EAA 47

WEST STOW
Early Anglo-Saxon Animal Husbandry

East Anglian Archaeology

Suffolk County Planning Department, 1990

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EAST ANGLIAN ARCHAEOLOGY

West Stow, Suffolk: Early Anglo-Saxon Animal Husbandry

by Pam J. Crabtree

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Cover Illustration The Pearl Flock of Soay sheep
Property of Mr. and Mrs. R.J. Perry

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Foreword and Acknowledgements

The animal bones from West Stow represent one of the largest and best preserved faunal assemblages that has been analyzed in Britain to date. The analysis of this collection provides a unique opportunity to make a detailed and thorough study of early Anglo-Saxon animal husbandry and hunting practices. In this volume I hope to show how the study of approximately two tons of animal bones can contribute to our understanding of the day-to-day life of the early Anglo-Saxons.

A faunal collection of this size could not be studied without a lot of help. This research was made possible by grants from the National Science Foundation (Grant No. BNS 77-08141) and the Wenner-Gren Foundation for Anthropological Research (Grant No. 3267) and by a Fulbright-Hays Full Grant and renewal that allowed me to carry out the research at the University of Southampton. I would like to thank Jennie Coy of the Faunal Remains Unit, Department of Archaeology, University of Southampton, who identified the bird and fish remains and provided invaluable help throughout the West Stow project. Roger Jones of the Ancient Monuments Laboratory helped me with the initial computer analyses and solved a wide range of logistical problems for me, including the transportation of the bones. Colin Renfrew, formerly Professor of Archaeology at Southampton and now Disney Professor of Archaeology at Cambridge, kindly allowed me to carry out this research at Southampton University. My Ph.D. dissertation committee from the University of Pennsylvania, Professors Bernard Wailes, Alan Mann, Ward Goodenough, and the late Dr Dexter Perkins Jr were wonderfully supportive throughout the project. I am especially grateful to Bernard Wailes who introduced me to early medieval archaeology and to Dexter Perkins who first trained me in faunal analysis. I owe an immeasurable debt of gratitude to my husband, Douglas V. Campana. Doug entered all the West Stow data on the computer and designed the computer system that allowed me to reanalyze much of it. I am also grateful to Sebastian Payne for his constructive comments on the text and for providing Figure 8. Above all, I want to thank Stanley West who had the foresight and determination to save every scrap of animal bone from West Stow at a time when many archaeologists were saving only a select portion of their animal bone remains.

Chapter 1. Introduction

I. Introduction

The *Adventus Saxonum*, the arrival of the Anglo-Saxons in Britain, is an event which has profound implications for later English history. Documentary sources can provide a bare outline of the political and historical events which surrounded the *Adventus*, however the documents are silent on many important aspects of Early Anglo-Saxon lifeways. Information about fifth- and sixth-century settlement patterns, craft production, mortuary practices, and agriculture and animal husbandry can only be studied using archaeological data. The reconstruction of animal husbandry practices is a particularly significant aspect of archaeological research since animal bones are one of the most commonly recovered classes of archaeological data and since domestic animals played an important role in the economy of early medieval Europe.

II. Previous Studies of Anglo-Saxon Faunal Remains

Despite the growth in medieval archaeology since World War II, there are relatively few published studies of fauna recovered from Anglo-Saxon archaeological sites. Clutton-Brock's (1976) review article on Anglo-Saxon animal resources was based on the analysis of the animal bones from five sites: North Elmham (Norfolk), Thetford (Norfolk), Sedgeford (Norfolk), Sandtun (Kent), and Mawgan Porth (Cornwall). The fauna from Sandtun and Thetford has not been published in detail. The site of Mawgan Porth cannot be considered typically Anglo-Saxon, since 'the Anglo-Saxon invasions can have made little impact on this Cornish settlement' (Clutton-Brock 1976, 376-7). Clutton-Brock's survey provides a discussion of the animal species that have been identified from these five sites and a small amount of measurement information, but it provides no evidence for species ratios, kill-patterns, or butchery practices.

Since the publication of Clutton-Brock's review article, several comprehensive studies of fauna from Anglo-Saxon sites have been published. Detailed faunal reports are available for the sites of Hamwih (Southampton), Hants (Bourdillon and Coy 1977, 1980); North Elmham (Noddle 1980); Portchester Castle, Hants. (Grant 1976); Ramsbury, Wilts. (Coy 1980), and Flaxengate, Lincoln (O'Connor 1982). Hamwih and Flaxengate are substantial urban centers. The fauna recovered from Hamwih dates to the Middle Saxon period (*c.* 650-850 AD). The fauna from Flaxengate is somewhat more recent in date, spanning the period from *c.* 880-1200. The fauna recovered from North Elmham, a settlement that was the site of the bishopric of East Anglia, dates primarily to the Middle Saxon period, although a substantial number of bones were also recovered from the late ninth- and tenth-century features at the site. Ramsbury is a Middle Saxon iron-working site which produced an unusual faunal assemblage that included high proportions of deer and horse bones. Portchester Castle is an Saxon shore fort, which produced remains of the fifth to the eleventh centuries, although most of the animal bones are not early Anglo-Saxon in date. The fauna from the Anglo-Saxon levels of St Albans Abbey, Herts. (fifth-ninth century), an early ecclesiastical site, has also been analyzed in detail (Crabtree, n.d.), although the results have not yet appeared in press.

While these sites have provided valuable new information on Anglo-Saxon animal husbandry and hunting practices, we do not yet have a complete picture of Anglo-Saxon animal exploitation. Many of the sites which have produced extensive faunal assemblages are special purpose sites, such as Ramsbury and St Albans Abbey. None of these is a rural agricultural village, and none has produced extensive faunal remains of the Early Anglo-Saxon period (AD 400-650).

The excavation of the Early Anglo-Saxon village at West Stow (West 1985a) provided a unique opportunity to study the animal husbandry practices of the period. All the recovered faunal remains from the excavations were saved (but see below, p. 00) and the bones were generally in an excellent state of preservation. The resulting faunal assemblage (*c.* 180,000 fragments) is one of the largest that has been recovered and analyzed from a British archaeological site to date. The large size of the assemblage allowed us to reconstruct not only the animal species present and their relative importance, but also their ages at death, sizes, and the ways in which they were butchered. Before we describe the results of the analysis of the West Stow animal bone remains, the excavations and the environment surrounding the site will be briefly described.

III. The Environmental Setting
(Fig. 1)

West Stow is an Early Anglo-Saxon village located on the bank of the River Lark in Suffolk, eastern England. The site is located on the river terrace where fluviatile gravels are overlain by blown sand deposits. At West Stow twelfth- to thirteenth-century ridge-and-furrow is buried by up to one metre (3 ft) of blown sand (West 1969, 3). These sand deposits and the absence of later occupation helped to preserve the site for archaeological investigation.

The site is located in the Breckland (Fig. 1) region of East Anglia. The present-day vegetation in the uncultivated areas of the river terraces includes heath, bracken, and sand-sedge (*Carex arenaria*; Murphy 1983, 187). At West Stow, 'the main modern 'natural' vegetation is grass-heath, *Calluna*-heath with *Carex arenaria* on the blown sand' (Murphy 1985, 104).

The river terrace location would have allowed the Anglo-Saxon inhabitants to make use of several different micro-environments for pastoral activities. The river valley would have provided the best pasture land. Rougher grazing would have been available on the slopes and uplands beyond the river terraces. The river also would have served as a source of fish and waterfowl.

It is clear that the present environment of the West Stow area has been heavily influenced by human activities such as the establishment of rabbit warrens in the Middle Ages and the planting of conifers which the Forestry Commission began in the 1920s. There is also no reason to assume that the climate of the Breckland region is the same today as it was in the Early Anglo-Saxon period. Relatively small scale climatic changes may have had a significant

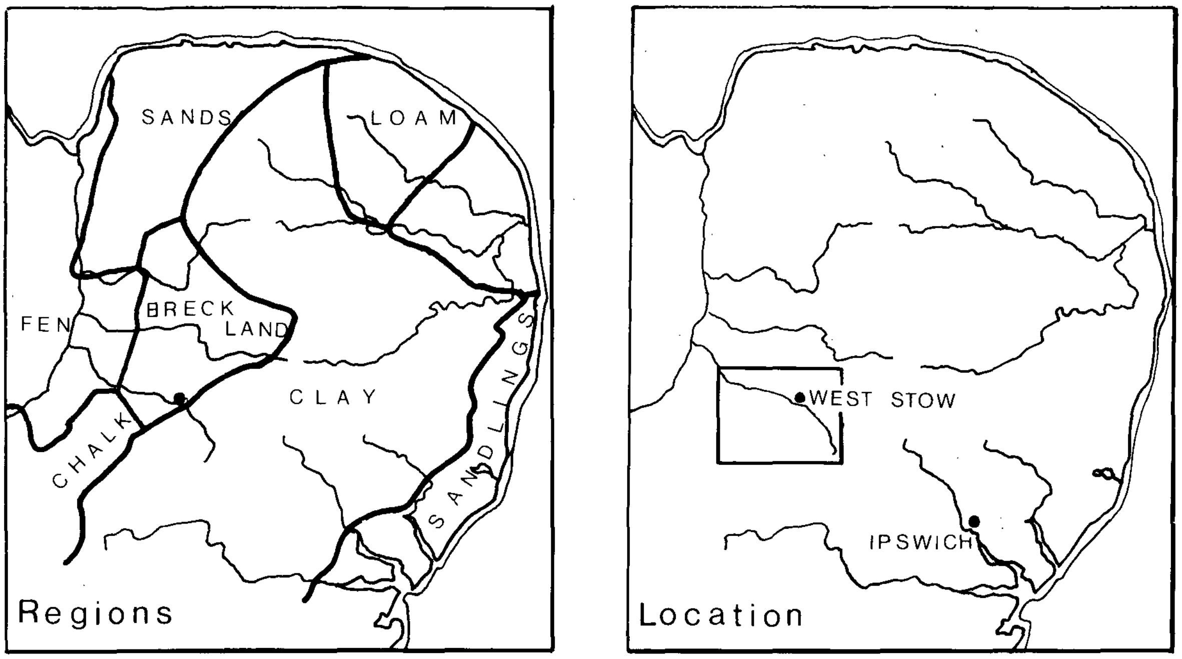


Figure 1 Location map: West Stow and the Lark Valley

impact on animal husbandry strategies in the Breckland region, an area of relatively poor soils and low moisture. What evidence can be used to reconstruct the climate of the West Stow region in the Early Anglo-Saxon period?

Lamb (1981) has summarized the available climatological evidence for the period 1000 BC to AD 1000 in Britain. He suggests that the climate in the late Roman period (*c.* AD 250-400) was warmer and drier than today, but that there is evidence of a shift toward colder summers and wetter conditions beginning in the late sixth century. Pollen data from Hockham Mere (Sims 1978) in Norfolk have provided evidence for a decrease in cereal cultivation during the Late Roman and Early Anglo-Saxon periods (*c.* AD 340-650). The pollen samples also provide evidence for expansion of cereal cultivation beginning about AD 650. Thus there is a broad correlation between climatic changes and changes in land use (Murphy 1983, 203). This is not surprising, as available moisture is a major limiting factor for cereal cultivation in the Breckland. Since the West Stow village was occupied between about AD 400 and AD 650, the site's occupation would have coincided with a relatively warm and dry climatic phase.

IV. The Site: Excavation and Chronology
(Fig. 2)

The Anglo-Saxon settlement at West Stow was discovered in 1947 during the excavation of a Romano-British pottery kiln at the site (West 1985a, 9). The site was initially excavated by Miss Vera Evison between 1957 and 1961, and major excavations at the site were undertaken by Dr Stanley West between 1965 and 1972. The excavations at West Stow are unique because they have provided the only relatively complete settlement plan for an early Anglo-Saxon village in England[1].

The excavations (see West 1985a for a complete description) uncovered seventy sunken-featured buildings (SFBs) or *grubenhäuser* clustered around seven small post-built structures termed 'halls' (Fig. 2). The sunken featured buildings are composed of a pit or hollow, approximately 5 metres long, which is usually roughly rectangular in shape. Post-holes are normally found along the short ends of the building. Sometimes one post-hole is located in the middle of each short end; other buildings have three post-holes along each short end. These buildings have traditionally been interpreted as some form of sunken hut. The evidence from West Stow, however, indicates that these buildings may have been more elaborate structures. West (1985a, 120-1) has argued that the pits were covered by suspended floors which were larger than the pits themselves. The pits may have served as a cellar or storage area.

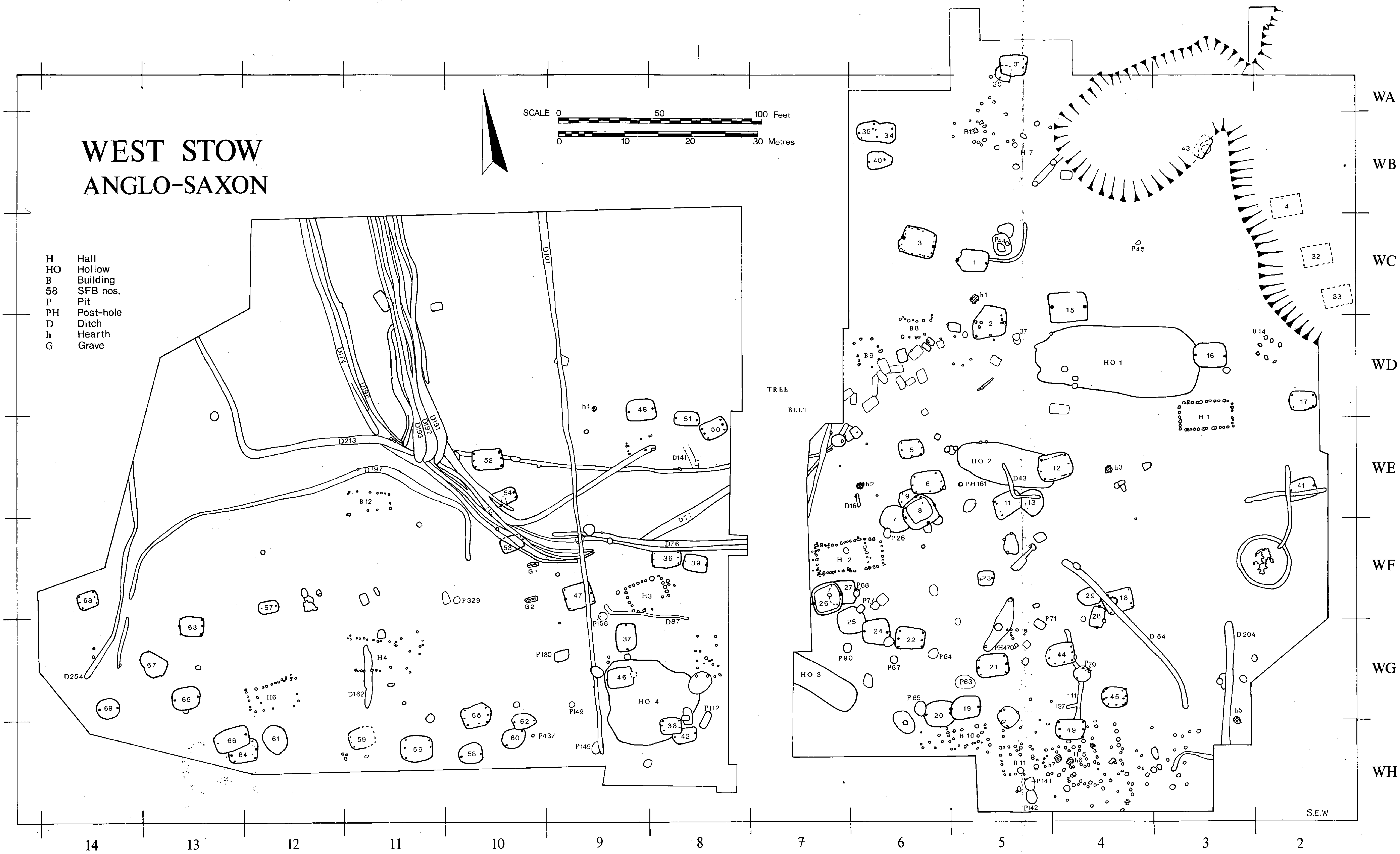
The second major type of structure discovered at West Stow is the 'hall'. These halls are small rectangular structures whose outline is marked by a row of post-holes. Six halls were excavated by Stanley West; a seventh, larger hall was discovered by Vera Evison.

As can be seen in the settlement plan (Fig. 2), the SFBs cluster around the seven small halls. West has suggested (1985b, 8) that each hall cluster was occupied by a family group.

The site was occupied from *c.* AD 400 to *c.* AD 650 (West 1985a, 146). In other words, the initial occupation of the site coincided with the end of the Roman period in Britain, and the site was abandoned about the beginning of the Christian, Middle Saxon period. The individual SFBs have been dated on the basis of the artefacts found in their primary fills. Most of the huts could be assigned to one of three broad chronological phases (West 1985a, 147):

Phase 1 (fifth century),
Phase 2 (sixth century), and
Phase 3 (late sixth-seventh century).

In addition, those SFBs containing early fifth-century artefacts, such as faceted-angled pottery, could be assigned to the first half of the fifth century, while those containing Illington/Lackford pottery could be assigned to the second half of the sixth century (West 1985a, 148). In order to study changes in faunal exploitation through time, the



WEST STOW
ANGLO-SAXON
H Hall
HO Hollow
B Building
58 SFB nos.
P Pit
PH Post-hole
D Ditch
h Hearth
G Grave
SCALE 0 50 100 Feet
0 10 20 30 Metres
TREE
BELT
WA
WB
WC
WD
WE
WF
WG
WH
14
13
12
11
10
9
8
7
6
5
4
3
2
HO 1
HO 2
HO 3
HO 4
H 1
H 2
H3
H4
H6
S.E.W

animal bones from the Phase 1, Phase 2, and Phase 3 SFBs at West Stow will be analyzed separately.

The chronological evidence from the SFBs provides additional support for West's division of the site into a series of hall clusters. Most of the SFBs associated with Halls 1, 2, 3, and 6 date to the fifth and earlier sixth centuries, while most of those associated with Halls 4, 5, and 7 date to the later sixth and seventh centuries. At any one time it was likely that the site was occupied by three or four family groups.

The other archaeological contexts which produced significant quantities of animal bones included Anglo-Saxon pits, ditches, 'post-hut' fills (see below), hollows, and Layer 2. The Anglo-Saxon ditches include ditches which can be assigned to the early seventh century (Phase 3) and those which cannot be closely dated. The fauna from the well-dated Phase 3 ditches has been analyzed separately. In many of the SFBs two distinct stratigraphic layers were present. The lower or primary fill was apparently deposited while the building was in use. The primary fills were always uncontaminated by residual material (West 1985a, 118). The primary fills have been of major importance in the development of a chronology for the site. The upper layer, the post-hut fill, was very different in character from the lower. It was probably deposited after the SFB was abandoned. These post-hut fills appear to be part of 'Layer 2', the general occupation layer. The animal bones from the post-hut fills were analyzed together.

Four areas of grey, disturbed soil were identified while cleaning the surface of the natural sand. These hollows lacked any structural features and contained many small, rather worn, pot sherds in addition to animal bones. While the function of these hollows is not clear, it is possible that they may have served as animal pens which were surrounded by some form of hurdling or light fencing (West 1985a, 53). The fauna from these hollows makes up nearly all the fauna recovered from the Anglo-Saxon features, however the fauna from a few small post-holes and other features has also been included in this category.

This volume presents the results of the analysis of the West Stow animal bone remains which were recovered from the Anglo-Saxon SFBs, pits, ditches, features, post-hut fills, and Layer 2. At the time that the site was excavated, in the late 1960s and early 1970s, water screening and bulk sampling were not regularly practiced at British archaeological sites. The faunal remains from West Stow were recovered by careful trowelling, without screening. It is therefore likely that some of the carpals, tarsals, and other small bones of medium-sized mammals such as sheep, goats, and roe deer were lost during excavation (Payne 1975). It is also likely that birds, fish, and other small animals are generally under-represented in the faunal assemblage. The effect of these recovery methods on the faunal assemblage will be considered in more detail in Chapter 2.

The report will focus primarily on the fauna recovered from the SFBs since this material can be most closely dated. The aim of the volume is to demonstrate the kinds of information about Early Anglo-Saxon animal husbandry that can be recovered from the archaeological record. It is therefore directed toward a general archaeological audience, rather than specialist zooarchaeologists. In the text quantitative data have been presented in both graph and tabular form.

The report is not intended to be a comprehensive survey of all the animal remains that were recovered from West Stow. A report on the fauna from the Iron Age and Roman features has been included in another monograph (West 1989). The reader should consult this volume for details on the Iron Age and Roman faunal remains. The report will focus primarily on mammal, rather than bird and fish, remains since the mammalian fauna were identified by the author. The primary emphasis will be on the domestic animals since these made up the vast majority of the animal bones recovered from West Stow[2].

V. Goals of the Analysis

The major aim of this study is the reconstruction of Early Anglo-Saxon animal husbandry practices. The analysis centered on the types of faunal data which could provide useful information on animal husbandry. Four major questions were investigated:

1. Which animal species are present at the site, and what is their relative importance? We also wanted to determine whether there were any changes in the relative importance of the different animal species through time, and whether different areas within the site produced different types or quantities of animal bones.
2. How large were the domestic animals? Animal sizes can inform us about meat yields and the dietary contributions made by different animal species. Size changes may also reflect changing animal husbandry practices and the introduction of new breeds.
3. How old were the animals when they died? Kill-patterns can be used to determine the economic uses (meat, milk, wool, or traction) to which the domestic animals were put.
4. How were the animals butchered, and how was the meat distributed?

Once these four questions have been answered, the data from West Stow will be compared to the faunal remains from other British Iron Age, Roman, and Anglo-Saxon sites. Through these comparisons we hoped to investigate possible long-term trends in animal husbandry practices in order to determine whether the *Adventus Saxonum* led to significant changes in animal economy. The West Stow Anglo-Saxon faunal remains are also compared to the animal bones from continental Saxon sites such as Feddersen Wierde, in northern Germany, to discover whether elements of West Stow animal husbandry practices may have been imported from the continental Saxon homelands.

VI. Methods and Materials

As noted above, the West Stow faunal collection is one of the larger animal bone assemblages that has been analyzed in Britain to date. The sheer numbers of animal bones made a simple, consistent means of data collection and recording a necessity. We also sought to record the data in a standardized manner that would allow for comparisons with other British faunal assemblages. The recording system used was based on the codes employed by the Ancient Monuments Laboratory (AML) of the Department of the Environment in London (now Historic Buildings and Monuments Commission for England; Jones, n.d.). Most of the West Stow data were initially sorted using the AML computer system. However, the need for more detailed analysis of the faunal remains from the Anglo-Saxon huts led us to develop a series of programs for processing animal bones using the DEC Rainbow 100+ and the IBM Personal Computer (Campana and Crabtree 1987). These programs are written in the C programming language and use a coding system that is very similar to the one used by the AML. The C language programs, however, allow for speedier data entry, more compact data storage, and quicker data processing. The following types of data were recorded for each bone fragment.

Archaeological context

This field was used to indicate the archaeological provenence of each bone or bone fragment.

Species

The animal species represented by each bone or fragment was coded using a three-letter mnemonic code. Since many bone fragments could not be identified to species because distinctive morphological points were missing or obliterated, higher order codes were also used. In particular, *OXO* was used to describe a fragment which was 'cattle-sized', *i.e.*, which might have belonged to horse, cattle, or red deer. *LAR* was used to designate an unidentified large artiodactyl (cattle, red deer, and possibly pig), while *SAR* indicates a small artiodactyl (sheep, goat, roe deer, and possibly pig). The use of these higher order taxa follows Coy (1980, 41-2). In addition, all ribs and vertebrae, other than atlas, axis, and sacrum, were simply classified as *LAR, SAR,* and *OXO.* This procedure was adopted because of time constraints and because fragmentary ribs, in particular, are often impossible to identify to species. Moreover, ribs and vertebrae are not usually measured and are not always used in the calculation of specific proportions. It is acknowledged that this procedure may have resulted in the loss of some osteological information.

Sheep bones were separated from goat remains, when possible, using the criteria set forth by Boessneck *et al.* (1964). Unfortunately sheep and goat mandibles and pelves could not be identified to species. The category 'sheep/goat' was used for all indeterminate caprine fragments.

Anatomical element

This field was used to indicate the bone element or part of the body represented by each bone fragment.

Handedness

This field was used to indicate whether the bone came from the right or left side of the body.

Portion

In this field one could record the part of the bone that was present, *i.e.,* proximal (the end closest to the midline of the body), distal (the end farthest from the midline), or midshaft (the central portion of the bone).

Fragmentation

This field was used to indicate the proportion of the bone that was preserved; less than half the bone, approximately half, more than half, or the whole bone.

State of dental eruption and wear

Mandibles (lower jaws) can also be used to reconstruct age profiles for the domestic mammals (Ewbank *et al.* 1964; Payne 1973; Grant 1975; 1982). Most mammals have two sets of teeth: *1.* deciduous or milk teeth, and *2.* permanent teeth which replace the deciduous teeth in a set sequence. The age of death for juvenile mandibles can be estimated quite closely based on the degree to which the deciduous teeth have been replaced by the permanent ones. For adult mandibles, *i.e.,* those with fully erupted permanent dentitions, more general age estimates can be based on the degree of wear seen on the permanent teeth.

State of epiphysial fusion

These data can also be used to determine the ages at death of the domestic animals. In mammals bone growth takes place at the ends of the long bone shafts. For juvenile mammals, the articular ends of the bones (epiphyses) are separated from the bone shafts (diaphyses) by cartilaginous plates. When bone growth ceases, the plates ossify, and the end of the bone becomes permanently attached to the shaft. Since the long bone epiphyses usually fuse in a set sequence for each species[3], the proportions of fused and unfused epiphyses for each anatomical element can be used to reconstruct animal kill patterns. The limitations of using epiphysial data for the reconstruction of ancient kill-patterns are discussed in greater detail in Chapter 4.

Butchery

The following information was recorded for each butchered bone:

1. the type of butchery marks present (*e.g.,* knife cuts, saw marks),
2. the location of the butchery marks on the bone, and
3. the orientation and direction of the butchery marks.

These data were used in an attempt to identify the specific operations that were involved in the disarticulation of the animal carcass and the removal of meat from the skeleton.

Bone measurements

All mature, relatively complete bone elements were measured following the recommendations of von den Driesch (1976). The use of von den Driesch's standardized measurements allows the West Stow measurements to be compared to those from other British and continental sites. Nearly all the bone measurements were taken using a Mitutoyo 35cm sliding vernier caliper. The measurements were recorded to the nearest 0.1mm. The maximum lengths of cattle and horse long bones were measured using an osteometric board supplied by the AML.

Additional information

The following additional information was recorded: evidence of dental or skeletal pathologies and anomalies, descriptions of the cattle horn cores (following Armitage and Clutton-Brock 1976), condition of the bones (*e.g.,* severely eroded, stained), evidence of bone gnawing, traces of bone working and bone tool manufacture (Crabtree 1985, 96), and the sex of the animal where this could be determined.

Chapter 2. The Composition of the Faunal Assemblage

I. Introduction

(Table 1)

In studying an archaeological faunal collection, some of the most important questions the zooarchaeologist seeks to answer are:

1. What animal species are present in the faunal sample?
2. How important were hunting and stock-raising to the economy at the site?
3. What is the relative importance of the domestic species, particularly cattle, sheep and goat, pig, and horse?
4. Is there any evidence for change through time in the composition of the faunal assemblage?

Before we can begin to answer these questions, the overall characteristics of the faunal assemblage from West Stow will be briefly described. The mammalian bones which made up the bulk of the faunal assemblage will be discussed first. The smaller collection of bird and fish remains will be described at the end of this chapter.

The faunal assemblage from the Anglo-Saxon features at West Stow included 175,263 mammal bones and fragments (Table 1), of which over 40% could not be identified. Thirty-seven per cent (64,762) could be identified as domestic mammal remains, most commonly cattle, sheep/goat, and pig. Since sheep bones outnumber goat remains by a factor of approximately 100:1, it is likely that most of the indeterminate sheep/goat bones represent sheep rather than goats.

Although a relatively wide range of wild mammal species was identified, the number of wild mammal bones is quite small indeed. The most frequently represented wild mammal species is the rabbit. Unfortunately, it is very likely that the rabbit remains recovered from the excavations are post-medieval rather than Anglo-Saxon in date. Rabbit warrens were established in the West Stow area in the Middle Ages, and rabbit farming continued to be economically important in the region until the nineteenth century (Clarke 1925, 131-45). Wild rabbits are very common in the area today. None of the rabbit remains was recovered from a sealed Anglo-Saxon context. Unlike the rest of the mammal bones, most of the rabbit remains were recovered as partial skeletons. In the absence of evidence to the contrary, it seems prudent to assume that West Stow rabbit bones represent the remains of modern animals which entered the site as a result of burrowing activity.

Other than the rabbits, the most commonly identified wild mammals were red deer and roe deer. Animals such as hare, badger, bear, and fox were represented by only a limited number of bones. Overall wild mammal remains represent only 0.5% of the total identified mammal bones from West Stow.

The proportion of unidentified mammal remains (72,005 or 41% of the total mammalian bone sample) is rather low. This fact may result in part from the recovery methods used by the excavators, which may have led to the loss of some smaller fragments of bone. The faunal assemblage was not wet-screened or even bulk sampled for wet-screening. The faunal remains were recovered by careful trowelling (see Chapter 1, above). Experimental archaeological research (see, for example, Payne 1975) has shown that the lack of screening will bias archaeological recovery of faunal remains. It is likely that bird, fish, and small mammal remains are significantly underrepresented as a result of the recovery strategy used at West Stow. Other small bones, such as the carpals and tarsals of sheep and goats, may also have been missed.

In the analysis of the animal bones recovered from the Anglo-Saxon features at West Stow, particular attention will be paid to the animal bones recovered from the SFBs. Nearly all of the SFBs can be assigned to one of the three main chronological phases: Phase 1 (fifth century), Phase 2 (sixth century), or Phase 3 (late sixth-seventh century). Comparison of the faunal remains from these three phases, will allow us to detect changes through time in the composition of the faunal assemblage.

Domestic Mammals	
Cattle (*Bos taurus*)	26012
Sheep (*Ovis aries*)	5142
Goat (*Capra hircus*)	48
Sheep/goat (*Ovis/Capra*)	23209
Pig (*Sus scrofa*)	9192
Horse (*Equus caballus*)	1237
Dog (*Canis familiaris*)	615
Cat (*Felis catus*)	274
Total domestic mammals	64762
Wild Mammals	
Red deer (*Cervus elaphus*)	58
Roe deer (*Capreolus capreolus*)	33
Hare (*Lepus* sp.)	10
Badger (*Meles meles*)	6
Bear (*Ursus arctos*)	1
Watervole (*Arvicola terrestris*)	2
Mole (*Talpa europaea*)	24
Fox (*Vulpes vulpes*)	1
Rabbit (*Oryctolagus cuniculus*)	197
Total wild mammals	332
Small artiodactyl	18430
Large artiodactyl	2543
Large mammal	17191
Unidentified mammal	72005
Total mammal bones and fragments	175263

Table 1 Total mammal remains (NISP) from all Anglo-Saxon features

II. Faunal Remains from the Sunken Featured Buildings

(Tables 1-4; Pls I and II)

Mammal remains from Phase 1 sunken featured buildings

A total of 21,716 mammal bones and fragments was recovered from the Phase 1 SFBs. The domestic species present included cattle (*Bos taurus*), sheep (*Ovis aries*), goat (*Capra hircus*), pig (*Sus scrofa*), horse (*Equus caballus*), dog (*Canis familiaris*), and cat (*Felis catus*). Small numbers of wild animals were also present including red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), and badger (*Meles meles*). Both red and roe deer were represented by post-

Domestic Mammals	Phase 1	Phase 2	Phase 3
Cattle (*Bos taurus*)	2539	4811	523
Sheep (*Ovis aries*)	678	1257	123
Goat (*Capra hircus*)	4	12	3
Sheep/goat (*Ovis/Capra*)	2797	5675	599
Pig (*Sus scrofa*)	1683	1912	308
Horse (*Equus caballus*)	90	149	42
Dog (*Canis familiaris*)	40	50	1
Cat (*Felis catus*)	10	220	
Total Domestic Mammals	7841	14086	1599
Wild Mammals			
Red deer (*Cervus elaphus*)	7	9	1
Roe deer (*Capreolus capreolus*)	7	4	1
Hare (*Lepus* sp.)	4	3	1
Badger (*Meles meles*)	1	1	1
Watervole (*Arvicola terrestris*)		1	1
Mole (*Talpa europaea*)	1	23	
Rabbit (*Oryctolagus cuniculus*)	8	39	3
Total Wild Mammals	28	80	8
Small artiodactyl	3069	7080	707
Large Artiodactyl	211	622	77
Large mammal	2158	4676	488
Unidentified mammal	8409	23822	2011
Total	21716	50366	4890

Table 2 Mammal species present in Phase 1, 2 and 3 SFBs. Numbers indicate total fragment counts (NISP).

	Cattle	Sheep/goat	Pig	Horse
Skull	274	220	277	2
Horncore	55	85	0	0
Maxilla	59	122	83	3
Upper teeth	205	223	71	7
Mandible	240	536	176	5
Lower teeth	179	349	119	12
Tooth frag.	2	18	10	4
Hyoid	17	21	0	1
Atlas	13	21	19	2
Axis	29	14	11	2
Scapula	147	162	90	1
Humerus	99	168	63	4
Radius	100	280	41	6
Ulna	71	48	51	5
Carpal	46	10	4	2
Metacarpal	99	209	107	5
Innominate	149	137	96	1
Sacrum	13	5	6	0
Femur	94	90	56	4
Patella	8	4	1	0
Tibia	106	325	66	5
Fibula	0	0	59	0
Astragalus	46	51	18	1
Calcaneus	52	50	32	6
Tarsal	31	15	6	0
Metatarsal	124	231	102	3
Metapodia	10	10	21	0
First phalanx	141	52	47	4
Second phalanx	74	14	25	1
Third phalanx	51	9	25	4
Sesamoid	5	0	1	0
Total	2539	3479	1683	90

Table 3 Body part distribution for the main domestic mammals from the Phase 1 SFBs

cranial bones in addition to antlers, showing that these species were hunted for food on an occasional basis. Table 2 presents a summary of the identified mammal bones from SFBs of all three phases.

The vast majority of the identifiable animal bones are those of cattle, sheep (Pl. I) and goat, pig (Pl. II), and, to a lesser extent, horse, indicating that these species formed the bulk of the fifth-century West Stow diet. Both sheep and goats are present, although sheep bones vastly outnumber goat remains. It is possible that a small number of goats were kept for a specialized purpose such as dairying.

The body part distributions for the main domestic mammals recovered from Phase 1 SFBs are shown in Table 3. For the main domestic mammals, all parts of the body are present in the faunal collection, although carpals, tarsals, and other small bones are relatively poorly represented, probably as a result of recovery bias. The presence of all the skeletal elements would indicate that cattle, sheep and goats, pigs, and horses were slaughtered, butchered, consumed, and disposed of at the site.

Plate I Complete Anglo-Saxon sheep skull. Scale 1:2

Plate II Complete Anglo-Saxon pig skull. Scale 1:2

The body part distribution for the fifth-century domestic mammals points up some interesting anomalies in anatomical representation. Although carpals, tarsals, phalanges, and sesamoids are generally poorly represented, the small bones of sheep and goats are most conspicuously underrepresented. This pattern of body part representation would suggest that recovery bias was one of the factors that structured the composition of the faunal assemblage, though preservation bias may be another factor.

In general, the bones are exceptionally well preserved. The bones recovered from the SFBs show no evidence of weathering, indicating that they were probably rapidly buried. The major agents of bone destruction were probably the ubiquitous West Stow dogs. Dog gnawing was frequently recorded on the animal bones from the site. Sizeable shaft fragments, whose epiphysial ends were missing, were relatively common (Table 4), especially among the sheep/goat remains. Binford (1981, 51) and others have shown that carnivores will rapidly destroy the epiphysial ends of bones leaving only the diaphysis behind. Relatively high numbers of mandibles, tibial and radial shafts, and loose teeth are seen in modern Hottentot faunal assemblages which have been subject to dog gnawing (Brain 1967). The body part distribution for the sheep/goat remains from West Stow also show high numbers of mandibles, radii, tibiae, and loose teeth. Brain (1967, 5) suggested that the fragile unfused epiphyses of immature goat limb bones may be particularly susceptible to destruction by carnivores. The implications of this for the West Stow data will be discussed in more detail in the section on the ages at death of sheep and goats (Chapter 4).

Mammal remains from Phase 2 sunken-featured buildings

(Tables 2 and 5)

The sixth-century SFBs produced the largest of the faunal samples including 50,366 mammal bones and fragments. The mammals present (Table 2) include cattle, sheep and goat, pig, horse, dog, cat, red deer, roe deer, hare and badger; the same range of species present in the fifth-century sample. Sheep clearly outnumber goats by a factor of 100:1. Hunting played only a minor role in the sixth-century economy. The vast majority of bones were those of the large domestic mammals: cattle, sheep and goat, pig and horse.

Body part distributions for the main mammalian species are shown in Table 5. Although all the parts of the body are present in the sixth century, there are marked anomalies in the anatomical distributions. As is the case for the fifth-century assemblage, sheep and goat carpals, tarsals, phalanges, sesamoids and other small anatomical elements are particularly poorly represented. Sheep/goat mandibles, radii, and tibiae are relatively common.

Mammal remains from Phase 3 sunken-featured buildings

(Tables 2 and 6)

The faunal sample from the late sixth-earlier seventh century Anglo-Saxon huts is small, including only 4890 mammal bones and fragments (Table 2). The domestic mammal species present include cattle, sheep, goat, pig, horse, and dog. While domestic mammals are by far the most common species represented in the seventh-century huts, occasional finds of wild mammals including bones of red deer, roe deer, hare, and badger indicate that the Anglo-Saxons continued to supplement their diet by hunting.

Body part distributions for the main domestic mammals are shown in Table 6. Even though the Phase 3 faunal assemblage is small, the body part distributions mirror those seen in the larger Phase 1 and Phase 2 assemblages.

	Proximal	Distal	Midshaft	Complete
Phase 1				
(5th C.)				
Cattle				
Humerus	10	38	51	0
Radius	48	26	25	1
Ulna	12	6	53	0
Metacarpal	45	19	23	10
Femur	26	20	47	1
Tibia	24	43	39	0
Metatarsal	40	39	43	2
Sheep/goat				
Humerus	8	58	74	1
Radius	76	13	183	8
Ulna	20	0	28	0
Metacarpal	81	25	79	24
Femur	21	21	47	1
Tibia	23	86	214	2
Metatarsal	92	20	108	11
Pig				
Humerus	3	33	27	0
Radius	31	1	8	1
Ulna	10	3	38	0
Femur	21	9	26	0
Tibia	6	27	33	0
Fibula	10	15	34	0
Phase 2				
(6th C.)				
Cattle				
Humerus	17	90	34	1
Radius	106	35	48	1
Ulna	22	4	114	0
Metacarpal	69	44	47	13
Femur	31	44	80	1
Tibia	32	75	84	0
Metatarsal	72	57	92	6
Sheep/goat				
Humerus	24	144	99	0
Radius	129	34	341	10
Ulna	41	5	80	1
Metacarpal	183	40	131	22
Femur	53	35	75	1
Tibia	30	172	329	2
Metatarsal	165	30	204	23
Pig				
Humerus	17	40	43	2
Radius	25	5	20	0
Ulna	21	8	47	0
Femur	23	13	32	2
Tibia	11	29	34	0
Fibula	7	21	37	0
Phase 3				
(Late 6th-7th C.)				
Cattle				
Humerus	3	10	5	1
Radius	3	5	4	0
Ulna	1	0	11	0
Metacarpal	4	8	1	1
Femur	3	7	3	0
Tibia	3	7	8	0
Metatarsal	3	7	7	0
Sheep/goat				
Humerus	2	30	9	0
Radius	19	10	42	2
Ulna	9	0	5	0
Metacarpal	17	4	14	4
Femur	8	7	6	0
Tibia	10	18	51	0
Metatarsal	21	3	17	0
Pig				
Humerus	4	9	4	0
Radius	4	2	3	1
Ulna	4	1	4	0
Femur	8	7	3	0
Tibia	3	4	2	0
Fibula	2	3	3	0

Table 4 Numbers of proximal, midshaft, and distal fragments and complete bones for fauna recovered from Phase 1, 2 and 3 SFBs

	Cattle	Sheep/goat	Pig	Horse
Skull	583	561	290	2
Horncore	84	160	0	0
Maxilla	130	256	88	3
Upper teeth	351	523	82	15
Mandible	469	1024	206	10
Lower teeth	493	736	135	25
Tooth frags.	25	26	13	3
Hyoid	31	85	0	0
Atlas	31	41	14	2
Axis	30	27	4	0
Scapula	278	339	118	6
Humerus	142	267	102	4
Radius	190	514	51	1
Ulna	140	127	76	4
Carpals	106	19	16	5
Metacarpals	175	380	93	7
Innominate	216	249	95	3
Sacrum	34	20	4	0
Femur	156	164	70	3
Patella	15	21	2	0
Tibia	191	533	74	11
Fibula	0	0	66	0
Astragalus	73	81	19	6
Calcaneus	75	85	29	4
Tarsals	53	20	20	15
Metatarsals	229	422	92	9
Metapodia	19	20	27	1
First phalanx	228	152	83	2
Second phalanx	151	55	26	3
Third phalanx	102	37	17	5
Sesamoids	11	0	0	0
Total	4811	6944	1912	149

Table 5 Body part distributions for the main domestic mammals from the Phase 2 SFBs

	Cattle	Sheep/goat	Pig	Horse
Skull	49	40	30	1
Horncore	13	6	0	0
Maxilla	12	23	15	1
Upper teeth	37	62	5	13
Mandible	50	95	27	5
Lower teeth	37	81	21	6
Tooth frag.	4	4	2	2
Hyoid	0	2	0	0
Atlas	13	5	3	0
Axis	6	4	1	1
Scapula	41	26	27	0
Humerus	19	41	17	1
Radius	12	73	10	1
Ulna	12	14	9	1
Carpal	17	1	2	2
Metacarpal	14	40	15	0
Innominate	38	22	31	0
Sacrum	3	4	1	0
Femur	13	21	18	1
Patella	0	0	1	0
Tibia	18	79	9	2
Fibula	0	0	8	0
Astragalus	12	12	3	0
Calcaneus	15	7	6	1
Tarsal	5	1	2	1
Metatarsal	17	41	16	3
Metapodial	4	2	9	0
First phalanx	28	11	9	0
Second phalanx	18	6	5	0
Third phalanx	15	2	6	0
Sesamoid	1	0	0	0
Total	523	725	308	42

Table 6 Body part distributions for main domestic mammals from the Phase 3 SFBs

Species ratios

(Figs 3-12; Tables 7-9)

One major goal of the analysis of the faunal remains from West Stow is an estimation of the relative importance of the different animal species at the site. Unfortunately, there is no consensus among faunal analysts concerning the ways in which species ratios ought to be calculated[4]. Two main methods have been advocated for the calculation of specific proportions: the minimum number of individuals and the fragment count method.

The minimum number of individuals (MNI) method (White 1953; Chaplin 1971) is often used by zooarchaeologists on both sides of the Atlantic. It is conceptually elegant, as it is based on the principle that seven left cattle humeri must have belonged to seven cows. To use the method, a table is drawn up for each species showing the numbers of right and left bones for each anatomical element. The highest number represents the minimum number of animals of that species that were present at the site.

The MNI method has also had its share of criticisms. The first concerns the concept of a minimum number. Guilday (1977) has shown that minimum numbers may represent a mere fraction of the animals present at the site. Therefore minimum numbers of animals cannot be used to indicate the actual numbers of animals that were consumed by the site's inhabitants.

Second, minimum numbers of individuals are variable and unpredictable for small samples. In most cases, the use of the MNI will lead to the over-representation of rare species. The reason for this is fairly obvious. While one cow bone always produces a minimum of one cow, anywhere between two and the number of bones in a cow skeleton plus one are needed for a minimum of two cattle.

The main drawback of the MNI method is its unpredictable response to the problem of aggregation (Grayson 1984), *i.e.*, the ways in which archaeological contexts are combined to form meaningful analytical units. To illustrate this problem with a very simple example, suppose an Anglo-Saxon pit contains two cattle bones (a right radius and a left humerus) and two sheep bones (a right tibia and a left innominate). This pit will therefore contain a minimum of one cow and one sheep. Suppose, however, that we subdivide the pit into two distinct (and presumably chronologically different) layers and that we include the cattle left humerus in the first layer and the other bones in the second layer. The pit as a whole would now contain a minimum of two cattle (one from each layer) and one sheep. The results of these unpredictable aggregation effects may make the MNI 'an extremely poor choice as the basic measure of relative taxonomic abundance' (Grayson 1984, 92).

The problems associated with the minimum number of individuals measure have led many analysts to use the fragment count or number of identified specimens per taxon (NISP) method (see, for example, Gautier 1984). It is a very simple method to use, as specific proportions are based on raw fragment counts. Thus a faunal assemblage containing twenty-five cattle bones and twenty-five sheep bones would produce a species ratio of 50% cattle and 50% sheep.

Unfortunately, the NISP method is not without drawbacks either. A major criticism is that the method fails to account for skeletal complexity, *i.e.*, that different animals have differing numbers of identifiable bones in their skeletons. This problem can be easily remedied. Gilbert and Singer (1982) have shown experimentally that if fragment counts are adjusted for skeletal complexity, they are more accurate predictors of known specific proportions than MNI calculations are.

Fragment count estimates, however, are subject to a more serious flaw, the problem of independence. The question of independence arises because the NISP method fails to account for associated skeletal elements or bones which originally came from the same animal. For example, eighty cattle bones might have come from eighty different animals, or they might represent a large proportion of a single animal skeleton.

The main conclusion that one can draw from this brief review of quantitative methods in zooarchaeology is that no

	Phase 1		Phase 2		Phase 3	
	NISP	%	NISP	%	NISP	%
Cattle	2539	32.6	4811	34.8	523	32.7
Sheep/goat	3479	44.7	6944	50.3	725	45.4
Pig	1683	21.6	1912	13.8	308	19.3
Horse	90	1.2	149	1.1	42	2.6
Total	7791		13816		1598	
	MNI	%	MNI	%	MNI	%
Cattle	119	24.3	230	26.8	29	28.7
Sheep/goat	278	56.9	519	60.5	51	50.5
Pig	87	17.8	103	12.0	19	18.8
Horse	5	1.0	6	0.7	2	2.0
Total	489		858		101	

Table 7 Comparison of species ratios based on fragment counts (NISP) with those based on MNIs for Phase 1, 2 and 3 SFBs

single technique can adequately and unambiguously measure the relative proportions of the animal species present at an archaeological site. Klein and Cruz-Uribe (1984, 37) have suggested that 'the NISP can be very useful when it is presented together with the MNI'. We have therefore calculated the both MNI and the NISP for the faunal assemblages from the well-dated Anglo-Saxon SFBs at West Stow (Table 7).

The species ratios based on fragment counts and minimum numbers of individuals for Phase 1 SFBs are included in Table 7. On the basis of NISP or fragment counts, sheep and goats are the most numerous of the main

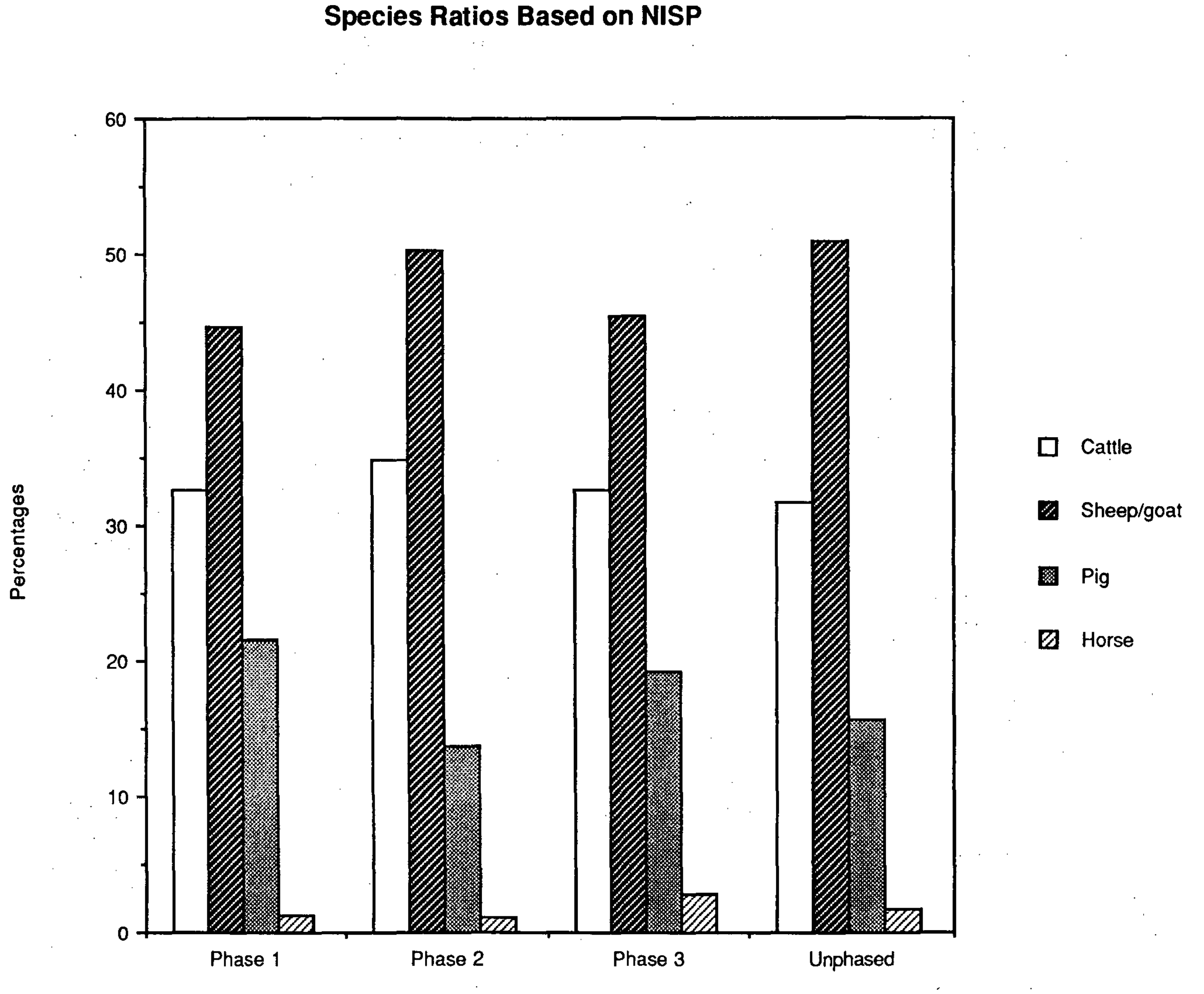


Figure 3 Species ratios based on fragment counts (NISP) for Phase 1, 2, 3 and unphased SFBs

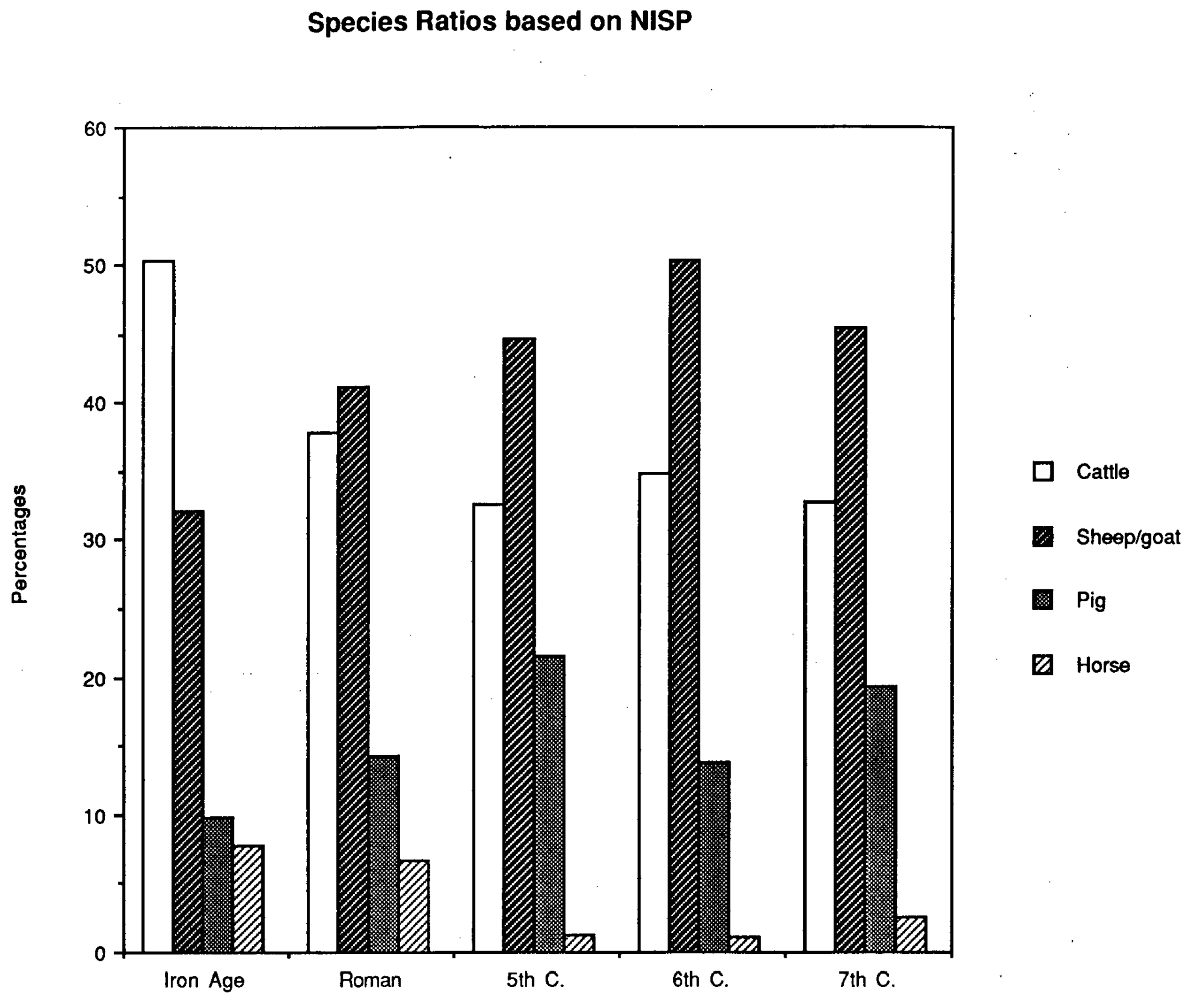


Figure 4 Species ratios based on fragment counts (NISP) for the Iron Age and Roman features and the Phase 1, 2 and 3 SFBs

domestic species, followed by cattle, pigs, and horses (Fig. 3).

These proportions are interesting for several reasons. First, there is an apparent increase in sheep and decrease in cattle when compared to Iron Age and Romano-British features (Fig. 4). While the faunal sample from the Romano-British features at West Stow is quite small (n=1824 fragments), the Iron Age features produced a substantial faunal assemblage (n=7574 fragments) which was recovered in the same way as the Anglo-Saxon animal bones. Both the MNI and the fragment count methods of quantification indicate that cattle were the most important of the main domestic mammals at West Stow during the Iron Age (Table 8).

The increased importance of sheep in the fifth century cannot be directly attributed to Anglo-Saxon influence. At coastal north German sites such as Feddersen Wierde, Wulfshof, Hessens, Hodorf, Tofting, and Barnkrug, cattle bones comprise between 60.4 and 68.5% of the main domestic mammal species[5] on the basis of fragment counts (Reichstein 1972, 146). At these north German sites sheep are relatively poorly represented, forming between 5.9 and 22.4% of the main domestic mammal assemblage on the basis of fragment counts (Reichstein 1972, 148). The evidence from Iron Age and Romano-British West Stow would suggest that we are seeing a long term local trend toward increasing numbers of sheep, a trend that continued into the high middle ages.

	NISP	% NISP	MNI	% MNI
Cattle	1390	50.3	71	46.1
Sheep/goat	890	32.2	56	36.4
Pig	270	9.8	18	11.7
Horse	215	7.8	9	5.8

Table 8 Species ratios based on MNI and NISP for all Iron Age features

Pigs also seem to increase in importance in the early Anglo-Saxon period. While pig bones make up only 9.8% of the main domestic mammals during the Iron Age and 14.3% of the small Romano-British sample (on the basis of fragment counts) more than 20% of the main domestic mammal bones at fifth-century West Stow are pig bones. Particularly high proportions of pig bones are seen in SFBs 36, 48, 52, 61, and 64 (Fig. 5 and Table 9). All but SFB 64 are dated to the early part of the fifth century. Hut 64 is dated to the fifth century in general, but the presence of faceted-angled pottery sherds in the primary fill suggests that the building was initially occupied in the early part of the century (West 1985a, 148). Thus pigs seem to have played an important role in the establishment of the farming village at West Stow in the early part of the fifth century. The high proportions of pigs at this site in the

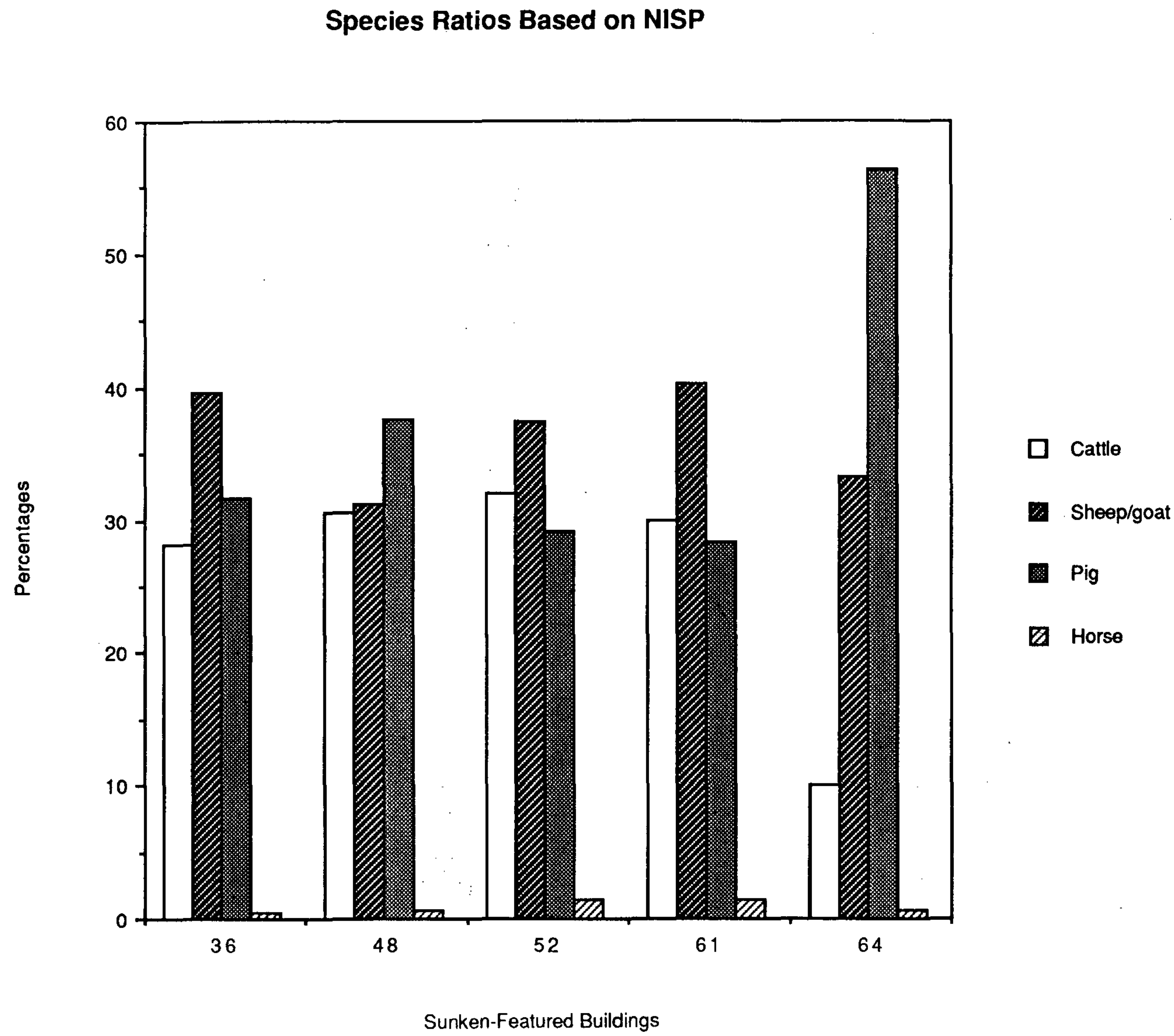


Figure 5 Fifth-century SFBs showing high proportions of pig remains (based on NISP).

	SFB 36		SFB 48		SFB 52		SFB 61		SFB 64	
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Cattle	270	28.1	43	30.5	114	32.0	104	29.9	61	10.0
Sheep/goat	382	39.7	44	31.2	133	37.4	140	40.3	205	33.2
Pig	305	31.7	53	37.6	104	29.2	99	28.4	348	56.3
Horse	5	0.5	1	0.7	5	1.4	5	1.4	4	0.6

Table 9 Species ratios for fifth-century SFBs showing high proportions of pig bones based on NISP

early fifth century cannot be attributed to Continental Saxon influence. At Feddersen Wierde (Reichstein 1972, 144), for example, pig bones comprise only 5.3% of the main domestic mammal remains on the basis of fragment counts.

The importance of pigs in the earliest phases of the Anglo-Saxon occupation of West Stow can be seen most clearly when we compare the proportion of pig bones in the SFBs that are clearly dated to the early part of the fifth century (SFBs 21, 36, 48, 51, 55, and 61) to the proportion of pig remains in the later fifth-century huts (SFBs 5, 6, and 17; Fig. 6). Of the 3124 large domestic mammal bones identified from the early fifth-century SFBs, 30.6% are cattle, 45.0% are sheep and goats, 23.4% are pigs, and 0.9% are horsesThe late fifth-century huts produced 1647 large domestic mammal bones of which 38.5% were cattle, 47.5% were sheep and goats, 12.3% were pigs and 1.7% were horses. There therefore seems to be a substantial decline in the proportion of pigs between the early and the later part of the fifth century.

The high proportion of pigs in the early fifth-century faunal assemblage can be explained in two ways. If we assume that the Anglo-Saxons who settled in the village were immigrants from the Continent, then the high proportion of pigs can be seen as an adaptation to the colonial situation. These early Anglo-Saxon settlers would have had to establish farms in parts of Britain that were quite unlike their continental homelands.

It is possible, and perhaps more likely, that the West Stow settlement was established by a group of 'saxonized'

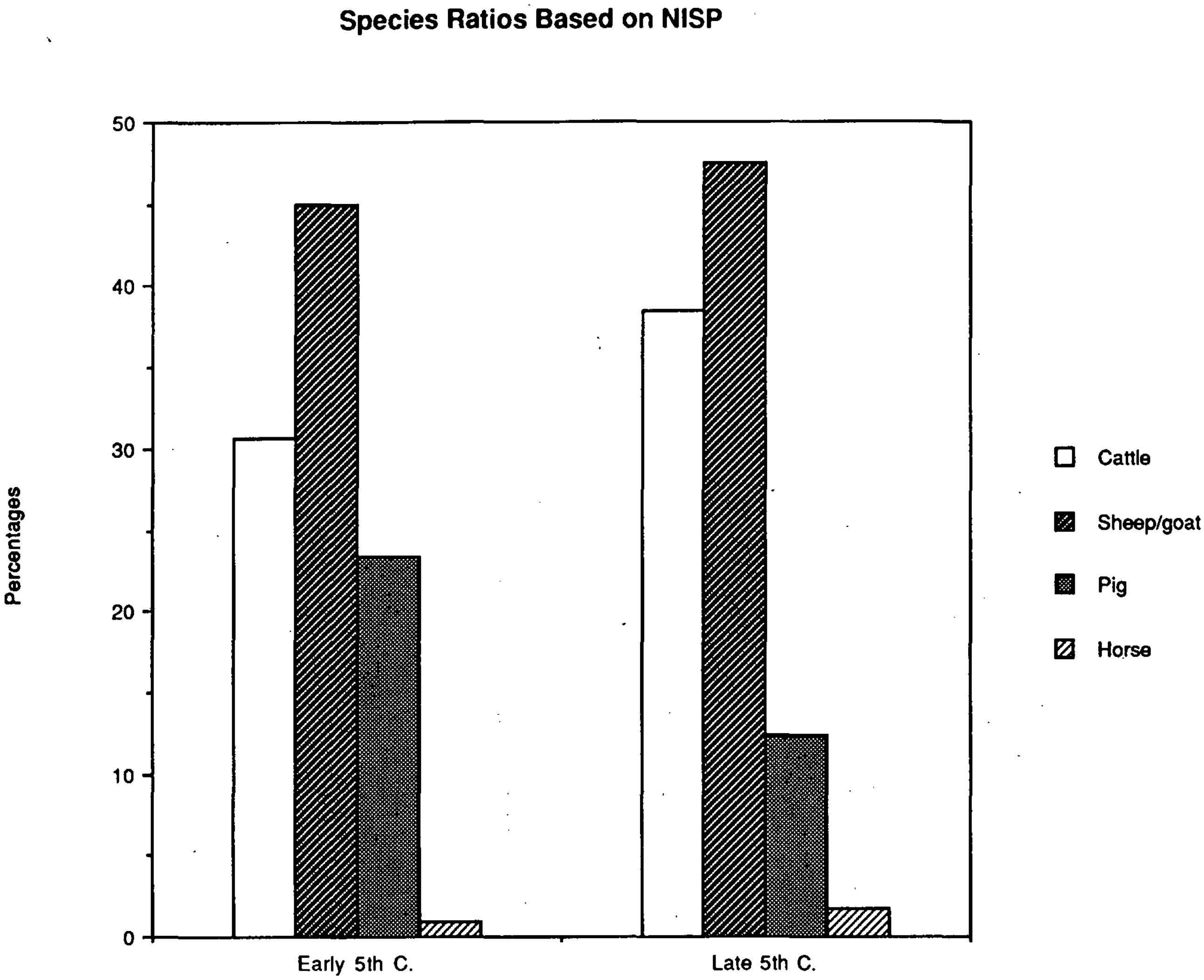


Figure 6 Comparison of species ratios based on NISP for early and late fifth-century SFBs

Britons in the early part of the fifth century. Pigs may have been advantageous in this case as well, since they reproduce rapidly and would have allowed the farmers at the new village to establish their herds quickly.

The high proportion of pigs in many of the early fifth-century SFBs raises the question of the availability of pannage, since the West Stow Breckland is not ideal pig rearing country. Some low-lying parts of the river terraces support oaks even today, and these areas may have provided local pannage for pigs. It is possible that the inhabitants of West Stow made use of the more heavily forested areas of the central clay belt (Fig. 1) in order to provide additional areas of pannage. Since the clay areas were heavily occupied in Roman times, the use of the clay belt for pannage might provide some indirect evidence for continuity between the Romano-British and Anglo-Saxon settlements.

In contrast to the pigs, horse bones appear in very small numbers. In the fifth century, horses comprise a mere 1.2% of the main domestic mammals on the basis of fragment counts, down from 7.8% during the Iron Age and 6.6% during the Romano-British period. The small numbers of horses at West Stow are in sharp contrast to the data from Feddersen Wierde where horses comprise 14.6% of the main domestic animal bones (Reichstein 1972: 144). The West Stow data suggest that horses were at most a relatively minor part of the pagan Anglo-Saxon diet.

Estimates of species ratios based on the Minimum Numbers of Individuals[6] for the fifth-century SFBs (Table 6 and Fig. 7) show some interesting differences from those based on fragment counts. The MNI-based species ratios increase the relative importance of sheep/goat at the expense of the other species. The reasons for this will be explored in greater detail when we examine the body part distributions for the main domestic species (see below). Despite these differences, it is clear that the rank order importance of the main domestic mammals remains the same. Sheep and goats remain the most common animals, followed by cattle, pigs, and horses, respectively.

The body part distributions for the main fifth-century mammalian species are shown in Table 3. The sheep/goat bones include relatively high numbers of mandibles, radii, and tibiae. In contrast, the smallest elements of the sheep/goat skeleton (phalanges, carpals, tarsals, sesamoids, and the like) appear to be markedly underrepresented. This can be seen most clearly in Figure 8. The vertical lines show the overall proportion of cattle to sheep based on the total minimum number of individuals (MNI) and the total fragment count (NISP) for the Phase 1 faunal assemblage. The proportion of cattle to sheep also has been calculated for each anatomical element. The relatively low proportions of sheep/goat phalanges, carpals, tarsals, and

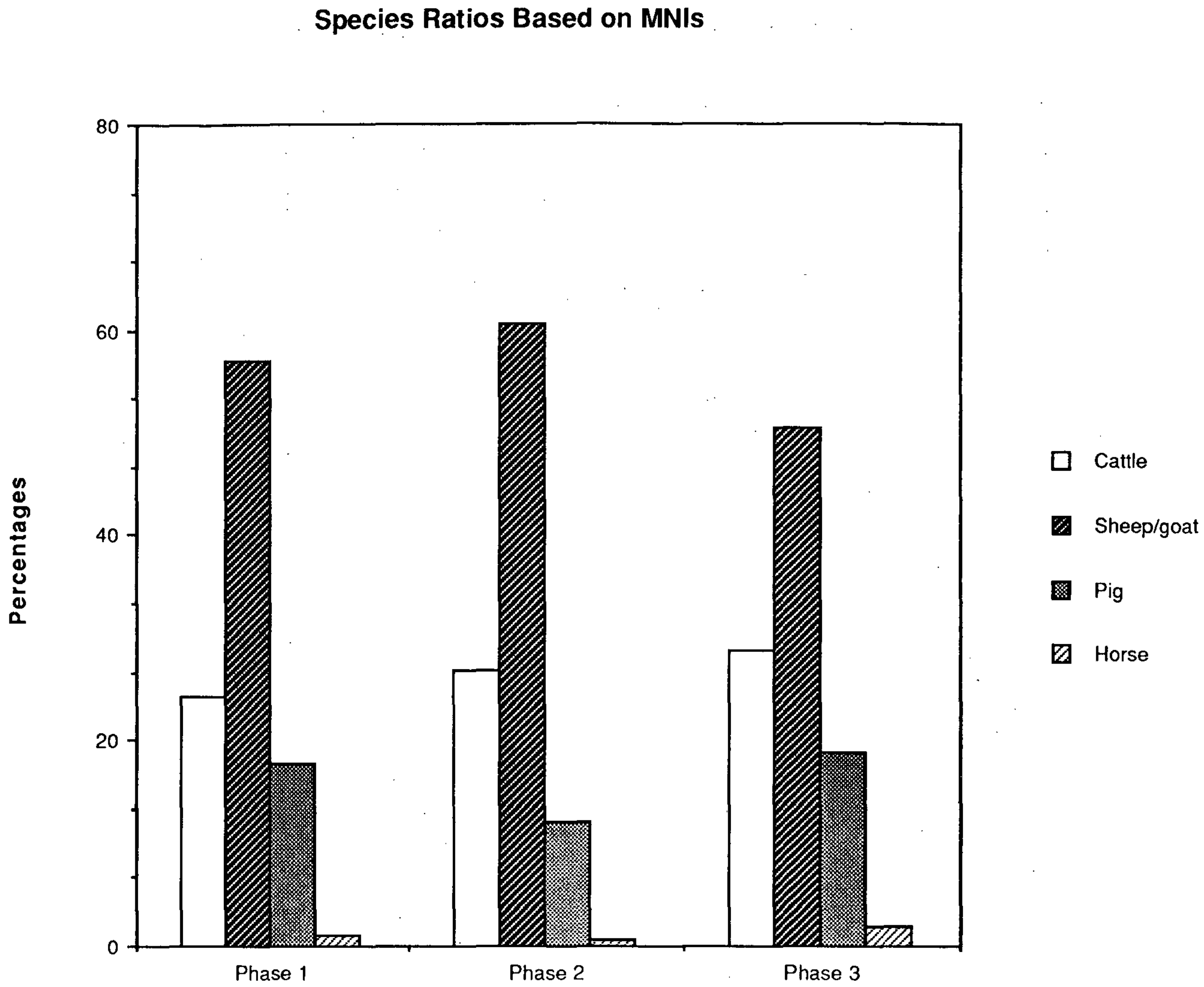


Figure 7 Species ratios based on MNIs for the Phase 1, 2 and 3 SFBs

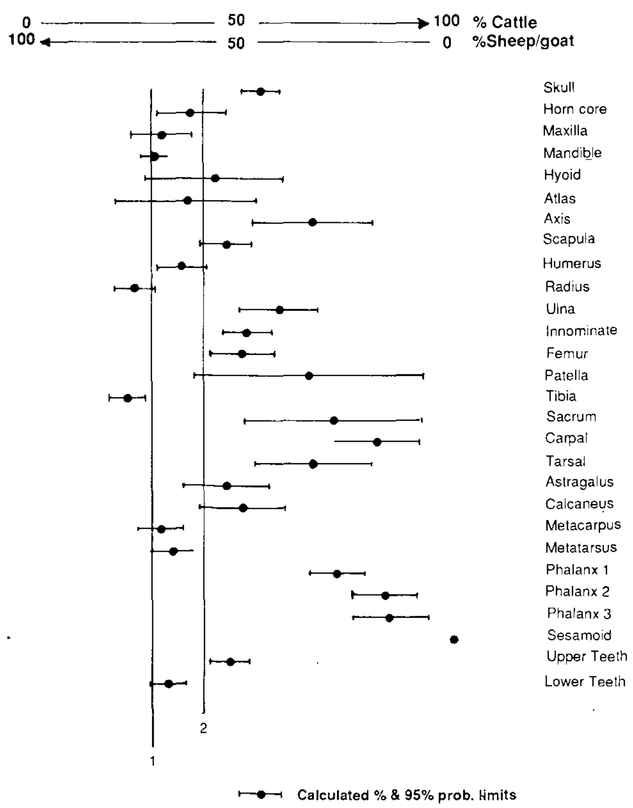


Figure 8 Species ratios calculated for each anatomical element for cattle and sheep/goats from Phase 1 SFBs. *1.* Ratio of cattle to sheep based on MNI; *2.* Ratio of cattle to sheep based on NISP (illustration supplied by Sebastian Payne)

sesamoids undoubtedly result from recovery bias. These small anatomical elements are generally poorly recovered in unsieved samples (Payne 1975).

This systematic recovery bias has important implications for our attempts to estimate the relative importance of the main domestic mammals at West Stow. Fragment count (NISP) estimates are based on the total number of bones identified for each animal species. In an unsieved sample proportions based on fragment counts may systematically underestimate the importance of the smaller species whose bones are more likely to be missed by excavators without sieves. The species ratios based on MNIs may more accurately reflect the relative proportions of species of different sizes. These are based on the most common anatomical elements (generally mandibles) which are less subject to recovery bias in an unsieved sample than small elements.

Although the lack of wet sieving may hamper our ability to accurately estimate the relative importance of species of different sizes, it should not prevent us from

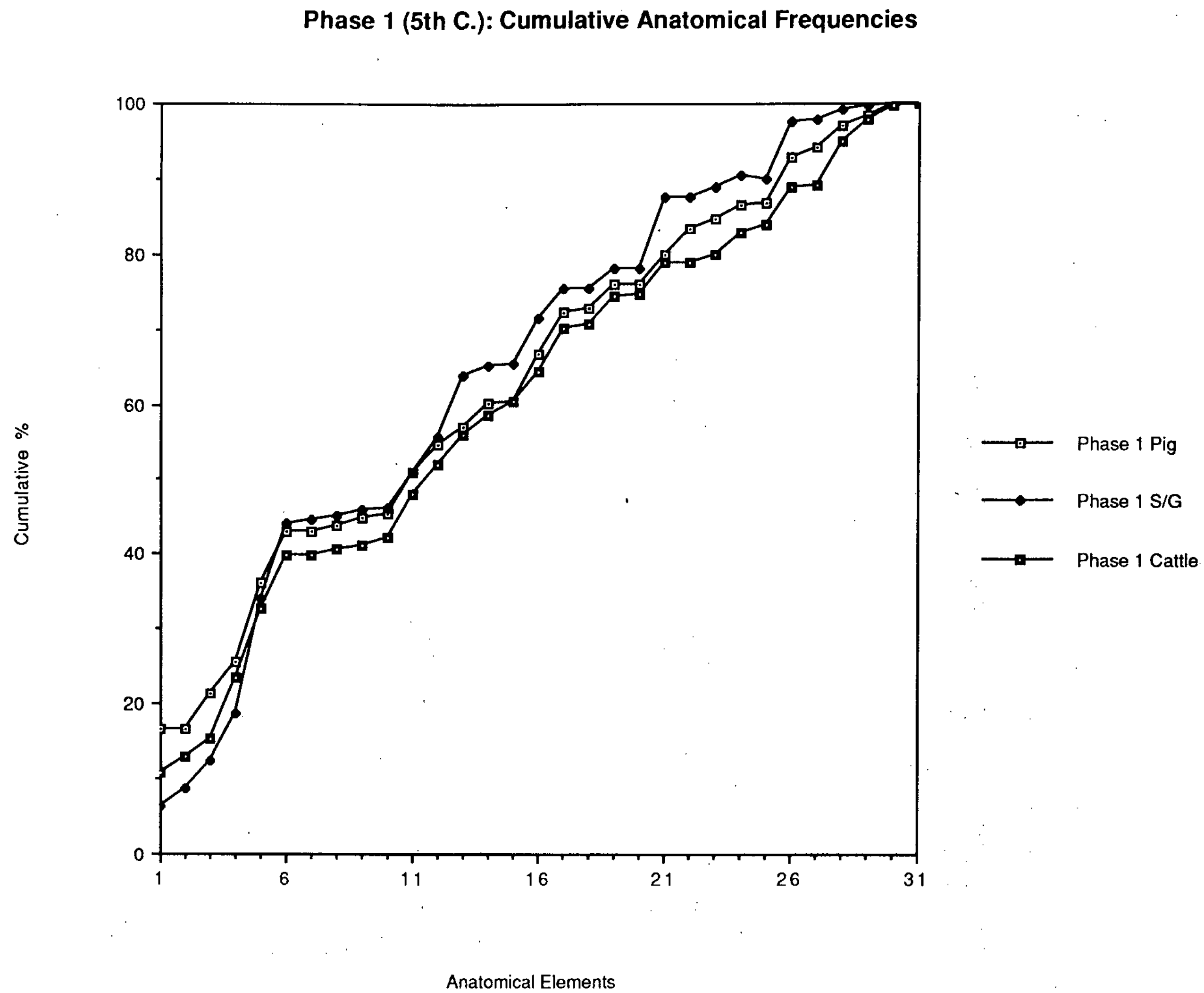


Figure 9 Body part distributions for cattle, sheep/goats, and pigs from Phase 1 SFBs expressed as a cumulative percentage

Key:

1. skull;	*2.* horncore;
3. maxilla;	*4.* upper teeth;
5. mandible;	*6.* lower teeth;
7. tooth fragments;	*8.* hyoid;
9. atlas;	*10.* axis;
11. scapula;	*12.* humerus;
13. radius;	*14.* ulna;
15. carpal;	*16.* metacarpus;
17. innominate;	*18.* sacrum;
19. femur;	*20.* patella;
21. tibia;	*22.* fibula;
23. astragalus;	*24.* calcaneus;
25. tarsal;	*26.* metatarsus;
27. metapodium;	*28.* first phalanx;
29. second phalanx;	*30.* third phalanx;
31. sesamoid.	

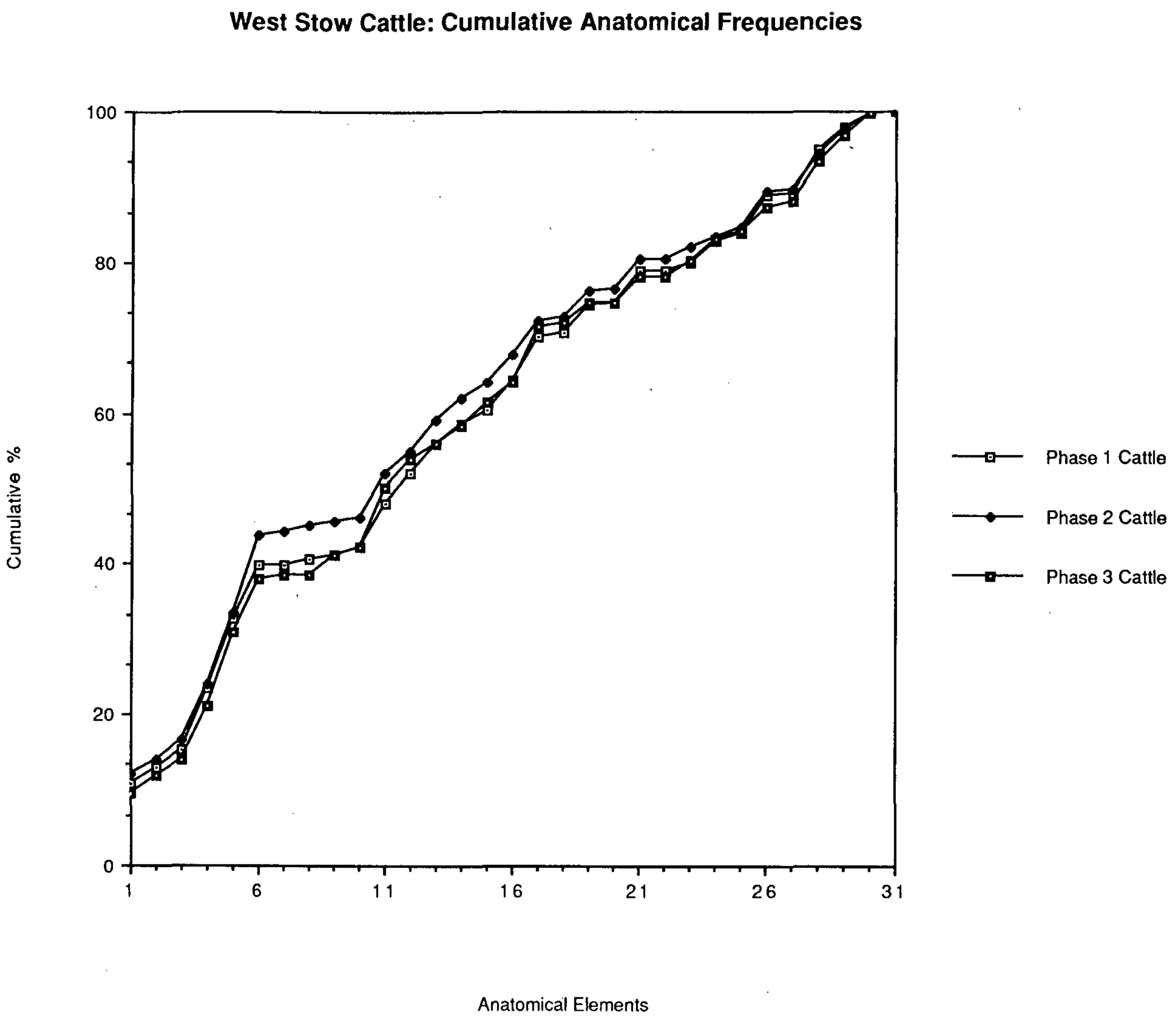


Figure 10 Body part distributions for cattle expressed as a cumulative percentage.

observing changes through time in species ratios, provided that all the deposits were recovered in the same way. All the fauna from the SFBs was recovered through careful hand trowelling, though by a variety of individual excavators working under varying conditions. Recovery bias will therefore affect all the hut deposits in more or less the same ways, though not necessarily to a uniform extent. However, when the body part distributions for the cattle, sheep/goats, and pigs from Phase 1 SFBs are expressed as cumulative proportions and compared (Fig. 9), we see real differences between the different species. For example, small anatomical elements, such as phalanges and sesamoids, are most poorly represented among the sheep/goat bones and least poorly represented among the cattle bones. As noted above, this seems to indicate that recovery bias was one of the factors structuring the faunal assemblage. When the body part distributions for the fifth-, sixth- and seventh-century cattle (Fig. 10), sheep/goat (Fig. 11) and pig (Fig. 12) are compared, we see that the pattern of body part representation for each species remains essentially unchanged throughout the Anglo-Saxon occupation. This would seem to indicate that whatever biases were structuring the faunal assemblage from West Stow, they were structuring the faunal assemblages from all three Saxon phases in similar ways. It is therefore reasonable to suggest that differences in species ratios between the fifth-, sixth- and seventh-century faunal assemblages reflects real differences in taxonomic abundance, and not simply differences in the way the assemblages were structured.

When the species ratios for the Phase 2 faunal assemblage are estimated on the basis of fragment counts, we see an increase in the proportion of sheep/goat bones to 50.3% of the identifiable large domestic mammal bones (Table 6). Cattle are next in importance, followed by pigs and horses. The species ratios (Fig. 3) are broadly similar to those of the fifth century, indicating no radical change in animal husbandry practice through time. In the sixth century, however, there is a decline in the proportion of pigs and a corresponding increase in the relative importance of sheep and goats. Once a permanent Anglo-Saxon farming community had been established at West Stow, pigs may have declined in importance due to the limited availability of forest in the immediate area.

Species ratios based on the Minimum Number of Individuals for the faunal sample from the Phase 2 SFBs (Table 6 and Fig. 7) also indicate a relative increase in the proportions of sheep and goats and a decline in the proportion of pigs[7]. The species ratios based on MNIs show a higher proportion of sheep/goat and a relatively lower proportion of the other domestic mammals,

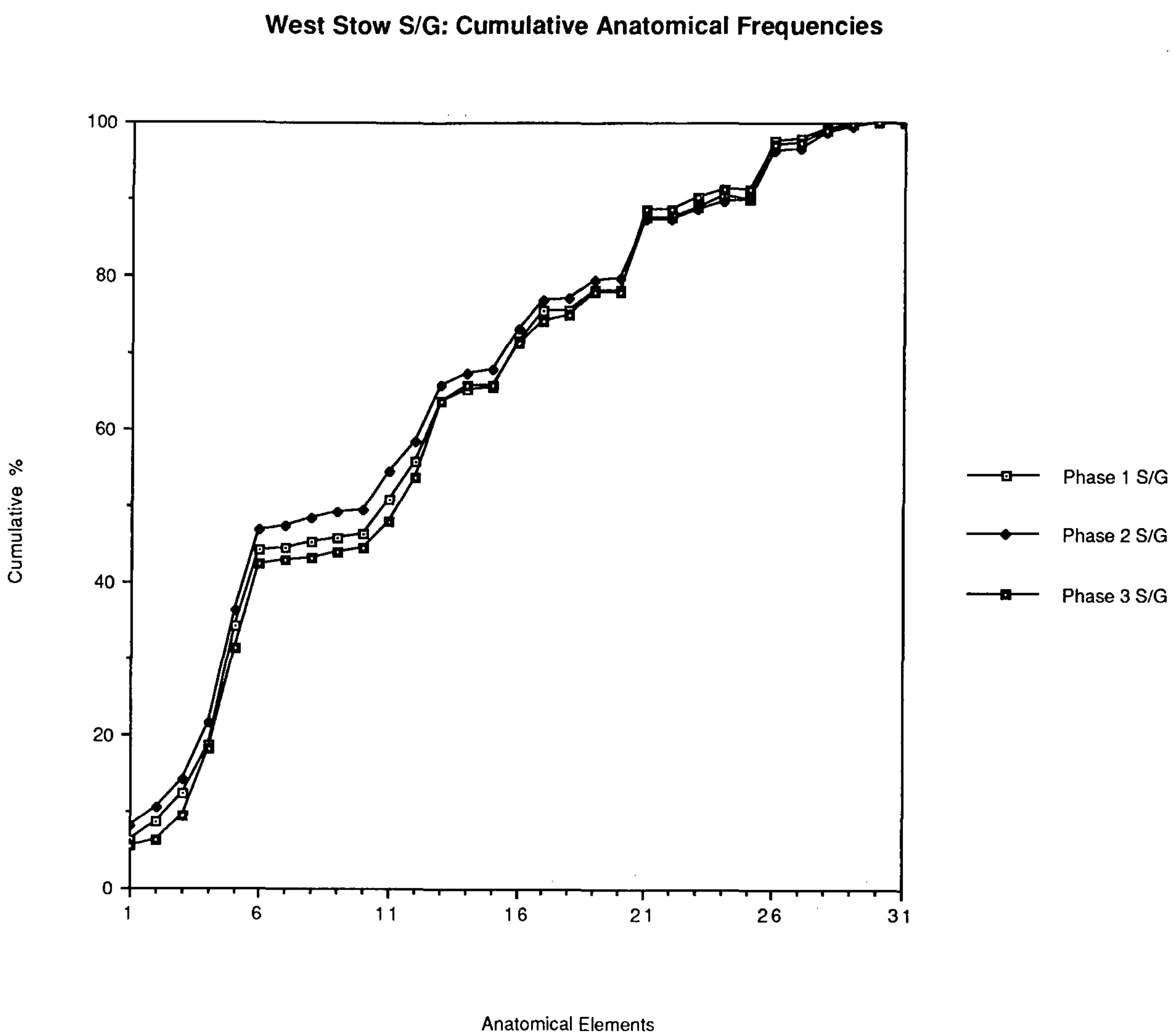


Figure 11 Body part distributions for sheep/goats expressed as a cumulative percentage.

especially cattle, when compared to the species ratios based on fragment counts (NISP). Since, as noted above, the NISP-based ratios are likely to underrepresent the relative importance of smaller species such as sheep, the MNI-based proportions may provide better estimates of the relative importance of sheep in the sixth century.

Species ratios based on fragment counts indicate that sheep/goat remains the predominant species during the seventh century. Cattle are second in importance, followed by pigs and horses. The seventh-century species ratios are generally similar to the fifth- and sixth-century proportions, suggesting broad continuities in animal husbandry practices. When compared to Phase 2, the Phase 3 assemblage shows an increase in the proportion of pigs and horses and corresponding decreases in the proportions of sheep and cattle. They are generally more similar to the fifth- than to the sixth-century species ratios.

Species ratios based on minimum number of individuals calculations also reflect an increase in the proportion of pigs and horses and a decrease in the importance of sheep when compared to the sixth-century data. In terms of MNIs, cattle show a slight increase in frequency, while they show a slight decrease in terms of fragment counts. These changes are so small, however, that it seems reasonable to assume that the proportion of cattle remained unchanged between the sixth and seventh centuries.

Due to the small size of the late sixth-earlier seventh-century sample, any conclusions drawn from it should be treated with some caution. Nevertheless, it is possible that the changes in the proportions of sheep and pigs, which are apparent in both the MNI and NISP calculations may reflect real changes in the availability of and access to pasture and pannage through time.

Unphased huts
(Tables 10 and 11)
A small number of the Anglo-Saxon huts could not be assigned to one of the three main chronological phases. These huts generally produced only a small number of artefacts, and the animal bone samples from these contexts are not large either. The fauna were analyzed to determine whether species present and their relative proportions were similar to those already described for the phased huts. The unphased huts produced a total of 7123 mammal bones and fragments (Table 10). The mammal species present include cattle, sheep and goat, pig, horse, dog, cat, red deer, roe deer, and badger. The vast majority of the identifiable remains are those of the domestic mammals.

On the basis of fragment counts, sheep and goats

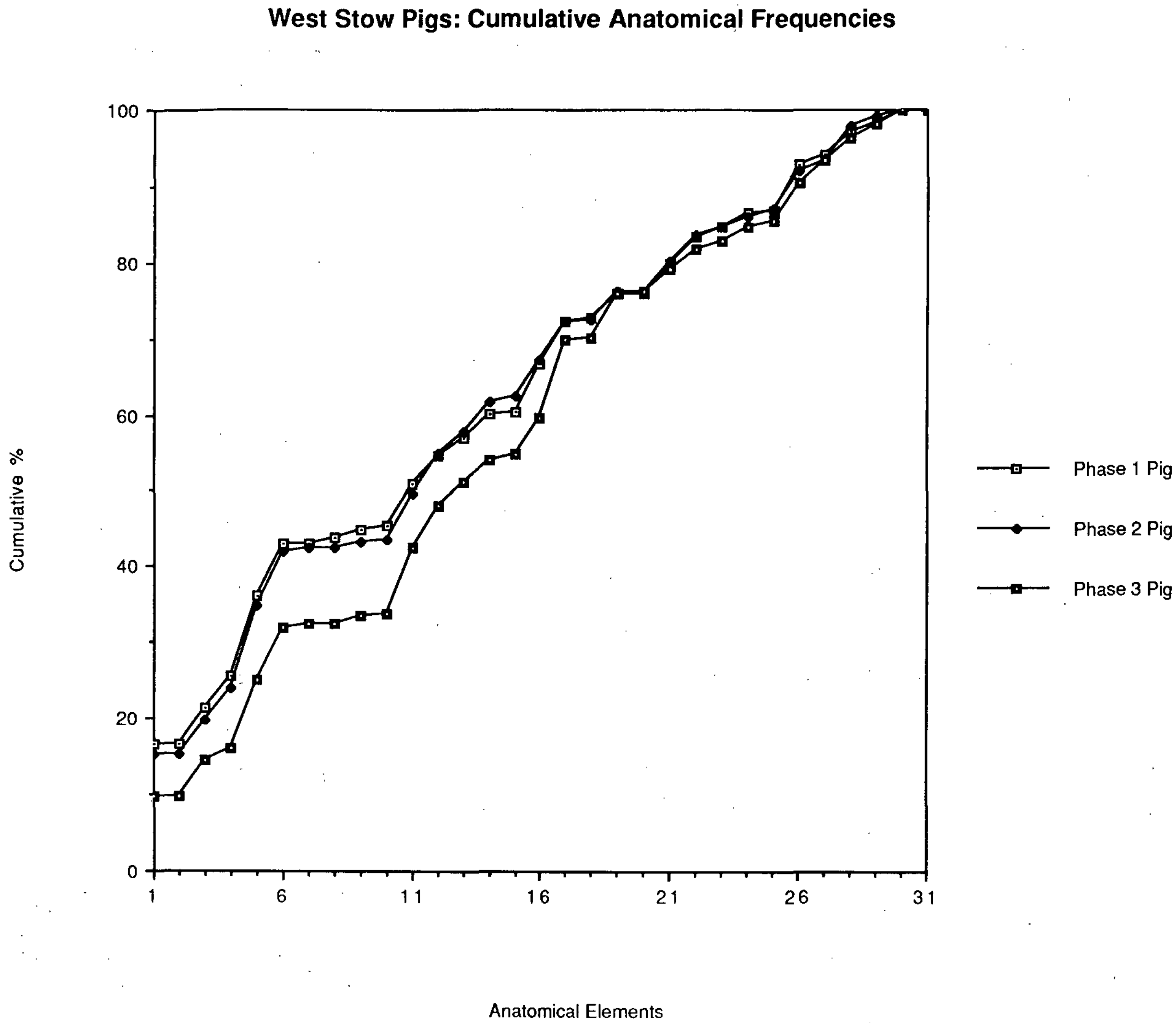


Figure 12 Body part distributions for pigs expressed as a cumulative percentage.

(51.0%) are the most commonly represented of the main domestic food mammals, followed by cattle (31.7%), pigs (15.6%), and horses (1.7%). The species ratios based on fragment counts are generally similar to those calculated for the phased huts (Fig. 3). Sheep outnumber goats by a ratio of nearly 50:1. The unphased huts also include a large number (211) of dog bones. This reflects the presence of two dog skeletons which were recovered from SFB 16.

The body part distributions for the main mammalian species are shown in Table 11. High proportions of sheep/goat radii, tibiae, mandibles, and loose teeth are present in the unphased hut sample, while sheep/goat phalanges, carpals, tarsals, and sesamoids are underrepresented. The body part distributions are generally similar to those seen in the faunal assemblages from the phased SFBs.

Anglo-Saxon huts: spatial distributions

(Fig. 13; Table 12)

In an analysis of the Anglo-Saxon settlement pattern at West Stow, West (1985a) has convincingly shown that the SFBs at the site cluster around seven small post-built halls. We therefore examined the faunal remains from each hut cluster to determine whether there were any systematic differences in species ratios between the different hall groups. The species ratios, based on fragment counts, for the seven hall clusters are shown in Figure 13 (see also Table 12). From the figure it is clear that there are real differences in species ratios between the different clusters of huts.

While most of the hall groups produced 13-15% pig remains, pigs make up over 23% of the Hall 3 domestic mammal bones and 26% of the Hall 6 assemblage. As noted above, particularly high proportions of pig bones are found in SFBs 36, 48, and 52 (associated with Hall 3) and SFBs 61 and 64 (associated with Hall 6). All are well dated to the fifth century, and all but SFB 64 are convincingly assigned to the earliest part of the fifth century. West (1985a, 148) notes that the fragmentary *Buckelurne* from SFB 64 indicates that it was occupied between AD 450 and 500, 'but the presence of faceted-angled sherds suggests a beginning in the earlier half of the century'. These data lend further support to the idea that the earliest Anglo-Saxon settlers at West Stow relied heavily on pigs. It is interesting to note that the Hall 6 group includes only about 27% cattle bones, the lowest proportion of all the hall groups. It seems reasonable to assume that pigs were a major source of meat during the earliest phase of the occupation, and that beef became a more important source of meat during the sixth century. This hypothesis will be

	Unph.	ASP	ASD7	ASD	ASF	PHF	L.2
Domestic Mammals							
Cattle	744	883	457	273	2536	1396	11850
Sheep	240	183	85	50	422	328	1776
Goat	5	2	1	0	6	0	15
Sheep/goat	951	902	459	300	2232	1491	7803
Pig	366	348	196	100	832	374	3073
Horse	41	71	21	17	103	43	660
Dog	211	19	4	3	21	15	251
Cat	8	2	0	2	4	2	26
Total Domestic Mammals	2566	2410	1223	745	6156	3649	25454
Wild Mammals							
Red deer	4	2	0	0	6	5	24
Roe deer	1	2	1	2	2	1	12
Hare	0	0	0	1	0	0	1
Badger	1	0	0	0	0	0	2
European brown bear	0	0	0	0	0	0	1
Fox	0	0	0	0	1	0	0
Rabbit	26	5	6	5	23	8	74
Total Wild Mammals	32	9	7	8	32	14	114
Small artiodactyl	945	612	263	134	1185	1367	3068
Large artiodactyl	60	76	27	36	246	107	1081
Large mammal	614	640	232	270	1520	1009	5584
Unidentified mammal	2906	2450	2268	1009	5579	4782	18769
Total	7123	6197	4020	2202	14718	10928	54070

Table 10 Animal bones identified from unphased SFBs (Unph.), Anglo-Saxon pits (ASP), Anglo-Saxon seventh-century ditches (ASD7), Anglo-Saxon ditches (ASD), post-hut fills (PHF), and Layer 2 (L.2). Numbers indicate the number of identified specimens per taxon (NISP)

	Cattle	Sheep/goat	Pig	Horse
Skull	69	82	58	1
Horncore	14	19	0	0
Maxilla	13	38	16	0
Upper teeth	53	101	8	2
Mandible	76	137	48	4
Lower teeth	71	125	32	12
Tooth frag.	6	20	6	0
Hyoid	6	7	0	0
Atlas	7	7	5	1
Axis	9	6	1	0
Scapula	45	50	20	0
Humerus	27	59	21	1
Radius	26	100	13	2
Ulna	19	23	12	1
Carpal	15	6	1	2
Metacarpal	42	70	7	1
Innominate	28	46	28	2
Sacrum	6	9	0	0
Femur	23	37	14	2
Patella	6	3	3	0
Tibia	29	111	13	2
Fibula	0	0	12	1
Astragalus	24	20	6	0
Calcaneus	11	14	7	1
Tarsal	14	4	2	0
Metatarsal	27	59	15	1
Metapodial	5	4	1	0
First phalanx	26	27	12	2
Second phalanx	35	8	2	1
Third phalanx	12	4	3	3
Sesamoid	0	0	0	0
Total	744	1196	366	42

Table 11 Body part distributions for the main domestic mammals from the unphased SFBs

examined in greater detail in the section on ageing (Chapter 4), below.

The Hall 1 group includes a comparatively high proportion of cattle bones (42%). In terms of fragment counts, cattle bones are almost as common as those of sheep and goats. The significance of the high percentage of cattle remains is not entirely clear. The three SFBs associated with Hall 1 produced only a small faunal assemblage (1138 bones of cattle, sheep, goat, pig, and horse), and it is possible that this variation in the frequency of cattle remains is simply a reflection of the small size of the Hall 1 faunal sample.

A relatively high percentage of horse bones (2.3%) was recovered from Hall 7. Most of the SFBs associated with Hall 7 are dated to the late sixth-seventh centuries. The high percentage of horses in the Hall 7 faunal sample parallels the increasing frequency of horses seen in the Phase 3 faunal sample in general. It is not clear why the relative frequency of horse bones should have increased in the early seventh century. It is possible that the Anglo-Saxons at West Stow may have slaughtered any excess or ageing horses before abandoning the site, leading to an increase in the proportion of horse bones in the Phase 3 faunal samples.

The Hall 7 SFBs also produced a relatively high proportion of sheep and goat bones. In general, the proportions of sheep in the Hall 4, 5, and 7 samples are slightly higher than the percentage of sheep in the Hall 1, 2, 3, and 6 assemblages. This might suggest a slight increase in the importance of sheep during the course of the West Stow occupation. This is not an unexpected development, for, by the time of the *Domesday Survey*, sheep were the predominant animals in Suffolk generally (West 1985a, 169).

Species Ratios Based on NISP

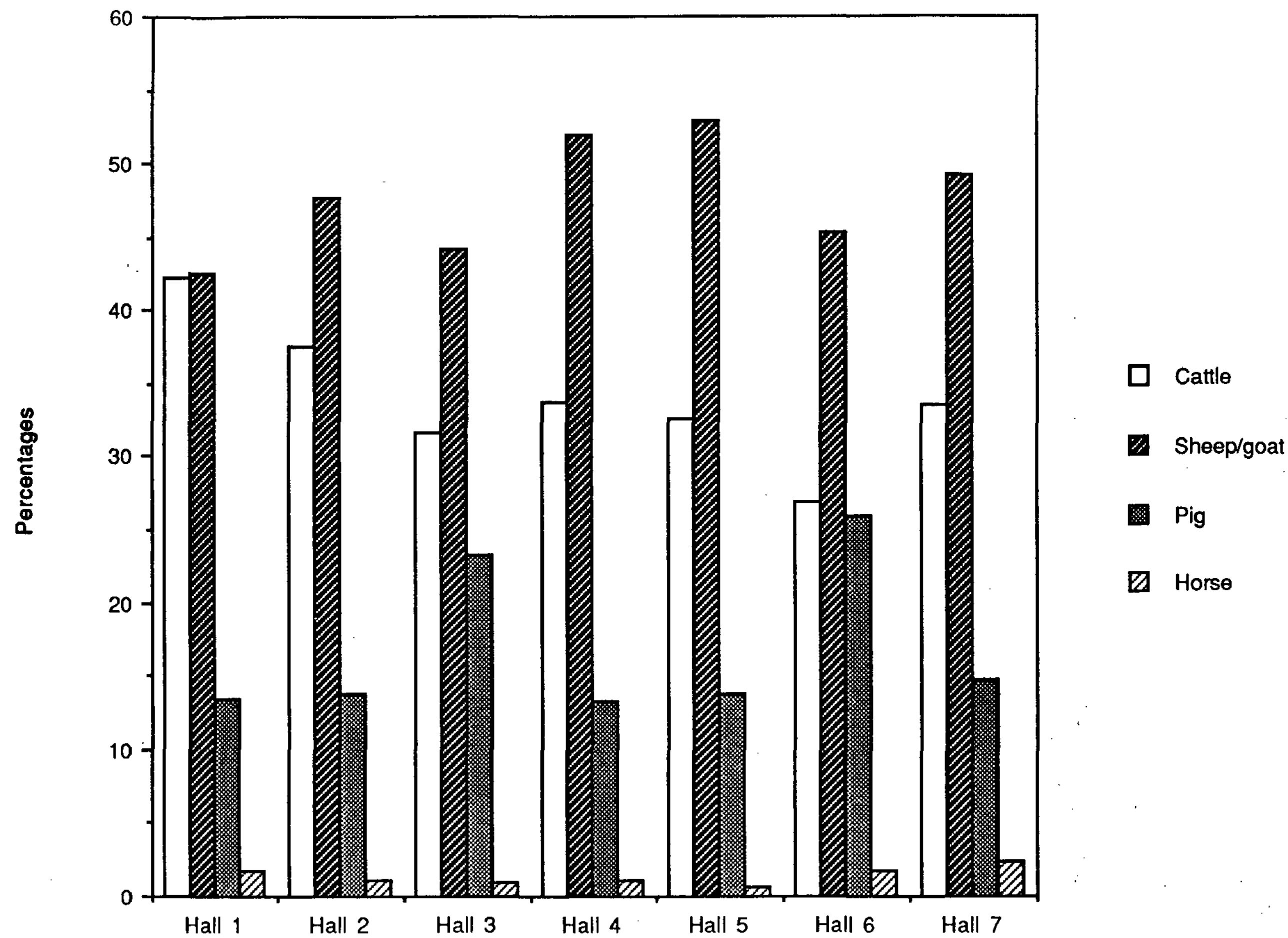


Figure 13 Species ratios based on fragment counts (NISP) for the SFBs associated with each of the small halls

	COW	%	S/G	%	PIG	%	HOR	%	TOTAL
Hall 1	481	42.3	485	42.6	152	13.4	20	1.8	1138
Hall 2	2676	37.5	3394	47.6	987	13.8	79	1.1	7136
Hall 3	1051	31.7	1465	44.1	771	23.2	32	1.0	3319
Hall 4	848	33.7	1308	52.0	334	13.3	27	1.1	2517
Hall 5	1447	32.6	2345	52.9	611	13.8	30	0.7	4433
Hall 6	859	26.9	1446	45.3	830	26.0	54	1.7	3189
Hall 7	1092	33.6	1603	49.3	482	14.8	75	2.3	3252

Table 12 Species ratios based on NISP for the SFBs associated with each of the small halls

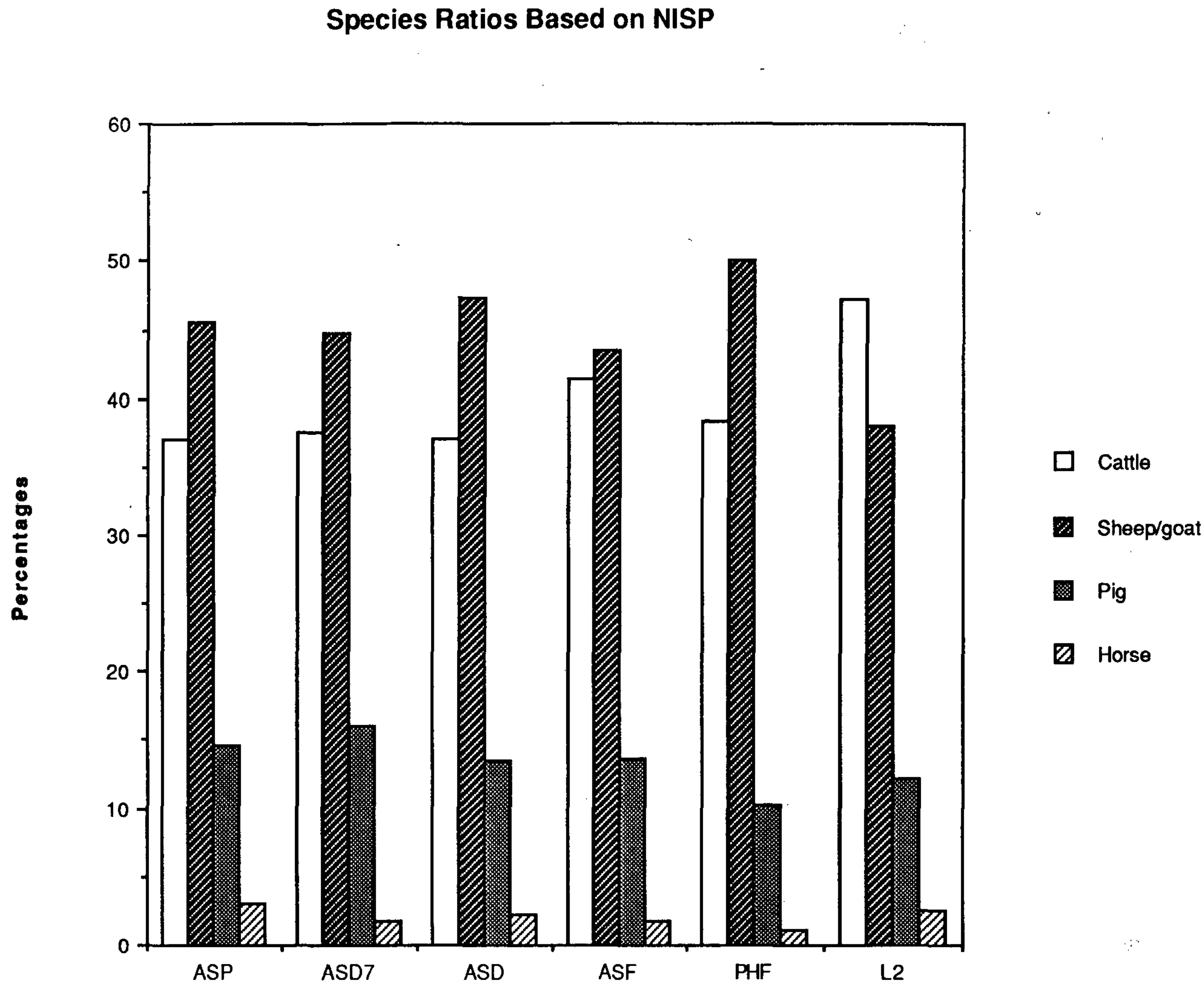


Figure 14 Species ratios based on NISP for all other Anglo-Saxon features

No clear conclusions can be drawn from the analysis of the fauna by hall groups. Most of the differences that are apparent between the different hall groups seem to reflect chronological changes in species ratios, rather than differences in social or economic status between the family groups.

III. Other Anglo-Saxon Features

(Fig. 14; Tables 10, 13-18)

In addition to the faunal material from the fifth-, sixth-, and seventh-century huts, animal bones were recovered from Anglo-Saxon pits, ditches, features (primarily hollows), and Layer 2 (Fig. 14). The mammal bones from these contexts were studied to determine whether there is any significant intrasite variation in the distribution of animal bones across the site.

Pits

(Table 13)

A total of 6197 mammal bones and fragments was recovered from the Anglo-Saxon pits (Table 10). The species present included cattle, sheep, goat, sheep/goat, pig horse, dog, cat, red deer, and roe deer. The species ratios based on fragment counts are comparable to those calculated for the huts; 45.5% of the domestic mammal remains are those of sheep and goats, followed by cattle (37.0%), pigs (14.6%), and horses (3.0%). The body part distributions for the main domestic mammal species are shown in Table 13.

Seventh-century ditches

(Table 14)

The majority of Anglo-Saxon ditches are of seventh-century date. These features produced a total of 4020 mammal bones and fragments including the remains of cattle, sheep, goat, pig, horse, dog, and roe deer (Table 10). The species ratios are quite similar to those seen for the Phase 3 SFBs. Sheep and goats are the predominant species, accounting for 44.8% of the identifiable domestic food mammal bones. Cattle are second in importance (37.5%), followed by pigs (16.1%), and horses (1.7%).

The anatomical distributions for the main domestic mammals are shown in Table 14. When the anatomical distributions for these ditches are compared to those for the Anglo-Saxon pits, we find a higher proportion of loose teeth in the ditches. Cranial fragments are relatively more common from the pits. This pattern was also seen in the

	Cattle	Sheep/goat	Pig	Horse
Skull	81	86	43	4
Horncore	14	13	0	0
Maxilla	20	26	16	1
Upper teeth	70	79	12	7
Mandible	89	164	39	4
Lower teeth	74	144	24	8
Tooth frags.	5	1	2	3
Hyoid	1	4	0	0
Atlas	16	10	6	1
Axis	4	4	5	1
Scapula	48	52	30	2
Humerus	32	58	22	3
Radius	40	83	11	1
Ulna	29	12	21	1
Carpal	20	2	2	3
Metacarpus	48	61	4	6
Innominate	45	53	20	2
Sacrum	9	3	0	0
Femur	31	26	16	0
Patella	4	3	1	0
Tibia	35	116	15	2
Fibula	0	0	11	0
Astragalus	20	8	4	2
Calcaneus	22	8	3	1
Tarsal	12	1	5	1
Metatarsus	47	58	16	4
Metapodium	6	1	4	2
First phalanx	33	9	8	5
Second phalanx	19	2	4	5
Third Phalanx	9	0	4	2
Sesamoid	0	0	0	0
Total	883	1087	348	71

Table 13 Body part distributions for the main domestic mammal bones recovered from the Anglo-Saxon pits

	Cattle	Sheep/goat	Pig	Horse
Skull	29	30	24	0
Horncore	5	11	0	0
Maxilla	6	10	16	0
Upper teeth	54	77	14	2
Mandible	38	49	20	1
Lower teeth	53	74	19	1
Tooth frags.	10	19	3	0
Hyoid	2	1	0	0
Atlas	1	4	2	0
Axis	4	5	0	0
Scapula	23	8	4	0
Humerus	14	27	9	0
Radius	7	48	3	0
Ulna	16	4	12	0
Carpal	17	2	0	1
Metacarpus	14	28	11	3
Innominate	16	22	11	1
Sacrum	2	0	1	0
Femur	13	11	5	1
Patella	0	0	0	1
Tibia	15	42	6	3
Fibula	0	0	6	0
Astragalus	4	8	5	0
Calcaneus	11	11	5	0
Tarsal	7	0	3	1
Metatarsus	32	41	4	1
Metapodium	7	1	3	1
First phalanx	30	5	4	2
Second phalanx	18	5	4	0
Third Phalanx	7	3	2	1
Sesamoid	2	0	0	1
Total	457	546	196	21

Table 14 Body part distribution for the main domestic mammal bones recovered from seventh-century ditches

	Cattle	Sheep/goat	Pig	Horse
Skull	25	22	17	1
Horncore	5	2	0	0
Maxilla	6	8	11	0
Upper teeth	23	46	3	3
Mandible	25	50	7	0
Lower teeth	24	39	6	5
Tooth frags.	1	8	1	0
Hyoid	2	2	0	0
Atlas	1	0	1	0
Axis	3	0	0	0
Scapula	9	12	10	0
Humerus	5	18	9	0
Radius	7	26	6	0
Ulna	9	3	2	0
Carpal	4	0	0	0
Metacarpus	20	20	2	1
Innominate	17	13	4	2
Sacrum	1	0	0	0
Femur	1	10	5	0
Patella	0	1	1	1
Tibia	19	41	4	2
Fibula	0	0	4	0
Astragalus	6	2	0	0
Calcaneus	7	2	3	0
Tarsal	5	0	1	0
Metatarsus	15	21	1	1
Metapodium	3	0	0	1
First phalanx	17	3	1	0
Second phalanx	9	0	0	0
Third Phalanx	3	1	1	0
Sesamoid	1	0	0	0
Total	273	350	100	17

Table 15 Body part distribution for the main domestic mammal bones recovered from Unphased Anglo-Saxon ditches

Iron Age fauna from West Stow (Crabtree, in press). It is possible that the animal bones in the pits were covered over more rapidly than those in the ditches. The fauna from the ditches would therefore be subject to more intensive weathering and to attack by domestic dogs. This may have led to the fragmentation of mandibles and maxillae, producing relatively larger numbers of loose teeth. Weathering and carnivore gnawing and the consequent fragmentation may also have rendered small cranial fragments less identifiable.

Unphased ditches
(Table 15)
A very small faunal sample of 2202 mammal bones and fragments was recovered from Anglo-Saxon ditches which could not be assigned to a specific chronological phase. The mammal species identified include cattle, sheep, sheep/goat, pig, horse, dog, cat, roe deer, and hare (Table 10). On the basis of fragment counts, sheep/goat bones (47.3%) are the most common of the main domestic mammal bones, followed by cattle (36.9%), pig (13.5%), and horse (2.3%). The proportions are comparable to those calculated for the faunal assemblages from the huts. Body part distributions for the unphased ditches are presented in Table 15. The sample is so small that it is difficult to draw any meaningful conclusions from it.

Features
(Table 16)
A large sample (14,718 bones and fragments) of mammal remains was recovered from the Anglo-Saxon features. The vast majority of the fauna came from the hollows. The mammals identified (Table 10) include cattle, sheep and goat, pig, horse, dog, cat, red deer, roe deer, and fox. Sheep and goat bones (43.4% of the main domestic mammals on the basis of fragment counts) are only slightly more common than cattle remains (41.4%). The proportions of pigs (13.6%) and horses (1.7%) are comparable to those calculated for the SFBs. It is possible that exposure in the hollows led to the differential destruction of many of the sheep unfused epiphyses and small bone elements. The body part distribution for the sheep and goats (Table 16) shows high proportions of mandibles, loose teeth, tibiae, radii, and metapodia. More fragile anatomical elements such as the ulna are very poorly represented.

Post-hut fills
(Table 17)
A total of 10,928 mammal bones and fragments were recovered from the post-hut fills. The animal species identified include cattle, sheep, pig, horse, dog, cat, red deer, and roe deer (Table 10). Species ratios based on fragment counts indicate that sheep/goats are the predominant domestic mammals (50.1%), followed by cattle (38.4%), pigs (10.3%), and horses (1.1%). The relatively low proportion of pig bones in the post-hut fills is somewhat surprising and not easily explained. The species/anatomy distributions for the main domestic mammals are included in Table 17. The overall anatomical distributions for the post-hut fills compare remarkably well with those for the fifth-, sixth-, and seventh-century huts.

	Cattle	Sheep/goat	Pig	Horse
Skull	212	114	104	1
Horncore	33	42	0	0
Maxilla	46	53	48	1
Upper teeth	226	240	36	12
Mandible	276	361	114	3
Lower teeth	210	375	74	12
Tooth frags.	3	11	17	9
Hyoid	16	2	0	0
Atlas	17	20	15	1
Axis	17	17	2	0
Scapula	150	123	71	2
Humerus	82	121	46	1
Radius	103	207	27	4
Ulna	71	16	51	2
Carpal	46	2	1	1
Metacarpus	104	196	24	14
Innominate	123	124	46	3
Sacrum	6	3	1	0
Femur	78	49	24	1
Patella	8	0	0	0
Tibia	104	317	36	4
Fibula	0	0	10	0
Astragalus	52	18	13	2
Calcaneus	58	16	13	2
Tarsal	26	2	4	10
Metatarsus	139	196	31	9
Metapodium	20	5	5	1
First phalanx	155	21	16	4
Second phalanx	93	6	2	4
Third Phalanx	60	3	1	0
Sesamoid	2	0	0	0
Total	2536	2660	832	103

Table 16 Body part distribution for the main domestic mammal bones recovered from Anglo-Saxon features (hollows)

	Cattle	Sheep/goat	Pig	Horse
Skull	127	137	48	5
Horncore	24	32	0	0
Maxilla	23	50	23	0
Upper teeth	92	137	15	4
Mandible	137	246	46	4
Lower teeth	123	193	30	3
Tooth frags	6	9	2	0
Hyoid	9	11	0	0
Atlas	10	9	4	0
Axis	9	9	1	0
Scapula	89	86	27	2
Humerus	54	76	21	1
Radius	49	147	17	2
Ulna	49	27	9	1
Carpal	29	5	3	1
Metacarpus	61	86	23	3
Innominate	66	80	32	1
Sacrum	5	3	1	0
Femur	40	58	13	3
Patella	4	2	0	1
Tibia	80	214	17	0
Fibula	0	0	8	0
Astragalus	29	18	5	0
Calcaneus	23	13	8	2
Tarsal	25	5	0	0
Metatarsus	82	124	9	2
Metapodium	16	5	2	1
First phalanx	57	31	7	2
Second phalanx	43	2	2	4
Third Phalanx	35	4	1	1
Sesamoid	0	0	0	0
Total	1396	1819	374	43

Table 17 Body part distribution for the main domestic mammal bones recovered from the post-hut fills

	Cattle	Sheep/goat	Pig	Horse
Skull	702	331	300	12
Horncore	139	100	0	0
Maxilla	110	123	158	5
Upper teeth	1070	656	115	65
Mandible	1071	1100	387	21
Lower teeth	942	1323	248	61
Tooth frags.	40	57	28	25
Hyoid	21	4	0	0
Atlas	121	64	46	8
Axis	71	38	12	4
Scapula	655	431	268	27
Humerus	505	577	269	18
Radius	633	943	125	32
Ulna	355	47	169	14
Carpal	132	0	1	18
Metacarpus	637	647	95	51
Innominate	666	432	227	38
Sacrum	65	9	6	1
Femur	415	194	124	21
Patella	37	1	1	2
Tibia	550	1530	235	27
Fibula	0	0	43	0
Astragalus	355	48	30	16
Calcaneus	362	64	64	24
Tarsal	166	6	3	13
Metatarsus	775	822	75	50
Metapodium	82	4	15	11
First phalanx	722	38	25	48
Second phalanx	295	3	3	30
Third Phalanx	156	2	1	16
Sesamoid	0	0	0	2
Total	11850	9594	3073	660

Table 18 Body part distribution for the main domestic mammal bones recovered from Layer 2

Layer 2
(Table 18)
A substantial proportion of the faunal assemblage (54,070 bones and fragments) was recovered from Layer 2, the general occupation layer. The species identified include cattle, sheep and goat, pig, horse, dog, cat, red deer, roe deer, hare, badger, and European brown bear (Table 10). The presence of a single bone of brown bear is particularly interesting, as this is one of the most recent examples of brown bear known from Britain. Since this bone is a metacarpus, it is possible that it was introduced to West Stow as part of a bear skin.

In contrast to other contexts, the fauna from Layer 2 show a predominance of cattle bones (47.1%). Sheep are second in importance (38.1%), followed by pigs (12.2%), and horses (2.6%). The high proportion of cattle and, to a lesser extent, horse bones may result from the ways in which the fauna from Layer 2 was collected, in a coarser and less careful way than were the bones from the Anglo-Saxon features. Much of the Layer 2 material was removed by machine, and the final few inches were removed by careful shovelling (West 1985a, 10). The effect of the methods used in the excavation of Layer 2 can be seen in the low proportion of small bones such as sheep/goat phalanges, carpals, and tarsals. This can be seen more clearly when the body part distributions from Layer 2 (Table 18) are compared to those from the post-hut fills (Table 17) and hollows (Table 16). The post-hut fills and hollows are filled with what is essentially Layer 2 material, but the bones from these contexts were recovered by careful trowelling. The post-hut fills and hollows generally include slightly higher proportions of sheep/goat small anatomical elements, however the overall differences in anatomical representation are not that great. It is possible that the high proportion of cattle and horse bones in the Layer 2 assemblage cannot be attributed solely to differences in excavation methods.

The higher proportion of cattle and horse bones in the Layer 2 assemblage may result in part from the way in which the layer was formed. Bones which were recovered from Layer 2 were probably subject to longer periods of exposure prior to burial. These bones were also certainly gnawed by dogs. This exposure probably led to the differential destruction of the more fragile post-cranial bones of sheep and pigs. It is likely that exposed contexts such as Layer 2 favour the preservation of the thick-walled bones of the larger mammals such as cattle and horse. This may also account for the relatively high proportion of cattle bones in the hollows.

IV. Conclusions: Mammal Species Present At West Stow
(Fig. 15)

What general conclusions about animal husbandry at West Stow can be drawn from these quantitative data on species ratios? First, it is clear that sheep and goats are the most common animals in the faunal assemblage, making up just under 50% of the large domestic mammal bones on the basis of fragment counts. Species ratios based on minimum

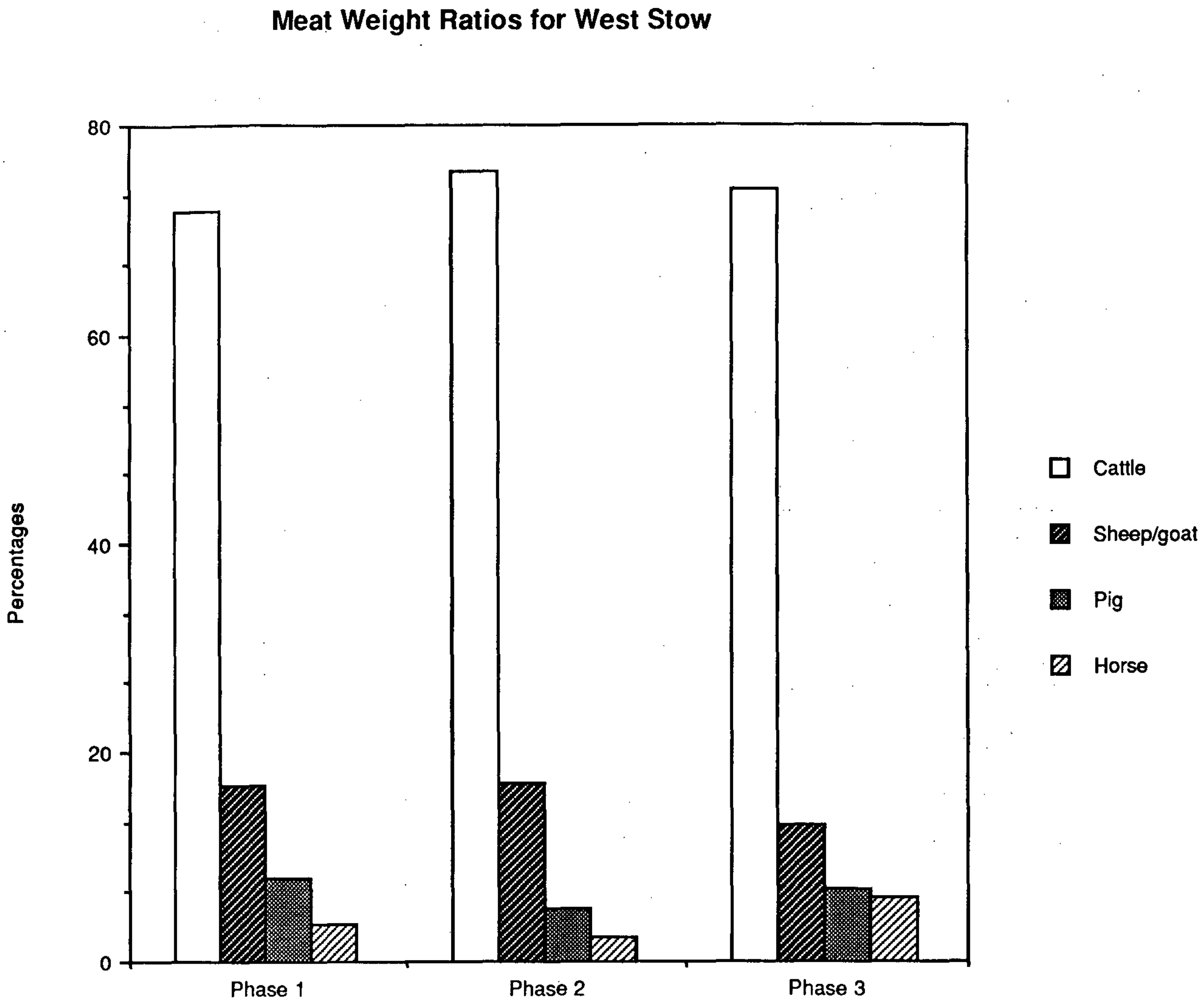


Figure 15 Meat weight ratios based on MNIs for Phase 1, 2 and 3 SFBs

numbers of individuals suggest that sheep and goats made up 50-60% of the large domestic mammals. The MNI-based species ratios may be somewhat more accurate reflections of the true importance of sheep and goats, since the small bones of these species seem to be systematically underrepresented in the assemblage. While small numbers of goat bones are present throughout the faunal assemblage, sheep bones outnumber goat remains by a factor of approximately 100:1. At Anglo-Saxon West Stow, sheep do not predominate to the degree that they do at the time of the *Domesday Survey*. Cattle are not mentioned in the *Domesday Survey* of the region, and sheep were by far the predominant animals (West 1985a, 169). Darby (1935, 443) notes that while sheep were relatively evenly distributed throughout Suffolk at the time of *Domesday*, the largest number of sheep were to be found in the Breckland hundred of Lackford, which included West Stow.

At Anglo-Saxon West Stow, cattle are the second most common farm animals, forming about 35% of the identifiable large domestic mammal bones on the basis of fragment counts. Proportions based on fragment counts may overestimate the importance of cattle; species ratios based on MNIs suggest that cattle formed only about 25% of the faunal assemblage. Even if we assume that this lower figure is accurate, beef would still have provided the bulk of the meat for the inhabitants of the site (Fig. 15), as a single cow can provide up to ten times as much meat as a single sheep or goat[8].

The high numbers of pigs are surprising in that the Breckland is not ideal pig country and the provision of adequate pannage a likely problem (see p. 00). Pigs seem to have played a particularly crucial role in the earliest Anglo-Saxon settlement of the site, as they make up well over 20% of the early fifth-century faunal assemblage.

Horses were a relatively minor component of the diet. While horses were certainly eaten (see Chapter 5, below) occasionally, it is likely that they were kept primarily for traction, for transport, and as symbols of status and wealth.

At West Stow the diet was supplemented by a wide range of other foods. Small numbers of red and roe deer bones are found throughout the faunal assemblage, and the presence of post-cranial deer bones (see Table 34, below, for a list of measurements taken on these bones) indicates that these animals were actually hunted. This interpretation is further supported by the discovery of four small iron arrowheads which were probably used in hunting (West 1985a, 124).

V. Bird Remains
(Table 19)

A wide variety of wild and domestic bird remains was

Species	Phase 1	Phase 2	Phase 3
Domestic Birds			
Domestic fowl (*Gallus* sp.)	115	389	17
Domestic goose (*Anser* sp.)	110	146	29
Domestic duck/mallard (*Anas platyrhynchos*)	2	11	14
Total Domestic Birds	227	546	60
Wild Birds			
White-fronted goose (*Anser albifrons*)		2	
Swan (*Cygnus* sp.)	1	1	
Teal (*Anas crecca*)		3	
Wild duck (*Anas* sp.)	1		
Cranes (Gruidae)	25	5	
Grey heron (*Ardea cinerea*)			1
Plovers (Charadriidae)		1	
Grey plover (*Pluvialis squatarola*)		5	
Lapwing (*Vanellus vanellus*)		1	
Woodcock (*Scolopax rusticola*)		1	
Herring/lesser black-backed gull (*Larus* sp.)		1	
Common gull (*Larus canus*)		2	
Snipe (*Gallinago gallinago*)	1		
Thrushes (Turdidae)			1
Song thrush (*Turdus philomelos*)	2	4	1
Starling (*Sturnus vulgaris*)		1	1
Common buzzard (*Buteo buteo*)		1	
Total Wild Birds	30	28	4
Unidentified birds	67	66	4
Total Bird Bones	324	640	68

Table 19 Bird remains from Phase 1, 2 and 3 SFBs

Species	Phase 1	Phase 2	Phase 3
Pike (*Esox lucius*)	2	8	2
Perch (*Perca fluviatilis*)		2	
Plaice/flounder (*Pleuronectes* sp./ *Platichthys* sp.)		1	
Unidentified fish	4	20	4
Total fish	6	31	6

Table 20 Fish remains from Phase 1, 2 and 3 SFBs

recovered from the excavations. This report will focus on the bird remains recovered from the SFBs since these bones can be most closely dated. A list of the bird remains recovered from the Phase 1, 2 and 3 SFBs has been included in Table 19).

The most common bird remains recovered from the SFBs are those of the domestic chicken (*Gallus* sp.) and the domestic goose (*Anser* sp.). A fairly extensive range of wild birds was also occasionally hunted. Most of these are water birds or waders such as cranes, swans, and wild ducks. All the birds, with the exception of the cranes, are breeding or migrant species in East Anglia today. A species of crane bred in East Anglia until about AD 1600 (British Ornithologists' Union 1971).

It seems reasonable to suggest that birds played only a minor role in the West Stow diet. It should be noted, however, that without wet screening some smaller bird remains may have been lost during excavation.

VI. Fish

(Table 20)

A small number of fish remains were also recovered from the SFBs (Table 20). Almost all the fish bones are the remains of pike (*Esox lucius*) and perch (*Perca fluviatilis*) which would have been locally available in the River Lark. A single bone of a flatfish, either plaice or flounder, was also identified from the Phase 2 faunal assemblage. Since this is not a freshwater fish, the presence of a flatfish would indicate the occasional use of non-local food resources. Since West Stow is a good 50 km from the coast (Fig. 1), the presence of a marine fish provides some limited evidence for long distance trade in foodstuffs.

VII. Environmental Exploitation at West Stow

(Pl. III)

The environment surrounding the site would have included a variety of different ecological zones which were exploited by the Anglo-Saxon inhabitants of West Stow in differing ways. The River Lark itself was the source of freshwater fish, pike and perch. The remains of cranes also occur in the faunal assemblage, and the crane breeds on the ground in wet bogs, reed-beds, and lightly wooded swamps (Peterson *et al.* 1966, 109) which would have been located on the valley floor. The meadowlands of the valley floor also would have provided ideal grazing for the cattle which played a major role in the West Stow animal economy.

The broad, flat river terraces which are located between the valley floor and the upland slopes would have provided the best arable land. Analysis of the weeds associated with the cereals recovered from West Stow indicate that cultivation centered on the dry, sandy soils of the river terraces (Murphy 1983, 191). The stubble from these cereal crops may have provided additional fodder for livestock. The livestock, in turn, would have provided manure for the crops.

Some parts of the low-lying river terraces could have provided pannage for the West Stow swine, but pannage available in the immediate vicinity of the site may not have been sufficient to support the numbers indicated by the faunal assemblage, especially in the early fifth century. It is possible that the Early Anglo-Saxon farmers made use of the more heavily forested areas of the central clay belt for additional pannage.

There is no clear evidence for animal pens or sties at the site itself, although the presence of clusters of coprolites in the fill of SFBs 34 and 35 indicate that pigs may occasionally have been tethered in some of the huts (West 1985a, 118 and Fig. 286). There is at least one piece of possible osteological evidence in support of the practice of tethering. One pig tibia shows a severe infection (possibly as the result of a fracture) on the distal portion of the midshaft (Pl. III). A fracture has been reported for a pig tibia from Hamwih (Bourdillon and Coy 1980, fig. 17,9 c). Von den Driesch (1975, 421) notes that many of the pigs from the Heuneberg and Manching showed tibial fractures at this point on the shaft. It has been suggested that the fractures were a result of tethering pigs by their hind legs. The livelier pigs may have broken their legs by pulling against the tether (Boessneck *et al.* 1971, 78; Bourdillon and Coy 1980, 96).

The slopes located between the river terraces and the uplands (interfluves) would have provided extensive grazing areas for sheep and goats. The slope soils support some of the most productive grasslands in the Breckland region (Murphy 1983, 196). Given the availability of extensive areas of productive grasslands near the site, it is

Plate III Pathological pig tibia showing severe infection (possibly as a result of a fracture. Scale 2:3

not surprising that sheep are the most common animals in the West Stow faunal assemblage.

The faunal data from the West Stow Anglo-Saxon village indicate that the inhabitants of the site had a successful and broadly based subsistence strategy. A mixed economy based on cattle, sheep/goat, and pig allowed these farmers to make effective use of valley bottom, river terrace, and grassland environments that would have been available in the vicinity of the site. The zooarchaeological data further suggest a general continuity and stability in animal husbandry practice. Sheep are the predominant animals throughout the site's history, followed by smaller numbers of cattle and pigs. There is, however, some evidence for flexibility in animal husbandry patterns. Pigs seem to have played an important role in the establishment of the farming village, probably because they mature rapidly and produce large litters. In the later parts of the fifth century, when livestock husbandry was well established, the role of pigs in the economy declined. These data suggest that the early Anglo-Saxon inhabitants of the village should be seen as prosperous and sophisticated husbandmen and not simply as 'barbarians'.

Chapter 3. Measurement

I. Introduction

Bone measurements can give us information about the size, shape, and conformation of ancient animals and can allow us to make inferences about sex and breed. To allow for meaningful intersite comparisons, bone measurements must be accurately defined and replicable. For this reason the West Stow bone measurements follow the standards set forth by von den Driesch (1976). In addition, bone measurements should bear some direct relationship to the height or weight of the animal. Dexter Perkins (pers. comm.) has argued that measurements of weight-bearing members, such as the trochlear breadth of the humerus (von den Driesch's BT), are the best indicators of body weight, and therefore meat-weight. Maximum lengths of complete long bones were taken whenever possible, since these measurements can be used to estimate withers heights (von den Driesch and Boessneck 1974).

Analyses of the West Stow bone measurements emphasized the domestic mammals (cattle, sheep, pig, and horse), as these species comprise the bulk of the faunal sample. Measurements of the smaller domestic mammals, cats and dogs, are also included. This study will focus primarily on bones from the huts which can be assigned to one of the three Saxon phases, as this will allow us to study possible size changes through time.

II. Cattle

(Figs 16-23; Tables 21-8)

A complete summary of the measurements taken on the cattle bones from the Iron Age and Romano-British features and from the well-dated SFBs is included in Table 21. Standard deviation and the coefficient of variation have been calculated for all sample sizes greater than or equal to five.

Maltby (1981) has shown that the astragalus length (von den Driesch's GLl, see Fig. 16a) is the measurement most commonly taken on British cattle bones. This measurement seems to be related to the overall size and robusticity of the carcass, as Noddle (1973) has shown that it varies with body and carcass weight. Table 22 shows the West Stow astragalus lengths in relation to the Iron Age, Roman, and Anglo-Saxon astragalus lengths summarized by Maltby (1981, 187). The West Stow Iron Age mean astragalus length falls right in the middle of the Iron Age range. Based on a t-test of the significance of the difference between two sample means, the West Stow Iron Age mean is not significantly different from mean astragalar lengths of Iron Age cattle from Croft Ambrey, Hereford. (Whitehouse and Whitehouse 1974), Barley, Herts. (Jarman *et al.* 1968), and Ashville, Oxon. (Wilson 1978).

As can be seen from Table 22, the West Stow mean astragalus length for Romano-British cattle is larger than all the Iron Age means summarized by Maltby (1981, 187). Although the mean astragalus length for the Romano-British cattle from West Stow is larger than the Iron Age mean, the differences between the two means are not statistically significant.

Comparisons based on two-tailed Student's t-tests indicate that the West Stow fifth-century (Phase 1) cattle mean astragalus length is significantly larger than the mean astragalus lengths from the Iron Age site of Croft Ambrey (Whitehouse and Whitehouse 1974) and from the Iron Age features at West Stow (Crabtree 1982, 193). These data would suggest that we are seeing an increase in cattle size some time between the Iron Age and the Early Anglo-Saxon period.

Withers height estimates were calculated for all well-dated complete cattle long bones, following the recommendations of von den Driesch and Boessneck (1974, 336)[9]. Withers height estimates for the Iron Age cattle are shown in Table 23. The withers heights estimated for the Iron Age cattle are generally comparable to those estimated for the Iron Age sites of Gussage All Saints, Dorset and Ashville (Fig. 17).

Withers heights were estimated for twelve complete cattle long bones from Phase 1 SFBs (Table 24 and Fig. 18). Withers height estimates for the sixth-century (Phase 2) cattle are shown in Table 25. The cattle appear to be slightly taller, on the average, than British Iron Age cattle. On the other hand, the West Stow Anglo-Saxon cattle may not be quite as large as the largest specimens from Middle Saxon Hamwih (Bourdillon and Coy 1977, 13) and North Elmham (Noddle 1980, 387-8).

To determine whether there were significant differences in size between the Hamwih and the West Stow fifth-century cattle, two-tailed Student's t-tests (used to determine the significance of the difference between two means) were used to compare twenty-two measurements on the scapula (SLC, GLP, BG, and LG), humerus (BT and Bd), radius (Bp, BFp, and BFd), metacarpal (GL, Bp, SD, and Bd), femur (DC), tibia (Bd and Dd), astragalus (GLl and Bd), and metatarsal (GL, Bp, SD, and Bd). Only two significant differences were found[10]. The West Stow metacarpal shaft diameter (SD) is significantly larger ($t = 2.26$, significant at $p = 0.05$), while the metatarsal shaft diameter (SD) is significantly smaller ($t = 2.375$, significant at $p = 0.05$). It is likely that the West Stow and the Hamwih cattle are not significantly different in size, and that the two apparent differences are the results of chance factors.

Statistical comparisons between the Phase 1 and Phase 2 cattle measurements (Crabtree 1982, 218) provide no clear evidence for size change between the two phases. Student's t-tests were used to compare the means of thirty-four measurements of the scapula (SLC, GLP, BG, and LG), humerus (BT and Bd), radius (Bp, BFp, Bd, and BFd), metacarpus (GL, Bp, SD, Bd, DD, and the breadth and depth of the distal fusion point), first phalanx (Bp, SD, Bd, and GLpe), femur (DC), tibia (Bd and Dd), astragalus (GLl, GLm, Bd, and Dl), and metatarsus (Bp, SD, Bd, DD, and the breadth and depth of the distal fusion point). Only three significant differences between the two phases were found. The distal breadth (Bd) and lateral depth (Dl) of the astragalus and the distal breadth (Bd) of the metatarsus were all significantly smaller (at $p = 0.05$) in the Phase 2 cattle sample. The reasons for these differences are unclear. However, they are not much more than would have been expected on the basis of chance alone. Moreover, it would be difficult to demonstrate a size decrease through time, as the average estimated withers height actually increases between the fifth and sixth centuries. It seems

	Mean	Min.	Max.	s	C.V.	N
SCAPULA						
Scapula (SLC)						
Iron Age	48.2	44.8	52.7	3.0	6.2	5
Phase 1 (5th C.)	45.1	41.9	49.1	2.7	6.0	6
Phase 2 (6th C.)	46.3	37.0	63.9	7.1	15.3	15
Phase 3 (7th C.)	45.8					1
Scapula (GLP)						
Iron Age	62.3	58.1	67.1			3
Phase 1 (5th C.)	61.4	56.9	72.9	5.0	8.1	9
Phase 2 (6th C.)	62.9	55.6	80.3	6.9	11.0	17
Scapula (BG)						
Iron Age	44.5	40.0	49.4			3
Phase 1 (5th C.)	42.9	38.1	51.3	4.3	10.0	9
Phase 2 (6th C.)	43.9	38.3	54.7	3.9	8.9	24
Phase 3 (7th C.)	40.4					1
Scapula (LG)						
Iron Age	52.9	48.4	58.0			3
Phase 1 (5th C.)	53.6	48.6	59.3	3.7	6.9	9
Phase 2 (6th C.)	54.1	47.2	66.9	4.3	7.9	22
HUMERUS						
Humerus (GLC)						
Iron Age	223.3					1
Phase 2 (6th C.)	234.4					1
Phase 3 (7th C.)	247.8					1
Humerus (Bp)						
Phase 2 (6th C.)	78.1					1
Humerus (Dp)						
Iron Age	91.0					
Phase 1 (5th C.)	94.1					1
Humerus (BT)						
Iron Age	58.1	51.1	65.0			2
Phase 1 (5th C.)	66.7	63.0	68.3	2.1	3.1	5
Phase 2 (6th C.)	67.5	62.3	73.5	2.5	3.7	15
Phase 3 (7th C.)	69.1	65.8	72.5			4
Humerus (Bd)						
Iron Age	67.6					1
Phase 1 (5th C.)	74.3	73.3	75.3			3
Phase 2 (6th C.)	74.4	64.8	82.2	4.0	5.4	15
Phase 3 (7th C.)	74.4	69.7	81.9			4
Humerus (SD)						
Iron Age	30.2	28.8	31.6			4
Phase 1 (5th C.)	31.1					1
Phase 2 (6th C.)	32.7	31.8	33.8			3
RADIUS						
Radius (GL)						
Iron Age	246.7					1
Phase 1 (5th C.)	251.8					1
Phase 2 (6th C.)	259.9					1
Radius (Bp)						
Iron Age	73.5	71.0	76.5			2
Roman	78.8					1
Phase 1 (5th C.)	74.0	65.2	88.4	5.5	7.4	14
Phase 2 (6th C.)	74.1	62.8	86.0	5.6	7.6	25
Radius (BFp)						
Iron Age	66.3	63.4	69.0			3
Roman	73.4					1
Phase 1 (5th C.)	68.4	59.8	80.3	5.5	8.0	16
Phase 2 (6th C.)	67.7	57.9	77.7	4.9	7.2	24

Cattle Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
Radius (Bd)						
Iron Age	67.1	62.9	75.5	5.1	7.6	5
Roman	68.2	60.9	75.5			2
Phase 1 (5th C.)	66.7	60.1	84.6	7.9	11.8	10
Phase 2 (6th C.)	67.5	58.0	77.4	6.1	9.0	9
Phase 3 (7th C.)	64.8					1
Radius (BFd)						
Iron Age	60.6	56.2	67.6			3
Roman	61.0	54.7	67.2			2
Phase 1 (5th C.)	61.6	56.2	80.8	8.1	13.1	10
Phase 2 (6th C.)	60.2	51.2	66.8	5.0	8.3	9
Phase 3 (7th C.)	60.3					1
Radius (SD)						
Iron Age	35.5	31.5	37.9	2.8	8.0	5
Phase 1 (5th C.)	36.1	35.4	36.7			2
Phase 2 (6th C.)	37.1	34.5	43.2			4
ULNA						
Ulna (LO)						
Phase 1 (5th C.)	119.0					1
Phase 2 (6th C.)	94.2					1
Ulna (BPC)						
Phase 1 (5th C.)	42.0					1
Phase 2 (6th C.)	44.0	41.2	49.5			3
Ulna (SDO)						
Phase 1 (5th C.)	44.6					1
Phase 2 (6th C.)	49.9					4
METACARPUS						
Metacarpus (GL)						
Iron Age	180.1	166.7	189.8	10.4	5.8	5
Phase 1 (5th C.)	182.9	170.8	194.7	8.2	4.5	8
Phase 2 (6th C.)	187.0	176.9	198.2	7.8	4.2	13
Phase 3 (7th C.)	184.3					1
Metacarpus (Bp)						
Iron Age	50.2	43.7	57.8	5.6	11.2	6
Roman	51.3	50.8	51.8			3
Phase 1 (5th C.)	53.7	46.4	63.6	5.4	10.1	16
Phase 2 (6th C.)	52.6	46.3	61.2	4.1	7.8	35
Phase 3 (7th C.)	51.3	51.2	51.3			2
Metacarpus (Bd)						
Iron Age	53.6	49.7	60.3			4
Roman	61.4	60.4	62.3			2
Phase 1 (5th C.)	53.6	48.8	62.6	3.4	6.3	16
Phase 2 (6th C.)	55.4	49.2	68.8	5.7	10.3	31
Phase 3 (7th C.)	53.1					1
Metacarpus (SD)						
Iron Age	28.3	25.0	33.2	3.4	12.0	6
Phase 1 (5th C.)	27.6	25.5	30.4	1.5	5.4	9
Phase 2 (6th C.)	28.3	25.2	33.7	2.3	8.1	15
Phase 3 (7th C.)	28.9					1
Metacarpus (DD)						
Iron Age	20.2	18.3	23.3	2.1	10.4	7
Roman	20.8					1
Phase 1 (5th C.)	20.2	28.5	21.4	1.0	5.0	10
Phase 2 (6th C.)	20.3	18.3	22.2	1.1	5.4	16

Cattle Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
FEMUR						
Femur (GLC)						
Iron Age	287.0					1
Phase 1 (5th C.)	317.5					1
Phase 2 (6th C.)	305.5					1
Femur (Bp)						
Phase 2 (6th C.)	103.3	96.1	110.5			2
Femur (DC)						
Iron Age	38.1	36.6	39.9			3
Phase 1 (5th C.)	40.9	39.0	44.9	2.0	4.9	7
Phase 2 (6th C.)	41.8	37.8	45.2	2.8	6.7	7
Phase 3 (7th C.)	42.4					1
Femur (Bd)						
Phase 1 (5th C.)	88.5					1
Phase 2 (6th C.)	79.7	77.6	82.5			3
Femur (SD)						
Iron Age	30.1	29.3	32.9			2
Phase 1 (5th C.)	32.0					1
Phase 2 (6th C.)	30.5					1
TIBIA						
Tibia (GL)						
Iron Age	296.3	295.6	297.0			2
Tibia (Bp)						
Iron Age	80.6					1
Tibia (Bd)						
Iron Age	57.3	50.8	65.4	5.5	9.5	9
Roman	54.0	52.6	55.4			2
Phase 1 (5th C.)	55.9	50.8	67.4	4.0	7.2	23
Phase 2 (6th C.)	56.0	50.5	65.5	4.3	7.7	37
Phase 3 (7th C.)	57.3	52.0	68.5	6.0	10.5	6
Tibia (Dd)						
Iron Age	42.4	37.8	48.5	3.6	8.5	7
Roman	40.0					1
Phase 1 (5th C.)	43.0	38.9	50.1	3.1	7.2	18
Phase 2 (6th C.)	42.1	37.6	51.5	3.6	8.6	21
Phase 3 (7th C.)	42.6	41.2	44.1			2
Tibia (SD)						
Iron Age	33.9	30.9	35.5	1.6	5.8	6
Phase 1 (5th C.)	33.2	32.1	34.3			2
Phase 2 (6th C.)	32.5	31.4	33.9			3
ASTRAGALUS						
Astragalus (GLl)						
Iron Age	58.0	53.9	61.3	3.0	5.2	8
Roman	60.8	59.7	63.0			4
Phase 1 (5th C.)	61.1	54.2	65.8	3.2	5.2	27
Phase 2 (6th C.)	60.1	53.6	67.2	2.7	4.5	61
Phase 3 (7th C.)	60.7	56.1	70.3	4.4	7.2	8
Astragalus (GLm)						
Iron Age	52.0	49.2	54.7	1.9	3.7	8
Roman	56.4	54.7	58.5			3
Phase 1 (5th C.)	55.6	49.8	60.0	2.9	5.2	29
Phase 2 (6th C.)	55.1	48.4	60.8	2.5	4.5	66
Phase 3 (7th C.)	55.7	52.8	64.0	3.6	6.5	8

Cattle Measurement Data--continued

	Mean	Min.	Max	s	C.V.	N
Astragalus (Bd)						
Iron Age	37.3	34.1	39.1	1.7	4.6	8
Roman	40.5	39.0	42.6			3
Phase 1 (5th C.)	39.9	34.9	45.5	2.6	6.5	29
Phase 2 (6th C.)	38.3	34.2	44.7	2.3	6.0	61
Phase 3 (7th C.)	39.4	35.5	46.9	3.9	1.0	7
Astragalus (Dl)						
Iron Age	32.6	29.9	34.5	1.2	3.7	9
Roman	35.1	33.8	36.7			3
Phase 1 (5th C.)	34.5	30.6	37.7	1.9	5.5	29
Phase 2 (6th C.)	33.7	29.7	36.7	1.5	4.5	61
Phase 3 (7th C.)	34.1	32.0	40.0	2.6	7.6	8
METATARSUS						
Metatarsus (GL)						
Iron Age	204.1	188.0	213.3			3
Phase 1 (5th C.)	207.2	192.6	221.8			2
Phase 2 (6th C.)	211.7	204.8	222.4			3
Metatarsus (Bp)						
Iron Age	44.1	41.5	45.9			4
Roman	43.8					1
Phase 1 (5th C.)	45.1	40.0	53.1	3.7	8.2	15
Phase 2 (6th C.)	44.1	38.9	51.2	3.7	8.4	31
Phase 3 (7th C.)	43.8	41.6	46.0			2
Metatarsus (Bd)						
Iron Age	54.2	53.2	56.2			3
Phase 1 (5th C.)	52.3	46.8	61.1	4.9	9.4	15
Phase 2 (6th C.)	49.1	44.9	58.6	3.1	6.3	20
Phase 3 (7th C.)	48.3	46.2	50.4			2
Metatarsus (SD)						
Iron Age	25.0	22.6	25.9	1.4	5.6	5
Phase 1 (5th C.)	22.6	19.8	25.0	1.8	8.0	6
Phase 2 (6th C.)	23.9	21.1	26.4	1.6	6.7	8
Metatarsus (DD)						
Iron Age	23.7	21.5	24.8			3
Phase 1 (5th C.)	22.4	21.7	24.3	0.9	4.0	15
Phase 2 (Sixth C.)	22.4	19.9	24.0	1.3	5.8	12
FIRST PHALANX						
First Phalanx (Bp)						
Iron Age	27.5	22.5	33.4	3.2	11.6	16
Roman	26.3	25.5	27.2			3
Phase 1 (5th C.)	27.3	23.0	36.0	2.8	10.3	74
Phase 2 (6th C.)	27.3	22.4	35.6	2.8	10.3	117
Phase 3 (7th C.)	28.2	24.3	34.8	3.3	11.7	17
First Phalanx (SD)						
Iron Age	23.0	20.0	27.9	2.1	9.1	22
Roman	22.8	21.1	26.6	2.2	9.6	5
Phase 1 (5th C.)	22.9	19.0	29.6	2.4	10.5	92
Phase 2 (6th C.)	23.1	19.1	29.6	2.3	10.0	127
Phase 3 (7th C.)	23.6	20.9	30.7	2.7	11.4	19
First Phalanx (Bd)						
Iron Age	25.9	23.1	31.1	2.4	9.3	14
Roman	26.5	24.8	29.8			4
Phase 1 (5th C.)	25.9	20.7	33.3	2.6	10.0	81
Phase 2 (6th C.)	26.2	22.2	35.8	2.8	10.7	120
Phase 3 (7th C.)	26.6	23.3	33.2	2.7	10.2	19

Cattle Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
First Phalanx (GLpe)						
Iron Age	53.6	49.6	60.0	2.8	5.2	16
Roman	52.0	50.5	53.3			4
Phase 1 (5th C.)	56.1	50.4	67.0	3.5	6.2	80
Phase 2 (6th C.)	56.9	49.0	67.9	3.8	6.7	124
Phase 3 (7th C.)	56.7	51.7	62.1	3.2	5.6	18

Table 21 Measurement data on cattle bones from Iron Age, Romano-British, Phase 1, 2 and 3 contexts

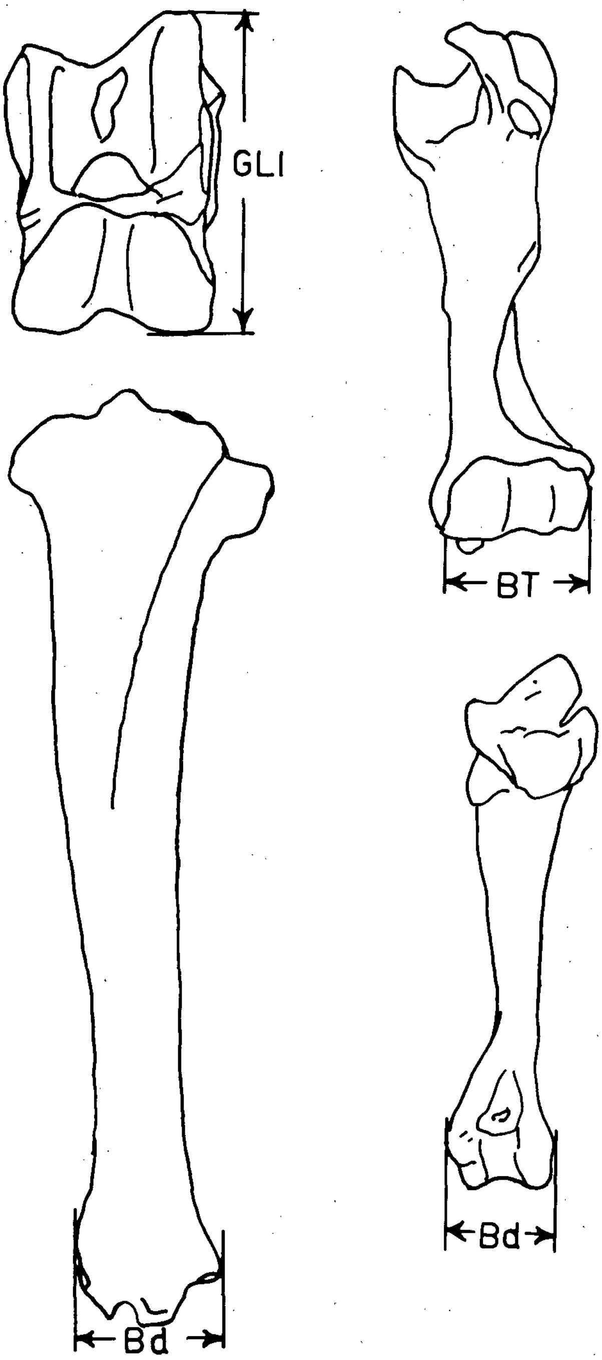


Figure 16 Illustrations of some of the main measurements taken on the West Stow animal bones:
a. astragalus greatest lateral length (GLl)
b. tibia distal breadth (Bd)
c. humerus (BT)
d. humerus (Bd)

Site	Date	N	Mean	Min.	Max.
Exeter	A.D. 55-300	14	55.2	50.7	59.6
Catcote	Iron Age	14	57.0	51.0	63.0
Gussage All Saints	Iron Age	54	57.0	54.0	62.0
Winnall Down	Middle I.A.	7	57.3	53.1	61.0
Croft Ambrey	Iron Age	20	57.7	55.0	63.0
Balksbury	Middle I.A.	12	57.9	55.0	63.1
Appleford	Iron Age	8	58.0	55.0	60.0
Winnall Down	Early I.A.	8	58.0	55.8	61.6
West Stow	Iron Age	8	58.0	53.9	61.3
Corstopitum	Roman	9	58.0	53.0	63.0
Exeter	A.D. 300-400	18	58.3	54.3	62.0
Ashville	Iron Age	18	58.5	53.0	64.0
Barley	Iron Age	13	58.5	54.1	62.1
Grimthorpe	Early I.A.	8	59.5	56.3	61.5
West Stow	6th C. A.D.	61	60.1	53.6	67.2
West Stow	7th C. A.D.	8	60.7	56.1	70.3
West Stow	Roman	4	60.8	59.7	63.0
Hamwih	Mid Saxon	167	60.9	49.2	71.5
West Stow	5th C. A.D.	27	61.1	54.2	65.8
Baylham House	A.D. 100-200	10	61.3	56.0	65.8
Alcester	Late Roman	30	61.4	53.9	67.6
Shakenoak Farm	Late Roman	44	61.6	53.0	72.0
Winnall Down	Early Roman	16	61.6	56.1	68.4
Ramsbury	Mid Saxon	6	61.9	51.5	66.5

Data source: Maltby (1981): 187

Table 22 Comparison of the greatest lateral length of the cattle astragalus (GLl) from Iron Age, Roman, and Anglo-Saxon contexts with the astragalus lengths from other Iron Age, Roman-British, and Anglo-Saxon sites

Greatest Length (mm)	Withers Height (cm)
Metacarpus	
166.7	102.1
168.1	103.0
177.6	108.8
186.1	114.0
189.8	116.3
Humerus	
223.3	106.5
Femur (GLC)	
287.0	99.6
Tibia	
295.6	102.0
297.0	102.5
Metatarsus	
118.0	102.5
211.0	115.0
213.3	116.2

Mean = 107.4 cm, s.d. = 6.4

Table 23 Withers height estimates for cattle recovered from Iron Age contexts.

Note: Following von den Driesch and Boessneck (1974, 336), Fock's factors have been used to calculate withers heights for metapodia, while Matolcsi's factors have been used for the other long bones.

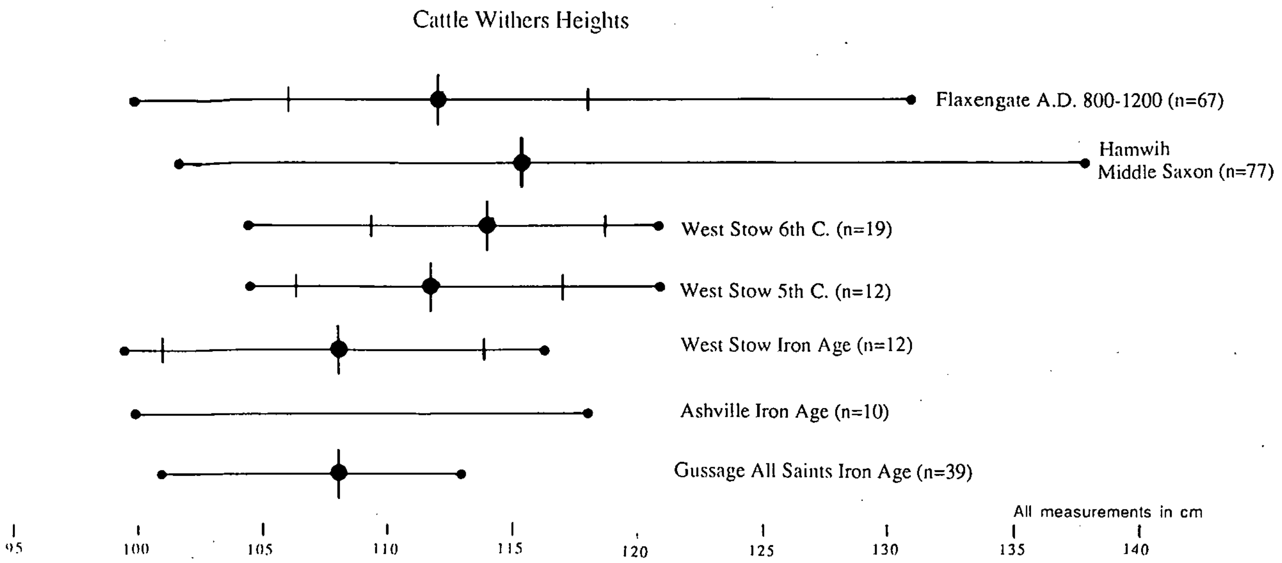


Figure 17 Comparison of the withers heights calculated for the West Stow cattle with those from other Iron Age and Anglo-Saxon sites in Britain.

Greatest Length (mm)	Withers Height (cm)
<u>Radius</u>	
251.8	108.3
<u>Metacarpus</u>	
170.8	104.6
175.6	107.6
177.1	108.5
180.4	110.5
185.1	113.4
188.3	115.3
190.8	116.9
194.7	119.3
<u>Femur (GLC)</u>	
317.5	109.5
<u>Metatarsus</u>	
192.6	105.0
221.8	120.9

Mean = 111.7 cm, s.d. = 5.4

Table 24 Withers height estimates for cattle recovered from Phase 1 SFBs.

Note: Following von den Driesch and Boessneck (1974, 336), Fock's factors have been used to calculate withers heights for metapodia, while Matolcsi's factors have been used for the other long bones.

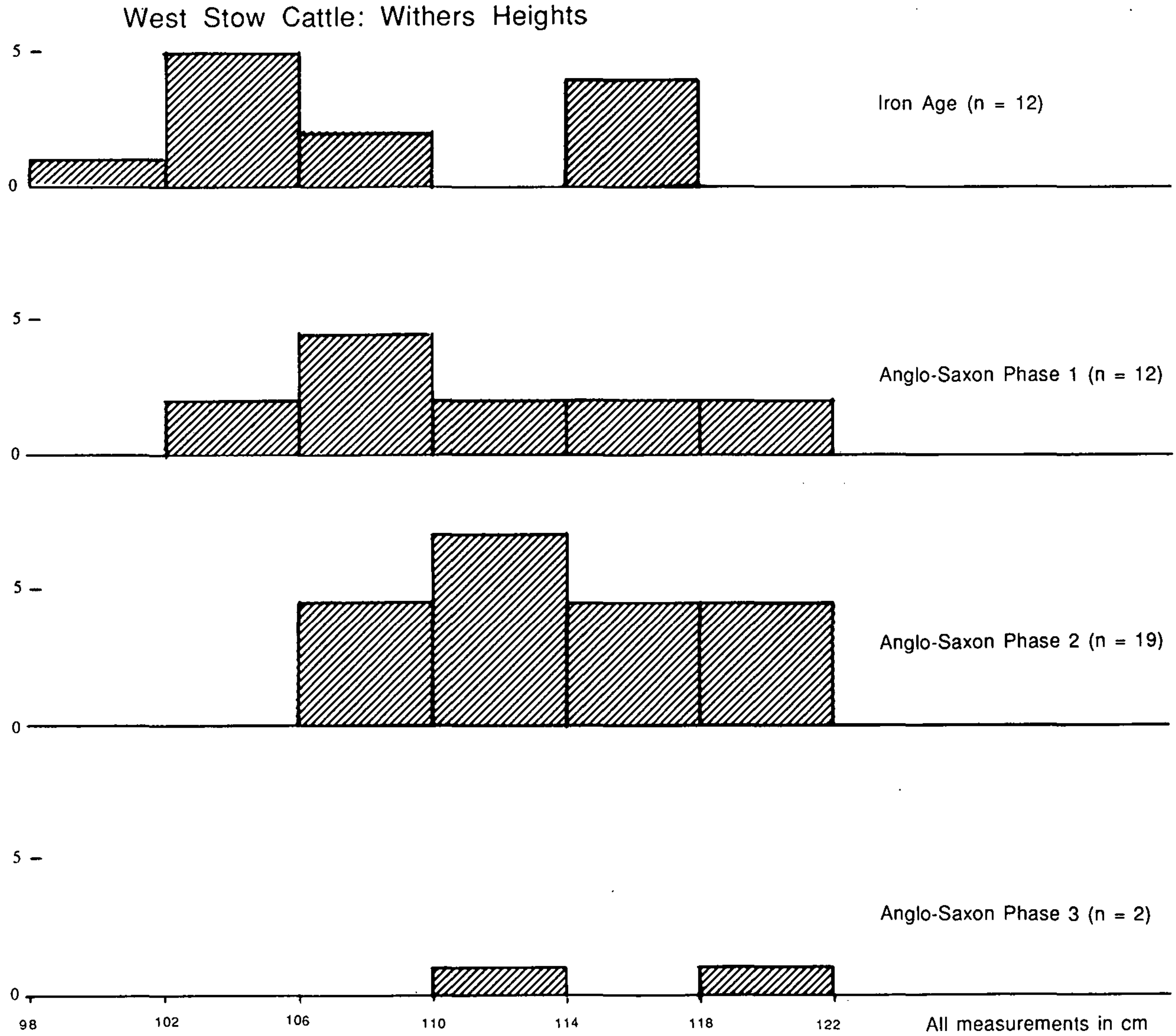


Figure 18 Distribution of withers heights for Iron Age, Phase 1 and Phase 2 cattle

reasonable to suggest that there is little evidence for size change between the two phases, especially since measurements of weight bearing members such as the trochlear breadth of the humerus (BT) show no significant changes.

Few measurable cattle bones were recovered from the Phase 3 (late sixth-earlier seventh century) SFBs. A complete metacarpus and humerus from Phase 3 provided a withers height estimates of 112.9 and 118.2cm, respectively. In order to compare the sizes of the Phase 2 and Phase 3 cattle, eleven t-tests were carried out to test the significance of differences between the means of measurements on the humerus (BT and Bd), tibia (Bd), astragalus (GLl, GLm, Bd, and Dl), and first phalanx (Bp, SD, Bd, and GLpe). No significant differences were found. It therefore seems reasonable to conclude that there is no clear evidence for size change through time in the West Stow cattle.

A comparison between the West Stow cattle and the Late Saxon and early medieval cattle from Flaxengate, Lincoln, indicates a general similarity in withers height between the two samples (Fig. 17). The Flaxengate cattle had an average estimated withers height of 111.9cm and a range of 99.8-130.8cm (O'Connor 1982, 21). O'Connor suggests that the Flaxengate cattle are comparable in size, and possibly also in body conformation, to Kerry cattle. Kerry cattle have a live weight of between 300 and 400 kg.

It is possible, however, that the West Stow cattle were considerably more gracile. Noddle (1973) has shown that a number of measurements, including the trochlear breadth of the humerus (von den Driesch's BT; Fig. 16c), show close correlations with live weights and carcass weights among modern cattle breeds. Based on the measurements of the trochlear breadth of the humerus, it is estimated that the average West Stow cattle would have had an average live weight of only about 150-170 kg, and a fat-free carcass weight of about 100 kg (Table 26). It is probably fair to say that Tacitus' description of Germanic cattle which were valued more for their quantity than their size would apply equally well to the Early Anglo-Saxon cattle from West Stow.

The West Stow cattle are closely comparable in size to cattle from Roman Britain. In particular, the distal tibial breadth (Bd; Fig. 16b) ranges for cattle from Phase 1 (50.8-67.4 mm) and Roman Portchester Castle (50-69 mm; Grant 1975: 401) are nearly identical. The Alcester late-

Greatest Length (mm)	Withers height (cm)
Humerus (GLC)	
234.4	111.8
Radius	
259.9	111.8
Metacarpus	
176.9	108.4
178.6	109.4
178.8	109.5
179.6	110.0
180.0	110.3
181.7	113.3
190.3	116.6
190.4	116.6
190.9	116.9
192.4	117.8
195.7	119.9
196.9	120.6
198.2	121.4
Femur (GLC)	
305.5	106.0
Metatarsus	
204.8	111.6
208.4	113.6
222.4	121.2
Mean = 114.0 cm, s.d. = 4.7	

Table 25 Withers height estimates for cattle from Phase 2 SFBs.

Note: Following von den Driesch and Boessneck (1974, 336), Fock's factors have been used to calculate withers heights for metapodia, while Matolcsi's factors have been used for the other long bones.

Roman mean astragalus length (Table 22) is also comparable to the West Stow mean astragalus lengths.

Measurements on complete cattle metacarpi have been used to infer the sex of ancient animals. Theoretically, metacarpals of female animals will be short and gracile, while those of intact males will be robust and relatively short. As castration delays maturation, and thus epiphysial union, steers will tend to be taller than bulls. Castrates are usually gracile to intermediate in robusticity. Several indices have been derived to infer sex from archaeological specimens. Howard (1963) suggests that two metapodial indices (Bd × 100/GL and SD × 100/GL) can be employed to distinguish male from female cattle. Figure 19 plots the ratio of distal breadth × 100 to greatest length against the greatest length of the metacarpus for all well-dated West Stow specimens. Those bones with indices of less than 30 are likely to be female, while those over 31 are probably males. The index of shaft diameter × 100/greatest length is plotted against greatest length in Figure 20. This graph presents a similar but slightly more ambiguous picture. The more easily interpreted data from Figure 19 suggest that most of the adult cattle were females. A few more robust specimens are likely to be male. Given the relatively high mortality of young cattle at West Stow (see Chapter 4), it is likely that many of the males were killed before maturity. These specimens would not be measurable and therefore would not be included in Figures 19 and 20.

A clearer picture of sexual dimorphism is presented when the maximum distal breadth of the metacarpal epiphysis (Bd) is plotted against the maximum distal breadth of the diaphysis[11], following Higham and Message (1969). Figure 21 indicates that the majority of adult cattle at West Stow were female, and that relatively few males survived to maturity.

The size, shape, and conformation of the West Stow cattle horn cores were recorded following the recommendations of Armitage and Clutton-Brock (1976). Only fourteen complete, measurable horn cores (one Iron Age and thirteen Anglo-Saxon) were recovered (Table 27). Most of the cattle were short or medium horned cattle,[12] although two small horns were recovered from SFB 6. It was difficult to determine the sex of many of these horn cores. Armitage and Clutton-Brock (1976, 332) have suggested that male cores are generally heavy and robust and somewhat flattened in cross-section. They are relatively short in proportion to the basal circumference of the core. Using these criteria it is reasonable to suggest that one, and possibly two, of the specimens are bulls. It is difficult to determine whether the rest of the cattle are cows or steers.

The measurements taken on all complete cattle long bones from all Iron Age, Romano-British, and Anglo-Saxon features have been listed in Table 28. Complete long bones from all the Anglo-Saxon SFBs, pits, ditches, features, post-hut fills, and Layer 2 are included. The distributions of the greatest lengths (GL) of the metacarpus and metatarsus are illustrated in Figures 22 and 23. While the metacarpal lengths are nearly normally distributed, the metatarsi show a bimodal distribution which may reflect sexual dimorphism.

III. Sheep

(Figs 24-9; Tables 29-32; Pl. IV)

A complete summary of the measurable Iron Age, Romano-British, and well-dated Anglo-Saxon sheep bones is presented in Table 29. In addition to mean and range, standard deviation and the coefficient of variation have been calculated for all sample sizes greater than or equal to five.

Maltby (1981) has shown that the distal tibial breadth

	Mean BT (mm)	Live Wt. (kg)	Carcass Wt. (kg)
Phase 1 (5th C.)	66.7	150	94
Phase 2 (6th C.)	67.5	157	96
Phase 3 (7th C.)	69.1	170	103

Table 26 Estimates of live weights for cattle based on measurement of the trochlear breadth (BT) of the humerus

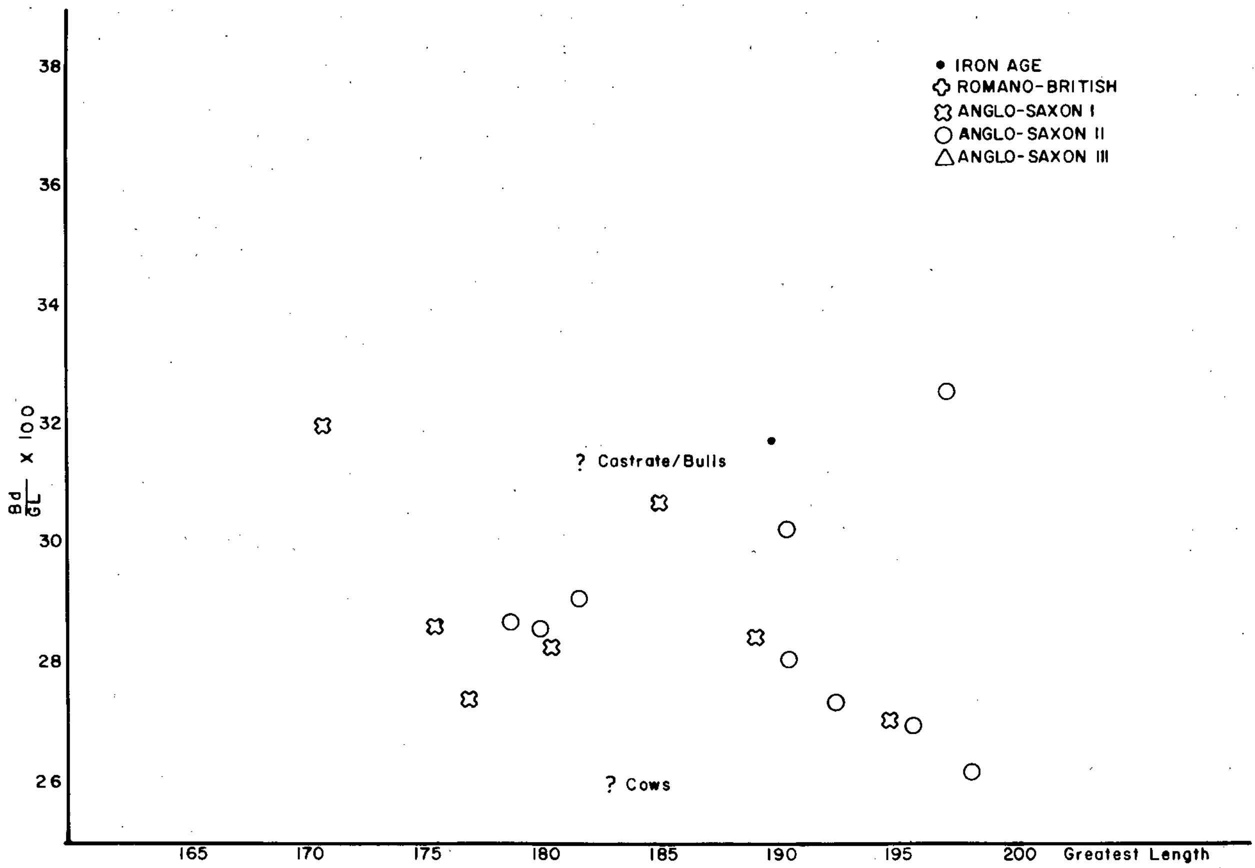


Figure 19 Plot of West Stow cattle metacarpal lengths against the metacarpal index: Bd X 100/GL

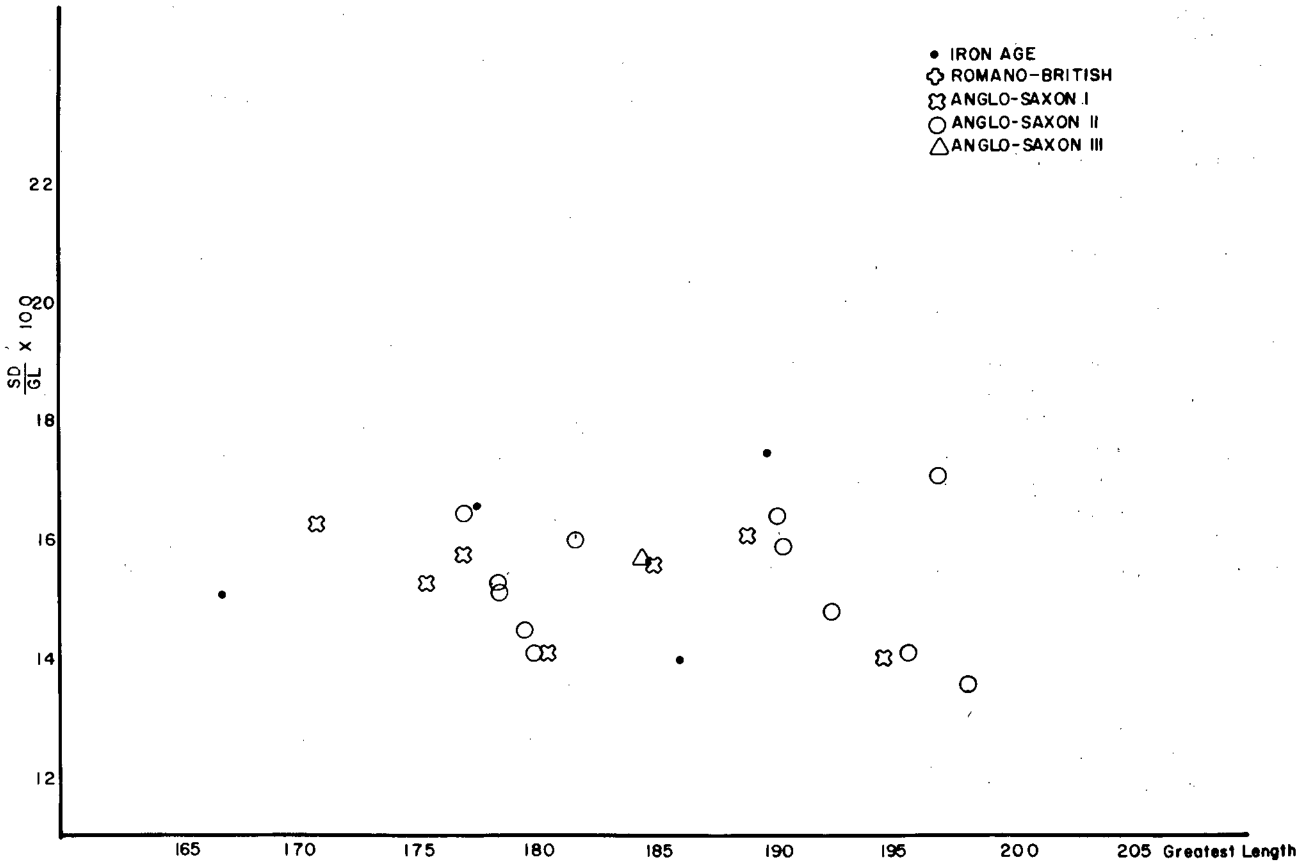


Figure 20 Plot of the West Stow cattle metacarpal lengths against the metacarpal index: SD X 100/GL.

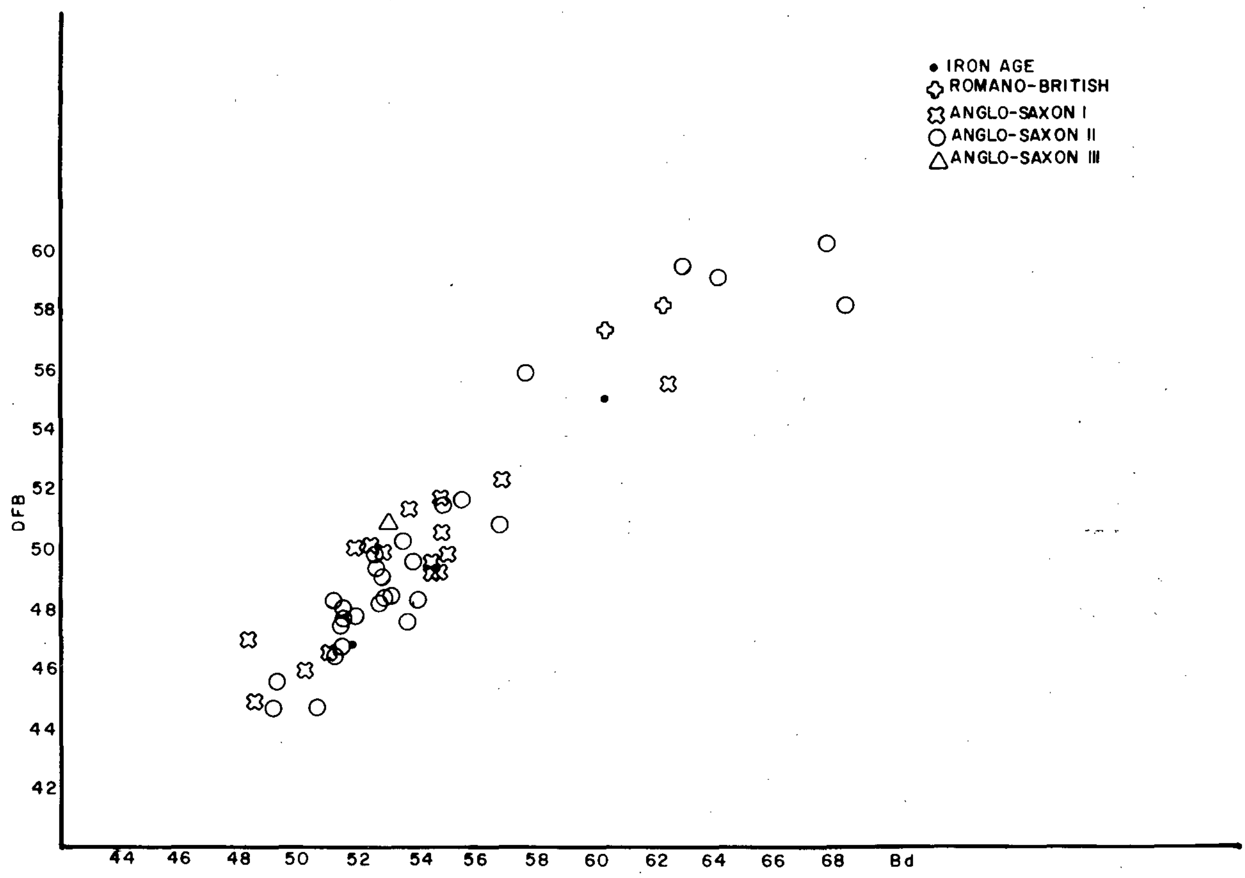


Figure 21 Plot of the distal breadth (Bd) against the distal fusion point breadth for cattle metacarpi

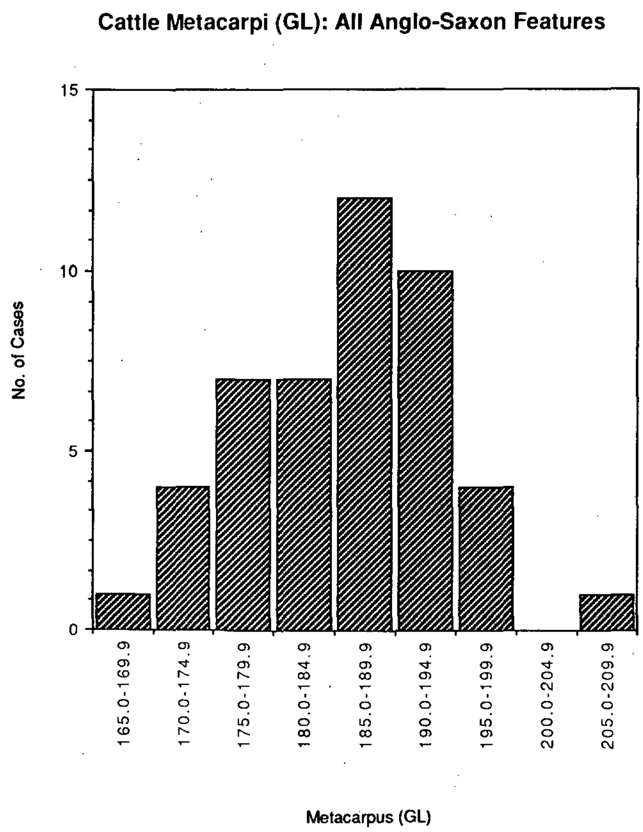


Figure 22 Cattle metacarpus greatest length (GL) for all Anglo-Saxon features

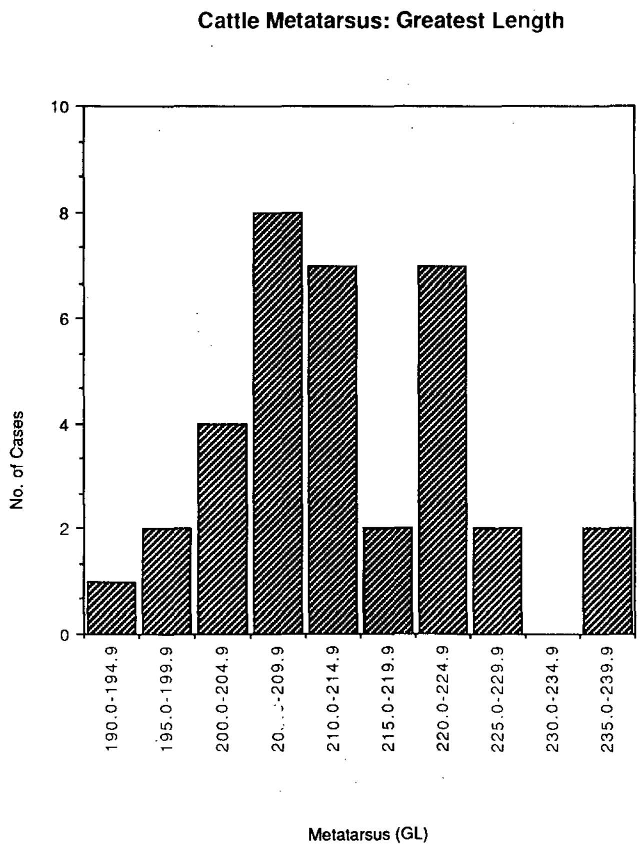


Figure 23 Cattle metatarsus greatest length (GL) for all Anglo-Saxon features

Context	Size group	47	44	I 1	45	46	I 2	Comment
SFB 6	Small horned	80	105	131	41.8	31.7	76	
SFB 6	Small horned	86	103	120	37.6	30.6	81	
PHF	Short horned	130	118	91	40.9	32.7	80	
SFB 56	Short horned	145	111	77	44.7	29.9	67	
SFB 57	Short horned	138	120	87	42.8	34.6	81	
SFB 17	Short horned	134	155	116	53.5	41.1	77	
SFB 12	Short horned	105	116	110	41.8	31.7	76	
ASF	Short horned	139	121	87	45.0	32.2	72	
SFB 36	Short horned	129	133	103	51.0	33.2	65	Possible bull
IRON AGE	Short horned	125	140	112	49.5	37.0	75	
ASP	Medium horn	179	190	106	74.8	51.7	69	Probable bull
Layer 2	Medium horn	156	127	81	45.8	34.8	76	
L2	Medium horn	159	121	76	45.9	34.5	75	
SFB 45	Medium horn	190	140	74	51.6	37.8	73	

Notes:
47 (von den Driesch 1976: 28): Length of the outer curve of the horn core.
44 (von den Driesch 1976: 28): Horn core basal circumference.
I 1 (Index 1): Horn core basal circumference X 100/Length of outer curve.
45 (von den Driesch 1976: 28): Greatest diameter of the horn core base.
46 (von den Driesch 1976: 28): Least diameter of the horn core base.
I 2 (Index 2): Least diameter X 100/Greatest diameter (Armitage and Clutton Brock 1976: 334).

Table 27 Measurements of complete cattle horn cores

Domestic Cattle; *Bos taurus* Humerus

	Bd	Bp	GLC
IRONAGE			223.3
H2	81.9		247.8
H57	73.5	78.4	234.4

Domestic Cattle; *Bos taurus* Radius

	Bd	Bp	GL	SD
IRONAGE	62.9	71.0	246.7	37.9
H57	63.9	70.9	259.9	34.5
H61	62.5	72.1	251.8	36.7
L2			258.3	38.0
L2	61.8	70.4	250.3	35.2
L2			253.1	34.0
L2	76.8		316.0	44.4
L2	63.3	73.6	253.3	34.6
L2	60.8	70.5	261.0	35.0
L2	61.6	71.4	251.0	35.3
L2	61.0		246.0	33.7
PHF	62.7	70.6	249.2	34.3
Summary Statistics for All Anglo-Saxon Features				
MEAN	63.8	71.4	259.1	36.0
STANDARD DEVIATION	5.0	1.1	19.4	3.1
MINIMUM	60.8	70.4	246.0	33.7
MAXIMUM	76.8	73.6	316.0	44.4
CASES	9	7	11	11

Cattle Complete Long Bones--Continued

Domestic Cattle; *Bos taurus* Metacarpus

	Bd	Bp	GL	SD
IRONAGE			186.1	26.1
IRONAGE	49.7	45.9	168.1	23.7
IRONAGE		43.7	166.7	25.3
IRONAGE	60.3	57.8	189.8	33.3
IRONAGE		52.0	177.6	29.6
ASD7	58.2	53.1	187.2	29.6
ASP			170.8	27.9
ASP	50.6	48.4	180.4	26.6
H12	53.9	51.8	190.9	30.1
H12	53.5	52.5	190.4	30.3
H16	51.1	46.6	180.4	25.5
H22	50.3	48.4	175.6	26.8
H34-35	57.7	54.3	190.3	31.3
H35		49.0	179.6	26.0
H36	48.6	48.3	177.1	27.9
H39			170.8	27.9
H40		51.2	184.3	28.9
H44		53.5	178.6	27.0
H44	52.8	50.2	192.4	28.4
H49	51.1	52.3	180.0	25.4
H5	52.1	51.0	190.8	25.7
H50	53.0	51.0	181.7	29.0
H56	52.9	48.7	195.7	27.6
H57	64.2	60.4	196.9	33.7
H57	51.3	47.1	178.8	27.3
H6	51.1	50.8	188.3	29.7
H6	53.0	50.0	194.7	27.2
H62	52.0	50.2	198.2	27.0
H63	56.9	55.0	185.1	28.9
H65		49.3	176.9	29.2
L2	53.8	52.5	173.9	27.1
L2	56.0	51.0	190.7	30.0
L2	54.2	50.7	188.4	28.5
L2	50.2	48.6	165.4	27.1
L2	53.8	50.9	189.1	30.4
L2	62.2	59.6	195.1	35.9
L2	51.2	51.4	186.6	28.3
L2			171.1	25.3
L2	52.6	51.8	187.9	29.7
L2	53.8	50.7	186.1	28.4
L2			190.1	27.7
L2	52.0	53.0	185.1	30.0
L2	66.9	60.2	209.1	37.2
L2			182.2	27.8
L2	52.7	54.6	191.5	30.6
L2	53.2	51.5	180.4	26.7
L2	52.3	50.0	178.6	27.0
L2	51.5	52.8	189.7	25.4
PHF	55.2	54.1	190.8	30.4
PHF			187.3	
PHF	51.7	50.0	185.0	27.3

Summary Statistics for All Anglo-Saxon Features

MEAN	53.8	51.7	185.2	28.6
STANDARD DEVIATION	3.9	3.1	8.4	2.5
MINIMUM	48.6	46.6	165.4	25.3
MAXIMUM	66.9	66.9	209.1	37.2
CASES	36	40	46	45

Domestic Cattle; *Bos taurus* Femur

	Bd	DC	GLC	SD
IRONAGE		37.7	287.0	29.3
ASP	76.9		284.2	28.4

Cattle Complete Long Bones--Continued

Domestic Cattle; Bos taurus Tibia

	Bd	Bp	GL	SD
IRONAGE			297.0	34.1
IRONAGE	51.9	80.6	295.6	30.9
ASF	54.6	84.6	309.5	31.7
PHF	57.9		326.0	34.3

Domestic Cattle; *Bos taurus* Metatarsus

	Bd	Bp	GL	SD
IRONAGE	53.2	45.3	213.3	25.7
IRONAGE			188.0	25.2
IRONAGE	56.2		211.0	25.9
ASD7	50.7	43.9	206.1	25.8
ASF	49.4	43.3	220.2	23.2
ASP		42.2	211.8	23.2
ASP	46.0	40.6	196.9	24.2
ASP	47.2	42.3	215.5	24.5
H39			192.6	24.0
H57	49.9	43.3	204.8	24.0
H57	62.6	49.3	222.4	
H6	47.3	42.6	221.8	21.9
H8	49.4	44.0	208.4	26.4
L2	46.7	41.9	209.1	23.4
L2	50.4	41.8	208.8	26.0
L2	56.1	47.9	227.0	26.2
L2	46.2	41.5	208.9	22.2
L2	46.0	41.5	201.6	22.7
L2	49.2		209.8	23.0
L2		52.5	227.0	26.8
L2	46.8	41.6	201.0	23.6
L2	49.2	45.0	210.0	25.9
L2	50.6	45.5	224.7	26.0
L2	47.4	41.2	209.5	22.7
L2		41.7	212.1	22.6
L2		49.8	236.9	27.8
L2	52.3	47.4	223.3	26.3
L2	47.5	44.1	209.3	22.6
L2	48.1	42.0	211.0	22.2
L2		44.5	218.4	24.3
L2		42.1	214.3	
L2	48.4	43.0	221.3	23.0
L2	57.3	48.0	235.0	32.8
L2	51.4	46.9	199.5	26.1
PHF	47.6	42.6	204.6	24.3
PHF	50.9	44.2	213.2	25.5
PHF	60.0	52.1	224.9	28.8
PHF	49.5	42.7	213.6	25.0

Summary Statistics for All Anglo-Saxon Features

	Bd	Bp	GL	SD
MEAN	50.1	44.3	213.6	24.8
STANDARD DEVIATION	4.2	3.2	10.3	2.3
MINIMUM	46.0	40.6	192.6	21.9
MAXIMUM	62.6	52.5	236.9	32.8
CASES	28	33	35	33

Table 28 Measurements on complete cattle long bones from all contexts

	Mean	Max.	Min.	s	C.V.	N
SCAPULA						
Scapula (SLC)						
Iron Age	18.2	15.7	21.7			4
Phase 1 (5th C.)	18.8	14.7	22.9	2.1	11.2	33
Phase 2 (6th C.)	18.4	14.6	23.9	2.1	11.4	71
Phase 3 (7th C.)	17.2	14.8	19.6	1.7	9.9	7
Scapula (GLP)						
Phase 1 (5th C.)	31.5	27.6	35.5	2.2	7.0	25
Phase 2 (6th C.)	31.8	27.1	36.8	2.2	6.9	46
Phase 3 (7th C.)	29.4	26.8	33.0			3
Scapula (BG)						
Phase 1 (5th C.)	19.9	17.3	22.9	1.5	7.5	26
Phase 2 (6th C.)	19.4	16.6	24.9	1.9	9.8	48
Phase 3 (7th C.)	16.1					1
Scapula (LG)						
Phase 1 (5th C.)	24.8	22.0	29.4	1.9	7.7	24
Phase 2 (6th C.)	24.9	21.2	29.1	1.8	7.2	48
Phase 3 (7th C.)	23.9	21.9	26.7			3
HUMERUS						
Humerus (Dp)						
Phase 1 (5th C.)	41.2	37.5	45.4			4
Phase 2 (6th C.)	43.5					1
Humerus (BT)						
Iron Age	27.4	25.6	29.5	1.4	5.1	5
Roman	24.5					1
Phase 1 (5th C.)	28.3	25.1	32.0	1.7	6.0	31
Phase 2 (6th C.)	27.7	24.5	31.9	1.7	6.1	64
Phase 3 (7th C.)	27.8	26.1	29.4	1.1	4.0	11
Humerus (Bd)						
Iron Age	29.1	27.0	32.5	2.2	7.6	5
Roman	26.7	26.5	26.9			2
Phase 1 (5th C.)	29.6	26.2	34.0	1.9	6.4	36
Phase 2 (6th C.)	29.6	25.0	33.8	2.1	7.1	67
Phase 3 (7th C.)	29.5	27.4	31.8	1.5	5.1	11
Humerus (SD)						
Iron Age	14.3	12.4	16.1			2
Roman	12.6	12.1	13.1			2
Phase 1 (5th C.)	14.1	12.1	16.3	1.1	7.8	15
Phase 2 (6th C.)	13.6	11.5	16.0	1.4	10.3	11
Phase 3 (7th C.)	13.2					1
RADIUS						
Radius (GL)						
Phase 1 (5th C.)	153.7	138.7	163.3	8.9	5.8	6
Phase 2 (6th C.)	146.0	135.3	161.3	8.0	5.5	10
Phase 3 (7th C.)	151.7	140.0	163.4			2
Radius (Bp)						
Iron Age	30.9	29.3	33.0			3
Roman	31.0					1
Phase 1 (5th C.)	31.1	27.7	35.6	2.3	7.4	18
Phase 2 (6th C.)	30.2	25.1	35.9	2.4	7.9	44
Phase 3	30.8	27.5	33.3	2.0	6.5	8
Radius (BFp)						
Iron Age	28.5	26.7	32.0			3
Roman	27.7					1
Phase 1 (5th C.)	28.1	24.5	32.1	1.9	6.8	19
Phase 2 (6th C.)	27.6	21.8	32.3	2.2	8.0	44
Phase 3 (7th C.)	27.2	24.5	29.8	1.9	7.0	8

Sheep Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
Radius (Bd)						
Phase 1 (5th C.)	29.4	25.4	34.0	2.7	9.2	10
Phase 2 (6th C.)	28.2	25.4	31.0	1.6	5.7	19
Phase 3 (7th C.)	28.8	27.5	30.0			2
Radius (BFd)						
Phase 1 (5th C.)	24.2	22.0	26.0	1.2	5.0	9
Phase 2 (6th C.)	23.9	21.5	26.1	1.2	5.0	19
Phase 3 (7th C.)	24.2	23.2	25.3			2
Radius (SD)						
Iron Age	16.9	15.6	19.5			3
Phase 1 (5th C.)	16.7	15.0	20.1	1.6	9.6	13
Phase 2 (6th C.)	16.2	13.3	22.6	1.9	11.7	35
Phase 3 (7th C.)	17.3	15.2	19.4			2
ULNA						
Ulna (LO)						
Phase 1 (5th C.)	41.7	37.5	45.4			3
Ulna (SDO)						
Phase 1 (5th C.)	22.6	20.7	24.4			3
Ulna (BPC)						
Phase 1 (5th C.)	18.6	17.0	19.8			3
METACARPUS						
Metacarpus (GL)						
Iron Age	127.6	125.1	130.1			2
Roman	109.4					1
Phase 1 (5th C.)	127.2	110.1	141.5	9.9	7.8	19
Phase 2 (6th C.)	128.7	117.1	142.1	7.2	5.6	18
Phase 3 (7th C.)	128.9	121.4	136.3			2
Metacarpus (Bp)						
Iron Age	23.2	21.0	24.6	1.5	6.5	7
Roman	22.8	19.0	25.5			3
Phase 1 (5th C.)	22.9	20.5	26.4	1.5	6.6	48
Phase 2 (6th C.)	23.0	20.0	26.9	1.4	6.1	81
Phase 3 (7th C.)	24.0	20.6	26.4	2.0	8.3	6
Metacarpus (Bd)						
Iron Age	26.9	26.7	27.1			2
Roman	22.1					1
Phase 1 (5th C.)	24.6	22.7	27.0	1.4	5.7	18
Phase 2 (6th C.)	24.9	22.2	27.5	1.6	6.4	27
Phase 3 (7th C.)*	26.3	26.2	26.4			2
Metacarpus (DD)						
Iron Age	10.1	9.2	11.1			3
Roman	8.2					1
Phase 1 (5th C.)	9.5	8.0	10.7	0.9	9.5	14
Phase 2 (6th C.)	9.6	8.4	10.7	0.7	7.3	21
Phase 3 (7th C.)	10.1	9.9	10.3			3
Metacarpus (SD)						
Iron Age	14.1	12.9	14.6	0.7	5.0	5
Roman	11.9					1
Phase 1 (5th C.)	13.9	11.5	15.9	1.1	7.9	37
Phase 2 (6th C.)	14.0	11.4	16.4	1.2	8.6	50
Phase 3 (7th C.)	14.4	13.4	14.9			4
FEMUR						
Femur (GL)						
Phase 1 (5th C.)	175.2					1
Femur (GLC)						
Phase 1 (5th C.)	172.2					1
Phase 2 (6th C.)	163.0					1

Sheep Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
Femur (Bp)						
Phase 1 (5th C.)	44.9	42.6	46.5			3
Phase 2 (6th C.)	41.8	36.4	48.2	3.4	8.1	12
Phase 3 (7th C.)	40.2					1
Femur (DC)						
Phase 1 (5th C.)	19.6	19.4	19.8			2
Phase 2 (6th C.)	19.6	18.4	20.5	0.6	3.1	12
Phase 3 (7th C.)	18.7					1
Femur (Bd)						
Phase 1 (5th C.)	36.1	33.6	38.7	2.4	6.6	5
Phase 2 (6th C.)	33.3	33.1	33.5			3
Phase 3 (7th C.)	34.8					1
Femur (SD)						
Phase 1 (5th C.)	15.6					1
Phase 2 (6th C.)	14.1	13.8	14.3			2
TIBIA (Sheep/goat)						
Tibia (GL)						
Phase 1 (5th C.)	189.7					1
Phase 2 (6th C.)	202.7	188.4	217.0			2
Tibia (Bd)						
Iron Age	25.6	17.9	27.9	2.6	10.2	13
Roman	25.6	22.1	27.4	1.9	7.4	9
Phase 1 (5th C.)	26.2	22.4	27.9	1.7	6.5	42
Phase 2 (6th C.)	26.0	22.8	29.5	1.5	5.8	96
Phase 3 (7th C.)	26.1	23.9	29.0	1.7	6.5	9
Tibia (Dd)						
Iron Age	19.6	14.5	21.3	2.2	11.2	9
Roman	20.6	18.7	22.3	1.4	6.8	6
Phase 1 (5th C.)	20.3	17.8	22.5	1.3	6.4	31
Phase 2 (6th C.)	20.3	18.1	23.1	1.1	5.4	57
Phase 3 (7th C.)	20.6	18.1	23.2			4
Tibia (SD)						
Iron Age	14.0	12.2	15.6	1.0	7.1	11
Roman	12.5					1
Phase 1 (5th C.)	14.7	11.9	17.4	1.4	9.5	21
Phase 2 (6th C.)	14.5	12.2	18.0	1.1	7.6	47
Phase 3 (7th C.)	15.1					1
CALCANEUS						
Calcaneus (GL)						
Phase 1 (5th C.)	55.0	49.3	59.3	2.7	4.9	15
Phase 2 (6th C.)	55.2	48.9	63.4	3.1	5.6	38
Phase 3 (7th C.)	54.8	53.9	55.7			2
Calcaneus (GB)						
Phase 1 (5th C.)	19.1	16.2	21.5	1.6	8.4	12
Phase 2 (6th C.)	19.0	17.1	21.6	1.2	6.3	29
Phase 3 (7th C.)	19.4	19.2	19.6			2
ASTRAGALUS						
Astragalus (GL1)						
Iron Age	26.9	23.8	31.9			3
Roman	24.1					1
Phase 1 (5th C.)	28.0	26.0	29.9	1.4	5.0	25
Phase 2 (6th C.)	28.1	24.8	31.6	1.6	5.7	70
Phase 3 (7th C.)	27.9	26.6	29.8	1.2	4.3	5

Sheep Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
Astragalus (GLm)						
Iron Age	23.0					1
Roman	23.2					1
Phase 1 (5th C.)	27.1	24.8	30.8	1.5	5.5	25
Phase 2 (6th C.)	26.6	24.1	29.7	1.4	5.3	72
Phase 3 (7th C.)	26.8	25.0	27.9	1.2	4.5	5
Astragalus (Bd)						
Iron Age	16.2	15.9	16.5			3
Roman	15.6					1
Phase 1 (5th C.)	18.7	16.9	21.0	1.2	6.4	24
Phase 2 (6th C.)	18.2	16.2	20.7	0.9	4.9	67
Phase 3 (7th C.)	17.8	16.6	18.8	1.0	5.6	5
Astragalus (Dl)						
Iron Age	15.0	13.5	17.5			3
Roman	13.5					1
Phase 1 (5th C.)	15.7	14.0	17.0	0.8	5.1	25
Phase 2 (6th C.)	15.6	14.0	18.0	0.9	5.8	70
Phase 3 (7th C.)	15.5	14.3	16.8	1.1	7.1	5
METATARSUS						
Metatarsus (GL)						
Phase 1 (5th C.)	134.7	122.2	148.2	8.0	5.9	7
Phase 2 (6th C.)	138.4	128.6	150.4	6.3	4.6	17
Metatarsus (Bp)						
Iron Age	19.1	18.5	19.6			3
Roman	20.8	20.2	21.3			2
Phase 1 (5th C.)	20.2	18.1	23.6	1.5	7.4	27
Phase 2 (6th C.)	20.7	17.5	26.2	1.3	6.3	86
Metatarsus (Bd)						
Iron Age	22.4	22.3	22.5			2
Phase 1 (5th C.)	23.1	21.6	24.7	0.9	3.9	10
Phase 2 (6th C.)	24.0	21.1	26.4	1.3	5.4	30
Phase 3 (7th C.)	22.6	20.0	25.2			2
Metatarsus (DD)						
Iron Age	9.3	9.0	9.6			2
Phase 1 (5th C.)	9.7	9.0	10.6	0.6	6.2	13
Phase 2 (6th C.)	10.1	9.0	11.7	0.6	5.9	24
Phase 3 (7th C.)	11.0					1
Metatarsus (SD)						
Iron Age	11.0	10.7	11.2			2
Roman	12.0	11.9	12.2			2
Phase 1 (5th C.)	12.2	10.0	16.4	1.4	11.5	22
Phase 2 (6th C.)	12.3	10.3	14.6	1.0	8.1	69

Table 29 Measurements on sheep bones from Iron Age, Romano-British, Phase 1, 2, and 3 contexts

Site	Date	N	Mean	Min.	Max.
Winklebury	Iron Age	20	21.1	16.9	23.9
Winnall Down	Middle I.A.	12	22.3	21.1	23.7
Barley	Iron Age	11	22.3	19.9	26.0
Balksbury 1973	Middle I.A.	19	22.4	20.4	24.0
Mawgan Porth	9-11th C.	7	22.6	21.0	25.0
Winnall Down	Early I.A.	7	22.7	21.3	24.0
Croft Ambrey	Iron Age	10	22.7	21.0	24.0
Balksbury 1973	Roman	7	22.8	21.0	27.3
Frocester Court	A.D. 100-300	12	22.8	20.0	25.0
Exeter	A.D. 55-100	21	23.1	21.3	29.2
Exeter	A.D. 100-300	30	23.3	21.4	25.9
Alcester	A.D. 100-200	9	23.6	21.1	26.0
Exeter	A.D. 300-400	15	23.9	22.3	27.0
Winnall Down	Early Roman	8	23.9	21.9	25.6
Grimthorpe	Early I.A.	5	24.0	22.0	25.5
Frocester Court	Late Roman	13	24.0	23.0	27.0
Shakenoak Farm	Late Roman	26	24.5	22.0	28.0
Baylham House	A.D. 100-200	22	24.5	21.6	28.8
Sedgeford	Mid Saxon	29	25.2	22.0	28.0
Alcester	Late Roman	59	25.5	21.2	29.4
West Stow	Iron Age	13	25.6	17.9	27.9
West Stow	Roman	9	25.6	22.1	27.4
Ramsbury	Mid Saxon	12	25.9	22.7	28.0
Hamwih	Mid Saxon	267	25.9	21.8	30.0
West Stow	6th C. A.D.	96	26.0	22.4	27.9
West Stow	7th C. A.D.	9	26.1	23.9	29.0
North Elmham	Mid Saxon	191	26.1	23.0	29.0
West Stow	5th C.	42	26.2	22.4	27.9
North Elmham	Late Saxon	71	26.2	22.0	29.5
Thetford	Late Saxon	13	26.3	21.0	29.0

Data Source: Maltby (1981: 190)

Table 30 Comparisons of the measurements of the distal tibial breadth (Bd) on sheep/goat bones from Iron Age, Romano-British, and Anglo-Saxon contexts at West Stow to other Iron Age, Romano-British, and Anglo-Saxon Sites

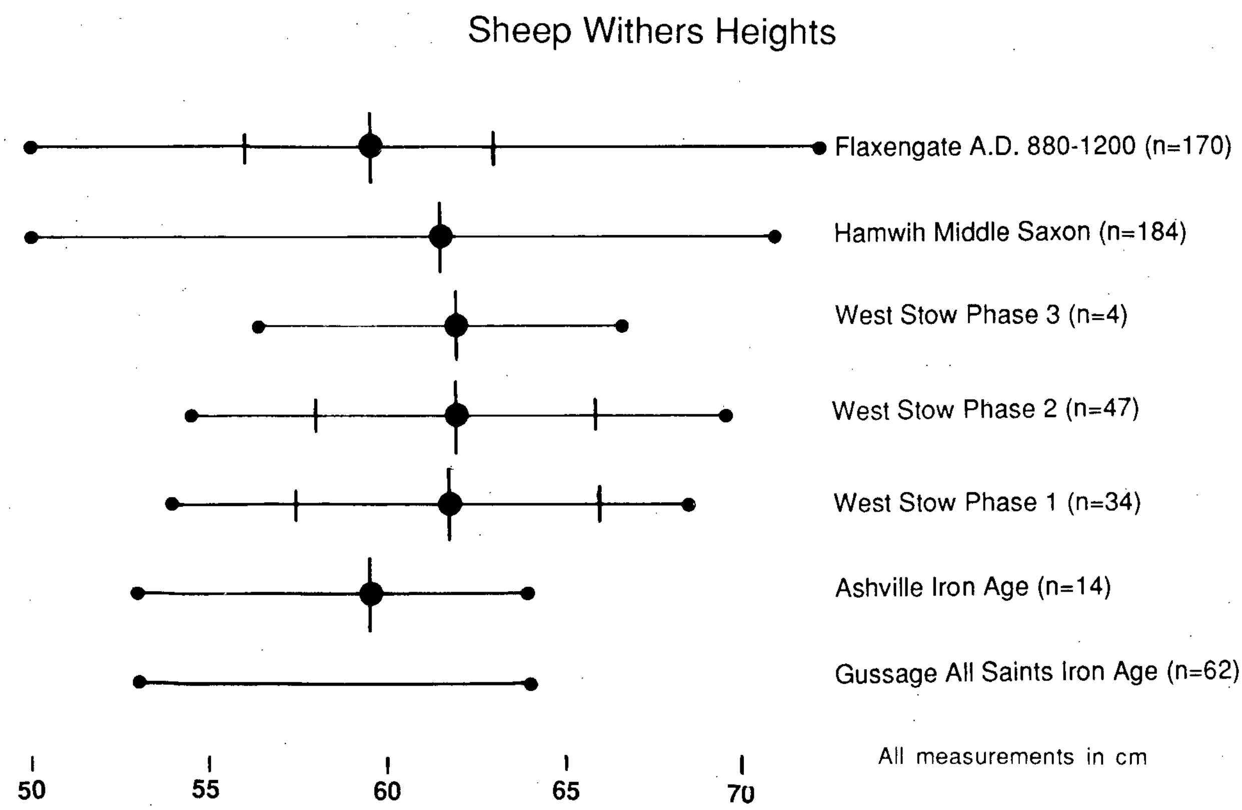


Figure 24 West Stow sheep withers heights compared to those from other Iron Age and Anglo-Saxon sites in Britain

Phase 1 (Fifth Century):

Measurement	N	Est. Withers Hts. (cm)	Mean (cm)
Radius (GL)	6	55.8-65.6	61.8
Metacarpus (GL)	19	53.8-68.6	62.2
Femur (GL)	1	61.8	
Tibia (GL)	1	57.1	
Metatarsus (GL)	7	55.5-67.3	61.2
Total	34	53.8-68.6	61.7, s.d.= 4.3

Phase 2 (Sixth Century):

Measurement	N	Est. Withers Hts. (cm)	Mean (cm)
Radius (GL)	10	54.4-64.8	58.7
Metacarpus (GL)	18	57.3-69.5	62.9
Tibia	2	56.7-65.3	61.0
Metatarsus	17	58.4-69.5	62.9
Total	47	54.4-69.5	61.9, s.d.= 3.9

Phase 3 (Later Sixth-Earlier Seventh Century):

Measurement	N	Est. Withers Hts. (cm)	Mean
Metacarpus (GL)	2	59.4-66.7	63.1
Radius (GL)	2	56.3-65.7	61.0
Total	4	56.3-66.7	62.0

Table 31 Withers height estimates for sheep from Anglo-Saxon SFBs

(von den Driesch's Bd; see Fig. 16b) is the measurement most commonly taken on sheep/goat[13] remains from Iron Age, Romano-British, and Anglo-Saxon sites in Britain. In Table 30, the mean distal tibial breadths for the West Stow Iron Age and Anglo-Saxon sheep are compared to the Anglo-Saxon, Romano-British, and Iron Age sheep surveyed by Maltby (1981, 190). The Phase 1, 2 and 3 means are larger than the means for all the Iron Age sites surveyed by Maltby (1981). It should be noted, however, that the Phase 1 distal tibial breadth is not *significantly* larger[14] than the West Stow Iron Age mean distal tibial breadth. Many of the sites surveyed by Maltby are located in Wessex, and it is possible that the size differences between the West Stow Anglo-Saxon tibiae and some Iron Age samples from Wessex may be due to regional variations in sheep breeds rather than to size increases through time.

Figure 24 compares the withers height estimates for the West Stow sheep to those for other Iron Age and Anglo-Saxon sites in southern Britain. The withers height estimates for the fifth-, sixth-, and late sixth-earlier seventh-century sheep from West Stow are summarized in Table 31 and in Figure 25. As can be seen in Figure 24, the Anglo-Saxon sheep from West Stow are larger than the Iron Age sheep from Gussage All Saints and Ashville. The withers height estimates for the Anglo-Saxon sheep from West Stow are closely paralleled by those from the Middle Saxon site of Hamwih.

A series of twenty-six two-tailed t-tests were used to compare the West Stow fifth-century sheep measurements with those from the extensive Middle Saxon collections from Hamwih. The t-tests were carried out on measurements on the scapula (SLC, GLP, BG, LG), humerus (BT, Bd), radius (GL, Bp, BFp, SD, Bd, BFd), ulna (LO, SDO, BPC), metacarpus (GL, Bp, SD), tibia (Bd), femur (Bd), astragalus (GLl), calcaneus (GL, GB), and metatarsus (GL, Bp, SD). Only two of these tests showed significant differences: the minimum width of the neck of the scapula, SLC, ($t = 5.3$, $p < 0.01$) and the greatest breadth of the calcaneus, GB ($t = 2.24$, significant at $p = 0.05$). These results are about what would have been expected on the basis of chance alone. They indicate no systematic size differences between the West Stow and the Hamwih sheep. This remarkable similarity in size demonstrates that Hodges' (1982, 142) contention that 'the Hamwih sheep . . . are abnormally large — larger than either their earlier or later medieval counterparts' is entirely without foundation. Instead, the West Stow and Hamwih sheep are apparently typical of Anglo-Saxon sheep from southern Britain.

A series of thirty-nine two-tailed t-tests was carried out on measurements on the scapula (SLC, GLP, BG, LG), humerus (BT, Bd, SD), radius (GL, Bp, BFp, SD, Bd, BFd), metacarpus (GL, Bp, SD, Bd, DD, and the depth and breadth of the distal fusion point), femur (Bp, DC, Bd), tibia (Bd, Dd, SD), calcaneus (GB, GL), astragalus (GLl, GLm, Bd, Dl), and metatarsus (GL, Bp, SD, Bd, DD, and the depth and breadth of the distal fusion point) to determine whether there were any significant size changes between the Phase 1 and Phase 2 sheep. Only two measurements, the distal breadth of the astragalus ($t = 2.10$) and the distal breadth on the metatarsus ($t = 2.12$) showed significant differences at the $p = 0.05$ level. This is exactly what would have been expected on the basis of

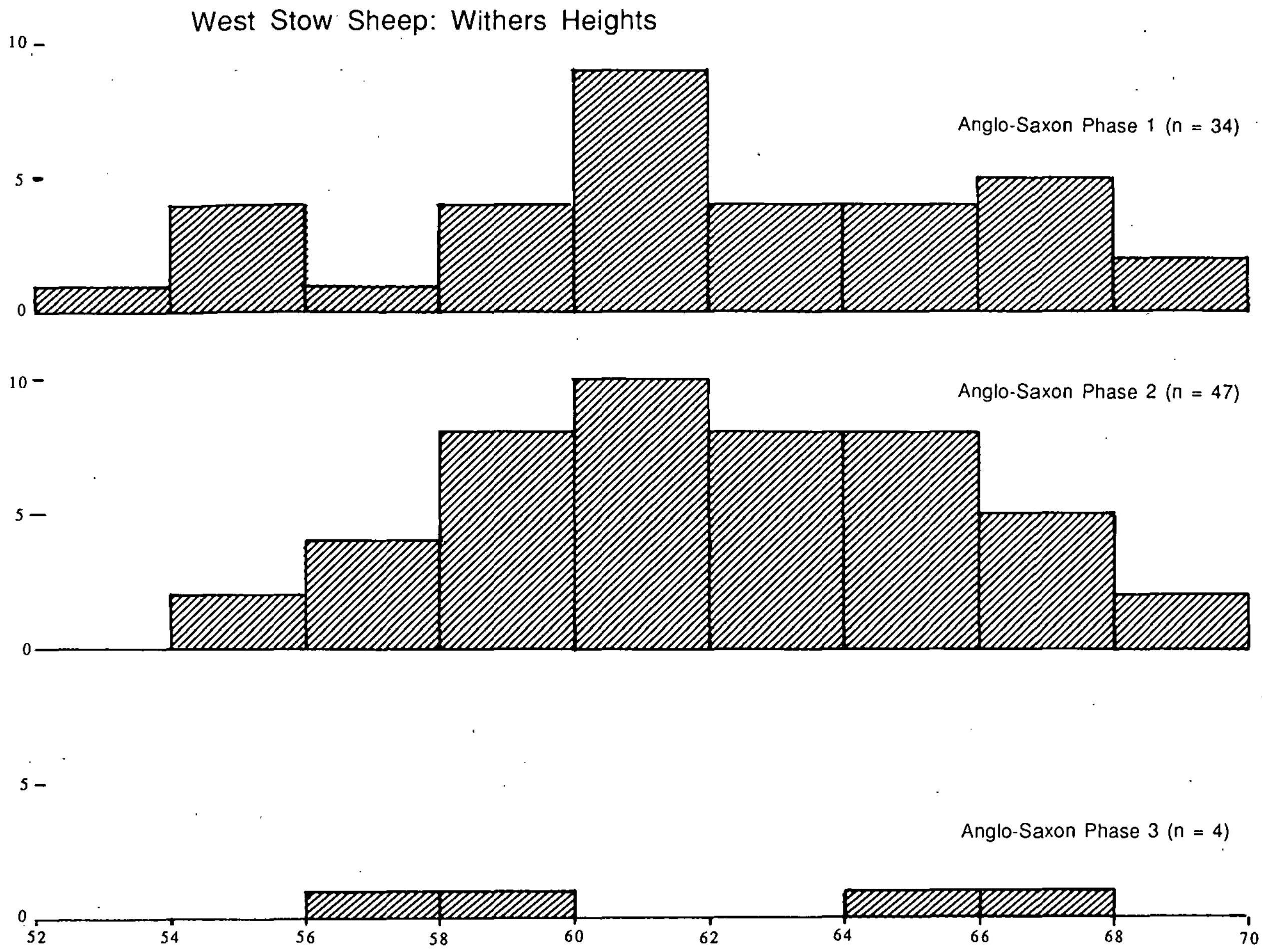


Figure 25 Distribution for the withers heights for sheep from Phase 1, 2 and 3 SFBs

chance alone, and it indicates that there is no real evidence for size change in the West Stow sheep.

The sample of measurable sheep bones from the Phase 3 SFBs is small. T-tests were used to compare the means of five measurements on the tibia (Bd), radius (Bp, BFp), and humerus (BT, Bd) for the Phase 2 and Phase 3 sheep. No significant differences were found, and it therefore seems reasonable to conclude that there is no evidence for size change in sheep between the sixth and seventh century at West Stow.

It is dangerous to compare ancient sheep to modern breeds since many of the characteristics that distinguish modern breeds of sheep cannot be reconstructed from animal bone evidence alone. It may nevertheless be useful to compare the West Stow sheep to modern Soay sheep since these animals have often been likened to prehistoric and early historic sheep. The Soay is an unimproved feral sheep known from the Island of St Kilda in Scotland. Ryder (1983, 41) found that Soay ewes averaged about 52cm. in height, while Soay rams averaged about 56cm. The average West Stow sheep was as tall as the largest of the Soay rams (61 cm); the smallest West Stow sheep are taller than the average Soay ewe. Thus, the West Stow sheep are larger, on average, than the Soay.

The West Stow sheep are slightly larger in height than the Late Saxon and medieval sheep from Flaxengate, Lincoln which had an average withers height of 59.5cm and a range of 50.1-72.2 cm (O'Connor 1982, 28; see Fig. 17). O'Connor (1982, 28) compares the Flaxengate ewes to small Welsh mountain sheep with an average body weight of 35 kg[15], but he notes that the largest Flaxengate sheep are comparable in height to mature Romney marsh sheep although they may not have been nearly as heavy.

Metrical determination of sex for the West Stow sheep was based on a measurement taken on the acetabulum (hip socket) of the pelvis[16]. The 129 measurable pelves from all Anglo-Saxon features (Fig. 26) show a clearly bimodal distribution, with the female mode centered at about 2.2 mm and the male mode centered at about 4.2mm. Very few cases fall into the 2.8-3.6mm range. The probable male group is larger and somewhat more variable in acetabular thickness. This group probably includes males which were killed for meat during the second and third years of life (Payne 1973, 282) and some older males and castrates which were kept for wool production. Some of the females which were not required for breeding and milking purposes may have been slaughtered as lambs, *i.e.*, before the acetabulum fuses. These animals would therefore not be included in Figure 26. It would, however, be risky for farmers to slaughter large numbers of female lambs unless the reproduction rates and survival rates for lambs were very high or there was a heavy emphasis on wool production. The ageing data (see below, Chapter 4) provide no real evidence for specialized wool production. We might therefore conclude that either

1. the West Stow farmers were very successful and could afford to slaughter large numbers of female lambs, or
2. sheep are being traded in and out of West Stow.

If sheep are being traded, then it is possible that surplus males (probably wethers) were being brought to the

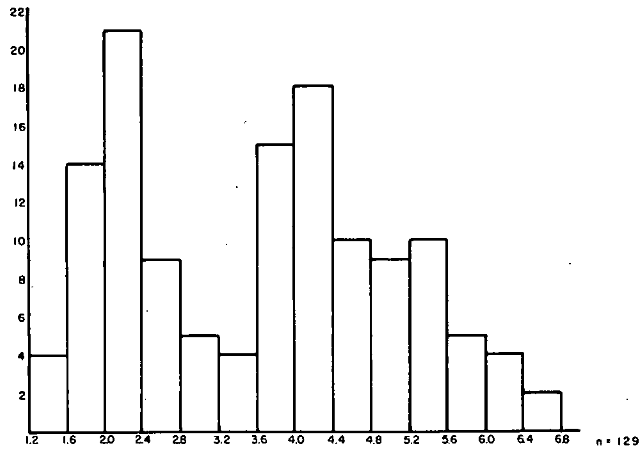


Figure 26 Distribution of measurements of the acetabular wall of the pelvis for sheep and goats from all Anglo-Saxon contexts

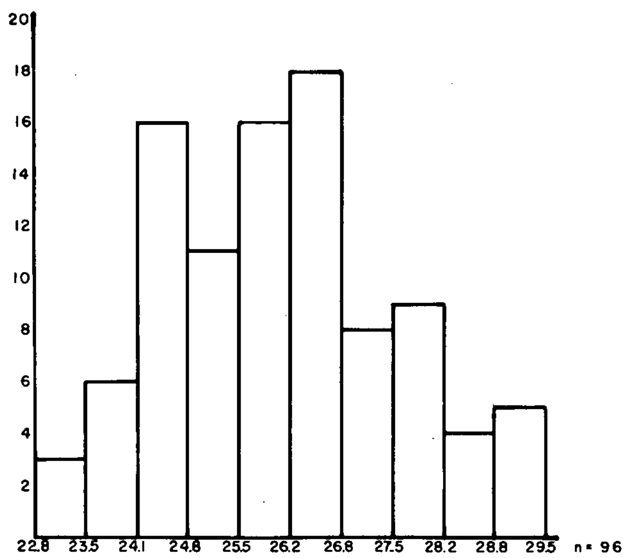


Figure 27 Distribution of the distal tibial breadth (Bd) for all Phase 2 sheep and goats

site from other places. These animals may have been kept by the villagers for wool production. In exchange, some of the surplus females may have been traded. The mechanisms through which this trade may have taken place are difficult to discover. There is no evidence for market towns, or for large scale urban centers of any kind, in Britain during the fifth and sixth centuries. In the absence of convincing evidence for urban markets, we must assume that trade relationships were established between rural communities.

Noddle (1980, 396) has suggested that the sheep distal tibial breadth has a trimodal distribution within a single breed. The small, middle, and large modes would correspond to ewes, wethers, and rams, respectively. The distribution of the Phase 2 distal tibial breadths is shown in Figure 27. The distribution does show some trimodality, although the discrimination between the sexes is not as good as it is for acetabular thickness (Fig. 26). Once again, these data would seem to indicate that more males than females were present among the adult sheep from West Stow. The majority of these would be wethers rather than rams. These wethers may have been kept for wool production (see Chapter 4).

The measurements taken on complete sheep limb bones from all Iron Age, Romano-British, and Anglo-Saxon contexts are listed in Table 32. The distribution of the greatest length (GL) and the distal breadth (Bd) of the metacarpus are shown in Figures 28 and 29. Both distributions show some degree of bimodality (see also Pl. IV). If this bimodality reflects sexual dimorphism, then it seems reasonable to conclude that the population of adult sheep included substantial numbers of both males and females.

The relationship between the length (GL) and the breadth (SD) of the metacarpus has been used as a possible sex discriminator (Haak 1965; O'Connor 1982, 28). Three basic shapes of metacarpus have been defined: long and robust (rams), long and gracile (wethers), and short and gracile (ewes). In Figure 30 the greatest length of the metacarpus for all the Anglo-Saxon sheep is plotted against the relative breadth (SD/GL X 100). Unfortunately, no clear clusters are apparent.

IV. Pigs

(Tables 33 and 34)

The measurements taken on archaeological pig bones from the Iron Age, Romano-British, and Anglo-Saxon contexts are summarized in Table 33. Measurements on archaeological pig bones can be used to distinguish wild boar from domestic stock in addition to providing evidence for the size and robusticity of ancient swine. The length of the lower third molar, in particular, has been used for this purpose, since this tooth becomes shortened upon domestication. The Phase 1 lower third molar lengths for pigs range from 30-37mm. All are below the traditional dividing line of 40mm (Dexter Perkins, pers. comm.), but the largest are near the top of the domestic pig size range. Although the largest lower third molars are shorter than both the largest one from North Elmham and the modern wild sow measured by Noddle (1980, 400-1), they are larger than the largest lower third molars recovered from Hamwih (Bourdillon and Coy 1977, 13). The most reasonable interpretation is that the largest West Stow specimens probably represent large domestic pigs, as the limb bones give no indication of the presence of wild boar. The co-efficient of variation for the length of the M3 is relatively low (6.7), which suggests that the pig measurements are drawn from a single variable (domestic) population.

West Stow, along with Middle Saxon Hamwih (Bourdillon and Coy 1977, 13-16), is one of the few British sites to have produced an extensive collection of measurable pig bones. The distal humeral breadth (Bd) is one of the most commonly taken pig bone measurements (Fig. 16d). Since the distal humerus is a weight-bearing member, its breadth should reflect overall animal size. The West Stow distal humeral breadths are not significantly different from those of Middle Saxon Hamwih based on a two-tailed Student's t-test[17]. Detailed statistical comparisons between the fifth-and sixth-century pig measurements from West Stow (Crabtree 1982, 228-9) provide no conclusive evidence for size change through time.

Very few measurable pig bones were recovered from the Phase 3 faunal sample. The measurable pig bone sample from the earlier seventh-century huts is so small that statistical comparisons with the Phase 2 pigs are not possible. All that can be said is that the measurements of

Sheep; *Ovis aries*

	Humerus			
	Bd	GL	GLC	SD
L2	28.9		126.0	14.0
L2	29.9	126.2	113.8	13.2

Sheep; *Ovis aries*

	Radius			
	Bd	Bp	GL	SD
ASF	28.3	30.1	136.4	15.6
ASF	30.2	31.7	145.8	17.0
ASF	27.7	29.4	155.3	15.0
ASF	29.4	33.7	173.4	17.6
ASP	24.6	27.8	136.9	14.2
ASP	26.1	27.7	133.8	14.4
ASP	23.9		135.8	16.2
H12	28.9		155.1	17.5
H12	26.4	28.0	141.1	15.3
H12	27.8	29.6	149.0	16.2
H12	27.5	28.9	146.5	14.7
H12	30.0	32.7	161.3	16.9
H17	27.3	30.0	151.7	16.2
H2	30.0	31.0	163.4	19.4
H27	27.4	29.3	136.3	15.0
H3	27.5	31.2	140.0	15.2
H36	28.7	32.2	160.7	16.1
H37	27.5	29.6	138.7	15.1
H45	25.4	27.3	135.3	13.7
H45	27.6	30.1	147.8	15.1
H47	26.4	27.6	146.1	14.1
H55	29.6	32.0	150.0	18.2
H6	32.3	35.6	157.7	18.0
H66	26.6	29.3	141.2	15.8
H66	26.0	27.1	136.8	13.8
H7	31.0	34.9	163.3	17.9
L2	25.2	27.7	141.3	15.6
L2		34.1	169.9	18.1
L2		35.0	167.0	18.9
L2	27.9	31.4	162.4	16.6
L2			152.3	19.3
L2	29.5	32.2	156.5	18.3
L2	27.1	29.9	160.2	16.3
L2	28.7	29.8	153.8	17.6
L2	26.6	30.7	148.7	17.0
L2	30.2	33.7	170.7	17.8
L2	28.3	30.6	149.4	17.9
L2	27.2	30.5	143.9	15.5
L2	27.5	28.5	154.8	17.0
L2	28.7	32.1	155.9	19.1
L2		28.6	136.9	15.0
L2	29.5	32.6	147.4	17.8
L2	27.9	29.7	145.0	15.0
L2	27.3		144.3	16.6
L2	28.1		138.6	15.6
L2	32.2	36.5	177.4	17.2
L2	29.7	31.1	154.2	17.4
PHF	27.6	32.1	165.0	17.8
Summary Statistics for All Anglo-Saxon Contexts				
MEAN	28.0	30.8	150.7	16.5
STANDARD DEVIATION	1.8	2.3	11.2	1.5
MINIMUM	23.9	27.1	133.8	13.7
MAXIMUM	32.3	36.5	177.4	19.4
CASES	44	43	48	48

Sheep; *Ovis aries*

	Metacarpus			
	Bd	Bp	GL	SD
IRONAGE	27.1	24.6	130.1	14.5
IRONAGE			125.1	14.6
Roman	22.1	19.0	109.4	11.9

Complete Sheep Long Bones--Continued

	Bd	Bp	GL	SD
ASD7	22.3	19.9	118.1	12.8
ASD7	24.5	21.8	122.8	13.8
ASD7	24.4	22.2	118.8	12.4
ASF	25.2		136.1	14.9
ASF	24.7	21.6	122.7	13.1
ASF	27.4	25.3	136.0	14.8
ASF	23.4	20.9	123.9	11.3
ASF	25.0	21.9	125.0	13.2
ASF	24.3	22.2	120.1	13.3
ASP	24.6	22.8	123.1	13.7
H12	25.5	22.7	132.1	15.0
H12	26.8	25.1	134.8	16.0
H12	22.6	20.7	123.8	12.2
H12	26.9	23.3	134.2	16.4
H17	27.0	24.8	130.8	15.6
H17	25.4	23.9	135.1	15.4
H17	23.5	22.2	128.4	13.0
H2	26.4		121.4	14.7
H22	24.4	21.0	113.7	12.6
H26	26.7	23.8	131.3	15.0
H26	24.7	23.6	131.4	13.7
H34	27.0	24.0	133.5	14.9
H37	22.8	20.5	110.1	12.5
H37	25.8	24.1	137.3	14.9
H39	26.3	23.4	132.5	13.0
H40	26.2	25.3	136.3	14.4
H44	24.1	22.8	127.5	12.2
H44	23.3	20.8	118.7	12.3
H44	23.5	22.6	126.4	11.8
H44		25.5	136.0	16.4
H45	24.0	22.0	126.8	13.6
H45			117.1	
H47	23.2	22.3	127.4	12.6
H48	25.9	24.4	137.6	14.5
H49	26.6	24.3	132.9	15.3
H52	22.8	21.6	122.6	14.0
H52	26.1	23.6	138.8	14.3
H52	26.1	25.0	141.5	15.6
H55	23.0	21.8	118.6	12.3
H55	26.6	24.7	140.3	15.9
H56	25.3	22.8	125.0	15.0
H6	24.6	22.2	126.0	13.5
H6	23.5	20.6	119.5	12.8
H61	23.4	22.7	124.6	12.8
H61	25.3	23.7	128.4	13.7
H64	24.2	21.4	119.3	13.0
H65	27.1	23.5	138.1	15.3
H65		21.8	120.6	13.7
H65	23.0	21.8	119.3	12.0
H66	26.6	26.1	142.1	15.6
H67	23.5		118.0	12.3
H68	23.0	21.7	117.4	
H7	22.7	20.8	111.5	12.7
L2	25.6	23.1	125.0	13.6
L2	24.8	23.9	133.7	13.6
L2	25.1	21.6	112.9	13.3
L2		24.0	129.1	
L2	27.3	23.6	134.6	
L2	26.0	23.8	131.0	15.1
L2	22.9	21.7	115.8	12.4
L2	27.0	24.9	140.3	14.8
L2	26.0	24.9	137.6	15.8
L2	25.7	22.9	130.2	13.8
L2	23.9	22.1	128.6	12.2
L2	23.5	20.2	120.4	12.5
L2	23.7		133.9	
L2		20.0	114.0	12.4
L2		20.4	118.2	12.5
L2		20.7	114.5	13.3

Complete Sheep Long Bones--Continued

	Bd	Bp	GL	SD
L2	23.1		120.2	11.4
L2	26.8	24.1	126.3	14.9
L2			126.6	
L2	25.9	23.3	136.0	15.0
L2	26.5	23.0	140.8	16.2
L2	22.1	18.8	109.1	11.7
L2	23.5		116.0	
L2	24.1	22.9	122.1	13.3
L2	25.5	22.7	119.0	13.0
L2	23.8	21.5	118.0	13.4
L2	23.8	22.9	119.1	13.8
L2	24.5	23.9	131.5	13.8
L2	28.1	24.6	128.2	15.6
L2			122.0	13.3
L2		24.6	137.2	15.3
L2	26.0	23.1	133.1	14.1
L2	26.9	25.9	134.2	15.0
L2	23.0	20.8	116.0	13.0
L2	24.1	21.4	128.6	14.8
L2	24.8	22.1	122.2	12.7
PHF		21.3	122.8	14.1
PHF	23.2	22.0	113.3	13.0
PHF	24.5	22.0	126.4	13.0
PHF	22.5	21.1	115.4	13.2
PHF	23.3	22.1	132.4	13.8
PHF	23.2	20.6	123.9	12.8
PHF	24.5	20.7	121.9	12.5

Summary Statistics for all Anglo-Saxon Contexts

	Bd	Bp	GL	SD
MEAN	24.8	22.7	126.2	13.8
STANDARD DEVIATION	1.5	1.6	8.2	1.3
MINIMUM	22.1	18.8	110.1	11.3
MAXIMUM	28.1	26.1	142.1	16.4
CASES	85	87	96	89

Sheep; *Ovis aries* Femur

	Bd	Bp	GL	GLC
H36	38.7	46.5	175.2	172.2
H45	33.4	39.5		163.0

Sheep; *Ovis aries* Metatarsus

	Bd	Bp	GL	
IRONAGE	20.6	18.0	126.1	10.2
ASF	24.3	21.6	150.2	13.3
ASF	25.5	22.4	140.6	14.9
ASF	24.6	21.1	140.7	12.8
ASF	22.0	19.2	128.1	10.9
ASF	25.3	22.6	141.3	13.6
ASF	20.8	17.4	119.8	11.1
ASF	24.9	21.7	148.7	12.9
ASF	23.1	19.4	133.3	10.6
ASF	24.2	20.3	132.2	11.8
ASF	22.5	19.2	138.7	10.9
H11	24.6	20.6	147.2	13.4
H12	25.0	21.0	132.7	13.4
H12	24.6	21.5	136.5	13.2
H12	25.7	23.2	145.5	
H12	22.5	20.4	132.1	11.5
H12	23.4	20.4	134.2	11.6
H17	21.6	18.1	122.2	10.5
H20	23.3	19.4	133.4	12.0
H26	25.8	21.4	143.4	13.3
H26	23.3	20.6	132.6	12.1
H26		21.3	143.4	13.8

Complete Sheep Long Bones--Continued

	Bd	Bp	GL	SD
H34	24.9	21.5	140.0	13.4
H35	21.1	18.8	135.2	12.0
H36	22.5	19.0	132.5	12.0
H36	24.7	22.3	148.2	13.0
H44	25.9	22.1	143.3	13.0
H44	23.3	21.0	134.6	12.7
H45	23.5	19.3	135.7	12.4
H45	22.7	18.8	140.2	11.5
H47	25.3	22.1	150.4	13.6
H47	24.0	21.0	147.6	13.3
H53	23.9	20.8	132.8	11.7
H56	25.4	21.4	137.0	13.5
H6	23.9	20.7	139.1	11.8
H61	22.3	19.4	133.0	12.8
H68	23.2	20.0	140.8	12.4
H7	22.8	18.9	130.7	11.2
H8	23.9	20.2	128.6	13.5
L2	24.0	20.3	143.7	12.2
L2	24.3	21.2	132.6	13.5
L2	26.1		22.5	13.5
L2		21.2	148.2	14.0
L2	22.0	18.7	124.9	10.4
L2		19.3	128.6	11.4
L2	23.5	19.7	140.6	11.7
L2	25.6	22.4	154.4	12.9
L2	25.1	22.1	156.8	13.5
L2	22.8	19.1	127.3	10.9
L2	24.7	21.4	141.1	12.5
L2		20.1	129.1	12.2
L2		16.2	118.5	8.7
L2	25.7	22.7	153.2	14.0
PHF	26.8	22.5	152.4	13.3
PHF	22.6	18.8	122.7	10.5
PHF	22.5	19.6	128.6	11.3

Summary Statistics for All Anglo-Saxon Features

MEAN	23.9	20.5	137.3	12.4
STANDARD DEVIATION	1.3	1.3	9.2	1.2
MINIMUM	20.8	16.2	118.5	8.7
MAXIMUM	26.8	23.2	156.8	14.9
CASES	50	54	55	54

Sheep or Goat; Small caprine Tibia

	Bd	Bp	GL	SD
H12	25.8	42.4	217.0	15.3
H12	23.8		188.4	
H17	24.0		189.7	12.5
ASF	27.0	43.0	205.6	15.6
L2	23.8	36.8	185.0	13.2

Summary Statistics for All Anglo-Saxon Features

MEAN	24.9	40.7	197.1	14.1
STANDARD DEVIATION	1.5	****	13.6	****
MINIMUM	23.8	36.8	185.0	12.5
MAXIMUM	27.0	43.0	217.0	15.6
CASES	5	3	5	4

Table 32 Summary statistics for all complete sheep and sheep/goat long bones from all Anglo-Saxon contexts

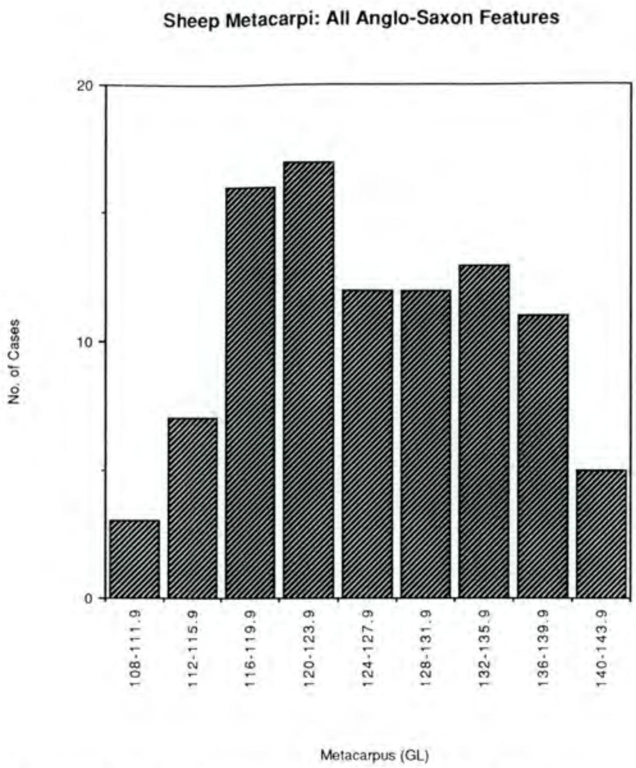


Figure 28 Distribution of the greatest length of the metacarpus (GL) for sheep from all Anglo-Saxon features

Plate IV Two sheep metacarpi from SFB 55. Scale 2:3

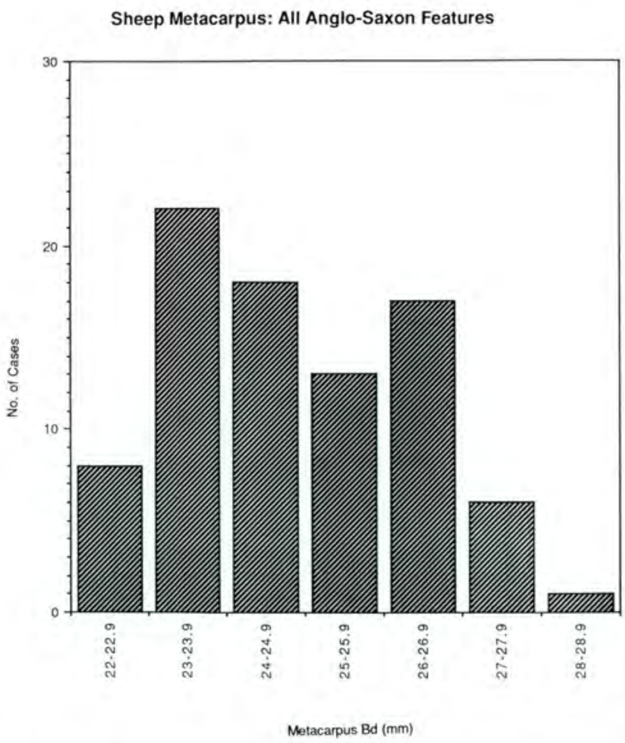


Figure 29 Distribution of the distal breadth (Bd) of the metacarpus for sheep from all Anglo-Saxon features

weight-bearing members, such as the distal humerus, are within the range of those seen in the larger Phase 1 and Phase 2 samples.

No complete pig long bones were recovered from the huts. A single complete tibia was recovered from one Anglo-Saxon feature, and it provides an estimated withers height of 73.1cm (Table 34). In general, the West Stow pigs are similar in size to the Hamwih swine whose withers height estimates ranged from 63.2-77.8cm. These heavily built Anglo-Saxon pigs would have served as an important source of meat (Bourdillon and Coy 1980, 112).

V. Horses

(Fig. 31; Tables 35-7)

A summary of the measurements taken on the Iron Age, Romano-British, Phase 1 and Phase 2 horse bones is included in Table 35. As horse bones represent a very small proportion of the Anglo-Saxon faunal assemblage, measurable horse bones are rare, and possible statistical comparisons are limited.

At West Stow, horse bones were relatively more common in the Iron Age features than in the Anglo-Saxon SFBs. Withers height estimates[18] could be calculated for seven complete Iron Age long bones (two radii, four metacarpi, and one metatarsus). The Iron Age withers height estimates range from 110-136cm, or from about 11-13½ hands. Withers height estimates for the Ashville Iron Age horses range from 120-142cm (Wilson 1978, 117), while those from Gussage All Saints range from 102-145cm, or 10-14 hands (Harcourt 1979, 153). Thus the West Stow horses are within the usual Iron Age range of 10-14 hands and are comparable in size to horses from other large Iron Age sites.

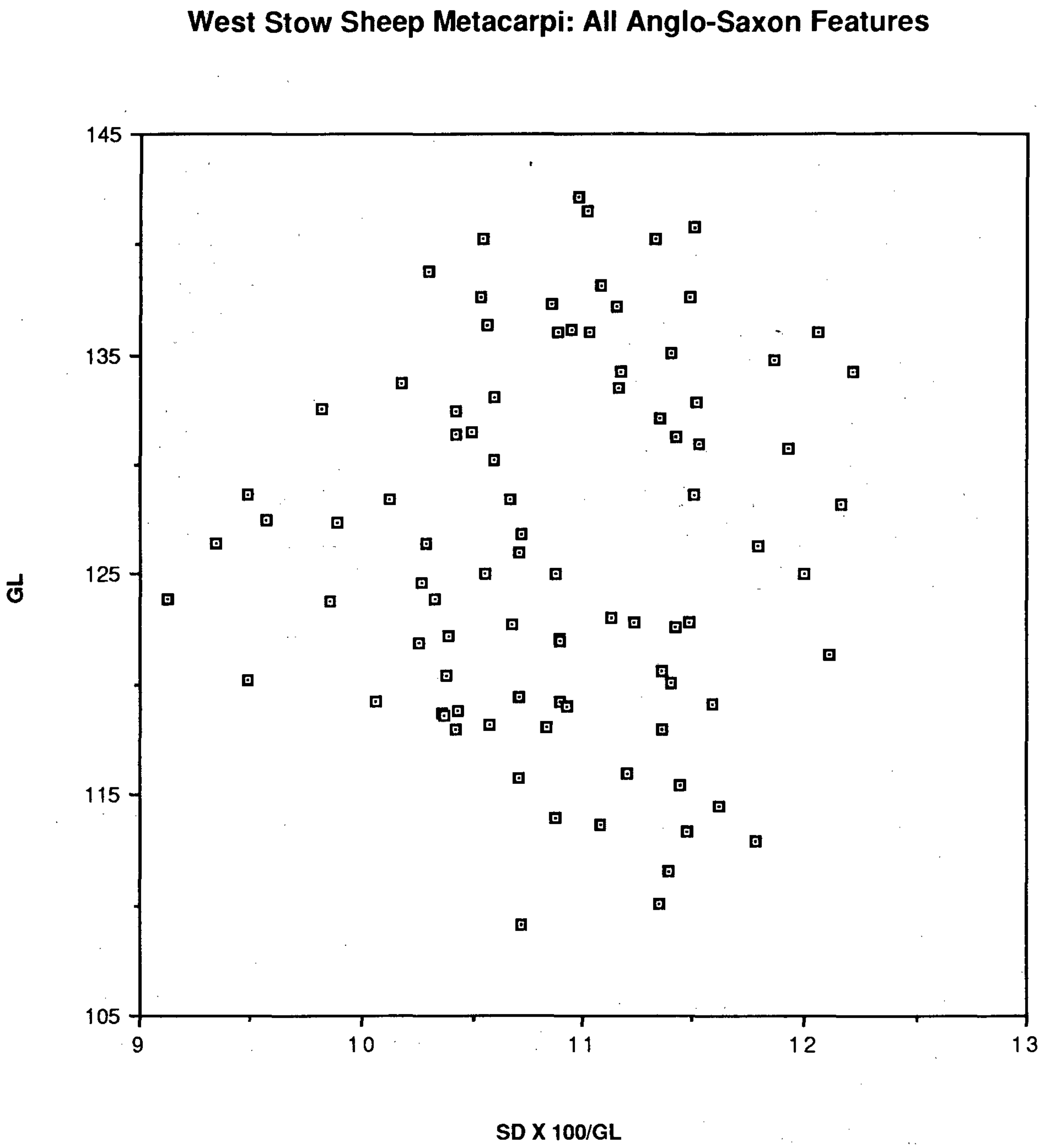


Figure 30 Plot of the greatest length of the metacarpus against the metacarpal index: SD X 100/GL for sheep from all Anglo-Saxon features

	Mean	Min.	Max.	s	C.V.	N
MAXILLA						
Maxilla M3L						
Phase 1 (5th C.)	30.6	27.9	31.9			4
Phase 2 (6th C.)	30.6	27.3	33.2	1.9	6.2	13
MANDIBLE						
Mandible (M3L)						
Iron Age	33.0	28.4	35.1	2.7	8.2	5
Roman	30.3	29.3	31.3			2
Phase 1 (5th C.)	32.9	30.0	37.0	2.2	6.7	10
Phase 2 (6th C.)	31.8	29.9	35.1	1.4	4.4	11
SCAPULA						
Scapula (SLC)						
Iron Age	21.6	20.4	24.4	1.3	6.0	7
Phase 1 (5th C.)	22.3	19.4	25.6	1.5	6.7	25
Phase 2 (6th C.)	22.5	18.9	27.3	2.1	9.3	26
Phase 3 (7th C.)	23.2	20.3	27.8	3.0	12.9	6
Scapula (GLP)						
Iron Age	32.7					1
Phase 1 (5th C.)	34.7	32.0	37.6	1.9	5.5	9
Phase 2 (6th C.)	35.0	30.1	39.9	2.6	7.4	16
Phase 3 (7th C.)	35.0	30.8	40.5			4
Scapula (BG)						
Iron Age	22.1					1
Phase 1 (5th C.)	24.4	22.3	26.8	1.2	4.9	11
Phase 2 (6th C.)	25.3	22.8	28.9	2.0	7.9	14
Phase 3 (7th C.)	23.2	20.7	26.1	2.3	9.9	5
HUMERUS						
Humerus (Dp)						
Phase 2 (6th C.)	43.2					1
Humerus (Bd)						
Roman	39.4					1
Phase 1 (5th C.)	38.6	34.1	43.6	2.4	6.2	12
Phase 2 (6th C.)	40.0	36.0	43.1	2.1	5.3	15
Phase 3 (7th C.)	39.7					1
Humerus (SD)						
Phase 1 (5th C.)	15.1	13.5	16.8	1.1	7.3	11
Phase 2 (6th C.)	16.6	14.6	18.5	1.3	7.8	9
RADIUS						
Radius (Bp)						
Iron Age	25.3					1
Roman	27.8					1
Phase 1 (5th C.)	28.6	25.5	31.0	1.5	5.2	10
Phase 2 (6th C.)	28.7	26.4	30.8	1.5	5.2	12
Phase 3 (7th C.)	29.7					1
Radius (SD)						
Roman	17.3					1
Phase 1 (5th C.)	16.8	14.9	19.1	1.1	6.5	11
Phase 2 (6th C.)	17.9	16.0	20.6	1.5	8.4	7
Radius (Bd)						
Phase 3 (7th C.)	33.8					1
ULNA						
Ulna (LO)						
Phase 1 (5th C.)	56.2					1
Ulna (SDO)						
Phase 1 (5th C.)	29.4					1

Pig Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
FEMUR						
Femur (Bd)						
Iron Age	41.4					1
Phase 1 (5th C.)	46.3					1
TIBIA						
Tibia (Bp)						
Phase 2 (6th C.)	45.5					1
Tibia (Bd)						
Phase 1 (5th C.)	29.6	27.6	31.7	1.6	5.4	10
Phase 2 (6th C.)	29.4	27.2	31.0	1.2	4.1	11
Tibia (Dd)						
Phase 1 (5th C.)	26.0	24.1	28.1	1.2	4.6	9
Phase 2 (6th C.)	26.7	24.4	29.0	1.8	6.7	5
Tibia (SD)						
Roman	17.5					1
Phase 1 (5th C.)	18.9	17.9	19.6	0.7	3.7	5
Phase 2 (6th C.)	18.6	17.9	19.0			4
Phase 3 (7th C.)	20.6					1
ASTRAGALUS						
Astragalus (GLl)						
Phase 1 (5th C.)	37.7	35.7	40.8	1.8	7.4	9
Phase 2 (6th C.)	39.5	43.9	45.0	2.5	6.3	14
Phase 3 (7th C.)	39.0	38.5	39.5			2
Astragalus (GLm)						
Iron Age	33.4					1
Phase 1 (5th C.)	35.7	33.2	38.6	1.9	5.3	11
Phase 2 (6th C.)	36.8	32.5	40.9	2.4	6.5	15
Phase 3 (7th C.)	36.4	35.0	37.8			2
FIRST PHALANX						
First Phalanx (Bp)						
Iron Age	15.9	14.8	16.6			4
Phase 1 (5th C.)	16.1	14.3	17.7	0.9	5.6	18
Phase 2 (6th C.)	16.1	14.5	19.1	1.1	6.8	22
Phase 3 (7th C.)	16.5	15.4	17.7	0.8	4.8	5
First Phalanx (SD)						
Iron Age	12.6	11.1	13.4			4
Phase 1 (5th C.)	12.8	10.7	15.0	1.0	7.8	19
Phase 2 (6th C.)	12.9	11.0	15.1	1.0	7.8	24
Phase 3 (7th C.)	13.3	11.9	15.0	1.2	9.0	5
First Phalanx (Bd)						
Iron Age	15.0	14.5	15.6			4
Phase 1 (5th C.)	14.9	13.5	16.6	0.8	5.4	18
Phase 2 (6th C.)	15.0	13.5	16.6	0.8	5.3	25
Phase 3 (7th C.)	15.4	14.0	16.6	1.1	7.1	5
First Phalanx (GLpe)						
Iron Age	37.9	36.9	38.3			4
Phase 1 (5th C.)	34.0	31.8	38.0	1.7	5.0	18
Phase 2 (6th C.)	35.7	32.0	39.1	2.1	5.9	23
Phase 3 (7th C.)	34.8	32.2	37.0	2.3	6.6	5

Note: All measurements in mm. Abbreviations are those of von den Driesch (1976).

Table 33 Measurements data for pig bones recovered from Iron Age, Romano-British, Phase 1, 2 and 3 contexts

Pig; *Sus scrofa*	Tibia			
	Bd	Bp	GL	SD
ASF	31.0	46.2	186.6	20.9

Table 34 Measurements on complete pig long bone

	Mean	Min.	Max.	s	C.V.	N
SCAPULA						
Scapula (SLC)						
Iron Age	50.1	49.0	51.2			2
Phase 2 (6th C.)	58.7	56.9	60.5			2
Scapula (GLP)						
Iron Age	77.8	72.6	83.0			2
Phase 2 (6th C.)	89.1	83.8	95.8			3
Scapula (BG)						
Iron Age	39.1	36.4	41.8			2
Phase 2 (6th C.)	39.8	38.5	41.0			2
Scapula (LG)						
Iron Age	47.2	45.2	49.2			2
Phase 2 (6th C.)	51.5	51.3	51.6			2
HUMERUS						
Humerus (BT)						
Iron Age	70.2					1
Phase 1 (5th C.)	68.8					1
Humerus (Bd)						
Roman	69.0					1
Humerus (SD)						
Iron Age	31.9					1
Roman	27.2					1
Phase 1 (5th C.)	35.5					1
RADIUS						
Radius (GL)						
Iron Age	318.7	308.0	329.5			2
Radius (Bp)						
Iron Age	74.8					1
Phase 1 (5th C.)	83.2					1
Radius (BFp)						
Iron Age	67.0					1
Phase 1 (5th C.)	73.0					1
Phase 2 (6th C.)	68.4					1
Radius (Bd)						
Iron Age	66.9	66.7	67.0			2
Phase 1 (5th C.)	74.5	69.8	78.9			2
Radius (BFd)						
Iron Age	56.0					1
Phase 1 (5th C.)	62.8	61.7	64.4			2
ULNA						
Ulna (BPC)						
Phase 1 (5th C.)	43.8	41.7	45.9			2
METACARPUS						
Metacarpus (GL)						
Iron Age	200.7	176.7	219.0			4
Phase 1 (5th C.)	217.9	217.7	218.0			2
Phase 2 (6th C.)	213.4					1

Horse Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
Metacarpus (Bp)						
Iron Age	44.8	41.7	50.0			4
Phase 1 (5th C.)	48.8	48.5	49.2			2
Phase 2 (6th C.)	46.7	44.4	48.9			2
Metacarpus (Dp)						
Iron Age	29.7	27.4	33.6			4
Phase 1 (5th C.)	32.4	32.1	32.7			2
Phase 2 (6th C.)	27.6					1
Metacarpus (Bd)						
Iron Age	45.7	41.4	50.4			4
Phase 1 (5th C.)	51.4	47.8	55.0			2
Phase 2 (6th C.)	49.0					1
Metacarpus (SD)						
Iron Age	30.3	28.3	33.6	2.5	8.3	5
Phase 1 (5th C.)	33.7	31.6	35.7			2
Metacarpus (DD)						
Iron Age	19.9	16.5	22.7	2.3	11.6	5
Phase 1 (5th C.)	23.0	21.1	24.6			3
TIBIA						
Tibia (Bd)						
Iron Age	62.0					1
Phase 2 (6th C.)	70.8	68.0	73.5			2
Tibia (Dd)						
Iron Age	38.6					1
Phase 2 (6th C.)	43.1	42.0	44.2			2
Tibia (SD)						
Iron Age	33.7	31.5	36.6			2
ASTRAGALUS						
Astragalus (LMT)						
Iron Age	55.9	51.6	60.1			2
Roman	55.5	44.2	67.2			3
Phase 1 (5th C.)	60.6					1
Phase 2 (6th C.)	57.7	53.2	62.0	3.1	5.4	5
Astragalus (GB)						
Iron Age	62.0					1
Roman	61.8	56.0	72.0			3
Phase 1 (5th C.)	64.5					1
Phase 2 (6th C.)	59.6	57.0	64.5	3.1	5.2	5
Astragalus (GH)						
Iron Age	56.3	51.0	61.5			2
Roman	55.2	49.0	63.5			3
Phase 1 (5th C.)	59.0					1
Phase 2 (6th C.)	56.3	52.5	62.5	3.7	6.6	5
Astragalus (BFd)						
Iron Age	48.9	45.5	52.2			2
Roman	51.8	48.2	57.9			3
Phase 1 (5th C.)	51.3					1
Phase 2 (6th C.)	51.0	46.8	57.2	4.1	8.0	5
METATARSUS						
Metatarsus (GL)						
Iron Age	266.8					1
Phase 1 (5th C.)	228.1					1
Metatarsus (Bp)						
Iron Age	46.4	42.3	52.3			4
Phase 1 (5th C.)	51.8					1
Phase 2 (6th C.)	47.1	44.2	51.0			1

Horse Measurement Data--continued

	Mean	Min.	Max.	s	C.V.	N
Metatarsus (Bd)						
Iron Age	47.3					1
Phase 1 (5th C.)	47.1					1
Phase 2 (6th C.)	46.4	43.2	49.7			1
Metatarsus (SD)						
Iron Age	30.4					1
Phase 1 (5th C.)	25.6					1
Metatarsus (DD)						
Iron Age	26.3					1
Phase 1 (5th C.)	24.4					1
Phase 2 (6th C.)	25.1					1
Metatarsus (Ll)						
Iron Age	255.8					1
FIRST PHALANX						
First Phalanx (SD)						
Iron Age	30.3	29.3	32.1	1.2	4.0	8

Note: All measurements in mm. Abbreviations are those of von den Driesch (1976).

Table 35 Measurement data for Iron Age, Romano-British, Phase 1 and 2 horses

Two complete metacarpi were recovered from fifth-century huts. Withers height estimates of 134 and 135cm were calculated for these cannon bones. These horses would have stood just over 13 hands, the equivalent of a large pony, such as the New Forest pony, in size. A single complete metatarsus provided a withers height estimate of 122cm (about 12 hands). The Phase 1 horse measurements are comparable to the few available horse bone measurements from Hamwih (Bourdillon and Coy 1977, 2-3). They are in the upper half of the Iron Age size range of 10-14 hands. The fifth-century West Stow horses are also comparable in size to those from Middle Saxon Ramsbury (Coy 1980, 46) where withers heights range from 121-140cm.

Measurable horse limb bones from Phase 2 huts are few. A single complete metacarpus provided a withers height estimate of 133cm (about 13 hands). All that can be said of the sixth-century horses is the few available measurements are comparable to those taken on the fifth-century equines.

Almost no measurements could be taken on the seventh-century horse remains. No complete long bones were recovered, and no measurements of weight-bearing members could be taken. Therefore no comments can be made on the size of the Phase 3 horses.

All the complete horse bones from all the Anglo-Saxon features have been summarized in Table 36. Withers height estimates could be calculated for one radius, ten metacarpi, three metatarsi, and one tibia. The withers heights range from 118-139 cm (about 12 to 13½ hands), with a mean of 132.2 cm (about 13 hands; Table 37 and Figure 31). These data indicate that the typical Anglo-Saxon horse from West Stow was a very large pony, comparable to the New Forest pony in size.

VI. Dogs

(Pls V-IX; Tables 38 and 39)

The ubiquitous presence of dog bones at West Stow makes it possible to say something about the size of these animals (Pl. V). In addition to the dog skeletons recovered from SFB 16 (Pls VI and VII), individual bones have been recovered from a variety of Anglo-Saxon contexts. A summary of measurements taken on complete dog long bones and the withers heights estimated from them has been included in Table 38.

The West Stow dogs are large straight-limbed animals, with an average estimated withers height of 59.5cm, or just under 2 ft. The largest of these animals would be comparable in size to a modern Alsatian or German Shepherd[19].

In his discussion of Anglo-Saxon dogs in general, Harcourt (1974, 168) has suggested that there is 'a clear indication ... that there were two distinct populations of dog', a larger and a smaller variety. There is no evidence for this degree of variability from Early Anglo-Saxon West Stow. The reconstructed withers heights for the dogs range from 50.5-67.0 cm, with most clustering around 60cm. These animals are larger than the dog recovered from the Romano-British features (Pl. VIII; measurements also summarized in Table 38 and 39). They are also larger than the typical Anglo-Saxon dog described by Harcourt (1974, 172) which had an average estimated withers height of only 53cm. All measurements taken on the complete dog long bones have been summarized in Table 39.

The large Early Anglo-Saxon dogs from West Stow would have been ideally suited to tasks such as hunting, guarding, (Harcourt 1974, 168) and possibly herding. There is no evidence for butchery on the bones, and no evidence that dogs were ever used as food animals. These dogs, however, were not pampered household pets. West (1985a, 23) notes that one of the dogs discovered in SFB 16 appears to have crawled into a hole under the hut and died there. This animal had a fractured tibia (Pl. IX) which had healed prior to its death. It died at about 15 months of age, possibly of a skull fracture and other injuries. The second dog skeleton from SFB 16 was even younger; it was about 7 months old when it died. The West Stow dogs should be

Horse; *Equus caballus*	Humerus		
	Bd	GLC	SD
ASP	67.2	231.0	29.6

Horse; *Equus caballus*	Radius			
	Bd	Bp	GL	SD
IRONAGE			308.0	
IRONAGE	67.0	74.8	329.5	32.7
L2	73.3	77.0	332.5	38.6

Horse; *Equus caballus*	Metacarpus				
	Bd	Bp	SD	GL	Ll
IRONAGE	50.4	50.0	33.6	219.0	209.9
IRONAGE		41.7	28.6	195.8	189.6
IRONAGE	46.0	45.8	32.4	211.4	203.6
IRONAGE	41.4	41.8	28.3	176.7	171.5
ASF	50.1	52.4	34.6	224.9	215.5
ASP	47.7	47.4	33.7	225.5	217.1
H17	47.9	49.2	31.6	218.0	209.8
H35	49.0	48.9		213.4	206.9
H5	47.8	48.5	35.7	217.7	209.9
L2				218.6	210.9
L2			33.3	218.4	
L2	49.2	45.3	30.7	211.8	
L2			27.8	197.1	189.0
L2	50.9		33.8	215.7	
L2	47.8	46.1	33.0	211.4	207.5
L2	44.4	45.4	28.7	195.9	188.2
PHF	48.6	47.1	32.5	214.1	207.2
Summary Statistics for All Anglo-Saxon Contexts					
MEAN	48.3	47.8	32.3	214.0	206.2
STANDARD DEVIATION	1.8	2.2	2.2	8.9	9.9
MINIMUM	44.4	45.3	27.8	195.9	188.2
MAXIMUM	50.9	52.4	35.7	225.5	217.1
CASES	10	9	13	13	10

Horse; *Equus caballus*	Metatarsus				
	Bd	Bp	GL	Ll	SD
IRONAGE	47.3	52.3	266.8	255.8	30.4
ASF	48.6	50.8	259.4	250.9	31.9
H52	43.2	44.2	228.1	221.1	25.6
L2	49.6	50.8	266.7	260.0	33.8
L2			254.9		31.7

Horse; *Equus caballus*	Tibia				
	Bd	Bp	GL	Ll	SD
L2	72.6	90.1	343.0	307.8	38.6

Table 36 List of measurements on all complete horse long bones

Measurement (mm)	Withers' Height (cm)
Radius (Ll)	
319.0	138.4
Metacarpus (Ll)	
215.5	138.1
217.1	139.2
209.8	134.5
206.9	132.6
209.9	134.5
210.9	135.2
189.0	121.1
207.5	133.0
188.2	120.6
207.2	132.8
Metatarsus (Ll)	
250.9	133.7
221.2	117.9
260.0	138.6
Tibia (Ll)	
307.8	134.2
Mean Withers' Height	137.6
S.D.	6.9

Table 37 Withers height estimates for horse long bones from all Anglo-Saxon features

Plate V Dog skull from layer 2. Scale 1:2

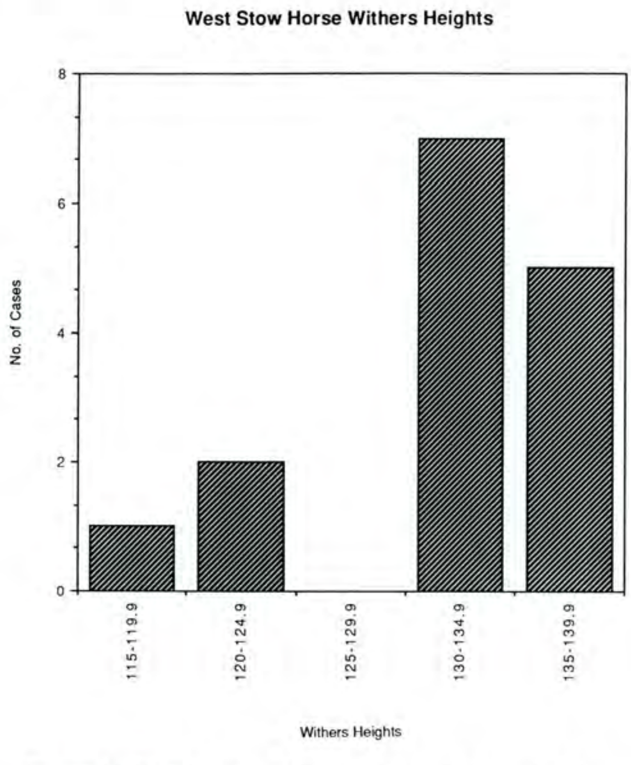


Figure 31 Distribution of horse withers heights for all Anglo-Saxon features

Plate VI SFB 16, dog 1 showing depression fracture on skull. Scale 1:2

Context	Anatomy	GL (mm)	WH (cm)
Roman	Femur	146.4	44.1
Roman	Femur	131.7	39.6
Same skeleton	Tibia	117.5	34.3
Same skeleton	Humerus	119.5	40.3
Same skeleton	Radius	110.4	35.5
Layer 2	Ulna	212.5	56.7
Layer 2	Humerus	181.0	61.0
Layer 2	Femur	221.6	66.7
Same skeleton	Tibia	225.1	65.7
Same skeleton	Humerus	203.9	68.7
Same skeleton	Radius	208.1	67.0
Same skeleton	Ulna	241.3	64.4
SFB 36	Femur	198.3	59.7
SFB 16	Humerus	180.3	60.8
Same skeleton	Radius	178.0	57.3
SFB 46	Humerus	179.1	60.4
SFB 34-35	Tibia	173.0	50.5
SFB 20	Humerus	182.1	61.4

Note: Withers' height estimates are based on Koudelka's factors as described in von den Driesch and Boessneck (1974: 343).

Table 38 Greatest lengths and withers height estimates on complete dog long bones from Romano-British and Anglo-Saxon contexts.

Note: Withers height estimates are based on Koudelka's factors as described in von den Driesch and Boessneck (1974, 343)

Plate VII SFB 16, dog 2. Scale 1:2

Plate VIII Roman dog skull. Scale 1:2

Dog; *Canis familiaris*	Humerus			
	Bd	SD	Dp	GL
ROMAN	31.4	13.2	38.4	119.5
H16	35.7	14.3	45.4	180.3
H20	37.0	14.0		182.1
H46	35.0	13.6	45.1	179.1
L2	40.9	17.8	51.4	203.9
L2	37.1	14.1	44.5	181.0
Summary Statistics for All Anglo-Saxon Features				
MEAN	37.1	14.8	46.6	185.3
STANDARD DEVIATION	2.3	1.7	****	21.0
MINIMUM	35.0	13.6	45.1	179.1
MAXIMUM	40.9	17.8	51.4	203.9
CASES	5	5	4	5

Dog; *Canis familiaris*	Radius			
	Bd	Bp	GL	SD
ROMAN	26.0	17.9	110.4	15.0
H16	28.4	21.5	178.0	14.3
L2	30.6	22.4	208.1	18.5

Dog; *Canis familiaris*	Ulna			
	BPC	DPA	GL	SDO
ROMAN	16.5	25.4	132.4	20.3
L2	22.3	30.7	241.3	26.5
L2	20.2	29.3	212.5	24.8

Dog; *Canis familiaris*	Femur			
	Bd	Bp	GL	SD
ROMAN	26.9	32.8	146.4	11.4
ROMAN	29.6	35.6	131.7	13.4
H36	36.4	42.5	198.3	14.8
L2	36.1	47.5	221.6	17.4

Dog; *Canis familiaris*	Tibia			
	Bd	Bp	GL	SD
ROMAN	22.2	32.3	117.5	14.9
H34-35	20.6	29.1	173.0	10.8
L2	27.8	40.7	225.1	18.3

Table 39 Summary of measurements on all complete dog long bones from all Anglo-Saxon and Romano-British features

Plate IX Fractured and healed tibia, SFB 16, dog 1. Scale 1:2

Context	Anatomy	GL(mm)*
Layer 2	Humerus	93.3
Layer 2	Radius	91.4
Layer 2	Ulna	112.5
Layer 2	Femur	103.6
Layer 2	Femur	118.6
Layer 2	Femur	99.5
Layer 2	Tibia	114.0
Layer 2	Tibia	106.1
A/S ditch	Humerus	89.4
SFB 46	Mandible	59.3
SFB 57	Mandible	58.9
Same skeleton	Humerus	101.4
Same skeleton	Radius	101.0
Same skeleton	Ulna	118.2
Same skeleton	Femur	110.4
Same skeleton	Tibia	121.2
SFB 60	Mandible	64.0
SFB 67	Radius	95.2
Same skeleton	Ulna	112.3
?Same skeleton	Femur	109.1

Table 40 Measurements on cat bones from Anglo-Saxon features.

* The measurement taken on the mandible is the total length (measurement 1; von den Driesch 1976, 63)

seen as working dogs that formed an integral part of the agrarian landscape.

VII. Cats

(Table 40)

In her survey of Anglo-Saxon animal resources, Clutton-Brock (1976, 384) noted that substantial numbers of cat bones are found on nearly all Anglo-Saxon sites in Britain. West Stow is no exception. Measurements on the cat bones from Anglo-Saxon features have been summarized in Table 40. While the sample sizes of measured bones are too small to allow for detailed statistical comparisons, the West Stow cats appear to be at the large end of the Anglo-Saxon size range, when compared to those from Thetford, Norfolk and Sandtun (Clutton-Brock 1976, 385).

VIII. Other Species

(Table 41)

A list of measurements taken on badger, bear, red deer, roe deer, and goat bones is included in Table 41.

IX. Conclusions

Measurements on the animal bones from the fifth-, sixth-, and seventh-century SFBs indicate that the Anglo-Saxon

Context	Measurement	(mm)	
Badger	*Meles meles*		
SFB 27	Radius (GL)	88.9	
Bear	*Ursus arctos*		
Layer 2	Metacarpus 2 (GL)	80.7	
Red deer	*Cervus elaphus*		
Iron Age	Metatarsus (Bp)	33.9	
SFB 61	Scapula (SLC)	34.3	
	Scapula (GLP)	57.1	
	Scapula (BG)	41.1	
	Scapula (LG)	44.9	
Layer 2	Radius (Bd)	50.0	50.3
	Radius (BFd)	48.5	48.8
PHF	Radius (Bp)	62.2	
	Radius (BFp)	56.8	
	Ulna (BPC)	32.4	
Roe deer	*Capreolus capreolus*		
SFB 45	Scapula (SLC)	18.4	
	Scapula (GLP)	27.7	
	Scapula (BG)	20.8	
	Scapula (LG)	22.0	
Layer 2	Humerus (BT)	25.8	
Layer 2	Humerus (BT)	25.7	
	Humerus (Bd)	27.1	
Layer 2	Humerus (Bd)	27.2	
Iron Age	Humerus (BT)	28.1	
	Humerus (BD)	30.2	
Layer 2	Radius (Bp)	25.4	
	Radius (BFp)	23.8	
SFB 22	Radius (Bp)	24.3	
	Radius (BFp)	22.6	
7th C. Ditch	Radius (Bp)	24.2	
	Radius (BFp)	21.6	
SFB 27	Ulna (LO)	34.4	
	Ulna (SDO)	20.1	
	Ulna (BPC)	14.1	
Goat	*Capra hircus*		
A/S Feature	Horn core (41)	35.6	
	Horn core (42)	21.1	
Layer 2	Horn core (41)	30.7	
	Horn core (42)	20.0	
A/S Pit	Horn core (41)	30.2	
	Horn core (42)	18.9	
Layer 2	Horn core (41)	31.0	
	Horn core (42)	20.3	
SFB 60	Humerus (Bd)	29.4	
	Humerus (BT)	28.7	
SFB 12	Humerus (Bd)	28.5	
	Humerus (BT)	28.0	
Iron Age	Radius (Bp)	28.6	
	Radius (BFp)	27.0	
A/S Feature	Ulna (LO)	39.1	
	Ulna (SDO)	21.1	
	Ulna (BPC)	17.3	
Layer 2	Metacarpus (Bp)	25.0	

Table 41 Measurements (in mm) taken on the bones of badgers, bear, red deer, roe deer, and goats

animals from West Stow are, on the average, comparable in size to the domestic stock from other Romano-British and Anglo-Saxon sites in Britain. The cattle, sheep, pigs, and horses from Early Anglo-Saxon contexts are somewhat larger that British Iron Age stock. Much of this size increase, however, may have taken place during the Roman period in Britain. There is as yet no clear evidence for size improvement during the Early Anglo-Saxon period. Animal sizes remain unchanged during the fifth-earlier seventh centuries at West Stow. This stability in animal size might indicate that the inhabitants of the site had developed efficient, self-sufficient animal husbandry practices by the fifth century and that these practices persisted for over two hundred years.

Chapter 4. Ageing

I. Introduction

Analysis of ages at death is an essential part of any faunal study for once we have reconstructed the kill-patterns for the major domestic species, it is then possible to make inferences about seasonality of slaughter and the economic uses to which the stock animals may have been put. For the West Stow faunal collection ageing analysis centered on the three major domesticates: cattle, sheep/goats[20], and pigs.

II. Methods

Age determinations were based on two main lines of evidence: dental eruption and wear, and epiphysial fusion of the long bones. Although the latter was carefully recorded in all cases, estimates of age at death will be based primarily on dental evidence for the following reason. Epiphysial union ceases when an animal reaches maturity. It is therefore impossible to distinguish a young but full-grown animal from an aged one on the basis of epiphysial fusion data alone. The ability to distinguish aged from mature animals is necessary if we are to reconstruct the economic uses of the domestic species. For example, if a sheep population is raised for meat, one would expect the majority of the animals to be killed at or near maturity, with a relatively small breeding stock surviving to old age. In contrast, one would expect a large number of older animals, especially middle-aged wethers, from a wool-producing sheep flock.

Age estimates for sheep and goats, cattle, and pigs are based on the dental eruption and wear scheme proposed by Grant (1975, 1982). Initially each tooth in each mandible is scored for state of eruption or wear using a system of up to twenty stages. A relative age estimate or mandibular wear stage (MWS) for the entire jaw is provided by summing the scores for the first, second, and third molars. As many of the West Stow mandibles were incomplete, mandibular wear stages were initially calculated for complete mandibles only. These jaws were then used to construct a matrix (from youngest to oldest) which permitted us to estimate the mandibular wear stages for many of the incomplete examples. Since mandibular wear stages were estimated for incomplete mandibles, loose teeth were eliminated from the calculations to avoid the possibility of double counting. The resulting distribution of mandibular wear stages was depicted following Maltby (1981).

III. Cattle: Ageing Evidence

Dental Eruption and Wear

(Fig. 32)

Distributions of mandibular wear stages (relative age estimates) for cattle were calculated for mandibles derived from all the Anglo-Saxon features at West Stow (Fig. 32). When examining this distribution, it is important to note that the scale of the diagram is not linear. Different mandibular wear stages seem to have lasted for differing lengths of time. In general, the later wear stages appear to have lasted longer than the earlier ones. Figure 32 indicates that a significant number of neonates or young calves (mandible wear stages 1-4) must have died early in their first year, well before the age of six months. There is an apparent clustering around 20 (a period when the second molar is coming into wear) which suggests a mode of mortality at about eighteen months of age (Silver 1969, 296, younger figures used). A mandible wear stage of about 30 corresponds to a fully erupted permanent dentition. Thus it is clear that almost half (45%) the cattle survived to maturity. Among the mature cattle there are a substantial number of older individuals (mandible wear stages greater than 40).

The high mortality in the first two years combined with the presence of a number of old individuals suggests that milk production may have played a role in West Stow cattle husbandry. This is especially likely since metrical analyses indicate that most of the adult cattle were females rather than bulls or steers.

When the kill-pattern is considered in detail, three modes of mortality are apparent. The first, centered at MWS=2, represents the loss or slaughter of substantial numbers of neonates and very young calves. A minor mode at MWS = 8-11 probably represents the autumn slaughter of calves born the previous spring. The second major mode (MWS = 21) probably represents the autumn killing of a substantial number of 1½ year olds (Silver 1969: 296). It is likely that a large number of bullocks were slaughtered at this age, although this is difficult to demonstrate as most cattle of this age would have unfused distal metacarpal epiphyses, and therefore the sexing of these cattle on the basis of metacarpal measurements is impossible. The final mode of mortality is seen at MWS = 44-47. These are mature to elderly cattle, all well over 5 years of age, most of which were probably female.

Epiphysial fusion

(Figs 33-6; Table 42)

A complete summary of the epiphysial fusion data for cattle from the phased SFBs has been included in Table 42 and in Figures 33, 34, and 35. The epiphyses of all major limb bones were scored as either fused or unfused, and the data were summarized using the *ANIMALS* program (Campana and Crabtree 1987)[21].

To facilitate interpretation of the data on epiphysial fusion, the limb bone epiphyses have been separated into early, middle, and late fusing elements (Fig. 36). The early fusing elements are those which fuse by 1½ years[22] and include the distal humerus, proximal radius, and the proximal first and second phalanges. The middle fusing elements, those which fuse by 3 years, include the distal tibia and the distal metapodia. The late fusing elements, those which fuse by 4 years, include the proximal calcaneus, proximal femur, distal radius, proximal and distal ulna, distal femur, and proximal tibia.

In general, the ageing profiles derived from the analysis of dental eruption and wear are confirmed by the evidence for epiphysial fusion of the cattle long bones. The epiphysial fusion data for the Phase 1 huts suggest that 78% of the fifth-century cattle survived for more than 1½ years. Just under half the cattle (49%) survived for more than 3 years. Thus roughly 30% were killed at between

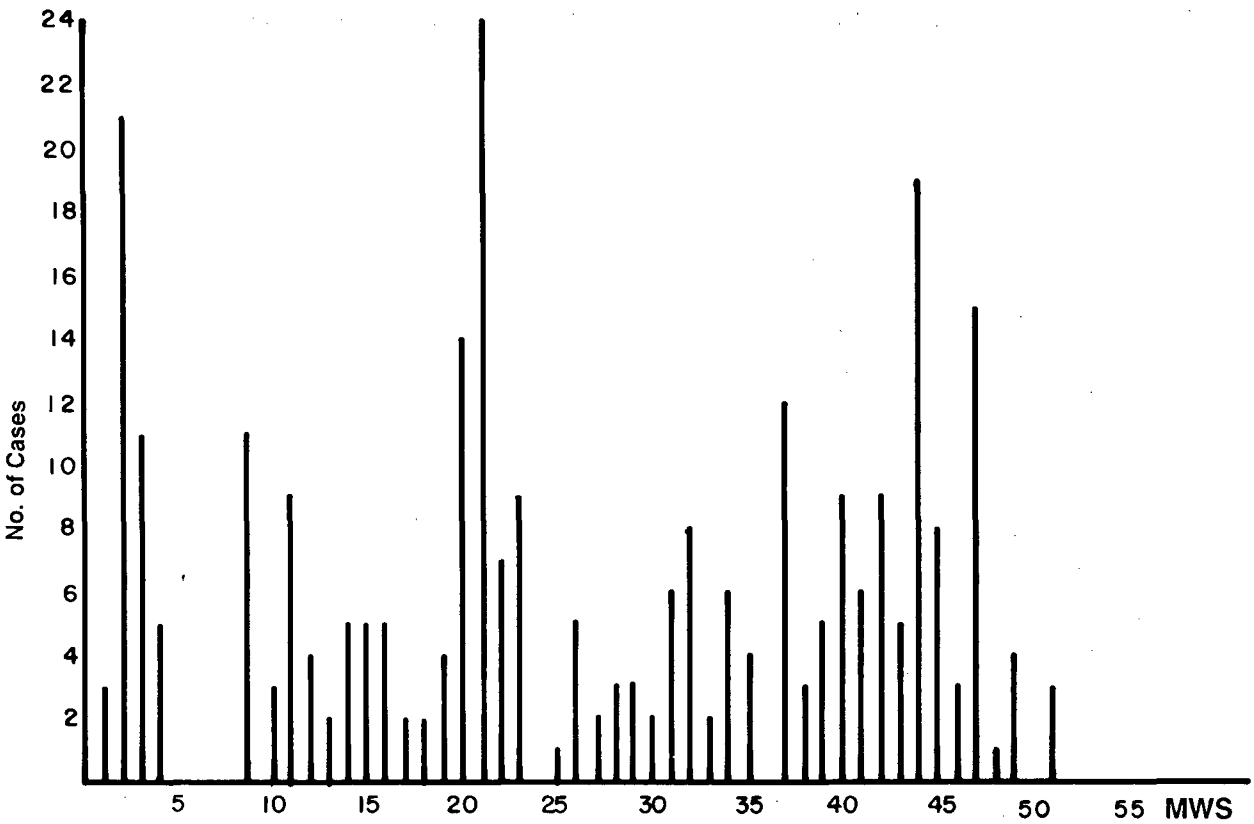


Figure 32 Distribution of mandibular wear stages (MWS) for cattle from all Anglo-Saxon features

		Phase 1			Phase 2			Phase 3	
	Unfused	Fused	% Fused	Unfused	Fused	% Fused	Unfused	Fused	% Fused
Humerus distal	17	25	60%	19	71	79%	2	8	80%
Radius proximal	7	45	87%	12	99	89%	0	3	100%
First phalanx proximal	34	101	75%	46	168	79%	6	21	78%
Second phalanx proximal	8	65	89%	20	128	86%	5	13	72%
Total Early Fusing	66	236	78%	97	466	83%	13	45	78%
Tibia distal	19	24	56%	27	50	65%	0	7	100%
Metacarpus distal	17	18	51%	24	41	63%	2	7	78%
Metatarsus distal	23	21	48%	29	40	58%	2	5	71%
Metapodium distal	7	1	12%	13	2	15%	1	0	0%
Total Middle Fusing	66	64	49%	93	133	59%	5	19	79%
Calcaneus tuber	17	8	32%	29	15	34%	7	2	22%
Femur proximal	17	10	37%	20	16	44%	1	2	67%
Humerus proximal	10	6	37%	7	12	63%	0	4	100%
Radius distal	21	12	36%	28	16	36%	3	2	40%
Ulna proximal	9	3	25%	14	9	39%	1	0	0%
Ulna distal	6	0	0%	5	0	0%	0	0	
Femur distal	19	24	56%	30	16	34%	1	3	75%
Tibia proximal	15	10	40%	13	20	61%	2	1	33%
Total Late Fusing	114	73	39%	146	104	42%	15	14	48%

Table 42 Epiphysial fusion data for cattle

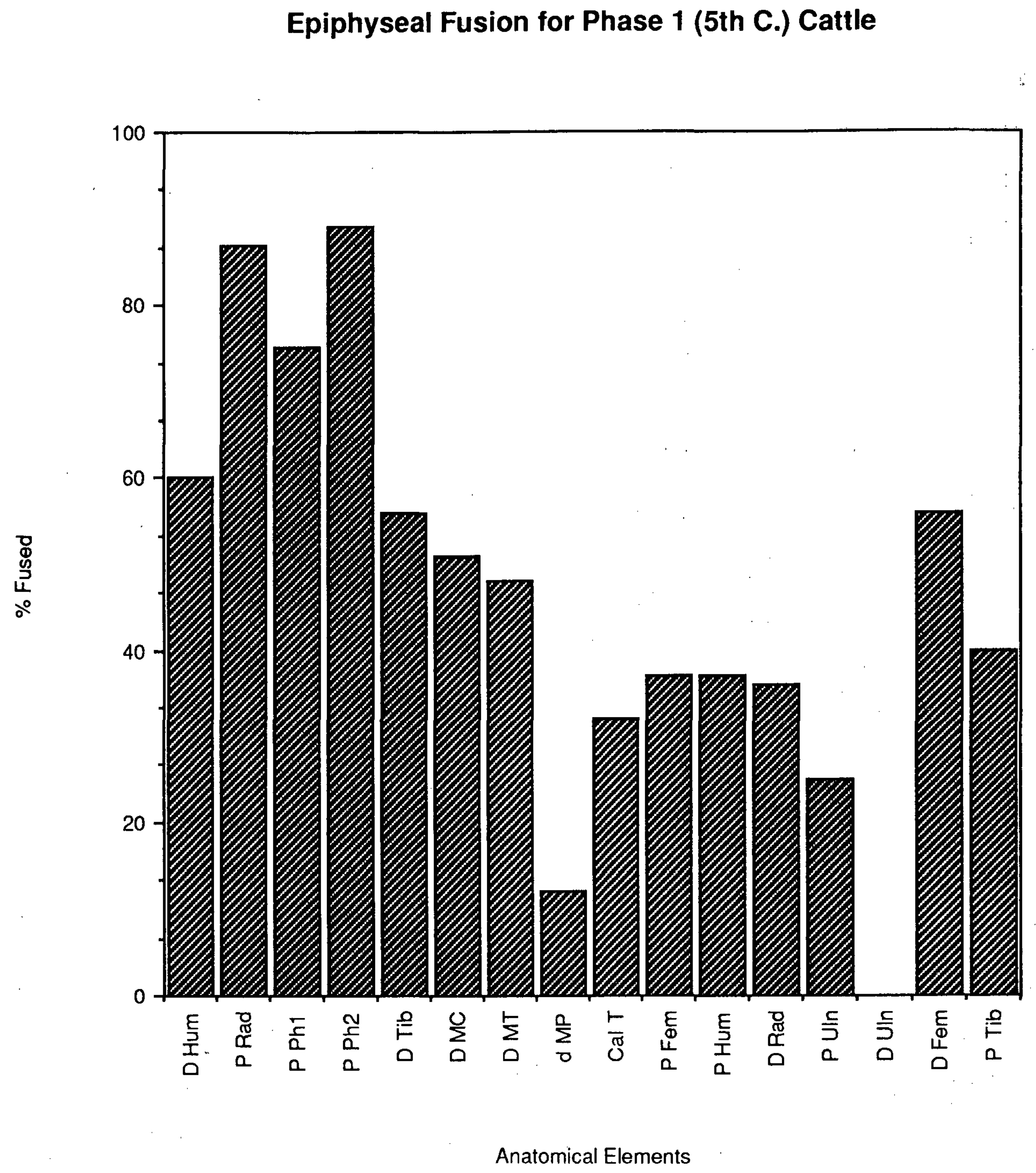


Figure 33 Epiphysial fusion data for Phase 1 cattle

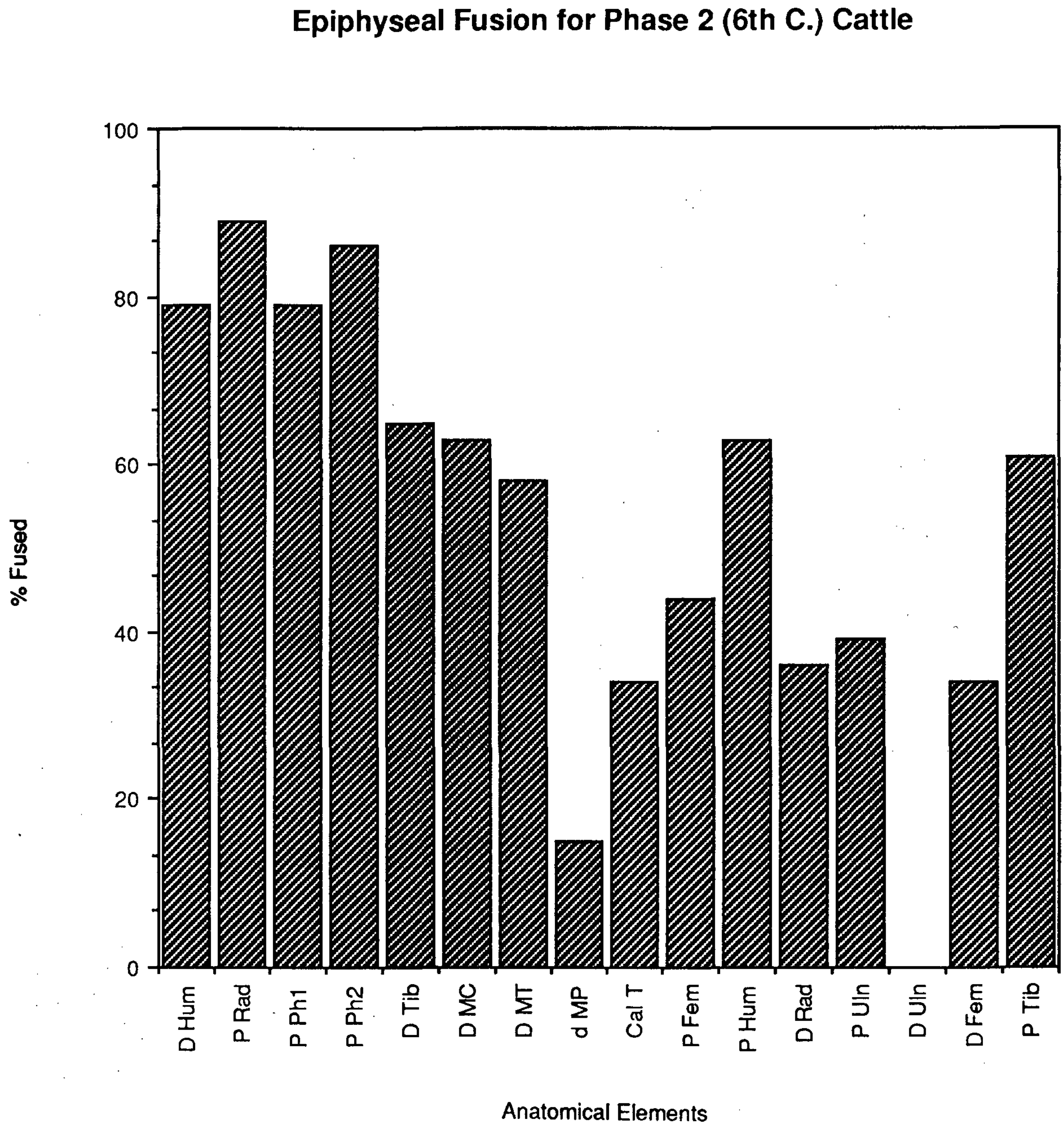


Figure 34 Epiphysial fusion data for Phase 2 cattle

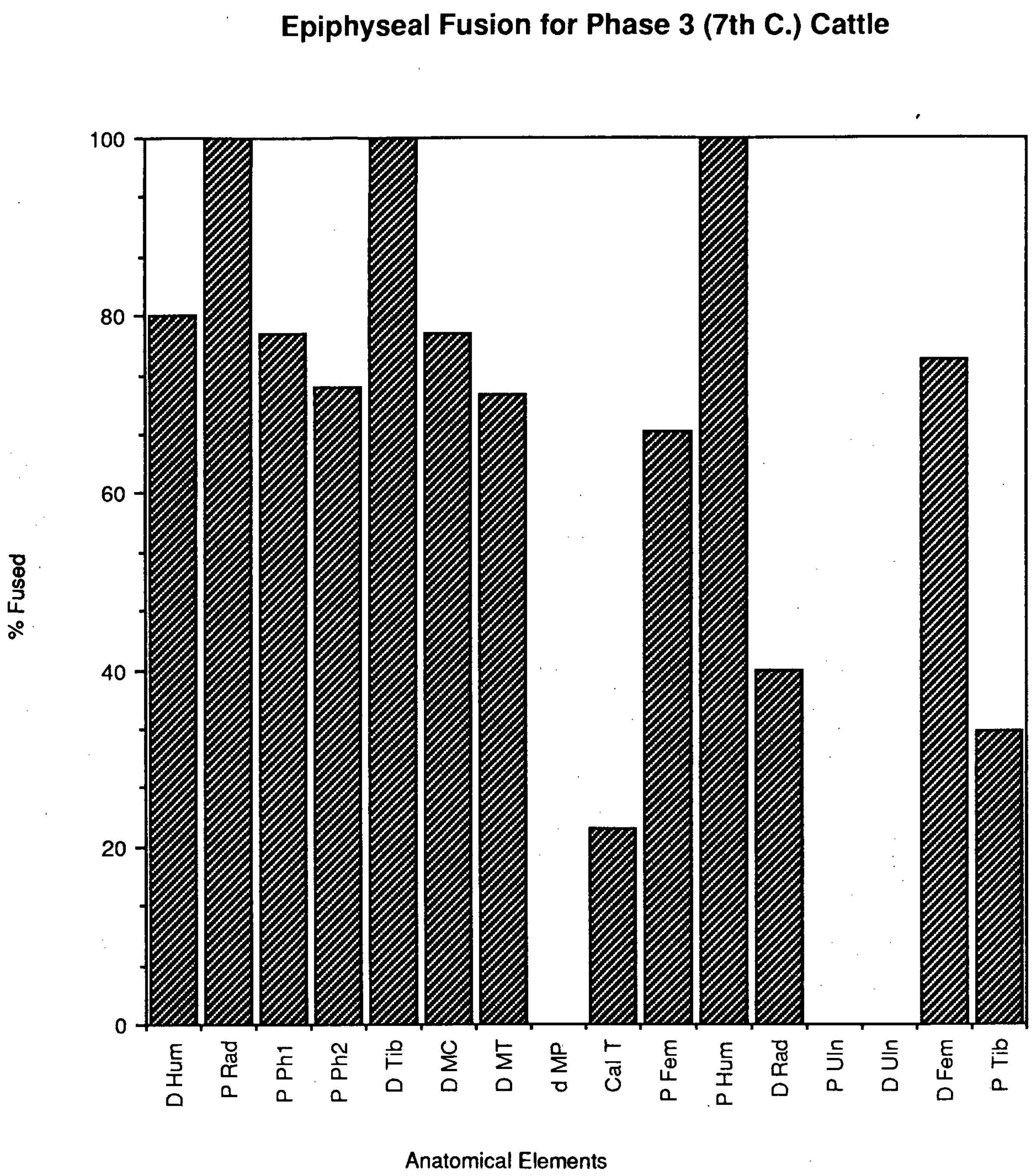


Figure 35 Epiphysial fusion data for Phase 3 cattle

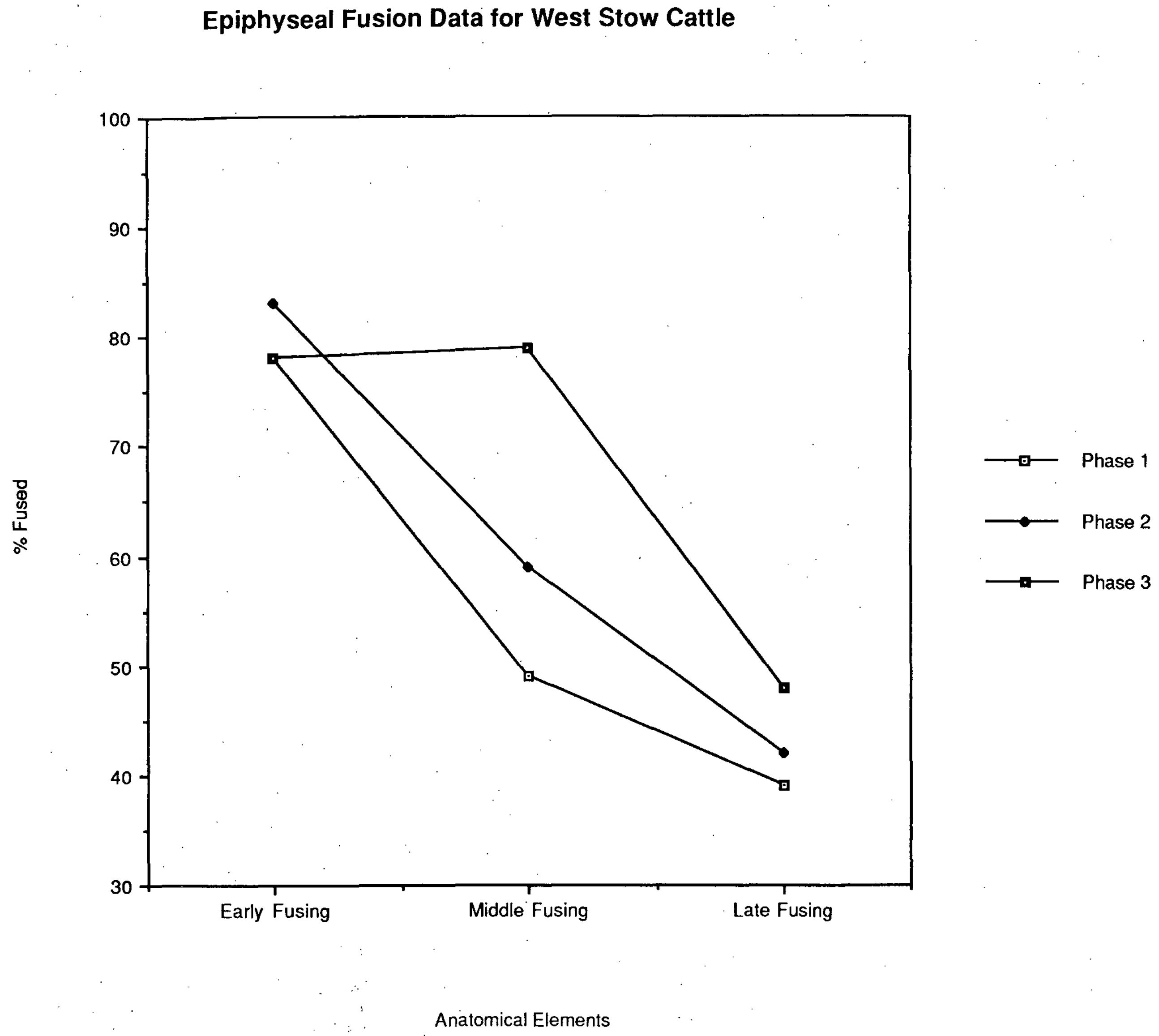


Figure 36 Patterns of epiphysial fusion for cattle from SFBs

1½-3 years of age. During the fifth century, 39% of the cattle survived for more than 4 years.

The evidence from the sixth century (Phase 2) huts produces a similar picture. Approximately 17% of the cattle were killed during the first year and a half of life, while 24% were killed between 18 months and 3 years of age. An additional 17% were killed between 3-4 years of age, and 42% survived for more than 4 years. When the Phase 1 and Phase 2 patterns are compared, we see a somewhat higher proportion of cattle surviving to 1½ and 3 years in the sixth-century sample. The sixth-century data also show a slightly higher kill-off in the 3-4 year age range. It is tempting to suggest that beef production became somewhat more important in the sixth century, since beef cattle are commonly slaughtered at 3-4 years of age. As the proportion of pigs, which are kept solely for their meat, declines in the sixth century, it is reasonable to suggest that beef production may have increased correspondingly.

The Phase 3 faunal sample is small, but it does suggest some continuation of this trend. During this phase 22% of the cattle were killed during the first year and a half of life, and there is no evidence for a kill-off between 1½ and 3 years. Approximately 30% of the cattle were killed during the fourth year of life, and just under half survived to more than 4 years of age. While the results of the analysis of the small seventh-century sample should be treated with caution, they do suggest a continuation of the sixth-century pattern.

The ageing data for cattle provide no evidence for a specialized beef- or dairy-producing economy at West Stow. In a specialized dairy-producing economy, we would expect to see a high proportion of young calves (primarily males) killed early in the first year of life. Most of the adult cattle will be females, with only a very small number of males kept for breeding purposes. Older females will be slaughtered when their milk production declines or when they fail to produce calves. In a beef herd we would expect a smaller proportion of the herd to be killed during the first two years of life. Most animals will be slaughtered in late adolescence or early adulthood (approximately 42-48 months), when they have reached bodily maturity. Only a small number of adults will be kept for breeding purposes.

The ageing pattern seen at West Stow shows some similarities with both the dairy and the beef models. The mortality peak at MWS = 2-4 combined with the presence of a large number of older female cattle would suggest that dairying played a role in West Stow cattle husbandry. The relatively high proportion of animals slaughtered between 1½ and 4 years would seem to indicate that beef production also was an important goal. What we seem to see at West Stow is a self-sufficient agricultural village where cattle are kept for a variety of purposes including both meat and milk production. Changing circumstances, such as the decline in the importance of pigs during the sixth century, may have led to changes in the relative importance of beef and dairy in the overall economy. Cattle were also undoubtedly used for hides and traction, although these uses are more difficult to document from the ageing evidence alone. Skeletal pathologies can provide some evidence for the use of cattle for traction at West Stow. Several of the cattle first phalanges show evidence of osteoarthritis of the proximal joint surface. Osteoarthritis is marked by grooving of the articular surface, eburnation, extension of the articular surface by new bone formation, and exostoses around the periphery (Baker and Brothwell 1980, 115). One of the causes of osteoarthritis can be heavy work.

Comparisons with Other Sites

(Fig. 37; Table 43)

Comparisons between kill-patterns from different sites can be difficult because of the wide variety of ageing schemes in use. Some authors have used simple descriptive systems employing such terms as immature, juvenile, and mature (Noddle 1980), while others have used more complex dental eruption and wear stages (Grant 1975, 1982). Despite these limitations, comparisons are necessary in order to assess variations in cattle exploitation in Anglo-Saxon England.

Bourdillon and Coy (1977) used a six stage system to record dental eruption and wear on the Middle Saxon cattle mandibles (n = 211) from Hamwih (see Fig. 37 and Table 43). Nearly 60% of the Hamwih cattle showed wear on the third molar (age classes 4-6). In contrast, only 45% of the West Stow mandibles show the third molar in wear. Thus the Hamwih sample shows a higher proportion of mature individuals. The Hamwih sample also includes a much lower percentage of young individuals. While Classes 1 and 2 include only 18% of the Hamwih mandibles, nearly 32% of the West Stow mandibles fall into these two stages. Similar proportions of the West Stow and Hamwih mandibles are included in Class 3, 23.4% and 22.3%, respectively. This stage corresponds to mid-adolescence. These animals were probably slaughtered for their meat, since adolescent animals provide an optimal return in terms of the ratio of meat yield provided to fodder consumed. In terms of the overall pattern, however, the West Stow cattle are killed much earlier than the Hamwih stock[23].

The West Stow cattle also appear to be killed much earlier than the Middle Saxon cattle from Portchester Castle (Grant 1975). The Portchester sample included only one mandible with a mandible wear stage of less than 10. There is a substantial kill-off in the mid-adolescent range (MWS = 20-29), similar to both West Stow and Hamwih, but the majority of cattle survived to an advanced age (MWS $\geq$ 40).

It is difficult to compare the ages at death for the West Stow cattle with those from Middle Saxon North Elmham as Noddle (1980) used three broad classifications (immature, juvenile, and mature) to age the North Elmham cattle mandibles. In the Middle Saxon period the majority of the North Elmham cattle were mature, while in the late ninth and tenth centuries about half the cattle are so classified. If we assume that mature (defined as more than four years in modern terms) corresponds to age classes 5 and 6 of the system used by Bourdillon and Coy, then the North Elmham cattle would also appear to be killed later than their West Stow counterparts.

The West Stow cattle are therefore killed earlier than those from all other large Anglo-Saxon assemblages. Maltby (1981, 179-82) has noted that during the Roman period in Britain cattle from military and urban sites were predominantly mature, while rural and villa sites produced the remains of cattle of all ages. He suggests that the rural sites may have been relatively self-sufficient 'and therefore their deposits include a higher percentage of immature cattle not required for breeding or working but also not in demand for redistribution to other centres' (Maltby 1981, 182). The military and urban sites, on the other hand, may have been provisioned with cattle of specific ages which were brought to these sites for slaughter. The model of a self-sufficient rural community which yields the remains of cattle from a wide age range would seem to fit the West Stow data well. Hamwih, an urban site, may have been provisioned with cattle of older ages.

The Iron Age pits and ditches at West Stow produced a relatively small number (n = 20) of ageable cattle jaws. Although the sample is too small to produce a detailed picture of mortality patterns, it is clear that cattle of all ages were slaughtered, with no concentration on either young or elderly animals. In that sense, the Iron Age and Anglo-Saxon ageing distributions are quite similar.

The West Stow cattle kill-patterns are most closely paralleled by the age distributions from the Early Iron Age levels at Gussage All Saints (Harcourt 1979). At Gussage, 36% of the cattle mandibles showed wear on the first molar only (corresponding to a mandibular wear stage of less than 20). At West Stow, 31.7% of the Anglo-Saxon mandibles had mandibular wear stages of less than 20, as did 32% of the Iron Age mandibles from the site. The Iron Age sample from Ashville (Hamilton 1978, 132) also produced a substantial number of mandibles with mandibular wear of less than 20. The West Stow cattle kill-patterns thus find their closest equivalents in the age distributions from small, self-sufficient Iron Age sites in southern Britain.

IV. Pigs: Ageing Evidence

Dental Eruption and Wear

(Fig. 38)

Unlike sheep, cattle, or even horses, which may be raised for a wide variety of economic purposes such as meat, milk, wool or hair, and traction, pigs have only one major economic use — food. Studies of pig mortality patterns can, however, indicate whether they were raised for home consumption or, as is often the case on military or urban sites, whether pigs of certain ages were brought from elsewhere for slaughter.

In order to assess ages at death, each tooth in each complete pig mandible was scored for state of eruption or wear using Grant's (1975) system. Mandibular wear stages were estimated for fragmentary mandibles, but single loose teeth were not included in the calculations. Unlike the cattle jaws, however, pig mandibles were often quite heavily fragmented, and it was impossible to calculate a

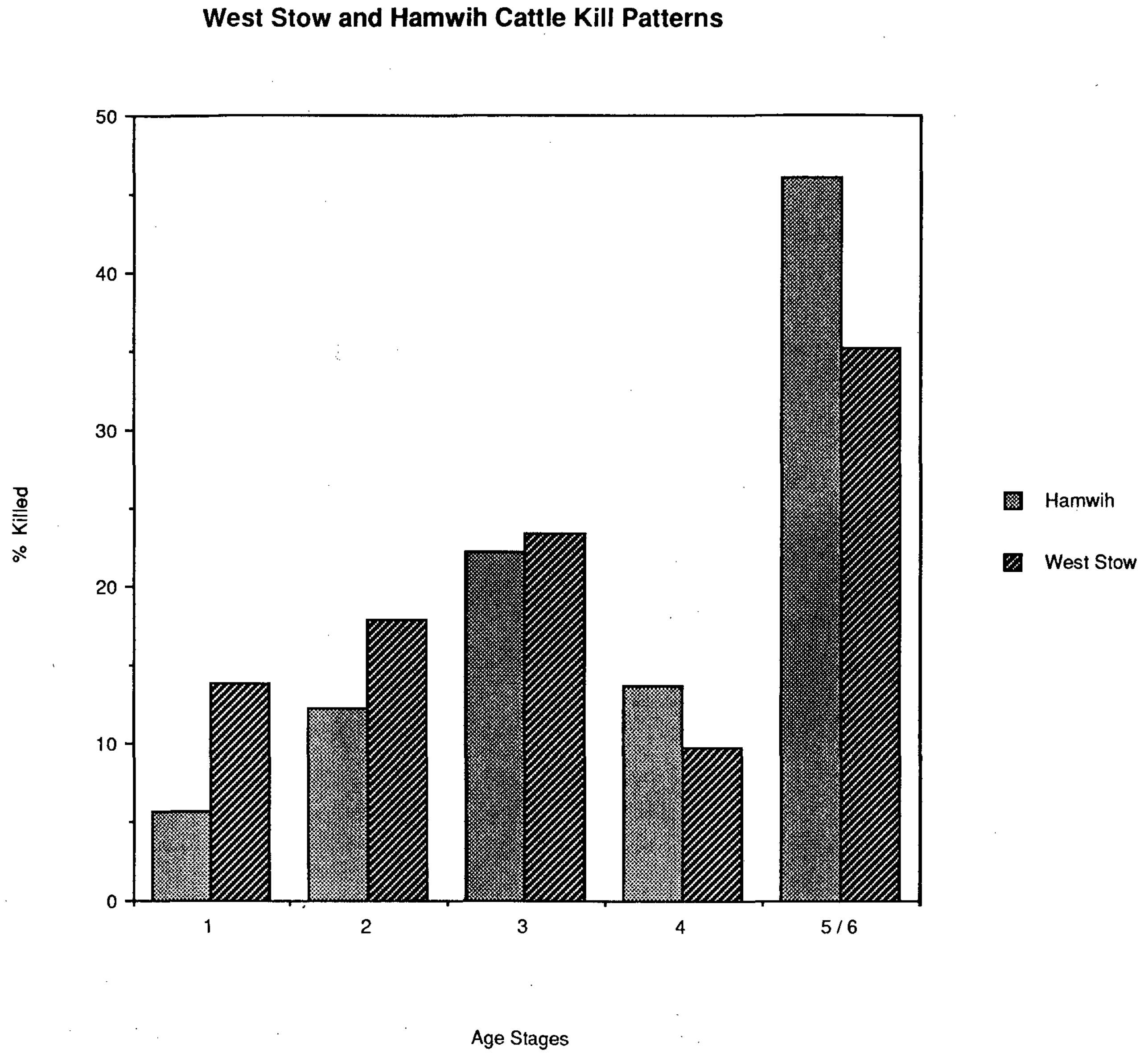


Figure 37 Kill-patterns for mandibles from Hamwih and West Stow

Stage	Definition	Approximate MWS	West Stow n
1	M_1 unworn	1-5	40
2	M_2 unworn	6-19	52
3	M_3 unworn	20-29	68
4	M_3 coming into wear	30-36	28
5	M_3 full wear	over 36	102
6	M_3 advanced wear		

Table 43 Age determination for cattle mandibles: concordance table

precise mandibular wear stage for many of the jaws. Mandibular wear stages were therefore estimated within class intervals of five (1-5, 6-10, and so on). Using this broader classification it was possible to provide age estimates for 315 pig mandibles from all the Anglo-Saxon features at West Stow (Fig. 38).

Distinctive modes of mortality are seen in the MWS = 21-5 and MWS = 31-5 classes. These numerical values correspond to periods when the second and third molars are in early stages of wear and probably represent pigs in their second and third years of life. Over 35% of the pigs appear to have been killed during the first year (MWS = 1-20). A substantial number were killed at the time that the lower third molar is coming into wear (MWS = 31- 5). It is at this stage that a pig reaches bodily maturity. Continuing to feed a pig beyond this age will not substantially increase its body weight or meat yield. Thus, killing a substantial number of pigs at this age will maximize the ratio of meat yield to food input. The secondary mode of mortality (MWS = 21-5) corresponds to mid-adolescence.

As is the case for the cattle, the Anglo-Saxon features produced pig mandibles of all ages classes, implying self-sufficiency in pig husbandry. No clear concentration on either very young or very old animals is apparent.

Epiphysial fusion

(Figs 39-42; Table 44; Pl. X)

The data on epiphysial fusion for the fifth-, sixth-, and seventh-century pigs have been summarized in Table 44 and Figures 39-41. The epiphyses have been divided into early, middle, and late fusing elements. The early fusing elements are those which fuse by 1 year of age and include the distal humerus, proximal radius, and proximal second phalanx. The middle group, those elements that fuse by 2½ years, include the proximal first phalanx, distal metapodia, distal tibia, proximal calcaneus, and distal fibula. The late fusing elements include the proximal and distal ulna, proximal humerus, distal radius, proximal and distal femur, proximal tibia, and proximal fibula. These elements all fuse by 3½ years of age (data on timing of fusion derived from Silver 1969, 285-6).

Figure 42 summarizes the data on epiphysial fusion for the Phase 1, Phase 2 and Phase 3 pigs. These data generally support the conclusions drawn from the evidence for dental eruption and wear discussed above. During the fifth century, nearly 30% of the pigs were killed during the first year of life (Pl. X). Only 38% survive to 2½ years, and less than 4% survive beyond 3½ years. Since pigs are fecund animals, only a small number of adult animals are needed to maintain the population.

A generally similar pattern is seen in the sixth-century data, however an even larger proportion of very young animals were killed during this period. Over 40% were killed during the first year of life. An additional 30% were killed by age 2½, and less than 2% survived beyond age 3½. In short, during the sixth century, a greater proportion of pigs was killed during the first year of life, while somewhat fewer were killed between 2½ and 3½ years of age.

This changing mortality pattern may represents a change in pig husbandry strategy. During the fifth-century the Anglo-Saxon colonists were establishing their settlement at West Stow. The faunal assemblage includes high numbers of pigs, and these settlers may have attempted to increase numbers by killing fewer juveniles less than one year of age. Pannage for pigs was probably located well away from the settlement (see p.00). Once the settlement was well established, the culling of a higher proportion of juveniles and neonates may have kept the pig population in check. It is possible that we see a shift toward sty husbandry and/or the more local rearing of pigs at this time. Regulation of numbers would have been of particular importance if sty husbandry was practiced (see below). Although the Phase 3 sample is relatively small, the kill-pattern is very similar to that seen in the much larger sixth-century sample.

Comparisons with other sites

When the West Stow Anglo-Saxon pigs are compared to those from Hamwih, the West Stow animals appear to have been killed at distinctly earlier ages. At Hamwih only 1.5% of the pig mandibles include an unworn first molar, while at West Stow 13.3% of the pig mandibles showed no wear on the first molars. At the opposite end of the age spectrum, 26.6% of the Hamwih pig mandibles show full or heavy wear on the third molars. In contrast, only 8.5% of the Anglo-Saxon mandibles from West Stow have mandible wear stages greater than or equal to 36. Since a mandible wear stage of 36 indicates a third molar in a relatively early stage of wear, the difference in the proportion of older pigs between Hamwih and West Stow may be even greater than this comparison indicates.

Two factors may account for these age differences. First, Hamwih as an urban center may have been shipped pigs of selected age classes (*e.g.,* adults) for slaughter. At rural West Stow, on the other hand, one would expect to see a wide range of age classes including a large number of younger pigs which were not needed to maintain the breeding stock. Second, as pannage may have been in short supply, the inhabitants of West Stow may have had to provide substantial amounts of feed for their pigs. If sty husbandry was practiced, there would have been a strong economic motive to eliminate excess young animals.

The ages of the West Stow pigs are also in contrast to those from North Elmham where, during the Middle Saxon period, 50-85% of the pigs were 'mature', while in the late ninth and tenth centuries the proportion drops slightly to 45-50%. Many of the animals were elderly with heavy wear on all the teeth (Noddle 1980, 400). Noddle (1980, 400) notes that during the post-medieval period the proportion of mature pigs drops to 20% and suggests by way of explanation that '... during the Saxon period the pigs were almost wild and were difficult to catch when young. Later pigs may well have been kept in stys'. If we accept her suggestion, it would also seem to indicate that the West Stow pigs were kept in sties, at least during the later phases of the settlement's history. Her explanation should not be accepted without question, however. I suspect that semi-wild adult pigs would have been as difficult to catch as semi-wild young ones. If the changing age distribution seen at North Elmham does reflect a change from pannage to sty husbandry, then the increased kill-off of young pigs in the post-medieval period may reflect seasonal shortages of fodder.

During both the Roman and Saxon periods at Portchester Castle (Grant 1975; 1976) substantial numbers of pigs were killed during the second and third years of life (MWS = 21-35). In this respect the Portchester evidence parallels West Stow. The Portchester fauna from both periods, however, show somewhat fewer young pigs than are found at West Stow. For example, only 16.4% of the

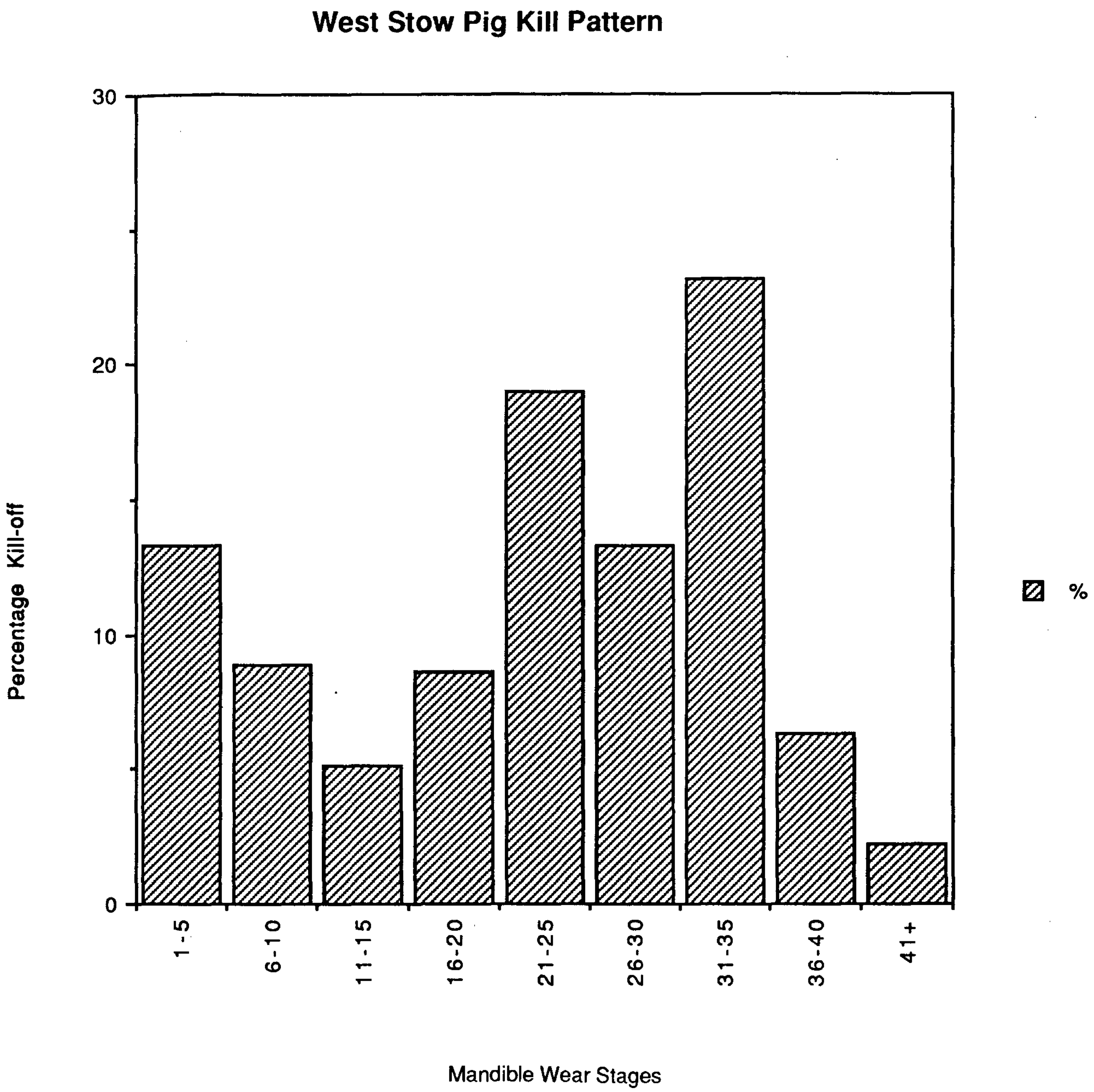


Figure 38 Distribution of mandibular wear stages (MWS) for pigs from all Anglo-Saxon features

		Phase 1			Phase 2			Phase 3	
	Unfused	Fused	% Fused	Unfused	Fused	% Fused	Unfused	Fused	% Fused
Humerus distal	16	20	56%	25	29	54%	5	4	44%
Radius proximal	8	29	78%	14	22	61%	3	5	62%
Second phalanx proximal	4	20	83%	8	18	69%	0	5	100%
Total Early Fusing	28	69	71%	47	69	59%	8	14	64%
First phalanx proximal	11	36	77%	41	42	51%	2	7	78%
Metacarpus distal	54	37	41%	51	18	26%	10	4	29%
Tibia distal	18	13	42%	26	15	37%	4	1	20%
Metatarsus distal	53	24	31%	52	12	19%	10	3	23%
Metapodium distal	15	1	6%	18	3	14%	7	0	0%
Calcaneus tuber	21	2	9%	24	3	11%	4	0	0%
Fibula distal	16	3	16%	24	1	4%	3	1	25%
Total Middle Fusing	188	116	38%	188	94	28%	40	16	29%
Ulna proximal	11	1	8%	33	1	3%	6	0	0%
Ulna distal	5	0	0%	21	0	0%	3	0	0%
Humerus proximal	8	0	0%	34	1	3%	3	1	25%
Radius distal	13	0	0%	21	0	0%	5	1	17%
Femur proximal	27	2	7%	37	0	0%	9	0	0%
Femur distal	16	1	6%	26	0	0%	7	1	12%
Tibia proximal	12	0	0%	23	2	4%	4	0	0%
Fibula proximal	15	0	0%	12	1	0%	3	0	0%
Total Late Fusing	107	4	4%	207	4	2%	40	2	5%

Table 44 Epiphysial fusion data for pigs

Phase 1 (5th C.) Pigs: Epiphyseal Fusion

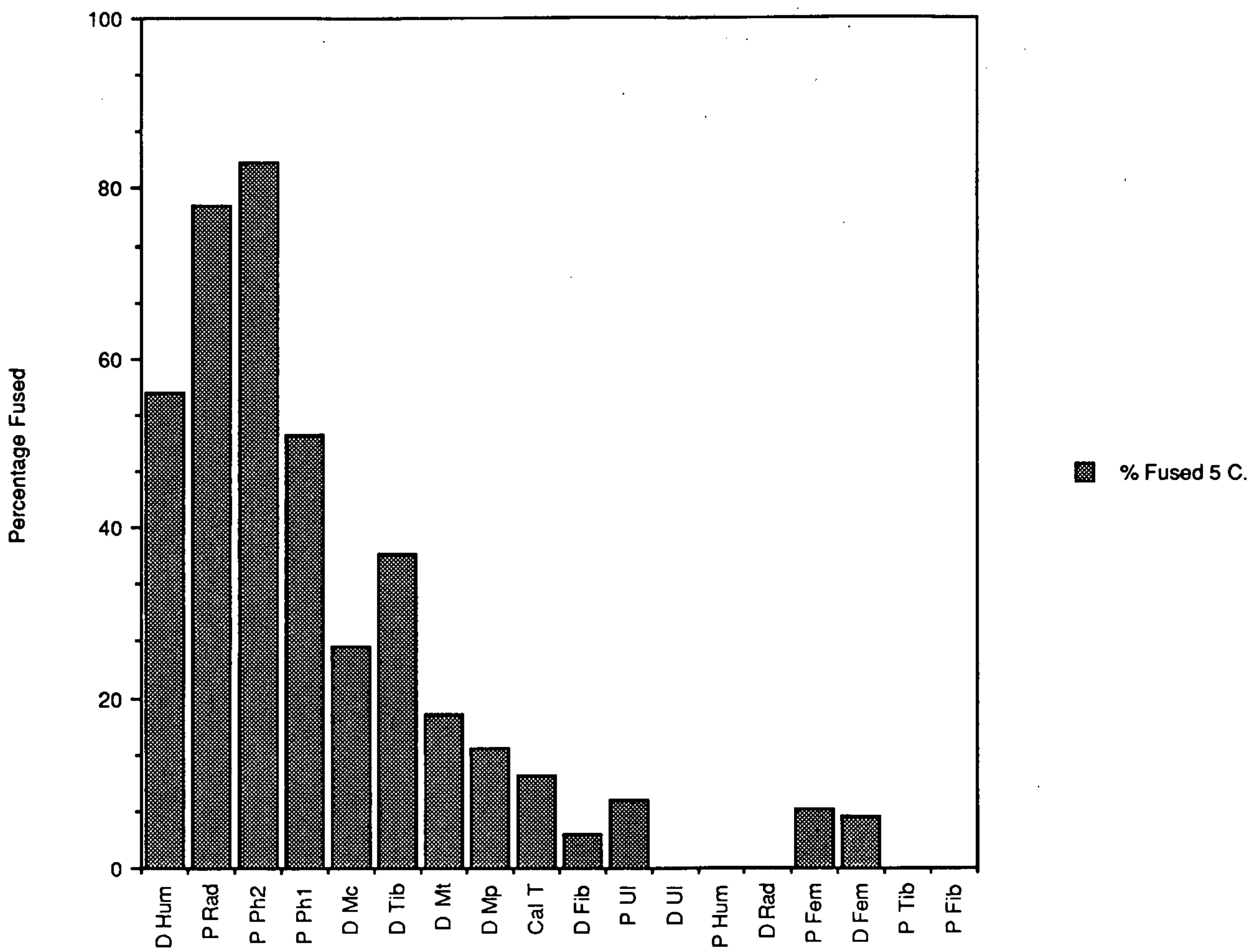


Figure 39 Epiphysial fusion data for Phase 1 pigs

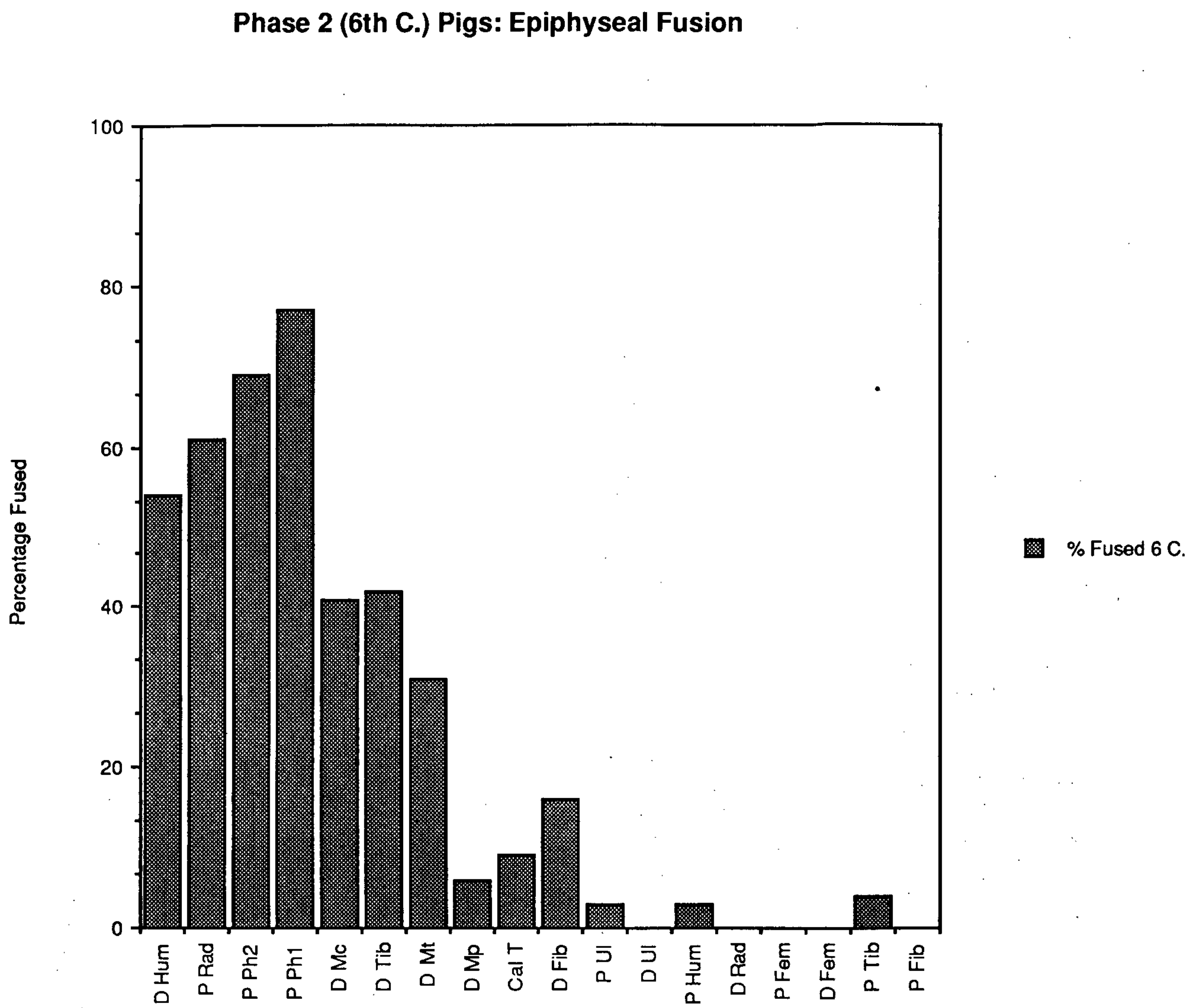


Figure 40 Epiphysial fusion data for Phase 2 pigs

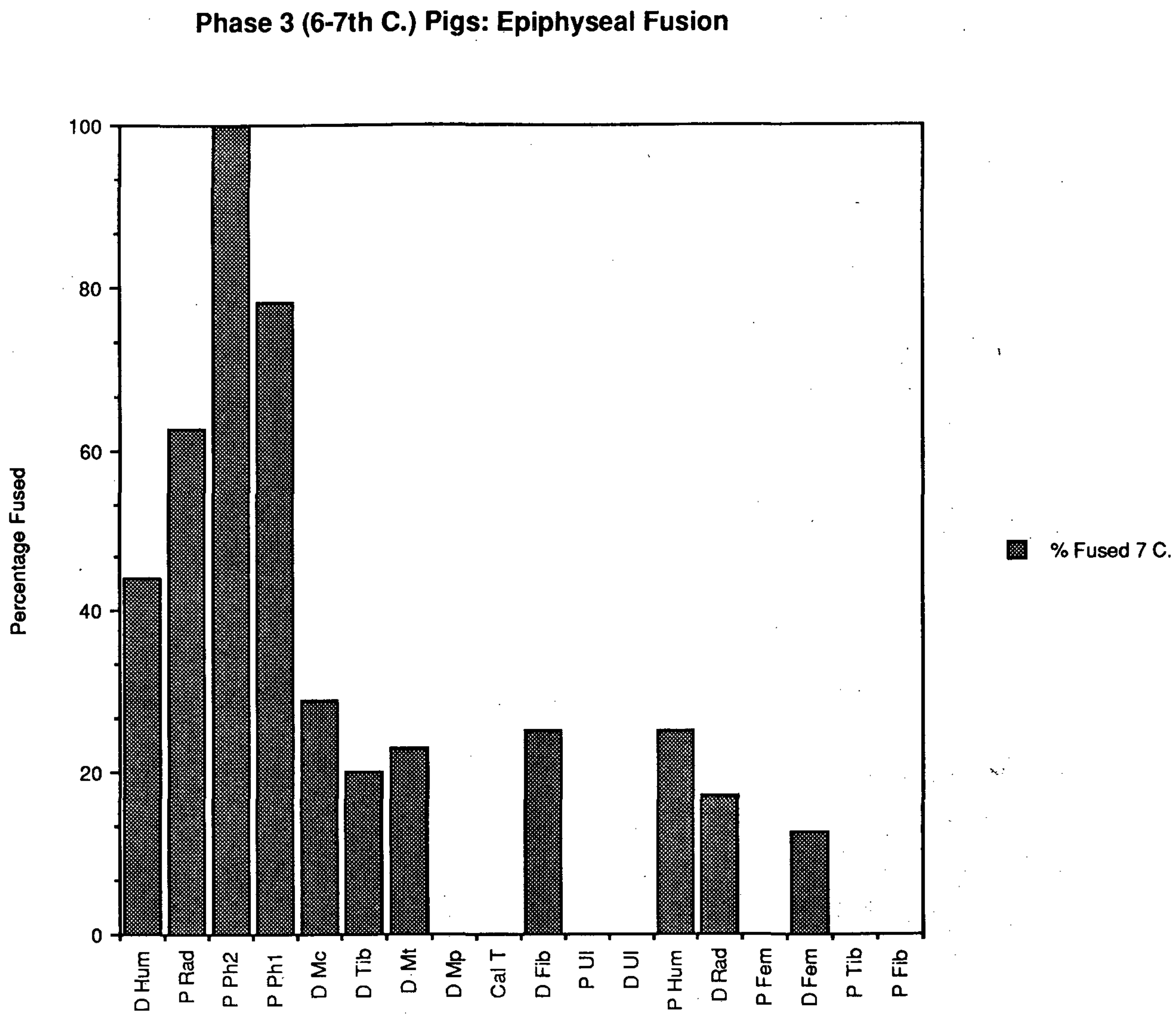


Figure 41 Epiphysial fusion data for Phase 3 pigs

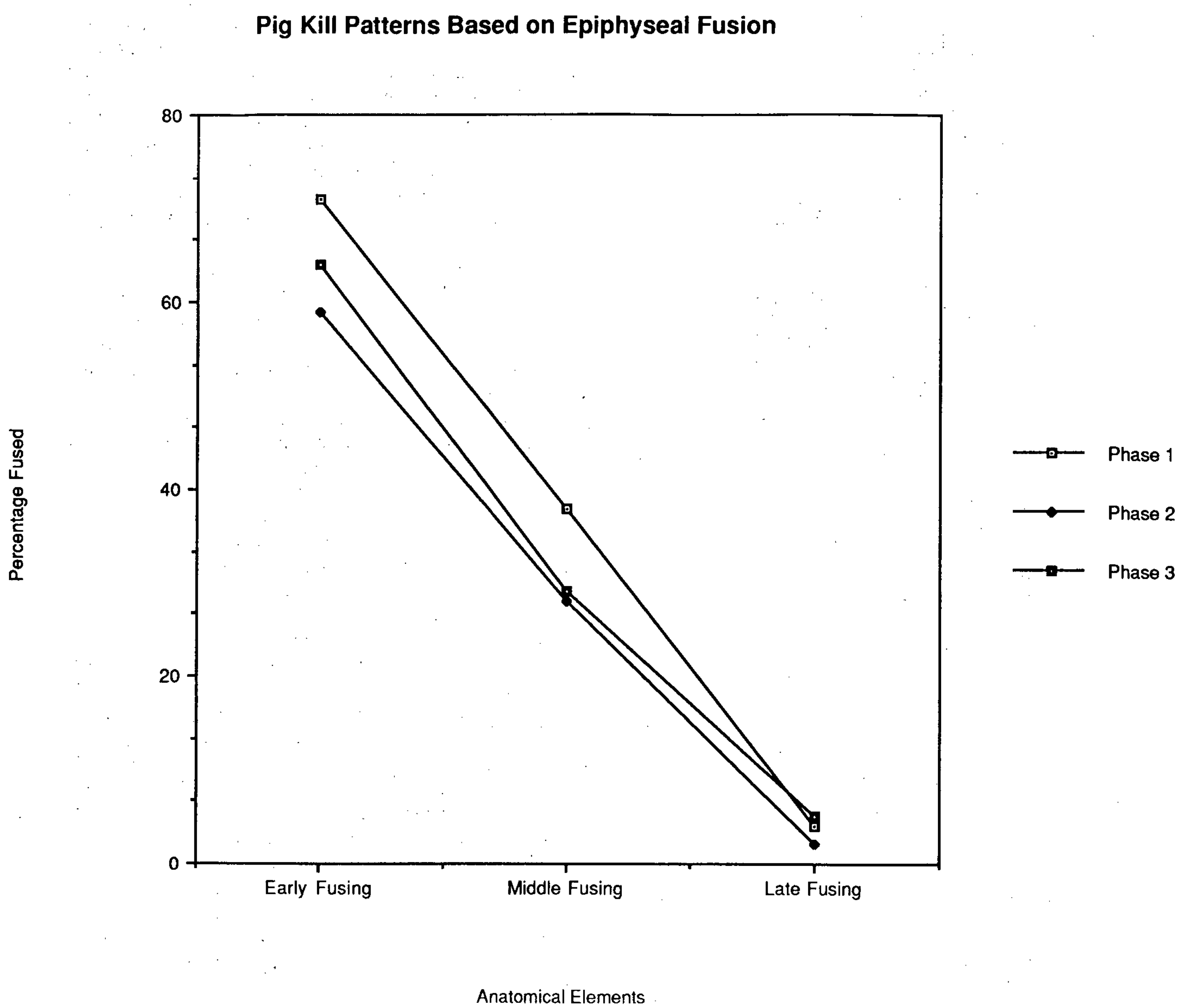


Figure 42 Patterns of epiphysial fusion for pigs from SFBs

Plate X Juvenile pig bones including neonatal radius and ulna and pig mandible with M1 erupted and M2 unerupted. Scale 1:1

Portchester Roman pigs have mandible wear stages of 10 or less. This contrasts with the 22.2% of the West Stow Anglo-Saxon pigs which were of similar age.

The higher mortality of pigs in their first year of life at West Stow is most closely paralleled by the evidence from Roman Fishbourne, Sussex and Roman Exeter. At Fishbourne Periods 2 and 3, 16.2% of the pigs were killed during the first year of life (Grant 1971, 383). Similarly, the Roman levels of Exeter show that an average of 25% of the pigs were killed during the first year (Maltby 1979, 57). The Exeter pigs also show a fairly steady kill-off during the second and third years of life.

Thus, the closest parallels to the mortality pattern of the West Stow pigs are seen in the Roman faunal samples from Exeter and Fishbourne. At Exeter, in particular, the steady mortality throughout the first three years of life, with only a small proportion of the pigs surviving to advanced years, is similar to the pattern seen at West Stow. The West Stow pigs are consistently younger than those from later Anglo-Saxon sites. The lack of available pannage near West Stow and the substantial number of young pigs killed lead to the suggestion that sty husbandry may have been practiced during the later phases of occupation.

V. Sheep and Goats: Ageing Evidence

Dental eruption and wear

(Figs 43-6; Pl. XI)

In contrast to pigs, sheep and goats are multi-purpose animals, sources of meat, milk, and wool or hair. Analysis of sheep and goat mortality patterns may shed light on the relative importance of dairying, meat production, and wool production in West Stow animal husbandry practices. As sheep and goats were the most common animals at Anglo-Saxon West Stow, special emphasis was placed on the study of their kill-patterns. Unfortunately, sheep and goat mandibles must be treated as a group, since it is not yet possible to distinguish between the two species on the basis of dental evidence alone[24]. It is possible that sheep and goats, both of which were present, may have been used for different economic purposes. It is likely that most of the mandibles considered in this study are those of sheep, since sheep vastly outnumber goats (see p.00).

The age distributions (following Grant 1975) for the sheep/goat mandibles from Phase 1, Phase 2 and Phase 3 are shown in Figures 43-5. The overall age distribution for the mandibles from all Anglo-Saxon features is shown in Figure 46 a and b, where it is clearly polymodal, indicating a complex kill-pattern[25]. A small number of sheep were killed before about 6 months of age (MWS < 6). Most of these immature animals show some wear on their milk teeth indicating that they were more than 2 months old when they died. Thus they are more likely to represent seasonal cullings in the first year of life than neonatal mortalities. A larger number of animals were killed in the second half of the first year (MWS = 11). This may reflect autumn killing of excess young animals, possibly as a response to seasonal shortages of fodder. There is also a significant kill-off in the second year of life (MWS = 25). Most of the adult animals (Pl. XI) were killed between 3 and 6 years of age (MWS = 30-45), while a very small number of sheep survived for more than 6 years.

Payne (1973) has outlined models for the types of kill-patterns one might expect from meat-, milk-, and wool-producing flocks. When sheep are kept primarily for meat, most of the animals will be killed by approximately 2-3 years of age. It is at this age that the sheep approach bodily maturity, and continuing to feed them beyond this will not substantially increase meat output. A relatively small number of adults will be kept for breeding purposes. Shepherds emphasizing milk-production will eliminate excess lambs, especially males, early in the first year of life. Wool-production strategies lead to very different age distributions, since adult animals, and especially wethers or castrated males, are primary wool-producers. One might therefore expect to find a high proportion of adult animals in the kill-off from a wool-producing flock.

As might be expected, the age distribution shows some significant differences from all three idealized strategies. A high mortality in the first year of life (comparable to the milk pattern) is indicated, but more animals appear to be killed in the second half of the first year of life. If milk production were the primary goal of West Stow sheep husbandry, we might expect to see more animals killed early in the first year. In the second year, mortality is also quite high, and this is more comparable to a meat production model. In this case, however, we see a higher mortality in the 4-6 year age group than would be expected from a meat-or milk-production model. We should not, however, expect the West Stow data to match Payne's idealized patterns exactly. In the real world, sheep are rarely used for only one purpose; some combination of meat-production, wool production, and dairying would be more likely. While there is no evidence for specialized wool production, the measurement evidence (see Chapter 3) suggests that many of the adult animals were male (possibly wethers). The adult sheep were probably kept for their wool which was undoubtedly used for domestic purposes. SFB 15 produced over 100 loomweights (West 1985a, 23), and a mass of unfired clay loomweights was also recovered from SFB 21 (West 1985a, 26). A number of weights were also found in the eastern half of SFB 3, indicating that this

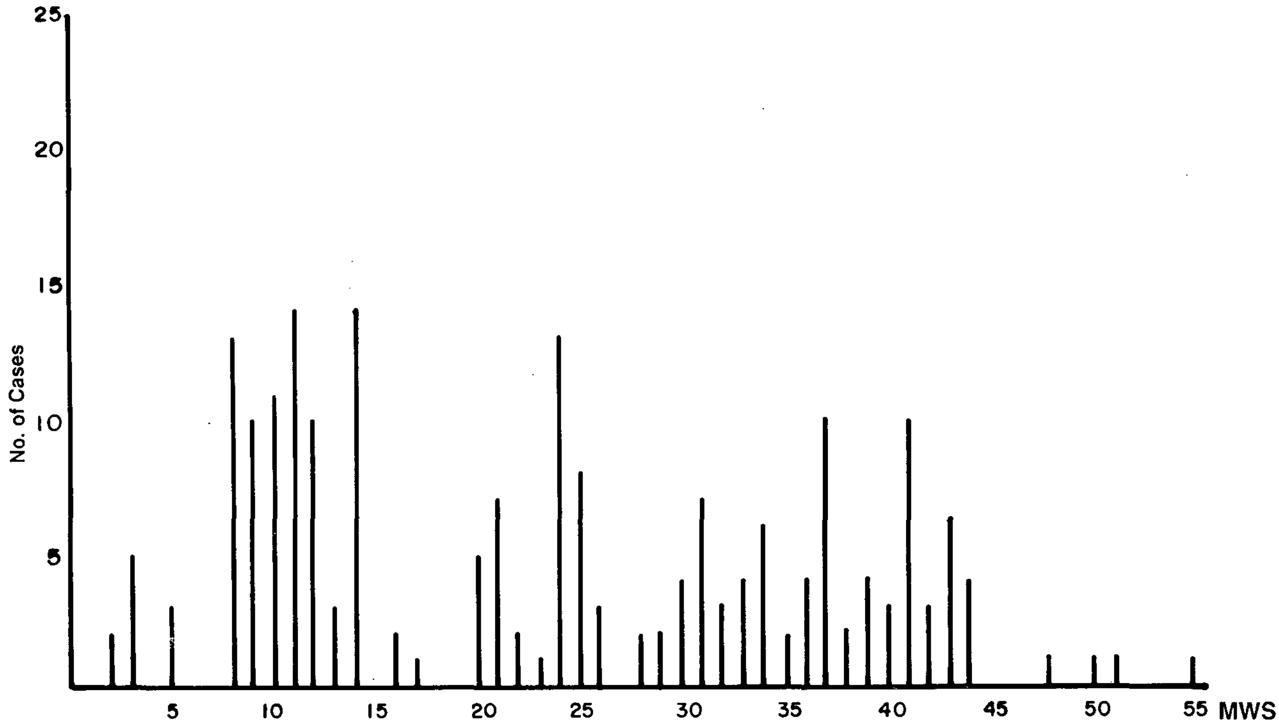


Figure 43 Distribution of mandibular wear stages for sheep and goats from Phase 1 SFBs

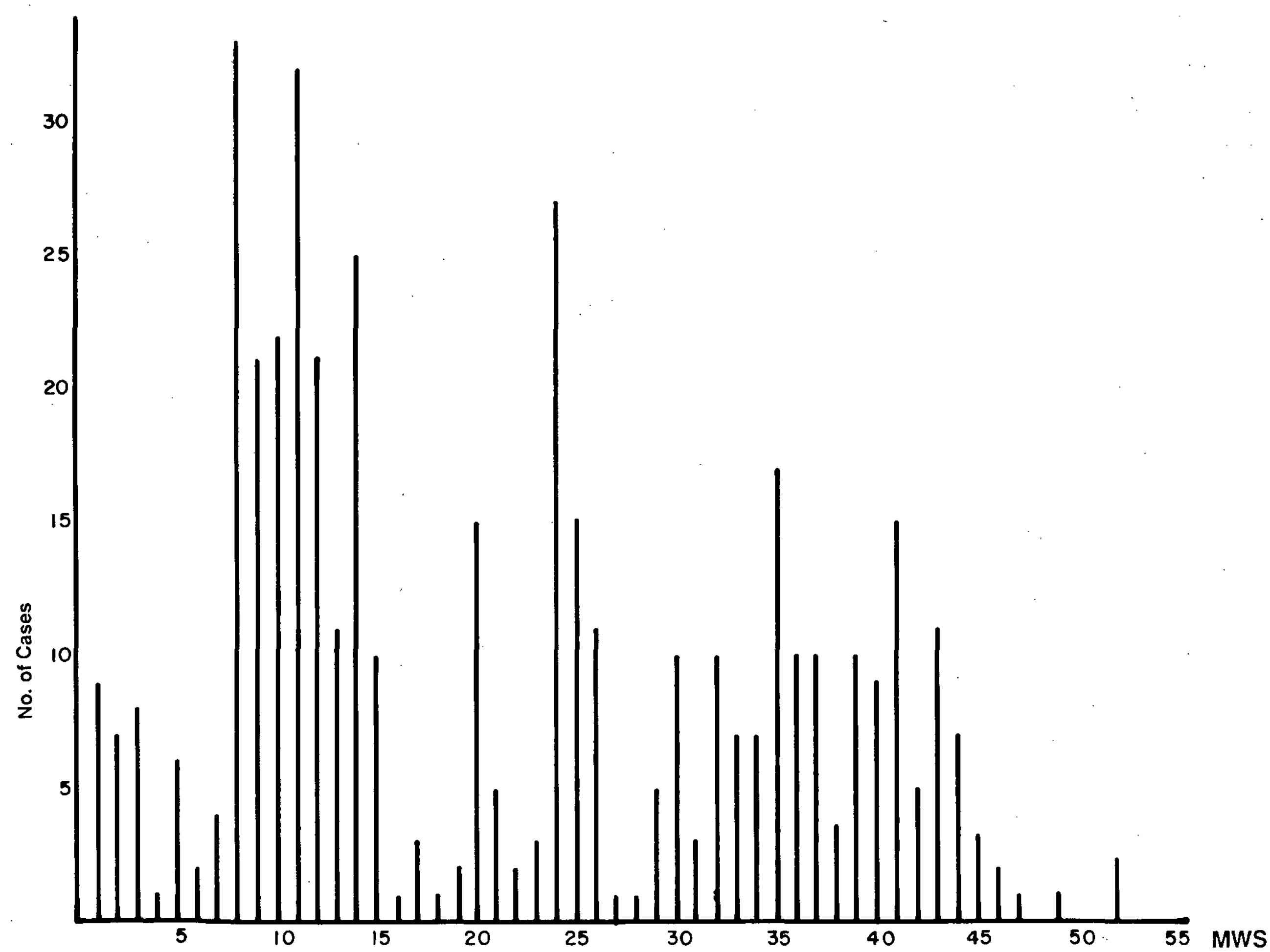


Figure 44 Distribution of mandibular wear stages for sheep and goats from Phase 2 SFBs

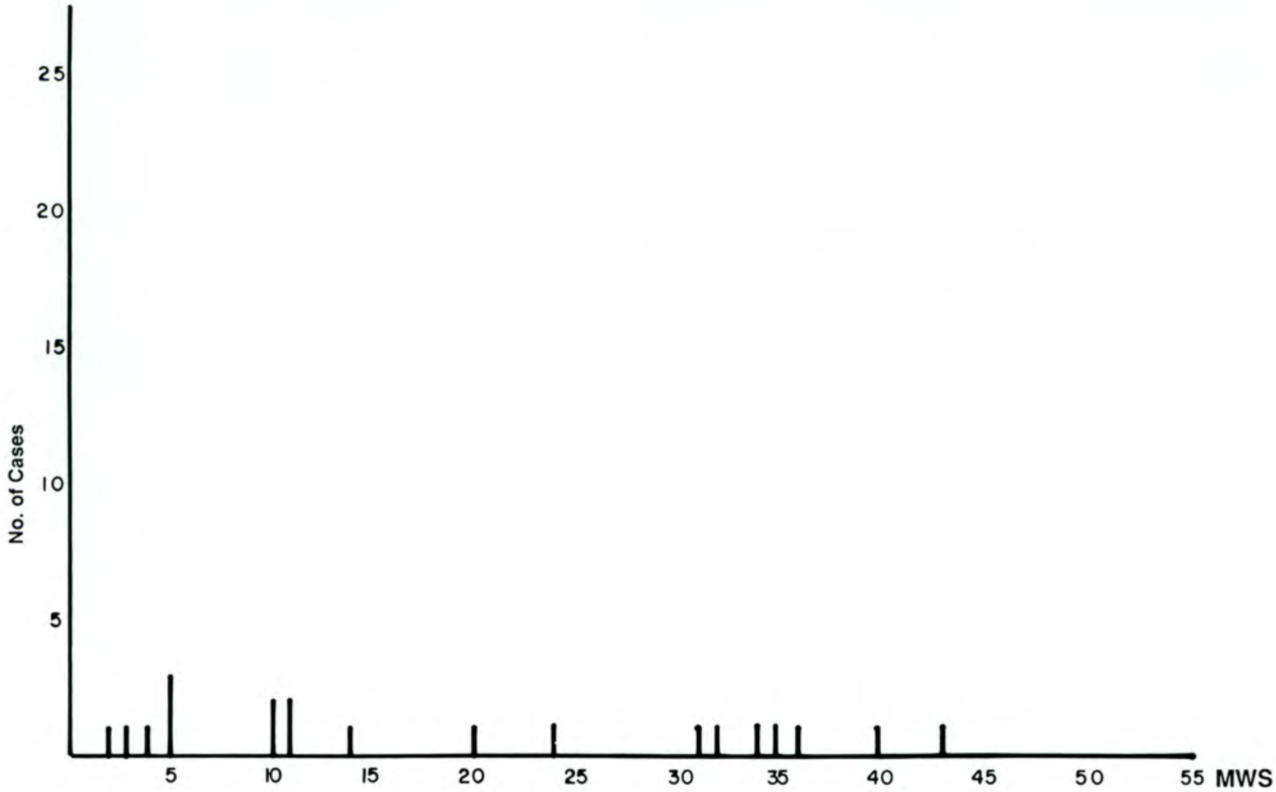


Figure 45 Distribution of mandibular wear stages for sheep and goats from Phase 3 SFBs

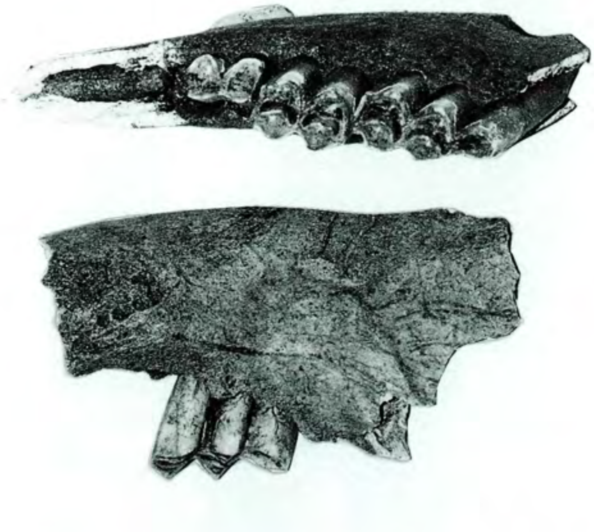
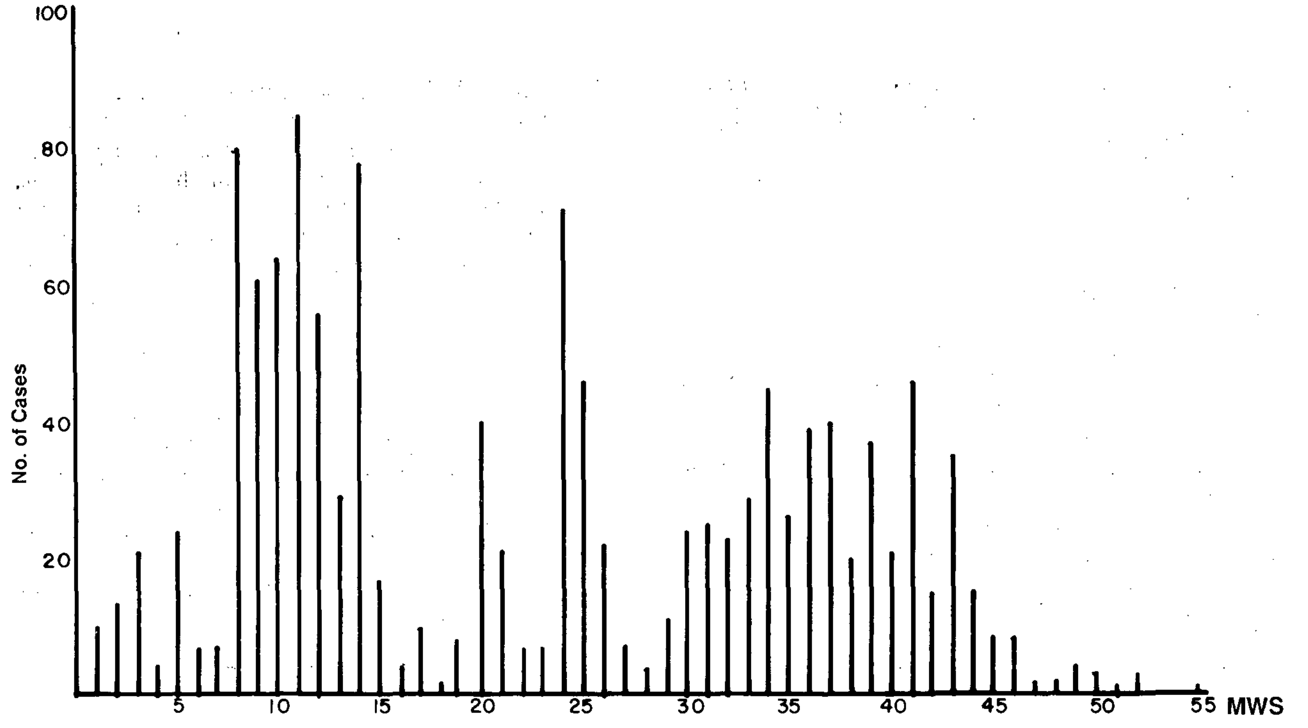


Plate XI Mandibles of adult sheep showing M3 fully erupted and in wear. Scale 1:1



Kill-Patterns for Early Anglo-Saxon Sheep

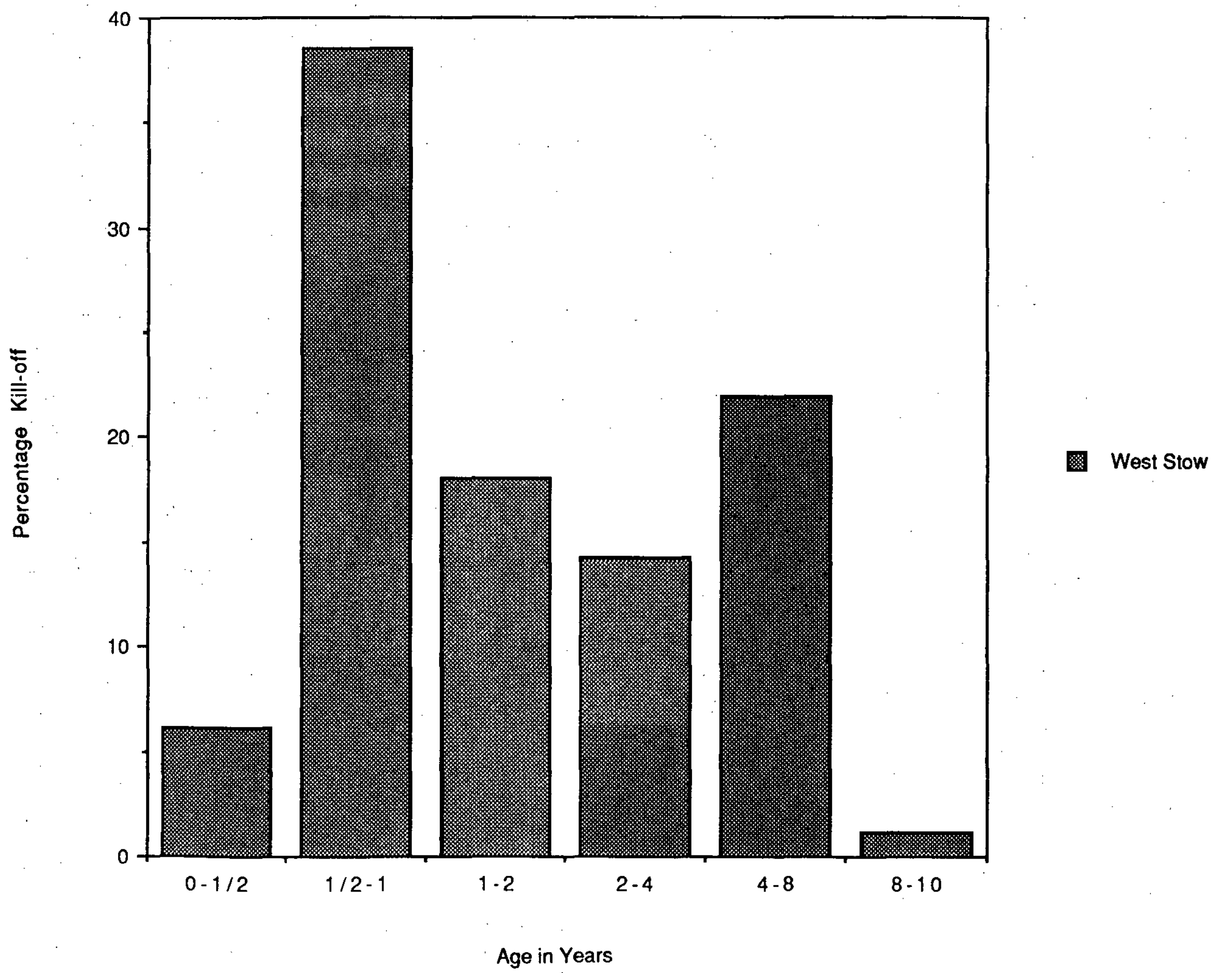


Figure 46 Kill patterns for sheep/goat mandibles from all Anglo-Saxon contexts:
a. Distribution of mandibular wear stages for sheep and goats from all Anglo-Saxon features.
b. Summarized kill pattern (see Table 46 for details).

building housed a loom (West 1985a, 16). West (1969, 5) has interpreted SFB 3 and SFB 15 as weaving sheds. The use of sheep for meat, milk, and wool production is just what one would expect to find at a small, self-sufficient agricultural village.

Epiphysial fusion

(Figs 47-50; Table 45)

The data on epiphysial fusion for the sheep and goat long bones are summarized in Figures 47-9 and in Table 45. The long bones were divided into early, middle, and late fusing elements (Fig. 50). The early category includes those epiphyses that fuse by 16 months (the distal humerus, proximal radius, and proximal first and second phalanges). The middle fusing elements are those that fuse by 28 months, including the distal tibia and the distal metapodia. The late fusing epiphyses include the proximal and distal ulna, proximal femur, proximal calcaneus, distal radius, proximal humerus, distal femur, and proximal tibia[26]. These epiphyses all fuse by 3½ years of age (Silver 1969, 285-6).

The kill-patterns based on epiphysial fusion for the fifth-century sheep and goats (Fig. 50) show marked differences from the patterns based on dental eruption and wear. The profile based on mandibles indicates that over one-third were killed during the first year of life and that nearly two-thirds were killed by the end of the second year. In contrast, the epiphysial data suggest that only about 15% of the sheep and goats were killed during the first 16 months and that approximately 40% were killed by 28 months of age.

How can we reconcile these contradictory data? It is possible that the small, immature limb bones of young sheep and goats, especially those less that one year of age, were differentially destroyed[27] by carnivores, including dogs, or other agents of bone destruction.

The epiphysial fusion data for the sixth-and seventh-century sheep and goats present a similar picture. The limb bone evidence indicates that fewer sheep were killed during the first two years than do the dental eruption data. If we assume that these bones are poorly preserved, then dental eruption and wear are likely to provide more accurate assessments of slaughter schedules for sheep and goats. The dental data will therefore be used to compare the West Stow kill patterns to those from other sites.

Comparisons with other sites

(Figs 51-4; Table 46)

The age distribution seen at West Stow contrasts markedly with the patterns seen at other Anglo-Saxon sites such as Hamwih. There, the sheep/goat mandibles (n = 265) were divided into six broad age categories (Table 46), and for comparative purposes the West Stow mandibles have been classified in the same way (Fig. 51). A higher proportion of West Stow sheep were killed during the first year of life, while larger numbers of Hamwih sheep were killed after 2 years of age. Equal proportions of animals were killed during the second year of life. These adolescent animals would have yielded significant quantities of meat. The overall comparison, however, indicates that the West Stow sheep were killed earlier than were their counterparts at Hamwih[28].

The sheep mandibles from the Anglo-Saxon levels at North Elmham are consistently older than those from West Stow. The Middle and Late Saxon contexts at North Elmham include more than 60% mature individuals. Mature individuals are those which are the equivalent of more than 4 years old in modern terms. If we assume that these mature jaws are the equivalent of mandibles with mandibular wear stages greater than 36, then only 23% of the West Stow jaws would be considered mature. Noddle (1980, 396) suggests that most of the sheep at North Elmham were kept for wool-production. As noted above, it is unlikely that specialized wool-production played a role in West Stow sheep husbandry.

The Middle/Late Saxon sheep from Portchester Castle (Grant 1976) also included substantial numbers of older individuals, as did the smaller Saxon faunal samples from Ramsbury (Coy 1980) and Durham (Rackham 1979, 53). The predominance of older animals at most Anglo-Saxon sites has led Maltby (1981, 178) to suggest that large-scale wool production became important in this period, and that the roots of this development may be Early Anglo-Saxon. The West Stow ageing data provide no clear evidence to support this contention. One other Anglo-Saxon faunal collection, Sedgeford, Norfolk, has produced substantial numbers of young sheep. Clutton-Brock (1976, 382) notes that only two of twenty-six mandibles from Sedgeford had the third molar fully erupted and suggests that these sheep were killed for meat when less than four years old. This pattern also differs from West Stow in that it includes a lower proportion of mature animals.

To find parallels for the West Stow pattern of high mortality in the first and second years of life, combined with a minor mode of mortality among older individuals, we most look to the Iron Age and Romano-British sheep/goat ageing evidence. At first sight, the mortality pattern for sheep at Anglo-Saxon West Stow seems to parallel the patterns of earlier Iron Age sites in southern England. The sheep/goat samples from the R17 phase 4 and Baulksbury Middle Iron Age sites show 'a concentration of very young mandibles, very few that were assigned values [mandibular wear stages] of 15-30 and then a broad concentration of older mandibles with fully erupted tooth rows' (Maltby 1981, 172). Maltby has suggested that although the Middle Iron Age samples seem to resemble Payne's (1973) model for dairy-production, these age distributions may simply indicate relatively inefficient sheep husbandry practices resulting from, for example, a shortage of winter fodder. The Middle Iron Age samples resemble West Stow in the high proportion of first year mortalities, but the Anglo-Saxon sample produced a considerably higher percentage of animals killed during the second year of life. This would seem to indicate that meat production played a greater role West Stow sheep husbandry than in did in the Middle Iron Age samples examined by Maltby.

In terms of mortality pattern, the West Stow sheep/goat sample seems most similar to later Iron Age samples such as Gussage All Saints (Harcourt 1979, 152) and Micheldever Wood, Hants. (Coy 1978, 8). Of the Gussage mandibles, 21% showed the second molar in wear and the third molar unworn, *i.e.,* sheep in the second year of life. Micheldever Wood produced equal numbers of sheep of this age and younger sheep (Maltby 1981, 174). At West Stow, 18% of the sheep and goat mandibles had the second molar in wear and the third molar unworn. The sample of sheep/goat mandibles from Ashville (Hamilton 1978, 130) included 22.6% second year mortalities and seems to show an overall kill-pattern that is very similar to West Stow. The closest parallel to the West Stow sheep/goat ageing pattern is seen at Barley, Herts. (n =

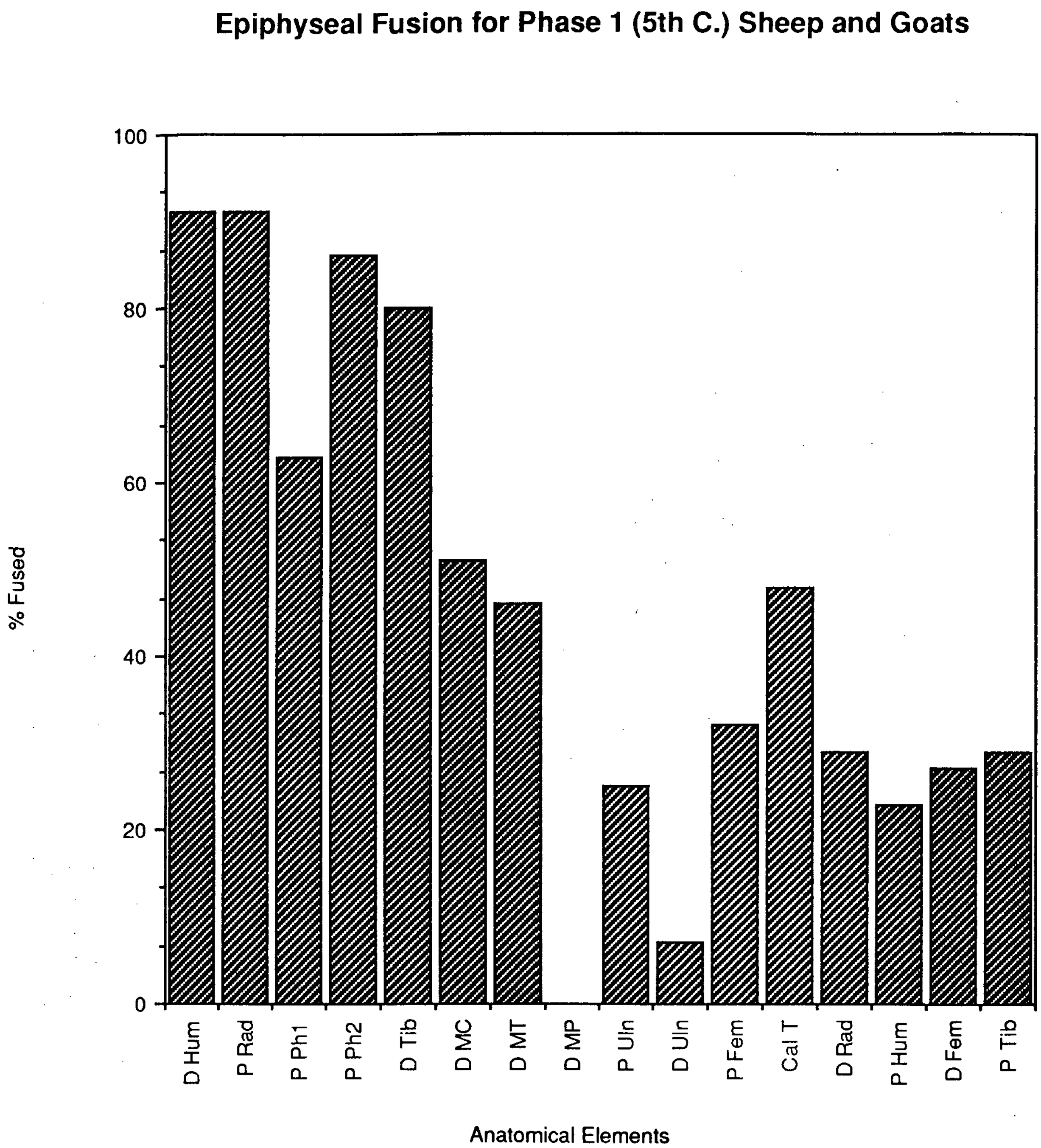


Figure 47 Epiphysial fusion data for Phase 1 sheep and goats

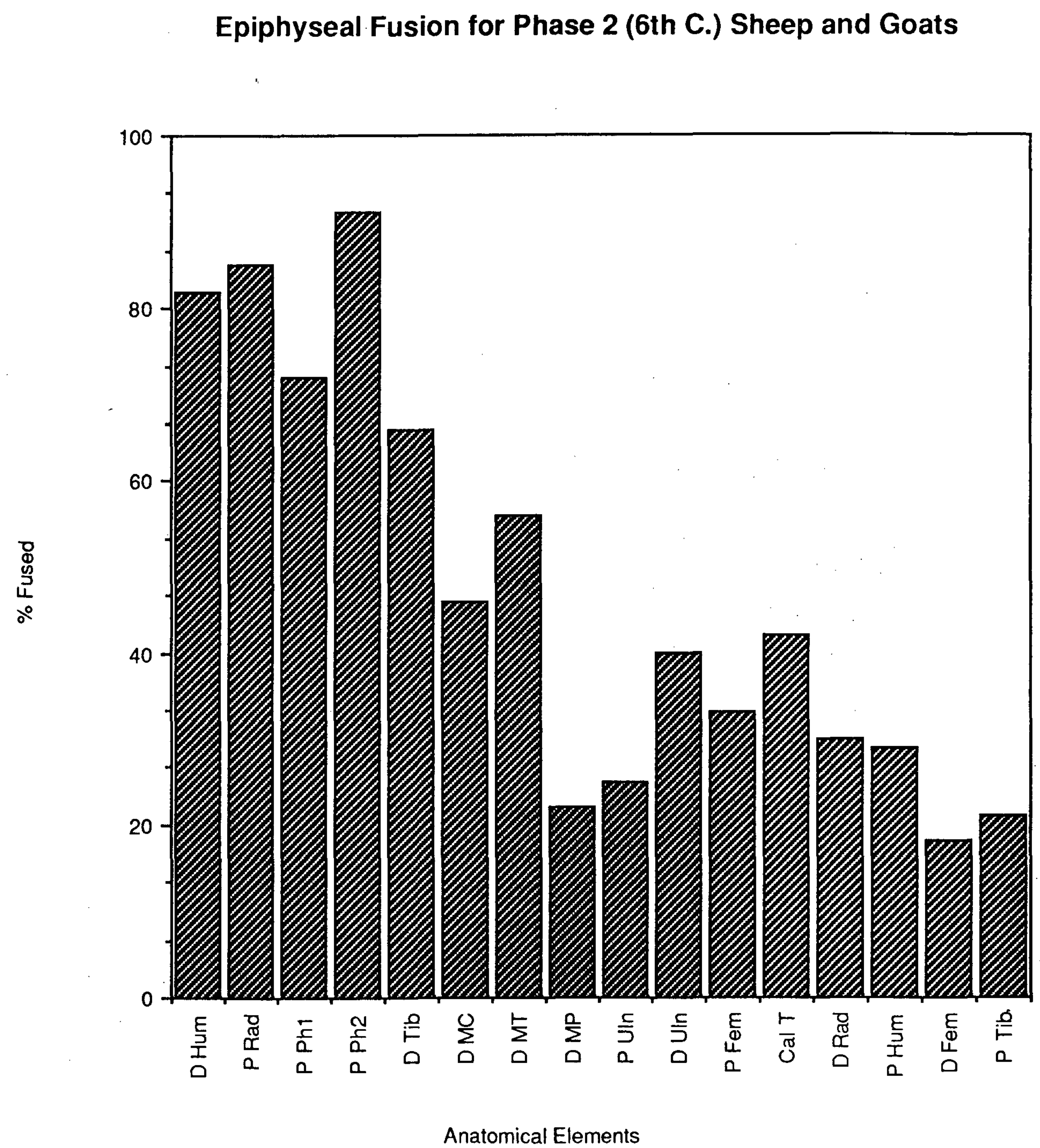


Figure 48 Epiphysial fusion data for Phase 2 sheep and goats

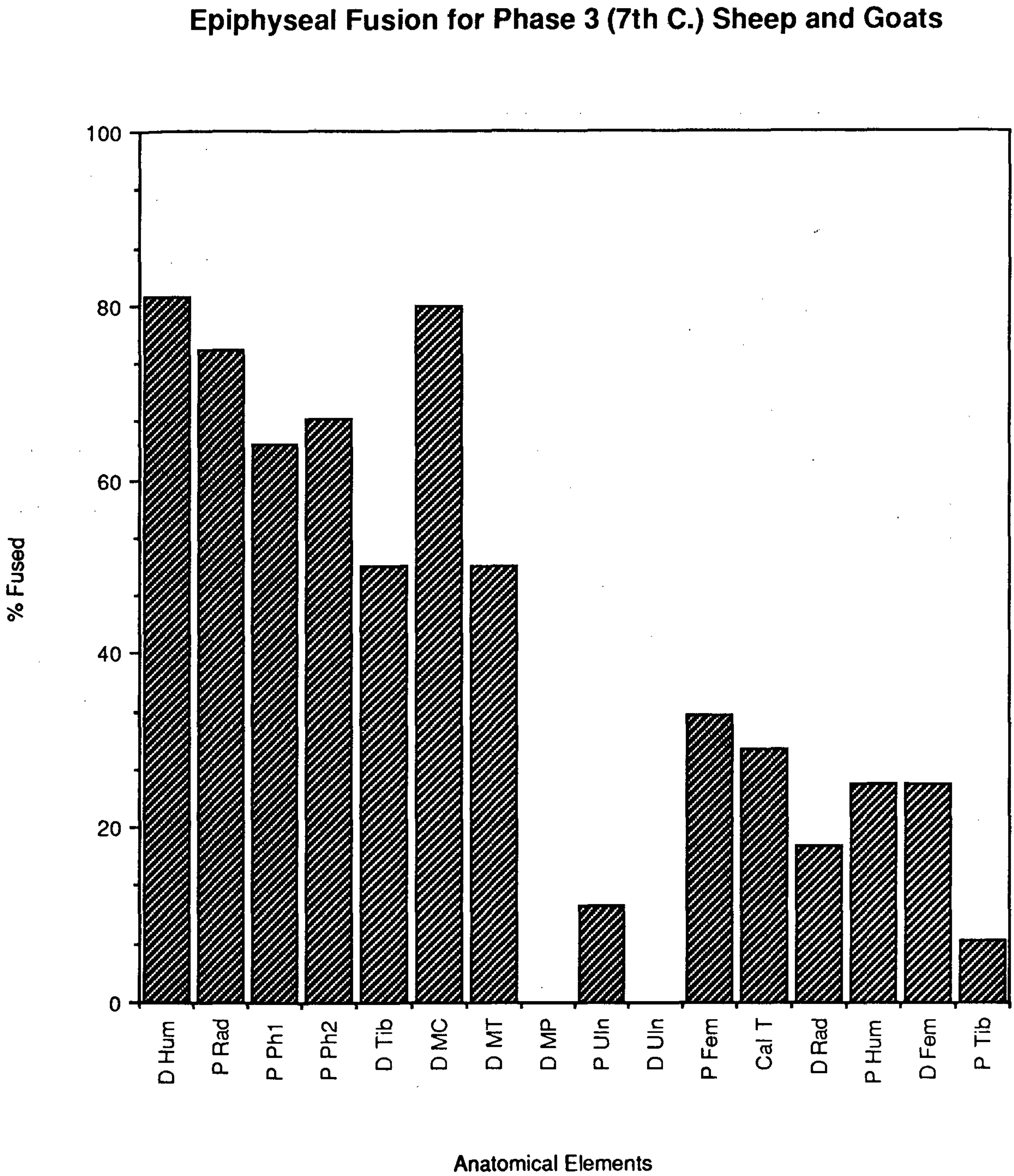


Figure 49 Epiphysial fusion data for Phase 3 sheep and goats

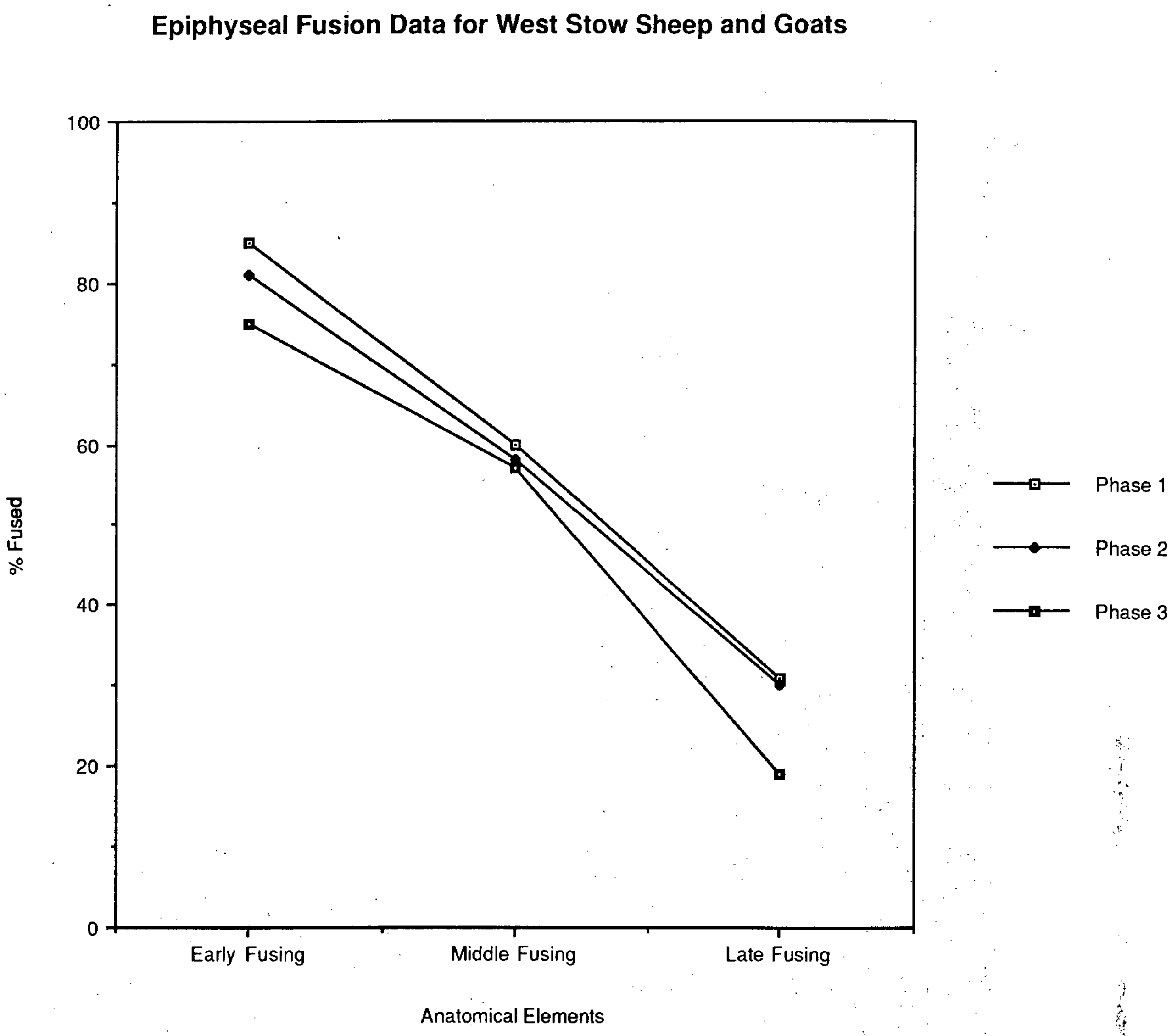


Figure 50 Epiphyseal fusion data for sheep and goats from SFBs

		Phase 1			Phase 2			Phase 3	
	Unfused	Fused	% Fused	Unfused	Fused	% Fused	Unfused	Fused	% Fused
Humerus distal	8	80	91%	26	121	82%	6	26	81%
Radius proxial	8	80	91%	22	123	85%	6	18	75%
First phalanx proximal	18	31	63%	39	102	72%	4	7	64%
Second phalanx proximal	2	12	86%	5	50	91%	2	4	67%
Total Early Fusing	36	203	85%	92	396	81%	18	55	75%
Tibia distal	18	73	80%	64	124	66%	11	11	50%
Metacarpus distal	31	32	51%	46	41	46%	2	8	80%
Metatarsus distal	29	25	46%	31	39	56%	2	2	50%
Metapodium distal	9	0	0%	7	2	22%	1	0	0%
Total Middle Fusing	87	130	60%	148	206	58%	16	21	57%
Ulna proximal	15	5	25%	33	11	25%	8	1	11%
Ulna distal	14	1	7%	3	2	40%	0	0	---
Femur proximal	15	7	32%	43	21	33%	6	3	33%
Calcaneus tuber	23	21	48%	43	31	42%	5	2	29%
Radius distal	25	10	29%	50	21	30%	14	3	18%
Humerus proximal	10	3	23%	24	10	29%	3	1	25%
Femur distal	16	6	27%	37	8	18%	6	2	25%
Tibia proximal	20	8	29%	37	10	21%	13	1	7%
Total Late Fusing	138	61	31%	270	114	30%	55	13	19%

Table 45 Epiphysial fusion data for sheep and goats

Stage	Definition	MWS	Payne	Age in Years	WS n
1	M_1 unworn	1-6	A-B	0 - 1/2	79
2	M_2 unworn	7-18	C	1/2 - 1	498
3	M_3 unworn	19-28	D	1 - 2	233
4	M_3 coming into wear	29-35	E-F	2 - 4	183
5	M_3 in full wear	36-46	G-H	4 - 8	284
6	M_3 in heavy wear	47+	I	8 - 10	16

Table 46 Age estimates for sheep and goat mandibles: concordance table

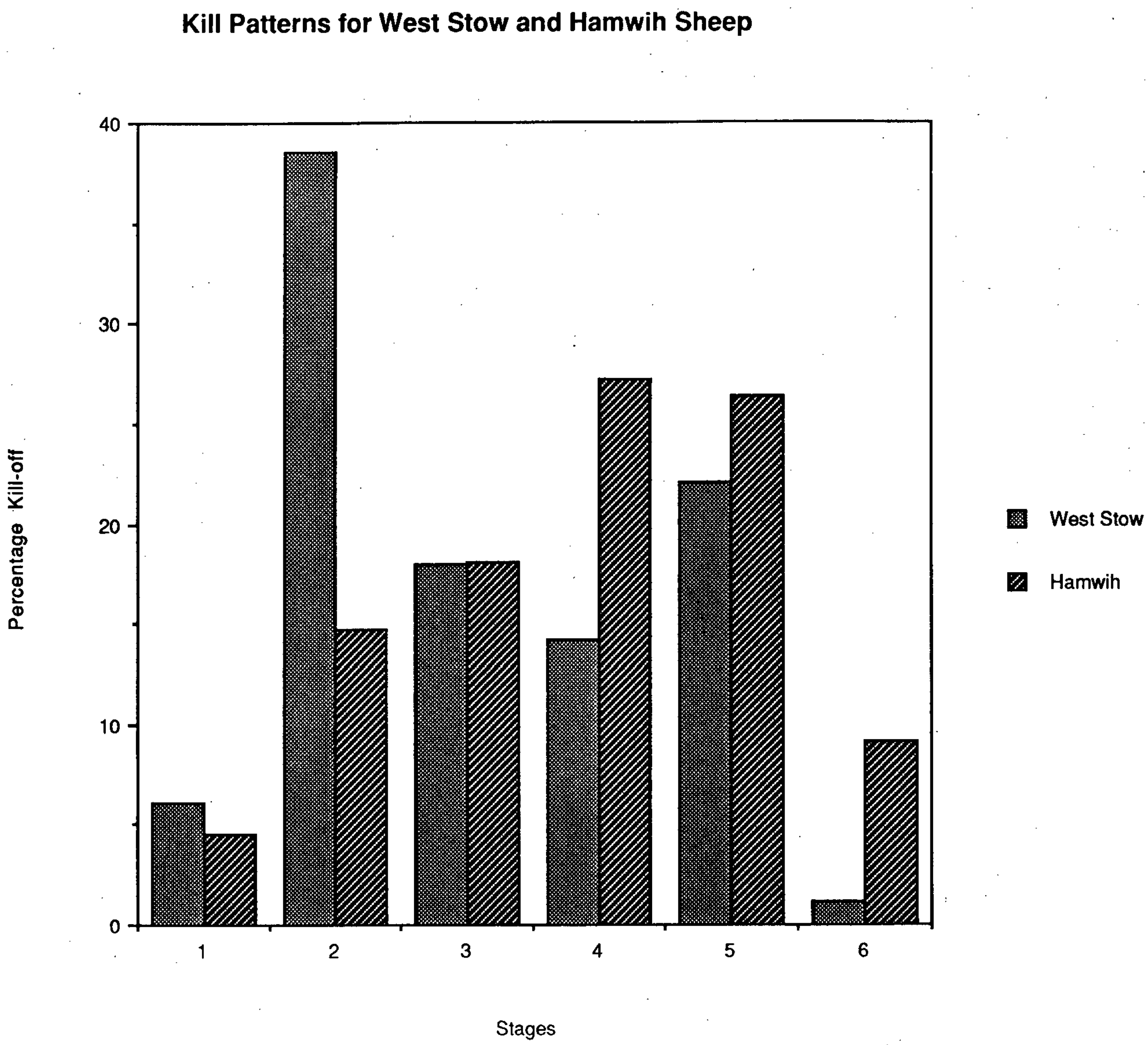


Figure 51 Kill patterns for sheep/goat mandibles from Hamwih and West Stow

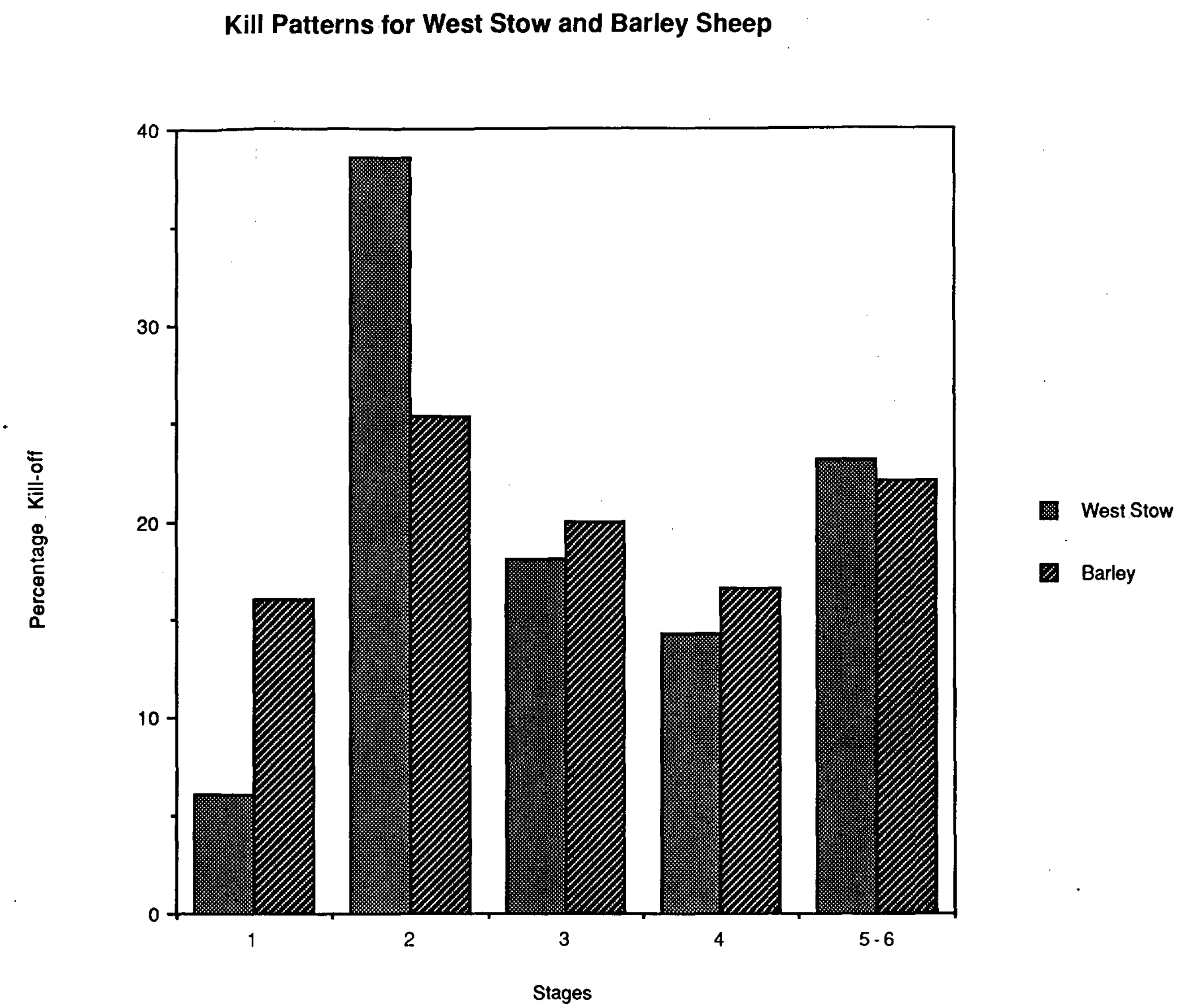


Figure 52 Kill patterns for sheep/goat mandibles from Barley and West Stow

181; Fig. 52; Ewbank *et al.* 1964). Over 40% of the sheep in both samples were killed during the first year of life, (Fig. 52), although more Barley sheep were killed early in the first year. Both samples include just over 20% adults killed after 4 years of age. In both collections nearly 20% of the sheep were killed during the second year. At this age sheep have completed much of their growth, and culling animals at this stage will produce a high meat yield relative to the amount of fodder consumed[29].

The age distribution for Anglo-Saxon sheep at West Stow also closely resembles the kill-pattern for the Iron Age sheep (Crabtree in press). Although the sample of ageable Iron Age mandibles is quite small, overall similarities in kill-pattern are nevertheless apparent[30] (Fig. 53).

The West Stow Anglo-Saxon age distribution for sheep thus finds its closest parallels in the kill-patterns seen at later Iron Age villages in southern Britain. This evidence indicates basic long-term continuities in sheep raising practices. The later Iron Age kill-pattern involving high kill-off in both the first and second years of life continued into the Early Anglo-Saxon period. We must look elsewhere than West Stow for evidence of an early shift to large scale wool production.

The evidence for local continuity in sheep husbandry is strengthened when the sheep kill-pattern is compared to the age distribution seen at the continental Saxon site of Feddersen Wierde (n = 962 mandibles) (Reichstein 1972, 153). At West Stow, over 40% of the sheep were killed during the first year of life, while at Feddersen Wierde only 20% were killed at this age (Fig. 54). Over 60% of the Feddersen Wierde sheep survived to more than 2 years of age compared to less than 40% at West Stow[31]. The West Stow sheep were therefore killed earlier than the sheep from Feddersen Wierde. This evidence suggests that the *Adventus Saxonum* did not lead to the introduction of new patterns of sheep husbandry to Britain. If West Stow was settled by Anglo-Saxon immigrants, then these Germanic settlers must have adopted local sheep rearing practices. Alternatively, the evidence for long-term continuities in sheep rearing practices would suggest that the site was inhabited by Saxonized Britons who continued to practice traditional methods of sheep husbandry.

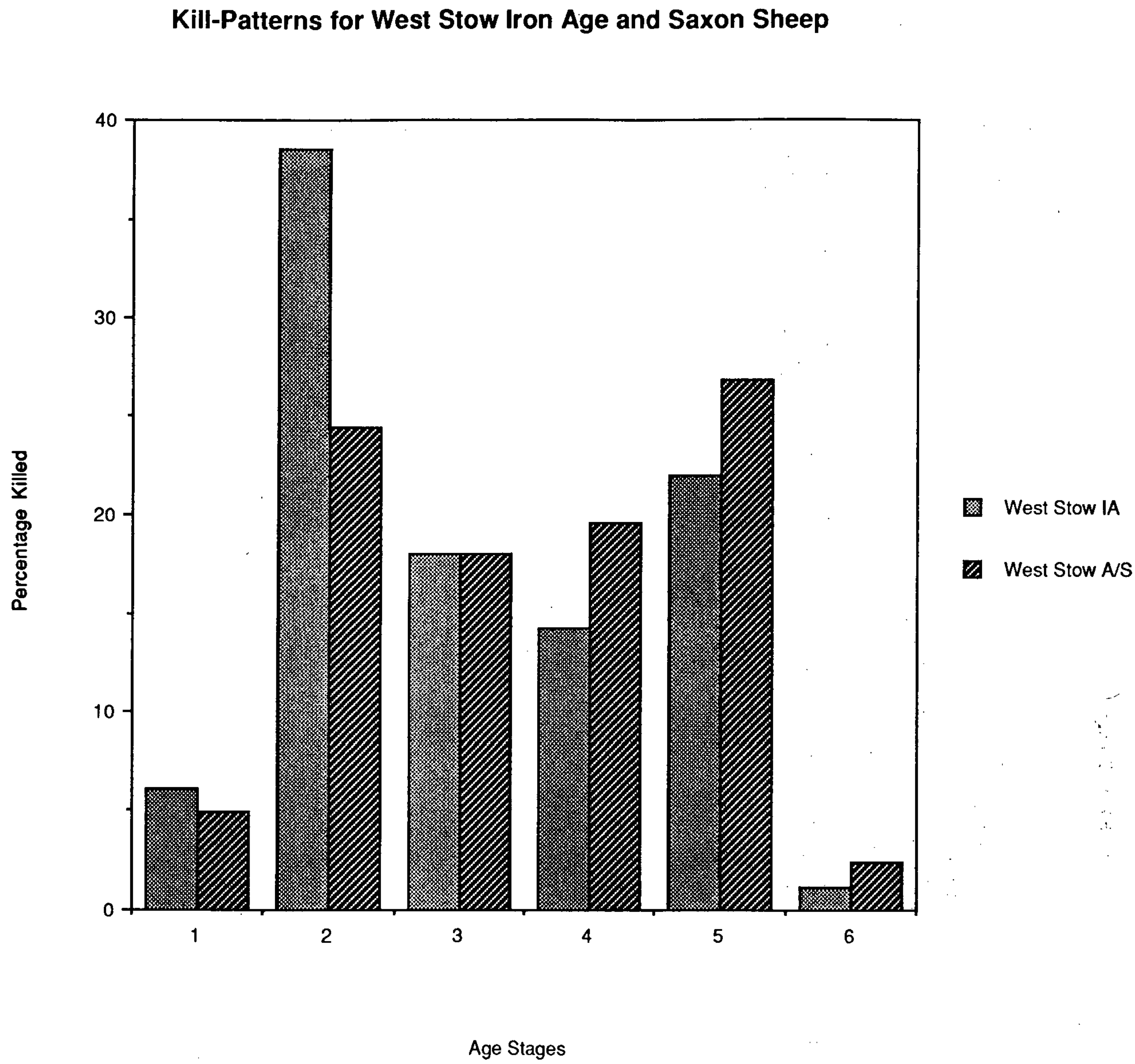


Figure 53 Kill patterns for mandibles from Iron Age and Anglo-Saxon contexts

VI. Horses: Ageing Evidence

Assessing the ages at death of the horses presents some difficulties. Systems of dental eruption and wear are not as well developed for horses as they are for the other domestic animals. The ageing evidence is somewhat different from that seen for the other domestic species. The vast majority of teeth are adult; only two deciduous teeth were recovered. These adult teeth include a number that show heavy wear, indicating that some of the horses survived to advanced years. On the other hand, a minority of the horse teeth, including some recovered from the SFBs, show little or no wear. This dental evidence is paralleled by the data on epiphysial union. While the vast majority of horse limb bones have fused epiphyses, a number of immature horse long bones were recovered from the Anglo-Saxon features.

The presence of a number of elderly horses would seem to suggest that some were used primarily for purposes other than meat. These could include traction and riding. The paleopathological evidence indicates that horses may have been used for heavy work. Several instances of spavin were identified on tarsal bones. While spavin may be due to a number of causes, one possible cause is heavy work (Baker and Brothwell 1980, 118). It is possible that excess foals which were not required for working were eaten at a young age, while those animals which were used for traction and riding were allowed to survive to advanced years. In addition, the presence of some young specimens would suggest that horses were bred at West Stow.

The ageing pattern of the West Stow horses contrasts markedly with the pattern seen at urban Hamwih where all the horse remains were mature (Bourdillon and Coy 1980, 105). Ramsbury, on the other hand, did produce a number of younger animals (Coy 1980, 46).

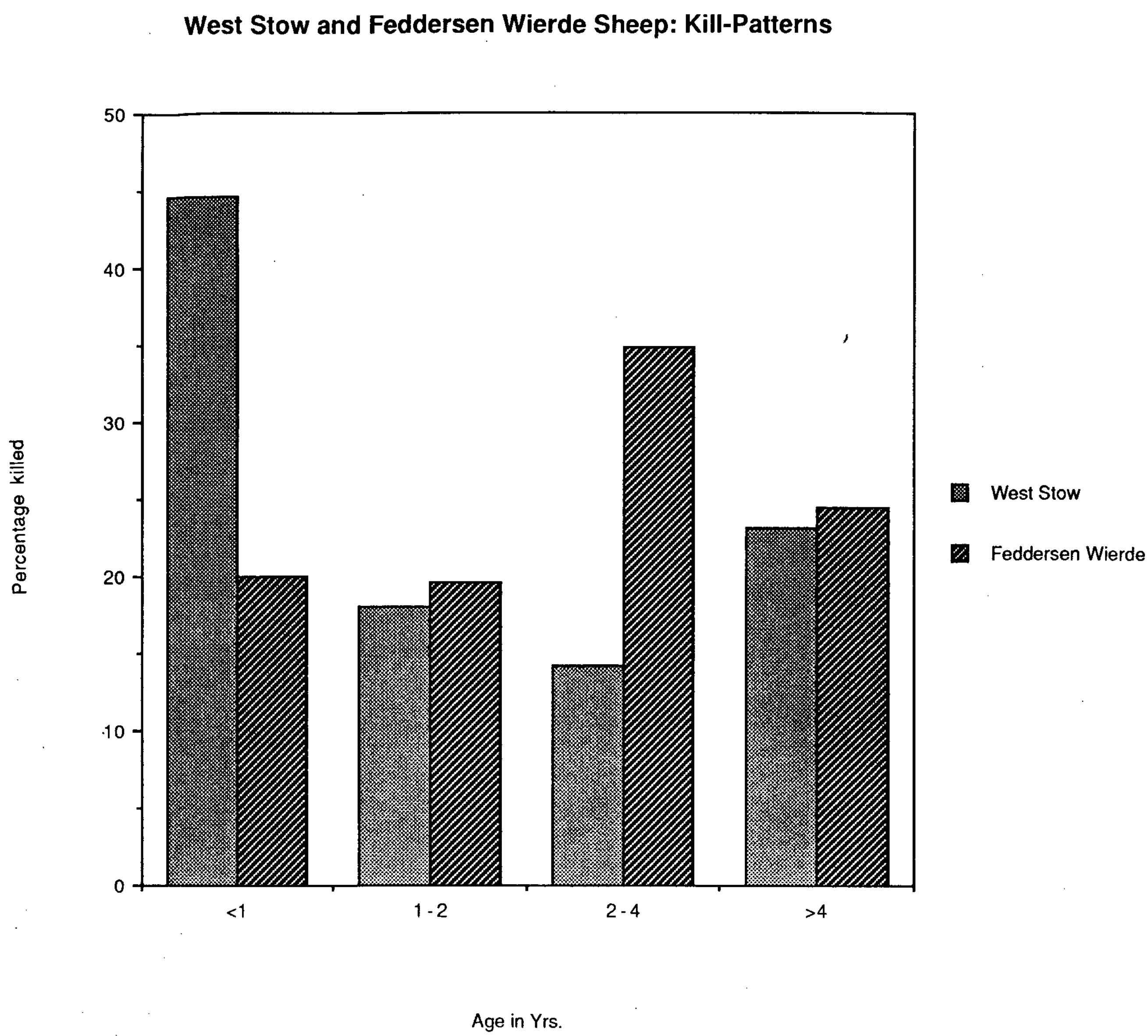


Figure 54 Kill patterns for sheep/goat mandibles from Feddersen Wierde and West Stow

Chapter 5. Butchery and Other Cut Marks on Bone

I. Introduction

The study of past butchery practices can provide several types of useful archaeological information. Identification and analysis of butchery marks on bones allow us to reconstruct past behaviour, specifically acts associated with the dismemberment and distribution of animal carcasses. The large size of the West Stow faunal sample allows us to reconstruct butchery patterns, standards or norms for the dismemberment and distribution of animals. Butchery practices may also help to explain certain anomalies in species/anatomy distributions, thus shedding light on ways in which cultural practices can structure the composition of a faunal assemblage.

II. Methods

(Figs 55-7)

Although butchery practices have interested faunal analysts for many years, standardized methods for recording and analyzing butchery patterns have not yet been developed. The absence of standardized techniques makes intersite comparison of butchery practices particularly difficult. Under ideal conditions, one would like to draw or photograph all butchery marks. Needless to say, this is a time-consuming process, and the large size of the sample made this impractical. We chose instead to photograph representative examples of bone working and butchery.

In addition, we needed to record butchery marks so that they could be entered and processed on a computer[32]B. A string character system of recording was therefore used. A series of characters was used to describe the location *(proximal, distal)*, direction *(axial, medio-lateral)*, and nature *(knife-cut, chop)* of each butchery mark. The main advantage of this system is that it allows the analyst to describe several different instances of butchery on a single bone. The major disadvantage is that one is forced to devise additional conventions (*e.g.*, using 'distal distal' to indicate the medial malleolus on the tibia) to indicate the precise locations of butchery marks on bones.

This analysis of butchery practices concentrates on cattle, sheep/goat, and pig, as these animals were the mainstays of the Early Anglo-Saxon diet. The major areas of butchery on the cow, the sheep, and the pig skeleton have been illustrated in Figures 55-7. For analytical purposes sheep and goat bones are considered together, since the fragmentary bones of these two species often cannot be distinguished. As horse bones are relatively uncommon, horse butchery is treated cursorily. Horse butchery marks were studied primarily to determine whether horse was in fact a food animal.

Sample size presents another technical problem in this study. The Anglo-Saxon villagers were iron-using, and a skillful butcher using metal tools can dismember a carcass without leaving a trace on the bones. Not surprisingly, a minority of bones showed butchery traces. In order to study butchery pattern, a large number of butchered bones of each anatomical element for each species is needed. To maximize the butchered bone sample, analysis was based on a single combined Anglo-Saxon faunal sample which included all the huts, pits, ditches, features (hollows) and Layer 2.

As ribs and vertebrae (other than axis, atlas, and sacrum) were not identified to species, they will be excluded from this analysis. Cut marks on bones of deer and other minor species will also be excluded, since there are too few deer bones in the sample to say anything about butchery pattern.

III. Techniques of Butchery

(Pl. XII)

In general, two types of butchery marks were visible. The first are chop marks that appear to have been made with a heavy knife or cleaver-like implement. While no cleavers were recovered from the excavations, West (1985a, 124) notes that no large metal tools at all were recovered from the site. It is likely that broken large metal implements were reused as scrap metal. Most chop marks appear at or near joint surfaces, indicating that heavy knives or cleavers were often used to chop through joints.

Fine cut marks, probably made with a sharp knife, represent the second type of butchery mark seen on the West Stow bones. Parallel knife-cuts are seen on the hock and other joints, indicating that knives were also used in the disarticulation of the carcass. Fine, chevron-like knife cuts are also seen near the origins and insertions of major muscle groups, indicating that knives were used to remove the meat from the bones.

Characteristic saw marks are seen almost exclusively on deer antlers (Pl. XII) and on horn cores (Table 47). This would suggest that the technique of sawing was restricted to bone working, a pattern which is paralleled at Hamwih (Bourdillon and Coy 1980, 97).

IV. Cattle

(Table 48)

The majority of butchery traces was found on cattle bones. (See Table 48 for a complete summary of the butchered animal bones). Although sheep/goat bones are more common in the assemblage, the larger size of cattle bones might account for the greater frequency of butchery marks[33]. This relationship between the size of the animal and the quantity of butchery marks has been documented for prehistoric North America by Guilday *et al.* (1962).

Head

Fifty-one cattle horn cores show chop or cut marks indicating that the horns were removed after the animal was slaughtered. This practice may indicate that horn was an important raw material for the West Stow residents. Horn-working may have been an important Anglo-Saxon industry which, because of the perishable nature of the horn, left no other traces in the archaeological record. Alternatively, the horns may simply have been detached

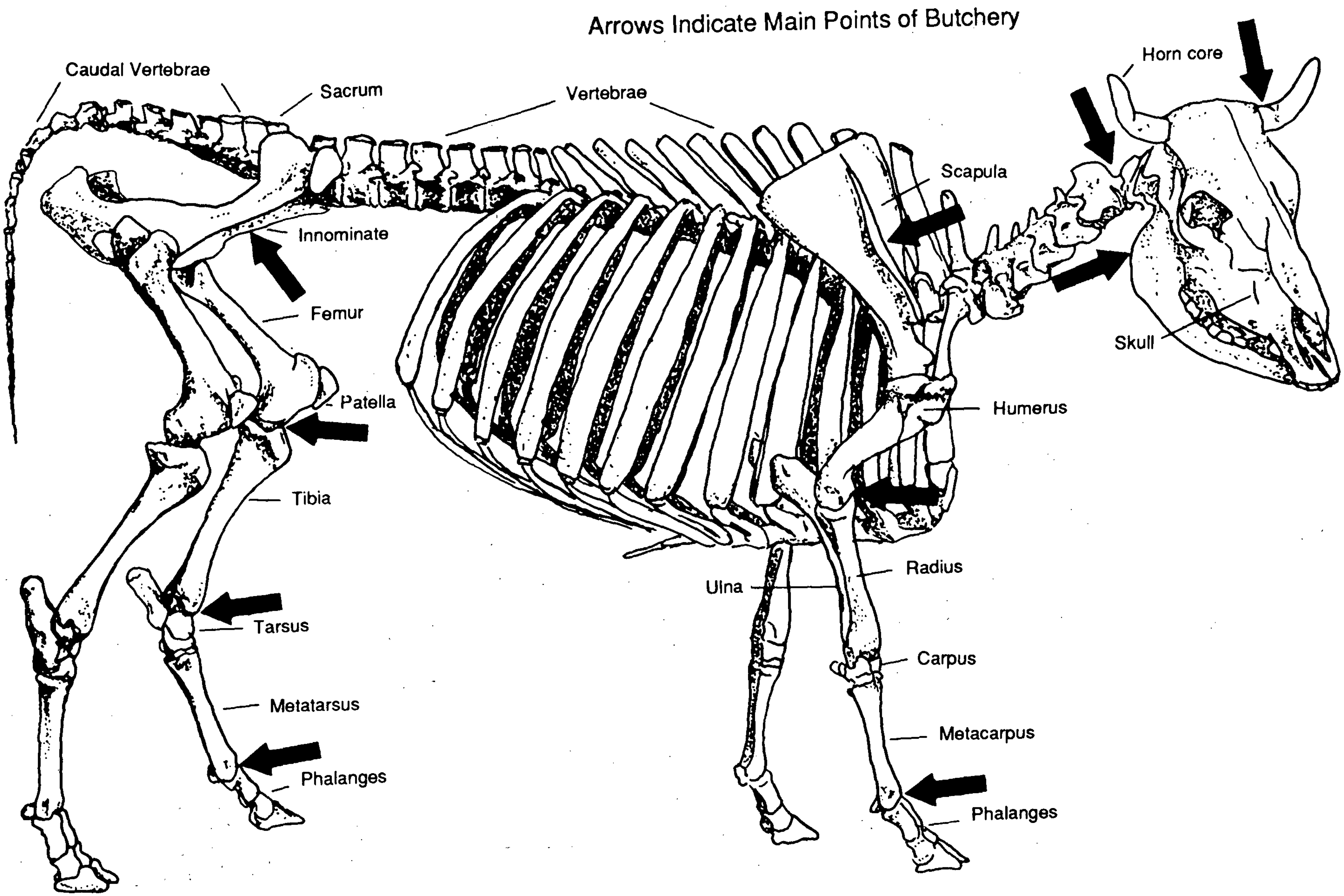


Figure 55 Main points of butchery on Anglo-Saxon cattle

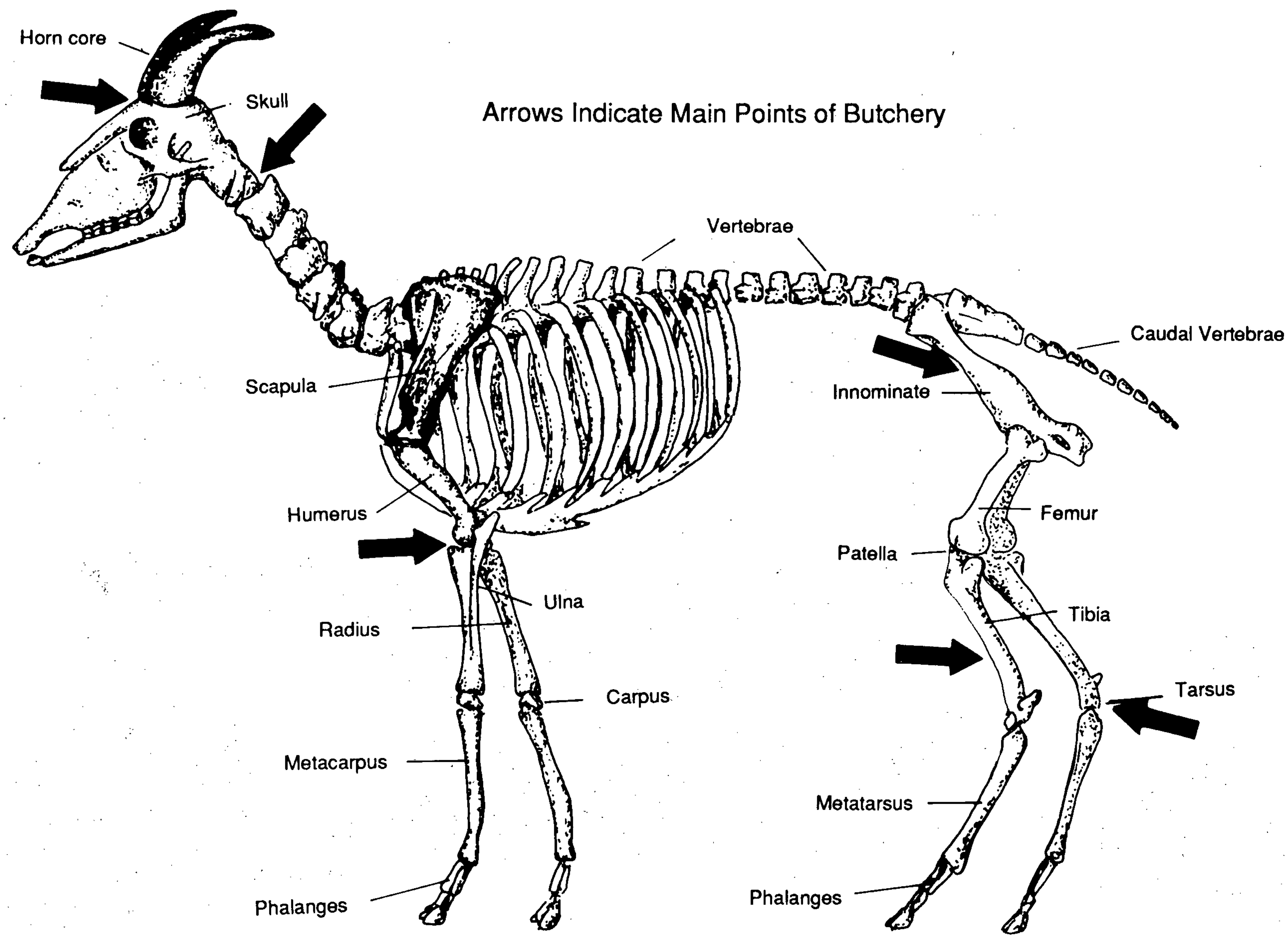


Figure 56 Main points of butchery on Anglo-Saxon sheep and goats

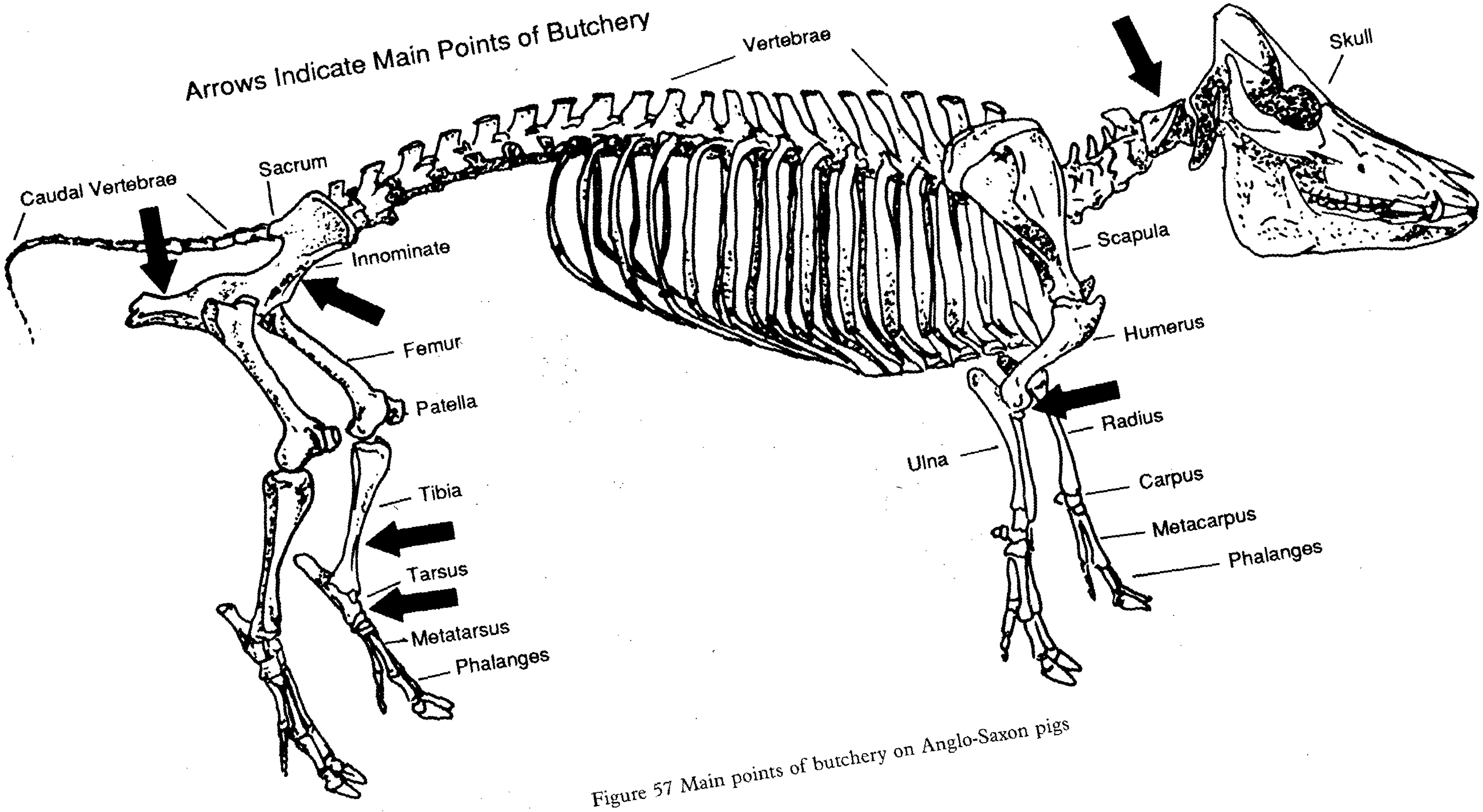


Figure 57 Main points of butchery on Anglo-Saxon pigs

Species	Anatomy	Main Methods of Working	No.
Red deer	Antler	Sawing	17
Roe deer	Antler	Shaving, incising	5
Cattle	Horn core	Sawing	1
Sheep	Horn core	Sawing	7
Sheep/goat	Tibia	Perforation	4
Horse	Tibia	Punched	1
Pig	Fibula	Polish, shaving, perforation	4
Sheep	Astragalus	Drilled	1
Cattle	Metatarsus	Groove-and-splinter	18
Cattle	Metapodium	Groove-and-splinter	3
Horse	Metapodium	Groove-and-splinter	5
Sheep/goat	Metapodium	Perforation	11
Red deer	Metacarpus	Shaved	1
Horse	Phalanx	Sawing	1
Cattle	Phalanx	Perforation	1
Unidentified		Various	17
Total			80

Table 47 Summary of evidence for bone working

	Cattle	Sheep/goat	Pig
Skull	31	8	13
Horn core	51	60	0
Maxilla	1	0	1
Mandible	171	23	3
Hyoid	7	1	0
Atlas	27	17	18
Axis	27	18	1
Scapula	87	15	22
Humerus	77	78	19
Radius	56	75	7
Ulna	27	3	19
Carpal	2	0	0
Metacarpus	34	26	1
Innominate	91	60	37
Sacrum	22	8	0
Femur	26	9	2
Tibia	43	84	5
Tarsal	22	2	1
Astragalus	65	11	6
Calcaneus	35	5	5
Metatarsus	37	27	0
First phalanx	80	0	0
Second phalanx	5	0	0
Total	1024	530	160

Table 48 Distribution of butchery marks on cattle, sheep/goat, and pig bones from all Anglo-Saxon contexts

Plate XII Sawn red deer antler. Scale 1:2

from the skull before the head was cooked (*cf.* Brain 1967, 2).

Turning to the butchery of the skull itself, eight nasal bones and one incisive bone show transverse cut marks, possibly cutting across the muscles of the nostrils and muzzle. A single chop through the frontal may have resulted from stunning or pole-axing. Although the cattle skulls show relatively few butchery traces, the fragmentary nature of many cranial bones suggested that they may have been broken up to extract the brain.

At the back of the skull, several occipital bones show knife cuts and/or chop marks. These marks are matched by an extensive butchery series on the atlas and axis and result from the removal of the head. The majority of the butchered axes and atlases show ventral knife-cuts and/or chops that would have been produced by tilting back the chin and then removing the head. However, fourteen atlases and axes are axially split, resulting from the splitting of the cervical vertebrae after the head was removed.

Mandibles are the most commonly butchered of all cattle bones; most show butchery on the back portion of the jaw (the mandibular angle and ascending ramus areas). Lateral chop and knife marks probably result from cutting through the extensive masseter muscle. These marks are matched by occasional butchery marks on the zygomatic and temporal bones. Similar marks are seen just beneath the orbit on Saxon cattle from Portchester Castle (Grant 1976, 272). Medial knife cuts on the mandible, plus occasional cut marks on the hyoid, resulted from the removal of the cow's tongue, which is a substantial piece of meat.

Forelimb

Both the medial and lateral side of the scapula show extensive butchery traces, indicating that this bone was butchered after the forelimb was removed from the body. This is to be expected, since the scapula 'floats' on the thorax. It is connected to the trunk by muscles rather than bones, and removal of the forelimb is a relatively easy task that need not leave any marks on the bones. The majority of butchery marks are located on the scapular blade and probably resulted from the removal of the meat, as many of the cuts run parallel to the scapular spine. Cuts near the glenoid end of the scapula are less common at West Stow than they are at either Ashville (Wilson 1978, 119), Exeter (Maltby 1979, 39), or Roman Portchester Castle (Grant 1975, 392). Cuts at or near the glenoid fossa are also rare among the Portchester Anglo-Saxon cattle. At Portchester, however, the scapular spines are frequently cut off (Grant 1976, 272). This technique was not practiced at West Stow.

Proximal humeri are generally rare in the West Stow faunal assemblage, suggesting a destruction/preservation bias, and butchery traces were noted on only a few. Two bones show proximal knife cuts, while a third was split in two directions at the proximal end. No conclusions can be drawn from this meager evidence. Both chops and knife cuts are frequent on the distal humerus and the proximal radius. Similar butchery traces are seen on the Saxon cattle from Portchester (Grant 1976, 272). At West Stow, twenty-seven humeri show chops at or near the distal epiphysis, while sixteen radii show proximal chops. Seven ulnae are also proximally chopped. In addition, a small number of distal humeri and proximal radii have been split along the lateral portion of the bone. This evidence would suggest that the elbow joint was a main point for the disarticulation of the forelimb. Even more striking are the substantial numbers of medio-lateral and oblique cut marks along all sides of the distal humeri and proximal radii. These cuts were clearly for meat removal as the proximal radius/distal humerus area serves as the place of origin for many of the muscles of the forearm and as an insertion point for many of the shoulder/upper arm muscles. Occasional dorso-ventral cuts along the radial shaft are also associated with meat removal. Butchery traces on the distal portion of the radius are rare, and this is to be expected as the distal radius is considerably less meaty than the proximal end.

Hindlimb

The innominate bone is the most commonly butchered of all the hindlimb elements. Chop marks are most common on the iliac and pubic rami, with twenty-three instances of each recorded. In contrast, only four ischia were chopped. Cuts and chops through the acetabulum are rare. This pattern contrasts with that of Ashville (Wilson 1978, 121) where ilia werc only occasionally chopped. Cuts on or near the acetabulum were common at Exeter (Maltby 1979, 39). At Roman Portchester Castle (Grant 1975, 392) the pelvis is frequently cut in half through the acetabulum. Cuts on the acetabulum are also common on the Anglo-Saxon cattle from Portchester Castle, although chops on the ilium and ischium are also common at the site (Grant 1976, 272).

Chops on the lateral wings of the sacrum are common at West Stow (ten occurrences) and were probably produced when the pelvic limb was separated from the body.

Cattle femoral epiphyses are comparatively rare. Four proximal femora show knife cuts or chops at or near the head, produced when the hip joint was disarticulated. Turning to the stifle joint, eight femora were distally chopped or split, and corresponding chops are seen on eight proximal tibiae. This evidence would suggest that the knee joint was an important point of disarticulation. This pattern contrasts with that seen at Roman Portchester (Grant 1975, 392) where knife cuts, but not chop marks, were found at the joint, suggesting meat removal rather than disarticulation. At West Stow the use of heavy chopping may partially explain the low numbers of distal femora in the overall faunal assemblage. The distal femur is made up of a large quantity of cancellous tissue covered with a very thin layer of compact bone. As noted above, the distal femur is a late-fusing anatomical element, and unfused epiphyses generally do not survive well in the archaeological record. When this late-fusing, fragile portion of the anatomy is regularly subjected to a butchery practice involving heavy chopping, it is little wonder that so few distal femora survive. Other knife cuts along the femoral (eleven instances) and tibial (twenty-one instances) shafts are certainly associated with meat removal.

Feet

(Pl. XIII)

One of the most consistent patterns of West Stow butchery is seen in the cattle hock (tarsal) joint. Butchery at this joint would have served to separate the feet (metapodia and phalanges) from the upper part of the hind limb. Twenty-two centroquartals (fused central and fourth tarsals) showed knife cuts, and all were cut on the dorsal face in a medio-lateral direction. Sixty-two astragali show medio-lateral knife cuts on the dorsal surface of the bone, fifty-one of these on the distal joint surface. The adjacent calcaneus shows twenty-five examples of knife cuts on the distal portion. Knife cuts on the proximal anterior (dorsal) surface of the metatarsus are seen occasionally (six instances), but no knife cuts are apparent on the distal tibia. This pattern of butchery of the hock joint is paralleled by the evidence from Ashville (Wilson 1978, 122-3) and Saxon Portchester (Grant 1976, 272).

Metapodia bear little meat but do contain an ample supply of marrow. Sixteen examples of splitting are recorded on metapodia, probably for marrow extraction.

Butchery marks on the carpus are rare, with only two carpal bones showing chop marks on their anterior (dorsal) faces. Two corresponding examples of chop marks on proximal metacarpi were also recorded. Cattle metatarsi were also commonly used as raw materials for bone implement production, and several examples of partially worked metatarsi were recovered from the faunal collection (Pl. XIII). The metatarsi were worked using the groove-and-splinter technique. Grooves were incised along all four faces of the metatarsus.

Plate XIII Cattle metatarsi worked by groove-and-splinter technique. Scale 2:3

Butchery marks are common on both distal metapodia and first phalanges, and this butchery is almost certainly associated with the removal of the toes. Knife cuts are seen on fifty-three first phalanges and on nine distal metapodia. Fourteen distal metapodia are chopped, while twenty-four first phalanges show chop marks. Occasional combinations of chop and cut marks[34] are seen on both distal metapodia and proximal first phalanges. Cut marks on the distal metapodia can also result from skinning or removal of the hide and from severing the tendons or sinew which can be used for sewing and other purposes.

V. Sheep/Goat

Head

(Pl. XIV)

The butchery traces seen on sheep and goat skulls broadly parallel those seen on the cattle. Sixty sheep and goat horn cores were chopped or cut near the base for the removal of the horn. Occasional sawn cores (Pl. XIV), not included in the butchery totals, were also recorded. These data reinforce the suggestion, made on the basis of the cattle evidence, that horn may have been an important raw material for the Anglo-Saxon inhabitants of West Stow.

Plate XIV Sawn sheep horn core. Scale 1:2

Turning to the skull itself, four examples of axial splitting are recorded, probably for extraction of the brain. One occipital shows transverse knife cuts on the condyles, and another was chopped. These marks are undoubtedly the results of decapitation and are paralleled by large numbers of chops and knife cuts on the atlas and axis vertebrae. Transverse ventral knife cuts are particularly common on the axis (thirteen examples).

The butchery pattern on the mandible also parallels that seen in the cattle. Medial knife cuts on the horizontal ramus of the mandible and a single cut on a hyoid were associated with the removal of the tongue. Lateral knife cuts were probably made through the masseter muscle. The sheep and goat mandibles lack the heavy chop marks that were seen on the cattle jaws.

Forelimb

Only fifteen sheep/goat scapulae show butchery traces. All are knife cuts, and these are found on both the medial and lateral faces of the bone. Most are probably associated with meat removal. In particular, a dorso-ventral knife cut along the scapular spine indicates removal of the muscle meat.

Unlike the scapulae, sheep/goat radii and humeri are heavily butchered. Not a single butchered proximal humerus was noted, but both chop and cut marks were seen on the distal humerus. Cut marks substantially outnumber chops; only fourteen distal humeri and one radial shaft showed chop marks. Cut marks were common on all faces of the distal humerus and proximal radius. As in the case of the cattle, the elbow joint appears to be a major point of disarticulation for the sheep. In contrast, no butchery marks were identified at or near the distal radius. This portion of the anatomy of sheep and goats bears very little meat. It is, however, a common area for cut marks made while removing the feet. At Exeter, for example, the distal radius was a common butchery point for sheep (Maltby 1979, 53).

Hindlimb

Butchery marks are common on the sheep/goat innominate; butchery traces are found on the iliac, ischial, and pubic rami rather than the acetabulum. Seventeen pubic bones show knife cuts, and, among these, cuts across the ventral portion of the pubic ramus are common.

Knife cuts seen on two proximal femora probably resulted from the disarticulation of the hip joint. Midshaft knife cuts, on the other hand, represent meat removal. Unlike the cow, the sheep's distal femora are not chopped through, and only two examples of proximal chopping on the tibia were identified.

The most common butchery point on the tibia was the midshaft. Of the eighty-four butchered sheep/goat tibiae, all but five showed cut marks on the midshaft. This pattern was also seen at Exeter (Maltby 1979, 53). Most of these chevron-like cut marks probably result from meat removal (*cf.* Binford 1981, 132).

Feet

The sheep's hock (tarsal) joint was treated in the same manner as the cow's. Ten astragali and two centroquartals show medio-lateral knife cuts across their anterior (dorsal) surfaces. The distal portions of three calcanei show knife cuts, as do three distal tibiae and two proximal metatarsi. A similar butchery pattern is seen on the sheep bones from Ashville (Wilson 1978, 122-3).

Sheep and goat metapodia are good sources of marrow, and seven of the butchered metapodia were split. Midshaft knife cuts were also common, appearing on thirty-eight of the butchered cannon bones. These may have been produced during the removal of the animal's skin. Unlike the cattle, butchery traces were absent from the distal metapodia and first phalanges of sheep and goats.

VI. Pigs

Head

Butchery on West Stow pig skulls is of two main types: cuts or splits along the midline and butchery traces at or near the occipital condyles. The five examples of butchery along the midline are probably associated with removal of the brain, while the six examples of butchery on the occipital were produced during decapitation. These traces are matched by cut and chop marks on the atlas.

Cut marks on the pig mandible are rare (three examples), and none suggests removal of the tongue. In addition. there is no evidence for splitting the mandible between the central incisors as was done at Saxon Portchester (Grant 1976, 273).

Forelimb

Knife cuts are found on found on both the medial and lateral sides of the pig scapula, including several dorso-ventral cuts parallelling the spine which were probably produced when the shoulder meat was removed from the bone. As is the case for sheep and cattle, the elbow joint appears to be a major butchery point. Cut marks are common on both the distal humerus and proximal ulna. The radius is less commonly butchered, but most cuts on the radius are to be found on the dorsal face of the proximal-midshaft region.

Hindlimb

The innominate is the most frequently butchered of all pig bones. No examples of butchery on the acetabulum were

Plate XV Horse tibia showing 'punch' marks. Scale 2:3

recorded; the rami were apparently the major butchery points. Eight ilia show chop marks, while cut marks were more common on the ischial and pubic rami. No butchery marks were identified on the proximal femur. Three examples of cut marks on the femoral shaft were noted, and these are almost certainly associated with meat removal. As is the case for the sheep, butchery marks on the tibia are concentrated on the midshaft and distal midshaft. Midshaft chops may have served to separate the meaty proximal tibia from the less desirable distal portion, while knife cuts on the midshaft may have been made when the meat was removed from the bone. As we have no examples of butchered proximal tibiae or distal femora, no conclusions about butchery of the pig stifle joint can be drawn.

Feet

The hock (tarsal) joints of pigs were butchered in the same manner as those of sheep and cattle. Medio-lateral knife cuts were identified on the anterior (dorsal) portion of the astragalus, the distal part of the calcaneus, and the anterior (dorsal) face of the central tarsal. Only one metacarpal was butchered, and it showed chop marks on both the proximal and the distal ends. Pigs' feet may have been an Anglo-Saxon favourite.

VII. Horses
(Pl. XV)

As noted above, too few butchered horse bones were recovered from West Stow to allow a detailed analysis of butchery. Only thirty-eight butchered horse bones were recovered from the Anglo-Saxon contexts[35]. Butchery marks on horses can be studied instead to determine whether these animals were regularly butchered and eaten. If the marks on horse bones are similar to those seen on cattle, sheep, and pig skeletons, then horses were probably butchered for food. If, on the other hand, horse bones show very different patterns and locations of butchery traces, then carcasses may have served primarily as sources of raw materials such as sinew for sewing and bone for bone working.

Overall, the butchery on horse bones is similar to that seen on the other domestic animals. Three atlases and one axis show butchery marks resulting from decapitation. Two scapulae show butchery traces which probably resulted from meat removal. The knife cuts seen on three humeral and one radial shaft were probably produced in the same way. One radius and associated ulna were chopped near the proximal end, as were numerous cattle and sheep radii. These marks represent the disarticulation of the elbow joint. On the pelvic limb, the rami of one ilium and two ischia were chopped, a pattern paralleled on cattle innominates. Knife cuts on a femoral and a tibial shaft should be attributed to meat removal.

A single horse tibia (Pl. XV) exhibits one of the most unusual examples of bone working in the West Stow assemblage. Several punch marks are visible near the distal end, indicating that the tibia was struck repeatedly with a metal object with a diamond-shaped tip. It is possible that this represents an unsuccessful attempt to split the tibia, possibly for marrow or for raw materials for bone object production.

Butchery marks are quite common on horse foot bones, especially metapodia. Six metacarpi and five metatarsi showed butchery traces. One metatarsus showed medio-lateral knife cuts on the proximal anterior surface of the bone. These marks were associated with the disarticulation of the hock joint, as were the cuts marks seen on the distal calcaneus and dorsal astragalus. Three metapodia were split, possibly for the extraction of marrow. Knife cuts on other cannon bones may have resulted from the removal of hide or sinew, both of which would have been important raw materials. On the whole, however, the butchery marks on the West Stow Anglo-Saxon horse bones appear to be associated with butchery for food.

VIII. Longitudinal Splitting of Limb Bones

One aspect of Anglo-Saxon butchery that is conspicuously absent from West Stow is the longitudinal splitting of the long bones. This practice has been recorded at both Hamwih (Bourdillon and Coy 1980, 97) and Saxon Portchester Castle (Grant 1976, 272-3). Grant (1976, 272) has described this longitudinal splitting as 'the most conspicuous characteristic of the Saxon butchery technique'. West Stow, however, produced very few examples of longitudinal splitting. Those limb bones which were split (primarily metapodia and a few distal humeri and proximal radii) were split at or near the epiphysial ends. The low frequency of longitudinal splitting suggests that there are real chronological and/or regional variations in Anglo-Saxon butchery practices.

IX. Marks on Cat Bones

Perhaps the most interesting feature of the cat bones from West Stow is the presence of knife-cuts on four cat bones. In two cases, knife-cuts were recorded on the horizontal ramus of the mandible. Knife cuts were also seen on the ventral portion of an atlas and on the pubic ramus. While the cut marks on the atlas undoubtedly resulted from slitting the cat's throat, the other marks are not the kinds of marks that one would expect if the cats were being slaughtered for food. The other marks could have been produced as a result of skinning, and it seems more reasonable to suggest that the cats may have been slaughtered for their pelts. Here we may see the source of the old English expression, 'There's more than one way to skin a cat'.

Chapter 6. Conclusions

I. Introduction

There are two main types of conclusion that can be drawn from the analysis of the animal bone remains from West Stow. First, these faunal materials can contribute to our understanding of the day-to-day life of the early Anglo-Saxon settlers in Britain, informing us about their animal husbandry patterns, diet, and hunting practices. Second, these data can provide new insights into the general nature of the *Adventus Saxonum*. By examining the faunal remains from West Stow and comparing them to those from other Iron Age, Romano-British, and Anglo-Saxon sites, we may begin to understand the impact of the *Adventus Saxonum* on the countryside.

This review will focus first on the evidence for animal husbandry practices that is provided by the animal bone remains. The broader implications of these data for our understanding of the Early Anglo-Saxon period in Britain will then be briefly considered (see also Crabtree 1984a; Crabtree 1984b; Crabtree 1989).

II. The West Stow Animal Economy

The animal economy of Early Anglo-Saxon West Stow was based on three main domestic animals: sheep, cattle, and pigs. Of these, sheep were the most numerous, making up about 50% of the identifiable large mammal bones and up to 60% of the minimum number of individuals. Sheep, however, were not as important in the total economy as they were in the later medieval period. Cattle, in fact, would have provided most of the meat. Sheep, like cattle, were multi-purpose animals raised for meat, milk, and wool. The fact that sheep could be raised for a variety of different products probably accounts for their popularity with the Early Anglo-Saxon farmers at West Stow. The sheep were relatively large by Iron Age and medieval standards, with an average withers' height of about 62cm. These animals would have been ideally suited to the Breckland, since they could be grazed on the slope and upland areas which are less suitable for cattle and pigs.

It is important to note, however, that cattle and pigs played crucial roles in the subsistence strategy. Pigs were particularly numerous in the earliest phases of the settlement. Since swine have large litters and reproduce rapidly, they would have allowed for the rapid establishment of animal husbandry at the site. Unfortunately, the West Stow area was not heavily wooded and pannage limited. It is possible that additional pannage was sought in the central clay belt. During the fifth century, most pigs were killed by 2½-3½ years of age. There is good evidence that the importance of pigs in the West Stow economy declined, in relative terms, by the late fifth century, from about 20% to about 13% of the large domestic mammal bones. It is possible that pig keeping became more locally based during the late fifth and sixth centuries, and sty husbandry may even have been practiced.

As the proportion of pigs declined, beef production may have become more important. During the sixth century, we see a slight increase in the average age at which cattle were killed, with higher numbers slaughtered between 2½ and 4 years of age. These animals were most likely slaughtered for their meat. The evidence for the slaughter of some very young cattle and the fact that most of the adult cattle appear to be female would suggest that dairying was also important throughout the life of the settlement. It is possible that oxen were used for traction as well. Once the cattle were slaughtered, their bones were used for the production of bone objects, and their hide and sinews would have been other important secondary products. The wide range of products produced by cattle may explain why these animals are always second in number to sheep at West Stow.

While cattle, sheep, and pigs formed the mainstays of the West Stow economy, several other animals played a regular, if smaller, part in the Early Anglo-Saxon subsistence system. Horse bones consistently form 1-3% of the large domestic mammal remains. These horses were actually large ponies, comparable in size to a New Forest pony. While butchery marks indicate that the horses were eaten, they would have formed only a small portion of the diet. Most of the horses survived to advanced years, suggesting that they were raised primarily for transportation and traction. The presence of a small number of immature horse bones suggest that horses may have been raised at the site.

Goat bones are also widely distributed across the site. Small numbers of goat bones were recovered from SFBs from the fifth, sixth, and seventh centuries and from a wide variety of other Anglo-Saxon features. It is possible that goats were kept for a specialized purpose such as dairying.

Red deer, roe deer and rabbit are the most common wild mammals at West Stow. Their remains are widely distributed across the site. Although red deer antler was commonly used in artefact production, the presence of a number of post-cranial bones of both red and roe deer indicates that these animals were also hunted for their meat. It is important to note, however, that hunting played a very minor role in the overall subsistence strategy. Wild mammal bones never comprise more than 1% of the total faunal assemblage.

A range of other wild mammals such as hares, foxes, badgers, and even a bear were recovered. While these animals would have contributed very little to the overall diet, they serve to indicate the wide range of animals that were exploited, at least occasionally, by the Anglo-Saxon settlers at West Stow. The single bear bone is especially interesting, as it seems to be one of the most recent known from Britain.

The mammals were complemented by an even wider range of non- mammalian bones that were recovered. The most commonly identified birds are domestic fowl and geese, followed by smaller numbers of domestic duck or mallard remains, as well as a wide range of wild birds, primarily water birds and waders. These include birds such as teals, swans, white-fronted geese, grey herons, and cranes.

Fishing was the final zoological component of the West Stow subsistence system. Nearly all the fish bones identified were those of pike and perch. These fresh-water fish would have been locally available in the River Lark.

The wide range of animal bones recovered from Anglo-

Saxon contexts at West Stow points to a major feature of the subsistence strategy at the site; its varied and well-balanced economic base. While the Anglo-Saxons relied primarily on cattle, sheep, and pigs, they were able to make use of a whole range of other animal resources when necessary. Sheep, cattle, and horses were raised for a variety of purposes, allowing the settlers to establish a successful, self-sufficient farming economy. The subsistence system also shows some degree of flexibility which allowed them to adjust to changing conditions over the life of the settlement. For example, as the numbers of pigs declined in the sixth century, beef production seems to have become somewhat more important. The extensive, carefully-collected faunal assemblage from West Stow allows us to see the details of this broadly-based system. If only a fraction of the animal bones had been preserved and studied, we probably could have reconstructed the general outlines of the subsistence system, but we would never have been able to see the details. It is the fine points of butchery practices, kill-patterns, animal sizes, and species ratios that allow us to begin to reconstruct the every day life of the early Anglo-Saxons.

III. Broader Implications

While adaptability is the first outstanding characteristic of the West Stow subsistence system, continuity from the preceding Iron Age and Roman periods is its second. The animal husbandry and hunting practices seen at West Stow do not represent a sharp break from those of earlier periods, and they are quite unlike those seen in the continental Saxon homelands, especially in terms of species ratios. The overall evidence for species ratios, animal sizes, ages at death, and butchery practices shows many points of similarity with pre-Saxon animal husbandry patterns in Britain.

The first points of continuity are seen in the sizes of the animals. The cattle are larger, on average, than Iron Age cattle, however they are quite comparable in size to Roman cattle from sites such Portchester Castle. Evidence for an increase in the size of Anglo-Saxon cattle is more convincing for the Middle Saxon period. The largest cattle from sites such as Hamwih, Ramsbury, and North Elmham are larger than the West Stow kine. Similarly, the Anglo-Saxon sheep bones from West Stow are not significantly larger than the Iron Age and Roman sheep remains recovered from the site. This evidence would suggest that the Anglo-Saxon settlers did not bring new cattle or sheep breeds or radically different husbandry techniques with them when they came to Britain. Alternatively, if the Anglo-Saxons did introduce new breeds or types, they were so similar to the indigenous stock that they could not be identified archaeologically.

Some degree of continuity is seen in the evidence for species ratios. When the Iron Age, Romano-British, and Anglo-Saxon species ratios are compared (Fig. 4), we can see a general trend toward increasing numbers of sheep and pigs, and decreasing proportions of cattle and horses. The Romano-British species ratios, although based on a relatively small sample, are generally intermediate between those of the Iron Age and Anglo-Saxon periods. The Anglo-Saxon species ratios seen at West Stow are certainly not a product of continental Saxon influence, since the specific proportions seen at sites such as Feddersen Wierde are closer to the West Stow Iron Age proportions than they are to the Anglo-Saxon species ratios.

There is also an indication of some degree of continuity in butchery practices. Certain well-documented butchery patterns seen at West Stow, such as the treatment of the hock joint, have parallels at Iron Age sites, such as Ashville. The butchery evidence alone, however, cannot make the case for continuity in animal use.

It is the ageing evidence that really points to continuity in economic pattern. The ageing distributions for cattle and sheep are most closely paralleled by those from pre-Roman Iron Age sites, while the Saxon pig kill-patterns have their closest counterparts at a number of Romano-British sites. In contrast, they are very different from those seen at continental sites such as Feddersen Wierde.

The fundamentally conservative nature of the West Stow animal economy has important implications for our understanding of the *Adventus Saxonum*. The fifth and sixth centuries in Britain were marked by changes in political organization, settlement pattern, and language. These changes included the withdrawal of Roman military power from Britain, the abandonment or reduction in size of the urban centres, and the replacement of the British language by Anglo-Saxon. The Anglo-Saxons in the countryside, however, continued to practice patterns of animal husbandry that were not unlike those of previous centuries. In short, the zooarchaeological evidence from West Stow indicates that animal husbandry practices showed remarkable continuity in the face of large scale changes in other aspects of culture.

The degree of continuity in animal husbandry practices seen at West Stow forces us to ask whether we may also be seeing a continuity in population from the preceding Romano-British period. If the Anglo-Saxon inhabitants of West Stow were Germanic immigrants, they may have found it advantageous to preserve the ongoing pattern of rural economy. The patterns of mixed animal use were well suited to the Breckland environment, since they made use of all the available environmental niches including the river valley, valley terraces, and the slope and upland regions.

There is, however, a growing body of documentary, linguistic, and place-name evidence that would argue against the complete replacement of romanized Britons by Anglo-Saxons during this period. The place-name data, in particular, provide some evidence for British survival in eastern England. Although Celtic names survive most frequently as names of the larger rivers, forests, and hills, a variety of other British place-names survive as well. These names increase in frequency as one moves from east to west, but there are a number of notable exceptions including a concentration of Celtic place-names near Penge in Surrey (Gelling 1978, 90). Moreover, even in areas where Celtic names are rare, such as Berkshire, Oxfordshire, and Warwickshire, those that do survive tend to occur in clusters, suggesting small groups of Celtic speakers in an Anglo-Saxon context. In addition, English place-names containing the Old English place-name elements *wahl* and *Cumbre* seem to refer to people of either whole or partial British descent (Gelling 1978, 93). The presence of a small number of place-names with British elements in East Anglia (Jackson 1953, 236) would argue for some degree of local continuity in population.

Documentary evidence would also support some British survival. For example, St Guthlac encountered Celtic-speaking Britons in the Fenland as late as AD 700 (Frere 1974, 419).

In light of the evidence for some degree of British survival in eastern England, and the compelling evidence for long term continuity in subsistence strategies, it is not unreasonable to assume that at least a portion of the West Stow population may have been made up of 'saxonized' Britons. Archaeological evidence indicates that many settlements were established in the central clay belt during the Roman period. There is, however, no evidence for the survival of these communities into the early Anglo-Saxon period (West 1985a, 168). There is at least some faunal and floral evidence to link the West Stow settlement to the central clay belt. Stinking mayweed (*Anthemis cotula*) has been identified from a flotation sample from SFB 63 (Murphy 1985, 105). This plant is most commonly found in the boulder clays of Norfolk and Suffolk, and its presence may indicate the introduction of seed corn from the clay belt (West 1985a, 169), which may also have provided pannage in the fifth century (see p.00). It may be possible to suggest that some of the population of West Stow may have been made up of romanized Britons from the central clay belt.

We do not yet have quantitative knowledge of the extent to which the native British population survived in areas of Anglo-Saxon settlement, let along the regional variations in that probable survival. Every additional indication for native survival would (theoretically at least) provide more reason to expect continuity in rural settlement patterns, land use, and rural economy.

Endnotes

1. The excavations of the Early Anglo-Saxon settlement of Sutton Courtenay, Berks., by E.T. Leeds (Leeds 1922-3; 1926-7; 1947), were conducted before the development of modern archaeological methods. It is possible that some of the post-built structures were undetected by the excavator.
2. For additional information on the domestic mammals from West Stow the interested reader is referred to my dissertation (Crabtree 1982). Summaries of the results of the analysis of the faunal remains are available in the following publications: Crabtree 1984a; 1984b; 1989. A preliminary report on the faunal remains is included in Crabtree 1985.
3. The actual age in years at which this fusion takes place can be influenced by factors such as nutrition, but the sequence of fusion is relatively consistent for each species.
4. See Grayson (1984) for an up-to-date review of the problems of zooarchaeological quantification.
5. Cattle, sheep, pig and horse.
6. There are many different methods used to calculate the MNI. The method used here is the one described by White (1953). Bones were not matched for size or age, as this would have been impractical given the large size of the faunal sample. When the sample was analyzed, every attempt was made to reconstruct fragmentary specimens. Most bones could not be reconstructed. I therefore treated identifiable fragmentary long bones as if they were whole bones, that is, I assumed a fragmentary distal tibia represented a whole tibia whose whole proximal end had been lost or destroyed. The sheep, goat and sheep/goat catagories were combined when the MNI calculations were made.
7. The MNIs calculated for the Phase 1 and 2 faunal assemblages were compared using a 2×4 Chi Square test. The differences in composition between the two phases are statistically significant (Chi Square = 9.22; $p < 0.05$).
8. The meat weight ratios for the SFBs are based on the MNIs. Following Harcourt (1979, 155), I have assumed that a single cow can produce 10x as much meat as a single sheep; a horse 12x; and a pig 1.5x as much. Harcourt's estimates are based on Iron Age animals which are broadly similar in size to the Anglo-Saxon animals from West Stow.
9. Following the recommendations of von den Driesch and Boessneck, I have used Matolcsi's factors to calculate withers' heights from cattle long bones and Fock's factors to calculate withers' heights from metapodia. Since it can often be difficult to distinguish male and female metapodia, I have used the intermediate values for all West Stow specimens.
10. On the basis of chance alone, we would expect one out of twenty measurement comparisons to be significant at the 0.05 level.
11. That is, the breadth at the point of fusion between the epiphysis and the diaphysis, here termed the distal fusion point breadth (DFB), following Maltby (1979, 33).
12. Following Armitage and Clutton-Brock (1976, 331), cattle are characterized as small horned when the length of the outer curve of the horn core is less than 96 mm. Short-horned cattle have an outer curve length of 96-150 mm, while medium-horned cattle have an outer curve length of 150-200 mm.
13. Following Boessneck *et al.* (1964), I did not distinguish sheep from goat distal tibias during analysis. Richard Meadow has recently shown that sheep and goat distal tibias can be distinguished morphologically. The proportion of goat bones in the West Stow assemblage is so small, however, that this is unlikely to represent a significant source of bias.
14. At the $p = 0.05$ level, based on t-test of the significance of the difference between two means.
15. Alderson (1976) gives the weight of a Welsh mountain ewe at 40 kg.
16. A measurement of the thickness of the acetabular wall was taken at a point on the ventral (medial) border where the iliac and pubic portions of the acetabulum join. This measurement was suggested to me by Philip Armitage (pers. comm.). Measurements taken on the sheep and goat pelves in the Museum of Comparative Zoology at Harvard suggest that this measurement can be used to distinguish male from female pelves. Male acetabula have a consistently thicker ventral margin.
17. For a detailed comparison of the pig measurements from Hamwih and fifth-century West Stow, see Crabtree 1982, 208.
18. Estimates based on Kieswalter's factors, following von den Driesch and Boessneck (1974, 333).
19. This is a comparison of size only. Most of the features that distinguish modern breeds of dog (coat colour, shape of the ears and tails, *etc.*) cannot be reconstructed from the zooarchaeological record.
20. In this chapter I have combined the sheep, goat and sheep/goat catagories. I realize that it is possible that sheep and goats may have been used for different economic purposes. The identifiable goat bone sample is very small, too small to allow for detailed ageing analysis. Moreover, I did not attempt to distinguish sheep and goat mandibles and loose teeth (see Payne 1985), so all analyses based on dental eruption and wear are necessarily based on a combined sheep/goat catagory.
21. In this analysis, both unfused epipyses and unfused diaphysis fragments were counted as unfused elements. While some may argue that this overestimates the number of unfused bones, the procedure was adopted for the following reason. During analysis, every attempt was made to match unfused epiphyses and their associated diaphyses. When a match could be made, these bones were counted as a single unfused element. In many cases, however, unfused epiphyses and diaphyses could not be matched with their opposite members. Since unfused, immature bones are more susceptible to destruction by dogs and other agents of bone destruction, it was assumed that the missing epiphysis or diaphysis fragment had been destroyed.
22. The ages of epiphysial fusion used here are those of Silver (1969). These should be seen only as general guidelines, since factors such as castration, sex, health and nutrition can affect the timing of epiphysial fusion.
23. The Kolmogorov-Smirnov test indicates that the West Stow and Hamwih age distributions are significantly different at the $p = 0.01$ level.
24. Since the completion of this research, Sebastian Payne (1985) has shown that the deciduous third molar (sometimes termed the deciduous fourth pre-molar) can be used to distinguish sheep from goats. Unfortunately, the permanent teeth cannot yet be distinguished.
25. Note that the distribution of mandibular wear stages is not linear. Some stages last considerably longer than others.
26. In this analysis the sheep, goat, and sheep/goat categories have been combined since many juvenile bones could not be identified to species.
27. Or rendered more difficult to identify.
28. A Kolmogorov-Smirnov test indicates that the two age distributions are significantly different at the $p = 0.01$ level.
29. The differences between the West Stow and the Barley age distributions are not significant at the $p = 0.05$ level based on the Kolmogorov-Smirnov test.
30. The differences between the Iron Age and the Anglo-Saxon sheep kill- patterns are not significant at the $p = 0.05$ level based on the Kolmogorov-Smirnov test.
31. The Feddersen Wierde age distribution also shows some differences from the Middle Saxon pattern seen at Hamwih. At both sites roughly 20% of the sheep are killed during the first year and an additional 20% during the second. At Feddersen Wierde, however, we see a much higher kill-off in the 2-4 year age catagory, while the Hamwih assemblage includes a higher proportion of older animals.
32. The rapidly developing field of computer graphics may allow drawings of butchery marks to be processed directly by the computer in future but this technology was not available when this project was undertaken in 1976.
33. Nowadays, chickens and turkeys are often roasted whole, a leg of lamb is a standard roasting joint, and cattle are always cut up into a large number of roasting pieces.
34. A clear distinction was apparent between cut marks and chop marks on the West Stow bones. What I have termed cut marks are fine scratches, often parallel to one another, which only damaged the outer surface of the bone. Chop marks are deeper and broadly v-shaped in cross- section. Both types of mark could have been made with a heavy knife. The lack of intergradation between the two types, however, might be circumstantial evidence that they were made by two different types of tool.
35. Butchery marks were noted on *c.* 3% of the identified horse bones and *c.* 4% of identified cattle bones.

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