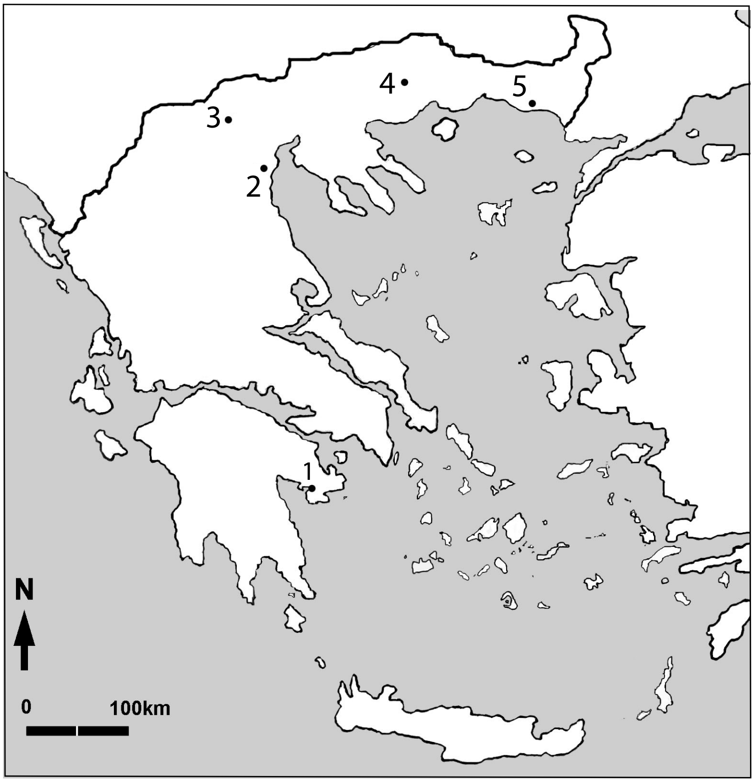

Figure 5.1: Map of Greece showing location of sites mentioned in text. Key: 1 Franchthi Cave, 2 Makriyalos, 3 Mandalo, 4 Arkadikos, 5 Makri.

mobility (e.g., Barker 1975; van Andel *et al.* 1995) have been regarded as adaptations to local or regional ecological constraints, while the co-occurrence of a 'package' of domesticates has been interpreted in terms of an integrated mixed farming regime (e.g., Garrard 1984; Halstead 1996; Bogaard 2005).

These cultural and practical perspectives are not necessarily contradictory: until very recently in the Mediterranean, many cereal farmers and transhumant shepherds regarded possession of oxen and sheep, respectively, not only as the basis of their livelihood but also as a statement of their identity. This paper is primarily concerned with the practical significance of domestic animals, however, summarising arguments (presented elsewhere) for their multi-dimensional role in the Neolithic of Greece, before focussing on the degree and nature of their integration with arable farming. This latter discussion examines certain aspects of recent Mediterranean farming (drawing, unless stated otherwise, on the author's fieldwork in Greece and Spain) as the basis for a model of intensive mixed farming, which is argued to be of relevance to the Neolithic. In conclusion, some broader implications of this model are briefly considered.

THE CONSUMPTION OF LIVESTOCK IN THE NEOLITHIC OF GREECE

As far as can be ascertained from the ages at which male and female domestic animals were killed, Neolithic livestock in Greece were managed in a manner more conducive to the production of meat than secondary products (Halstead 1996). The evidence is most abundant for sheep, the commonest domesticate, and least so for cattle. There is some evidence that cows were also exploited as non-specialised traction animals (Isaakidou this volume) and it should be stressed that 'meat' mortality patterns are compatible with management for a mixture of goals, including milk and wool as well as carcass products. There is no indication that either the consistent recurrence of the full suite of domestic animals or the predominance of sheep can be attributed to specialised exploitation of any of these species for particular products.

One implication of the prevalence of generalised 'meat' strategies of management is that livestock are unlikely to have made a major, regular contribution to human nutrition in the Neolithic, unless raised on a very large scale. It is argued below that Neolithic animal husbandry was of modest scale, and a subsidiary dietary role for animal products is consistent with available evidence from dental and isotopic analysis of Neolithic human remains (Triantaphyllou 2001, 117–41). The consumption of animal carcasses may nonetheless have been of considerable social and economic significance. A high proportion of the domestic animals killed (cattle; subadult and adult sheep, goats and pigs) will have been too large for rapid consumption by a small 'household' group, the existence of which is implied architecturally with increasing clarity during the course of the Neolithic in Greece (Halstead 1995; Kotsakis 1999). Neither age at death nor body part representation hints at systematic processing of carcasses for storage, while fragmentation data suggest that exploitation of carcasses was thorough rather than wasteful (e.g., Isaakidou 2004). To a considerable extent, therefore, domestic animals were probably consumed by extended social gatherings, thus reinforcing ties between kin and neighbours that may have been undermined by the emergence of the household.

In this respect, the consumption of domestic animals was perhaps of greater social than nutritional importance. On the other hand, archaeobotanical evidence from Late Neolithic (LN) Makriyalos) in the late sixth-fifth millennium BC (Valamoti 2004, 125) suggests that surplus grain as well as crop residues may have been fed to livestock. If livestock fattened on surplus grain and consumed in large-scale commensality played a vital role in creating social debts that could be mobilised in times of need (Halstead 2004), the social and risk-buffering roles of livestock may have been particularly closely entwined.

LIVESTOCK, LANDSCAPE AND LAND USE

A coarse-grained approach to exploring the scale of early farming is to consider its *aggregate* impact on the landscape. Regional-scale pollen diagrams from Greece fail to register human impact at least during the earlier Neolithic (Bottema 1982; Willis and Turner 1994) and, especially in Thessaly with a high density of EN (seventh–early sixth millennium BC) settlements (Gallis 1992; Perlès 1999), the lack of a clear anthropogenic signal in the palynological record (Bottema 1979; 1994) is apparently not because early farmers were very sparse. This suggests that early arable and pastoral land use was intensive (with high inputs of labour and high yields per unit area) and small-scale (in terms of land area) rather than extensive and large-scale (*cf.* Halstead 2000).

Indirect archaeobotanical support for intensive crop husbandry is provided by the relatively balanced representation of cereals and labour-intensive pulses in Neolithic assemblages from Greece, in stark contrast with the predominance of cereals in recent extensive agriculture (Halstead 1994, 204 table 7.1). Studies of arable weed floras may in the future provide more direct confirmation of intensive early crop husbandry, as they already have for the Balkans (Bogaard *et al.* in press; Marinova 2001 [cited in Bogaard 2004a) and central Europe (Jones 1992; Bogaard 2004), but as yet this is precluded for the Neolithic of Greece by the particular taphonomic histories of the available data (Valamoti 2004).

Indirect support for small-scale, intensive farming is also provided by archaeozoological evidence for the relative proportions of the principal animal domesticates. The heavy predominance of sheep in earlier Neolithic assemblages gives way in the later Neolithic to a more balanced mixture of sheep, pigs, cattle and goats, at open settlements, and to dominance by sheep and goats in roughly equal proportions, at cave sites. The abundance of goats at cave sites, usually located in relatively rugged landscapes, can be interpreted as an adaptation to rough terrain and scrubby vegetation. The abundance of cattle, pigs and goats at later open settlements is likewise consistent with exploitation of local woodland browse and pannage, support for which could be claimed (e.g., Halstead 2000, 119–20) in the palynological (expansion of browse-resistant hornbeams) and geoarchaeological (widespread alluvial episodes) records. The early dominance of sheep, however, runs counter to environmental expectations in that cattle, pigs and goats were all better suited to exploit a more or less wooded landscape. The suggestion that early farmers were unable to breed sufficient cattle, pigs and goats to alter the sheep-dominated composition of the earliest domestic herds (Bökönyi 1973) is implausible over the time span of the EN (several centuries), especially given that goats and pigs reproduce more prolifically than sheep. As noted above, there is no evidence that sheep were intensively exploited for some product unavailable from the other domesticates. Different domesticates may have been preferred for cultural rather than practical reasons, but a predilection for apparently bovine figurines in the Neolithic of Greece (e.g., Toufexis 2003) suggests that this does not account for the prevalence of sheep. For this reason, it has been argued that early livestock, dominated by sheep, were few in number and primarily associated with the cultivated parts of the landscape (Halstead 1981).

Several lines of evidence now offer piecemeal support to this suggestion. First, over the course of the Neolithic in mainland Greece, there is a clear decrease in the size of domestic pigs and cattle (e.g., von den Driesch 1987), resulting in a widening size differential between these animals and wild boar and aurochs. This implies that domestic pigs and cattle were managed sufficiently closely to be largely isolated from their wild counterparts and so is more compatible with small- than large-scale husbandry. Isotopic analysis of human and animal bone from late LN (fifth millennium BC) Makriyalos (Triantaphyllou 2001, 137 figs. 7.16–17) points in a similar direction: domestic pigs appear to be intermediate in diet between wild boar and humans, implying that domestic pigs were few enough to be largely confined to the settlement or cultivated area. Dental microwear analysis of sheep and goats from the same site reveals an abrasive diet, suggesting confinement to disturbed (e.g., cultivated) land or to an area of pasture small enough to result in over-grazing (Mainland and Halstead 2005); similar results from EN Hungary (Mainland in press) suggest that the Makriyalos results may be of wider relevance. Finally, archaeobotanical samples deriving from animal dung suggest grazing of arable land at Final Neolithic (FN) (late fifth millennium BC) Mandalo and perhaps FN (late fifth or early fourth millennium BC) Arkadikos, but of more diverse habitats at LN (late sixth–early fifth millennium BC) Makri (Valamoti and Jones 2003, 32–34; Valamoti 2004, 123–25).

The patchy available evidence is thus consistent with the suggestions that early animal husbandry was modest in scale and that livestock spent much of the year confined on arable land. This in turn lends support to the model of intensive crop husbandry. While stubble fields and any land left fallow would, in the form of fallen grains and emerging weeds, have offered richer if less abundant pasture than surrounding woodland, grazing in succession by cattle and sheep(/goats) and then rooting by pigs would have prepared the ground for tillage, in which human labour was perhaps assisted by cows. Whatever the contribution of domestic animals to working the soil, grazing animals will have enriched fields with their manure, so will have helped to maintain soil fertility and also improve its tractability. High levels of fertility, however, pose risks as well as benefits to crop production.

SOIL FERTILITY: RISKS AND BENEFITS TO GRAIN PRODUCTION

Poor yields, ineffective tillage and low fertility have been regarded as characteristic of pre-mechanised agriculture in the Mediterranean (e.g., Semple 1922; Grigg 1974). The dropping of manure by grazing sheep and goats was often limited to half of the year by seasonal transhumance, while labour costs prevented the spreading of heavy stall-manure on distant fields. Despite these restrictions, the spreading of stall-manure and the penning of livestock on stubble or fallow fields could cause problems to Old World grain crops. First, manure promoted the growth of weeds that competed with crops for nutrients, moisture and light. Secondly, early vigorous growth of crops on manured land could enhance vulnerability to late frosts or, in years without spring rainfall, to drought. Thirdly, in years of abundant spring rainfall (otherwise expected to produce good harvests), well-fertilised crops could grow too tall and fall or ‘lodge’, if the long and slender stems were unable to support the weight of the developing ear and withstand the beating of rain and wind. The crop might recover from lodging early in the growth cycle, but not if it occurred at a late stage or if the stems were broken. Tall crops were also more likely to be pulled down by climbing weeds such as *Vicia* or *Galium* species and these would then impede the resumption of vertical growth. In the recent past, the crop so affected was usually wheat, as this tended to be sown for grain on the most fertile plots, rather than the less demanding barley, oats and rye or the nitrogen-fixing pulses. At worst, lodged wheat fails to develop ripe grains and is fit only for grazing; at best, it is difficult to harvest and elderly farmers in Asturias, NW Spain, recall separating out mould-blackened grains for animal feed (Gill and Vear 1966, 250–51; Halstead field notes).

It is important to emphasise that these drawbacks of manuring are *potential* risks, dependent on husbandry decisions and weather conditions in the year(s) immediately after application, and that they pose *short-term* problems. These short-term, potential problems have to be set against the certainty of repeatedly low yields if no measures are taken to restore soil fertility (*cf.* Palmer 1998). Thus, to maintain good medium- and long-term levels of crop production in the Mediterranean without long fallow periods, it is necessary to manure fields but to control weeds and avoid excessive crop growth. Weed control is necessary in both manured and unmanured fields and is likely to have been achieved through effective tillage, weeding and crop rotation in the intensive husbandry regime envisaged for the Neolithic, rather than by frequent fallowing as in traditional extensive agriculture. To avoid problems associated with excessive crop growth, recent Mediterranean farmers describe a variety of tactics.

First, rules of thumb on appropriate manuring rates, often tailored to individual plots of land, were passed on between generations and adjusted on the basis of personal experience. Secondly, sowing methods or times might be adjusted to limit crop growth on manured fields. Farmers in Greece occasionally report that fertile fields vulnerable to lodging were sown more sparsely than usual, so that the crop would 'tiller' strongly (i.e., the main shoot from each germinating grain would give rise to a 'rosette' of side-shoots – Gill and Vear 1966, 236, 246) and form a denser and shorter stand. This precaution, however, runs counter to the normal practice of sowing fertile fields heavily so that the crop can smother weeds and achieve high yields. In Asturias, where wheat growing is now in decline and restricted to small in-field plots of very high fertility, farmers counter the increased risks of lodging by delaying sowing from the traditional date of November–December to as late as January–February. This retards crop growth, but is only viable because wheat is now grown on a negligible scale as a 'gourmet' supplement to shop-bought bread. Mediterranean farmers usually aim to complete sowing in autumn–early winter, partly to avoid the risk that the onset of severe frosts or heavy rain may force some fields to remain unsown or destroy emerging seedlings and partly because early-sown crops are less at the mercy of unreliable spring rains.

Thirdly, in the hope of achieving big harvests, most farmers sowed manured fields neither late nor sparsely, but regularly monitored the growing crop. Those who noted signs of excessive growth in December–January, suggesting risk of frost damage, or in February–March, raising fears of lodging in late spring–early summer, let sheep into the field to graze it down. Sheep were allowed to graze for a few hours or a few days, depending on the height of the crop and on the farmer's estimation of its ability to recover and the likelihood of further rain. During the vegetative phase of growth (prior to flower initiation), even cereals grazed to the ground could, given sufficient moisture and nutrients, recover to yield harvestable grain crops. Questioned about alternatives to sheep, some farmers replied that goats were also suitable, but sheep were always cited unprompted in this context. Sheep were perhaps preferred because they graze in an orderly phalanx and so tend to crop a field more evenly than goats which are more anarchic in their movements and more likely to be distracted by opportunities for browsing in or around the field (e.g., Merrill and Taylor 1981). Cattle and pigs were regarded as inappropriate because their feeding habits are too destructive and because the former trample the ground too heavily.

Figure 5.2: Sheep grazing sprouting wheat in southern Thessaly, Greece.

Preventive grazing with sheep was widespread a few decades ago in northern and southern Greece (Figure 5.2; Theocharis 1973, fig. 153; Forbes 1998; Halstead field notes) and other parts of the Mediterranean (e.g., Spurr 1986, 64) and was practised in both Greece and Italy in classical Antiquity (Renfrew 1973, 151; White 1970, 134). It is also recalled by some of the older inhabitants of modern hill villages in Asturias, but the plots still sown with spelt and emmer are too small to justify the attention of the few remaining sheep flocks. In this region, late–winter harrowing of wheat plots, usually described as a method of controlling weeds, was explicitly perceived by some as a means of retarding crop growth (also Spurr 1986, 53) and, in the absence of sheep or goats, small wheat plots in Asturias were occasionally mown in late winter with a scythe to check excessive growth. In some hill villages in southern Greece, sickles were similarly used to cut back very localised areas of dangerously vigorous growth, for example under a tree where sheep had sheltered in summer from the mid-day sun (Halstead field notes), and the same method may have been deployed more extensively in 19th century southern Italy (Spurr 1986, 65). Grazing with sheep (or goats) is quicker and less laborious, however, and seems generally to have been the preferred preventive measure for all but small patches of cereals at risk of lodging. To what extent was lodging a problem in the Neolithic and how likely is it that early farmers used sheep or goats as a preventive measure?

THE MANAGEMENT OF SOIL FERTILITY IN NEOLITHIC FARMING

The frequency and severity of the problems posed by manuring are of course related to the pre-existing soil fertility and the intensity of manuring. In Asturias, where spelt and emmer are now grown in rotation with heavily-manured maize or potatoes on rich garden soils (and preventive grazing by sheep is no longer practicable), lodging is frequent and probably the major threat to successful harvests. Conversely, Greek farmers applying manure at much lower levels (dictated by non-availability and/or problems of transport rather than their assessment of what was needed) regarded excessive growth and lodging as a hazard requiring constant vigilance and periodic counter-measures rather than a regular major threat to grain production. These recent farmers, however, were cultivating surfaces long stripped of topsoil (e.g., Zangger 1992; Krahtopoulou 2000) and then subject to long-term nutrient depletion by successive cropping episodes, whereas the forest soils cultivated by early farmers will have been rich in accumulated nutrients. Elderly farmers who have cleared plots of 'woodland', whether deciduous oak-hornbeam woodland in lowland northern Greece or mixed evergreen and deciduous communities in the south, describe significantly raised yields for periods of perhaps 3–5 years or longer. These clearances took place on agriculturally rather marginal land with only modest inputs of leaf litter and, moreover, clearance sometimes revealed old cultivation terraces or clearance cairns, identifying the land as abandoned rather than virgin. It is likely that land cleared in the Neolithic was both substantially more fertile and substantially more resilient to cultivation than recent clearances. There is isotopic, archaeobotanical and dental microwear evidence for grazing of cultivated land and, given the density of housing on many Neolithic settlements, it is likely that livestock were often penned overnight on nearby arable plots rather than stalled intra-murally. The high initial fertility of arable plots will thus have been sustained to some degree by the manure of livestock, implying that early farmers in Greece will have faced recurrent and probably enduring problems of excessive crop growth.

Preventive grazing of such plots is unlikely to be detectable by studies of animal diet (e.g., dental microwear analysis), because it represents such a fleeting episode in the life of the animals, but awareness of its benefits would have been acquired easily. The ideal period for such preventive grazing is late winter (February–March), a time of scarce pasture: cereal crops start their spring growth a little before uncultivated grassland and so will have been a magnet to domestic animals, if their herders did not take the same initiative. In several recent oral histories from north and south Greece and Asturias, understanding of the benefits of preventive late winter grazing was based on or reinforced by first-hand observation of the effects of unintended or unauthorised intrusions into crops by sheep. Early farmers in Greece, cultivating significantly more fertile soils than their early-20th century counterparts and facing the risk of both more frequent and more severe lodging, probably discovered the benefits of preventive winter grazing through similar experiences.

SHEEP IN THE GARDEN: FURTHER THOUGHTS ON THE INTEGRATION OF EARLY CROP AND ANIMAL HUSBANDRY

Although sheep arguably played a key role in maintaining intensive garden cultivation in the Neolithic of Greece, it would be hard to claim that this accounts for the predominance of sheep in the earlier Neolithic. Preventive winter grazing of cereals is unlikely to have occupied Neolithic sheep for more than a few days each year – and could have been undertaken adequately by goats. Likewise, cattle, goats and pigs could have contributed to the clearance of stubble and weeds and, if penned on arable land at night after browsing in the woods by day, could have been richer sources of manure than sheep. As a means of indirect storage, sheep convert surplus or spoiled grain into fat more efficiently than cattle or goats, but hold no such advantage over pigs (Dahl and Hjort 1976, 170–1, 204–5; Redding 1981, 152–60; Morand-Fehr 1981, 268–9; Naudé and Hofmeyr 1981). In the Mediterranean lowlands today, sheep are most closely associated with arable land, grazing stubble fields over summer–autumn and fallow fields, or uncultivated rough pasture, in winter–spring, but the intensive gardening proposed for the Neolithic probably involved infrequent fallowing and palynological evidence does not indicate a wealth of open rough pasture. This begs the question of how domestic herds, dominated by sheep, were fed year-round.

One solution may be to envisage significantly closer integration between early crop and animal husbandry than has normally been envisaged. Recent non-mechanised farmers in Greece often devoted a significant part of their arable land to cereals intended as fodder and variously grazed in late winter–early spring, mown in late spring for hay, or harvested ripe in early summer for grain and straw. Barley or oats (or, less commonly, wheat) intended for grazing or mowing were often sown early and more thickly than normal on heavily or recently manured plots, to encourage precisely those qualities of early and lush growth that would be a source of concern in a crop to be harvested for grain. Farmers normally perceived crops, at the time of sowing, as intended either for grazing/mowing as herbage or for harvesting as grain and also as destined either for fodder or for human consumption. In practice, however, their plans were often rethought during the course of the agricultural year.

If late winter–early spring weather was wet and mild, favouring the growth of fallow weeds or rough pasture, livestock could be moved off grazed barley or oats early and the crop might recover well enough to be mown for hay and later perhaps also harvested for grain. Conversely, a crop sown for grain might be damaged by winter frosts or early summer drought or might, conversely, grow too vigorously and lodge to the extent that it was decided to let livestock graze it to the ground. Sometimes preventive winter grazing of a crop intended for grain was too heavy, either because the farmer anticipated further rainfall that failed to materialise or because a deliberate risk was taken to ensure the survival of hungry sheep; either way, an intended grain crop was converted into sown pasture. Finally, in light of the failure or success of the harvest, grain intended for fodder was diverted to human consumption and *vice versa* (Forbes 1982, 165; Halstead 1990).

It is often assumed that the feeding of domestic animals with *sown* pasture, hay or grain crops is a feature of modern, market-oriented farming, but this arguably betrays a modern predilection for drawing neat distinctions between food and fodder and between grain and herbage crops. This predilection in turn is partly shaped by the market economy, in which the sale of a surplus product and purchase of a scarce resource are relatively easy. Elderly Mediterranean farmers, on the other hand, brought up in a world of higher transport costs and less reliable markets, were more inclined towards the self-sufficient solution of flexibly reassigning available resources as needs must. It is becoming increasingly clear, from archaeobotanical research, that grain was widely fed to livestock in prehistory (e.g., Charles 1998; Robinson and Rasmussen 1989) and it is arguably time to contemplate early farming regimes characterised by fluid boundaries not only between food and fodder, but also between grain and herbage crops. Such close integration between livestock and crop husbandry would be consistent with the predominance of sheep in early farming contexts in southern Europe, while winter–spring grazing of growing cereals on freshly tilled land may account for the very high levels of dental microwear observed in Neolithic sheep from both Greece and Hungary.

CONCLUSION

It has been argued that early farming in Greece took the form of integrated crop and animal husbandry, with livestock contributing to field clearance and perhaps tillage, to maintaining soil fertility and to solving the short-term problems of lodging associated with growing cereal crops on fertile land. The heavy initial predominance of sheep, in a landscape more favourable to the other domestic animals, suggests the possibility of even more closely integrated husbandry, with sown plots flexibly used, for pasture and/or grain crops and for fodder or human consumption, in the light of inter-annual variation in growing conditions. By letting sheep graze plots exhibiting either excessive or insufficient growth, farmers would have reduced the risk of crop failure by lodging in rainy years and would have reared sheep with fat carcasses as an alternative food source for dry years. In the case of Greece, the 'Neolithic package' thus surely represents not only an empirical reality – in the narrow sense that cattle, sheep, goats, pigs, cereals and pulses are normally found together – but an integrated and interdependent system of intensive, mixed agro-pastoral farming.

It is not suggested that the suites of domestic plants and animals attested on Neolithic sites are of solely agronomic significance: as Bogaard (2004b, 164–66) has perceptively observed in relation to the earliest Neolithic of central Europe, the kind of intensive, integrated mixed farming adumbrated above entails the creation of a radically different cultural (and cultivated) landscape and, as such, represents an ideological, as well as economic and ecological, revolution. On the other hand, if the various domesticates were components of a closely integrated mixed-farming regime, it is plainly dangerous to treat faunal (e.g., Vigne and Helmer 1999) or crop spectra (e.g., Colledge *et al.* 2004) as cultural traits that discriminate between acculturated indigenous foragers and colonist farmers or reveal the geographical origins of the latter. The recurrence of sheep-dominated faunal assemblages at Early Neolithic sites in the Balkans and west Mediterranean, rather than being a marker *per se* of East Mediterranean colonist farmers, may indicate that an integrated 'package' of intensive horticulture and sheep was widespread in southern Europe.

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Chapter 6

The Use of Spent Grain as Cattle Feed in the Neolithic

Merryn Dineley

INTRODUCTION

The practice of animal husbandry was introduced into the British Isles, together with cereal agriculture and pottery manufacture, around 4000 BC. These new skills and specialised crafts changed the way of life in Britain. They had originated in the Fertile Crescent several thousands of years earlier, spreading across Europe and into Britain as part of an integrated holistic and developed package (Smith 1998). The newly introduced cereal crops were cultivated and processed in a variety of ways for both humans and animals to eat.

There are many different products that can be made from cereals. Oats can be made into porridge or gruel by cooking or simmering with water or milk but unprocessed wheat and barley are not digestible, and so these grains must be processed in some way. It has always been assumed that, in the Neolithic, wheat and barley was ground into flour to make bread, or at least partly milled to remove the husks so as to make it palatable in soup or gruel. However, wheat and barley can also be partially germinated, a process known as malting. This process breaks down the husk and endosperm, making the malt soft, friable and very much easier to crush than unmalted grain is to grind.

Malt can be easily crushed using a saddle quern. It will naturally produce malt flours which, when baked, produce a product which is sweet because of the presence of starch-converting enzymes. Crushed malt can be mashed, and the liquid malt sugars that are produced can be consumed, mixed with milk to make a malted milk drink, or fermented (Lewis and Young 1995; Hough 1985). A useful by-product of this kind of wet processing for sugars, known as sparging, is the spent grain, that is, the husks and insoluble fibre of a sparged mash. The by-product of malting for beer, brewers' spent grain, has been used as cattle feed for many hundreds, if not thousands, of years. It is rich in moisture, proteins, minerals, lipids and dietary fibre (Hernandez *et al.* 1999). It is slowly digested by the animal, making it ideal as a winter feed. This paper investigates the possibility that spent barley grain was available for use as cattle feed in Britain during the Neolithic. In order to do so, it is necessary to explain the processes of malting, mashing and sparging in some detail so that it is clear what spent grain is and how it is produced.

THE ANCIENT CRAFTS OF MALTING, MASHING AND SPARGING

Malting

Malt is partially germinated grain, and any grain can be malted. Barley is the most common grain to be malted because it produces the most sugars, although wheat can also be made into malt (Hough 1985). Malting is an ancient craft whose origins are unknown. The traditional method involves first steeping the grain in water for two to three days. The grain also has to be aerated for the germination process to begin. The wet grain is spread out in a layer 9 – 15 cm deep on a smooth, level floor surface in a dark, well ventilated building. The gradually germinating grain is raked and turned regularly until the green roots and shoots are visible. This takes between four and seven days, depending upon ambient temperature.

Germination makes the grain soft and friable. The green malt is then dried in a kiln. This has to be done carefully, as temperatures above 67 degrees centigrade will kill the enzymes produced during germination. Where harvested grain is dried in a kiln, the same kiln can be used for malting. Dry malt stores well, provided that it is kept completely dry, and it was therefore available to be processed into malt sugars at any time of the year. A series of biochemical processes are involved in the germination of grain. Gibberellin, a growth hormone, is released by the embryo. This acts as the inducer and its presence allows the enzyme induction of amylase, an enzyme which breaks down starch into sugar (Figure 6.1). The maltster interrupts this natural process before it is complete (Bewley and Black 1994). Modern technology has changed the way malting is carried out, but the basic process of germination remains the same (Lewis and Young 1995; Hough 1985).

Mashing

To make a sweet barley mash, the crushed malt is then mixed with hot water. The malt must be crushed so that the constituent parts, that is the starch from the endosperm and the enzymes from the aleurone layer that have been activated by germination, are intimately mixed and continue the conversion from starch into sugars (Figure 6.1). The optimum

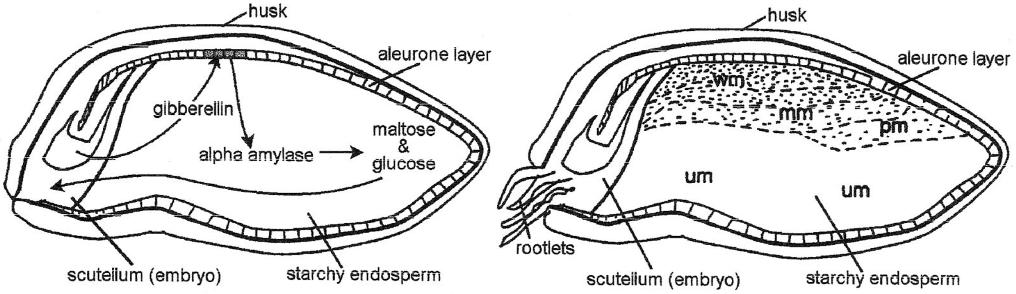

Figure 6.1: Diagram showing what happens inside the grain whilst it is beginning to germinate on the malting floor. Gibberellin, a growth hormone, is released by the embryo. It acts as the inducer and its presence allows the enzyme induction of amylase, an enzyme which breaks down starch into sugar (after Bewley and Black 1994).

temperature for the mash is between 65–67 degrees centigrade. At these temperatures the enzymes make the best conversion from starch to maltose. The process results in liquid malt sugars being liberated from the malt.

Mashing, like malting, requires specialised knowledge, skill and practical experience, but can be done in a pottery bowl (Dineley 2004). There is a characteristic pungent aromatic smell that is easily recognisable when the enzymitic conversion begins. It is possible to mash using earthenware vessels that have been sealed with animal fats or beeswax (Dineley 2004). Practical work shows that gentle heating of crushed malt and water produces a sweet mash and liquid malt sugars. This is quite different from porridge or gruel, for it is an entirely different process and product.

Sparging

After mashing the sweet liquid is run off. More of this liquid can be washed from the mash by pouring hot water through it and collecting the run off in a large vessel. This process is called sparging. The resultant liquid is known as the wort, which is an excellent nutritional food in its own right (Vietor and Voragen 1993). Once most of the liquid sugars have been washed from the mash, what remains is the spent grain. It is only at this point that the fatty lipids are mobilised by the hot water. Spent grain, that is, the barley husks and insoluble fibre left after sparging, is an excellent fodder for both ruminant and monogastric animals. It is still very slightly sweet and still contains high levels of protein, fibre, lipids and vitamins.

Nutritional properties of spent grain

Although the exact composition varies with the particular barley variety, spent barley grain contains moisture, cellulose, proteins and lipids or fats (Hernandez *et al.* 1999). It is suitable for cattle, pigs and goats (Santos *et al.* 2002). The energy in spent grain is derived from the fibre and fats rather than from starch or sugars, for there is very little of these left after processing. This energy is absorbed by the animal over a period of time. Today spent grain is used as a versatile source of animal feed which can be given to the animals on its own or added to poor forage and dry fodder in order to make them more succulent and palatable.

SPENT GRAIN IN NEOLITHIC BRITAIN

Some of the novel aspects of Neolithic life were the keeping of livestock, the manufacture of pottery, and the cultivation of wheat and barley. These meant that new types of foods were available for people and also for their domesticated animals. Barley and wheat would have been a brand new food resource. The keeping of livestock, unlike hunting, was closely integrated with the growing of cereals.

Some potential food resources for the livestock would have been limited to specific seasons only. Grazing and browsing would have been possible for cattle in the spring, summer and autumn, but the foodstuffs that would have been available for cattle during the long, dark, cold months of winter in northern latitudes were very restricted. The practice of transhumance may have been a part of animal husbandry during the Neolithic in some parts of Europe and Britain (Waddington 1996, Akaret and Jacomet 1997), but this, though it extends the grazing season, is also a seasonal food resource. There is some evidence that branch foddering was one way of feeding the livestock. The foddering of livestock with branches and twigs has been indicated by the analysis of goat and sheep faeces from Neolithic sites in Switzerland (Rasmussen 1993, Akaret and Rentzel 2001). The branch and leaves can be used immediately or stored. Spent grain would have been available all year round and would have been a valuable supplement to limited winter food.

Wheat and barley are generally considered to have been a main source of carbohydrate during the Neolithic, being ground into flour to make some kind of flat bread and probably also added to soups and stews (Serjeantson this volume). However, even using the basic equipment that was available in the Neolithic, such as pots, saddle querns and grain drying facilities, it would also have been possible to transform barley into malt, a sweet mash and wort. This would have released spent grain as a by-product, which would have been an excellent food resource for the domestic livestock.

BARLEY LIPIDS AS EVIDENCE FOR MASHING AND SPARGING

Cereal grain products are ephemeral, since they are eaten and survive only if they are charred, which happens as a result of any exposure to fire, including the over-kilning of malt. Spent grain that was fed to the animals would leave no evidence other than the husks in the dung, which survives only in very exceptional contexts. As there is unlikely to be much direct evidence for malting, it is necessary to look at the surviving material culture to assess whether the processing of grain to make malt, sweet mash or malt sugars was being practised in Britain during the Neolithic. Such an analysis has been undertaken (Dineley 2004) and it does appear that the particular techniques of malting, mashing and sparging were known of and being practiced throughout Britain at this time.

Gas Chromatography/Mass Spectrometry (GC/MS) is now being used to detect the presence of lipids or other substances within the fabric of ancient pottery and to identify the organic residues that are sometimes to be found on ancient pottery surfaces (Evershed *et al.* 2001). Lipids are the fats, oils, waxes and resins that occur in all plants and animals which survive as absorbed organic residues in ancient ceramics. This technique makes it possible to assess the probable function of pots and can clarify what processing methods were used for wet barley in the Neolithic. The structural diversity of lipids means that specific food types can be identified. Barley lipids have been identified in the fabric of Neolithic pottery from Barnhouse, Orkney (Jones 2002). A number of sherds of Grooved Ware pottery were analysed using the technique of GC/MS (Jones 1997) and several different food groups were identified. These included cattle milk and meat, unidentified plant material, bark resins, barley lipids and unidentified sugars (Jones 2002, 132–133). The latter two food groups are the ones that, I suggest, indicate the wet processing of barley using the specific techniques of mashing and sparging.

The discovery of barley lipids and unidentified sugars raises the question of how they got into the fabric of the pottery. The sugars, being unidentified, are a difficult area to interpret and further research is needed to determine whether they came from milk or barley processing. The barley lipids, however, can only have come from the barley grain itself. Lipids are present in the husk of the grain. The residues were originally interpreted as being evidence for the storage of dry barley within the largest pottery vessels (Jones 2002,132), but it is not clear how the barley lipids could have migrated from the husk of the grain into the very fabric of the pots, simply by being stored as a dry product. Barley lipids are only liberated in the latter stages of the sparging process, once most of the malt sugars and proteins have been washed out of the crushed barley mash by the hot water. If a vessel was repeatedly used for this type of processing, then the lipids would indeed transfer into the fabric.

A likely explanation of the barley lipid residues is that these large pots were being used for mashing the malt and/or sparging the barley mash and the traces were probably generated by wet processing for malt sugars. In my opinion, the presence of barley lipids in Grooved Ware pottery from Barnhouse is the clearest evidence so far that barley was being processed into sugars in the Neolithic. If spent grain was available on the Orkney islands, it was probably also available elsewhere in Britain during the Neolithic to be used as animal feed.

DISCUSSION AND CONCLUSIONS

Grain cultivation and the processing of wheat and barley into a variety of different foods and drinks was an important part of daily life during the Neolithic. Unprocessed grain is not digestible by humans or animals. It has to be processed in some way in order to make it edible. The easiest way to make grain tasty and nutritious is by processing it to extract the malt sugars as a liquid product.

This sweet malt liquid could be consumed with milk, thus making a nutritious malted milk drink for people. Alternatively, the sweet liquid could be boiled with herbs and then fermented into an alcoholic drink. Animals would have eaten the spent grain, the by product of this kind of barley processing, with as much relish as the people, both adults and children, would have eaten and drunk the sweet malt products.

The skills of malting and brewing were learned over millennia. It is not clear how old the craft of malting is. The knowledge of malting may date back to the early Neolithic cultures of the Near East and Levant, *c*.10,000 years ago (Dineley 2004). The earliest chemical evidence for beer comes from pottery jars found at Godin Tepe, in the Zagros Mountains of Iran and is dated to *c*.4000 BC (Badler 2000). Calcium oxalate, a substance which precipitates out of a fermenting barley wort, was identified on the inner surface of the jars. The discovery and knowledge of the several stages of the transformation of grain into its various products developed between these two dates. Much more research is needed to establish when they first took place.

Grain was probably processed for a wide variety of purposes in the Neolithic. There are many possibilities, ranging from grinding it into flour to make flat bread to processing it by malting, mashing, sparging and fermenting. One of the benefits of spent grain was that it would have been available all year round, as it can be stored. This research, as well as suggesting a previously unconsidered food resource for livestock in the Neolithic, has highlighted the many potential products of grain as well as the skills required for malting.

Grain processing was a fundamental part of the Neolithic cultural package. An appreciation and understanding of the necessary techniques and the possible products that were made from grain illuminates our understanding of daily life in the Neolithic. Much has been written about where, when and how grain domestication took place and why people decided to deliberately cultivate this particular crop (e.g. Smith 1998, 207–214). The explanations are wide ranging and include discussions of population growth, climate change, competitive feasting and social pressure. It is equally important to ask what was being made from the grain and what kind of processing was being undertaken by the first agriculturalists. The malting and mashing of grain for sugars has not been widely considered as a possibility for grain processing within the Neolithic context. The assumption that grain was used to make only flour, bread or perhaps some kind of porridge or gruel has ignored the crafts of malting and mashing. Further research will enable us to understand more fully the evolution of grain processing and the important part that it has played in the development of farming and animal husbandry.

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Chapter 7

Neolithic Shepherds and their Herds in the Northern Adriatic Basin

Preston Miracle

INTRODUCTION

It has become a truism that there was much more to the Neolithic than subsistence, sedentism, and demography, and that the development and spread of food production was predicated on changes in cosmology and the construction and negotiation of social relationships rather than the other way around. Postprocessual prehistorians have repeatedly chastised palaeoeconomists for their calorie fetish and focus on subsistence economics. After repeated failures of the proverbial horse to drink when led to water, zooarchaeologists, particularly in Britain, have not only started to drink, but have plunged into the water trough. The new *modus operandi* is often now 'ask not how an animal was used or exploited but what it was like or meant'.

Whittle (2003, 78–106) makes a particularly persuasive argument for examining 'what animals were like'. He contends that during the Neolithic 'animals were central to the way of life; ... they were an inseparable part of how identities were constructed and how the world was seen'. In particular he focuses on the 'intimacy of the ways in which animals were used as social and symbolic assets' (*ibid.* 87). Necessarily, much of Whittle's theoretical discussion hinges on ethnographic examples, while many of the archaeological case studies are selectively sampled to make his general points.

In this paper we show how by starting from a detailed analysis, a 'thick description' if you like, of a Neolithic faunal assemblage from Pupićina Cave (Croatia), we can develop interpretations of animals as 'social and symbolic assets' and examine how they changed over time. Any study of the Neolithic as 'difference', however, requires a careful consideration of the nature and range of variability in remains – when is something different enough to qualify as 'difference'? Unlike Whittle's (2003) relatively well characterised and understood case studies, we work in a part of Europe where detailed zooarchaeological analyses are rare and syntheses of the existing data are even rarer. Hence, to understand similarities and differences, we also synthesise the Neolithic faunal record from the northern Adriatic region. First we describe and interpret zooarchaeological evidence at the local scale of Pupićina Cave and its environs during the Neolithic. We organise our discussion around issues of humans and herds, hunting, and the consumption of food. We then consider these results in the wider context of Neolithic faunal assemblages from the northern Adriatic and Dalmatia (Figure 7.1). In making these wider comparisons we buck some of the trends alluded to above, not because cosmologies and social

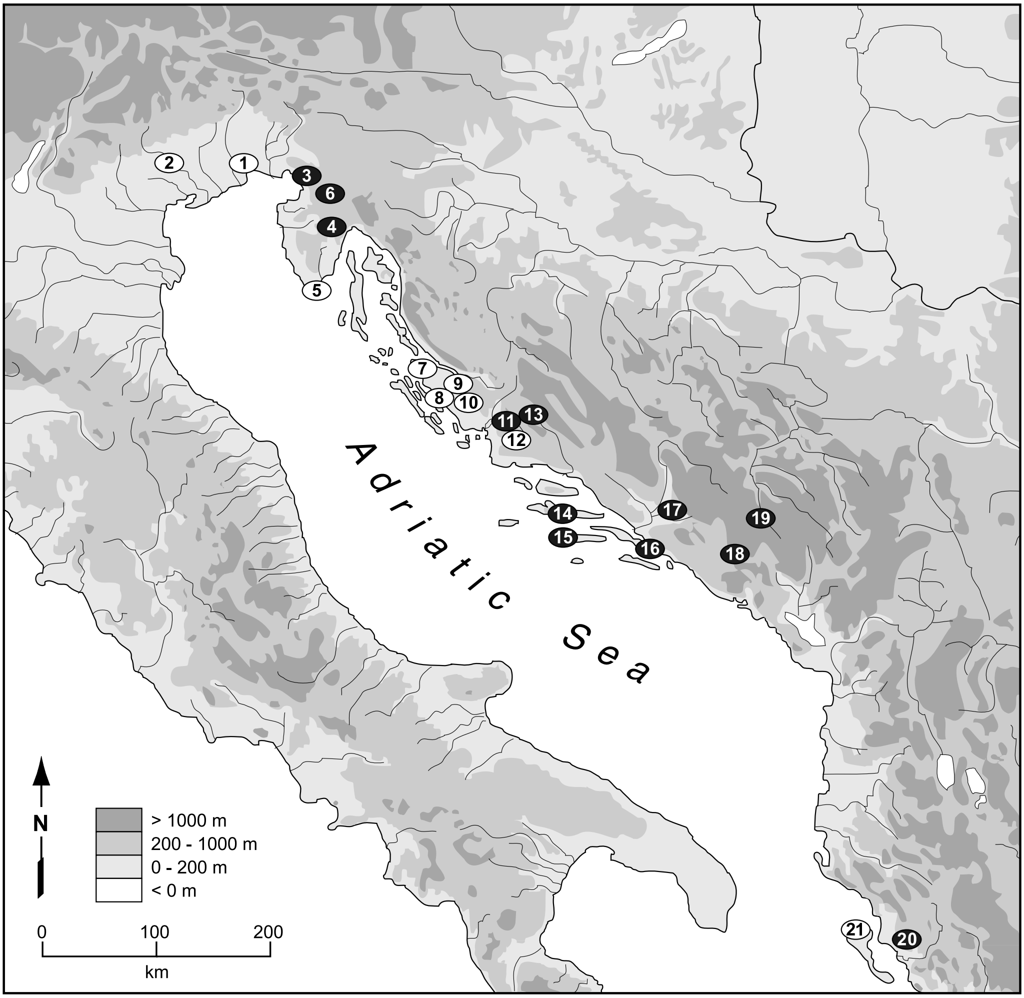

Figure 7.1: Location map of sites in the Northern Adriatic region discussed in the text. Black number on white: open-air sites; white number on black: cave sites. 1. Piancada 2. Bannia-Palazzine di Sopra 3. Selected caves of the Trieste Karst (Edera, Mitreo, Azzurra, Zingari) 4. Pupićina 5. Vižula 6. Caves of the Slovenian Karst (Podmol, Acijev Spodmol, Mala Triglavca) 7. Nin 8. Tinj 9. Smilčić 10. Buković 11. Škarin Samograd 12. Danilo 13. Gospodska 14. Grapčeva 15. Vela Spila (Korčula) 16. Gudnja 17. Zelena pećina 18. Crvena Stijena 19. Odmut 20. Konispol 21. Sidari.

relationships were not important in the past, but because a rich understanding of the past requires both the intimacies of lived lives and the metanarratives of general processes.

Neolithic shepherds and their herds at Pupićina Cave

Pupićina Cave is situated at 220 m/sl in the lower reaches of Vela draga canyon in north-eastern Istria, Croatia (Figure 7.1). The cave is funnel shaped; the southeast-facing entrance is about 20 m wide and 8 m high. We estimate that Neolithic deposits are preserved over at least 190 m^2 of the cave's surface. Here we report on assemblages recovered from a 33 m^2 block excavated within the drip line in the entrance area of the cave from 1995 – 1998 (Miracle and Forenbaher 2005, 2006a). Pupićina Cave contains significant deposits spanning the late glacial period to the present; here we focus on the faunal evidence from the Middle Neolithic (Horizon H and I) and Late Neolithic (Horizon G) occupations at the site.

Sediment containing Middle Neolithic (Danilo/Vlaška) pottery, flaked stone tools mostly expediently made on locally available flint, and abundant animal remains everywhere overlay the trampled surface of Mesolithic horizons. Two major types of deposit were identified. The first consists of alternating layers of white ash and dark brown to black 'soot'. The second was fairly homogeneous silty clay with abundant small limestone rubble. Two reliable ^{14}C determinations from Horizon I suggest that the Neolithic use of Pupićina started in the mid sixth millennium BC (Miracle 1997: Miracle and Forenbaher 2006b). These ^{14}C dates from Pupićina are among the earliest on Neolithic remains from northern Istria and the wider region extending through north-eastern Italy and southern Slovenia; the first domestic animals and plants in this region are associated with typologically Middle Neolithic pottery of the Danilo/Vlaška Group (Forenbaher and Miracle 2005, 2006). Two other ^{14}C determinations associated with Horizon H show that Middle Neolithic use of Pupićina continued into the second half of the sixth millennium BC. The shape and size of Middle Neolithic pots suggests a variety of food preparation, cooking and communal serving of food; very few of the Middle Neolithic vessels are individual-portion sized (Forenbaher *et al.* 2004).

The Late Neolithic Horizon G consisted of relatively homogeneous silty clay with many medium to large angular stones. A single ^{14}C determination from the upper part of this horizon provided a date of 4530 – 4250 BC (cal. 1 S.D. range). The pottery assemblage shows many similarities with the Middle Neolithic in vessel shape and technology; the main difference is the presence of an apparent import – a long-necked jar (Forenbaher *et al.* 2004). The small lithic assemblage is now dominated by non-local raw materials and prepared-blade technology; there is also obsidian, an unquestionable exotic, imported from Lipari islands in the southern Tyrrhenian basin (Forenbaher 2006). Long-distance interaction during the Neolithic, as reflected in lithic raw materials and to a lesser extent ceramic imports, increased with the passage of time.

THE FAUNAL ASSEMBLAGE

The animal remains from Pupićina Cave provide a wealth of information about past human activities at the cave, in the immediate region of north-eastern Istria, and beyond. A detailed analysis of the Pupićina Neolithic faunal assemblages is presented elsewhere (Miracle and Pugsley 2006). Here we summarize temporal trends in assemblage composition, culling and penning practices, and food consumption at the cave.

The faunal assemblage was hand excavated; all sediment was dry sieved on site using a mesh size of either 3 mm or 6 mm, and 288 litres of sediment (1.2% of the total volume excavated) was 'floated' using either 0.5 mm or 1 mm mesh. Comparison of the dry-sieved and flotation assemblages shows that by weight over 90 per cent of remains were

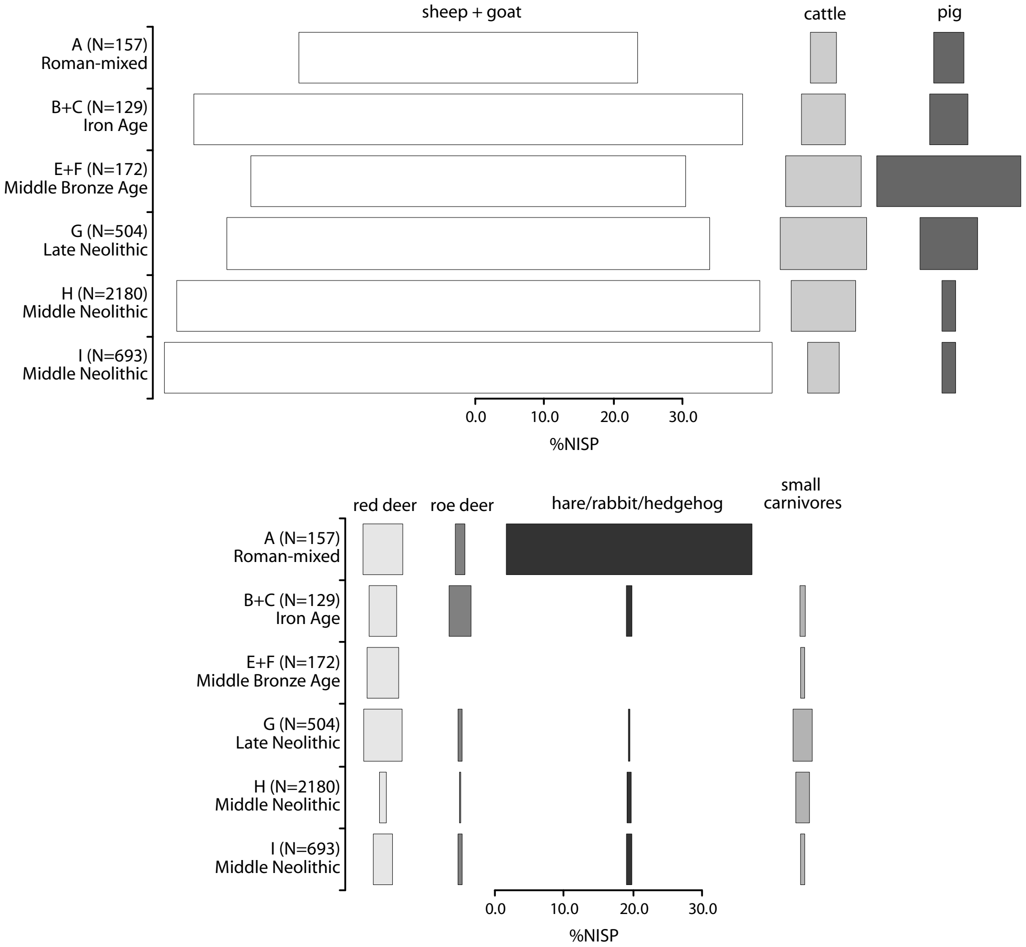

Figure 7.2: Relative frequency (% NISP) of the main vertebrates in post-Mesolithic horizons at Pupićina Cave. Top: main domesticates. Bottom: wild mammals. 'Pig' includes wild and domestic animals, and 'small carnivores' include badger, marten, fox, and wild cat.

recovered in the dry sieves. A total of 14,933 faunal remains weighing 31.7 kg was recovered, and 5604 fragments (38%) were identified to body part and/or taxon (Figure 7.2). We have quantified the remains using Number of Identifiable Specimens (NISP), Minimum Number of Elements (MNE) calculated relative to complete elements based on shared anatomical features, and Minimum Number of Individuals (MNI) taking into consideration the expected frequency of the element in a skeleton, side of the body, and age at death (see Miracle and Pugsley 2006 for further details). Systematic refitting produced 90 sets from 193 conjoined or articulated fragments; conjoins/articulations within horizons outnumber those between horizons by over 30:1. We have thus calculated the MNE and MNI on each horizon separately. The identified species from the Neolithic (Tables 7.1

Table 7.1: Faunal remains (NISP) from Neolithic levels at Pupićina Cave identified to taxon and body size.

	Middle Neolithic				Late Neolithic	
	I		H		G	
Species	NISP	%	NISP	%	NISP	%
Ovis/Capra (sheep/goat)	539	77.8	1615	74.1	317	62.9
Ovis aries (sheep)	61	8.8	189	8.7	34	6.7
Capra hircus (goat)	11	1.6	38	1.7	2	0.4
Sus scrofa (pig/boar)	14	2.0	46	2.1	42	8.3
Bos taurus (cattle)	31	4.5	204	9.4	63	12.5
Canis familiaris (dog)	4	0.6	6	0.3		
Cervus elaphus (red deer)	19	2.7	19	0.9	28	5.6
Capreolus capreolus (roe deer)	4	0.6	6	0.3	3	0.6
Castor fiber (beaver)			1	0.0		
Lepus sp. (hare)	6	0.9	8	0.4	1	0.2
Erinaceus europaeus (hedgehog)			2	0.1		
Martes sp. (marten)	1	0.1	34	1.6	8	1.6
Meles meles (badger)	2	0.3	1	0.0	6	1.2
Felis silvestris (wild cat)			2	0.1		
Vulpes vulpes (fox)	1	0.1	8	0.4		
Ursus arctos (bear)			1	0.0		
Subtotal	693	100.0	2180	100.0	504	100.0
Identified to taxon	693	76.2	2180	72.3	504	66.7
large ungulate	10	1.1	92	3.0	73	9.7
medium ungulate	23	2.5	59	2.0	51	6.7
small ungulate	154	16.9	624	20.7	114	15.1
small-medium carnivore	1	0.1	5	0.2	1	0.1
rabbit-small carnivore	1	0.1	4	0.1	6	0.8
micromammal	17	1.9	23	0.8	5	0.7
Aves indet. (bird)	7	0.6	30	1.0	1	0.1
Reptilia indet. (reptile)					1	0.1
Bufo bufo (common toad)	2	0.2	1	0.0		
Leuciscus sp. (dace/chub)	1	0.1				
Tinca tinca (tench)			1	0.0		
Total	909	100.0	3019	100.0	756	100.0

and 7.2) include the five common domestic animals (sheep, goat, cattle, pig, and dog), and eleven wild species (red deer, roe deer, beaver, hare, hedgehog, marten, badger, wild cat, fox, bear). Remains of micrommals, birds, fish, reptiles, and amphibians are poorly represented in the assemblage, despite an extensive sieving and flotation programme designed for their recovery. A few marine molluscs (*Mytilus galloprovincialis*) demonstrate contacts with the coast about 10 km distant (Laurie *et al.* 2006). There is little evidence of the consumption of aquatic resources at the site.

Table 7.2: Minimum Number of Elements (MNE) and Minimum Number of Individuals (MNI) by taxon and horizon at Pupićina. Human, micromammal, bird, reptile, fish and amphibian remains are excluded.

	Middle Neolithic								Late Neolithic			
	I				H				G			
Species	MNE	%	MNI	%	MNE	%	MNI	%	MNE	%	MNI	%
Ovis/Capra	263	73.7	17	53.1	631	68.4	39	62.9	131	53.7	10	41.7
Ovis aries	25	7.0	[6]		94	10.2	[18]		21	8.6	[5]	
Capra hircus	5	1.4	[2]		26	2.8	[3]			0.0	[1]	
Sus scrofa	14	3.9	2	6.3	23	2.5	2	3.2	25	10.2	3	12.5
Bos taurus	21	5.9	3	9.4	84	9.1	7	11.3	41	16.8	5	20.8
Canis familiaris	2	0.6	1	3.1	4	0.4	2	3.2		0.0	0	0.0
Cervus elaphus	13	3.6	3	9.4	16	1.7	2	3.2	17	7.0	1	4.2
Capreolus capreolus	4	1.1	1	3.1	6	0.7	1	1.6	2	0.8	1	4.2
Castor fiber		0.0	0	0.0	1	0.1	1	1.6		0.0	0	0.0
Lepus sp.	6	1.7	3	9.4	8	0.9	2	3.2	1	0.4	1	4.2
Oryctolagus cuniculus		0.0	0	0.0		0.0	0	0.0		0.0	0	0.0
Erinaceus europaeus		0.0	0	0.0	2	0.2	0	0.0		0.0	0	0.0
Martes sp.	1	0.3	1	3.1	16	1.7	2	3.2	3	1.2	1	4.2
Meles meles	2	0.6	1	3.1	1	0.1	1	1.6	3	1.2	2	8.3
Felis silvestris		0.0	0	0.0	2	0.2	1	1.6		0.0	0	0.0
Vulpes vulpes	1	0.3	0	0.0	8	0.9	1	1.6		0.0	0	0.0
Ursus arctos		0.0	0	0.0	1	0.1	1	1.6		0.0	0	0.0
Subtotal	357	100.0	32	100.0	923	100.0	62	100.0	244	100.0	24	100.0
Identified to taxon	357	92.2			923	88.2			244	79.7		
large ungulate	2	0.5			8	0.8			14	4.6		
medium ungulate	3	0.8			1	0.1			10	3.3		
small ungulate	23	5.9			109	10.4			34	11.1		
small-medium carnivore	1	0.3			4	0.4			1	0.3		
rabbit-small carnivore	1	0.3			2	0.2			3	1.0		
Total	387	100.0	32	100.0	1047	100.0	62	100.0	306	100.0	24	100.0

Temporal trends in the faunal assemblage

Considered together, sheep and goat contribute the most remains to the Pupićina assemblage. Sheep and goat make up 88 per cent of the identified assemblage during the initial Middle Neolithic occupation (Horizon I); their abundance progressively declines to about 70 per cent of the assemblage in the Late Neolithic (Figure 7.2). For the assemblage as a whole, sheep outnumber goat by 5.4 to 1. This ratio changes significantly over time; small sample sizes make these results suggestive rather than definitive. The sheep:goat ratio in the Middle Neolithic is around 5:1. The frequency of sheep relative to goats increases significantly to 17:1 in Horizon G. The sheep and goat assemblage is dominated by neonates and juveniles; remains from adult and old adults are relatively rare (Table 7.3). Not only are goats rare in the assemblage, but they appear to have been

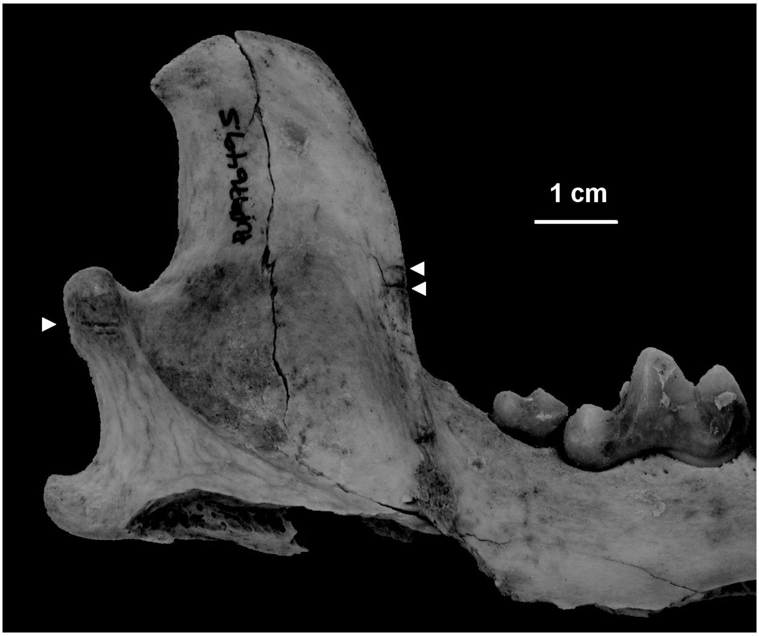

Figure 7.3: Dog mandible (Pup97 649.5, Horizon X – mixed Neolithic and Bronze Age) with transverse cut marks on the buccal surface of the ascending ramus and immediately below the articular condyle from disarticulating the mandible from the cranium.

Table 7.3: Age categories (%NISP) for the major ungulates from Pupićina G–I.

Species	% NISP Age Category Fetal	 Neonate	 Juvenile	 Adult	 Old	Total Age-able NISP
Ovis/Capra	7.7	40.5	28.2	19.3	4.3	1494
Ovis aries	0.5	21.3	74.6	3.6	0.0	197
Capra hircus	0.0	73.1	23.1	3.8	0.0	26
Sus scrofa	0.0	16.3	44.9	34.7	4.1	49
Bos taurus	0.0	5.6	48.0	43.2	3.2	125
Cervus elaphus	4.5	0.0	27.3	68.2	0.0	22
Capreolus capreolus	0.0	0.0	14.3	85.7	0.0	7

culled at a relatively younger age than sheep. Very few adults and even fewer old animals of either sheep or goat, however, are represented. People were progressively herding and keeping more sheep relative to goats during the Late Neolithic relative to the Middle Neolithic.

The second most frequent taxon is cattle. The few measurable remains are for the most part comparable to Neolithic cattle from other sites in southern Europe (Miracle and Pugsley 2006). Cattle remains, wild or domestic, were infrequently brought to the site during the initial, Neolithic, occupation; they make up only 4.5 per cent of NISP identified to genus/species in Horizon I. This frequency doubles to 9 per cent in Horizon H, and increases significantly yet again to around 12 per cent in the Late Neolithic. Interestingly, the few particularly large specimens (possibly from aurochs) come from the Late Neolithic assemblage. In contrast to sheep and goat, there are no foetal cattle remains and only 5.6 per cent of NISP are from neonates (Table 7.3). The ageable specimens are equally divided between juveniles and adults. Remains of old animals are very rare. Thus relatively many remains of adult cattle are present in the assemblage; this pattern is very different from that found among the sheep and goats.

The third most frequent species is pig/boar. Working from scanty metrical data, we suggest that there is no evidence for domestic pigs during the initial Middle Neolithic visits to the site represented by Horizon I, while from Horizon G (Late Neolithic) and above, there is no definitive evidence of wild boar at the site. Shed deciduous pig teeth appear in Horizon H, perhaps from animals penned in the cave. Alongside this potential shift from wild to domestic pig, there is an increase in the frequency of their remains from about 2 per cent of NISP in the Middle Neolithic (Horizons H and I), to about 8 per cent in the Late Neolithic. Roughly 16 per cent of the pig remains came from neonates (Table 7.3). Of the remaining elements that could be aged more precisely, most came from juveniles, followed by adults and only a few remains from old animals. Thus although the pig assemblage is overwhelmingly dominated by remains of young animals, relatively few of these are from very young individuals. The pig assemblage thus shows similarities (few adults) and differences (few neonates) with the sheep and goat assemblage.

Domestic dog is extremely rare in the assemblage. Gnawed and digested bones are also relatively rare in the assemblage (0.8% and 0.6% of NISP, respectively). Dogs and other scavengers appear to have been well fed or kept away from carcass/food waste left in the cave. Although dog remains are rare, one mandible has cut marks and impact scars from disarticulation and marrow consumption (Figure 7.3).

Wild species (deer and small game) make up less than 5 per cent of the earliest Neolithic assemblage, Horizon I. This frequency rises to 9 per cent in the Late Neolithic (Horizon G). Red deer is the most common wild taxon, although it is much less common than any of the domestic ungulates. The age distribution of red deer remains shows a strong dominance of adult remains (68% of NISP, Table 7.3). This pattern is very different from that for sheep/goat and pig; it most closely resembles the cattle age distribution. Roe deer is relatively rare throughout the post-Mesolithic sequence at Pupićina. The age distribution is even more strongly biased towards adult animals than that of red deer. Although the sample is small, these data suggest that differences in age distributions are not simply related to body size. The selection criteria for wild ungulates were quite different from those for domestic ungulates.

Culling

Herd management decisions of prehistoric shepherds were studied through the analysis of sheep/goat mortality data (Miracle and Pugsley 2006). Dental eruption and wear were coded for lower teeth using standard systems (Ewbank *et al.* 1964: Payne 1973; 1987). Survivorship graphs were constructed using the age stages (A–I) proposed by Payne

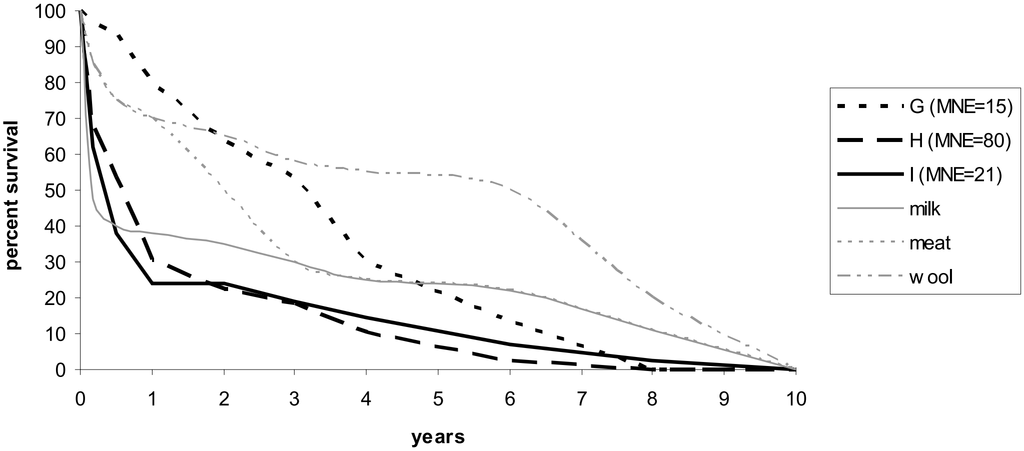

Figure 7.4: Age at death of sheep and goat at Pupićina, based on tooth eruption and wear, shown as percent survival. The graph also shows the expected curves for 'milk', 'meat' and 'wool', after Payne (1973).

(1973) for distinct demi-mandibles from each horizon. Owing to small sample sizes we treat sheep and goat together. Survivorship curves from the different horizons are compared to Payne's (1973) idealized survivorship curves of herd management and cull practices that optimized for the production of milk, meat, or wool (Figure 7.4). The survivorship curves for the Middle Neolithic (Horizons H and I) are very similar. Assemblages are overwhelmingly dominated by very young animals, with less than a third of dentitions from adults. These curves are similar to the 'milk' curve, although both show a relatively greater cull of very young animals and poorer survivorship of adult animals than found in the optimal milk curve. Mortality curves based on long-bone fusion (fusion times from Silver 1969: Reitz and Wing 1999; methodology from Redding 1981 [cited in Zeder 1991, 90–91]) present a very similar picture – in Horizons H and I most animals died during their first year, with only 20–21 per cent of animals surviving beyond the age of 16 months and fewer than 10 per cent of animals surviving beyond 3.5 years (Figure 7.5). The Late Neolithic survivorship curve from Horizon G is very different in shape from those of Horizons H and I (Figure 7.4). Juvenile mortality is very much reduced and the curves are between the 'meat' and 'wool' curves up through the end of year 4. Likewise long-bone fusion shows most animals culled between their second and fourth years (Figure 7.5). We interpret the Late Neolithic survivorship curves as reflecting meat production more than milk production; this suggests a shift in herd management strategies from the Middle to Late Neolithic.

We also use long-bone fusion to examine culling patterns in other species (Figure 7.6). For reasons of small sample size, we have not broken down the pig and cattle assemblages by horizon. Although the actual age at fusion varies among these species, the relative order of fusion is quite similar; hence it is useful to compare early-fusing, mid-fusing, and late-fusing bones among the different species. The pig survivorship curve is somewhat similar to that of the sheep and goats, but pigs show higher survivorship as juveniles. Whether hunted from wild or culled from domestic herds, many pigs were obtained as

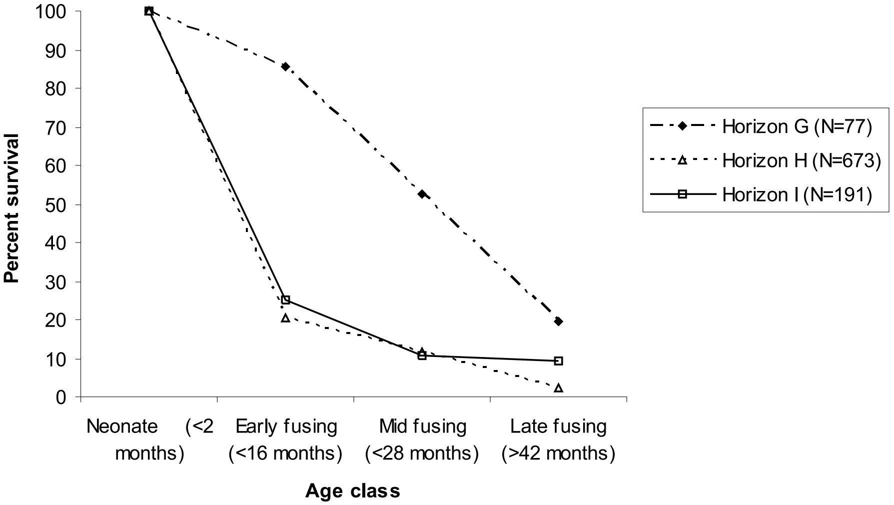

Figure 7.5: Age at death of sheep and goat at Pupićina, based on long bone fusion, shown as percent survival (data in Miracle and Pugsley 2006, Table 7.24).

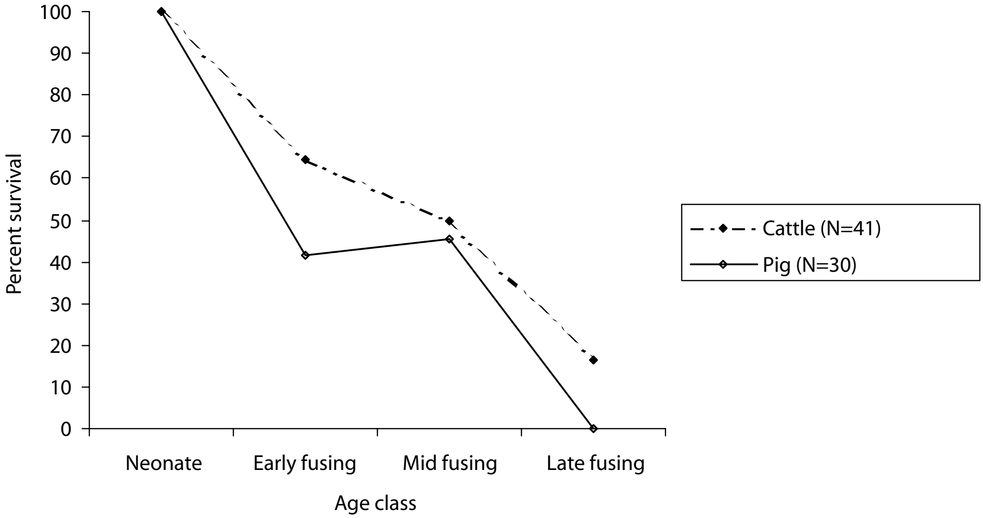

Figure 7.6: Age at death of cattle and pig at Pupićina, based on long bone fusion, shown as percent survival (based on data from Miracle and Pugsley 2006, Table 7.26).

sub-adults when they would have provided considerable meat. Cattle survivorship is higher than sheep/goat or pig (Figure 7.6); in particular, the cull of neonates and young juveniles (through mid-fusing bones) was only moderate. Nonetheless, only 17 per cent of animals were surviving into adulthood; cattle appear to have been culled primarily for their meat. Comparisons at Pupićina confirm our previous conclusion that sheep and goats were being treated in very different manner from other taxa. During the Middle

Table 7.4: Sheep and goats (MNI) from Pupićina based on shed deciduous (exfoliated) teeth (from 'living' adults) and ageable dentitions from dead sub-adults and adults. Age-stages after Payne (1973; 1987). G Late Neolithic. H and I Middle Neolithic.

Horizon	MNI Exfoliated teeth	MNI Sub-Adult (C/D, D, D/E)	MNI Adult (E-I)
G	4	2	6
H	14	5	10
I	9	0	4
Total	27	7	20

Neolithic sheep and goats were culled at a very young age, most likely as part of a herding strategy in which milk was important. Pig and cattle appear to have been managed for their meat; unfortunately we lack sufficient data to consider this pattern by horizon. Nevertheless, it is interesting that sheep/goat survivorship in Horizon G is quite similar to that for pig and cattle overall. We conclude that during the Late Neolithic at Pupićina all of the major domestic animals were being herded primarily for meat.

Information about the season of slaughter of sheep/goat and pigs comes from tooth eruption and the presence of fetal/neonatal remains. Sheep and goat during the Middle Neolithic were culled mostly during the spring; 84 per cent (N = 70) of seasonally-ageable lower dentitions were from neonates and yearlings (12–13 months old). In contrast, the sheep/goat and pig seasonally-ageable dentitions from the Late Neolithic indicate cull during the autumn/winter. These seasonality data thus complement evidence of a shift in herd management strategies; a 'milk' strategy was practiced during a very narrow season shortly after birth, while a 'meat' strategy was practiced in the autumn/winter.

Penning

There is strong evidence from soil micromorphology that live animals were periodically kept at Pupićina (Boschian 2006). Evidence of animal penning is also provided by shed or exfoliated deciduous teeth. It is impossible to be sure from the morphology of a tooth itself whether it was shed by a living animal or present in the mouth of a sub-adult animal killed just prior to the tooth being shed. There are several jaws of sheep and goats in which permanent premolars are partially erupted and the deciduous premolars are barely held by partly-resorbed roots in the alveolus. One thus expects there to be a few apparently 'shed' deciduous teeth in an assemblage with high mortality of sub-adult animals. Most of the 'shed' deciduous teeth, however, were probably dropped from an animal's mouth (or passed through its gut if swallowed).

Sheep/goat shed milk teeth are present throughout the sequence. In Table 7.4 we have calculated the MNI represented by shed deciduous teeth. (These MNI cannot be added to the overall totals for the site). Here we compare them to the sheep/goat MNI, by horizon, for sub-adults with erupting permanent cheek teeth (age stages C/D, D, D/E) and adult animals that had already shed milk teeth (age stages E–I). The MNI represented by shed deciduous teeth is in all horizons much greater than that for sub-adults (Table 7.4). We can thus show that the majority of these teeth were shed by living animals rather than coming from dentitions of slaughtered sub-adult animals. Furthermore, with the exception of Horizon G, 'living' adults represented by shed deciduous teeth are better represented than dead ones. This pattern is particularly strong for Horizon I. Sheep and goat were penned at Pupićina during every significant period of human use. Pupićina's importance as a pen decreased from the Middle Neolithic to the Late Neolithic.

Herding

Thus there is abundant evidence from the very earliest Neolithic use of the cave of stock keeping at Pupićina. Initially, people were almost exclusively keeping mixed herds of sheep and goat. These they were exploiting primarily for milk and meat, and there is good evidence for penning animals in the cave as well as the periodic slaughter of very young lambs and kids. People were coming to use the cave for a relatively short period of time during the spring, although there is limited evidence of human use during other seasons too. Although the use of ethnographic parallels is always problematic, recent practices of Greek shepherds provides an interesting comparison for the pattern at Pupićina. There is abundant ethnographic evidence that Greek shepherds confined very young lambs/kids, often in caves or natural pens, to prevent them from grazing prior to slaughter (personal communication, Andreas Kapetanios). Very young lambs/kids so confined are reported to provide the best rennet for making cheese. Shepherds also kept very young animals in caves to shelter them from weather and predators. Despite the abundance of sheep/goat remains during the Neolithic occupation of the site, most of the meat would have been provided by cattle, red deer, and wild boar, and probably also domestic pig from the Middle Neolithic on; the latter may have been occasionally penned at Pupićina during the Middle Neolithic. Overall, the sophistication of this early herding system in conjunction with the rarity of wild animal remains argues against 'residual' hunter-gatherers being responsible for the accumulation of the Neolithic levels at Pupićina.

There thus appear to have been three major activities practiced at Pupićina during the Middle Neolithic. The first was penning and milking flocks of sheep and goat in the cave. The second was culling young lambs and kids at Pupićina. The third was the periodic consumption of meat/marrow from cattle, adult sheep/goat, wild boar, red deer, etc. The resolution of the data does not allow us to tell whether these activities were concurrent or sequential. Nonetheless, Pupićina was regularly used for both herding animals and human occupation during the Middle Neolithic. Modern shepherds in the Velebit Mountains of northern Dalmatia occasionally sleep with their flocks in the same cave that is used as a pen for limited periods of time (days or sometimes weeks). This practice is particularly common when shepherds are relatively far from their village (Forenbaher, personal communication).

In the Late Neolithic herds of almost exclusively sheep were now slaughtered primarily for meat. The importance of domestic cattle and pig has also risen relative to the Neolithic, along with wild game (see above). Sheep were not penned as regularly at the site as during the Middle Neolithic, although there is slight and equivocal evidence from 'shed' deciduous teeth of cattle also being penned at the site during the Bronze Age. Visits to the site were probably still short in duration, but now occurred at all seasons of the year rather than being limited to the spring. Pupićina now appears to have primarily served as a human habitation site. The seasonality data complement evidence of herd management; a 'meat' strategy was practiced during multiple seasons of occupation, while a 'milk' strategy was practiced during a short time in the spring shortly after birth of the lambs and kids.

Hunting

There is limited evidence of hunting large game (wild boar, red deer, roe deer) and hunting/trapping small game (marten, badger); the taphonomic status of other small game is uncertain. There is some selective transport of red deer remains (antler and metapodials) perhaps related to bone tool manufacture. The infrequency of cut marks suggested that most of the butchery, including abandonment of butchery waste, occurred away from the site. This suggests some separation between hunting and herding. The shepherds may have hunted occasionally while tending their flocks; some of the carnivores may have been hunted to protect flocks from predation. On the other hand, it is also possible that hunting and herding were temporally and/or spatially separated. Similarities or differences in the seasonality of procurement would provide one line of evidence. The single red deer fetal bone from Horizon H suggests a spring season of death, which overlaps with seasonality indicators from the sheep and goat.

Hunting increased slightly in importance from the Middle Neolithic to Late Neolithic and Bronze Age; it was always, however, a relatively unimportant subsistence activity relative to herding. We suspect that the changing frequency of hunted animals is reflecting human choices and decisions beyond the relative proximity and availability of wild game at Pupićina.

Food Consumption

Archaeologists have been recently probing and pushing their data to examine the social contexts within which food was prepared and the various social strategies pursued and meanings created through its consumption and disposal (Hodder 1982: Wiessner and Schiefenhövel 1996: Dietler and Hayden 2001: Miracle and Milner 2002). Here we focus on carcass processing and preparation from evidence of cut marks and bone burning. These data are not easy to interpret. As numerous authors have noted, cut mark frequency and location are strongly influenced by anatomy and the ease with which bone can be avoided during skinning, carcass disarticulation, and defleshing. There is also anecdotal evidence of cultural 'styles' of butchery (Langenwalter 1980: Lyman 1987: Yellen 1977). Likewise, ethnoarchaeological and experimental studies suggest that there is not a clear and direct relationship between cooking and bone burning (Kent 1993: Stiner *et al.* 1995). One major problem is that bones may show no evidence of burning even though cooked to temperatures of up to 200 °C (Nicholson 1993) or even up to 500 °C (Spennemann and Colley 1989). Nonetheless, such data may provide clues about the scale and intensity of carcass preparation (Miracle 2001), and although imperfect, are often the only data available for studying how food was prepared, consumed, and thrown away.

Sample sizes are too small to examine food consumption by horizon. Likewise, wild animals are too rare to provide robust patterns for interpretation. There is positive evidence of the consumption of meat from red deer and marten; the latter in particular is an unusual food item that probably had far more ritual/symbolic meaning than dietary significance. A dog mandible was also cut away from the cranium and then broken, perhaps for its marrow. Again we can only speculate as to whether this was a calorifically unimportant snack or a ritually-loaded, symbolic 'meal'.

Detailed study of element representation indicates that complete sheep and goat carcasses were introduced to this site; the underrepresented parts of the skeleton can be accounted for by density-mediated destruction (Miracle and Pugsley 2006). It is hardly surprising that complete sheep/goat carcasses were brought to the cave given their relatively small size and, more importantly, given other evidence that sheep and goats were penned in the cave. Whether or not animals were slaughtered at the cave while it was being used as a pen, sheep/goat carcasses appear to have been butchered at Pupićina. Most of the culled animals were very young sheep and a few goats.

The frequency of cut marks and burning (%NISP) by body part is presented for sheep/goat and small ungulates in Figure 7.7; data are too scant to compare butchery/cooking practices by horizon. Cut marks are extremely rare on the fetal-neonatal animals; their carcasses were not processed very much and may have been deposited fairly complete with little consumption. Burning, in contrast, occurs on a number of elements in low frequency and without making a clear pattern. The juvenile-adult animals have a relatively even distribution of cut marks on the limbs, ribs, and mandibles; they appear to be from initial butchery/disarticulation (e.g. on skull base and long-bone ends) as well as defleshing (e.g. on ribs and long-bone shafts). There is no clear evidence of segmenting the neck and back into smaller units prior to transport, cooking, and/or consumption. Most elements show some burning, much of which is probably post-depositional and/or related to refuse discard rather than cooking. Burning is relatively more common on limbs than on axial elements, and within limbs, articular ends are burned more frequently than shafts. Burning is found preferentially on teeth relative to skulls and long-bone ends relative to shafts, a pattern of differential burning across elements which suggests that the head (with atlas attached) and limbs were disarticulated prior to burning, and that some of this burning came from roasting meaty elements. From these cut mark and burning data, we conclude that fetal-neonatal carcasses were processed and treated quite differently from the juvenile-adult carcasses. The former appear to have been disposed with little modification; much of the burning may be incidental. The latter were skinned, disarticulated and defleshed. In addition to incidental burning, there is compelling evidence of roasting limbs and heads in a regular manner.

There is strikingly little evidence of human consumption of lamb and kid meat; there is relatively little bone burning, even fewer cut marks, and little bone breakage. At best one can argue that it would have been relatively easy to process these very young juveniles without marking the bones. If these lamb and kid carcasses were discarded unused, why is there not better evidence of carnivore consumption (only two neonatal bones were gnawed)? There was no clear evidence from depositional contexts of special treatment or burial of these carcasses. Lamb and kid carcasses left to rot must have had a fairly rapid and detrimental effect on the living environment at Pupićina. Perhaps culling of juveniles occurred immediately before seasonal abandonment of the site (as suggested above), and perhaps the periodic burning of the cave floor was in part to remove the neonatal

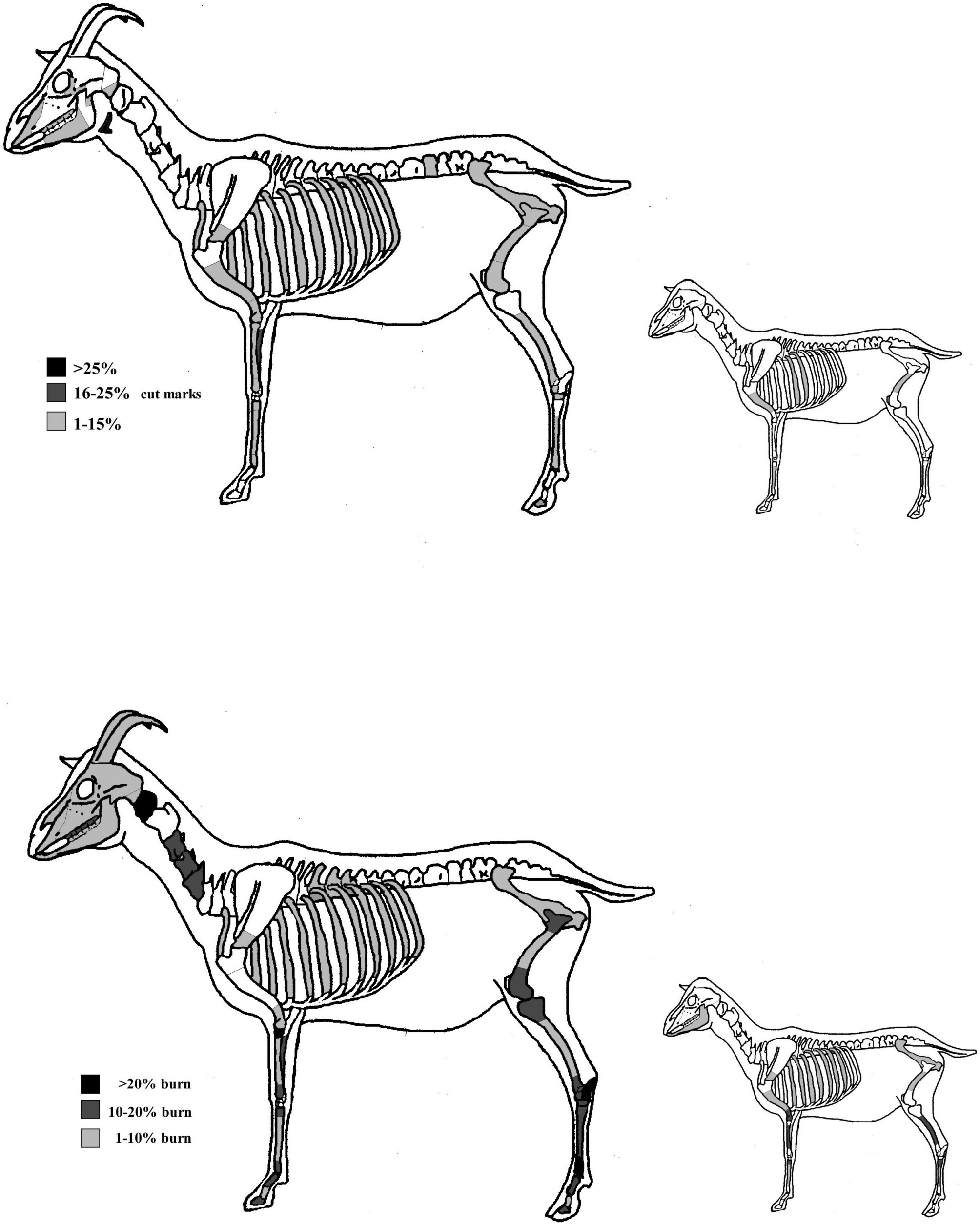

Figure 7.7: Sheep/goat and small ungulate remains (%NISP) with cut marks (above) and burning (below). The smaller drawing represents fetal-neonatal animals, while the larger drawing represents juvenile-adult animals.

carcasses. The lack of carnivore gnawing and burning on the neonatal remains militates against such an interpretation; again we are not sure what alternative there is other than human consumption. Adult sheep and goat were slaughtered in or near the cave, followed by initial butchery, cooking, and consumption. All stages of carcass processing and marrow/meat consumption appear to be present. The pattern of burning is suggestive of roasting, particularly of limbs and heads. This food appears to have been prepared for local consumption; we imagine that the occasional 'excess' juvenile, sub-adult, or adult animal (weak, old, injured, etc.) was slaughtered and consumed over a several day/week period by shepherds.

The slaughter and consumption of cattle was a completely different affair. Cut marks on cattle and large ungulate bones are clearly clustered around the articular ends of long bones; they are also present on ribs, a few vertebrae, and an occipital condyle (Figure 7.8). Most of the cut marks on long bones appear to be related to disarticulation; the exception is cuts on two femur shafts from defleshing. Cut marks are particularly frequent on metapodials, tarsals, and carpals. These data complement body part frequencies in suggesting that lower limbs and feet were removed as part of initial butchery and discarded on site; the remaining carcass parts were probably transported elsewhere for consumption. The few cut marks on ribs and femur shafts, however, do indicate that some limited consumption of beef occurred on site.

Many cattle bones are burned (Figure 7.8). Burning is extremely frequent on metapodials and feet. Again with the exception of femur shafts, burning is concentrated on long bone ends on the remaining limbs. If fleshy limbs were roasted on fires, then one would expect more burning on lower relative to upper limbs since the former have much less flesh covering the bone. Much of the burning on metapodials and feet may thus be related to roasting limbs; however, one cannot rule out the possibility that people placed cattle bones on fires to dispose of 'waste' or as a 'ritual' offering. While there is relatively frequent burning on ribs, there is very little on vertebrae. There is relatively frequent burning on horn cores and bony parts of the head. As with the sheep and goat, many upper teeth are burned (22%), while maxilla are not burned at all. Mandibles, on the other hand, are more frequently burned than lower teeth (13% and 7% respectively). Our interpretation, again, is head roasting. In many ways these patterns are very similar to the sheep/goat. On the other hand, the data seem to indicate relatively larger limb units being cooked at once in cattle compared to sheep/goat. This may suggest food preparation aimed at comparatively larger consumptive units than for sheep/goat. Although the data are somewhat thin, they suggest rather different social contexts and motivations associated with the consumption of beef compared to mutton. Although much of the 'excess' beef appears to have been transported away from Pupićina, a slaughtered calf/cow/bull must have provided a sudden surplus of meat, well beyond the consumptive needs of a few shepherds. The slaughtering of a calf/cow/bull almost certainly marked a special occasion. In this light, it is interesting to note that such 'special occasions' occurred with greater frequency during the Late Neolithic than at other times during the history of cave use.

Evidence for pork consumption increases significantly in the Late Neolithic at the time when the bones indicate domestic pig replaces wild boar. Pig carcasses, domestic or wild, appear to have been differentially transported to and away from Pupićina; heads are greatly over-represented in the assemblage. Heads may have been preferentially transported

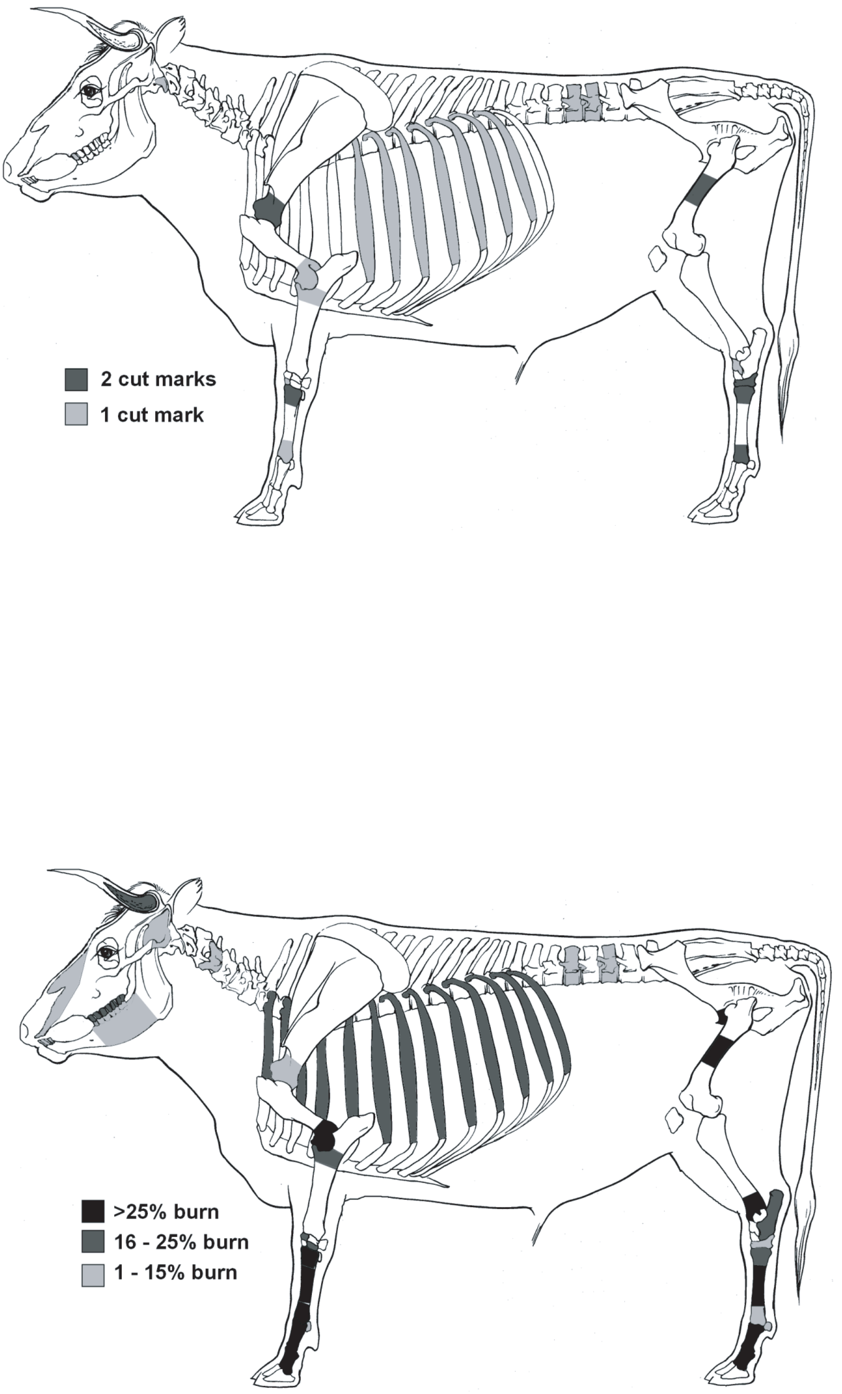

Figure 7.8: Cattle and large ungulate remains (%NISP) with cut marks (above) and burning (below).

to Pupićina because of their relatively high food value (Pugsley 2003), or carcasses below the head may have been preferentially transported off site. Again there are a number of potential interpretations of this pattern. Hunters may have travelled relatively greater distances (hence greater transport constraints) in pursuit of wild boar; on the other hand pork may have been packed out of Pupićina for consumption at a nearby village. Although pig bones are frequently broken and heads were intensely processed (hence the contrast between tooth and bony skull/mandible frequency), there are relatively few cut marks and little burning on pig remains. Pork may have been boiled, while beef/veal or lamb/mutton was roasted.

Discussion

There were major shifts in the use of animals between Middle Neolithic and Late Neolithic occupations at Pupićina Cave. During the Middle Neolithic people kept many sheep with a few goats penned in Pupićina, culling very young animals for milk/cheese production. Hunting was not very important and cattle were only occasionally slaughtered for their meat. These activities were concentrated in the spring. The accumulated dung and rubbish from these herds was burned periodically, forming large ash lenses. During the Late Neolithic people less frequently kept goats and sheep penned at the site. Sheep were culled as sub-adults for the production of meat. Cattle and pig were also slaughtered more frequently than before (or later), and along with hunted game, provided meat for consumption at Pupićina and elsewhere. People came to the site during the autumn instead of the spring; there is no evidence of year-round occupation. Along with the decrease in penning animals, there was also a decrease in the amount of dung and the need to burn it. Pupićina, however, provides only a single point of reference. How do Neolithic practices at Pupićina compare to the wider region?

NEOLITHIC ANIMALS IN THE NORTHERN ADRIATIC REGION

To what extent did Neolithic people in the region rely on different domestic animals? When, where, and why did they collect/hunt wild animals? How did people relate to their herds? How stable were these practices; how, when, and why did they change during the Neolithic? These are just a few of the questions that one can pose with zooarchaeological assemblages, but despite the ubiquity of animal remains in archaeological sites in Istria and Dalmatia (they are often preserved on open-air as well as cave sites), these data have received relatively little interest and attention. For example, even though there has been some interest in the relative frequency of wild versus domestic animals at the beginning of the Neolithic (e.g. Budja 1993; 1996: Tringham 1971: Trump 1980), there are not any comprehensive syntheses and few of the relevant collections have been analysed in detail. There is even less information about Neolithic animals after the transition to food production (Chapman *et al.* 1996: Frame 1998), and the available information has not been synthesised. Even in northern Italy, where faunal data has been published and synthesised by Riedel (1988; 1990; 1991; 1996), we mostly have information about assemblage composition to address these issues. Nevertheless, much can be gained by synthesising the data at hand. We organise our discussion around the following topics: the role of domestic and wild animals in the spread of the Neolithic, assemblage variability in the Neolithic, herding in the Neolithic, and diversification and hunting in the Late Neolithic and Copper Ages.

Domesticated Animals and the Spread of the Neolithic

There is compelling evidence that domesticated animals were transmitted along with early Neolithic (Impressed Ware) and Middle Neolithic (Vlaška/Danilo group) pottery by people moving up the eastern Adriatic seaboard, arriving in southern Istria shortly after 6000 Cal BC (Chapman and Müller 1990: Forenbaher and Miracle 2006). Fauna from levels containing only 'Mesolithic' lithics without pottery is always dominated by wild taxa, usually to the exclusion of domesticated animals (Boschin and Riedel 2000: Cannarella and Cremonesi 1967: Miracle 1997; 2001; 2002).

The earliest dated Neolithic site in Istria and the northern Adriatic region (5970 – 5560 Cal BC, 1 s.d.) is the open-air site of Vižula, at which sheep and goat make up the small animal bone assemblage and the majority of remains come from marine shells (Baćić 1969: Batović 1979, 510: Chapman and Müller 1990). The open-air site of Piancada in the Friuli of north-eastern Italy has poorly-preserved ceramics that do not show clear cultural affiliation and radiocarbon dates as early as *c.*5800 Cal BC (Pessina and Rottoli 1996). These are associated with a small, poorly-preserved faunal assemblage completely dominated by domestic animals (Table 7.5). Likewise, the earliest Neolithic visitors to Pupićina Cave left a faunal assemblage overwhelmingly dominated by domestic sheep and goat at about 5600 Cal BC.

In the northern Adriatic there is, for the time being, a single credible example – level 3a of Edera cave in Trieste Karst, dated to 6700±130 bp – where one can talk about an undisturbed context containing a few potsherds, Castelnovian lithics, and a mixed (wild/domestic) faunal assemblage (Biagi and Voytek 1994: Biagi *et al.* 1993: Boschin and

Table 7.5: Dated initial Neolithic faunal assemblages from Piancada (Petrucci and Riedel 1996); Grotta dell'Edera (Boschin and Riedel 2000); Pupićina (Table 1); Nin, Smilčić (Schwartz 1988); Tinj (Schwartz in Chapman et al. *1996).* [1] *Remains identified as 'cattle/red deer' allocated to each taxon in proportion to their relative frequency in the assemblage.* [2] *Percentages measured on Figure 133 in Chapman* et al. *(1996).*

Region	**Friuli**	**Trieste Karst**	**Istria**	**Dalmatia**	**Dalmatia**	**Dalmatia**
site type	open-air	cave	Cave	open-air	open-air	open-air
Age	EN/MN	EN/MN	EN/MN	EN	EN	EN
site name	Piancada	Edera 3-3A	Pupićina I	Nin	Smilčić	Tinj[2]
%NISP Ovis/Capra	26.8	32.1	88.2	90.1	40.0	92.2
%NISP Bos	43.5	5.2[1]	4.5	1.6	32.1	4.2
%NISP Sus	29.6	7.4	2.0	1.3	11.5	0.7
%NISP Wild	0.0	55.4	4.8	6.0	11.5	1.9
Total NISP	108	271	693	385	*ca.* 131	3212
Total Remains	224	2604	2247	N/A	N/A	15365

Riedel 2000: Budja 1993, 177). Potsherds from Edera 3a have been described as few, coarse, undecorated, and different from 'Danilo/Vlaška' pottery. Other data from Edera, however, suggest that domestic sheep and goat were penned in the cave, much as at Pupićina Cave. Shed deciduous teeth from Level 3A at Grotta dell'Edera, most likely 'dropped from the jaws of living individuals' (Boschin and Riedel 2000, 79), suggest stabling animals in the cave. The 'Late Castelnovian' people at Edera clearly obtained resources other than a few coarse pots (*cf.* Biagi *et al.* 1993, 49: Biagi and Starnini 1999, 12); domestic sheep and goat make up over one third of the faunal assemblage, reached Edera while still alive, and remained in such a state for some period of time. If 'Mesolithic' people used Grotta dell'Edera during the formation of Level 3A, they were more than just supplementing their hunting economy with the odd domestic animal acquired by whatever means. Edera 3a may be providing interesting hints about contacts between hunters-gatherers and farmers.

The initial Neolithic in northern Istria, and the Karst around Trieste and southern Slovenia is associated with typologically Middle Neolithic pottery. Thus, many of the undated Middle Neolithic assemblages may reflect the first use of these caves by herders and/or hunters of domestic animals. Leaving aside the questionable validity of dichotomising broadly contemporary assemblages as 'Mesolithic' or 'Neolithic' based on lithic and/or faunal assemblages, one can see that there is considerable variability in human settlement and practices within a relatively small region at the time of the first appearance of pottery in the northern Adriatic. At Zingari Level 5, sheep/goat and pig/boar co-dominate the ungulate assemblage followed by cattle. Red and roe deer are by far the most common of the wild taxa. Both deer species are represented by antler, teeth, and post-cranial bones. Nearby, the Grotta del Mitreo produced another Middle Neolithic assemblage, in this case overwhelmingly dominated by sheep/goat (87.5% of NISP), followed by wild animals, cattle, and pig/boar. Faunal data from reasonably well excavated and documented sites in Istria and the Trieste Karst indicate that assemblages from levels containing Neolithic pottery are usually dominated by domesticated taxa (mostly sheep and goats), often constituting 70 per cent or more of all faunal remains (Tables 7.5–7.6) . This pattern is true of caves and open-air sites; although the latter contexts are rare and have poorly preserved faunal remains.

If we compare the picture sketched for Istria with that for the wider eastern Adriatic region, we find that the two have much in common. Batović (1979), Chapman and Müller (1990), Müller (1994), and many other authors generalize that the first farmers in Dalmatia used impressed pottery. Indeed, an evaluation of all reasonably well excavated and documented sites from Corfu to the caves of the Trieste Karst indicates that throughout the eastern Adriatic littoral domesticated animals show up together with the earliest pottery. Examples include levels with impressed pottery at Smilčić, Nin (Schwartz 1988), Tinj (Schwartz in Chapman *et al.* 1996, 186–187), Škarin samograd, Gudnja (Chapman and Müller 1990, 129–131, table 1: Müller 1994, 65), Vela Spila (Korčula) (Čečuk and Radić 2001, 81), Spila (Nakovana) (Miracle, unpublished data), Spila (Perast) (Marković 1985, 26), as well as the level with plain pottery (Level C, Base) of Sidari (Sordinas 1969, 406, note 14). In all cases where quantitative data are available, domesticated animals dominate the assemblages with 80–95 per cent, most of them (65–95%) being ovicaprines, except at Smilčić, where cattle constitute 55 per cent of all

Table 7.6: Middle Neolithic (MN) faunal assemblages from Bannia-Palazzine di Sopra (Cottini et al. *1997); Grotta Azzurra (Cannarella and Cremonesi 1967); Grotta degli Zingari (Bon 1996); Grotta del Mitreo (Petrucci 1997); Grotta dell'Edera (Boschin and Riedel 2000); Podmol pri Kastelcu (Turk* et al. *1993); Acijev spodmol (Turk* et al. *1992); Mala Triglavca (Budja 1996); Pupićina (Table 1); Smilčić (Schwartz 1988).* [1] *Excludes 66 badger remains.* [2] *Remains identified as "cattle/red deer" allocated to each taxon in proportion to their relative frequency in the assemblage.* [3] *Total NISP standardized to sediment volume (m^3).*

Region	**Friuli**	**Trieste Karst**				**Slovenian Karst**			**Istria**	**Dalmatia**
Site type	open-air	cave	cave	cave	cave	cave	cave	cave	cave	open-air
Age	MN	MN	MN	MN	MN	MN	MN-LN	MN-LN	MN	MN
Site name	Bannia-Palazzine di Sopra	Azzurra I	Zingari 5	Mitreo 5-6	Edera 2A	Podmol (K-M)[3]	Acijev (E-F)[3]	Mala Triglavca (3-9)	Pupićina H	Smilčić
%NISP Ovis/Capra	46.0	39.0	26.2	87.6	89.4	66.9	46.4	11.3	84.5	36.3
%NISP Bos	30.0	21.0	14.0	3.3	1.6[2]	+	+	10.7	9.4	42.0
%NISP Sus	24.0	11.0	23.2	0.8	1.9	+	+	10.9	2.1	8.2
%NISP Wild	0.0	29.0	40.0[1]	7.4	7.1	0.0	21.9	66.9	3.8	8.7
Total NISP	50	100	164[1]	121	1119	52	66	523	2180	*ca.* 245
Total Remains	N/A	N/A	195	128	5936	N/A	N/A	N/A	7298	N/A

domesticates. As opposed to that, the few Mesolithic faunal assemblages that have been studied (Konispol Cave: Russell 1998: Odmut Cave I: Srejović 1974: Marković 1985) contain only wild taxa.

In addition to Edera, there are several other notable exceptions from the wider eastern Adriatic region, Konispol Cave (Albania), Crvena Stijena and Odmut Cave (Montenegro), and Zelena pećina (Herzegovina). Crvena Stijena and Odmut come from geographically remote and – from a farmer's perspective – environmentally marginal zones in the interior. Konispol Cave and Zelena pećina, however, both overlook agriculturally productive valleys. Konispol is a large cave in southern Albania about 7 km inland and at about 400 m/sl (Korkuti *et al.* 1996: Harrold *et al.* 1999). Domestic animals (cattle, sheep/goat, about 50% of NISP) appear alongside a 'Mesolithic lithic industry' in 'transitional' contexts with 'very few sherds of pottery' (Russell 1998, 148). The pottery sherds may be intrusive (Russell 1998) or reflect a mixed deposit, as may also be the case of faecal spherulites observed in geoarchaeological thin sections (Schuldenrein 2001, 576–577). Crvena Stijena is a huge rock shelter situated some 35 km inland, at *c.*700 m/sl, near the crest of a steep ridge overlooking the valley of Trebišnjica river. Layer III of Crvena Stijena contained a substantial amount of impressed pottery associated with 'only wild animals' (Benac 1975, 127), although in the same monograph Malez (the faunal specialist) reports the presence of domestic goat and cattle (Malez 1975, 159–160) from the same layer. Benac (1975, 127) reported that red deer dominated the assemblage from Layer III; we have greater confidence in this observation, and accept the impressed ware horizon (Layer III) from Crvena Stijena as dominated by wild fauna. Odmut cave is even farther inland (85 km from the coast and across the watershed), located in a steep canyon at the headwaters of the Drina. A small assemblage (263 sherds) of Early Neolithic pottery is present in Layer II. Wild taxa make up 85.5 per cent of the faunal assemblage from Layers IIA and IIB combined (Marković 1985, 40). Zelena pećina, about 45 km inland, overlooks the spring of Buna, a short tributary of the Neretva River with its wide floodplain. A rich assemblage of impressed pottery in Layer III is associated with mostly wild fauna (Benac 1958, 79: Batović 1979, 510–513). Remarkably, at Crvena Stijena and Odmut, fauna from directly overlying layers remains virtually unchanged, although those layers are attributed to Middle Neolithic (Crvena Stijena II) and Late Neolithic (Odmut III) (Benac 1975, 139–140: Marković 1985, 40, 45). Although these examples are suggestive of exchanges and contacts between hunt-gatherers and herders, each has potential problems with regards to the integrity of deposits and/or the identification of remains.

There is a fifth possible example of wild fauna associated with impressed ceramics, which exemplifies some of the potential problems of data from old excavations: Gospodska pećina in northern Dalmatia. Chapman and Müller (1990, table 1) assign a radiocarbon date of 7010±90 bp (z-579) to an association between impressed ceramics and domestic animals. Müller's (1988, fig. 9; 1991, fig. 9) interpretation of the ceramics seems sound (*c.f.* Malez's [1979, 49] and Batović's [1979, 482, 575–576] attribution of ceramics to later periods), and prehistoric ceramics are reported to have been associated with a faunal spectrum of domestic animals in Layer a (Malez 1979, 45, 52). The sample that provided the date of 7010±90 bp, however, comes from Layer c, a layer that, according to Malez (1979, 45, 53–56), lacked artefacts and was dominated by wild taxa (mostly red deer, roe deer, and wild boar). This layer was capped by a flowstone, Layer b, within which a hearth was dated to 5130±90 bp (z-580) (Srdoč *et al.* 1981). The older radiocarbon date would fit well with Müller's identification of impressed ceramics from the site, and would imply that impressed ware was associated with a wild faunal assemblage at Gospodska pećina, and that contrary to Malez (1979), some artifacts were recovered from Layer c. If, on the other hand, Malez's description of the stratigraphy is reliable, then there must be something wrong with the radiocarbon date on Layer b or Müller's identification of impressed and Danilo ceramics from Layer a, or both. In this case, the earlier radiocarbon date from Layer c might even relate to a Late Mesolithic component at the site. Whatever the situation, Gospodska pećina does not provide evidence of an association of Impressed Ware ceramics and domestic animals (*cf.* Chapman and Müller 1990, table 1).

Like Edera 3a farther north, these examples may provide evidence of interaction between late foragers and early farmers (Müller 1994, 67, 200–202), although these associations could also be interpreted as evidence of hunting by early Neolithic herders. At Edera 3a and Konispol, a mixed (wild/domesticated) faunal assemblage is associated with Castelnovian lithics and a few atypical (Edera 3a) or intrusive (Konispol) potsherds. At Crvena Stijena, Odmut, and Zelena pećina, in contrast, an essentially wild fauna (with a few domesticates) is associated with substantial amounts of pottery and a mixed/transitional lithic industry (Forenbaher and Miracle n.d.a.). This suggests that, depending on local circumstances, such interaction differed from place to place. Relatively low resolution of data from the two Montenegrine sites prevents a more specific discussion of the character of this interaction.

In summary, domestic animals dominate faunal assemblages associated with Early Neolithic pottery in open-air sites. The pattern is much more variable in caves; at some caves the appearance of pottery is associated with assemblages dominated by wild taxa

(Crvena Stijena, Odmut, Zelena pećina, Mala Triglavca), in other caves there is a fairly even representation of wild and domestic taxa (Edera 3/3a, Konispol, Azzurra I, Zingari 5), while at Pupićina and a number of other sites (Mitreo 5–6 [6–8 excavated in 1971 and radiocarbon dated], Podmol, Vela Spila [Korčula], Spila Nakovana) domestic animals dominate assemblages. The earliest dated occurrences of pottery in caves are associated with domestic animals. In the southern Adriatic these assemblages appear to have been created by highly mobile Neolithic 'explorers', while in the northern Adriatic might have been made by Neolithic shepherds from nearby open-air villages (Forenbaher and Miracle 2005, 2006).

Neolithic Variability

In the Po Valley west of our study area Riedel (1990; 1996) has interpreted variability in the frequency of wild taxa in Neolithic faunas using an evolutionary model of 'neolithisation' as a gradual process of replacement of hunted, wild animals by herded, domestic animals in the subsistence economy of indigenous foragers. The underlying assumption is that assemblages dominated by wild animals (e.g. Molino Casarotto) and those dominated by domestic animals (e.g. Rivoli, Moletta, etc.) were created by different populations – hunters and herders, respectively (Riedel 1996, 70). Thus, Late Neolithic assemblages like Razza di Campegine and Cornuda still have a 'Mesolithic-like' economy owing to the predominance of remains of wild animals (mostly red deer and wild pig). In Zvelebil's (1986) terminology, the north-east Italian Neolithic has long 'availability' and 'substitution' phases during which indigenous hunter-gatherers had a major input to neolithisation; this process is in part evidenced by local differentiation in subsistence behaviour (Riedel 1996, 70).

As discussed above, faunal data from the northern Adriatic region do not support such an evolutionary model. Neolithic pottery assemblages dominated by wild taxa appear later and may have been left by hunting people interacting with farmers or farming people hunting. Neither is there a time-transgressive shift from wild-dominated to domestic-dominated assemblages nor are temporal changes gradual (Tables 7.5 and 7.6). For example, at Grotta dell'Edera, the frequency of domestic animals rises dramatically from Level 3/3A to Level 2A (Middle Neolithic), despite the fact that radiocarbon dates from these occupations significantly overlap at 1 s.d. For the time being, we can eliminate a number of potential causes of assemblage variability. For example, stratigraphic mixing or Zilhão's (1993) 'taphonomic filter' cannot account for all of these assemblages. Acijev spodmol and Grotta Edera have been dug relatively recently by extremely experienced and competent field archaeologists. Furthermore, several of these sites either lack pre-Neolithic deposits (e.g. Acijev spodmol), or have concreted sediment in the surface of the Mesolithic (e.g. Azzurra). The latter situation, of course, is also characteristic of Pupićina. In any case, it seems unlikely that excavators could have mixed Mesolithic and Neolithic deposits in such circumstances. All of these assemblages are in terms of ceramic typology from the Vlaška Group, *sensu lato*. A chronological explanation for the pattern seems unlikely, although further radiometric determinations may require re-evaluation of this argument. Neighbouring, more or less contemporary, Middle Neolithic sites often show contrasting strategies of use; for example Podmol pri Kastelcu vs. Acijev spodmol (*c.*0.4 km separates them) and Edera 2A vs. Azzurra I (*c.*1 km separates them). All of these sites appear to have afforded similar opportunities with regards to either herding domestic stock or hunting/trapping locally available game. Thus site location at a fairly fine scale does not appear to explain this pattern either.

Time of occupation, on a finer scale, however, is one possibility. That is, sites may have only been seasonally used; those sites with a relatively high frequency of wild animals may have been occupied at a time of the year when hunting was particularly productive relative to culling domestic animals. Evaluation of this argument would require evidence of seasonal use of resources and site occupation, whether from faunal remains, carbonised wood and seeds, phytoliths, and/or micromorphological analyses of occupation floors, middens, and hearths. Another possibility is that some people more or less exclusively relied on domestic animals (early herders), while others used domestic animals as a supplement (whether traded, poached, given, or stolen) to a diet that revolved around wild animals (hunter-gatherers). Here we have put forward only a few of the many other possible explanations. Our contention is that the contrast in faunal composition is more than a product of excavation/sampling strategy, and that evaluation of these arguments requires the collection of detailed information on faunal, archaeobotanical, sedimentological, as well as artefact assemblages, similar to those we have collected for Pupićina Cave.

Herding in the Neolithic

We have mortality data from only a few of the Middle Neolithic faunal assemblages. Despite these limitations, several interesting points emerge. First, although the assemblages vary significantly in the relative frequency of wild animals (e.g. Zingari vs. the rest) the sheep/goat mortality profiles are very similar. Zingari 5, Edera 2A, Mitreo 5–6, and Pupićina H all show profiles dominated by neonatal and juvenile individuals (Table 7.7). Some of the differences among them, particularly in the representation of neonatal animals, may reflect contrasts in the season of slaughter and the manipulation of birthing seasons by prehistoric herders. Taken at face value, one might even interpret the contrast between Mitreo 5–6 and the other sites as reflecting a contrast between culling for meat at the former as opposed to milk production at the latter. Sample sizes, however, are too small to be sure that these differences are not just statistical artifacts. More interesting is the similarity in mortality profiles despite variability in the relative frequency of wild animals (e.g. Zingari vs. the rest of the sites). This is a provocative argument for interpreting the relative high frequency of wild animals at Zingari as evidence of Neolithic hunters. In addition to the mortality data, shed deciduous teeth of sheep/goat from Edera Level 2A (Boschin and Riedel 2000) and soil micromorphological studies of Grotta dell'Edera, Grotta Caterina and Grotta Azzurra (Boschian and Montagnari-Kokelj 2000) attest to the frequent use of caves as stock pens during the Middle Neolithic. The available data on sheep/goat mortality points to a close management of the herds, perhaps for the production of milk among other products, from the onset of the Neolithic in the northern Adriatic.

Table 7.7: Middle Neolithic sheep/goat mortality at Grotta degli Zingari (Bon 1996); Grotta del Mitreo (Petrucci 1997); Grotta dell'Edera (Boschin and Riedel 2000, Table 5); Pupićina (Miracle and Pugsley 2006, Table 7.23). Remains identified to multiple age stages equally divided among them. Edera stages correspond to Boschin and Riedel's age classes: "pd4±" = A; "pd4+ or ±" = A/B; "pd4+" = B; "M1+" = C; "M2+" = D; "M3± or M2+" = D/E; "M3±" = E; "M3+, M3++, M3+++" = F-I.

Age Stage	Zingari 5	Mitreo 5-6	Edera 2A[1]	Pupićina H
%Neonate (A)	31	10	30	31
%Juvenile (B-C)	50	53	30	38
%Sub-adult (D)	0	5	10	8
%Adult (E-I)	19	32	30	23
N	16	19	15	80

Table 7.8: Comparison of faunal composition of Late Neolithic (LN) and Copper Age (CA) assemblages in Trieste Karst, Istria, and Dalmatia. Data sources: Grotta Azzurra (Cannarella and Cremonesi 1967); Grotta dell'Edera (Boschin and Riedel 2000); Podmol pri Kastelcu (Turk et al. *1993); Acijev spodmol (Turk* et al. *1992); Pupićina (Table 1); Buković (Schwartz in Chapman* et al. *1996); Grapčeva špilja (Frame 1998).* [1]*Remains identified as "cattle/red deer" allocated to each taxon in proportion to their relative frequency in the assemblage.* [2]*Total NISP standardized to sediment volume (m^3).* [3]*Estimated based on the %identifiable from the assemblage as a whole.* [4]*Percentages calculated from counts measured on figure 4.5 in Frame (1998). Total NISP is the sum of these estimates.*

Region	**Trieste Karst**		**Slovenian Karst**			**Istria**	**Dalmatia**		
Site type	cave	cave	cave	cave	cave	cave	open-air	cave	cave
Age	CA	LN-CA	LN	CA	CA	LN	CA	LN	CA
Site name	Azzurra II	Edera 2	Podmol (J)[2]	Podmol (E-I/J)[2]	Acijev (C-D)[2]	Pupićina G	Buković 1	Grapčeva[4]	Grapčeva[4]
%NISP Ovis/Capra	45.5	78.6	41.0	46.1	40.2	70.0	59.1	83.4	80.6
%NISP Bos	31.2	7.1[1]	+	+	+	12.5	26.5	5.1	3.1
%NISP Sus	3.9	8.1	+	+	+	8.3	13.3	2.7	4.6
%NISP Wild	19.5	5.2	36.0	21.9	40.7	9.1	1.1	7.8	11.2
Total NISP	77	520	73	549	52	504	465	*ca.* 923	*ca.* 196
Total Remains	N/A	5040	N/A	N/A	N/A	2501	2690[3]	N/A	N/A

Diversification and Hunting in the Late Neolithic and Copper Ages

Compared to the Middle Neolithic assemblages, we can observe a number of trends common to most of the Late Neolithic sites. Firstly, the frequency of sheep/goat drops relative to other taxa, in many assemblages by 10–20 per cent of NISP. This trend is present at all of the assemblages with the exception of Azzurra (Table 7.8). Secondly, the frequency of cattle increases relative to other taxa. (This trend and that for pig/boar discussed below cannot be evaluated for the Slovenian sites owing to the way in which data are presented). Thirdly, the frequency of pig/boar and wild animals increases at all of the sites with the exception of Azzurra. The age distribution of sheep and goats also shows a general shift towards culling animals at an older age, although this shift should be treated with caution since comparative data are available from only three sites (Table 7.9). The

Table 7.9: Percent of sheep and goat remains by age class at Late Neolithic (Pupićina and Grapčeva) and Copper Age (Edera 2) sites along the eastern Adriatic coast. Data sources: Grotta dell'Edera (Boschin and Riedel 2000, Table 5); Pupićina (Miracle and Pugsley 2006, Table 7.23); Grapčeva špilja (Frame 1998, Figure 4.13). As Table 7.7.

Age Stage	Edera 2[1]	Pupićina G	Grapčeva
%Neonate (A)	17	3	5
%Juvenile (B-C)	50	17	28
%Sub-adult (D)	0	17	21
%Adult (E-I)	33	63	46
N	6	15	39

frequency of neonates decreases and the frequency of adults increases relative to MN horizons from these sites. Mortality data from Grapčeva are somewhat problematic, as the data appear to be for the site as a whole, i.e. Late Neolithic-Copper Age-EBA combined, but since roughly 80 per cent of the sheep/goat assemblage comes from the Late Neolithic horizons, there is some justification to treating the aggregate profile as primarily reflecting Late Neolithic culling practices. The poor representation of neonates and relative abundance of sub-adult and adult animals argues against much dairying (Table 7.9). In fact, the Grapčeva mortality profile is almost identical to the idealised meat profile. This interpretation is rather different from that of Frame (1998, 126), who suggests that the kill-off pattern conforms to a mixed dairy strategy. Ironically, a cull strategy that provides meat by targeting sub-adults and adults better fits Frame's (1998, 129) scenario for cyclical feasting at the site. At Bukovic, the ageable sheep/goats are mostly from adults, as is also the case for the cattle and pig remains (Schwartz in Chapman *et al.* 1996, 203–204). More detailed mortality data from Bukovic would be useful in this regard. There thus appears to be a common pattern of exploiting sheep/goat herds primarily for meat. From these comparisons we can see that the changes in faunal composition observed at Pupićina from the MN to LN are part of much wider regional trends. Even at cave sites in the hinterland we can see a trend towards a mixed herding economy. This may indicate a shift in how these cave sites, often interpreted as pastoralist camps, were articulated with settled villages on more productive agricultural land. Likewise, the increased importance of wild animals in the Late Neolithic and Copper Age is also interesting. This may reflect the recovery and spread of forests and with them the resident wild animal populations or it may reflect the fact that Late Neolithic and Copper Age landscapes became increasingly differentiated, with wild animals decreasing around settled villages but increasing in the more distant hinterland. On the other hand, a greater premium might now have been placed on the hunt as a source of food and prestige, or as an arena for creating and negotiating identities.

CONCLUSION

Herding, hunting, and food consumption practices all show important temporal changes and/or inter-specific contrasts, whether viewed in detail at an individual site like Pupićina Cave, or in general trends in the northern Adriatic region. At the relatively intimate scale of Pupićina Cave, we have rich evidence for examining how people's attitudes towards their herds and the animal world around them might have changed over time. As a start we speculate about the contrasts between the two major occupational patterns, Middle Neolithic and Late Neolithic, discussed above. During the Middle Neolithic we might infer relatively close relations between shepherds and flocks from penning animals in the cave, and the regular and careful selection of very young animals for slaughter to obtain rennet and milk. Pupićina at these times might have been associated with lambing, the rejuvenation of the flock and with it the perpetuation of the human social group through the transformation of milk into cheese for human consumption. Each seasonal cycle of renewal might have been symbolically closed (or opened) by the burning of dung from the previous season(s) of occupation. During the Late Neolithic the importance of animals came from their meat; this importance was increased when meat came from larger sized packages (e.g. cattle) or relatively greater distances (e.g. hunted game). While people would still have had detailed knowledge of their herds, this was no longer expressed in proximate spatial relations. The symbolic currency of milk and cheese was replaced by meat (perhaps conspicuously consumed). Pupićina might have been associated with the slaughter of animals for meat and hunting; activity was no longer structured around the lambing season, but occurred in the autumn when people made preparations for winter. Whereas the site may have previously (and later, see Miracle and Pugsley n.d.) been associated with a restricted set of relatively fixed meanings and attitudes, these were much more diverse and situationally flexible during the Late Neolithic.

In the wider region, changes in human-animal relationships appear to have been sudden and dramatic with the appearance of domestic animals and Neolithic pottery. Certainly by the Middle Neolithic in the region people were penning sheep and goats in caves, and culling very young animals for milk/cheese production. Animal dung from these herds was allowed to accumulate before it was burned periodically in caves, in acts of transformation, renewal, marking, and/or cleansing of space. During the Late Neolithic people kept goats and sheep less frequently. At least in cave sites, sheep and goat were culled later in life than during the Middle Neolithic. Cattle and pig were also slaughtered more frequently than before, and wild game increased in significance at cave sites. The social value of this meat may have been different, both from the significance of products of the hunt, as well as the situations and opportunities provided by a sudden and large surplus of meat resulting from the slaughter of a cow or red deer. Thus although the faunal record from the region shows a good deal of variability, the data show surprising similarities in patterns of animal association and use, as well as in temporal trends within the region. We lack key pieces of the pattern, in particular faunal assemblages from open-air sites, to make sense of these changes in caves, whether as homes, pens, places, nodes on paths, hubs in networks, portals to other worlds, or whatever. Nonetheless, these regional patterns and trends implicate general processes lurking around in search of a metanarrative.

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Chapter 8

Ploughing with Cows: Knossos and the Secondary Products Revolution

Valasia Isaakidou

INTRODUCTION: THE SPR MODEL AND THE ARCHAEOLOGICAL RECORD

Andrew Sherratt's (1981) model of a 'secondary products revolution' (SPR) involved a widespread and broadly contemporaneous set of innovations in Old World farming: early use of domestic animals for primary carcass products (meat) was broadened from the fourth-third millennia BC to include exploitation of renewable 'secondary' products (milk, wool, traction and riding/pack-transport). These innovations became available in Europe thanks to the westwards diffusion of new species (horse, donkey), breeds (*e.g.,* woolly sheep), technology (*e.g.* wheel, ard) and know-how (*e.g.* milking, ploughing), while their adoption was to be understood in terms of the role of pastoralism, plough agriculture and animal-based transport in facilitating marginal agricultural colonisation and settlement nucleation. Ultimately, the SPR was revolutionary in both origins (the rapid diffusion of innovations in animal management) and consequences (the expansion of trade and emergence of social stratification).

With its breadth of vision and wide-ranging implications for economic, social and landscape change, the SPR has proved influential (*e.g.,* Shennan 1986; van Andel and Runnels 1988; Watrous 1994; Alvard and Kuznar 2001, 306; and, more guardedly, Barker 1985; Whittle 1996) and is often cited as a historical fact to which scholars accommodate their own case studies. The archaeological evidence for these innovations, however, was of 'uneven value' (Sherratt 1981, 262); it was based largely on iconographic representations (*e.g.,* ploughing and milking scenes from Near Eastern contexts, models of carts and yoked cattle from Europe) and artefacts from waterlogged north European contexts (*e.g.,* finds of woollen textiles, yokes and ards). Also important was the argument, based on studies of modern populations, that the ability of livestock to release milk for human consumption, and of adult humans to digest milk (lactose tolerance), evolved some time after domestication. Bioarchaeological evidence (*e.g.,* appearance of horses and donkeys in faunal assemblages) played a minor part in documenting the SPR.

Both the dating and the significance of the archaeological evidence cited by Sherratt (and thus the validity of the SPR model) have been questioned. Chapman (1982) underlined the dangers of dating the innovations associated with secondary products on the basis of evidence (iconography, written texts, waterlogged organic remains) of restricted chronological and geographical availability; such sources only provide, as Sherratt acknowledged (1981, 180), a *terminus ante quem* for the invention of milking and ploughing (Chapman 1982, 115). The development of adult lactose tolerance in humans is undated (Chapman 1982, 116) and would anyway be irrelevant if early farmers transformed milk into the more durable and, as Sherratt notes (1981, 277), more digestible form of cheese or yoghurt. The function of the ceramic vessels cited by Sherratt (*e.g.,* 'milk bowls', 'milk boilers') is ambiguous (Chapman 1982, 116) and even the apparently unassailable evidence of ard-marks preserved under north European burial mounds has been questioned. The restricted distribution of such marks under some barrows suggests that they represent part of the funerary ritual, rather than a fortuitously preserved record of previously ploughed surfaces, and so indicate knowledge of ploughing, rather than its regular practice (Rowley-Conwy 1987).

This last point raises a broader issue. The SPR model incorporates two key elements: (1) the discovery and diffusion of secondary products innovations; and (2) their systematic application, leading to transformation of European economy and society (Sherratt 1981, 283). While the *diffusion* of such technology and know-how may perhaps be traced in the kinds of evidence presented by Sherratt, *systematic exploitation* can only be identified in data more ubiquitous in time and space and more amenable to quantitative analysis. Insofar as Sherratt provided separate empirical support for the second component of his model, he (like subsequent proponents of the SPR) pointed to the indirect evidence of radical shifts in settlement patterns in many parts of Europe in the third millennium BC (Sherratt 1981, 292–93). This, however, is a circular argument: plough-agriculture and pastoralism are inferred from changing settlement patterns and these, in turn, are interpreted as consequences of the SPR. A stronger case could be made if more direct evidence were available for the exploitation of secondary products, with changing settlement patterns used only to evaluate the wider consequences of their usage.

Direct evidence for how domestic animals were exploited in later prehistoric Europe has grown substantially, in quantity and diversity, since 1981. The detection of milk residues in ceramic vessels (*e.g.* Dudd *et al.* 1999) is gradually pushing back the *terminus ante quem* for milking and is considered, in Sherratt's retrospective evaluation of the SPR (1987, 205), the most promising means of detecting the origins of milking. On the other hand, the detection of milk residues is dependent on preservation conditions and, more seriously, on the use of ceramic rather than organic vessels to process dairy products. Residue analysis can thus document the presence of milking, but not its absence and certainly not its importance.

More ubiquitous and more amenable to quantification (though by no means unproblematic) are faunal assemblages. Faunal evidence for exploitation of secondary products (as opposed to the presence or abundance of relevant domesticates) played little part in Sherratt's original study, although the potential of mortality data as a guide to management goals was recognised. From 1981 onwards, however, several studies have explored mortality patterns in cattle, sheep and goats with the specific aim of distinguishing between alternative management goals (*e.g.,* Legge 1981; Greenfield 1988; Halstead 1989; Rowley-Conwy 2000). These studies suggest that intensive management for milk may indeed be associated with colonisation of agriculturally marginal areas (*e.g.,* Legge 1981; Halstead 1998), but may have occurred from an earlier stage of the Neolithic than envisaged by Sherratt (*e.g.,* in the case of caprines at Arene Candide, northwest Italy –

Rowley-Conwy 2000) and may have been rare in many parts of Europe both before and after the fourth-third millennia BC. Similarly, reports of cattle arthropathies (*e.g.,* Armour-Chelu and Clutton-Brock 1985; Döhle 1997, 119–20; Müller 1985 [cited by Sherratt 1997, 202]; Schibler and Jacomet 1999) offer tentative osteological support for the use of draught animals not only in the fourth and third millennia BC, but in earlier phases of the Neolithic inaccessible through the patchy record of iconography or waterlogged artefacts.

Faunal studies thus offer expanding opportunities to confirm, refine or reject the SPR model and to begin to explore the regional and local variability in secondary products exploitation that might be expected in a land-mass as large and diverse as Europe. This paper explores diachronic evidence for secondary products exploitation in one region of Europe, Crete, based on faunal assemblages from Knossos (Figure 8.1). Knossos is in many ways ideal for such diachronic investigation: over six millennia of continuous occupation (Evans 1994), one of the earliest farming settlements in Europe grew into a major regional centre. The later second millennium BC 'palace' has yielded written records of working oxen (Killen 1993a) and large-scale wool production (Killen 1964; 1993b), as well as iconographic representation of milking (Sherratt 1981, 280 fig. 10.14). And the long-term growth of the settlement at Knossos (Evans 1971; Whitelaw 2001; 2004) and widespread evidence of 'marginal colonisation' in fourth-third millennium BC Crete

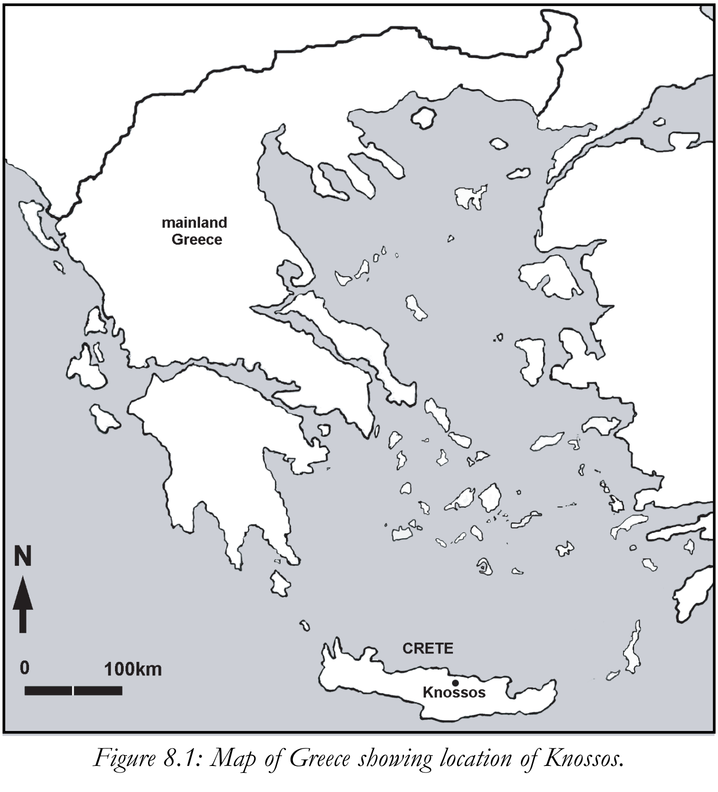

Figure 8.1: Map of Greece showing location of Knossos.

(Watrous 1994) are obvious candidates for interpretation in terms of plough-agriculture and pastoralism, respectively. Before considering the data from Knossos, however, brief consideration must be given to some contentious issues in zooarchaeological interpretation.

FAUNAL EVIDENCE FOR ANIMAL MANAGEMENT: SOME BONES OF CONTENTION

The relative importance of carcass and secondary products at Neolithic Knossos is explored on the basis of mortality profiles (age at death data and adult sex ratios) of cattle, sheep and goats, and pathological conditions of cattle. Both data sets pose problems of interpretation.

On the principle that the productive potential of an animal is dictated partly by its age and sex, Higham (1968), Payne (1973) and Legge (1981) elaborated idealised mortality models, differentiated primarily by the age at death of males: slaughter in infancy maximises availability of milk for human consumption; slaughter of juveniles or subadults maximises meat production; and slaughter of (castrated) adults is ideal for production of wool or draught-oxen. The 'milk model' has been questioned on the grounds that primitive cattle do not let down milk in the absence of the calf (Clutton-Brock 1981; McCormick 1992; also Sherratt 1987, 206), but iconographic evidence clearly indicates knowledge of techniques for inducing let-down by the third millennium BC at the latest (*e.g.,* Sherratt 1981, 279 fig. 10.13). A more fundamental issue is that the alternative models assume optimisation for a single product (Payne 1973), with two important implications. First, the models represent measures of productive potential and need independent corroboration (*e.g.,* butchery marks, milk residues, traction pathologies) to serve as a guide to actual production. Secondly, the models are useful in detecting specialised or intensive production, but shed no light on whether products were exploited at a low level. For example, mortality approximating to the milk model does not preclude the consumption of meat nor the exploitation of adults for wool or traction, and the 'meat model', in particular, is compatible with exploitation of a balanced mixture of products (Halstead 1998). Mortality data, therefore, are complementary to the evidence deployed by Sherratt in that they are relevant to the intensive exploitation rather than knowledge or (potentially small-scale) use of secondary products.

Insofar as they reflect the life histories of animals, pathological conditions shed light on actual rather than potential exploitation and as such complement mortality data. Pathological manifestations pose severe problems of equifinality, however, and are difficult to quantify – especially in fragmentary zooarchaeological material. The approach to quantification adopted at Knossos is set out below and, on this basis, the frequency of pathologies in different anatomical parts, age/sex categories and archaeological contexts is explored in an attempt to choose between alternative aetiologies.

Table 8.1: Absolute and relative chronologies for Knossos and mainland Greece. Sub-phasing of Knossos Early Neolithic follows Tomkins (2001; in prep.). Absolute dates for Knossos follow Tomkins (in prep.) and for mainland Greece follow Andreou et al. *(1996, 538, table 1).*

Years cal BC (approx.)	**Knossian Pottery Sequence**	**Mainland Greece**
1000	Late Minoan IIIB/C	LBA
	Late Minoan I-IIIB early	
	Middle Minoan II-III	MBA
2000	Middle Minoan I	
3000	Early Minoan	EBA
3500	LN/FN	FN
4000	MN/LN	
4500	ENII	LN
5000	ENIc	
5500	ENIb	MN
6000 **6500**	ENIa	EN
7000	Aceramic	Aceramic

THE FAUNAL EVIDENCE FROM KNOSSOS

Background and methodology

The faunal remains discussed below were recovered during the late 1950s and 1960s in excavations largely within and below the Bronze Age palatial complex at Knossos, under the auspices of the British School at Athens. The Knossian Neolithic is divided here into five chronological units: Aceramic-Early Neolithic Ia (ENIa), ENIb, ENIc-ENII, Middle/Late Neolithic (MN/LN), and Late/Final Neolithic (LN/FN). It should be noted that these subdivisions follow the traditional terminology of the Knossian Neolithic pottery sequence (*e.g.,* Evans 1964; 1971), with subdivisions of ENI after Tomkins (2001). In calendar years, ENIa corresponds to mainland Greek EN, ENIb to MN, ENIc-ENII to early LN, etc. (Table 8.1).

A preliminary publication by Jarman and Jarman (1968) provides limited information on only part of the earlier Neolithic faunal material from Knossos. The whole assemblage, therefore, comprising *c.*20,000 identifiable specimens of Neolithic date and *c.*10,000 from the Bronze Age, was recently re-analysed in the context of doctoral research on animal management and consumption at prehistoric Knossos (Isaakidou 2004). Sheep and goat mandibles were assigned to species following Payne (1985) and Halstead *et al.* (2002). Age data presented here are based on eruption and wear of mandibular teeth, following Payne (1973; Deniz and Payne 1982) for sheep and goats and following Grant (1982), Grigson (1982) and Halstead (1985) for cattle; these dental data are broadly consistent with the corresponding epiphyseal fusion data (Isaakidou 2004). Adult sex ratios are based on pelves, following the morphological criteria of Boessneck *et al.* (1964) for sheep and goats and of Grigson (1982) for cattle, supplemented by metrical data for other limb bones recorded following von den Driesch (1976). Pathologies were observed and interpreted following Baker and Brothwell (1980) and Bartosziewicz *et al.* (1997). Quantification of anatomical, taxonomic, age and sex data is based on 'minimum numbers of anatomical units' (MinAU), following Halstead (in press).

With the partial exception of the Aceramic-EN levels, the assemblage is unsieved, causing demonstrable under-representation of sheep, goats and pigs relative to cattle. With the partial exception of the Aceramic levels and most Palatial contexts of the Middle – Late Bronze Age (MB-LB), the assemblage has been subjected to fairly high levels of scavenger attrition, leading to under-representation of vulnerable body parts. The assemblage has also been systematically fragmented for the extraction of within-bone nutrients, with cattle and adult animals more intensively processed than smaller taxa and younger animals. The Neolithic and Early Bronze Age (EB) Pre-palatial sub-assemblages are derived from a mixture of 'indoor' and 'outdoor' habitation contexts (Evans 1964; 1971; Wilson 1994), but most of the Palatial material is derived from the 'public/elite core' (Whitelaw 2001) of Knossos. The effects of these contextual contrasts and pre- and post-depositional processes, discussed in detail elsewhere (Isaakidou 2004), will be considered below where relevant. Of greater concern in the present context is the uneven distribution of the assemblage between different chronological phases and the relative rarity of goat and cattle remains in the earlier phases of the Neolithic, as a result of which samples of age, metrical and, especially, pathological data are sometimes too small for statistically reliable inference (van der Veen and Fieller 1982).

Exploring management goals

Mortality patterns in sheep and goats

During the Neolithic, *c.*50 per cent of sheep mandibles are from animals slaughtered between 6 months and 2 years of age (Figure 8.2), that is after the end of their mothers' lactation and, in the case of females, before their first lambing. An overwhelming 75–85 per cent of mandibles represent deaths between 6 months and 4 years, by which stage females might have produced one or two lambs. Sexed pelves indicate selective culling of young males and retention of adult females (Table 8.2), and the same conclusion can be drawn from metrical evidence (Isaakidou 2004). The scarcity of mature adults, coupled with the predominance of adult females, argues against emphasis on wool production; coupled with the rarity of deaths under 6 months of age, it argues against intensive milking. High infant mortality, characteristic of intensive milking, might be obscured by taphonomic processes (*e.g.* Munson and Garniewicz 2003), but the observed pattern of mortality consistently approximates to the 'meat' model throughout the Neolithic at Knossos, despite levels of scavenger attrition ranging from low to high in sub-assemblages from individual phases. In the case of goats, sample sizes are smaller, especially in the earlier phases of the Neolithic (Aceramic-ENIb), but again mortality consistently

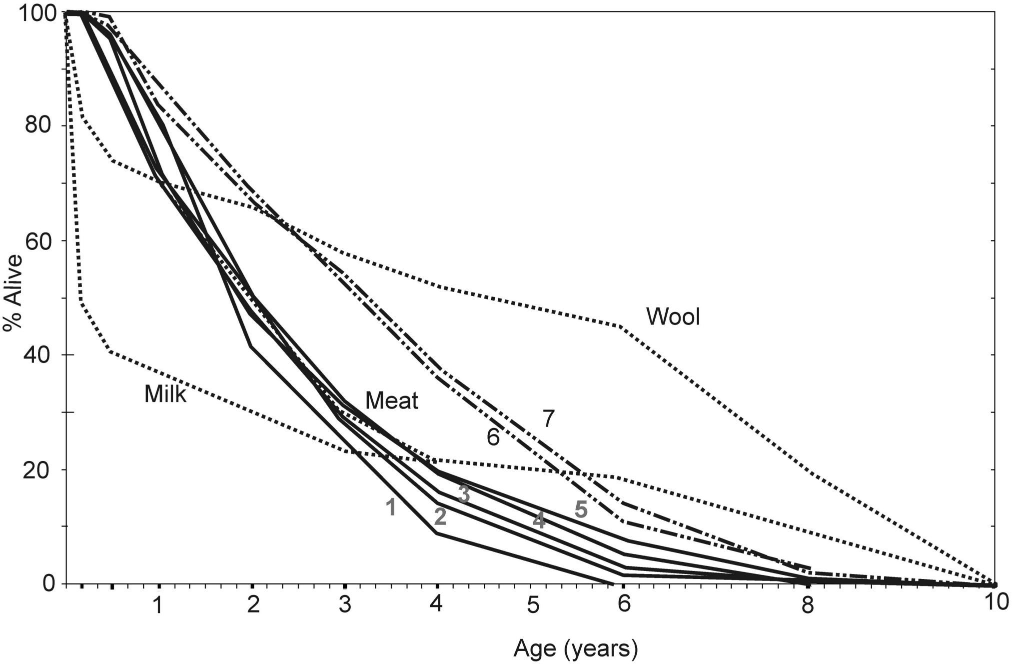

Figure 8.2: Age at death of sheep at Neolithic and Bronze Age Knossos, shown as percent alive in each year (based on Minimum Anatomical Units). Expected profile curves for 'milk', 'meat' and 'wool' also shown (after Payne 1973). Key and sample size: 1 Aceramic-Early Neolithic Ia (93); 2 Early Neolithic Ib (243); 3 Early Neolithic Ic-Early Neolithic II (382); 4 Middle/Late Neolithic (308); 5 Late/Final Neolithic (770); 6 Prepalatial (234); 7 Palatial (136).

Table 8.2: Adult sex ratios for cattle, sheep and goats from Knossos, based on pelves. Counts are of Minimum Anatomical Units (MinAU).

		Neolithic					Bronze Age	
		Aceramic-ENIa	**ENIb**	**ENIc-ENII**	**MN/LN**	**LN/FN**	**Prepalatial**	**Palatial**
		MinAU=3	MinAU=20	MinAU=34	MinAU=61	MinAU=81	MinAU=13	MinAU=15
Cattle	♀	67%	85%	85%	74%	86%	62%	67%
	♂	33%	15%	15%	26%	14%	38%	33%
		MinAU=26	MinAU=35	MinAU=39	MinAU=64	MinAU=194	MinAU=27	MinAU=60
Sheep	♀	50%	80%	64%	75%	82%	41%	50%
	♂	50%	20%	36%	25%	18%	59%	50%
		MinAU=5	MinAU=7	MinAU=17	MinAU=21	MinAU=54	MinAU=9	MinAU=52
Goat	♀	80%	71%	88%	76%	83%	56%	56%
	♂	20%	29%	12%	24%	17%	44%	44%

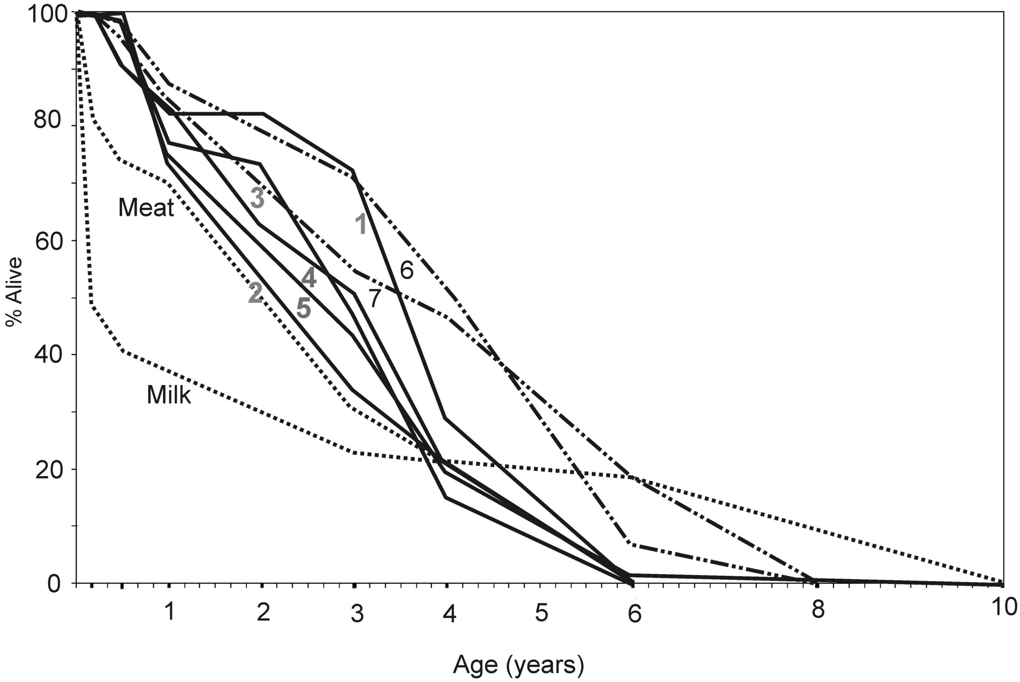

Figure 8.3: Age at death of goats at Neolithic and Bronze Age Knossos, as Figure 8.2. Sample size: 1 (11); 2 (37); 3 (61); 4 (83); 5 (214); 6 (72); 7 (52).

approximates to the meat model: 70–80 per cent of mandibles are from animals slaughtered between 6 months and 4 years of age (Figure 8.3); and selective culling of young males and retention of adult females is suggested by both sexed pelves and metrical data.

The lack of secondary products specialisation in Neolithic sheep and goats at Knossos is underlined by the much older kill-off, and balanced survivorship of male and female adults, of both species in the Bronze Age. In the case of sheep, at least, this contrasting pattern is compatible with the emphasis on wool production in Linear B texts from the end of the Bronze Age. Nonetheless, the 'meat' mortality patterns of sheep and goats throughout the Neolithic by no means preclude a diversified strategy, including exploitation of breeding females for their milk and of both these and younger animals for their wool or hair. Certainly, the staggered culling of juveniles, subadults and young adults of both species does not suggest systematic slaughter at some perceived optimum carcass size. The consistently younger slaughter of sheep than goats might also reflect the desire to balance production of meat and some other product in one or both species. The likelihood of management for a mixture of primary and secondary products would of course be increased by the discovery of milk residues in ceramics, but as yet such analyses have not been carried out for Neolithic Knossos.

Mortality patterns in cattle

As in the case of goats, samples of cattle mandibles are very small for the earlier phases of the Neolithic (Aceramic-ENIb) and also for the Bronze Age. With this *caveat* in mind, mortality profiles imply that 30–45 per cent of Neolithic cattle were slaughtered by 2.5 years (Figure 8.4). It is likely that many or even most cows did not produce their first calf until about 3 years old and recent non-mechanised farmers in Greece did not usually begin training cattle as traction animals before their third year, as they were not considered

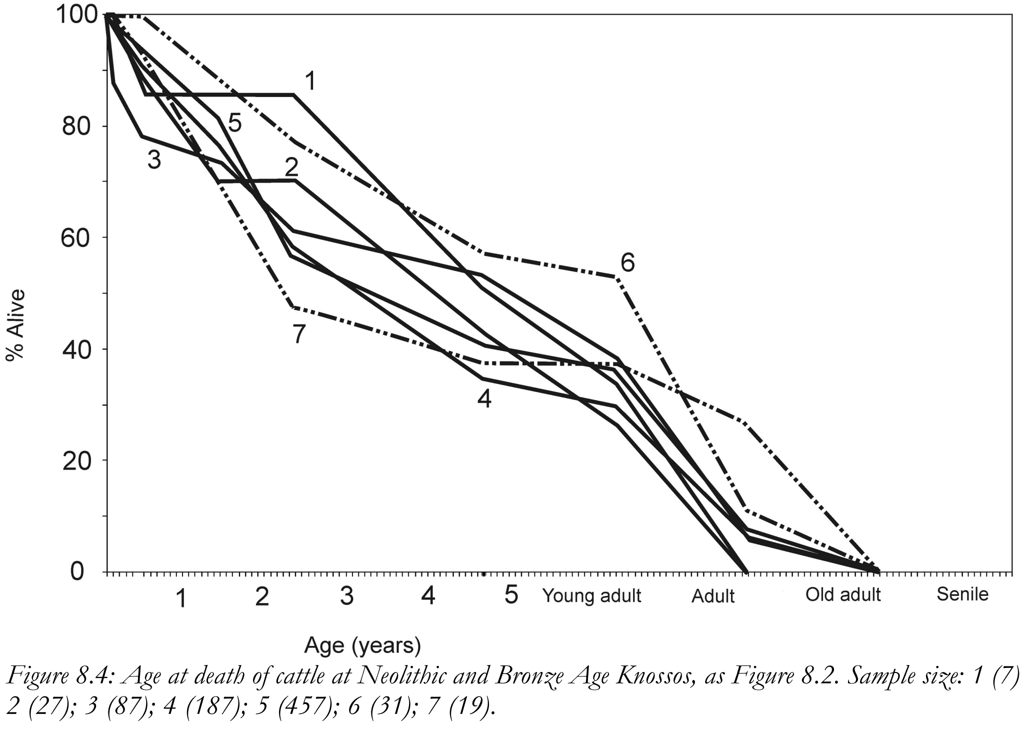

Figure 8.4: Age at death of cattle at Neolithic and Bronze Age Knossos, as Figure 8.2. Sample size: 1 (7); 2 (27); 3 (87); 4 (187); 5 (457); 6 (31); 7 (19).

strong enough for heavy work. Therefore, these immature animals are unlikely to have provided offspring, and thus milk, or power. The next category, aged perhaps between 2.5 and 5 years and representing another 10–25 per cent of animals slaughtered, is likely to have contributed at most two calvings and two seasons of traction. As many as 35–55 per cent of animals, however, were kept alive beyond their fifth year, and so could have made a more substantial contribution to reproduction and milk production (if female) and to traction (especially if male). Sexed pelves of mature individuals indicate an adult sex ratio during the Neolithic heavily biased towards females (75–85 per cent); metrical data point in the same direction (Isaakidou 2004). Thus, there is no evidence for the systematic keeping of males into advanced adulthood, as would be expected if cattle management were geared to the production of specialised traction animals. On the other hand, with the possible partial exception of the ENIc-ENII sample, the modest level of infant mortality (0–6 months old, *i.e.* before the end of the mother's lactation) argues against intensive dairying in the Neolithic. Despite the rather high proportion of adult deaths, therefore, mortality patterns do not imply any specialisation in management of cattle for secondary products at Neolithic Knossos and this picture may again contrast with that for the Bronze Age: the small samples of mandibles are rather contradictory, but pelves imply a fairly balanced adult sex ratio that is at least consistent with textual evidence for palatial interest in working oxen towards the end of the period.

As in the case of sheep and goats, mortality evidence for cattle indicates considerable potential for the production of meat, but is equally compatible with small-scale exploitation for milk and power. Butchery traces and patterns of bone breakage suggest that the carcasses of all three species were exploited thoroughly throughout the Neolithic and Bronze Age, but pathological specimens may also indicate actual use of cattle for traction.

Cattle pathologies

A number of pathological conditions, potentially attributable to traction-induced stress, were observed in Neolithic cattle from Knossos (Figures 8.5 and 8.6). These conditions included: eburnation on the acetabulum of the pelvis and the caput femoris; lipping and osteophytic growths (exostoses) around the proximal articulations of metapodials and phalanges; extension and asymmetry of the distal epiphyses of metapodials, occasionally accompanied by grooving of the articular surface and exostoses around the diaphysis. The chronological and anatomical distribution of these conditions is shown in Table 8.3, in terms of both numbers of specimens (MinAU) and their percentage frequency among the fragments of mature cattle which include at least part of the articular end of each anatomical part. These 'traction pathologies' occur throughout the Neolithic and Bronze Age, but appear to be substantially more frequent in ENII and MN/LN/FN than in the Bronze Age; the samples from the earliest phases (ENIa-ENIb) are again very small. Significantly, pathological specimens are strongly concentrated in the hip and feet, despite the abundance of preserved articular surfaces from the knee (distal femur and proximal tibia) and, especially, from the shoulder (glenoid of scapula) and elbow (distal humerus and proximal radius). Lastly, when the incidence of pathologies on the pelvis is compared with morphological evidence for sex (Table 8.4), eburnation of the acetabulum is overwhelmingly associated with adult females.

These pathological conditions are symptoms of osteoarthritis, meaning the failure of

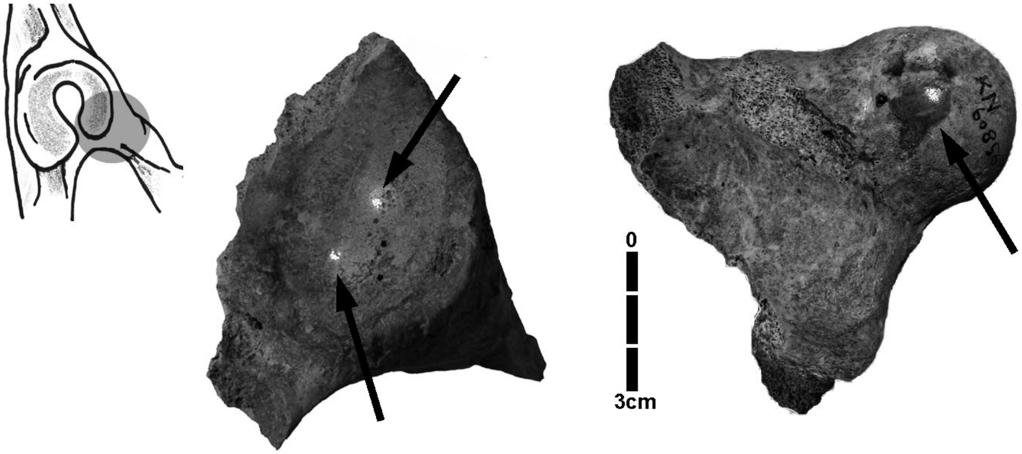

Figure 8.5: Examples of 'traction pathologies' on bovine pelvis (female) and femur from Knossos, arrowed. Left: sketch showing area of pelvis shown in the photograph. Middle: fragment of acetabulum (pubis) of right-sided pelvis, lateral/ventral view, showing eburnation and pitting (Early Neolithic Ic, ca. 5300–4900 BC). Right: left-sided proximal femur, posterior view, showing eburnation on caput femoris *(Middle/Late Neolithic, ca. 4400–3900 BC).*

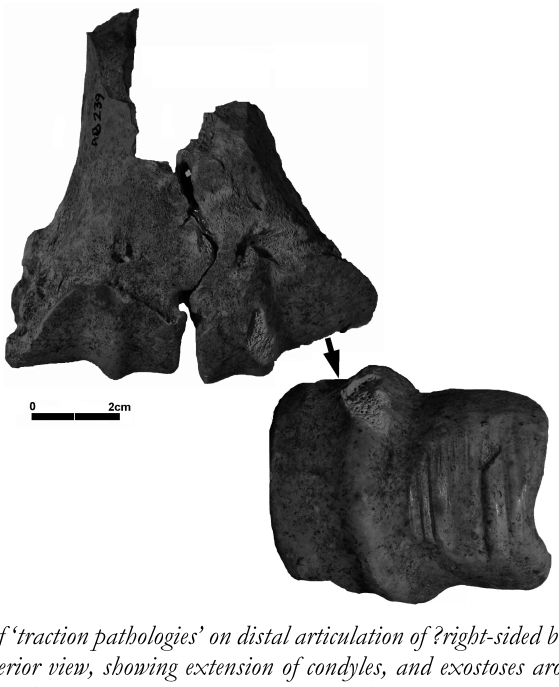

Figure 8.6: Examples of 'traction pathologies' on distal articulation of ?right-sided bovine metacarpal (?male) from Knossos. Left: anterior view, showing extension of condyles, and exostoses around articulation. Right: detail of ?medial condyle, distal view, showing eburnation and grooving, arrowed (Early Neolithic II, ca. 4900–4500 BC).

Table 8.3: Anatomical and chronological distribution of 'traction pathologies' in limb bones of cattle from Knossos. Numbers (MinAU) exclude shaft-only and immature specimens. Key: SC scapula, H humerus, R radius, MC metacarpal, PE pelvis, F femur, T tibia, A astragalus, MT metatarsal, PH1 1st phalanx, PH2 2nd phalanx, PH3 3rd phalanx, p proximal, d distal.

Number of non-pathological specimens (MinAU)

	SC	Hp	Hd	Rp	Rd	MCp	MCd	PE	Fp	Fd	Tp	Td	A	MTp	MTd	PH1	PH2	PH3
Aceramic	1			1		3	2	1			1	1	3	1		7	4	5
ENIa			1	2		3		3		1		4	9	2	2	8	5	1
ENIb	8		12	13	2	19	11	23	4	2	1	11	13	13	8	51	49	30
ENIc-ENII	46	7	54	43	18	64	54	45	13	17	15	41	65	48	45	129	110	74
MN/LN	37	11	91	72	26	77	48	82	24	31	19	54	78	74	60	183	160	151
LN/FN	54	24	88	93	36	118	41	100	37	55	18	61	94	102	67	345	310	316
Prepalatial	20	5	28	29	9	25	16	25	9	11	6	12	30	16	9	60	41	27
Palatial	14	8	32	20	15	22	21	22	28	22	7	12	60	30	22	101	75	29

Number of pathological specimens (MinAU)

	SC	Hd	MCp	MCd	PE	Fp	A	MTp	MTd	PH1	PH2	PH3
Aceramic											1	
ENIa					1						2	
ENIb				4	2				5	8	6	8
ENIc-ENII	1		4	14	1	2	2	1	5	15	9	6
MN/LN	1		1	10	6	13	1		5	33	5	5
LN/FN		1	6	10	7	4		1	12	23	10	13
Prepalatial				1		1				2	1	
Palatial				1	1		1			9	1	

% Pathological specimens per part of skeleton

	SC	Hd	MCp	MCd	PE	Fp	A	MTp	MTd	PH1	PH2	PH3
Aceramic											20.0%	
ENIa					25.0%						28.6%	
ENIb				26.7%	8.0%				38.5%	13.6%	10.9%	21.1%
ENIc-ENII	2.1%		5.9%	20.6%	2.2%	13.3%	3.0%	2.0%	10.0%	10.4%	7.6%	7.5%
MN/LN	2.6%		1.3%	17.2%	6.8%	35.1%	1.3%		7.7%	15.3%	3.0%	3.2%
LN/FN		1.1%	4.8%	19.6%	6.5%	9.8%		1.0%	15.2%	6.3%	3.1%	4.0%
Prepalatial				5.9%		10.0%				3.2%	2.4%	
Palatial				4.5%	4.3%		1.6%			8.2%	1.3%	

normal joint biomechanical function. Although intensively researched in humans, the aetiology of osteoarthritis is poorly understood (Shepstone *et al.* 2000, 513) and causes as diverse as severe or repeated trauma, infection, ageing and genetic predisposition are invoked (*e.g.,* Spector *et al.* 1996, 940–43). For domestic animals, Brothwell and Baker (1980, 115) state that osteoarthritis may only be diagnosed when at least three of the following conditions are observed: grooving; eburnation; extension of the articular surface; and peripheral exostoses. In the Neolithic material from Knossos, all of the above were

Table 8.4: Incidence of eburnation of the acetabulum in male, female and indeterminate-sex cattle pelves from Knossos, by period. Numbers (MinAU) exclude immature specimens.

		Neolithic						Bronze Age	
	Sex	Aceramic	ENIa	ENIb	ENIc-ENII	MN/LN	LN/FN	Prepalatial	Palatial
Non pathological	Indeterminate	1	1	4	14	29	27	12	7
	♀		1	13	21	34	56	7	10
	♂		1	3	5	14	9	2	4
	? ♀			1	5	4	6	1	
	? ♂					1	2	3	1
Pathological	Indeterminate						1		1
	♀		1	2	1	5	6		
	♂					1			

occasionally observed together, but the fragmentary state of the cattle bones minimises the chances of a reliable, multi-symptom diagnosis of osteoarthritis. Nonetheless, medical research suggests that, whereas osteophytic growth may be primarily linked to ageing and occur independently of other symptoms, eburnation and grooving are late stages of the condition (Shepstone *et al.* 2000, 513) and thus, even in isolation, are reliable indicators of osteoarthritis. Extension of the distal articular surfaces of the metapodials is plausibly attributable to heavy loading on these joints. In the sample of modern Romanian cattle examined by Bartosiewicz *et al.* (1997, 54 tables 8–9), extension of distal metapodial articulations was common in oxen but absent in young bulls, leaving open the relative contributions of yoking/traction and increased live weight to loading on the joint. In the modern oxen, however, the incidence in the foot of all 'traction pathologies' combined was correlated not with age (a proxy measure of the duration of traction-stress) but with live weight (Bartosiewicz *et al.* 1997, 68 table 19). Peripheral exostoses may be the result of concussion, triggered by heavy work or faulty conformation of the limb (Brothwell and Baker 1980, 117–22). Such exostoses were common in modern Romanian oxen and rare in young bulls (Bartosiewicz *et al.* 1997, 54 tables 8–9), again leaving open the relative contributions of age, labour and weight to development of the condition.

'Traction pathologies' thus pose significant problems of equifinality, but several considerations may help to narrow down their interpretation in the case of Neolithic Knossos. First, the contrasting incidences of 'traction pathologies' in oxen and young bulls of the same Romanian cross-breeds (Bartosiewicz *et al.* 1997, 18) argue against genetic predisposition as the main cause of the observed conditions. Secondly, in a study of osteoarthritis of infective origin in 63 modern calves, the condition occurred in all joints of the appendicular skeleton (Nuss 1998, table 1), in marked contrast to the more localised distribution in Knossian Neolithic cattle, and was common in two joints (the radio-carpal and femoro-tibial) that were unaffected in the Knossos material. Thirdly, although the effects of age are hard to disentangle from those of increasing body weight and cumulative labour, the proportions of 'old adults' in the Neolithic levels from Knossos are low, while the admittedly modest Bronze Age samples include more adults (Prepalatial) or old adults (Palatial) but fewer pathological specimens. Fourthly, the association of eburnation with female pelves at Neolithic Knossos argues against large body size as a major cause of observed pathologies (also Armour-Chelu and Clutton-Brock 1985). Finally, the anatomical distribution of 'traction pathologies' at Neolithic Knossos, concentrated in the hip and feet, is consistent with the stresses imposed by traction. The hip provides much of the power for forward propulsion (*e.g.,* Mousio Benaki 1978, 56 fig. 2; Bartosiewicz *et al.* 1997, 94). The feet, for basic biomechanical reasons, are subject to the maximum backward drag of the ploughshare, or, in the case of a cart, potentially forward as well as backward forces. At the same time, they must maintain transverse balance while moving slowly (*cf.* Alexander 1982, 82–88) on often uneven terrain and while the animal is yoked to a second with irregular and more or less poorly synchronised movements. The lack of pathological alterations to the scapula at Knossos, in contrast to Neolithic Etton in southern England (Armour-Chelu and Clutton-Brock 1985), might tentatively be attributed to differences in methods of yoking.

The most economical interpretation of the pathologies observed in Knossian cattle is that they are at least partly due to the stresses of traction and thus that the use of cattle for traction on Crete probably dates back to ENIc-ENII (late sixth-mid fifth millennium BC), at least, if not earlier. Whether ard-ploughs, carts or both were pulled, adult cows were apparently the main source of draught power. Cows were widely used as plough-animals in Greece until the mid-20th century, normally by small land-owners unable to support specialised oxen that did not also produce calves and milk. The exploitation of cattle at Neolithic Knossos, therefore, is consistent with small-scale provision of a range of products or services and contrasts with the textual evidence for specialised working oxen in the Late Bronze Age.

DISCUSSION: THE SPR RECONSIDERED

At the outset of this paper, it was argued that a distinction must be drawn between *knowledge* of secondary products and their *systematic exploitation* and that exploration of the latter, in particular, requires evidence more ubiquitous (in time and space) and more quantifiable than that deployed by Sherratt (1981) in his original presentation of the SPR model. The faunal assemblage from EN-LB Knossos provides a diachronic record of animal management that spans the first six millennia of farming in Europe and is amenable to coarse quantitative analysis.

Over the four millennia of the Knossian Neolithic, cattle, sheep and goats were slaughtered at a range of ages, with males tending to be culled before maturity and females being selectively retained into adulthood. Mortality patterns of all three species more or less resemble a 'meat' production strategy, which in effect means management capable of yielding a balanced mixture of carcass and secondary products. Such a mixed strategy is supported by pathological evidence for ploughing with cows (and thus probably on a modest scale), while the consistent difference in mortality pattern between sheep and goats suggests that management of one or both of these species may also have represented a compromise between meat production and some other goal. The assemblage from Knossos thus adds to the growing body of indications that secondary products usage, including both animal traction and milking, can be traced to a much earlier stage of the European Neolithic than the purported fourth-third millennium BC SPR. This observation is important in that it undermines the diffusionist element in the SPR model, or at least pushes this diffusion backwards in time to the point of severing its links, emphasised in later elaborations of the SPR model (Sherratt 1983; 1997, 157) with the urban revolution in the Near East.

Bronze Age Knossos falls outside the main focus of this paper and the Palatial sub-assemblage, derived almost entirely from the 'public-elite core' of the site, may not be representative of animal management in the Knossos area. Nonetheless, it must be acknowledged that mortality patterns of Bronze Age sheep, goats and, to some extent, cattle exhibit the increased proportions of adults and improved male survivorship expected of specialised management for wool, hair and traction, respectively. The Knossos faunal data are thus compatible with intensive exploitation of secondary products from the third millennium BC onwards and, as such, consistent with the SPR model. On the other hand, it must be stressed that Knossos underwent major changes during the third millennium BC, including the development of increasingly formal drinking ceremonies (Day and Wilson 2004) and, towards the end of the period, a massive expansion of the settlement and some sort of monumental building activity in the 'public/elite core' (Whitelaw 2004, figs. 13.8–9). If animal traction, and perhaps milk and wool, had been exploited on Crete since an early stage of the Neolithic, then their intensified use in the Bronze Age might just as well have been a consequence of as a stimulus to social and economic change. Certainly, the comparison of textual and faunal evidence suggests that the LB palaces of southern Greece took a very selective interest in the management of sheep and oxen for wool and traction (Halstead 1998–9). At the risk of premature generalisation, it may be suggested that intensive exploitation of secondary products is a far scarcer and more contingent phenomenon than envisaged by Sherratt's model, with specialised dairying occurring in agriculturally marginal situations and specialised management of wool sheep and male plough oxen being largely restricted to elite control under conditions of marked social inequality (*e.g.,* Halstead 1995).

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Chapter 9

Food or Feast at Neolithic Runnymede?

Dale Serjeantson

INTRODUCTION

The excavations at the site of Runnymede Bridge revealed an exceptionally large quantity of animal bone in occupation levels of both the Late Bronze Age and the Middle Neolithic period. The quantity in the Neolithic horizon suggested that the bones could have been discarded after feasts which included the eating of a large amount of meat. Feasting is thought to have been an integral part of social life in the Neolithic of Britain and Europe. The ceremonial monuments such as long barrows and causewayed enclosures are thought to be places where communities came together to feast and celebrate. However, Runnymede has few of the structures found on contemporary ceremonial sites: there are no monumental constructions, but instead many small features (Needham 2000). Runnymede appears to be a settlement rather than a ceremonial site, but nevertheless has much evidence for meat eating.

Feasting is a means by which human societies mark many important life activities, being held to celebrate important events in the larger group and domestic rites of passage such as birth, marriage and death. In farming societies the important feasts often mark major events in the year, since the annual round of planting and harvest, and the birth and death of livestock, are the basis of survival and in historic times in Western Europe have been subsumed into the Christian calendar and attached to the major Saints' Days. More generally, those who have leadership roles and hold power over their fellows hold feasts to demonstrate social solidarity or power. When held from time to time, they serve to reinforce social cohesion, ensure the allegiance of existing members of the group and to attract followers (Dietler 1996, Hayden 1996).

In *Cooking, Cuisine and Class,* Goody (1982) describes feasting in a society which has not developed what he defines as a 'high cuisine'. In such societies the rich and the poor eat the same foods, if in different quantities. 'The actual content of the meal is that of everyday life' and 'feasting is a matter of more of the same, but especially more meat' (*ibid.* 91). Goody describes the main community festival in Northern Ghana, the Festival of Damba, a feast which lasts three days. 'On the second day [of preparation] a cow donated by the divisional chief is killed in the middle of the courtyard, following a series of prayers and processions around the beast' and it is this cow that is eaten on the last day. All Damba feasts are communal events, with the whole family or the whole community partaking of larger quantities of food, including meat. Recent life ways in Ghana are not in general proposed as a direct model for prehistoric Britain, but there may well be parallels in the role of the killing and eating of cattle in feasts.

As has been pointed out many times, the slaughter of an animal of the size of a cow or adult pig provides meat for a large number of people. The option of preserving some of the meat was probably not available in the Neolithic Britain as salt only became widely available from the Late Bronze Age onwards (Morris 1994). Though smoking could have been used as a means of preservation, in a damp climate it is only effective for small quantities. Large animals must have been killed and eaten only on special occasions when extended family groups or larger communities came together. The fact that in the ancient world meat eating was regarded as a sacrifice is a reminder that domestic animals were not killed without serious consideration, as the death of an animal represented a diminution in the goods of the family or community.

To what extent did the consumption of meat at Runnymede take place in the context of feasting? In this chapter I shall consider four aspects of the Neolithic bone assemblage in order to examine whether large scale feasting took place at Runnymede: the quantity of bone, the main animals eaten, the other sources of food, and the ways in which animals were consumed. Earlier publications have sought to identify the sequence of processes (the '*chaîne operatoire*') which affected animal bones and other material at Runnymede (Serjeantson 1991; Needham *et al.* 1996; Serjeantson 1996) and at other Neolithic sites (Marciniak 2002); here I use this information specifically to interpret meat consumption.

The site

The excavations at Runnymede include rescue campaigns from 1975 to 1980 and a major research campaign by the British Museum between 1984 and 1989 (Needham 2000, 3). The site lies on the banks of the River Thames at its confluence with the River Colne where today the M25 motorway crosses the river (Figure 9.1). The Neolithic settlement, which dates from the middle of the fourth millennium BC, was on the floodplain of the river, possibly on an island. The original vegetation around the site was dense alder woodland (Needham 2000, 194), but parts of the floodplain had been opened up and used for grazing before the settlement was created. The end of the occupation was marked by flooding which carried with it sheets of gravel (Figure 9.2); this took place at the very end of the fourth millennium or the beginning of the third millennium BC (Needham 2000, 240). After a hiatus of more than 2000 years, the site was reoccupied in the Late Bronze Age. Neolithic occupation was found in two main areas, designated the Riverside Zone and the Interior Zone. The occupation in the Interior Zone comprised a spread of cultural material including a large quantity of bone, while in the Riverside Zone there were deposits on the river bank and within the channel. Two publications (Needham 1991, Needham and Spence 1996) include reports on subsamples of the bone assemblage, from Areas 4 and 6 (Done 1991) and Area 16 (Serjeantson 1996). This paper also takes into account the Neolithic bone finds from those areas of the site where publication is still in progress. Post-excavation analysis is not complete for other areas of the site, but the Neolithic material was clearly distinguished over most of the site because the Middle Neolithic and Late Bronze cultural layers are separated by sterile alluvium (Figure 9.2).

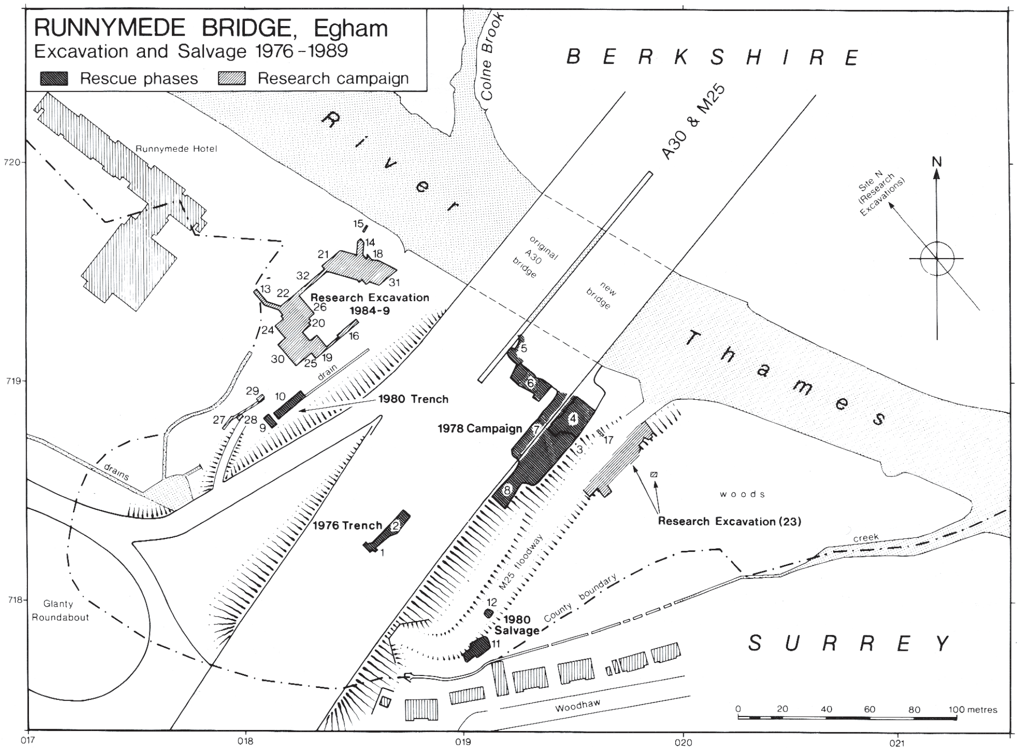


Figure 9.1: Runnymede: plan showing site areas (numbered) excavated in the rescue phases and research campaigns (from Needham 1992, fig. 23.1).

QUANTITY OF BONE

In the research excavations bones were carefully recovered by hand and extensive samples were taken and sieved through a 2 mm mesh. All the bones collected by hand and a subsample of the fragments from the soil samples have been recorded. Records of identifications are held with the bones at the British Museum. The bones recovered in the samples include mainly small fragments from the larger mammals; they have not increased the number of small animals identified. Approximately 87,000 bone fragments have been recorded from the Neolithic occupation horizon. Of these, *c.* 10,000 bones have been identified to species from the hand-retrieved material (Table 9.1), an exceptional quantity for a Neolithic site in the British Isles.

Good recovery contributed to the quantity of bones, but the main reason why so much bone survived is undoubtedly the very good conditions for bone preservation. The clayey sediments are calcareous, due to the position of the site downstream from the chalk of the Chilterns, and almost anaerobic. The material in the Interior Zone was derived from two main horizons (Figure 9.2). The material in the lower units is *in situ.* The bone surface is well preserved and there has been little fragmentation in the ground (Serjeantson 1991; Needham *et al.* 1996; Serjeantson 1996). In Area 16 some unfused

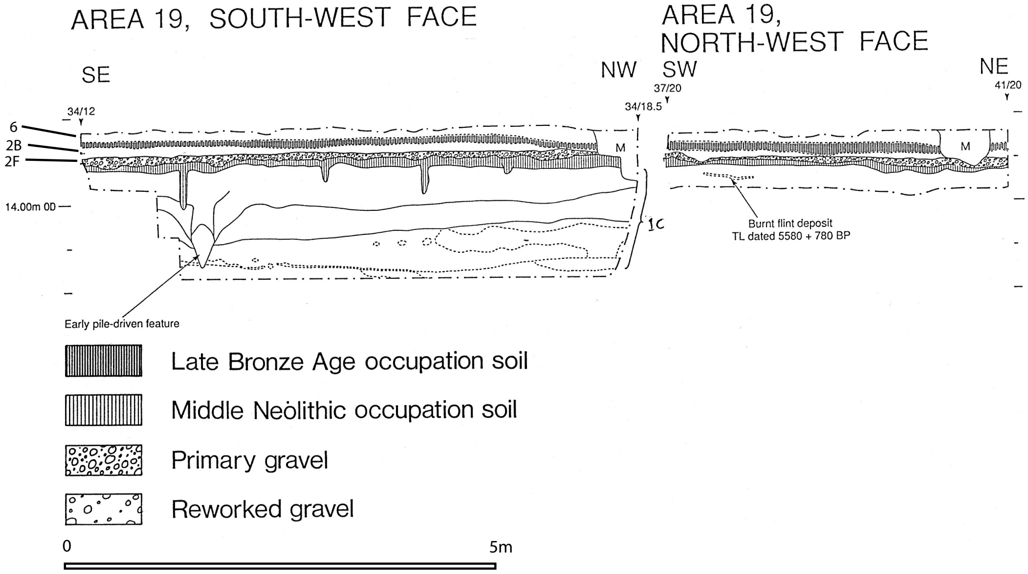


Figure 9.2: Runnymede Area 19, south-west face, SE – NW section, showing Late Bronze Age occupation soil, sterile alluvium, primary gravel horizon with reworked Neolithic material and Neolithic occupation soil.

Table 9.1: Number of hand retrieved identified bones (NISP) from Neolithic Runnymede by site Area and Zone.

Area	**Zone**	**NISP**	**Reference**
4	Riverside	181	Done 1991
6	Riverside	235	Done 1991
13	Interior	1580	In prep
16 East	Interior	271	Serjeantson 1996
19	Interior	3470	In prep
20	Interior	2165	In prep
22	Interior	755	In prep
24	Interior	1846	In prep
Total		*10,503*	

epiphyses were found associated with the bone shafts, and associated bones, such as a radius and an ulna, were found together, but in general the bones are disarticulated and butchered. Those in the upper Neolithic horizon have been reworked in the flooding and in these units preservation is only fair. Bones are more fragmented, but even in this horizon they have survived in quantity. The distribution of anatomical elements is what would be expected if the whole skeleton had originally been present, with biases in favour of the denser bone ends.

The radiocarbon dates suggest that the site was occupied for 500 years or longer, whether continuously, seasonally or intermittently. This calls into question whether the quantity of bone is indeed very great in an absolute sense. To put it into perspective: only 175 fragments, of which 30 could be identified, have survived for each year that the site was occupied. Despite appearances, therefore, the sheer quantity of bones on its own cannot be used as evidence that feasting took place at Runnymede. If it was taking place, we have to seek evidence for it from other aspects of the assemblage.

WHAT MEAT DID PEOPLE EAT?

Most of the meat eaten at Neolithic Runnymede was from cattle and pigs. The relative number of identified bone specimens (NISP) of cattle, pig and sheep is shown in Figure 9.3. The 'sheep' bones include those identified as 'sheep or goat', as only one goat bone has been identified from the Neolithic horizon. The calculation of minimum number of individuals (MNI) in Area 16 enhances the numbers of pigs and sheep relative to cattle, but even if the number of bones is used as a proxy for the relative numbers of the different species, cattle provided much the greater quantity of meat. Each cow would have been approximately 8 – 10 times larger than each pig and sheep, so meat from cattle predominated. Most of the cattle were full-grown at death, with a few younger and older. Figure 9.4 shows the age of the cattle in eight age stages (Legge 1992); about 40 per cent of the cattle selected for slaughter were between two and six years of age. This is a higher percentage of young adult animals than on many other Neolithic sites, and suggests that here a higher priority was given to meat consumption than to using cattle for milking or traction. Each individual cow or bull would have provided a substantial carcase, and the quantity of meat provided could only have been consumed by a large group of people. The cattle must have been slaughtered and eaten communally, and, given the ethnographic evidence, the most likely context for this is in periodic feasts.

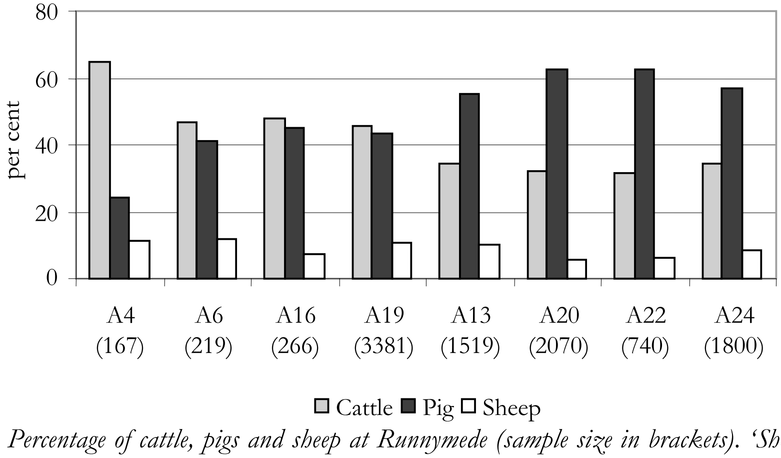


Figure 9.3: Percentage of cattle, pigs and sheep at Runnymede (sample size in brackets). 'Sheep' include a single specimen identified as goat. A = Area.

The pig bones indicate that the amount of pork eaten, even if less than of beef, is unusually high for the Neolithic of southern Britain. It contrasts particularly with the contemporary causewayed enclosure at Staines, less than a kilometre distant, where cattle are much more common than pigs. Staines is typical of causewayed enclosures and other Middle Neolithic sites in southern Britain; only one of these sites, White Sheet Hill, has more pig than cattle remains (Rawlings *et al.* 2004). Some of the reasons why pigs were numerous at Runnymede have been explored elsewhere (Serjeantson 1996, 222). The settlement is certainly in an environment of woodland and marshy riverbanks that would

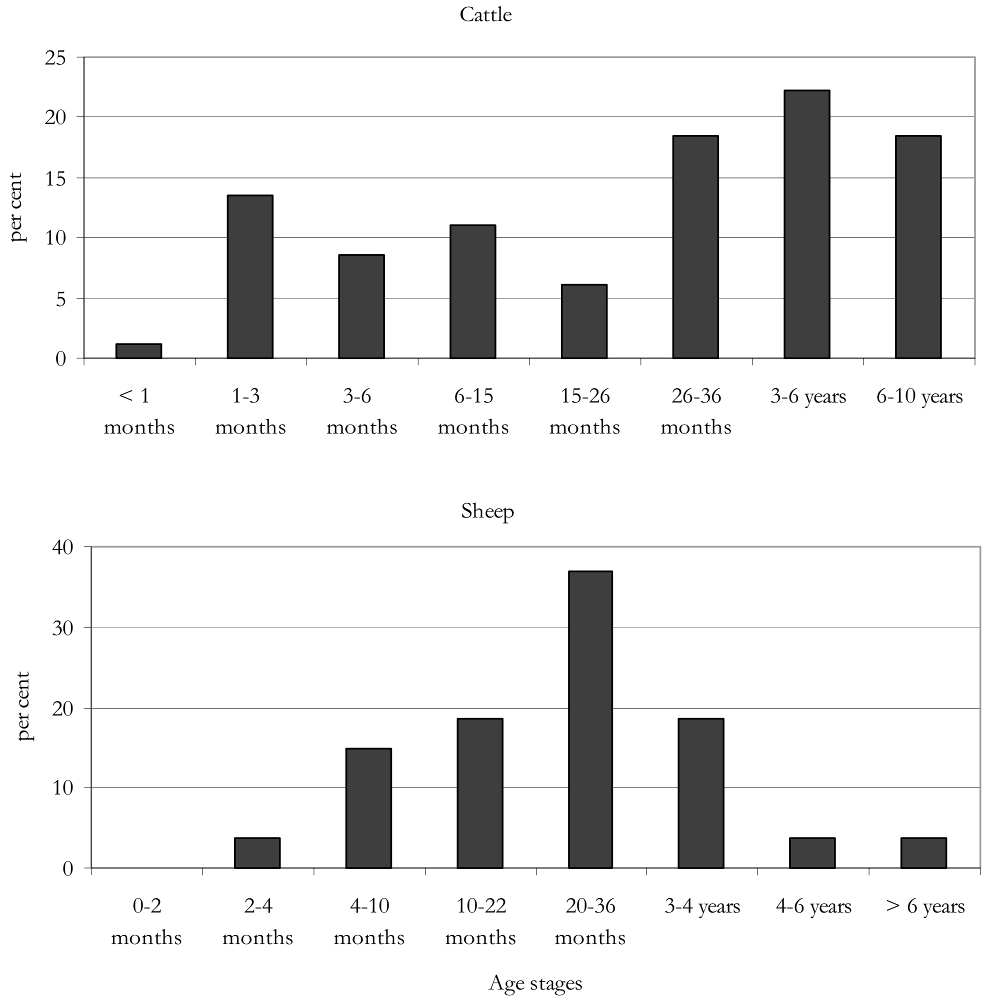


Figure 9.4: Age at death of Runnymede cattle (n = 81) and sheep (n = 27). Cattle age-stages after Legge 1992; sheep stages correspond to Payne's (1973) stages A-H. The age of the youngest sheep is based on work in progress by G. Jones.

have been very suitable for pig-keeping, but Staines was in a very similar environment. It may be that pigs were more often eaten at settlements, while cattle were selected for consumption at ritual centres, since most other Middle Neolithic sites with bone assemblages are ceremonial. Pigs were certainly associated with feasting in the Late Neolithic (Albarella and Serjeantson 2002), but Runnymede is the only middle Neolithic site where they were so common. A high percentage of pigs is typical for contemporary settlements in north and east Europe (Tresset 1994), but the material culture at Runnymede is otherwise closer to that of other sites in Britain. Their abundance must reflect regular meat eating, as they have no other role in food provision. Pigs too may only have been slaughtered on special occasions, but these may have been on a smaller scale, perhaps a more domestic scale.

There are some contrasts between the different areas of excavation. (Areas referred to in the text are shown in Figure 9.1). Area 4 stands out as having the largest proportion of cattle bones. This area was excavated under rescue conditions, so the recovery of a higher percentage of cattle bones would not be unexpected, but in fact the percentage in Area 6, like Area 4 a rescue site, is similar to elsewhere on the site, so survival and retrieval do not seem to account for the larger proportion in Area 4. This area included deposits within the river and its damp margins, so one explanation may be that the larger bones were deliberately removed from the centre of the settlement and thrown in the river. I have suggested (Serjeantson 1991) that the settlement was cleaned up periodically and the larger bones removed, but it is also possible that some bones were deposited deliberately in the river. The numbers of pig and cattle bones are approximately equal in the part of the occupied land surface in Areas 16 and 19, but the percentage of pig bones is higher in the adjacent dry ground to the north-west (Areas 13, 20, 22, 24). This too cannot be explained by survival or recovery, since conditions were very similar throughout, so the question must arise as to whether different activities were taking place in the two areas or whether they are strictly contemporary. The northern end of the site may have been a more domestic area, where the smaller animal was eaten within households, and the south end of the site may have been a more communal part of the settlement, where cattle were eaten. Settlement sites in Continental Europe, for instance the earlier Linear Bandkeramik site at Cuiry-les-Chaudardes in Northern France (Whittle 2003, 73) and some LBK sites in Poland (Marciniak 2005, 152–153), also showed contrasts in the main species in different areas of the site. When the stratigraphy and the remaining cultural material from Runnymede has been analysed, it should be possible to understand the contrast between the areas better.

Foods avoided

It is also of interest to see which of the available animal foods were not eaten. The number of bones of minor species is very small, fewer than 2.5 per cent of all identified bones (Table 9.2). The table shows red deer antler separately, as it may not be from hunted animals, and also shows rodents separately, as these are presumed to be intrusive rather than anthropogenic.

There is no doubt that dogs lived on and around the site, as the percentage of bones which has been gnawed is high, as discussed below. However, the number of bones is

Table 9.2: Minor species from Runnymede (NISP). Rodents (probably intrusive) and red deer antler fragments are shown separately.

	Dog (*Canis familiaris*)	Fox (*Vulpes vulpes*)	Otter (*Lutra lutra*)	Cat (*Felis sylvestris*)	Carnivore indet.	Badger (Meles meles)	Polecat (*Putorius*)	Equid	Wild pig (*Sus scrofa*)	Roe deer (*Capreolus*)	Red deer (*Cervus elaphus*)	Aurochs (*Bos primigenius*)	Bird (*Aves*)	Fish (*Pisces*)	Beaver (*Castor fiber*)	**Total**	Red deer antler	Rodent indet.
A4+A6	15										1	1				**17**	5	
A16	1															**1**		
A13	4		1		1	3	1		1	3	15		3	2	3	**37**	17	5
A19	19	1	2	1				8	1	7	33	2	2	1	1	**78**	10	2
A20	7		5							11	39		1		16	**79**	8	6
A22	1									1	8				2	**12**	2	2
A24	1	1				1		1		1	22	1	1	5	2	**36**	8	2
Total	**48**	**2**	**8**	**1**	**1**	**4**	**1**	**9**	**2**	**23**	**118**	**4**	**7**	**8**	**24**	**260**	**50**	**17**

very small and the bones do not show signs of butchery. Unlike in Iron Age sites in Britain, where dogs can be quite common and the bones have sometimes been butchered, dogs do not seem to have been eaten at Runnymede, and may even have been a taboo food.

Wild animals were also rarely eaten. The wild mammals include (in order of abundance) red deer, beaver, roe deer, otter, badger, aurochs, wild pig, fox, wild cat and polecat. The numbers of aurochs and wild pig is probably underestimated, as the table is based on the primary data records and metrical analysis may show that more of the cattle and pigs were in fact wild. The records also include nine horse bones. As none of the claimed Early and Middle Neolithic horse bones from elsewhere have been confirmed by C14 dating (Robin Bendrey pers comm), the Runnymede finds will be checked before they are confirmed as Neolithic. They may prove to be from the Late Bronze Age horizon, which is not far above the Neolithic in this part of the site. Other than red deer, wild mammals are so rare that they can never have been systematically hunted for food. Some of the ponded wood found at the site is thought to be from a late third millennium BC beaver dam and it is likely that beavers were quite common in the River Thames at this time, but they were scarcely if at all eaten at Runnymede. Wild carnivores too cannot have been uncommon even in the immediate vicinity of human settlement. These (otter, polecat, wild cat, fox), together with beaver, were probably caught for their fur and not for food. It would be surprising if furs were used as rarely as the bone evidence suggests, and it may be that the bodies of the small animals, once skinned, were not always brought back to the settlement.

In some farming cultures in which wild animals are not part of the subsistence, they were, nevertheless, killed and eaten as part of a rite of passage. This may have been the case in Britain in the Late Neolithic, when wild animal remains are found more often, but there is scant evidence for this at Runnymede. The settlement is not unusual in having so few remains of wild mammals; they are also rare in other Middle Neolithic sites in southern Britain and also in most of continental Europe at this time. Just a few sites have been found where wild herbivores are found in large enough numbers to suggest that they were important for food (Boyle, this volume) or for skins (Zeiler, this volume).

It is surprising too how few bones there are of birds such as ducks and swans and fish such as eels, salmon, pike and other freshwater fish, in view of the good conditions for bone preservation, the high standards of recovery and the fact that all these animals must have been present in the river. An early study of the lipids in pots interpreted some traces as oils from marine resources (Serjeantson *et al.* 1994), but no animal remains have been found to suggest what these might have derived from. The waterfowl and fish would not have been difficult to catch, but they were certainly not eaten in quantity and may not have been eaten at all. Again, it may imply that there was a taboo on eating these creatures.

It appears that the inhabitants of the settlement were able to obtain enough food from other sources to allow them to ignore potential wild food animals. The animals consumed were exclusively or almost exclusively the large domestic animals. The type of meat was unvaried, so far as species is concerned. The fact that the cattle include young adults and that pigs are so numerous does indicate that the provision of meat was important. As in the example from Africa in the recent past referred to earlier, it will have been quantity, not the variety or rarity, which characterised meat consumption.

OTHER FOODS: PLANTS AND DAIRY FOOD

To understand whether meat was consumed regularly or episodically during feasting, it is important to have some idea about the foods other than meat which were eaten. This is not easy, since it is even more problematical to attempt inferences about quantities of plant food and dairy food than about meat. Doubts have been expressed about the quantity of cereals grown and eaten in Neolithic Britain (Moffett *et al.* 1989), but recent research is revealing that cereal growing was ubiquitous in the British Isles (McLaren 2000; Rowley-Conwy 2004).

The plant remains from Runnymede so far examined comprise wild species, some of them edible, associated with the damp river margins and the grassland on the floodplain. Few remains of cultivated plants were found in the initial samples (Greig 1991). However, there is sufficient evidence for cereals, emmer wheat and barley, at other Neolithic sites as to suggest that cereals would also have been eaten at Runnymede. Two peas were recovered in the Runnymede samples, confirming the consumption of domesticated pulses. There is little evidence for bread wheat at this time, so the cereals may have been eaten only rarely as bread, though other wheat types can be used to make a type of bannock or unleavened bread. If the wheat and barley was eaten as ‘frumenty’, a type of porridge made with wheat, or in a soup, the grains have to be cracked to remove the husk and make them palatable, but do not undergo many transformations and are not exposed to fire. Consequently, they are less likely to become carbonised than when they are made into bread, which may partly account for the paucity of cereal grains from Neolithic sites (Rowley-Conwy 2004).

Dairy foods are becoming better understood in the light of recent research into chemical residues within Neolithic pots (Copley *et al* 2003, Barclay and Case Forthcoming). The analysis of sherds from several Neolithic sites has shown that dairy products were cooked or processed in some of the vessels. Many of the traditional methods of processing milk involved heating it in pots (Lucas 1989), a process likely to result in dairy fats becoming incorporated within vessel walls. At Runnymede itself two chemical tests, of the delta 13 values and the stable isotopes, on a sample of sherds indicate that dairy foods were cooked or stored in up to half of the vessels. In others the evidence indicated a mix of meat and dairy products and yet other potsherds have the signature for the cooking of meat (Copley Forthcoming). It is clear that people were taking some milk from the cows and also probably the sheep. At some later prehistoric settlements the cattle and sheep were milked intensively, inferred from the high percentage of young calves, sometimes up to 40 per cent, in the assemblages (Legge 1981, 1992, Serjeantson and Bond Forthcoming, Isaakidou, this volume). The cattle from Runnymede do not include a very high percentage of young, but almost one quarter of calves were killed off in the first summer and autumn (Figure 9.4), indicating that cattle were milked. Sheep may have been kept as much for milk as for meat, since pigs were there to provide meat. At some sites in continental Europe such as Arene Candide (Rowley-Conwy 2000) and Pupiçina (Miracle, this volume) sheep milking seems to have been taken place in the Early and Middle Neolithic, but the age at death of the Runnymede sheep does not suggests that they were milked as intensively here as at the Continental sites. In contrast, during the Late Bronze Age at the same site, a very high percentage of lambs was killed off, suggesting a much more intensive use of the sheep (Serjeantson In press). Most dairy foods are likely to have been eaten in late spring, summer and early autumn, at the time of year when the cattle and sheep were giving milk after giving birth to the calves and lambs in the spring. Though butter and cheese can be stored for eating later, salt is required if either is to be kept for any length of time, so storage will have been limited at this time.

It is clear that plants, both cultivated and wild, and butter, cheese and milk will have provided food which sustained the community in the intervals between the slaughtering of animals. The dairy foods in particular reduced the need to slaughter animals solely for dietary reasons, since these supply some of the fat which is needed in every diet which would otherwise have to come from animals.

PREPARING AND EATING MEAT

The ways in which meat was cooked and eaten can suggest whether it was consumed in feasting and/or whether it was eaten to meet everyday subsistence needs. Cooking and consumption can be deduced from the traces of burning on the bones (if any) and from the way bones were chopped up. If bones are complete or fairly complete, it suggests that meat was filleted from the bones or that large joints were roasted over open fires, methods of cooking often associated with feasting. When meat is provided in abundance, as at feasts, it is not essential to extract every last scrap of nourishment from the carcase, and bones may be fairly complete when discarded. Some may even remain in articulation. Marrow from roasted bones was a delicacy in Europe and elsewhere until recently, and marrow consumption can also be part of feasting.

On the other hand, if bones have been chopped into small pieces it suggests that they were used for soups and stews (Outram 2001). The traditional subsistence food in Europe has been a thick soup or 'pottage' of cereals and vegetables in which bones were included. As well as the fatty marrow, there are fats and protein within the interstices of the bone itself and boiling up the bones ensures that no scrap of possible nourishment is lost (Outram 2003). In earlier medieval England, for instance, 'pottage' was the principle dish eaten daily by the majority of the population. It contained cereals (usually barley and/or oats), peas and/or beans, and vegetables such as leeks, onions and garlic. Other ingredients such as wild and garden herbs were also added (Woolgar *et al.* Forthcoming). The ingredients would have been slightly different in Neolithic Britain, with wheat rather than oats, and wild rather than cultivated forms of vegetables.

The degree to which bones have been fragmented will indicate whether or not they were used in soups, but there are many other destructive agencies which work to fragment and destroy bone which also have to be taken into account.

The evidence from fragmentation

For each limb bone, a record was made of the surviving parts of the bone, using the presence or absence of each of eight diagnostic 'bone zones'. The record also allows the surviving fraction of the bone to be calculated (Serjeantson 1991, 1996). The surviving fraction of the four main limb bones is shown in Figure 9.5 for cattle and Figure 9.6 for pig. Some fragments were sufficiently distinctive to be identified to species even where they did not include an area of bone large enough to be recorded as a 'bone zone': this was the case with about ten per cent of identified limb bone fragments of cattle and pig. These fragments have been included in the NISP totals, but have been excluded from Figures 9.5 and 9.6.

The limb bones of both species are, in general, highly fragmented, and there are some differences between the treatment of the two species. Out of the whole assemblage, two limb bones only of cattle, both radii, are complete; these were probably given special treatment of some sort. Just below ten per cent are half complete or more, most having been chopped through the shaft. These have not been chopped further to enable them to be put into cooking pots, so will have been discarded after occasions when the meat was roasted, so can convincingly be seen as feasting remains. None of the pig limb bones is complete, but the quantity half-complete is higher for pigs than cattle, with over one third of humeri, radii and tibias half complete or more, and 20 per cent of the femurs. Some of these are also likely to have been discarded during feasts, but they are also small enough to fit into cooking pots.

Much of the assemblage of cattle bones comprises fragments for which only one-eighth (12.5%) survives: for cattle this is the case with more than half of the femurs, over 40 per cent of the humeri and tibias, and over one third of the radius fragments. The pig bones are

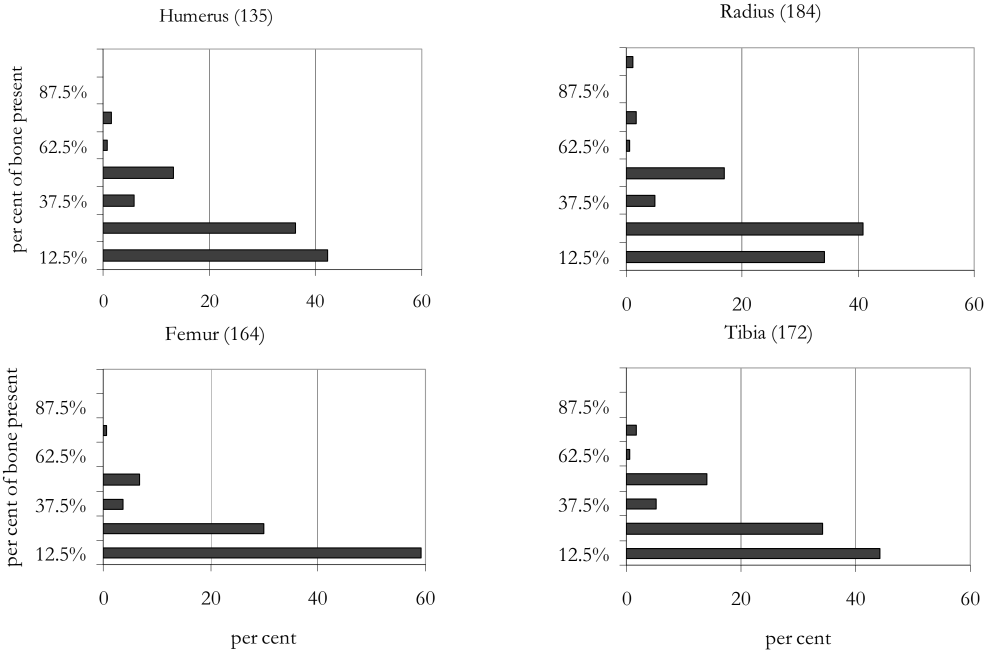


Figure 9.5: Fragmentation of cattle humerus, radius, femur and tibia showing percentage of bone present (sample size in brackets).

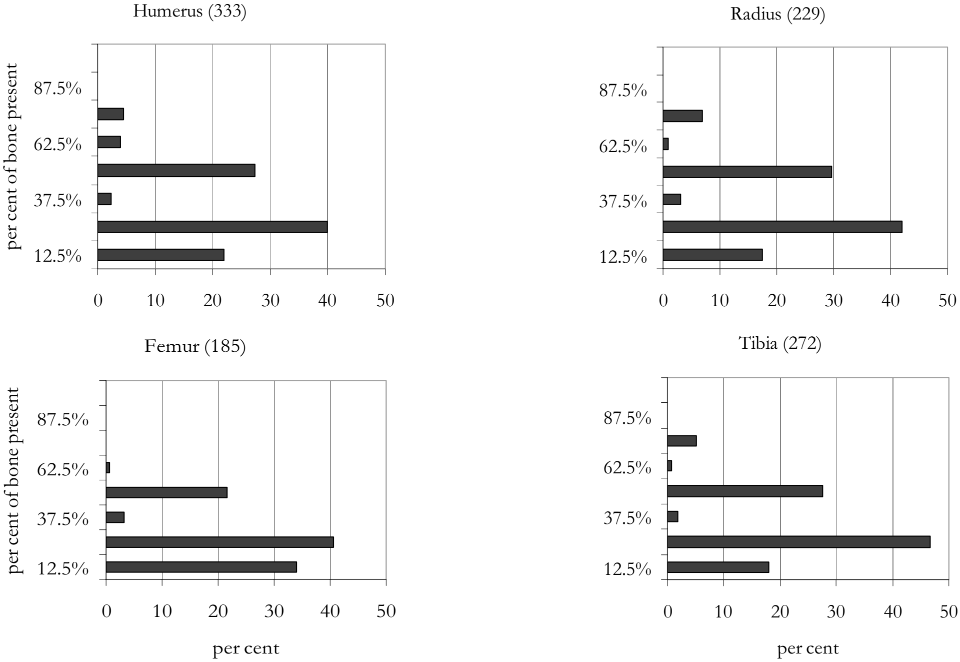


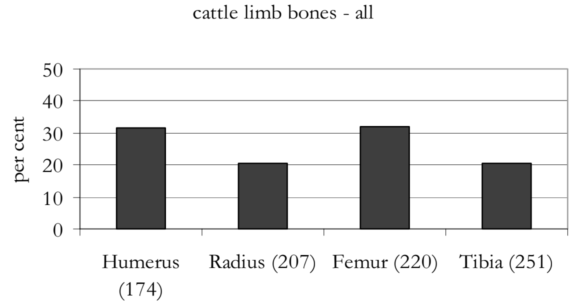
Figure 9.6: Fragmentation of pig humerus, radius, femur and tibia, as Figure 9.5

not as heavily fragmented as cattle. The highest fraction is one-quarter complete, but even with pig, over one third of femur and over 20 per cent of humerus, and just under 20 per cent of radius and tibia fragments consist of only about 12.5 per cent of the bone. The relative number of small limb bone fragments is greatly enhanced if the fragments recognised but too small to 'zone' and the very large number of unidentified limb bone splinters (estimated at somewhat more than 10,000 from the whole site) are taken into account.

The flooding and gravel which washed over the site at the end of the Neolithic occupation damaged and broke up the bones but did not wash them away or destroy them completely. In all units, even in the least disturbed lower units, bones appear to have suffered some damage from trampling (Serjeantson 1991, 1996). Once the detailed phasing has been carried out for the Neolithic horizon at Runnymede it will be possible to take this post-depositional damage into account, but for the present, we can only say that, by analogy with Area 16, a fairly high proportion of the fragmentation is accounted for by post-depositional damage. Nevertheless, the great majority of cattle bones, and all of the pig bones, are of a size which would allow them to be used for soup, and the majority must have been used for this purpose. The types of vessel used for cooking in the Early and Middle Neolithic were the medium and particularly the large bowls. The size range of these was from 120 mm to 400 mm diameter, with most between 150 mm and 300 mm. At Ascott-under-Wychwood, five of the nine large bowls had fatty residues of either adipose or dairy fats (Barclay and Case Forthcoming).

The evidence from dog gnawing

Gnawing by dogs is another cause of damage to bones. It can also suggest whether bones were further used after the meat had been eaten. Gnawing by dogs was recognised on approximately one quarter of the cattle limb bone fragments and on 20 per cent of pig limb bones. The percentage of long bones gnawed is higher than the percentage of all identified fragments. In Area 16, the percentage gnawed of all identified bones ranges from 8 to 18 per cent, varying slightly between units. Gnawing was more easily recognised on bones from the lower units, where the bone surface was well preserved, than on those from the upper reworked units (Serjeantson 1996, Tab. 32). The percentage gnawed of each limb bone is shown in Figures 9.7 and 9.8, and also the percentage gnawed of fragments where half of more of the bone has survived. Gnawing was seen as frequently on the larger as on the smaller fragments of cattle bone (Figure 9.7), but with pigs more of the large pieces have been gnawed than of all fragments together (Figure 9.8). The fact that many of the more complete bones have been gnawed supports the likelihood that these at least were discarded after the eating of roasted meat, and were not cooked in stews. They were discarded or abandoned to the dogs after the meat and fresh marrow had been eaten. Dogs would preferentially chew up bones which have not been boiled, as these would have contained more nourishment than when cooked, so it is possible that all or most of the bones which have been gnawed were discarded fresh. If so, and given the ethnographic evidence, it suggests that up to 20 per cent derive from eating fresh roast meat and so may be from feasts.



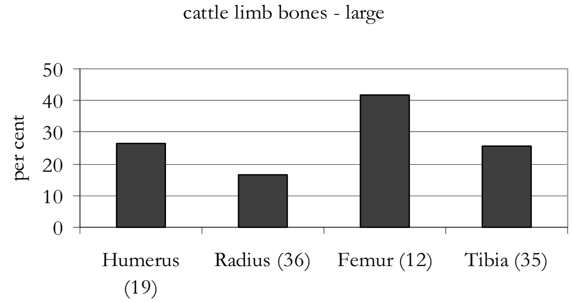
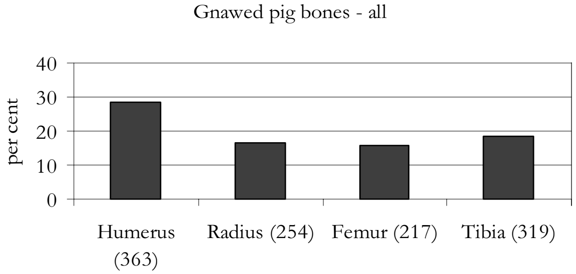


Figure 9.7: Gnawed limb bones of cattle. Top: as percentage of all fragments. Bottom: as percentage of large fragments (>50%) only



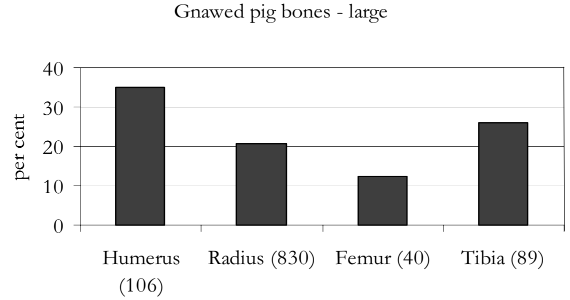


Figure 9.8: Percentage of pig limb bones gnawed, as Figure 9.7.

Figure 9.9: Two butchered metacarpals of cattle from Runnymede. The bone wall below the epiphysis on the medial side is eroded and stained, evidence of exposure to heat before the bone was chopped or smashed.

Butchery, cooking and consumption

We have seen how bones are heavily fragmented, and that much of the fragmentation results from damage after deposition, but also that a large element is the result of deliberate bone chopping with a stone pounder or axe. The initial disarticulation of the carcass was carried out using flint knives to separate the parts of the body and the individual bones, and chopping was then used to open up the marrow cavity and to break up the bones for soups and stews. To release the marrow and the nutrients within the bones themselves, they are best chopped into small pieces (Outram 2001). The 'large' bones, those least broken up, were chopped just once, midshaft or above or below the epiphysis. Many of these, as well as some of the smaller fragments, also have an area of burning on the shaft. Two chopped or smashed cattle metacarpal bones are illustrated; one (L) has marks of exposure to heat on the medial wall of the bone at the point below the epiphysis where it was smashed and the other (R) has been chopped more cleanly midshaft (Figure 9.9).

The colour and extent of the marks of burning was recorded, and the incidence of burning is shown here (Tables 9.3 and 9.4) as either charring or partial burning. The charred bones are white, grey and black. This degree of burning is not associated with cooking, but is an indication that the bones have been exposed to high temperatures by

Table 9.3: Burnt cattle bones from Runnymede, distinguished as per cent charred and per cent partly burnt.

	Total burnt	***% charred***	***% partly burnt***
Scapula	25	*60.0*	*40.0*
Humerus	56	*48.2*	*51.8*
Radius	62	*30.6*	*69.4*
Ulna	44	*52.3*	*47.7*
Pelvis	84	*50.0*	*50.0*
Femur	52	*40.4*	*59.6*
Tibia	76	*52.6*	*47.4*
Patella	4	*100.0*	*0.0*
Med. metap.	16	*93.8*	*6.3*
Metacarpal	28	*39.3*	*60.7*
Metatarsal	30	*66.7*	*33.3*
Astragalus	25	*36.0*	*64.0*
Calcaneum	38	*39.5*	*60.5*
Tarsals	6	*66.7*	*33.3*
Lat. cuneif.	3	*66.7*	*33.3*
Phalanx 1	25	*64.0*	*36.0*
Phalanx 2	23	*82.6*	*17.4*
Phalanx 3	6	*83.3*	*16.7*
Carpals	33	*57.6*	*42.4*
Atlas	3	*66.7*	*33.3*
Axis	3	*33.3*	*66.7*
Sesamoid	5	*80.0*	*0.0*
Skull frags.	70	*67.1*	*32.9*
Total / overall percent	**717**	***53.1***	***47.3***

being thrown into a fire. Approximately 10 per cent of all bones of cattle and pig have been affected in this way. Just as many bones have been only partly burned; they have also been exposed to fire, but the marks cover part of the bone only and are brown or sometimes show only as erosion and slight discolouration. One of the techniques used for chopping limb bones, especially cattle limb bones, was to heat the area of the shaft before the chop was attempted. This destroys the membrane covering the bone, the periosteum, and weakens the bone wall, making chopping easier (Binford 1981). Exposure to heat also warms the marrow within the bone cavity, making it easier to extract and eat. A couple of dozen of the more complete cattle bones show this characteristic partial burning. They were probably heated and the marrow eaten as a delicacy, very likely in the

Table 9.4: Burnt pig bones from Runnymede, as Table 9.3.

	Total burnt	***% charred***	***% partly burnt***
Ulna	99	*78.8*	*21.2*
Pelvis	86	*72.1*	*27.9*
Femur	79	*69.6*	*30.4*
Tibia	105	*72.4*	*27.6*
Fibula	29	*96.6*	*3.4*
Patella	2	*50.0*	*50.0*
Med. metap.	26	*80.8*	*19.2*
Lat. metap.	24	*87.5*	*12.5*
Metacarpal	36	*80.6*	*19.4*
Metatarsal	28	*82.1*	*17.9*
Astragalus	23	*69.6*	*30.4*
Calcaneum	52	*71.2*	*28.8*
Tarsals	8	*87.5*	*12.5*
Lat. cuneif.	1	*100.0*	*0.0*
Phalanx 1	28	*78.6*	*21.4*
Phalanx 2	19	*84.2*	*15.8*
Phalanx 3	18	*72.2*	*27.8*
Lat. phal. 1	11	*90.9*	*9.1*
Lat. phal. 2	7	*85.7*	*14.3*
Lat. phal. 3	1	*100.0*	*0.0*
Carpals	19	*89.5*	*10.5*
Atlas	20	*65.0*	*35.0*
Axis	5	*60.0*	*40.0*
Skull fragments	112	*84.8*	*15.2*
Mandible frag.	69	*78.3*	*21.7*
Total / *overall percent*	**1200**	***77.5***	***22.5***

context of feasting. The same practice has been observed at Kujavian LBK sites (Marciniak 2005, 150).

Some of the pig bones are also partly burnt, but the number is relatively fewer. The burning on certain leg bones of pigs at Durrington Walls and some other Late Neolithic sites was interpreted to mean that that pig meat was cooked by roasting in large joints

(Albarella and Serjeantson 2002, Westron 2002). Very few of the pig bones from Runnymede show the same charring, so it does appear that meat at Runnymede was cut into smaller units before being cooked.

It appears therefore that the meat from some of the joints of cattle and pigs and some of the bone marrow were eaten in a manner which suggests that there was feasting on the meat; this is not contradicted by the dog gnawing even on the large bones. Only a minority of bones were discarded in this condition, though the proportion may be higher than is suggested by the bone remains, because subsequent use of the bones in soups and stews will have masked some of the direct evidence for feasting. Most, as the fragmentation shows, must have been cooked in soups and stews and formed part of everyday food. As might be expected, the animal fats identified in sherds from the Early Neolithic long barrow at Ascott-under-Wychwood (Barclay and Case Forthcoming) were found in the medium and large size bowls, the types of vessels used as cooking pots. They probably became incorporated into the walls of the vessels during the slow cooking of soups and stews.

CONCLUSIONS

Everyday foods

In mixed farming regimes in temperate regions it is usual for plants to provide the main everyday foodstuffs and for the quantity of plant foods to be up to ten time the quantity of meat eaten (Legge 1981). However, this may overestimate the quantity of cereals and other plant foods which would have been available in Neolithic Britain, since traces of cultivation and plant remains themselves are scant or overlooked compared to later periods. Foods also included dairy products. The bone remains suggest that dairy animals were not exploited as intensively in the Neolithic as later, so these foods would have been available mainly in summer. The milk products contributed to the fat and protein needed in the diet, so removed some of the need to eat meat regularly.

The animal bones and meat scraps on them remained a food resource in themselves even after the fresh meat had been eaten on large and small scale occasions of feasting. The fragmentation and butchery at Neolithic Runnymede show that most bones were intensively chopped, to extract the marrow and other nutrients. Even the dense concentrations of bones, identified on site as ‘bone groups’, tend to include bones from several different species and different animals, suggesting that they have gone through many processes of cooking and consumption before being discarded. I argue that these bones were probably an important ingredient in the soups and stews, the ‘pottage’, which made up the everyday meals at the settlement. They would probably have been stewed up with cereals, wild herbs and possibly pulses.

Feasting

Though the quantity of bones is very large, this does not in itself indicate feasting. There are, however, many other aspects of the assemblage which do indicate that feasting took place here. Most obviously, the food animals are large animals, particularly when adult. When a cow was killed the whole community will have had a share, since, as discussed, it is unlikely that meat was preserved on a large scale at this time. Food sharing on a large scale is one signature of feasting. Some cattle were slaughtered before the natural end of their lives, so probably included bullocks as well as cows, a sign of a community able to keep animals for meat. The slaughter of a bullock or cow must have been a momentous event, and probably always represented a sacrifice. The pigs, and also the small number of sheep, were a more appropriate size to have been eaten by individual households; the contrast in relative numbers at the northern and southern ends of the settlement may confirm this. But it is likely that the consumption of adult pigs and sheep was also restricted to special occasions, possibly also communal occasions.

The meat eating and feasting was restricted almost totally to the three domestic animals. Wild animals were avoided, though they must have been all around. The reasons for this avoidance bring us into the realm of the relationship between the Neolithic farmers and wild nature. Wild animals may have been eschewed at the settlement because they were viewed as part of the alien world of nature rather than of the controlled domestic world, as Hodder (1990) has proposed, or left alone as a mark of respect for natural life, as suggested by Whittle (2003, 93).

The fragmentation, and more specifically the butchery and burning, shows that some bones are from animals or joints that were cooked over a fire rather than stewed, and meat eaten in this way is also characteristic of feasting. Food consumption included the eating of marrow from freshly heated and chopped bones, as well as of meat. The bones found in articulation, identified so far in Area 16 and probably present in other areas, confirm that some of the fresh joints eaten were discarded and not subsequently exploited intensively.

Since neither cereals nor dairy foods can have been as abundant in the Neolithic as they became later in prehistory, it is likely that feasting on meat took place fairly regularly. We might look at another analogy with meat eating in Medieval Europe. The Christian church (following the teaching of St Benedict) attempted to control the consumption of flesh meat and to restrict its consumption to special occasions. The rules were particularly strict for those living in religious communities, but all were supposed to follow them. But in fact even in the strictest monasteries meat eating was permitted on the main festivals of the Christian calendar and on other locally important festival days, and by the end of the middle ages the number of feast days reached at least a hundred in a year (Harvey 1996). The effect was that meat was eaten quite regularly, but yet its consumption was regarded as a special occasion. At Neolithic Runnymede it is likely that everyday consumption of soups and stews, to which the bones contributed a share, together with some dairy foods, was interspersed with what may have been quite frequent meat eating in the form of feasts.

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Chapter 10

A Community of Beings: Animals and People in the Neolithic of Southern Britain

Joshua Pollard

WHY ANIMALS MATTERED

Recent work by prehistorians has served to emphasise the centrality of animals in Neolithic social life (e.g. Jones 1998, Jones and Richards 2003, Ray and Thomas 2003, Tilley 1996, Whittle 2003). Acknowledging that animals were much more than simple resources – providers of food or secondary products such as milk and traction – these studies illustrate the physical, ontological and cosmological inseparability of human and animal lives during the period. All this work has drawn upon an increasingly rich ethnographic and anthropological literature relating to attitudes to and understandings of animals amongst hunter-gatherers, horticulturalists and pastoralists (e.g. Descola 1994, Ingold 2000, Morris 1998, 2000, Serpell 1986). What this illustrates, at one level, is a common fascination with animals: they have behaviours that people find intriguing, beguiling, sometimes familiar, sometimes amusing, sometimes irritating and annoying. They thus contribute to the tapestry of everyday life; observation of their behaviours providing a rich source of material for didactic stories and myths, metaphors and metonyms. Animals are woven into the fabric of social life through their ubiquitous presence and involvement in the creation and maintenance of social relations as a medium of exchange, feasting and offering. By extension, they contribute to the construction of personhood and identity (Fowler 2004; Whittle 2003, chapter 4); and through different kinds of engagement, in herding or hunting, or pet keeping, new identities were created for both human and animal.

But the centrality of animal life in shaping human social existence goes much further. Totemic and animic systems of classification provide powerful cosmological schemes in which close identification is made between people and animals, dissolving the distinction often made in western thought between different kinds of being. In totemism human society draws upon natural forms to order and classify social units; society is modelled after nature. Animism may be seen as the symmetrical inverse of totemism, 'a mode of conceptually organising the relationship between human beings and natural species on the basis of the system of social classification' (Århem 1996, 185). Here nature is society (Fowler 2004, table 5.1). Seen by many traditional societies as sentient beings involved in a mutual embodied inhabitation of the world, with spirits or vital life-essences, and operating with purposeful agency, animals become 'other forms of 'people' (Jones and Richards 2003, 50). Such understandings surely existed within prehistory. According to

Ray and Thomas, 'the notion of 'a mere animal', a creature that existed without social relations, cultural significance, and spiritual values, would have been all but incomprehensible' for Neolithic people (2003, 38).

There is a need, therefore, to avoid interpretations that stop at the objectification of animals as subsistence resources, forms of wealth, or constituent components of an externalised environment upon which people acted. We should be open to the fluidity of relations between humans and animals during prehistory, and the values ascribed to those relationships. Likewise, we should not seek to define the symbolic and ontological status of animals within rigid classifications, especially ones that unconsciously reproduce our own modern western order of the world, such as the strict distinction between cultural and natural domains. It is this distinction – a problematic legacy of Cartesian thought – that I would like to address, while also offering some thoughts on the mutually constitutive relationships between humans and animals in the Neolithic of southern Britain.

The identity of animals

Throughout its life as an academic construct, the Neolithic has been projected as a period that sees the coming into being of new relationships between people and the natural world. One dominant meta-narrative has been the creation of a conceptual division between natural and cultural domains, between the wild and domestic (e.g. Hodder 1990), a mental construct which allowed human communities a more active role in shaping the environment through technologies such as monument construction, the keeping of domesticated animals, and the cultivation of plant foods. Grahame Clark's remark that 'the very domain of farming had to be carved out of primeval forest' (Clark 1952, 92), with its clear connotations of human dominance over the environment, is still reflected in our comprehension of the Neolithic as a period which sees the first fundamental alterations of the landscape, and with it an asymmetrical relationship to 'nature'.

The composition of early Neolithic faunal assemblages in southern Britain and recent evidence for marked dietary change at the beginning of the period (particularly the avoidance of marine foods: Richards and Hedges 1999, Richards *et al.* 2003), at first sight seems to support the coming into being of a nature-culture distinction, and perhaps even a dichotomous relationship between such domains. The remains of non-domesticated animals are surprisingly rare in fourth millennium BC faunal assemblages from occupation sites, enclosures and other contexts in Britain and Ireland (Figure 10.1), as other work confirms (see Serjeantson, this volume). Domesticated animals such as cattle, pig, sheep and goat regularly make up 90 percent or more of the record. Strikingly, there appears to be no evidence that the former ever included domesticated indigenous stock. While the bones of some non-domesticated animals (especially deer, wild cattle and wild pig) are occasionally present in small numbers, those of other species, such as cat, fox, wolf and brown bear, are exceptionally rare. The situation is all the more remarkable given the heavily-wooded character of earlier Neolithic landscapes within which occupation took place, and across which such animals must have been ubiquitous.

Various interpretations can be offered for this seemingly anomalous pattern, which suggests that a ready supply of 'forest' meat was not made more use of. It is possible that

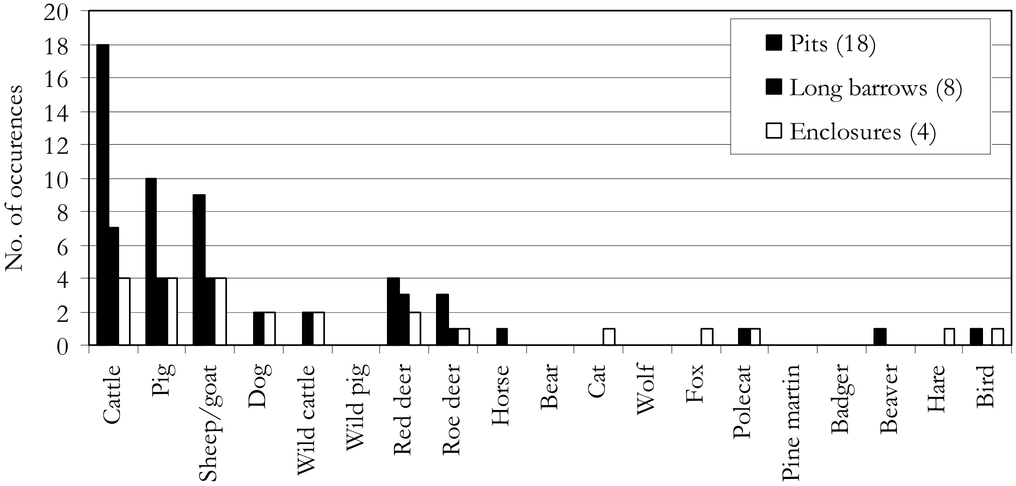

Figure 10.1: The occurrence of different animal species, according to context, in a sample of 30 earlier Neolithic sites in Wiltshire and Dorset. The graph illustrates occurrence per site, rather than relative abundance or absolute numbers of bones or animals.

wild species were rarely 'exploited'; or that animals such as aurochs and red deer were regularly hunted, but consumed away from settlements and enclosures; or that their bones were deliberately taken away to be deposited off-site.

Each scenario seems to imply the existence of a conceptual distance between domesticated and non-domesticated species. However, this need not reflect a nature-culture split. Elsewhere I have argued that while it is possible that Neolithic communities might have defined an ontological realm that was equivalent to our category of 'nature', there is little reason to think that this was always opposed, in a dualistic fashion, with a social realm (Pollard 2004). The ontological and cosmological status of animals was constructed as much through an understanding of their habits, their perceived proximity to people, and their involvement in social relations as any kind of abstracted symbolic scheme.

The complexity of the situation is best illustrated by reference to four species whose remains do occur on many earlier Neolithic sites, though generally not in any quantity: wild cattle, wild pig, red and roe deer. Significantly, in fourth millennium BC contexts, there is little evidence of these animals being afforded special treatment through deposition. At Windmill Hill, bones of wild cattle and pig occur in the same contexts as their domesticated equivalents (Whittle *et al.* 1999): at that site there is certainly little sense of any symbolic distinction between domestic and wild being played out. These nominally wild animals were hunted, though perhaps not on any large scale. They perhaps formed a somewhat ambiguous category: they had similar patterns of behaviour to domesticated cattle and pigs, and occupied similar environmental niches, but were not directly controlled by human groups, nor were they subject to formalised ownership.

In the case of red deer, the distinction we might make between animals classified as either domesticated or wild starts to dissolve. Herds of deer are thought to have been managed by means of selective culling and the creation of browse during the Mesolithic and it now appears likely that they were deliberately introduced by human communities to Orkney, Ireland and perhaps other regions during the earlier Neolithic (Sharples 2000, Woodman *et al.* 1997). Sharples suggests that on Orkney herds must have been tolerated, if not actively managed (2000, 113), and we can perhaps infer the same for other regions where there existed high demand for antler to provide digging tools for the construction of monuments and the excavation of flint mines (Clutton-Brock 1984).

Roe deer bone and antler is not as common, though there exists one remarkable deposit that deserves comment. The rich assemblage from the Coneybury Anomaly, near Stonehenge, may come very early in the Neolithic sequence of that region (Richards 1990). The faunal assemblage is dominated by cattle and roe deer bones, each species being represented by several animals, perhaps deriving from one butchery episode, along with the remains of at least one pig, two red deer, a trout and beaver (Maltby in Richards 1990, 57–61). The number of non-domesticated animals is particularly high, and this may reflect a 'transitional' economy based around hunting and animal husbandry. Given the quantity of faunal remains from the deposit another unusual feature is the absence of sheep or goat. Maltby (in Richards 1990, 61) argues for an absence of sheep from the region at this time, and from this we might infer that roe deer here acted as a sheep-substitute, being close in size and character.

In this connection it is remarkable how frequently mixed deposits of cattle, pig and sheep/goat bones occur within early Neolithic pit and enclosure contexts (seen, for example in the Inner Ditch bone groups at Windmill Hill: Whittle *et al.* 1999). If we follow Whittle's suggestion that sociality and size were important in Neolithic animal classifications and that appropriate combinations were considered desirable (2003, 91), then we might regard these three domesticated species as a 'set', with substitutions made on the basis of gross physical similarity. There is a real question of why sheep and goats were adopted at all. It is possible they were kept for milk, or that they served a role within risk management, providing a source of meat when cattle or pigs would fail (Grigson in Whittle *et al.* 1999, 229). Alternatively, the explanation may lie in the long ancestry of sheep and goats, going back to Neolithic beginnings in the Near East. Along with the production of ceramics and cultivation of cereals, their keeping may have been seen as an integral part of an engagement with Neolithic lifestyles. A third possibility is that they were adopted 'because they filled a gap in the size range', produced more manageable amounts of meat, or were valued for their novelty (Whittle 2003, 91–3). It is possible that combinations of the three animals were deemed appropriate for certain consumption events – a form of *suovetaurilia*, the Roman sacrifice of a pig, a sheep and an ox.

It may be their relative distance from human social practices rather than any position within predetermined symbolic schemes, such as a nature-culture divide, that explains the regular under-exploitation of wild ungulates. If domestic animals embodied social relationships through biographies of ownership and exchange, it is easy to envisage how domesticated animals might become preferentially valued over their wild cousins; the status of the latter being lessened by their existence outside mainstream social life. There is certainly no doubting the social value of cattle during the fourth millennium BC. In addition to providing a rich source of meat, milk and leather, a close identification was often made between cattle and people by the placing of the bones of the former within mortuary contexts (Grigson in Ashbee 1966). Ray and Thomas (2003, 41) argue that cattle existed as a form of inalienable wealth, used in gift exchanges, as bridewealth, in procuring alliances, or settling death payments, with slaughter and consumption only on special occasions. Their enchainment within such practices would develop close links between cattle and kinship, herds becoming living histories of kinship links, genealogies and lines of descent: cattle became 'congealed lumps of social relations'. Through histories of ownership and exchange, domesticated animals might become subjects with biographies, and therefore constituted important agents in the creation of personhood and identity. In this respect the ownership of animals was very much part of what it was to be Neolithic, embroiling people in complex social networks and situating them within histories built around their animals that told of ancestors, kin and others. Engagement with non-domesticated ungulates slipped into the background, simply because these beings were less entwined in the fabric of social life.

Domesticated cattle would not be unique in terms of carrying with them genealogies and biographies of ownership: the same was surely true of domesticated pigs, sheep and goats. All these animals were originally acquired via exchanges of sorts, during which histories of ownership could be established. There is little evidence of local domestication of indigenous ungulates in Britain and Ireland; all four species appear to have been introduced from the Continent; sheep and goat certainly so. Beyond the technical practicalities (Case 1969), what is rarely remarked upon is the mechanism by which these animals were introduced. Their widespread occurrence across so much of Britain and Ireland in the early centuries of the fourth millennium BC deserves comment in itself. For herds and flocks to reach levels that were sustainable in any way – and by the middle of the millennium providing numbers sufficient to maintain the massive scale of consumption seen at certain enclosures (e.g. Pryor 1998, Whittle *et al.* 1999, Healy 2004) – we must be looking at the large-scale importation of animals. Whether casual exchange with continental Neolithic communities fronting the English Channel could have provided sufficient numbers is open to question. More likely is regular exchange utilising extensive networks, some possibly long-standing, that extended well into Continental Europe. Perhaps many of the first domesticated animals travelled along the same exchange networks that facilitated the movement of jadeite axes in the first half of the fourth millennium BC. If so, some animals would have arrived with complex histories and genealogies, stretching off to distant and dimly comprehended realms, making them all the more intriguing and valuable.

DANGEROUS BEINGS OR ANIMAL ANCESTORS?

If the scarcity of non-domesticated ungulates on fourth millennium BC sites lay in their diminished value in the context of social practices, what of the other 'wild' species known to be present in the Neolithic landscape: cat, fox, wolf, bear, badger, polecat and so forth? Many of these are fur-bearing animals, but as a resource rarely seem to have been exploited. The same also holds true of birds, despite the edibility of many and the uses to which their feathers could be put (Grigson in Whittle *et al.* 1999, 235). When these species do turn up it is within very particular contexts. They are generally absent from pit deposits associated with occupation events, but do occur in low but significant numbers amongst bone deposits from the chambers, ditches and mounds of contemporary long barrows/tombs (Thomas 1988; see Jones 1998 for analogous Orcadian instances) and from enclosures (Figure 10.1).

The very rarity of these species, we claim, reflects the existence of taboos on their hunting or encounter. Such prohibitions could have developed from an awareness of these animals' behaviour, specifically their occasional contact with the human dead. Mortuary practices that involved the exposure or excarnation of human bodies were widespread during the period, and while these transformative processes sometimes took place in the protected environments of tombs or enclosures, there are plentiful instances where weathering and animal gnawing on human bones indicate exposure in less protected settings (Whittle and Wysocki 1998, 155–8). Many of these animals are either carnivores or omnivores, and must occasionally have encountered human corpses set out for exposure. The possibility of animals and birds consuming human flesh would have ascribed them a status as 'impure', dangerous or powerful beings; and to have eaten such creatures would be tantamount to cannibalism. Drawing upon varied African and Amerindian ethnography relating to comparable species (e.g. Descola 1994, Morris 2000), we might even go so far as to suggest certain forest animals were being identified with, or as, ancestors of varying kinds. Perhaps corpses were even deliberately set out on occasions to be consumed by forest animals; it is but a fraction of the Neolithic dead that survives in the archaeological record. This could be seen in the context of vital exchanges of matter, a necessary process for maintaining the flow of human, animal and spirit life – a cosmic food web (*cf.* Århem 1996).

Albeit of late Neolithic date, one rather unusual faunal assemblage does provide a further contextual link between a range of wild animals, including carnivores, and the transformed human dead/ancestors. During phase 2 at Stonehenge the bones and even skeletons of wolf, fox and bird (including raven) were placed in the same sectors of the henge ditch as disarticulated human bone and cremations (Serjeantson in Cleal *et al.* 1995). Overall, the proportion of wild animals from the site is unusually high (*ibid.*, 450). Both the character of other depositions within the monument, and the employment of stone settings during the latest Neolithic, can be read as an explicit link with ancestral domains (Parker Pearson and Ramilisonina 1998, Pollard and Ruggles 2001); if so the occurrence of these animals in the ditch may also not be without significance.

INTERTWINED WORLDS: PEOPLE, ANIMALS AND THE DEAD

In many non-western societies vital life energies are seen to reside among a variety of spirits, humans, animals and natural things, with the transmission of generative energies between these a vital process for reproducing the world (see Fowler 2004, 118–29). From such a perspective, the consumption of meat and plant food (and of the human dead by animals) is not just a means of sating hunger, but contributes to an ongoing flow of life and vitality. A blurring of distinctions between different kinds of being is inevitable, and identities may be highly context-specific: depending on circumstance, animals may be seen to become people and, in shamanic turn, people animals (*cf.* Århem 1996).

If we talk of animals as the embodiment of ancestors we acknowledge how fluid different states of personhood and animality may have been in the Neolithic. The connections between animals and the remains of the human dead are often striking, and seem to break down any categorical distinction between certain kinds of animal and particular sorts of people. The inclusion of cattle bones and hides with the human dead in long barrows and chambered tombs is well attested (Grigson in Ashbee 1966; Thomas 1988). At Fussell's Lodge and other Salisbury Plain barrows the draping of hides over mortuary deposits almost bespeaks of a containment, melding together, or absorption of ancestral bone and cattle. Animal and human bone was often mixed together in striking combinations, as with the 'nesting' of an infant cranium and cattle frontlet in an outer ditch deposit at Windmill Hill, and the insertion of a human infant femur into the marrow cavity of a cattle humerus in another deposit (Whittle *et al.* 1999, 89, 110). These may be attempts to generate new and hybrid forms of identity, manage the flow of vital essences, or they may simply commemorate the intimate ontological connections between humans and animals. Certainly the equivalent treatment afforded to animal and human bone in some depositional contexts (notably within enclosures and chambered tombs: see Whittle *et al*, 384–6; Thomas 1988, 547) could lead us to infer that people and animals were conceived to undergo similar cycles of transformation and regeneration following death.

While the contextual link between cattle and fourth millennium BC mortuary deposits in southern England has long been recognised, a closer reading of the evidence suggests more complex links were drawn between the human dead and a variety of animal species. In these contexts, different animal species were perhaps envisaged to embody qualities that linked them to particular genders, age groups and generative processes. Because of their association with collective mortuary deposits – resources with real time-depth and genealogical value – it is tempting to see cattle and cattle offerings as inextricably associated with the transformed, ancestral, dead. By contrast, there are instances of pig mandibles being placed with *articulated* male burials (corpses that retained their identity) from under the outer bank at Windmill Hill (Whittle *et al.* 1999, 80) and within a linear mortuary structure at Barrow Hills, Oxfordshire (Barclay and Halpin 1999, 28). Two infant burials in the outer ditch at Windmill Hill were also associated with complete pig/piglet skeletons (Whittle *et al.* 1999). Was the consumption of pig appropriate for funerary rites following the immediate death of an individual (and perhaps that of just males), whereas cattle were reserved for those celebrations associated with the transference of the dead to an ancestral community?

This scheme may not be applicable to all situations, and notice should be taken of local detail. Cattle bone was frequently placed in the chambers of Cotswold-Severn long mounds, in association with deposits of human bone (Thomas 1988, 549), but a different picture emerges from Hazleton North in Gloucestershire (Saville 1990). Here, only one cattle bone was found with human bone deposits in the chambers, but a probably complete (when deposited) perinatal sheep had been placed in the south chamber, along with other sheep bones and the limb of a roe deer (Levitan in Saville 1990, 211–2). In contrast, deposits of disarticulated human bone in the south quarry ditch were associated with cattle and one pig bone; and cranial elements of the same species predominated in the forecourt deposits. Significantly, bones of these species were spatially differentiated, with pig skulls and mandibles being placed in the centre of the forecourt, flanked on either side by those of cattle (*ibid.*, 212–3).

This may reflect a more embedded, routine, categorisation of these domesticated animals. In the pre-cairn occupation at Hazleton North sheep bones were almost exclusively restricted to a midden deposit; and it is perhaps not coincidental that it was against this that the cairn chambers were constructed. By contrast, the bones of cattle and pig were spread more generally across the buried soil and midden (*ibid.*, 203, fig. 197). The midden also included most of the broken quern fragments and pieces of polished axe. Querns might have been associated with female roles and practices surrounding the processing and transformation of foodstuffs. So were sheep and roe deer here linked to human remains undergoing transformation and qualities of femaleness, with cattle and pig to ancestral essences, commemoration, distant times and maleness?

LATER NEOLITHIC

Shifts in attitude to, and engagements with, certain animal species can be detected throughout the Neolithic. Significantly, non-domesticated species occur with greater frequency on third millennium BC Grooved Ware-associated sites in southern England than they do in fourth millennium BC contexts (Wainwright and Longworth 1971, table 29). The range of species present on occupation and ceremonial sites also increases, with the notable occurrence of brown bear from at least three sites in Wessex and East Anglia (Legge 1991). Again the relative frequency of different species is context-specific, and the picture is perhaps quite regionalised. In Wessex, the bones of a wide range of non-domesticated species are found on henges, albeit often in small numbers: here we have wild cattle and pig, deer, horse, cat, wolf, fox, pine martin, badger, beaver and bird, but no bear. Dog remains are also common. Fewer species are present in pit deposits,

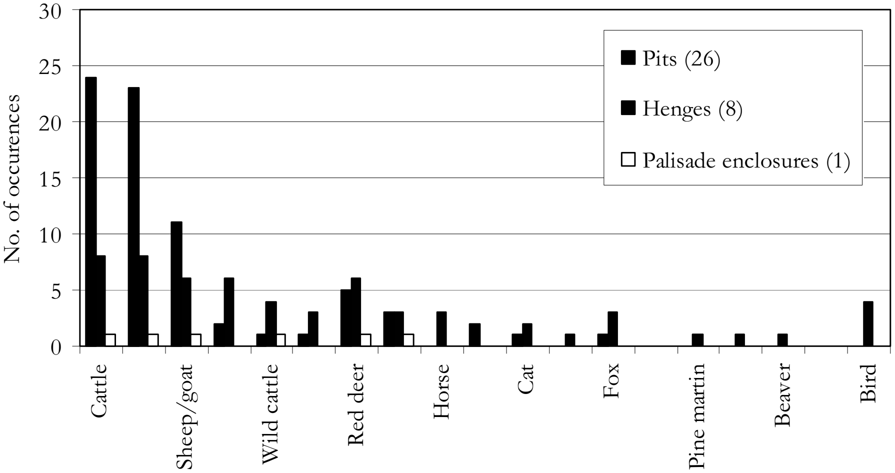

Figure10.2: The occurrence of different animal species, according to context, in a sample of 35 later Neolithic sites in Wiltshire and Dorset, as Figure 10.1.

though alongside the familiar range of ungulates there are cat, fox and brown bear (Figure 10.2).

In comparison with the fourth millennium BC, the greater occurrence of bones from wild animals is striking, especially given the opening up of woodland in many regions, which might be expected to lead to a corresponding decrease in the number of such animals. In some regions at least, there seem to have been frequent encounters with non-domesticated ungulates. Grooved Ware pit assemblages from the Bedfordshire-Hertfordshire-Cambridgeshire region sometimes contain high proportions of aurochs and wild pig. At Blackhorse Road, Letchworth (Legge, Williams and Williams in Moss-Eccardt 1988, 93), and Puddlehill, Bedfordshire (Grigson in Matthews 1976, 11–18), bones of aurochs make up between 30–40 per cent of the faunal remains. A similar pattern pertains in certain pit clusters at Over, Cambridgeshire (Mark Knight pers. comm.). As purposeful and often highly contrived acts of deposition involving careful selections of material, there is of course the question of whether the contents of these pits in any way reflect routine situations. Bones from aurochs and wild pig could easily have been preferentially selected for deposition, especially since other components of the faunal assemblages from these features include special deposits such as burials of neo-natal pigs and sheep, and cattle hides (Legge, Williams and Williams in Moss-Eccardt 1988; Clark in Miles *et al.* 2003, 237–40). That differential treatment could be afforded to the bones of domesticated and wild cattle and pig is illustrated by the seeming restriction of the latter to ditch contexts at Woodhenge and Durrington Walls (Richards and Thomas 1984, Pollard 1995; though see cautionary notes in Albarella and Serjeantson 2002).

Despite occasionally receiving special treatment through deposition in both pit and henge contexts, no attempt was made to physically separate the bones of wild from domesticated animals, suggesting that the two categories were not antithetically opposed; the remains give no reason to envisage a conceptual divide between natural and cultural domains. What we may be observing are displays that played upon the enhanced value now ascribed to non-domesticated animals, particularly those that were large, or potentially dangerous, and whose encounter involved an element of risk. The hunting of these animals may have taken on a special significance. Prowess in the hunt and in combat were perhaps skills that gained in social value during the late Neolithic, and became important in the creation of masculine identities (Edmonds and Thomas 1987). This may be inferred from the range of elaborate arrowhead styles in currency at that time and the rare examples of boar tusk blades with third millennium BC burials (e.g. Duggleby Howe 7, Yorkshire: Kinnes *et al.* 1983). Ray and Thomas (2003, 42) argue for wild cattle becoming ‘prized trophies’ during the third and early second millennia BC, and make the intriguing suggestion that herds were perhaps ‘maintained’ for hunting. Certainly, as they became a scarcer presence within the landscape, respect for these animals was displayed by the careful burial of their skulls and skeletons. At Etton, Cambridgeshire, two skulls were found in a late Neolithic pit (Pryor 1998, 45) and a near skeleton which dates from the terminal Neolithic or very early Bronze Age was found in Hillingdon, West London (Cotton 1991; Cotton *et al*, this volume). Another skeleton from Bradley Fen, Cambridgeshire may date from the Late Neolithic or Bronze Age; the date has still to be confirmed (Swaysland and Serjeantson, n. d.; see also www.unearthingthe past.net).

While it is normally possible to distinguish between domesticated and wild varieties of individual species on the basis of morphological traits, it is much more difficult to be certain about the kinds of husbandry or control exerted over animals. Even with nominally domesticated species we can postulate that there may have been different degrees and intensities of interaction with people, from close husbandry to a very loose form of management in which animals may have been largely feral. Recent re-analysis of the faunal assemblage from Durrington Walls by Albarella and Serjeantson has revealed surprising evidence for morphologically 'domesticated' pigs and cattle being shot with flint-tipped arrows (2002, 43–4). Given the context of these remains within a large henge enclosure, such practices might have comprised a form of 'ritualised' slaughter, but killing domesticated animals by methods normally employed on their non-domesticated cousins shows how the status of animals could be re-contextualised. During the course of the later Neolithic there may have developed much more fluid or contextually-specific categorisations of animals which make a clear-cut distinction between that which was domesticated and that which was not more or less meaningless. Claims for the management of red deer in Orkney during the period again illustrate the complexity of human-animal relationships (Sharples 2000).

There is much ambiguity surrounding the status of two species within the later Neolithic 'animal estate', brown bear and horse. These are quite intriguing animals, being large mammals whose bones occur only rarely, but when they do turn up it is generally in very particular contexts. Both seem to have been afforded a special status, but in quite different ways. Perhaps because of their size, solitary character, and ability to stand on two legs, bears are often conceived as another kind of 'person', as for example in Hopi (Bahti 1990) and Inuit cosmology (Saladin d'Anglure 1990). There are three recorded occurrences of brown bear on later Neolithic sites in southern England: from Down Farm on Cranborne Chase, Ratfyn near Stonehenge, and Blackhorse Road, Letchworth (Legge 1991, Legge, Williams and Williams in Moss-Eccardt 1988, 93); all comprising single bones in pit deposits. A mandible from Blackhorse Road was from a derived context, the fill of an Iron Age ditch that had cut through a Grooved Ware pit but it seems clear that it was originally contained within a late Neolithic deposit. An ulna from pit 11a at Down Farm was associated with an elaborate and rich deposit that included a cattle skull. It was weathered and heavily gnawed (Legge 1991, 59–60), which might imply rather casual treatment, even disregard, though its incorporation in the pit is nonetheless significant. In fact, the bone's condition might imply a rather complex history, representing a chance woodland 'find' brought back to an occupation site and buried with care and reverence rather than the remains of a hunted animal.

Horse is claimed from several fourth millennium BC contexts in southern England. Nearly all of these are from long mounds and chambered tombs, and include Fussell's Lodge, Wiltshire (above the burial deposit: Grigson in Ashbee 1966), Wayland's Smithy, Oxfordshire (apparently stratified under the primary barrow and within its primary ditch: Gardner in Whittle 1991, 91), and several Cotswold-Severn tombs (Thomas 1988). None of the finds of horse from Early and Middle Neolithic contexts have been confirmed by radiocarbon dating so their status is open to debate. Many could be intrusive, though it is admittedly difficult to make such an argument for Wayland's Smithy. Horse is however closely associated with major Late Neolithic ceremonial sites. In Wessex, horse was recorded from the Sanctuary (Cunnington 1931, 331), Durrington Walls and Marden

(Wainwright and Longworth 1971, 265). It is also known from later Neolithic deposits at Newgrange in Ireland (Wijngaarden-Bakker 1986), and from a pit dug within the Etton causewayed enclosure, where a skull was deposited alongside an antler pick (Armour-Chelu in Pryor 1998, 112). Seemingly no longer indigenous within Britain by the Neolithic, these animals had to be introduced. Horses may have been kept for riding. Remains are so scarce that it is unlikely that they were introduced for their meat, but they may nevertheless have been consumed on very special occasions. We should probably think of horses in the Neolithic as exotic and alien creatures, and therefore imbued with great cosmological value. As they were introduced very late in the Neolithic sequence, they could have arrived alongside other paraphernalia that made up the Beaker 'package', and like Beakers themselves, copper knives and metallurgy, served as important elements in the creation of specific social identities.

CONCLUSION

Ingold has suggested that the move from hunting to domestication brought with it a change in human-animal relations, from one of trust to one of domination (2000, 61–76). In this scheme, animals came to be ranked below humans, though Ingold is careful to stress that this transformation was largely a '*change in the terms of engagement*' (*ibid.*, 75; original emphasis) rather than the assignation of domesticated animals to a separate domain of being. Like hunters, traditional herders and pastoralists see their animals as 'subject-persons' rather than 'object-things', 'endowed with powers of sentience and autonomous action which have either to be respected… or overcome through superior force' (*ibid.*, 74). Such a perspective recognises that both humans and animals remain in a 'mutual embodied inhabitation of the world' (Jones and Richards 2003), and do not exist within exclusive ontological domains.

Nonetheless, valuable though Ingold's reading of the situation is, a shift from trust to domination does not wholly encompass the complex attitudes to and engagements with animals displayed in the Neolithic. I hope to have shown how imbricated the relationship between people and their animals might have been, and how distinctions between them, and supernatural domains, were highly contextual and could occasionally dissolve.

If we examine the record for the British Neolithic, a rigid, antithetical distinction between those animals that were subject to human husbandry and those that dwelt 'in the wild' in the British Neolithic is difficult to sustain. We could instead envisage a hierarchy or relational classification of animals based on proximity or distance to people, spatially and/or ontologically. The ordering of the animal estate was achieved through perceptual knowledge of species, an understanding of the characteristics of their behaviour, and perceived similarity or dissimilarity to people. The habits of animals, their place of dwelling (Jones 1998), and even their size, sound and sociality (Whittle 2003, 91), could well have contributed to their classification. The way that animals dwelt, their needs and actions, would have served to structure the way in which people engaged with and understood them. The understanding that developed came through perceptual knowledge, deriving from encounter and familiarity, rather than rigid conceptual schemes, and surely held true for all species in the animal estate, whether domesticated or not.

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Taming the Wild: A Final Neolithic/Earlier Bronze Age Aurochs Deposit from West London

Jonathan Cotton, Nicholas Elsden, Alan Pipe and Louise Rayner

INTRODUCTION

The deposit containing the skeleton of an aurochs (*Bos primigenius*) that forms the subject of this paper was excavated in 1987 as part of a long running watching-brief conducted on a site to the north of Heathrow airport, Greater London. A short report on the deposit appeared some years ago (Cotton 1991), and it has been referred to in print on several subsequent occasions (e.g. Brown and Cotton 2000, 86; Cotton 2000, 19 and fig. 2.12), but it has not yet been fully published.

The paper is divided into discrete sections. Following a description of the site location and the background to the fieldwork, the first outlines the aurochs deposit and its associated finds. The second looks briefly at its date and at those of other final Neolithic/earlier Bronze Age and later aurochsen; the third at hunting and the role of archery in the final Neolithic/earlier Bronze Age; while the closing section assesses the deposit's local and regional significance.

Location and background

The aurochs deposit was discovered on a 26 ha gravel quarry in Holloway Lane in the south of the London Borough of Hillingdon. The quarry, worked between 1980 and 1988, lies above 27m OD one kilometre or so north of Heathrow airport (Figure 11.1; site code HL80) in an area now largely given over to mineral extraction and its aftermath. The underlying geology is Taplow terrace gravel variably capped with brickearths of the Langley Silt Complex (Gibbard 1985), a free-draining silty clay-loam of probably Devensian (last glacial) origin.

These brickearths range from a few centimetres to up to four metres in depth. Their presence almost certainly masks a series of late Pleistocene land surfaces, and they also effectively inhibit the development of clear cropmarks – hence the watching-brief approach adopted here. The free-draining properties of the brickearths usually provide a particularly aggressive burial environment for organic materials such as human and animal bone.

Prior to the work conducted in the 1980s little had been recorded from the immediate area. Stray finds of Palaeolithic and later date had been made during brickearth and gravel digging a little way to the north in the late nineteenth and early twentieth centuries (e.g. Wymer 1968; Collins 1978), while several later prehistoric sites were examined in the

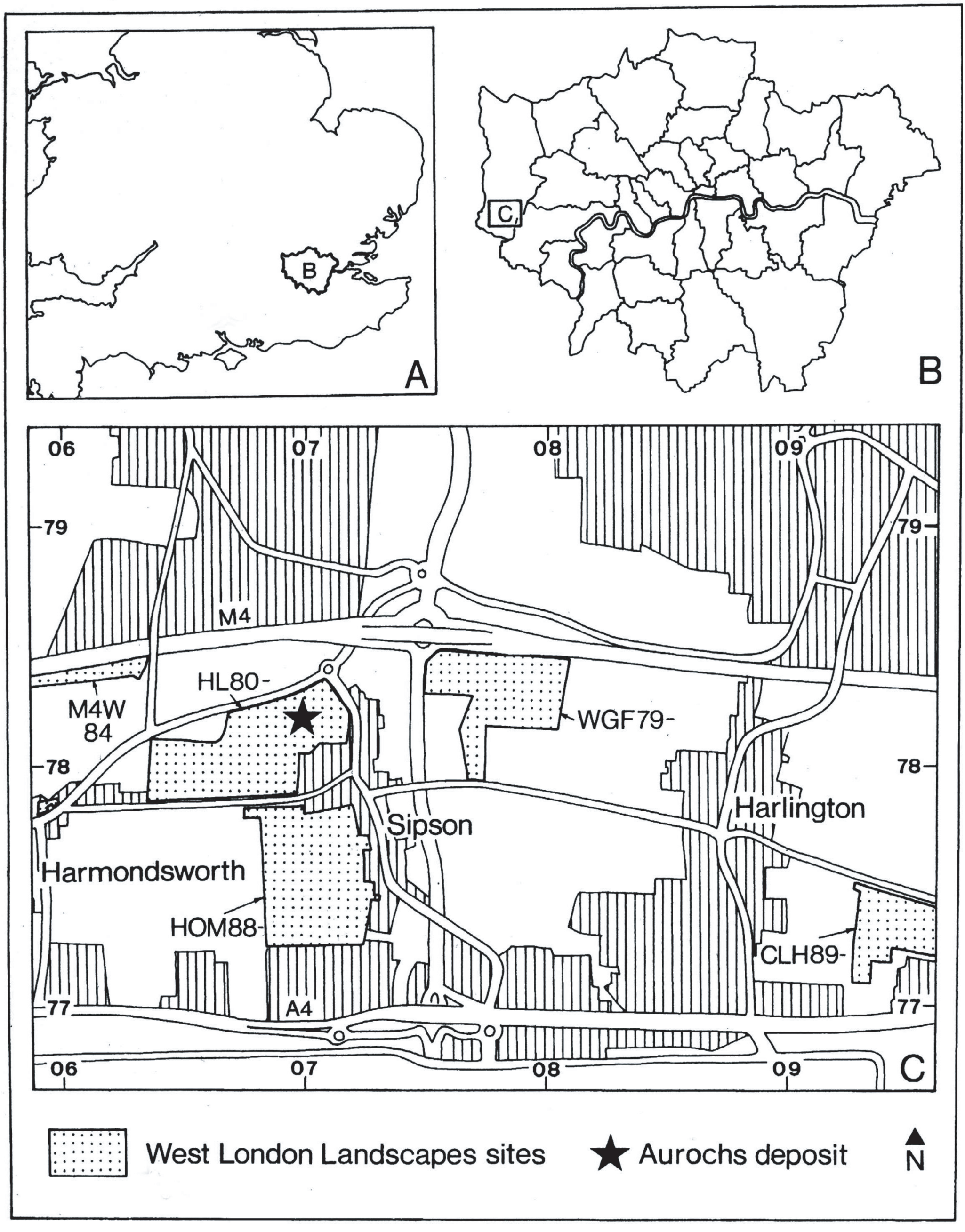

Figure 11.1: Holloway Lane (HL80) in relation to other West London Landscapes sites. The position of the aurochs deposit is marked.

context of the construction and extension of Heathrow airport to the south from 1944 onwards (e.g. Grimes and Close-Brooks 1993; Canham 1978). Moreover, the discovery of successive Neolithic ceremonial and Bronze Age agricultural landscapes at Stanwell on the western edge of the airport from 1979 (O'Connell 1990) provided an early flavour of what was to come from the more recent and much larger scale work conducted on the Heathrow terrace at Perry Oaks (Barrett *et al* 2000; 2001) and elsewhere (e.g. MoLAS 2000a; Farwell *et al* 1999; Crockett 2001).

THE AUROCHS DEPOSIT

As extraction work progressed east to west across the Holloway Lane quarry, and then swung round to move west to east, a number of archaeological features of all periods were identified cutting into the surface of the brickearths. These included a scatter of small, usually isolated, shallow pits containing sherds of Grooved Ware pottery and/or flintwork. It was the presence of one of these small charcoal-rich pits [4] that led initially to the discovery of the much larger, paler and deeper pit [75] containing the animal remains at NGR TQ (5)06975 (1)78205. Fittingly perhaps, this latter deposit was under excavation as the great storm of October 1987 raged across southern England.

Pit [4]

The small pit [4] was roughly circular in shape, c. 1.10m in diameter and 0.30m deep, with rounded sides and a flattish base (Figure 11.2). The primary fill [74] comprised a grey-black silt loam some 50mm thick with 5 per cent charcoal. Finds included an assemblage of Grooved Ware (Clacton sub-style) representing a minimum of fifteen vessels, together with fragments of fired clay and burnt and struck flint, the latter including a fragment of ground flint axe and a number of scrapers. The pottery and flint were noted to have lain in separate areas of the fill.

The primary fill was sealed by a grey-brown silt loam up to 0.20m thick [72]. This contained a few pieces of struck and burnt flint, charcoal flecks and a large lens of clean brickearth [73] up to 0.15m thick (Figure 11.3).

Pit [75]

The large pit [75] in which the aurochs remains were buried had clipped the north western edge of pit [4] and was roughly oval in shape. It measured 3.10m by 2.15m, with its long axis aligned north west – south east (Figure 11.2). The pit had been dug down through the brickearth and 0.13m into the underlying terrace gravels, an overall depth of at least 1.85m. The excavators noted some difficulty in defining the sides of the cut, but the drawn profiles show the lower walls to have been nearly vertical and the upper walls weathered to a more rounded shape (Figure 11.3). At least three main stages in the in-filling of the pit could be discerned, here termed primary (pre-aurochs), secondary (aurochs) and tertiary (post-aurochs).

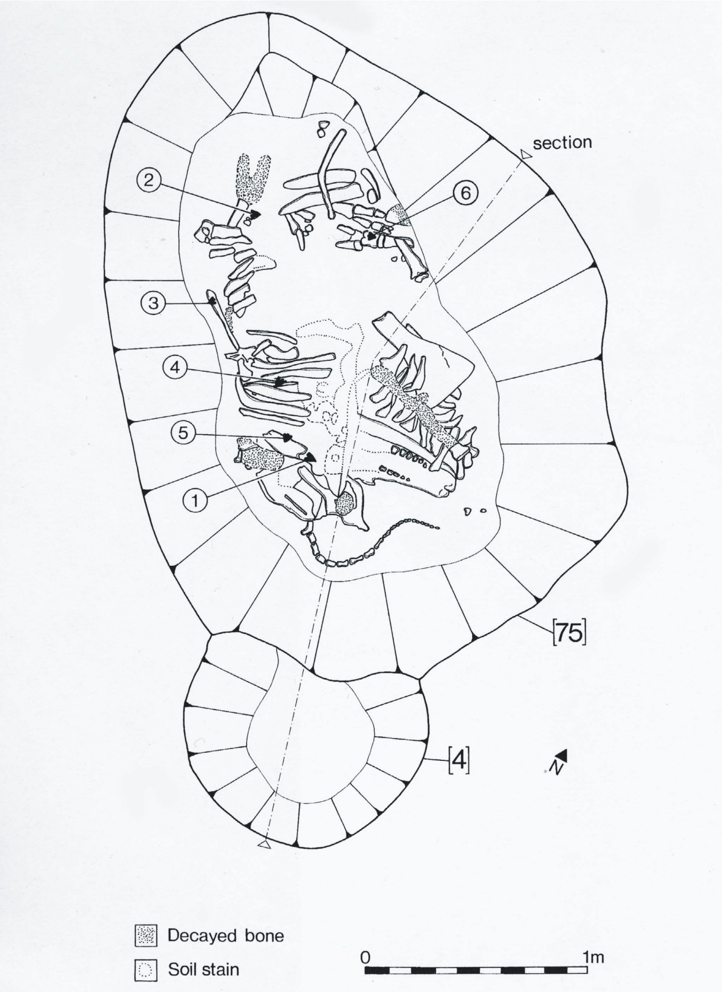

Figure 11.2: Plan showing Grooved Ware pit [4], the aurochs deposit and arrowheads within pit [75].

Pre-aurochs fills

The primary (pre-aurochs) fills, [104], [103], [102] and [86], comprised a sequence of what were described as 'black greasy loamy clays' [104] sealed by dirty brickearths mixed with 'greasy ashy clay' [103] and dark grey staining [102] and [86]. Finds were few but comprised a moderate quantity of fired clay from [103] and [102], a handful of struck flints including two cores from [103], two small abraded sherds of Grooved Ware from [86], and a single barbed and tanged flint arrowhead (no 5) from the top of fill [85].

These layers appear to represent the results of a combination of silting, slumping and trampling prior to the deposition of the animal remains. The length of time between the digging of the pit and the deposition of the aurochs cannot be determined. However,

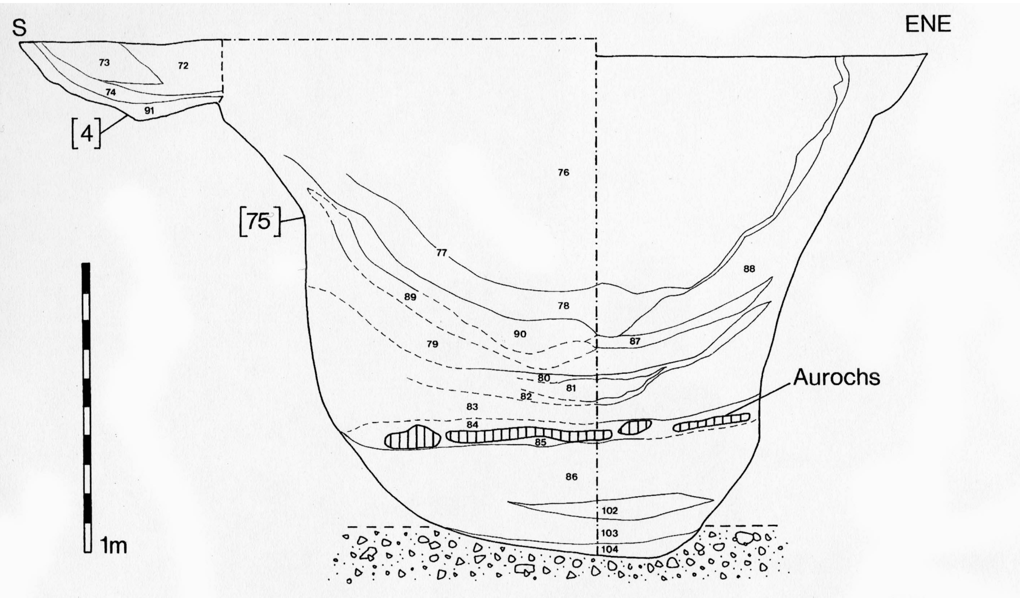

Figure 11.3: Composite section through Grooved Ware pit [4] and aurochs pit [75] following the removal of up to 0.50m of topsoil and subsoil. Note that pit [75] broaches the underlying Taplow terrace gravels.

experience indicates that it would have been almost wholly dependent on the local weather conditions: in wet weather the slumping could have occurred virtually overnight but a longer period would have been required in drier conditions. This raises an interesting point: was the pit specially prepared to receive the aurochs deposit or does it represent the serendipitous appropriation of an open feature dug for other purposes?

Aurochs deposit

The remains of an aurochs were then deposited over layer [86] with 'three [of the] feet … on the northern side' of the pit resting on fill [85] and the ribs on the southern side lying half in [85] and half in the overlying fill [84] (Figure 11.4). Furthermore, the tail and part of the sacrum of the beast lay banked up against the wall of the pit at a slightly higher level and within fill [83] (Figure 11.5). To judge from their dark colour, fills [86] – [84] may have been at least partly derived from the decay products of the animal carcass. Fill [83] could be seen as a deliberate attempt to cover the decomposing remains; its markedly concave profile as recorded in section may have resulted from the compaction of the fills within the pit or more likely the decomposition and collapse of the carcass itself. Either way the decomposition products created a micro-environment of their own, and this, together with the depth at which the remains lay, probably explains the otherwise unexpected preservation of the skeletal remains in the pit.

Finds from these secondary (aurochs) deposits were few: one small abraded sherd of Grooved Ware from [84] and five barbed and tanged flint arrowheads from [85]. The arrowheads appeared to concentrate in the area of the animal's hindquarters.

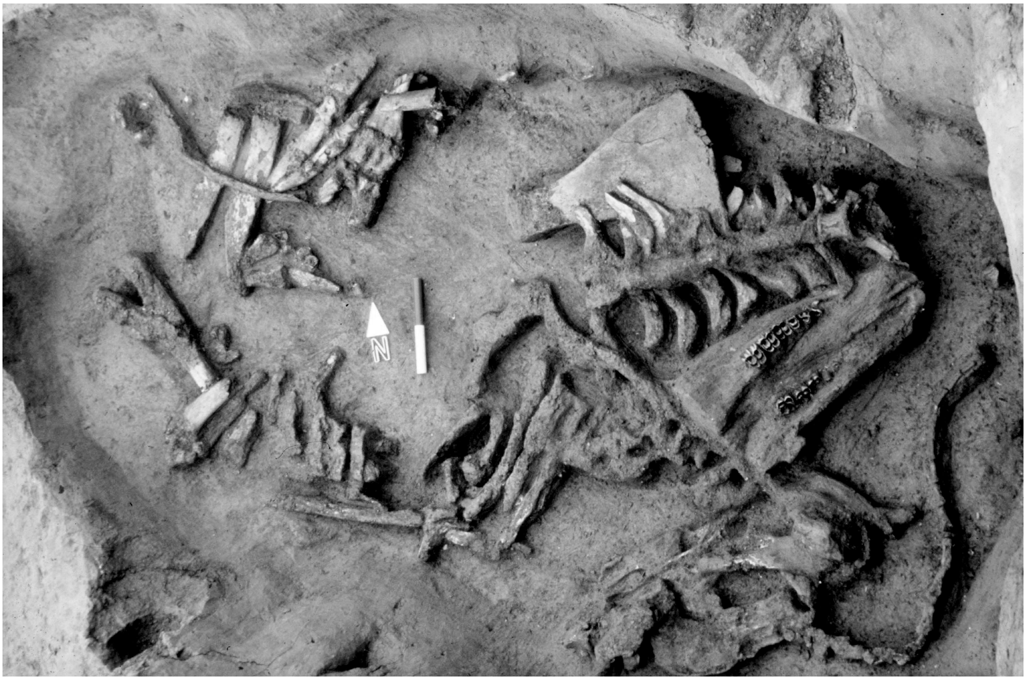

Figure 11.4: The aurochs deposit within pit [75], as excavated. Note that three ribs have already been lifted in the area to the left of the visible arrowhead (no 1). (Photograph: Jan Scrivener, Museum of London.)

Post-aurochs fills

Above fill [83], the profile of the pit assumed a more eroded appearance and the succeeding tertiary (post-aurochs) fills appeared to be a combination of deliberate backfilling, natural slumping and/or slow weathering. The majority of this material comprised brickearth: some of the deposits are recorded as being dark brown in colour [80], [87] and [89], or dark and 'charcoally' [77] and [78]. The ultimate fill [76] comprised orange-brown brickearth.

Finds from these tertiary (post-aurochs) fills included groups of abraded sherds of Grooved Ware (again Clacton sub-style) from [78] and [76], together with a large quantity of fired clay from fill [77] and smaller amounts from fills [79], [80], [82] and [87]. Struck flint was also present in some quantity from fills [76], [76/78], [77] and [78]; this included a number of scrapers together with a single transverse arrowhead from [76]. It seems likely that much of this material derived from the fill of the adjacent pit [4]. (A further pit, [6], was noted in section some metres to the north of pits [4] and [75]. This measured at least 1.0m north-south by 0.40m in depth and was empty apart from a single barbed and tanged flint arrowhead recovered from a charcoal spread at its lip).

The animal remains

The animal bones from the aurochs deposit within pit [75] were in poor condition. Even

Figure 11.5: Pit [75] looking south with the aurochs deposit in situ. The tail and part of the sacrum are lying banked up against the furthest (south) wall of the pit, above which lies the already excavated Grooved Ware pit [4]. (Photograph: Jan Scrivener, Museum of London.)

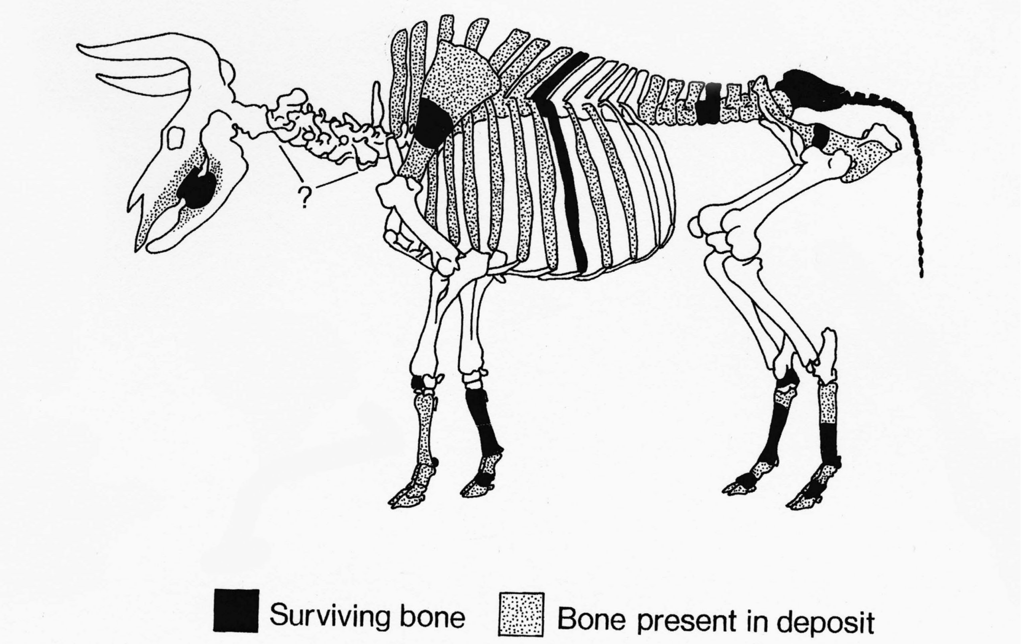

Figure 11.6: Diagram of the Holloway Lane aurochs showing surviving bone (solid) and bone likely to have been present within the original deposit (stippled).

the apparently more robust pieces such as the metacarpals and metatarsals had the consistency of soft soap, and proved difficult to retrieve. The tooth rows were little more than shells of enamel. Much of the other material visible in the photographs comprised fugitive soil stains. However, observations made during excavation by Barbara West and subsequently on the surviving bones by Jane Sidell and Alan Pipe confirmed that they belonged to a single animal and that it was of large size, consistent with its identification as *Bos primigenius*, the native wild ox or aurochs (see Grigson 1978; Clutton-Brock 1981, 62–5).

The surviving bones comprise the caudal vertebrae, a thoracic vertebra, a lumbar vertebra, sacrum, scapula, metacarpal, carpal, metatarsal, tarsal, sesamoid, second phalanx and the upper and lower teeth (Figure 11.6). They do not include the pelvis or innominate, although this was visible in the photographs (Figure 11.4). The surviving ribs, scapula and metatarsal bones all derive from fragmented parts of the bone midshaft, so it is not possible to assign them to the left or right side.

The surviving identifiable bone has at least slight surface damage. Examination under a binocular microscope has revealed no visible traces of butchery marks nor of any signs of gnawing or burning though, given the small proportion of bone available for study (Figure 11.6), these observations are of limited value. Despite the presence of the arrowheads, and of macro-fractures on two of them (see below), there were no obvious lesions on any of the bones.

The following fusion and dental evidence was noted, with ages based on those of the domestic ox. The distal metacarpal was fused, indicating an animal of at least 2.0–2.5 years (Amorosi 1989, 64); the thoracic vertebral body epiphyses were unfused indicating an animal of less than 8 years (Amorosi, 1989, 66); the lumbar vertebral body epiphyses were unfused indicating an animal of less than 2.5–4.0 years (Amorosi 1989, 67); the third molars show light wear on the second cusp but none on the third suggesting an animal of 2.5–3.0 years (Amorosi 1989, 56). The evidence for age at death therefore indicates a young adult animal of two to three years. The sex was indeterminate.

In view of the aggressive burial environment, care needs to be exercised in any assessment of the significance of the absence of particular bones from the deposit such as the upper leg bones and the horn cores. Furthermore, the position of the remains in the pit clearly indicates that the carcass had been dismembered. However, the semi-articulated nature of some of the bones, such as the pelvis and tail, suggests that the deposit was made while the flesh and sinews were still present.

The arrowheads

The six arrowheads are of mottled grey-brown flint with fine bifacial retouch and have flat or slightly convex bases and squared-off barbs and tangs (Figure 11.7). They conform to Green's (1980, 51 and fig. 46) 'fancy' 'Conygar Hill' type. The largest, no 1, measures 41mm in length, 28mm in breadth across its barbs, is 4mm thick and, although broken, weighs 3.80g; the smallest, no 2, measures 29mm in length, 21mm in width across its barbs, is 3mm thick and weighs 1.54g. Two (nos 3 and 5) bear clear traces of macro-fractures at their tips and damage to their barbs/tang, while the largest and finest (no 1) is missing its tang – as though a botched attempt had been made to recover it from the carcass.

It is perhaps possible to regard the arrowheads as comprising three matched pairs defined by their general size and overall shape, as follows: 1 and 4, 2 and 6, 3 and 5 (Figure 11.7). Analysis has identified microscopic traces of animal fats and beeswax on their surfaces (John Evans pers comm). The former is hardly a surprise given the nature of the find; it is conceivable that the latter formed a constituent part of the mastic used to secure the arrowheads to their wooden shafts.

DATING AND OTHER LATE AUROCHSEN

In view of the fact that 'there is absolutely no hope of a date [from the aurochs bones themselves] with current technology' (Alex Baylis pers comm), it is the stratigraphic relationship with Grooved Ware pit [4] and the morphology of the arrowheads themselves that offer the best means of dating the deposit.

Grooved Ware is a firmly third millennium BC phenomenon, as Paul Garwood (1999, 152) has recently shown. Furthermore, he suggests that the dates for the Clacton sub-style cluster in the earlier part of the millennium. No radiocarbon date has yet been secured for Grooved Ware pit [4], and it is likely that the abraded sherds of Grooved Ware (predominantly Clacton sub-style) in pit [75] were also introduced from pit [4]. Other

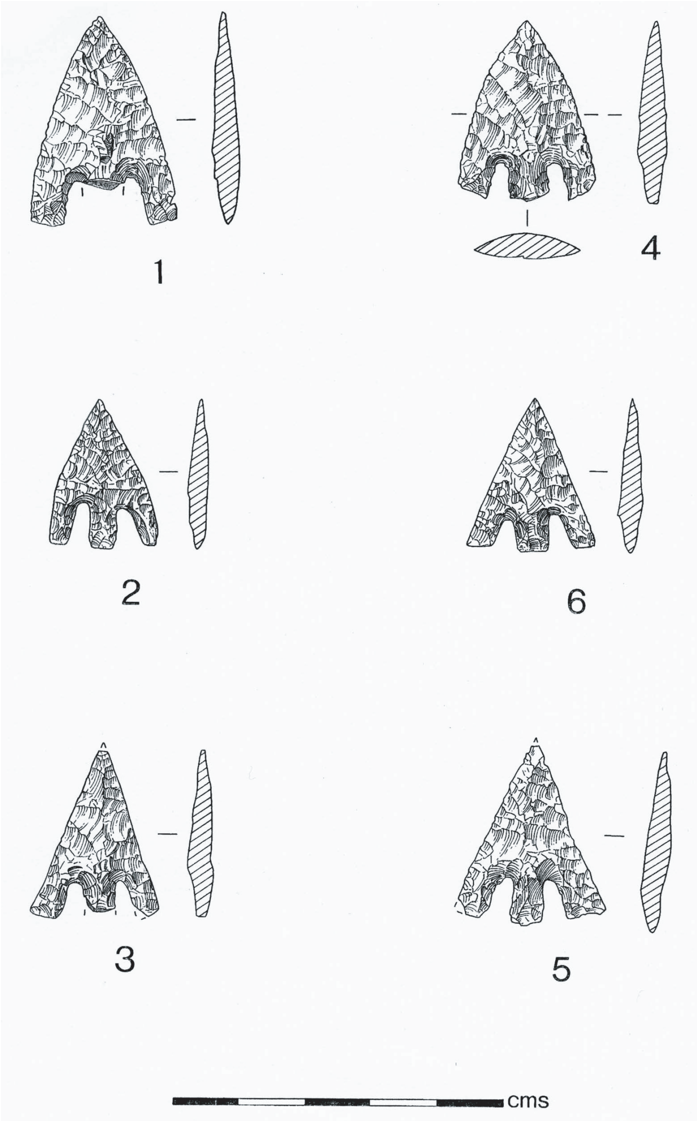

Figure 11.7: The six barbed and tanged flint arrowheads from the aurochs deposit. No 1 is missing its tang; Nos 3 and 5 have sustained damage to their tips and around their barbs/tangs; No 4 is markedly plano-convex in section.

Grooved Ware pits from Holloway Lane (including one containing sherds of Durrington sub-style) have produced dates falling broadly within the mid-third millennium BC.

According to Green (1980, 138–9 and table VI.20) 'fancy' Conygar arrowheads have a few Beaker associations, but many more Food Vessel associations. At least one and possibly two of the three complete arrowheads associated with a Beaker-type burial at

Stonehenge were of Conygar type (Evans 1984); this burial has a radiocarbon date of 3715+/-70BP (2340–1930cal BC at 95% confidence) BM-1582 (Cleal *et al* 1995, 455–6). Barbed and tanged flint arrowheads apart, virtually no Beaker-related material is known away from the Thames and its floodplain in west London, while Food Vessels have yet to be recognised anywhere within the London region.

Taking these two strands of evidence together, a generally final Neolithic/earlier Bronze Age date for the aurochs deposit looks to be the most appropriate. If so, the west London animal is likely to have been a relatively late insular survival, for aurochsen are thought to have gone extinct in Britain during the Bronze Age (e.g. Tinsley 1981, 219). It is not unreasonable to suggest that this was due to a combination of habitat loss and trophy hunting, of which the present deposit is a prime example. The latest British aurochsen of which we are aware are those from Charterhouse Warren Farm in Mendip (dated to 3245+/-37BP (1620–1430cal BC at 95% confidence) BM-731; Burleigh and Clutton-Brock 1977; Yalden 1999, 109), and Porlock Weir, Somerset (dated to 3300+/-55BP (1740–1450cal BC at 95% confidence) AA-30681, (Vanessa Straker pers comm).

However, in mainland Europe, aurochsen survived into the early modern period (see Pyle 1994; Hemming 2002) (Figure 11.8) through a combination of chance, the existence of suitably secluded habitat, and (in Poland) by active royal protection. The last survivor,

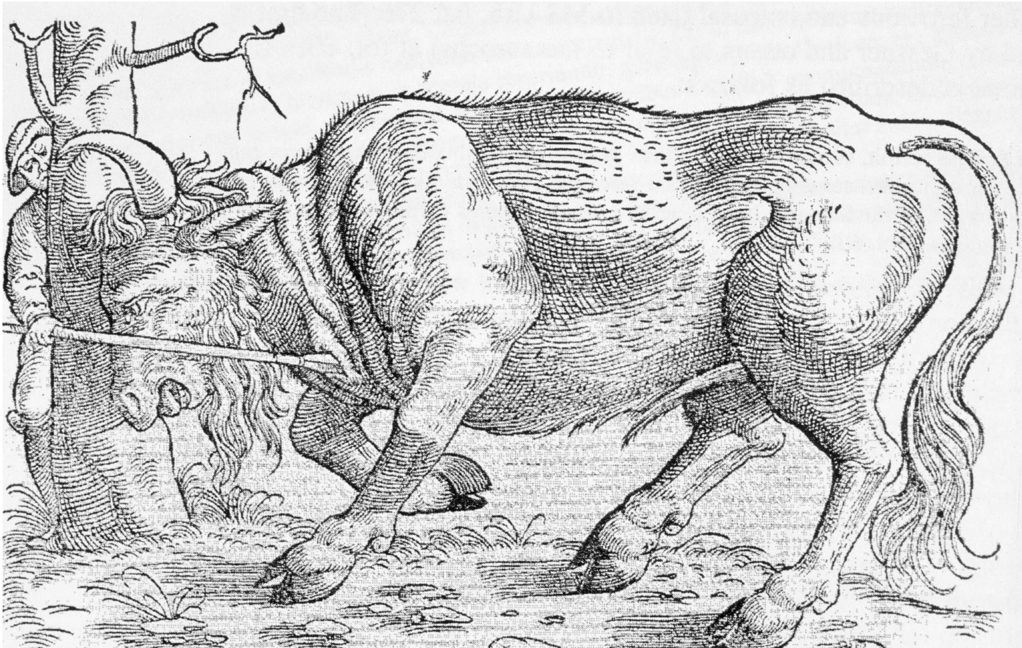

Figure 11.8: Woodcut of a charging aurochs being speared by a hunter taking cover behind a sturdy tree, from Conrad Gessner's Historia Animalium: Liber I. De quadrupedibus viviparis *(from Pyle 1994, 280, fig. 5).*

an elderly cow, was reported to have died a natural death in the Jaktorówka Forest in 1627 (Lydekker 1912, 52 and 55). That these last survivors exerted a considerable influence on the psyche of the early modern populations of Europe is underlined by the folktales and folklore that surround them (e.g. Hemming 2002). These usually hint at 'otherworldly' or 'fairy' connections, and something of this may also be reflected in the deposit considered here. The Old English Rune Poem of ninth century Germanic origin describes the aurochs as 'fierce and immoderately horned, a very dangerous beast, it fights with its horns, renowned moor-walker – it is a brave creature' (Griffiths 1996, 205; Dickins 1915; see also Elliott 1959, 46).

Wild animals in general and aurochsen in particular are rare in Neolithic and Bronze Age faunal assemblages (but see Serjeantson in Cleal *et al* 1995, 450), though complete and semi-complete aurochsen have turned up on occasion as stray finds, as for instance in the one from Littleport, Cambridgeshire (Shawcross and Higgs 1961) and the two beasts from Somerset mentioned above. The present deposit apart, few remains of Holocene aurochsen have been recorded from the London region hitherto. There are parts of one or two individuals represented amongst the large Neolithic faunal assemblage from Runnymede Bridge (Serjeantson this volume) and possible others from the causewayed enclosure at Yeoveney Lodge, Staines (Robertson-Mackay 1987, 123), for example. These are complemented by several undated aurochs radii which have been deliberately perforated which were found in the Thames at Kew Bridge and Hammersmith and are now in the collections of the Museum of London (Acc nos A27555 and C707). A further radius fragment bearing incised herringbone decoration, found in the river at Hammersmith, is in the British Museum (Acc no 1927.7–73; Lawrence 1929, 81). Of most interest in the present context perhaps is the presence of a polished bone scoop made from an aurochs tibia in a Grooved Ware pit located just off the Heathrow terrace at Lower Mill Farm, Stanwell (Jones and Ayres 2004).

HUNTING AND ARCHERY IN THE FINAL NEOLITHIC/EARLIER BRONZE AGE

In terms of their disposition within the Holloway Lane aurochs deposit itself, four of the flint arrowheads appeared to concentrate in the area of the ribs and pelvis and the remaining two lay amongst the bones of the lower legs. As noted above, two of those from the ribs and hindquarters (nos 3 and 5) have sustained macro-fractures, presumably through sudden impact with the bony portions of the skeleton (e.g. Fischer *et al* 1984), though, as noted earlier, the bone was too poorly preserved for an impact to be confirmed. It would be perverse in the circumstances to regard the arrowheads as anything other than the cause of death, though given the size of the beast this is unlikely to have been instantaneous. Rather, the positions of the arrowheads relative to that of the bones suggests that the animal was stalked, ambushed from the rear, wounded, and then pursued until it eventually succumbed to a combination of blood loss, shock and exhaustion (Humphrey Case, pers comm) (Figure 11.9). It is possible that this occurred at some distance from the pit in which the remains were eventually placed, necessitating the dismemberment of the carcass for ease of carriage. Assuming, for the sake of argument,

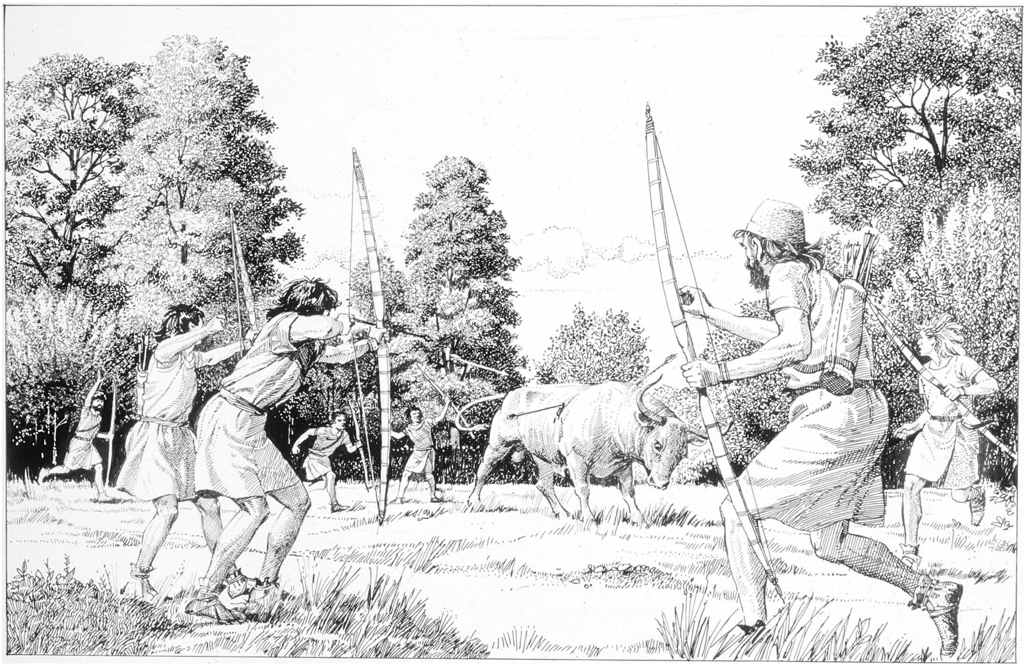

Figure 11.9: Reconstruction of the aurochs hunt by Derek Lucas. A hunting party has flushed the forest-dwelling aurochs out into the open, and is now attacking the aurochs with bow and arrow to devastating effect. The archers are depicted using Neolithic Meare Heath-type bows, but the exact form that the bow took during the Late Neolithic/ Early Bronze Age remains unclear (see Piggott 1971, 89–92 and Gdaniec 1996, 656).

that the pit was specially dug to receive the remains, this could account for the delay which allowed the primary (pre-aurochs) fills to accumulate.

A similar 'strike and follow' strategy appears to have been employed on a late Mesolithic aurochs at Prejlerup, Denmark, which was discovered, fully articulated, with no fewer than fifteen microliths embedded in its hind-quarters (Aaris-Sorensen 1984, fig. 16; see also Fischer *et al* 1984, 39–40). The articulated nature of the skeleton suggests that, in this instance, the beast had eluded its hunters to die alone in a small bog. Moreover, a healed lesion with an embedded flint chip on one of the ribs of a second fully articulated Mesolithic Danish aurochs from Vig further underlines the difficulties of successfully stopping such a large animal (Hartz and Winge 1906; Fischer *et al* 1984, 39). According to Noe-Nygaard (1974, 239–40), the best place to aim for a killing shot is just behind the shoulder blade, where the chance to hit the heart is greatest. A shot at the throat and lung is also considered fatal, though more risky for the hunter (see Figure 11.8).

Deaths of humans and animals directly attributable to bow-shots are surprisingly rare, despite the relative frequency with which archery gear is placed in graves. This latter point led Humphrey Case to argue (2004a; 2004b, 202–4) that the provision of hunting gear was overtly symbolic and primarily intended to equip favoured 'archer-envoys' in the Otherworld with the means of protecting those left behind in this. In support of this notion he noted that the so-called Amesbury Archer was permanently lame, and unlikely to have been able to deploy a bow effectively when alive (Case 2004b, 202; Fitzpatrick 2003, 148). A similar situation appears to have obtained with regard to the elder of the so-called Boscombe Bowmen (Fitzpatrick 2004, 12).) A miniature antler bow buried in a deep pit at Isleham may have been imbued with rather similar symbolism (Gdaniec 1996); likewise too perhaps the bow-pendants identified by Piggott (1971).

Symbolism notwithstanding, the present deposit also demonstrates the very practical uses to which archery could be put on occasion, as indeed do a handful of final Neolithic/ earlier Bronze Age human burials. These include a male inhumation from Barrow Hills, Radley (Barclay and Halpin 1999, 138) which has a date of 3360+/-50BP (1770–1520cal BC at 93% confidence, BM-2700) and another young male, part of a multiple inhumation deposit from Wassenaar, Netherlands (Louwe Kooijmans 1993), both of whom were found with single, impact-fractured barbed and tanged arrowheads in the thoracic cavity. The male burial from Stonehenge, mentioned already, showed even clearer evidence of dramatic trauma in the form of the tips of two flint arrowheads lodged in the fourth left rib and in the first segment of the mesosternum, respectively (Evans 1984, 15–17 and figs. 12–14). Green (1980, 178–9) has summarised the few earlier instances of death by bowshot. To these can now be added, infamously, the Italian iceman 'Ötzi' (Pain 2001, 12), the latter dated to the late fourth millennium BC, for x-rays have shown that he has a single arrowhead embedded in his shoulder. Together with the west London aurochs, these burials constitute some of the latest identifiable victims of hunter-archers; shortly thereafter prestige presumably transferred to those who successively wielded metal spears, rapiers and swords.

CONCLUSIONS

Turning finally to the wider local landscape setting, the huge amount of work that has been undertaken on the Heathrow terrace since 1987 allows considerable light to be shed on the way in which the landscape was being manipulated and transformed. As a result we can reasonably confidently suggest that by the final Neolithic/earlier Bronze Age large parts of the terrace had begun to evolve from a communally exploited and locally open Neolithic monumental landscape, into a cleared Bronze Age agricultural landscape eventually dominated by ditched/hedged fields, droveways, waterholes and small settlements of roundhouses (e.g. Barrett *et al* 2000; 2001; Crockett 2001).

Set against this background, the Holloway Lane deposit stands out prominently, and not just because it comprises a slaughtered and dismembered aurochs. Spatially and chronologically, the feature in which it was placed occupies something of a liminal position. Spatially, it lies towards the northern edge of the Heathrow terrace, away from the Stanwell monument complex to the south west; also it occupies the highest part of the terrace between the valleys of the Colne to the west and the Crane to the east. Chronologically, it represents the culmination of a millennium or more of Neolithic pit digging on the terrace, and its close physical relationship with the demonstrably earlier Grooved Ware pit [4] may not be coincidental either. Furthermore, in terms of its size, scale and likely date it presages a series of large Middle and Late Bronze Age waterholes dug down into the gravels elsewhere on the terrace, as at Perry Oaks. Ironically, not only were many of these probably intended to water domestic cattle, but many also seem to have acted as foci for the deposition of placed deposits, some of which appear to reference the distant (ancestral) past (Barrett *et al* 2001, 224).

Widening the focus a little further still, there is a mismatch evident between the sequences recovered from the Heathrow terrace and those recovered from the west London Thames and its floodplain to the south and east. In the third millennium BC, for example, placed deposits of Grooved Ware are relatively plentiful on the terrace but virtually absent from the Thames and its floodplain. By the later third and early second millennium BC the picture appears to have been reversed: Beakers are absent from the Heathrow terrace but present, albeit in low numbers, along the river and its floodplain in west London (e.g. Celoria and Macdonald 1969, 37 and 43). It is at just about this time that the long established monumental landscape begins to be parcelled up into a more ordered landscape of fields and droveways, and it is at just about this time that the aurochs deposit was probably made.

In this context the deposition of the Holloway Lane beast could suggest, in the phrase of Julian Thomas, a 'conscious anachronism' (Thomas 1996, 229). In other words it is possible that the new uses to which this location was increasingly being put were legitimised by the incorporation of a totemic and possibly 'Otherworldly' reference back to earlier times (something also occasionally glimpsed in the later waterhole deposits). Furthermore, the aurochs deposit may encapsulate a range of other complicated and not necessarily complementary messages: the traditional importance of cattle to the subsistence economy, the apparently careful separation of the remains of wild and domesticated animals, and the symbolic and occasionally practical importance of hunting and archery. In effect, the deposit makes flesh the tensions inherent in socialising a wildscape.

That the remains of dead aurochsen were being used to assert similar claims to ancestry, power and territory elsewhere can be shown by the deposition of a single aurochs skull amongst other domestic cattle skulls in an Early Bronze Age round barrow at Irthlingborough in Northamptonshire (Halpin 1987; Davis and Payne 1993, 20), for example, and indeed nearly three millennia later, by the incorporation of imported silver-mounted bull aurochsen horns in high status pagan Anglo-Saxon burials such as those at Taplow and Sutton Hoo (Oddy and Grigson 1983). These objects find an echo in a passage from Julius Caesar (*De bello Gallico* VI, 28) concerning the collection of aurochs horns as a rite of passage by young men of the Germani in the 1st century BC (also discussed by Elliott (1959, 50–1)). The passage in Caesar is worth setting out in full: 'A third species [of rare animals] is that which they call aurochs. These are somewhat smaller in size than elephants, and are like bulls in appearance, shape, and colour. Great is their strength and great is their speed, and once they have spied man or beast they do not spare them. These the Germani capture skillfully in pits; and their young men harden themselves by such labour and exercise themselves by this kind of hunting. And those who have slain most of the beasts bring the horns as evidence thereof to a public place and win great fame. The animals, even if caught very young, cannot be tamed or accustomed to human beings. Their horns differ very much from those of our oxen in size and shape and kind. The Germani collect them eagerly, encase their edges in silver, and use them as beakers at their most magnificent banquets.' However, there is no need to invoke such exceptional parallels distant in space and/or time for the Holloway Lane deposit. Instead, explanations can be sought much closer to home: in the aspirations of local communities seeking to come to terms with changing circumstances – as a communal Neolithic monumental landscape was gradually giving way to another geared more to the specific requirements of agriculture. In short, the landscape of the Heathrow terrace was being tamed, and it was one in which wild aurochsen (and hunter-archers) had a vanishingly small part to play.

ACKNOWLEDGEMENTS

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Chapter 12

Animals in the Neolithic: A Research Agenda? No Thanks.

Umberto Albarella

The Neolithic period occupies a special place in archaeological research and in people's fascination with the past. The characteristic that makes the Neolithic so unique among other periods of our history is that its beginnings coincide with the origins of the domestication of plants and animals. This great innovation modified people's ways of life arguably as no other. However, like those artists condemned to be remembered for one famous masterpiece, while the rest of their work is neglected, the Neolithic has often been restricted to these important cultural changes that define its onset. Thousands of years of subsequent developments have somehow played second fiddle. It is understandable that our interests have been concentrated on the key steps in the evolution of human societies, and it would therefore be wrong to stigmatise this bias excessively. Nevertheless, Neolithic people left us traces of a great diversity of activities, which go well beyond the origins of farming, and each represents a potential mine of information about prehistoric life, all equally worthy of attention.

This collection of articles on the interaction between people and animals in the Neolithic has many virtues that I will discuss in this brief commentary. One is that it presents case studies that range widely across the duration of the Neolithic period. No paper focuses on the intensively researched Mesolithic/Neolithic transition, though some of them (Boyle, Halstead, Miracle) discuss it on the basis of the evidence for later stages of the Neolithic. Most papers deal with issues that span the Neolithic period, and those that have a greater chronological focus, concentrate on the middle Neolithic (Serjeantson), the late Neolithic (Isaakidou, Cotton *et al.*) or both (Boyle, Miracle), but none with the period of origins of food production – the early Neolithic. Interestingly enough the two papers by Isaakidou and Cotton *et al.* tackle the much less commonly discussed upper boundary of the period – the transition between the Neolithic and the Bronze Age. The approach is, however, very different, with Isaakidou focussing on economic change in Crete and Cotton *et al.* with modifications in the use of the landscape in southern England. I believe that this chronologically diverse representation reflects the vitality of Neolithic research and demonstrates that the bias in research focus between the earlier and later parts of the period is being gradually redressed.

Equally commendable is the fact that this volume makes good use of the great diversity of skills, approaches and knowledge that characterise archaeological research. In a book dealing with prehistoric human-animal relations it is expected that zooarchaeologists would write the lion's share of the contributions. Though this is certainly the case here, it is refreshing that there is also a substantial input from archaeologists with different backgrounds. This results in an interesting diversity of approaches and viewpoints, with subjects such as the history of archaeology (Field), the integration of plant and animal studies (Halstead, Dineley), ethnography (Halstead) and patterns of deposition (Pollard, Cotton *et al.*) playing an important complementary role to the analysis of animal remains.

Even within zooarchaeology many methods and lines of evidence are considered, which ensures that the full potential of the discipline is exploited. Occurrence and frequency of species play an important role in the research questions raised by a number of contributors (Boyle, Zeiler, Halstead, Miracle), but it is particularly the analysis of kill-off patterns in domesticated livestock that plays a major role for our understanding of Neolithic life. This is analysed in some depth by Isaakidou, in order to define the characteristics of Neolithic life and discuss how they compare with Sherratt's suggestion of a secondary products revolution (Sherratt 1983). Miracle and Serjeantson throw further light on this subject by discussing the mid and late Neolithic evidence from other parts of Europe. An important issue that emerges from the analysis of ageing patterns, particularly in the papers by Halstead and Miracle, is that we have not yet sufficiently explored the potential of using animal remains for detecting seasonal activities. Though it has many interpretative difficulties, the detection of seasonal patterns can be very important for our understanding of patterns of formation of faunal assemblages. These may reflect cultural and economic preferences but also availability and profitability of different resources at different times of the year.

Other lines of zooarchaeological evidence that seem to be extremely productive include the evidence deriving from butchery marks (Miracle and Serjeantson in particular), pathological conditions (Clark, Isaakidou) and – most innovatively – animal diet (Halstead, Dineley) and organic residues from pots (Serjeantson, Dineley). Other areas of study, such as isotopic and biomolecular analysis, which have recently made rapid progress in providing further important information about our prehistoric past, are not represented, though the results are referred to in a number of papers. This is a pity, but the approaches are sufficiently diverse for the book to be regarded as a significant sample of the directions that Neolithic research in human-animal interactions is taking nowadays.

The use of a biometrical/morphological approach to the study of animal bones, here adopted in only one paper, that by Clark, deserves a separate comment. In the early studies of domestication, biometry was almost the only method of study used, so it has suffered the fate of having been snubbed by both processual and post-processual archaeologists, with both schools regarding it as terribly old fashioned. I have discussed elsewhere the misjudgement in this rejection (Albarella 2002), but it is interesting to see that the legacy of this attitude has not completely gone away. This is despite the fact that the power of modern computerised analysis has made biometrical analysis far easier than it used to be. I originally became interested in biometry because I wanted to understand better the role that wild fauna played in Neolithic economies and societies and realised that that this would have been difficult to understand without being able to assess relative proportions of wild/domestic cattle and pigs. These forms are difficult to distinguish from each other and the best tool we have for their discrimination is their metric analysis at population level. In her – otherwise impressive – analysis of the contribution of wild animals to human life in the European Neolithic, Boyle should have perhaps taken this question into account.

A further reason why this book is successful is that it does not fall into the trap of adopting an artificial dichotomy between an economic as opposed to a social archaeology. The emphasis placed on either one or the other of these aspects has generated much – generally fruitless – debate in the last few decades. An accusation which has often been addressed to zooarchaeologists is that they have interpreted their evidence exclusively on the basis of environmental or economic factors – what Miracle calls here a 'calorie fetish and focus on subsistence economies' – but it has been motivated more by a desire on the part of the critics to enhance their own sphere of influence within archaeology than by any real concern for the hypothetical bias (Albarella 2001). In my experience, most zooarchaeologists – even those less inclined to a theoretical approach – have always been aware of the social and ideological sphere of the human world and have not been shy of interpreting their evidence on the basis of ritual or social patterns of behaviour (e.g. Davis and Payne 1993; Wilson 1999; Lauwerier 2002). Nonetheless, it would be foolish not to accept that an excessive interest in taphonomic histories and utility indices has occasionally led to social and cultural perspectives being lost from sight. Most of the contributors to this book remain unchallenged by these potential problems. I suspect that this is not because they have embraced a 'new *modus operandi*' (see Miracle's paper) – the old *modus operandi* was just an artificial construct – but simply because they all have the necessary awareness that social and economic issues are so entangled that their interpretations cannot be tackled separately. Most papers in this book do take the whole range of environmental, economic, social and ideological factors into account in their interpretations. It is perhaps worth mentioning in particular Serjeantson's attempt to interpret the archaeological assemblage from Runnymede as possible evidence of feasting activities and Pollard's suggested association of different animals with symbolic meanings based on the analysis of funerary practices. Even Clark, who bases her paper on traditional morphological analysis, takes the ceremonial element into account in her interpretation of possible hybrid forms of Neolithic canids. It is important that various lines of interpretation are taken into account because they make sense in that particular archaeological context, rather than to reassure or please any potential readership, or show an awareness of social and ideological issues at all costs. There are points in this book where the writers are almost apologetic for tackling issues concerning subsistence and environment. There is no need for that: interpretations must be the product of an intellectual curiosity for the past and an honest process of analysis, not of a perceived orthodoxy of thinking.

Having dealt with the range and breadth of approaches that characterise this book I would like to use the second part of this commentary to highlight some of the areas of Neolithic research to which various papers provide a particularly important contribution. There are endless potential readings of the various lines of investigation presented here, and the choice of subjects possibly reflects no more than my personal interests.

NEOLITHIC LIFEWAYS

The European Neolithic witnessed a great diversity of life styles, though there is a general perception that once farming had been introduced to a particular area, Neolithic societies started relying on the cultivation of crops and husbandry of animals as their almost exclusive source of subsistence. This undoubtedly holds true for some areas of Europe but it is a phenomenon that should not be entirely generalised, as several contributions to this book demonstrate. An interesting contrast emerges between the south and the northwest of Europe. Halstead and Miracle underline the fact that in the Aegean and north Adriatic areas most Neolithic assemblages are dominated by the bones of domestic animals. The beginning of the Neolithic seems to have been abrupt in these regions, with animal domestication – including species which were certainly imported such as sheep and goats – rapidly taking over from hunting. A similar scenario has also been reported for the southern Adriatic (Bökönyi 1983) and the western Mediterranean (Vigne 1999). The fourth millennium BC in England seems to witness a similar phenomenon of rapid economic change. Pollard regards this situation as 'peculiar' but we have seen that is attested in other European areas too. The situation presented by Boyle for Western Europe, Zeiler for the Netherlands and Miracle for some north Italian examples is different. It is, however, unclear whether this represents a difference in space or time. Most of the examples of the abundance of wild fauna in Neolithic contexts belong to the middle and late Neolithic rather than the earlier part of the period, a trend also recognised by Pollard for Britain. Boyle mentions a number of French sites with abundant wild animals, of which the most remarkable is probably the middle Neolithic site of Rocadour (Lesur *et al.* 2001) which seems to have relied almost exclusively on hunting. In the Netherlands the predominance of wild or domestic fauna seems to depend mainly on environmental conditions (Zeiler in this volume and 1997), whereas in Italy, as in France, most sites with a predominance of wild fauna belong to the mid/late Neolithic. Examples of this are Molino Casarotto (Jarman 1971), Cornuda (Riedel 1988), Razza di Campegine (Riedel 1990) and Mulino S.Antonio (Albarella 1987–88).

The information that we have so far is probably insufficient to reconstruct a general European trend, but there are hints that we are not simply dealing with the persistency of a hunter-gather style of life, but rather with a possible return to hunting in later Neolithic cultures. The consequences of this, for our understanding of the mechanisms of cultural evolution, are enormous. I suspect that our interpretations of the transition to farming have so far been biased by an element of evolutionary determinism. As long as we see farming as a superior economic strategy we will have to assume that once introduced this new system rapidly replaced hunting and gathering and any society that managed to hang on to the previous system of life was inevitably marginalized and destined to disappear within a few generations. It is perhaps with such scenario in mind that Pollard interprets the abundance of wild animals at Coneybury Anomaly as an indication of a 'transitional economy' – seemingly implying the existence of an intermediate stage in the inevitable progress from a primitive form of food procurement (hunting) to a more sophisticated one (farming). Similarly, Boyle sees the 'persistency' of hunting societies in the later part of the Neolithic as the possible result of a response to harvest failure and climatic change. Hunting is therefore seen mainly in negative terms, almost as a buffer option – when farming fails, people have no other choice but resort to hunting. Both authors may well be correct in their interpretations, but I wonder whether we should not consider the possibility that hunting may have represented – given the right ecological conditions – a deliberate cultural choice and a perfectly viable and desirable option for some Neolithic communities. Boyle alternatively suggests that in the later Neolithic hunting may have played a 'recreational' role. This once again seems to imply that at this stage of human cultural evolution hunting is not expected to represent a sustainable economic system.

If we rid ourselves of the idea that hunting represented an economic system only practiced by marginal communities in periods of crisis, we can perhaps interpret patterns of activities in the European Neolithic in a more dynamic way. A range of different activities may have been in place in the Neolithic, with different communities adopting a diversity of strategies according to their environmental settings, surrounding human communities, cultural backgrounds and seasonal movements. A complex system of interactions based on variable combinations of hunting, foraging, farming and trade has for instance been suggested for the Neolithic of central Africa (cf. Gifford *et al.* 1980) and the fact that such a model can be reflected in the reality of human life is confirmed by several ethnographic examples (Blackburn 1970; Newman 1970). There are also attested cases of pastoral communities returning to a predominantly hunting economy (e.g. Ingold 1974). I see no reason why such models cannot have a role to play in our interpretation of the middle and late Neolithic in at least some areas of Europe. It is likely that people interacted with animals in many different ways and if predation and stock-breeding represent two useful categories for our understanding of the past, there is little doubt that interactions were more complex than this, with a multitude of different possibilities also in place.

The contributions by Halstead, Miracle and Pollard add useful evidence and thought to our understanding of Neolithic lifeways and the interactions between different communities. Halstead's key point – strongly backed by his expertise in Greek ethnography – is that despite the abundance of the bones of domestic animals from Neolithic sites in Greece, animal husbandry probably played a minor role in an economy which was mainly geared towards cereal production. This could explain the great predominance of sheep and goats, which are regarded as causing less damage to cereal cultivation than pigs and cattle, and also perhaps even the dearth of wild fauna, which would be expected among communities strongly oriented towards a vegetarian diet. Miracle adds to the complexity of the situation by suggesting that some of the sites that are dominated by wild fauna may in fact have been occupied only seasonally. Perhaps some farming communities concentrated on hunting at times of greater availability of game. What I find interesting here is that, unlike other contributions, in this scenario hunting is regarded as a potentially useful strategy and not just as a makeshift solution.

On the subject of the interaction between different communities, Pollard's hypothesis that the people living in Britain in the early Neolithic had to be supplied with domestic animals coming from the European mainland is interesting. This suggestion, however, does not take into account that, once domestic animals had been introduced, there are no reasons why local communities should have not taken up the technology of animal breeding. We do now have evidence of the existence of domestication events in Europe (Larson *et al.* 2005) in the case of the pig. Though it is not possible to be certain about the precise areas where these events occurred, we cannot rule out the possibility that local domestication of the pig also happened in Britain. Nevertheless, Pollard is certainly right that interactions between communities living at the opposite ends of the Channel occurred, as animals such as sheep and goats were certainly imported. If archaeologically we find traces only of the material evidence of these contacts there is little doubt that exchanges occurred at an ideological level too, creating the foundations for the development of new and possibly even more diversified ways of life.

SCALE OF ANALYSIS

Rather than getting diverted by pointless discussions about the impossibility of generalisation in archaeological interpretations (Hodder 1986) the papers in this book just get on with the job of reconstructing Neolithic life by tackling the archaeological evidence at both local and regional level. There is here an impressive range of different case studies, dealing with examples as specific as a single pit or as general as the whole of Western Europe. What is particularly stimulating is the readiness of the contributors to try to contextualise the findings they discuss by moving continuously from the particular to the general and *vice versa*. A successful example of this approach is represented by the paper by Cotton *et al.* Here, by analysing the evidence of a very discrete individual event, the killing of an aurochs by human hunters, the authors provide evidence that they then apply to the interpretation of the whole late Neolithic landscape. Their interpretations may well be open to debate but the attempt is certainly admirable.

In their analyses, Miracle, Serjeantson and Isaakidou also move from the micro- to the macro-regional scale. The specificity of their case studies is however subject to great variation, ranging, as it does, from a small cave to a settlement and to a whole palace. The example of Pupićina Cave is I believe particularly interesting as, by analysing in depth the evidence of what probably was no more than a sheep pen, Miracle manages to make important considerations concerning regional patterns of Neolithic activities. Boyle's approach is very different as she provides information at a regional scale gathered from a large number of individual studies. Once trends are identified they are then effectively applied to aid the understanding of specific sites.

The lesson to be learnt is undoubtedly that both approaches are effective. Studies of individual assemblages and sites represent the foundations on which our regional patterns can be defined and, however limiting their evidence may appear initially, should never be discounted as being uninformative. At the same time overviews are essential to detect patterns that are only apparent at a larger scale, and are of great use for our understanding of more localised phenomena. Sweeping generalisations are often made not by those who are brave enough to propose them, but rather by researchers who do not understand their inevitable limitations and end up using them inappropriately.

NEW ASPECTS

People of my generation grew up with a rather simplified notion of the Neolithic. Apparently Neolithic people lived in an environment where almost all the late glacial fauna had disappeared, hunting played no significant economic role, and animals were exclusively reared for meat. The last few years have seen a slow but gradual change to this view, and some of these accepted beliefs have started to crumble.

One of the most significant new pieces of evidence that archaeological research has recently produced is that Neolithic people kept livestock for milk as well as meat. The direct evidence for this has been obtained through the analysis of organic residues from pots (Copley *et al.* 2005), but the analysis of kill-off patterns obtained from various archaeological sites across Europe has also highlighted the existence of husbandry strategies that seem to be geared towards milk production. Some of the papers in this book contribute to dismantle the old myth of a meat-specialised Neolithic husbandry. Miracle and Serjeantson both identify milk oriented mortality curves in mid-late Neolithic sheep and cattle from Croatia and Britain. Isaakidou focuses specifically on this question and concludes that at Neolithic Knossos cattle and sheep were used as part of a mixed economy in which milk production must have played a part. She also suggests that cattle were probably used for traction too, which, if confirmed, would take apart another commonly held view regarding a later introduction of this practice. This last question will deserve further investigation, but as research makes further progress it seems that the writing is on the wall for a 'secondary products revolution' which only took place after the end of the Neolithic. It has been a hugely stimulating idea for more than twenty years, but it has been gradually been losing elements bit by bit, and today, at the very least, we can no longer call it a 'revolution'.

Another area where recent research seems to have produced important new evidence concerns the survival of Pleistocene relicts well into the Neolithic. In particular the notion that horses became extinct soon after the end of the last glaciation in Europe has now been proved to be incorrect (Uerpmann 1990). Once again various contributions to the volume provide important supplementary information to this question. Serjeantson mentions the presence of horse bones in what may be mid-Neolithic levels at Runnymede, though she is sensibly cautious about their chronology until radiocarbon dates become available. However, considering the now fully accepted idea that horses were present in continental Europe in that period – as indicated in Boyle's paper – it would not be that surprising if they survived in Britain too. Horses were certainly present in Britain and Ireland in the late Neolithic, as the evidence from Durrington Walls (Harcourt 1971), Newgrange (van Wijngaarden-Bakker 1974) and Grimes Graves (Clutton-Brock and Barleigh 1991) indicates, though their status as wild or domestic in this period is debatable, as it coincides with the time when domestic horses had started being introduced to Europe from the Eurasian steppes. What seems, however, very likely – though see a different view provided by Pollard in this volume – is that those horses were eaten, as clear butchery marks on the Durrington Walls bones indicate (U. Albarella Personal observation).

An important consideration regarding the possible survival of the horse and other Pleistocene relicts in the Neolithic is provided by Boyle, who suggests that these species may have become rare and therefore confined to limited pockets of the countryside. Consequently they may have become difficult to hunt and in general not worth pursuing by human hunters. We must therefore be careful in using the archaeological evidence for the reconstruction of faunal spectra in different periods and regions. It is possible that a failure to find these animals in the archaeological record simply reflects rarity rather than absence. A similar scenario can be envisaged in the case of the aurochs, which survived in small numbers until the Middle Ages in Poland, but in many other areas of

Europe – including Britain – seem to have disappeared as early as the Late Bronze Age (see the paper by Cotton *et al.* and Clutton-Brock 1986). Perhaps later cases of survival of the *Bos primigenius* will one day be discovered.

NATURE AND CULTURE

Did Neolithic people see the 'cultural' world of the village in which they lived, the animals they kept and the objects they made as clearly distinct from a 'natural' world made of forest, wild animals and uncultivated land? According to Serjeantson and Pollard the answer is a resounding 'yes'. Serjeantson explains the apparent avoidance of the use of wild animals in feasting activities as a consequence of the fact that Neolithic people perceived the 'world of nature' as 'alien', and, presumably, inappropriate for these kind of celebrations. Pollard goes further and suggests that the Neolithic brought about 'the creation of a conceptual division between natural and cultural domains' and that the status of wild animals 'was lessened by their existence outside mainstream social life'. It is difficult to either agree or disagree with these statements – the archaeological evidence concerning the ideological sphere of prehistoric life is notoriously ambiguous and prone to subjective interpretations. I will, however, put diplomacy aside and confess my scepticism. Firstly, I suspect that the proposed dichotomy may be more the product of our view of the world than of any Neolithic perception. Ingold (2000, chapters 3 to 5 in particular) has, among others, provided several examples of societies that keep domestic animals but see the boundaries between cultural and natural worlds blurred or even non-existant. There is, of course, a great deal of variation, but also no real reason to assume *a priori* that such a dichotomy represents an inherent characteristic of farming communities. Secondly, the evidence on which these assumptions are made seems to me not entirely persuasive. The suggestion that wild animals may have purposefully been excluded from feasting activities would gain some strength if they had instead occurred in ordinary everyday meals, but this evidence is either absence or not available. This may be a consequence of the fact that any meat consumption event was a feast, but, if this is the case, we are still left with the problem that we miss a comparative example – and zooarchaeology is a discipline that mainly relies on relative rather than absolute evidence. Pollard's assumption that the absence of fur animals in fourth millennium sites suggests that they must have been regarded as taboo food can also be difficult to sustain when we consider that mustelids are common in contemporary Dutch sites (see Zeiler's paper) and are also present in late fourth millennium contexts from Runnymede (see Serjeantson's paper). It is certainly true that some populations may choose to avoid deliberately the meat of specific wild species, but at the moment it seems difficult to prove this for the British early Neolithic. Even if we could, we should still leave the door open for the possibility that some animals were left untouched because they were regarded *highly* rather than *lowly*.

Later in the same paper Pollard, however, suggests the possibility of a more complex 'classification of animals based on proximity or distance to people, spatially and/or ontologically', which takes us away from the simple dichotomy of a cultural world opposed to a natural one. If that was the case it is intriguing to think where hybrid forms, such as the possible wolf/dog discussed by Clark, would fit. This animal may well have been difficult to categorise and could have therefore played a special role in people's imagination. This would explain its presence in a ceremonial deposit, as Clark herself suggests. In general the question of hybrid animal forms and the way they are perceived by people is of great interest and should perhaps be pursued with greater intensity. In medieval times hybrid forms (or their symbolised representations) were regarded with disdain rather than respect (Salisbury 1994) perhaps just because they did not clearly fit in any of the mental categories of the people of the time. There is of course no cultural connection between the Neolithic and the Middle Ages, but this example just shows how diverse human responses to natural phenomena can be.

As a conclusion to this commentary I must say that this book presents a collection of studies on the role of animals in the Neolithic of remarkable interest and diversity. It would have indeed been sad if all of the papers had taken a similar approach, or followed a similar intellectual model. Fortunately the editors of this volume have not made the mistake of imposing any restrictions on the scope of the individual authors or, worse, have attempted to set a research agenda. I find the pursuing of research agendas a rather pointless exercise: they are either too general to be of any use or they try to impose detailed plans for future research and become needless straightjackets. Each of the papers in this book is structured in a different way, uses a different source of evidence, adopts a different methodology and pursues a different research interest – and this is refreshing to see. In addition, as I said at the beginning of this commentary, it also provides a good cross-section of where research on Neolithic animals is today. The main problem that archaeological research is presently facing is its excessive *sameness* rather than *diversity*. This needs addressing because the most stimulating research always emerges outside pre-constituted agendas. This book provides its own excellent contribution to this particular pursuit of greater intellectual freedom. If I have occasionally picked on some of the aspects that can be controversial it is because I wanted to try to stimulate reflection and discussion. Rather than providing us with a predictable research agenda, the book offers a great range of different sets of data and ideas that should be sufficient to stimulate much future research. I have no doubt that, like his companion volume on the relationship between people and plants in the Neolithic (Fairbairn 2000), this book will become an important source of information for bioarchaeologists and prehistorians alike. In his memorable forward to his edited volume *Animal Bones, Human Societies* Rowley-Conwy (2000) predicted that the next decade of zooarchaeological research was 'going to be fun'. This book undoubtedly meets his expectations.

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